



Analysis, Design and Estimation of Residential Building G+13 by using Staad.Pro and Microsoft Excel

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Abstract: This venture primarily centers on the major issues that the nation confronting quickly developing populace, which necessities more offices within the restricted availability of arrive this will be illuminated to a certain degree with the development of private building. A residential building is defined as a building which provides accommodation like individual houses or private dwellings, apartments, hotels. In this project aims to finding better Analysis, Design and Estimation of a Residential Building G+13 By Using STAAD Pro and Microsoft Excel. This complete design is in the standard code books IS-456:2000, IS-800:2007, IS-875(Part-I), IS-875(Part-II), IS-875(Part-III), IS-1893:2002, IS-2502:1963, IS-5525:1969 are used for the building analysis and design.

KEY WORDS: Planning, Analysis, Designing, Estimation, AutoCAD, STAAD Pro, STAAD Foundation and Microsoft Excel.

1. INTRODUCTION

Any development venture to start with begins with the Format of the building or structure taken after by Plan and Investigation of the structure which is succeeded by fetched estimation and planning for the said venture. This venture includes the planning, Examination, plan and fetched estimation of G+13 private building located in Hyderabad, Telangana.

For completing the venture exceptionally prevalent Respectful Designing software's such as AutoCAD, STAAD Pro V8i and Microsoft Excel expectations for Fetched Estimation have been utilized.

1.1 AUTOCAD:

AutoCAD is fundamental instrument modelers utilize around the world to realize their plans. It's been around since 1982. Over a long time, it has advanced into a capable however user-friendly program with numerous highlights that make it important when planning complex structures. In this web journal post, we'll investigate AutoCAD's part in building plan, illustrating how consolidating this instrument can upgrade your workflow and bring your ventures to life with more noteworthy ease and exactness.

1.2 STAAD. PRO:

It is one of the foremost broadly utilized plan and basic examination software's for concrete, steel and timber plan codes. STAAD Pro permits creators and basic engineers to plan and examine essentially any sort of structure through its exceptionally adaptable displaying environment, familiar information collection and progressed highlights. STAAD professional bolsters over 70 worldwide codes counting IS456:2000, IS800:2007 and over 20 U.S codes in more than 7 dialects.

1.3 MICROSOFT EXCEL:

Exceed expectations may be a ordinary spreadsheet which is nowadays broadly utilized in taken a toll estimation conjointly in some cases for arranging purposes. Exceed expectations has different inbuilt calculation apparatuses which can be utilized for complex calculation. Separated from that one can too input one's poses equation for uncommon calculations.

2. OBJECTIVES OF THE PROJECT

The objectives of the project are mentioned below:

1. Draft the format of the proposed building utilizing AutoCAD.
2. Analyse and Design the Plan of building on STAAD Pro V8i.

3. To get a handle on the basic standards of structures with the assistance of Indian standard codes.
4. To realize the parameters for beams, columns, slabs and alternative structural parts.
5. To discover out shear constrain, bowing minutes and avoidance of basic individuals.
6. Effectively completed the STAAD Foundation which has been imported from STAAD Pro software.

3. LITERATURE REVIEW

Ms. Aradhana Chavan 2021(IJERT): They used the STAAD Pro for the Planning Designing and cost Estimation by a G+4 residential building. The dead loads acting on the piece were calculated physically whereas live stack, seismic stack and wind stack have been entered by taking after individual IS Codes. The plan was done utilizing constrain state of plan agreeing to IS 456:2000. They appeared how productively and effectively such a tall rise building can be outlined inside a really brief span of time.

Mr. Sowrav Saha 2021(IJSRCE): This report focuses on the Design and Analysis of multistorey (G+13) residential building using Auto CAD and STAAD Pro. And we considered as the Generate structural plan and to apply various load combinations.

Mr. Deepak Bhurkud 2021(IJIES): This report studied on the Development and design of G+20 residential structure by using advance tools at palghar. They used advance tools as AutoCAD and STAAD pro. And we learnt the When a 20-Storey high raise structural with same beam and column size is analysed and design for static and dynamic loads.

Mr. Syed Usam Ali 2021(IRJET): This research paper focuses on the Planning Designing and cost Estimation by a G+4 residential building. It shows the how to Analyse and design using STAAD Pro, Planning using Primavera and conclude with the cost.

Mr. Suyog R Jadhav 2021(IRJET): This study shows the Planning designing and estimation of residential building. And it helps to the cost estimate for the project has been calculated using long and short wall method in Microsoft excel.

Mr. Sakib Salam Sofi et.al. 2022(IJIREM): This paper shows the Analysis and Design of multistoreyed building using STAAD Pro software. By considering the all loads the design is to be calculated for IS Considerations.

4. METHODOLOGY

4.1 Planning of Residential Building using AutoCAD

The format for the proposed building was planned, examined and affirmed by a planner. The format was at that point arranged utilizing AutoCAD. The different formats were arranged and after that afterward talked about with the modeler for mistake redress.

4.2 Analysis and Design by using Staad Pro

Once the format of the building was affirmed by the modeler the format was exchanged from AutoCAD to STAAD Pro employing a DXF record organize. Once the format was exchanged, different stories were made utilizing the Translational Rehash Instrument in STAAD Pro.

After this part properties were doled out. Following the stack cases were produced and connected to the structure. Once the loads were connected the structure was dissected and adjustments were made to the structure for the different blunders that were produced whereas the structure was being dissected. After the investigation, we begun planning the structure by entering the Plan tab in STAAD Pro.

All the plan parameters were entered and stack cases chosen. This completes the plan of the bar, columns and Slabs. For planning the establishment STAAD establishment program is opened and the structure along with the stack cases is transferred. Once this can be done the soil conditions and the sort of establishment is entered. After this the program examinations and plans the establishment.

4.3 Estimation Using Microsoft Excel

The entire concrete and steel and except slab reinforcement prerequisite is calculated by STAAD Pro software and it decreasing a part of calculation. Remaining calculation cleared out to be done is the calculation of Brickwork, cement mortar, entryways and windows, earthwork and establishment. The calculations are based on the Long Wall, Short Wall method. The method which is very simple to do. And slab reinforcement has been calculated manually by dividing the slabs into one way and two way in the Microsoft excel.

5. LAYOUT OF G+13 STRUCTURE

The plot measure for the venture was 62x52 mts. Appropriately the building has been laid within the middle of the plot clearing out adequate space on all the sides for arranging and pathways, a cellar is given for the cars and for guests parking. And it can be divided like G+13+Terrace as shown in Table 1.

Table 1 - Layout Details

Layout Details	Specifications
Plot Size	62 X 52 m (3224 Sq.m)
Plot Details	Hyderabad, Telangana
Number Of Floors	G+13+Terrace
Number Of Flats	110+2 (Including 2 Emergency exits)
Type Of Apartment	2BHK & 3BHK
Average Flat Area	224 Sq.m

6. PLAN OF G+13 STRUCTURE

The format has been generally completed utilizing the Line command. The unit for the format is meters with exactness of "0.00". Underneath may be a screenshot of the Column Positioning and beam plan for the G+13 residential building.

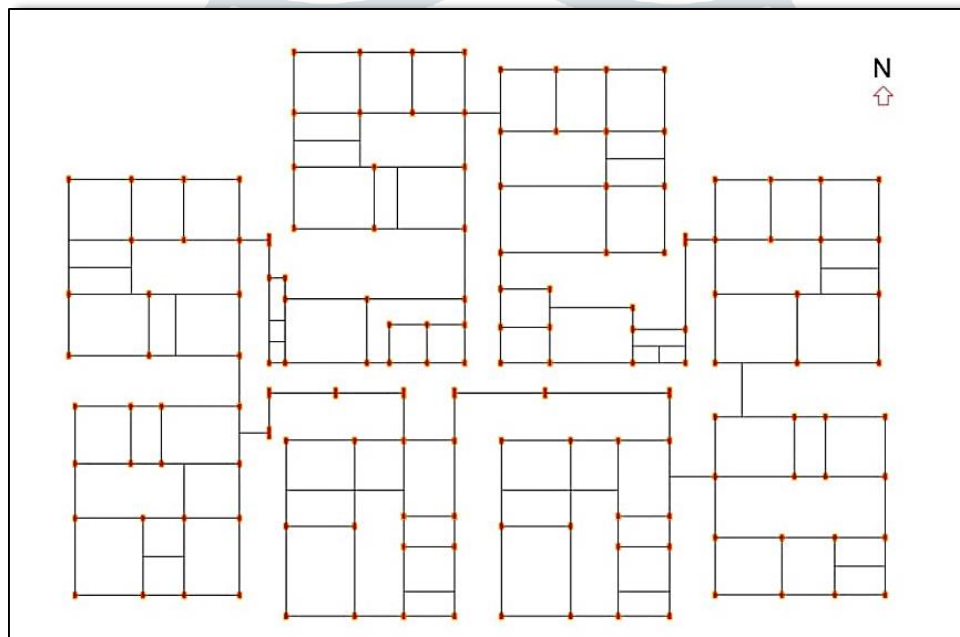


Fig 1. Beam and Column Layout using AutoCAD

Within the over Fig -1 the dark lines imply the Beam middle line whereas the red rectangular boxes imply the Columns. The Beam have a cross area of 0.300x0.300 m. The columns have a cross segment of 0.300x0.450 m. Slabs have a uniform thickness of 135mm whereas the staircase thickness features a thickness of 300 mm. The floor to floor to height is kept at 3.15 m.

The arrange for the proposed venture has G+13 flats in each floor having a 2BHK and 3BHK format in conjunction with a consider and a family relax. A few flats have two ace rooms and a few other has the three ace bed rooms with joined shower can. The third room offers a common shower and latrine with the rest of the loft. There are a add up to of 112 flats partitioned in 13 floors including emergency exits. The ground floor of the building too be utilized for the house holding which suggests the lofts developed over Ground floor too. And a cellar is given beneath the plinth for the parking purpose.

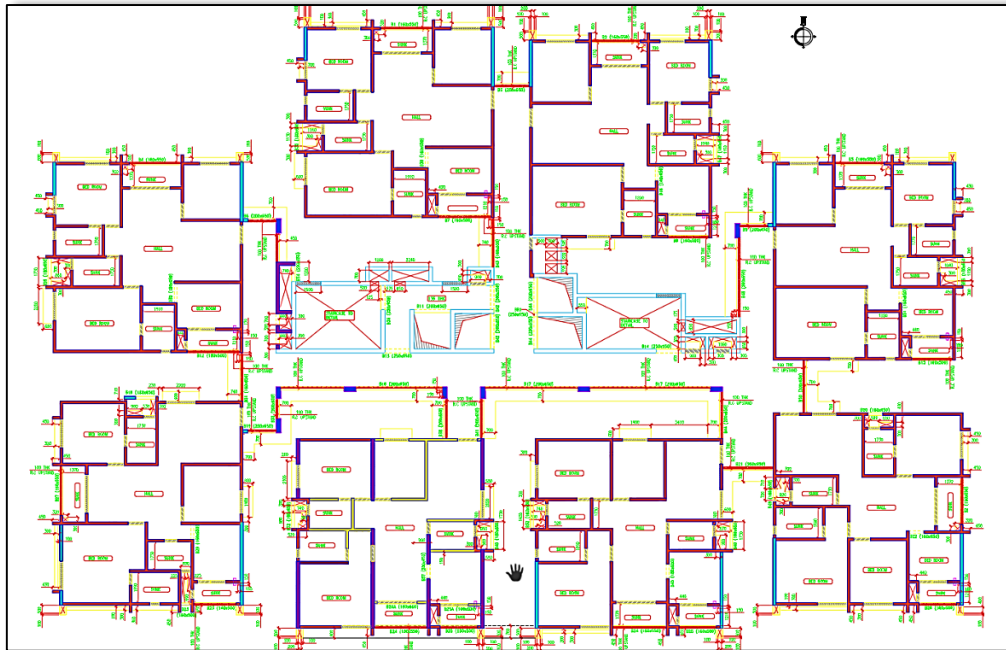


Fig 2. Layout of G+13

All the walls have a thickness of 300mm leaving a room of 0.1m for plaster and paint. There are three sizes of doors

- a) 1.2 X 2.1m
- b) 1.0 X 2.0m
- c) 0.8 X 2.0m

The smaller size door has been used in bathrooms and closets. There is also a provision for balcony with a width of 2.4m along the family cum dining lounge as shown in Fig -2.

7. ANALYSIS AND DESIGN OF G+13 STRUCTURE

The format from AutoCAD is exchanged to STAAD Professional employing a DXF record format. The height is at that point made by utilizing Translational repeat tool as shown in Fig -3. The beams and columns that has been transferred from AutoCAD, the Beams in X, Z direction and Columns in Y direction.

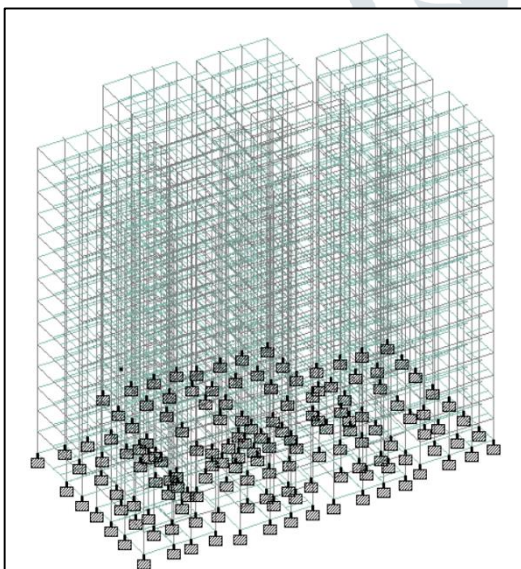


Fig 3. Elevation of G+13

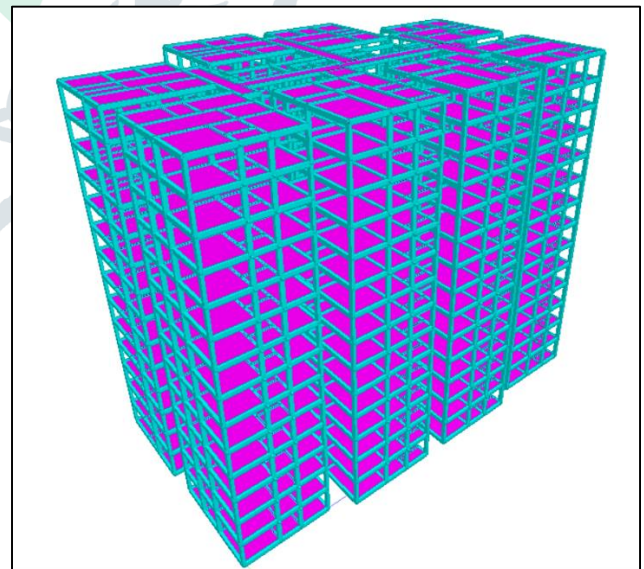


Fig 4. 3D Elevation of G+13

- a. **Properties:** By using the Property Characterizing window we are able produce the part property in STAAD Pro. From Fig -4, the part area is chosen and the measurements are indicated. The Beams have a cross-section of 0.3 m x 0.45m, 0.3m X 0.45m, 0.23m X 0.23m., and the columns have a cross area of 0.3m x 0.45m. additionally the cantilever beams are also provided having a cross-section of 0.3m X 0.15m as shown in Table 2.
- b. **Supports:** All the columns have been relegated settled back utilizing the STAAD professional Bolster maker and have been allotted in like manner as Shown in Fig -3. Settled Bolsters have confined developments in all bearings as well there's confined minute. This implies FX FY FZ MX MZ MY all will have a few values.
- c. **Materials:** The materials have been selected from the IS Codes from the Design tool from the STAAD pro software.

- d. **Loads:** The Loading that has been considered on the structure are as takes after assigning properties and loads to the structure are Primary loads like Dead Load, Live Load, Wind Load and Seismic load.

Table 2- Structural details

Length of Plot	62m
Width of Plot	52m
Height	42m
Live Load on the Floor	4 kN/m ²
Grade of Concrete	M30 for super structure & M40 for sub structure
Steel	415 N/mm ²
Column Size	0.3m X 0.45m
Beam Size	0.3 X 0.45m & 0.3m X 0.3m.,
Slab Thickness	135mm
Total No Columns	149 No's
Total No Beams	7392 No's
Total No of Cantilever Beams	339 No's

7.1 Dead load: It includes Self Weight of the G+13 structure, by default we can assign as the 1 kN/m². For external beams we considered as 12 kN/m², for internal beams and corridor beams considered as 6 kN/m², Lift area considered as 18 kN/m² and cantilever beams taken as 2 kN/m². These loads should be taken from the IS 875(Part-I).

7.2 Live load: Imposed Loads are also known as Live Loads. Loads over the floor i.e. load of person it is calculated as 1 kN/m². It can be taken the live load of 4 kN/m² as shown in Fig -5. This load is applied over the length of the structure, live load should be taken from IS-875 (Part-II).

7.3 Wind Load: Wind load variables are fundamental components in structural building and development, utilized to account for the impacts of wind on buildings and structures. These factors help ensure that structures are designed and built to withstand the forces exerted by wind, and the wind capacity for **Hyderabad** is **44 m/s** which was taken from the IS-875 (Part-III). And the wind load is assigned in four directions such as WL+X, WL-X, WL+Z and WL-Z as shown Fig - 6a, 6b, 6c and 6d respectively.

7.4 Seismic load: The seismic load should be considered as four directions and there will be the seismic load positive X direction (SL+X), seismic load negative X direction (SL-X) and seismic load in positive Z direction (SL+Z), seismic load in negative Z direction (SL-Z). The Seismic Code as IS 1893: 2002/2005.

- The zone factor is 0.1 for Hyderabad.
- The response reduction factor (RF) is taken as 3.0
- The importance Factor for the building is taken as 1.2
- Rock and soil site factor (SS) is taken as 1 for Gravel
- Type of structure is taken as 1
- Damping Ratio is taken as 0 for accurate results. By the default value is 5

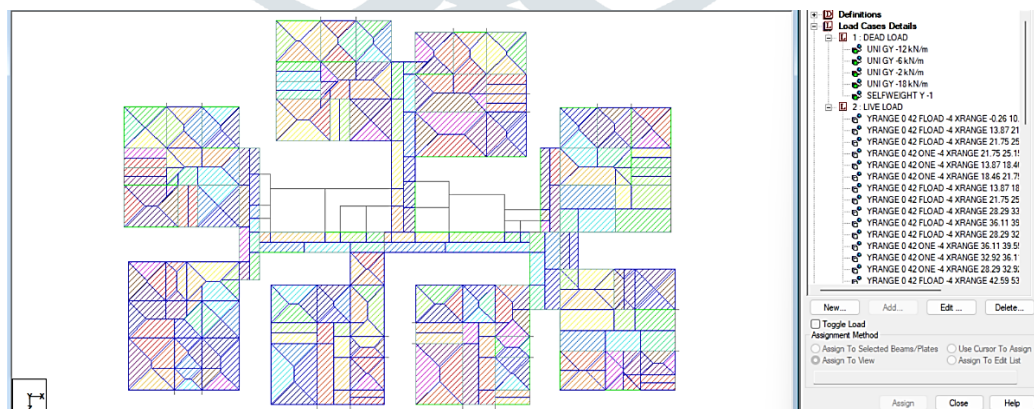


Fig 5. showing the Live Load over the slab

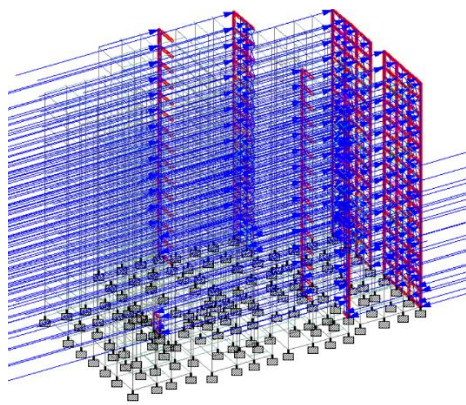


Fig 6(a). WL+X

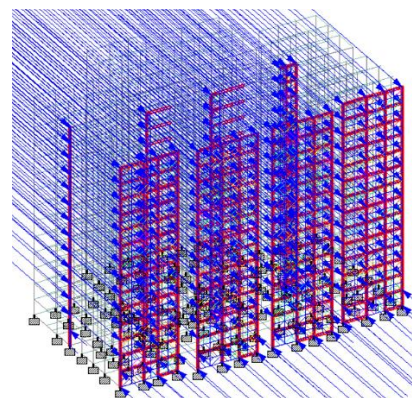


Fig 6(c). WL+Z

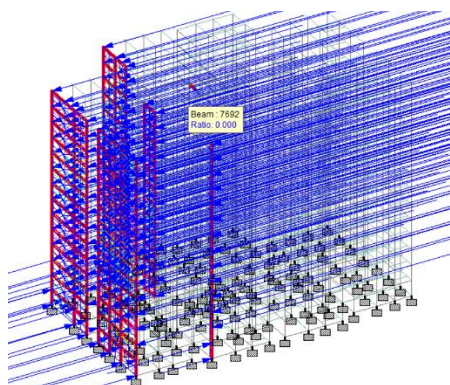


Fig 6(b). WL-X

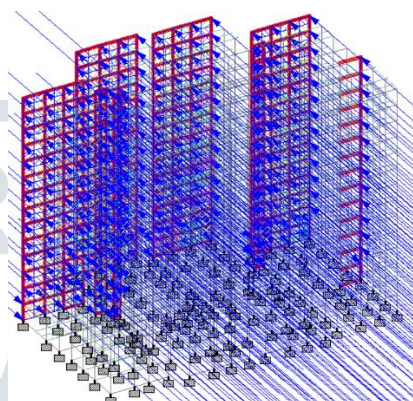


Fig 6(d). WL-Z

7.5 Analysis of the G+13 structure

STAAD Pro may be a comprehensive basic limited component investigation and plan application that permits clients to perform investigation on any structure uncovered to inactive, energetic, wind, earthquake, thermal, and moving loads. STAAD comes in several variations.

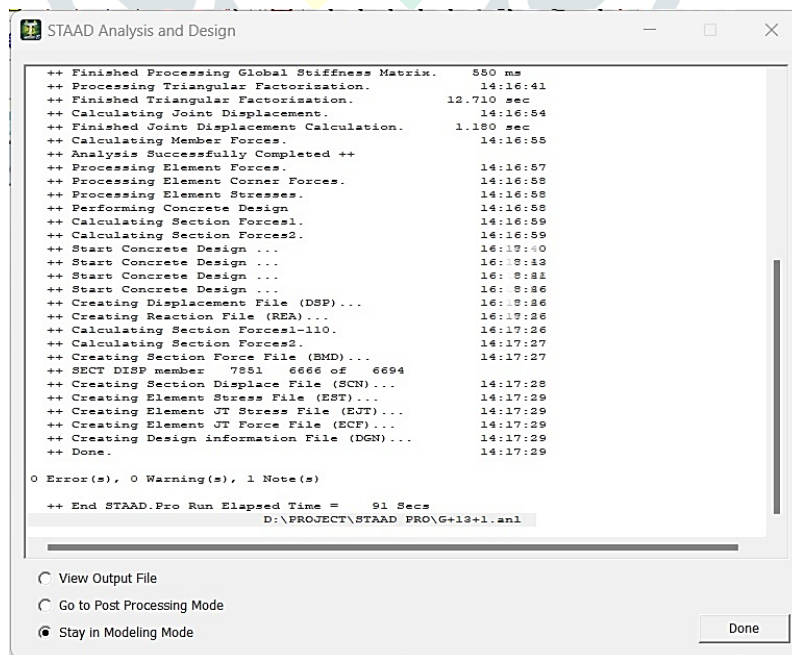


Fig 7. Analysis and Design Window for G+13

The above Fig -7 Shows that the successfully completed the analysis for the G+13 Structure with Zero warnings, Zero Errors and One Note.

8. DESIGN OF G+13 STRUCTURE

After the STAAD Pro has completed dissecting the entire structure, able to presently continue to the plan portion of the structure. STAAD Pro can design a structure for different sorts of materials like Steel, Concrete, Aluminium & Timber. We'll select RCC or Fortified Cement Concrete for planning our structure. After the Completion of analysis we go back to the demonstrating mode and press on the Plan Tab where we select concrete as the fabric. Once that's done we select the Plan Code which is to be taken after. We select IS 456 for designing of G+13 structure as shown in Fig -8.

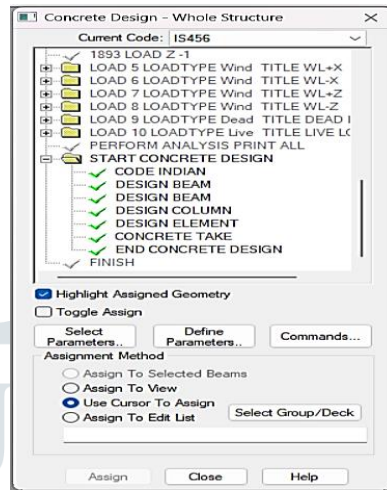


Fig 8. Design parameters for G+13

9. ANALYSIS AND DESIGN RESULTS FOR G+13

The Fig – 9(a), 9(b) and 9(c) shows the Beam results:

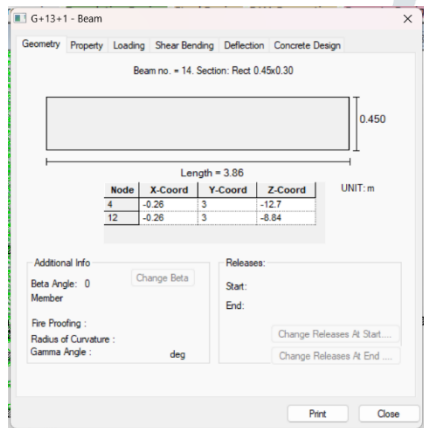


Fig 9(a). Properties of Beam No.14

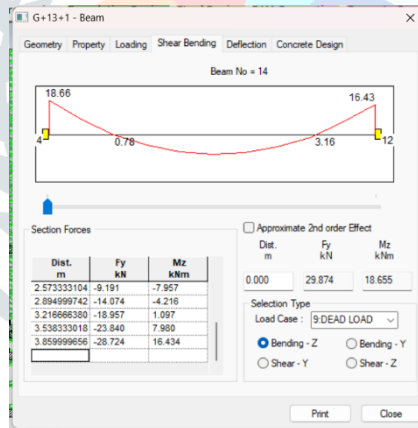


Fig 9(b). Shear bending for Beam No.14

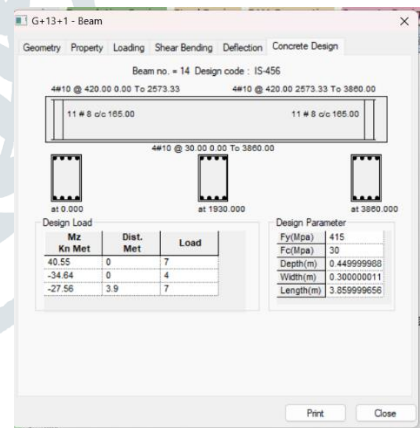


Fig 9(c). Concrete Design for Beam No.14

The Fig – 10(a), 10(b) and 10(c) shows the Column results:



Fig 10(a). Properties of Column No.1

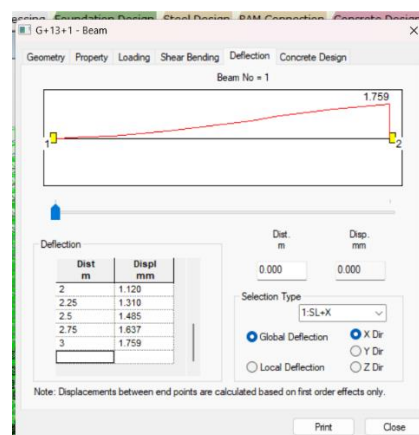


Fig 10(b). Deflection for Column No.1

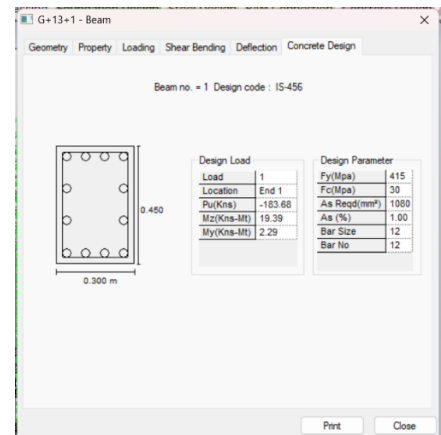


Fig 10(c). Concrete Design for Column No.1

Z9.1 STAAD Foundation

The establishment for the structure has been outlined utilizing STAAD Establishment. The structure and stack cases can be exchanged to STAAD Establishment utilizing in-built program. The Establishment is outlined as per IS details an in understanding to the soil conditions where the structure is to be built.

The soil bearing capacity of the soil can be taken as the 1098 kN/m² from the client. And we designed with bottom cover of 75mm and we have been taken as the minimum diameter of bar 12mm and maximum diameter of bar 25mm with a spacing of minimum of 120mm and maximum of 180mm. The depth of soil above the footing is 3m, in designing stage we recommended the INDIAN code to design the footing to the G+13 structure. The arrangement of the footings in total 149 columns for the G+13 structure. There is a combination of footings are there like Isolated footing, Combined footing and Mat or Raft footing.

Types of footings held for the G+13 structure as Shown in Fig -11(a).

- Isolated Footings - 131 No's
- Combined Footings - 11 No's
- Mat Footings - 7 No's

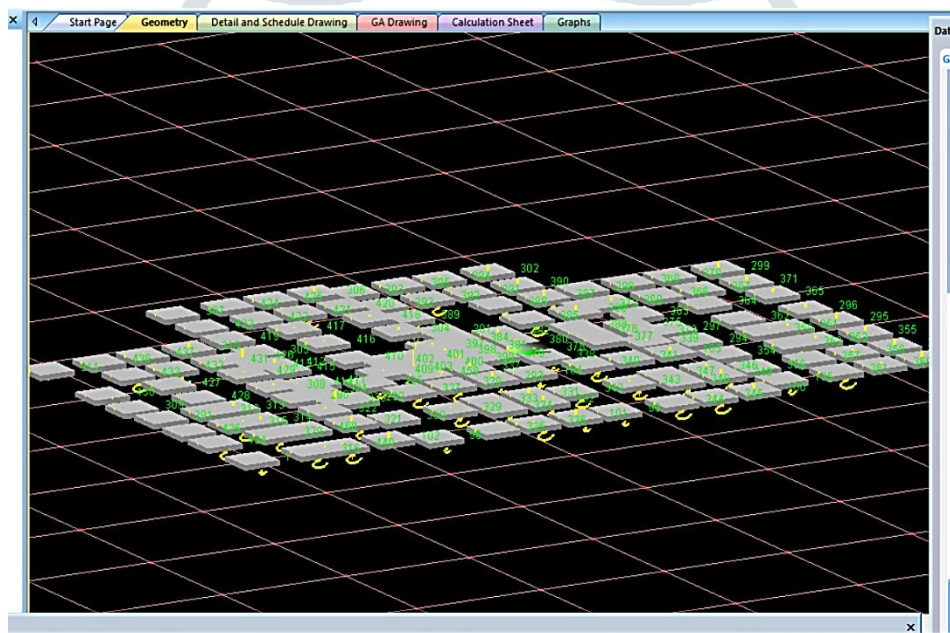


Fig 11(a). Overview of the Types of Footings Designed

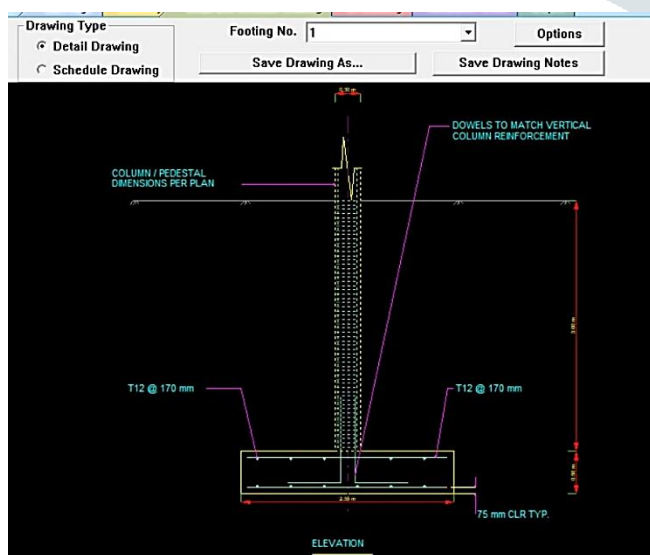


Fig 11(b). Elevation of Footing No.1

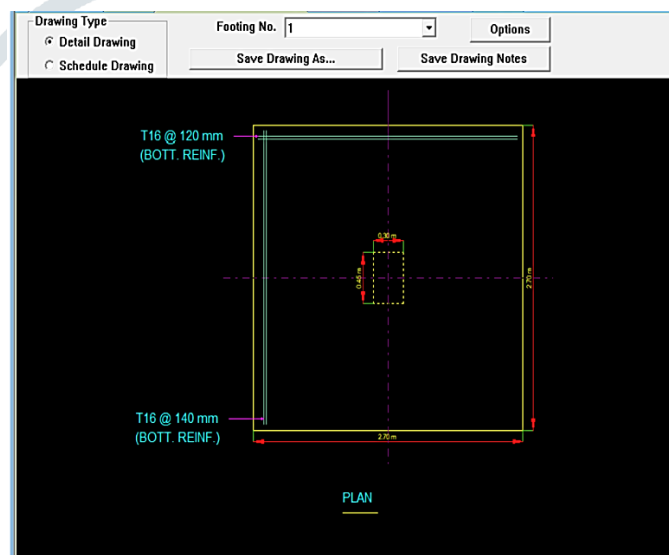


Fig 11(c). Plan of Footing No.1

Over the Fig -11(b),11(c) showing the Elevation and Plan of the Footing No.1 after completion of the STAAD Foundation.

10. QUANTITY AND COST ESTIMATION FOR G+13 STRUCTURE

From the reference of TS Standard Data (with Schedule of Rates 2023-24) having G.O.No.49, the rates have been taken for the Quantity and Cost Estimation of G+13 Structure in Table 3.

10.1 QUANTITIES**10.1.1 Sub Structure**

Earthwork Excavation	: 9672 Cub.m
Back filling	: 2194.62 Cub.m
Concrete Quantity	: 1029.214 Cub.m
Reinforcement	: 31 Tones

10.1.2 Super Structure

Brick work	: 10560.576 Cub.m
Concrete Quantity	: 26090.4 Cub.m
Plastering	: 81928.327 Sq.m
Painting	: 80210.377 Sq.m
Reinforcement	: 266 Tones

10.2 COST ESTIMATION

Table 3. Cost estimation for G+13

QUANTITY AND COST ESTIMATION OF G+13 STRUCTURE					
S.NO	DESCRIPTION OF ITEM	QUANTITY	UNIT	RATE PER UNIT	AMOUNT
1	SUB STRUCTURE				
a	Earthwork Excavation	9672	Cu.m	₹ 412.40	₹ 39,88,733.00
b	Back Filling	2194.786	Cu.m	₹ 257.10	₹ 5,64,280.00
c	Concrete Quantity	1029.214	Cu.m	₹ 12,816.66	₹ 1,31,91,086.00
d	Reinforcement	31	Tones	₹ 84,888.58	₹ 26,31,546.00
2	SUPER STRUCTURE				
a	Brick work	10560.576	Cu.m	₹ 7,155.28	₹ 7,55,63,879.00
b	Concrete Quantity	26090.4	Cu.m	₹ 12,816.66	₹ 33,43,91,787.00
c	Plastering	81928.327	Sq.m	₹ 252.80	₹ 2,07,11,482.00
d	Painting	80210.377	Sq.m	₹ 634.10	₹ 5,08,61,401.00
e	Reinforcement	266	Tones	₹ 84,888.58	₹ 2,25,80,363.00
COST OF THE BUILDING					₹ 52,44,84,557.00
f	Cost of WS	5% of building cost			₹ 2,62,24,228.00
g	Sanitation Cost	5% of building cost			₹ 2,62,24,228.00
h	Electrification Cost	7% of building cost			₹ 3,67,13,919.00
OVERALL COST OF BUILDING					₹ 61,36,46,932.00
i	Miscellaneous Charges	5% of Overall cost of Building			₹ 3,06,82,347.00
j	Work charges Establishment	2.5% of Overall cost of Building			₹ 1,53,41,174.00
FINAL COST OF RESIDENTIAL BUILDING (G+13)					₹ 65,96,70,453.00

11. CONCLUSIONS

- The layout of the proposed G+13 residential building is based on a plot of size 62 m x 52 m located at Hyderabad, Telangana.
- According to the plan it will be used as a multi- storied residential building. The cellar is place under the building, it will be used for parking while the remaining 13 floors will be divided into 112 apartments including 2 emergency exists and 1 terrace also provided. The average Flat area of 224 sq m.
- Apartment having both 2BHK & 3BHK configuration. all the drafting was done using AutoCAD. These drawings made on AutoCAD also served as a base for transfer of the structure for analysis and design into STAAD pro.
- The analysis and design of the entire structure has been completed using STAAD Pro. The results include the various forces acting on various members as well various schedules for various members.
- Also using the STAAD Pro software we got the concrete take-off as well as the weight of the various reinforcement bars. the foundation has been designed as both Isolated, Combined and Mat Footings using soil condition as medium. the foundation design values were calculated using STAAD Foundation.

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