

## Project Acceleration Analysis Using the Crashing Method with The Alternative of Additional Labor and Additional Working Hours in Drainage Work

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### ABSTRACT

Project work delays often occur due to differences in site conditions, design changes, weather influences, and planning errors. The problem faced is the project duration, where if the project duration is accelerated or crashes, there will be several options to cut the project duration. This is the problem that becomes the topic of the thesis/journal, namely "Analysis of Project Acceleration with the Crashing Method with Alternatives for Adding Manpower and Additional Working Hours in Drainage Works". The author uses the primary method, with sources of RAB, Time Schedule, working drawings and analysis of city unit prices. As well as secondary research methods with sources, from relevant books, and project data such as price lists and wages. From the results of the study it can be concluded that the total wages of workers under normal conditions is IDR. 16,864,000.00 with the duration of project work for 30 working days. From the results of the analysis in this study, the total wages of workers with alternative labor additions of IDR. 19,672,000.00 with the duration of project construction work for 25 working days or 15.15% faster than the normal duration. Meanwhile, the total wage for workers with the alternative of additional working hours (overtime) is IDR. 25,052,300.00 with the duration of the project construction work for 25 working days or 15.15% faster than the normal duration. A more economical alternative to completing the project is the addition of manpower because it saves IDR. 2,228,000.00 from additional working hours (overtime), from normal wages.

**Keywords:** Working Hours, labor, construction, crashing

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### INTRODUCTION

Construction project control is a systematic activity or effort to determine standards that are in accordance with planning objectives, compare implementation with planning, and make necessary corrections so that costs, resources, and time can be used effectively and efficiently in order to achieve the desired construction project objectives. So that with project control, construction project deviations, losses incurred, and possible project delays can be avoided. Project work delays often occur due to differences in location conditions, design changes, weather influences, and errors in planning. Project delays can be anticipated by accelerating (crashing) in its implementation, but must still pay attention to cost factors. The additional costs incurred are expected to be as minimal as possible and still pay attention to quality

standards. Acceleration (crashing) of implementation can be done by adding working hours, more productive tools, adding the number of workers, using materials that are faster to install, and faster construction methods. The problem faced is the duration of the project, where if the project duration is accelerated or crashed there will be several options to cut the project duration. This is the problem that is the topic of the thesis/journal, namely "Analysis of Project Acceleration Using the Crashing Method with Alternatives of Adding Labor and Adding Working Hours (Overtime) on Drainage Work".

## LITELATURE REVIEW

A project in network analysis is a series of activities that aim to produce a unique product and are only carried out in a certain period (temporary) (Maharesi, 2002). A project can be defined as a series of activities that only occur once, where its implementation from beginning to end is limited by a certain period of time (Tampubolon, 2004) Project activities can be intelDRreted as a temporary activity that takes place in a limited period of time, with a certain allocation of resources and is intended to produce a product or deliverable whose quality criteria have been clearly outlined (Soeharto, 1999). states that a project is part of an organization's work program that is temporary in nature to support the achievement of organizational goals, by utilizing human resources and non-human resources (Munawaroh, 2003).

A project is a job that has the following special signs According to Subagya (2000), namely, a. The start and finish times have been planned. b. It is a unit of work that can be separated from the others. c. Usually the volume of work is large and the relationships between activities are complex. explains that a project can be defined as a series of tasks directed towards a major result (Heizer and Render, 2005). Project activities – in the process of achieving the final result are limited by the budget, schedule, and quality that must be met – are distinguished from operational activities, this is because of their dynamic, non-routine, multi-activity nature with varying intensity, and have a short cycle (Akbar, 2002). "The project is complex enough that the subtasks require careful coordination and control in terms of timing, precedence, cost, and performance" (Meredith and Mantel 2006).

The difference between CPM and PERT (Program Evaluation and Review Technique) is that PERT uses activity oriented, while CPM uses event oriented. In activity oriented, arrows indicate activities or work with some descriptions of the activity, while event oriented events are the main focus of an activity. CPM is often also called AOA (Activity On Arrow) which consists of arrows and circles/squares. Arrows describe activities, while circles/squares describe events. The event at the beginning of the arrow is called the "I" node, while the event at the end of the arrow is called the "J" node. The graph or chart consisting of arrow symbols and circles/squares symbolizes an illustration of a project. The shape of the node commonly used in the CPM circle is as follows:

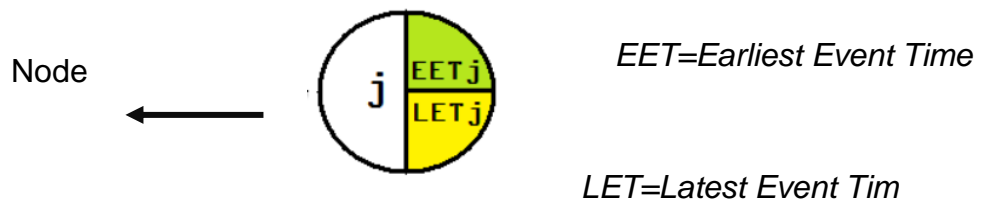


Figure 1. Symbol of Event

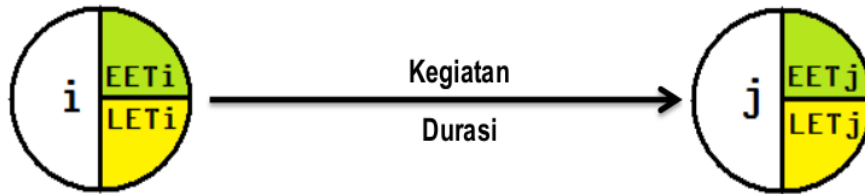


Figure 2. Inter-Event Symbol (Sources : Nugroho, 2007)

A simple form of the CPM network can be seen in Figure 3. below

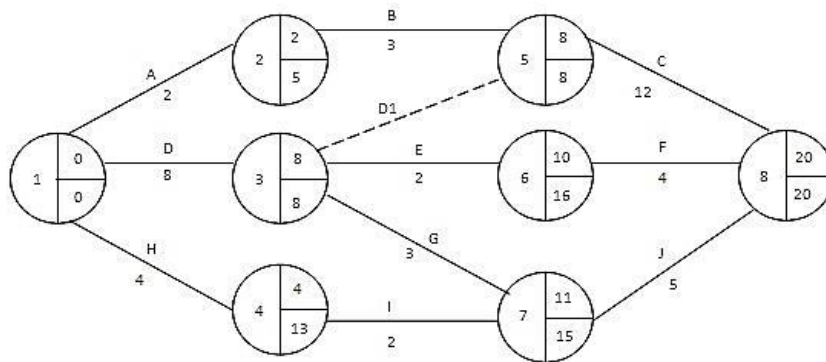


Figure 3. CPM Diagram

**METHOD**

**Research Object**

The object of this research is the Drainage Channel / Culvert Rehabilitation project located on Bangkala Dalam Street, Biring Romang Village, Makassar City by the Makassar City Public Works and Spatial Planning Service, with CV. Irzhal Maulana Konstruksi as the implementer.

**Research Stages**

The stages of research that will be carried out can be described in the following steps: a. Data Collection Stages Primary Data Data obtained by interview to obtain the causes of delays and changes that may occur during the work. Secondary Data The data taken are project data, previous research journals and literature books in the form of theories, basic concepts, information, or methods that will support the writing of this final assignment. Collection of project data needed in this research, namely:

- a. Time Schedule and S-Curve
- b. Unit Wage Price
- c. Budget Plan (RAB)
- d. Project Drawing b. Data Analysis Stages The stages that need to be carried out in this study are as follows: 1. Secondary data collection. 2. Preparation of work networks. The steps for preparing a work network are: a. Describe each work item. b. Determine interrelated activities and activities that precede other activities (predecessors). c. Compile the normal duration of each activity. d. Analyze critical paths and non-critical paths using the CPM (Critical Path Method) method. 3. Analyze normal labor requirements to obtain the total labor wage price. 4. Analyze normal labor productivity.
- e. Apply the Crashing method by calculating crash costs and crash durations using the alternative of adding labor (15% of the total workforce) and work duration (overtime) for 2 hours. 6. Compare the time and cost of project implementation before and after Crashing to find out more economical alternatives.

**FINDING AND DISCUSSION**

The results of the identification that has been carried out are based on the list of descriptions of the work of the Drainage Channel / Culvert Rehabilitation. So the next step is to provide symbols based on the sequence of project work process activities. The sequence of project work can be seen in table 1 below:

**Table 1: Sequence of activities for the Rehabilitation work project Drainage Channels**

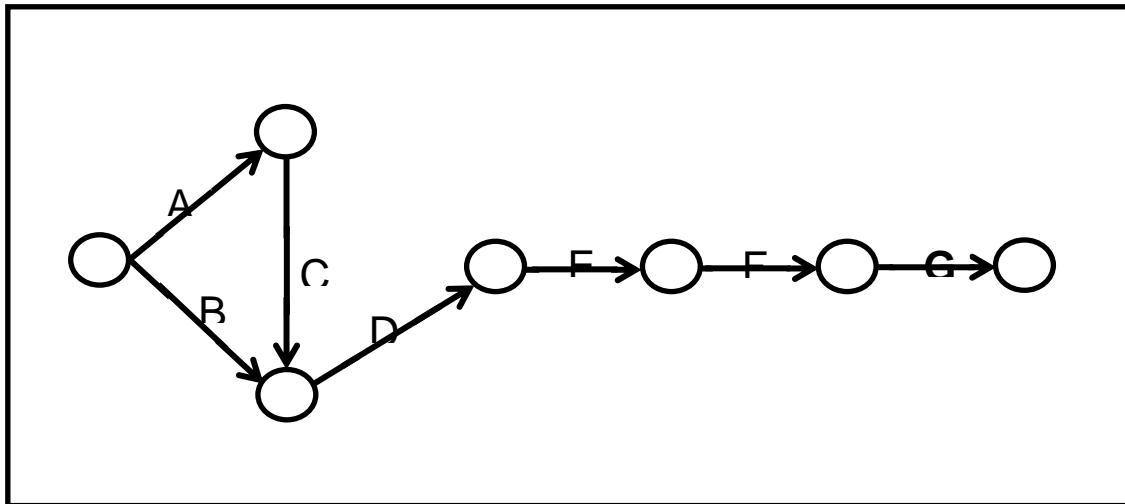
No	Item of Work	Symbol	Duration (Day)
1	Project board Stone Iron	A	1
2	Mobilization	B	1
3	masonry	C	5
4	Plastering	D	5
5	Rebar Instalation	E	25
6	Formwork	F	11
7	Concrete casting K225	G	28

The preparation of a work network is very useful for knowing how long the project will take to implement and which activities are critical which cannot be known without first preparing a work network.

**Table 2: Description of Drainage / Culvert Rehabilitation Project Activities**

No	Item of Work	Predecessor activity	Duration (Day)
1	Project board Stone Iron	-	1
2	Mobilization	-	1
3	masonry	A,B	5
4	Plastering	C	5
5	Rebar Instalation	D	25
6	Formwork	E	11
7	Concrete casting K225	F	28

A network diagram is a work network consisting of several descriptions of activities that will be carried out during the implementation of the project. With a network diagram, it can be seen which work paths are included in the critical path. Based on table 4.3, researchers can describe the work network diagram of the drainage channel / culvert rehabilitation project.



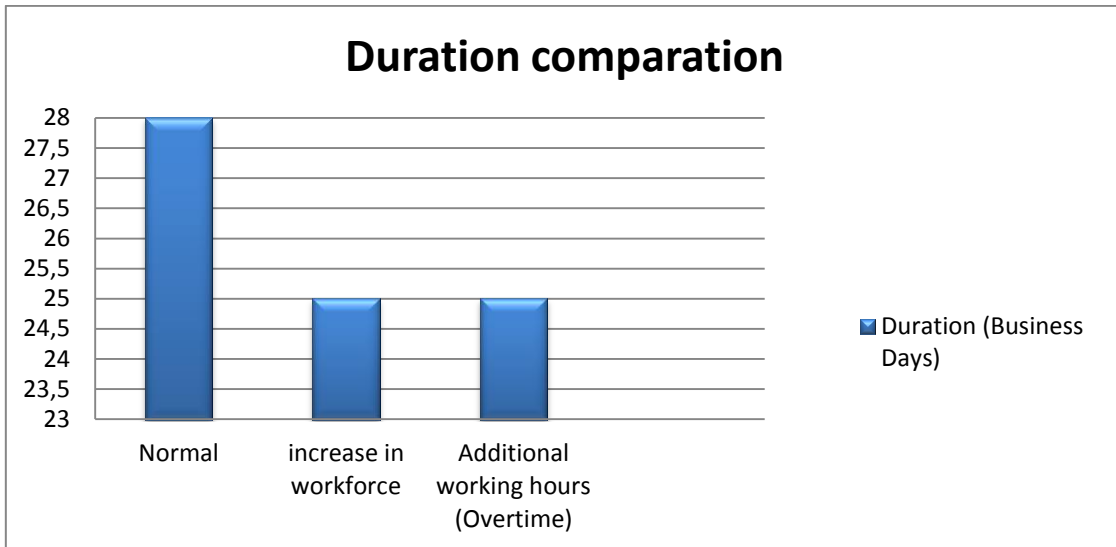
**Figure 4 Network of Drainage / Culvert Rehabilitation Projects**

Once the network of a project can be described, the next step is to estimate the time required for each activity, and analyze the entire network diagram to determine the time of each event. In estimating and analyzing this time, we will get one or more specific paths of activities in the network that determine the completion time of the entire project. The float concept provides flexibility or “room to maneuver” in the schedule to complete certain tasks so that there is a period of time where activities can slip but not affect the critical path and completion date.

NO	Event	Duration	EET		LET		FF	TF
			Ei	Ej	Li	Lj	FFij = Ej – Ei -Dij	TFij = Lj – Ei -Dij
1	A	1	0	1	0	1	0	0
2	B	1	0	6	0	6	5	5
3	C	5	1	6	1	6	0	0
4	D	5	6	11	6	11	0	0
5	E	25	11	36	11	36	0	0
6	F	11	36	47	36	47	0	0
7	G	28	47	75	47	75	0	0

The research on the Drainage Channel Rehabilitation project / Culvert - Culvert focuses on construction work that is planned to be completed within 30 working days with labor wages of IDR. 16,864,000.00. To compare costs and duration, this study was conducted with 2 alternatives, namely increasing the number of workers (resources) and increasing working hours (overtime). The use of these 2 alternatives aims to compare more efficient and economical alternatives. The results of the acceleration process on the work show that the acceleration duration with the alternative of increasing labor is 25 working days, faster than the normal duration for construction work on the project with labor wages of IDR. 19,672,000.00. While with the alternative of increasing working hours (overtime) the duration of the project acceleration is 25 working days, the same as the alternative of increasing labor. However, with the labor wages obtained, namely IDR. 25,052,300.00, it is IDR. 5,380,300.00 greater than the alternative of increasing labor.

So that a more efficient and economical alternative is to add workers. This is because the productivity of workers in the alternative of adding workers is greater than the addition of working hours. In addition, it is also caused by overtime wages being 1.5 or 2 times the normal wage based on the Decree of the Minister of Manpower Number KEP.102/MEN/VI/2004 Concerning Overtime Working Hours and Overtime Wages. The following is a comparison graph of costs and duration of normal work with the alternative of adding workers and working hours (overtime). The calculation of additional costs and total labor wages after crashing can be seen in the appendix. Based on the calculation of the duration after adding overtime hours in the appendix table, the total duration of the project implementation is 25 working days.



**Figure 5. Comparison Chart of Normal and Post-Crashing Project Duration**

## CONCLUSION

Based on the results of the analysis in this study, several conclusions were obtained, as follows:

The total labor wages under normal conditions are IDR. 16,864,000.00 with a project work duration of 30 working days. From the results of the analysis in this study, the total labor wages with the alternative of adding labor are IDR. 19,672,000.00 with a project construction work duration of 25 working days or 15.15% faster than the normal duration. While the total labor wages with the alternative of adding working hours (overtime) are IDR. 25,052,300.00 with a project construction work duration of 25 working days or 15.15% faster than the normal duration.

A more economical alternative to complete the project is adding labor because it is more economical IDR. 2,228,000.00 from adding working hours (overtime), from normal wages.

## REFERENCES

- Adi, Traulia, Wibowo. 2016, Analisa Percepatan Proyek Metode Crash Program Studi Kasus: Proyek Pembangunan Gedung Mixed Use Sentraland.: Jurnal Karya Teknik Sipil, Volume 5, Nomor 2, Tahun 2016.
- Oetomo, Priyoto, Uhad, 2017. Analisis Waktu Dan Biaya Dengan Metode Crash Duration Pada Keterlambatan Proyek Pembangunan Jembatan Sei Hanyu Kabupaten Kapuas.: Media Ilmiah Teknik Sipil Volume 6 Nomor 1 Desember 2017.
- Santoso, 2017. Analisis Percepatan Proyek Menggunakan Metode Crashing Dengan Penambahan Jam Kerja Empat Jam Dan Sistem Shift Kerja (Studi Kasus : Proyek Pembangunan Gedung Animal Health Care Prof. Soeparwi, Fakultas Kedokteran Hewan Ugm, Yogyakarta: <https://Dspace.Uii.Ac.Id/Bitstream/Handle/>

- Anggraeni, 2016. Analisis Percepatan Proyek Menggunakan Metode Crashing Dengan Penambahan Tenaga Kerja Dan Shift Kerja (Studi Kasus : Proyek Pembangunan Hotel Grand Keisha, Yogyakarta). <https:// Docplayer. Info/ 50186771>.
- Ningrum, Hartono, Sugiyarto, 2017. Penerapan Metode Crashing Dalam Percepatan Durasi Proyek Dengan Alternatif Penambahan Jam Lembur Dan Shift Kerja (Studi Kasus: Proyek Pembangunan Hotel Grand Keisha, Yogyakarta),: E-Jurnal Matriks Teknik Sipil/Juni 2017
- Ervianto, 2004. Teori-Aplikasi Manajemen Proyek Konstruksi. Yogyakarta: Andi.
- Rani Hafnidar A, 2016. Manajemen Proyek Konstruksi. Edisi 1, cetak 2, Yogyakarta : Deepublish, Agustus 2018.