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Integration of Revit to Microsoft Project for Construction Project Management: A Comparative Analysis of Scheduling and Resource Allocation

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Abstract

Building Information Modelling (BIM) has revolutionized the construction sector by having architectural, structural, and mechanical design on one 3D platform. Autodesk Revit application enables real-time updates and changes without increasing errors and omissions. Its parametric nature allows users to develop intelligent models, enhancing decision-making, resource allocation, and cost estimation. Revit's visual representation allows effective coordination and communication with stakeholders, promoting a higher degree of client satisfaction. The application and benefits of Revit and MSP in construction management and how it contributes to optimizing project efficiency, accuracy, and coordination are the focus of this article. The study Revit 3D planning, design and Microsoft Project (MSP) usage in construction project duration analysis. The methodology of research includes case studies qualitative data and quantitative data analysis, showing the interoperability of Revit and MSP in achieving project productivity maximization.

Keywords: Autodesk Revit, building information modelling (BIM), construction, planning, 3D design, Microsoft project (MSP)

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INTRODUCTION

Successful construction project management is paramount, and the growing complexity of projects requires sophisticated collaboration and process-streamlining tools. Two of the most used platforms in construction are Autodesk Revit and Microsoft Project. Revit is a Building Information Modeling (BIM) application that architects, engineers, and contractors utilize for building design, visualization, and building project management. It enables users to create smart 3D models, improving collaboration with stakeholders and improving data quality. Microsoft Project is a project management tool used by project managers to plan, schedule, and effectively manage resources. Integrating Revit and Microsoft Project can enhance construction project management by bringing together BIM's rich design functionality and conventional project scheduling functionality. This integration enables project teams to keep design and timelines aligned, facilitating

communication and avoiding potential misalignment and delays. This merging can result in improved visibility into project schedules, enhanced resource management, and enhanced project results. This pairing can revolutionize how construction projects are planned, delivered, and controlled, resulting in more effective and successful project completions Figures 1 and 2.

Objectives

1. To analyze the capabilities of Revit 3D design in enhancing project visualization and communication.
2. To investigate the effectiveness of MSP in duration analysis, schedule optimization and resource allocation.
3. To propose a framework for integrating Revit and MSP for construction project management.

Need of Study

Construction projects are complex by nature and involve many stakeholders, activities, and resources. Traditional project management approaches tend to result in inefficiencies, delays, and cost overruns. Implementing Building Information Modeling (BIM) via Revit enables better visualization and coordination of project teams. At the same time, MSP offers powerful scheduling features that can be used for optimizing resources and timelines.

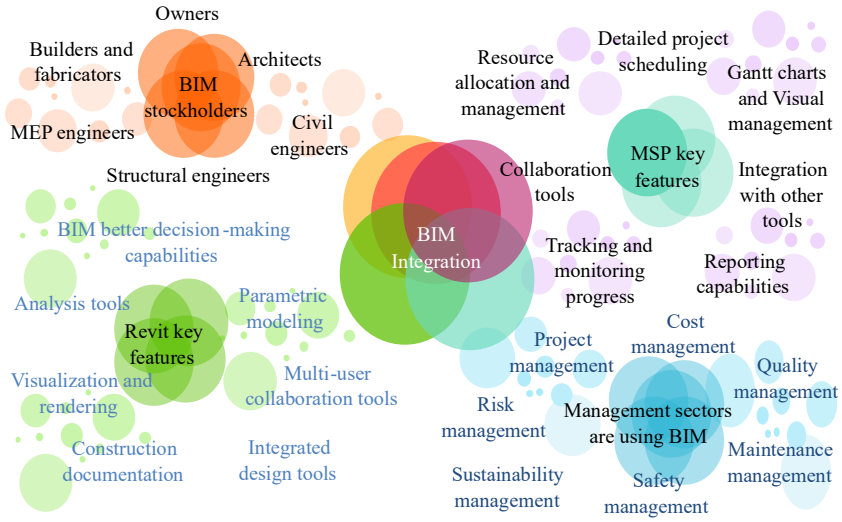


Figure 1. BIM Integration.

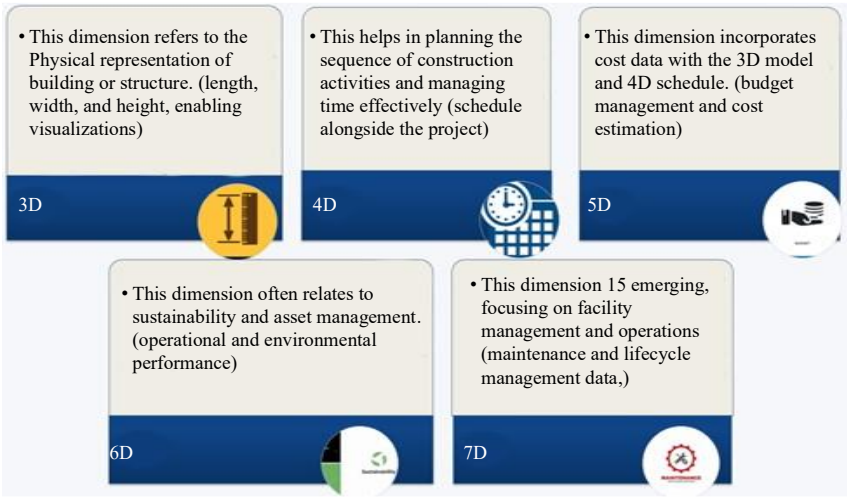


Figure 2. BIM Levels and Dimensions.

Figure 3. Research methodology.

Scope of Study

To investigate the potential benefits of integrating Revit 3D modeling and analysis with Microsoft Project scheduling and resource allocation in the construction industry. The scope of this study on Residential and Commercial Construction Site.

RESEARCH METHODOLOGY

The integration of Autodesk Revit with Microsoft Project (MSP) is an essential aspect of modern project management in the construction industry, particularly for Building Information Modeling (BIM). This methodology enhances project planning, scheduling, and resource management by linking design data with project timelines (Figure 3).

DATA COLLECTION METHODS (METHODOLOGY)

Qualitative Data

- *Interviews:* Semi-structured interviews with experienced project managers, architects, and engineers using both Revit and Microsoft Project will be undertaken. The interviews are to get first-hand opinions of their experience using the integration.
- *Focus Groups:* Industry professionals will discuss in groups to share common experiences and gain further insights into the problems encountered during the integration process.
- *Document Analysis:* Reviews of project documentation, integration process guidelines, and previous case studies to understand the outcomes of previous integrations will be undertaken Figure 3.

Quantitative Data

Surveys: A structured survey will be designed to quantify the effectiveness of integration in terms of several key indicators, such as:

- Scheduling accuracy (on-time task completion rate).
- Resource utilization rates (percentage of resources effectively used).
- Time savings (reduction in time spent on scheduling tasks).

Surveys will be distributed to a larger audience of project stakeholders involved in construction projects with experience in the use of both platforms.

Method of Integration for Revit to MSP

- Workflow for Transferring Data from Revit to Microsoft Project

Step 1: Prepare Revit Model

1. *Check Model Completeness:* Ensure your Revit model is complete with all relevant elements reflecting the design.

2. *Organize Elements:* Organize elements using Work sets, Phases, or Categories that align with your project schedule or tasks.
3. *Add Task Data:* If needed, assign appropriate parameters to Revit elements (e.g., task names, durations, resource assignments).
4. *Create Custom Parameters:* Use shared parameters to store data that can be exported to Excel later.

Step 2: Prepare Excel for Import into Microsoft Project

1. *Open Exported Excel File:* Open the Excel file containing the Revit schedule.
2. *Format Excel Data:* Adjust the data in Excel to align with Microsoft Project's requirements:
   - Ensure that the columns for Task Name, Start Date, Finish Date, Duration, and Resource Names are present Figures 4 and 5.
   - Remove any unnecessary rows or columns.
   - If using resource assignments, ensure that resource names match those in Microsoft Project.
3. *Save the Excel File:* After formatting, save the Excel document.

Step 3: Import Excel Data into Microsoft Project

1. *Open Microsoft Project:* Start a new or existing project in Microsoft Project.
2. *Import Excel File:* Go to File → Open → Browse. Select the Excel file and choose to open it.
3. *Import Wizard:* Use the Import Wizard to map the Excel columns to the appropriate fields in Microsoft Project:
   - Map 'Task Name' to 'Name'.
   - Map 'Start Date' to 'Start'.
   - Map 'Finish Date' to 'Finish'.
   - Map 'Duration' to 'Duration'.
   - Map 'Resource Names' to 'Resource Names'.
4. *Finish Import:* Complete the import process and review the task list for accuracy.

Step 4: Review and Update Project Schedule

1. *Check for Errors:* Look for any discrepancies such as incorrect dates, durations, or resources.
2. *Adjust Task Dependencies:* Define task dependencies (predecessors) in Microsoft Project as needed.
3. *Optimize Schedule:* Review and optimize the project schedule based on resources and timelines.

Step 5: Ongoing Maintenance

1. *Synchronize Data:* Establish a routine for updating schedules as project progresses, typically by repeating the export-import process.
2. *Track Changes:* Utilize Microsoft Project's features to track changes in tasks and resources over time.
3. *Review Collaboration:* Ensure that collaboration between design and project management teams is ongoing to maintain accuracy.

CRITICAL LITERATURE REVIEW

Integration of Revit (BIM) With MSP

Saeed et al. (2010) developed the Visual Scheduling Application (VSA) to improve activity sequencing and project scheduling. The software uses Microsoft Project and Revit CAD software to create a virtual building prototype, allowing users to view activities and choose tasks [1].

Saeed et al. (2012) Introduced a new approach to teaching construction planning and scheduling, using computer game and simulation technologies to create 3D virtual learning environments. This eliminates redundant work, allowing students to focus on schedule refinement and cost optimization Figure 6 [2].

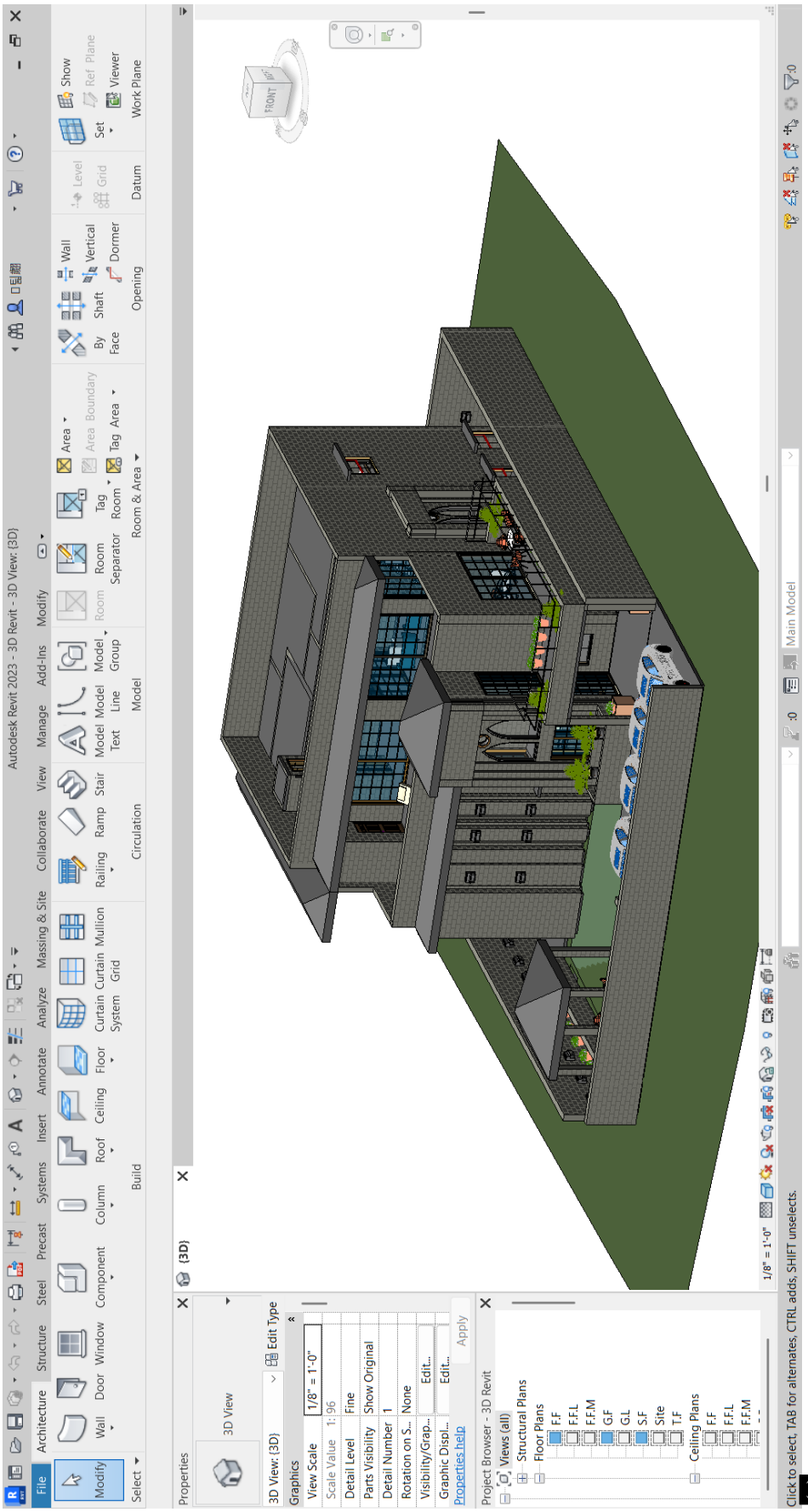
Project Name: Synnove Atmosphere ,Vadodara, Gujarat 391101Client: Sky Seven Synnove Atmosphere
Construction Firm: Srishti Builders (Commercial + Residential Project)
Project Duration: January 2021 - December 2025 (4 Year)
Budget: 400 Cr.
Build up area: 60000 square feet
Stakeholders- Client, Architectural, Engineers, General Contractor, Consultants (Structural, MEP, Mechanical, Electrical, Plumbing)

SR. NO.	START DATE	END DATE	DURATION	MAIN ACTIVIY	ACTIVITIS	SOURCE	QUANTITY (CUBIC METER)	GRADE/IS
1	01-01-2021		1 YEAR	M	**Construction pre-setup Activity**			
2			3 MONTH	S	Land pugetions and government Documentation	Gov.Body and Client		
3			3 MONTH	S	Designing and execute (Documentation)	Architecture and Consultant		
4			3 MONTH	S	Office Founding or Placing / Vendor Selection	Client, Consultant and Engineer		
5			1 MONTH	S	Site Survey (150 Nos.)	Surveyor, Engineer,Contractor		
6			1 MONTH	S	Site Marking	Engineer,Contractor		
7			1 MONTH	S	Geotechnical Survey	Geo Tecnician and Engineer		
8			1 MONTH	M	**Foundation Site Excavation (All Foundtion Area)**			
9			6 DAYS	S	Commercial Part	Equi.Contractor, Engineer	2000	ton
10			6 DAYS	S	Tower-A Part	Equi.Contractor, Engineer	2000	ton
11			6 DAYS	S	Tower-B Part	Equi.Contractor, Engineer	2000	ton
12			6 DAYS	S	Tower-C Part	Equi.Contractor, Engineer	2000	ton
13			6 DAYS	S	Tower-D Part / U.G TANK	Equi.Contractor, Engineer	2000	ton
14			21 DAYS		**Foundation Work**			
15				M	**U.G R.C.C Tank Work**	Contractor,Engineer, RMC Vendor		
16			1 DAYS	S	P.C.C For U.G TANK	Contractor,Engineer, RMC Vendor	10	M10
17			2 DAYS		U.G Tank Raft Rinforcement Work	Contractor,Engineer, RMC Vendor	5610	Kg

Figure 4. Excel File preparing.

MANPOWER RATE (INR)						MANPOWER TOTAL AMOUNT (INR)	MATERIAL REQUIRED	MATERIAL RATE (PER M3 OR PER KG)	MATERIAL TOTAL AMOUNT (INR)	CONCRETE-PUMP STATUS	RATE OF CONCRETE-PUMP STATUS PER M3	AMOUNT CONCRETE-STATU
No of Skill Labour	No of Un-skil labour	Skill Labour	Un-Skil Labour	Supervisor	Contractor							
NO	NO	RS.	RS.	RS.	RS.	RS.			RS.		RS.	RS.
5	5	1000	650	1000	1000	14477.5	RMC	4000	40000			
2	5	1000	650	1000	1000	8477.5	Steel	75	420750			
5	15	1000	650	1000	1000	21432.5	RMC	5000	165000	PUMPING	1500	
5	5	1000	650	1000	1000	14477.5		200	46200			
10	5	1000	650	1000	1000	24477.5	Steel	75	981750			
5	20	1000	650	1000	1000	24910	RMC	5000	385000	PUMPING	1500	
2	3	1000	650	1000	1000	7086.5		200	19800			
3	5	1000	650	1000	1000	10477.5	Steel	75	420750			
3	10	1000	650	1000	1000	13955	RMC	5000	165000	PUMPING	1500	
5	20	1000	650	1000	1000	24910	RMC	4000	256000	PUMPING	1500	
5	10	1000	650	1000	1000	17955	Steel	75	1912500			
3	3	1000	650	1000	1000	9086.5		200	90000			

Figure 5. Excel based calculating quantity and rate.



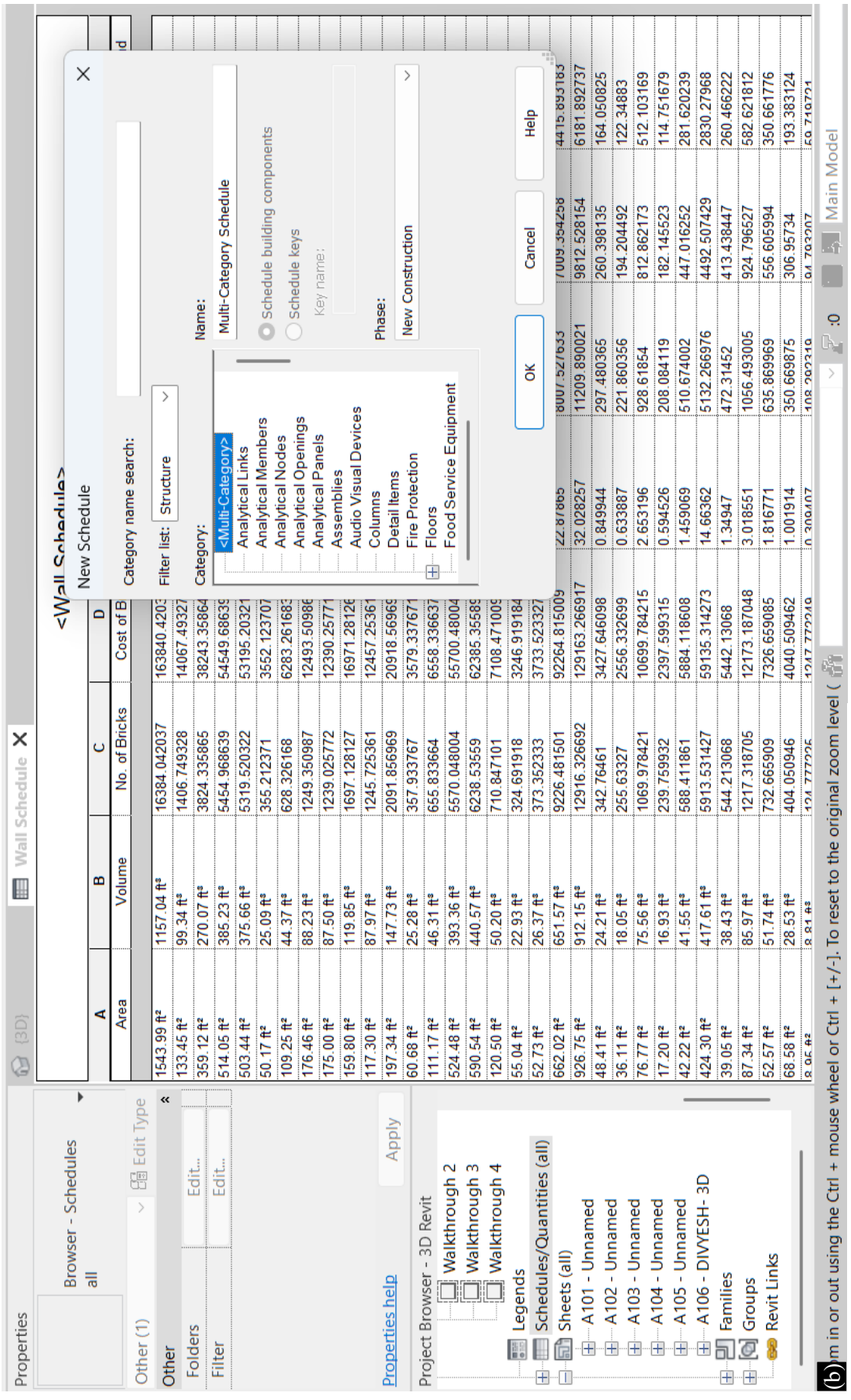


Figure 6. (a and b) Autodesk revit architecture.

Hexu et al. (2014) developed an automated on-site scheduling system using a building information model (BIM) in Autodesk Revit, reducing human error in panelized construction scheduling. The system requires additional time studies and past data prediction for enhanced performance [3].

Fernanda et al. (2016) developed a data management methodology for building construction using BIM (Autodesk Revit) and Business Intelligence (BI tools), enhancing decision-making reliability, project deliverability, and sustainability by minimizing errors, enhancing productivity, and environmental sustainability [4].

Deosarkar et al. (2021) use Building Information Modelling (BIM) to create a 3D smart model for a residential building in Pune, India. BIM (Autodesk Revit) helps manage project complexity, coordinates contractor and designer demands, and provides design reports, scheduling, estimation, and clash detection [5].

Hadi et al. (2021) study the use of Building Information Modelling (BIM) for engineers, comparing its integration with structural analysis programs like Robot Structural Analysis and Etabs. They found BIM reduces time, maximizes structural scenarios, and provides economical design with minimal mistakes [6].

Bedilu Habte et al. (2021) highlight the benefits of Building Information Modelling (BIM) in building construction, particularly in structural analysis and design. BIM provides a shared model for all building elements, enabling multi-discipline collaboration without requiring traditional platforms. The research uses Revit, ETABS, and SAFE software for modelling, analysis, design, and clash detection Figure 7 [7].

Zita et al. (2024) created a 4D application using Building Information Modelling (BIM) to simulate buildings, detect incompatibilities, and facilitate collaborative decision-making. The application created a 3D model of architecture, structures, and water supply disciplines using Navisworks and Revit software. However, setbacks like expensive training and equipment procurement may hinder BIM adaptation Figure 8 [8].

Mahendra et al. (2024) use Autodesk Revit architecture to design and model a G+5 residential building. The project uses 2D to 3D computer interfaces and BIM technology for easy modelling.

Figure 7. Integration Revit with ETABS and SAFE software.

Figure 8. Integration Revit software and Navisworks.

Revit Architecture provides clear visualization of buildings, making it useful for commercial buildings before construction. The project uses various templates to create realistic models and estimates, reducing manual work and making the project more sustainable and cost-effective [9].

Microsoft Project (MSP)

Wale et al. (2015) points out the significance of project management and the demerits of conventional techniques such as construction in India. They suggest Microsoft Project (MSP) as a contemporary tool that expedites construction and renders projects cost-effective through proper planning [10, 11].

The poor planning, scheduling, and execution can cause time and cost overruns in projects. The research has analysed manpower planning, scheduling, and resource tracking of a six-story residential block building project executed at Bhopal, Madhya Pradesh. The research has made use of Microsoft Project 2013 for comparing baseline duration and cost with actual duration and cost of the manpower. Effective time and manpower management is essential for effective and timely completion of projects.

Rashmi (2017) stresses the significance of project management in the success of construction projects, pointing out the necessity of systematic use of skills and techniques, including resource optimization and monitoring activities, to minimize time and cost, and even possibly maximize interest cost savings [12].

Tripathi et al. (2018) explore the use of Microsoft project software in planning and scheduling multi-story buildings, focusing on a hypothetical RCC residential G+4 building. The study reveals that the software can create Gantt charts for construction schedules and provide the shortest construction time duration through schedule crunching and project crashing techniques. The research concludes that scheduling is crucial for project managers to minimize time and cost, but cannot guarantee quality due to project completion speed [13].

Prajakta et al. (2019) highlight the significance of money and time in the construction sector, as every project is different in its characteristics. Delays are responsible for extra costs and budget issues. This paper takes into account a housing building project and utilizes Microsoft Project (MSP) for scheduling and planning its implementation, in order to carry out successful execution [14].

Srivastva et al. (2020) emphasize the importance of project planning in project management, using scheduling tools like Gantt charts. They use a case study of a high-rise commercial building to demonstrate the benefits of Microsoft Project (MSP) in accelerating construction and keeping projects cost-effective. They emphasize the need for efficient time schedules and a well-established scheduling system for successful project completion without additional costs [15].

Aldrin (2021) explains the application of computer-based software in project management, in particular, M.S Excel, M.S Project, and Primavera. The thesis aims to plan and schedule a multistorey

building project, Indraprastha Greens, with the help of Microsoft Project. The project constitutes 10 blocks of 7 stories, each having 4 flats. The research applies E-block for scheduling and planning, creating work schedules from excavation to completion, sending critical paths, and assigning resources. The duration and cost of the project are also computed. The thesis proposes that the project duration and cost can be minimized by adjusting the number of workers, availability of materials, and H-frame. The overall time can be shortened from 654 to 643, and the overall cost can be lowered from 37,729,857 to 37,653,357 [16].

Affan et al. (2021) Affan Shaikh et al. (2021) conducted a study on the construction management of high-rise residential structures in key cities. They used Microsoft Project Management Software to schedule activities, resources, and costs. The study identified challenges and provided corrective measures. It also provided insights into the current construction activities in Ariana residency in Borivali, covering time, material, and cost. The project was informative and highlighted crucial elements in such projects [17].

Manish (2022) highlights the complexity of High-Rise building construction, requiring diverse teams and significant investment. Effective resource management is crucial for timely possession delivery and efficiency. Microsoft Project is a popular project management software due to its simplicity. As technology advances, more efficient software becomes more popular [18].

Vikram et al. (2023) explores the use of Microsoft Project software and construction management practices in planning, scheduling, and monitoring a residential bungalow project. The study highlights the advantages of using MS Project, a user-friendly program, for streamlined decision-making and enhanced productivity in scheduling and planning labour activities for the project [19].

Rutuja et al. (2022) study Indian construction techniques for multi-story buildings, comparing traditional methods with Microsoft Project (MSP) for efficiency and cost savings. They used MS software for scheduling and planning materials and labour, resulting in a CPM analysis of 312 days and 1,30,91,600/-. Using MSP, resource allocation was achieved, resulting in a 209-day completion time and cost of 1,10,53,400/- [20].

Hosein et al. (2014) proposed a simulation-based auction protocol (SBAP) framework for effective resource scheduling of large-scale modular construction projects. The system relies on a database to retrieve data, execute a simulation model, and produce graphical reports to assist superintendents and project managers in decision-making. SBAP is able to schedule fast-track projects with reduced data, level resources, and schedule resources by shift and calendars [21].

Other BIM Software Integration

Korman et al. (2008) highlight the challenges of coordinating mechanical, electrical, and plumbing (MEP) systems in building construction, which involves placing equipment and routing HVAC ducts and pipes. Building Information Modelling (BIM) can improve this process by creating a computable, three-dimensional data set that allows visualization of the entire project scope, including cost and installation schedules Figure 9 [22].

Yulong LI et al. (2013) constructed a Teaching Practice Model that integrates BIM technology and Sand Table Simulation for enhancing the teaching quality of Construction Project Management. The model is used to increase students' understanding of BIM software and dynamic construction processes. But it needs to enhance laboratory construction, give process guidance, employ standardized operating processes, and foster teamwork [23].

The study by Kasim et al. (2016) explores the use of Building Information Modelling (BIM) and 3D laser scanning technologies in building construction. It found that while BIM offers cost enhancements,

communication simplicity, and fewer omissions, its adoption is hindered by high costs, training requirements, and large file sizes. The research underscores the need for industry-specific research on these technologies [24].

Ralph Tayeh et al. (2020) developed a new visualization method for building information models and interactive holograms. They created a plugin for model transfer to game engines, software for easy interaction, and a hologram visualization display platform. This innovative approach improved BIM-data, human-building, and human-human interaction levels, making a collaborative visualization tool accessible for construction project teams [25].

Ya Hui Teo et al. (2022) suggest that high-level technology in Building Information Modelling (BIM) can improve productivity, accuracy, and efficiency in the construction sector.

Figure 9. Different types of BIM software used in construction management.

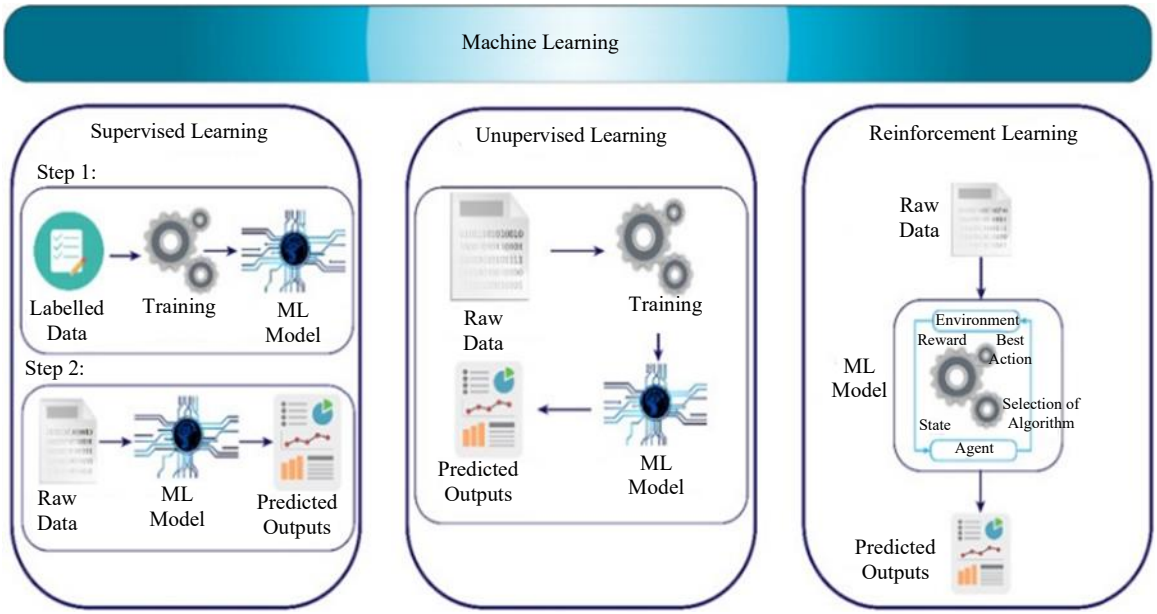


Figure 10. Machine learning.

They propose a hybrid approach of visual programming and machine learning, enabling contractors to deliver work on time and client satisfaction (Figure 10) [26].

Keshav et al. (2022) emphasize the importance of construction management in ensuring timely project completion. They highlight the transformation of the construction sector through Building Information Modelling (BIM), which enhances design transparency, costing, and visualization. The study also highlights the significance of BIM and construction management in overcoming time management, financial constraints, unrealistic expectations, and hazard management [27].

CRITICAL LITERATURE OUTCOMES

1. The integration of Revit with Microsoft Project marks a significant step forward in construction project management. By closely linking Building Information Modeling (BIM) functionality with strong project scheduling and management capabilities, this integration closes the gap between design and delivery.
2. Teams can realize greater collaboration, better communication, and improved efficiency, resulting in more precise project planning and execution.
3. By synchronizing project schedules in real time with precise 3D models, stakeholders are better able to visualize project progress and interdependencies. This not only facilitates risk management and resource planning but also encourages proactive handling of potential issues.
4. The integration allows stakeholders, from architects and engineers to project managers and contractors, to share a common view of project timelines and costs, reducing misunderstandings and conflicting goals.
5. With the development of the construction sector, it is imperative to adopt digital tools for greater productivity and transparency. With the integration of Revit and Microsoft Project, teams are enabled to deliver projects within time and budget while ensuring top-notch quality and reduced waste.
6. To conclude, with this dynamic duo, one can facilitate transformational changes in planning, executing, and managing construction projects, and subsequently propel future construction projects to success.

CASE STUDY (RESIDENTIAL BUNGALOW HOUSE)

Integration of Revit to Microsoft Project

Phase 1: Design Planning in Revit

The initial phase focused on using Revit design and collaborating with various stakeholders.

Key activities included:

1. *Creating 3D Models:* The architectural team developed a detailed 3D model of the building, enhancing visualization for the client and stakeholders.
2. *Collaboration Tools:* Stakeholders used Revit's collaboration features, including shared models and cloud-based coordination, allowing for real-time updates and communication.

The use of Revit was expanded to construction planning:

1. *4D Scheduling:* The team integrated project schedules with the 3D model to create a 4D simulation, enabling visualization of the construction process over time.
2. *Material Take-offs:* Revit's automated quantity take-off features provided accurate material lists, which improved budgeting and procurement planning.

Throughout the construction, ongoing collaboration using Revit allowed for:

1. *Real-Time Updates:* Changes made to the model in response to field conditions were reflected in real-time, ensuring all stakeholders had access to the latest information.
2. *Client Engagement:* Interactive 3D walkthroughs were presented to the client, increasing their engagement and satisfaction Figures 11–13 and Table 1.

Table 1. Project overview.

Project Name	Synnove Atmosphere
Client	Sky Seven Synnove Atmosphere
Construction Firm	Srishti Builders (Commercial + Residential Project)
Location	Vadodara, Gujarat 391101
Project Duration	January 2022 - December 2025 (3Year)
Budget and Build up area	400 Cr. and 40000 square feet
Stakeholders	Client, Architectural, Engineers, General Contractor, Consultants (Structural, MEP, Mechanical, Electrical, Plumbing)

Figure 11. On-site construction photos.

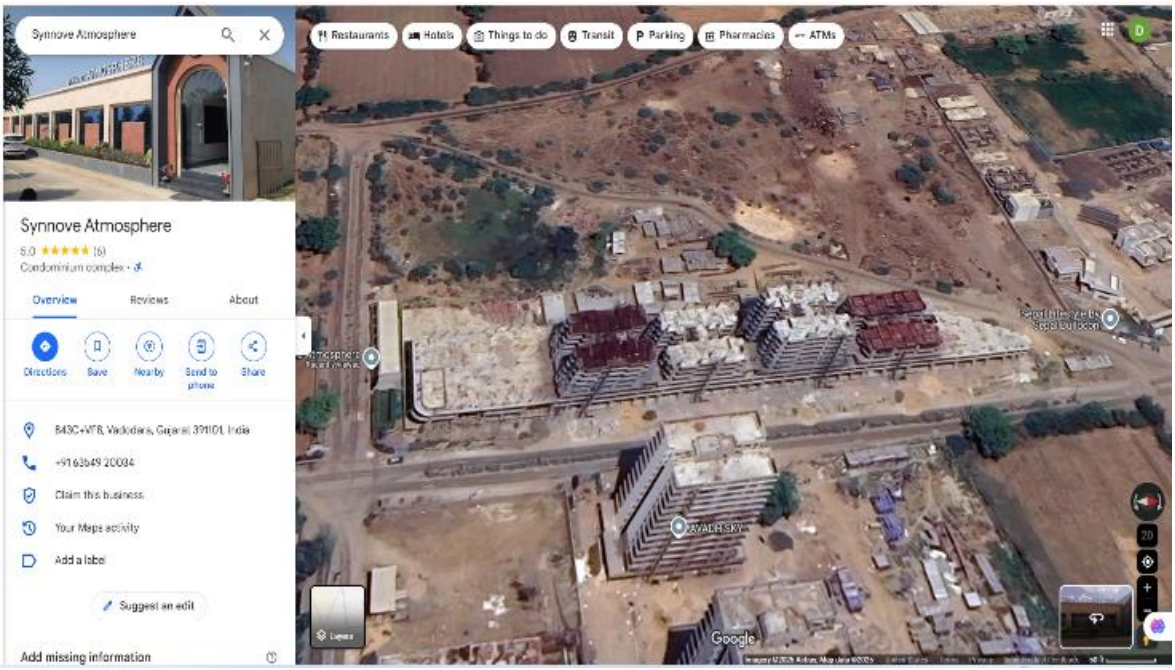


Figure 12. Construction live location.

Phase 2: Construction Planning, Scheduling and Resource Allocation in Microsoft Project

Effective pre-planning using Microsoft Project enables construction teams to visualize the entire project lifecycle, allocate resources judiciously, and set realistic timelines. This structured approach increases the likelihood of delivering the project on time, within budget, and to the desired quality standards.

Benefits of Advance Planning with Microsoft Project

1. Improved resource utilization and reduced risk of overallocation.
2. Early identification of potential delays and cost overruns.
3. Enhanced communication and collaboration among project stakeholders.
4. Streamlined documentation for billing, claims, and regulatory compliance Figures 14–24.

Phase 3: Report and Results

- 1st Stage Construction Work 61% Completed.
- 2nd Stage Construction Work 100% Completed (Figure 25).

Discussions of Possible Solutions to Overcome Delay

1. *Weather condition:* Conducting detailed and perfect surveys towards the field condition and previous weather data.
2. *External factors:* Keep tracking the work carried out by the previous contractors to ensure that delays that are beyond your control are identified and recorded.
3. *Shortage of funds:* Maximize the cash flow as per the needs and ensure fund required for project is available in order to carry out the project.
4. *Deviation of scheduling:* Create detailed and precise schedule to enable convenient and controlled scheduled execution
5. *Lack of communication:* Planning and implementing Management Information System (MIS)
6. *Poor decision-making process:* Conduct regular/regular coordination meeting and create a procedure concerning decision making.
7. *Lack of coordination / Incorrect delegation of authority:* Make a good, simple and easy to understand system to control coordination procedures and responsibility of units. Prepare organization chart with detail job description which contains responsibilities and roles of every function.
8. *Absence of inspection:* Give independent technical personnel or site in-charge for regular inspection and monitoring work process involving late starting, late submission of drawings, errors or mistakes, availability of resources, etc. then appropriate record has to be maintained in order to identify risk and avoid.
9. *Poor planning:* Know the degree of demand and supply in order to prepare detail planning and schedule. Make automatic machine working to prevent scarcity of labour like automatic plastering machine, painting of wall, precast concrete wall, etc.
10. *Lack of knowledge/expertise:* Contractor should be aware of new technique and technology in order to cut down time length for activity or labour force.
11. *Absence of facilities at site:* Site management should be done in appropriate manner to facilitate proper resource; basic facilities for worker are provided to enhance productivity by conducting detail study in site condition.
12. *Inefficient vendor selection:* Take into account supplier day capacity and quality of material in order to select vendors to avoid delay and disputes.
13. *Shortage of labour Early:* owners and contractors should plan workforce to manage effectively the project labour risks. Then giving incentives/awards to workers such as best employer of the year/month so that productivity and quality of work will be enhanced.
14. *Shortage of skilled labour:* Training and upgrading skills to employ new technology and methods for unskilled labours to enhance productivity and efficiency of the worker (Table 2).

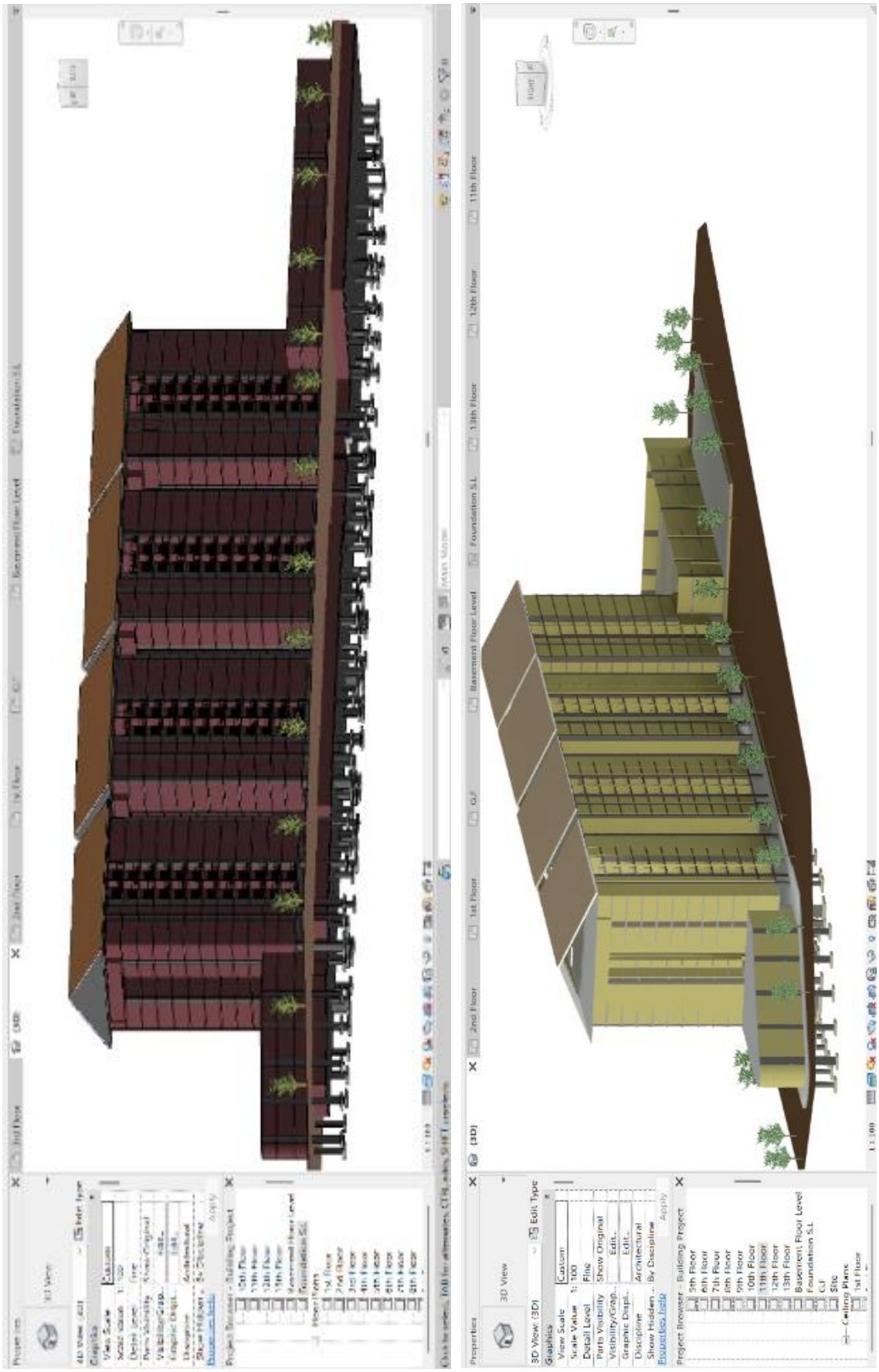
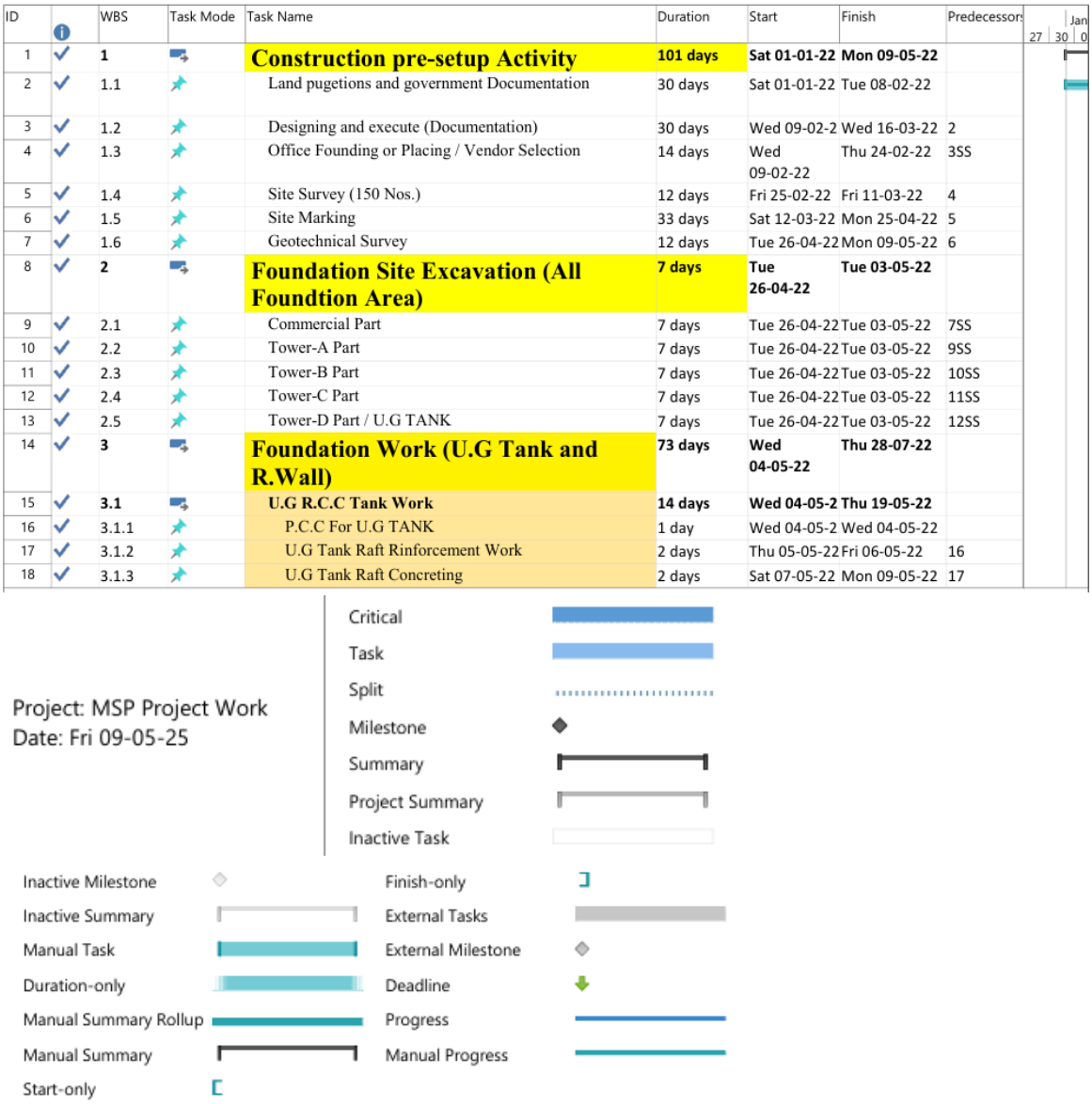


Figure 13. Autodesk revit architecture 3D and 4D modelling.

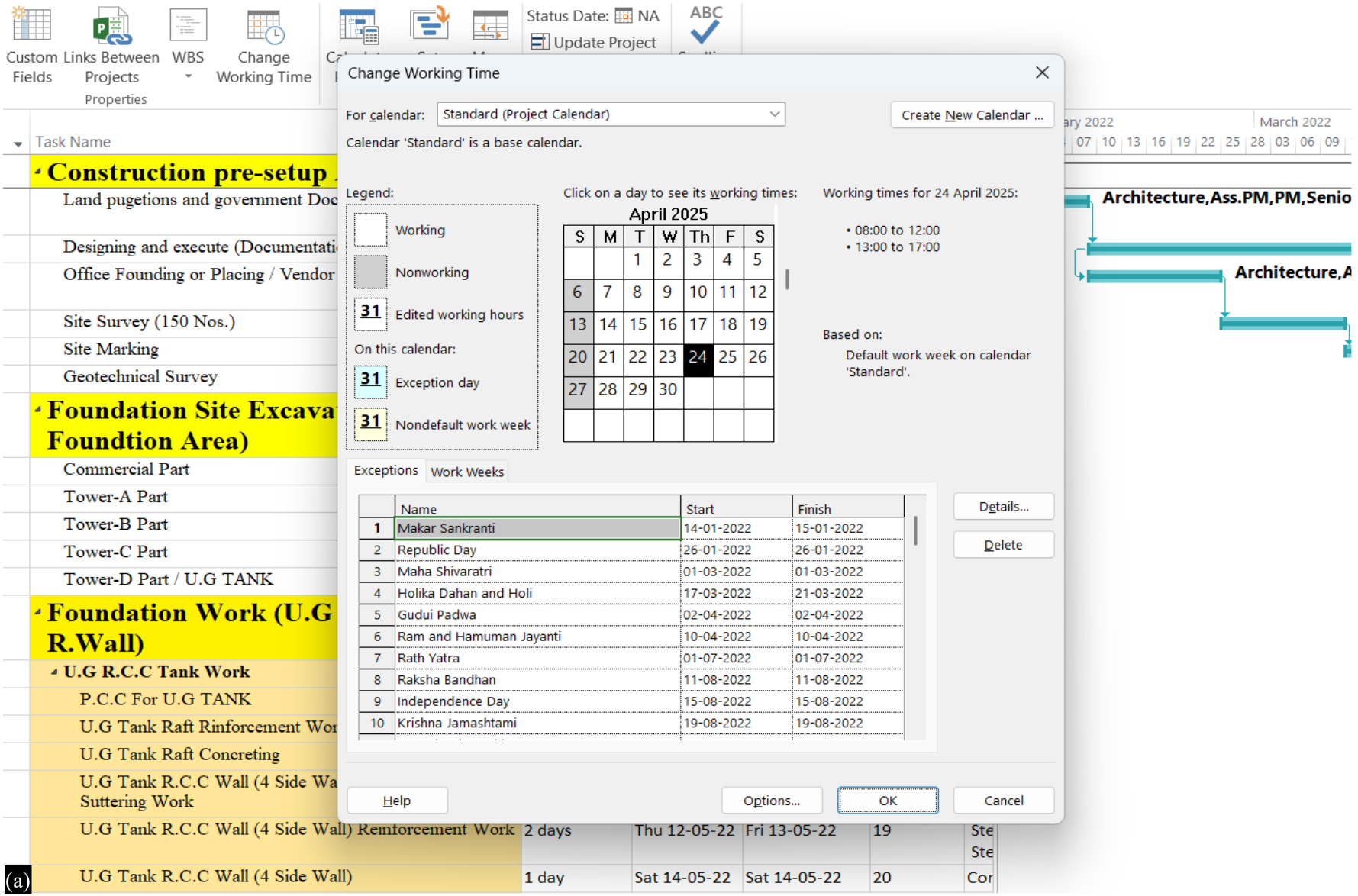


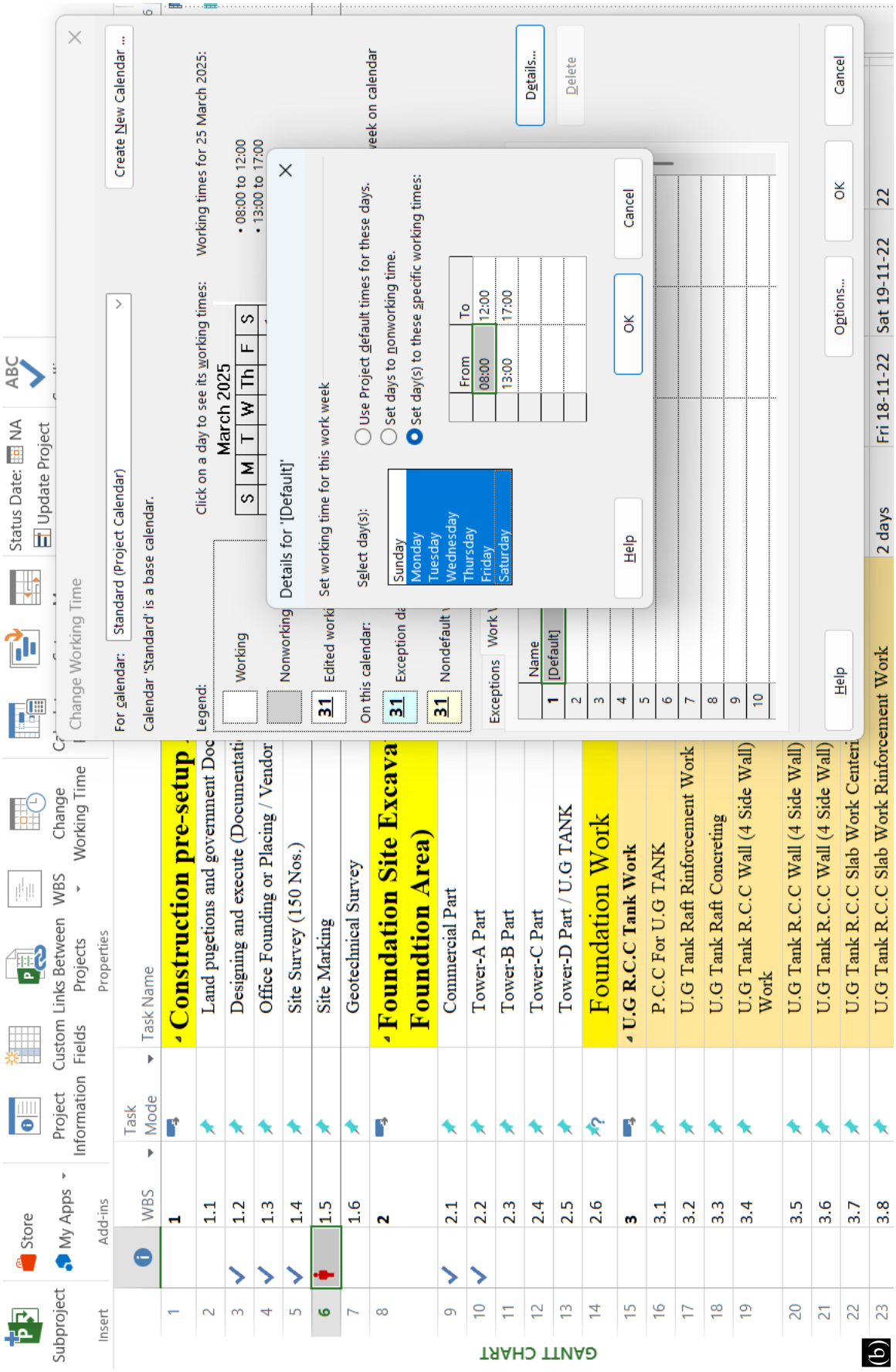
ID	WBS	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1	1		**Construction pre-setup Activity**	**101 days**	**Sat 01-01-22**	**Mon 09-05-22**	
2	1.1		Land pugetions and government Documentation	30 days	Sat 01-01-22	Tue 08-02-22	
3	1.2		Designing and execute (Documentation)	30 days	Wed 09-02-2	Wed 16-03-22	2
4	1.3		Office Founding or Placing / Vendor Selection	14 days	Wed 09-02-22	Thu 24-02-22	3SS
5	1.4		Site Survey (150 Nos.)	12 days	Fri 25-02-22	Fri 11-03-22	4
6	1.5		Site Marking	33 days	Sat 12-03-22	Mon 25-04-22	5
7	1.6		Geotechnical Survey	12 days	Tue 26-04-22	Mon 09-05-22	6
8	2		**Foundation Site Excavation (All Foundtion Area)**	**7 days**	**Tue 26-04-22**	**Tue 03-05-22**	
9	2.1		Commercial Part	7 days	Tue 26-04-22	Tue 03-05-22	7SS
10	2.2		Tower-A Part	7 days	Tue 26-04-22	Tue 03-05-22	9SS
11	2.3		Tower-B Part	7 days	Tue 26-04-22	Tue 03-05-22	10SS
12	2.4		Tower-C Part	7 days	Tue 26-04-22	Tue 03-05-22	11SS
13	2.5		Tower-D Part / U.G TANK	7 days	Tue 26-04-22	Tue 03-05-22	12SS
14	3		**Foundation Work (U.G Tank and R.Wall)**	**73 days**	**Wed 04-05-22**	**Thu 28-07-22**	
15	3.1		**U.G R.C.C Tank Work**	**14 days**	**Wed 04-05-2**	**Thu 19-05-22**	
16	3.1.1		P.C.C For U.G TANK	1 day	Wed 04-05-2	Wed 04-05-22	
17	3.1.2		U.G Tank Raft Rinforcement Work	2 days	Thu 05-05-22	Fri 06-05-22	16
18	3.1.3		U.G Tank Raft Concreting	2 days	Sat 07-05-22	Mon 09-05-22	17

Figure 14. Developing plans and create work breakdown structure.

Table 2. Possible solutions to overcome delay.

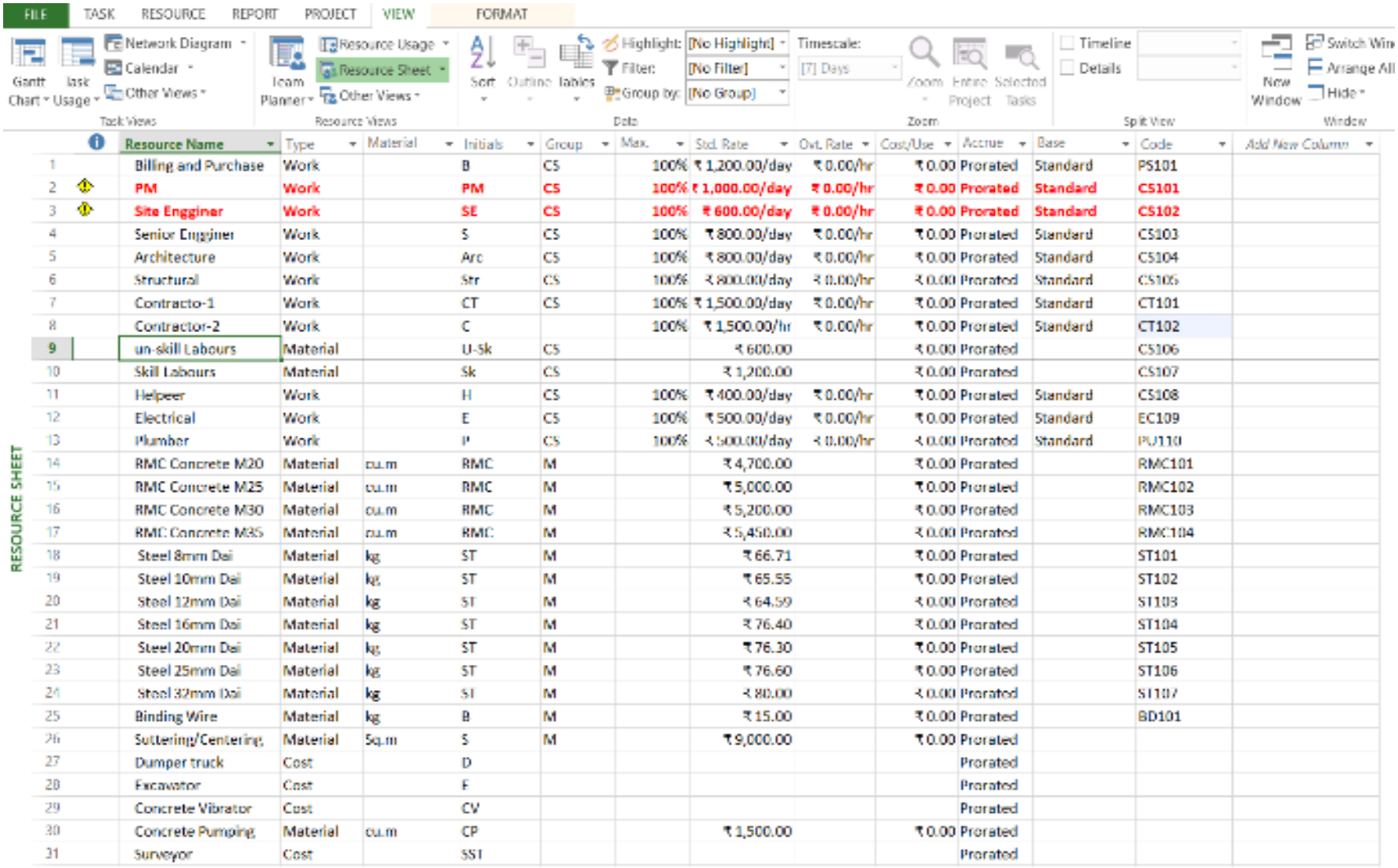
Solution Area	Key Actions	Impact on Delay Reduction
Planning & Scheduling	Task breakdown, dependencies, contingencies	Prevents oversights, prepares for risks
Communication	Frequent updates, clear roles, digital tools	Reduces misunderstandings, aligns teams
Technology	Project management software, BIM, drones, digitization	Increases efficiency, real-time tracking
Resource Management	Dynamic allocation, overtime, shift adjustments	Maintains productivity, recovers lost time
Risk & Contingency Planning	Early risk ID, backup plans, risk matrices	Enables rapid response to issues
On-Site Activity Adjustment	Re-sequencing, fast-tracking	Keeps work moving, shortens delays
Supplier Management	Contract incentives, progress reports, relationship building	Ensures timely delivery, proactive fixes
Continuous Improvement	Monitoring, lessons learned	Drives better future performance





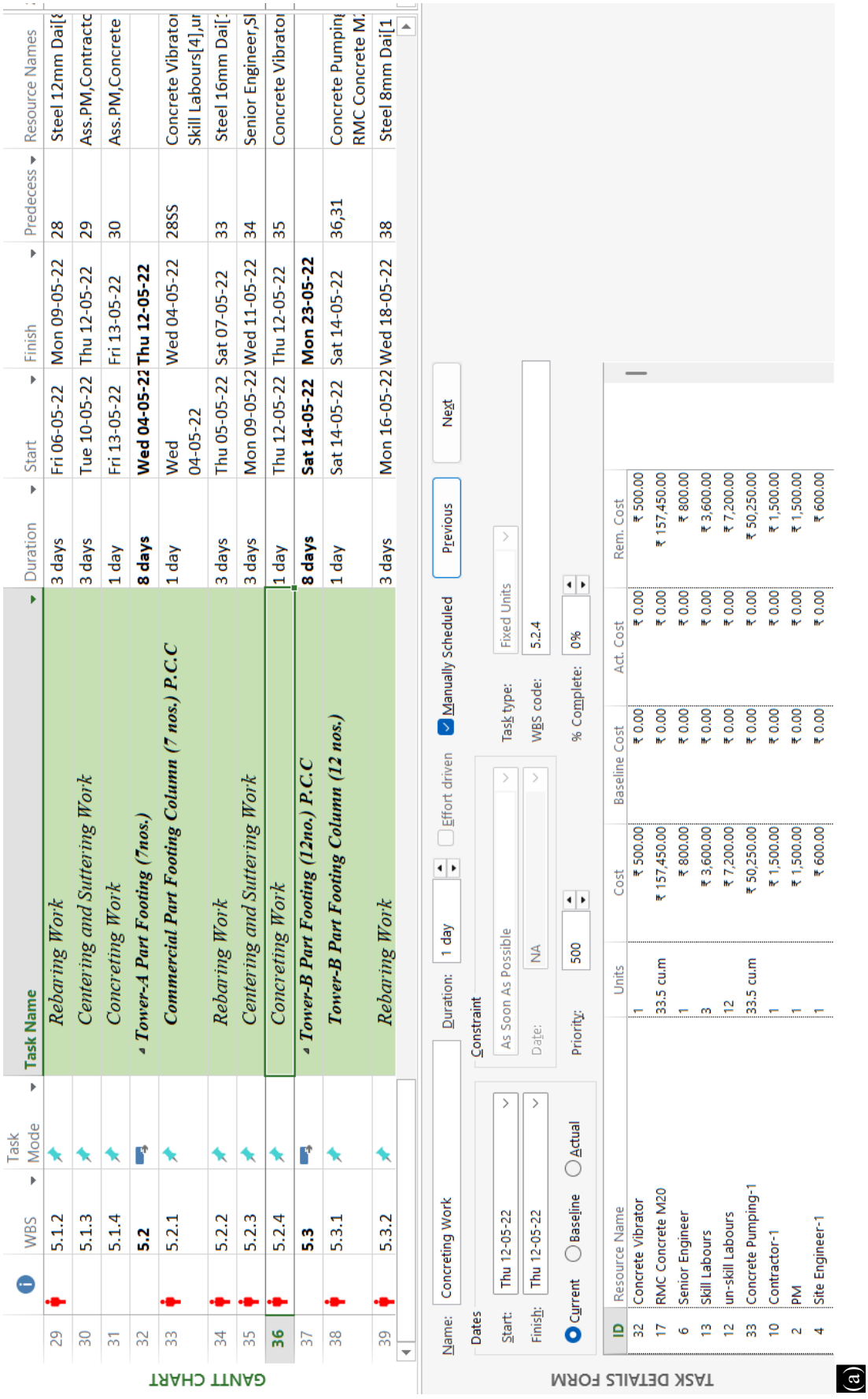
(b)

Figure 15. (a and b) Define calendar and work time.



		Resource Name	Type	Material	Initials	Group	Max.	Std. Rate	Ovt. Rate	Cost/Use	Accrue	Base	Code	Add New Column
1		Billing and Purchase	Work		B	CS	100%	₹ 1,200.00/day	₹ 0.00/hr	₹ 0.00	Prorated	Standard	PS101	
2	⚠	PM	Work		PM	CS	100%	₹ 1,000.00/day	₹ 0.00/hr	₹ 0.00	Prorated	Standard	CS101	
3	⚠	Site Engginer	Work		SE	CS	100%	₹ 600.00/day	₹ 0.00/hr	₹ 0.00	Prorated	Standard	CS102	
4		Senior Engginer	Work		S	CS	100%	₹ 800.00/day	₹ 0.00/hr	₹ 0.00	Prorated	Standard	CS103	
5		Architecture	Work		Arc	CS	100%	₹ 800.00/day	₹ 0.00/hr	₹ 0.00	Prorated	Standard	CS104	
6		Structural	Work		Str	CS	100%	₹ 800.00/day	₹ 0.00/hr	₹ 0.00	Prorated	Standard	CS105	
7		Contracto-1	Work		CT	CS	100%	₹ 1,500.00/day	₹ 0.00/hr	₹ 0.00	Prorated	Standard	CT101	
8		Contractor-2	Work		C		100%	₹ 1,500.00/hr	₹ 0.00/hr	₹ 0.00	Prorated	Standard	CT102	
9		un-skill Labours	Material		U-Sk	CS		₹ 600.00		₹ 0.00	Prorated		CS106	
10		Skill Labours	Material		Sk	CS		₹ 1,200.00		₹ 0.00	Prorated		CS107	
11		Helpeer	Work		H	CS	100%	₹ 400.00/day	₹ 0.00/hr	₹ 0.00	Prorated	Standard	CS108	
12		Electrical	Work		E	CS	100%	₹ 500.00/day	₹ 0.00/hr	₹ 0.00	Prorated	Standard	EC109	
13		Plumber	Work		P	CS	100%	₹ 500.00/day	₹ 0.00/hr	₹ 0.00	Prorated	Standard	PU110	
14		RMC Concrete M20	Material	cu.m	RMC	M		₹ 4,700.00		₹ 0.00	Prorated		RMC101	
15		RMC Concrete M25	Material	cu.m	RMC	M		₹ 5,000.00		₹ 0.00	Prorated		RMC102	
16		RMC Concrete M30	Material	cu.m	RMC	M		₹ 5,200.00		₹ 0.00	Prorated		RMC103	
17		RMC Concrete M35	Material	cu.m	RMC	M		₹ 5,450.00		₹ 0.00	Prorated		RMC104	
18		Steel 8mm Dai	Material	kg	ST	M		₹ 66.71		₹ 0.00	Prorated		ST101	
19		Steel 10mm Dai	Material	kg	ST	M		₹ 65.55		₹ 0.00	Prorated		ST102	
20		Steel 12mm Dai	Material	kg	ST	M		₹ 64.59		₹ 0.00	Prorated		ST103	
21		Steel 16mm Dai	Material	kg	ST	M		₹ 76.40		₹ 0.00	Prorated		ST104	
22		Steel 20mm Dai	Material	kg	ST	M		₹ 76.30		₹ 0.00	Prorated		ST105	
23		Steel 25mm Dai	Material	kg	ST	M		₹ 76.60		₹ 0.00	Prorated		ST106	
24		Steel 32mm Dai	Material	kg	ST	M		₹ 80.00		₹ 0.00	Prorated		ST107	
25		Binding Wire	Material	kg	B	M		₹ 15.00		₹ 0.00	Prorated		BD101	
26		Suttering/Centering	Material	Sq.m	S	M		₹ 9,000.00		₹ 0.00	Prorated			
27		Dumper truck	Cost		D						Prorated			
28		Excavator	Cost		E						Prorated			
29		Concrete Vibrator	Cost		CV						Prorated			
30		Concrete Pumping	Material	cu.m	CP			₹ 1,500.00		₹ 0.00	Prorated			
31		Surveyor	Cost		SST						Prorated			

Figure 16. Preparing and planning Resource Sheet.



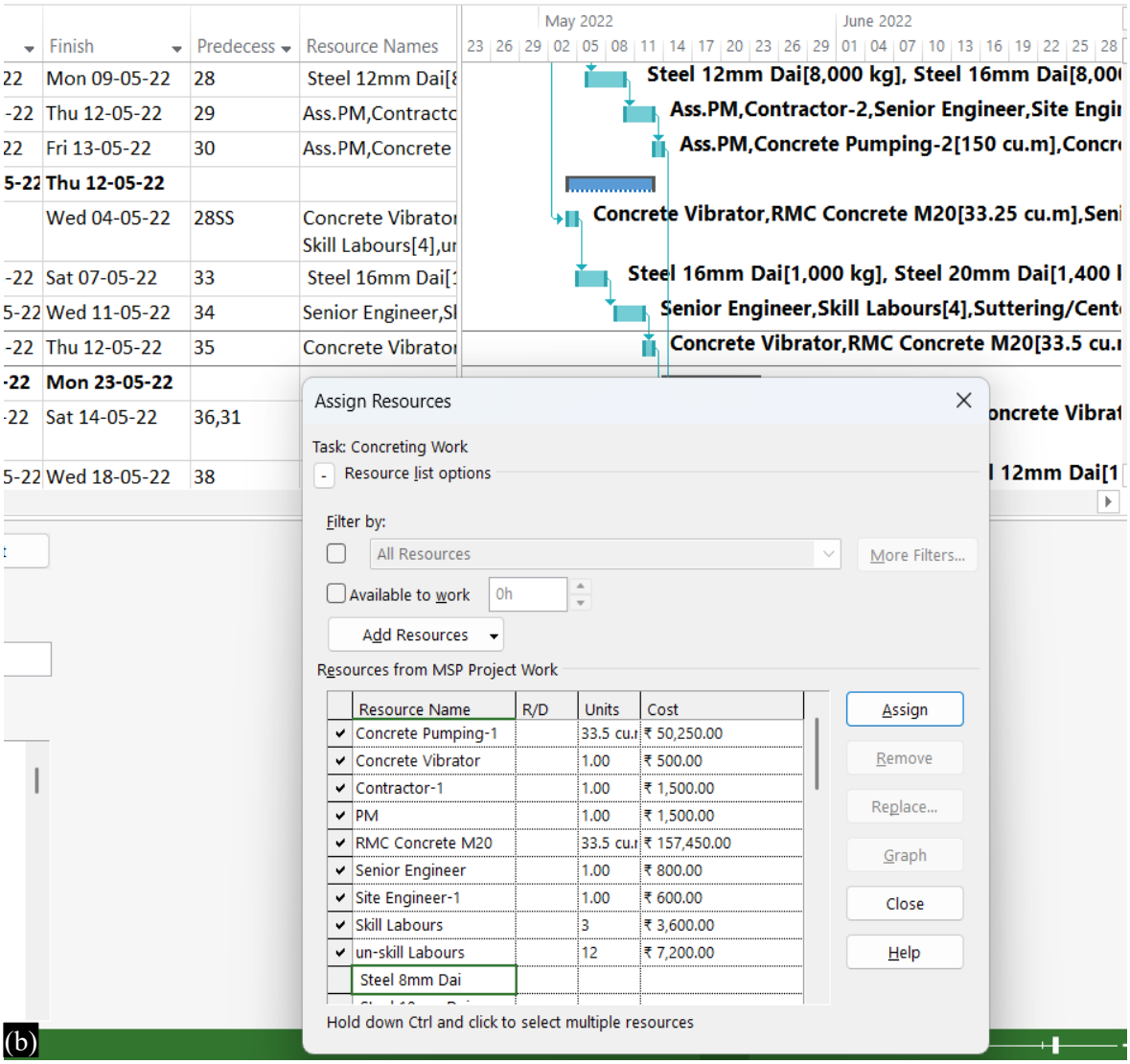


Figure 17. (a and b) assign resources.

CONCLUSIONS

- In conclusion, this construction project was strategically planned with a clear objective to complete the work within the stipulated 48 months for company project manager schedule was prepared to finish the work by 48 months excluding grace period of 6 months and the project manager also work based on advance construction planning and Budgeting, which is commonly implemented in all construction companies.
- Reason responsible for maximum no. of delay for labour shortage.
- Max cost incurred due to A delay for not follow proper planning, scheduling and coordination of stakeholders.
- The initial estimated cost of the project Rs. 1,103,929,353.30/-
- The schedule was lacking along with the delay in process due to problems in lack of manpower and materials, shortage of labour and the main reason for the delay observed was the inadequate coordination and productivity of contractor labour etc.
- Scheduling using computer as a tool was found to be easy and accurate. Software used here i.e., MS project. The project schedule and project track generation were its main highlight. The schedule report helps in identifying start date, finish date, total float, also the duration of the project as A whole. The schedule tracking report helps in delay calculation.

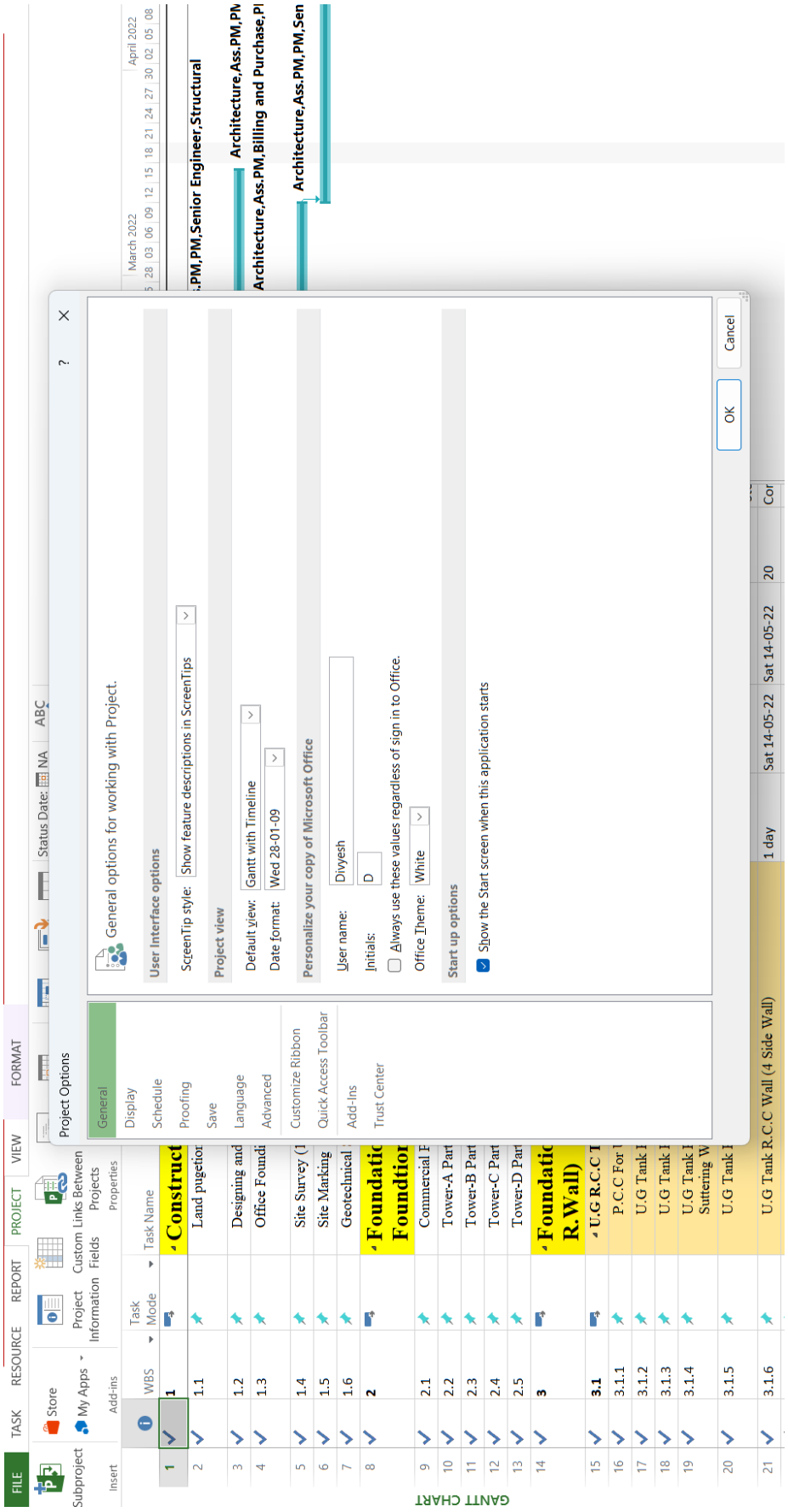
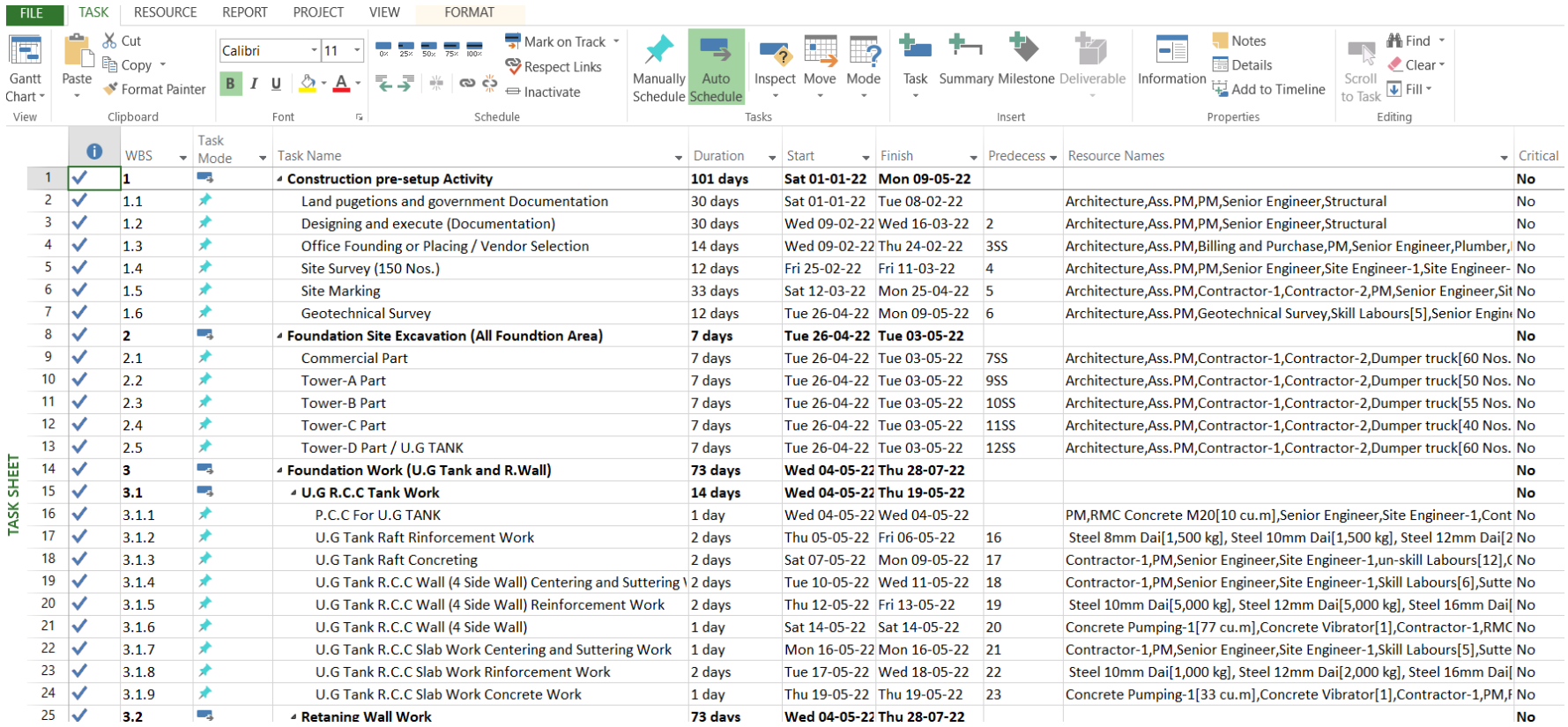


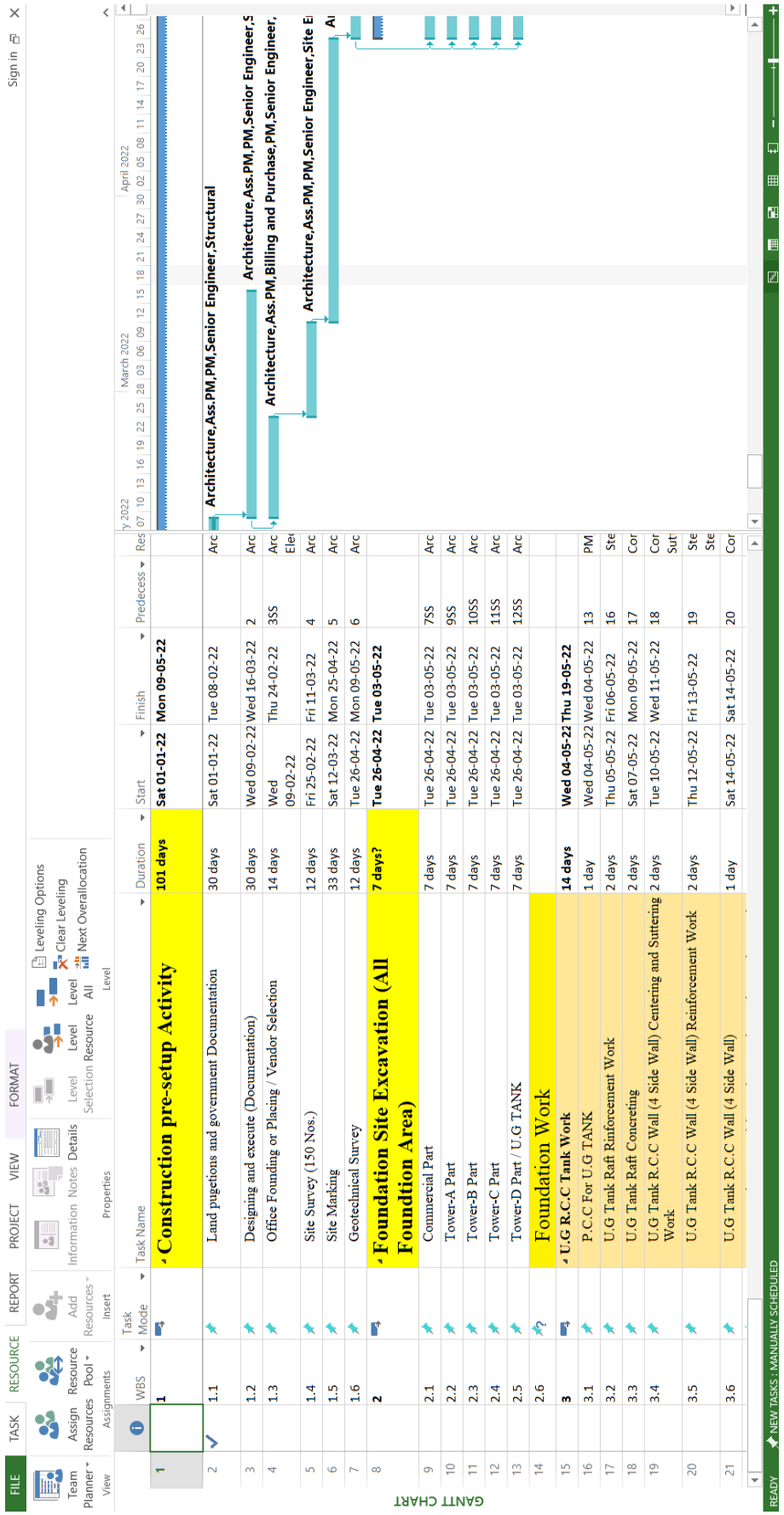
Figure 18. Project options.



		WBS	Task Mode	Task Name	Duration	Start	Finish	Predecess	Resource Names	Critical
1	✓	**1**		**Construction pre-setup Activity**	**101 days**	**Sat 01-01-22**	**Mon 09-05-22**			**No**
2	✓	1.1		Land pugetions and government Documentation	30 days	Sat 01-01-22	Tue 08-02-22		Architecture,Ass.PM,PM,Senior Engineer,Structural	No
3	✓	1.2		Designing and execute (Documentation)	30 days	Wed 09-02-22	Wed 16-03-22	2	Architecture,Ass.PM,PM,Senior Engineer,Structural	No
4	✓	1.3		Office Founding or Placing / Vendor Selection	14 days	Wed 09-02-22	Thu 24-02-22	3SS	Architecture,Ass.PM,Billing and Purchase,PM,Senior Engineer,Plumber,	No
5	✓	1.4		Site Survey (150 Nos.)	12 days	Fri 25-02-22	Fri 11-03-22	4	Architecture,Ass.PM,PM,Senior Engineer,Site Engineer-1,Site Engineer-	No
6	✓	1.5		Site Marking	33 days	Sat 12-03-22	Mon 25-04-22	5	Architecture,Ass.PM,Contractor-1,Contractor-2,PM,Senior Engineer,Sit	No
7	✓	1.6		Geotechnical Survey	12 days	Tue 26-04-22	Mon 09-05-22	6	Architecture,Ass.PM,Geotechnical Survey,Skill Labours[5],Senior Engin	No
8	✓	**2**		**Foundation Site Excavation (All Foundtion Area)**	**7 days**	**Tue 26-04-22**	**Tue 03-05-22**			**No**
9	✓	2.1		Commercial Part	7 days	Tue 26-04-22	Tue 03-05-22	7SS	Architecture,Ass.PM,Contractor-1,Contractor-2,Dumper truck[60 Nos.	No
10	✓	2.2		Tower-A Part	7 days	Tue 26-04-22	Tue 03-05-22	9SS	Architecture,Ass.PM,Contractor-1,Contractor-2,Dumper truck[50 Nos.	No
11	✓	2.3		Tower-B Part	7 days	Tue 26-04-22	Tue 03-05-22	10SS	Architecture,Ass.PM,Contractor-1,Contractor-2,Dumper truck[55 Nos.	No
12	✓	2.4		Tower-C Part	7 days	Tue 26-04-22	Tue 03-05-22	11SS	Architecture,Ass.PM,Contractor-1,Contractor-2,Dumper truck[40 Nos.	No
13	✓	2.5		Tower-D Part / U.G TANK	7 days	Tue 26-04-22	Tue 03-05-22	12SS	Architecture,Ass.PM,Contractor-1,Contractor-2,Dumper truck[60 Nos.	No
14	✓	**3**		**Foundation Work (U.G Tank and R.Wall)**	**73 days**	**Wed 04-05-22**	**Thu 28-07-22**			**No**
15	✓	**3.1**		**U.G R.C.C Tank Work**	**14 days**	**Wed 04-05-22**	**Thu 19-05-22**			**No**
16	✓	3.1.1		P.C.C For U.G TANK	1 day	Wed 04-05-22	Wed 04-05-22		PM,RMC Concrete M20[10 cu.m],Senior Engineer,Site Engineer-1,Cont	No
17	✓	3.1.2		U.G Tank Raft Rinforcement Work	2 days	Thu 05-05-22	Fri 06-05-22	16	Steel 8mm Dai[1,500 kg], Steel 10mm Dai[1,500 kg], Steel 12mm Dai[2	No
18	✓	3.1.3		U.G Tank Raft Concreting	2 days	Sat 07-05-22	Mon 09-05-22	17	Contractor-1,PM,Senior Engineer,Site Engineer-1,un-skill Labours[12],(	No
19	✓	3.1.4		U.G Tank R.C.C Wall (4 Side Wall) Centering and Suttering \	2 days	Tue 10-05-22	Wed 11-05-22	18	Contractor-1,PM,Senior Engineer,Site Engineer-1,Skill Labours[6],Sutte	No
20	✓	3.1.5		U.G Tank R.C.C Wall (4 Side Wall) Reinforcement Work	2 days	Thu 12-05-22	Fri 13-05-22	19	Steel 10mm Dai[5,000 kg], Steel 12mm Dai[5,000 kg], Steel 16mm Dai[	No
21	✓	3.1.6		U.G Tank R.C.C Wall (4 Side Wall)	1 day	Sat 14-05-22	Sat 14-05-22	20	Concrete Pumping-1[77 cu.m],Concrete Vibrator[1],Contractor-1,RMC	No
22	✓	3.1.7		U.G Tank R.C.C Slab Work Centering and Suttering Work	1 day	Mon 16-05-22	Mon 16-05-22	21	Contractor-1,PM,Senior Engineer,Site Engineer-1,Skill Labours[5],Sutte	No
23	✓	3.1.8		U.G Tank R.C.C Slab Work Rinforcement Work	2 days	Tue 17-05-22	Wed 18-05-22	22	Steel 10mm Dai[1,000 kg], Steel 12mm Dai[2,000 kg], Steel 16mm Dai[	No
24	✓	3.1.9		U.G Tank R.C.C Slab Work Concrete Work	1 day	Thu 19-05-22	Thu 19-05-22	23	Concrete Pumping-1[33 cu.m],Concrete Vibrator[1],Contractor-1,PM,F	No
25	✓	**3.2**		**Retaning Wall Work**	**73 days**	**Wed 04-05-22**	**Thu 28-07-22**			**No**

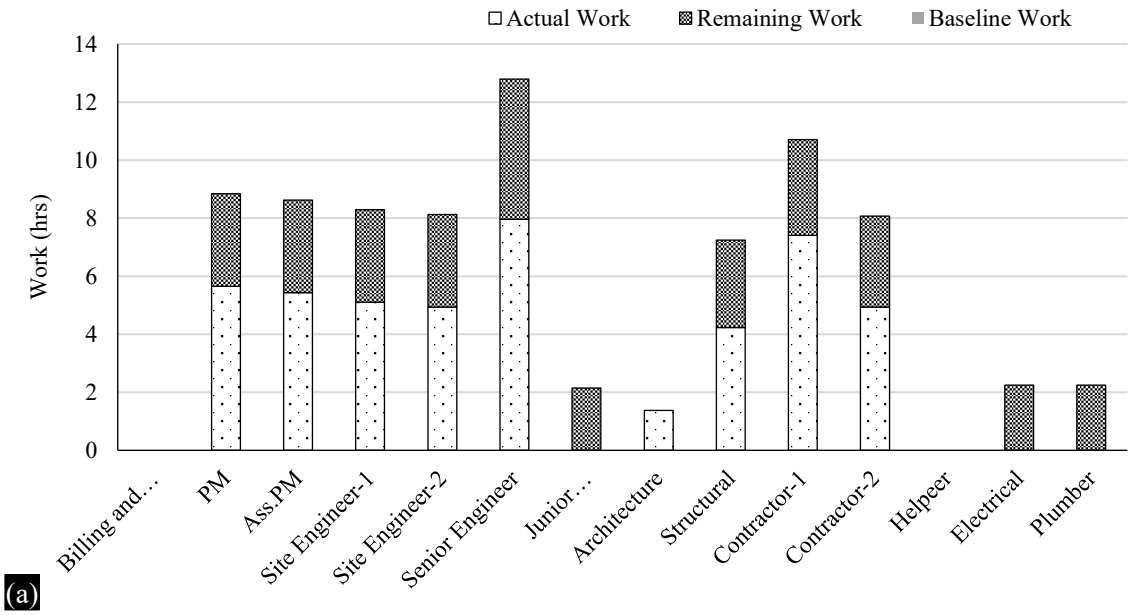
Figure 19. Work task sheet.

Figure 20. Resource overallocated graph analysis.

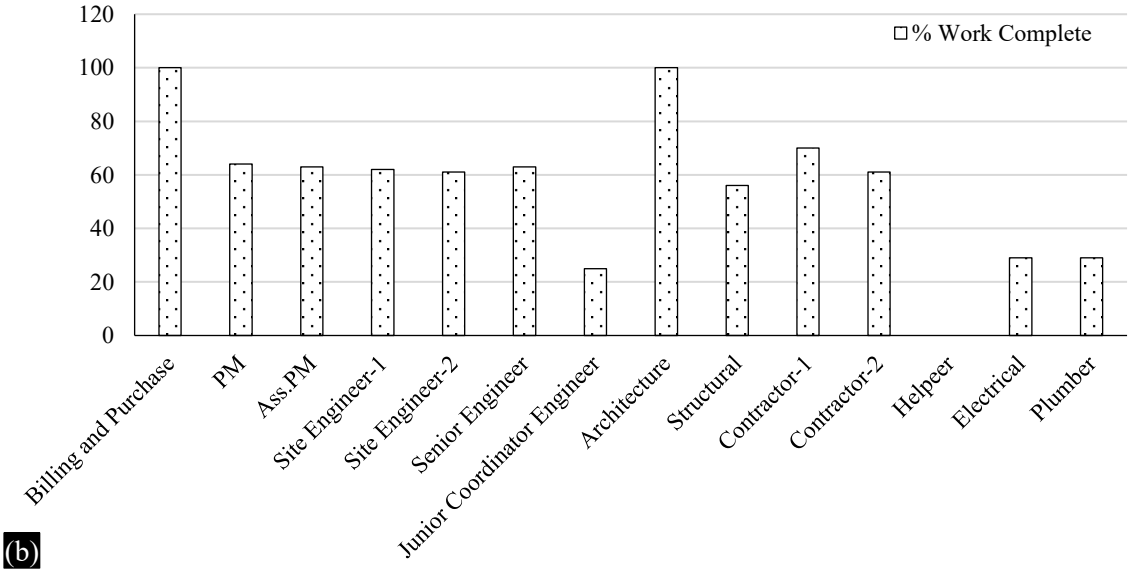


	WBS	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1	1		**Construction pre-setup Activity**	**101 days**	**Sat 01-01-22**	**Mon 09-05-22**		
2	1.1		Land pugetions and government Documentation	30 days	Sat 01-01-22	Tue 08-02-22		Arc
3	1.2		Designing and execute (Documentation)	30 days	Wed 09-02-22	Wed 16-03-22	2	Arc
4	1.3		Office Founding or Placing / Vendor Selection	14 days	Wed 09-02-22	Thu 24-02-22	3SS	Arc Ele
5	1.4		Site Survey (150 Nos.)	12 days	Fri 25-02-22	Fri 11-03-22	4	Arc
6	1.5		Site Marking	33 days	Sat 12-03-22	Mon 25-04-22	5	Arc
7	1.6		Geotechnical Survey	12 days	Tue 26-04-22	Mon 09-05-22	6	Arc
8	2		**Foundation Site Excavation (All Foundtion Area)**	**7 days?**	**Tue 26-04-22**	**Tue 03-05-22**		
9	2.1		Commercial Part	7 days	Tue 26-04-22	Tue 03-05-22	7SS	Arc
10	2.2		Tower-A Part	7 days	Tue 26-04-22	Tue 03-05-22	9SS	Arc
11	2.3		Tower-B Part	7 days	Tue 26-04-22	Tue 03-05-22	10SS	Arc
12	2.4		Tower-C Part	7 days	Tue 26-04-22	Tue 03-05-22	11SS	Arc
13	2.5		Tower-D Part / U.G TANK	7 days	Tue 26-04-22	Tue 03-05-22	12SS	Arc
14	2.6		Foundation Work					
15	3		**U.G R.C.C Tank Work**	**14 days**	**Wed 04-05-22**	**Thu 19-05-22**		
16	3.1		P.C.C For U.G TANK	1 day	Wed 04-05-22	Wed 04-05-22	13	PM
17	3.2		U.G Tank Raft Rinforcement Work	2 days	Thu 05-05-22	Fri 06-05-22	16	Ste
18	3.3		U.G Tank Raft Concreting	2 days	Sat 07-05-22	Mon 09-05-22	17	Cor
19	3.4		U.G Tank R.C.C Wall (4 Side Wall) Centering and Suttering Work	2 days	Tue 10-05-22	Wed 11-05-22	18	Cor Sut
20	3.5		U.G Tank R.C.C Wall (4 Side Wall) Reinforcement Work	2 days	Thu 12-05-22	Fri 13-05-22	19	Ste Ste
21	3.6		U.G Tank R.C.C Wall (4 Side Wall)	1 day	Sat 14-05-22	Sat 14-05-22	20	Cor

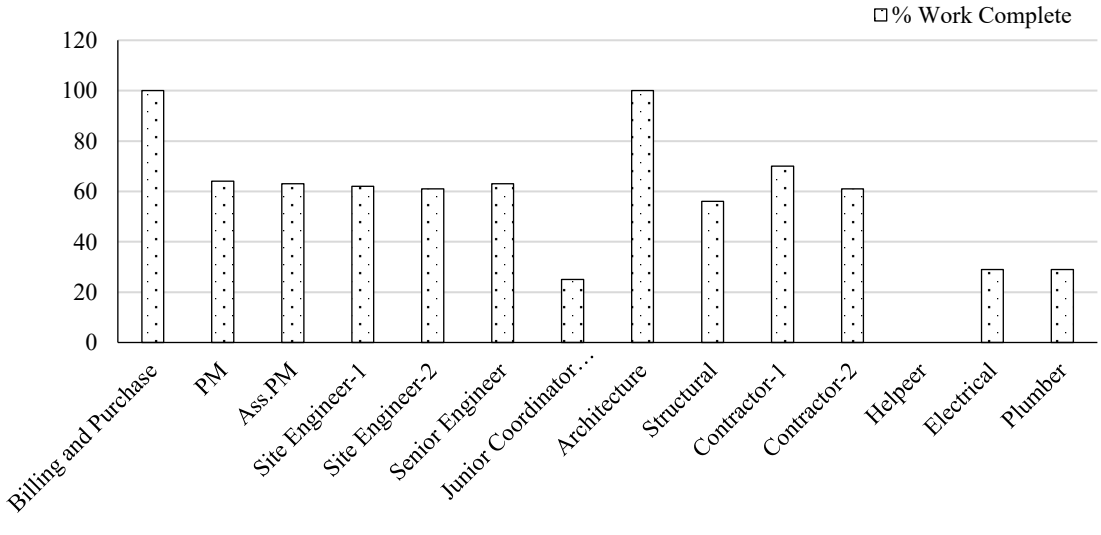
Figure 21. Overallocated resources levelling.



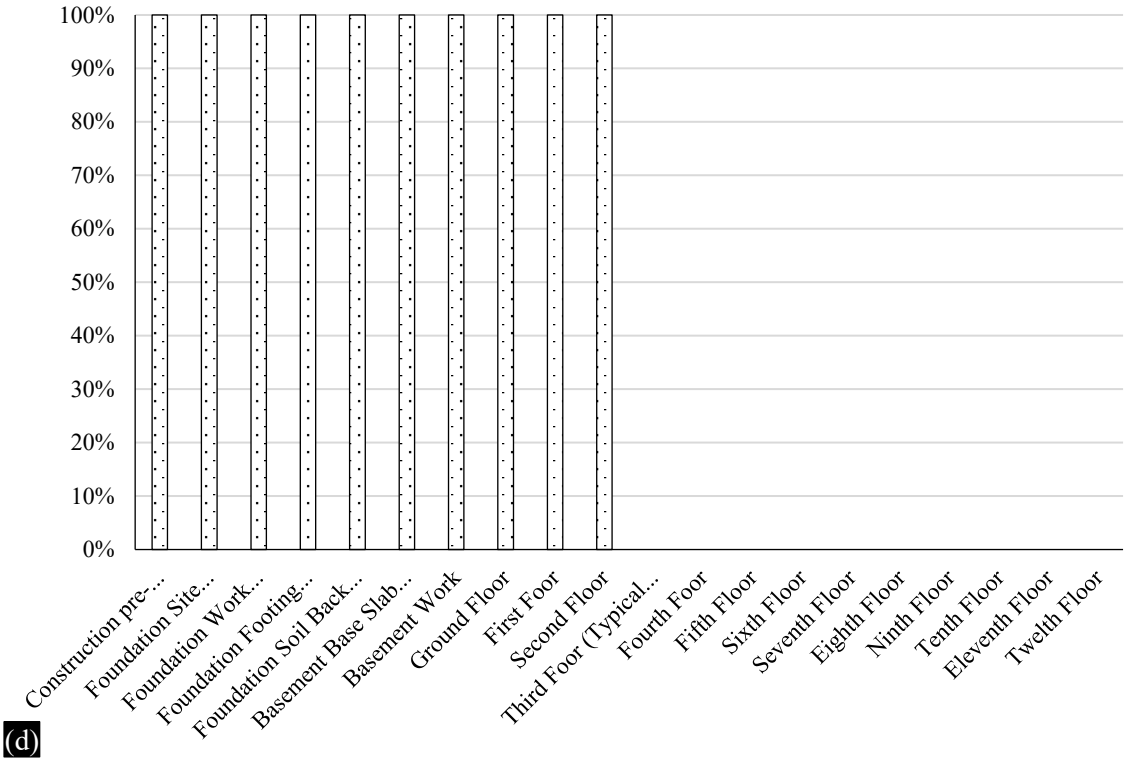
(a)



(b)



(c)



(d)

Figure 22. (a-d) Phase 3: report and results.

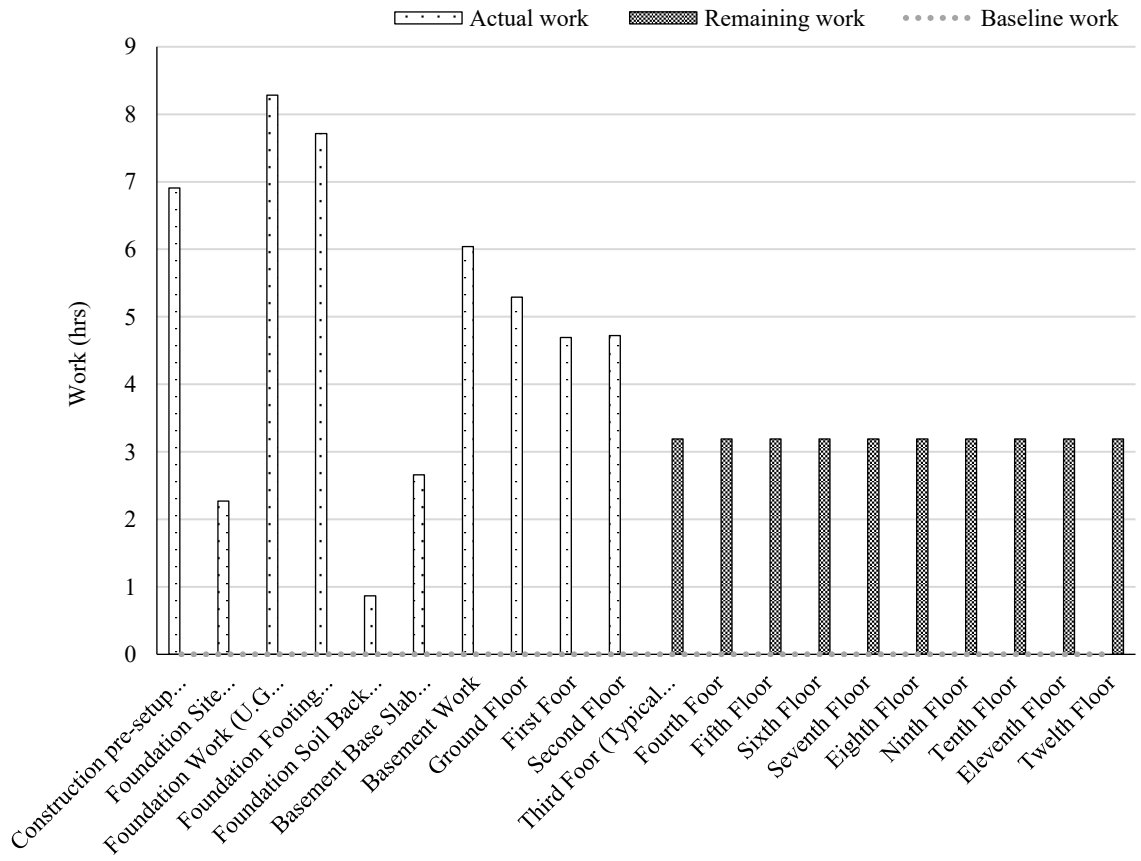
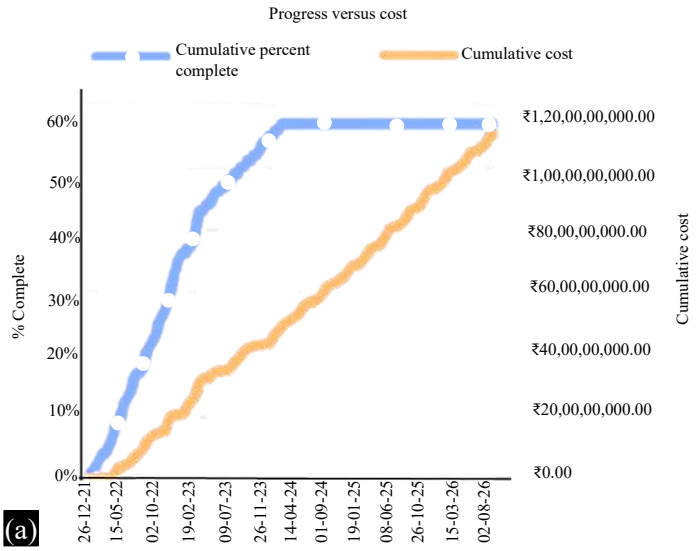
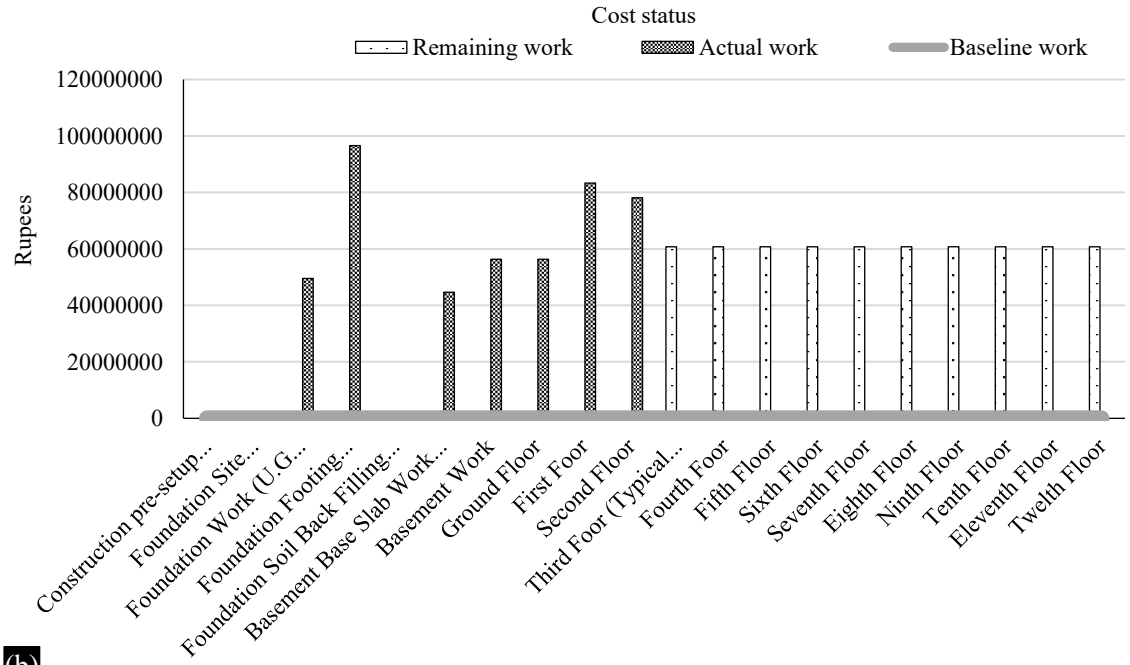


Figure 23. Work completed in hours.



(a)



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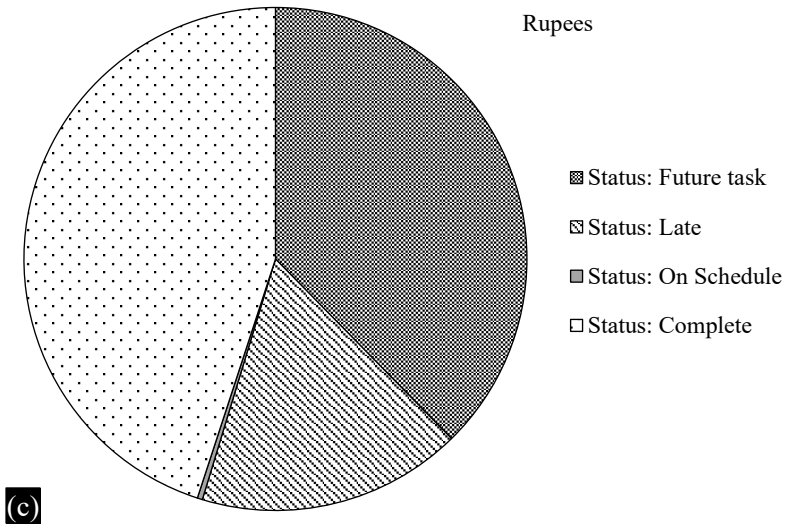

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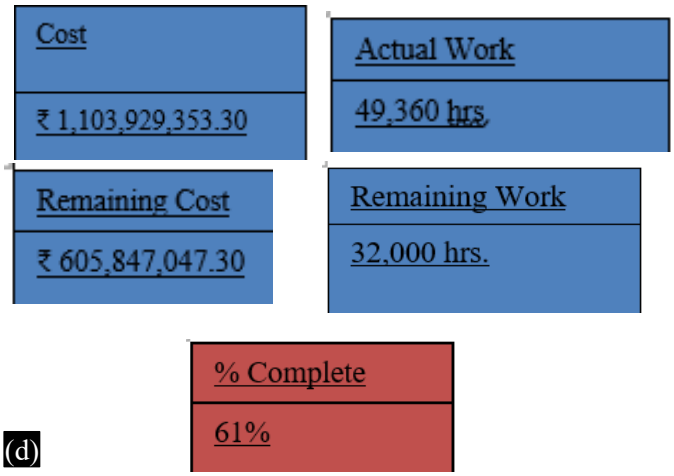
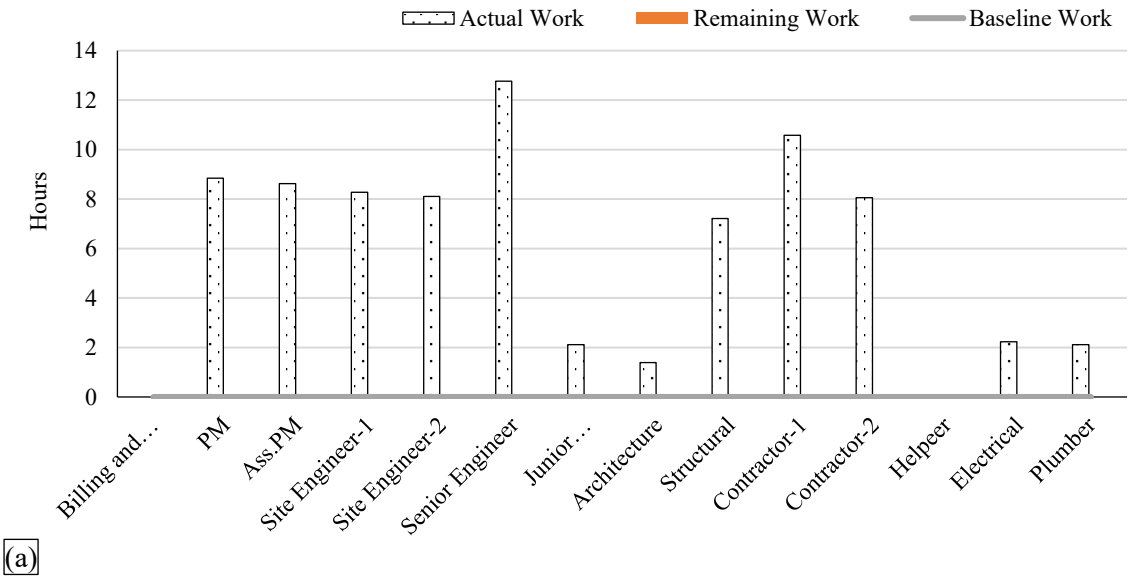
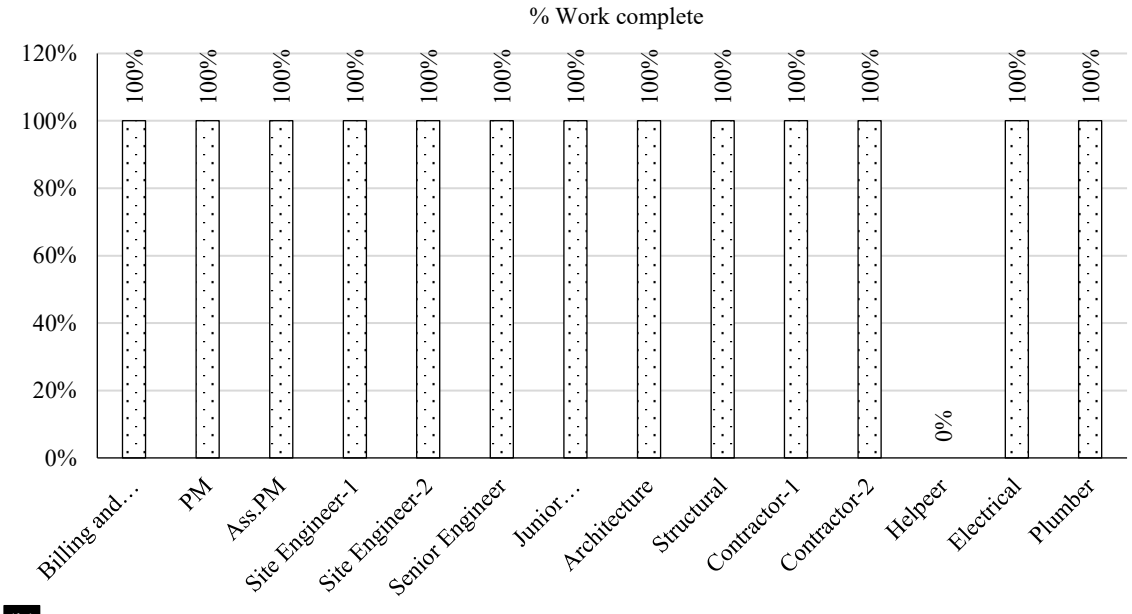


(d)

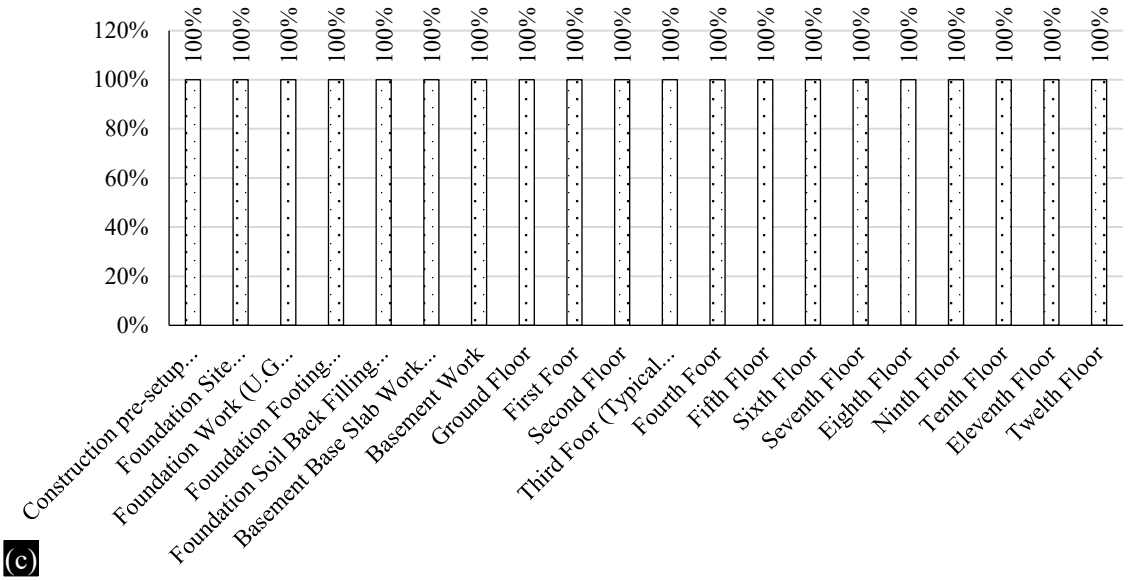
Figure 24. (a-d) Cost overview.



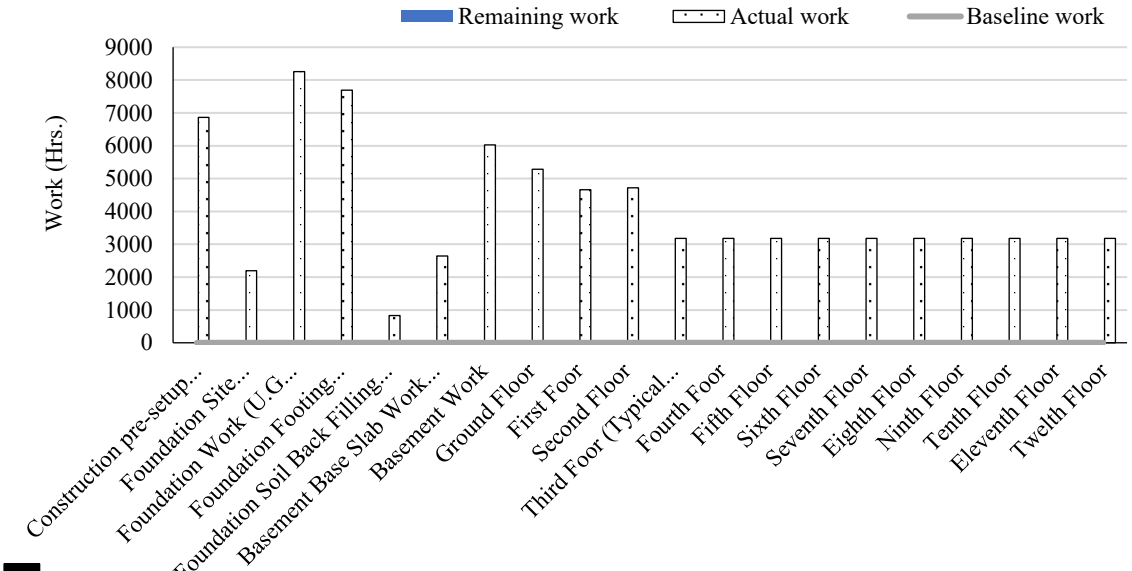
(a)



(b)



(c)



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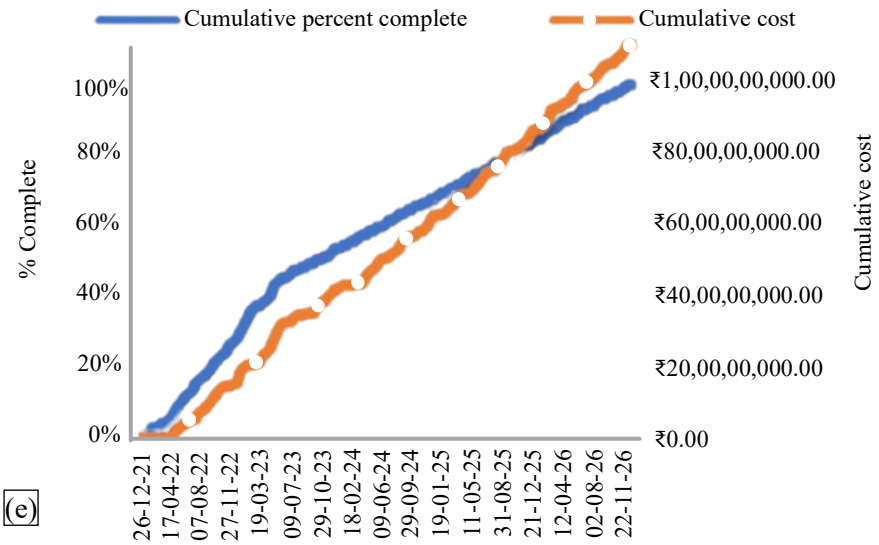
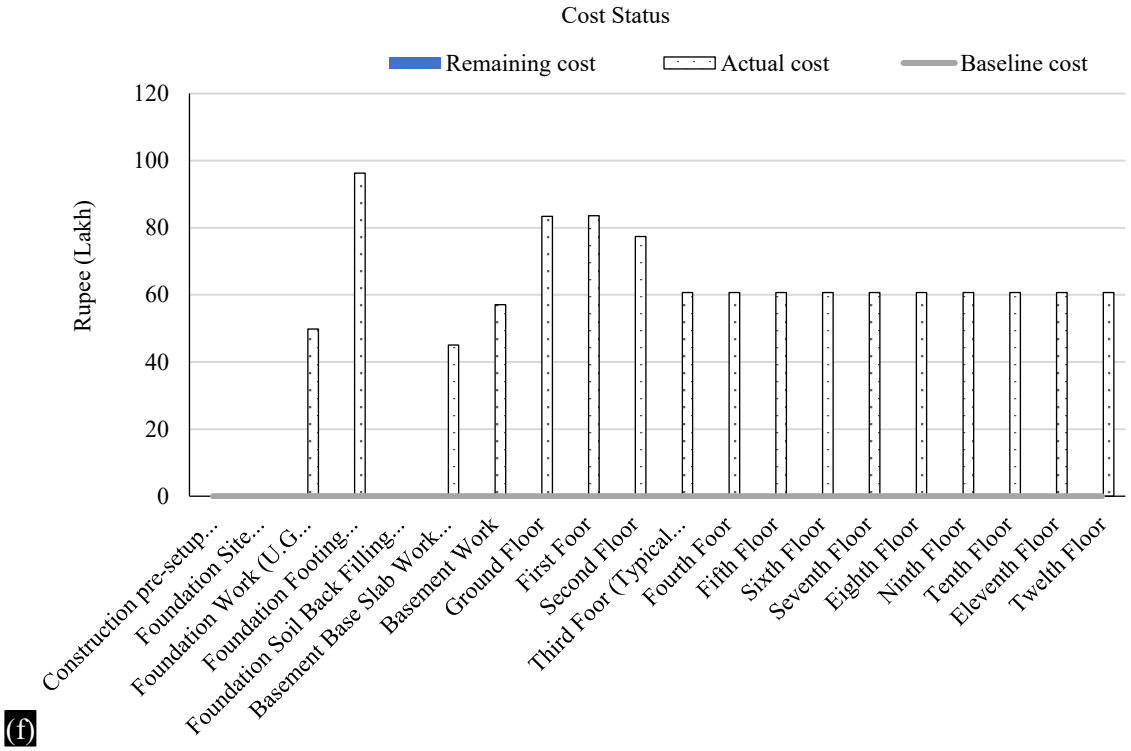
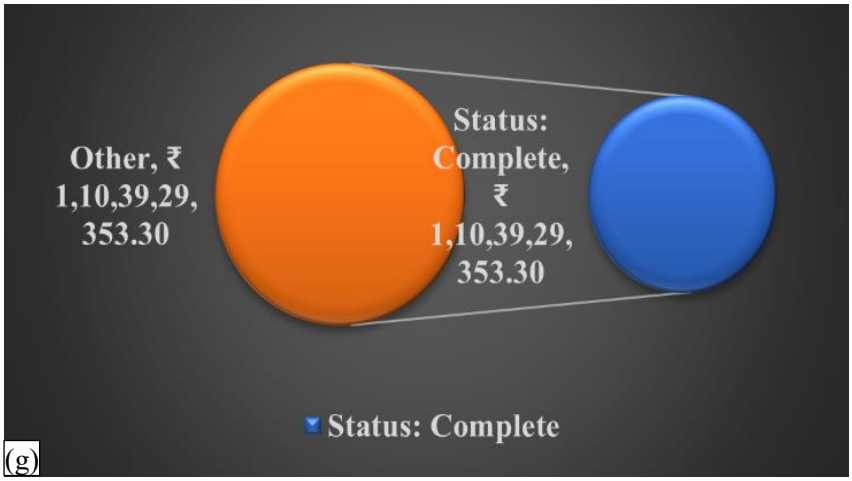


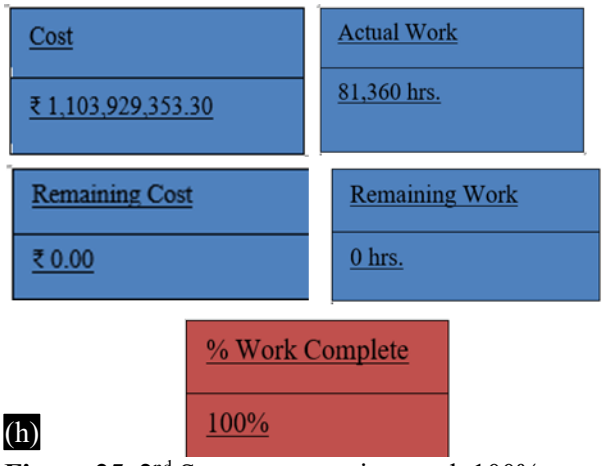
(e)



(f)



(g)



(h)

Figure 25. 2nd Stage construction work 100% completed.

Moving forward, this experience underscores the necessity for rigorous planning, scheduling, and enhanced stakeholder coordination in order to mitigate delays and optimize project execution. By addressing labour shortages and emphasizing effective communication and productivity in contractor coordination, similar projects can be completed within their designated timelines and budgets.

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