STRUCTURAL & ARCHITECTURAL DESIGN OF A NEW BUILDING

A REPORT

Submitted In partial fulfilment of the requirements
for the Degree
"Bachelor in Technology"
in
" Civil Engineering"

BY

SANJITA MOHANTY 2021298021

AKASH PANIGRAHY 1901298047

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Under the guidance of

Prof **. Surajit Pattnaik**

DEPARTMENT OF CIVIL ENGINEERING
GANDHI INSTITUTE FOR TECHNOLOGY, AUTONOMOUS,
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CERTIFICATE

This is to certify that the thesis entitled "**STRUCTURAL & ARCHITECTURAL DESIGN OF A NEW BUILDING**") submitted by (" Sanjita Mohanty (2021298021) , (Akash Panigrahy (1901298047) & (Abinash S. Baral (2021298030) in partial fulfilment of the requirements for the award of Bachelor of Technology Degree in Civil Engineering at Gandhi Institute For Technology, Bhubaneswar is an authentic work carried out by him under my supervision and guidance . To the best of my knowledge, the matter embodied in this Project Report has not been submitted to any other University/Institute for the award of any Degree or Diploma.

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DECLARATION

We, Sanjita Mohanty , Akash Panigrahy , Abinash S. Baral hereby declare that the project report entitled **"STRUCTURAL & ARCHITECTURAL DESIGN OF A NEW BUILDING",** Under the guidance of **Prof . Surajit Pattnaik** is submitted in the fulfillment of the requirements for the **MAJOR-PROJECT** This is a bonafide work carried out by us and the results embodied in this project report have not been reproduced copied from any source. The results embodied in this project report have not been submitted to any other university or institution for the award of any other degree or diploma .

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ABSTRACT

Structural design is the methodical investigation of the stability, strength and rigidity of structures. The basic objective in structural analysis and design is to produce a structure capable of resisting all applied loads without failure during its intended life. An architectural designer is someone who design research , coordinates and manages such enhancement project. we would be allotted the area of new project settlement with maps and survey co-ordinates to design the plan, as the plan gets the approval from the decision making body the structural analysis would be done to check various factors of the structure, we need to design the plan so that the approval drawings become perfect and can be sent to various governing bodies. Different parameters are to be observed like Architectural Design SOFTWARES TO BE USED Staad pro & Autocad drafting.

SYMBOLS:

The following symbols have been used in our project and its meaning is clearly mentioned respective to it:

A	-Area
Ast	- Area of steel
B	-Breadth of beam or shorter dimension of rectangular column
D	-Overall depth of beam or slab
D	-Dead load
d1	-effective depth of slab or beam
L	
D	-Overall depth of beam or slab
Mu.max	-moment of resistance factor
Fck	-characteristic compressive strength
Fy	-characteristic strength of steel
Ld	-development length
LL	-live load
Lx	-length of shorter side of slab
Ly	-length of longer side of slab
B.M.	-bending moment
Mu	-factored bending moment
Md	-design moment

Mf -modification factor

Mx -mid span bending moment along short span

My - mid span bending moment along longer span

M'x -support bending moment along shorter span

M'y - support bending moment along longer span

Pt -percentage of steel

W -total design load

Wd -factored load

Tmax -maximum shear stress in concrete with shear

Tv -shear stress in concrete

TV -nominal shear stress

Φ -diameter of bar

Pu -factored axial load

Mu,lim -limiting moment of resistance of a section without compression reinforcement

Mux,Muy -moment about X and Y axis due to design loads

Max1,Muy1 - maximum un axial moment capacity for an axial load of Pu, bending moment x and Y axis respectively

Ac - area of concrete &

Asc -area of longitudinal reinforcement for column

LIST OF TABLES

LIST OF FIGURES

TABLE OF CONTENT

INTRODUCTION

GENERAL

Building construction is the engineering deals with the construction of Building such as residential houses. In a simple building can be define as an enclose space by walls with roof, food, cloth and the basic needs of human beings. In the early ancient times humans lived in caves, overt trees of under trees, to protect themselves from wild animals, ram, sun, etc. as the times passed as humans being started living in huts made of timber branches. The shelters of those old have been developed nowadays into beautiful houses. Rich people live in sophisticated condition houses. Buildings are the important indicator of social progress of the county. Every human has two- third life times in the houses. The security civic sense of the responsibility. These are the few reasons which are responsible that the person do utmost effort and spend hard earned saving in owning houses. Nowadays the house building is major work of the social progress of the county. Daily new techniques are being developed for the construction of houses economically, quickly and fulfilling the requirements of the community engineers and architects do the design work, planning and layout etc , of the buildings. Draughtsman is responsible for doing the drawing works of building as for the direction of engineers and architects, The draughtsman must know his job and should be able to follow the instruction of the engineer and should be able to draw the required drawing of the building, site plans and layout plans etc, as for the requirements. Building consists of number of bays storey . A multi-storey, multi-Paneled frame is a complicated statically Intermediate Structure. A design of R.C building of G+1 storey frame Work is taken up.

The building in plan consists of columns built monolithically forming a network. The plan area of building is 139.355sqm. the number of columns is 22. It is residential complex. The design is made using software on structural analysis design (staad- pro). The building subjected to the vertical loads. The vertical load consists of dead load of structural components such as beams, columns, slabs etc and live loads. . The horizontal load consists of the seismic forces thus building is designed for dead load, live load and seismic load as **per IS 875 & IS 1893**. The building is designed as two dimensional vertical frame and analyzed for the maximum and minimum bending moments and shear forces by trial and error methods as per **IS456-2000.** The help is taken by software available in institute and the computations of loads, moments and shear forces and obtained from this software.

Design of multi storied residential building:

General:

A structure can be defined as a body which can resist the applied loads without appreciable deformations Civil engineering structures are created to serve some specific functions like human habitation, transportation, bridges, storage etc. in a safe and economical way A structure is an assemblage of individual elements like pinned elements (truss elements), beam element, column, shear wall slab cable or arch. Structural engineering is concerned with the planning, designing and the construction of structures.

Structure analysis involves the determination of the forces and displacements of the structures or components of a structure. Design process involves the selection and detailing of the components that make up the structural system.

The main object of reinforced concrete design is to achieve a structure that will result in a safe economical solution.

The objective of the design is

1. Foundation Design
2. Column Design
3. Beam Design

The basic objective in structural analysis and design is to produce a structure capable of resisting all applied loads without failure during its intended life.

OBJECTIVES OF THE PRESENT STUDY

The specific objectives of the present study are as below.

1. Autocad
2. Load analysis
3. Beam design

ORGANISATION OF THE REPORT

The present work has been organized into six chapters. Following is a brief outline of the report. In the second chapter, general overview of literatures from various journals and publication Overviewed and discussed. The third chapter presents the general overviews of various materials used in this study are discussed. The fourth chapter presents the experimental program like mixing procedure, specification, Detail of various tests and their procedure. The fifth chapter deals with the various results and discussions of the study. As a result of the study carried out, overall conclusions, contribution are presented in the chapter to bring out the outcome of the present work.

STATEMENT OF PROJECT

Salient features:

Utility of building : Residential

Complex No of stories : G+1

Shape of the building : Rectangular

No of staircases : 1

No. of flats : 4

Type of construction : R.C.C framed

structure Types of walls : brick wall

Geometric details:

Ground floor : 3m

Floor to floor height : 3 m.

Height of plinth : 0.6m

Depth of foundation : 600mm

Materials:

Concrete grade : M25

Steel grades : Fe415 to Fe500

Bearing capacity ofsoil : 250KN/M^2

CHAPTER 2:
LITERATURE REVIEW:

1) Dinesh Dhanji Patel et al.(1989)

Authors have listed the causes of damages that occurred in Bhuj earthquake, Gujra India, of 2001. The distinct reason out of all others is, old structures predating mode Construction practices. Photographs are produced, showing respective details under Different categories of failures and is therefore a very good documentation of the so and last but not the least have detailed the guide lines for the benefit of public at large owners, and engineers about dealing with rehabilitation of different types of structure as well as for new structures.

2) F. Lazzali et al.(1990)

Seismic Performance of Masonry Buildings in Algeria. The authors have categorized data of numbers and types of house construction in Algeria. They have observed following types of damages after the 21st May 2003, Boumerdas earthquake Horizontal cracks between walls and floors, Vertical cracks at wall intersections, Out of plane collapse, diagonal cracks in piers, Cracks in spandrel walls, Partial or complete disintegration of walls, partial or complete collapse of building. In the conclusion they point out the vulnerability is due to, Heavy weight of construction material, Substandard workmanship, Inferior quality of mortar.

3) M.Haseeb et al. (1990)

The authors are referring to 8th Oct. 2005 earthquake in Pakistan. The majority of t houses collapses were located on the hill slopes or in vicinity hence, when earthquake struck; landslides, rock slides and subsidence followed it, they automatically became culprit of not single but quadraphonic attack. Un-engineered structures constructed traditional stone masonry pattern, with poor quality cement or mud mortar, and with use of steel reinforcement, as the causes of such large scale of massacre. The therefore compared the provisions of earthquake resistant cods of Pakistan with Japan .

4) Jerome et.al. (1991)

In the study "The Maze of Urban Housing Markets: Theory, evidence, and Policy", examined the determinants of housing demands which they described as being influenced by elements outside housing markets and within housing market. The elements outside housing markets include income and preference distributions and prices; of non-housing good, while the element within housing market includes market valuations of substitute submarkets.

5) Bruin and cook et al.(1997)

Explored that behavioral characteristic like residential characteristics, safety and security and friendly relationship with their neighborhood pose are the powerful factors of housing satisfaction.

6) Nayar, K. R. et al (1997)

It has correlated the housing amenities to health improvements and examined the conventional idea that factors such as housing conditions availability of drinking water, sanitary facilities etc, could contribute to health improvement among the population sometimes even more significantly than health services. The study indicates a definite contribution of housing condition including sanitary facilities in health improvement.

7) Ukoha, O. et al (1997)

It is found that the satisfaction is based on the services provided by the construction company. The satisfaction level also depends on some economic factors like economy benefit, improvement in quality of life, planning and environmental issues.

8) Al-Momani et. Al (2000)

Examined the quality in service provided by the construction company and also these research evaluate the service quality by using SERVQUAL gap analysis. He found that the construction company pays little attention to the customer needs like customization and this leads to poor performance of the company.

9) Soetanto et.al (2001)

Suggest that performance of a construction company should be improved to increase the customer satisfaction level. Satisfactory performance of the company leads t maintain harmonious relationship with the customers'.

10) Parker and Mathews et.al (2001)

states that satisfaction can be measured by determine the relationship between the customer expectations and what they received. This method is widely used to measure the customer satisfaction level.

CHAPTER 3:

METHODOLOGY

ASSUMPTIONS AND NOTATIONS USED:

The notation adopted throughout the work is same IS-456-2000.

Assumptions in Design:

Using partial safety factor for loads in accordance with clause 36.4 of IS-456-2as Y=1.5

Partial safety factor for material in accordance with clause 36.4.2 is IS- 456-2000 is taken as 1.5 for concrete and 1.15 for steel.

Using partial safety factors in accordance with clause 36.4 of IS- 456-2000 combination of load. D.L+L.L. 1.5

Density of materials used:

MATERIAL:	**DENSITY**
i} Plain concrete	24.0KN/m^3
ii) Reinforced	25.0KN/m^3
iii) Flooring material	20.0KN/m^3
iv) Brick masonry	19.0KN/m^3

LIVE LOADS: In accordance with IS 875-86

i) Live load on slab si 20.0KN/m²

ii) Live load on passage 4.0KN/m²

iii) Live load on stairs 3.5 KN/m²

DESIGN CONSTANTS :

Using M25 and Fe500 (main) grade of concrete and steel for beams, slabs, footings, column

Therefore:

Fck - characteristic strength of M25 - 25N/mm2

Fy - Characteristic strength of steel- 500N/mm2

Assumptions Regarding Design:

i) Slab is assumed to be continuous over interior support and partially fixed on edges, due to monolithic construction and due to construction of walls over it.

ii) Beams are assumed to be continuous over interior support and they frame in to the column at ends.

Assumptions on design:-

1) M25 grade is used in designing unless specified.

2) Tor steel Fe 500 is used for the main reinforcement.

3) Tor steel Fe 415 and steel is used for the distribution reinforcement.

SOFTWARES USED:-

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

List of software's used

1. Staadpro(v8i)

2. Staad foundations5(v8i)

3. Autocad

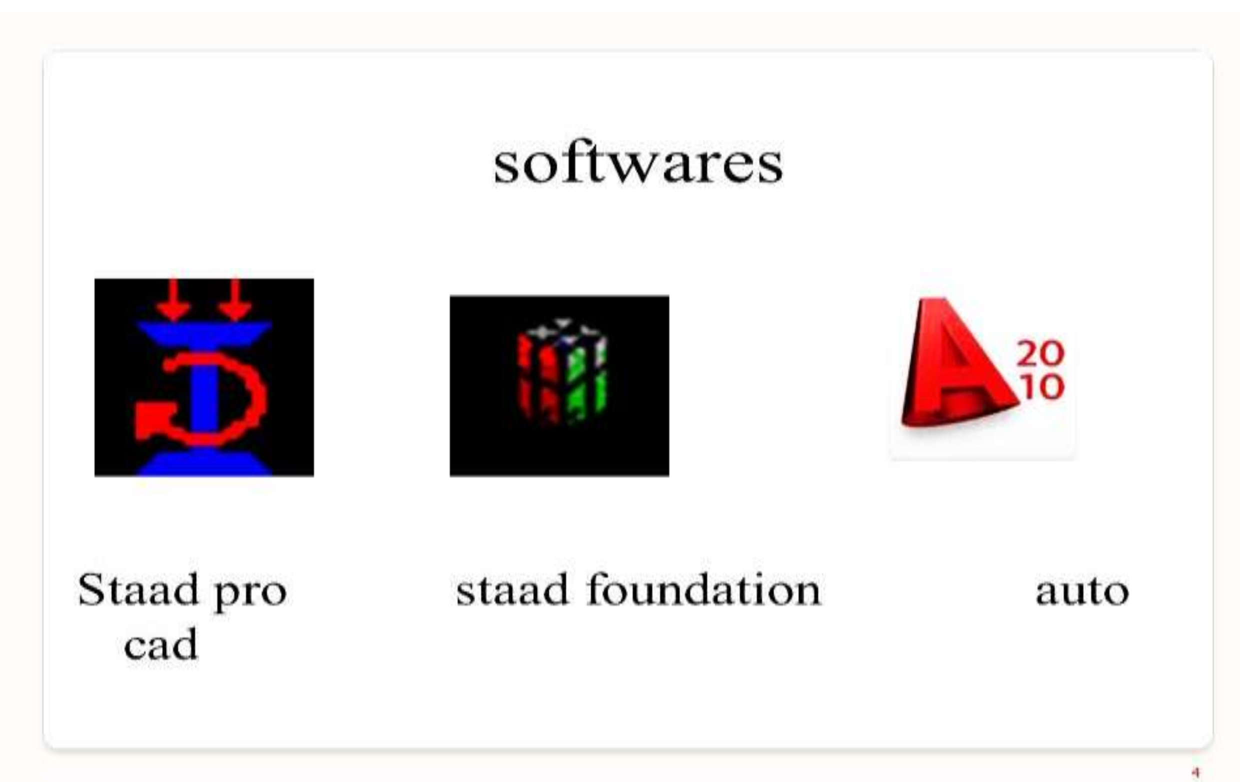


Fig : 1 (Stadd pro) **Fig : 2 (Stadd foundation)** **Fig : 3 (AutoCad)**

STAAD

Staad is powerful designs of 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, where as 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 Shear force diagram and bending moment diagram, 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.

Now a day's most of the high rise buildings are designed by staad
which makes a compulsion for a civil engineer to know about this software.

This software can be used to carry rec, steel, bridge, truss etc according to various country codes.

Staad Editor :

Staad has very great advantage to other software's i.e., Staad editor. Staad editor is the programming For the structure we created and loads we taken all details are presented in programming format in staad editor. This program can be used to analyze other structures also by just making some modifications, but this require some programming skills. So load cases created for a structure can be used for another structure using staad editor.

Alternatives for staad:

Struts, sap, add pro which gives details very clearly regarding reinforcement and manual calculations. But these software's are restricted to some designs only whereas staad can deal with several types of structure.

Limitations of Staad pro:

1. Huge output data
2. Even analysis of a small beam creates large output.
3. Unable to show plinth beams.

Staad foundation:

Staad foundation is a powerful tool used to calculate different types of foundations. It is also licensed by Bentley software's. All Bentley software's cost about 10 lakhs and so all engineers can't use it due to heavy cost.

Analysis and design carried in Staad and post processing in staad gives the load at various supports. These supports are to be imported into these software to calculate the footing details i.e., regarding the geometry and reinforcement details .

This software can deal different types of foundations:

SHALLOW (D<B)

1.Isolated (Spread)Footing

2.Combined (Strip)Footing

3.Mat (Raft) Foundation

DEEP (D>B)

1. Pile Cap
2. Driller pier

Depending on the soil at type we have to decide the type of foundation required.

Also lot of input data is required regarding safety factors, soil, materials used should be given in respective units .

After input data is give software design the details for each and every footing and gives the details regarding .

Geometry of footing

Reinforcement

Column layout Graphs

Manual calculations

These details will be given in detail for each and every column. . Another advantage of foundations is even after the design, Properties of the members can be updated if required .

The following properties can be updated

1 Column Position

2 Column Shape

3. Column Size

4. Load Cases

5. Support List .

It is very easy deal with this software and we don't have any best alternative to this .

AutoCAD:

AutoCAD is powerful software licensed by auto desk. The word auto came from auto Desk 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 th 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.

AutoCAD is a very easy software to learn and much user friendly for anyone to handle and can be learn quickly.

Learning of certain commands is required to draw in AutoCAD.

PLAN :

The auto cad plotting no.1 represents the plan of a g+2 building. The plan clearly shows that it is a combination of two apartments in each block. We can observe there is a combination between each and every apartment.

In each block the entire floor consists of a eight rooms which occupies entire floor of a block.It is a G+1 proposed building, so for three storey building we have 2x2-4 flats

represents a middle class locality with minimum areas for each house.

The plan shows the details of dimensions of each and every room and the type of room and orientation of the different rooms like bed room, bathroom, kitchen, hall etc. There are total four balconies in this building. Each flat consist of one balcony.

The entire plan area is about 139.355 sq.m.

The plan also gives the details of location of stair case in the building..
We have 1 stair case and designing of stair case is shown in AutoCAD. So these represent the plan of our building and detailed explanation of remaining parts like section, elevation, and designing is carried in the next sections.

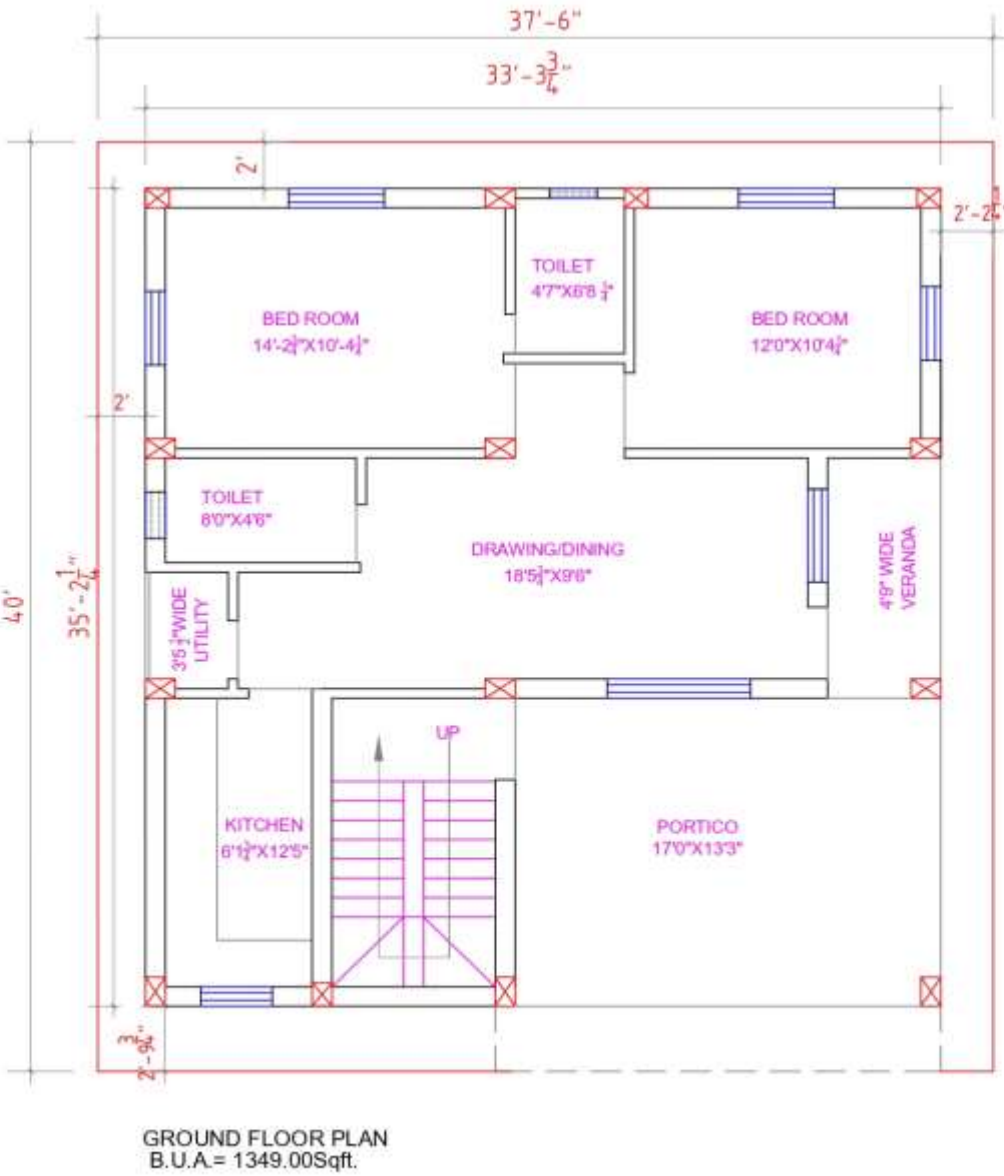


Figure : 4 Ground floor plan

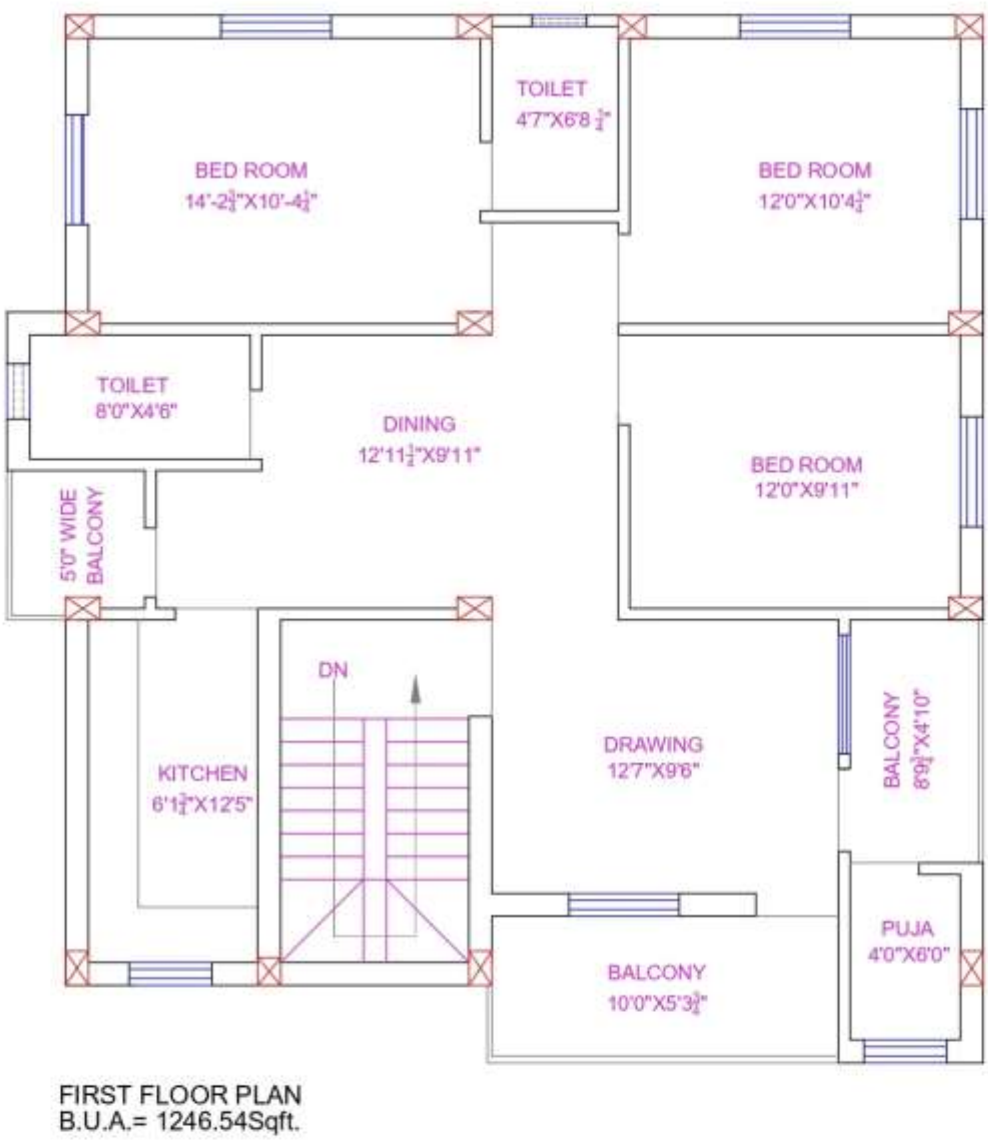


Figure : 5 First floor plan

ELEVATION:

AutoCAD plotting no 2 represents the proposed elevation of building. It shows the elevation of a g+1 building representing the front view which gives the overview of a building block. Each floor consists of height 3 m which is taken as per AMC (AGARTALA MUNICIPAL CORPORATION) rules for residential buildings. The building is not designed for increasing the number of floors in future. So the number of floors is fixed for future also for this building due to unavailability of the permissions of respective authorities.

Also special materials like fly ash and self compacted concrete were also used in order to reduce the dead load and increase life of the structure and also improve economy. But these materials were not considered while designing in staad.

This is regarding the plan and details of the site and next section deals with the design part of the building under various loads for which the building is design.

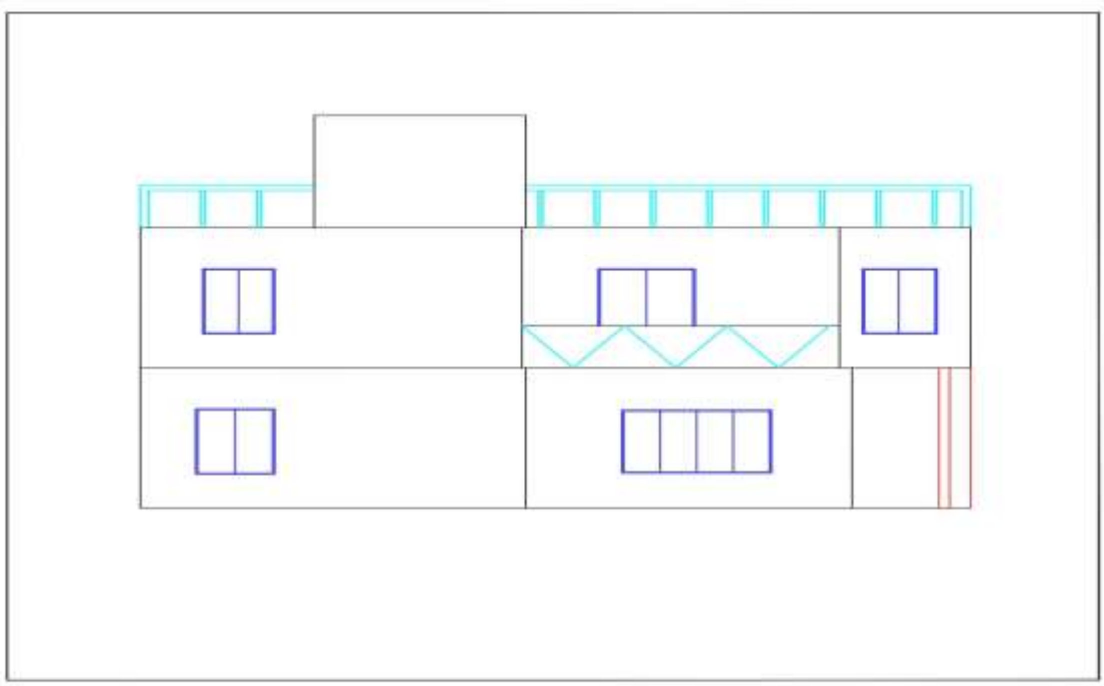


Figure : 6 FRONT ELEVATION

BEAM POSITION IN AUTOCAD :

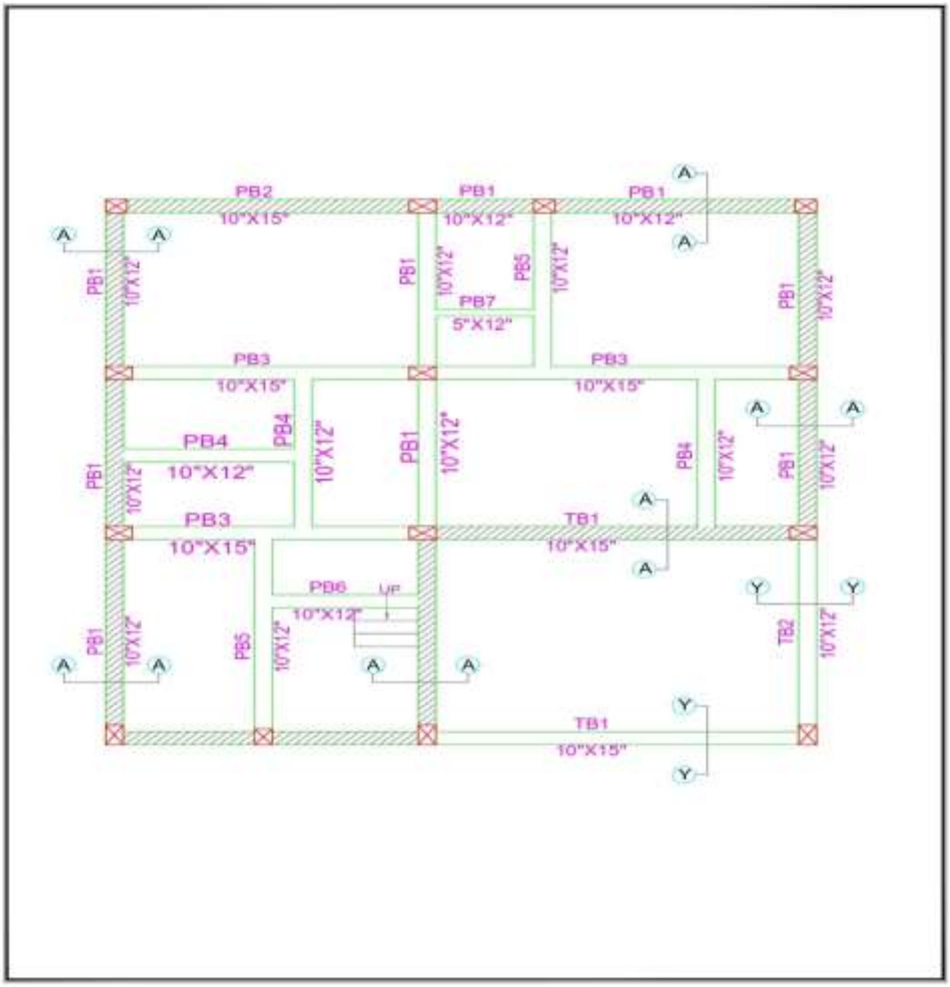


Figure : 7 BEAM POSITION

CENTER LINE PLAN

The below figure represents the center line diagram of our building in staad pro. Each support represents the location of different columns in the structure This structure is used in generating the entire structure using a tool called transitional repeat and link steps After using the tool the structure that is created can be analyzed in staad pro under various loading cases. Below figure represents the skeletal structure of the building which is used to carry out the analysis of our building All the loadings are acted on this structure to carryout the analysis of our building. This is not the actual structure but just represents the outline of the building in staad pro A mesh is automatically created for the analysis of these building.

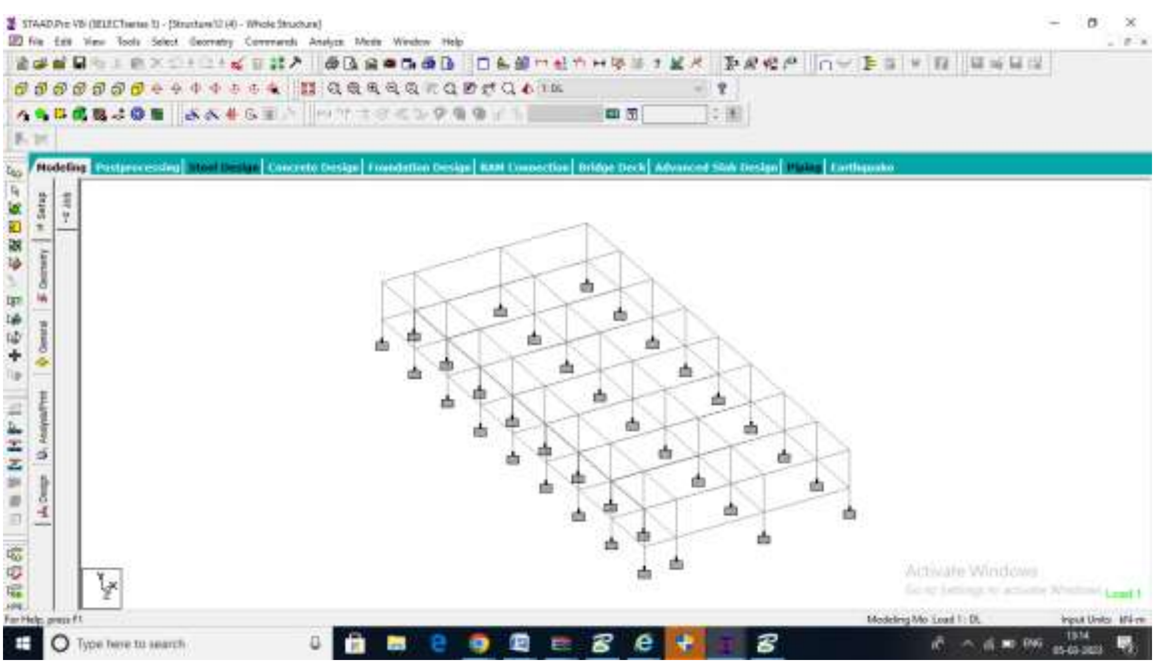


Figure : 8 skeletal structure of the building

RENDERING VIEW :

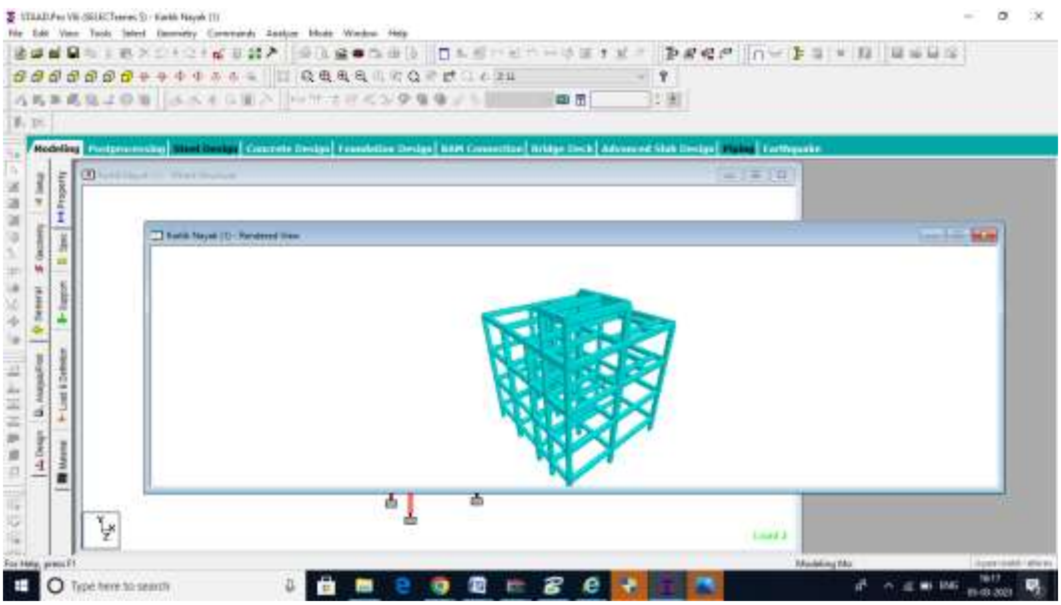


Figure: 9 Rendering view

Load Conditions and Structural System Response:

The concepts presented in this section provide an overview of building loads and their effect on the structural response of typical wood-framed homes. Building loads can be divided into types based on the orientation of the structural action or forces that they induce; vertical and horizontal (i.e., lateral) loads. Classifications of loads are described in the following sections.

Building Loads Categorized by Orientation:

Types of loads on a hypothetical building are as follows.

- Vertical Loads > Dead (gravity)
- Live (gravity)
- Snow (gravity)
- Wind (uplift on roof)
- Seismic and wind (overturning) > Seismic (vertical ground motion)

Horizontal (Latéral) Loads:

Direction of loads is horizontal w.r.t to the building.

- Wind
- Seismic (horizontal ground motion)
- Flood(static and dynamic hydraulic forces
- Soil (active lateral pressure)

Vertical Loads:

Gravity loads act in the same direction as gravity (i.e downward or vertically) and include dead, live, and snow loads. They are generally static in nature and usually considered a uniformly distributed or concentrated load. Thus, determining a gravity load on a beam or column is a relatively simple exercise that uses the concept of tributary areas to assign loads to structural elements, including the dead load (i.e. weight of the construction) and any applied loads(i.e live load). For example, the tributary gravity load on a floor joist would include the uniform floor load (dead and live) applied to the area of floor supported by the individual joist. The structural designer then selects a standard beam or column model to analyze bearing connection forces (i.e., reactions) internal stresses (i.e., bending stresses, shear stresses, and axial stresses) and stability of the structural member or system a for beam equations.

Lateral Loads :

The primary loads that produce lateral forces on buildings arc attributable to forces associated with wind, seismic ground motion, floods, and soil. Wind and seismic lateral loads apply to the entire building. Lateral forces from wind are generated by positive wind pressures on the windward face of the building and by negative pressures on the leeward face of the building, creating a combined push and pull effect. Seismic lateral forces are generated by a structure's dynamic inertial response to cyclic ground movement.

The magnitude of the seismic shear (i.e, lateral) load depends on the magnitude of the ground motion, the buildings mass, and the dynamic structural response characteristics (i.e, dampening, ductility natural period of vibration, etc) for houses and other similar low rise structures, a simplified seismic load analysis employs equivalent static forces based on fundamental Newtonian mechanics (F=ma) with somewhat subjective(i.e., experience-based) adjustments to account for inelastic, ductile response characteristics of various building systems. Flood loads are generally minimized by elevating the structure on a properly designed foundation or avoided by not building in a flood plain.

Lateral loads from moving flood waters and static hydraulic pressure are substantial. Soil lateral loads apply specifically to foundation wall design, mainly as an "out-of-plane" bending load on the wall. Lateral loads also produce an overturning moment that must be offset by the dead load and connections of the building. Therefore, overturning forces on connections .

Designed to restrain components from rotating or the building from overturning must be considered. Since wind is capable of the generating simultaneous roof uplift and lateral loads, the uplift component of the wind load exacerbates the overturning tension forces due to the lateral component of the wind load. Conversely the dead load may be sufficient to offset the overturning and uplift forces as is the case in lower design wind conditions and in many seismic design conditions.

Structural systems:

As far back as 1948, it was determined that "conventions in general use for wood, steel and concrete structures are not very helpful for designing houses because few are applicable" (NBS,1948). More specifically, the NBS document encourages the use of more advanced methods of structural analysis for homes. Unfortunately the study in question and all subsequent studies addressing the topic of system performance in housing have not led to the development or application of any significant improvement in the codified design practice as applied to housing systems .

This lack of application is partly due to conservative nature of the engineering process and partly due to difficulty of translating the results of narrowly focused structural systems studies to general design applications. Since this document is narrowly scoped to address residential construction, relevant system. Based studies and design information for housing are discussed, referenced, and applied as appropriate. If a structural member is part of system, as it typically the case in light frame residential construction, its response is altered by the strength and stiffness characteristics of the system as a whole.

Design loads for residential buildings:

General

Loads are a primary consideration in any building design because they define the nature and magnitude of hazards are external forces that building must resist to provide a reasonable performance(i.e., safety and serviceability) throughout the structure's useful life. The anticipated loads are influenced by a building's intended use (occupancy and function), configuration (size and shape) and location (climate and site conditions). Ultimately, the type and magnitude of design loads affect critical decisions such as material collection, construction details and architectural configuration.

Thus, to optimize the value (i.e., performance versus economy) of the finished product, it is essential to apply design loads realistically. While the buildings considered in this guide are primarily single-family detached and attached dwellings, the principles and concepts related to building loads also apply to other similar types of construction, such as low-rise apartment buildings. In general, the design loads recommended in this guide are based on applicable provisions of the ASCE 7 standard- Minimum Design; loads for buildings and other structures (ASCE,1999), the ASCE 7 standard represents an acceptable practice for building loads in the United states and is recognized in virtually all U.S. codes. For this reason, the reader is encouraged to become familiar with the provisions, commentary, and technical references contained in the ASCE 7 standard. In general structural design of housing has not been treated as a unique engineering discipline or subjected to a special effort to develop better, more efficient design practices. Therefore, this part of the guide focuses on those aspects of ASCE 7 and other technical resources that are particularly relevant to the determination of design loads for residential structures.

Dead Loads:

Dead loads consist of the permanent construction material loads compressing the roof, floor, wall, and foundation systems, including claddings, finishes and fixed equipment. Dead load is the total load of all of the components of the components of the building that generally do not change over time, such as the steel columns, concrete floors, bricks, roofing material etc.

In staad pro assignment of dead load is automatically done by giving the property of the member.

In load case we have option called self weight which automatically calculates weights using the properties of material i.e., density and after assignment of dead load the skeletal structure looks red in colour as shown in the figure.

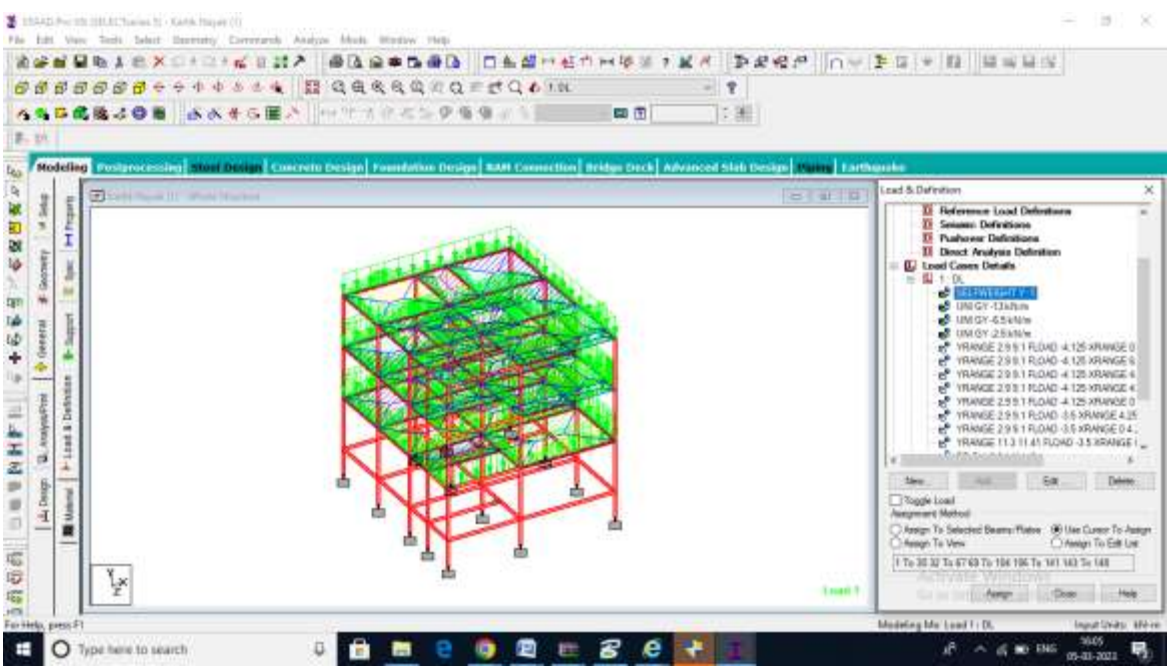


Figure : 10 Dead Load

Live Loads:

Live loads are produced by the use and occupancy of a building Loads include those from human occupants, furnishings, no fixed equipment, storage, and construction and maintenance activities. As required to adequately define the loading condition, loads are presented in terms of uniform area loads, concentrated loads, and uniform line loads. The uniform and concentrated live loads should not be applied simultaneously structural evaluation.

In staad we assign live load in terms of U.D.L. we has to create a load case for live load and select all the beams to carry such load. After the assignment of the live load the structure appears as shown below.

For our structure live load is taken as 0.003 N/mm² for design

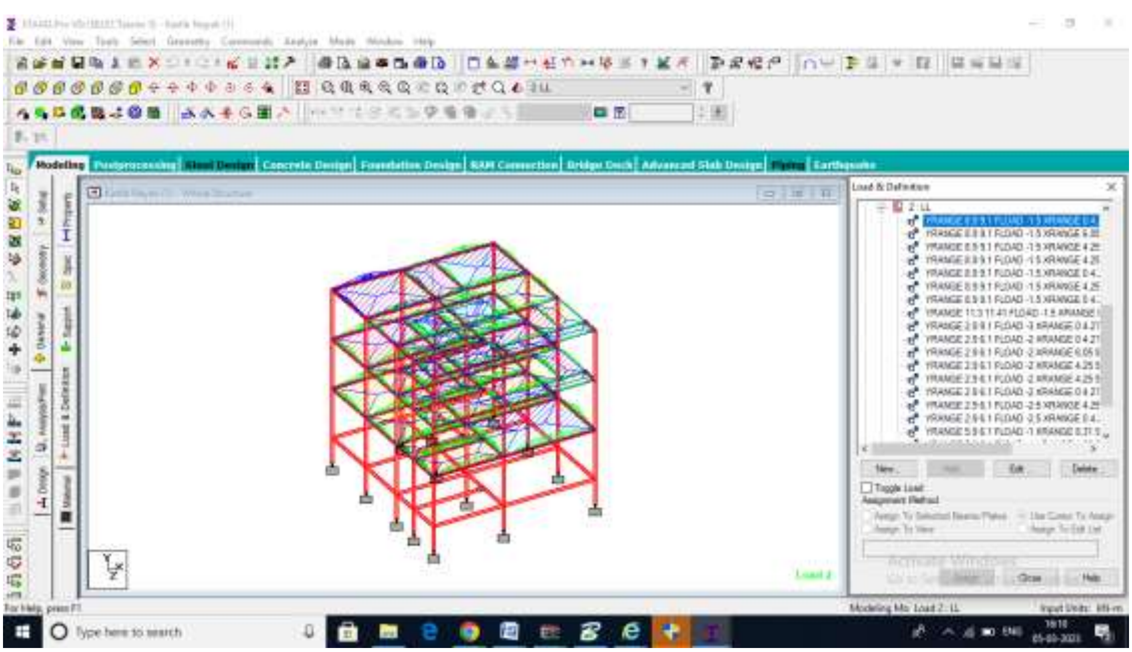


Figure : 11 Live load

Reinforced concrete beams:

It is reinforced under compression tension regions. The necessity of steel of compression region arises due to two reasons. When depth of beam is restricted. The strength availability singly reinforced beam is in adequate. At a support of continuous beam where bending moment changes sign such as situation may also arise in design of a beam circular in plan. Figure shows the bottom and top reinforcement details at

three different sections. These calculations are interpreted manually.

STAAD Pro Query Concrete Design

Beam no 24 Design Code IS-456

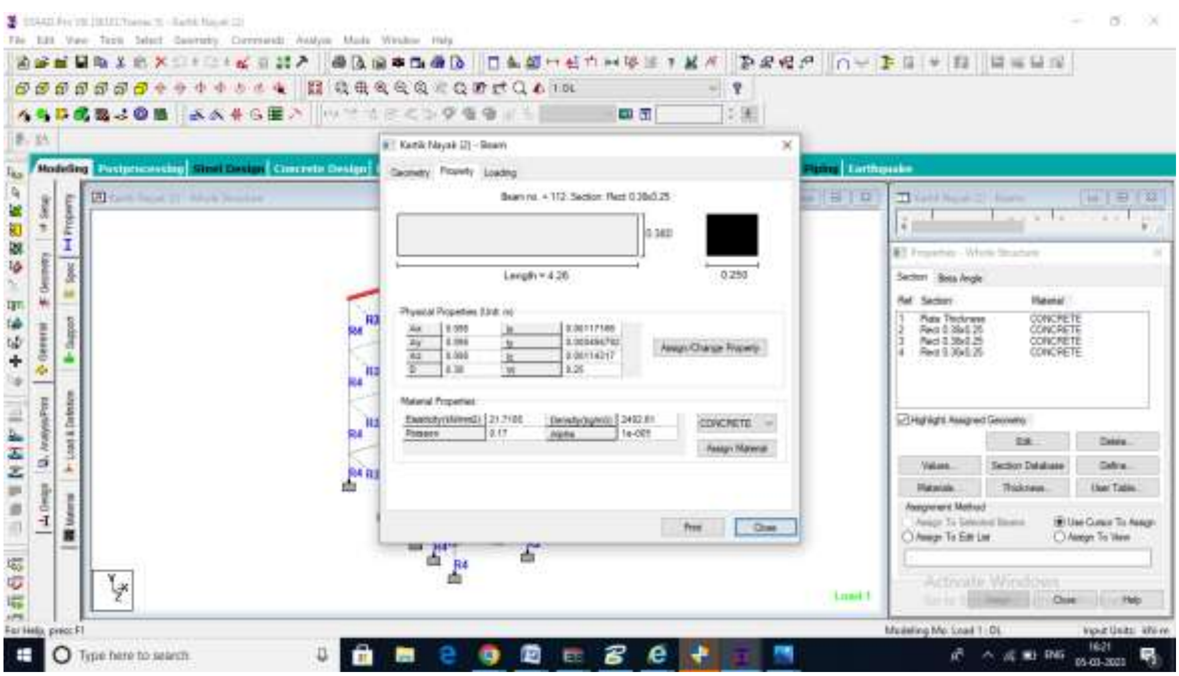
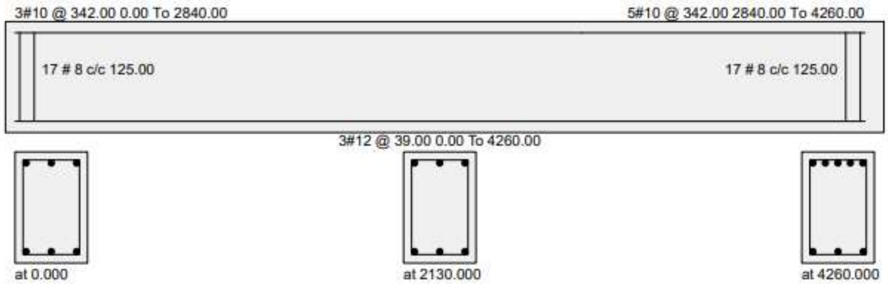


Figure: 12 A diagram of the reinforcement details of beam

STAAD.Pro Query Concrete Design

Beam no. 117

Design Code: IS-456



Design Load

Mz(Kn Met)	Dist.et	Load
22.209999	2.100000	4
-26.049999	0.000000	4
-47.160000	4.300000	4

Design Parameter

Fy(Mpa)	500.000000
Fc(Mpa)	25.000000
Depth(ft)	1.246717
Width(ft)	0.820208
Length(ft)	13.976350

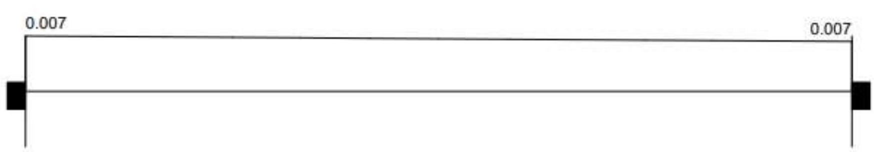
Fig : 13 Reinforcement details of a beam

The following figure shows the deflection & shear result of same beam :

STAAD.Pro Query Deflection Result

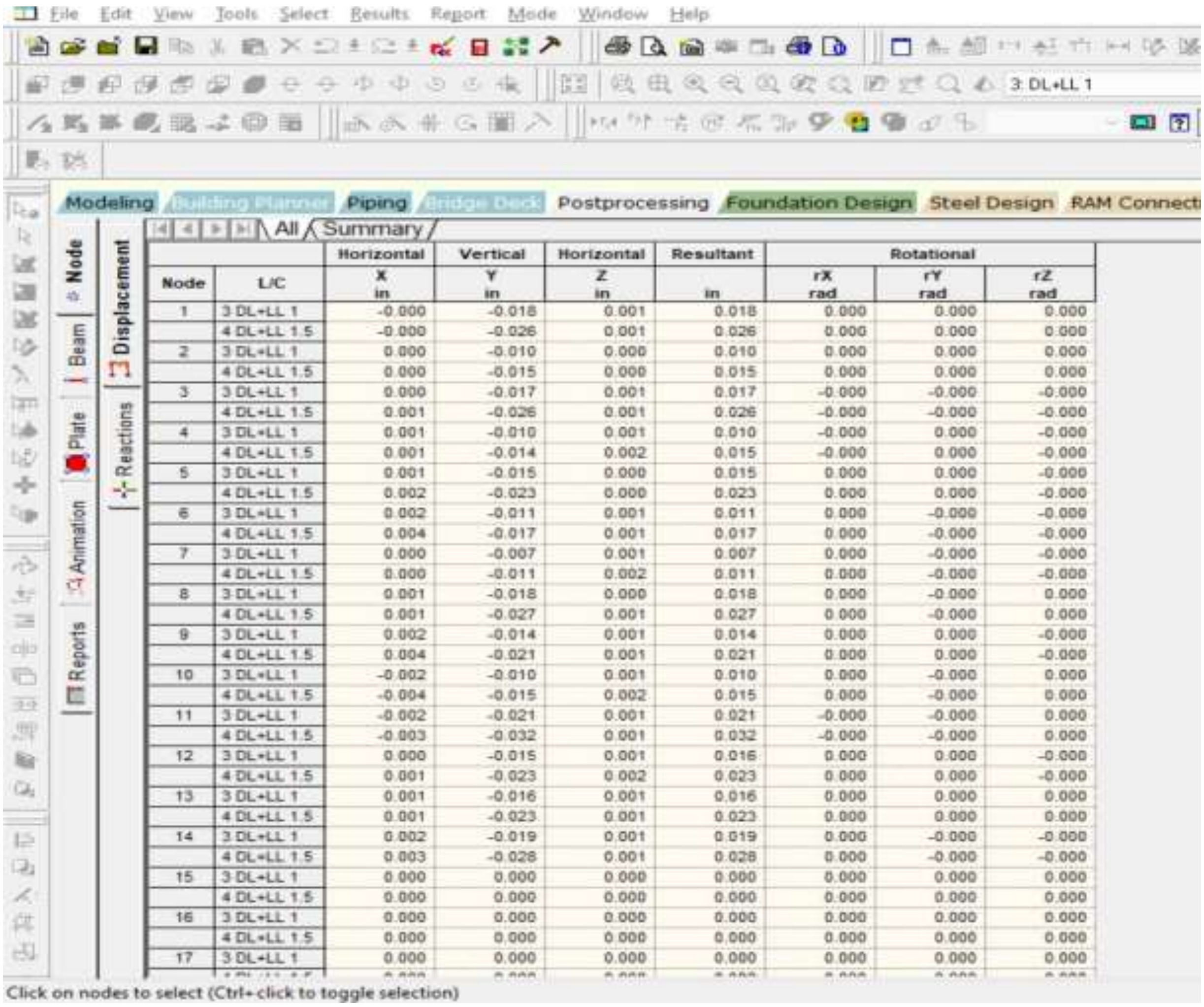
Beam no. 117

Deflection in Global X axis. Load case 1.



Dist.ft	X(in)	Y(in)	Z(in)
0.000000	0.0073	-0.0375	0.0187
1.164696	0.0073	-0.0428	0.0187
2.329392	0.0072	-0.0493	0.0187
3.494087	0.0072	-0.0558	0.0188
4.658783	0.0071	-0.0613	0.0189
5.823479	0.0070	-0.0651	0.0191
6.988175	0.0070	-0.0666	0.0193
8.152871	0.0069	-0.0659	0.0195
9.317567	0.0069	-0.0634	0.0198
10.482262	0.0068	-0.0598	0.0201
11.646958	0.0067	-0.0563	0.0204
12.811654	0.0067	-0.0543	0.0208
13.976350	0.0066	-0.0555	0.0212

DESIGN LOAD SUMMARY (KN/MT)

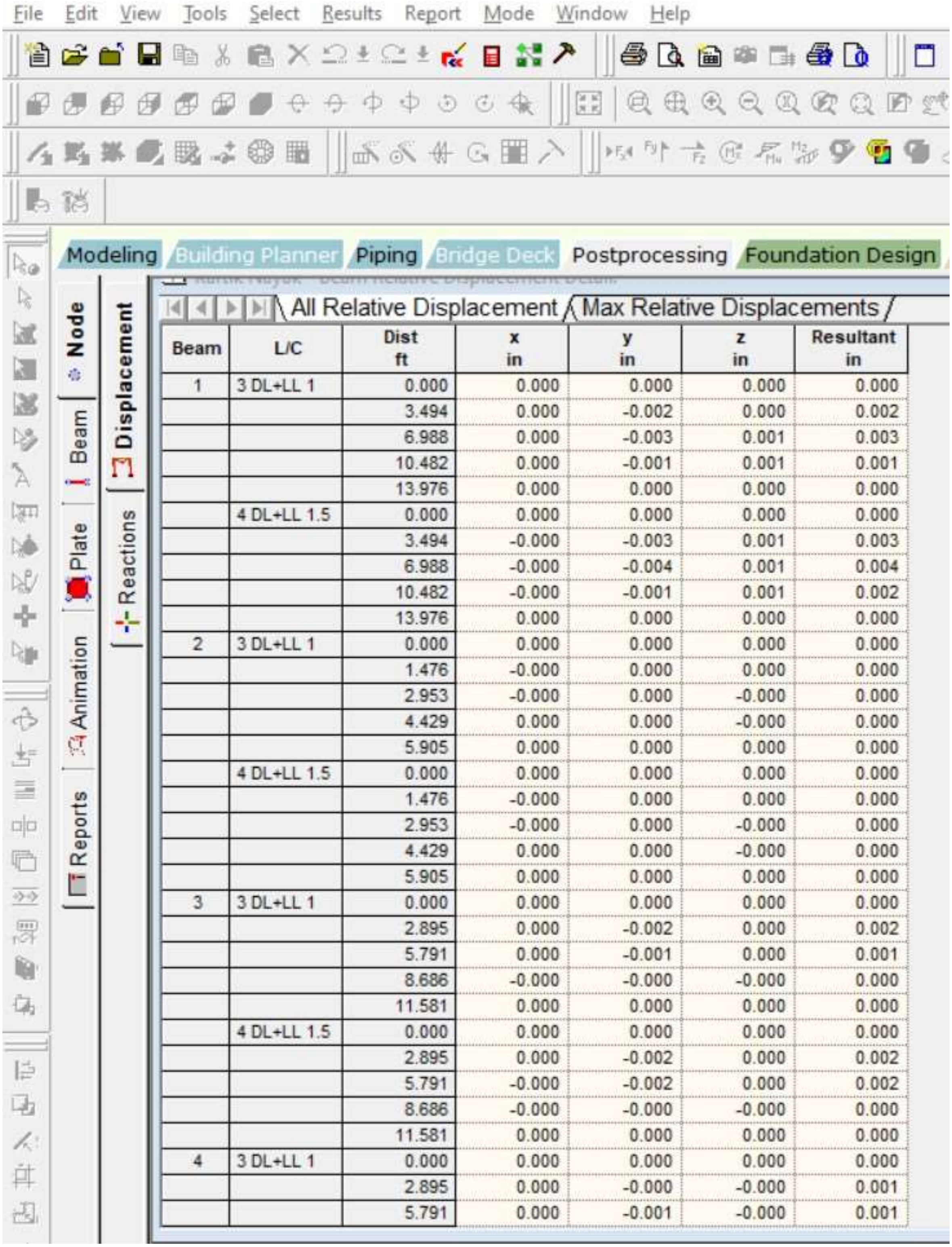


		Horizontal	Vertical	Horizontal	Resultant	Rotational		
Node	L/C	X in	Y in	Z in	in	rX rad	rY rad	rZ rad
1	3 DL+LL 1	-0.000	-0.018	0.001	0.018	0.000	0.000	0.000
	4 DL+LL 1.5	-0.000	-0.026	0.001	0.026	0.000	0.000	0.000
2	3 DL+LL 1	0.000	-0.010	0.000	0.010	0.000	0.000	0.000
	4 DL+LL 1.5	0.000	-0.015	0.000	0.015	0.000	0.000	0.000
3	3 DL+LL 1	0.000	-0.017	0.001	0.017	-0.000	-0.000	-0.000
	4 DL+LL 1.5	0.001	-0.026	0.001	0.026	-0.000	-0.000	-0.000
4	3 DL+LL 1	0.001	-0.010	0.001	0.010	-0.000	0.000	-0.000
	4 DL+LL 1.5	0.001	-0.014	0.002	0.015	-0.000	0.000	-0.000
5	3 DL+LL 1	0.001	-0.015	0.000	0.015	0.000	0.000	-0.000
	4 DL+LL 1.5	0.002	-0.023	0.000	0.023	0.000	0.000	-0.000
6	3 DL+LL 1	0.002	-0.011	0.001	0.011	0.000	-0.000	-0.000
	4 DL+LL 1.5	0.004	-0.017	0.001	0.017	0.000	-0.000	-0.000
7	3 DL+LL 1	0.000	-0.007	0.001	0.007	0.000	-0.000	-0.000
	4 DL+LL 1.5	0.000	-0.011	0.002	0.011	0.000	-0.000	-0.000
8	3 DL+LL 1	0.001	-0.018	0.000	0.018	0.000	-0.000	0.000
	4 DL+LL 1.5	0.001	-0.027	0.001	0.027	0.000	-0.000	0.000
9	3 DL+LL 1	0.002	-0.014	0.001	0.014	0.000	0.000	-0.000
	4 DL+LL 1.5	0.004	-0.021	0.001	0.021	0.000	0.000	-0.000
10	3 DL+LL 1	-0.002	-0.010	0.001	0.010	0.000	-0.000	0.000
	4 DL+LL 1.5	-0.004	-0.015	0.002	0.015	0.000	-0.000	0.000
11	3 DL+LL 1	-0.002	-0.021	0.001	0.021	-0.000	-0.000	0.000
	4 DL+LL 1.5	-0.003	-0.032	0.001	0.032	-0.000	-0.000	0.000
12	3 DL+LL 1	0.000	-0.015	0.001	0.016	0.000	0.000	-0.000
	4 DL+LL 1.5	0.001	-0.023	0.002	0.023	0.000	0.000	-0.000
13	3 DL+LL 1	0.001	-0.016	0.001	0.016	0.000	0.000	0.000
	4 DL+LL 1.5	0.001	-0.023	0.001	0.023	0.000	0.000	0.000
14	3 DL+LL 1	0.002	-0.019	0.001	0.019	0.000	-0.000	-0.000
	4 DL+LL 1.5	0.003	-0.028	0.001	0.028	0.000	-0.000	-0.000
15	3 DL+LL 1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4 DL+LL 1.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	3 DL+LL 1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4 DL+LL 1.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	3 DL+LL 1	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Click on nodes to select (Ctrl+click to toggle selection)

Table : 1 Summary

DESIGN LOAD SUMMARY (KN/MT)



Beam	L/C	Dist ft	x in	y in	z in	Resultant in
1	3 DL+LL 1	0.000	0.000	0.000	0.000	0.000
		3.494	0.000	-0.002	0.000	0.002
		6.988	0.000	-0.003	0.001	0.003
		10.482	0.000	-0.001	0.001	0.001
		13.976	0.000	0.000	0.000	0.000
	4 DL+LL 1.5	0.000	0.000	0.000	0.000	0.000
		3.494	-0.000	-0.003	0.001	0.003
		6.988	-0.000	-0.004	0.001	0.004
		10.482	-0.000	-0.001	0.001	0.002
		13.976	0.000	0.000	0.000	0.000
2	3 DL+LL 1	0.000	0.000	0.000	0.000	0.000
		1.476	-0.000	0.000	0.000	0.000
		2.953	-0.000	0.000	-0.000	0.000
		4.429	0.000	0.000	-0.000	0.000
		5.905	0.000	0.000	0.000	0.000
	4 DL+LL 1.5	0.000	0.000	0.000	0.000	0.000
		1.476	-0.000	0.000	0.000	0.000
		2.953	-0.000	0.000	-0.000	0.000
		4.429	0.000	0.000	-0.000	0.000
		5.905	0.000	0.000	0.000	0.000
3	3 DL+LL 1	0.000	0.000	0.000	0.000	0.000
		2.895	0.000	-0.002	0.000	0.002
		5.791	0.000	-0.001	0.000	0.001
		8.686	-0.000	-0.000	-0.000	0.000
		11.581	0.000	0.000	0.000	0.000
	4 DL+LL 1.5	0.000	0.000	0.000	0.000	0.000
		2.895	0.000	-0.002	0.000	0.002
		5.791	-0.000	-0.002	0.000	0.002
		8.686	-0.000	-0.000	-0.000	0.000
		11.581	0.000	0.000	0.000	0.000
4	3 DL+LL 1	0.000	0.000	0.000	0.000	0.000
		2.895	0.000	-0.000	-0.000	0.001
		5.791	0.000	-0.001	-0.000	0.001

Reinforcement Details of roof beam: Ground Floor

REINFORCEMENT DETAILS OF GROUND FLOOR ROOF BEAM

ame of roof beam	Roof beam size	Top LVL.	At 1st support	At Mid span	At 2nd support
RB1	10"x16"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB2	10"x12"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB3	10"x16"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB4	10"x18"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB4a	10"x18"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB5	10"x20"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB6	10"x18"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB6a	10"x18"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB7	10"x20"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB8	10"x16"	Roof Lvl.	[illegible]	[illegible]	[illegible]

Table : 3

REINFORCEMENT DETAILS OF GROUND FLOOR ROOF BEAM

Name of roof beam	Roof beam size	Top LVL.	At 1st support	At Mid span	At 2nd support
RB9	10"x16"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB10	10"x20"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB11	5"x20"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB12	10"x20"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB13	10"x16"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RBX	10"x12"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB14	10"x16"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB15	10"x12"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB16	10"x16"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB16a	10"x20"	Roof Lvl.	[illegible]	[illegible]	[illegible]

Table : 4

REINFORCEMENT DETAILS OF GROUND FLOOR ROOF BEAM

Name of roof beam	Roof beam size	Top LVL.	At 1st support	At Mid span	At 2nd support
RB17	10"x16"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB18	10"x16"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB19	10"x20"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB19a	10"x20"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB20	10"x20"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB21	10"x20"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB22	10"x16"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB23	10"x16"	Roof Lvl.	[illegible]	[illegible]	[illegible]

Table : 5

Reinforcement Details of roof beam: First Floor

REINFORCEMENT DETAILS OF 1ST FLOOR ROOF BEAM

Name of roof beam	Roof beam size	Top LVL.	At 1st support	At Mid span	At 2nd support
RB1	10"x16"	Roof Lvl.	2-#16+1-12 #8 @5" C/C 2-#16	2-#16 #8 @7" C/C 2-#16	5-#16 #8 @5" C/C 2-#16
RB2	10"x16"	Roof Lvl.	2-#16+1-12 #8 @5" C/C 2-#16	2-#16 #8 @7" C/C 2-#16	5-#16 #8 @5" C/C 2-#16
RB3	10"x16"	Roof Lvl.	5-#16 #8 @5" C/C 2-#16	2-#16 #8 @7" C/C 2-#16	2-#16+1-12 #8 @5" C/C 2-#16
RB4	10"x18"	Roof Lvl.	2-#16 2-#16 #8 @5" C/C 3-#16	2-#16 #8 @7" C/C 3-#16	3-#16 2-#16 #8 @5" C/C 3-#16
RB4a	10"x18"	Roof Lvl.	2-#16 2-#16 #8 @5" C/C 2-#16	2-#16 2-#16 #8 @5" C/C 2-#16	2-#16 2-#16 #8 @5" C/C 2-#16
RB5	10"x20"	Roof Lvl.	3-#16 #8 @5" C/C 2-#16 2-#16 2-#16	3-#16 #8 @7" C/C 2-#16 2-#16	3-#16 #8 @5" C/C 2-#16 2-#16 2-#16
RB5a	10"x16"	Roof Lvl.	2-#16+1-12 #8 @5" C/C 2-#16	2-#16 #8 @7" C/C 2-#16	3-#16 #8 @5" C/C 2-#16
RB6	10"x18"	Roof Lvl.	3-#16 #8 @5" C/C 2-#16 2-#16 2-#16	3-#16 #8 @7" C/C 2-#16	3-#16 #8 @5" C/C 3-#16 2-#16 2-#16
RB6a	10"x18"	Roof Lvl.	3-#16 #8 @5" C/C 2-#16 2-#16 2-#16	3-#16 #8 @5" C/C 2-#16 2-#16 2-#16	3-#16 #8 @5" C/C 2-#16 2-#16 2-#16
RB7	10"x20"	Roof Lvl.	3-#16 #8 @5" C/C 3-#16 2-#16 2-#16	3-#16 #8 @7" C/C 2-#16 2-#16	3-#16 #8 @5" C/C 2-#16 2-#16 2-#16
RB8	10"x16"	Roof Lvl.	2-#16+1-12 #8 @5" C/C 2-#16	2-#16 #8 @7" C/C 2-#16	2-#16+1-1 #8 @5" C/ 2-#16

Table : 6

REINFORCEMENT DETAILS OF 1ST FLOOR ROOF BEAM

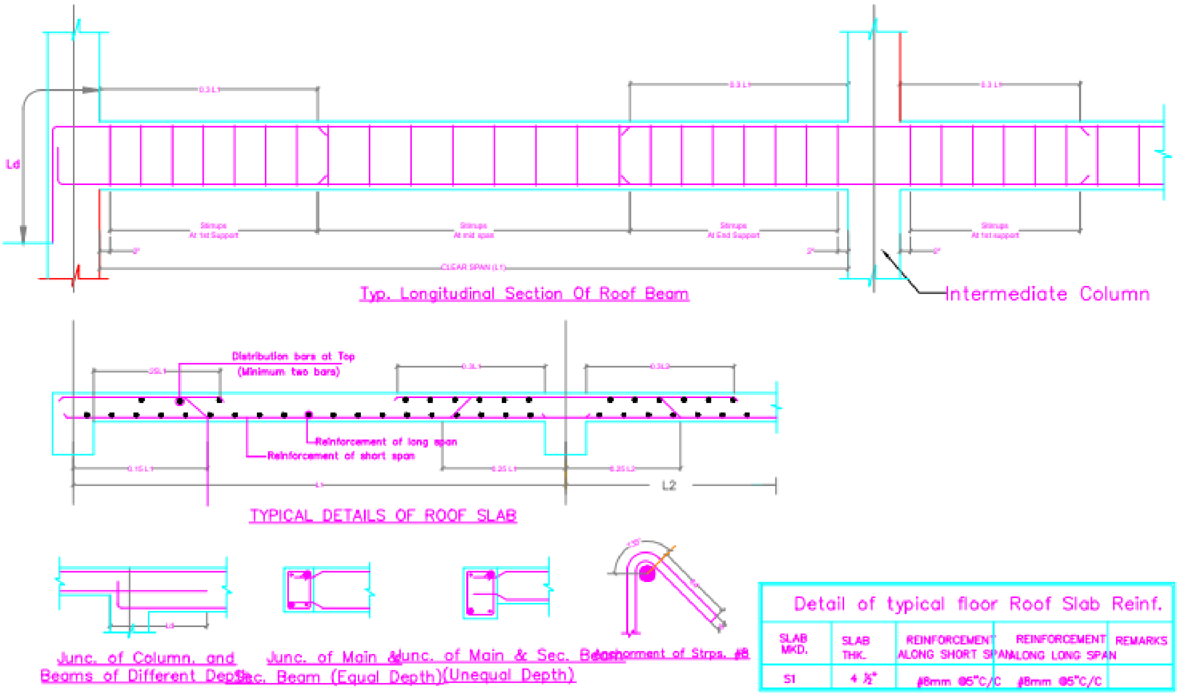
Name of roof beam	Roof beam size	Top LVL.	At 1st support	At Mid span	At 2nd support
RB9	10"x16"	Roof Lvl.	2-#16+1-12 #8 @5" C/C 2-#16	2-#16 #8 @7" C/C 2-#16	2-#16 #8 @5" C/C 2-#16 2-#16
RB9a	10"x20"	Roof Lvl.	2-#16+1-12 #8 @5" C/C 2-#16	2-#16 #8 @7" C/C 2-#16	2-#16 #8 @5" C/C 2-#16 2-#16
RB11	5"x20"	Roof Lvl.	2-#12 #8 @5" C/C 2-#12	2-#12 #8 @5" C/C 2-#12	2-#12 #8 @6" C/C 2-#12
RB12	10"x20"	Roof Lvl.	2-#12 #8 @5" C/C 3-#12	2-#12 #8 @7" C/C 3-#12	2-#12 #8 @5" C/C 3-#12
RB13	10"x16"	Roof Lvl.	2-#16+1-12 #8 @5" C/C 2-#16	2-#12 #8 @7" C/C 2-#16	2-#16+1-12 #8 @5" C/C 2-#16
RBX	10"x12"	Roof Lvl.	2-#12 #8 @7" C/C 4-#12	2-#12 #8 @7" C/C 4-#12	2-#12 #8 @7" C/C 4-#12
RB14	10"x16"	Roof Lvl.	2-#16 #8 @7" C/C 3-#16	2-#16 #8 @7" C/C 3-#16	3-#16 #8 @5" C/C 3-#16
RB15	10"x16"	Roof Lvl.	2-#16 2-#16 #8 @5" C/C 3-#16	2-#16 #8 @7" C/C 3-#16	2-#16 #8 @5" C/C 2-#16 3-#16
RB16	10"x20"	Roof Lvl.	2-#16 2-#16 #8 @5" C/C 3-#16	2-#16 #8 @7" C/C 3-#16	2-#16 #8 @5" C/C 2-#16 3-#16
RB16a	10"x16"	Roof Lvl.	2-#16 2-#16 #8 @5" C/C 3-#16	2-#16 #8 @7" C/C 3-#16	2-#16 #8 @5" C/C 2-#16 3-#16

Table : 7

REINFORCEMENT DETAILS OF 1ST FLOOR ROOF BEAM

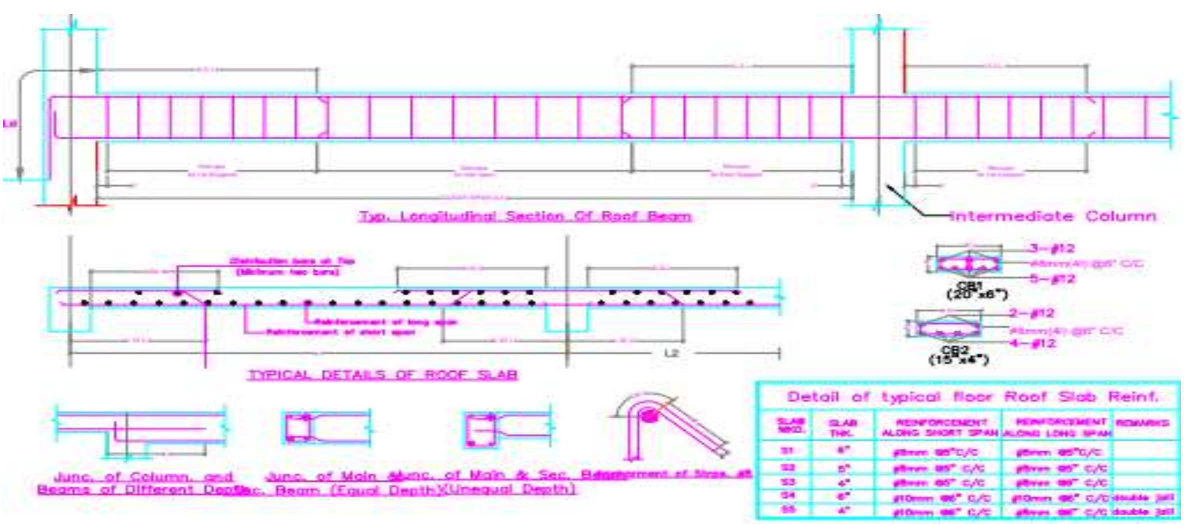
Name of roof beam	Roof beam size	Top LVL.	At 1st support	At Mid span	At 2nd support
RB17	10"x16"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB18	10"x16"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB19	10"x16"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB19	10"x16"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB20	10"x20"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB21	10"x20"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB22	10"x16"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RB23	10"x16"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RBX	10"x16"	Roof Lvl.	[illegible]	[illegible]	[illegible]
RBY	5"x16"	Roof Lvl.	[illegible]	[illegible]	[illegible]

Table : 8



Longitudinal Section of Roof Beam: Ground Floor

Fig : 14



Longitudinal Section of Roof Beam: First Floor

Fig : 15

COLUMN

A column or strut is a compression member, which is used primary to support axial compressive loads 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 CG of the column 1 the longitudinal direction. Depending upon the architectural requirements and loads to be supported, R.C columns may be cast in various shapes i.e. square , rectangle, and hexagonal octagonal, circular. Columns of L shaped or T shaped are also sometimes used in multistoried buildings. The longitudinal bars in columns help to bear the load in the combination with the concrete. The longitudinal bars are held in position by transverse reinforcement, or lateral binders. The binders prevent displacement of longitudinal bars during concreting operation and also check the tendency of their buckling towards under loads.

Positioning of columns : Some of the guiding principles which help the positioning of the columns are as follows . A) Columns should be preferably located at or near the corners of the building and at the intersection of the wall, but for the columns on the property line as the following requirements some area beyond the column, the column can be shifted in side along a cross wall to provide the required area for the footing with in the property line. Alternatively a combined or a strap footing may be provided . B) The spacing between the columns is governed by the lamination on spans of supported beams, as the spanning of the column decides the span of the beam. As the span of the of the beam increases, the depth of the beam, and hence the self weight of the beam and the total.

Effective length :

The effective length of the column is defined as the length between the points of contra flexure of the buckled column. The code has given certain values of the effective length for normal usage assuming idealized and conditions shown in appendix D of IS-456(table 24)A column may be classified based as follows based on the type of loading:1) Axially loaded column2 A column subjected to axial load and uneasily bending 3) A column subjected to axial load and biaxial bending**.**

Axially loaded Column :

All compression members are to be designed for a minimum eccentricity ofloadinto principal directions. Ispractice , atrulyaxially loaded column is rare,if not nonexistent. Therefore, every column should be designed for a minimum eccentricity.

clause 22.4 of IS code E min (L/500)+(D/300), subjected to a minimum of 200 mm .

Where L is the unsupported length of the column (see 24.1.3 of the code for definition unsupported length) and D is the lateral dimension of the column in the direction under the consideration.

Column design:

A column may be defined as an element used primary to support axial compressive loads and with a height of a 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. A column may be classify based on deferent criteria such as

1.) Shape of the section

2.) Slenderness ratio (A L+D)

3.) Type of loading, land

4.) Pattern of lateral reinforcement.

Column design:

A column may be defined as an element used primary to support axial compressive loads and with a height of a 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 In our structure we have 3 types of columns .C Column with beams on two sides C Columns with beams on three sides C Columns with beams on four sides.

So we require three types of column sections. So create three types of column sections and assign to the respective columns depending on the connection. But in these structure we adopted same cross section throughout the structure with a rectangular cross section.

In foundations we generally do not have circular columns if circular column is given it makes a circle by creating many lines to increase accuracy . The column design is done by selecting the column and from geometry page assigns the dimensions of the columns. Now analyze the column for loads to see the reactions and total loads on the column by seeing the loads design column by giving appropriate parameters like

1. Minimum reinforcement, max, bar sizes, maximum and minimum spacing.
2. Select the appropriate design code and input design column command to the entire column.
3. Now run analysis and select any column to collect the reinforcement details

The following figure shows the reinforcement details of a beam in staad . The figure represents detailsgarding1. Transverse reinforcement2 Longitudinal reinforcement The type of bars to be used, amount of steel and loading on the column is represented in the below figure.

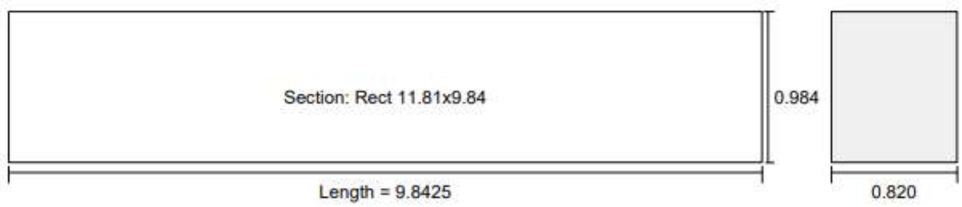
Output :

Due to very huge and detailed explanation of staad output for each and every column we have shown a column design results below showing the amount of load, moments, amount of steel required, section adopted etc.

Cross section of a column :

STAAD.Pro Query Property

Beam no. 132



Unit : kip - ft

Physical Properties

Ax	0.807	Ix	0.090
Ay	0.807	Iy	0.045
Az	0.807	Iz	0.065
Depth	0.984	Width	0.820

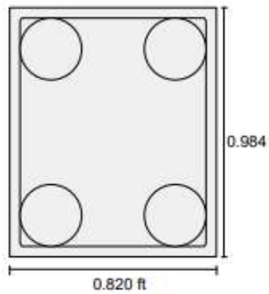
Material Properties

Elasticity(kip/in2)	3150.016	Density(kip/in3)	86.8 E-6
Poisson	0.170	Alpha	10 E-6

STAAD.Pro Query Concrete Design

Beam no. 132

Design Code: IS-456



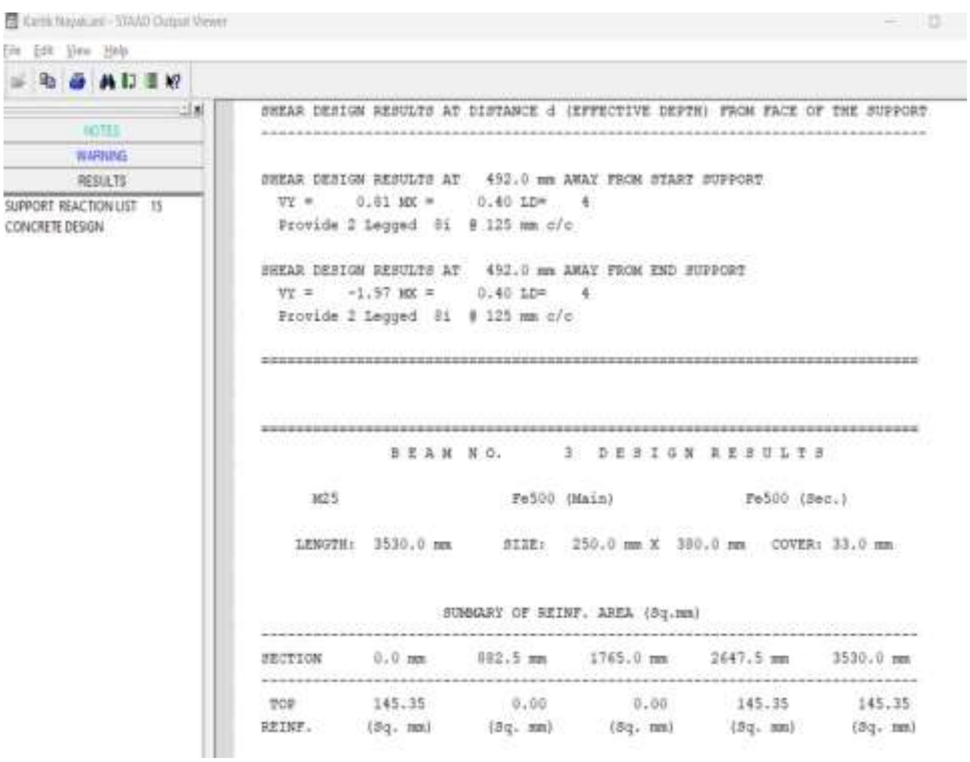
Design Load

Load	4
Location	Long Col
Pu(Kns)	196.949997
Mz(Kns-Mt)	13.480000
My(Kns-Mt)	1.630000

Design Results

Fy(Mpa)	500
Fc(Mpa)	25
As Reqd(mm²)	141.000000
As (%)	0.603000
Bar Size	12
Bar No	4

Fig : 16 Reinforcement details of a column

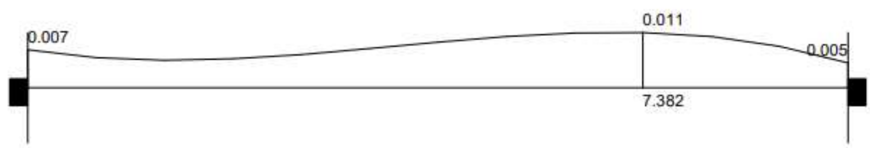


The following figure shows the deflection & shear result of same column :

STAAD.Pro Query Deflection Result

Beam no. 132

Deflection in Global X axis. Load case 1.



Dist.ft	X(in)	Y(in)	Z(in)
0.000000	0.0073	-0.0796	0.0187
0.820208	0.0058	-0.0788	0.0184
1.640416	0.0053	-0.0781	0.0183
2.460625	0.0055	-0.0774	0.0184
3.280833	0.0064	-0.0766	0.0186
4.101041	0.0075	-0.0759	0.0188
4.921249	0.0087	-0.0751	0.0189
5.741458	0.0098	-0.0744	0.0188
6.561666	0.0105	-0.0736	0.0186
7.381874	0.0105	-0.0729	0.0180
8.202082	0.0098	-0.0721	0.0171
9.022291	0.0079	-0.0714	0.0157
9.842499	0.0048	-0.0706	0.0138

STAAD.Pro Query Bending and Shear Results

Bending about Z for Beam 132

Load Case: 1:DL

Dist.ft	Fy(kip)	Mz(kip-in)
0.000000	-1.0361	-54.6253
0.820208	-1.0361	-44.4272
1.640416	-1.0361	-34.2290
2.460625	-1.0361	-24.0309
3.280833	-1.0361	-13.8327
4.101041	-1.0361	-3.6346
4.921249	-1.0361	6.5636
5.741458	-1.0361	16.7618
6.561666	-1.0361	26.9599
7.381874	-1.0361	37.1581
8.202082	-1.0361	47.3562
9.022291	-1.0361	57.5544
9.842499	-1.0361	67.7525

FOOTING:

Foundations a 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 excessive settlement or rotation, to minimize differential settlement and to provide adequate safety against sliding and overturning.

GENERAL:

1.) Footing shall be designed to sustain the applied loads, moments and forces and the induced reactions and to assure that any settlements which may occur will be as nearly uniform as possible and the safe bearing capacity of soil is not exceeded.

2.) Thickness at the edge of the footing: in reinforced and plain concrete footing at the edge shall be not less than 150 mm for footing on the soil not less than 300mm above the tops of the pile for footing on piles.

BEARING CAPACITY OF SOIL:

The size foundation depends on permissible bearing capacity of soil. The total load per unit area under the footing must be less than the permissible bearing capacity of soil to the excessive settlements.

Foundation design:

Foundations a are structure elements that transfer loads from building or individual column to earth this loads are to be properly transmitted foundations must be designed to prevent excessive settlement are rotation to minimize differential settlements and to provide adequate safety isolated footings for multi storey buildings. These may be square rectangle. are circular in plan that the choice of type of foundation to be used in a given situation depends on a number of factors.

1.) Bearing capacity of soil

2.) Type of structure

3.) Type of loads

4.) Permissible differential settlements

5.) Economy

PLACEMENT OF COLUMN

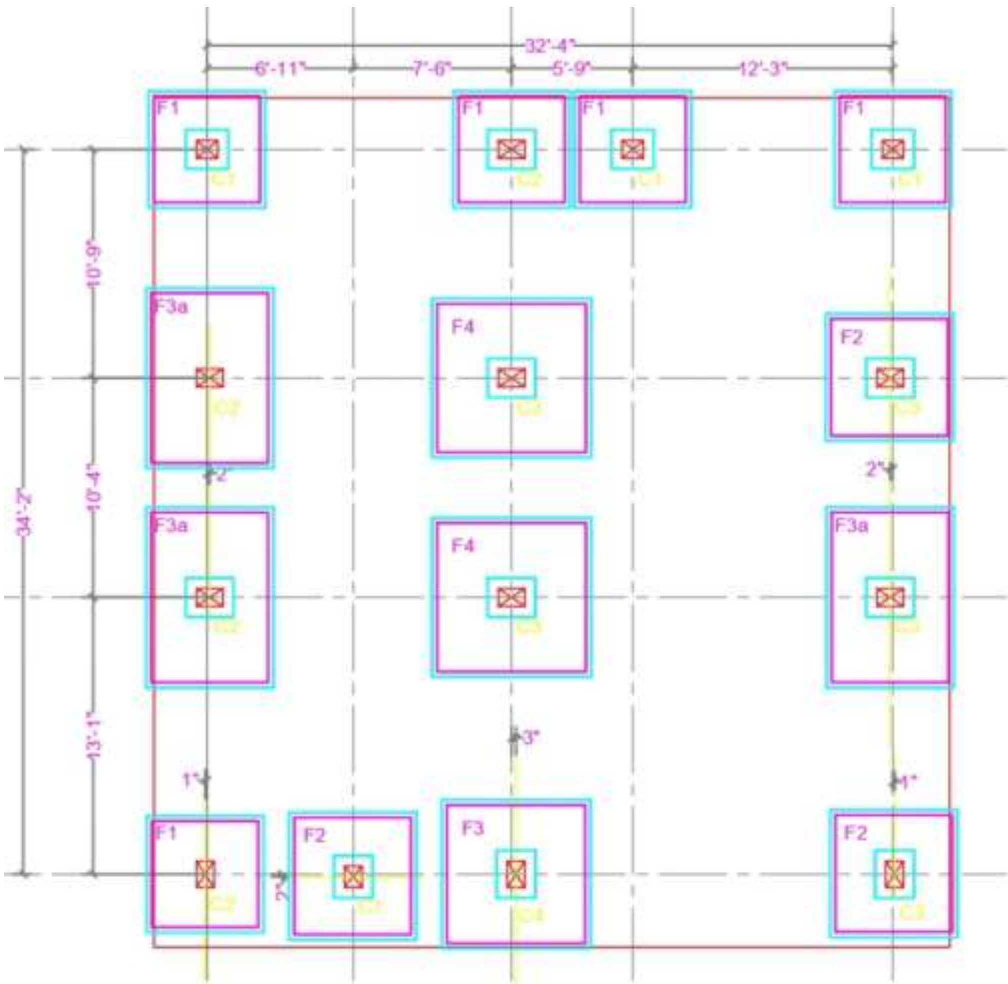


Figure : 17 COLUMN POSITION

FOOTING REINFORCEMENT DETAILS : Table : 9

Output

FootNo	GrpID	Footing Dim			Footing Reinforcement			
		Length m	Width m	Thickness m	Reinf(Mz)		Reinf(Mx)	
					Bar	Spacing	Bar	Spacing
15	1	1.45	1.45	0.41	6 mm	56.00 mm	6 mm	53.76 mm
16	2	1.10	1.10	0.31	6 mm	71.00 mm	6 mm	71.00 mm
17	3	1.45	1.45	0.41	6 mm	56.00 mm	6 mm	53.76 mm
18	4	1.20	1.20	0.36	6 mm	60.78 mm	6 mm	60.78 mm
19	5	1.50	1.50	0.41	6 mm	55.76 mm	8 mm	87.00 mm
20	6	1.30	1.30	0.36	6 mm	62.84 mm	6 mm	59.70 mm
21	7	1.05	1.05	0.31	6 mm	72.62 mm	6 mm	72.62 mm
22	8	1.65	1.65	0.46	8 mm	90.71 mm	8 mm	81.16 mm
23	9	1.45	1.45	0.41	6 mm	56.00 mm	6 mm	53.76 mm
24	10	1.10	1.10	0.31	6 mm	71.00 mm	6 mm	71.00 mm
26	11	1.35	1.35	0.36	6 mm	59.24 mm	6 mm	51.83 mm
27	12	1.55	1.55	0.46	8 mm	90.13 mm	8 mm	90.13 mm
28	13	1.65	1.65	0.46	8 mm	90.71 mm	8 mm	77.10 mm

Design Progress Report | Isofoot Design Summary

Isolated Footing 15

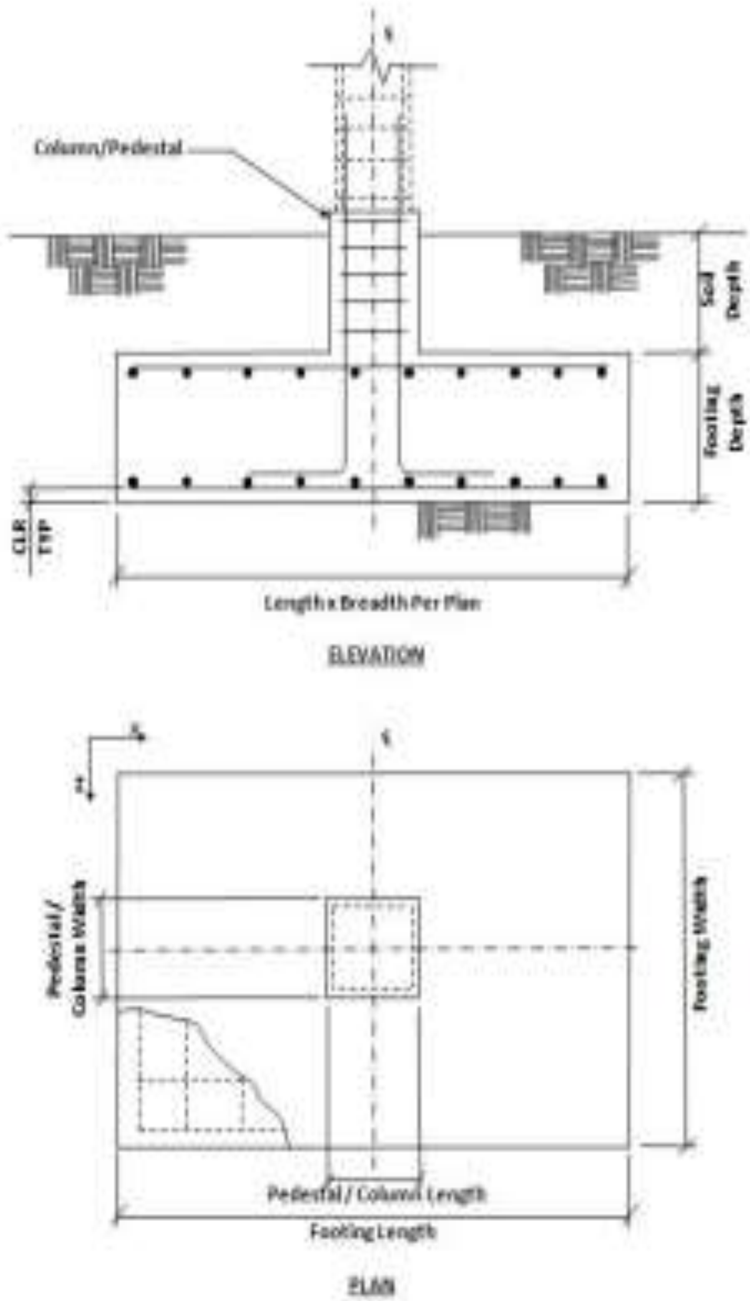


Fig : 18 Isolated Footing

Isolated Footing Design (IS 456-2000)

Design For Isolated Footing 15

Design For Isolated Footing 16

Design For Isolated Footing 17

Design For Isolated Footing 18

Design For Isolated Footing 19

Design For Isolated Footing 20

Design For Isolated Footing 21

Design For Isolated Footing 22

Design For Isolated Footing 23

Design For Isolated Footing 24

Design For Isolated Footing 26

Design For Isolated Footing 27

Design For Isolated Footing 28

Design For Isolated Footing 109

Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
15	1	1.450 m	1.450 m	0.405 m
16	2	1.100 m	1.100 m	0.305 m
17	3	1.450 m	1.450 m	0.405 m
18	4	1.200 m	1.200 m	0.355 m
19	5	1.500 m	1.500 m	0.405 m
20	6	1.300 m	1.300 m	0.355 m
21	7	1.050 m	1.050 m	0.305 m
22	8	1.650 m	1.650 m	0.456 m
23	9	1.450 m	1.450 m	0.405 m
24	10	1.100 m	1.100 m	0.305 m
26	11	1.350 m	1.350 m	0.355 m
27	12	1.550 m	1.550 m	0.456 m
28	13	1.650 m	1.650 m	0.456 m
109	14	1.100 m	1.100 m	0.305 m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
15	Ø6 @ 55 mm c/c	Ø6 @ 50 mm c/c	Ø6 @ 70 mm c/c	Ø6 @ 70 mm c/c	N/A	N/A
16	Ø6 @ 70 mm c/c	Ø6 @ 70 mm c/c	Ø6 @ 70 mm c/c	Ø6 @ 70 mm c/c	N/A	N/A
17	Ø6 @ 55 mm c/c	Ø6 @ 50 mm c/c	Ø6 @ 70 mm c/c	Ø6 @ 70 mm c/c	N/A	N/A
18	Ø6 @ 60 mm c/c	Ø6 @ 60 mm c/c	Ø6 @ 70 mm c/c	Ø6 @ 70 mm c/c	N/A	N/A
19	Ø6 @ 55 mm c/c	Ø8 @ 85 mm c/c	Ø6 @ 60 mm c/c	Ø6 @ 60 mm c/c	N/A	N/A
20	Ø6 @ 60 mm c/c	Ø6 @ 55 mm c/c	Ø6 @ 70 mm c/c	Ø6 @ 70 mm c/c	N/A	N/A
21	Ø6 @ 70 mm c/c	Ø6 @ 70 mm c/c	Ø6 @ 70 mm c/c	Ø6 @ 70 mm c/c	N/A	N/A
22	Ø8 @ 90 mm c/c	Ø8 @ 80 mm c/c	Ø6 @ 60 mm c/c	Ø6 @ 60 mm c/c	N/A	N/A
23	Ø6 @ 55 mm c/c	Ø6 @ 50 mm c/c	Ø6 @ 70 mm c/c	Ø6 @ 70 mm c/c	N/A	N/A
24	Ø6 @ 70 mm c/c	Ø6 @ 70 mm c/c	Ø6 @ 70 mm c/c	Ø6 @ 70 mm c/c	N/A	N/A
26	Ø6 @ 55 mm c/c	Ø6 @ 50 mm c/c	Ø6 @ 70 mm c/c	Ø6 @ 70 mm c/c	N/A	N/A
27	Ø8 @ 90 mm c/c	Ø8 @ 90 mm c/c	Ø6 @ 60 mm c/c	Ø6 @ 60 mm c/c	N/A	N/A
28	Ø8 @ 90 mm c/c	Ø8 @ 75 mm c/c	Ø6 @ 55 mm c/c	Ø6 @ 55 mm c/c	N/A	N/A

Table : 10

Footing Geomtery

Design Type: Calculate Dimension

Footing Thickness (Ft): 305.000 mm

Footing Length-X (FI): 1000.000 mm

Footing Width -Z (Fw): 1000.000 mm

Eccentricity along X (Oxd): 0.000 mm

Eccentricity along Z (Ozd): 0.000 mm

Column Dimensions:

Column Shape: Rectangular

Column Length: X (PI): 0.300 m

Column Width Z (Pw): 0.250 m

Pedestal

Include Pedestal? No

Pedestal Shape: N/A

Pedestal Height (Ph): N/A

Pedestal Length-X (PI): N/A

Pedestal Width 2 (PW) N/A

Design Parameters

Concrete and tebar Properties

Unit Weight of Concrete: 25.000 kN/m3

Strength of Concrete: 25.000 N/mm2

Yield Strength of Steel 415.000 N/mm2

Minimum Bar Size 06

Maximum Bar Size 032

Minimum Bar Spacing: 50.000mm

Maximum Bar Spacing:500.000 mm

Pedestal Clear Cover (P. CL): 50.000 mm

Soil Properties

soil Type : Drained
Unit Weight : 22.000 kN/m3
Soil Bearing Capacity : 250.000 kN/m2
Soil Surcharge : 0.000 kN/m2
Depth of Soil above Footing : 0.000 mm
Cohesion : 0.000 kN/m2
Min Percentage of Slab : 0.000

Sliding and Overturning

Coefficient of Friction : 0.500
Factor of Safety Against Sliding : 1.500
Factor of Safety Against Overturning : 1.500

Load Combination/s- Service Stress Level	
Load Combination Number	Load Combination Title
101	1.000 x DL+1.000 x DL
102	0.800 x DL+0.800 x DL

Load Combination/s- Strength Level	
Load Combination Number	Load Combination Title
201	1.500 x DL+1.500 x DL
202	0.960 x DL+0.960 x DL
203	1.200 x DL+1.200 x DL
204	0.900 x DL+0.900 x DL

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	485.321	0.497	0.692	0.524	-0.173
102	388.257	0.398	0.553	0.419	-0.139

Applied Loads - Strength Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
201	727.981	0.746	1.038	0.786	-0.260
202	465.908	0.477	0.664	0.503	-0.166
203	582.385	0.597	0.830	0.629	-0.208
204	436.789	0.447	0.623	0.472	-0.156

Design Calculations

Footing Size

Initial Length (L_o) = 1.000 m

Initial Width (W_o) = 1.000 m

Uplift force due to buoyancy = 0.000 kN

Effect due to adhesion = 0.000 kN

Area from initial length and width, $A_o = L_o \times W_o$ = 1.000 m^2

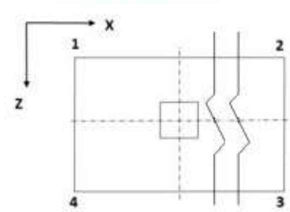
Min. area required from bearing pressure, $A_{min} = P / q_{max}$ = 1.972 m^2

Note: A_{min} is an initial estimation.
P = Critical Factored Axial Load(without self weight/buoyancy/soil).
q_{max} = Respective Factored Bearing Capacity.

Final Footing Size

Length (L_2) =	1.450 m	Governing Load Case :	# 101
Width (W_2) =	1.450 m	Governing Load Case :	# 101
Depth (D_2) =	0.405 m	Governing Load Case :	# 101
Area (A_2) =	2.103 m^2		

Pressures at Four Corner



Load Case	Pressure at corner 1 (q_1) (kN/m2)	Pressure at corner 2 (q_2) (kN/m2)	Pressure at corner 3 (q_3) (kN/m2)	Pressure at corner 4 (q_4) (kN/m2)	Area of footing in uplift (A_u) (m^2)
101	**236.3693**	237.6487	240.5414	239.2620	0.000
101	236.3693	**237.6487**	240.5414	239.2620	0.000
101	236.3693	237.6487	**240.5414**	239.2620	0.000
101	236.3693	237.6487	240.5414	**239.2620**	0.000

If A_u is zero, there is no uplift and no pressure adjustment is necessary. Otherwise, to account for uplift, areas of negative pressure will be set to zero and the pressure will be redistributed to remaining corners.

Summary of adjusted Pressures at Four Corner

Load Case	Pressure at corner 1 (q_1) (kN/m2)	Pressure at corner 2 (q_2) (kN/m2)	Pressure at corner 3 (q_3) (kN/m2)	Pressure at corner 4 (q_4) (kN/m2)
101	**236.3693**	237.6487	240.5414	239.2620
101	236.3693	**237.6487**	240.5414	239.2620
101	236.3693	237.6487	**240.5414**	239.2620
101	236.3693	237.6487	240.5414	**239.2620**

Details of Out-of-Contact Area
(If Any)

Governing load case = N/A

Plan area of footing = 2.103 sq.m

Area not in contact with soil = 0.000 sq.m

% of total area not in contact = 0.000%

Check For Stability Against Overturning And Sliding

-	Factor of safety against sliding		Factor of safety against overturning	
Load Case No.	Along X-Direction	Along Z-Direction	About X-Direction	About Z-Direction
101	504.216	362.362	494.597	1118.340
102	508.247	365.259	498.551	1127.280

Critical Load Case And The Governing Factor Of Safety For Overturning and Sliding X Direction

Critical Load Case for Sliding along X-Direction : 101

Governing Disturbing Force : 0.497 kN

Governing Restoring Force : 250.676 kN

Minimum Sliding Ratio for the Critical Load Case : 504.216

Critical Load Case for Overturning about X-Direction : 101

Governing Overturning Moment : 0.735 kNm

Governing Resisting Moment : 363.474 kNm

Minimum Overturning Ratio for the Critical Load Case : 494.597

Critical Load Case And The Governing Factor Of Safety For Overturning and Sliding Z Direction

Critical Load Case for Sliding along Z-Direction : 101

Governing Disturbing Force : 0.692 kN

Governing Restoring Force : 250.676 kN

Minimum Sliding Ratio for the Critical Load Case : 362.362

Critical Load Case for Overturning about Z-Direction : 101

Governing Overturning Moment : -0.325 kNm

Governing Resisting Moment : 363.474 kNm

Minimum Overturning Ratio for the Critical Load Case : 1118.340

Moment Calculation

Check Trial Depth against moment (w.r.t. X Axis)

Critical Load Case = #201

Effective Depth = $D - (cc + 0.5 \times d_b)$ = 0.352 m

Governing moment (M_u) = 90.779 kNm

As Per IS 456 2000 ANNEX G G-1.1C

Limiting Factor1 (K_{umax}) = $\frac{700}{(1100 + 0.87 \times f_y)}$ = 0.479107

Limiting Factor2 (R_{umax}) = $0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times k_{umax})$ = 3444.291146 kN/m2

Limit Moment Of Resistance (M_{umax}) = $R_{umax} \times B \times d_e^2$ = 618.792807 kNm

$M_u \le M_{umax}$ hence, safe

Check Trial Depth against moment (w.r.t. Z Axis)

Critical Load Case = #201

Effective Depth = $D - (cc + 0.5 \times d_b)$ = 0.352 m

Governing moment (M_u) = 83.164 kNm

As Per IS 456 2000 ANNEX G G-1.1C

Limiting Factor1 (K_{umax}) = $\frac{700}{(1100 + 0.87 \times f_y)}$ = 0.479107

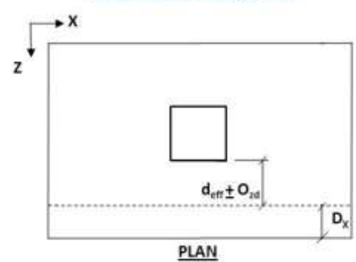
Limiting Factor2 (R_{umax}) = $0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times k_{umax})$ = 3444.291146 kN/m2

Limit Moment Of Resistance (M_{umax}) = $R_{umax} \times B \times d_e^2$ = 618.792807 kNm

$M_u \le M_{umax}$ hence, safe

Shear Calculation

Check Trial Depth for one way shear (Along X Axis)
(Shear Plane Parallel to X Axis)



Critical Load Case = #201

D_X = 0.352 m

Shear Force(S) = 125.157 kN

Shear Stress(T_v) = 245.213045 kN/m2

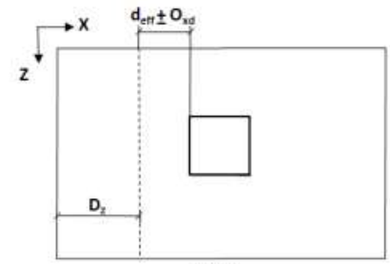
Percentage Of Steel(P_t) = 0.1381

As Per IS 456 2000 Clause 40 Table 19

Shear Strength Of Concrete(T_c) = 280.296 kN/m2

$T_v < T_c$ hence, safe

Check Trial Depth for one way shear (Along Z Axis)
(Shear Plane Parallel to Z Axis)



PLAN

Critical Load Case = #201

D_Z = 0.352 m

Shear Force(S) = 112.221 kN

Shear Stress(T_v) = 219.869067 kN/m2

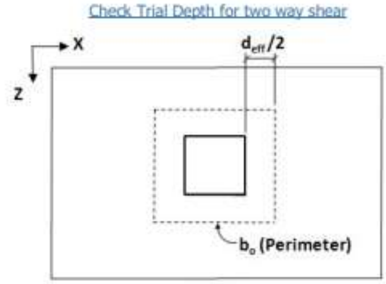
Percentage Of Steel(P_t) = 0.1434

As Per IS 456 2000 Clause 40 Table 19

Shear Strength Of Concrete(T_c) = 285.093 kN/m2

$T_v < T_c$ hence, safe

Check Trial Depth for two way shear



PLAN

Critical Load Case = #201

Shear Force(S) = 592.079 kN

Shear Stress(T_v) = 670.671 kN/m2

As Per IS 456 2000 Clause 31.6.3.1

$K_s = \min[(0.5 + \beta), 1] = 1.000$

Shear Strength(T_c)= $0.25 \times \sqrt{F_{ck}}$ = 1250.0000 kN/m2

$K_s \times T_c$ = 1250.0000 kN/m2

$T_v <= K_s \times T_c$ hence, safe

Reinforcement Calculation

Calculation of Maximum Bar Size

Along X Axis

Bar diameter corresponding to max bar size (d_b) = 12 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) = $\frac{d_b \times 0.87 \times f_y}{4 \times \tau_{bd}}$ = 0.484 m

Allowable Length(l_{db}) = $\left[\frac{(B-b)}{2} - cc\right]$ = 0.525 m

l_{db} >= l_d hence, safe

Along Z Axis

Bar diameter corresponding to max bar size(d_b) = 12 mm

As Per IS 456 2000 Clause 26.2.1

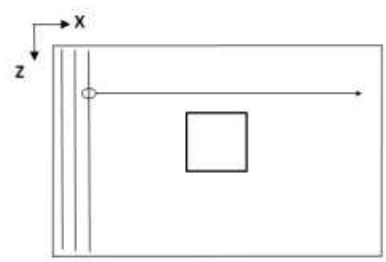
Development Length(l_d) = $\frac{d_b \times 0.87 \times f_y}{4 \times \tau_{bd}}$ = 0.484 m

Allowable Length(l_{db}) = $\left[\frac{(H-h)}{2} - cc\right]$ = 0.550 m

l_{db} >= l_d hence, safe

Bottom Reinforcement Design

Along Z Axis



PLAN

For moment w.r.t. X Axis (M_x)

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = #201

Minimum Area of Steel (A_{stmin}) = 704.700 mm2

Calculated Area of Steel (A_{st}) = 731.717 mm2

Provided Area of Steel ($A_{st,Provided}$) = 731.717 mm2

A_{stmin} <= $A_{st,Provided}$ Steel area is accepted

Selected bar Size (d_b) = Ø6

Minimum spacing allowed (S_{min}) = 46.000 mm

Selected spacing (S) = 53.760 mm

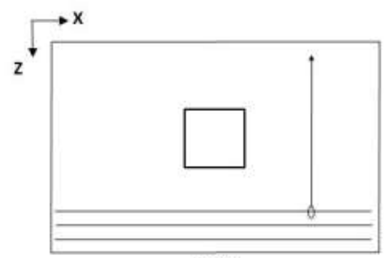
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...

The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø6 @ 50.000 mm o.c.

Along X Axis



PLAN

For moment w.r.t. Z Axis (M_z)

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = #201

Minimum Area of Steel (A_{stmin}) = 704.700 mm2

Calculated Area of Steel (A_{st}) = 668.939 mm2

Provided Area of Steel ($A_{st,Provided}$) = 704.700 mm2

A_{stmin} <= $A_{st,Provided}$ Steel area is accepted

Selected bar Size (d_b) = Ø6

Minimum spacing allowed (S_{min}) = = 50.000 mm

Selected spacing (S) = 56.000 mm

S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...

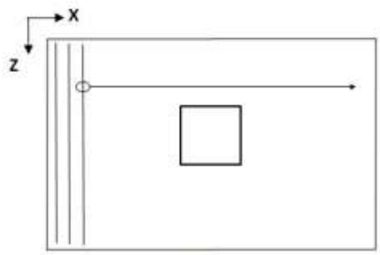
The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø6 @ 55.000 mm o.c.

Top Reinforcement Design

Along Z Axis



PLAN

Minimum Area of Steel (A_{stmin}) = 704.700 mm2

Calculated Area of Steel (A_{st}) = 530.700 mm2

Provided Area of Steel ($A_{st,Provided}$) = 704.700 mm2

$A_{stmin} <= A_{st,Provided}$ Steel area is accepted

Governing Moment = 2.211 kNm

Selected bar Size (d_b) = Ø6

Minimum spacing allowed (S_{min}) = 50.000 mm

Selected spacing (S) = 74.667 mm

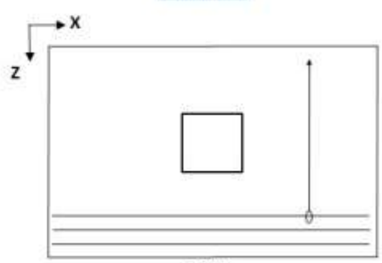
$S_{min} <= S <= S_{max}$ and selected bar size < selected maximum bar size...

The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø6 @ 70 mm o.c.

Along X Axis



PLAN

Minimum Area of Steel (A_{stmin}) = 704.700 mm2

Calculated Area of Steel (A_{st}) = 562.828 mm2

Provided Area of Steel ($A_{st,Provided}$) = 704.700 mm2

$A_{stmin} <= A_{st,Provided}$ Steel area is accepted

Governing Moment = 2.031 kNm

Selected bar Size (d_b) = Ø6

Minimum spacing allowed (S_{min}) = = 50.000 mm

Selected spacing (S) = 70.737 mm

$S_{min} <= S <= S_{max}$ and selected bar size < selected maximum bar size...

The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø6 @ 70 mm o.c.

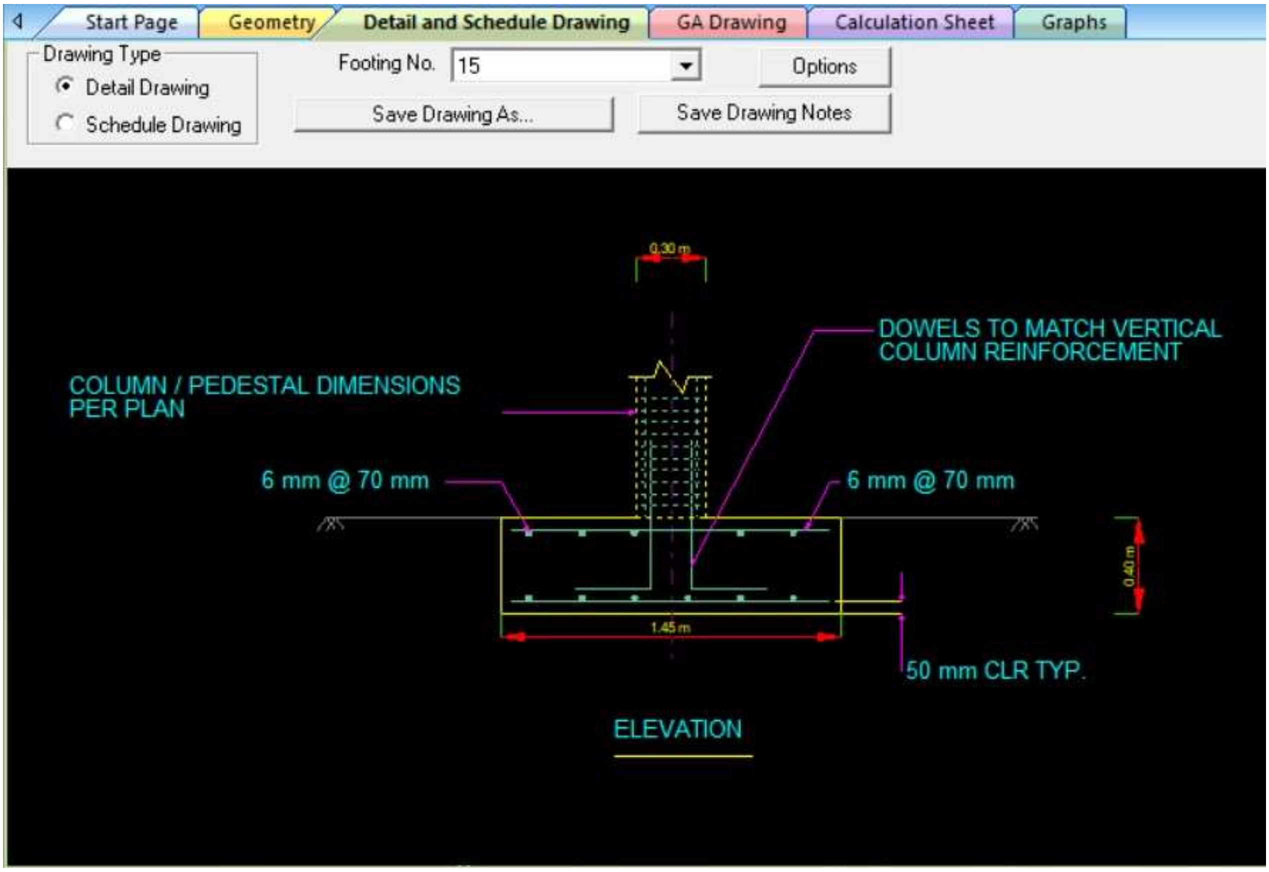


Fig : 19 Elevation of reinforcements

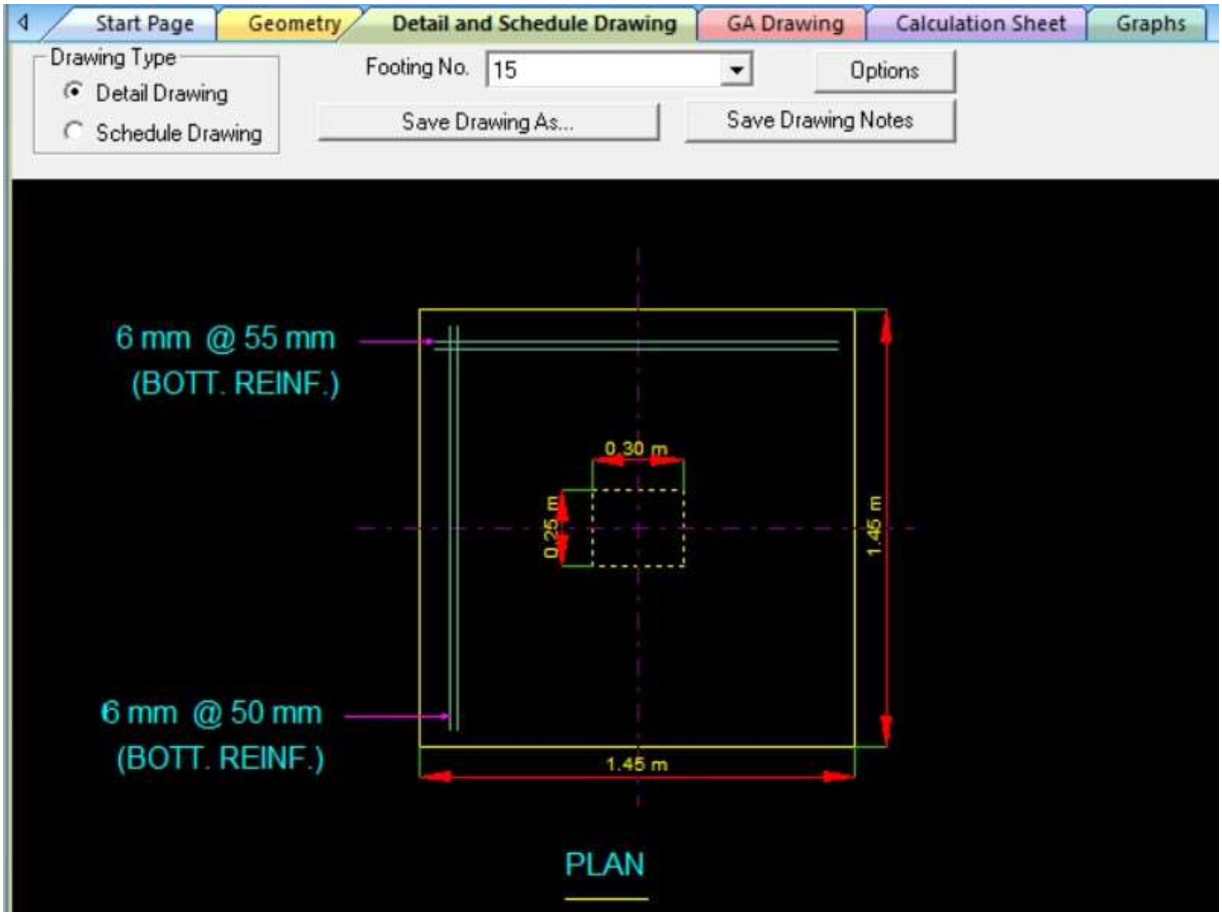


Fig : 20 Plan of reinforcements

CONCLUSION:

In this report, a design of multi - storey building for residential purpose is presented. We have successfully completed the planning and designing of a multi- storey (G+1) Structure .

Designing using Software's like Staad reduces lot of time in design work. Details of each and every member can be obtained using staad pro. All the List of failed beams can be obtained and also Better Section is given by the software Accuracy is improved by using this software . Many load combinations were applied to different structural members with the help of the design provisions .All the aspects of design were met while analyzing and designing was done using STAAD Pro.

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