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ACCELERATION ANALYSIS USING THE CRASHING METHOD IN THE SDN KUTISARI 2 DEVELOPMENT PROJECT

Muhammad Bayu Firdaus[1*], Hanie Teki Tjendani[2], Budi Witjaksana[3]
[1-3]University 17 August 1945 Surabaya
E-mail: [1)] mbayufirdaus246@gmail.com

Abstract

In the construction of the Kutisari 2 SDN Project, there were several obstacles that hampered the implementation of the project, such as heavy rainy weather. The aim of the research is to determine the cost and acceleration time for the construction of the SDN Kutisari 2 Project. The research design was carried out to identify the time and costs of implementing the building construction completion project. The research was conducted at CV.Nisya Multi Bintang as the implementing contractor with a budget of Rp. 1,614,171,924 for 165 calendar days. The research subjects were contractors completing work on the Kutisari 2 Elementary School Development Project. This research used secondary data from the Draft Expenditure Budget, Schedule, weekly reports and project cost costs. Data analysis used Microsoft Project 2016 software. The results of the research stated (1) The duration of the Crashing was 8 calendar days with work that was on the Critical Work Route for the Construction of School Facilities, Infrastructure and Utilities at SDN Kutisari 2, namely water proofing coating with fiber on the 2nd floor, cleaning location to the end, B-0 work to cover 2nd floor columns, 2nd floor column cutting work, and floor screading work. (2) From the initial cost of the Kutisari 2 SDN School Facilities, Infrastructure and Utilities Construction Work Project, namely Rp. 1,164,171,924 with additional costs due to Crashing of Rp. 24,569,780 so the total costs due to the Crashing are Rp. 1,638,741,704.

Keywords: *Acceleration Of Work, Crashing, Time And Cost Requirements*

1. INTRODUCTION

Development project activities can be interpreted as temporary activities that last for a limited period of time, with a certain allocation of resources and are intended to produce products whose quality criteria have been clearly outlined (Fadhilah 2020). A project is an activity carried out with limited time and resources to achieve a specified end result. Construction projects are activities aimed at building facilities and infrastructure within a planned time period. A project is an activity carried out with limited time and resources to achieve a specified final result (Alamsyah 2019).

The requirement for the success of a development project is the realization of project objectives according to the Triple Constraints theory, namely right cost, right time and right quality, so that all project plans can be implemented smoothly at the pre-construction, construction implementation and post-construction stages. A construction project is always required to be completed on time without any delays in project implementation. Triple constraint is an effort to achieve goals based on three constraints, namely: 1) Exact cost, the project must be carried out at a cost that does not exceed the budget, both the cost of each work item, the cost of each implementation period and the total cost until the project is completed. 2) On time, the project must be carried out on time according to the previously planned schedule which is shown in the form of work

progress. 3) Correct quality, product quality/performance must meet the specifications and criteria required by the owner.

A project can be considered successful if the work is completed on time according to plan and can utilize human resources effectively and efficiently as well as maintaining minimal control over funds (Putra 2018). Therefore, careful planning before the completion of a project needs to be planned well in order to reduce the risk of obstacles that will occur. But in reality, in the implementation of construction projects, discrepancies often occur between the planned schedule and the reality in the field. This is caused by several obstacles, both obstacles that have been calculated and obstacles that have not been calculated. The causes of these delays include differences in location conditions, design changes, weather influences, lack of meeting the needs of workers, materials or equipment, planning or specification errors, and the influence of the involvement of the project owner (Frederika 2020).

To overcome delays that occurred on the project, action was taken to accelerate project work. This acceleration must be carefully calculated to obtain maximum results at a cost that is not too large. If the calculation is wrong, the contractor can receive losses in the availability of resources, including human resources, materials, work tools and time spent. So it is necessary to carry out analysis using the Crash program to get a good acceleration plan. Crash program is a method to speed up project duration by reducing the duration of a job which affects the project completion time. Acceleration is carried out in critical activities and what must be done in analyzing project costs and time is to create a project network, look for critical activities and calculate the project duration. Project acceleration will take into account efficiency in terms of time and costs using the Crashing method through the use of Microsoft Project 2016 software.

The SDN Kutisari 2 construction project is one of the new projects on Jl. Kutisari Park No.10, RT.01/RW.01, Kutisari, Kec. Tenggilis Mejoyo, Surabaya, East Java 60291. This project was carried out in order to meet the needs of the surrounding community for educational services in the district. Tenggilis Mejoyo, Surabaya. The Kutisari 2 Elementary School Development Project is a development in order to meet the community's need for health services in the district. Tenggilis Mejoyo, Surabaya, East Java. However, the Kutisari 2 Elementary School Development Project had several obstacles that hampered project implementation, such as heavy rainy weather. So this research aims to determine the cost and time for accelerating the construction of the Kutisari 2 Elementary School Project to achieve the functional target time so that it can facilitate transportation for the local community.

2. LITERATURE REVIEW

2.1. Project management

Project management is the implementation of experience, skills and knowledge using the best methods with existing resources to produce goals and objectives as planned, to achieve good results in terms of cost, quality, performance time and safety at work (Bulba, A. T. 2022). Project management is concerned with managing and coordinating human and physical resources using advanced management techniques to achieve specific goals: quality, time, cost, and meeting stakeholder expectations (Mahapatni 2019).

2.2. Project Delays

Delay is the addition of time beyond the completion date of a project which has been agreed by all (Assaf, S., & Al-Hejji 2006). Project delays are the time limit for project completion that has been determined in the contract, or the time agreed by the parties involved in completing a project. According to Yudhagama (2020), delays that occur in a construction project are delays in the work process when compared to the planned Time Schedule.

2.3. Project Acceleration

Acceleration of work can be done on 2 (two) different platforms. The first basis is when work acceleration is carried out at the behest of the project owner or MK consultant to the contractor to increase the number of workers, work time (overtime), or alternate work (shift work) so that the work can be completed faster than the time agreed in the contract. This acceleration is called actual acceleration. Meanwhile, the second type of work acceleration is called constructive acceleration, namely efforts to accelerate work carried out by contractors without any direct instructions from the project owner or MK consultant (Ningrum, F. G. A 2017).

2.4. Previous Research

Previous research was conducted by Ayuningtyas (2018) with the title "Project Acceleration Analysis Using the Crashing Method". The acceleration method for projects is using the Crashing method with 2 alternatives, namely by increasing working hours (overtime) by 3 hours from normal working hours and adding 1 group of workers for each activity on the critical path. It can be concluded that by adding 3 working hours, the project can be accelerated for 61 days with cost savings of IDR 1,237,636,060.51 and for the alternative of additional labor, the project can be accelerated for 30 days with cost savings of IDR 734,255,443.89. So the most optimal alternative from these two alternatives is an additional 3 working hours.

Research by Adi et al., (2018). with the title "Crash Program Method Project Acceleration Analysis". (Case Study: USE Sentraland Mixed Building Construction Project). The problem discussed in this research is that delays that occur in the Mixed Use Sentraland building project can affect the overall duration of the project. If there is a delay in project work, it will have an impact on increasing construction costs so that it is detrimental to all parties, both the owner and the implementing party. The data processing method uses the Crashing to determine the critical and non-critical paths of several activities in the construction project. Crashing speeds up column work for each zone on each floor by 1 day.

Meanwhile, research by (Malifa, Y., Dundu 2019) entitled Analysis of acceleration of construction project time and costs using the Crashing method (case study: construction of Iain Manado flats). The aim of this research is to find Crashing costs resulting from time acceleration. In carrying out cost analysis due to time acceleration, the Crashing method was used (Adi, R. R. B. 2018). From the Crashing which was carried out with the alternative of adding labor to the IAIN Manado Flats construction project, it can be concluded that there was an acceleration of time duration of 14 calendar days with

an additional direct cost of IDR 2,800,000 and a decrease indirect costs amounting to IDR 48,347,484.

3. RESEARCH METHODS

3.1. Research Type

This research uses a quantitative research type which is a research method based on the philosophy of positivism, used to research certain populations or samples, data collection using research instruments, quantitative/statistical data analysis, with the aim of testing predetermined hypotheses (Sugiyono 2019).

3.2. Research Sites

The research was carried out on the completion of work on the Kutisari 2 Elementary School Development Project. By selecting this location, researchers are expected to find meaningful and new things (Muchtar 2015). The research was carried out on the completion of the Kutisari 2 Elementary School Development work project which is located on Jl. Kutisari Park No.10, RT.01/RW.01, Kutisari, Kec. Tenggilis Mejoyo, Surabaya.

3.3. Research Instrument

This research uses secondary data from the Draft Expenditure Budget (RAB), Schedule, weekly reports, and project costs on the completion of work for the SDN Kutisari 2 Project Development.

3.4. Data Collection Procedures

The method used in data collection is the observation method, namely collecting data by directly observing the study object and recording the desired data. Apart from that, it also uses the documentation method, namely collecting data by recording existing documents or reports.

3.5. Data analysis technique

Data analysis was carried out with the help of Microsoft Project 2016 software. By inputting the relevant data to be analyzed into the software, Microsoft Project will then carry out calculations automatically according to the calculation formulas contained in this program.

4. RESULTS AND DISCUSSION

4.1. Project Overview

In this project, this type of work will be carried out in the form of construction of school facilities, infrastructure and utilities with the employer, namely SDN Kutisari 2 and the service provider by CV. Nisya Multi Bintang. Total development funding is IDR. 1,614,171,924 with an Implementation Time of 165 calendar days.

4.2. Job Critical Paths based on S-Curves

Critical tasks are obtained by looking at the Network Diagram in Microsoft Project. Critical tasks are shown in the following table:

Table 1. Critical Task

Name	Start	Finish	% Complete	Remaining Work
Water Proofing Coating with 2nd Floor fiber	Mon 24/10/22	Wed 09/11/22	0%	0 hrs
Site Cleaning to the end	Mon 31/10/22	Wed 09/11/22	0%	0 hrs
Work B-0 2nd Floor Column Cover	Mon 31/10/22	Wed 09/11/22	0%	0 hrs
Pack. 2nd Floor Column Cuttings	Mon 31/10/22	Wed 09/11/22	0%	0 hrs
Floor Screading Work (With Rebated Concrete)	Mon 31/10/22	Wed 09/11/22	0%	

Source: Researcher Data (2023)

4.3. Job Needs Analysis

There are 4 jobs that become critical tasks which are then carried out by Crashing analysis, so as to obtain the acceleration of time and costs required for the acceleration of time that will occur.

Table 2. Labor Coefficient

No	Type of work	Labor Coefficient (OH)				
		Foreman	Craftman Chief	Painter	Bricklayer	Worker
1	Water Proofing Coating with 2nd Floor fiber	0,0025	0,0075	0,075		0,05
2	Site Cleaning to the end	0,025				0,06
3	Work B-0 2nd Floor Column Cover	0,01	0,01		0,1	0,2
4	Pack. 2nd Floor Column Cuttings	0,0007	0,007			0,007
5	Floor Screading Work (With Rebated Concrete)	0,018	0,018		0,18	0,36

Source: Researcher Data (2023)

Next, the required number of workers is calculated for a duration of 165 days. The formula for calculating the need for the number of workers that the author uses is as follows :

Calculation of labor requirements per day :
Number of Workers required = Volume x Coefficient/Duration
Example of Calculation for 2nd Floor Fiber Water Proofing Coating Work:
Job volume = 263,47 m3
Foreman's Coefficient = 0,0025 OH

Duration = 13 days
Number of Foremen required = 263,47 x 0,0025/13
= 0,05 ≈ 1 person per day

The required number of workers for each job on the critical path is shown in the following table:

Table 3. Requirements for Number of Workers

No	Type of work	Job volume	Volume Units	Duration (Days)	Total manpower				
					Foreman	Craftman Chief	Painter	Bricklayer	Worker
1	Water Proofing Coating with 2nd Floor fiber	263,47	m2	13	1	1	2	0	2
2	Site Cleaning to the end	1,00	Ls	8	1	0	0	0	1
3	Work B-0 Floor Column Cover2	3,98	m2	8	1	1	0	1	1
4	Pack. 2nd Floor Column Cuttings	596,61	m2	8	1	1	0	0	1
5	Floor Screading Work (With Rebated Concrete)	12,75	m2	8	1	1	0	1	1

Source: Researcher Data (2023)

After getting the required number of workers, the duration acceleration is carried out using the crash method. The process of accelerating duration in this research was carried out by emphasizing the duration of activities on the critical path with additional workforce. The decision to crash must consider the cost slope that occurs. The cost slope value shows the increase in costs per day for each activity.

From the table above, the increase in the number of workers experiencing a crash, the results of the addition of workers experiencing a crash of 50% are shown in the following table:

Table 4. The addition of workers experienced a crash

No	Type of work	Total manpower										Normal Total	Crashing Total
		Foreman		Craftman chief		Painter		Bricklayer		Worker			
		Normal	Addition 50%	Normal	Addition 50%	Normal	Addition 50%	Normal	Addition 50%	Normal	Addition 50%		
1	Water Proofing Coating with 2nd Floor fiber	1	2	1	2	2	3	0	0	2	3	6	10
2	Site Cleaning to the end	1	2	0	0	0	0	0	0	1	2	2	4
3	Work B-0 Floor Column Cover2	1	2	1	2	0	0	1	2	1	2	4	8
4	Pack. 2nd Floor Column Cuttings	1	2	1	2	0	0	0	0	1	2	3	6
5	Floor Screading Work (With Rebated Concrete)	1	2	1	2	0	0	1	2	1	2	4	8

Source: Researcher Data (2023)

After obtaining a calculation of additional labor of 50% for each job that experienced a crash, we continue with the productivity calculation. Example of Productivity Calculation for Calculation of Water Proofing Coating Work with 2nd Floor Fiber :

a. Normal productivity (Pn)

= Volume/Duration
= 263,47/13
= 20,27

b. Productivity Crashing

= Pn x (total normal workers+total additional 10%)/(total normal workers)
= 20,27 x (6 + 10)/6
= 54,045

c. Crash duration

= Volume/(Crashing productivity)
= 263,47/54,045
= 4,88 ≈ 5 days

Complete calculations of Crashing productivity and crash duration are shown in the following table:

Table 5. Crashing Productivity and Crash Duration

No	Type of work	Productivity Crashing	Duration (days)	
		= a /c x (f/d)	Normal	Crash
1	Water Proofing Coating with 2nd Floor fiber	54,04512821	13	5
2	Site Cleaning to the end	0,375	8	3
3	Work B-0 Floor Column Cover2	1,4925	8	3
4	Pack. 2nd Floor Column Cuttings	223,72875	8	3
5	Floor Screading Work (With Rebated Concrete)	4,78125	8	3

Source: Researcher Data (2023)

From the table above, continue calculating crash costs, normal costs, and cost slopes. Example of Productivity Calculation for Waterproofing Layer Work with Fiber Floor 2 :

Crash coefficient (OH) = (OH x Number of workers after addition)/Number of additional workers

Foreman's Crash Coefficient = (0,0025 x 2)/1 = 0,005
Crash Coefficient craftman chief = (0,0075 x 2)/1 = 0,015
Painter Crash Coefficient = (0,075 x 3)/1 = 0,225
Worker Crash Coefficient = (0,05 x 3)/1 = 0,15

Total Crash Cost

Foreman = (0,005 x Rp 181.285 x 263,47)

Craftman chief = (0,015 x Rp 178.850 x 263,47)
Painter = (0,225 x Rp 176.420 x 263,47)
Worker = (0,15 x Rp 176.420 x 263,47)
Total = Rp 18.376.156

Cost Slope = (crash cost-normal cost)/(normal duration-crash duration)
= (Rp 18.376.156-Rp 23.847)/(13 - 5)
= Rp 2.258.746

The results of the recapitulation of additional costs are shown in the following table:

Table 6. Recapitulation of additional costs for accelerating work

No	Type of work	Crash Cost (Rp.)	Normal Cost (Rp.)		Cost Slope (Rp.)
1	Water Proofing Coating with 2nd Floor fiber	18.376.156	23.847		2.258.746
2	Site Cleaning to the end	30.235	15.117		2.835
3	Work B-0 Floor Column Cover2	449.958	48.381		75.296
4	Pack. 2nd Floor Column Cuttings	3.118.826	12.128		582.506
5	Floor Screading Work (With Rebated Concrete)	2.594.605	980.285		302.685
Total			24.569.780	1.079.758	3.222.067

Source: Researcher Data (2023)

After adjusting the time schedule based on the predecessor of each job using the Crashing method, the total project duration becomes 160 days from 168 days with an acceleration of 8 days for work on the critical path.

The additional workers used in this Crashing method are 50% of the initial number of workers on each job that is on the critical path which can be seen in Table 4.4. With the addition of workers, it is estimated that the additional costs for the project will be Rp. 3,222,067 per unit time day.

5. CONCLUSION

In accordance with the research objectives and results of the discussion, it can be concluded that: 1) The duration of the Crashing is 8 calendar days with the work being in the Critical Work Route for the Construction of School Facilities, Infrastructure and Utilities at SDN Kutisari 2, namely water proofing coating with fiber on the 2nd floor, site cleaning until the end, B-0 cover work for 2nd floor columns, 2nd floor column cutting work, and floor screading work (with rebated concrete). 2) From the initial cost of the Kutisari 2 SDN School Facilities, Infrastructure and Utilities Construction Work project, namely Rp. 1,164,171,924 with additional costs due to Crashing of Rp. 24,569,780 so the total costs due to the Crashing are Rp. 1,638,741,704.

Meanwhile, the suggestions from the research results are: 1) Analyze acceleration data using calculations without using Microsoft Project 2016 and 2) Cost optimization results and shorter time will require greater implementation costs, but will not make the contractor lose costs.

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