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"PROJECT MANAGEMENT FOR CONSTRUCTION OF RESIDENTIAL BUILDING"

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Abstract - *Any construction project to begin which starts with the layout of the building or structure followed by the design and analysis of the structure which is succeeded by the cost of estimation and planning for the project. This project involves the planning, design, analysis, scheduling, 3D modeling and also the cost estimation and as well as the labour and material management of (G+1) Residential building located at malini nagar kanbargi road belagavi.*

The layout of a proposed (G+1) residential building is based on plot size 30'x50'. The ground floor having a built up area of 850sq.ft. The first floor having built up area of 934.5sq.ft. The requirement of client was 4BHK duplex house. All the drafting is being done use AutoCAD. Also the drawings made on AutoCAD also served as a base for transfer of the structure for analysis and design in ETABS. The scheduling was carried out by using Microsoft project.

The analysis and design of the entire structure has been completed using ETABS. The results include the various forces acting on various members as well various schedules for various members. The 3D model of the building carried out using 3DS max. The cost estimate for the project has been calculated. A parametric study of G+1 residential building is carried out using ETABS Software.

***Key Words*: Planning, Designing, Labour management, Material management, Scheduling, Estimation.**

1. INTRODUCTION

Building construction is an ancient human activity. It began with the purely functional need for a controlled environment to moderate the effects of climate. Constructed shelters were one means by which human beings were able to adapt themselves to a wide variety of climates and become a global species.

The engineer has to keep in mind the municipal conditions, building bylaws, environment, financial capacity, water supply, electrical connectivity, sewage arrangement, provision of future aeration, ventilation etc. in suggestion a particular type of plan to any client.

The aim of the project is to plan with elevation and section which includes all the details of proposed building as well as its full estimation. The design will be done as per the limit state method as per recommended IS 456-2000. This gives as a complete study to build a residential building and complete design like design of footing, columns, beams, slabs etc. After designing those components we will estimate the approximate cost of proposed building.

1.1 Objectives

1. To plan as per the client requirement.
2. To design the RCC structures using suitable software's as well as comparing the results by manual calculations.
3. To understand the basic knowledge about the material management and labour management.
4. To understand the basic difference between the theoretical part and the practical work.
5. To estimate the approximate quantity for the construction of a residential building G+1.

1.2 Methodology

1. Planning: planning as per the client requirements and drafting the same using AUTOCAD software. Planning is done keeping in mind the basic requirements of humans like water supply, electrical connectivity, sewage etc.
2. Estimation: estimating the quantity required for the construction of building using excel sheets. Estimating the time and resources required for the completion of project using Microsoft project software.
3. Designing: Designing the RCC structures using ETABS/STAAD PRO software. Designing the elevation of building using 3DS Max.
4. Execution: executing as per the plan and designs on the site.

2. PLANNING

The planning is done as per the building by laws rules and regulations. The general rules are as follows,

1. The front and rear setbacks shall be with reference to the depth of site.
2. Left and right setbacks shall be with reference to width of the site.
3. When the building lines are fixed, the front setback or the building line whichever is higher shall be applicable.
4. In case of corner sites both the sides facing the road shall be treated as front side and regulations applied accordingly.
5. Setback should be provided in the owners plot, public space or conservancy lanes adjoining the plot should not be considered as setback etc.
6. The maximum floor area ratio for G+1 residential building should be 1.25.
7. The minimum width of corridor for residential building should be 1 m.

Some helpful points regarding the orientation of a building are as follows:

1. Long wall of the building should face north south, short wall should face East and west because if the long walls are provided in east facing, the wall. Absorb more heat of sun which causes discomfort during night.
2. A verandah or balcony can be provided towards east and west to keep rooms cool.

2.1 SITE DETAILS.

1. Size of the plan : 30’ x 50’
2. Location of site: Malini nagar kanbargi road Belgaum.
3. Requirements of client : 2bhk duplex house
4. Facing of the site : North facing
5. No of storey : G+1
6. Ground floor built up area : 850 sq.ft
7. First floor built up area : 934.15 sq.ft
8. Porch area : 152 sq.ft
9. Storey height : 3 meters
10. FAR – 1.18 < 1.25

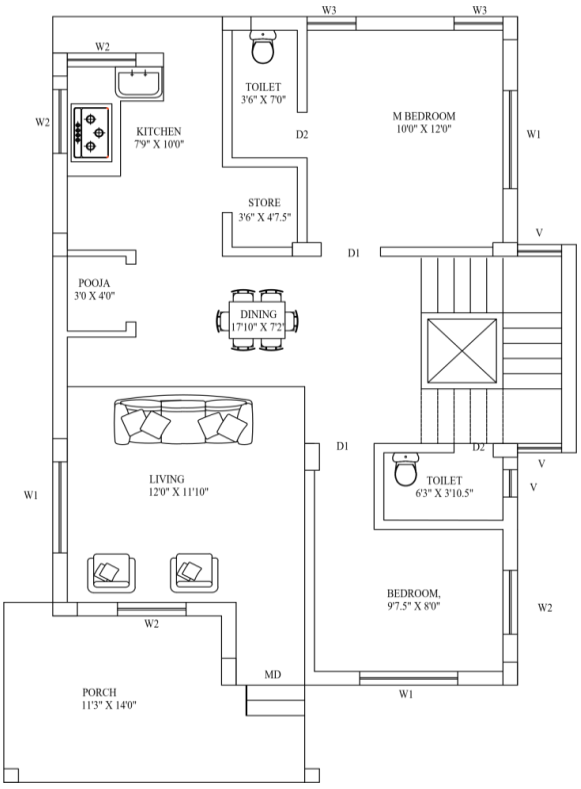


Figure 1: Ground floor plan

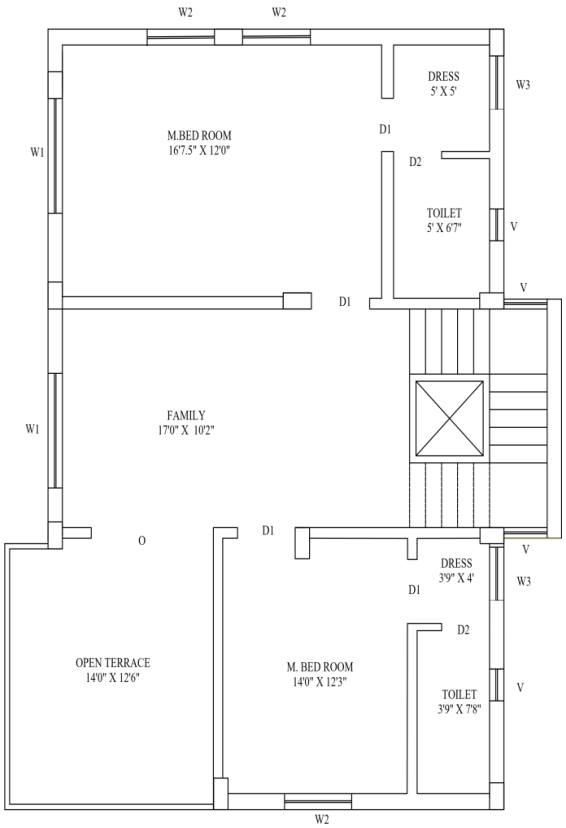


Figure 2: First floor plan

3. MODELING AND DESIGN OF STRUCTURE

The above 2d plan is developed in ETAB software for furthur design process. The Fig3. Shows the general floor plan of the building. Fig 4 shows the 3D view of the plan.

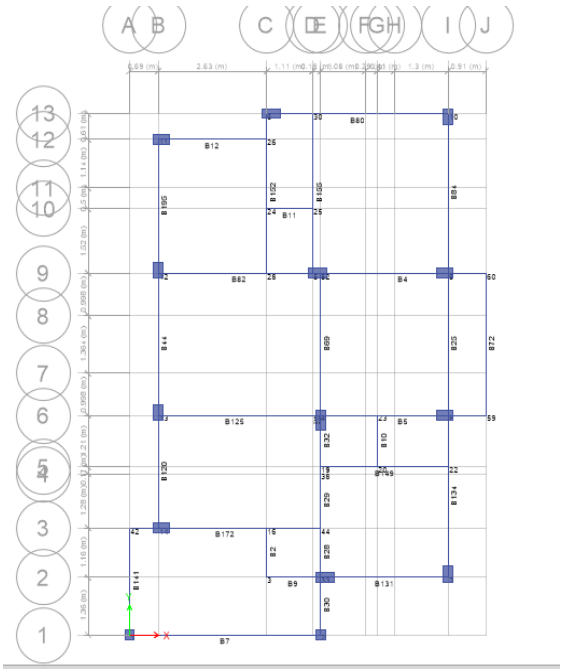


Figure 3: General floor plan in ETABS

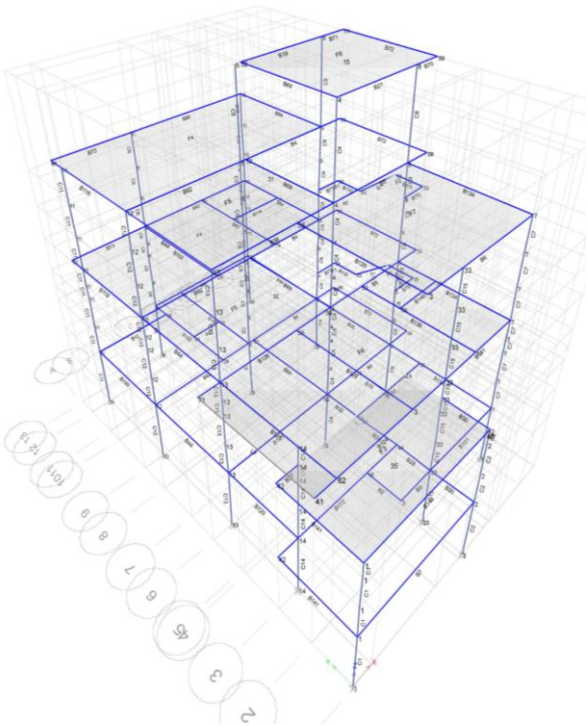


Figure 4: 3D view in ETABS

Table 1: Material Properties

Concrete Properties	
Grade of concrete	M25
Modulus of elasticity	22360.68MPa
Density of concrete	25KN/m^3
Poisson's ratio	0.2
Reinforcement Properties	
Grade of steel	Fe500
Modulus of elasticity	200000Mpa
Poisson's ratio	0.3
Masonry properties	
Density of brick wall including plaster	20KN/m^3
Poisson's ratio	0.2
Steel Properties	
Grade of steel	Fe250
Modulus of elasticity	210000MPa
Poisson's ratio	0.3

Table 2: Gravity Loads on Structure

Live Load	
Floor	3KN/m^2
Roof	3KN/m^2
Dead Load	
Masonry wall load	13KN/m

Table 3: RCC Parameters

Column Parameters	
C1 & C2	230X230
C4,C5,C6,C8,C9,C11,C12,C14	230X380
C3,C7,C10,C13,	230X450
Plinth Beam Parameters	
PB1,PB2,PB4,PB5,PB18	230X300
PB3,PB10-17,PB19-26	230X380
PB6-9,PB11	230X450
Beam Parameters	
B5,B10,B13,B20	230x300
B1,B2,B4,B7,B9,B11,B12,B14-B19,B21	230x380
B3,B6,B8	230x450

3.1 ANALYSIS AND DESIGN RESULTS

The below fig 5 and fig 6 tells about the maximum bending moment in 3-3 direction and shear force applied in 2-2 direction after analyzing the model.

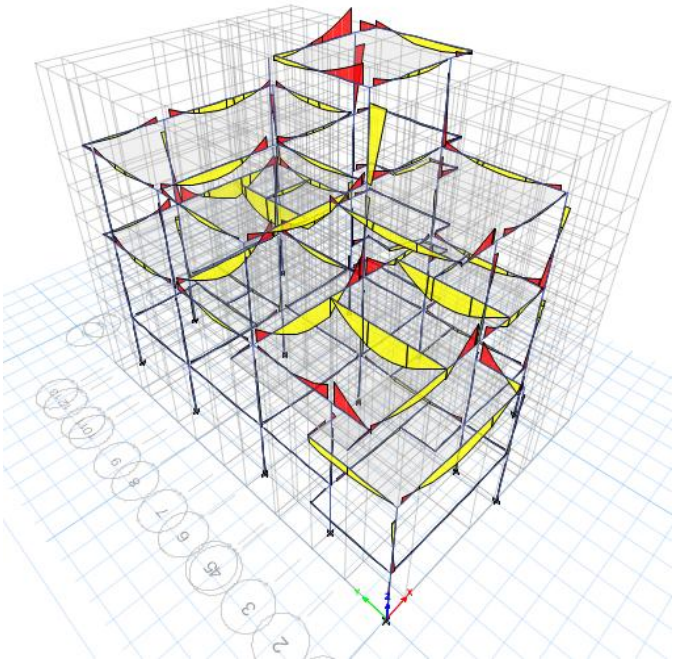


Figure 5: Bending Moment Diagram in 3-3 Direction

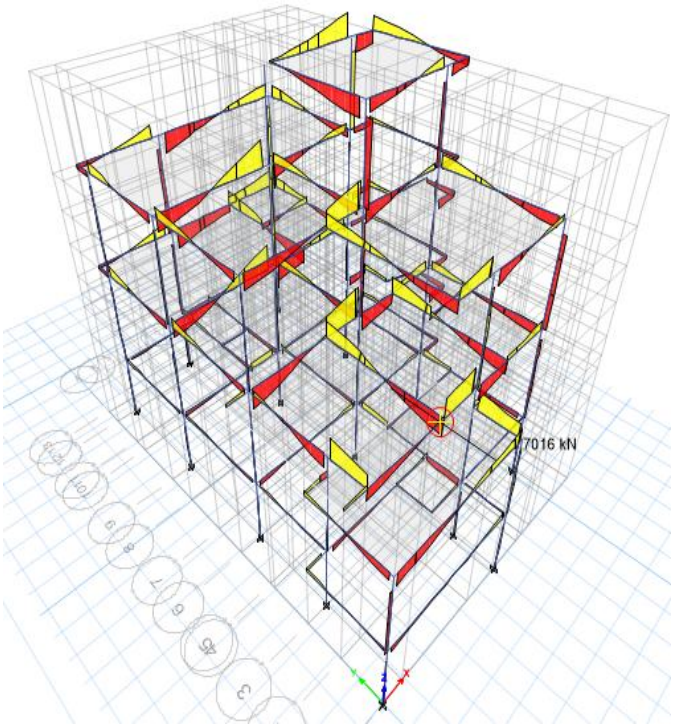


Figure 6: Shear Force Diagram in 2-2 Direction

The below figure 7 shows the plan results after analyzing it by applying certain load cases and combinations. The pink color indicates the safe results of the column.

The figure 8 showing the 3D view of the plan along with the percentage longitudinal reinforcement required.

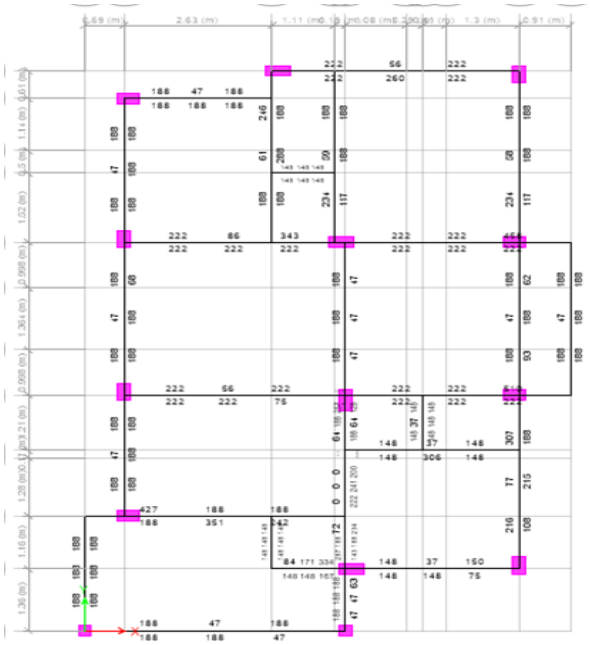


Figure 7: Showing the reinforcement details

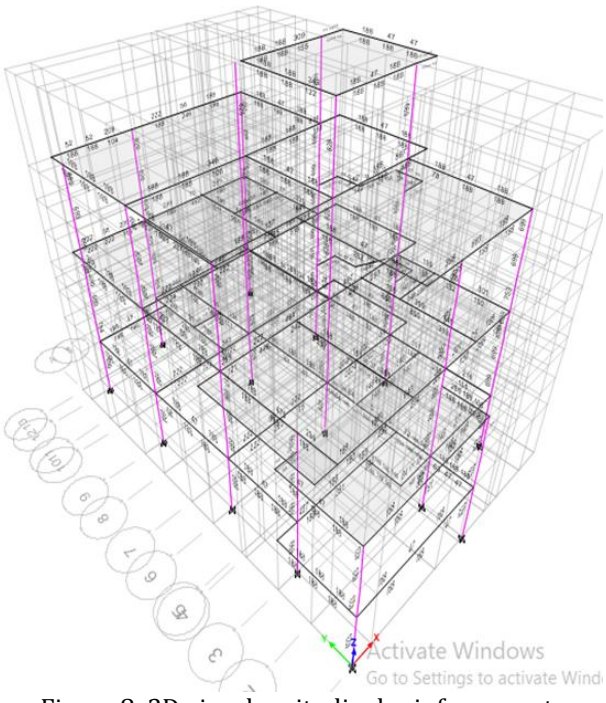


Figure 8: 3D view longitudinal reinforcement

3.2 DESIGN DETAILS

The given plan is modeled in ETABS and analyzed it and designing is been carried out for the given parameters using ETABS software. The design results obtained are as follows.

Table 4: Schedule of Column Reinforcement

COLUMN NO.	COLUMN SIZE	COLUMN REINFORCEMENT NO # DIA.	STIRRUPS NOMINAL	LINK TYPES
C1,C2	230X230	4 # 12	8 @ 180 C/C	TYPE-1
C3,C10,C13	230X450	6 # 16	8 @ 100 C/C	TYPE-1
C4,C5,C6,C8,C9,C11, C12,C14	230X380	4 # 16 + 2 # 12	8 @ 100 C/C	TYPE-1
C7	230X450	8 # 16	8 @ 100 C/C	TYPE-2

Table 5: Schedule of Beams at Porch Level

SCHEDULE OF BEAMS AT PORCH LEVEL							
BEAM NO.	SIZE	BOTTOM STEEL		TOP STEEL		STIRRUPS(2 LEGGED)	
		STRAIGHT	EXTRA	STRAIGHT	EXTRA	DIA	OVERALL
B1	230 X 380	2 # 12	-	2 # 12		8	100
B2	230 X 380	2 # 12	-	2 # 12		8	150
B3	231 X 380	2 # 12	-	2 # 12		8	150
B4	232 X 380	2 # 12	-	3 # 12		8	150

Table 6: Schedule of Beams at Plinth Level

SCHEDULE OF BEAMS AT PLINTH LEVEL							
BEAM NO	SIZE	BOTTOM STEEL		TOP STEEL		STIRRUPS(2 LEGGED)	
		STRAIGHT	EXTRA	STRAIGHT	EXTRA	DIA	OVERALL
B1	230 X 380	2 # 12	-	2 # 12	-	8	150
B2	230 X 300	3 # 12	-	2 # 12	-	8	150
B3	230 X 300	2 # 12	-	2 # 12	-	8	150
B4	200 X 380	3 # 12	-	2 # 12	2 # 12	8	150
B5	200 X 300	3 # 12	-	2 # 12	-	8	150
B6	230 X 450	2 # 12	-	2 # 12	-	8	100
B7	200 X 450	2 # 12	-	3 # 16	-	8	100
B8	200 X 450	2 # 12	-	2 # 12	1 #12	8	100
B9	230 X 450	3 # 12	-	3 # 16	-	8	100
B10	230 X 380	2 # 12	-	2 # 12	-	8	150
B11	230 X 450	3 # 12	-	2 # 12	-	8	100
B12	200 X 300	2 # 12	-	2 # 12	-	8	150
B13	230 X 380	2 # 12	-	2 # 12	-	8	150
B14	230 X 380	2 # 12	-	2 # 12	-	8	150
B15	230 X 300	2 # 12	-	2 # 12	-	8	150
B16	230 X 380	3 # 12	-	3 # 12	-	8	100
B17	200 X 380	2 # 12	-	3 # 12	-	8	100
B18	230 X 380	2 # 12	-	2 # 12	-	8	100
B19	230 X 300	2 # 12	-	2 # 12	-	8	150
B20	230 X 380	2 # 12	-	2 # 12	-	8	150
B21	230 X 380	2 # 12	-	2 # 12	-	8	150
B22	230 X 380	2 # 12	-	2 # 12	-	8	150
B23	230 X 380	2 # 12	-	2 # 12	-	8	150
B24	230 X 380	3 # 12	-	3 # 12	-	8	100
B25	230 X 380	2 # 12	-	2 # 12	-	8	150
B26	230 X 380	2 # 12	-	2 # 12	-	8	150

Table 7: Schedule of Beams at First Floor Level

SCHEDULE OF BEAMS AT FIRST FLOOR LEVEL							
BEAM NO	SIZE	BOTTOM STEEL		TOP STEEL		STIRRUPS(2 LEGGED)	
		STRAIGHT	EXTRA	STRAIGHT	EXTRA	DIA	OVERALL
B1	230 X 380	2 # 16	-	3 # 16	-	8	100
B2	230 X 380	3 # 12	-	3 # 12	-	8	100
B3	230 X 450	3 # 16	-	3 # 16	-	8	100
B4	230 X 380	3 # 12	-	3 # 16	-	8	100
B5	230 X 300	2 # 12	-	2 # 12	-	8	100
B6	230 X 450	3 # 16	-	4 # 16	-	8	100
B7	230 X 380	3 # 12	-	3 # 16	-	8	100
B8	230 X 450	2 # 12	-	2 # 12	-	8	100
B9	230 X 380	4 # 12	-	3 # 12	-	8	150
B10	230 X 300	2 # 12	-	2 # 12	-	8	150
B11	230 X 380	2 # 12	-	3 # 16	-	8	100
B12	230 X 380	4 # 16	-	2 # 12	-	8	100
B13	230 X 300	3 # 16	-	3 # 12	-	8	100
B14	230 X 380	3 # 12	-	3 # 12	-	8	100
B15	230 X 380	3 # 12	-	3 # 12	-	8	150
B16	230 X 380	2 # 12	-	2 # 12	-	8	150
B17	230 X 380	2 # 12	-	2 # 12	-	8	150
B18	230 X 380	2 # 12	-	3 # 12	-	8	150
B19	230 X 380	3 # 12	-	3 # 12	-	8	150
B20	230 X 300	4 # 16	-	4 # 12	-	8	100
B21	230 X 380	3 # 12	-	3 # 12	-	8	150

Table 8: Schedule of Beams at Terrace Floor Level

SCHEDULE OF BEAMS AT TERRACE FLOOR LEVEL							
BEAM NO.	SIZE	BOTTOM STEEL		TOP STEEL		STIRRUPS(2 LEGGED)	
		STRAIGHT	EXTRA	STRAIGHT	EXTRA	DIA	ELSEWHERE
B1	230 X 380	2 # 12	-	3 # 16	-	8	100
B2	230 X 380	2 # 16	-	3 # 16	-	8	100
B3	230 X 380	2 # 12	-	3 # 16	-	8	100
B4	230 X 380	3 # 12	-	3 # 12	-	8	100
B5	230 X 380	2 # 12	-	3 # 16	-	8	100
B6	230 X 380	2 # 12	-	2 # 12	-	8	150
B7	230 X 380	2 # 12	-	2 # 12	-	8	150
B8	230 X 380	2 # 12	-	2 # 12	-	8	150
B9	230 X 380	2 # 12	-	2 # 12	-	8	150
B10	231 X 380	2 # 12	-	2 # 12	-	8	150
B11	232 X 380	2 # 12	-	2 # 12	-	8	150
B12	233 X 380	2 # 12	-	2 # 12	-	8	150
B13	234 X 380	2 # 12	-	2 # 12	-	8	150
B14	235 X 380	2 # 12	-	2 # 12	-	8	150

Table 9: Schedule of Beams at Headroom Level

SCHEDULE OF BEAMS AT HEADROOM LEVEL							
BEAM NO.	SIZE	BOTTOM STEEL		TOP STEEL		STIRRUPS(2 LEGGED)	
		STRAIGHT	EXTRA	STRAIGHT	EXTRA	DIA	OVERALL
B1	230 X 380	2 # 12	-	2 # 12		8	150
B2	230 X 380	2 # 12	-	2 # 12		8	150
B3	231 X 380	2 # 12	-	4 # 12		8	150
B4	232 X 380	2 # 12	-	2 # 12		8	150

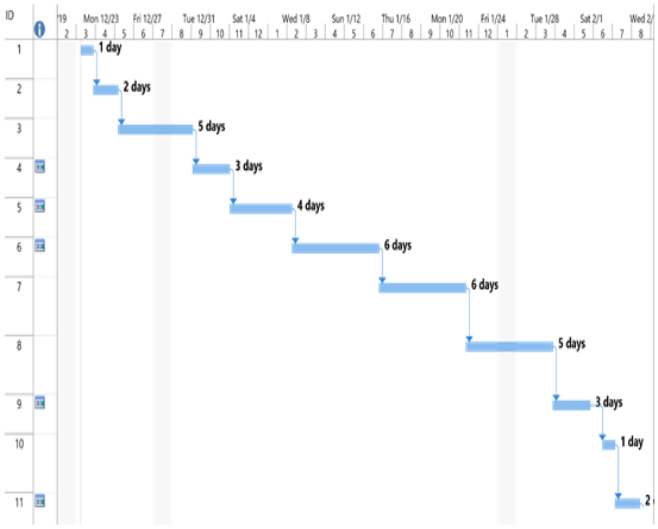
4. SCHEDULING

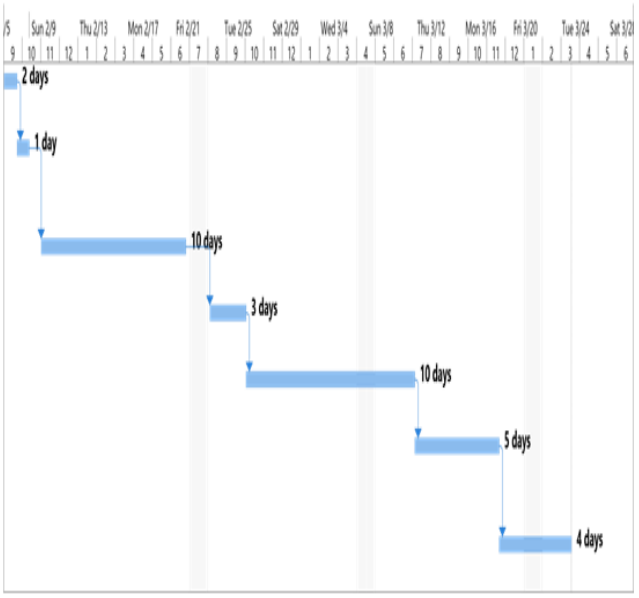
The project scheduling is done using Microsoft project software for labour management as well as for material management.

The total working days estimated is 72 days for the completion of the project. The critical works observed during the scheduling are pile diving, bar bending and concreting of pile cap, brickwork upto sill level, brick work upto slab level, staircase bar bending and concreting etc. The below table 10 shows the total duration of each work to be carried out.

Table 10: Constrains and Recurring Task

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		Site visit	1 day	Mon 12/23/19	Mon 12/23/19	
2		Line out	2 days	Tue 12/24/19	Wed 12/25/19	1
3		Pile Drilling	5 days	Thu 12/26/19	Tue 12/31/19	2
4		Bar bending	3 days	Wed 1/1/20	Fri 1/3/20	3
5		Concreting and laying of Pile	4 days	Sat 1/4/20	Wed 1/8/20	4
6		Excavation of Pile cap	6 days	Thu 1/9/20	Wed 1/15/20	5
7		Bar Bending and Concreting of Pile cap	6 days	Thu 1/16/20	Wed 1/22/20	6
8		Plinth beam bar bending and Concreting	5 days	Thu 1/23/20	Wed 1/29/20	7
9		Filling of Plinth level	3 days	Thu 1/30/20	Sat 2/1/20	8
10		Marking of compound wall columns	1 day	Mon 2/3/20	Mon 2/3/20	9
12		Placing of columns	2 days	Thu 2/6/20	Fri 2/7/20	11
13		Concreting of compound wall columns	1 day	Sat 2/8/20	Sat 2/8/20	12
14		Brickwork masonry upto sill level	10 days	Mon 2/10/20	Fri 2/21/20	13
15		Sill work	3 days	Mon 2/24/20	Wed 2/26/20	14





5. ESTIMATION

The approximate cost estimated for the construction of residential building G+1 is 28 lakhs (4BHK Duplex House).

The rates of various items of work and materials for the estimation of building are referred from the rate analysis of local authorities.

6. MODELING

The 3D modeling of the plan is carried out using 3D's max software to have clear vision of the building which is to be constructed. The below fig 7 shows the 3D view of the structure.

Figure 9: Model Developed in 3D's max

7. CONCLUSIONS

1. ETABS gives hardly any variation in results compared to the results computed manually.
2. ETABS is a much easier and faster way of analysing and designing a structure when compared to manual computation
3. 3DS max Visualize high-quality architectural renderings and Bring characters and features to life with animation and VFX.
4. Scheduling using Microsoft project Software gives good controlling and clear schedule to a project.
5. 3DS max Produce high-quality renders, faster and Accelerate manual steps to boost productivity.

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