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Planning,Analysis and Design of Hospital At Eruvessi Panchayath

Ms.Anuragi P
Assistant Professor
Department Of Civil Engineering
Vimal Jyothi Engineering College
Chemperi, Kannur (District), Kerala, India

Aswanth Bhaskaran V,Kirandev,Sarang C.K
UG Student, Department Of Civil Engineering
Vimal Jyothi Engineering College, Chemperi (Autonomous)
Kannur (District), Kerala, India

***Abstract*— Structural design is the primary aspect of Civil engineering. The very basis of construction of any building, residential, educational, dams, bridges etc. is designing.**
Hospital building provides medical service to the people. The main purpose of our project is satisfying the medical needs of that people.in this project we are concerned about the plan, analysis and design hospital building. The plan of the hospital building is done by using AUTOCAD software and STADD PRO. The design of RCC slab, beam, column, footing and staircase is based on working stress method as per IS 456-2000 code. The plan and elevation are done using AutoCAD software. The hospital building is proposed to a site in Eruvessi panchayath, in sreekandapuram, Kannur district.
***Keywords*— IS 456-2000, National Building Codes, Kerala Panchayath Building Rules:2019, ,AutoCAD , STAAD Pro .**

I. INTRODUCTION

This project aims in preparing the plan of HOSPITAL building with reference to KBR and NBC. According to the national building code, a building is any structure for whatsoever purpose and of whatsoever material constructed and every part thereof whether used as human habitation or not and includes foundation, plinth, walls, roofs etc.
Planning of a building is assembling, grouping, and arranging its component part in systematic manner and proper order so as to perform a meaningful wholesome and homogeneous body with a comprehensive look out to meet its functional purpose. This project aims at the planning and analysis of a hospital at Eruvessi grama-panchayath.

II. OBJECTIVES

The main objectives of this work to analysis of hospital building and the designing is done with the help of AutoCAD software. It helps to gain knowledge on various structural elements like beam slab foundation etc.

III. SCOPE OF THE STUDY

Design using software can be useful if any additional modification has to be done in structure during its future life is a main objective of this project. In the future also analysis of the building can be done with the use of software Staad pro

IV. METHODOLOGY

The first phase of the project is the site selection. The site visit helps in collecting data and to conduct reconnaissance survey. Site selection depends upon available fund mode of construction, purpose of building, the soil condition can be noted through this. The selected land is finalized. The structure to be constructed must satisfies the need of the client and shall be durable for it's designed for its life span.

A. Methodology flow chart

a) Site surveying
b) Preparation of plan
c) Architectural design and planning
d) Load calculation
e) Structural analysis and design
f) Structural detailing
g) Doccumentation

V. SITE ANALYSIS

A. Proposed Site
The proposed site is at eruvessi panchayath, chemperi, Kannur district

B. Geographic condition
The soil in our site is red soil. The condition of the soil seems to be medium soil. So, we decided there is no deep foundation and the seal would be so strong has to support our structure and water control failure to large extent.

C. Climactic Condition
The present climatic conditions and humidity are normal; hence a pleasant atmosphere can be achieved and warm atmosphere can be maintained.

D. Water table and electricity arrangement
The present climatic conditions and humidity are normal; hence a pleasant atmosphere can be achieved and warm atmosphere can be maintained

E. Land Survey
The proposed site for the work is puritan. We are conducting a recommission and preliminary survey. This site is almost plain the atmosphere as far as considered is suitable for our hospital building.

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F. Availability of resources

The resources for the construction purpose and those requirements of the hospital are available nearby.

G. Transportation facility

Our site is near to chemperi, So that transportation and the construction material is easily available.

VI. GENERAL PROVISIONS REGARDING BUILDING REQUIREMENTS

A. Height of room

The height of room in any building other than residential occupancy and livestock/poultry farm under group 1 hazardous occupancy, shall not be less than 3.00 meters: Provided that in the case of air-conditioned rooms it shall be not less than 2.4 meter.

B. Toilets

A minimum of special toilet water closet shall be provided for use of person with disabilities with essential provision of washbasin at an easily accessible location with proper signage.
1.They shall be provided at a ground floor for AT A2 BCDE&F Occupancies and at every floor in a multiple of 3 for A2 BCDE &F occupancies
2. Minimum size of toilet shall be 1.50mX1.70 m
3. Minimum clear opening of door shall be 90 cm
4.The water closet seat shall be 50cmabove from floor level

C. Staircases

1. Any building having more than four floors including basement or sunken floors, shall have at least two staircases, one of which may be an external stairway: Provided that when the second staircase provided as external stair way conforms to the provisions of fire escape staircase, a separate fire escape stair need not be provided.
2. The minimum width of stair shall not be less than 1.20 meters
3. The minimum width of tread shall be 30 cm.
4. The height of the riser shall not exceed 15 cm.
5. The height of handrail shall be not less than 90 cm.
6. The width of passages giving access to the staircase in any building shall not at any point, be less than the width of the stair

D. Ramps

1. The maximum gradient of a ramp approach intended for the physically handicapped persons shall not exceed 1 in 12 and shall be finished with approved non slippery materials. The minimum width of the ramp shall be 1.2metres and provided with handrails of height not less than 80cm.
2. Every part of a building within a floor shall be accessible by a wheelchair and in case of level difference between parts they shall be connected by ramp/slope ways with minimum specifications as above.

E. Corridors,Verandhs and passageways

The clear width of any corridor, verandah or passageway in any building shall not be less than 1.0 meter at any point.

F. Fire escape stairway

All the requirements are from the fire protection shall be as in part iv, fire protection in NBC India 1983 and amendment No 3 under Fire protection annexure i

G. Travel distance to emergency exit

1. Every building meant for human occupancy shall be provided with emergency exits sufficient to permit safe escape of occupants in case of fire or whenever other emergency occurs.
2. Emergency exits shall be located in such a way that the travel distance on each floor shall not exceed 30 meters for the occupancy.
3. Exits shall be either horizontal or vertical type.
4. An exit may be a doorway or passageway to an internal staircase or external staircase, ramps to the street or to the roof of a building; it may be a horizontal exit leading to an adjoining building at the same level: Provided that lifts and escalators shall not be considered as exits.

VII. FACILITIES IN A HOSPITAL

A. Outpatient Department

An outpatient department/ outpatient clinic is the part of a hospital designed for the treatment of outpatients, people with health problems who visit the hospital for diagnosis of treatment, but do not at this time require a bed or to be admitted for overnight care.

B. Casualty

Casualty department is a medical treatment facility specializing in emergency medicine, the acute care of patients who present without prior appointment either by their own means or by that of an ambulance. Due to the unplanned nature of patient attendance, the department must provide initial treatment for a broad spectrum of illnesses and injuries. some of which may be life threatening and require immediate attention.

C. Lobby

The lobby is the first thing that a patient will see, and seats the tone for the entire patient experience. Choosing a safe, comfortable and quality flooring option for a healthcare lobby is an important part of hospital lobby design. A lobby that is clean, well fit, soft and embracing will set the tone for a comforting experience.

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D Console room

This space includes for relief, washing and clean-up activities. Accessible to all administrative spaces. Special toilets for disabled people are provided.

E. *Toilet facilities*

This space includes for relief, washing and clean-up activities. Accessible to all administrative spaces. Special toilets for disabled people are provided.

F. *Nurses station*

Nurse's station is an area of health care facility, which nurses and other health care staff work behind when not working directly with patients and where they can perform some of their duties. The station has a counter that can be approached by visitors and patients who wish to receive attention from nurses.

G. *Lift*

This is an assistive device that allows patients in hospitals to be transferred between a bed and a chair or other similar resting places, by the use of electrical or hydraulic power. Lise for patients as well as for carrying heavy hospital equipment from one place to another.

H. *Scanning room*

It offers imaging services to patients. Diagnostic imaging includes CT scans, X-rays, ultrasounds, MRIS and more.

VIII. LOADS

A. *Dead load*

The dead load in building shall comprise the weight of the wall, partitions floor and roofs and shall include the weight of all bother permanent construction on the building.

B. *Imposed load*

Imposed Load is the total load produced intendent use for occupancy of building, including the weight of movable partitions, distributed concentrated load due to impact and vibration and dust load but including wind, seismic, snow and other loads due to temperature changes, shrinkage, differential settlement etc.

C. *Seismic load*

It is the basic concepts of earthquake engineering which means application of a seismic oscillation to a structure. It happens at contact surface of a structure either with the ground or with the adjacent structures.

IX. METHOD OF DESIGNING

Reinforced Cement Concrete members can be designed by Limit sate method.

A. *Limit state method*

In this method of design based on limit state concept, the structure shall be designed to withstand safely all loads liable to act on it throughout its life; it shall also satisfy the serviceability requirements, such as limitations on cracking and deflection.

The acceptable limit for the safety and serviceability requirements before failure occurs is called a Limit State. The aim of design is the achieves acceptable probabilities that the structure will not become unfit for which it is intended ie, it will not reach a limit state.

All relevant limit state shall be considered in design to ensure the adequate degree of safety and serviceability. In general, the structure shall be designed on basis of the most critical limit state and shall be checked for other limit states.

For ensuring the above objective, the design should be based on characteristic values for material strength and applied loads, which consider the variation in the material strength and in the loads to be supported.

B. *Assumption in the limit state method*

The design of a RCC section for limit state of collapse in bending on the following assumptions as per IS 456:2000

a) Plane sections normal to the axis remain plane after bending.

b) The maximum strain in concrete at the outermost compression fiber is taken as 0.0035 in bending.

c) The tensile strength of concrete is ignored.

d) The stresses in reinforcements are obtained from stress-strain curves of steel. For design purpose safety factor equal 1.15 shall be applied.

e) The maximum tensile strain in the tension reinforcement shall not be less than fy/1.15Es + 0.002.

f) The relationship between the compressive stress distribution in concrete and strain in concrete is assumed to be rectangular parabolic. For design purpose the compressive strength of concrete in the structure shall be assumed to be 0.67 times the characteristics strength. The partial safety factor 1.5 shall be applied addition to this.

X. BUILDING PLANS

A. *General*

The building plan are drawn using the software AutoCAD. The main drawings that are drawn using this software are Site Layout (Figure 1), Ground Floor Plan and elevation (Figure 2), First Floor Plan (Figure 3), Second Floor Plan (Figure 4). The Doors, Windows and Ventilations are provided or drawn in this Structure. The plans are drawn based on the IS Code provisions. The plans and elevations are the following; -

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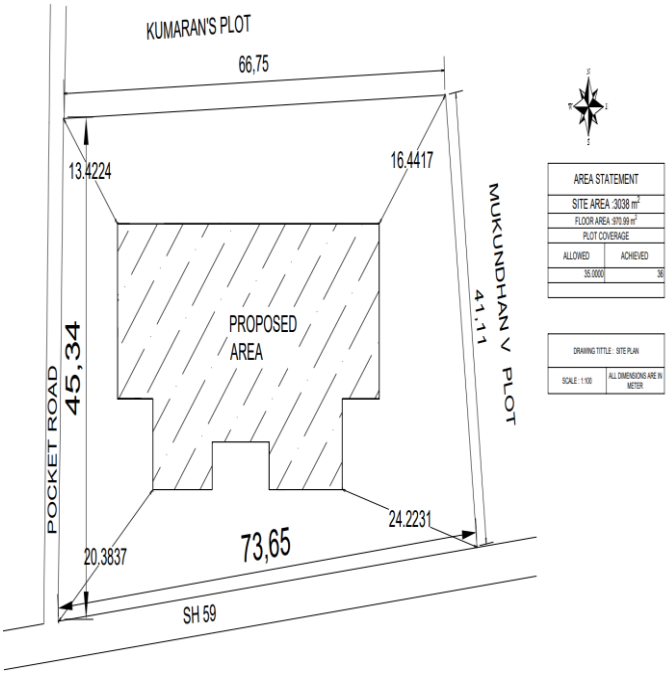

Figure 1: Site Layout

Figure 2: Ground floor plan and elevation

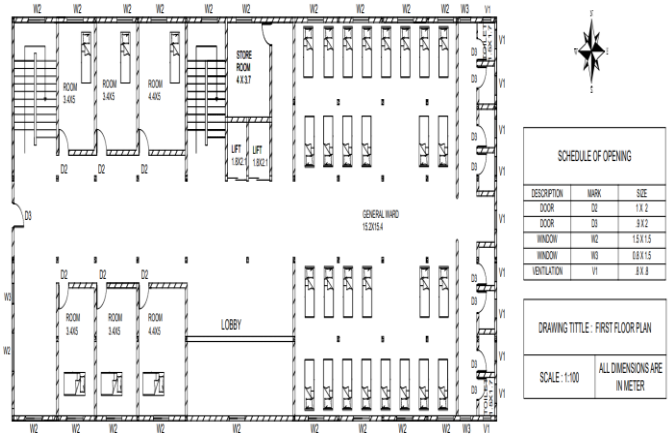

Figure 3: First floor plan

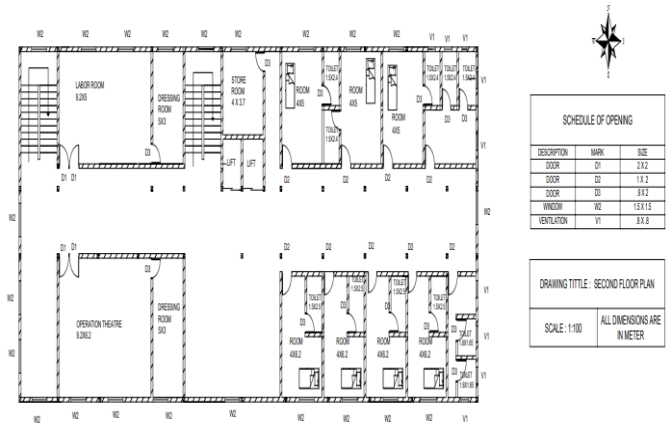

Figure 4: Second floor plan

XI. LOAD CALCULATION

Load are primary consideration of building design they define the nature and magnitude hazards or external forces that a building must resist to provide reasonable performance throughout the structure's useful life. The type and magnitude of design loads effect critical decision such as material selection, construction details etc.. Generally dead load, live load and seismic loads are calculated for the building

A. Dead loads

Dead Load is the self weight of the concrete member, walls and floor finishes. Dead load shall be calculated on the basis of unit weights which shall be established taking into consideration the material specified for construction. Alternatively, the dead loads may be calculated on the basis of unit weights of materials given in IS 875 (Part 1). The dead load has to be considered inorder to make the structural design correctly. Dead loads vary from structure to structure

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1) Wall load

Unit Weight of Brick Masonry = 20 kN/m

Width of the wall = .23m

Height of the Building = 3m

Wall Load = 0.23*3*20= -13.8 kN/m

2) Parapet load

Unit Weight of Brick Masonry = 20 kN/m

Width of the wall = 0.23m

Height of Parapet = 0.9m

Parapet Load = 0.2*0.9*20= -3.6 kN/m

B. Live load

Imposed loads are the loads assumed to be produced by the intended use or occupancy of a building, including the weight of movable partitions, distributed concentrated loads, loads due to impact and vibration ,and dust load but excluding wind, seismic, snow and other loads due to temperature changes, creep, differential settlement etc.… Live load for this project is taken by IS 875 code for different occupancies. The live load for a hospital building according to IS 875 part 2 is as follows: -

For bed rooms, wards, dressing rooms, dormitories and lounges = 2 kN/m^2

For laboratories = 3 kN/m^2

For Toilets and bathrooms = 2 kN/m^2

For X-ray rooms, operating rooms, general storage areas = 3 kN/m^2

For Office rooms and OPD rooms = 2.5 kN/m^2

For passages, lobbies and staircases including fire escapes = 4 kN/m^2

1) Floor load

Floor load = Thickness of slab x Density of concrete

=0.125 x 25

=3.125 kN/m^2

C. Seismic load

In Kerala, seismic loads primarily depend on two key factors: the region's proximity to seismic zones and the geological characteristics of the area. Kerala is located in seismic zone III, which indicates moderate seismic activity. However, the specific seismic load at two points within Kerala would also be influenced by factors such as soil type, topography, and local geological conditions. Kerala has Laterite Soil. Also, the Damping Ration is 5%. So, by giving the IS code ie, IS 1893-2002 / 2005 the values will be generated , In Figure 5 Shown below

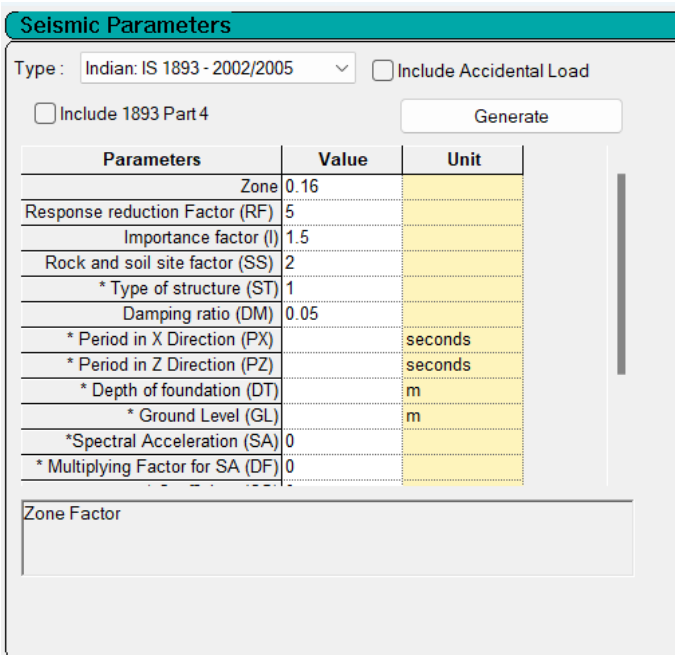

Figure 5

XII. ANALYSIS OF STRUCTURE USING STAAD.PRO

A. INTRODUCTION

Staad.Pro is a structural analysis design program software. The building plan designed with the help of AutoCAD, is analyzed for its structural stability towards considered forces using Staad.Pro analysis software. The plan is developed into an entire 3-D structure and the basic details such as shear and displacement are studied. The commercial version of Staad.Pro supports several steel, concrete and timber codes. It is one of the software applications created to help structural engineers to automate their tasks and to remove the tedious and long procedures of the manual methods.

Using Centre Line Method, Plan of the structure is drawn and converted to DXF file. Then it is imported to Staad.Pro [Figure 6]. Then Duplicate and Orphan nodes are checked. Intermediate Beams are provided. Then using Interceptional Repeat it is brought to a Three-storey structure. Then plates are created and moving to properties, thickness is provided as 0.125m. The Column Size and Beam size is applied to the structure. Column size is 0.40x0.40 m and Beam size is provided as two. That is for Ground and First floor as 0.4x0.45m and for Second floor it is 0.4x0.35m. Then it is assigned. Supports and Materials are assigned to the structure and we will get 3D view of the structure [Figure 7].

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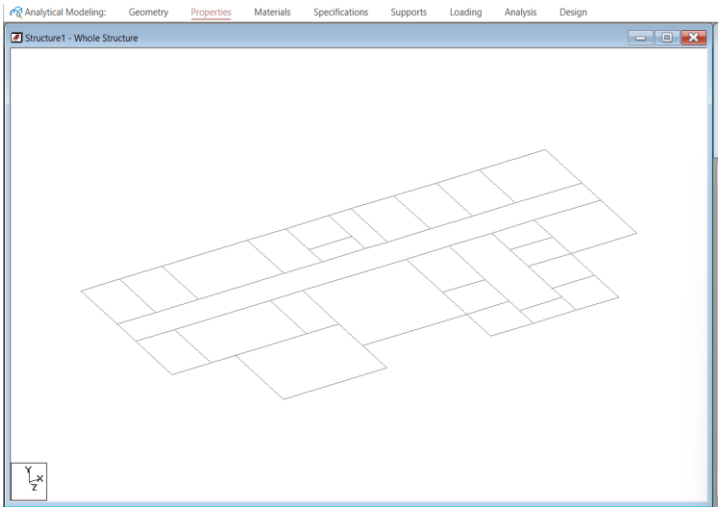

Figure 6

The loads are applied to the structures. Dead loads (Wall Load and Parapet Load) are assigned to it. Live Load (Floor Load) is assigned to it. Then the Seismic load is also assigned to it. Then Load Combination is Auto Generated. Analysis is done and Zero error Occurred. Then Design is given with Material as Concrete and IS 475 codes. The Design parameters given are Clear cover 0.03m, Fc as 25000 kN/m², Fy-main as 415000kN/m², Fy-sec as 415000kN/cm², Max main as 20mm, Max sec as 12mm, Min main as 16mm, Min sec as 10mm. Then Commands need to be provided like takeoff, design of column beam and slab. Then again go for analysis and zero error occurred. Then Post Processing and get the results of Job Info, Loading Diagram, Deflection, Displacement, Axial Force, Shear Y and Shear Z, Bending Y and Bending Z diagrams.

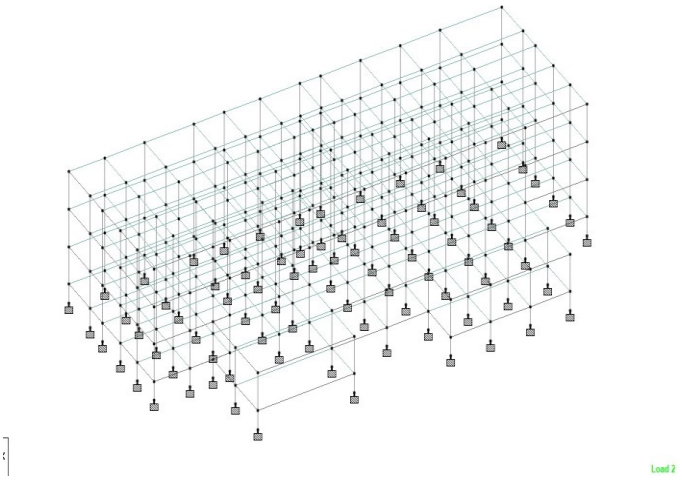

Figure 7

XIII. RESULTS AND DISCUSSIONS

By Analysing the structure, after the run analysis and concrete design, we can obtain the results of our structures. Here we can obtain the maximum and minimum values of Loading diagram, Shear Force diagram, Bending moment diagram, Axial force diagram etc. By using these diagram post processing can be completed. It is all about analysing the structure to check whether the completed building structure is safe or not and getting various reactions.

The results that we collected in this project are

1) Loading diagram (Figure 8)
2) Displacement force diagram (Figure 9)
3) Shear y diagram (Figure 10)
4) Shear z diagram (Figure 11)
5) Bending y diagram (Figure 12)
6) Bending z diagram(Figure 13)
7) Axial force diagram(Figure 14)

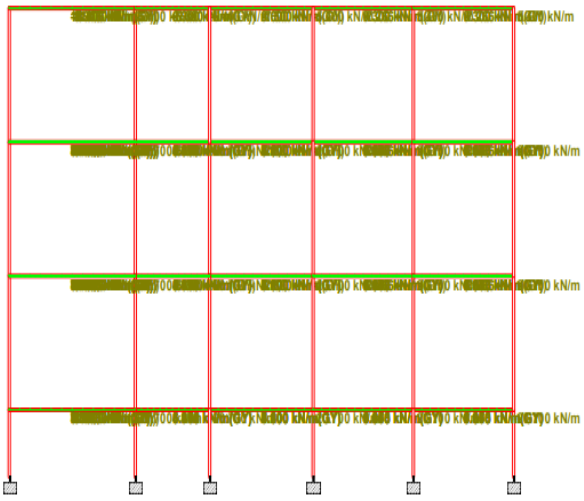

Figure 8 :Loading diagram

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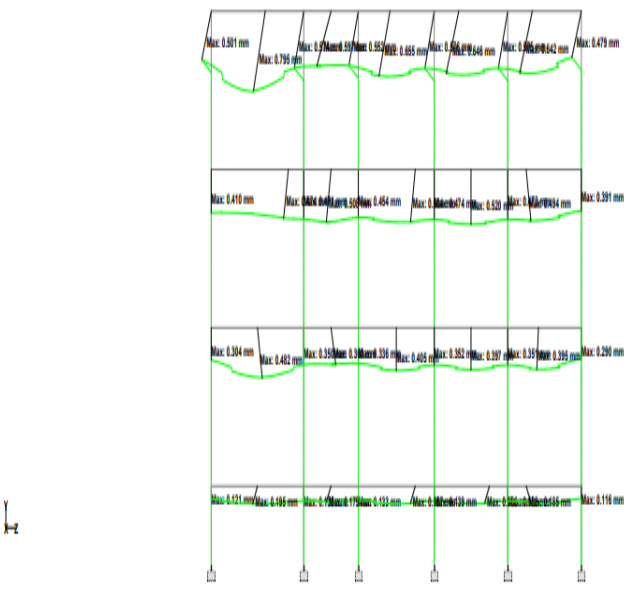

Figure 9 :Displacement force diagram

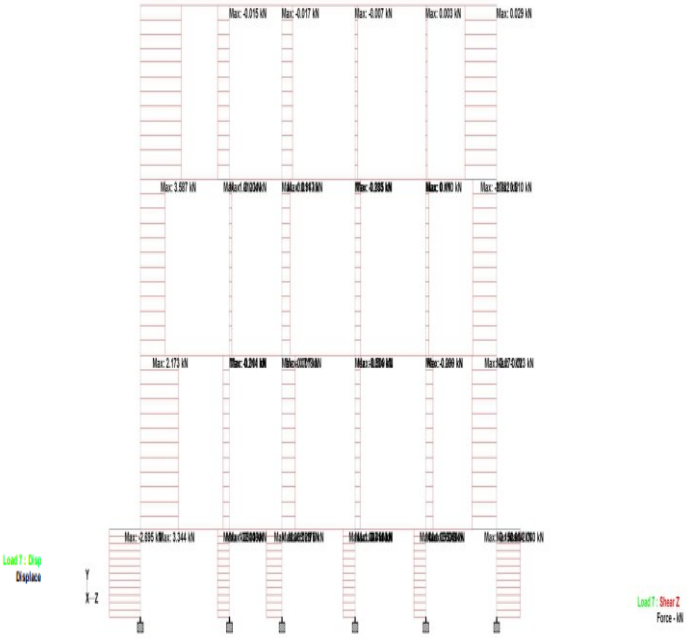

Figure 11: Shear z diagram

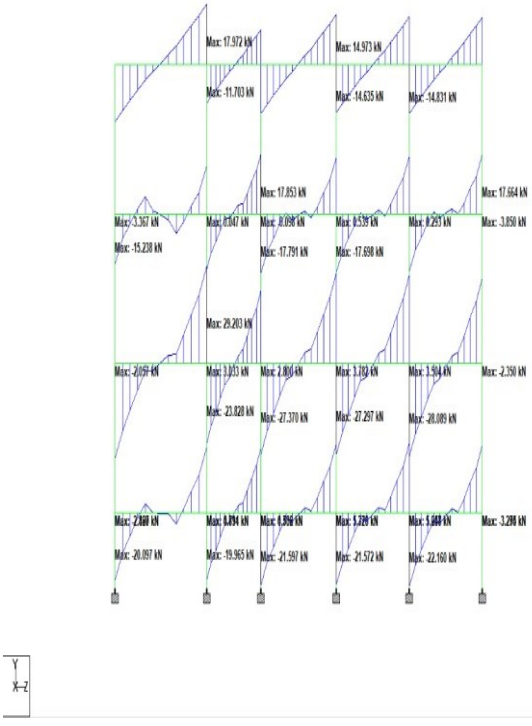

Figure 10: Shear y diagram

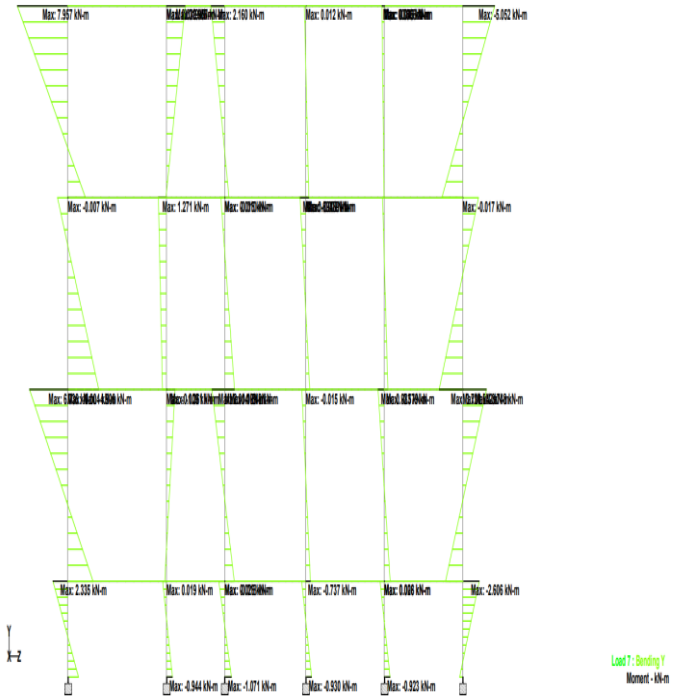

Figure 12: Bending y diagram

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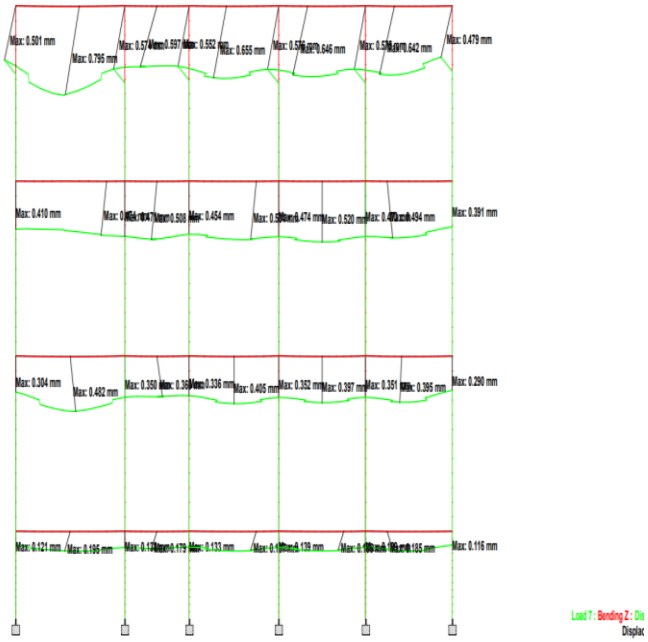


Figure 13: Bending z diagram

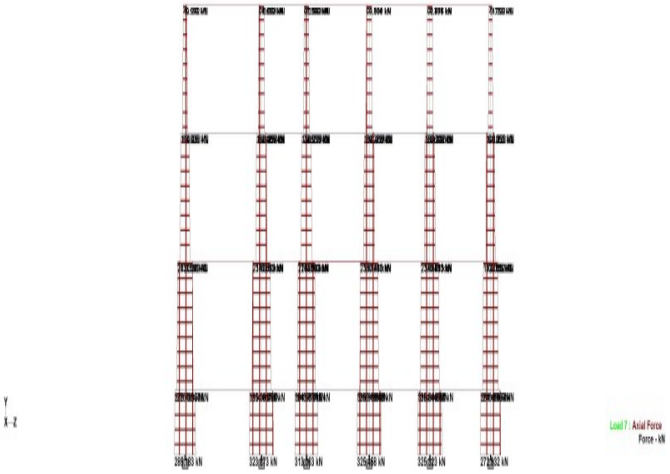
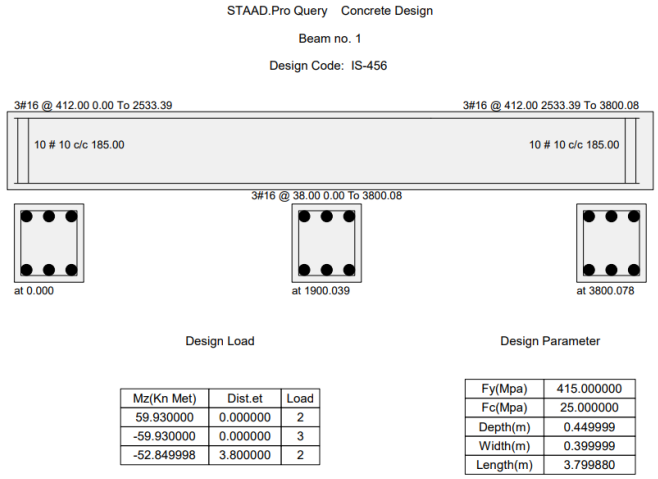


Figure 14: Axial force diagram

XIV. DETAILING

A. BEAM

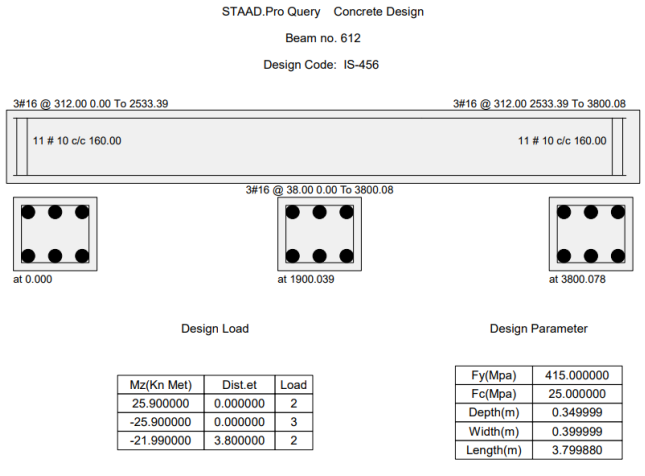
Here size of beam is 0.4x0.45m. It Is the Beam of Ground and First Floor. Here 10 nos of 10mm diameter stirrups with 185mm spacing. Tension and Compression bars here provided is of 3 nos with 16mm diameter is provided [Figure 15]. In Second Floor, size of beam is 0.4x0.35m. Here 11 nos of 10mm diameter stirrups with 160mm spacing is provided. Tension and Compression bars of 3 nos with 16mm diameter is provided[Figure 16]



Mz(Kn Met)	Dist.et	Load
59.930000	0.000000	2
-59.930000	0.000000	3
-52.849998	3.800000	2

Fy(Mpa)	415.000000
Fc(Mpa)	25.000000
Depth(m)	0.449999
Width(m)	0.399999
Length(m)	3.799880

Figure 15: Beam detailing of ground and first floor



Mz(Kn Met)	Dist.et	Load
25.900000	0.000000	2
-25.900000	0.000000	3
-21.990000	3.800000	2

Fy(Mpa)	415.000000
Fc(Mpa)	25.000000
Depth(m)	0.349999
Width(m)	0.399999
Length(m)	3.799880

Figure 16: Beam detailing of second floor

B. COLUMN

Column Size provided is 0.40 x 0.40m. The Bar Size of the column is 16mm and No of Bars is 8 (Figure 17).

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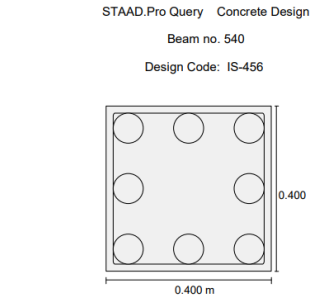


Design Load

Load	2
Location	End 1
Pu(Kns)	-17.020000
Mz(Kns-Mt)	23.309999
My(Kns-Mt)	1.950000

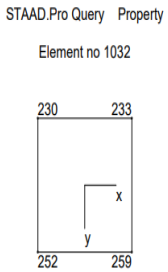
Design Results

Fy(Mpa)	415
Fc(Mpa)	25
As Reqd(mm²)	1280.000000
As (%)	1.005000
Bar Size	16
Bar No	8

Figure 17: Column detailing

C. SLAB

The Slab Thickness provided is 0.125m (Figure 18).



Physical Properties

Node	Thickness (m)
230	0.125000
233	0.125000
259	0.125000
252	0.125000

Material Properties

Elasticity(kip/in2)	Density(kip/in3)	Poisson	Alpha
3150.001	0.000	0.170	5.5 E-6

Figure 18: Slab detailing

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