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Simulation of Mantuil 09 Bridge Construction Scheduling Due to Delays Using Microsoft Project

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ABSTRACT

The construction of the Mantuil 09 Bridge in Banjarmasin is a complex project that requires precise time planning to avoid delays. This study uses Microsoft Project to develop the schedule, identify the critical path, and simulate solutions for delays caused by the late delivery of Grade 345 structural steel materials. The results show that the initial project duration was 215 calendar days with 27 critical activities. After simulating the delay, the project duration increased to 221 days, and the number of critical activities decreased to 21. Solutions such as overtime and changes to working hours successfully returned the project duration to 215 days, in line with the original schedule

INTRODUCTION

Infrastructure development, particularly bridge construction, plays a vital role in supporting regional connectivity and economic growth. However, construction projects frequently face challenges such as delays caused by technical issues, supply chain disruptions, and ineffective project management. These delays not only extend project duration but also increase costs and potentially compromise quality. Therefore, accurate scheduling and effective project control are critical to achieving successful project delivery (Husen, 2010).

With the advancement of digital project management tools, Microsoft Project has become one of the most widely used applications to enhance scheduling accuracy and efficiency. This software provides features to visualize the Precedence Diagram Method (PDM), identify critical paths, and simulate various scenarios of project delays. Its implementation is particularly relevant in large-scale infrastructure projects such as bridge construction (Sorongan et al., 2022).

Recent studies emphasize the significance of effective scheduling in mitigating project risks. Luntungan et al. (2023) identified that construction delays in Indonesia are often triggered by material supply issues and weak coordination among stakeholders. Tombokan et al. (2022) demonstrated that critical path analysis can minimize the impact of structural material delays in bridge construction. Furthermore, Hia and Nusa (2024) highlighted that PDM-based scheduling offers greater flexibility and precision compared to conventional methods.

The Mantuil 09 Bridge project in Banjarmasin exemplifies these challenges, as it encountered delays due to late delivery of structural steel Grade 345. This case underscores the importance of analyzing and simulating schedule adjustments using project management software. Therefore, this study aims to analyze project duration, identify critical activities, and simulate alternative solutions to delays in the Mantuil 09 Bridge construction through the application of Microsoft Project.

METHODS

This study employed a descriptive quantitative approach with a case study on the Mantuil 09 Bridge construction project in Banjarmasin, South Kalimantan. The project was funded by the South Kalimantan Provincial Budget for the fiscal year 2024. The research focused on analyzing project scheduling and simulating delays using Microsoft Project software.

Data Collection

The data used in this study were secondary data obtained from the project, including:

1. Time schedule (S-curve).
2. Project method of execution.
3. Project progress reports (daily, weekly, and monthly).

Data Analysis

The analysis was conducted through the following steps:

1. Preparation – Collecting time schedule and project execution documents.
2. Work Breakdown Structure (WBS) – Structuring project activities into smaller, manageable components.
3. Simulation of Scheduling – Inputting project activities, duration, and dependencies into Microsoft Project to generate the baseline schedule.
4. Delay Simulation – Introducing delay scenarios (e.g., late delivery of structural steel Grade 345 and equipment mobilization issues) into the schedule.
5. Solution Simulation – Applying alternative strategies such as overtime adjustments and rescheduling to minimize delays.
6. Critical Path Analysis – Identifying critical activities and evaluating their effect on the overall project duration.

The results were then analyzed to determine the impact of delays on total project duration and to assess the effectiveness of proposed solutions in maintaining the original completion schedule.

RESULTS AND DISCUSSION

This study aims to analyze the scheduling of the Mantuil 09 Bridge construction project using Microsoft Project, especially in addressing delays caused by material delivery issues. The simulation was conducted in three stages:

A. Baseline Schedule Simulation The initial scheduling using Microsoft Project shows that the project was planned to be completed in 215 calendar days with 46 work activities, including 27 critical tasks. The critical path was identified using the Precedence Diagram Method (PDM), helping to visualize task sequences and dependencies.

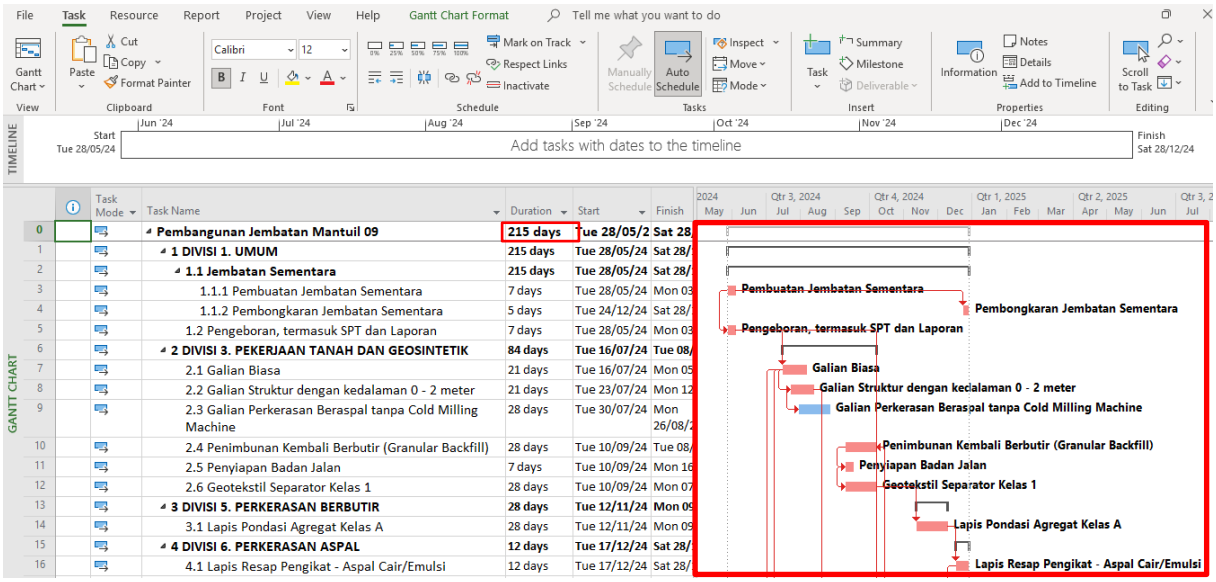

Figure 1. Baseline Schedule Simulation

B. Delay Simulation Delays occurred due to late delivery of Grade 345 structural steel and other logistical challenges. These delays affected several downstream tasks such as steel installation, concrete works, and pile driving.

After inputting the delay data, the updated simulation indicated an extended duration of 221 days, with a reduced number of critical tasks to 21, showing the impact of rescheduling.

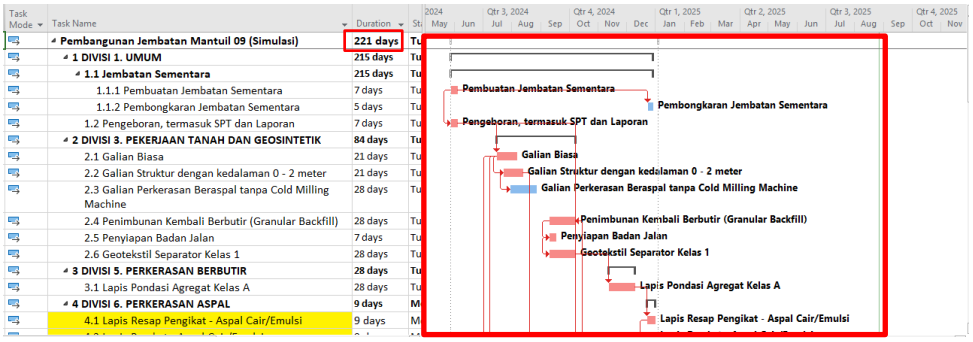

Figure 2. Delay Simulation

C. Delay Simulation Corrective Action Simulation

To mitigate the delay, the schedule was optimized through overtime and modified working hours on specific tasks. Adjustments were made on asphalt paving, concrete casting (fc'30 MPa), and pile driving tasks. Custom calendars were applied in Microsoft Project, resulting in reduced slack and restored overall duration to 215 days, matching the original plan.

1) Data Processing for Asphalt Work Delay Solution

- To address delays in the asphalt work, a custom calendar was created in Microsoft Project. This process involved clicking Project > Change Working Time, then selecting Create New Calendar (for example, named Aspal). Under the For Calendar option, the Work Weeks tab was modified to set a total of 17 working hours per day. The working days were also adjusted to align with the specific period of delay in the asphalt activity. This adjustment allowed the task to accelerate progress and recover the lost time within the project schedule.

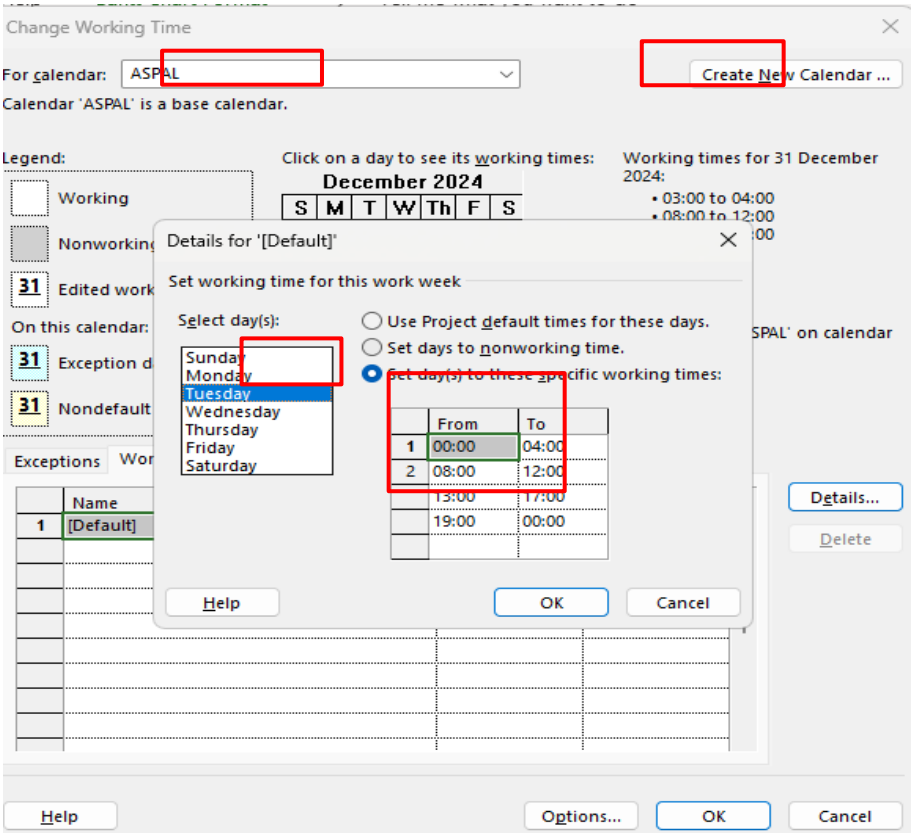

Figure 3. Asphalt Work – Days and Working Hours

- In the calendar settings, go to the Exceptions tab, then click Details. Under Working Times, set the Start date to *December 31, 2024*, and define the End After field according to the one-day overtime work schedule.

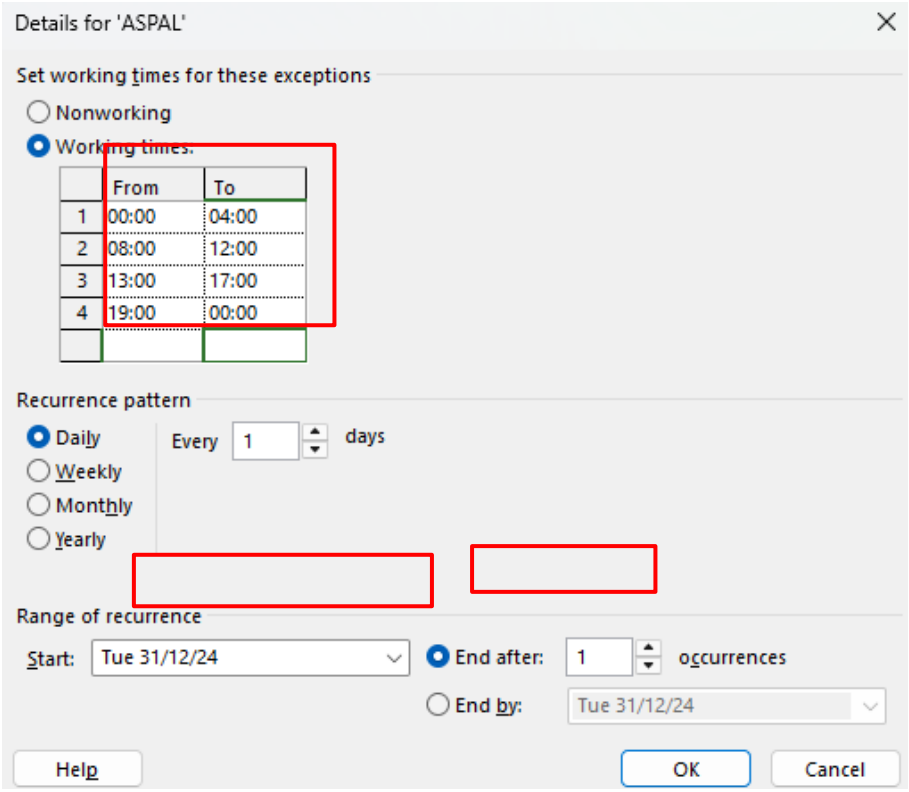

Figure 4. Overtime Calendar Settings for Asphalt Work

- To ensure the custom calendar settings take effect regardless of resource calendars, right-click on the asphalt task, select Information, go to the Advanced tab, and under Task Calendar, check the option “Scheduling ignores resource calendars.”

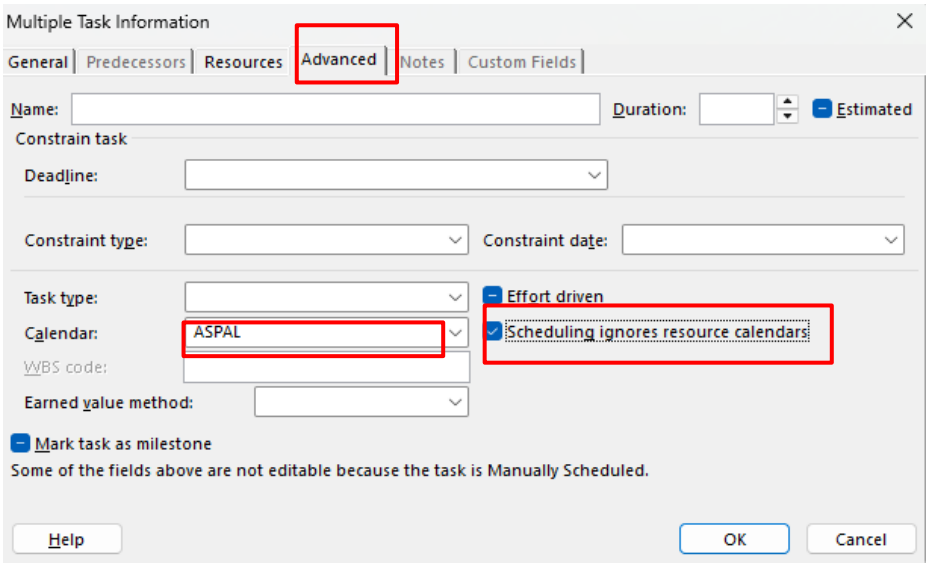

Figure 5. Assigning a Specific Calendar to the Asphalt Work Task

2) Solution Data Processing Procedure for Plain Reinforcement Steel Work (BjTP 280)

- Navigate to *Project* > *Change Working Time*, then create a new calendar (e.g., BjTP 280). Under *For Calendar*, go to *Work Weeks*, set the total working time to 11 hours per day, and adjust the working days based on the delay period of the BjTP 280 reinforcing steel work.

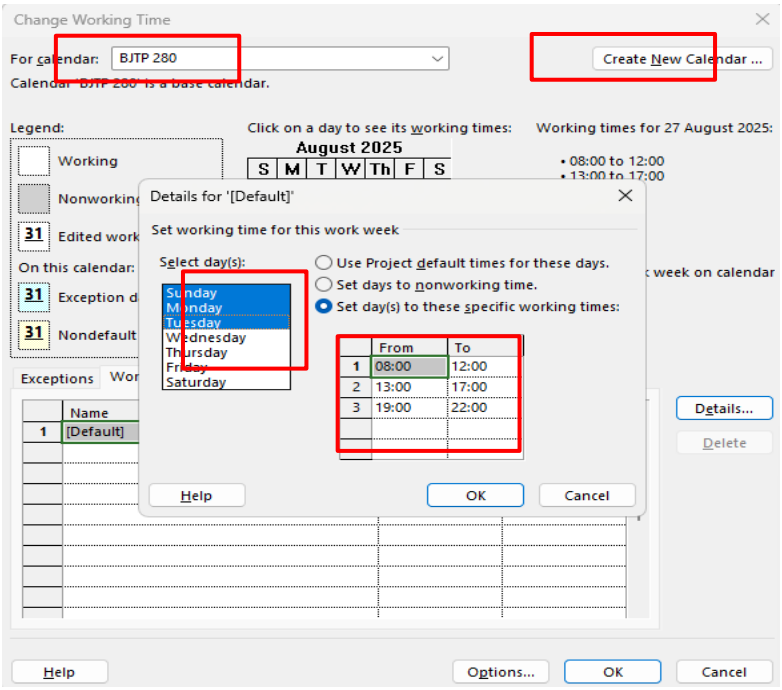

Figure 6. BjTP 280 Work – Days and Working Hours

- Go to the *Exceptions* tab, click *Details*, then under *Working Times*, set the Startdate to October 6, 2024. In the End After field, specify the number of days the overtime will last (for example, 3 days)

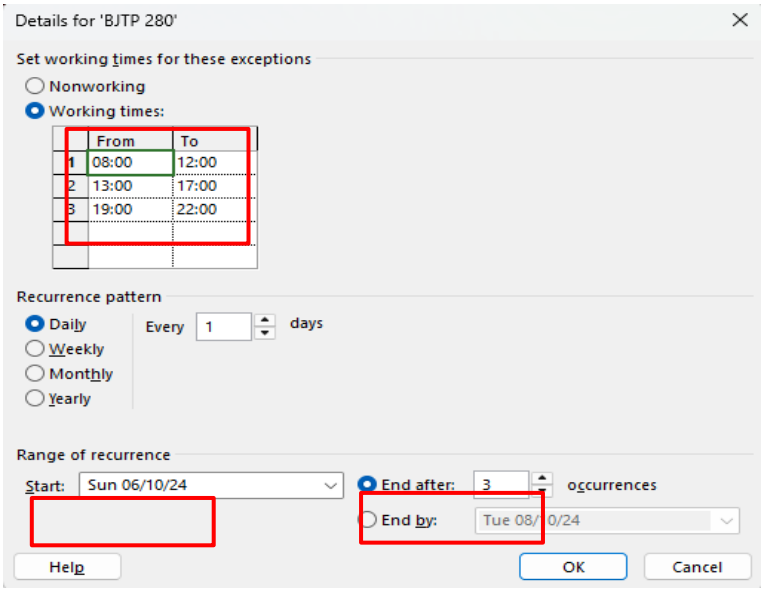

Figure 7. Overtime Calendar Settings for BjTP 280 Work

- Right-click on the BjTP 280 task > select Information > go to the Advanced tab > under Task Calendar, choose the appropriate calendar > check the option "Scheduling ignores resource calendars."

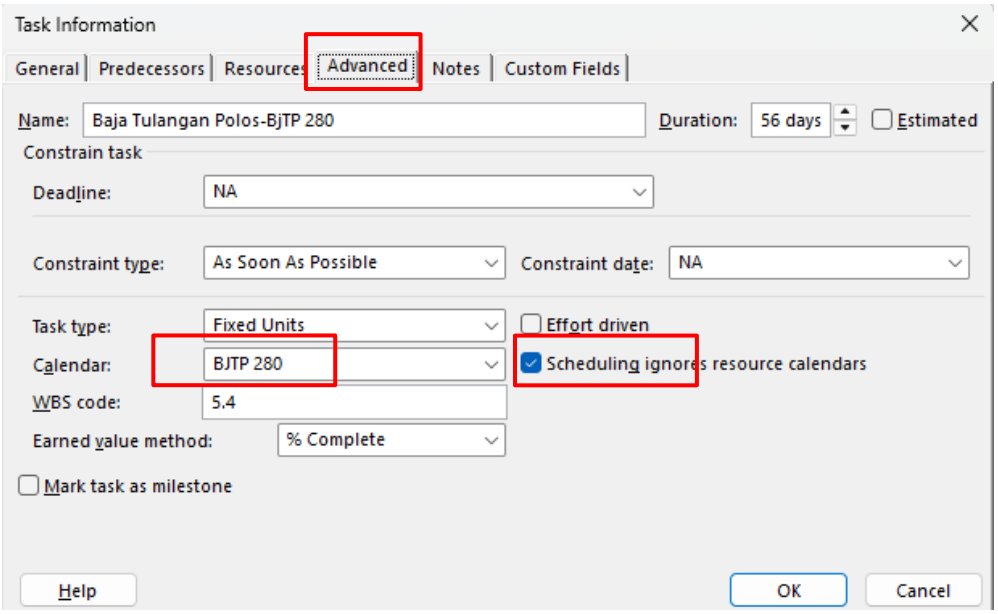

Figure 8. Assigning a Specific Calendar to the BjTP 280 Work Task

CONCLUSION

Based on the results of analysis, data processing, and discussion, the following conclusions can be drawn:

1. The total planned duration for the Mantuil 09 Bridge Construction Project, scheduled using Microsoft Project 2021, is 215 days. This reflects the estimated time if the project proceeds without delays. However, the actual (realized) project duration was 221 days, indicating a delay of 6 days.
2. The project consists of 46 activities. In the planned schedule, 27 tasks were identified as critical. In the realized (delayed) schedule, 21 tasks remained critical. After applying delay recovery simulations, only 13 critical tasks remained.

3. Delay recovery was simulated by applying overtime and adjusting working hours for specific tasks. For example: asphalt paving was given 1 day of overtime (17 working hours), FC'30 Mpa concrete (b) had 2 days of overtime (12 hours per day), FC'30 Mpa concrete (d) had 2 days of overtime (10 hours per day), BjTP 280 and BjTS 480B (a) had 3 days of overtime (11 hours per day), minipile work had 2 days (9 hours/day), and spun pile work had 2 days (10 hours/day). These adjustments aligned the delayed project duration with the original plan, ensuring that the overall project schedule remained unaffected by delays in specific activities.

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