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Optimization of Duration of Shophouse Construction Project in Malalayang, Manado City

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ABSTRACT

Time delays in construction projects are a common issue that significantly impacts both project costs and overall success. This study aims to optimize the duration of a four-story shop-house construction project in the Malalayang area of Manado City by applying the crashing method. This technique is employed to accelerate activities along the critical path through the addition of overtime work hours, without compromising the quality of the output. The analysis was conducted using the Critical Path Method (CPM) to identify critical project activities, followed by a quantitative simulation of schedule acceleration. The results indicate that the project duration can be reduced from 175 days to 148 days—an acceleration of 27 days—with an additional cost of IDR 32,723,678.95. This additional cost is considered acceptable given the time efficiency gained. These findings demonstrate that the crashing method is an effective and feasible strategy for schedule optimization in the management of building construction projects

INTRODUCTION

In construction project execution, discrepancies between the planned schedule and actual field implementation are a common challenge. These deviations often lead to extended project durations, which in turn result in increased costs and delays in project completion. Project delays can be attributed to various factors such as design changes, unpredictable weather conditions, labor shortages, delays in material or equipment procurement, and inconsistencies between planning and on-site execution (Khodijah et al., 2013).

This condition highlights the importance of managerial competence and the application of effective time control methods in construction project management. One widely adopted approach to address these challenges is the *Crash Program* method. This technique aims to accelerate project completion by expediting activities located along the critical path, thereby directly affecting the total project duration. Each acceleration alternative is evaluated in terms of the additional costs incurred and the amount of time saved, with the objective of achieving optimal efficiency without compromising work quality (Frederika, 2010; Ningrum, 2016).

Several previous studies have demonstrated the effectiveness of the crashing method in optimizing project duration. Research conducted by Marsudi Utomo and Agung Wibowo (2017) showed that a 120-day acceleration on an irrigation channel rehabilitation project resulted in a cost saving of IDR 9,692,409, as the reduction in indirect costs outweighed the additional direct costs due to acceleration. Similar findings were reported by Riski Ramadan (2018), whose study revealed that adding three hours of overtime work reduced the project duration by 29 days, with only a 0.85% increase in the total project cost.

Given the urgency of completing projects on time and the potential cost efficiency offered by acceleration strategies, it is essential to conduct a focused study on the construction of a commercial building (Ruko) in Malalayang, Manado City. Optimizing the project duration is crucial to ensuring timely completion, budget efficiency, and final output quality in accordance with standards. This study is expected to offer technical solutions through the implementation of the crashing method to accelerate construction projects in a measured and systematic manner.

METHODS

This study employs a quantitative approach with an analytical method based on actual project data to identify and evaluate the effectiveness of schedule acceleration strategies through the crashing technique. The research focuses on a four-story commercial building (ruko) construction project located in Malalayang, Manado City, utilizing a case study approach.

Type and Design of Research

The research adopts a descriptive quantitative design, which involves describing the actual project conditions through data collection and analysis, as well as performing a time optimization simulation using the *Critical Path Method* (CPM) and crashing technique. CPM is applied to determine the project's critical path, while crashing is implemented on activities along the critical path to reduce the total project duration in a controlled manner (Wijaya & Arifin, 2024).

Research Location and Object

The object of this study is the construction project of the Mykonos shop-house in Malalayang, Manado City. The project was selected due to the potential for schedule deviation and the availability of implementation planning data, including the S-curve, Bill of Quantities (BoQ), and unit prices for labor and materials.

Sources and Types of Data

The data used in this research includes:

- Bill of Quantities (BoQ)
- Unit prices for materials and labor wages
- Project schedule (Time Schedule)
- Work volume for each activity

Data Analysis Techniques

The data analysis process involves several stages:

1. **N**etwork Planning (CPM): Project data is used to construct the activity network diagram and identify the critical path as a basis for time optimization (Hasan & Dewi, 2025).

2. Application of the Crashing Method: Acceleration is performed on critical path activities by adding 3 hours of overtime per day. Each activity selected for crashing is analyzed in terms of the additional cost and its impact on project duration.
3. Cost and Duration Simulation: Total project costs are calculated before and after crashing to assess the trade-off between time and cost.
4. Efficiency Evaluation: The effectiveness of the acceleration is measured by calculating the differences in duration and cost, while considering the threshold of acceptable additional expenses.

This approach enables an objective comparison between the normal and optimized schedules, thus allowing the research findings to serve as a basis for managerial decision-making in similar building construction projects.

RESULTS AND DISCUSSION

Identification of Critical Path

The identification of the project's critical path was conducted using the *Critical Path Method* (CPM) based on the project's implementation schedule. Figure 1 illustrates the CPM network diagram used to determine the activities located on the critical path.

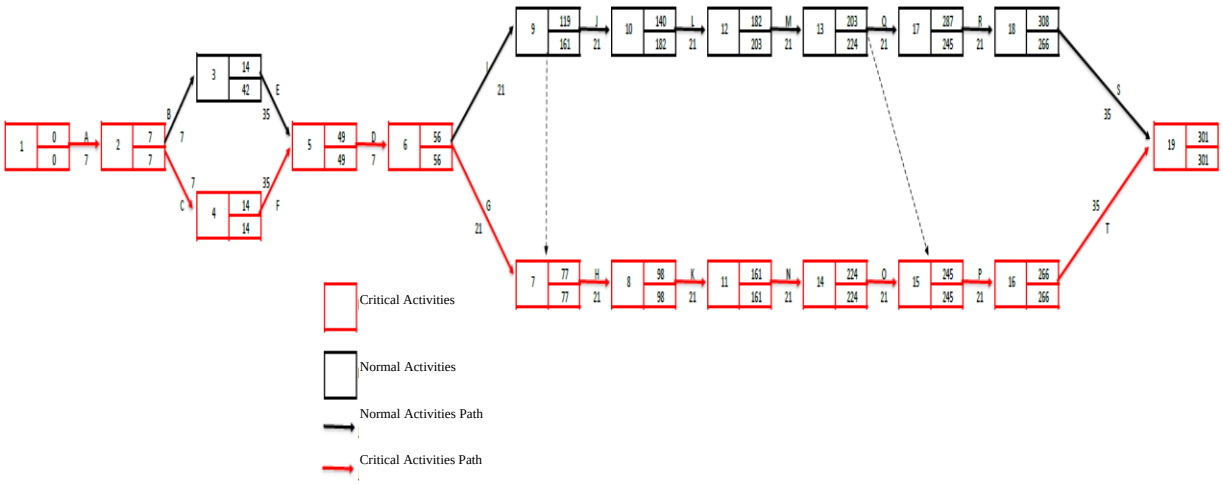

Figure 1. Critical Path Method Design

Critical path mapping, Table 1 presents a list of critical activities spanning from the start to the end of the project.

Table 1. List of Critical Activities

No	Activity	Normal Duration (days)	Crashing Duration (days)
A	Site Preparation	7	6
C	Excavation for Pilecap	7	6
D	Backfilling and Compaction	7	6
F	Pedestal Foundation	7	6
G	Columns – First Floor	21	18
H	Tie Beam	21	18
K	Beams – Second Floor	21	18
N	Beams – Third Floor	21	18
O	Slab – Third Floor	21	19
P	Columns – Fourth Floor	35	32
T	Roof Slab	36	32

Time and Cost Acceleration Analysis (Crashing)

The crashing simulation was performed by adding 3 hours of overtime per working day. The accelerated duration for each activity was calculated using the following formula:

$$Crashing\ Duration = \frac{Volume}{(Productivity \times Normal\ Working\ Hours) + (Overtime\ Hours \times Productivity\ Reduction \times Productivity}$$

Meanwhile, the calculation of overtime cost used the following formula:

$$Overtime\ Cost = (Wage/hour \times 1.5 + 2 \times 2 \times Wage/hour) \times Number\ of\ Workers$$

Sample calculation results are shown in Table 2.

Table 2. Selected Crashing Calculations

Activity	Volume	Crashing Duration	Crashing Cost (IDR)
Site Preparation	420 m²	20 days	7,469,406.72
Pilecap Excavation	147.35 m³	12 days	7,303,863.98
Compaction	41.06 m³	8 days	720,455.72
Pedestal Foundation	6.00 m³	35 days	1,132,841.06
Columns – First Floor	24.66 m³	21 days	2,383,049.70
Tie Beam	35.15 m³	21 days	1,933,278.09
Beams – Second Floor	38.37 m³	21 days	2,521,502.25
Beams – Third Floor	41.32 m³	22 days	2,647,918.01
Slab – Third Floor	32.17 m³	22 days	2,255,511.90
Columns – Fourth Floor	17.30 m³	22 days	1,742,677.42
Roof Slab	38.56 m³	36 days	2,609,174.09

Time and Cost Efficiency Evaluation

An evaluation was conducted by comparing the total duration and cost of the project under normal conditions and after applying the crashing method, as summarized in Table 3.

Table 3. Project Comparison Before and After Crashing

Phase	Duration (Days)	Cost (IDR)
Normal	175	12,855,458,720.71
Crashing	148	12,888,182,399.66
Difference	-27	+32,723,678.95

Based on the results, the implementation of crashing successfully reduced the project duration by 27 days with an additional cost of approximately IDR 32.7 million. Despite the cost increase, the significant time efficiency achieved adds value, particularly in the context of accelerating project handover to the client or end-user (Putra & Wibowo, 2025).

Interpretation of Results

The findings of this study demonstrate that crashing-based acceleration strategies provide flexibility in managing project time effectively. The relatively small increase in cost compared to the benefit of shortened duration makes this method a viable consideration for construction project management decisions (Lestari & Nugraha, 2024).

CONCLUSION

This study aimed to analyze the effectiveness of the crashing method in optimizing the duration of building construction projects, specifically focusing on a four-story commercial building (shop-house) project in the Malalayang area of Manado City. Based on the identification of the critical path using the Critical Path Method (CPM) and the implementation of a crashing simulation with added overtime hours, it was found that project acceleration can be systematically applied to critical activities without compromising work quality.

The simulation results indicated that the project duration was successfully reduced from 175 days to 148 days, achieving a total acceleration of 27 calendar days. This acceleration led to an additional cost of IDR 32,723,678.95, or approximately 0.25% of the total normal project cost. Although a slight cost increase occurred, the time efficiency gained is substantial and offers strategic advantages, particularly in ensuring timely project completion and reducing indirect costs.

Therefore, it can be concluded that the application of the crashing method is an effective approach for optimizing construction project durations, especially when managed by simultaneously considering cost, time, and resource factors. The findings of this study contribute meaningfully to the development of time management strategies in multi-story building construction projects and may serve as a practical reference for the implementation of rational and efficient acceleration methods in the field.

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