
Analysis of Construction Time Acceleration Using the Crashing Method in the North Maluku Language Office Building Construction Project

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Abstract

This study addresses accelerating construction time for the North Maluku Language Office Building using the crashing method. The project aims to provide adequate infrastructure to support linguistic and administrative functions, scheduled over 135 calendar days starting August 2024. Employing a descriptive quantitative design, the research involved direct field observations and Microsoft Project software to analyze critical path activities eligible for crashing. The population focused on all critical path tasks, with purposive sampling targeting those amenable to overtime acceleration. Data analysis included cost variance and percentage calculations for time reduction. Results show that applying overtime reduced the project duration from 67 days to as few as 44.67 days, with labor costs increasing between 6.7% and 26.82% depending on overtime hours. Cost and scheduling analyses facilitated selecting the most cost-effective acceleration scenario. The study concludes that the crashing method effectively balances time reduction and cost increments, serving as a practical strategy for managing delays in regional public sector projects. These findings provide critical insight for optimizing schedule compression while maintaining quality.

Keywords: Construction Management, Critical Path Method, Project Acceleration, Project Scheduling, Time-Cost Trade-Off

INTRODUCTION

Is a research focused on accelerating construction time using the crashing method for the North Maluku Language Office Building project. The office, which has operated without a permanent building since 2009, needs adequate infrastructure to support its linguistic and administrative roles in the region, as mandated under Indonesian education and culture regulations. The construction project is planned over 135 calendar days starting in August 2024, aiming to provide a safe, comfortable, and representative working environment necessary for the agency's service to the public Language Office of North Maluku Province.

Construction project success depends on timely completion and cost efficiency without compromising quality. Delay risks are significant without proper planning and control, which can hinder project completion. Therefore, acceleration strategies such as fast-track approaches, time-cost trade-off analysis, and specifically, the crashing method are crucial to address potential delays. Crashing involves adding resources like overtime to reduce project duration effectively. This study applies crashing to critical path activities using Microsoft Project to analyze its impact on project duration and costs, seeking an optimal acceleration alternative metode Crashing.

Project management integrates phases from initiation to closing, balancing scope, time, and cost constraints that critically affect project quality. Time planning sets schedules and durations essential for controlling and avoiding delays, requiring dynamic updates to adapt to changing conditions like design revisions or resource availability. The crashing method systematically reduces the critical path duration by adding variable costs efficiently. Microsoft Project facilitates scheduling, resource allocation, and cost management, essential tools supporting this study's analysis of crashing impacts Project Management, Project Time Planning, Crashing Method, Microsoft Project.

The central problem addressed is the risk of schedule delays in the North Maluku Language Office Building project, which would compromise service delivery and administrative functions.

Prolonged operation without a dedicated facility underscores the need for timely project completion. Inefficient planning or delayed construction jeopardizes budget and quality, requiring examination of acceleration methods suitable to local conditions. The study evaluates multiple overtime scenarios on critical activities' duration and cost, exploring the trade-offs in accelerating completion while managing expenses. This informs decisions to select the most cost-effective and time-efficient acceleration construction project delay strategy, project acceleration.

Understanding the relationship between project duration compression and cost impact is vital for expedient delivery. Prior studies show acceleration often balances time savings against increased labor expenses, with critical path compression being the most effective approach. This study's contribution lies in applying Microsoft Project and crashing method analysis specifically to the North Maluku context. It includes updated cost analysis for overtime labor and resource allocation, providing empirical data for localized project acceleration decisions that align with Indonesia's construction standards and regulations analysis time-cost trade-off.

The study aims to analyze the effect of the crashing method on project duration and costs, identifying the most optimal acceleration alternative that efficiently balances time reduction with additional expenditures. This research is urgent due to the agency's need for a permanent, functional building to support language and cultural activities in Maluku Utara. The novelty lies in integrating systematic crashing analysis with application of Microsoft Project software in a regional Indonesian public sector construction project, delivering actionable insights to improve planning and execution within government infrastructure initiatives research objectives, research urgency, research novelty.

RESEARCH METHODS

This study employs a descriptive quantitative research design aimed at analyzing the construction project duration acceleration. Descriptive quantitative research involves systematically describing the phenomena under study by collecting numerical data and analyzing it to establish facts and relationships relevant to the research questions (Sugiyono, 2022; Creswell, 2018). The design allows detailed examination of how the crashing method impacts project time and cost efficiency during the construction of the Maluku Utara Language Office building. This approach aligns with project management research frameworks emphasizing time-cost trade-offs and critical path optimization (Mahapatni, 2019; Sudaryono, 2023).

Research Instruments and Data Analysis Techniques

Primary data were obtained through direct field observations and the use of the Microsoft Project software for scheduling and crashing analysis of critical path activities. Quantitative data on project duration and costs were systematically compiled and analyzed to determine the effects of overtime hours on project acceleration (Sugiyono, 2021; Atlan, 2024). Data analysis employed cost variance analysis alongside percentage calculations of time reduction effects. The application of quantitative analytical techniques facilitates robust interpretation of correlations between additional labor hours and project duration reduction with considerations of cost efficiency (Sudaryono, 2023). This method adheres to project control and scheduling best practices (Mahapatni, 2019).

Population and Sample

The studied population encompasses all critical path activities within the Maluku Utara Language Office construction project, specifically focusing on activities eligible for crashing through overtime. Sampling targeted these critical activities identified by the Microsoft Project scheduling tool as susceptible to duration compression without compromising work quality. This purposive sampling method is common in construction project research to focus on high-impact variables for time and cost management (Emzir, 2023; Creswell, 2018). The project duration spans 135 calendar days as per the established project timeline from August to December 2024.

Research Procedure

The research procedure followed several systematic steps starting with an extensive literature review to ground the theoretical framework (Sugiyono, 2022; Mahapatni, 2019). Next, project scheduling data were gathered and analyzed using Microsoft Project to identify the critical path and activities eligible for crashing. Subsequently, various overtime scenarios were simulated to evaluate their impacts on project duration and associated costs. The final phase involved validating findings through cost variance analysis to determine the most cost-effective acceleration strategy (Sudaryono, 2023; Atlan, 2024). This thorough procedure ensures that conclusions on the optimal number of overtime hours are evidence-based and practically implementable.

RESULTS AND DISCUSSION

1.Results of Microsoft Project Critical

Path Analysis From the results of the critical path analysis carried out using Microsoft Project, as seen in the Gantt chart and network diagram below, a summary of the critical activities is presented in Table 1.

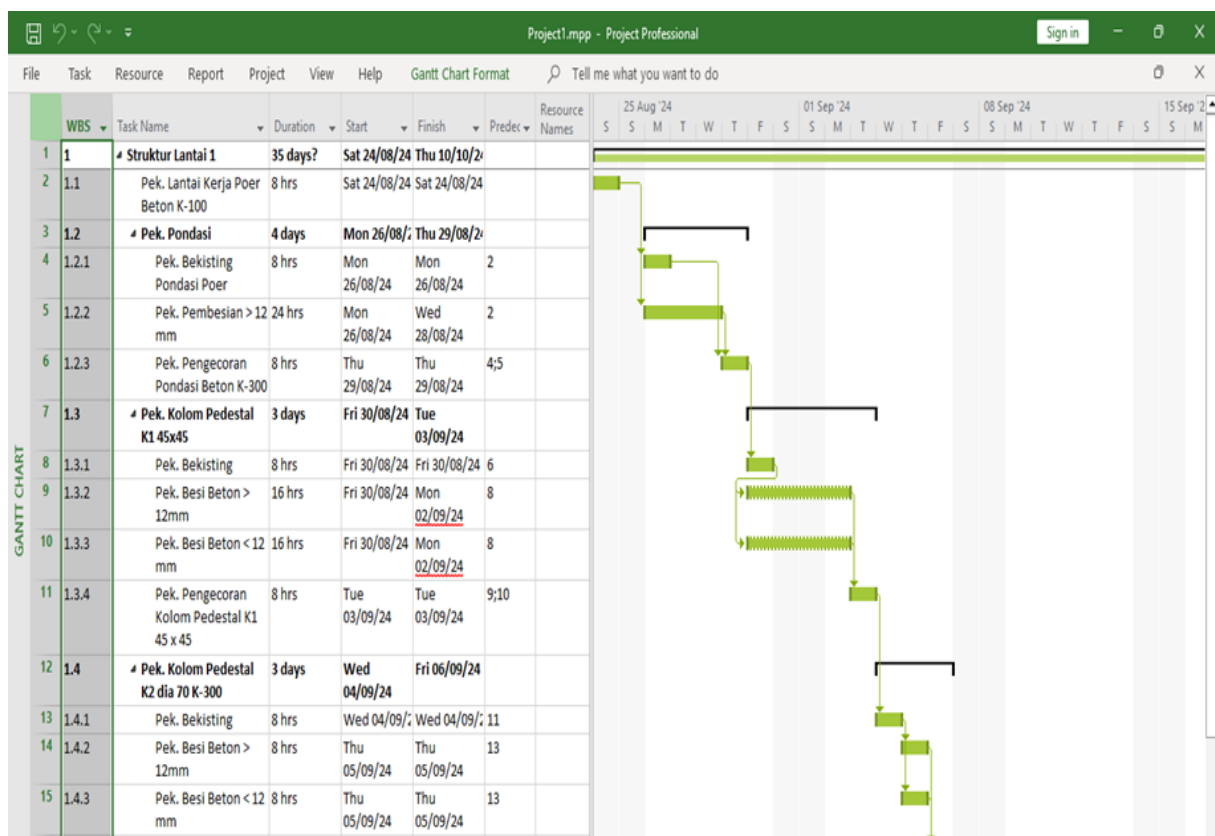


Figure 1. Critical path results from Microsoft Project
 Source: Analysis results, 2025

Table 1 Critical Activities Crashed Using Microsoft Project

No	WBS	Item Pekerjaan	Durasi (Hari)
1	1.2.1	Pek. Foundation Beam Formwork	2
2	1.2.2	Pek. Foundation Reinforcement	6
3	1.3.1	Pek. Formwork	3
4	1.3.2	Pek. Reinforcement	4
5	1.7.1	Pek. K1 Pedestal Column Formwork 45 x 45	5
6	1.7.2	Pek. Reinforcement of Pedestal Column K1 45 x 45	6
7	1.15.1	Pek. Formwork for Deck Plate Floor 1	14
8	1.15.2	Pek. Reinforced Concrete < 12 mm Floor Deck Plate 1	10
9	1.15.3	Pek. Casting of Floor Deck Plate 1	2
10	1.16.2	Pek. Reinforced Concrete > 12 mm Front Concrete Stairs	2
11	1.18.2	Pek. Reinforced Concrete < 12 mm Concrete plank mold 12x60	2
12	2.4.1	Pek. B2 Beam Formwork 25x45	5
13	2.4.2	Pek. Reinforcement for Beam B2 25x45	6

Source: Analysis results, 2025

2. Results of Overtime Crashing

The calculation of the acceleration duration results for each work item is shown in Table 2.

Table 2 Results of Duration Crashing Calculations in Microsoft Project

No	Work Item Item	Normal Duration (days)	Crashing Duration (days)			
			overtime 1 hours	overtime 2 hours	overtime 3 hours	Overtime 4 hours
1	Pek. Foundation Formwork Poer	2	1.88	1.75	1.63	1.50
2	Pek. Foundation Reinforcement	6	5.88	5.75	5.63	5.50
3	Pek. Formwork	3	2.88	2.75	2.63	2.50
4	Pek. Reinforcement	4	3.88	3.75	3.63	3.50
5	Pek. Pedestal Column Formwork K1 45 x 45	5	4.88	4.75	4.63	4.50
6	Pek. Pedestal Column Reinforcement K1 45 x 45	6	5.88	5.75	5.63	5.50
7	Pek. Floor Slab Formwork Level 1	14	13.88	13.75	13.63	13.50
8	Pek. Reinforcing Steel < 12 mm Floor Slab Level 1	10	9.88	9.75	9.63	9.50
9	Pek. Floor Slab Casting Level 1	2	1.88	1.75	1.63	1.50
10	Pek. Reinforcing Steel > 12 mm Front Concrete Stairs	2	1.88	1.75	1.63	1.50
11	Pek. Reinforcing Steel < 12 mm Concrete Plank Ledge 12x60	2	1.88	1.75	1.63	1.50
12	Pek. Beam Formwork B2 25x45	5	4.88	4.75	4.63	4.50
13	Pek. Beam Reinforcement B2 25x45	6	5.88	5.75	5.63	5.50

Source: Analysis results, 2025

3.Results of Overtime Cost Acceleration

Important tasks for which acceleration costs will be calculated are computed based on additional overtime work hours, as well as the duration of the acceleration according to the unit price analysis of the work found in the Budget Plan or RAB.

Table 3. Overtime Pay for Workers Due to Additional Overtime Hours

Normal Cost per Hour	Normal Hourly Rate (Rp)	Overtime Rate per Hour			
		overtime 1 hours (Rp)	overtime 2 hours (Rp)	overtime 3 hours (Rp)	overtime 4 hours (Rp)
Foreman	22,000.00	33,000.00	77,000.00	121,000.00	165,000.00
Foreman	22,687.50	34,031.25	79,406.25	124,781.25	170,156.25
Carpenter	18,768.75	28,153.13	65,690.63	103,228.13	140,765.63
Mason	18,768.75	28,153.13	65,690.63	103,228.13	140,765.63
Painter	18,768.75	28,153.13	65,690.63	103,228.13	140,765.63
Blacksmith	18,768.75	28,153.13	65,690.63	103,228.13	140,765.63
Worker	15,125.00	22,687.50	52,937.50	83,187.50	113,437.50

Source: Analysis results, 2025

Table 3 shows the comparison between normal costs and the costs of adding working hours. Next, the actual total cost in the field for workers will be obtained as shown in Table 4.

Table 4 Results of Worker Acceleration Cost Calculation in *Microsoft Project*

No	Work Item	Normal Duration	overtime pay			
			overtime 1 hours	overtime 2 hours	overtime 3 hours	overtime 4 hours
1	Pek. Foundation Formwork Poer	Rp 9,622,800.00	Rp 10,825,650.00	Rp 12,028,500.00	Rp 13,231,350.00	Rp 14,434,200.00
2	Pek. Foundation Reinforcement	Rp 2,975,919.24	Rp 3,347,909.15	Rp 3,719,899.05	Rp 4,091,888.96	Rp 4,463,878.86
3	Pek Formwork	Rp 13,703,936.40	Rp 15,416,928.45	Rp 17,129,920.50	Rp 18,842,912.55	Rp 20,555,904.60
4	Pek. Reinforcement	Rp 1,831,720.99	Rp 2,060,686.11	Rp 2,289,651.24	Rp 2,518,616.36	Rp 2,747,581.48
5	Pek. Pedestal Column Formwork K1 45 x 45	Rp 29,758,722.84	Rp 33,478,563.20	Rp 37,198,403.55	Rp 40,918,243.91	Rp 44,638,084.26
6	Pek. Pedestal Column Reinforcement K1 45 x 45	Rp 2,632,659.84	Rp 2,961,742.33	Rp 3,290,824.81	Rp 3,619,907.29	Rp 3,948,989.77
7	Pek. Floor Slab Formwork Level 1	Rp 76,808,213.96	Rp 86,409,240.70	Rp 96,012,857.18	Rp 105,611,294.19	Rp 115,212,320.93
8	Pek. Reinforcing Steel < 12 mm Floor Slab Level 1	Rp 4,665,209.42	Rp 5,248,360.60	Rp 5,831,511.78	Rp 6,414,662.95	Rp 6,997,814.13
9	Pek. Floor Slab Casting Level 1	Rp 17,210,460.91	Rp 19,361,768.52	Rp 21,513,076.14	Rp 23,664,383.75	Rp 25,815,691.37
10	Pek. Reinforcing Steel > 12 mm Front Concrete Stairs	Rp 375,000.70	Rp 421,875.79	Rp 468,750.87	Rp 515,625.96	Rp 46,744,987.41
11	Pek. Reinforcing Steel < 12 mm Concrete Plank Ledge 12x60	Rp 503,675.79	Rp 566,635.26	Rp 629,594.73	Rp 692,554.20	Rp 755,513.68

12	Pek. Beam Formwork B2 25x45	Rp 31,163,324.94	Rp 35,058,740.56	Rp 38,955,133.50	Rp 42,849,571.79	Rp 191,317.50
13	Pek. Beam Reinforcement B2 25x45	Rp 2,745,631.34	Rp 3,088,835.25	Rp 3,432,039.17	Rp 3,775,243.09	Rp 4,118,447.01
	TOTAL	Rp 193,997,276.36	Rp 218,246,935.91	Rp 242,500,162.51	Rp 266,746,255.00	Rp 290,624,731.00

Source: Analysis results, 2025

4. Cost Variance

In this cost variance analysis, the use of Microsoft Project allows for calculating the difference between normal costs and additional costs caused by increased overtime work.

Table 5. Results of Cost Variance Calculation in Microsoft Project with Overtime Addition

No	Work Item	overtime pay			
		overtime 1 hours (Rp)	overtime 2 hours (Rp)	overtime 3 hours (Rp)	overtime 4 hours (Rp)
1	Pek. Foundation Formwork Poer	1,202,850.00	2,405,700.00	3,608,550.00	4,811,400.00
2	Pek. Foundation Reinforcement	371,989.91	743,979.81	1,115,969.72	1,487,959.62
3	Pek . Column Formwork Pedestal K1	1,712,992.05	3,425,984.10	5,138,976.15	6,851,968.20
4	Pek. Reinforcement of Pedestal Column K1	228,965.12	457,930.25	686,895.37	915,860.49
5	Pek. K1 Pedestal Column Formwork 45 x 45	3,719,840.36	7,439,680.71	11,159,521.07	14,879,361.42
6	Pek. Reinforcement of Pedestal Column K1 45 x 45	329,082.48	658,164.96	987,247.44	1,316,329.92
7	Pek. Formwork for Deck Plate Floor 1	9,601,026.74	19,204,643.22	28,803,080.23	38,404,106.98
8	Pek. Reinforcing Steel < 12 mm Floor Slab Level 1	583,151.18	1,166,302.36	1,749,453.53	2,332,604.71
9	Pek. Casting of Floor Deck Plate 1	2,151,307.61	4,302,615.23	6,453,922.84	8,605,230.46
10	Pek. Reinforced Concrete > 12 mm Front Concrete Stairs	46,875.09	93,750.17	140,625.26	187,500.35
11	Pek. Reinforced Concrete < 12 mm Concrete plank mold 12x60	62,959.47	125,918.95	188,878.42	251,837.89
12	Pek. B2 Beam Formwork 25x45	3,895,415.62	7,791,808.56	11,686,246.85	15,581,662.47
13	Pek. Reinforcement of Beam B2 25x45	343,203.92	686,407.83	1,029,611.75	1,372,815.67
	TOTAL	24,249,659.55	48,502,886.15	72,748,978.64	96,998,638.18

Source: Analysis results, 2025

Figure 3 shows the percentage increase in labor costs from additional working hours. With a total cost of Rp218,246,935.91 for an extra 1 hour of work, there is a recorded percentage increase of 6.7%. An increase of 2 hours results in 13.41% with a cost of Rp242,500,162.51. A 20% increase for 3 hours requires a cost of Rp266,746,255.00, while an additional 4 hours requires a cost of Rp290,624,731.00. It can be seen in this graph, based on all comparisons, the effects of both acceleration of working time and normal labor costs.

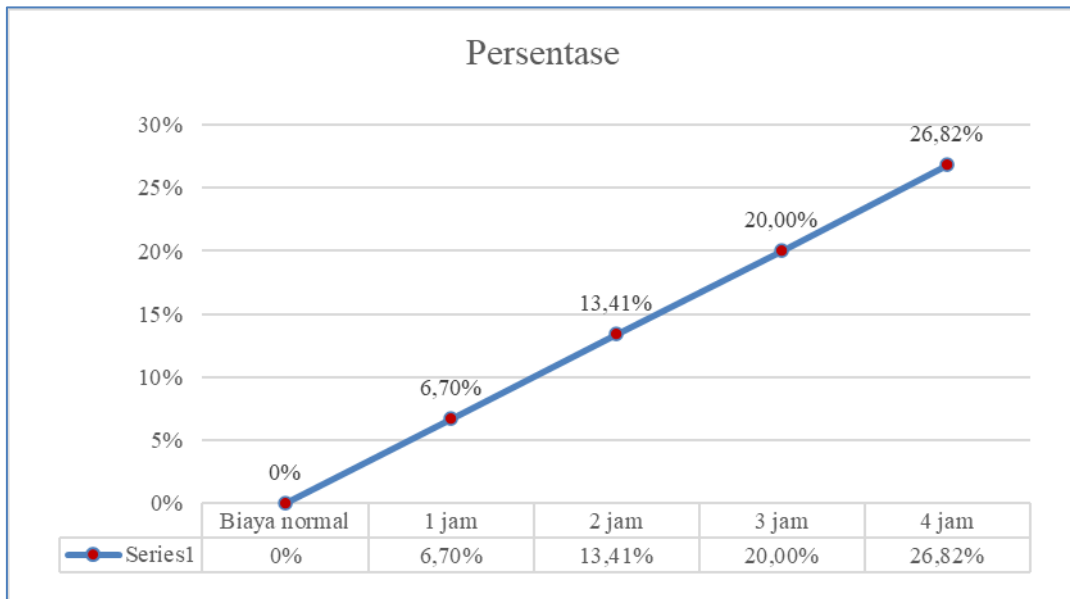


Figure 3 Graph Comparing Cost Variance with each increase in working hours in percentage
 Source: Analysis results, 2025

Figure 4 shows a comparison of cost variance in each scenario of adding working hours. This graph illustrates the impact of changes in working hours on the difference between actual and planned costs, allowing the cost-effectiveness of each acceleration alternative to be seen.

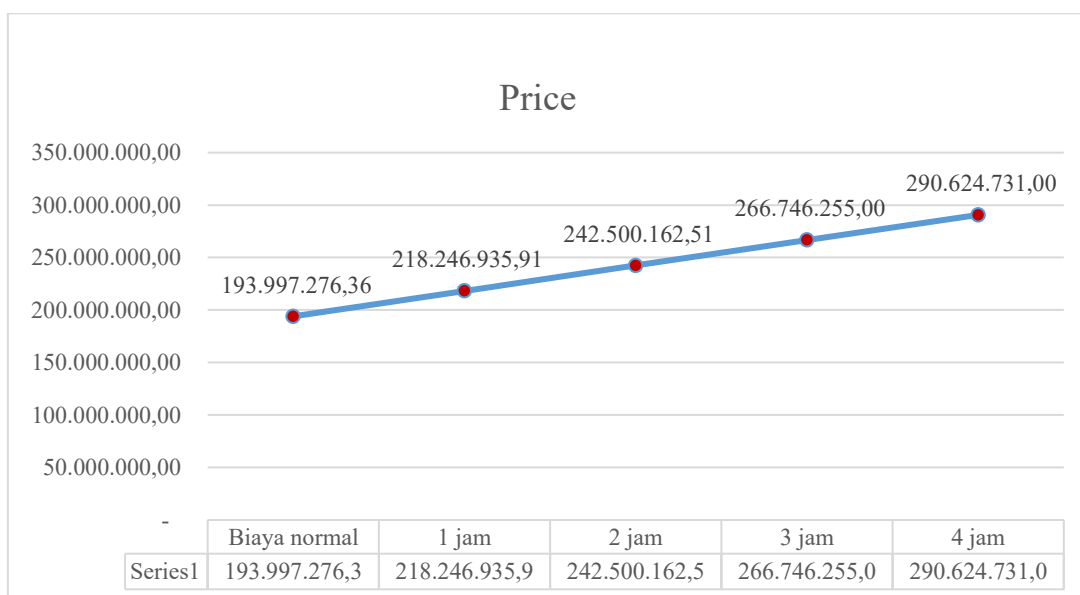


Figure 4 Graph Comparing Cost Variance with Each Additional Working Hour
 Source: Analysis results, 2025

From the differences in time and cost, the normal conditions in terms of time and cost after the acceleration process are shown in the following table, Table 6.

Table 6. Comparison of Costs and Time

No	Work Item	Normal Cost (Rp)	Biaya Lembur			
			Overtime 1 Hour (Rp)	Overtime 2 Hour	3 Hours Overtime	4 Hours Overtime
1	Pek. Foundation Beam Formwork	9,622,800.00	10,825,650.00	12,028,500.00	13,231,350.00	14,434,200.00
2	Pek. Foundation Reinforcement	2,975,919.24	3,347,909.15	3,719,899.05	4,091,888.96	4,463,878.86
3	Pek . Column Formwork Pedestal K1	13,703,936.40	15,416,928.45	17,129,920.50	18,842,912.55	20,555,904.60
4	Pek. Pembesian Kolom Pedestal K1	1,831,720.99	2,060,686.11	2,289,651.24	2,518,616.36	2,747,581.48
5	Pek. K1 Pedestal Column Formwork 45 x 45	29,758,722.84	33,478,563.20	37,198,403.55	40,918,243.91	44,638,084.26
6	Pek. Reinforcement of Pedestal Column K1 45 x 45	2,632,659.84	2,961,742.33	3,290,824.81	3,619,907.29	3,948,989.77
7	Pek. Formwork for Floor Deck Slab I	76,808,213.96	86,409,240.70	96,012,857.18	105,611,294.19	115,212,320.93
8	Pek. Reinforced Concrete < 12 mm Floor Deck Plate I	4,665,209.42	5,248,360.60	5,831,511.78	6,414,662.95	6,997,814.13
9	Pek. Casting of Floor Deck Plate I	17,210,460.91	19,361,768.52	21,513,076.14	23,664,383.75	25,815,691.37
10	Pek. Reinforced Concrete > 12 mm Front Concrete Stairs	375,000.70	421,875.79	468,750.87	515,625.96	46,744,987.41
11	Pek. Reinforced Concrete < 12 mm Concrete plank mold 12x60	503,675.79	566,635.26	629,594.73	692,554.20	755,513.68
12	Pek. B2 Beam Formwork 25x45	31,163,324.94	35,058,740.56	38,955,133.50	42,849,571.79	191,317.50
13	Pek. Reinforcement for Beam B2 25x45	2,745,631.34	3,088,835.25	3,432,039.17	3,775,243.09	4,118,447.01
TOTAL		193,997,276.36	218,246,935.91	242,500,162.51	266,746,255.00	290,624,731.00
Persentase		0%	6.70%	13.41%	20.00%	26.82%
duration		67 day	59.56 day	53.6 day	48.73 day	44.67 day

Source: Analysis results, 2025

CONCLUSION

The research examined the impact of the crashing method on accelerating the construction time and controlling costs for the North Maluku Language Office Building project. Key findings demonstrate that applying overtime to critical path activities effectively reduces project duration from 67 days to as low as 44.67 days, with associated increases in labor costs ranging from 6.7% to 26.82% depending on the overtime hours applied. The analysis using Microsoft Project provided precise scheduling, cost variance calculations, and labor cost escalation details, enabling an optimal balance between time savings and cost increments. These results confirm that the crashing method is a viable strategy for managing project delays while maintaining quality and budget considerations in regional public sector infrastructure projects.

This study's limitations include its focus on a single project and region, which may affect the generalizability of results to different project types or geographic contexts. The cost estimations rely heavily on local labor rates and overtime policies, potentially limiting wider

applicability. Future research could expand by incorporating multiple projects with diverse conditions, exploring alternative acceleration techniques, and integrating risk analysis for unexpected delays. Practically, the findings offer valuable insights for project managers aiming to optimize schedule compression through controlled overtime use, supporting more effective planning and resource allocation in government construction projects. This study enhances understanding of time-cost trade-offs in Indonesia's construction sector, providing a methodological framework and empirical data to aid decision-making in similar acceleration efforts.

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