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Implementation Analysis of Fast Track and Variable Work Overtime on Delays in the Building Construction Project

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Abstract: In the implementation of construction projects, complex challenges are often faced, one of which is project delays. This research aims to analyse the application of the Fast Track Construction (FTC) method based on time variables in the delay of the SII Office Surabaya building construction project. This research uses a quantitative method by collecting secondary data from the project contractor. The analysis was conducted on the remaining structural and architectural work using the Critical Path Method (CPM) and Microsoft Project. The research results show that of the three acceleration analyses with the FTC 50% method, 4 hours/day overtime and 6 hours/day overtime, the most effective and efficient application is with 4 hours/day overtime. With the addition of overtime, it is known that the more overtime is added, the less it reduces the duration of work items but can reduce the indirect costs of the project. And based on the results of statistical analysis using the Paired T Test, it was found that Ha was accepted and Ho was rejected, which means that the data is significant.

Keywords: fast track construction (FTC), construction project management, project delays, critical path method (CPM)

INTRODUCTION

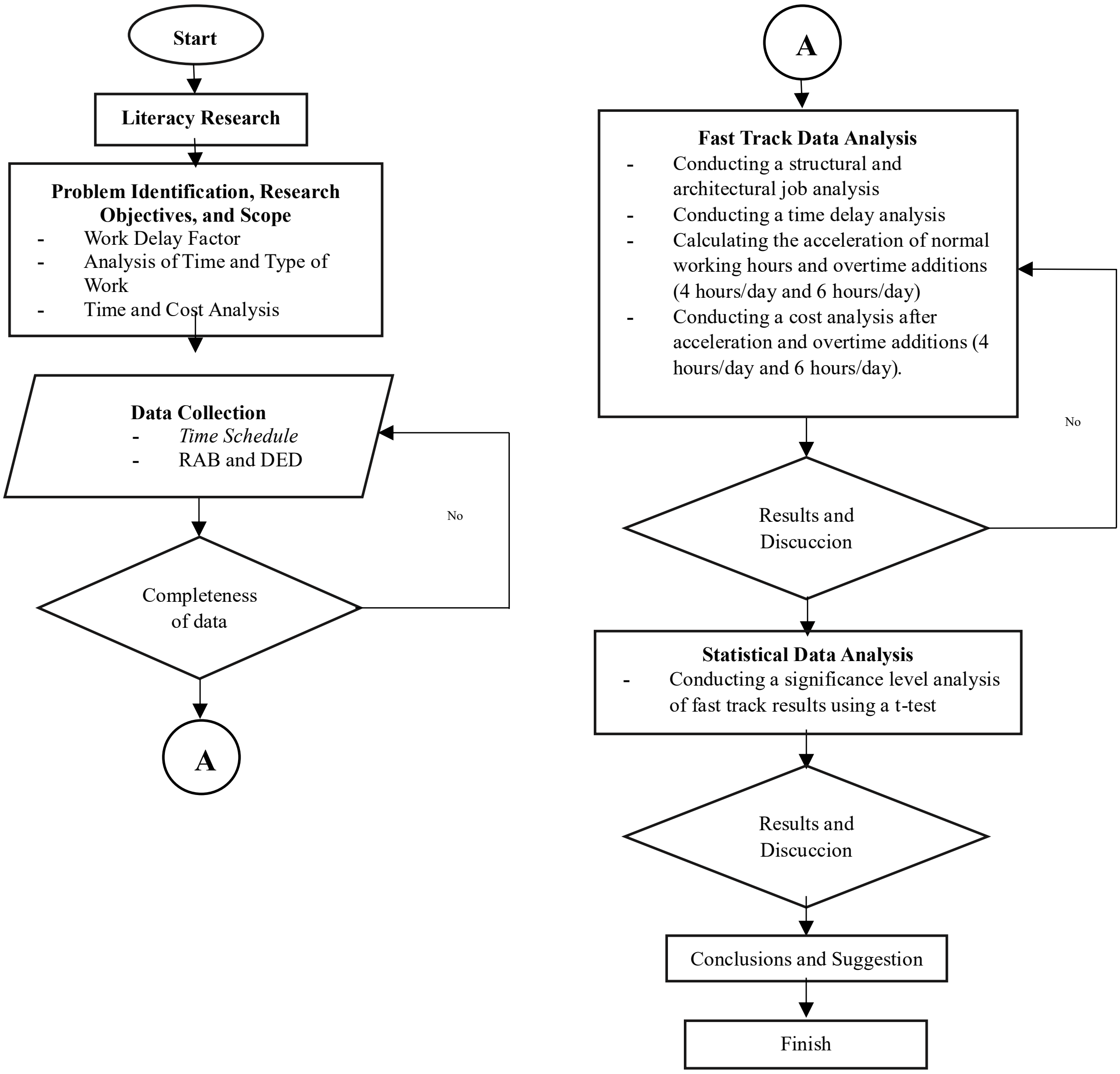
The construction industry plays an important role in a country. One sector that continues to grow is building construction. However, in its implementation, construction projects often face complex challenges, one of which is delays (Husen, 2011; Ikhsan 2021). Delays in construction projects can have significant negative impacts. First, delays can cause project costs to swell. Additional costs may be required to speed up work, pay workers overtime, or overcome problems that arise due to delays. Second, delays can result in fines or penalties from the project owner. Third, delays can damage the contractor's reputation and reduce client trust (Siswanto, 2007; Santosa 2009).

To overcome the problem of delays, various methods have been developed, one of which is Fast Track Construction (FTC). FTC is a method that aims to accelerate project completion by performing several activities simultaneously which are usually carried out sequentially. This reduction can significantly reduce the total time required to complete a project (Adegoke, 2011; Caesar, 2017).

This research focuses on analysing the application of the FTC method based on time variables in the SII Office Building Surabaya construction project. This project was chosen because it experienced a fairly significant delay. By analysing the application of FTC, it is hoped that solutions can be found to overcome delays and improve the efficiency of construction projects.

METHODOLOGY

This study uses a quantitative method by collecting secondary data from the implementing contractor for the SII Office Building Surabaya construction project. The data collected includes project plan drawings, Bill of Quantity (RAB), and time schedule or S curve (planned and actual) (Sugiyono, 2010).



RESULTS AND DISCUSSION

Data Collection

Based on the results of the identification of the remaining structural and architectural work items on the SII Office Building Construction project, it was stated that there was a delay from the start of the project due to the many changes in the contract from the drawings at the owner's request. From the identification results, the remaining work items were obtained as shown in Table 1.

Table 1. Remaining Work Items for the SII Office Project

No.	Work Items	Duration (days)	Volume	Unit
A	**Upper STR Work**			
1	Beam & Floor Slab 6	4	136	m^3
2	Column & Structure Wall Floor 6	3	40	m^3

3	Column, Structure Wall, Beam & Roof Slab	5	247	m^3
4	Structural Ladder	4	77	m^3
B	**Steel (Roof) Work**			
5	Steel Roof	5	2035	kg
C	**Architecture Work**			
6	Red Brick Couple Work	39	3234	m^2
7	Lightweight Brick Couple Work	30	1691	m^2
8	Gypsum Partition Work	12	400	m^2
9	Plaster Work, Red Brick Trasam	47	6523	m^2
10	Finishing Lightweight Brick Work	34	3338	m^2
11	Skim coat and Paint Work	38	8394	m^2
12	Finishing Smooth Acian Work	16	8292	m^2
13	Granite Walls Work	25	519	m^2
14	Finishing Lift Wall	12	393	m^2
15	Floor Finishing Flr.1 Works	21	398	m^2
16	Floor Hardener Works, Ground Floor to Roof	6	745	m^2
17	Waterproofing Works, Ground Floor to Roof	10	1002	m^2
18	Ceramic Floor Tile Works, Ground Floor to 6th Floor	5	543	m^2
19	Ceiling and Finishing Works	17	5044	m^2
20	Custom Doors and Windows Works	23	20	m^2
21	Aluminium Doors and Windows Works, Ground Floor to Roof	23	282	m^2
22	Glass Doors and Windows Works, Ground Floor to 3rd Floor and 6th Floor to Roof	6	35	m^2
23	Railing Works	16	556	m^2
24	Facade and Landscaping Works	14	917	m^2

Source : Researcher, 2024

Data Analysis and Calculations

After identifying the remaining work items, contract value, and duration of each work, an analysis will be conducted starting with the creation of a CPM network diagram.

Developing a Network Diagram in CPM Format

Before developing a network diagram using the CPM method, the relationship between work items must be determined. In determining the relationship between work items, several terms are used in its development, namely: predecessors and successors. The relationship chosen for this CPM network modelling is finish to start (FS), due to the remaining types of work and the number of available workers. In addition, the FS relationship can also make the time more efficient in completing the work.

Based on the network diagram from the relationship between work items used, the critical path work items were analysed using the CPM method as shown in Figure 1 and Microsoft Project software in Figure 2.

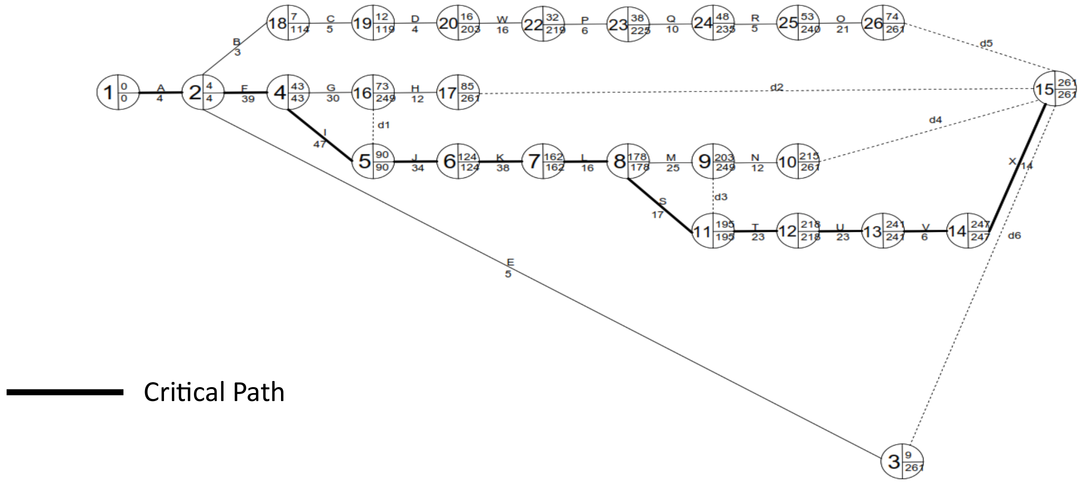


Figure 1. Normal Time CPM Chart
Source : Researcher, 2024

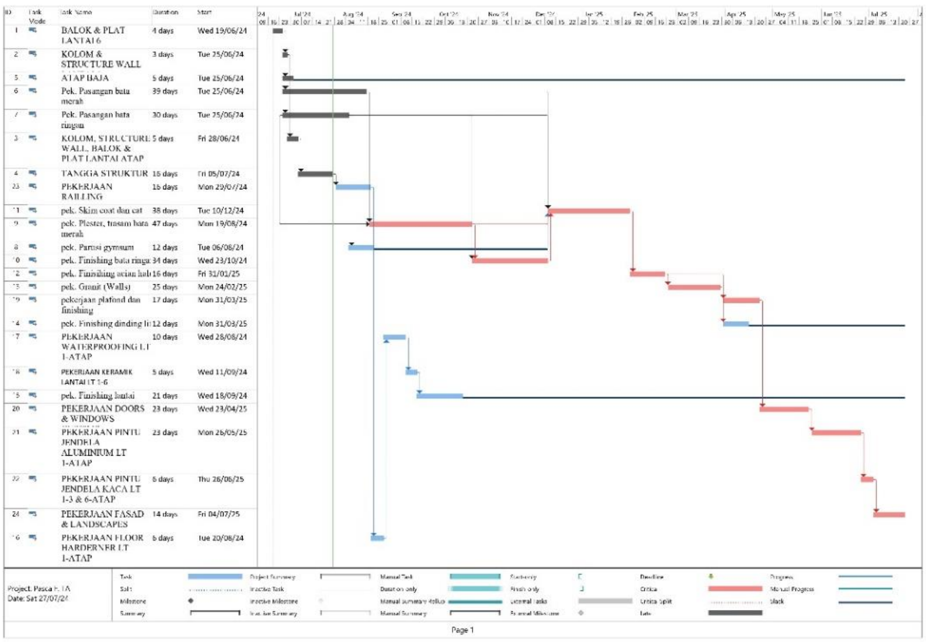


Figure 2. Normal Time Ms Project
Source: Researcher, 2024

Fast Track Method Analysis

Rescheduling using the fast-track method to accelerate the completion of work. This rescheduling is focused only on critical path work items by calculating the acceleration duration, which is a 50% reduction in normal duration with the addition of the number of workers according to the required daily productivity value.

Table 1. Normal and Fast Track Duration

Activity	Work Items	Normal Duration (Days)	Fast track (days)
	Upper STR Work		
A	Beam & Floor Slab 6	4	2
B	Column & Structure Wall Floor 6	3	3
C	Column, Structure Wall, Beam & Roof Slab	5	5
D	Structural Ladder	16	16
	Steel (Roof) Work		
E	Steel Roof	5	5
	Architecture Work		
F	Red Brick Couple Work	39	19,5
G	Lightweight Brick Couple Work	30	30
H	Gypsum Partition Work	12	12
I	Plaster Work, Red Brick Trasam	47	23,5
J	Finishing Lightweight Brick Work	34	17
K	Skim coat and Paint Work	38	19
L	Finishing Smooth Acian Work	16	8
M	Granite Walls Work	25	12,5
N	Finishing Lift Wall	12	12
O	Floor Finishing Flr.1 Works	21	21
P	Floor Hardener Works, Ground Floor to Roof	6	6
Q	Waterproofing Works, Ground Floor to Roof	10	10
R	Ceramic Floor Tile Works, Ground Floor to 6th Floor	5	5
S	Ceiling and Finishing Works	17	8,5
T	Custom Doors and Windows Works	23	11,5
U	Aluminium Doors and Windows Works, Ground Floor to Roof	23	11,5

V	Glass Doors and Windows Works, Ground Floor to 3rd Floor and 6th Floor to Roof	6	3
W	Railing Works	16	16
X	Facade and Landscaping Works	14	7
	Total	**415**	**272**

Source: Researcher, 2024

Based on Table 2, the results of the acceleration duration using the fast-track method show that it can reduce the duration by 143 days from the total normal duration of 415 days. The implementation of the fast-track method was carried out by adding the number of workers based on the daily productivity value. From the productivity value, one group of workers was added to the fast-tracked work, because the productivity value reached twice the normal duration.

Foreman : 1 OH with a labour index 0,275 → 0,275

Craftsman : 4 OH with a labour index 0,0028→0,0112

Laborers : 12 OH with a labour index 1,650 → 19,8

(Labor Index based on SNI-7394:2008)

By multiplying the labour index for each category (foreman, craftsman, and labour) by the respective quantity and summing up the results, we obtain a total labour index of 20.9. This indicates that the labour cost for this project is expected to be 20.9% higher than the standard or baseline labour cost.

Indirect Costs (Normal Duration) = Rp 659.020.318,-

Calculation of the budget after implementing the fast track, including:

Calculation of daily indirect costs

$$= \frac{indirect\ cost}{normal\ duration} = \frac{569.0202.318}{415} = Rp\ 1.588.000,-/days$$

Total days after implementing the fast track is 272, thus the cost is reduced by

$$= (415 - 272) \times 1.588.000 = Rp\ 227.084.110,-$$

So, the total final indirect cost is

$$= 569.0202.318 - 227.084.110 = Rp\ 431.936.200,-$$

After the fast track, the budget breakdown is as follows:

Direct project costs for normal duration = $Rp\ 4.393.468.788,-$

Indirect costs for normal duration = $Rp\ 659.020.318,-$

Total budget for normal duration = $Rp\ 5.052.489.000,-$

Direct project costs for fast track = $Rp\ 5.059.662.844,-$

Indirect project costs for fast track = $Rp\ 431.936.200,-$

Total budget for fast track = $Rp\ 5.491.599.053,-$

Analysis of Overtime Implementation

The analysis of overtime implementation shows that accelerating the project through overtime aligns with calculations based on daily, hourly, and overall acceleration duration productivity. To quantify this relationship, the following formula will be utilized:

- $daily\ productivity = \frac{job\ volume}{normal\ duration}$ (1)
- $hourly\ productivity = \frac{daily\ productivity}{daily\ working\ hours}$ (2)
- $acceleration\ daily\ productivity = (daily\ working\ hours \times hourly\ productivity) + (a \times b \times hourly\ productivity)$ (3)
- $acceleration\ duration = \frac{job\ volume}{accelerated\ productivity}$ (4)

Given the values of a and b as follows:

$a =$ duration of overtime

$b =$ Coefficient of productivity decline from overtime work

The coefficient of productivity decline is dependent on the worker's performance, as specified in Table 3.

Table 3. Worker Productivity Index Coefficients

Duration of overtime	Index Coefficient	Work Assignment (%)
1	0,1	90
2	0,2	80
3	0,3	70
4	0,4	60
5	0,5	50
6	0,6	40
7	0,7	30
8	0,8	20
9	0,9	10

Source: Soeharto, 1997

Therefore, productivity calculations were performed for each task, as overtime was applied to each remaining work item. A summary of the acceleration calculations with overtime for each work item is presented as table 4.

Table 2. Summary of Additional Overtime Hours

Work Items	Normal Duration (days)	Acceleration Duration (+4hour/day)	Acceleration Duration (+6hour/day)
Upper STR Work			
Beam & Floor Slab 6	4	3,33	3,41

Column & Structure Wall Floor 6	3	2,50	2,56
Column, Structure Wall, Beam & Roof Slab	5	4,17	4,27
Structural Ladder	4	3,33	3,41
Steel (Roof) Work			
Steel Roof	5	4,17	2,27
Architecture Work			
Red Brick Couple Work	39	32,50	33,29
Lightweight Brick Couple Work	30	25,00	25,61
Gypsum Partition Work	12	10,00	10,24
Plaster Work, Red Brick Trasam	47	39,17	40,12
Finishing Lightweight Brick Work	34	28,33	29,02
Skim coat and Paint Wor	38	31,67	32,44
Finishing Smooth Acian Work	16	13,33	13,66
Granite Walls Work	25	20,83	21,34
Finishing Lift Wall	12	10,00	10,24
Floor Finishing Flr.1 Works	21	17,50	17,93
Floor Hardener Works, Ground Floor to Roof	6	5,00	5,12
Waterproofing Works, Ground Floor to Roof	10	8,33	8,54
Ceramic Floor Tile Works, Ground Floor to 6th Floor	5	4,17	4,27
Ceiling and Finishing Works	17	14,17	14,51
Custom Doors and Windows Works	23	19,17	19,63
Aluminium Doors and Windows Works, Ground Floor to Roof	23	19,17	19,63
Glass Doors and Windows Works, Ground Floor to 3rd Floor and 6th Floor to Roof	6	5,00	5,12
Railing Works	16	13,33	13,66
Facade and Landscaping Works	14	11,67	11,95

Source: Researcher, 2024

Calculating additional budget with the addition of 4 hours/day and 6 hours/day overtime. Additional budget calculation uses the following formulas:

- $normal\ daily\ costs = productivity\ \times daily\ wages\ of\ work\ items$ (5)
- $daily\ acceleration\ costs = additional\ hours\ x\ overtime\ pay$ (6)
- $acceleration\ costs = acceleration\ time\ \times acceleration\ costs$ (7)
- $Crash\ cost\ total = crash + normal\ cost$ (8)
- $cost\ slope = \frac{crash\ total - normal\ cost}{normal\ duration - crash\ duration}$ (9)

- Based on the overtime agreement, the hourly rate for overtime work is Rp 35,000,-.

The calculation of the additional budget following the increase in working hours includes :

- Daily calculation of indirect costs
- $\frac{indirect\ costs}{normal\ duration} = \frac{569.0202.318}{415} = Rp\ 1.588.000,-/day$

With the addition of 4 hours of overtime per day for 346 days, the cost is reduced by a value of = $(415 - 346) \times 1.588.000 = Rp\ \ 109.836.720,-$

Thus, the ultimate total of indirect expenses is;

- $= 569.0202.318 - 109.836.720 = Rp\,549.183.600,-$

With the addition of 6 hours of overtime per day for 355 days, the cost is reduced by a value of = $(415 - 355) \times 1.588.000 = Rp\ \ 96.441.998,-$

Thus, the ultimate total of indirect expenses is;

- $= 569.0202.318 - 96.441.998 = Rp\,562.578.320,-$

Following the increase in working hours, the budget is detailed as follows:

- Direct costs of a normal duration = $Rp\ \ 4.393.468.788,-$
- Indirect costs of a normal duration = $Rp\ \ \ \ 659.020.318,-$
- Total normal duration = $Rp\,5.052.489.000,-$
- Direct costs of 4 hours overtime/day = $Rp\,4.442.184.600,-$
- Indirect costs of 4 hours overtime/day = $Rp\ \ \ \ 549.183.600,-$
- Total budget of 4 hours overtime/day = $Rp\,4.991.368.120,-$
- Direct costs of 6 hours overtime/day = $Rp\,4.468.171.500,-$
- Indirect costs of 6 hours overtime/day = $Rp\ \ \ 562.578.320,-$
- Total budget of 6 hours overtime/day = $Rp\,5.030.749.811,-$

Discussion of Research Results

After conducting an analysis of the remaining work items, a rescheduling process was implemented to expedite the construction completion. To accelerate these remaining tasks, the researcher employed three acceleration methods: fast-tracking and overtime work with two different overtime durations, namely 4 hours/day and 6 hours/day.

Optimization of Acceleration Implementation Form a Time Perspective

Following a critical path analysis, we implemented two acceleration methods: fast-tracking and overtime work with durations of 4 and 6 hours per day. The new durations for each remaining work item resulting from these methods are calculated and presented in Table 5.

Table 3. Recapitulation of Duration by Three Different Methods

Activity	Work Items	Duration (day)			
		Normal	Fast track	+4 hours	+6 hours
	Upper STR Work				

A	Beam & Floor Slab 6	4	2	3,3	3,4
B	Column & Structure Wall Floor 6	3	3	2,5	2,6
C	Column, Structure Wall, Beam & Roof Slab	5	5	4,2	4,3
D	Structural Ladder	4	4	3,3	3,4
	Steel (Roof) Work				
E	Steel Roof	5	5	4,2	4,3
	Architecture Work				
F	Red Brick Couple Work	39	19,5	32,5	33,3
G	Lightweight Brick Couple Work	30	30	25,0	25,6
H	Gypsum Partition Work	12	12	10,0	10,2
I	Plaster Work, Red Brick Trasam	47	23,5	39,2	40,1
J	Finishing Lightweight Brick Work	34	17	28,3	29,0
K	Skim coat and Paint Work	38	19	31,7	32,4
L	Finishing Smooth Acian Work	16	8	13,3	13,7
M	Granite Walls Work	25	12,5	20,8	21,3
N	Finishing Lift Wall	12	12	10,0	10,2
O	Floor Finishing Flr.1 Works	21	21	17,5	17,9
P	Floor Hardener Works, Ground Floor to Roof	6	6	5,0	5,1
Q	Waterproofing Works, Ground Floor to Roof	10	10	8,3	8,5
R	Ceramic Floor Tile Works, Ground Floor to 6th Floor	5	5	4,2	4,3
S	Ceiling and Finishing Works	17	8,5	14,2	14,5
T	Custom Doors and Windows Works	23	11,5	19,2	19,6
U	Aluminium Doors and Windows Works, Ground Floor to Roof	23	11,5	19,2	19,6
V	Glass Doors and Windows Works, Ground Floor to 3rd Floor and 6th Floor to Roof	6	3	5,0	5,1
W	Railing Works	16	16	13,3	13,7
X	Facade and Landscaping Works	14	7	11,7	12,0
	Total	**415**	**272**	**345,83**	**354,27**

Source: Researcher, 2024

After calculating the total duration for each acceleration method, it was determined that fast-tracking resulted in the shortest project duration of 272 days. The next shortest duration was achieved by adding 4 hours of overtime per day, taking 346 days. Adding 6 hours of overtime per day resulted in a slightly longer duration of 355 days. The longest duration was the original, normal duration of 415 days.

Analysis of Construction Acceleration Impact on Budget

After implementing construction acceleration using fast-tracking and overtime work (4 and 6 hours per day), a comparative analysis was conducted between time and cost to determine the most effective and efficient acceleration method. The following table presents the total project costs for each acceleration method.

Table 4. Summary of Duration and Standard Costs, with FTC at 50%, and additional overtimes of 4 hours and 6 hours

Metode Used	Duration (days)	Direct Cost Optimization (Rp)	Optimization Total Cost (Rp)
Normal	415	Rp 4.393.468.788,-	Rp 5.052.489.000,-
Fast Track	272	Rp 5.059.662.844,-	Rp 5.491.599.053,-
+4 Hour/days	346	Rp 4.442.184.521,-	Rp 4.991.368.120,-
+ 6 Hour/days	355	Rp 4.468.171.500,-	Rp 5.030.749.811,-

Source: Researcher, 2024

Based on the research findings, it is concluded that the project management triangle can be applied to the implementation of acceleration methods, as supported by the relationship between cost and time depicted in the graph. It can be explained that altering the work scope will increase the project's direct costs due to the need for additional labour or overtime, thereby increasing overall direct costs. However, if the project duration is shortened, the project's indirect costs will also decrease proportionally. Therefore, when selecting an acceleration method, the productivity of workers on a daily basis must be considered. The analysis shows that increasing working hours from 4 to 6 hours results in a decrease in productivity. Hence, a careful consideration is needed to determine the most effective and efficient acceleration method in terms of both time and cost.

Analysis of T-test in Hypothesis Testing

In this study, a paired t-test using SPSS v.21 was employed to analyse the correlation between the implementation of acceleration methods, including fast-tracking and additional overtime hours of 4 and 6 hours per day, and the normal project duration.

Based on the calculated t-value from SPSS v.21, it can be concluded that the significance level (α) and degrees of freedom (df) are greater than the critical t-value, where t-table = t(23, 0.05) = 2.069. Therefore, the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted, indicating that there is a significant difference between the results of each acceleration method. This conclusion is supported by the calculated t-values of 3.811, 6.638, and 6.615 for each acceleration method, which are all greater than the critical t-value of 2.069.

CONCLUSION

Based on the research findings and analysis, the researcher can draw the following conclusions:

1. Optimization of construction acceleration on the remaining unfinished work of the SII Office building project was conducted. The comparison of durations yielded the following results: 415 days for the normal duration, 272 days for fast-tracking, 346 days for 4 hours of overtime per day, and 355 days for 6 hours of overtime per day. Based on these durations, the total project costs were Rp 5,052,489,000 for the normal duration; Rp 5,491,599,053 for fast-tracking; Rp 4,991,368,120 for 4 hours of overtime per day; and Rp 5,030,749,811 for 6 hours of overtime per day. Therefore, it can be concluded that adding 4 hours of overtime per day is the most effective and efficient method as it resulted in the shortest duration compared to the normal duration with the lowest total cost.
2. The acceleration method with an additional 4 hours of overtime per day resulted in a duration of 345.83 days, which can be rounded up to 346 days, reducing the overall duration by 16.63% or 69 days. For an additional 6 hours of overtime per day, the duration was 354.27 days, rounded up to 355 days, reducing the overall duration by 14.46% or 60 days. Furthermore, the overtime method also affected the total project cost. The results showed that adding 4 hours of overtime per day reduced indirect costs by 17% or Rp 109,836,720, while adding 6 hours of overtime per day reduced indirect costs by 15% or Rp 96,441,998. It can be concluded that increasing overtime hours did not proportionally reduce the duration of work items. This is because as overtime hours increased, daily productivity decreased due to worker fatigue. While changing the work scope increases direct project costs, reducing the project duration also decreases indirect costs. Therefore, acceleration methods should consider the daily productivity of workers.
3. Based on the t-test results using SPSS v.21, the alternative hypothesis (Ha) was accepted and the null hypothesis (H_0) was rejected. The accepted hypothesis, Ha: $\mu1 < \mu2$, is supported by the t-table value of t (23, 0.05) = 2.069, and the calculated t-values of 3.811, 6.638, and 6.615 for the three methods.

SUGGESTION

Based on the research conducted, several areas for improvement have been identified for future research. These areas include:

1. A more varied sample selection should be employed to obtain a wider range of results.
2. For daily overtime, more variations should be considered, such as adding 2 hours or 3 hours of overtime per day. This would allow for a more comprehensive analysis to determine the most effective and efficient overtime duration.

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