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CPM-Based Baseline Scheduling of a Four-Door Rental House Project in Samarinda using Microsoft Project

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Abstract

Small-scale rental housing projects frequently suffer from severe schedule delays due to traditional management practices. This study aims to analyze scheduling, identify critical activities, and optimize resource allocation for a four-door rental house construction project in Samarinda, Indonesia. A quantitative single-case study methodology was applied by integrating the Critical Path Method with Microsoft Project software. Project data were collected from technical documents, budget plans, working blueprints, field observations, and interviews with site supervisors. The analytical framework involved establishing a detailed Work Breakdown Structure, defining logical finish-to-start task dependencies, executing forward and backward pass calculations, and conducting schedule evaluations. The findings reveal that the verified baseline duration computed through critical path analysis is 116 working days, which represents a 17-working-day reduction compared to the owner's original manual plan of 133 working days, achieved entirely without schedule crashing. Critical path evaluation successfully identified essential zero-float activities, ranging from foundation excavation through structural concrete and roofing to finishing milestones, indicating high vulnerability to operational delays. In contrast, flexible non-critical tasks such as ceramic tile installation possess a total float of 24 working days, providing valuable flexibility for resource leveling. Furthermore, at the specified status date, cumulative physical progress reached 75 percent using the physical-weight method. Ultimately, adopting digital project planning establishes an auditable baseline schedule, mitigates execution risks, and improves cash-flow planning for small-scale residential property.

Keywords: *Baseline Schedule, Critical Path Method, Microsoft Project, Rental House, Total Float*

1. Introduction

The construction sector is highly dynamic yet inherently prone to significant schedule delays and resource inefficiencies (Khofifah & Vilantika, 2025). This vulnerability is prominent not only in mega-infrastructure developments but also in small-to-medium-scale projects, such as rental housing construction. Projects at this scale carry a substantial risk of execution failure, which is often driven by weak contractor management and poor site coordination (Ananda et al., 2026). Such management failures are frequently rooted in a lack of integration between activity schedules and actual labor resource availability on-site.

In a rapidly developing city like Samarinda, the demand for rental housing continues to increase along with population growth and high worker mobility (Rahman et al., 2025). As a center of economic activity in East Kalimantan, Samarinda attracts migrant workers seeking temporary accommodation, making rental property investment a promising business opportunity. However, private developers in this local market face diverse operational and financial risks, particularly regarding construction timelines. For small-scale projects like the four-door rental housing examined in this study, any schedule delay directly postpones the commencement of rental operations, resulting in delayed rental income and potentially extending the investment payback period. Therefore, integrating structured scheduling frameworks like the Critical Path Method (CPM) is essential to strengthen capital efficiency and mitigate project failure by serving as an operational risk-mitigation tool that secures the owner's cash-flow stability (Kyokusiima, 2025).

Applying these principles, the four-door rental housing construction project in Samarinda serves as a compelling case study. The practical significance of this study is underscored by the inherent complexity of residential construction, which frequently suffers from inefficiencies in coordinating labor and material resources. Specifically, this project demands a substantial labor workload, with the general worker category alone requiring a total of 4,267 working hours. Without an accurate and structured scheduling method, inefficient resource allocation may result in overlapping activities or idle time, potentially increasing operational costs and affecting the planned project duration.

To establish a rigorous baseline schedule and systematically model project resources, this study utilized Microsoft Project software. This digital tool functions integratively to compile a structured Work Breakdown Structure (WBS), define logical predecessor-successor relationships, calculate critical paths, and visualize the master schedule through Gantt Charts (Doukari et al., 2022). Furthermore, utilizing this software facilitates detailed resource loading, allowing labor requirements and planned cost distributions to be mathematically integrated within a unified system. Rather than representing an active, real-time cost-tracking tool, the application of this digital platform serves to establish a transparent, data-driven baseline schedule. This baseline provides project owners with clear visibility into planned expenditures and project milestones, enabling systematic evaluation of schedule deviations and more effective labor allocation throughout the planned construction period.

A critical research gap exists in the scale and scope of existing construction management studies. Although project management methodologies have been widely applied, previous research has predominantly focused on large-scale projects, such as high-rise buildings and public infrastructure (Santoso et al., 2025). Studies specifically examining small- to medium-scale residential and rental housing projects remain limited, particularly those integrating Critical Path Method (CPM) scheduling, labor resource allocation, and planned cost distribution within a unified digital scheduling model. In the context of Samarinda, recent studies have examined the application of CPM in residential construction Satryawati et al. (2025), while other research has identified construction delays and resource-related challenges in the local market (Asdi & Utomo, 2025). However, the integration of project scheduling, labor resource loading, and planned cost distribution for small-scale rental housing projects remains insufficiently explored. Therefore, this study addresses the identified gap by developing a data-driven baseline schedule for a four-door rental housing project in Samarinda using Microsoft Project, integrating activity scheduling, labor resource allocation, and planned cost distribution to support more effective project time and resource management.

The novelty of this study lies in the unified digital integration of critical path analysis, labor resource allocation, and baseline budget distribution for small-scale rental housing projects, executed through Microsoft Project. As a theoretical foundation, Sigit et al. (2023) demonstrated that the Critical Path Method (CPM) is highly effective in establishing a balanced project trajectory, optimizing task sequencing, and identifying operational bottlenecks in residential construction. Similarly, Fijra et al. (2025) highlighted that applying CPM to residential developments significantly enhances time-efficiency by isolating critical, non-postponable tasks that dictate the final completion milestone. Complementing these insights, Purnomo & Ardan (2025) emphasized that effective resource optimization depends on accurate critical path determination, ensuring that labor and financial resources can be allocated efficiently throughout the project lifecycle.

To address these objectives, this study aims to analyze and develop a resource-loaded baseline schedule for a four-door rental housing construction project in Samarinda utilizing Microsoft Project-assisted CPM. The scope of this research focuses specifically on baseline schedule preparation, critical path identification, labor resource mapping, and planned budget distribution. This systematic modeling is designed to ensure that all construction phases, from preliminary preparatory works to the final key handover, are systematically planned to meet the target completion date of May 4, 2026. Ultimately, this study is expected to provide practical guidance for small-scale residential developers in adopting digital project planning tools to mitigate schedule delays and enhance baseline budget transparency.

2. Literature Review

Project scheduling is the process of arranging project activities in a logical sequence and assigning durations so that the project can be completed within its time and resource constraints. A schedule is not only a timeline; it is a control instrument that links scope, time, and cost, the three components of the classical triple constraint. In construction, the quality of the schedule determines whether delays can be anticipated and mitigated before they propagate through the project (Fardila & Adwayah, 2021; Kim & Kim, 2026).

The Critical Path Method (CPM) is one of the most widely used deterministic scheduling techniques. In CPM, the project is represented as a network of activities connected by dependency relationships, most commonly the finish-to-start relationship in which a successor cannot begin until its predecessor is complete. Two passes are performed over the network. The forward pass computes the earliest start (ES) and earliest finish (EF) of each activity and yields the minimum project duration. The backward pass computes the latest start (LS) and latest finish (LF) that still allow the project to finish on time. The difference between the late and early times gives the total float (TF = LS - ES = LF - EF), which is the amount of time an activity can be delayed without delaying the project (Baits et al., 2020; Zareei, 2018).

The critical path is the longest continuous chain of activities through the network, and it is composed of the activities whose total float is zero. These activities are time sensitive, any delay on a critical activity extends the project completion date by the same amount. Identifying the critical path allows managers to concentrate supervision, material readiness, and contingency on the activities that genuinely control the schedule, rather than spreading attention evenly across all activities. Activities with positive float, by contrast, carry schedule flexibility that can be used to smooth resource use (Mulia et al., 2023; Sa'adah et al., 2022).

Total float can be further distinguished from free float, although the present study uses total float as its principal measure. Free float is the amount of time an activity can be delayed without delaying the earliest start of any immediately following activity, whereas total float refers to delay tolerance relative to the project completion date. An activity with positive total float, such as ceramic tile installation in the present case, provides a resource-smoothing opportunity: its start can be shifted within its float window to avoid a peak in crew demand without affecting the delivery date. Managing float deliberately is therefore part of good scheduling practice, and it distinguishes a network-based plan from a bar chart, which contains no explicit float information at all (Mulia et al., 2023).

It is also useful to contrast the deterministic CPM approach used here with the probabilistic Program Evaluation and Review Technique (PERT). CPM assigns a single, most-likely duration to each activity and is appropriate when durations can be estimated with reasonable confidence from work volumes and productivity coefficients, as in a well-documented residential project. PERT, by contrast, assigns optimistic, most-likely, and pessimistic durations and models the project duration as a probability distribution, which is more suitable when field uncertainty is high. Several residential studies combine the two, using CPM for the baseline and PERT for a risk view (Baits et al., 2020; Perdana & Sari, 2022). The present study adopts the deterministic CPM baseline as its scope and identifies probabilistic analysis as a natural extension, so that the reported 116-working-day duration is understood as a computed baseline rather than as a probabilistic expectation.

A baseline schedule is a reference version of the schedule against which actual progress can later be measured. In this study, the term baseline is used strictly in this sense, a verified reference network and duration derived from the project input data, not an optimized or minimum-cost schedule. This distinction is important because CPM by itself computes the duration implied by the input network, it does not automatically prove that the schedule is optimal. Claims of optimization require an explicit comparison with an alternative schedule or the application of crashing or resource levelling, which are outside the scope of the present baseline study (Perdana & Sari, 2022).

Microsoft Project is a project-management application that operationalizes CPM. It stores the Work Breakdown Structure, computes ES, EF, LS, LF, and total float automatically from the entered durations and dependencies, and produces Gantt charts and network diagrams. It also allows a project calendar to be defined, which controls how working and non-working days are counted, and it supports resource and cost fields. For a small-scale construction project, the software facilitates the conversion of project documents and drawings into an auditable and easily updated network model (Sinurat & Misdalena, 2024).

Prior residential CPM studies consistently report that modelling dependencies and locating the zero-float path improves time control relative to bar charts. Sigit et al. (2023) evaluated the scheduling of a Perumnas house in Karawang Regency and identified a critical path that clarified time control. Perdana & Sari (2022) combined CPM and PERT to shorten residential implementation time. Ilwaru et al. (2018) scheduled a housing development project using CPM, and Saputra et al. (2024) applied CPM to time and cost control of a construction project. Studies of larger structures, such as Sinurat & Misdalena (2024) and Sa'adah et al. (2022), further demonstrate the applicability of CPM for systematic project scheduling. However, most of these studies stop at the presentation of the critical path and do not perform a transparent reconciliation between the computed duration and the owner's original plan.

Table 2.1 positions the present study against representative prior work and highlights its focus on network reconstruction, duration reconciliation, and verified baseline scheduling.

Table 2.1 Positioning of the present study against representative prior CPM residential studies

Study	Project type	Software	Critical	Duration reconciliation	Gap addressed
Sigit et al. (2023)	Perumnas house	Manual / MSP	Yes	No	Time control
Perdana & Sari (2022)	Residential (CPM+PERT)	Manual	Yes	No	Duration reduction
Ilwaru et al. (2018)	Housing development	Manual	Yes	No	Scheduling
Saputra et al. (2024)	Building	MSP	Yes	No	Time and cost control
This study	Four-door rental house	Microsoft Project	Yes	Yes (116 vs 133)	Reconciled baseline scheduling

Source: Processed Data (2026)

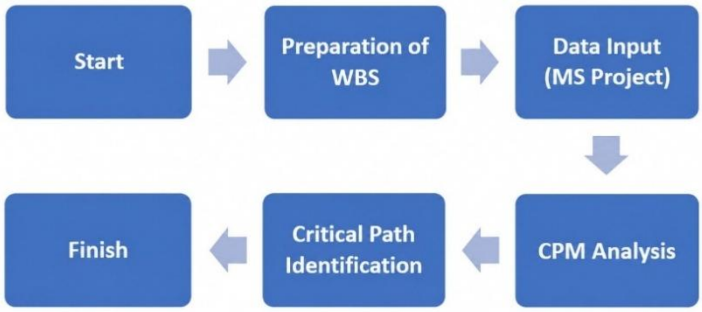
The conceptual framework of this study follows a linear analytical flow. Project documents (cost budget plan, drawings, and the original schedule) are the input. These are decomposed into a Work Breakdown Structure, from which activity durations are estimated and finish-to-start dependencies are defined. The dependency network is validated with the supervisor, and the CPM forward and backward passes are computed and verified in Microsoft Project. The output is a verified baseline schedule with an identified critical path and total-float profile. This framework, summarized as project data to WBS to dependency to CPM to Microsoft Project to verified baseline schedule, structures the methodology that follows.

3. Research Methodology

This study uses a quantitative approach with a single-case study design. The object of the research is the construction schedule of a four-door rental house located in Samarinda City, with an original planned duration of 133 working days from 18 November 2025 to 4 May 2026. The unit of analysis is the project activity, each activity is characterized by its duration, its predecessor relationships, and its computed schedule parameters. A single-case design is appropriate because the objective is a deep, verified reconstruction of one project network rather than a statistical generalization across many projects (Rosidin et al., 2026).

The data used in this study consist of two categories. Secondary data comprise the technical project documents, the Cost Budget Plan, the working drawings and blueprints, the bill of quantities, and the owner's original bar-chart time schedule prepared for 133 working days. Primary data were obtained through direct field observation and a semi-structured interview with the project supervisor, who has field experience in residential construction. The interview covered activity durations, the logic of the work sequence, crew sizes, and operational constraints such as material availability and the actual daily allocation of labor. Data validation was performed by triangulating the durations and dependencies obtained from the project documents with the supervisor's field assessment and the original schedule, and by recomputing the CPM parameters manually to confirm the Microsoft Project output (Hamdani et al., 2025).

The analysis procedure follows the conceptual framework. First, the Work Breakdown Structure decomposes the project into major work packages, namely preparation, excavation and landfill, masonry and plastering, concrete, roofing and ceiling, door and window frames, flooring and ceramics, hanging and locking, electrical and water installation, finishing, septic tank and infiltration, fencing, other jobs, and key handover. Each package is further broken down into detailed sub-activities. This systematic decomposition is consistent with Firmansyah et al. (2025), who applied WBS to organize construction activities into a structured work hierarchy as a basis for subsequent duration estimation and CPM analysis. Second, activity durations were estimated based on the work quantities, labor productivity coefficients, and assigned crew sizes



available in the project documents. For each activity, the work quantity was matched with the applicable productivity coefficient and the corresponding labor crew to determine the estimated working duration. The resulting durations were subsequently cross-checked against the owner's original schedule and the project supervisor's field assessment. Any discrepancy was reviewed by considering the work quantity, crew allocation, productivity assumptions, and work sequence before the final duration was incorporated into the reconstructed CPM network. Third, finish-to-start dependency relationships are defined between activities to represent their technological sequence, and the network is reconstructed so that every mandatory terminal branch, including electrical and water installation, septic-tank work, and hanging and locking work, converges into the final handover milestone. The overall sequence of these analysis steps is summarized in the research-flow diagram in Figure 3.1.

Figure 3.1 Research Methodology Flowchart

Fourth, the CPM calculation is performed. Using the event-time convention, in which an activity starts at the finish time of its latest predecessor, the forward pass computes ES = max (EF of predecessors) and EF = ES + D, where D is the activity duration. The backward pass computes LF = min (LS of successors) and LS = LF - D. The total float is TF = LF - EF = LS - ES, and an activity is critical when its total float equals zero. For example, activity B.1 with a duration of 10 has ES = 8 and EF = 8 + 10 = 18. Fifth, the network is entered into Microsoft Project and its computed schedule is compared with the manual calculation to verify consistency.

The Microsoft Project schedule uses the following assumptions, consistent with the project setting: a six-day working week with Sunday as a non-working day, eight working hours per day, finish-to-start relationships only, with no leads or lags, and deterministic activity durations. The project calendar recognizes national holidays that fall within the observation window. Project progress was considered separately from the baseline scheduling analysis. The Microsoft Project file reports a 66% progress value, however this value was not used as a validated physical-progress measure because the supporting physical-weight calculation and status-date documentation were not available. Therefore, progress percentage was not used as a primary variable in the CPM baseline analysis.

The dependency validation deserves particular attention because it is where many small-project schedules fail. In the initial data, several terminal activities, namely electrical and water installation, septic-tank work, and hanging and locking work, appeared as branches that did not reconnect to the final milestone, which would incorrectly allow the project to be reported as complete before these essential works were finished. During validation, each of these branches was traced with the supervisor and reconnected as a predecessor of the finishing and handover activities, so that the reconstructed network correctly represents a habitable, fully serviced house at the point of handover. This step ensures that the computed duration reflects genuine completion rather than an artificially early milestone, and it is the reason the master register in the Results section shows a single convergent critical path terminating at the key handover milestone.

Finally, the reconciliation between the computed and planned durations is treated explicitly. The critical-path duration computed by CPM is 116 working days, whereas the owner's original schedule allocated 133 working days, resulting in a 17-working-day difference. This difference is treated as a schedule-duration discrepancy arising from the reconstructed activity network and dependency relationships, rather than as evidence of schedule optimization or schedule crashing. The 116-working-day result is therefore reported as the CPM-derived verified baseline, while the 133-working-day duration is retained as the original owner schedule for comparison.

4. Result And Discussion

The four-door rental house comprises fourteen macro work packages, coded A to N, each decomposed into detailed sub-activities, and all mandatory branches converge into the Key Handover milestone (N). Table 4.1 presents the macro work packages, their codes, predecessor relationships, and summary spans as exported from Microsoft Project. Because the summary spans overlap where sub-activities of different packages run in parallel, the macro table is read together with the detailed register in Table 4.2.

Table 4.1 Macro work packages of the four-door rental house project

Job Group	Code	Predecessor	Summary span (Working days)
Preparatory	A	-	8
Excavation and Landfill	B	A	61
Masonry & Plastering	C	B	72
Concrete	D	C	42
Roofing and Ceiling	E	D	42
Door and Window Frame	F	E	43
Flooring and Ceramics	G	F	13
Hanging and Locking	H	F	50
Electrical and Water Installation	I	G	46
Finishing	J	I	64
Septic Tank and Infiltration	K	B	12
Fencing	L	J	6
Other Jobs	M	L	2
Key Handover	N	M	0

Source: Data Process by Author (2026)

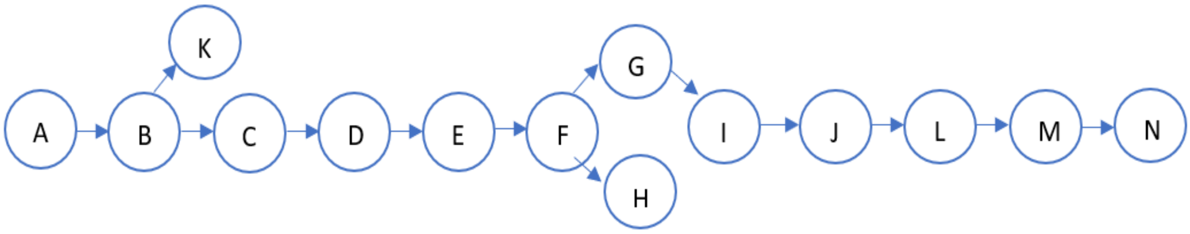


Figure 4.1 Network Diagram

The macro-level network diagram illustrates the sequence and interdependencies among the fourteen main work packages (coded A through N). As modeled, the workflow initiates linearly from Preparation (A) through Excavation and landfill (B), Masonry and plastering (C), Concrete (D), Roofing and ceiling (E), to Door and window frame (F). From node B, a parallel branch extends to Septic tank and infiltration (K). Following package F, the network splits into concurrent paths for Flooring and ceramics (G) and Hanging and locking (H), which subsequently converge back into Electrical and water installation (I). The sequence then proceeds through Finishing (J), Fencing (L), and other jobs (M), ultimately culminating in the final Key handover milestone (N).

Table 4.2 Master activity register with CPM parameters (working days)

Code	Activity	Duration	Predecessor	ES	EF	LS	LF	TF	Status
B.1	Foundation soil excavation	10	A.2	8	18	8	18	0	Critical
C.3	Brick masonry	18	D.1.c	46	64	47.5	65.5	1.5	Not critical
D.1.b	Sloof formwork 20x25 cm	4	D.1.a	40	44	40	44	0	Critical
D.2.b	Practical-column formwork	4	D.2.a	68	72	68	72	0	Critical
E.4	Hollow-iron ceiling frame	12	E.3	91	103	91	103	0	Critical
E.5	Gypsum board ceiling installation	6	E.4	103	109	103	109	0	Critical
F.1	Class-II frame wood (5/12)	10	C.3	64	74	64	74	0	Critical
F.2	Wooden panel door-leaf installation	6	F.1	74	80	74	80	0	Critical
G.1	Ceramic tile installation 30x30	15	C.5	80	95	104	119	24	Not critical
J.2	Ceiling paint	7	E.5	109	116	109	116	0	Critical
N	Key handover	0	J.2	116	116	116	116	0	Critical (milestone)

Source: Data Process by Author (2026)

The forward and backward pass over the reconstructed network gives a verified baseline duration of 116 working days. The critical path, formed by the activities with total float equal to zero, runs from Excavation through Concrete, Masonry, Roofing and Ceiling, Door and Window, Finishing, and Key Handover. Two representative activities carry positive float and are therefore schedule-flexible: ceramic tile installation (G.1) with a total float of 24 working days, and the brick-masonry detail C.3 with a total float of 1.5 working days. The baseline schedule and its critical path parameters are detailed in Table 4.2. Furthermore, the Gantt baseline schedule is presented in Figure 4.1, and the project overview with the progress snapshot at the status date is presented in Figure 4.2. These figures and parameters are exported directly from the Microsoft Project model that generated Table 4.2.

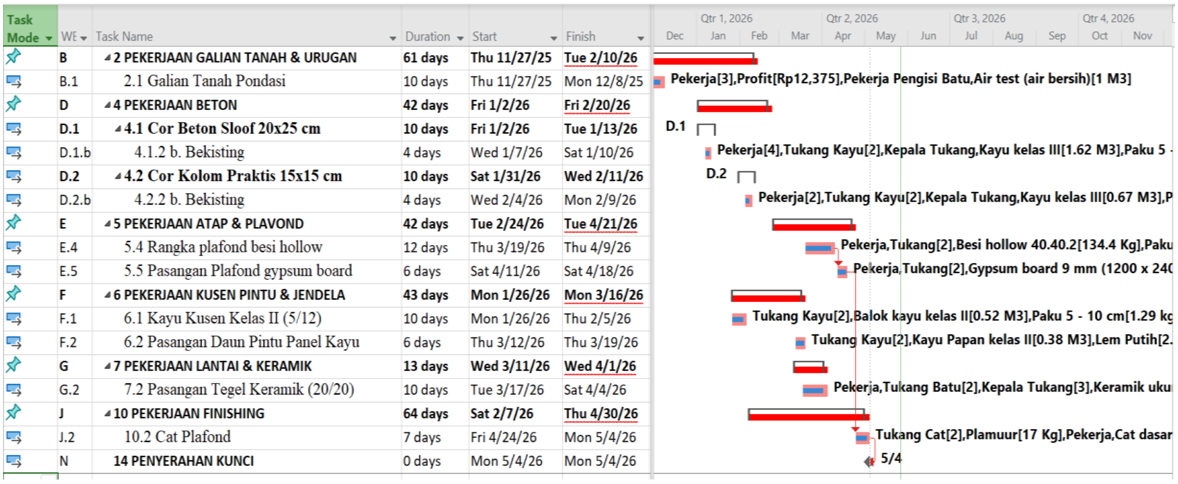


Figure 4.2 Gantt baseline schedule generate in Microsoft Project (part 1 of 2).

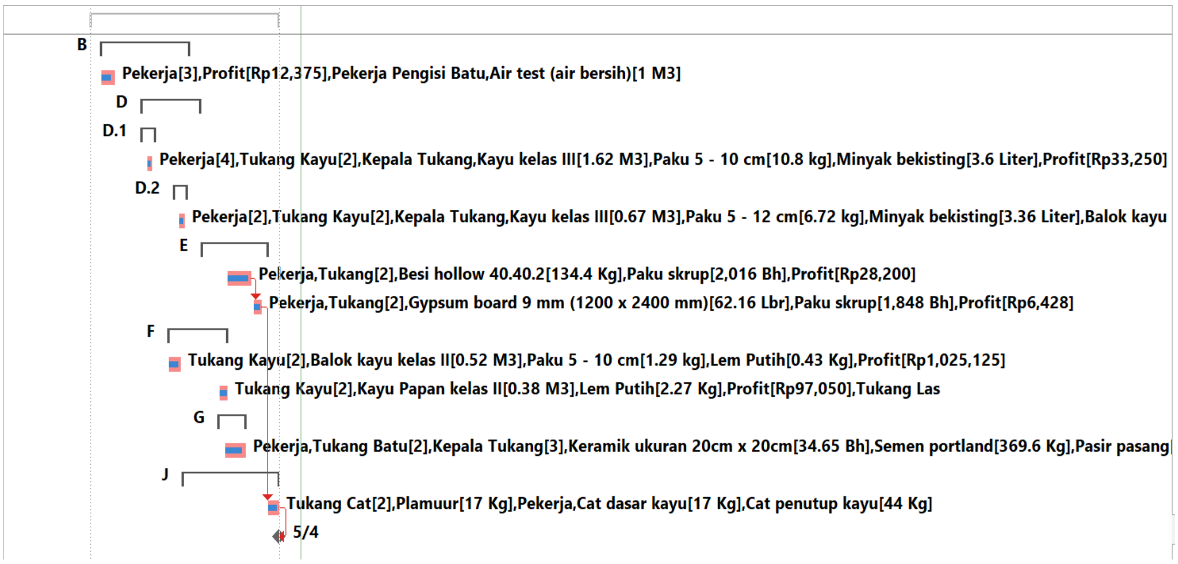


Figure 4.3 Gantt baseline schedule generated in Microsoft Project (part 2 of 2).

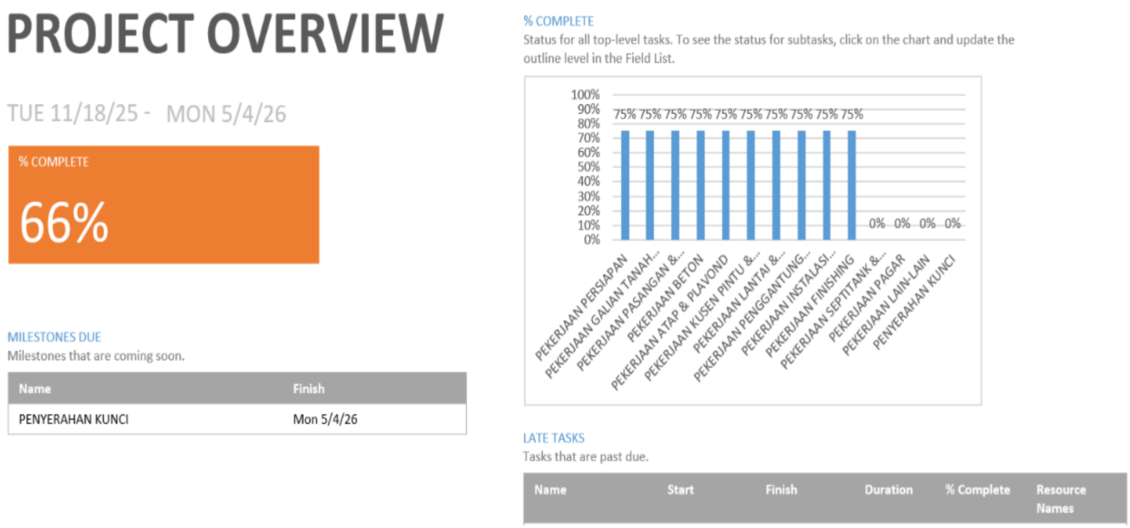


Figure 4.4 Microsoft Project Output (2026)

Reading the master register activity by activity clarifies how the critical path is formed. Foundation soil excavation (B.1) begins at working day 8, immediately after the preparation package, and finishes at day 18 with zero float, so it opens the critical chain. The concrete package then controls the sequence: the sloof formwork (D.1.b) is critical at days 40 to 44, and the practical-column formwork (D.2.b) is critical at days 68 to 72, because the frame must be cast before the walls and roof can proceed. The roofing and ceiling package carries the chain into the second half of the project, with the hollow-iron ceiling frame (E.4) critical at days 91 to 103 and the gypsum board ceiling installation (E.5) critical at days 103 to 109. The door and window package contributes the class-II frame wood (F.1) and the wooden panel door-leaf installation (F.2), both critical between days 64 and 80. The chain closes with ceiling paint (J.2) in the finishing package, critical at days 109 to 116, and finally the key handover milestone (N) at day 116. Every one of these activities has a total float of zero, which is why they jointly define the 116-working-day duration.

The near-critical activities are equally informative. Brick masonry detail C.3 has a total float of only 1.5 working days, which means it is almost critical and should be monitored closely, because even a small slippage would pull it onto the critical path. Ceramic tile installation (G.1), by contrast, has a comfortable total float of 24 working days; it can be scheduled flexibly within its window from day 80 to day 119 without affecting the completion date, and this float can be used to avoid a clash with other finishing crews. The presence of both a near-critical activity and a genuinely flexible one demonstrates that the network is not trivially linear, and it shows why an explicit float profile, rather than a simple bar chart, is needed to manage the project correctly.

At the stated status date, the project baseline records 75 percent physical completion, computed with the physical-weight method described in the methodology. It is worth clarifying that the Microsoft Project overview in Figure 4 shows a headline value of 66 percent; this is the software default, which weights progress by activity duration, whereas the 75 percent reported here weights progress by physical work volume. The two figures are not in conflict, they describe the same status date under two different weighting conventions, and the per-task bars in the same overview already display the 75 percent physical value. This snapshot confirms that the structural-to-finishing sequence had reached the ceiling and door stages while the finishing works remained in progress, which is consistent with the position of these activities on the critical path.

The verified baseline duration of 116 working days, and the critical path that runs through the structural-to-finishing sequence, can be interpreted in terms of the technological logic of house construction. Masonry cannot begin before the concrete frame is in place, ceiling finishing depends on the completed roof structure, and handover cannot occur until the finishing works are complete. Each of these is a hard technological predecessor, which is precisely why the total float on these activities is zero. In practical terms, the zero-float status is a warning label, it tells the supervisor that material readiness and crew availability for exactly these packages must be protected, because any slippage on them will move the completion date one for one.

The delay-sensitivity analysis makes this quantitative. Because the critical activities have zero float, a three-working-day delay on any one of them extends the project from 116 to 119 working days, and a seven-working-day delay extends it to 123 working days, in each case by the same amount as the delay. In contrast, an equal delay on a non-critical activity such as ceramic tile installation (G.1), which carries 24 working days of float, does not change the completion date at all until its float is exhausted. This asymmetry is the central managerial insight of the critical-path analysis: schedule protection effort, buffers, and expediting should be concentrated on the zero-float chain, not distributed evenly across all activities. For a small developer this is directly actionable, because it identifies where limited supervisory attention and contingency budget yield the greatest protection of the delivery date.

These findings are consistent with prior residential CPM studies. Sigit et al, (2024) and Perdana & Sari, (2022) similarly report that converting an opaque bar chart into an explicit network makes delay risk visible and supports time control. Ilwaru et al. (2018) confirm the usefulness of CPM for locating the constraining sequence in housing and building projects. The present study extends this literature in one specific respect, it performs a transparent reconciliation between the computed critical-path duration and the owner original plan. The reconciliation of 116 against 133 working days shows that the manual plan carried 17 working days of conservative, project-level slack that the network analysis removes. This is not a contradiction between two numbers, as an untrained reader might assume; it is the expected result of replacing an intuitive allocation with a computed critical path, and it demonstrates a potential 17-working-day reduction relative to the original plan without any crashing.

The managerial implications for small rental-housing developers are significant. A verified baseline supports realistic tenant hand-over dates and therefore realistic projections of when rental income will begin, which is central to the cash-flow planning of a micro property business. It supports staged material procurement aligned with the critical chain, reducing both idle inventory and last-minute shortages. It provides a defensible basis for progress claims and for communicating with financiers. More broadly, the adoption of Microsoft Project as a scheduling tool is a project-management capability that, once built, can be reused across future projects, so that reliable delivery becomes a repeatable source of competitive advantage rather than a one-off outcome. This capability framing is the business-innovation contribution that aligns the study with management research rather than with pure construction engineering (Saputra et al., 2024).

The contrast between the manual and the digital planning workflow deserves emphasis because it is the core of the business-innovation argument. In the conventional workflow, the owner or foreman draws a bar chart, assigns durations from experience, and updates it manually when the field situation changes, the chart shows when activities are planned but not why, and it cannot answer the question of how a specific delay will affect handover. In the digital CPM workflow demonstrated here, the same durations and a defined dependency network are entered once into Microsoft Project, and the software computes the critical path, the float of every activity, and the effect of any change instantly. The marginal effort of maintaining the digital model is small once it is built, while the information it provides, particularly the float profile and the delay sensitivity, is exactly the information a small developer needs to protect the delivery date and the rental cash flow. Adopting this workflow is therefore a low-cost, high-value capability upgrade rather than a burdensome formality.

The reconciliation of the schedule also has a direct financial reading for the developer. If the verified baseline of 116 working days can be achieved, the property reaches the point of first occupancy earlier than the original 133-working-day plan implied, which advances the start of rental income by up to 17 working days across four units. Even without a formal cost analysis, this timing effect is material for a micro property business whose return depends on occupancy, and it illustrates why an accurate baseline is a business asset and not only an engineering document. This interpretation stays within the scope of time scheduling and does not require actual-cost data, which is why it can be stated with confidence while cost-control claims are withheld.

The scope of this study is deliberately limited to baseline time scheduling. No Earned Value analysis was performed, because verified actual-cost records were not available, and no crashing or resource-levelling scenarios were evaluated. Consequently, this study makes no claim regarding cost control, cost efficiency, or schedule optimization, the total planned budget of about Rp 535 million is reported only as context for the scale of the project. Restricting the claims to what the schedule network demonstrably shows is a deliberate methodological choice that avoids overclaiming beyond the available evidence.

It is worth situating the 17-working-day gap in the broader literature on schedule performance. Studies of construction delay repeatedly find that a large share of overruns originates not in unforeseeable events but in planning that is too coarse to expose interdependencies, so that slack is added conservatively at the package level to absorb uncertainty that a proper network would localize. Anissafaroh & Vilantika, (2022); Lestari et al. (2022) The present result is consistent with this pattern, the owner original plan embedded conservative slack across packages, and the network analysis reallocated that slack to the specific activities that carry it, revealing a shorter controlling path. This does not mean the original plan was wrong; a conservative plan is a rational response to uncertainty when no network model is available. Rather, it means that the digital baseline gives the developer a more precise picture of where the schedule risk actually lies, and it converts undifferentiated slack into an explicit, manageable float profile.

Limitations. This study is a single-case design with deterministic activity durations, so its conclusions depend on the quality of the input data and are not statistically generalizable to other projects. It does not incorporate probabilistic duration analysis such as PERT, which would capture the uncertainty in field durations, and it does not include verified actual-completion data beyond the 75 percent progress snapshot. Resource levelling and cost analysis were outside the scope. These limitations do not weaken the internal validity of the baseline, but they define the boundary of its interpretation and motivate the future work below.

5. Conclusion

Using the Critical Path Method operationalized in Microsoft Project, the four-door rental house project in Samarinda has a verified baseline duration of 116 working days from a start date of 18 November 2025, which is 17 working days shorter than the owner original plan of 133 working days. The critical path runs through excavation, concrete, masonry, roofing and ceiling, door and window, finishing, and handover, and all of these activities have a total float of zero, which means they are time sensitive and must not be delayed. Non-critical activities such as ceramic tile installation carry positive float and therefore provide scheduling flexibility that can be used to smooth resource use. The delay-sensitivity analysis confirms that slippage on any critical activity extends the completion date one for one, so field supervision should priorities material readiness and crew availability for exactly these activities.

The study achieves its originality by presenting a fully reconciled, reproducible baseline network for a single low-cost rental-housing case and by framing the adoption of digital scheduling as a project-management capability that supports reliable delivery and rental cash-flow planning for small developers. It is important to state the limitations clearly. The study uses a single-case design with deterministic durations, it does not perform Earned Value or probabilistic analysis, and it makes no claim of cost control or schedule optimization. Future research should therefore extend this baseline by adding a transparent based cost baseline and a full Earned Value analysis against actual progress, by applying probabilistic duration analysis such as PERT to capture field uncertainty, and by evaluating crashing and resource-levelling scenarios to move from baseline planning to genuine time and cost optimization.

6. References

Ananda, K., Firdaus, & Mulyati, E. (2026). Analisis Faktor Penyebab Keterlambatan Proyek Konstruksi Bangunan Rumah Susun Mahasiswa di Palembang. *JMTS: Jurnal Mitra Teknik Sipil*, *9*(1), 197–210.

Anissafaroh, N. K., & Vilantika, E. (2022). Jurnal Manajemen Jurnal Manajemen. Analisis Pengendalian Biaya pada Perusahaan Konstruksi di Kabupaten Gresik, *6*(1), 131–143.

Asdi, R. Z., & Utomo, D. S. (2025). A Comprehensive Analysis of Building Construction Projects' Delay Using the Analytic Network Process. *International Journal of Economics, Business and Innovation Research*, *04*(01), 2025.

Baits, H. A., Puspita, I. A., & Bay, A. F. (2020). Combination of program evaluation and review technique (PERT) and critical path method (CPM) for project schedule development. *International Journal of Integrated Engineering*, *12*(3), 68–75. https://doi.org/10.30880/ijie.2020.12.03.009

Doukari, O., Seck, B., & Greenwood, D. (2022). The Creation of Construction Schedules in 4D BIM: A Comparison of Conventional and Automated Approaches. *Buildings*, *12*(8), 1145. https://doi.org/10.3390/buildings12081145

Fardila, D., & Adwayah, N. R. (2021). Optimasi Biaya dan Waktu Proyek Konstruksi dengan Lembur dan Penambahan Tenaga Kerja. *INERSIA: LNformasi Dan Ekspose Hasil Riset Teknik SIpil Dan Arsitektur*, *17*(1), 35–46. https://doi.org/10.21831/inersia.v17i1.39499

Fijra, R., Rahmalia Putri, A., Mawasandi, F., & Harisnanda, F. (2025). Implementasi Critical Path Method (Cpm) Pada Proyek Perumahan Xyz Untuk Meningkatkan Efisiensi Manajemen Proyek. *Journal Industrial Engineering and Management (JUST-ME)*, *6*(01), 86–93. https://doi.org/10.47398/justme.v6i01.105

Firmansyah, M. E., Cahyono, C., Siregar, M., & Wiwin, W. (2025). Perencanaan Dan Estimasi Waktu Serta Biaya Menggunakan Metode Work Breakdown Structure Dan Critical Path Method (Cpm). *PROFISIENSI: Jurnal Program Studi Teknik Industri*, *13*(2), 101–108. https://doi.org/10.33373/profis.v13i2.7865

Hamdani, Wibowo, S. E., Damayanti, F., Putri, K. P., & Hutapea, T. O. (2025). Application of Project Management with the CPM Method in a House Construction Project. *International Journal of Multidisciplinary Research and Growth Evaluation*, 141–146.

Ichwan Hadi Saputra, Yeni Erina, & Nova Nevila Rodhi. (2024). Analisis Pengendalian Waktu dan Biaya Proyek Konstruksi Dengan Metode CPM (Critical Path Method). *Journal of Social Science Research*, *4*(6), 1–13.

Ilwaru, V. Y. I., Rahakbauw, D. L., & Tetimelay, J. (2018b). Penjadwalan Waktu Proyek Pembangunan Rumah Dengan Menggunakan Cpm (Critical Path Method). *BAREKENG: JURNAL ILMU MATEMATIKA DAN TERAPAN*, *12*(2), 061–068. https://doi.org/10.30598/vol12iss2pp061-068ar617

Khofifah, A. N., & Vilantika, E. (2025). Analisis Pengendalian Biaya pada Perusahaan Konstruksi di Kabupaten Gresik. *Jurnal Manajemen*, *15*(1), 105–117.

Kim, S. H., & Kim, Y. S. (2026). Quantitative analysis of schedule impact due to design changes in finishing construction work: (A case study of office buildings). *KSCE Journal of Civil Engineering*, *30*(2), 100362. https://doi.org/10.1016/j.kscej.2025.100362

Kyokusiima, B. (2025). Integrating Financial Risk Assessment into Real Estate Development Decision-Making. *Engineering and Technology Journal*, *10*(12), 8084–8097. https://doi.org/10.47191/etj/v10i12.09

Lestari, F., Oktarina, D., & Fadilasari, D. (2022). Evaluasi Faktor-Faktor Penyebab Keterlambatan Pelaksanaan Proyek Konstruksi (Studi Kasus Pada Pekerjaan Pembangunan Gedung Lanjutan Smpn 39 Bandar Lampung). *Kolaborasi*, *2*(1), 25–38.

Mulia, T. N., Safrizal, & Candra, R. (2023). Analisis Penjadwalan Proyek Menggunakan Critical Path Method (CPM) Studi Kasus pada Pembangunan Gapura Taman Hutan Lindung Kota Langsa. *Jurnal Penelitian Ekonomi Akuntansi (JENSI)*, *7*(1), 82–90. https://doi.org/10.33059/jensi.v7i1.7731

Perdana, M. A., & Sari, R. P. (2022). Optimalisasi Waktu Pelaksanaan Proyek Konstruksi Rumah Tinggal Menggunakan Metode CPM (Critical Path Method) dan PERT (Program Evaluation and Review Technique). *Jurnal Media Teknik Dan Sistem Industri*, *6*(2), 116. https://doi.org/10.35194/jmtsi.v6i2.1944

Purnomo, K. B., & Ardan, M. (2025). Evaluasi Penerapan Teknik Crashing Dalam Manajemen Waktu Pembangunan Rumah Subsidi Metode CPM dan PERT (Studi Kasus Rumah Pondok Alam Desa Sigara-Gara). *Journal of Civil Engineering*, *17*(1).

Rahman, A., Yusnita, A., & Ekawati, H. (2025). Penerapan algoritma xgboost dalam prediksi harga sewa kos di kota samarinda. *Bulletin of Information Technology (BIT)*, *6*(4), 379–390. https://doi.org/10.47065/bit.v5i2.2304

Rosidin, K., Rifa'i, M. H., Zulkarnain, D. P., Surahman, & Kadang, T. (2026). Enrichment : Journal of Management Critical path method (CPM) for scheduling a type 36 residential house construction at Grand Permata Hijau housing , Samarinda city. *Enrichment: Journal of Management*, *16*(2).

Sa'adah, N., Iqrammah, E., & Rijanto, T. (2022). Evaluasi Proyek Pembangunan Gedung Stroke Center (Paviliun Flamboyan) Menggunakan Metode Critical Path Method (CPM) Dan Crashing. *Publikasi Riset Orientasi Teknik Sipil (Proteksi)*, *3*(2), 55–62. https://doi.org/10.26740/proteksi.v3n2.p55-62

Santoso, F. W., Handayani, F. S., & Setiono. (2025). A Comparative Analysis of the CPM and PERT Methods in Project Time Management for a High-Rise Building Construction Project in Yogyakarta. *Sustainable Civil Building Management and Engineering Journal*, *2*(2), 13. https://doi.org/10.47134/scbmej.v2i2.3927

Saputra, I. H., Erina, Y., & Rodhi, N. N. (2024). Analisis Pengendalian Waktu dan Biaya Proyek Konstruksi Dengan Metode CPM (Critical Path Method). *Journal of Social Science Research*, *4*(6), 1–13.

Satryawati, Zunaidah, U., Qumairo, E. L., Nurhalizah, S., & Tambing, W. (2025). Application of Project Management Using the Critical Path Method (CPM) in Residential Construction Projects. *Enrichment: Journal of Management*, *15*(2), 101–110.

Sigit, R. A. P., Al-Muqaffa, F. W., & Sutrisno, S. (2024). Evaluasi Penjadwalan Waktu Pada Proyek Pembangunan Rumah dengan Metode CPM (Studi Kasus: Pembangunan Rumah Tinggal di Perumnas Kabupaten Karawang). *Go-Integratif : Jurnal Teknik Sistem Dan Industri*, *4*(02), 148–157. https://doi.org/10.35261/gijtsi.v4i02.10876

Sinurat, F., & Misdalena, F. (2024). Analisis Manajemen Proyek Dengan Metode Critical Path Method (CPM) Pada Proyek Pembangunan Gedung Chandra Tanjung Karang. *Jurnal Konstruksi*, *22*(2), 98–107. https://doi.org/10.33364/konstruksi/v.22-2.2131

Zareei, S. (2018). Project scheduling for constructing biogas plant using critical path method. *Renewable and Sustainable Energy Reviews*, *81*, 756–759. https://doi.org/10.1016/j.rser.2017.08.025