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Planning Efficiency Analysis of A 2B+G+12 High-Rise Building Using Microsoft Project: A Case Study

Aditya Sagar[1], Niketan Keshari[2], Dr. Shobha Ram[3]
[1,2]MTech Student, Construction Planning and Management Engineering, Department of Civil Engineering, University School of Engineering, Gautam Buddha University, Greater Noida, India
[2]Head of Department, Department of Civil Engineering, University School of Engineering, Gautam Buddha University, Greater Noida, India

***Abstract*—High-rise building construction requires systematic planning, realistic scheduling, resource allocation and continuous monitoring to achieve timely project completion. This paper presents a case-study-based planning efficiency analysis of a 2 Basement + Ground + 12 upper-floor reinforced cement concrete high-rise building using Microsoft Project. The study develops a structured construction schedule consisting of 69 activities, supported by work breakdown structure, BOQ-to-activity mapping, activity dependency logic, critical path method, resource loading, schedule variance analysis and Relative Importance Index based delay factor ranking. The baseline schedule was prepared for a planned duration of 720 days, while the actual completion duration was considered as 780 days, indicating a delay of 60 days. Corrective planning measures, including improved procurement tracking, labour deployment, formwork rotation, weekly look-ahead planning and MEP coordination, reduced the revised duration to 735 days. The original planning efficiency was calculated as 92.31 percent, while the improved planning efficiency reached 97.96 percent. The results indicate that material procurement delay, labour productivity and shortage, drawing and approval delay, poor site coordination and equipment non-availability are the major factors affecting schedule performance. The paper concludes that Microsoft Project is an effective tool for planning and monitoring high-rise building projects when used with realistic activity sequencing, critical path monitoring, resource control and regular progress review.**

***Index Terms*—Construction planning, Microsoft Project, high-rise building, critical path method, planning efficiency, schedule variance, Relative Importance Index, resource planning.**

I. INTRODUCTION

Construction planning is a core function of construction project management because it directly influences project duration, resource utilisation, site coordination, monitoring and final completion. A building project cannot be completed successfully only by preparing drawings and executing work at site. It requires systematic sequencing of construction activities, realistic duration estimation, timely availability of labour, materials and equipment, and continuous progress monitoring. Weak planning generally results in project delay, idle resources, rework, productivity loss and difficulty in achieving the planned completion date.

High-rise building construction is more complex than low-rise construction due to the large number of interdependent activities. In a multi-storey RCC project, activities such as excavation, dewatering, raft foundation, basement retaining walls, RCC frame, masonry, MEP services, plastering, flooring, painting, lift installation, testing, commissioning and handover must be executed in a logical sequence. A delay in one critical activity can affect many succeeding activities and reduce overall planning efficiency.

In a 2B+G+12 high-rise building, basement construction is one of the most critical stages because it includes excavation, dewatering, raft foundation, retaining walls, waterproofing, ramp works, parking provisions, water storage, pump room, fire-fighting services and electrical room works. Delay in basement work directly affects the start of the ground floor and superstructure. After completion of the basement and ground floor, the upper floors follow a repeated RCC floor cycle. Therefore, even a small delay in a typical floor cycle may create cumulative delay in the total project duration.

Microsoft Project is widely used as a practical scheduling tool for preparing activity lists, assigning durations, linking predecessor-successor relationships, generating Gantt charts, identifying critical path activities, analysing float, assigning resources and monitoring planned versus actual progress. This paper focuses on the use of Microsoft Project for planning efficiency analysis of a 2 Basement + Ground + 12 high-rise RCC building project located in Noida, Uttar Pradesh.

II. PROBLEM STATEMENT AND OBJECTIVES

High-rise construction projects frequently face schedule delays due to poor planning, weak monitoring, material procurement delay, labour productivity issues, equipment breakdown, drawing approval delay, poor site coordination and slow repeated floor cycles. These issues become more serious in a 2B+G+12 building because basement works, RCC floor cycles, MEP services, finishing works, lift installation, testing and commissioning are strongly interdependent.

The main problem addressed in this study is the evaluation of planning and scheduling efficiency in a 2B+G+12 high-rise building using Microsoft Project. The study focuses on the relationship between planned duration, actual duration, revised duration, schedule variance, critical path, resource utilisation and delay factors affecting schedule performance.

The main objectives of the study are to prepare a construction schedule using Microsoft Project, identify major construction activities, study activity dependency relationships, compare planned and actual duration, calculate schedule variance and planning efficiency, identify critical path activities, analyse resource-related issues, rank major delay factors and recommend measures for improving planning efficiency in high-rise building construction.

III. LITERATURE REVIEW

Previous research in construction management shows that delays are commonly linked with poor planning, slow decision-making, design changes, material shortage, financial constraints, labour productivity issues, equipment failure, poor site supervision, weak coordination and change orders. Chan and Kumaraswamy (1997) identified poor site management, unforeseen ground conditions, slow decision-making and variations as important causes of time overrun. Assaf and Al-Hejji (2006) found that change orders, late payments, poor planning and contractor-related issues significantly affect project duration. Sambasivan and Soon (2007) highlighted that construction delays lead to time overrun, cost pressure, disputes and reduced project performance.

In the context of Indian construction projects, Doloi et al. (2012) reported that decision-making delays, design changes, poor labour productivity and coordination problems are major causes of delay. Delay ranking studies such as Aziz (2013) and Khatib et al. (2020) indicate that Relative Importance Index can be used to identify the most influential delay factors. Studies related to Microsoft Project show that scheduling software supports activity sequencing, duration allocation, dependency relationships, Gantt chart preparation, critical path analysis and monitoring of planned versus actual progress.

The reviewed literature confirms that construction delay is a multidimensional problem. However, many studies discuss construction delay in a general manner and limited studies specifically connect a 2 Basement + Ground + 12 high-rise RCC building with Microsoft Project-based planning efficiency, BOQ-to-schedule mapping, resource loading, critical path analysis and corrective scheduling. This research attempts to fill this gap through a focused case study.

IV. RESEARCH METHODOLOGY

The research methodology adopted for this paper is descriptive and analytical. The descriptive part explains the selected project, project assumptions, work packages, BOQ-to-schedule mapping, WBS and activity sequencing. The analytical part evaluates the baseline schedule, actual delay, revised duration, schedule variance, duration-based Schedule Performance Index, planning efficiency, critical path, resource utilisation and delay factor ranking.

The study follows a case-study approach. Microsoft Project was used as the main scheduling tool. The schedule was prepared by defining the project start date, entering activities with WBS codes, assigning durations, linking predecessor relationships, assigning resources, setting the baseline and updating actual and revised durations for analysis. The project start date was fixed as 01 January 2026, and the working calendar was considered as Monday to Saturday with 8 working hours per day.

Table 1. Project particulars and scheduling assumptions

Particular	Description
Project type	High-rise RCC building construction
Configuration	2 Basement + Ground + 12 upper floors
Location	Noida, Uttar Pradesh
Structural system	RCC framed structure
Foundation system	Raft foundation with retaining wall system
Planning software	Microsoft Project
Working calendar	Monday to Saturday, 8 hours/day
Project start date	01 January 2026
Baseline finish date	19 April 2028
Number of scheduled activities	69 activities including milestones
Baseline planned duration	720 project days
Actual duration considered	780 project days
Revised duration after corrective planning	735 project days

4.1. BOQ-to-Schedule Mapping

BOQ-to-schedule mapping was used to link the project scope with the Microsoft Project activity schedule. This improves the reliability of duration estimation and helps in connecting quantities, resources and execution scope with planned activities. Major BOQ groups such as earthwork, concrete work, formwork, reinforcement, masonry, MEP, finishing, waterproofing, external development and testing were mapped with the corresponding MSP activities.

Table 2. BOQ-to-schedule mapping used in the study

BOQ Group	Major Scope	Linked MSP Activities
Earthwork / excavation	Site clearing, excavation, backfilling, disposal and dewatering support	Excavation layout, dewatering, bulk excavation, trimming and backfilling
Concrete work	PCC, raft concrete, slabs, beams, walls, staircase and ramp works	PCC, raft concreting, B2/B1 slabs, ground floor and floor-wise RCC cycle
Formwork	Shuttering for raft, walls, columns, beams, slabs, staircase and terrace	Raft formwork, floor-wise slab formwork and vertical RCC cycle
Reinforcement steel	Cutting, bending, fixing and placement of Fe-500 steel	Raft reinforcement, retaining wall steel, columns, beams and slabs
Masonry work	Internal and external blockwork, shafts and service walls	Floor-wise masonry works for lower, middle and upper floors
MEP services	Electrical conduits, plumbing, firefighting sleeves, shafts and risers	MEP rough-in, riser installation, panel room and system testing
Finishing works	Plaster, flooring, tiles, painting, doors, windows and fixtures	Internal plaster, flooring, painting and final finishing sequence
Testing and handover	Inspection, commissioning, documentation and snag closure	Testing, QA/QC inspection, documentation and final handover

4.2. Planning Efficiency and RII Method

Planning efficiency was calculated by comparing the planned duration with the actual or revised duration. This indicates how closely site execution follows the planned schedule. Higher planning efficiency indicates stronger schedule control and better planning performance.

Planning Efficiency (%) = (Planned Duration / Actual Duration) x 100

Original Planning Efficiency = (720 / 780) x 100 = 92.31%

Improved Planning Efficiency = (720 / 735) x 100 = 97.96%

Relative Importance Index was used to rank delay factors affecting planning efficiency. The general expression used for RII is shown below, where W is the weight assigned to each factor, A is the highest weight and N is the total number of responses or observations considered.

$$RII = \Sigma W / (A \times N)$$

V. CASE STUDY AND SCHEDULE DEVELOPMENT

The selected case project is a 2 Basement + Ground + 12 upper-floor RCC high-rise building. The basement levels are planned for parking, water storage, fire-fighting services, pump room, electrical room, service rooms and ramp access. The ground floor includes entrance lobby, security, circulation and common functional areas. The twelve upper floors are typical residential floors involving repeated RCC, masonry, MEP and finishing cycles. The terrace includes waterproofing, overhead tank, lift machine room and roof service provisions.

The Microsoft Project schedule was developed by entering 69 activities with WBS codes, durations, start dates, finish dates, predecessors, resources and critical path status. The activity list covers mobilisation, site survey, temporary works, safety approvals, procurement planning, excavation, dewatering, raft works, basement RCC works, ground floor works, twelve RCC floor cycles, masonry works, MEP rough-in, internal plaster, flooring, painting, terrace works, lift installation, external development, testing, commissioning and handover.

Table 3. Floor-wise planning data

Floor Level	Functional Use	Major Activities	Planning Importance
Basement 2	Parking, tank and services	Excavation, raft, retaining wall, waterproofing and service coordination	Very critical
Basement 1	Parking, ramp and services	RCC frame, ramp, waterproofing and MEP services	Very critical
Ground Floor	Lobby and circulation	RCC frame, common areas and access planning	Transition level
1st to 12th Floors	Typical residential floors	RCC cycle, masonry, MEP, plastering, flooring and finishing	Repeated floor cycle
Terrace	Roof services	Waterproofing, overhead tank, lift machine room and rainwater work	Final roof completion

VI. RESULTS AND DISCUSSION

The Microsoft Project output shows that the baseline schedule has a planned duration of 720 days, while actual completion duration is 780 days. This indicates a total delay of 60 days. After corrective planning, the revised duration becomes 735 days. The improvement shows that timely monitoring and corrective actions can reduce the delay impact and improve planning efficiency.

6.1. Baseline, Actual and Revised Duration Analysis

The baseline planned duration of 720 days represents the target schedule generated in Microsoft Project.

Table 4. Project schedule output summary

Particular	Value / Result
Building configuration	2 Basement + Ground + 12 floors
Project start date	01-Jan-2026
Baseline finish date from MSP	19-Apr-2028
Number of scheduled activities	69
Planning software	Microsoft Project
Baseline planned duration	720 days
Actual completion duration	780 days
Total delay	60 days
Revised duration after corrective planning	735 days
Original planning efficiency	92.31%
Improved planning efficiency	97.96%

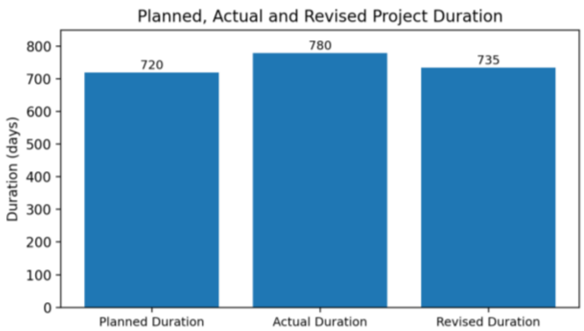

Figure 1. Planned, actual and revised duration comparison

The actual duration of 780 days indicates a 60-day delay. The revised duration of 735 days was obtained after applying corrective planning measures such as procurement tracking, additional labour teams, improved formwork rotation, MEP coordination meetings, weekly look-ahead planning and closer monitoring of critical activities. The improvement from 780 days to 735 days shows that schedule recovery is possible when management decisions are linked with critical path and resource analysis.

Table 5. Planned and actual duration comparison by work package

Project Stage	Planned Duration	Actual Duration	Delay Indicator
Mobilisation	30	30	0
Excavation and dewatering	60	68	8
Raft foundation	55	62	7
Basement works	83	98	15
Ground floor	28	32	4
RCC 1st-12th floors	216	240	24
Masonry and MEP	150	165	15
Finishing works	160	175	15

6.2. Schedule Variance and Performance

The schedule variance is negative because the actual duration exceeds the planned duration. A duration-based performance indicator was used to compare planned duration with actual and revised duration. The original duration-based index was 0.923, while the revised index improved to 0.980. This indicates that corrective planning brought the schedule closer to the planned target.

Schedule Variance = Planned Duration - Actual Duration = 720 - 780 = -60 days

Duration-Based SPI = Planned Duration / Actual Duration = 720 / 780 = 0.923

Revised Duration-Based SPI = Planned Duration / Revised Duration = 720 / 735 = 0.980

6.3. Critical Path and Float Findings

Critical path analysis indicates that the project completion is controlled by mobilisation, excavation, dewatering, raft works, basement structural works, ground floor works, repeated RCC floor cycle, upper-floor finishing, testing, commissioning and final handover. Activities with zero or very low float require strict monitoring because any delay in these activities directly affects the project completion date. Near-critical activities include MEP rough-in, external scaffolding, external plaster, terrace waterproofing and external development works. Although these activities may not always lie on the main critical path, delay in them can affect occupancy readiness, testing and handover.

6.4. Resource Utilisation Analysis

Resource loading shows that RCC team, formwork, MEP team, plaster team and masonry team are the dominant resources in the project schedule. In high-rise construction, resource continuity is very important because repeated floor cycles depend on timely availability of shuttering, reinforcement labour, concrete team, MEP teams and finishing teams. Any resource shortage in these activities may increase idle time and extend the project duration.

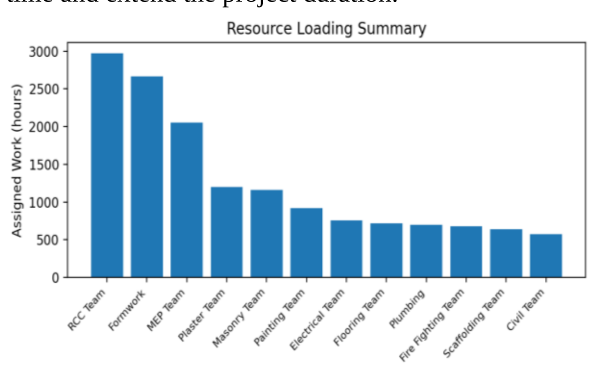

Figure 2. Resource loading summary

Table 6. Resource loading summary

Resource	Assigned Work
RCC Team	2968 hours
Formwork	2664 hours
MEP Team	2056 hours
Plaster Team	1200 hours
Masonry Team	1160 hours
Painting Team	920 hours
Electrical Team	760 hours
Flooring Team	720 hours
Plumbing	696 hours
Fire Fighting Team	680 hours
Scaffolding Team	640 hours
Civil Team	576 hours

6.5. Delay Factor and RII Analysis

The RII ranking identifies material procurement delay as the most important factor affecting planning efficiency, followed by labour productivity and shortage, drawing and approval delay, poor site coordination and equipment non-availability. These factors have a high influence because they affect several critical and near-critical activities simultaneously. In high-rise construction, procurement and labour productivity are especially important because the same type of activity is repeated floor-wise.

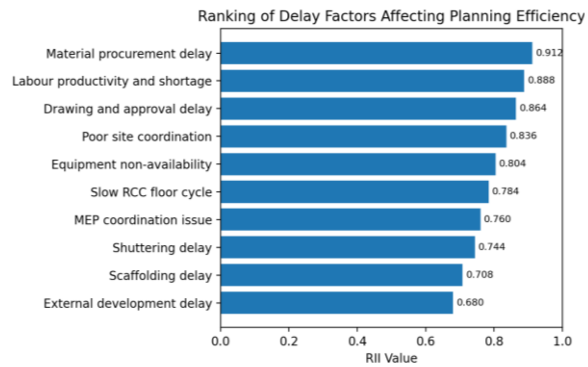

Figure 3. RII ranking of factors affecting planning efficiency

Table 7. RII ranking of delay factors

Rank	Factor	RII Value	Impact Level
1	Material procurement delay	0.912	Very High
2	Labour productivity and shortage	0.888	Very High
3	Drawing and approval delay	0.864	Very High
4	Poor site coordination	0.836	High
5	Equipment non-availability	0.804	High
6	Slow RCC floor cycle	0.784	High
7	MEP coordination issue	0.760	High
8	Shuttering delay	0.744	Moderate
9	Scaffolding delay	0.708	Moderate
10	External development delay	0.680	Moderate

6.6. Discussion

The analysis shows that planning efficiency is not only dependent on the preparation of a schedule but also on the practical control of site conditions. A schedule becomes useful only when activity logic, resource planning, procurement control and progress monitoring are integrated. The basement stage and repeated RCC floor cycle are the most sensitive parts of the high-rise schedule because they control the start and continuity of subsequent work packages. MEP and finishing works can be overlapped with structural works, but this overlap requires strong coordination to avoid rework and delay.

The improvement in planning efficiency from 92.31 percent to 97.96 percent indicates that corrective planning can reduce the delay gap. Microsoft Project supports this process by allowing planners to update actual progress, review baseline variance, identify critical activities, monitor resource allocation and prepare revised schedules. However, the effectiveness of the software depends on the accuracy of input data, realistic activity durations and regular updating by the planning team.

VII. RECOMMENDATIONS

Based on the results of the study, weekly review of critical and near-critical activities should be carried out in Microsoft Project. Procurement schedules should be prepared for steel, cement, RMC, blocks, tiles, pipes, lift items and other long-lead materials. Trade-wise labour productivity records should be maintained and additional manpower should be deployed on delayed work fronts. Shuttering rotation should be planned floor-wise to maintain the RCC cycle. Weekly MEP coordination meetings should be conducted before plastering and finishing activities. Baseline, actual start, actual finish, percent complete and variance fields should be updated regularly in Microsoft Project. Two-week and four-week look-ahead plans should be issued for site execution, and corrective actions such as fast tracking should be applied only where quality and safety are not affected.

Table 8. Recommendation matrix

Recommendation Area	Action Required
Critical path monitoring	Review critical and near-critical activities every week in Microsoft Project.
Procurement control	Prepare procurement schedule for steel, cement, RMC, blocks, tiles, pipes and lift items.
Labour productivity	Maintain trade-wise labour productivity records and increase manpower on delayed work fronts.
Formwork rotation	Plan shuttering rotation floor-wise to maintain the RCC cycle.
MEP coordination	Conduct weekly MEP coordination meetings before plaster and finishing activities.
Progress reporting	Use baseline, actual start, actual finish, percent complete and variance fields in MSP.
Look-ahead planning	Prepare two-week and four-week look-ahead plans for site execution.
Corrective actions	Apply fast tracking only where quality and safety will not be affected.

VIII. CONCLUSION

This paper analysed the planning efficiency of a 2 Basement + Ground + 12 high-rise RCC building using Microsoft Project. The study developed a 69-activity schedule supported by WBS, BOQ-to-schedule mapping, predecessor logic, critical path analysis, resource loading and delay factor ranking. The baseline planned duration was 720 days, while the actual duration was 780 days, resulting in a delay of 60 days. After corrective planning, the revised duration was reduced to 735 days.

The original planning efficiency was 92.31 percent and the improved planning efficiency was 97.96 percent. The critical path was mainly controlled by mobilisation, excavation, raft foundation, basement works, ground floor works, repeated RCC floor cycle, upper-floor finishing, testing and handover. The most important delay factors were material procurement delay, labour productivity and shortage, drawing and approval delay, poor site coordination and equipment non-availability.

The study concludes that Microsoft Project is an effective planning and monitoring tool for high-rise building construction when supported by realistic activity logic, BOQ-linked scope control, resource availability, critical path monitoring and regular progress review. The findings also show that planning efficiency can be improved through procurement control, resource management, formwork rotation, MEP coordination, weekly look-ahead planning and timely corrective action.

IX. LIMITATIONS AND FUTURE SCOPE

The study is limited to one 2B+G+12 high-rise RCC building case. Detailed structural design, detailed cost estimation and contractual claims are outside the scope of this paper. The actual duration and revised duration are used for planning analysis and may vary depending on real site conditions, project location, contractor capability, client decisions and market factors.

Future research may extend this study by comparing multiple high-rise projects, integrating cost control with schedule control, applying BIM-based 4D scheduling, using Primavera P6 for comparative analysis, studying actual productivity records from site and developing a digital dashboard for real-time monitoring of schedule variance, resource utilisation and planning efficiency.

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