

Design, Planning and Cost Estimation of a G+4 Residential Building by using Different Softwares

Musuab Muazzam Hamdule¹ Saurabh Vilas Kamane² Karan Sudhir Mhatre³ Adarsh Ravindra Thakur⁴ Yuga. R. Galinde⁵

^{1,2,3,4}B.E. Student ⁵Assistant Professor

^{1,2,3,4,5}Department of Civil Engineering

^{1,2,3,4,5}G.M. Vedak Institute of Technology Maharashtra, India

Abstract— Currently all work is done on computers whether or not it be drawing, estimating, project management etc. in civil engineering field. It helps an engineer to work with high accuracy in less time. This project involves the layout, design, analysis, Schedule planning and cost estimation of a G+4 residential building. For finishing the project very well-known Civil Engineering software's such as AutoCAD, STAAD Pro V8i, Microsoft Project and Microsoft Excel are used. The floor plan of the G+4 residential building is preliminary based on a plot of size 30m X 15m. The every floor of building have 4 flats having an area of 39,52sq m. Each flat is of 1BHK configuration. The time period of the project using Microsoft project has been calculated to be around 243 days excluding holidays. The total cost of project is Rs 2365055.21 which is calculated in Microsoft excel.

Keywords: Design, analysis, AutoCAD, Staad Pro, Microsoft project, Estimation

I. INTRODUCTION

Currently all work is finished on computers whether or not its drawing, estimating, project management etc. in civil engineering field. It helps an engineer to work with high accuracy in less time. If would like to be structural engineer you should have knowledge of STAAD PRO, ETABS, SAP, etc. If you wish to pursue a career in drafting, then you should know how to use AutoCAD. This project involves the layout, design, analysis, Schedule planning and cost estimation of a G+4 residential building. For finishing the project very well-known Civil Engineering software's such as AutoCAD, STAAD Pro, Microsoft Project and Microsoft Excel are used.

A. Objectives of Project:

- To get the practical knowledge of planning and design of residential building.
- To find out use of recent software's in field of civil engineering.
- To set up residential building as per IS codes.
- Draft the Layout of the building using AutoCAD.
- To analyse the structure in STAAD Pro.
- To design the structure in STAAD Pro.
- To set up Project Schedule using Microsoft Project.
- Calculate the approximate final cost of the building.

II. METHODOLOGY



Fig. 1: Methodology of project

A. Preparation of Building in AutoCAD

The AutoCAD is used to draft layout of building. The layout is created using layer to easily work of each layer of layout.

B. Analysis and Design in STAAD Pro

The layout of the building was transferred from AutoCAD to STAAD Pro exploitation a DXF file format. Once the layout was transferred, multiple stories were created by the translational Repeat Tool in Staad Pro. Then properties were assigned to member. After this load cases were generated and applied to the structure. Next structure was analysed and corrections were made to structure for the numerous errors.

After finishing analysis, design of the structure is done by entering the DESIGN tab. All the design parameters were entered and load cases selected. This completes the design of the beam, columns and slabs.

C. Cost Estimation in Microsoft Excel

In this project Microsoft excel was used for calculating quantities and to prepare cost abstract. The centreline method is used to quantity estimation.

D. Project Planning in Microsoft Project

For the purpose of schedule planning the project Microsoft Project has been used. Initially the project details were entered such as beginning and closing date, field connected to the project. When the project has been created WBS is created and their connected activity. Once this has been done the time schedule of every activity is entered and resources are assigned. After this the various activities are linked. As these things are carried out a gantt chart is created as same time

III. SOFTWARE TO BE USED

A. AutoCAD

AutoCAD is wide utilised within the engineering field because of its ability to set up sites tons easier then hand drawings, it will facilities design a lot of engineering provides, and is continually upgrading. In past civil engineers were hand draw their design plans which could take a huge time. AutoCAD makes this quicker and easier method. It can also layout sites, roads, sidewalks, bridges, and alternative engineering things. During this project AutoCAD has been used extensively for drafting and modelling for the structure. Use of AutoCAD reduced the drafting time when done manually thus saving time which might be utilized in alternative productive work.

B. STAAD Pro

STAAD Pro is a structural analysis and design software application originally developed by Research Engineers

International in 1997. In late 2005, Research Engineers International was bought by Bentley Systems. STAAD Pro is one of the most widely used structural analysis and design software products worldwide. It supports over 90 international steel, concrete, timber & aluminium design codes. STAAD can be used for analysis and design of every types of structural element, buildings, and bridges to towers, tunnels, metro stations, water/wastewater treatment plants etc. STAAD pro can integrate with other Bentley Products such as STAAD foundation. It can also integrate with other third party applications thus giving a decent flexibility to designers performing on various software's. STAAD Pro can check all the structural parameters in a design such as bending moment analysis, shear force analysis, buckling in a column, loads, deflection thereby helping the structural engineer in designing.

C. Microsoft Excel

Most companies in the construction industry are using modern, smart business systems to control these complex projects. The reality is, the primary business system used to control these projects is Microsoft Excel. MS Excel is a great, flexible tool for adding up and changing numbers. You can do anything you like with this program. There is clearly a place for MS Excel in every business, but the construction industry has a much higher dependency on this tool than any other business. Almost all the Civil Engineering business functions use MS Excel, be it execution, surveying, planning, contracts, budgeting, designing, quality control, quantity estimation, you name it. Everyone uses MS Excel. The data when represented in tables looks good. The required

calculations are done by MS Excel. You can store, replicate, and modify the data however you want. For example: Let's say the quantity estimation engineer wants to know the quantity of steel to be used at the site, he/she will have to make use of an excel sheet to make a bar bending schedule and assess the quantity of steel. Excel is one of the most powerful software for Civil Engineers. It helps in maintaining bills, making graphs, S scheduling things for a project, calculating sizes of beams and columns, etc.

D. Microsoft Project

Microsoft Project (MSP) is a project management software made for project managers so they can manage their projects. Microsoft Project allows you to schedule projects, assign tasks, manage resources, and build reports and additional. It offers a full plate of services and was quick to dominate the project management software market when it once it had been 1st introduced. Microsoft Project can also be integrate with other third party applications Such as primavera P6 therefore giving a decent flexibility to project manager working on various software's.

IV. LAYOUT OF G+4 BUILDING IN AUTOCAD

A. General

AutoCAD could be very helpful tool in drafting and designing any structure. AutoCAD has numerous inherent tools for complicated drafting. AutoCAD gives more accuracy than hand-drawn design All the drafting for the project has been done by AutoCAD.

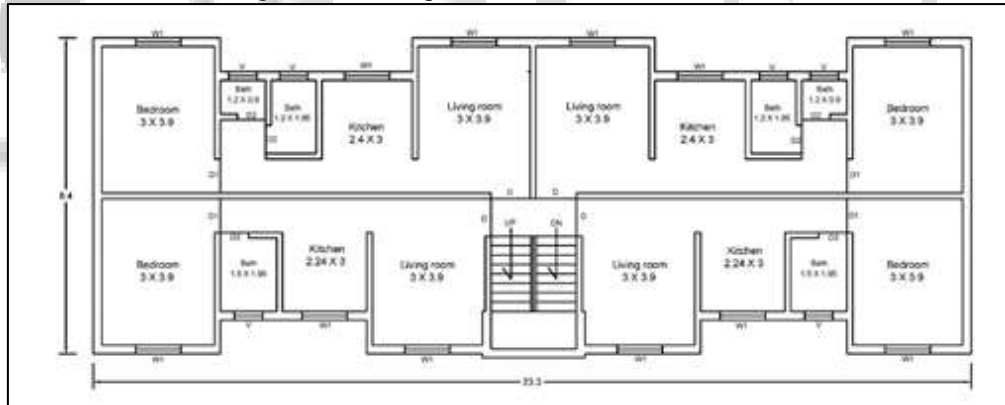


Fig. 2: Ground floor Layout

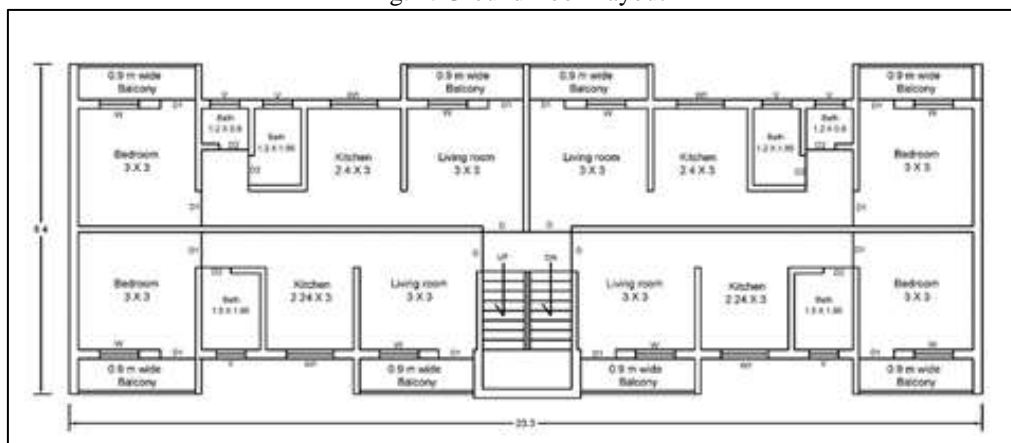


Fig. 3: 1, 2, 3 & 4 floor Layout

Type	Size	Remark
D	1 X 2.1	Wooden panelled door
D1	0.9 X 2.1	Wooden panelled door
D2	0.75 X 2	Wooden panelled door
W	1.2 X 1.2	Aluminium sliding window
W1	1 X 1.2	Aluminium sliding window
V	0.70 X 0.90	Louvered window

Table 1: Doors & windows schedule

V. ANALYSIS & DESIGN OF G+4 BUILDING IN STAAD PRO

A. Analysis of G+4 Building in STAAD Pro

The analysis of structure is carried out in following steps.

- 1) The layout from AutoCAD is transferred to STAAD Pro using a DXF file. The structure frame is then generated by Translational Repeat tool.
- 2) Generation of Member and Member Property: From general tab select Property defining window to generate the member property in STAAD Pro. The member section is selected and the dimensions are entered. The beams have a cross-section of 0.3 m x 0.4 m and the columns have a cross section of 0.4m x 0.4m.
- 3) Creation of Supports: All the columns are assigned fixed support using the STAAD pro Support creator.

- 4) Materials: The materials for the structure is chosen as concrete form general tab. The concrete is assigned to structure.
- 5) Loading: The loading that have been considered on the structure are as follows
 - a) Self-weight: The self-weight of entire structure is automatically generated by staad pro.
 - b) Dead Load: Dead load of slab is generated in STAAD Pro by specifying the Slab Thickness and this was found out to be 3.75KN/sq m
 - c) Live Load: The live load acting on each floor was considered to be 4.5KN/ sqm. The live load is then assigned to structure.
 - d) Seismic Load: The seismic load was derived from IS 1893-2002 and these load was generated by STAAD Pro.
 - e) Load Combinations: The structure was analysed for load combinations considering all the loads in proper ratio as per IS 456. These combinations were generated by the inherent auto- load generator for various load combinations as per IS 456.
- 6) Analysis of the Structure: The STAAD Pro analyse the structure the basis of the loads and member property defined. The can analyse each member of the structure and let the structural engineer know if any changes are needed in the structure for a safety.

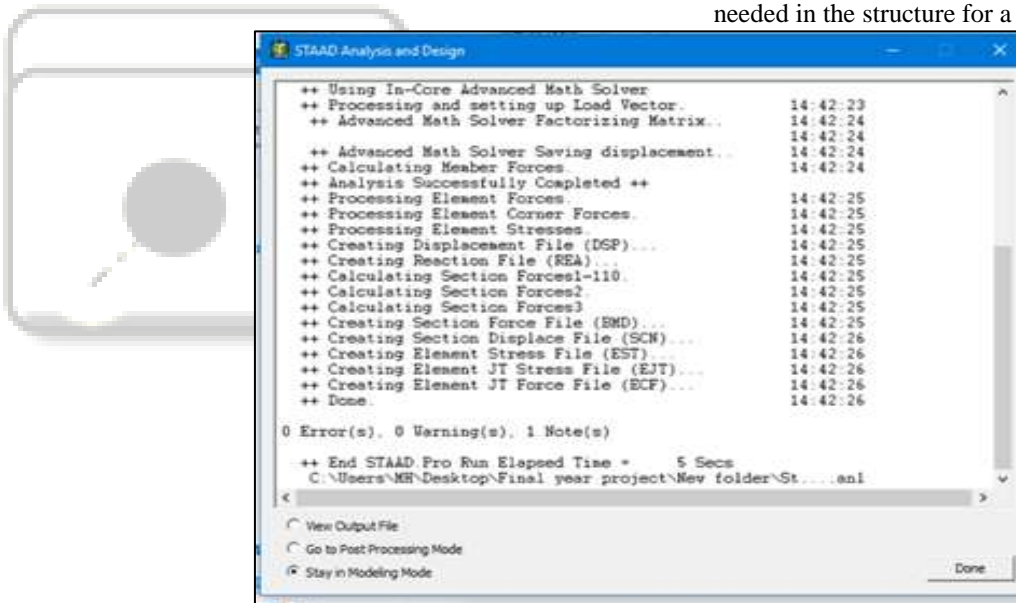


Fig. 4: GUI showing the analysing and design window

B. Design of G+4 structure using STAAD Pro

After the STAAD Pro finished analysis of the structure, then we can start design part of the structure. STAAD Pro is able to design a structure of materials like Steel, Concrete, Aluminium & Timber. We were choosed Reinforces Cement Concrete for designing structure. After finishing analysis part we go to the modelling mode and select Design Tab where we assigned concrete as the material. After that we select the Design Code which is to be followed. We selected IS 456. Then we select the different members to be design such as columns, beams slabs etc. After that we enter the design parameters for the structure, otherwise STAAD can take the

design parameters as per the specified Design Code. When all the parameters and information are entered into the STAAD Pro, we carried out analysis once more to get the design values. When the analysis is completed we get the design values for the numerous members in the form of a written information. To get the complete schedule of a member we just need to click the member and we see the schedule for that member. Various Design parameters can be entered in Staad pro as per our requirement such as the cover, reinforcement grade, maximum and minimum bar size, design for torsion, eccentricity etc. If design parameters are not entered the values will be taken as default by the STAAD Pro as per the IS Code

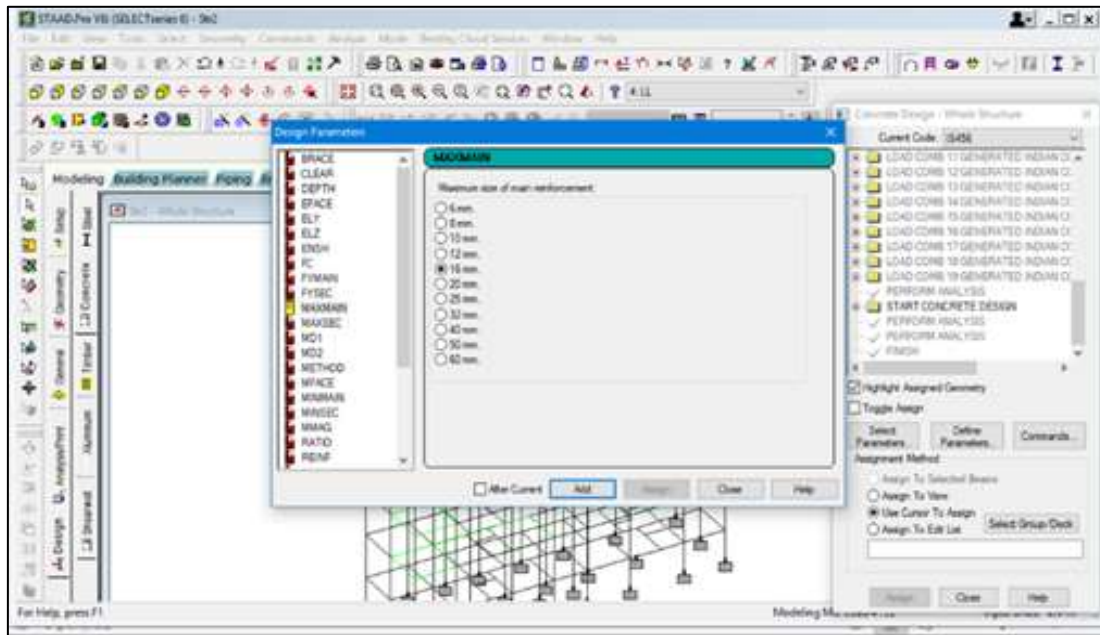


Fig. 5: Design Parameters

VI. COST ESTIMATION OF G+4 BUILDING IN MICROSOFT EXCEL

A. General

Most corporations in the construction industry are using modern business systems to control these complicated projects. Every Civil Engineering business functions uses MS Excel for execution, surveying, planning, contracts, budgeting, designing, quality control, quantity estimation.

Steps to prepare estimate:

- 1) For this project centreline method is used calculate quantity estimate. The centreline for external and internal wall were calculated separately. The no. of joints for both walls were calculated. In quantity estimation quantity of each item is calculated separately. The quantities were calculated by multiplying dimensions (length, breadth, height) by No. of items.

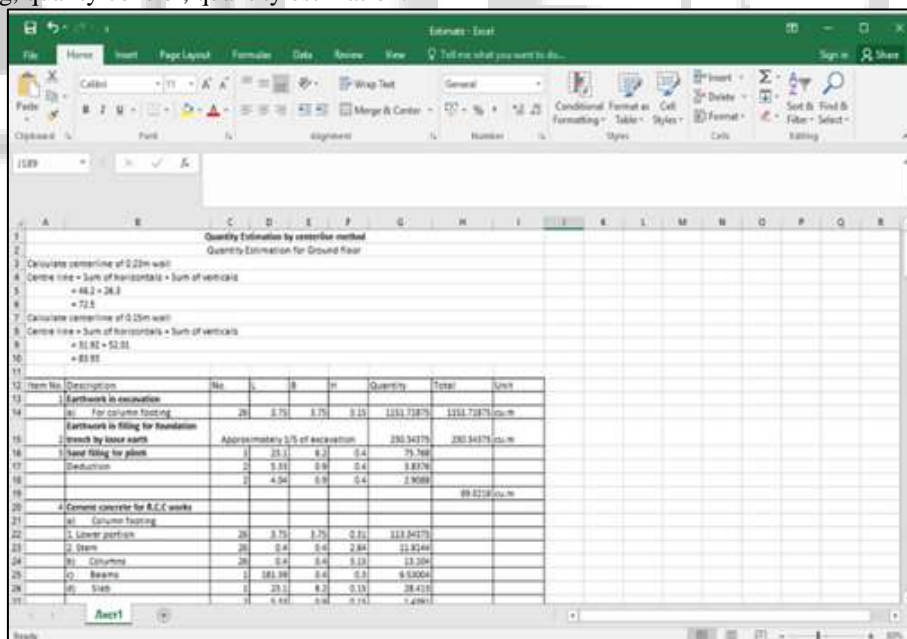


Fig. 5: Estimation in Microsoft excel

2) Prepare Abstract

The abstract of estimate contain the amount of money required for each item. The amount required for each item is calculated by multiplying No. of units to rate of each unit.

VII. PROJECT PLANNING IN MICROSOFT PROJECT

A. General

Microsoft Project permits you to schedule projects, assign tasks, manage resources, and make reports etc. In beginning the project details were entered such as begin and end date, field connected to the project. When this has been finished

the time schedule of individual activity is entered and their resources are assigned. Once this has been done numerous activities were linked together. As these things are carried out a Gantt chart is generated at same time.

B. Creation of Tasks

The procedure of creating tasks in Microsoft Project are as follows:

1) Create a task list

For preparing schedule we need to add list of required tasks. While adding the tasks, we should try to arrange them in the order they need to be completed. To get started, open Microsoft Project, click on Blank Project, and type individual task into each cell under Task Name. To enter begin and end dates, click the Start cell beside the first task and enter a date. Then click the Finish row and enter an end date.

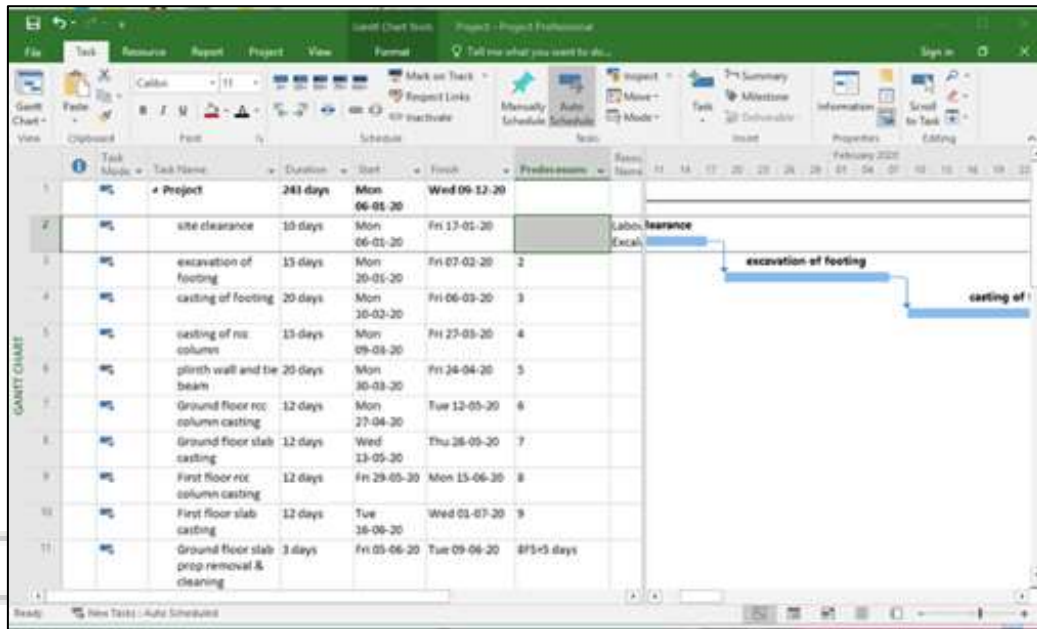


Fig. 6: Creation of task in Microsoft project

2) Set up resources in Microsoft project

From the View tab, go to Resource Sheet. The Resource Sheet will open on the screen. Type the name of the resource required in the Resource Name field and complete the other information: Type, Material (if it's a material), Initials, Max

(max amount of time), Standard Rate, Overtime, and Cost/Use. Click on in the Name section of the Task Form. Click on box under Resource Name and Select resources from the drop-down menu. Then click OK.

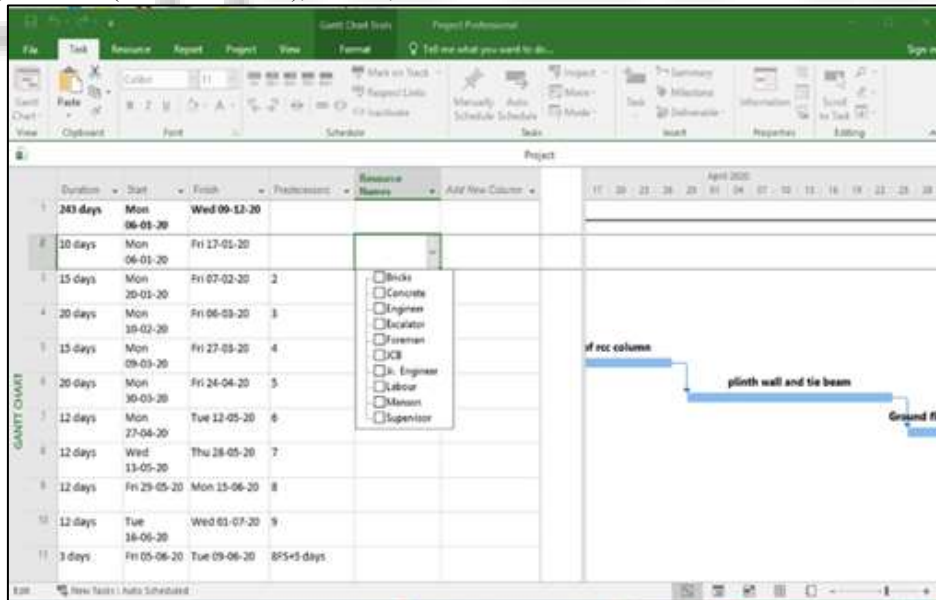


Fig. 7: Assign resources to task Microsoft project

3) Link tasks to prepare Gantt chart

Click the Task tab in the menu bar, choose the tasks in the list which required to be linked. Click the first task then press and hold the Ctrl key and select the other task. Click the chain icon in the ribbon to link the tasks. You will see an arrow

appear on the Gantt chart that connects the items. Or we Click on box under Predecessor Name and Select the predecessors.

VIII. RESULTS

A. Analysis & Design Results

1) Design of column

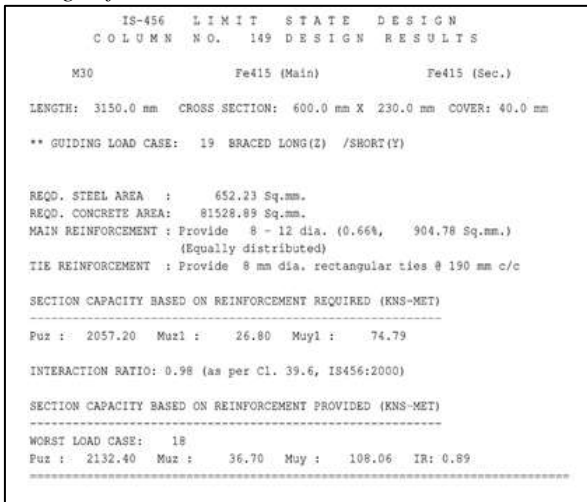


Fig. 8: Beam 149 report

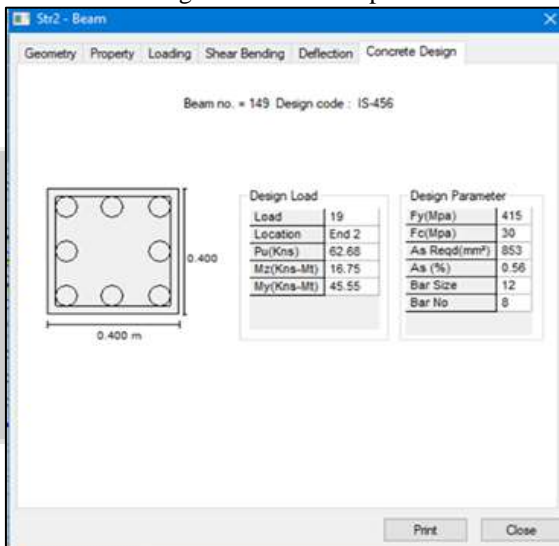


Fig. 9: Beam 149 Schedule

2) Design of Beam



Fig. 10: Beam 434 report

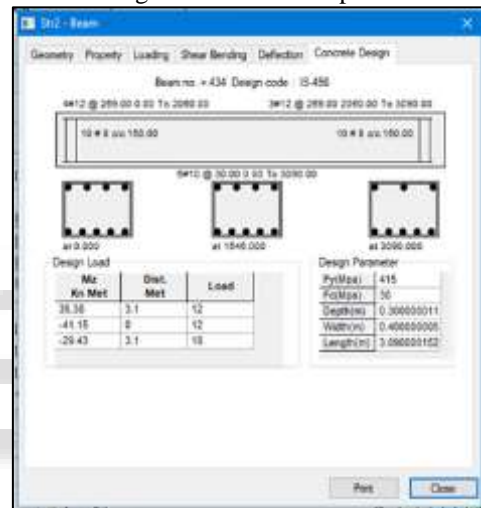


Fig. 11: Beam 434 Schedule

B. Cost Estimation of G+4 Building In Microsoft Excel

The total cost of project is Rs 2365055.21 which is calculated in Microsoft excel.

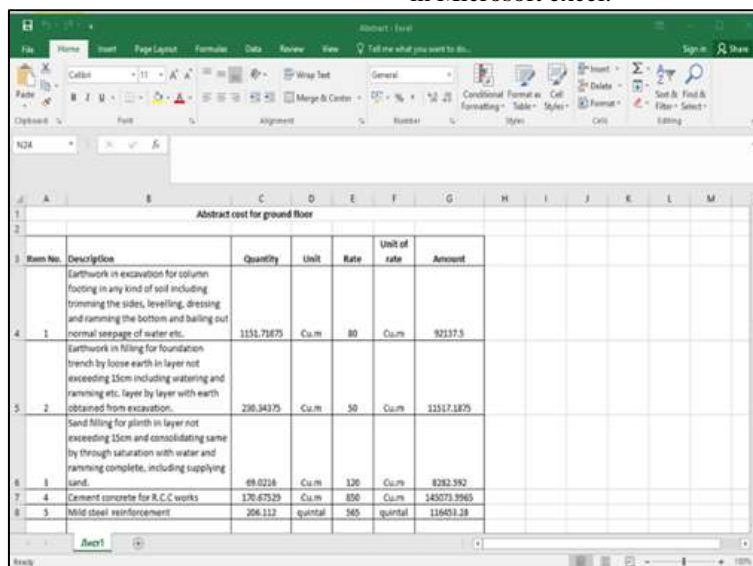


Fig. 12: Abstract in Microsoft excel

C. Project Planning of G+4 Building

The time required to complete the project is calculated by Microsoft Project is around 243days excluding holidays.

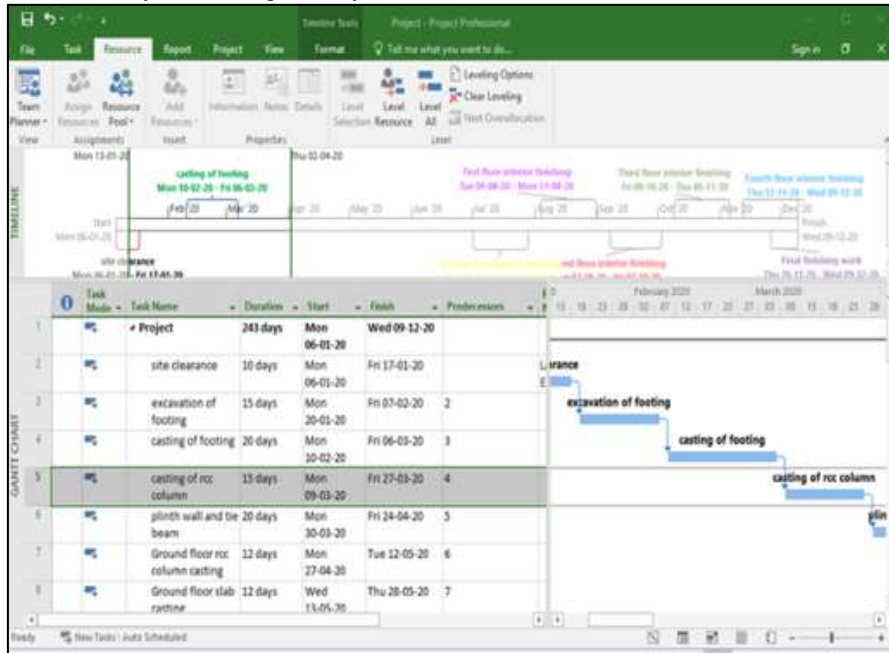


Fig. 13: Project schedule

IX. CONCLUSION

It can be concluded that modern software's makes an engineer's work easier and quicker. Currently all work is carried out by computers whether or not it be drawing, estimating, project management etc. in civil engineering field. In this project we prepared the layout, design, analysis, planning and cost estimation of a G+4 residential building. For finishing this project we used popular Civil Engineering software's such as AutoCAD, STAAD Pro, Microsoft Project and Microsoft Excel. The floor plan of the proposed G+4 residential building is based on a plot of size 30m X 15m. The each floor of building have 4 flats each have an area of 39,52sq m. Each flat is of 1BHK configuration. All the drafting work is completed by AutoCAD. This drawings made on AutoCAD also saved in DXF file to transfer the structure to STAAD Pro. The analysis of the entire structure carried out using STAAD pro. The results include the numerous forces acting on different members also various schedules for members. Microsoft project was used for planning the numerous activities related to construction of a building. The time required to complete the project is calculated by Microsoft Project is around 243days excluding holidays. The cost estimation of the project was carried out by Centre Line Method in Microsoft Excel. For the calculating Abstract cost PWD Schedule of rates was used and the total cost of project is Rs 2365055.21 which is calculated in Microsoft excel.

REFERENCES

- [1] IS 456 2000
- [2] STAAD Pro User Manual
- [3] <http://en.wikipedia.org/wiki/AutoCAD>
- [4] <http://en.wikipedia.org/wiki/STAAD>

- [5] http://en.wikipedia.org/wiki/Microsoft_Project
- [6] International Journal of Advanced Engineering Technology E-ISSN 0976-3945 IJAET/Vol.III/ Issue IV/Oct.-Dec., 2012/104-106
- [7] Research Paper "Earthquake analysis and design vs non earthquake analysis and design using STAAD Pro" ByB. Suresh, P.M.B Raj kiran Nanduri
- [8] Estimating, Costing, Specifications & Valuations in Civil Engineering By Monojit Chakraborti (Book)