K.S. School of Engineering & Management

15, Mallasandra, Off Kanakapura Road
Bangalore 560109

Department of Civil Engineering

VI Semester

Software Application Lab

(Code: BCVL606)

Academic Year: 2024-25

Laboratory Manual/Observation Book

Name of the Student :

University Seat No :

K S SCHOOL OF ENGINEERING AND MANAGEMENT

Holiday Village Road, Vajarahalli Village, Mallasandra, off, Kanakapura Rd,
Bengaluru, Karnataka 560109

VISION

To impart quality education in engineering and management to meet technological business and societal needs through holistic education and research.

MISSION

K. S. School of Engineering and Management shall,

- Establish state-of-art infrastructure to facilitate effective dissemination of technical and managerial knowledge.
- Provide comprehensive educational experience through a combination of curricular and experiential learning, strengthened by industry-institute interaction.
- Pursue socially relevant research and disseminate knowledge.
- Inculcate leadership skills and foster entrepreneurial spirit among students.

DEPARTMENT OF CIVIL ENGINEERING

VISION

- To emerge as one of the leading Civil Engineering Department by producing competent and quality ethical engineers with strong foot hold in the areas of Infrastructure development and research.

MISSION

- Provide industry oriented academic training with strong fundamentals and applied skills.
- Engage in research activities in Civil Engineering and allied fields and inculcate the desired perception and value system in the students.

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CONTENT PAGE

Experiment -01 : Analysis of plane trusses, continuous beams using software

Step-by-Step Guide to Generate SFD and BMD in ETABS

Step 1: Create a New Model

1. Open ETABS and create a new model.
2. Define the grid system and story levels (if needed).
3. Set up the material properties (e.g., concrete or steel).
    - Go to Define > Material Properties to create or select materials.

Step 2: Define Beam Section

1. Define the beam section properties.
    - Go to Define > Section Properties > Frame Sections.
    - Select or create a beam cross-section (e.g., rectangular or I-section).

Step 3: Draw the Beam

1. Use the Quick Draw Frame Element tool or Draw Line Objects tool to draw the beam.
    - Place nodes at the desired locations and connect them using beam elements.

Step 4: Assign Supports

1. Assign support conditions to the beam.
    - Go to Assign > Joint > Restraints.
    - Apply pinned or fixed supports to the ends of the beam, depending on your analysis requirement.

Step 5: Apply Loads

1. Apply loads to the beam:
    - Point Loads: Go to Assign > Frame Loads > Point Loads.
    - Uniform Distributed Loads (UDL): Go to Assign > Frame Loads > Distributed.
2. Define load cases:
    - Go to Define > Load Cases and add load cases like Dead Load, Live Load, etc.

Step 6: Run Analysis

1. Click Run Analysis (play button on the toolbar).

- ETABS will calculate the internal forces, deflections, and reactions.

Step 7: View Results (SFD and BMD)

1. After the analysis is complete, go to the Display menu.
    - Click Display > Force / Stress Diagrams > Frames/Cables.
2. In the dialog box:
    - Select the load case (e.g., Dead Load, Live Load, or a combination).
    - Choose the type of force diagram:
        - Shear 2-2 for Shear Force Diagram (SFD).
        - Moment 3-3 for Bending Moment Diagram (BMD).
3. The shear force and bending moment diagrams will be displayed graphically on the beam. You can toggle between different diagrams using the options in the dialog box.

Step 8: Export Results

1. To save or export the diagrams:
    - Use the File > Print Graphics option to take a screenshot of the diagrams.
    - Alternatively, use the Snipping Tool (Windows) or another screenshot tool to capture the diagrams directly.
    -

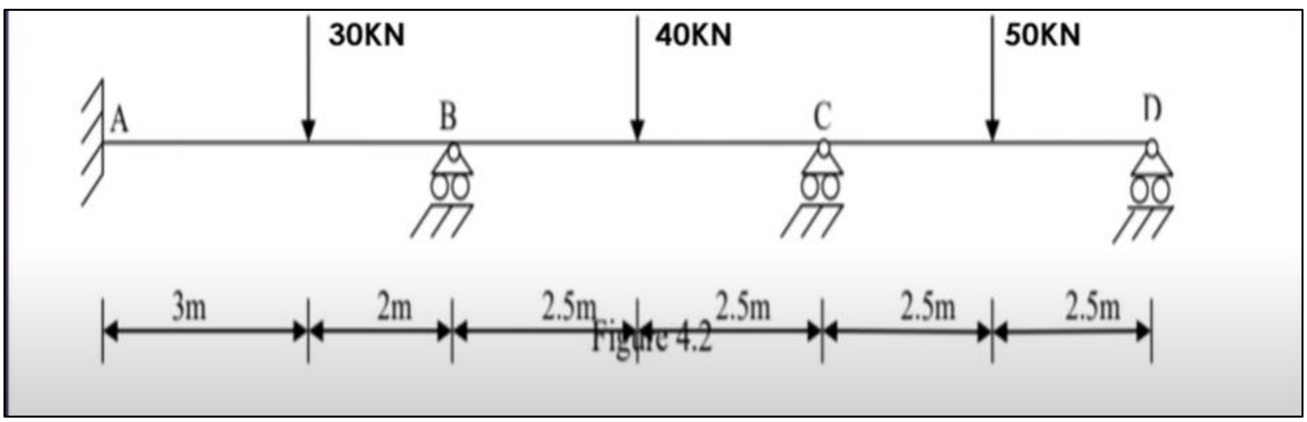


Figure 1 : Beam Loading

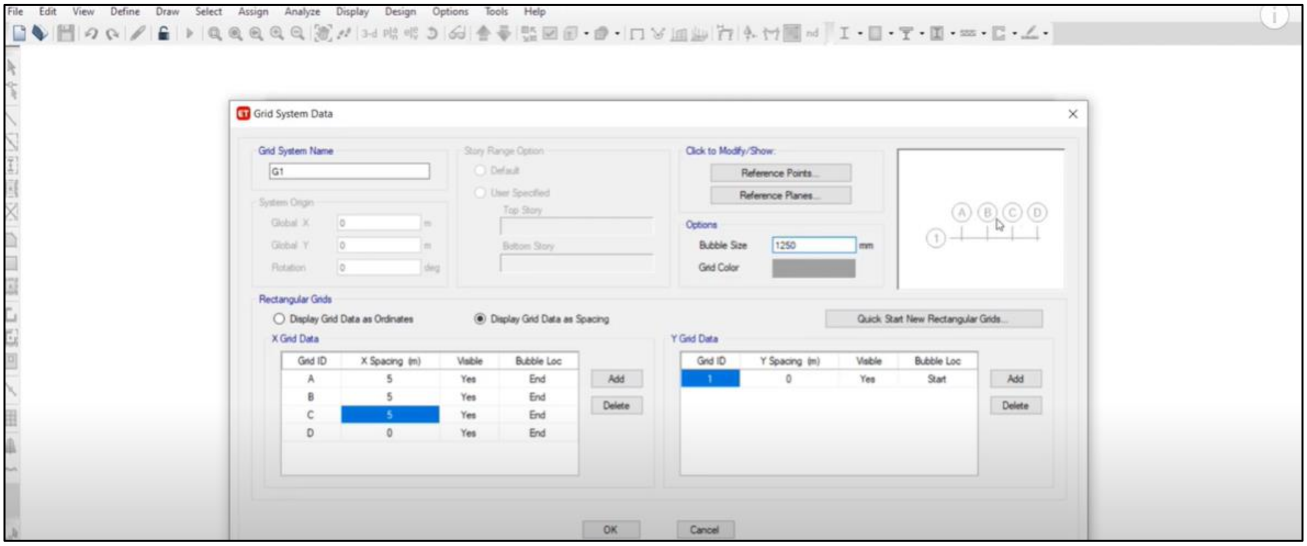


Figure 2: Grid Formation

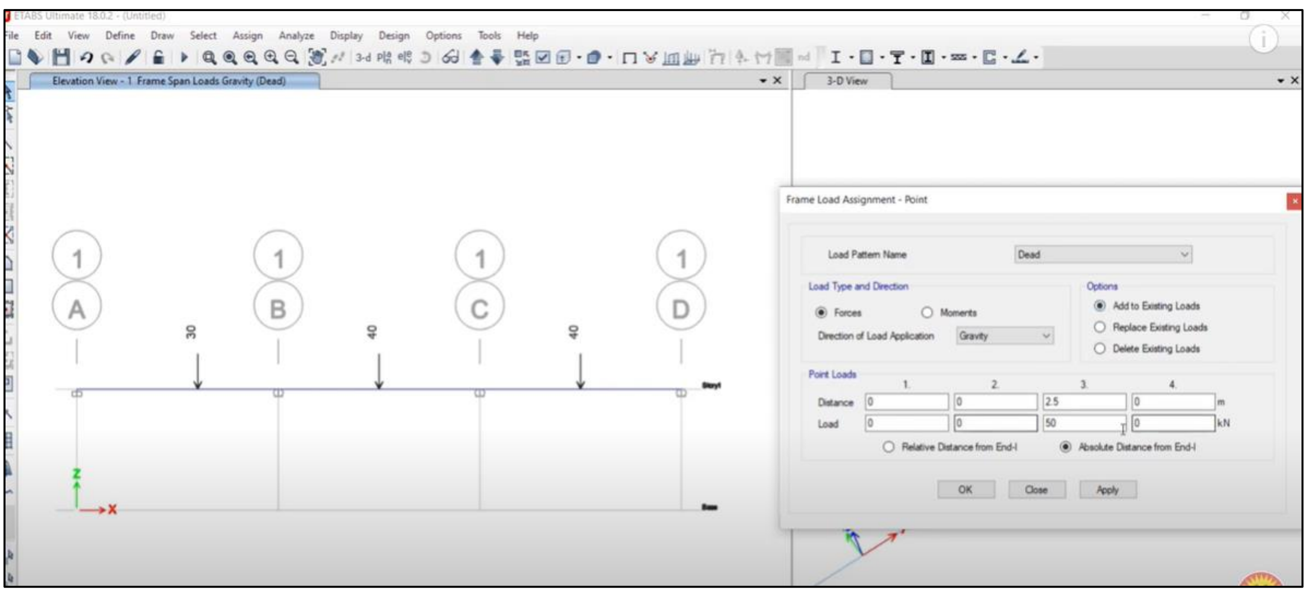


Figure 3: Loading Details

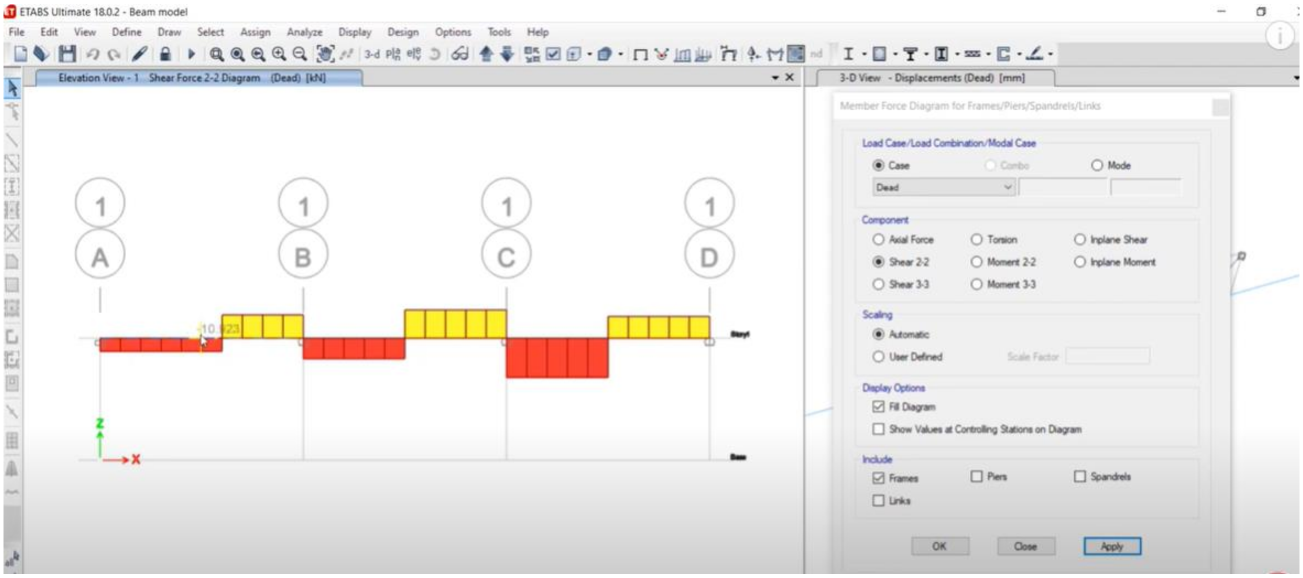


Figure 4: SFD and BMD

Experiment -02 : Analysis of portal frames using software

Step 1: Create a New Model

1. Open ETABS and select File → New Model.
2. Define the grid and story data:
    - You can set up a 2D frame grid for the portal frame geometry.
    - Specify the number of bays, spacing, and elevations.

Step 2: Define Material Properties

1. Go to Define → Material Properties and define materials for the portal frame members:
    - For steel portal frames, input properties such as modulus of elasticity, density, and yield strength.
    - For concrete portal frames, define compressive strength and other relevant properties.

Step 3: Define Section Properties

1. Go to Define → Section Properties → Frame Sections.
    - Define the beam and column sections (e.g., I-sections, rectangular sections, or custom sections).
    - Assign appropriate dimensions based on the design requirements.

Step 4: Draw the Portal Frame

1. Use the Draw Line Objects tool to model the portal frame geometry:
    - Draw vertical columns and connect them with horizontal/angled beams.
    - Include any bracing or secondary members if necessary.

Step 5: Assign Supports

1. Assign boundary conditions to the base of the columns:
    - Go to Assign → Joint → Restraints and select fixed or pinned supports depending on the structural design.

Step 6: Apply Loads

1. Define load patterns:
    - Go to Define → Load Patterns and create load cases such as Dead Load, Live Load, Wind Load, etc.

2. Apply loads to the portal frame:
    - Point Loads: Go to Assign → Frame Loads → Point Loads for concentrated loads.
    - Uniform Distributed Loads (UDL): Go to Assign → Frame Loads → Distributed for loads such as roof or wall cladding.
    - Wind Loads: Define lateral wind loads and apply them to the frame.

Step 7: Define Load Combinations

1. Go to Define → Load Combinations and create combinations such as:
    - Dead Load + Live Load.
    - Dead Load + Wind Load.
    - Custom combinations based on design codes.

Step 8: Run Analysis

1. Click the Run Analysis button (play icon on the toolbar).
    - ETABS will compute the internal forces, deflections, reactions, and other results.

Step 9: View Results

1. After the analysis is complete, you can view graphical and numerical results:
    - Deformed Shape: Go to Display → Show Deformed Shape to see the frame's behavior under loads.
    - Force Diagrams: Go to Display → Force/Stress Diagrams → Frames/Cables to view bending moment, shear force, and axial force diagrams.
    - Displacements: Check nodal displacements to ensure the frame's serviceability.

Step 10: Design and Optimization

1. Use the ETABS design module to check if the portal frame meets the design code requirements.
    - For steel frames, ETABS can design sections based on codes like AISC.
    - For concrete frames, it can perform reinforcement detailing as per codes like ACI.

Step 11: Export Results

1. Generate reports:
    - Go to File → Print Tables to export detailed analysis results.

- Use File → Print Graphics to save visual outputs like force diagrams and deformed shapes.

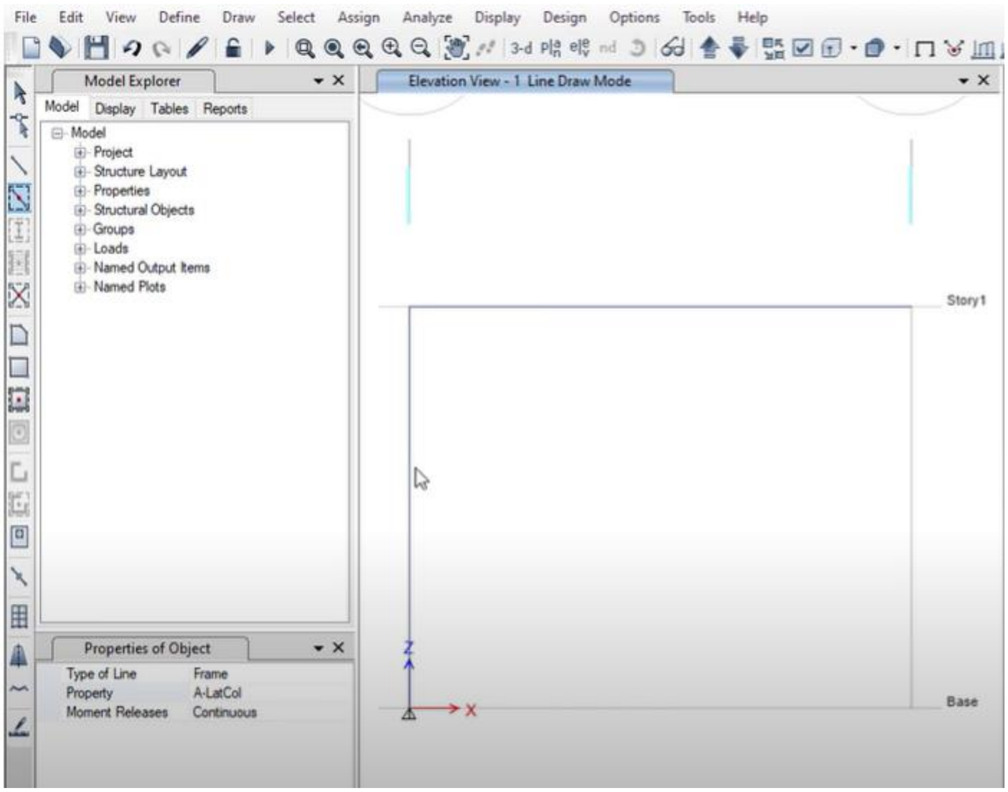


Figure 5 : Portal Frame

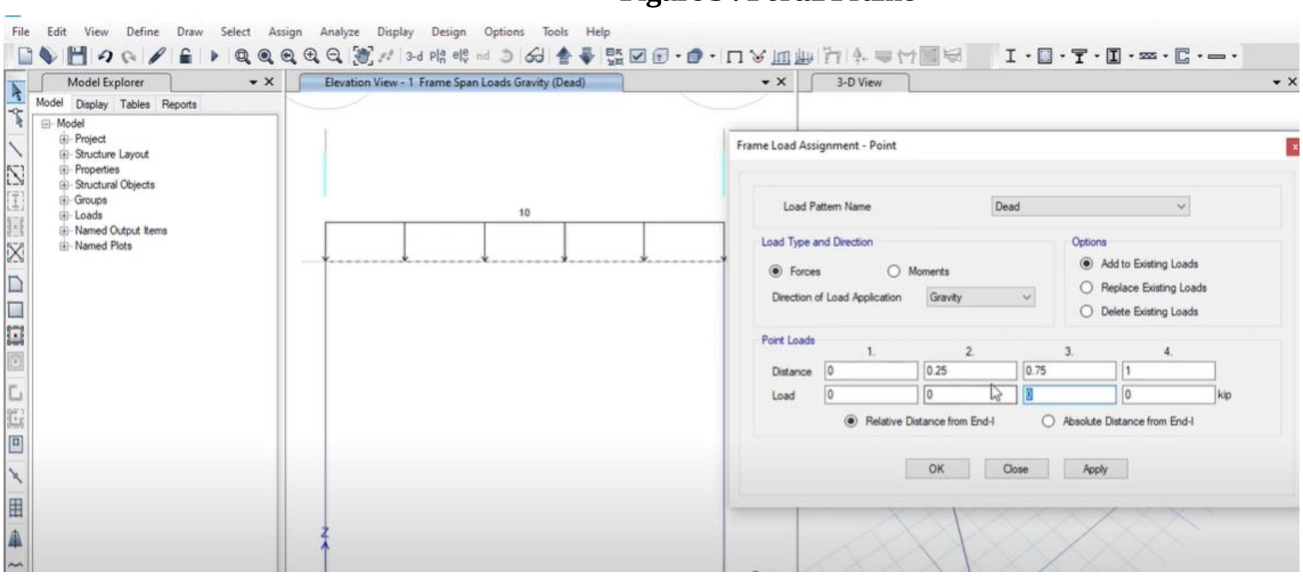


Figure 6 : Loading Condition

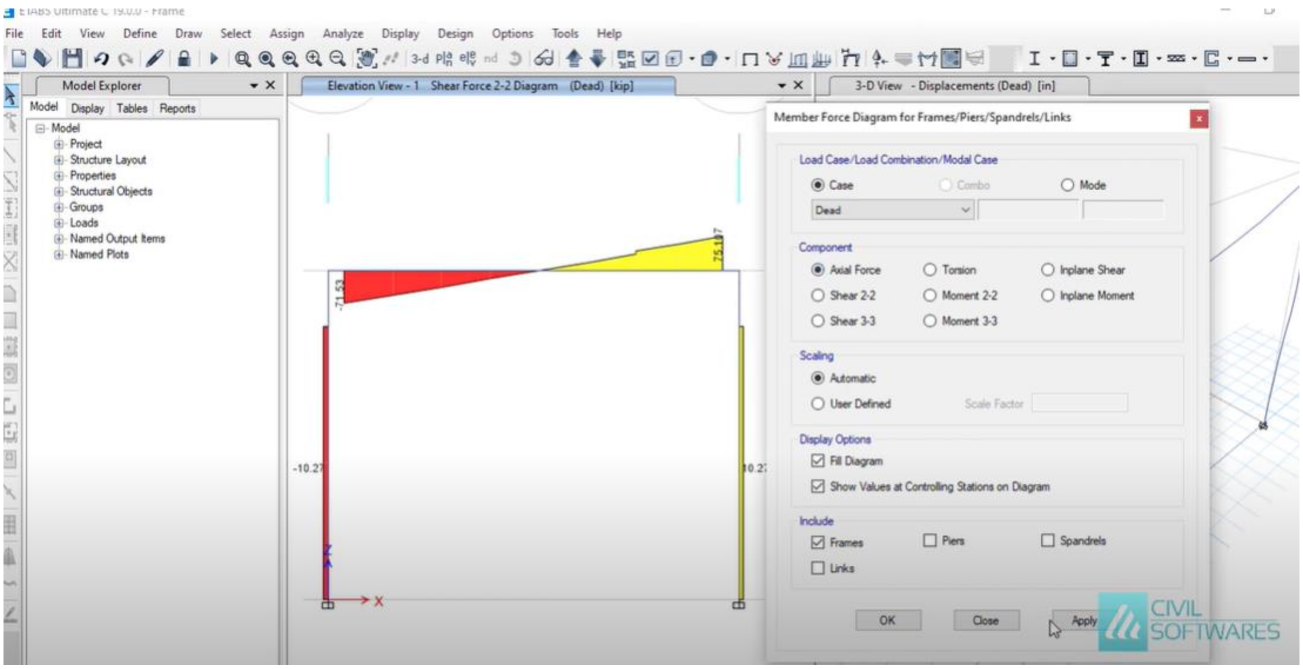


Figure 7: SFD and BMD

Experiment -03 :Understanding basic features of Project management software. Constructing Project: create WBS, Activities, and tasks and Computation Time using Excel spread sheet and transfer the same to Project management software.

There are 4 essential components In Microsoft Project to create WBS:

1. Task
2. Milestone task
3. Summary Task
4. Project Summary Task

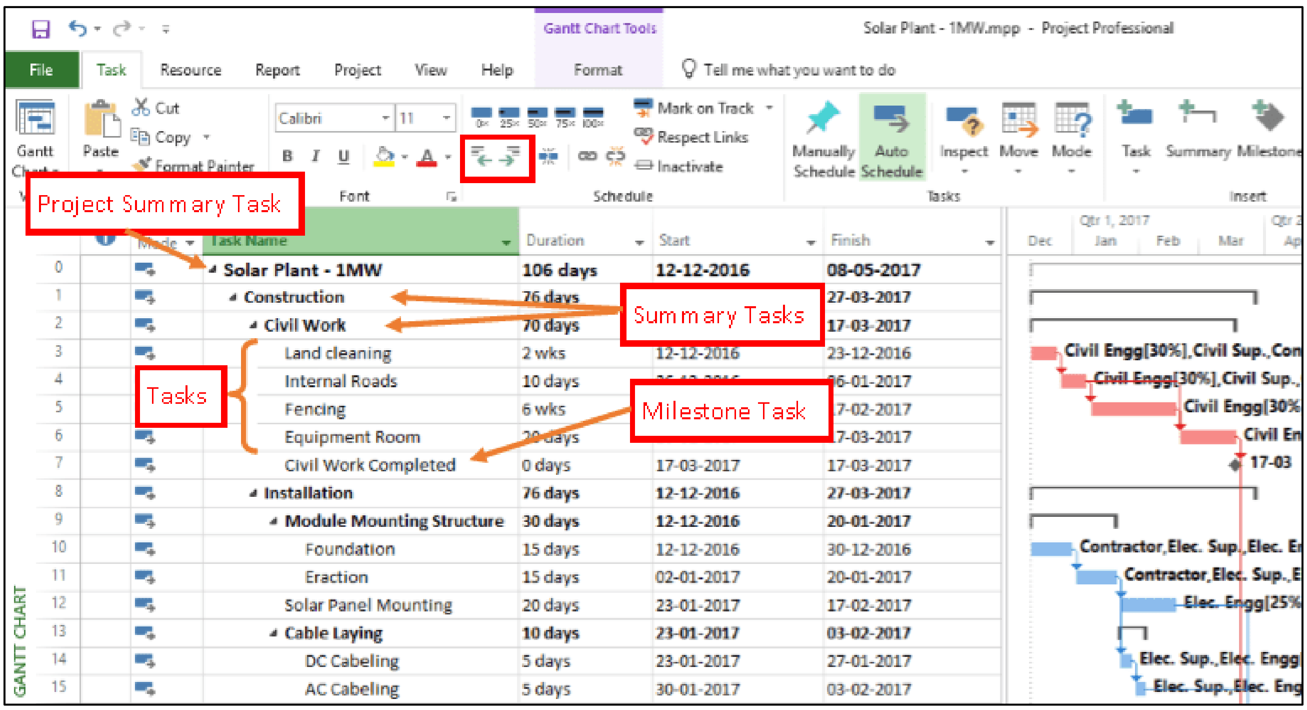


Figure 8: Task

Task

A task is an activity to be performed by a resource. It is last node in the WBS hierarchy. Project is broken down into planning packages, planning packages are broken down into further planning or work packages as needed. Work packages are broken down into activities also called tasks. Task is not broken down further.

Milestone task

A milestone is a point in time and introduced in WBS to denote important events during the project. A milestone is a significant stage or event in the development of projects. There is no work involved in the milestone and therefore milestones have no duration. To convert a task into a milestone, please change the duration of task as zero. MS Project shows a milestone as diamond on the right hand side chart area in Gantt Chart view.

Summary task

A summary task is basically a planning package or work package. All the tasks above activity and below project name in a WBS Hierarchy are called summary tasks in MS Project. A summary task contains one or more tasks under it.

Project Summary task

A project summary task is the top level task named same as project name. Refer 1^{st} task in the figure 1. Its id is 0. To create a project summary task, go to Format tab and tick the check box "Project Summary task" under Show/Hide group. A project summary task is inserted at the top. It is named same as project file name and its id is 0. All the tasks in the project become sub tasks of this summary tasks.

Work Breakdown Structure (WBS)

A Work Breakdown Structure (WBS) in Microsoft Project for construction projects is a hierarchical decomposition of the project scope into smaller, more manageable work packages. It's a visual tool that breaks down the entire project into tasks and sub-tasks, facilitating planning, organization, and progress tracking. In construction, a WBS typically includes levels representing the project phases, major deliverables, and individual work packages.

It is a helpful diagram for project managers because it allows them to break down their project scope and visualize all the tasks required to complete their projects.

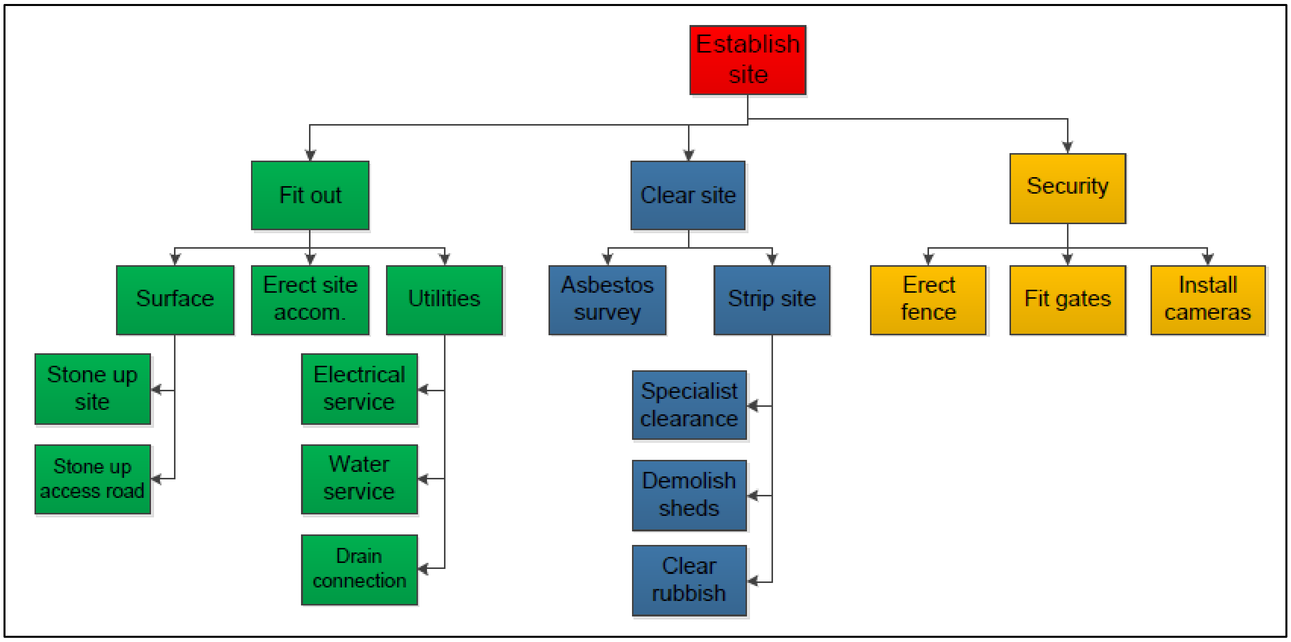
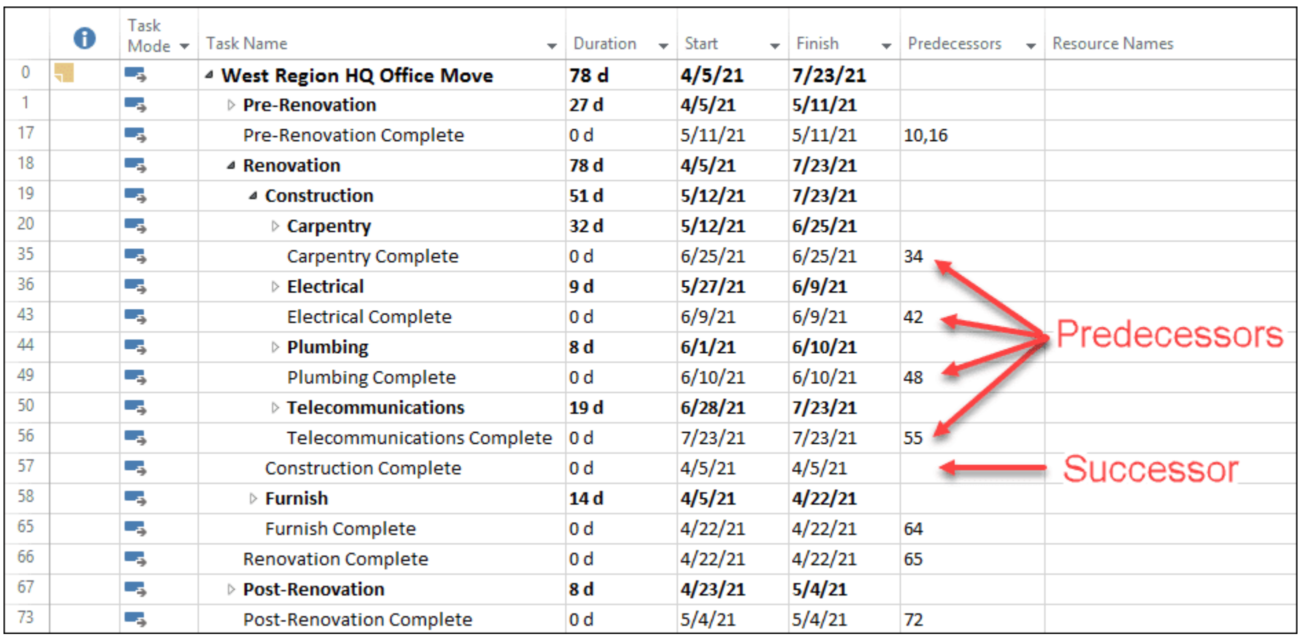


Figure 9: work Breakdown Structure

Experiment -04 :Identification of Predecessor and Successor activities with constrain. Constructing Network diagram (AON Diagram) and analyzing for Critical path

Microsoft Project (MSP), predecessors and successors are project tasks that define dependencies between activities. A predecessor is a task that must be completed before another task (the successor) can begin or end, while a successor is a task that depends on the completion or start of another task (the predecessor). These dependencies determine the order in which project tasks are executed.



		Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names
0			West Region HQ Office Move	78 d	4/5/21	7/23/21		
1			Pre-Renovation	27 d	4/5/21	5/11/21		
17			Pre-Renovation Complete	0 d	5/11/21	5/11/21	10,16	
18			Renovation	78 d	4/5/21	7/23/21		
19			Construction	51 d	5/12/21	7/23/21		
20			Carpentry	32 d	5/12/21	6/25/21		
35			Carpentry Complete	0 d	6/25/21	6/25/21	34	
36			Electrical	9 d	5/27/21	6/9/21		
43			Electrical Complete	0 d	6/9/21	6/9/21	42	
44			Plumbing	8 d	6/1/21	6/10/21		
49			Plumbing Complete	0 d	6/10/21	6/10/21	48	
50			Telecommunications	19 d	6/28/21	7/23/21		
56			Telecommunications Complete	0 d	7/23/21	7/23/21	55	
57			Construction Complete	0 d	4/5/21	4/5/21		
58			Furnish	14 d	4/5/21	4/22/21		
65			Furnish Complete	0 d	4/22/21	4/22/21	64	
66			Renovation Complete	0 d	4/22/21	4/22/21	65	
67			Post-Renovation	8 d	4/23/21	5/4/21		
73			Post-Renovation Complete	0 d	5/4/21	5/4/21	72	

Figure 10: Predecessor and Successor activities

Every task is important, but only some of them are *critical*. The critical path is a chain of linked tasks that directly affects the project finish date. If any task on the critical path is late, the whole project is late.

The critical path is a series of tasks (or sometimes only a single task) that controls the calculated start or finish date of the project. The tasks that make up the critical path are typically interrelated by task dependencies. There are likely to be many such networks of tasks throughout your project plan. When the last task in the critical path is complete, the project is also complete.

Show the critical path in the Gantt Chart view

The Gantt Chart view will likely be your most used view for showing the critical path.

1. Choose **View** > **Gantt Chart Format**.
2. Choose **Format**, and then select the **Critical Tasks** check box

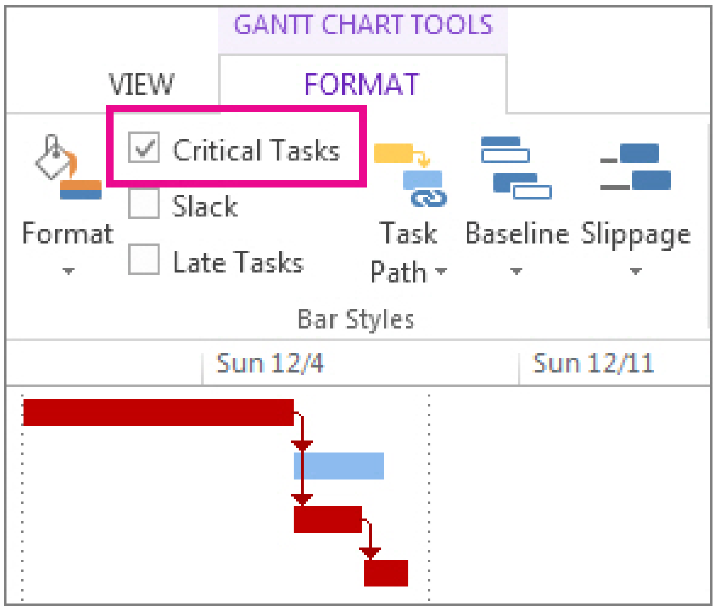


Figure 11: Critical Task

Experiment -05 : Critical activities and Other non-Critical paths, Project duration, Floats. Study on various View options available

Total float measures the potential for project schedule delays. Free float more stringently warns of a task's potential for delaying other related tasks. Most scheduling software is helpful because it lists both total float and free float data. But the beauty of scheduling software is its ability to describe schedule dynamics in a pictorial Gantt chart.

Displaying both the total float and free float of tasks on the Gantt chart provides the scheduler with greater insight into schedule flexibility. In Microsoft Project both float bars may be displayed directly on the Gantt chart supporting more in-depth schedule analysis.

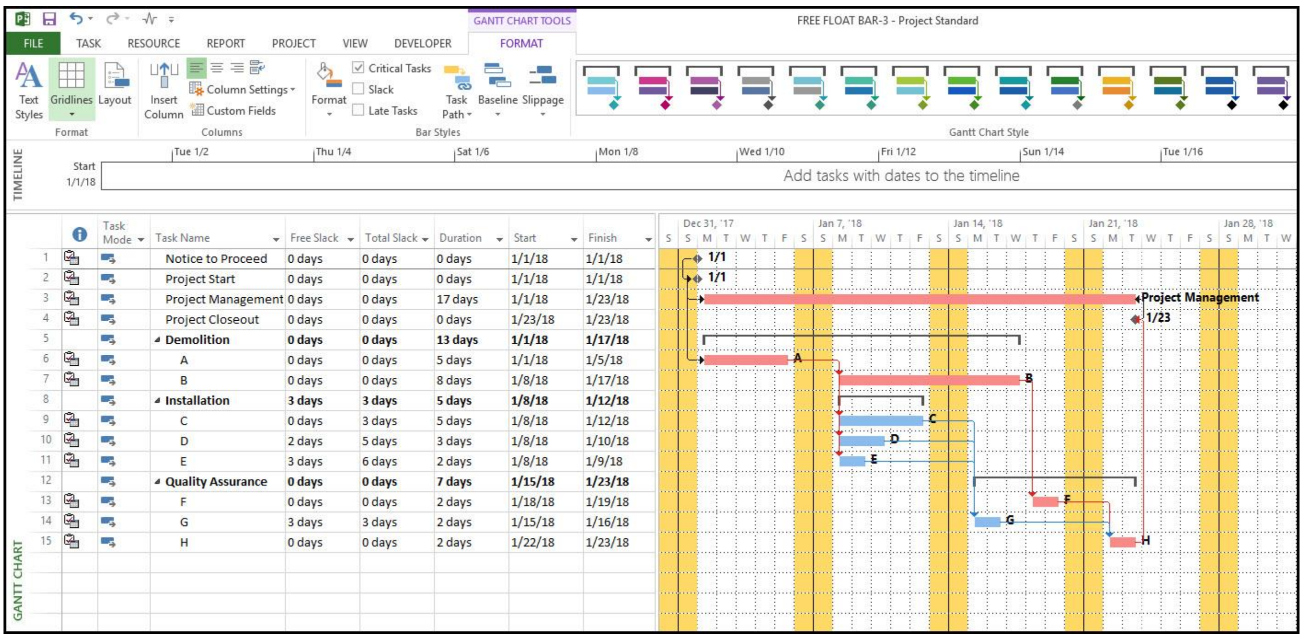


Figure 12 : Float

Note in particular the 'Free Slack' and 'Total Slack' data columns, which are Microsoft Project's terminology for free float and total float. The most important tasks to watch are those that have zero total float values. These tasks cannot delay without postponing the entire project. Schedulers may also want to locate tasks that cannot linger without delaying related successor tasks. Here look for tasks that have zero free float values.

Zero total float and free float tabulated values provide sufficient warning of potential task or schedule delays. However, more insight into schedule flexibility is achieved by displaying total float and free float on the Gantt chart. To display both total float and free float on the Gantt chart select Format tab, Bar Styles ribbon group, Format, and Bar Styles, Figure 13.

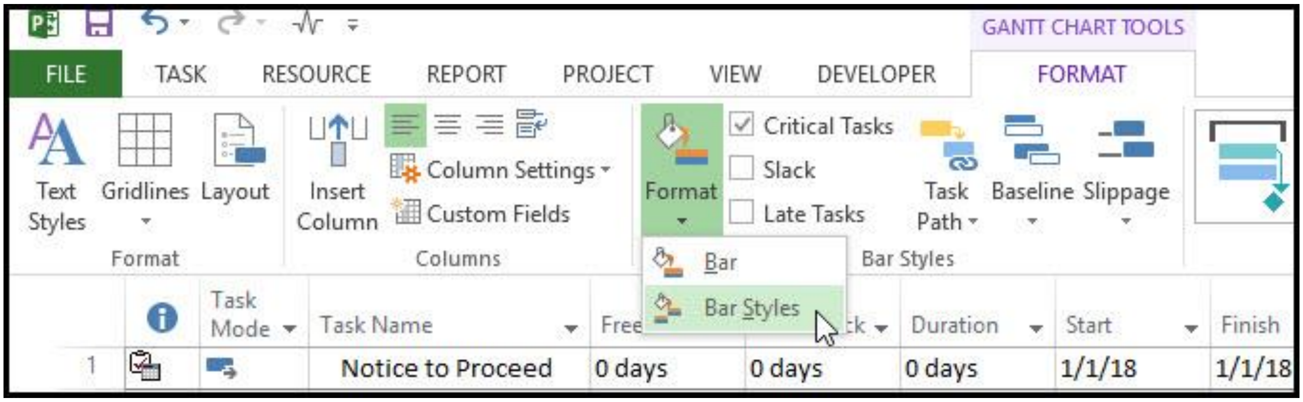


Figure 2

In Figure 13 we created a bar to display the total float of all normal tasks.

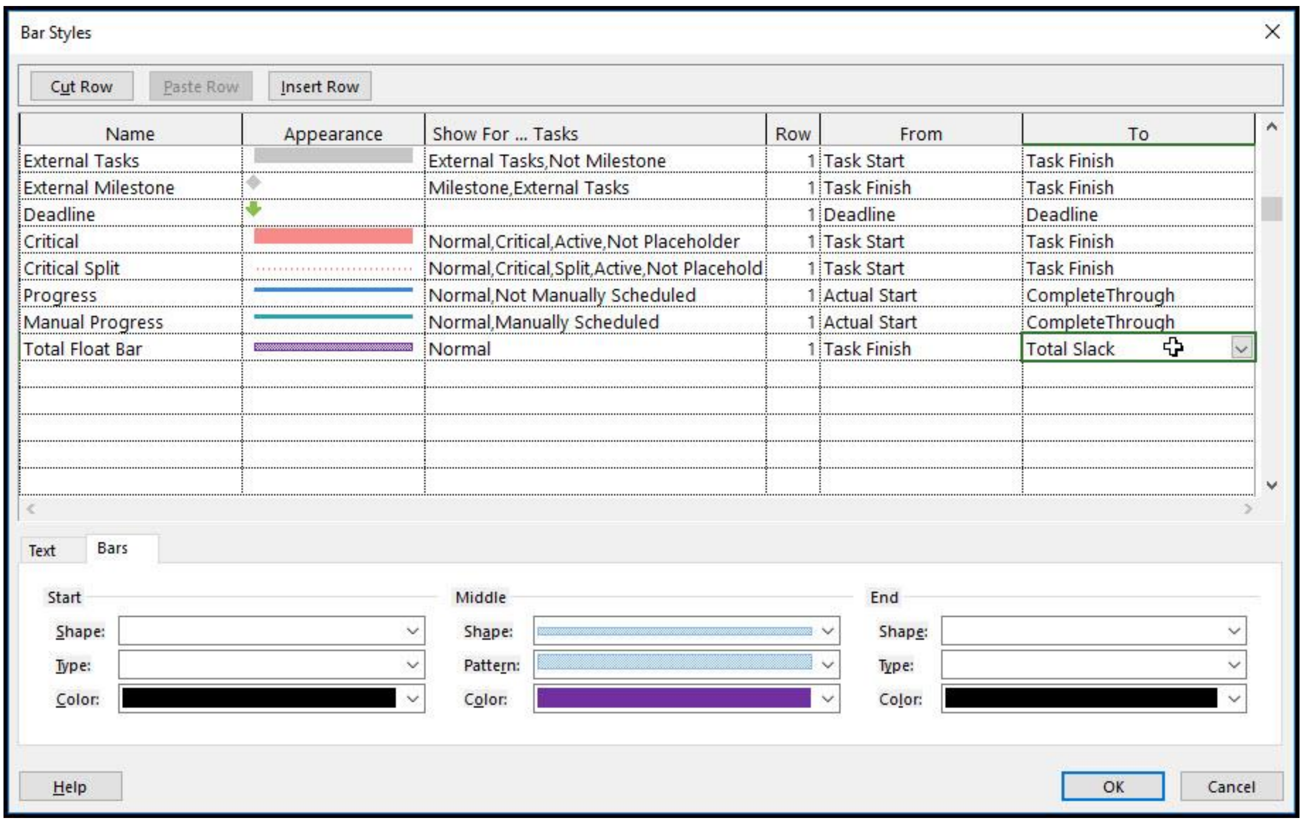


Figure 13 : total float of all normal tasks.

Note the bar shape and color in the appearance column. The key to displaying the total float bar is to set the 'From' parameter to 'Task Finish' and the 'To' parameter to 'Total Slack'. Let's now create a bar to display free float on the Gantt chart, Figure 14.

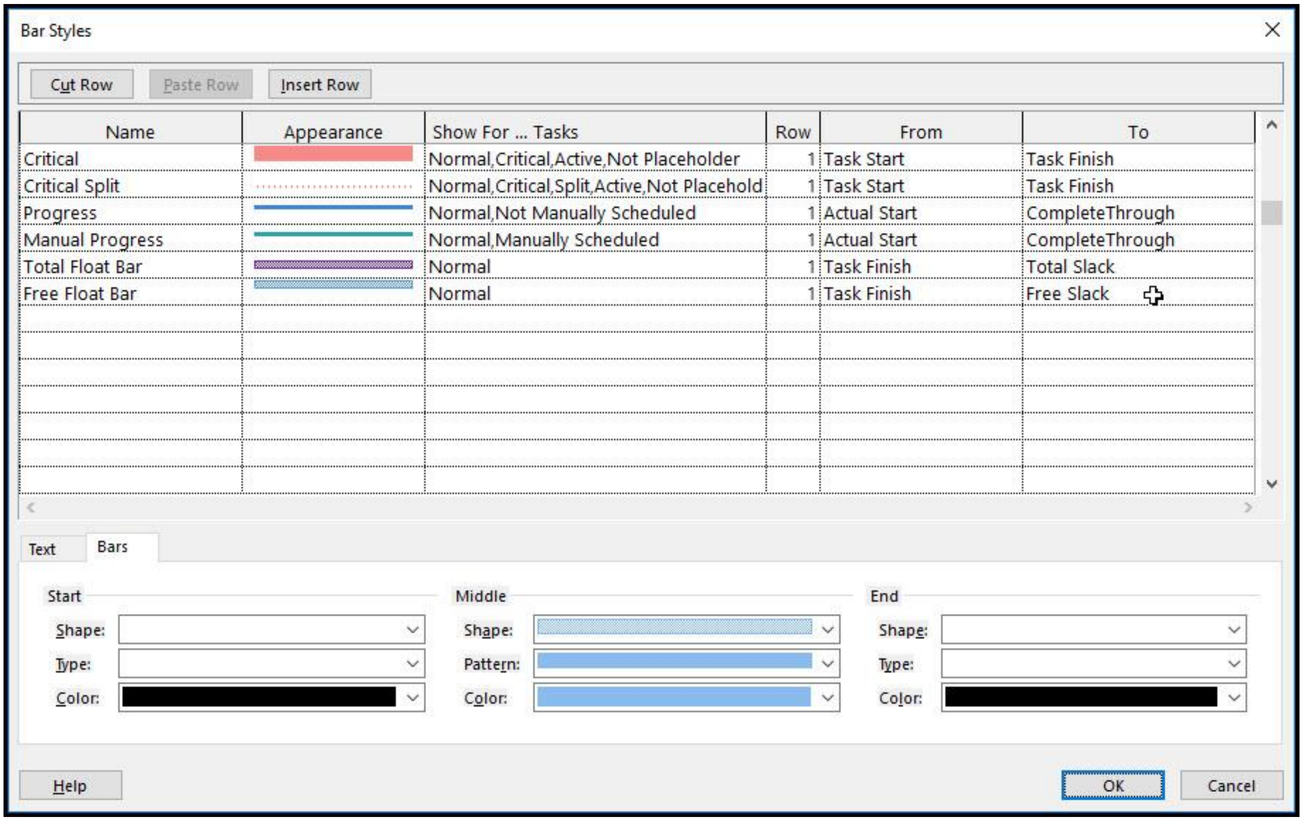


Figure 14 : float on the Gantt chart

Again, note the bar shape and color. The 'From' parameter is, again, 'Task Finish', and the 'To' parameter is 'Free Slack', which works nicely.

The Gantt chart displaying both total float and free float is in Figure 15.

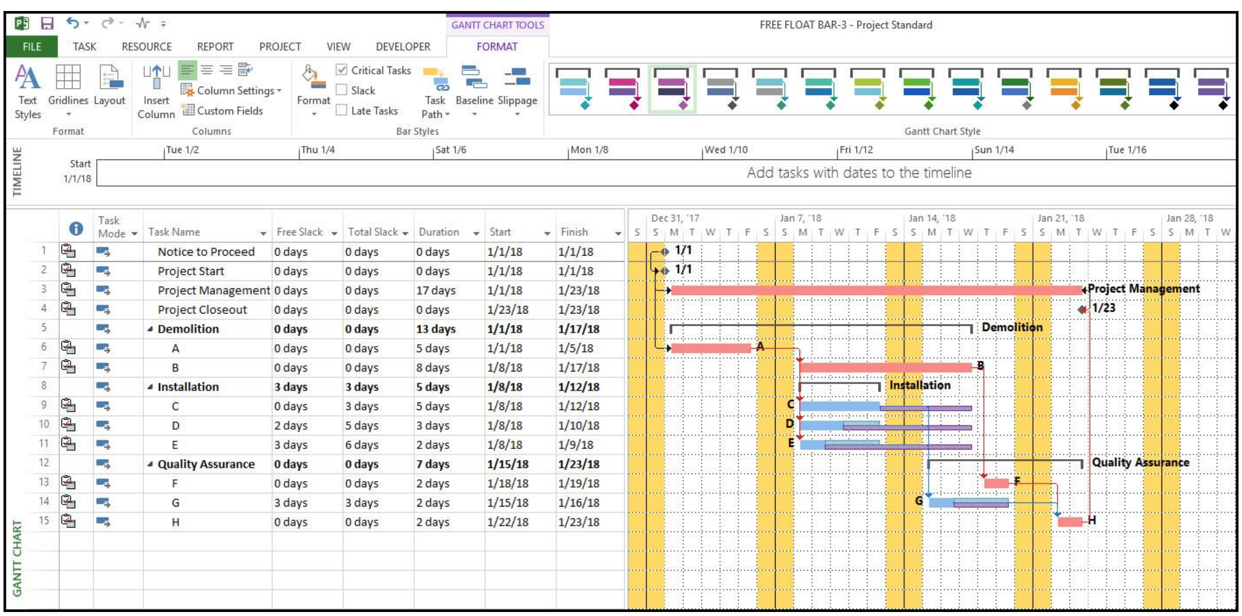


Figure 15: Gantt chart displaying both total float and free float

From this total float and free float Gantt chart view we find that task E has the most flexibility. It can delay three days without affecting successor task G, and it can delay six days without delaying the entire schedule.

Experiment -06 : Basic understanding about Resource Creation and allocation g. Understanding about Splitting the activity, Linking multiple activity, assigning Constrains, Merging Multiple projects, Creating Baseline Project

A project baseline is a fixed reference point in project management used to track progress and manage changes. It's essentially a snapshot of the project plan, including scope, schedule, and cost, agreed upon by stakeholders at the beginning of the project. This baseline allows project managers to monitor performance, identify deviations, and make necessary adjustments to ensure the project stays on track**.**

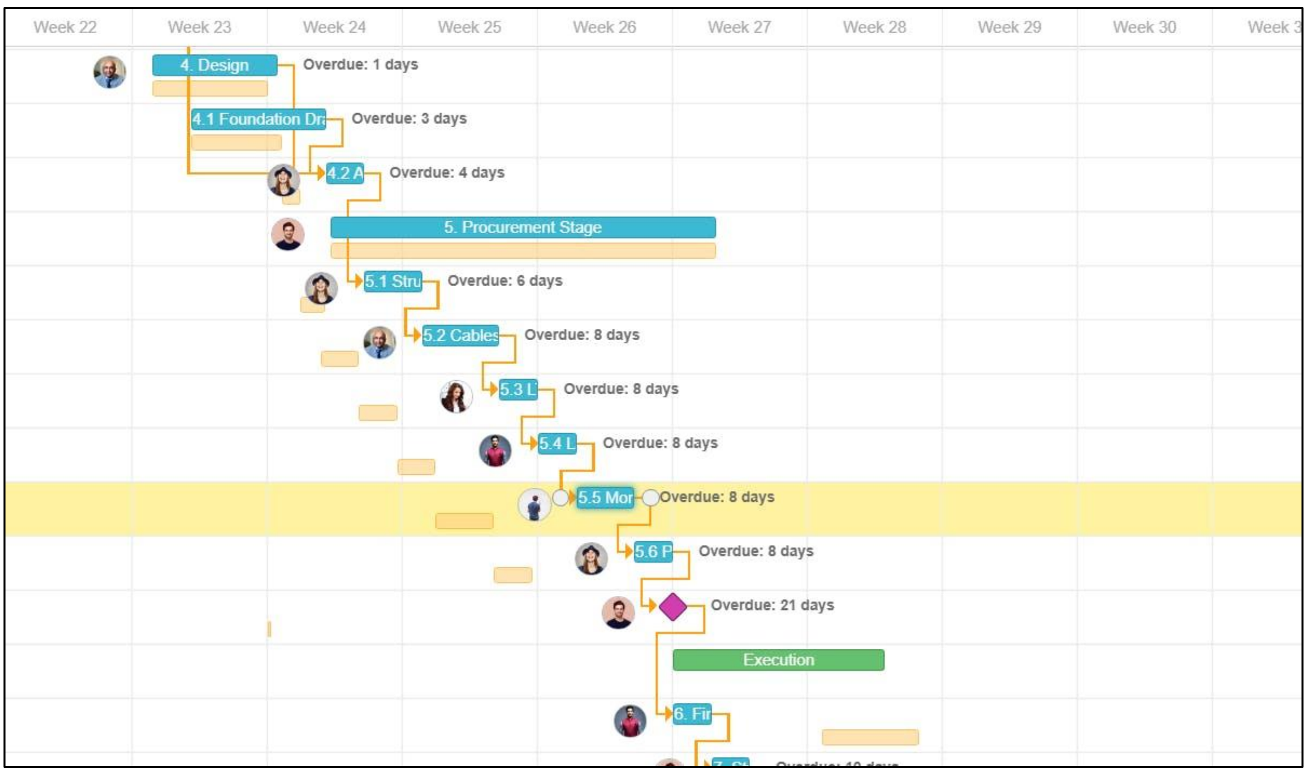


Figure 16: Baseline of Project

In Microsoft Project (MSP), resource allocation is the process of assigning the right resources (work, materials, costs) to tasks to meet project goals and deadlines. This involves defining resources in the Resource Sheet, assigning them to tasks in the Gantt Chart, and managing their availability and utilization to prevent over or under-allocation.

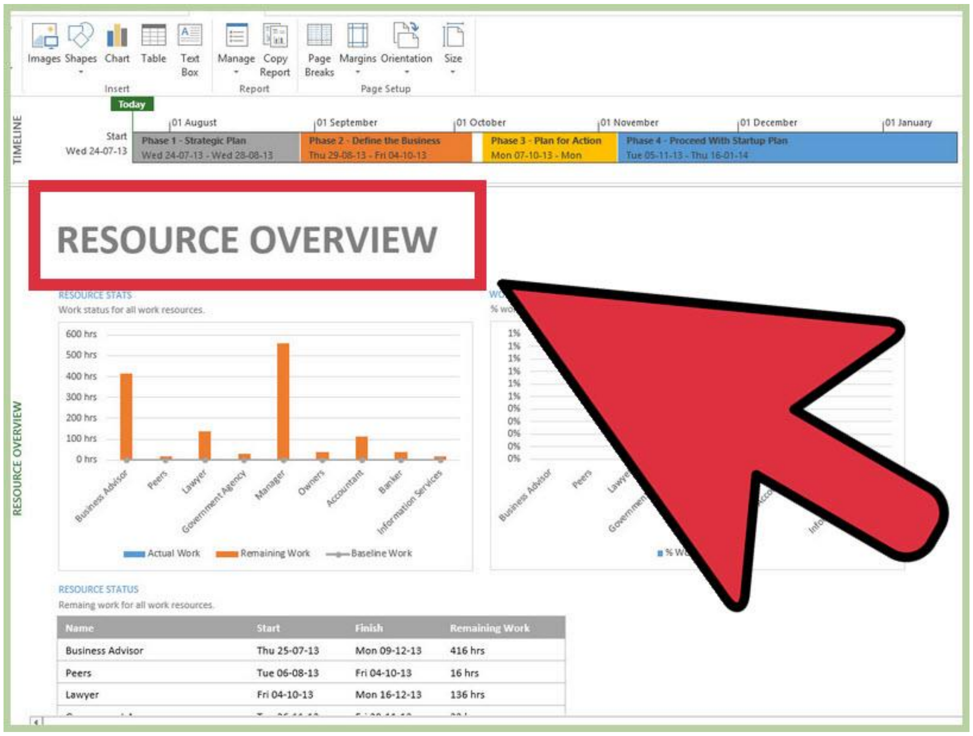


Figure 17: Resource Allocation

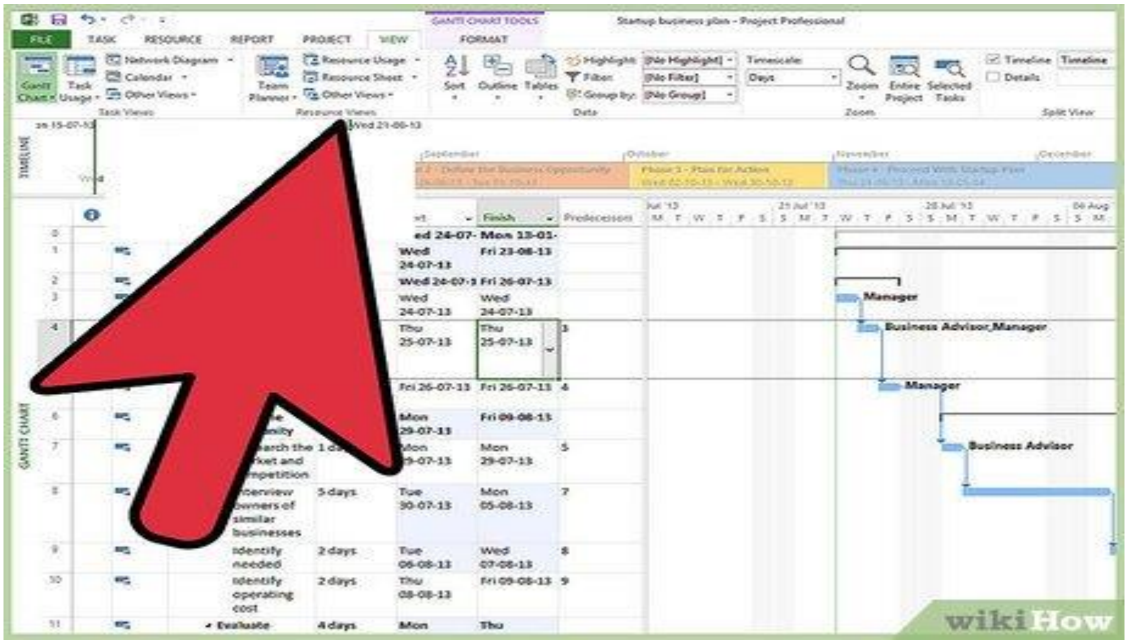


Figure 18: Resource Allocation

Experiment -07 : GIS applications using open source software: To create shape files for point, line and polygon features with a map as reference. To create decision maps for specific purpose

Using open-source GIS software like QGIS, you can create shapefiles for point, line, and polygon features based on a reference map and further generate decision maps for specific purposes by utilizing its spatial analysis tools and visualization capabilities. Here's a breakdown of the process:

1. Loading and Referencing the Base Map:

- Open your base map:

Import the base map (raster image or vector data) into QGIS. This serves as your spatial reference for placing your new features.

- Set the spatial reference:

Ensure the base map and your new data share the same coordinate system (projection) for accurate spatial relationships.

2. Creating Shapefiles:

- Point Features:

Use the "Digitizing Toolbar" to add point features directly onto the map by clicking on desired locations. You can then add attributes (data associated with each point) like location names or specific data values.

- Line Features:

Similar to points, use the line drawing tool to trace lines along features like roads or rivers.

- Polygon Features:

Define polygons by clicking and dragging vertices to outline areas of interest, such as land use zones or watersheds.

3. Decision Map Creation:

- Spatial Analysis:
    - Overlay analysis: Overlap different layers to identify areas where specific conditions intersect (e.g., floodplains and populated areas).
    - Buffer analysis: Create buffer zones around features (e.g., a buffer zone around schools).
    - Selection by Attribute: Select features based on their attribute values (e.g., only areas with high pollution levels).

- Visualization:
    - Symbology: Assign different colors, symbols, or patterns to different features based on their attributes to visually represent the results of your analysis.
    - Labeling: Add labels to features for identification.
    - Legends: Create a legend to explain the symbology used in your map.

Figure 19:GIS Application

Experiment -08 : Computation of earthwork, Design of horizontal curve by offset method, Design of super elevation Using Excel

To design horizontal curves and compute earthwork in Excel, you can leverage formulas and functions to automate calculations for elements like radius, tangent length, superelevation, and earthwork volume. The offset method is a standard technique for designing horizontal curves, and Excel can be used to implement it efficiently.

1. Design of Horizontal Curve by Offset Method:

- Input Data:

Start by inputting data like design speed, curve radius, and any relevant alignment details into an Excel sheet.

- Tangent Calculation:

Calculate the tangent length (T) using the formula: $T = R * \tan(\Delta/2)$, where R is the radius and Δ is the central angle.

- Curve Length Calculation:

Determine the length of the curve (L) using the formula: $L = R * \Delta * \pi / 180$, where R is the radius and Δ is the central angle in degrees.

- Offset Calculations:

Use the offset method to locate points along the curve using the formula: $Offset = R * (1 - \cos(\theta))$, where θ is the angular distance from the PC.

- Stationing:

Calculate the stationing of the PC, PT, and other relevant points along the curve.

2. Design of Superelevation:

- Input Data:

Input design speed, radius of the curve, and road width.

- Superelevation Calculation:

Calculate the required superelevation (e) using the formula: $e = (V^2) / (127R)$, where V is the design speed in km/h and R is the radius.

- Check for Limits:

Ensure the calculated superelevation (e) does not exceed the maximum allowable value (e.g., 0.07) based on design standards.

- Rate of Change:

Determine the rate at which superelevation should transition from the normal camber to the full superelevation.

3. Computation of Earthwork:

- Input Data:

Input data on ground elevations, cross-section dimensions (e.g., road width, side slopes), and any relevant earthwork parameters.

- Volume Calculation:

Use the end area method or other suitable methods to compute the earthwork volume between different sections of the road.

- Excel Functions:

Utilize Excel functions like SUM, AVERAGE, and VLOOKUP to automate calculations and organize data.

- Cuts and Fills:

Identify areas of cut (excavation) and fill (embankment) and calculate the corresponding volumes.

Workout the quantity of earth work f0r an embankment 150m long and 10m wide at the top. Side slope is 2:1 and depths at each 30m interval are 0.60, 1.2, 1.4, 1.6, 1.4, and 1.6m.

Station	depth	Center area =B.d	Area of sides=Sd^2	total area B.D +Sd^2	Mean area A1+A2/2	interval	quantity Cut	Fill
0	0.6	6	0.72	6.72				
30	1.2	12	2.88	14.88	10.8	30		324
60	1.4	14	3.92	17.92	16.4	30		492
90	1.6	16	5.12	21.12	19.52	30		585.6
120	1.4	14	3.92	17.92	19.52	30		585.6
150	1.6	16	5.12	21.12	19.52	30		585.6
Total filling or embankment quantity =							2572.8m^3	

$$\frac{6.72 + 14.88}{2} = 10.8 \text{ sq.m}$$

$$\frac{14.88 + 17.92}{2} = 16.4 \text{ sq.m}$$

Figure 20:Earthwork Calculation