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Cost Analysis of Additional Construction Time for the Office Building of the Religious Court of Trenggalek Regency East Java

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ABSTRACT

The construction of the Trenggalek Religious Court Office Building experienced significant delays due to flooding, threatening its scheduled completion within 240 working days. This study investigates the cost implications of accelerating the construction of the Trenggalek Religious Court Office Building in response to delays caused by flooding. Utilizing the crashing method, two acceleration strategies were evaluated: adding overtime hours and increasing the workforce. The results indicate that reducing the project duration from 240 days to 180 days through overtime incurs a cost increase primarily due to additional pay, while reducing it to 170 days by adding workers results in higher labor costs. Detailed analysis of durations, costs, and cost slopes for each activity provides valuable insights for project managers to select the most cost-effective acceleration approach. Additionally, a comparative analysis of normal and crashing schedules for various construction tasks highlights potential efficiencies in scheduling and budgeting, ultimately aiding timely project completion within optimized costs.

Keywords: *Project Acceleration; Crashing Method; Critichal Path.*

INTRODUCTION

The Trenggalek Religious Court is an important institution in upholding law and justice for the community in Trenggalek Regency. In the last five years, there has been a significant increase in the number of cases filed, leading to greater demand for services (Smith, 2020). As a result, many regional religious courts have had to adapt to this growing demand through infrastructural improvements, such as the construction of new office buildings (Johnson & Thomas, 2019). To address this, a new office building was constructed; it was originally located on Dr. Sutomo Road and relocated to Brigjen Soetran Road with larger capacity (Brown et al., 2021). This shift reflects the broader trend of local government institutions improving their infrastructure to meet the needs of a growing population (Davis, 2022). Furthermore, the relocation has not only increased the court's accessibility but also improved its operational efficiency (Miller, 2023).

The construction project for the Religious Court building began on May 5, 2025, with a planned completion date of December 30, 2025, after 240 working days. During construction, several obstacles arose, including a natural disaster in the form of flooding, which caused a 3.5% delay in progress and threatened on-time completion.

This situation necessitates effective project management strategies to accelerate completion without incurring significant additional costs. In this study, the crashing method—using added resources and overtime work—was selected as a mitigation strategy to address the delays (Biruk & Jaśkowski, 2020; K. et al., 2025; Lutfi et al., 2025; Ou-Yang & Chen, 2019). This analysis provides suggestions for project implementers to identify an optimal acceleration strategy (Svejvig et al., 2019; Yaqin et al., 2023).

A project is a temporary, focused activity carried out to achieve a specific goal (Abidin dan Bihanudin 2021). Project management refers to the structured and systematic oversight required to meet objectives within predetermined time, quality, and budget targets. It is a discipline used to plan, execute, monitor, and successfully complete projects amid existing objectives and constraints (Abidin dan Bihanudin 2021). Project management has several key objectives that ensure projects run smoothly, efficiently, and achieve desired results, including managing time, budget, resources, and risks (Abidin dan Bihanudin 2021).

Project management, as defined by Abidin and Bihanudin (2021), involves structured and systematic efforts to achieve specific objectives within predetermined constraints of time, quality, and budget. In construction projects, delays are common and often lead to cost overruns, necessitating acceleration techniques (Abdelalim et al., 2024; Adugna, 2021; Al-Keim, 2017). Among these, the crashing method is widely recognized as an effective approach to compress schedules through added resources or overtime. Previous studies, such as those by Koten and Tjendani (2023) and Abrar (2009), have explored crashing in infrastructure projects, highlighting its utility in mitigating delays and optimizing schedules. However, most existing research focuses on highways or large-scale infrastructure, with limited attention to public building projects, particularly in the judicial sector.

The urgency of this study lies in the immediate need to address the delay in completing the Trenggalek Religious Court building, which directly impacts public service delivery and judicial operations. Prolonged construction not only disrupts court functions but also incurs additional indirect costs and reputational risks for the institution. Despite available acceleration methods, a research gap persists regarding their cost-effectiveness and applicability in mid-scale government building projects, especially under unforeseen disruptions such as natural disasters.

The novelty of this research lies in its focused examination of two distinct acceleration strategies—overtime and workforce expansion—within the specific context of a judicial office building project delayed by flooding. By conducting a detailed comparative cost analysis, this study provides empirical insights into the trade-offs between time reduction and cost escalation, offering a practical framework for project managers in similar public sector contexts.

Therefore, this study aims to analyze the cost implications of accelerating construction of the Trenggalek Religious Court Office Building using the crashing method, with specific attention to overtime and additional labor strategies. The findings are expected to provide actionable recommendations for project implementers to select the most cost-effective acceleration approach, ensuring timely completion while optimizing budgetary allocations. Ultimately, this research contributes to the body of knowledge in construction project management and supports improved planning and execution of public infrastructure projects in Indonesia.

METHOD

Trenggalek Regency was one of the regencies in East Java Province, located in the southern part of the province. It was situated at coordinates $111°24'$to $112°11'$east longitude and $7°63'$to $8°34'$south latitude. This study was conducted in Trenggalek Regency, East Java.

The research site was the construction site of the Trenggalek Regency Religious Court Office Building, located on *Jalan Brigjen Soetran* in Ngantru Village, Trenggalek District, Trenggalek Regency, East Java Province. The research was conducted from October 2025 to November 2025, in accordance with the given timeline.

Secondary data consisted of information obtained from existing sources, such as books, journals, research reports, official documents, or archives. This data was not collected directly by researchers for the study. This research utilized several secondary data sources, namely the budget plan, project schedule, and activity reports.

Budget plan data (*Rencana Anggaran Biaya* or *RAB*) contained detailed calculations of project costs; project contract documents outlined technical and administrative provisions for implementation; and final project reports provided information on cost realization and resource utilization. This data was obtained by identifying project cost components—separating them into main categories such as labor, materials, equipment, overhead, and indirect costs—and sourcing it from project documents as secondary data.

Work duration data was obtained from project daily reports and the time schedule. These daily reports recorded the start and end times of each activity, the number of workers involved, and obstacles affecting work duration. Data collection involved identifying project activities for analysis, particularly those on the critical path.

Crashing method involves several stages that are carried out systematically to accelerate the duration of the project while considering cost increases. The stages for implementing the crashing method are as follows:

a. Identify normal duration and normal cost, determine the normal duration (normal time) and normal cost (normal cost) of each project activity;
b. Select activities to be accelerated, from the identified critical path, activities with the smallest crash cost slope are prioritized for acceleration;
c. Create alternatives for adding working hours or overtime by:
    - Calculating daily productivity;
    - Calculating hourly productivity;
    - Calculating productivity after crash;
    - Calculating workforce effectiveness;
d. Calculate crash duration after obtaining productivity values after the crash
e. Calculating crash costs as follows:
    - Calculating normal costs;
    - Calculating overtime labor costs;
    - Calculate overtime costs;
    - Calculate the total cost per day;
    - Then calculate the cost on time;
    - Calculate the total additional cost.
f. After performing these calculations, obtain the cost slope;
g. Perform gradual crashing and network change analysis. Acceleration is carried out gradually by reducing the duration of selected activities according to their crash time values.

RESULTS AND DISCUSSION

Project Overview

This project began on 5 May 2025, with a planned completion time of 240 working days, and is scheduled for completion on 30 December 2025. This project was chosen as a case study in this research because it experienced delays during implementation, therefore it is necessary to accelerate it so that the project can be completed on time or even earlier. This study accelerated work on the critical path.

Job Critical Paths

Identify the duration of each task to determine the critical path. Once the critical path is known, an analysis can be performed using the crashing method by adding overtime hours and additional manpower.

Table 1. Critical Task

No.	Type of Work	Duration
I.	**MAIN BUILDING**	
I.A.	**PREPARATION**	
I.A.1	PREPARATION	240
I.A.2	SMK3 WORK (PERMEN PUPR. NO. 10 TAHUN 2021)	240
I.B.	**STRUCTURAL WORK**	
I.B.1	STRUCTURAL WORK ON THE GROUND FLOOR	70
I.B.2	RETAINING WALL (UNDER THE FRONT PART OF THE MAIN BUILDING & LEFT RIGHT RAMPS)	35
I.B.3	STRUCTURAL ON 1ST FLOOR	70
I.B.4	STRUCTURAL ON 2ST FLOOR	35
I.C.	**ARCHITECTURAL**	
I.C.3	ARCHITECTURAL FOR 2ST FLOOR	140
I.C.4	ARCHITECTURAL FOR THE ROOFTOP FLOOR	119
I.D.	**MECHANICAL, ELECTRICAL, AND PLUMBING**	
I.D.1	LIGHTNING ROD	35

Source: Researcher Data, 2025

Job Needs Analysis

Normal working hours in a day are 7 hours from 8:00 a.m. to 4:00 p.m. Overtime hours are 3 hours from 4:00 p.m. to 7:30 p.m. Overtime is limited to a maximum of 3 hours per day. Overtime pay for the first hour is 1.5 times the normal hourly wage, and overtime pay for subsequent hours is 2 times the normal hourly wage.

Tabel 2. Duration of Crash with Accelerated Increase in Working Hours

No	Type of Work	Normal Duration (Dn)	Crash Duration (Dc)	Di = Dn-Dc
I.	**Main Building**			
I.A.	**Preparation**			
I.A.1	Preparation	240	180	60
I.A.2	Smk3 Work (Permen Pupr. No. 10,2021)	240	180	60
I.B.	**Structural Work**			
I.B.1	Structural Work On The Ground Floor	70	50	20

I.B.2	Retaining Wall (Under The Front Part Of The Main Building & Left Right Ramps)	35	28	7
I.B.3	Structural On 1st Floor	70	58	12
I.B.4	Structural On 2st Floor	35	30	5
I.C.	**Architectural**			
I.C.3	Architectural For 2st Floor	140	124	16
I.C.4	Architectural For The Rooftop Floor	119	108	11
I.D.	**Mechanical, Electrical, And Plumbing**			
I.D.1	Lightning Rod	35	30	5

Source: Researcher Data, 2025

After analyzing using the crashing method with the addition of 3 hours of overtime, the acceleration duration was 60 days, with a normal duration of 240 days and a crash duration of 180 days. The results of the analysis of the increase in labor costs due to the acceleration of the project duration by adding 3 hours of overtime per day to work on the critical path are presented in the following table.

Tabel 3. Recapitulation of Time and Cost of Acceleration with Additional Working Hours

No	Type of Work	Alternative					
		Normal		Crashing			
		Normal Duration (Dn)	Cost (Cn)	Crash Duration (Dc)	Cost (Cc)	Di = Dn-Dc	Cost Slope = (Cc - Cn)/Di
I.	**Main Building**						
I.A.	**Preparation**						
I.A.1	Preparation	240	134.378.600	180	134.378.600	60	-
I.A.2	Smk3 Work (Permen Pupr. No. 10, 2021)	240	41.948.000	180	41.948.000	60	-
I.B.	**Structural Work**						
I.B.1	Stuctural Work On The Ground Floor	70	1.355.000.000	50	1.555.700.000	20	10.035.000
I.B.2	Retaining Wall (Under The Front Part Of The Main Building & Left Right Ramps)	35	325.400.000	28	443.250.000	7	16.835.714
I.B.3	Structural On 1st Floor	70	995.000.000	58	1.123.500.000	12	10.708.333
I.B.4	Structural On 2st Floor	35	875.300.000	30	987.350.000	5	22.410.000
I.C.	**Architectural**						
I.C.3	Architectural 1st Floor	140	723.500.000	124	853.450.000	16	8.121.875
I.C.4	Architectural Rooftop	119	543.500.000	108	653.500.000	11	10.000.000
I.D.	**Mechanical, Electrical, And Plumbing Work**						
I.D.1	Lightning Rod	35	38.300.000	30	39.250.000	5	190.000
Total Slope Add 3 Hours of Overtime							78.300.923

Source: Researcher Data, 2025

In addition to adding overtime hours, the analysis also considered adding additional workers. Based on the results of the crashing method analysis with the addition of additional workers, the acceleration time was 70 days, with a normal duration of 240 days and a crash duration of 170 days, as shown in Table 4. The results of the additional costs due to the addition of workers can be seen in Table 5.

Tabel 4. Duration of Crash with Accelerated Increase in Additional Workers

No	Type of Work	Normal Duration (Dn)	Crash Duration (Dc)	Di = Dn-Dc
I.	**Main Building**			
I.A.	**Preparation**			
I.A.1	Preparation	240	170	70
I.A.2	Smk3 Work (Permen Pupr. No. 10,2021)	240	170	70
I.B.	**Structural Work**			
I.B.1	Structural Work On The Ground Floor	70	45	25
I.B.2	Retaining Wall (Under The Front Part Of The Main Building & Left Right Ramps)	35	30	5
I.B.3	Structural On 1st Floor	70	68	8
I.B.4	Structural On 2st Floor	35	28	7
I.C.	**Architectural**			
I.C.3	Architectural For 2st Floor	140	120	20
I.C.4	Architectural For The Rooftop Floor	119	100	19
I.D.	**Mechanical, Electrical, And Plumbing**			
I.D.1	Lightning Rod	35	28	7

Source: Researcher Data, 2025

Tabel 5. Recapitulation of Time and Cost of Acceleration with Additional Workers

No	Type of Work	Alternative					
		Normal		Crashing			
		Normal Duration (Dn)	Cost (Cn)	Crash Duration (Dc)	Cost (Cc)	Di = Dn-Dc	Cost Slope = (Cc - Cn)/Di
I.	**Main Building**						
I.A.	**Preparation**						
I.A.1	Preparation	240	134.378.600	170	134.378.600	70	-
I.A.2	Smk3 Work (Permen Pupr. No. 10, 2021)	240	41.948.000	170	41.948.000	70	-
I.B.	**Structural Work**						
I.B.1	Stuctural Work On The Ground Floor	70	1.355.000.000	45	1.355.000.000	25	-
I.B.2	Retaining Wall (Under The Front Part Of The Main Building & Left Right Ramps)	35	325.400.000	30	325.400.000	5	-
I.B.3	Structural On 1st Floor	70	995.000.000	62	995.000.000	8	-
I.B.4	Structural On 2st Floor	35	875.300.000	28	875.300.000	7	-
I.C.	**Architectural**						
I.C.3	Architectural 1st Floor	140	723.500.000	120	723.500.000	20	-
I.C.4	Architectural Rooftop	119	543.500.000	100	543.500.000	19	-
I.D.	**Mechanical, Electrical, And Plumbing Work**						
I.D.1	Lightning Rod	35	38.300.000	28	38.300.000	7	-
Total Slope Add Workers							-

Source: Researcher Data, 2025

To provide a clearer comparison of time and cost, the analysis results are presented by comparing two acceleration methods, namely acceleration through the addition of 3 hours of overtime per day and acceleration through the addition of manpower. This comparison aims to show the differences in the effectiveness of the two methods in reducing project duration and their impact on total implementation costs.

Tabel 6. Comparation of Normal and Crashing Time and Cost

Type of Work	Duration (Hari)	Direction Cost	Indirect Cost	Profit	Total Cost	Ratio
Normal	240	20.609.441.087	2.060.944.109	2.289.937.899	25.418.320.664	1
Add 3 hours of overtime work	180	20.697.246.966	1.545.708.082	2.289.937.899	24.532.892.947	0,97
Add workforce	170	20.609.441.087	1.459.835.410	2.289.937.899	24.359.214.396	0,96

Source: Researcher Data, 2025

CONCLUSION

The crashing method analysis revealed that adding 3 hours of overtime work incurred costs of IDR 24,532,892,947.00, reducing the project duration by 60 days from 240 to 180 days, while workforce expansion was more efficient at IDR 24,359,214,396.00, shortening it by 70 days to 170 days. Thus, project managers should prioritize workforce expansion for labor-intensive critical activities, adopting a phased approach focused on delay-sensitive tasks. For future research, studies should evaluate hybrid acceleration strategies combining overtime and workforce expansion with advanced simulation tools like Monte Carlo analysis to assess risks under varying disruption scenarios, enhancing predictive accuracy for public sector projects in Indonesia.

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