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Application of the Crashing Method in the Construction of District Office Buildings Karangrejo

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ABSTRACT

In the world of construction in the development sector, arrangements regarding cost, quality, and completion time of construction work are bound in the work contract and are decided before the construction work is carried out. This study aims to find out the total time and costs after adding working hours and knowing the comparison of time and costs from the initial plan with what has been done with additional working hours. Planning and control is something that cannot be explained in carrying out a project, this implementation requires a long time and serious effort and it depends on effective control. This research will speed up the schedule for the construction of the Karangrejo District Office Building project using the crashing method. From the results of the analysis and calculations described above, it can be concluded that the construction project for the Karangrejo District Office Building's total costs and project time under normal conditions is IDR 2,572,500,000 with a normal duration of 189 days. After adding 3 hours of overtime work, a total cost of Rp. 2,817,500,000 was obtained by consuming an accelerated duration of 180 days. In terms of project costs, applying acceleration by adding a 3-hour overtime system has increased costs by IDR 25,000,000 or more expensive than the normal project costs. Meanwhile, the duration experienced an increase of 4.70% or 9 days faster than the initial normal project duration.

Keywords: *Project control; Quality; Cost; Time; Acceleration*

INTRODUCTION

Development in a region is very important because development is a source of regional income [1]. In the world of construction in the development sector, arrangements regarding the cost, quality, and completion time of construction work are bound in the work contract and are decided before the construction work is carried out [2]. As is known, the required fulfillment time for the size of construction work is always kept in mind in the agreement notes because it will greatly influence the sales value and cost of the work [3]. Therefore, a development project requires something called project control. So that project implementation can proceed according to the initial plan and on time [4].

Development project control is a methodical action or effort to determine guidelines that are in accordance with development objectives, balanced implementation and output, and make important changes so that quality, costs and time can be used adequately and effectively to achieve a development project target [5]. So that by controlling the project, deviations, destruction and delays to a project that might occur can be avoided [6]. Good management such as supervision, planning and human power is very necessary in estimating the costs that need

to be budgeted for a company [7].

Work delays often occur due to differences in site conditions, changes in plans, climate impacts, and errors in project settings. [8] Project delays can be anticipated by accelerating *(crashing)* in its implementation, however, you must still focus on the cost factors incurred so that they are maintained. [9] Acceleration itself must be made possible by increasing working hours, more tools, expanding the number of workers, and faster development strategies. [10] During the implementation of project activities, there are often delays in work activities so that they do not go according to plan. [11] If there is a delay in the completion time of one work activity, this will result in a delay in the completion time of the next work activity. [11] Accelerating project completion must be done with good planning. [12] An alternative commonly used to support accelerated project completion is to increase working hours which will then have an effect on the total cost of the project [13].

One way to overcome delays in working on a project is to accelerate (crashing) its implementation [14]. Acceleration (crashing) in implementation can be done by increasing working hours (overtime), adding labor, shift systems, changing work methods, using efficient tools. [15] With this research, efforts to find a solution to the problem of accelerating project completion using the acceleration (crashing) method *by* adding three hours of working hours will then result in the difference in project implementation duration and project costs between the two alternatives [16].

Study previously about Crashing method with implementation addition workers in the field. Results Total wages power Work in normal conditions amounting to Rp. 96,074,700.00 with duration 66 days work. Analysis results with alternative addition power Work as big as Rp. 113,632,675.00 with duration 56 days. Work or more fast 15.15% of normal duration. Whereas with alternative additional working hours (overtime) amounting to Rp. 142,723,687.28 with duration 56 days. Work or more fast 15.15% of normal duration. So you can concluded that more alternatives _ economical is addition power Work Because more save Rp. 29,091,012.28 from additional working hours (overtime) [17].

The purpose of this research is to find out the total time and costs after adding working hours and knowing the comparison of time and costs from the initial plan with those that have been added working hours. In its implementation, project management will go through a number of stages, such as *initiation, planning, execution, to closure*[18]. This process is basically only carried out when a company or business wants to carry out a project or activity. Project management is an application of knowledge that includes expertise and skills with limited resources. In order to achieve maximum goals and maximum targets in terms of cost, time, quality and work safety performance [19].

METHOD

Data collection

In the initial planning stages, this project was planned to take 189 days. This project was chosen because there were indications of delays in structural work, so it was necessary to accelerate the project so that this project could be completed on time and could even be completed before the schedule that had been planned from the start. Activities that are accelerated are only structural work that is on the critical path. Data collection methods are techniques for obtaining data in the course of a project [20]. To support the author in making this final assignment,

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Vol 10 No.3 September 2023
http://cived.ppj.unp.ac.id/index.php/CIVED

several amounts of data are needed that come from outside and within the project. Therefore, this research uses two types of primary data collection obtained directly from the project location, namely; number of workers and daily data for the Karangrejo District Office Building Construction project . Secondary data, in the form of previous journals or document data and official archives, includes: Project Time Schedule, Cost Budget Plan, and Drawings of the Karangrejo District Office Building Construction project [21].

Critical Path

In carrying out data analysis on project acceleration, several stages are needed Collect the required project data , describe the duration of each work item , enter the duration data for each item into *Microsoft Project* and add the duration of working hours by 3 hours , determine the critical path from the initial project schedule , then calculate the project acceleration using the *crashing method* for the activities involved. is on the critical path [22].

With the 3 hour overtime method using the formula

- Labor Productivity _ Overtime
= (capacity + (overtime hours x capacity per hour x coefficient)) … …(1)
- Duration Job Crashing = Job Volume ….. …(2)
Capacity work 13 hours x amount power Work

Crashing

One tactic to speed up project completion is to extend workers' working hours. This approach was chosen because it is able to optimize field resource utilization and reduce additional costs effectively. Typically, work is carried out for 8 hours during regular working hours (starting from 08.00 and ending at 17.00 with a break of 1 hour). Efforts to increase productivity involve a comparison between extending working hours by 2 hours and 3 hours [23].

Cost

Completion of activities in a project requires the use of a minimum number of resources and an optimum completion time, so that activities can be completed at normal costs and in normal duration. If at any time it is necessary to complete it more quickly, adding resources allows reducing the duration of the project by compressing the duration of activities, efforts must still be made to ensure that the addition in terms of costs is as minimal as possible [18].

The cost control carried out is direct costs, because these costs will increase if the duration is reduced. This compression is carried out on activities that are on the critical path and have *a cost slope* Lowest. Acceleration of duration can be carried out by increasing the number of workers, increasing working hours (overtime), adding or replacing more productive equipment, and replacing materials that can make work faster without reducing quality and improving construction implementation methods .

RESULTS AND DISCUSSION

Connection Interrelationships Between Jobs

Relationships between jobs are carried out to find out when the job itself starts and finishes. The following is a job description that precedes the predecessor

Table 1 Job Relatedness

CIVED Journal of Civil Engineering and Vocational Education
EISSN: 2622-6774
Vol 10 No.3 September 2023
http://cived.ppj.unp.ac.id/index.php/CIVED

ID	Task Name	Code	Linkages
3	Final Cleanup of the Job Site	A	A
10	Site Landfill	B	D > B
12	The site is densely filled with fill	C	B > C
13	Foundation pile cap earth excavation work	D	D
15	Column K1 45x45	E	Q > E
21	Sloof S1 25x25	F	W > F
22	Sloof S2 20x40	G	W > G
23	Sloof S3 15x30	H	W > H
24	Pile cap work P1 100x100x40	I	D > I
25	P3 210x210x50 pile cap work	J	D > I
26	P4 210x210x50 pile cap work	K	D > I
50	Column K1 45x45	L	Q > L
61	PL plate work t:12cm	m	L > M
64	Steel structure 2L70.70.7	N	M > N
66	Gording CNP 150.65.20.2.3 (canopy)	O	N > O
67	Install the roof frame (ribs + Zincalum battens	P	O > P
71	Column reinforcement K1 45x45	Q	F > Q
72	K2 column reinforcement 40x40	R	G > R
73	Column K2 steps 40x40	S	H > S
140	Excavation work for river stone foundations	Q	D > T
142	River stone foundation sand filling work	U	T > U
143	Bare stone foundation work	V	U > V
144	Install a stone foundation 1 PC : 3 PS	W	V > W
145	Reinforced concrete sloof (10x15)	X	W >
150	1/2 brick wall masonry work	Y	P > Y

Critical Path

From Microsoft Project processing, it is found that work is on the critical path as follows:

Table 2. Jobs on track _ critical

ID	Task Name	Vol	Sat.	Crit	Du constellation
2	PREPARATORY WORK				
3	Final Cleanup of the Job Site	1.00	Is	Yes	1.2 days
9	EARTH WORKS				
10	Site Landfill	52.71	M3	Yes	10 days
12	The site is densely filled with fill	109.80	M3	Yes	2 days
13	Foundation pile cap earth excavation work	71.36	M3	Yes	9 days
14	STRUCTURAL WORK LT. 1				
15	Column K1 45x45	0.91	M3	Yes	5 days
21	Sloof S1 25x25	14.22	M3	Yes	12 days
22	Sloof S2 20x40	7.54	M3	Yes	12 days
23	Sloof S3 15x30	0.34	M3	Yes	12 days
24	Pile cap work P1 100x100x40	0.80	M3	Yes	16 days
25	P3 210x210x50 pile cap work	8.82	M3	Yes	14 days
26	P4 210x210x50 pile cap work	61.74	M3	Yes	18 days
49	STRUCTURAL WORK LT.2				
50	Column K1 45x45	0.81	M3	Yes	5 days
61	PL plate work t:12cm	20.74	M3	Yes	28 days

Journal of Civil Engineering and Vocational Education
EISSN: 2622-6774
Vol 10 No.3 September 2023
http://cived.ppj.unp.ac.id/index.php/CIVED

64	Steel structure 2L70.70.7	354.24	kg	Yes	11 days
66	Gording CNP 150.65.20.2.3 (canopy)	898.42	kg	Yes	5 days
67	Install the roof frame (ribs + Zincalum battens	76.87	M2	Yes	6 days
70	STRUCTURAL WORK LT. 3				
71	Column reinforcement K1 45x45	0.58	M3	Yes	5 days
72	K2 column reinforcement 40x40	19.12	M3	Yes	14 days
73	Column K2 steps 40x40	3.96	M3	Yes	13 days
140	PUMP HOMEWORK				
141	Excavation work for river stone foundations	7.36	M3	Yes	3 days
142	River stone foundation sand filling work	0.32	M3	Yes	1 day
143	Bare stone foundation work	0.64	M3	Yes	1 day
144	Install a stone foundation 1 PC: 3 PS	4.40	M3	Yes	0.5 days
145	Reinforced concrete sloof (10x15)	8.00	M3	Yes	0.89 days
150	1/2 brick wall masonry work	15.92	M2	Yes	2.1 days

From the table above, the work that is on the critical path can be described from analysis using Microsoft Project.

Costs Under Normal Conditions

From the calculation results, the Normal Duration is 189 days and the Planned Budget is IDR 2,450,000,000. From this explanation, overhead costs and profits can be found as follows:

Profit = Total project cost x 10% = IDR 2,450,000,000 x 10% = IDR 245,000,000

Overhead Costs = Total costs x 5% = IDR 2,450,000,000 x 5% = IDR 122,500,000

Overhead per day = O verhed / Normal duration = IDR 122,500,000 / 189 = IDR 648,148

After get cost *profit* and *overhead* , next look for cost direct and cost No direct

Direct Costs = 90% x Total costs = 90% x IDR 2,450,000,000
= IDR 2,205,000,000

Inderct Cost = Profit + Overhead Costs = IDR 245,000,000 + IDR 122,500,000
= IDR 367,500,000

Total cost = Direct Cost + Indirect Cost = IDR 2,205,000,000 + IDR 367,500,000
= IDR 2,572,500,000

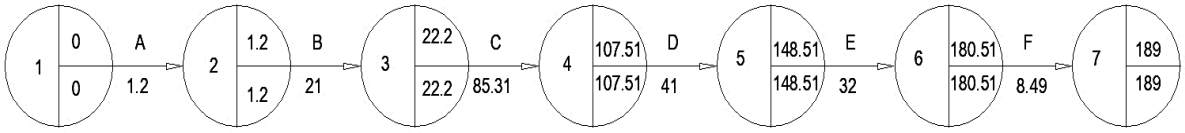

Figure 1. Dependency diagram normal condition

From the picture above, the dependency diagram for normal conditions / before acceleration can be described.

Fees Under Accelerated Conditions

In the acceleration calculation, an additional fee of IDR is obtained . 25,000,000 with the accelerated project duration of 180 days, meaning a difference of 9 days from the normal duration.

Direct costs = Normal direct costs + Cash Slope
= IDR 2,450,000,000 + IDR 25,000,000
= IDR 2,475,000,000

Indirect costs = (acceleration duration x overhead) + profit
= (180 x IDR 648,148) + IDR 245,000,000

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Vol 10 No.3 September 2023
http://cived.ppj.unp.ac.id/index.php/CIVED

= IDR 361,666,640

Total costs after acceleration = direct costs + indirect costs + profit

= IDR 2,205,000,000+ IDR 367,500,000 + IDR 245,000,000 = IDR 2,817,500,000

From the explanation above, the calculation of direct costs, indirect costs and total costs after quick calculation can be explained .

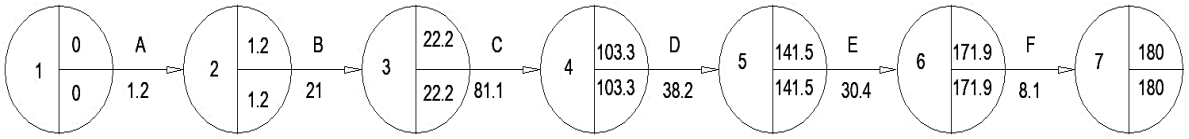

Figure 2. Dependency diagram condition accelerated

From the picture above, a dependency diagram for accelerated/after acceleration conditions can be described. The results of the project acceleration analysis for the construction of the Karangrejo District Office Building showed an accelerated duration of 180 days or 4.70% faster than the normal duration of 189 days.

Comparison of Project Duration and Cost

District Office Building Construction Project is planned to be completed within 189 days with a planned budget of IDR 2,450,000,000. By accelerating projects on the critical path of structural work. The following is a comparison table of time and costs normally and after acceleration.

Table 3. Recapitulation

Description	Duration	Direct k Cos	Indirec k Cos	Total
Normal Project	189	Rp 2,205,000,000 .	Rp 367,500,000 .	Rp 2,572,500,000 .
Project Accelerated	180	Rp 2,475,000,000 .	Rp 361,666,640 .	Rp 2,817,500,000 .

From the results of the acceleration analysis carried out, it turns out that the project can be accelerated to 180 days by implementing a system of adding 3 hours of overtime or 4.7% faster than the normal duration of 189 days. However, after acceleration, direct costs *changed* from IDR 2,205,000,000 to IDR 2,475,000,000. And this automatically affects indirect costs, which were initially IDR 367,500,000 to IDR 361,666,640. Below is a graphic table between direct costs , indirect costs and *total* costs.

CIVED Journal of Civil Engineering and Vocational Education
EISSN: 2622-6774
Vol 10 No.3 September 2023
http://cived.ppj.unp.ac.id/index.php/CIVED

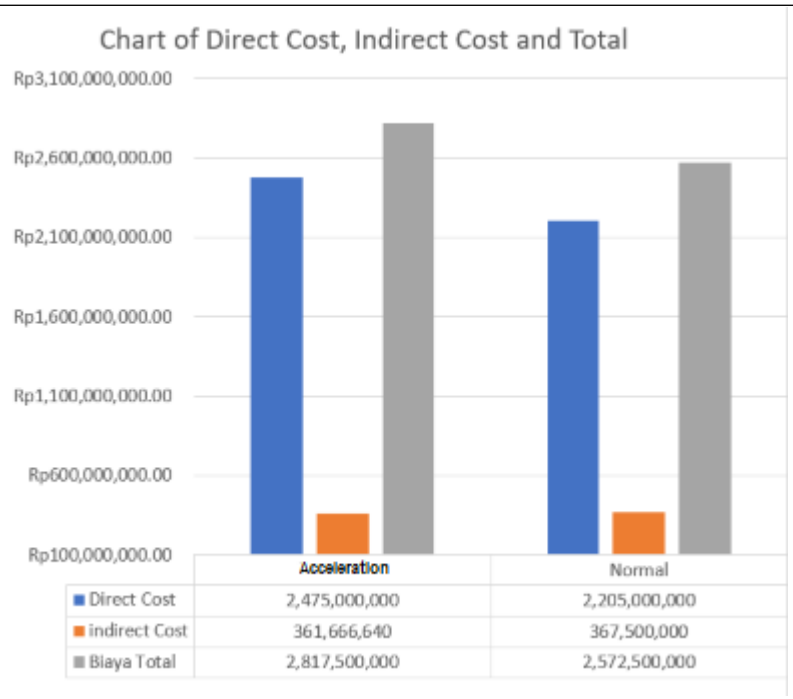

Figure 3. Comparison of Direct Cost, Indirect Cost, and Total Project Cost

From the picture above, it can be explained that the direct cost comparison under normal conditions is IDR 2,205,000,000 with an acceleration of IDR 2,475,000,000, for indirect costs under normal conditions it is IDR 367,500,000 with an acceleration of IDR 361,666,640, and the total project cost under normal conditions. amounting to IDR 2,572,500,000 with an acceleration of IDR 2,817,500,000 .

Critical Path Validation

After accelerating the project, critical path validation can be described in the table below.

Table 4. Critical Path Validation

No	Job description	Before Acceleration	After Acceleration
3	Final Cleanup of the Job Site	1.2 days	0.8 days
10	Site Landfill	10 days	7.28 days
12	The site is densely filled with fill	2 days	0.8 days
13	Foundation pile cap earth excavation work	9 days	2.66 days
15	Column K1 45x45	5 days	3.63 days
21	Sloof S1 25x25	12 days	8.7 days
22	Sloof S2 20x40	12 days	7.32 days
23	Sloof S3 15x30	12 days	7.00 days
24	Pile cap work P1 100x100x40	16 days	7.05 days
25	P3 210x210x50 pile cap work	14 days	10.25 days
26	P4 210x210x50 pile cap work	18 days	13.1 days
50	Column K1 45x45	5 days	3.63 days
61	PL plate work t:12cm	28 days	20.53 days
64	Steel structure 2L70.70.7	11 days	8 days
66	Gording CNP 150.65.20.2.3 (canopy)	5 days	3.62 days
67	Install the roof frame (ribs + Zincalum battens	6 days	4.36 days
71	Column reinforcement K1 45x45	5 days	3.86 days

CIVED Journal of Civil Engineering and Vocational Education
EISSN: 2622-6774
Vol 10 No.3 September 2023
http://cived.ppj.unp.ac.id/index.php/CIVED

72	K2 column reinforcement 40x40	14 days	10.22 days
73	Column K2 steps 40x40	13 days	9.65 days
141	Excavation work for river stone foundations	3 days	2.16 days
142	River stone foundation sand filling work	1 day	0.77 days
143	Bare stone foundation work	1 day	0.9 days
144	Install a stone foundation 1 PC:3 PS	0.5 days	0.5 days
145	Reinforced concrete sloof (10x15)	0.89 days	0.56 days
150	1/2 brick wall masonry work	2.1 days	0.12 days

From the table above, we can describe the Critical Path Validation before acceleration and after acceleration. From the calculations above, it can be seen that the acceleration results are suitable for use. Because the service provider, rather than being subject to claims or fines, is better off giving in by speeding up the implementation time even if the costs required are greater than planned. Because that is a consequence or risk when carrying out construction work in the world of government projects.

CONCLUSION

Based on the results of the analysis and discussion that have been described in this research, conclusions can be drawn on the Karangrejo District Office Building Construction project with a total project cost and time under normal conditions of IDR 2,572,500,000 with a normal duration of 189 days. After adding 3 hours of overtime, the total cost was IDR 2,817,500,000 with an accelerated duration of 180 days. In terms of project costs, implementing acceleration by adding an overtime system of 3 hours results in an increase in costs of IDR 25,000,000 or more expensive than the normal project costs. Meanwhile, the duration increased by 4.70% or 9 days faster than the normal initial duration of the project.

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