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RESCHEDULING STUDY OF THE BATU HARANG BRIDGE CONSTRUCTION PROJECT

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ABSTRACT

The contract value adjustment at the mutual check final quantity stage led to changes in the scope of work and volume in the Batu Harang Bridge Construction Project. Therefore, a rescheduling was carried out to align with the revised project scope while ensuring optimal implementation.

This research aims to reschedule the project in order to determine the total duration and critical path using the PDM method with Microsoft Project 2021. The scheduling process considered project holidays as well as the dependency relationships among activities. After entering the duration of each activity into Microsoft Project 2021, the schedule was visualized in a Gantt Chart, which automatically displayed the sequence and duration of activities from the start of the project, and was also used to generate the Network Diagram.

The analysis results indicate that the total project duration obtained using the PDM method is 161 calendar days, starting on March 7, 2023, and ending on August 22, 2023. Meanwhile, the actual project realization reached 218 calendar days. The schedule developed using PDM is shorter than the actual realization, with a difference of approximately 8 weeks, or 56 days. In addition, a critical path was identified, consisting of 10 activities, starting from soil testing work and ending with the installation of the bridge nameplate.

Keywords : Bridge, Microsoft Project 2021, Scheduling, Contract Value Reduction, PDM

1. INTRODUCTION

The Batu Harang Bridge construction project underwent a contract value reduction at the final stage, known as the Mutual Check Final Quantity, which affected both the sequence of activities and the overall project duration. Initially, the project utilized only a time schedule represented by an S-curve, without detailed network scheduling. During implementation, temporary work stoppages occurred due to national holidays, including Eid al-Fitr from April 20 to 26, 2023, and Eid al-Adha on June 28, 2023.

In this study, the researcher applied the Precedence Diagram Method (PDM) to develop a more accurate and efficient project schedule. This method was selected because it clearly illustrates activity dependencies and identifies the critical path, allowing the schedule to be adjusted according to the revised contract value.

The study also incorporates a rescheduling process and the development of a Work Breakdown Structure (WBS) up to level 3. The primary objective is to evaluate and refine the project schedule to ensure an optimal implementation period despite changes in the final contract value.

2. LITERATURE REVIEW

Construction Project

A construction project is a systematically organized activity aimed at producing a tangible outcome in the form of infrastructure, while being governed by three primary constraints-cost, quality, and time-commonly referred to as the triple constraint in project management (Huwae et al., 2024).

Project Scheduling

Project scheduling aims to ensure that every activity is carried out as planned, completed on time, performed efficiently, and contributes to achieving the overall project objectives (Ngabito et al., 2023).

S-Curve

The S-curve illustrates project progress by correlating activities, time, and work weight, which are represented as the cumulative percentage of the overall project performance (Sutopo & Hendarti, 2022).

Microsoft Project

Microsoft Project serves as a digital tool that assists in organizing, planning, and managing various administrative aspects of project activities (Khaidir et al., 2022).

Work Breakdown Structure (WBS)

The WBS functions to divide project work into smaller, manageable units, making it easier to understand the project's structure and elements from the overall framework down to the detailed components (Laksono et al., 2024).

Precedence Diagram Method (PDM)

The *Precedence Diagram Method* (PDM) is represented using rectangular symbols that serve as nodes containing activities, which is why it is also referred to as the Activity on Node (AON) method (Fahrian et al., 2021). The main components include :

1. *Early Start* (ES), the earliest possible time at which an activity can begin within the project schedule.

2. *Early Finish* (EF), the earliest point in time when an activity can be completed based on its planned duration.
3. *Latest Start* (LS), the latest allowable time for an activity to commence without causing any delay to the overall project timeline.
4. *Latest Finish* (LF), the latest possible completion time of an activity that will not result in a delay to the project's final completion.

Critical Path

The critical path represents the sequence of activities with the longest total duration, yet it defines the shortest possible completion time for the entire project. An activity is considered critical when:

1. ES = LS,
2. EF = LF,
3. (LF – ES) equals the activity duration, and
4. Total float equals zero.

Critical path analysis involves forward and backward pass calculations (Dirawan et al., 2024).

Types of dependencies in PDM (Marbun et al., 2023):

1. Finish to Start (FS), indicates that a succeeding activity can only begin once the preceding activity has been completed.
2. Start to Start (SS): describes a relationship in which the start of a following activity depends on the start of its preceding activity.
3. Finish to Finish (FF): represents a dependency where two activities are expected to finish at nearly the same time.
4. Start to Finish (SF), means that the completion of an activity is dependent on the initiation of another preceding task.

Float

Float is the allowable delay time for an activity without affecting the project schedule, categorized into total float and free float (Fahrian et al., 2021).

Lag and Lead

Lead represents a time advancement between activities, while lag indicates a waiting period or delay between dependent tasks (Marbun et al., 2023).

3. METHODOLOGY

Project Location

The Batu Harang bridge project is located in Mantewe Village, Mantewe District, Tanah Bumbu Regency, South Kalimantan, Indonesia.

Figure 3.1 Project Location

Research Procedure

The research began by constructing a Work Breakdown Structure (WBS) based on data derived from the project's S-curve. Subsequently, an interview was conducted with Mr. Rizal Mahesa, serving as the project's Official Engineer, to gather detailed information about task order, duration, lag time, lead time, and interdependencies among the tasks during field implementation.

The analysis focused on identifying relationships between activities, including SS, SF, FS, and FF dependencies, along with the application lag and lead times. Project scheduling was then carried out using Microsoft Project 2021 by inputting work items, activity durations, and dependency relationships. Through this modelling process, produced an output in the form of a Network Diagram.

4. RESULTS AND DISCUSSION

Work Breakdown Structure (WBS)

The WBS for the Batu Harang project was structured as follows:

1. Level 1: The project title, Batu Harang Bridge Construction Project.
2. Level 2: Divided into major work categories such as general works, earthworks and geosynthetics, structural works, and daily/other works.
3. Level 3: Detailed sub-tasks under each category.
4. Each work item was numbered and coded according to its hierarchical level.

Activity Duration and Dependencies

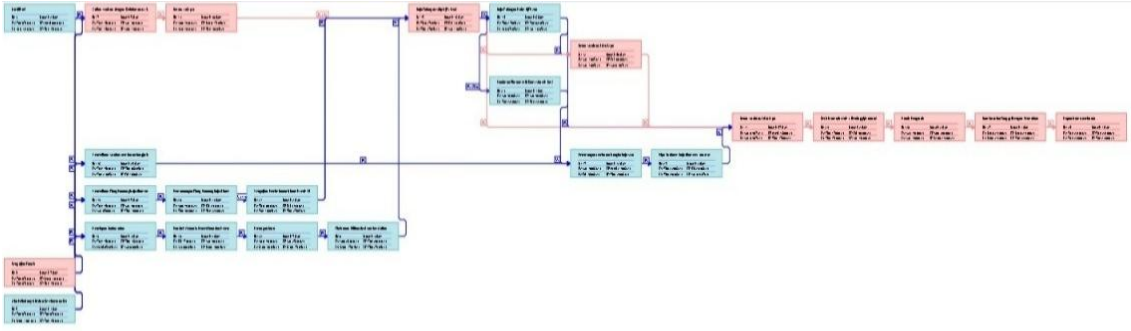
The duration and logical relationships between tasks were developed based on field data and are summarized in Table 4.1:

Table 4.1 Activity Duration and Interrelationship of Project Tasks

ID	Scope of Work	Dependency	Duration (Day)	*Relationship*	*Lag Time*	*Lead Time*
I.	**GENERAL WORKS**					
3	Mobilization	Start	2	-	-	-
4	Soil Testing	Start	7	-	-	-
5	Personal Protective Equipment (PPE) and Safety Implementation	Start	1	-	-	-
III.	**EARTHWORK & GEOSYNTHETICS**					
7	Structural Excavation with a Depth of 0-2 Meters	3	5	FS	-	-
		4		FS	-	-
		5		FS	-	-
8	Selected Fill Material from Borrow Pit	22	3	FS	-	-
9	Roadbed Preparation	3	3	FS	-	-
		4		FS	-	-
		5		FS	-	-
VII.	**STRUCTURAL WORKS**					
11	Structural Concrete, fc' 30 MPa	12	47	FS	-	-
		14		FS	-	-
		15		FS	-	-
		25		FS	-	-
12	Structural Concrete, fc' 20 MPa	14	48	FS	-	-
		15		FS	-	-
13	Concrete, fc'10 Mpa	7	30	FS	-	-
14	Plain Reinforcing Steel Bar BjTP 280	15	6	SS	-	-
		21		FS	-	-
15	Deformed Reinforcing Steel Bar BjTS 420A	8	16	FS	-	-
		13		FS	2	-
		21		FS	-	-
16	Supply of Standard Steel Bridge Structure, 50-Meter Span	3	24	FS	-	-
		4		FS	-	-
		5		FS	-	-
17	Installation of Standard Steel Bridge, 50-Meter Span	16	12	FS	-	-
		23		SS	-	-
18	Galam Pile Foundation, Supply and Installation	9	2	FS	-	-
19	Supply of Steel Pipe Piles, Diameter 406.5 mm, Thickness 9.5 mm	3	5	FS	-	-
		4		FS	-	-
		5		FS	-	-
20	Driving of Steel Pipe Piles, Diameter 406.5 mm, Thickness 9.5 mm	19	13	FS	-	-
21	Pile Dynamic Load Testing (PDLT) on Steel Piles, Diameter 406.5 mm	20	2	SS	11	-
22	Stone Masonry Work	18	7	FS	-	-
23	Elastoneric Bearing Pad with Steel Plate Layers	15	1	FS	28	-
24	Bridge Nameplate Installation	27	1	FS	-	-
25	Steel Drainage Pipe, Diameter 100 mm	17	2	FS	-	-
IX.	**DAILY & MISCELLANEOUS WORKS**					
27	Single Road Sign with Engineering Grade Reflective Surface	28	1	FS	-	-
28	Road Alignment Stake Installation	29	2	FS	-	-
29	Precast Kerb Type (Raised/Mountable)	11	2	FS	-	-

From Table 4.1, lag and lead times were identified in the activities of Deformed Reinforcing Steel Bar BjTS 420A (15), Pile Dynamic Load Testing (PDLT) on Steel Piles, Diameter 406.5 mm (21), and Elastomeric Bearing Pad with Steel Plate Layers (23). The determination of lag and lead durations was based on information through an interview with Mr. Rizal Mahesa, who served as the project's Official Engineer.

PDM Network Diagram and Critical Path



Critical Path and Non-Critical

Based on the generated Network Diagram, the critical path of the Batu Harang bridge project consists of ten key activities:

Table 4.2 Activities Included in the Critical Path

ID	Scope of Work	Duration	Start Date	Final Date
I.	**GENERAL WORKS**			
4	Soil Testing	7	07/03/2023	13/03/2023
III.	**EARTHWORK AND GEOSYNTHETICS**			
7	Structural Excavation with a Depth of 0-2 Meters	5	14/03/2023	18/03/2023
VII.	**STRUCTURAL WORKS**			
11	Structural Concrete, fc' 30 MPa	47	01/07/2023	16/08/2023
12	Structural Concrete, fc' 20 MPa	48	13/05/2023	30/06/2023
13	Concrete, fc'10 Mpa	30	19/03/2023	17/04/2023
15	Deformed Reinforcing Steel Bar BjTS 420A	16	27/04/2023	12/05/2023
24	Bridge Nameplate Installation	1	22/08/2023	22/08/2023
IX.	**DAILY & MISCELLANEOUS WORKS**			
27	Single Road Sign with Engineering Grade Reflective Surface	1	21/08/2023	21/08/2023
28	Road Alignment Stake Installation	2	19/08/2023	20/08/2023
29	Precast Kerb Type (Raised/Mountable)	2	17/08/2023	18/08/2023

5. CONCLUSION

From the analysis of the Batu Harang Bridge Construction Project in Mantewe Village, Mantewe District, Tanah Bumbu Regency, South Kalimantan, the following conclusions are drawn:

1. The scheduling of the Batu Harang Bridge construction project, located in Mantewe Village, Mantewe District, Tanah Bumbu Regency, South Kalimantan, was carried out using Microsoft Project 2021. Based on the Precedence Diagram Method (PDM), the project was scheduled for 161 calendar days, starting from March 7, 2023, to August 22, 2023. In contrast, according the actual project implementation data, the total duration reached 218 calendar days. Therefore, the schedule prepared using of approximately eight weeks, or 56 days, compared to the real project execution.
2. This study identified ten critical paths within the Batu Harang Bridge Construction project. These include activities such as Soil Testing, Structural Excavation with a Depth of 0-2 Meters, Structural Concrete, fc' 30 Mpa, Structural Concrete, fc' 20 Mpa, Concrete, fc'10 Mpa, Deformed Reinforcing Steel Bar BjTS 420A, Bridge Nameplate Installation, Single Road Sign with Engineering Grade Reflective Surface, Road Alignment Stake Installation, and Precast Kerb Type (Raised/Mountable).

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