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DESIGN AND ANALYSIS OF G+4 RESIDENTIAL BUILDING

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Abstract
This research paper consists of analysis and then design of G+4 residential building at this age of technical era through STAAD Pro V8i and plan was designed using Autodesk AutoCAD, Modeling was done using Autodesk Revit and design of Foundation using STAAD Foundation software. At first, The Dead Loads, The Live Loads and the Wind Loads acting on the Structure were analyzed as per specified under IS 875 (Part 1):1987, IS 875 (Part 2):1987 and IS 875 (Part 3):1987 containing provisions for code of practice for design loads having certain byelaws to be followed for Dead Load, Live Load and Wind Load respectively. After the analysis of the building, the structural members were designed i.e. the size, shape, geometry, quantity, area and volume of members such as beams, columns, slab, footings and staircases required to be designed were found out as per specifications and byelaws of Code of Practice of Plain and Reinforced Concrete i.e. IS 456:2000. All these processes were carried out in the software designed by Bentley i.e. STAADPro using Limit state method of analysis. After this process, the design data were fed into the STAAD Foundation software built by Bentley to find out the requirements of geometry, size and type of foundation to be adopted for safe erection of the residential building.
Keywords: STAAD, Parameters, Geometry, Property, Displacement, Fully Stressed Design.

I. Introduction

The Building and Construction industry has a huge scope in the near as well as farther future, because every lively creature requires a shelter to survive and therefore, it is well said by Winston Churchill that, "we shape our buildings; thereafter they shape us. "This industry works as oxygen to all other industries as we know that undoubtedly any industry requires an arena i.e. a constructed facility before the start of their production being viable. Therefore, a serious necessity to rethink on our methods of analysis and design of structures comes on picture along with making sure that they give extra accuracy and can be quick, reliable, have durable design to fulfill the needs of the designed service life, which could be made possible by technology i.e. the software's such as Autodesk AutoCAD, Autodesk Revit, Bentley STAADPro and Bentley STAAD Foundation etc. Also, The Limit State Method used by these software's is familiar and worldwide adopted. It comprises of Limit State of Collapse and Limit State of Serviceability. The goal of a design based on the limit state concept is to achieve acceptability such that the structure does not become unusable during its useful life for its intended use. It will not reach the limit state, i.e. the acceptable limit of safety and serviceability requirements before failure occurs. The collapse limit state corresponds to flexure, compression, Shear & torsion whereas Limit state of Serviceability consists of Deflection, cracking and vibration as its components. We need to design multistoried structures as much as possible because the population growth rate of world has been considerably increasing since the near past. Hence, It will be required to preserve land resources to avoid future scarcity for land and for achieving this target, maximum number of people should be minimized in minimum possible area, this could be best gained by construction of multistoried buildings. Also, we have to keep in mind that eco-friendly processes should be adopted for the fulfillment of above said objectives.

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Softwares used in the work:

This project is mostly based on software and it is essential to know the details about these softwares. List of softwares used are as follows: -

- Autodesk Revit
- Bentley Staad Pro.V8i
- Bentley Staad Foundations V8i (ver 5.3)

II. Methodology

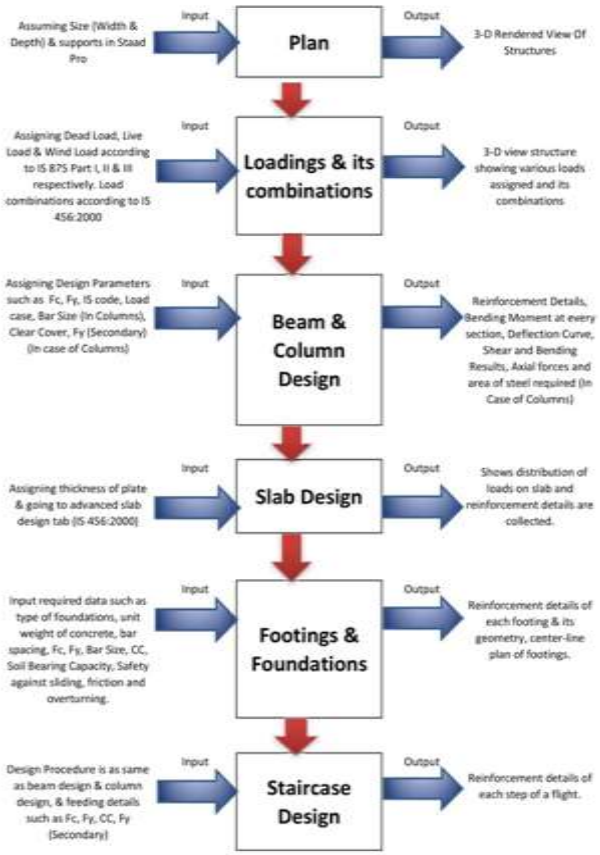

Fig.1: Flowchart of Methodology Adopted

The various steps shown in the working flowchart above can be illustrated by following figures:

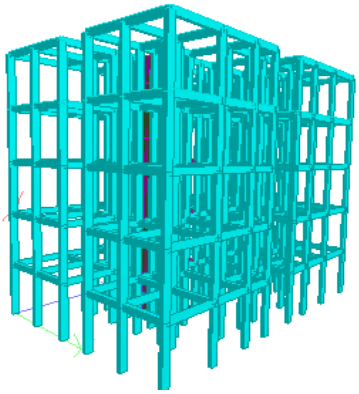

Fig.2: 3-D Rendered View of Structure

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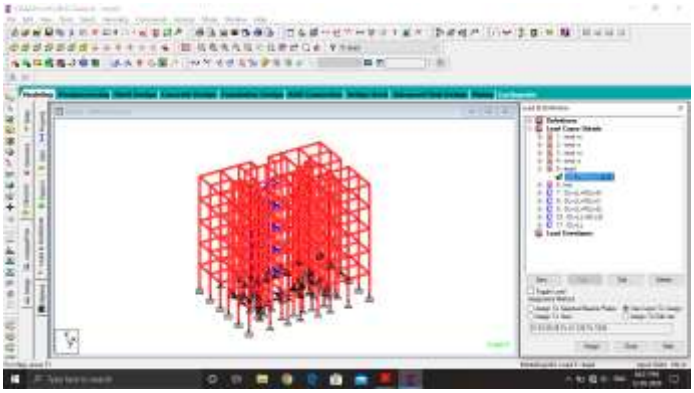

Fig.3: Dead Load Assigned to Structure

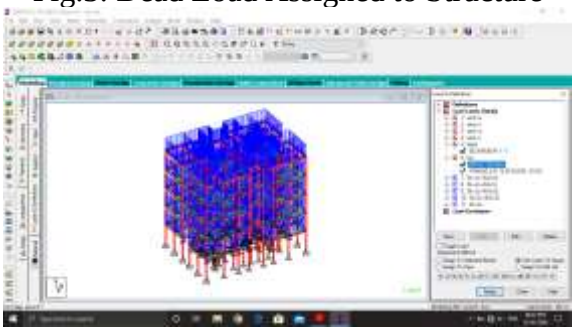

Fig.4: Live Load Assigned to Structur

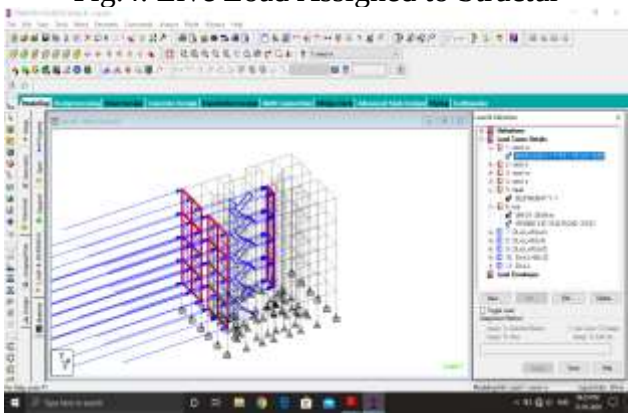

Fig.5: Wind Load Assigned to Structure in +X Direction

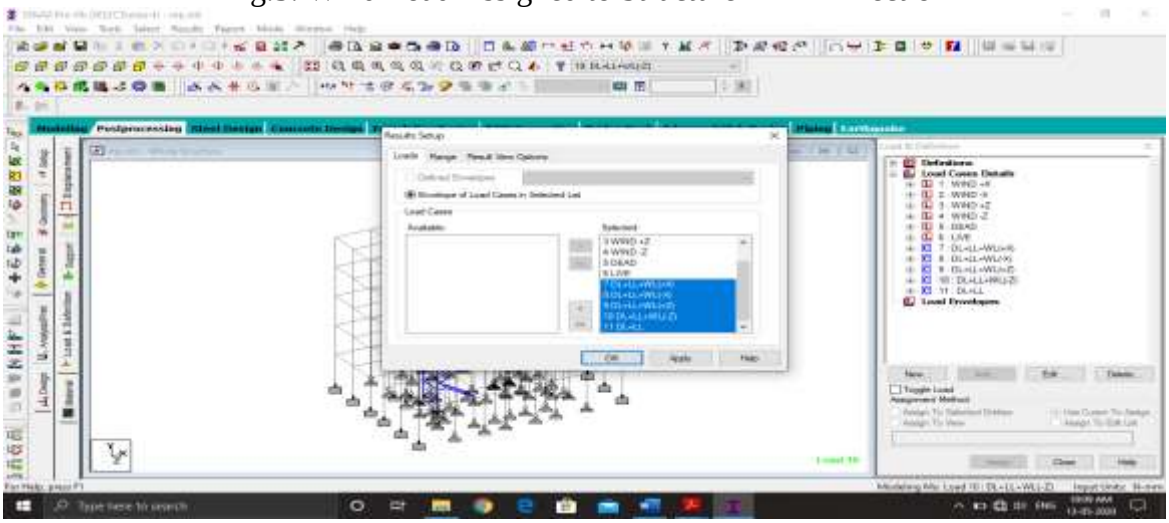

Fig.6: Load Combination Details

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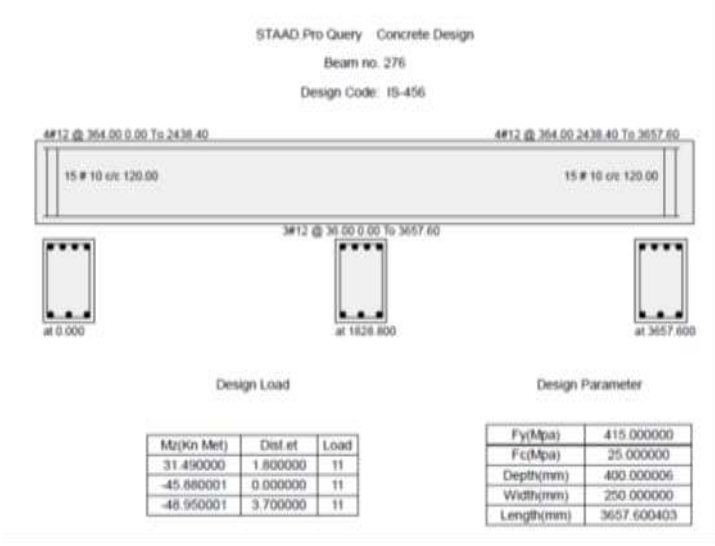


Mz(Kn Met)	Dist.et	Load
31.490000	1.800000	11
-45.880001	0.000000	11
-48.950001	3.700000	11

Fy(Mpa)	415.000000
Fc(Mpa)	25.000000
Depth(mm)	400.000006
Width(mm)	250.000000
Length(mm)	3657.600403

Fig.7: Design of Beam 276

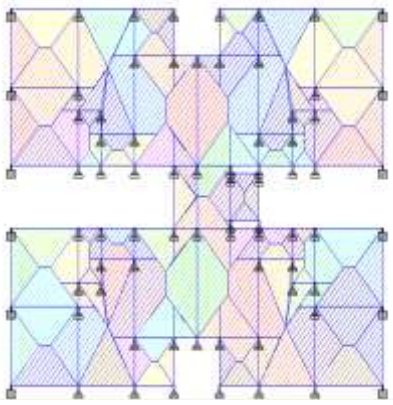
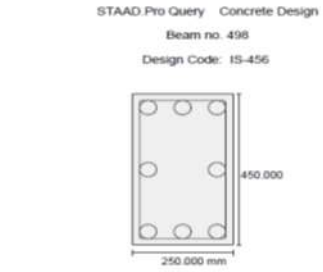


Fig.8: Distribution of Loads on Roof Slab



Load	3
Location	End 1
Pu(Kns)	-4.580000
Mz(Kns-Mt)	0.830000
My(Kns-Mt)	2.900000

Fy(Mpa)	415
Fc(Mpa)	25
As Reqd(mm²)	900.000000
As (%)	0.804000
Bar Size	12
Bar No	8

Fig.9: Design of Column 498

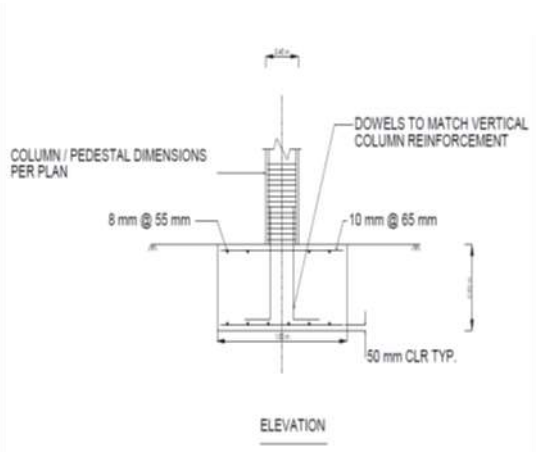


Fig.10: Elevation Details of Footing No. 1

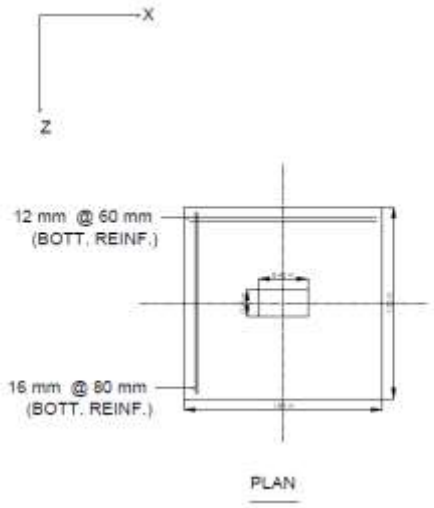


Fig.11: Plan of Footing No. 1

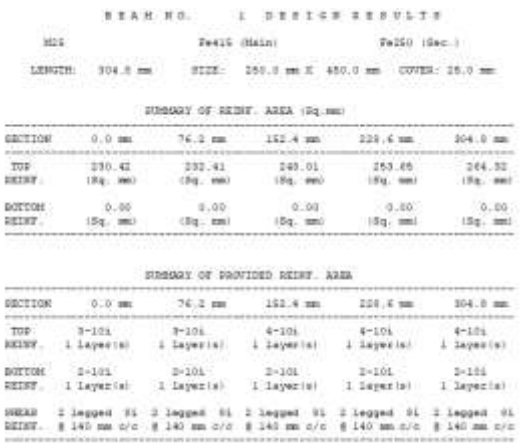


Fig.12: Reinforcement Details of Stairs

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Results

Fig.13: Displacement of Structure

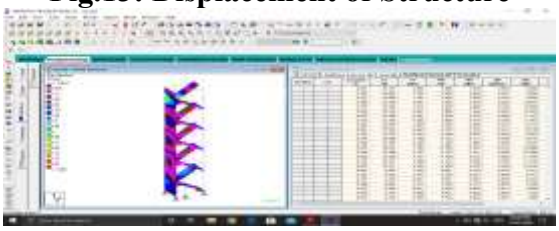

Fig.14: Maximum Absolute Loads on Stairs

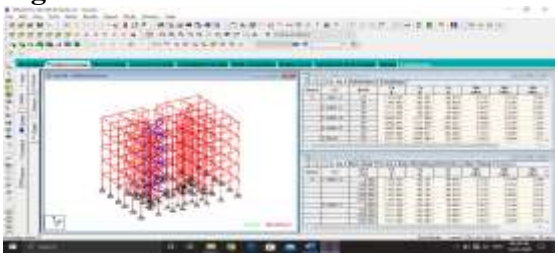

Fig.15: Bending of Structure in Z Axis

From staad.pro, we have got the following results of concrete and steel bars:

Total Volume of Concrete = 277.5 cubic meter

BAR DIAMETER (in mm)	WEIGHT (in Newton)
10	110383
12	140463
16	6604

Total Weight of Steel Bars = 257450 Newton

Conclusion

From the above results, the following points were concluded:

- The total volume of concrete obtained by STAAD Pro software is exclusive of Wastage of Concrete occured during transportation and placement of concrete to the desired place.
- STAAD Pro cannot be used for high rise buildings as it makes 3D complex structures. Instead of STAAD Pro, Etabs would be beneficial for such structures.
- Advantage of Revit by Bentley is to avoid repetition and maintain the productivity of Architects by saving much time.
- Design and Analysis of G+4 Multi-Storey Residential Building was done. It has parking in the basement and the rest of the floors are occupied with apartments.
- Designed and analyzed according to standard specifications for the use of Staad.pro for static and dynamic loads. Staad.pro reduces the time a lot.
- Details of each member can be obtained using Staad.pro. You can get the complete list of failed packages and the software also provides a better section.
- Accuracy is improved by using Staad.pro and Revit.
- Advantage of using Revit is it makes Elevation automatically when drawing

- 2-Dimensional plan. It saves a lot of time for Architects.
- Deflection and Shear results were obtained for each and every Beam, Column and Slab. And the results were safe.
- The virtual design result of the beam contains the bending and shear reinforcement available along the length of the beam.
- While designing the column all the main criteria for selection of longitudinal and transverse reinforcement as stipulated in IS 456 have been considered.
- This study concludes that application software in the field is quite good and comprehensive for further study of structural parameter.

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