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Planning and Design of Residential Building

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***Abstract:** This project analyzes and design a residential building.The structure has been designed Using pile foundation. The proposed residential building is to be constructed at Mendhasal, Bhubaneswar. The area of the proposed building 1500 sq ft (G+2) will be constructed framed structure. The analysis of frames to compute the force and moment will be carried out with staad pro software. AutoCAD software will be used for planning of the building. Staad pro software will be used for analysis of building as well as IS 456:2000 code of practice for plain and reinforced cement concrete. The structural members are like slabs, beams; columns are designed with limit state method using national building code and IS 456:2000 grade concrete and grade of steel are to be used.*

The project is to develop independent and creative thinking fundamental theoretical knowledge we obtained during the course of the study practical application of field.

I. INTRODUCTION

The basics need of human existences are food, clothing's & shelter. From times immemorial man has been making efforts in improving their standard of living. The point of his efforts has been to provide economic and efficient shelter. The possession of shelter besides being a basic, used, gives a feeling of security, responsibility and shown the social status of man.

Every human being has an inherent liking for a peaceful environment needed for his pleasant living, this object is achieved by having a place of living situated at the safe

and convenient location, such a plane for comfortable and pleasant living requires considered and kept in view.

1) A peaceful environment.
2) Safety from all-natural source & climate conditions
3) General facilities for community of his residential area.

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.

II. DEMAND OF HOUSES

The house ids the first unit of the society and it is the primary unit of human habitation. The house is built to grant the protection against wind, weathers and to give insurance against physical insecurity of all kinds.

The special features of the demand for housing consist of in its unique nature and depend on the following factors.

1) Availability of cheap finance.
2) Availability of skilled labors.
3) Availability of transport facility.
4) Cost of labors & material of construction.
5) Predictions of future demand.
6) Rate of population growth and urbanization.
7) Supply of developed plots at reasonable prices.
8) Taxation policy on real estates.
9) Town planning & environmental conditions.

III. RESIDENTIAL UNITS

A residential unit is a detached house, semi detached house, row house units, mobile home, floating or apartment it can be any part that is occupied by an individual as a place of residential of lodging.

1) Is leased as a place of residence or lodging.
2) Is vacant but was lost occupied or supplied as a place of residence or lodging for individual.

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IV. BUILDING PLANNING AND DESIGN

Boring and samples taken at the site will provide information regarding location and extent of rocks, bearing capacity of the subsurface strata at various points and level of the water table. A survey may indicate terrain and other conditions that will strongly influence the design decision. Limitations imposed by difficult
terrain, in addition to those imposed by local laws or ordinates may limit such items as drive ways and parking entrances. The process of designing a Soft Storied Residential Building involves:

1) Program development
2) Site analysis
3) Building planning
4) Building design

Program development is for the most part, evaluation of the information over which the architect has relatively less control but shapes up the project in basic way. In involves the evaluation of physical data, which much be recognized, identified and weighed by the architect in making design decision dealing with site views, allocation and development.

Physical characteristics of a site may impose limitation on a building program. Therefore, an early analysis of site data and conditions should be undertaken by the architect in order to ascertain and evaluate such limitations. Boring and samples taken at the site will provide information regarding location and extent of rocks, bearing capacity of the subsurface strata at various points and level of water table. A survey my indicate terrain and other conditions that will strongly influence the design decisions.

V. DESIGN PHILOSOPHIES

1) The object of reinforced concrete design is to design a structure using concrete and steel such that it results in safe and economical solution. For a given structural system, the design problem consists of the following steps: Idealization of structure of analysis
2) Estimation of loads
3) Analysis of idealized structural model to determinate the axial thrust, shearing force, bending moment and deflections.
4) Design of structural elements.
5) Detailed structural drawings and schedule of reinforcing bars.
6) There are three philosophies for the design of reinforced concrete and prestressed concrete as well as steel structures, namely:
7) Working stress method
8) Ultimate load method
9) Limit state method

VI. LABORATORY TEST

A. Plastic Limit

The value of the plastic limit is used to classify the fine-grained soils and evaluating the activities of clayey soil. It indicates the toughness index of soil.

The plastic limit is the water content at which a soil-water paste changes from a semisolid to a plastic consistency as it is rolled into a 3.175-mm (1/8-inch) diameter thread in a standard test

Watchglass no	3	4
Wt. of watch glass + wet soil	27	27.3
Wt. of watch glass + dry soil	24.7	25.5
Wt. of water	2.3	1.8
Wt. of continer (gm)	19	18.7
Wt. of dry soil (gm)	20	20
Moisture content %	50	50

B. Liquid Limit

Liquid limit is the water content where the soil starts to behave as a liquid. Liquid limit is measured by placing a clay sample in a standard cup and making a separation (groove) using a spatula. The cup is dropped till the separation vanishes. The water content of the soil is obtained from this sample.

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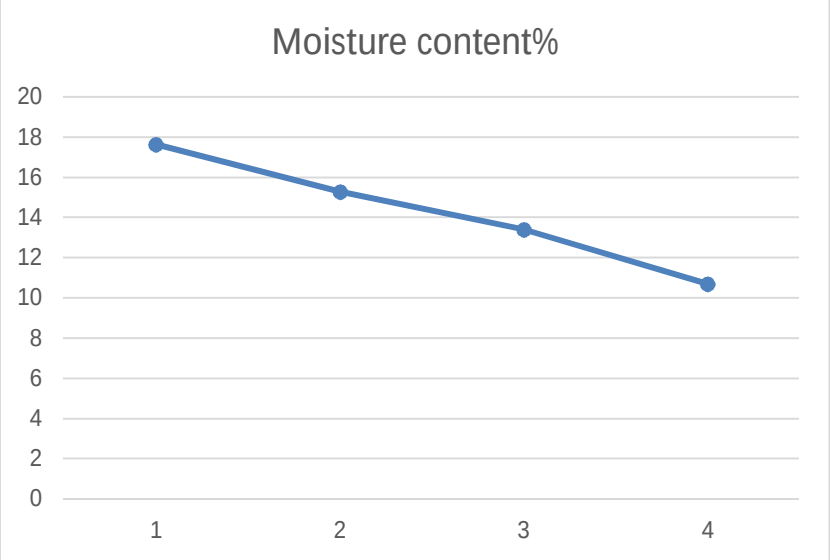
DESCRIPATION	TRAIL 1	TRAIL 2	TRAIL 3	TRAIL 4
No of observation	1	2	3	4
No of blows	20	25	30	38
Moisturation number	5	1	2	3
Wt. of wet soil + moisturation	37	33	30	27
Wt. of dry soil + moisturation	34	31	28	26
Wt. of moisture fur	20	20	18	19
Wt. of dry soil	120	120	120	120
Wt. of water	3	2	2	1
Moisture content%	17.64	15.3	13.4	10.7

C. Liquid Limit Graph



D. Maximum Dry Density

The determination of maximum dry density and optimum moisture content of the soil is a measure of compaction level of soils. This can be measured by mainly two methods Standard Proctor Compaction Test and Modified Proctor Compaction Test. Both the tests help to determine the optimum moisture content that is required for soil to attain maximum compaction i.e maximum dry density for performing construction.

TEST NO	1	2	3	4
Weight of empty mould	4.544	4.544	4.544	4.544
Internal dia of mould	10	10	10	10
Height of mould	12.5	12.5	12.5	12.5
Volume of mould	981.57	961.57	981.57	981.57
Wt. of mould + compacted soil	6.671	6.712	6.759	6.642
Wt. of compacted soil	2.427	2.168	2.215	2.098
Wet density	2.47	2.2	2.24	2.13
Container no	36	8	32	41
Wt. of container	12	11	13	12
Wt. of container + wet soil	50	50	50	50
Wt. of container + dry soil	48.29	43.3	45.6	43.4
Wt. of dry soil	36.29	32.3	32.6	31.4
Wt. of water	1.71	6.7	4.4	6.6
Water content W%	4	20	13	21
Dry density	2.37	1.83	1.98	1.76

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VII. PLANNING

First of all the plan for the building should be drafted. According to the needs and the usage of the building the loads are calculated and the slabs are then design for the loads based on its edge conditions specified. The size of the beam, area of steel reinforcement and the spacing of stirrups are calculated.

The columns are designed according to the loads transmitted from the floors, from the design the size of the column, area of steel reinforcement and the spacing of lateral ties required are determined.

According to the bearing capacity of the soil and the load from the super-structure the type of foundation suitable is chosen and it is designed.

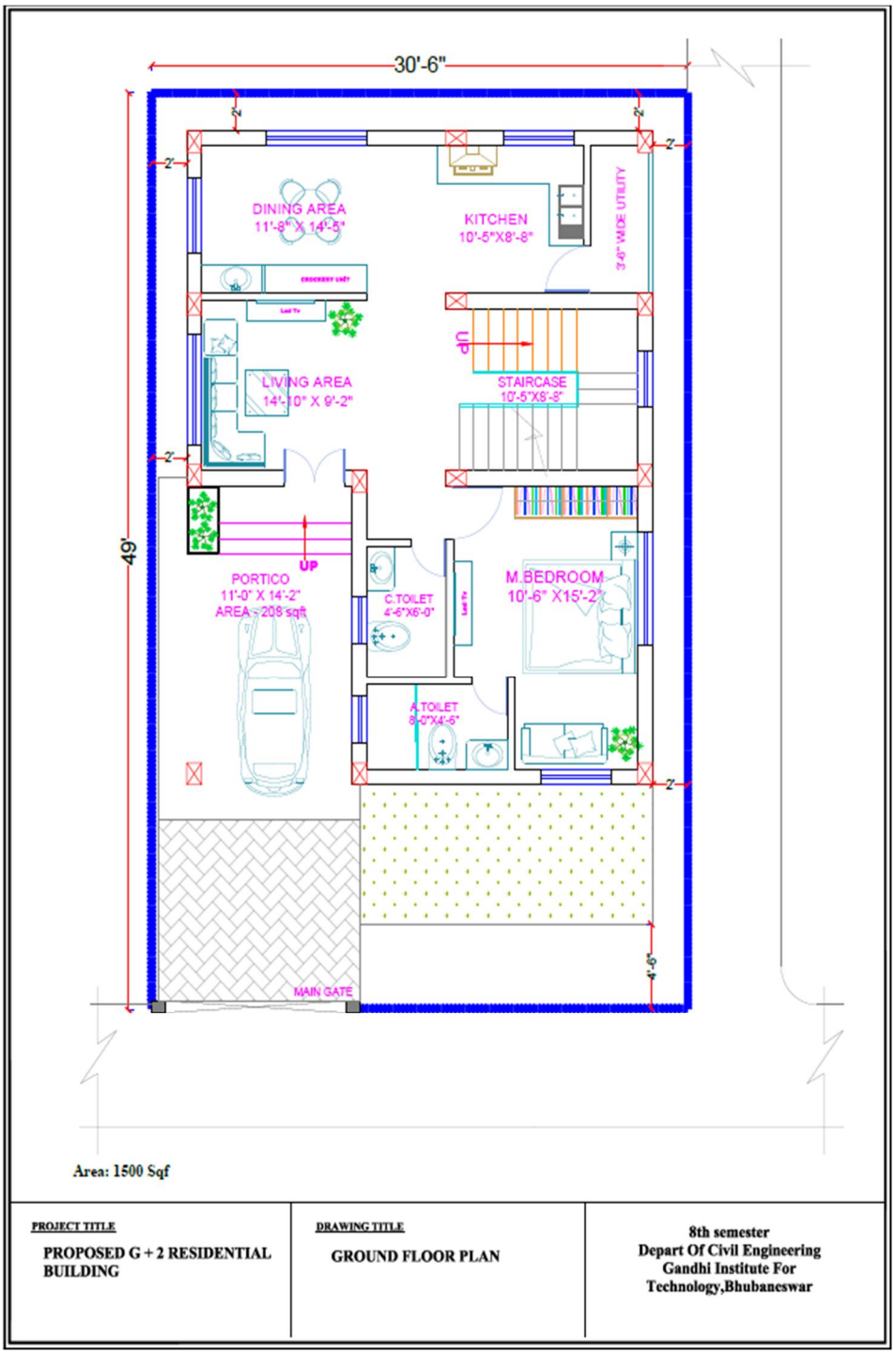

FIG 1 : GROUND FLOOR PLAN

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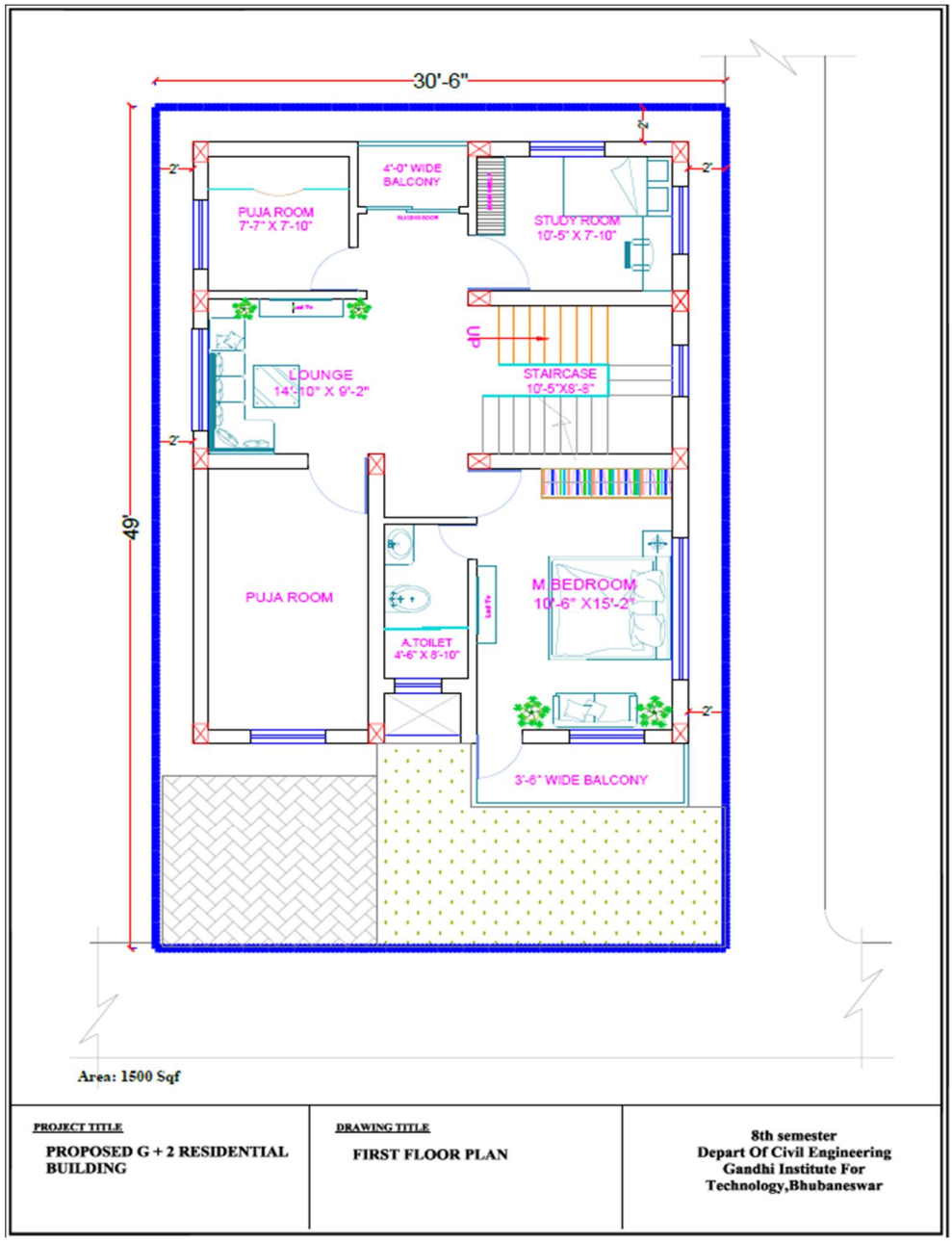

FIG 2 : FIRST PLAN

VIII. DESIGN OF BEAM

A beam is a horizontal structural element that is capable of withstanding load primarily by resisting bending. The load from the slab is transferred to beam. The bending force induced into the material of the beam as a result of the external loads, own weight, span and external reactions to these loads is called as bending moment. Therefore, beam is a structural member which is subjected to bending moments and shear force due to transverse load. The beam transfers its load to the column.

Considering a beam, bending moment and shearing stresses are greater than those of slabs. Therefore, the depth of the beam is governed by the bending moment criteria while deflection criteria normally get satisfied. A beam simply supported at its ends carrying a uniformly distributed loads bends with a concavity upwards. It is subjected to maximum sagging or positive bending moment at its mid-span and zero at its supports. Sometimes the beam will be subjected to maximum negative or hogging moment.

The point where the curvature changes from sagging to hogging is called as point of contra flexure. While designing a beam, according to the bending moment we design as a flanged section or rectangular section or a Tee-beam or an L-beam.

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IX. TYPES OF BEAMS

Based on support conditions Simply supported beams Based on shape

1) Tee beam
2) L beam
3) Rectangular beam
4) Cantilever beam
5) Fixed beam

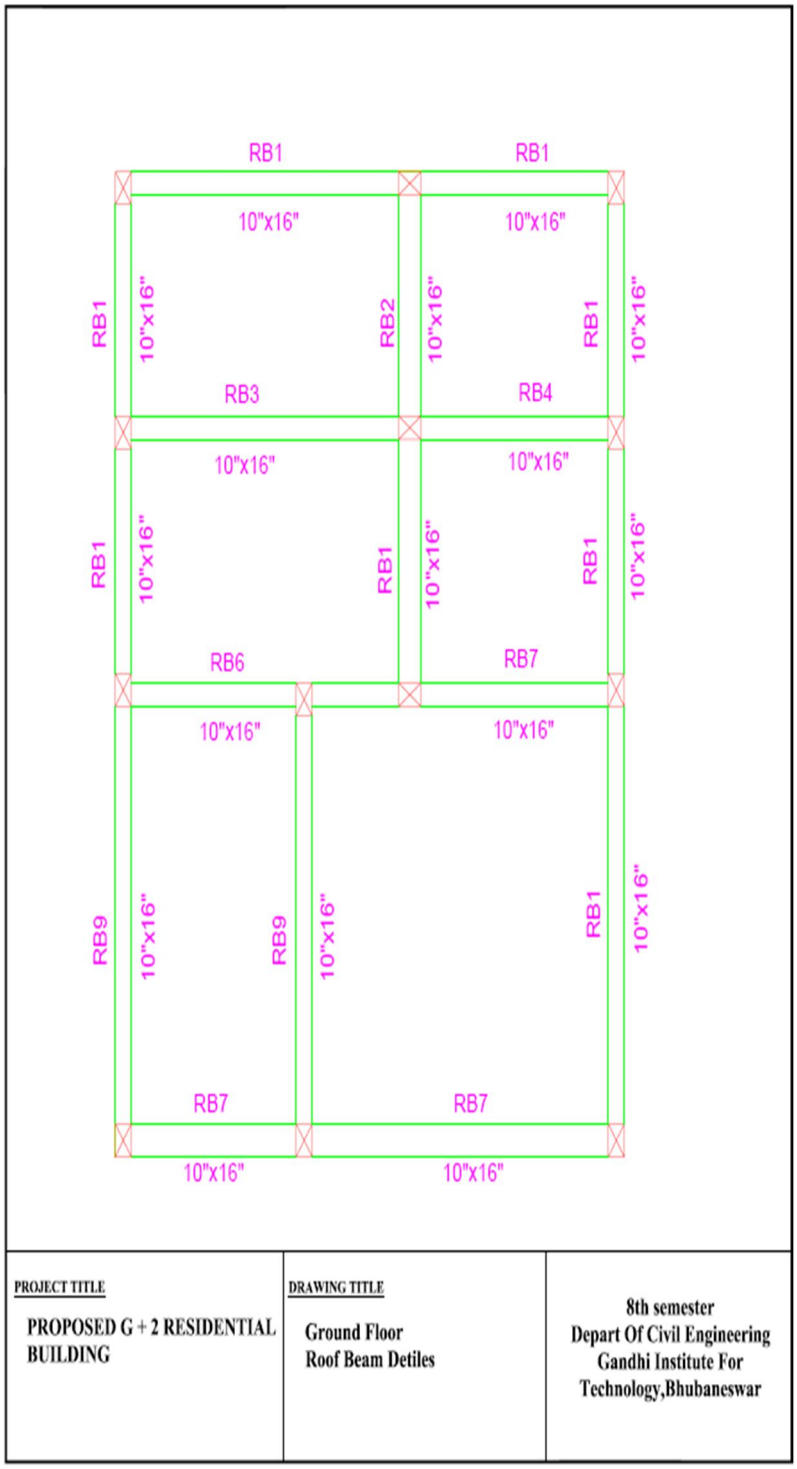

FIG 3 : BEAM PLACEMENT

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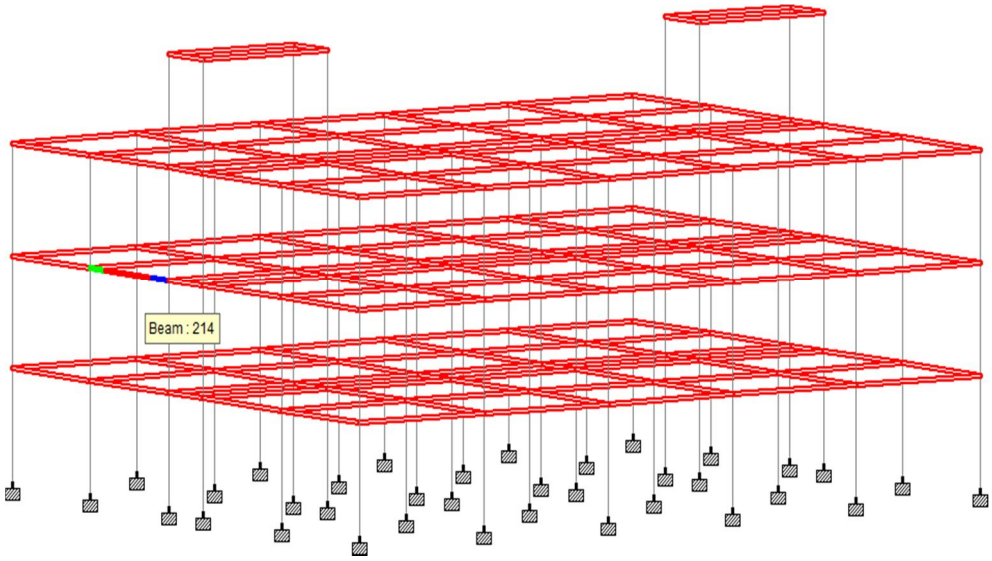

FIG 4 : BEAM LAYOUT

X. DESIGN OF COLUMN

A column is generally a compression member supporting beams and slabs in a structural system and having an effective length exceeding three times the least lateral dimension. A column may be considered to be short when its effective length does not exceed 12 times the least lateral dimension. If the ratio of effective length to least lateral dimension exceeds 12 times the column is considered as long or slender for design purposes.

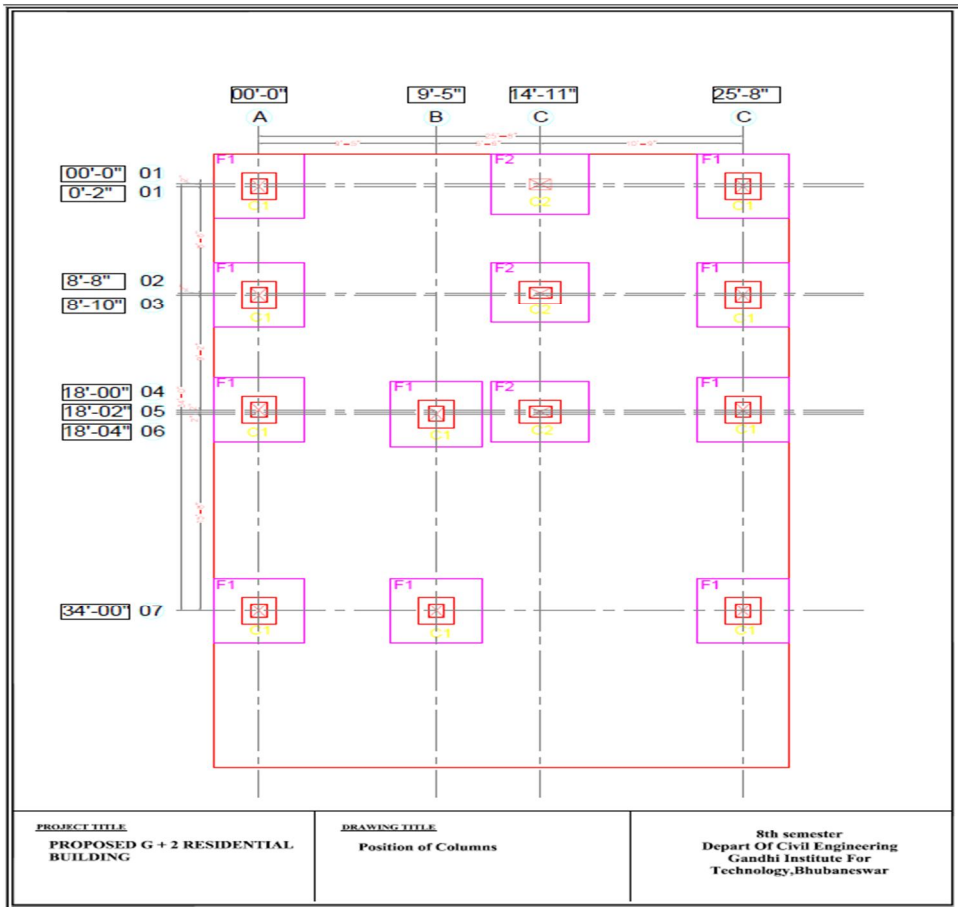

FIG 5 : Position of column

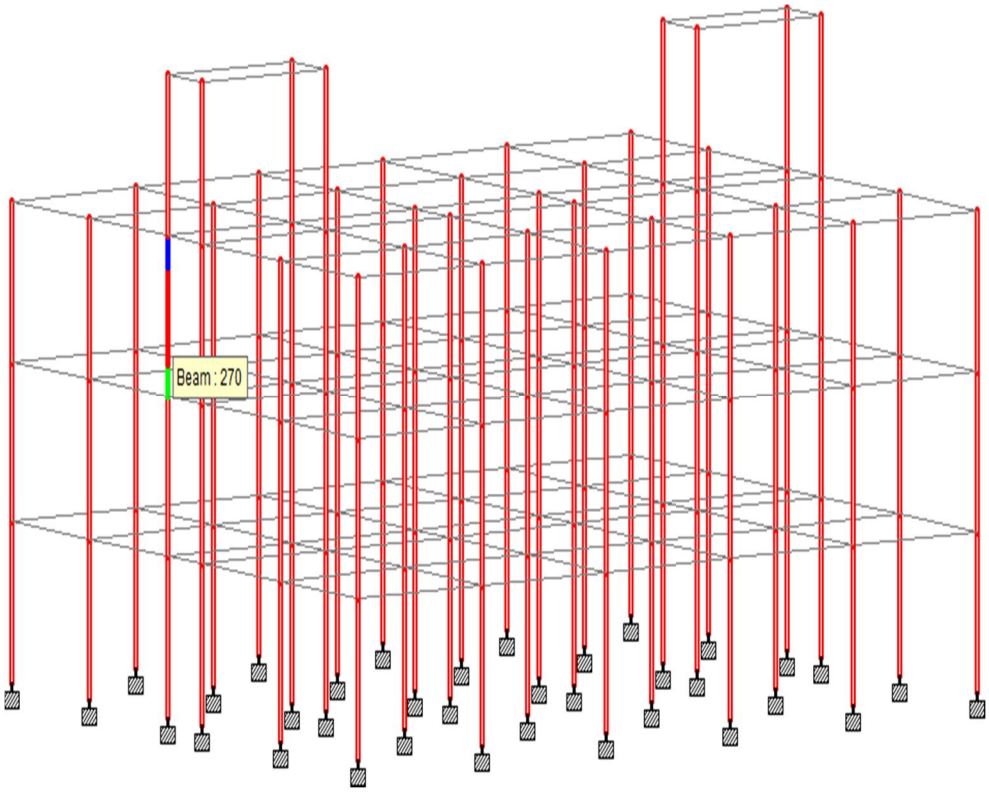

FIG 6 : COLUMN LAYOUT

XI. ANALYSIS

In the case of multi-storied frames, the degree of indeterminacy is very high and hence solution by consistent deformation, slope deflection, moment distribution or column analogy methods is almost ruled out. Kani's method, however, may be employed, but it needs more computational efforts. For quicker solution, design engineers use the following approximate methods of analysis.

XII. TYPES OF ANALYSIS

Vertical loads are taken from the appropriate code (IS 875)

Any one of the following methods for loads:

1) Portal method
2) Cantilever method
3) Factor method
4) STAAD Pro Analysis

Structural design is the primary aspect of civil engineering. The very basis of construction of any building, residential house or dams, bridges, culverts, canals, etc, is designing. Structural engineering has existed since humans first started to construct their own structures. The foremost basic in structural engineering is the design of simple basic components and members of a building viz., Slabs, Beams, Columns and Footings. In order to design them, it is important to first obtain the plan of the particular building that is, positioning of the particular rooms. Such that they serve their respective purpose and also suiting to the requirement and comfort of the inhabitants. Thereby depending on the suitability; plan layout of beams and the position of columns are fixed.

XIII. CONCLUSION

The project has given opportunity to understand the basic principles of design. Analysis and Design of residential building is carried out to have maximum utility and safety. The framed structures is performed using STADD pro software. As the result of analysis dead loads and live loads were found. The Structural components such as slabs for floors and roofs, beams at different floors and columns have been designed as per IS 456-2000.During the course of the project, we have gained knowledge on designing of slabs, beams, columns, footings and staircases. The building is designed as per IS 456-2000. We have used the application of AUTOCAD and STADD PRO during course of this project to obtain elevation, section and reinforcement details.

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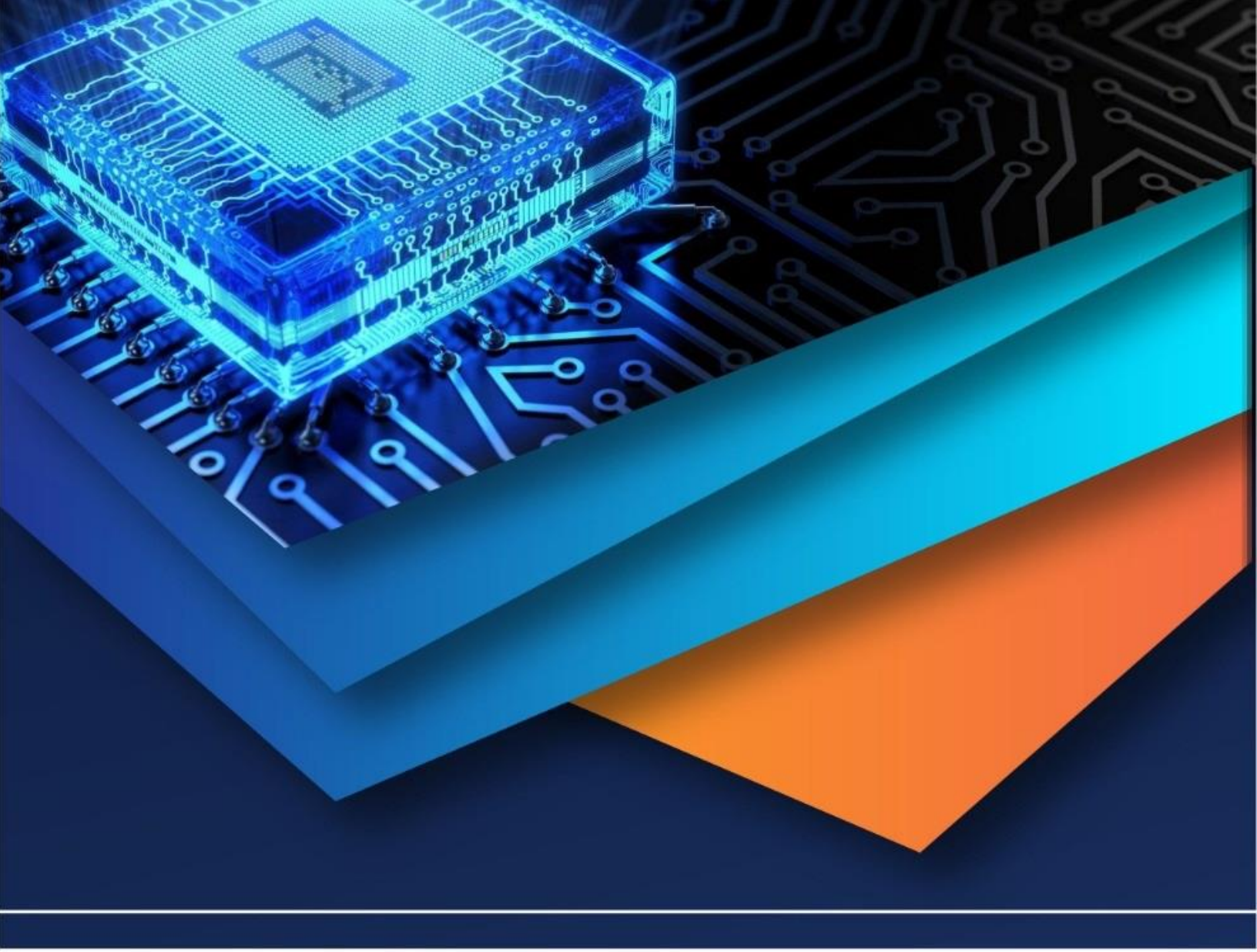

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