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DESIGN OF G+3 R.C.C. FRAMED BUILDING

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ABSTRACT: *Now a days people from villages are coming to town for employment and educational facilities hence with the limited land available, individual houses are feasible. One of the major problem facing by India is rapid growth of population which restricted the availability of land. Hence an apartment building is proposed in this project. The engineer has to keep in mind the Municipal conditions, building bye laws, environment, financial capacity, water supply, sewage arrangement, provision of future, aeration, ventilation etc. in suggestion a particular type of plan to any client. As at Gopeshwar car parking is a major problem. People used to park their vehicle on road site which causes major traffic jam here. In our project we proposed ground floor for car parking and first, second and third floor for residence purpose in Single land.*

Keywords: *Multistoried building, Limit state method, STAAD pro, Auto CAD etc.*

1. INTRODUCTION

1.1 Objective of Project

Carrying out a complete design of the main structure element of a multi-storied building including slab, beam and footing. Getting real life experience with the engineering practices.

Now a days people from village are coming to town for employment and education facilities hence with limited land available, individual houses are feasible. One of the major problem facing by India is rapid growth of population which restricted the availability of land. Hence an apartment building is proposed in this project.

1.2 General

The design process of structural planning and design requires not only imagination and concept thinking but also sound knowledge of science of structural engineering besides the knowledge of practical aspects, such as recent design codes, bye laws, backed up by sample experiment, intuition and judgement. The purpose of Standard is to ensure and enhance the safety, keeping careful balance between economy and safety.

The project involves G+3 residential building designing. The ground floor is proposed for car parking. The people can park their vehicle in ground floor of the building which can helps in control the traffic in locality. And first, second and third floor is for residential purpose. The apartment located at GOPESHWAR.

In each floor consists of a two apartments and each and every apartment having three bed rooms, hall and kitchen. We will design the 3BHK apartment on each floor. The plan shows the details of dimension of each and every room and type of room and the orientation of the different rooms like bed room, bathroom, kitchen and hall etc. All the six apartments have similar room arrangement.

The entire plot area is about (130*42) feet. There is some space left side around the building for garden. The garden area of the building cab be used for jogging, walking and yoga etc. which is very beneficial for peoples. And in the right side of building there is some space for the badminton court for playing the Racquet Sport.

2. LITERATURE REVIEW

2.1 General

A structure can be defined as a body which can resist the applied loads appreciable deformations. Structure analysis involves the determination of the forces and displacement of the structure or components of a structure. Design process involves the selection and detailing of the component that make up the structure system. The main object of reinforced concrete design is to achieve a structure that will result in a safe economical solution. The design of each part may be designed separately as follows:

1. Beam design

2. Column design

3. Slab design

4. Foundation design

These all are designed under limit state method.

2.2 LIMIT STATE METHOD

The acceptable limit for the safety and serviceability requirement before failure occurs is called a limit state. Since this method of design is adopted widely in recent practice. We have followed this method and all the

design works are carried out in accordance to IS 456-2000. In the limit state design structure shall be designed to safety as well serviceability.

2.2.1 Limit State of Collapse

This is corresponds to the maximum load carrying capacity. Violation of collapse limit state implies failure in the source that a clearly definite limit state of structural usefulness has been exceed. However it does not mean complete. The limit state corresponds to:

a) Flexural

b) Compression

c) Shear

d) Torsion

2.2.2 Limit State of Serviceability

This state corresponding to development of excessive deformation and is used for checking member in which magnitude of deformation may limit the rise of the structure of its components.

a) Deflection

b) Cracking

c) Vibration

2.3 RCC ELEMENT

The RCC elements are slab, beam, column, and footing and staircase etc.

2.3.1 SLAB

Slabs are plane structure member whose thickness is small as compared to its length and breadth. Slab are most frequently used as roof covering and floors in various shape such as square, rectangular, circular, triangular etc. in building. Slabs supports mainly transverse loads and transfer them to the supports by bending action in one or more directions. Beams or walls are the common supports for the slabs.

Type of slabs:

a) One Way Slab

When the slab is supported on two opposite side parallel edges. And the ration of the shorter span (l_y/lx) are greater than and equal to 2 are called as one way slabs. One way slab bends in one direction .i.e. along the shorter span and hence it needs main reinforcement in one
direction only (along the shorter span).

b) Two way slab

When the slab is supported on four edges and the load distribution is also on four edges of the panel. And the ratio of longer span to the shorter span (ly/lx)is less than 2, the slab are likely to be bend along the two span and such slab are called as two way slab. The load transfer in both the direction to the four supporting edges and hence main reinforcement has to design in both direction to resist two way bending.

2.3.2 BEAM

A reinforced concrete beam should be able to resist tensile compressive and shear stresses induced in it by the load on the beam. Concrete is fairly strong in compression but weak in tensile strength. Plain concrete beams are thus evaded in carrying capacity by the law tensile strength .steel is very strong in tension. Thus the weakness of concrete is overcome by the provision of reinforcing steel in the tension zone around the concrete to make a reinforced concrete beam. The design of the beam mainly consist of fixing the breadth and depth of the beam and arriving at the area of steel and the diameters of bars to be used. The breadth of the beam is generally kept equal to the thickness of the wall to avoid offset inside the room. It shall not exceed the width of the column for effecting transfer of the load from beam to column. The depth of the beam is taken by L/10 to L/6. There are two types of reinforced concrete beam-

a) Single reinforced beams:

In singly reinforced, simply supported beams steel bars are placed near the bottom of the beam where they are effective in resisting in the tensile bending stress.

b) Double reinforcement beam:

It is reinforced in both compression and tension zone. The necessities of steel of compression region arise due to two reasons.

2.3.3 COLUMN

A column or strut is a compression member, which used primary to support axial compressive load and with a height of at least three it is least lateral dimension. A reinforced concrete column is said to be subjected to axially loaded when line of the resultant thrust of loads supported by column is coincident with the line of C.G of the column in the longitudinal direction.

A column in general may be defined as a member carrying direct axial load which causes compressive stresses of such magnitude that these stresses largely control its design. The columns are subjected to axial loads (Pu) and uniaxial bending moment (Mu). The column section shall be designed just above and just below the beam column joint and larger of the two

reinforcements shall be adopted. The design carried on basis of IS 456:2000.

2.3.4 FOOTING

A footing is the bottom most part of the structure and last member to transfer the load.

Foundations are structural elements that transfer loads from the building or individual column to the earth .If these loads are to be properly transmitted, foundations must be designed to prevent to curtail differential settlement and to provide adequate safety against sliding and overturning. Foundation design involves a geotechnical study to establish the most appropriate type of foundation and a structural design to determine footing dimensions. Because compressive than that of the columns and walls.

2.3.5 STAIR CASE

Stairs consist of steps arranged in a series for purpose of giving access to different floors of a building. The location of stairs requires good and careful consideration. In the present design Dog-legged staircase is proposed.

3. SOFTWARE

This project is mostly based on software and it is essential to know the details about these Software's

i. STAAD Pro

STAAD is powerful design software licensed by Bentley. STAAD stands for structural analysis and design. Any object which is stable under a given loading can be considered as structure. So first find the outline of the structure, whereas analysis is the estimation of what are the type of loads that acts on the beam and calculation of shear force and bending moment comes under analysis stage. Design phase is designing the type of materials and its dimensions to resist the load. This we do after the analysis. To calculate S.F.D. and B.M.D. of a complex loading beam it takes about an hour. So when it comes into the building with several members it will take a week. STAAD Pro is a very powerful tool which does this job in just an hour's STAAD is a best alternative for high rise buildings. These software can be used to carry RCC, steel, bridge, truss etc. according to various country codes.

Limitations of STAAD Pro:

1. Huge output data

2. Even analysis of a small beam creates large output.

3. Unable to show plinth beams.

ii. AutoCAD

AutoCAD is powerful software licensed by Autodesk. The word auto came from Autodesk Company and cad stands for computer aided design. AutoCAD is used for drawing different layouts, details, plans, elevations, sections and different sections can be shown in auto cad.

It is very useful software for civil, mechanical and also electrical engineer. The importance of this software makes every engineer a compulsion to learn this software's. We used AutoCAD for drawing the plan, elevation of a residential building. We also used AutoCAD to show the reinforcement details and design details of a stair case.

4. METHODOLOGY

4.1 BUILDING DATA FOR ANALYSIS

Utility of Building: Residential Building

Area of the site: 130 ft. X 42 ft.

Number of Storey: (G+3)

Ground floor – Car Parking

Type of construction: R.C.C Framed Structure

Shape of Building: Rectangular

Number of staircase: four

Type of Walls: Brick Wall

Ground floor height: 10'

Floor to floor height: 10'

Height of plinth: 1'6"

Thickness of Slab: 6"

Thickness of External Wall: 1'

Thickness of Partition Wall: 9"

Dimensions of Column: 1' X 1'

Dimensions of Beams: 1' X 1'

4.2 OTHER SPECIFICATION

4.2.1 Staircase (dog legged):

Rise= 6", Tread = 1'

For Ground Floor-

Height of one flight = 6'6"

No. of treads in 1st flight = 12

No. of rise in 1st flight = 13

Height of 2nd flight = 3'6"

No. of treads in each flight= 6

No. of rise in each flight = 7

Width of landing = 3'10.2"

For 1st, 2nd & 3rd Floor-

Height of 2nd flight =

No. of treads in each flight= 9

No. of rise in each flight = 10

Width of landing at each side = 5' 4.2"

4.2.2 Door:

D1= 3'11.52" X 6'10.3"

D2= 3'3.6" X 6'

D3 = 3'6.6" X 6'

D4 = 2'7.8" X 6'

D5 = 6' X 6'10.3"

4.2.3 Window:

W1 = 4' X 4'

W2 = 3' X 2'9"

4.2.4 Ventilator:

V = 1'7.68" X 1'4.2"

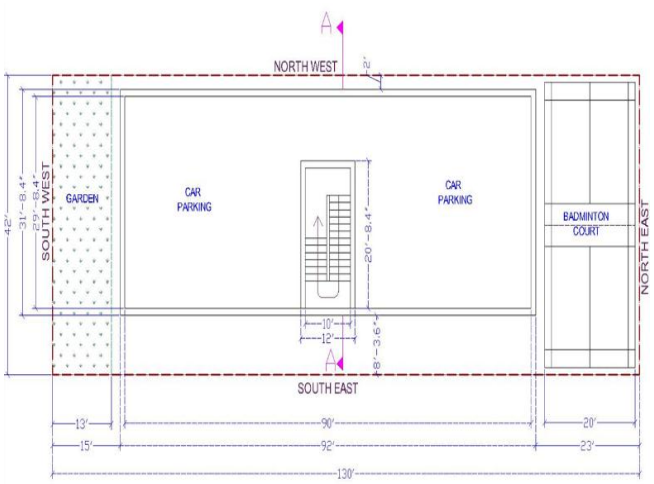
4.2.5 No. of Columns-

No. of columns = 26

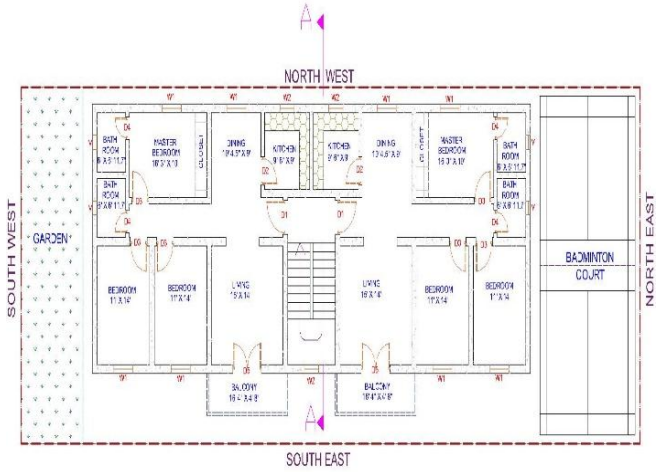
A1, A3, A4, B1, B3, B4, C1, C3, C4, D1, D2, E3, E4, F3, F4, G1, G2, H1, H3, H4, I1, I3, I4, J1, J3, J4

5. PLAN AND ELEVATION

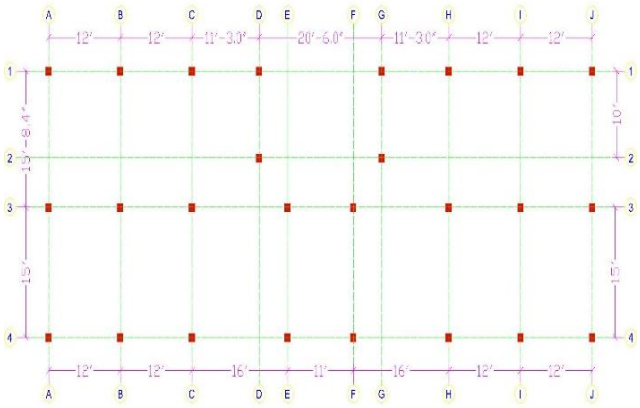
Detailed Plan and Elevation is drafted in AutoCAD.



GROUND FLOOR

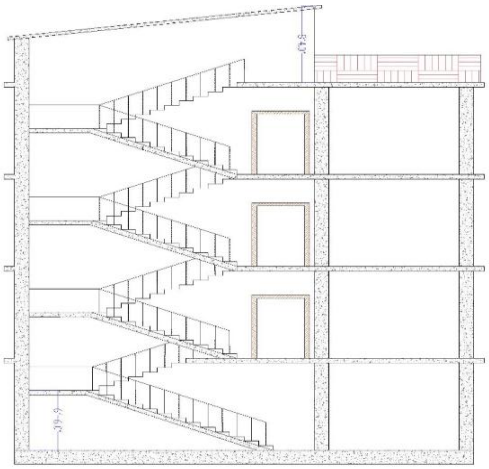


FIRST FLOOR



COLUMN LAYOUT PLAN

FRONT ELEVATION (SOUTH EAST)



SECTION AA

6. WORKING WITH STAAD Pro

6.1 MODEL DESIGNING

- **ISOMETRIC VIEW**

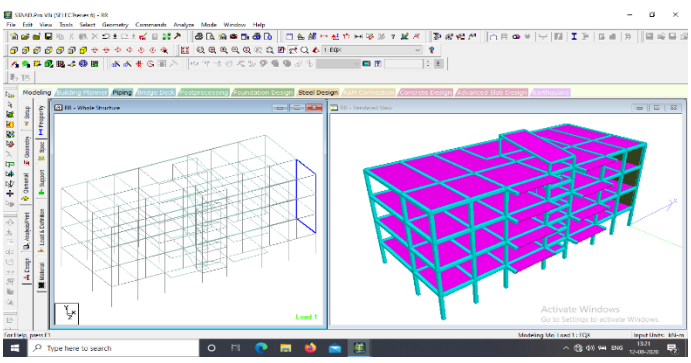


Fig. 6.1 Isometric View of Structure

- **FRONT VIEW OF STRUCTURE**

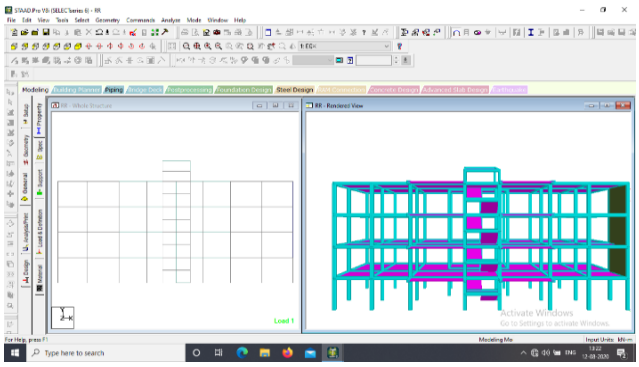


Fig. 5.2 Front View of Structure

- **TOP VIEW**

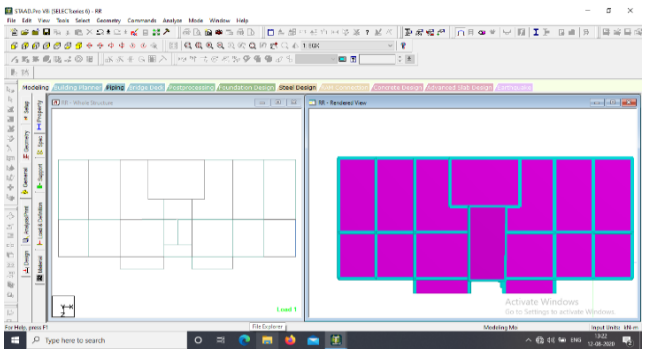


Fig. 6.3 Top View of Structure

- **SIDE VIEW**

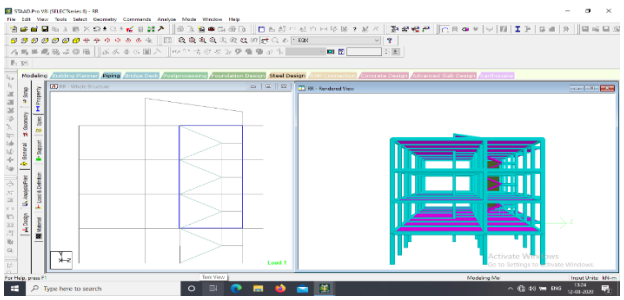


Fig. 6.4 Side View (North East)

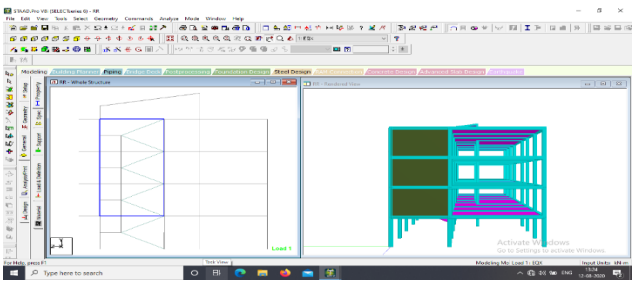


Fig. 6.5 Side View (Southwest)

6.2 PROPERTIES OF MEMBERS

- **PLATE/ SLAB PROPERTY**

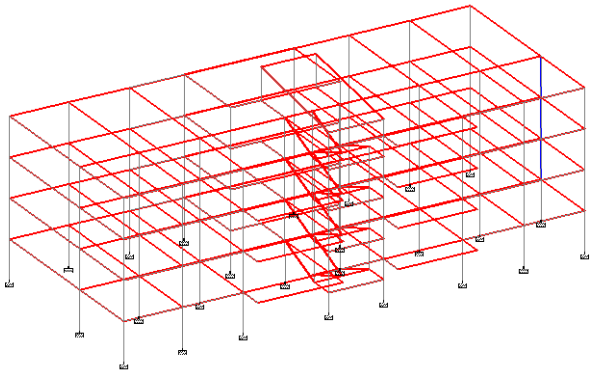


Fig. 6.6 Plate/ Slab Property

- **BEAM/ COLUMN PROPERTY**

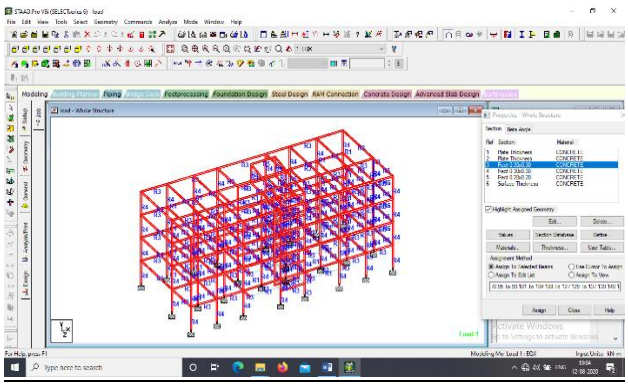


Fig. 6.7 Beam and Column Property

- **SUPPORT PROPERTY**

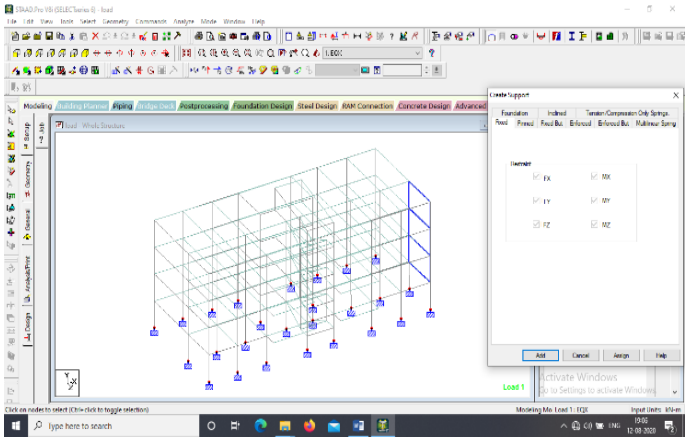


Fig. 6.8 Support Property (Fixed Property)

- **SURFACE PROPERTY**

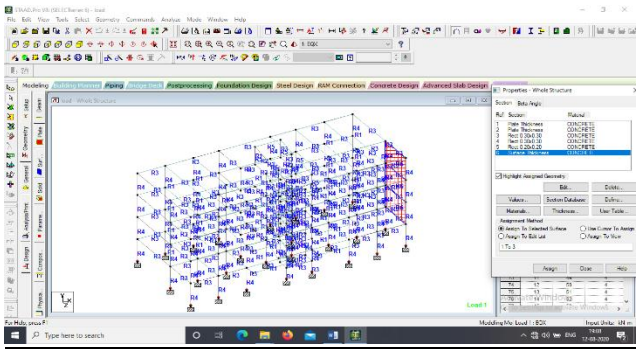


Fig. 6.9 Surface Property for Shear Wall

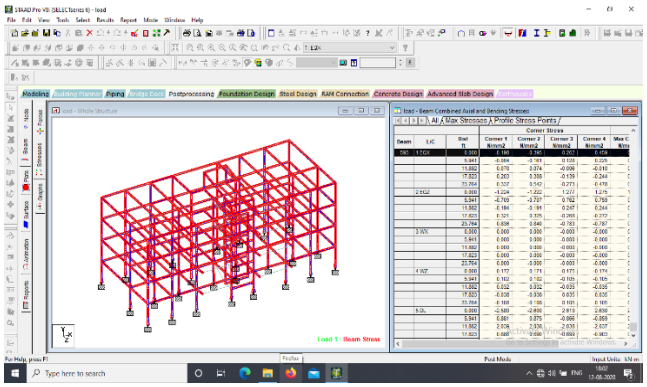


Fig. 6.10 Beam Stresses

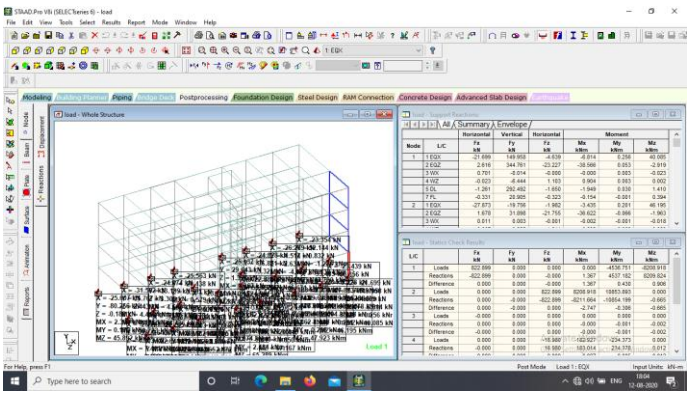


Fig. 6.11 Reaction at Node

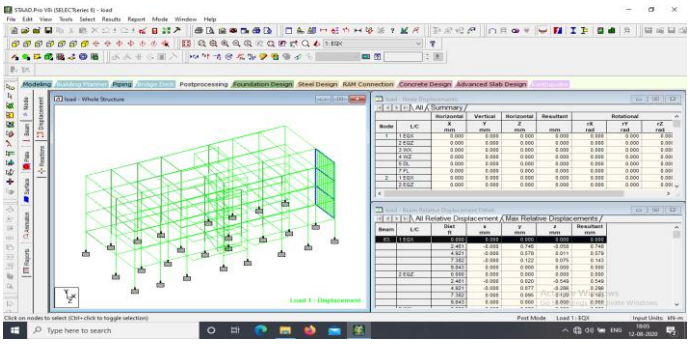


Fig. 6.12 Displacement at Node

6.3 DESIGN RESULT

A. BEAM DESIGN RESULT

B E A M N O. 63 D E S I G N R E S U L T S M30 Fe550 (Main) Fe550 (Sec.)

LENGTH: 3000.0 mm SIZE: 300.0 mm X 300.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

----------SECTION 0.0 mm 750.0 mm 1500.0 mm 2250.0 mm 3000.0 mm

---

TOP 459.65 254.50 0.00 125.18 125.18

REINF. (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm)

BOTTOM 125.18 125.18 125.18 125.18 301.88

REINF. (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm)

SUMMARY OF PROVIDED REINF. AREA

SECTION 0.0 mm 750.0 mm 1500.0 mm 2250.0 mm 3000.0 mm

TOP 8-10í 8-10í 2-10í 8-10í 8-10í

REINF. 1 layer(s) 1 layer(s) 1 layer(s) 1 layer(s) 1 layer(s)

BOTTOM 8-10í 8-10í 8-10í 8-10í 8-10í

REINF. 1 layer(s) 1 layer(s) 1 layer(s) 1 layer(s) 1 layer(s)

SHEAR 2 legged 8í 2 legged 8í 2 legged 8í 2 legged 8í 2 legged 8í

REINF. @ 125 mm c/c @ 125 mm c/c @ 125 mm c/c @ 125 mm c/c @ 125 mm c/c

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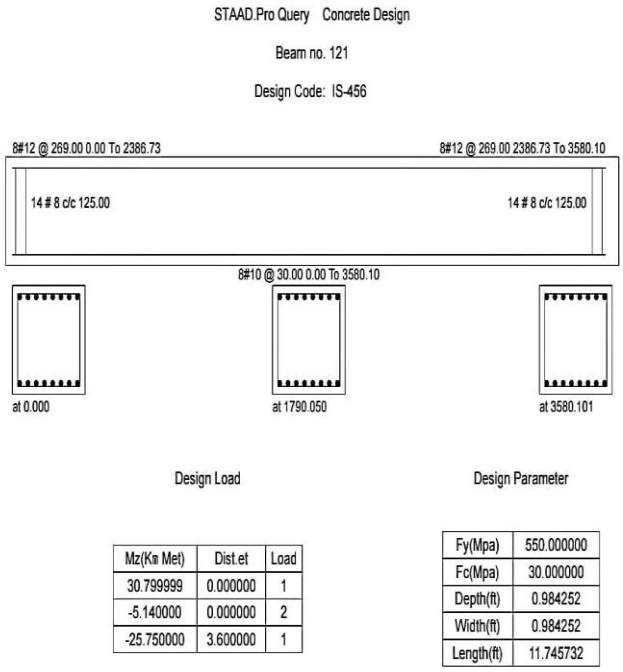

Mz(K⌀ Met)	Dist.et	Load
30.799999	0.000000	1
-5.140000	0.000000	2
-25.750000	3.600000	1

Fy(Mpa)	550.000000
Fc(Mpa)	30.000000
Depth(ft)	0.984252
Width(ft)	0.984252
Length(ft)	11.745732

Fig. 6.13 Concrete Beam Design

B. COLUMN DESIGN RESULT

COLUMN N O. 63 D E S I G N R E S U L T S

M30 Fe550 (Main) Fe550 (Sec.)

LENGTH: 3000.0 mm CROSS SECTION: 300.0 mm X 300.0 mm COVER: 40.0 mm

** GUIDING LOAD CASE: 1 END JOINT: 1 SHORT COLUMN

REQD. STEEL AREA : 934.96 Sq.mm.

REQD. CONCRETE AREA: 89065.05 Sq.mm.

MAIN REINFORCEMENT: Provide 4 - 20 dia. (1.40%, 1256.64 Sq.mm.) (Equally distributed)

TIE REINFORCEMENT : Provide 8 mm dia. rectangular ties @ 300 mm c/c

SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)

----------Puz : 1588.05 Muz1 : 63.21 Muy1 : 63.21

INTERACTION RATIO: 0.99 (as per Cl. 39.6, IS456:2000)

SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)

WORST LOAD CASE: 1

END JOINT: 1 Puz : 1716.40 Muz : 82.41 Muy : 82.41 IR: 0.76

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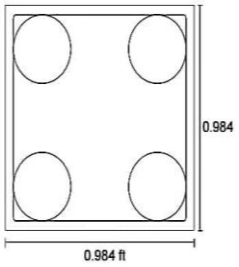
STAAD.Pro Query Concrete Design

Beam no. 80

Design Code: IS-456



Design Load

Load	1
Location	End 1
Pu(Kns)	-80.269997
Mz(Kns-Mt)	45.889999
My(Kns-Mt)	2.370000

Design Results

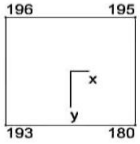
Fy(Mpa)	550
Fc(Mpa)	30
As Reqd(mm²)	1080.000000
As (%)	1.396000
Bar Size	20
Bar No	4

Fig. 6.14 Concrete Column Design

C. SLAB DESIGN RESULT

STAAD.Pro Query Property

Element no 596



Node	Thickness (ft)
196	0.410105
195	0.410105
180	0.410105
193	0.410105

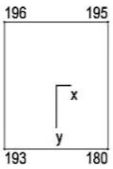
Material Properties

Elasticity(kN/mm^2)	Density(kg/m^3)	Poisson	Alpha
21.718	2408.142	0.170	5 E-6

Fig. 6.15 Slab Property Element

STAAD.Pro Query Geometry

Element no 596



Node	X-Coord (ft)	Y-Coord (ft)	Z-Coord (ft)
196	-91.863842	39.370079	-39.370079
195	0.000000	39.370079	-39.370079
180	0.000000	39.370079	0.000000
193	-91.863842	39.370079	-0.000000

Length of the Sides

	AB	BC	CD	DA
Length(ft)	91.863842	39.370079	91.863842	39.370079

Surface Area

Area (cm2)
3360013.207440

Fig 6.16 Slab Geometry

7. CONCLUSIONS

- Detailed Plan and Elevation is drafted in AutoCAD.
- Structural frame work was modelled in STAAD and analyzed. Designing using Software reduces lot of time in design work.
- Structural components will designed for max bending & shear which further warrants the well-being of Structure.
- Analysing and detailing software aids time wastage and also adds in accuracy of results.

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CODE BOOK-

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- **IS: 875 (Part 3) – 1987,** for Wind Loads, Indian Standard Code of Practice for Design Loads (Other than Earthquake) For Buildings and Structures.
- **IS: 875 (Part 5) – 1987,** for Special Loads and Combinations, Indian Standard Code of Practice for Design Loads (Other than Earthquake) For Buildings and Structures.

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