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A Review Paper on Construction Planning, Scheduling, and Delay Risk Impact Analysis of a G+2 RCC Residential Building Using Primavera P6

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Abstract

Construction projects require systematic planning and scheduling to be completed within the stipulated time and budget. Residential building projects often face delays due to material shortages, labour issues, design changes and poor coordination. Tools such as Primavera P6 assist in organising activities, establishing logical relationships, preparing baseline schedules and monitoring progress through the Critical Path Method (CPM). This review examines construction planning and scheduling techniques, major causes of delay, and delay-impact analysis methods, drawing on previous studies related to baseline scheduling quality, delay assessment and mitigation strategies. Building on these findings, a practical framework is proposed for analysing time and cost impacts in a G+2 residential building project, supporting the development of an organised schedule and effective delay-mitigation approach.

Keywords: Primavera P6, construction scheduling, residential building, delay analysis, risk assessment, critical path, RCC construction.

1. INTRODUCTION

Residential construction involves interrelated activities—excavation, foundation, structural work, masonry, plastering, electrical work and finishing—where delay in one activity affects the progress of others. Effective planning and scheduling help arrange activities, estimate durations, allocate resources and monitor progress. However, projects often face delays due to design changes, material shortages, labour problems, financial constraints and poor coordination, leading to increased duration, resource conflicts and additional costs. Primavera P6 is widely used for scheduling, defining activity relationships, identifying the critical path and tracking progress against the baseline, with recent studies exploring its integration with BIM. This review therefore focuses on construction planning, Primavera P6, CPM, and delay-risk impact analysis, aiming to identify gaps in existing approaches and establish a foundation for a practical scheduling methodology for a G+2 residential building project.

1.1 CONSTRUCTION PLANNING AND SCHEDULING

Construction planning identifies project activities, required resources, work sequence and expected completion time, while scheduling defines their duration and logical relationships (commonly Finish-to-Start). A Work Breakdown Structure (WBS) divides the project into manageable work packages by construction stage, forming the basis for a detailed schedule in Primavera P6, as illustrated below for the proposed G+2 building.

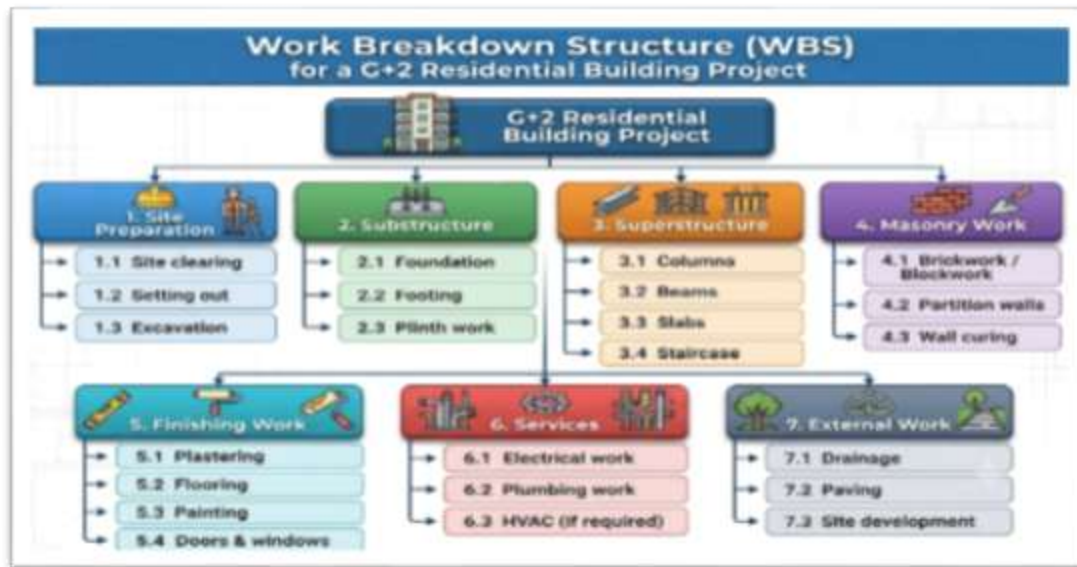


Fig. 1.1 Work Breakdown Structure (WBS) for a G+2 Residential Building Project.

1.2 PRIMAVERA P6 AND CRITICAL PATH METHOD (CPM)

Primavera P6 is scheduling software used to sequence activities, assign durations and relationships, allocate resources, and compare progress against an approved baseline schedule. CPM identifies the longest path of dependent activities controlling the project's completion date; critical activities have little or no float, so any delay in them extends the overall duration unless corrective action is taken. Primavera P6 offers benefits such as systematic organisation of activities, identification of critical activities, and baseline-vs-actual comparison, though it requires trained personnel and careful data entry, with output quality depending on the accuracy of input durations and logic (Jamal et al., 2026). Schedule reliability further depends on properly defined activity descriptions, WBS identifiers, logical relationships and float management — principles applied to the process below.



Figure 2. General Construction Planning and Scheduling Process.

Fig 1.2 – General Construction Planning and Scheduling Process

1.3 CONSTRUCTION DELAYS, RISK AND IMPACT ANALYSIS

A construction delay occurs when an activity exceeds its planned duration, affecting the scheduled completion date. Causes vary by project type and location; Eid et al. (2026) identify labour, material, financial, design and coordination-related issues as the most frequently ranked

causes, summarised below. Delays are further classified as excusable, non-excusable, compensable or non-compensable, depending on cause and contractual responsibility, which affects whether the contractor is entitled to additional time or cost. Delay-risk analysis ranks such risks by likelihood and impact, while delay impact analysis and what-if scenarios examine how a delay in one activity — such as late foundation work or material shortage — affects the overall schedule and critical activities, supporting suitable mitigation and recovery measures.

Table 1: Common Causes of Construction Delays

CATEGORY	COMMON CAUSES
Planning and management	Improper planning, poor coordination, inaccurate time estimation
Labour	Shortage of skilled workers, low productivity
Materials	Delayed procurement, material shortages
Design	Design changes, incomplete drawings, changes in client requirements
Financial	Delayed payments, funding problems, rising material costs
External factors	Approval delays, site conditions, supply-chain disruptions

2 OBJECTIVES

1. To study construction planning and scheduling techniques for residential building projects.
2. To understand the use of Primavera P6 for preparing and monitoring construction schedules
3. To study the Critical Path Method (CPM) and identify critical activities in a project
4. To identify the major causes and risks associated with construction delays
5. To understand delay impact analysis and its effects on project duration and cost.
6. To review methods for delay mitigation, recovery planning and schedule optimisation.

3 LITERATURE REVIEW

3.1 Kadam and Chavan-Patil (2026)

The authors studied the integration of BIM and Primavera P6 for delay mitigation and cost optimisation in an Indian public housing project. The study compared baseline, delayed and BIM-optimized schedules and found improvements in coordination, scheduling accuracy and cost control, with a 22.35% reduction in project duration and 25.83% cost savings. The authors highlighted the potential of BIM–Primavera integration for delay recovery, while noting the need for further project-based validation. This study supports the use of Primavera P6 for schedule and delay analysis in the proposed G+2 residential building.

3.2 Jamal et al. (2026):

The author examined the quality of baseline schedules used in construction projects. The study identified issues such as unclear activity descriptions, poor work breakdown structures, weak logical relationships, and unrealistic schedules. It emphasises that a properly prepared baseline schedule is necessary for reliable progress monitoring and delay analysis. The findings are relevant to the preparation of a baseline schedule for a G+2 residential building.

3.3 Eid et al. (2026):

The author studied construction delay factors through literature review, expert evaluation, and real project data. The study focused on identifying and ranking the major causes of delays in

construction projects. Its approach is useful for collecting expert opinions and prioritising delay risks related to labour, materials, equipment, management, and other project conditions.

3.4 Shobron, Kurniawan and Setiyanto (2025)

The authors compared project scheduling using Primavera P6 and Microsoft Project Planner. The study focused on improving scheduling efficiency and reducing project duration in a housing project. The findings presented in the project literature review indicate that Primavera P6 helped reduce the planned duration from 132 to 114 working days. This study supports the use of scheduling software for construction time optimisation.

3.5 Saiyad and Shinde (2025)

The authors studied the use of Primavera P6 for construction planning and scheduling. The study discussed the preparation of activities, activity relationships, resource allocation, and progress monitoring. It highlights the importance of developing a structured project schedule for improving construction management and controlling project duration.

3.6 Rohan Rajendra Shinde et al. (2025)

The author examined the time and cost differences between modular and conventional construction methods. Primavera P6 was used to prepare and compare project schedules for different construction alternatives. The study demonstrates how scheduling software can support time–cost analysis and help evaluate alternative construction methods. This approach is relevant to analysing the effect of construction delays on project duration and cost.

3.7 N.J Mohammed (2025)

The author investigated the integration of Building Information Modelling (BIM) with Primavera P6 for structural project planning. The study used a simulated five-storey residential building to examine coordination, resource utilisation, and project duration planning. The study indicates that integrating BIM with scheduling software can improve project coordination and planning accuracy. However, the implementation may require additional software knowledge and reliable project information.

3.8 Nanchari and Ansar (2024)

The authors focused on planning and scheduling activities for a residential building project. The study highlights the use of Primavera for developing activity sequences, assigning durations, and preparing a project schedule. It provides a relevant basis for applying Primavera P6 to residential building construction. The study is related to the present work because both projects focus on systematic planning and scheduling of building construction activities.

3.9 Ninpan, Huang and Plana (2024)

The authors discussed a scheduling approach for managing construction activities and co-activity problems. The study focused on improving the coordination of activities that may overlap or interfere with one another. Its approach is relevant to construction projects where several activities, workers, and resources operate simultaneously. Better activity coordination can help reduce conflicts and improve schedule performance

3.10 Saranya and Monigar (2024)

The authors examined schedule delay analysis using Primavera P6. The study focused on identifying delays and analysing their effect on project schedules. Primavera P6 can be used to compare planned and actual progress and to identify activities affecting project completion.

This study supports the use of baseline and delayed schedules for analysing construction delays.

3.11 Maurya (2024)

The author studied the relationship between construction delays and cost overruns. The study highlights how delays in activities can increase labour costs, equipment costs, material expenses, and overall project expenditure. Primavera P6 can assist in monitoring project progress and understanding the effect of delays on the planned schedule. The study is relevant to the present research because time and cost impacts are considered together.

3.12 Son et al. (2024):

The author examined common problems found in construction schedules and highlighted issues related to activity information, relationships, logic, durations, and overall schedule quality. The authors emphasised that poor-quality baseline schedules can reduce the reliability of schedule monitoring and delay assessment. The findings support the importance of preparing a well-structured and logically connected baseline schedule before conducting delay and schedule-impact analysis.

3.13 Jagtap, Thombre and Dutta (2023):

The authors focused on optimising the time and cost of a residential building project. The study considered the use of Primavera P6 for preparing construction schedules and analysing project performance. It demonstrates the importance of balancing project duration, resource utilisation, and construction cost. The findings provide a foundation for studying time–cost relationships in residential building projects.

3.14 Anthony and Shah (2023)

The authors examined resource allocation and cost optimisation in residential building construction. The study focused on monitoring the use of resources and improving cost management through construction management tools. Effective resource allocation is important because the shortage or improper use of labour, materials, and equipment can affect project progress. This study is relevant to the proposed analysis of resource-related delays and recovery measures.

3.15 Shirsath and Kulkarni (2022)

The authors focused on residential and ongoing building projects and considered important Primavera elements such as WBS, activities, calendars, relationships, baselines and critical path analysis. The authors showed that Primavera P6 can be used to establish a planned schedule, compare actual progress with the baseline and identify the effect of delays on subsequent activities. The study concluded that Primavera-based scheduling can improve project planning and help forecast construction progress. This study is relevant to the proposed framework because it supports the use of baseline scheduling, critical path identification and schedule updating for analysing delay impacts in the G+2 residential building.

3.16 Wagh and Lende (2022)

The authors highlighted that improper planning and scheduling can lead to delays and inefficient use of time, money and resources. Primavera P6 was used to organise project activities, prepare schedules, allocate resources and consider construction risks that may affect project objectives and completion time. The study emphasised the importance of systematic planning and risk consideration for improving project performance. This study is relevant to

the present work because it supports the integration of activity scheduling, resource planning and delay-risk assessment using Primavera P6 for the proposed G+2 RCC residential building.

3.17 Sevika and Işık (2021)

The authors reviewed existing research on construction delay analysis and discussed the importance of understanding how delays affect project duration and cost. The study organised previous research on delay-analysis approaches and highlighted the need for systematic methods to assess construction delays. Its findings provide a useful foundation for selecting an appropriate approach to delay assessment. This study is relevant to the present work because it supports the review of delay-analysis methods and the proposed comparison of baseline and delayed schedules for evaluating the effects of selected delay risks.

3.18 Balakrishna et al. (2021)

The authors examined schedule delays in a multi-storey residential building project. The authors used Primavera software to identify delay-related factors and the parties responsible for delays. They also developed an alternative schedule involving additional resources and time adjustments to reduce the effects of delays. The study highlights the usefulness of Primavera-based schedule analysis for identifying project delays and evaluating recovery measures. It is directly relevant to the present work because it supports the proposed use of Primavera P6 for assessing delay scenarios and recommending suitable corrective actions in a G+2 RCC residential building.

3.19 Al-Mohammad and Jamaludin (2020)

The authors examined delay causes reported in previous construction studies and highlighted factors related to planning and scheduling, project management, resources, financial issues, design changes, and coordination among project participants. The study showed that construction delays generally result from multiple interrelated factors rather than a single cause, emphasising the importance of identifying and assessing potential delay factors during project planning. This study is relevant to the present work because it supports the identification and ranking of delay risks before conducting what-if delay scenario analysis using Primavera P6 for the proposed G+2 RCC residential building.

3.20 Nguyen (2020)

The author investigated the relationship between construction management functions and project schedule delays using data from 195 completed construction projects. The study found that construction planning, schedule controlling, schedule directing and project finance organising significantly influence project schedule performance. The findings emphasise the importance of systematic planning and schedule control for completing projects on time. This study supports the present work by highlighting the importance of proper planning and schedule control before analysing delay risks in the proposed G+2 RCC residential building.

3.21 Guida and Sacco (2019)

The authors proposed a method for evaluating project schedule delays and allocating their effects among projects. The authors introduced a “float bank” concept to support delay evaluation and float management and demonstrated the method through a case study. The study emphasised the importance of considering activity float when assessing schedule delays. This work is relevant to the proposed study because Primavera P6 can be used to identify activity float and examine how selected delay scenarios influence the overall project schedule.

3.22 Shahsavand, Marefat and Parchamijalal (2018)

The authors investigated major causes of construction delays and compared different delay-analysis techniques with the Society of Construction Law (SCL) protocol. The study highlighted the importance of selecting an appropriate delay-analysis method according to project conditions and available schedule information. This study is relevant to the present work because it provides a basis for selecting a practical approach for analysing the impact of delay risks on the proposed construction schedule.

3.23 Han, Choi and O'Connor (2017)

The authors evaluated the quality of baseline schedules using industry-recognised schedule-quality metrics. The study identified common problems related to activity durations, relationships, lags, task identification and schedule logic. The authors emphasised that a reliable baseline schedule is essential for effective project monitoring and schedule control. This study directly supports the present work because a properly developed baseline schedule is required before evaluating the effect of delay scenarios using Primavera P6.

3.24 The Society of Construction Law (2017)

The author provided guidance for analysing delay and disruption in construction projects. The protocol discusses principles for identifying delay events, assessing their effects on project completion and considering issues such as concurrent delay and extension of time. The protocol provides a practical foundation for systematic delay analysis rather than simply identifying the existence of a delay. It is relevant to the present study because the proposed framework involves identifying delay risks and evaluating their influence on project activities and overall completion.

3.25 Prater, Kirytopoulos and Ma (2017)

The authors examined optimism bias in project planning and management. The study highlighted that project participants may underestimate project durations, costs or risks during planning. Such bias can reduce the reliability of initial project plans and schedules. This study is relevant to the proposed work because realistic activity-duration estimation is important for developing a reliable baseline schedule before conducting delay-risk analysis

3.26 Lim, Yi, Lee and Arditi (2014)

The authors developed a simulation approach for analysing construction schedules where activities may be performed concurrently. The study considered scheduling relationships and the effect of alternative activity execution strategies on project performance. The authors demonstrated the usefulness of simulation for examining different construction scheduling conditions. This study supports the present work by showing how alternative scheduling scenarios can be evaluated to understand their effects on construction duration and time–cost performance.

3.27 Doloi, Sawhney, Iyer and Rentala (2012)

The authors investigated 45 potential delay attributes in the Indian construction industry using questionnaire data, interviews, factor analysis and regression modelling. The study identified lack of commitment, inefficient site management, poor site coordination, improper planning, unclear project scope and poor communication among important delay-related factors. The authors also identified factors such as slow owner decisions, low labour productivity and rework as significant contributors to overall project delay. This study is particularly relevant to the present work because it provides an Indian context for identifying and ranking delay risks in construction projects.

3.28 Aleshia, Koskela and Tsioropoulos (2012)

The authors critically examined existing approaches used for investigating construction delays. The authors argued that many delay studies mainly focus on identifying and ranking causes, while less attention is given to developing approaches that can practically address specific delay problems. This observation is important for the present research because the proposed framework goes beyond identifying delay factors by linking selected risks to construction activities and analysing their possible schedule impacts.

3.29 Hamzah, Khairy and Rahmat (2011)

The authors reviewed construction delay factors and developed a theoretical framework for understanding the causes of delay. The study emphasised that delays can originate from different project participants and may be associated with management, resources, financial conditions, design and external factors. This study provides a foundation for classifying potential delay risks before they are incorporated into the proposed Primavera P6-based analysis.

3.30 Fuga and Ayukawa-Baah (2010)

The authors examined factors associated with financial difficulties, materials, project management, labour, equipment and external conditions. The study demonstrated that construction delays arise from a combination of technical, managerial and resource-related factors. This study supports the present work by providing a broad basis for selecting delay factors that may affect construction activities in a residential building project.

3.31 Yang, Yang and Kao (2010)

The authors examined factors contributing to schedule delays in construction projects and evaluated their influence on project performance. The study focused on identifying significant delay causes and evaluating their effect on schedule performance. The findings demonstrate the importance of systematic identification and assessment of schedule-delay causes. This supports the proposed framework's delay-risk identification and ranking stage.

3.32 Luu, Kim, Tuan and Ogunlana (2009)

The authors studied and considered relationships among risk factors and their influence on project schedule outcomes. The research demonstrated that construction schedule risk can be analysed through relationships between different uncertain factors rather than considering each factor independently. This study supports the proposed work by providing a basis for considering delay risks systematically before performing what-if schedule analysis.

3.33 Sweis, Sweis, Abu Hammad and Soboul (2008)

The authors studied factors related to financial difficulties, planning, management, labour, materials and project conditions. The findings demonstrated that delays can result from both internal project-management problems and external conditions. This study supports the proposed research by providing additional evidence for classifying and prioritising delay risks affecting construction projects.

3.34 Kao and Yang (2009)

The authors compared two approaches for analysing construction delays and examined how different delay events influence project completion. The study demonstrated the importance of selecting an appropriate schedule-analysis technique according to the characteristics of the delay and available project records. This work is relevant to the present study because it

reinforces the need for a structured approach when evaluating the effects of delay events on a construction schedule.

3.35 Sambasivan and Soon (2007)

The authors examined major causes of construction delays and their effects on project performance. The study identified factors associated with contractor performance, client-related issues, planning, materials, labour and external conditions. The authors also discussed consequences of delays such as time overrun, cost overrun and disputes. This study is relevant to the present work because it connects delay causes with their consequences, supporting the proposed assessment of time and cost impacts.

3.36 El-Razek, Bassioni and Mobarak (2008)

The authors investigated the causes of delays in building construction projects using responses from construction professionals. The study identified financial problems, contractor-related issues, material availability, project management and other organisational factors among the important causes of delay. The research demonstrates the importance of identifying delay causes at the project-planning stage. This study is relevant to the proposed work because several of these delay categories can be represented as what-if scenarios in Primavera P6.

3.37 Sakka and El-Sayegh (2007)

The authors investigated how project delays and activity changes can consume available total float within construction schedules. The study highlighted the importance of monitoring float because the consumption of available float can reduce schedule flexibility and potentially affect project completion. This study is particularly relevant to the proposed Primavera P6 framework because critical-path identification and activity float are important for determining which delayed activities may have a direct effect on project duration.

3.38 Arditi and Pattanakitchamroon (2006)

The authors examined different methods available for analysing construction delays and discussed their suitability under different project conditions. The study emphasised that delay-analysis methods should be selected according to the available schedule information, project circumstances and nature of the delay. This provides methodological support for selecting an appropriate delay-analysis approach for the proposed construction schedule.

3.39 Assaf and Al-Hejji (2006)

The authors investigated the major causes of delay in large construction projects. The authors identified numerous factors related to contractors, owners, consultants, materials, labour, equipment and project management. The study demonstrated that construction delays are influenced by several interacting factors rather than a single source. This study supports the present research by providing a broad classification of potential delay risks that can be considered during schedule development.

3.40 Faridi and El-Sayegh (2006)

The authors examined the factors responsible for delays in construction projects in the UAE. The study highlighted issues related to approvals, planning, coordination, materials, labour and project management as important contributors to delay. The findings reinforce the importance of identifying potential delay sources during project planning and monitoring their effects throughout construction. This study supports the delay-risk identification component of the proposed framework.

3.41 Williams (2003)

The author examined approaches for assessing delays and determining their effect on project completion time. The study discussed the complexity of assigning schedule effects to individual delay events and emphasised the importance of reliable project schedules and records. This work provides a foundation for understanding why delay impact should be assessed against the planned schedule rather than simply measuring the duration of individual delay events.

3.42 Odeh and Battaine (2002)

The authors investigated the major causes of construction delays under traditional contracting arrangements. The study identified factors associated with contractor management, client decisions, planning, labour, materials and project conditions. The findings emphasised the importance of effective management and coordination in controlling construction delays. This study provides an important foundational reference for the delay-risk identification stage of the proposed G+2 residential building framework.

CONCLUSION

After studying the above review, we concluded that construction planning and scheduling play an important role in completing residential building projects within the planned time and cost. The reviewed studies show that Primavera P6 can support activity planning, development of baseline schedules, critical-path identification, resource management, and delay analysis. Previous research has also highlighted the importance of identifying delay factors, maintaining schedule quality, and applying suitable mitigation and recovery strategies. However, limited attention has been given to analysing the impact of specific delay factors on individual activities in small G+2 residential building projects. Therefore, the present study focuses on developing a structured construction schedule for a G+2 residential building using Primavera P6. It will examine critical activities, identify potential delay risks, and compare baseline and delayed schedules through what-if analysis. The study will also consider the time and cost effects of delays and propose practical recovery measures. The findings are expected to support better construction planning, improve delay management, and help achieve more effective project scheduling in residential building projects.

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