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TIME DELAY ANALYSIS USING CRITICAL PATH METHOD (CPM)
(Case Study: Kerobokan Bali Parking Building Construction Project)

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Abstract

Parking Building is a structure specifically built for vehicle parking. Kerobokan Bali Parking Building is one such structure that utilizes steel as its main material. With dimensions of 13.97 meters in height, 32.8 meters in width, and 16.18 meters in length, this building had a planned construction duration of 259 calendar days starting from July 2023. The parking building experienced delays due to flooding in the basement area, necessitating time acceleration analysis using the CPM method. This thesis employs the CPM method to identify critical path activities. Once the critical paths are identified, a crashing program analysis will be conducted, involving an alternative such as overtime work with a duration of 4 hours. Based on the analysis using the CPM method, it was found that 75 activities are critical, listed in Microsoft Project rows 368-369-370-372-380-381-382-383-384-385-387-388-389-390-392-393-394-395-398-399-400-402-403-404-406-412-415-416-417-419-420-421-422-424-425-426-427-428-430-431-432-433-435-436-437-438-441-442-443-445-471-472-473-475-476-477-479-526-527-528-530-535-621-628-629-630-633-634-635-638-639-640-643-644.

Keywords: *Critical Path Method, Crashing Program, Overtime Work, Time Acceleration*

1. INTRODUCTION

A parking building is specifically constructed for vehicle parking, enabling efficient land use especially in downtown areas. Parking buildings can be combined with activity centers, where basement floors and several upper floors are used for parking, and above them are placed activity center buildings such as shops, offices, and other activity centers. The construction industry has varying characteristics from one construction project to another. These differing project characteristics will impact the progress of implementation work on-site. Progress on-site can experience delays, proceed as scheduled, or even be completed faster than planned. Therefore, effective management is crucial to plan and complete the project smoothly, known as project management (Abadiyah et al., 2020).

The Bali parking building is constructed using steel materials, with a length of 16.18 meters and a width of 32.8 meters, and a total building height of 13.97 meters. The planned construction duration for this parking building is 259 calendar days starting from July 23, 2023. However, as of March 2024, the project progress shows only 70%, still in the stage of wall plastering and constructing RAM for the access route to Global Xtreme office. The Planned Cost Budget (RAB) for the Bali Parking Building project is Rp 8,822,280,000.00. There has been a delay of 68 days in the project construction since early March. This delay was caused by flooding in the basement due to river water entering the project site. Excavation work reached a significant depth, allowing river

water to enter because the river surface is at an elevation of -2.85 meters, while the basement floor is at an elevation of -4.00 meters, hindering other work progress (Mulia & Candra, 2023).

Smooth cost flow and delays in the mobilization of equipment and building materials (Prabowo, 2020; Yaqin et al., 2023). Therefore, if there is a delay in the execution of work, it is necessary to expedite the work process to catch up on the delay (Jaya et al., 2019). Hence, an analysis of time acceleration methods is required to determine how long the project process can be completed and to explore the possibility of accelerating the project execution duration using the Critical Path Method (CPM) (Husna et al., 2022; Julian et al., 2023).

The Critical Path Method (CPM) is a network analysis that seeks to optimize the total project cost by reducing or accelerating the total project completion time (Astari et al., 2022; Aulia & Cipta, 2023). One of the methods applied for scheduling management analysis is the Critical Path Method (CPM) (Safitri et al., 2019). This method can depict a network of work, identify the sequence relationships of project tasks that must precede and follow each other in relation to time, and determine the criticality of a task (Khozinati, 2021; Maarif, 2021; Perdana & Rahman, 2019).

This study aims to analyze critical path activities within the context of the construction of the Kerobokan Bali Parking Building. It seeks to assess the impact of these critical activities on project duration and explore methods for accelerating project completion to mitigate time delays, focusing on the application of the Critical Path Method (CPM) and crashing program analysis. The study intends to provide recommendations for improving project management strategies to effectively address and minimize delays in construction projects.

2. LITERATURE REVIEW

2.1. Critical Path Method (CPM)

Critical Path Method (CPM) is used when the estimated processing time for each activity is well known, where deviations are relatively small or negligible (Abdurrasyid et al., 2019). Critical Path Method (CPM) is a technique used to carry out project planning using mathematical algorithms. In determining the duration of the project as a whole, it is done by counting forward and counting backward (Purwantoro et al., 2022; Santika et al., 2022; Siregar & Iffiginia, 2019).

2.2. Microsoft Project 2019

In this Anwar (2019) research, it has used the help of Microsoft Project 2019 software, here are the steps:

a. Tap 2x to open the Microsoft Project 2019 app.
b. To Create a Gantt Table

Select the task menu then click Gantt chart. Fill in the work definition of the work breakdown structure (WBS) that has been compiled in the Cost Budget Plan (RAB):

a) In the Task Name Column, fill in the name of the work / work item
b) In the Duration Column, fill in the length of work / work duration needed to

complete the work in days.

c) In the Start Column, fill in the date when the work item can be started
d) In the Finish Column, fill in the date when the work item has been completed. If the duration and start columns have been filled in, then the finish column will automatically be filled in.
e) Next, in the Predecessors column. Predecessors is a relationship activity between tasks/activities in a project, which means that if one task/activity changes in time, other tasks/activities will automatically change.
f) In the Recource Name column, fill in the name of the team member in charge of working on the project.

c. To determine working time

To determine holidays and working hours, select the Gantt Chart Format menu then select Change Working Time. Select Create New Calendar so that you can input holidays and adjust working hours in each company. Such as start time and end time. Input holidays through the Exceptions column, then adjust the days and dates of holidays according to calendar days. Then click Ok.

d. To create a Recource Sheet

Select the task menu then select Resource Sheet on the view toolbar. Fill in the team member's name, type (worker, cost or material). Then enter the wage/salary of each member, overtime pay and when the wage will be paid.

a) Indicator for the numbering sequence
b) Resource name to enter the name of the team member
c) Type to define whether the type of work (work), material (tools and materials used for the project) and cost (cost)
d) Material for defining the tools and materials used in the project
e) Initial to facilitate the initialization of the names of workers in the team
f) Group for placing team members into certain divisions
g) Max is used to determine the work achievements of members
h) Std. Rate is used to enter the wages or salaries of team members
i) Ovt. Rate is used to enter overtime wages or salaries
j) Cost is used to determine the total wages that workers will receive
k) Accrue is used for the time of giving wages
l) Base is used for the type of standard working time of 8 hours / day or shift

e. To create a Network Diagram

Select the network diagram menu to find out the flow of the project and the critical path.

2.3. Previous Research

Table 1. Previous Research

No	Researchers	Research Title	Research Methods	Research Results
1	2	3	4	5
11.	(Ulfa & Suhendar, 2021)	Implementation of Critical Path Method on Synthesis Residence Kemang Project	Critical Path Method	The results of calculations with the CPM method take 369 days at a cost of Rp. 62,852,324,528, - from the specified schedule of 484 days at a cost of Rp. 62,110,831,400.
12.	(Sutrisno, Audi, Pramudya, 2023)	Implementation of CPM, Crashing and PERT Methods on Scheduling of the Barokah Amanah Mustaqbal Mosque and Orphan Dormitory Construction Project	Critical Path Method & Program Evaluation And Review Technique	a. The PERT method resulted in a duration of: 86.7 days b. The CPM method takes 87 days. c. Crashing the maximum 8 days requires an increase in labor cost of 6.09%, amounting to Rp10,954,109.
13.	(Syaputra, 2019)	Analysis of Project Work Implementation Scheduling with CPM and PDM Methods on Road Improvement Sei Pakning (KM 130)-Teluk Masjid - Simpang Pusako Siak District	Critical Path Method & Precedence Diagramming Method	The number of activities on the critical path if calculated using the CPM method is 14 activities with the total duration obtained is 183 days while the PDM method has four constraints, namely SS, FF, FS and SF.
24.	(Akhir, 2019)	Crash Program Analysis Using Microsoft Project on Road Improvement SP. Lago-Sorek-I Pelalawan Regency	Crash Program	The direct cost of the project has increased from Rp8,337,708,810.24 in 153 days to Rp8,350,722,726.78 in 133 days (0.15% increase).

Source: Previous Research, 2024

3. RESEARCH METHODS

3.1. Research Procedure

The stages of this research are the stages that the research carried out in detail and sequentially during the research. Overall, the stages of this research aim to provide a general description of the steps of carrying out the research, which will direct it to be more precise during the research. The research steps are:

a. Literature Study
b. Data Collection
c. Data Analysis Using the CPM Method:
    a) Determine Each Activity
    b) Determine the Order of Activities
    c) Make a Network Diagram after the relationship between activities has been done.
    d) Estimated Project Completion Time
    e) Determine the Critical Path

4. RESULTS AND DISCUSSION

4.1. General Project Data

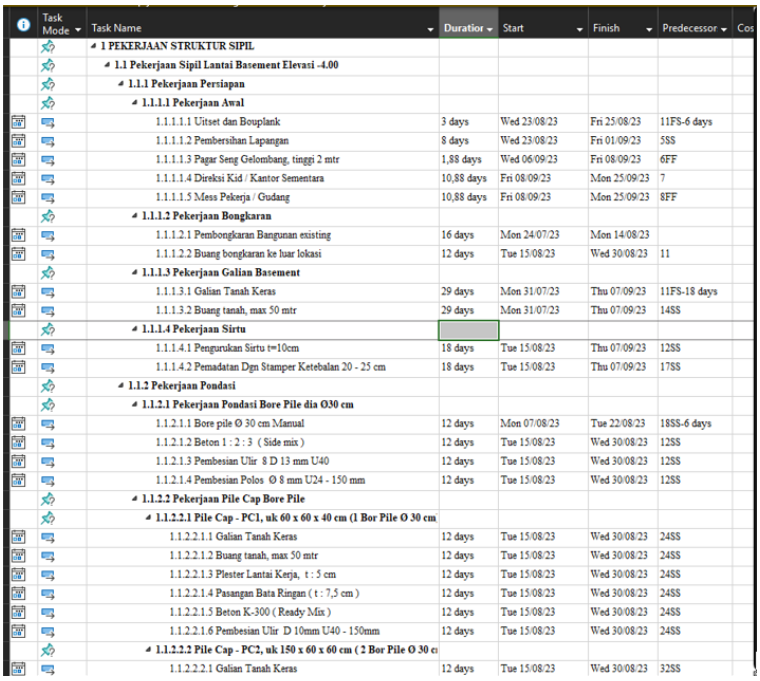
The basic principle of analysis using the CPM Method is the Critical Path Method (CPM) is a technique of analyzing the network of activities / activities when running a project in order to predict the total duration and can be done forward calculations and backward calculations so as to obtain a critical path and duration of implementation of the Kerobokan Bali Parking Building Project (Putra & Gandhi, 2019; Susilowati & Widayati, 2023). The location of the Kerobokan Bali Parking Building Project can be seen in Figure 1 as follows:

Source: Google Maps, 2024

Figure 1. Location of Kerobokan Bali Parking Building

4.2. Job Description

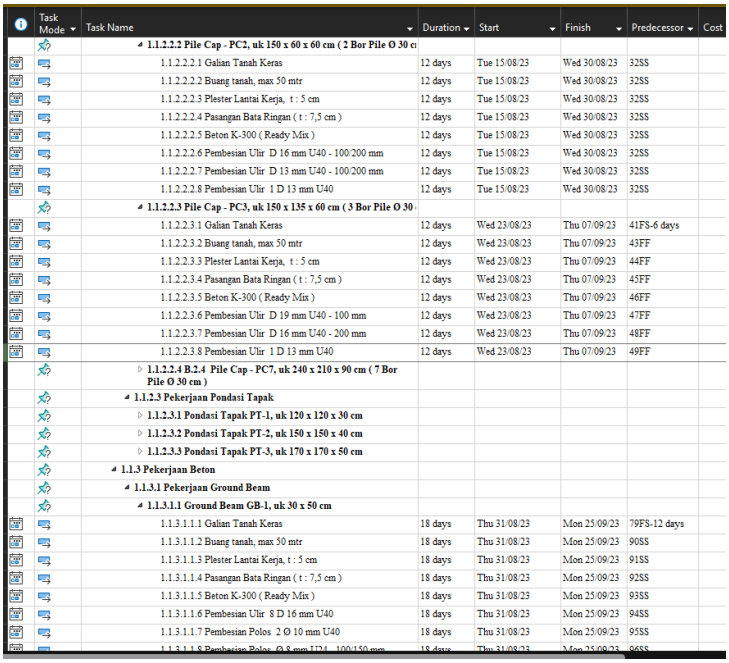
The scope of activities in the work of the Kerobokan Bali Parking Building Construction project that has been input into Microsoft Project 2019 can be seen in Figure 4.2 as follows:



Task Mode	Task Name	Duration	Start	Finish	Predecessor	Cos
	1 PEKERJAAN STRUKTUR SIPIL					
	1.1 Pekerjaan Sipil Lantai Basement Elevasi -4.00					
	1.1.1 Pekerjaan Persiapan					
	1.1.1.1 Pekerjaan Awal					
	1.1.1.1.1 Uitset dan Bouplank	3 days	Wed 23/08/23	Fri 25/08/23	11FS-6 days	
	1.1.1.1.2 Pembersihan Lapangan	8 days	Wed 23/08/23	Fri 01/09/23	5SS	
	1.1.1.1.3 Pagar Seng Gelombang, tinggi 2 mtr	1,88 days	Wed 06/09/23	Fri 08/09/23	6FF	
	1.1.1.1.4 Direksi Kid / Kantor Sementara	10,88 days	Fri 08/09/23	Mon 25/09/23	7	
	1.1.1.1.5 Mess Pekerja / Gudang	10,88 days	Fri 08/09/23	Mon 25/09/23	8FF	
	1.1.1.2 Pekerjaan Bongkaran					
	1.1.1.2.1 Pembongkaran Bangunan existing	16 days	Mon 24/07/23	Mon 14/08/23		
	1.1.1.2.2 Buang bongkaran ke luar lokasi	12 days	Tue 15/08/23	Wed 30/08/23	11	
	1.1.1.3 Pekerjaan Galian Basement					
	1.1.1.3.1 Galian Tanah Keras	29 days	Mon 31/07/23	Thu 07/09/23	11FS-18 days	
	1.1.1.3.2 Buang tanah, max 50 mtr	29 days	Mon 31/07/23	Thu 07/09/23	14SS	
	1.1.1.4 Pekerjaan Sirtu					
	1.1.1.4.1 Pengurukan Sirtu t=10cm	18 days	Tue 15/08/23	Thu 07/09/23	12SS	
	1.1.1.4.2 Pemadatan Dgn Stamper Ketebalan 20 - 25 cm	18 days	Tue 15/08/23	Thu 07/09/23	17SS	
	1.1.2 Pekerjaan Pondasi					
	1.1.2.1 Pekerjaan Pondasi Bore Pile dia Ø30 cm					
	1.1.2.1.1 Bore pile Ø 30 cm Manual	12 days	Mon 07/08/23	Tue 22/08/23	18SS-6 days	
	1.1.2.1.2 Beton 1 : 2 : 3 (Side mix)	12 days	Tue 15/08/23	Wed 30/08/23	12SS	
	1.1.2.1.3 Pembesian Ulir 8 D 13 mm U40	12 days	Tue 15/08/23	Wed 30/08/23	12SS	
	1.1.2.1.4 Pembesian Polos Ø 8 mm U24 - 150 mm	12 days	Tue 15/08/23	Wed 30/08/23	12SS	
	1.1.2.2 Pekerjaan Pile Cap Bore Pile					
	1.1.2.2.1 Pile Cap - PC1, uk 60 x 60 x 40 cm (1 Bor Pile Ø 30 cm					
	1.1.2.2.1.1 Galian Tanah Keras	12 days	Tue 15/08/23	Wed 30/08/23	24SS	
	1.1.2.2.1.2 Buang tanah, max 50 mtr	12 days	Tue 15/08/23	Wed 30/08/23	24SS	
	1.1.2.2.1.3 Plester Lantai Kerja, t : 5 cm	12 days	Tue 15/08/23	Wed 30/08/23	24SS	
	1.1.2.2.1.4 Pasangan Bata Ringan (t : 7,5 cm)	12 days	Tue 15/08/23	Wed 30/08/23	24SS	
	1.1.2.2.1.5 Beton K-300 (Ready Mix)	12 days	Tue 15/08/23	Wed 30/08/23	24SS	
	1.1.2.2.1.6 Pembesian Ulir D 10mm U40 - 150mm	12 days	Tue 15/08/23	Wed 30/08/23	24SS	
	1.1.2.2.2 Pile Cap - PC2, uk 150 x 60 x 60 cm (2 Bor Pile Ø 30 c					
	1.1.2.2.2.1 Galian Tanah Keras	12 days	Tue 15/08/23	Tue 15/08/23	32SS	

Source: Results of Data Analysis, 2024

Figure 2. Example of Activity List Floor - Basement



Task Mode	Task Name	Duration	Start	Finish	Predecessor	Cost
	1.1.2.2.2 Pile Cap - PC2, uk 150 x 60 x 60 cm (2 Bor Pile Ø 30 c					
	1.1.2.2.2.1 Galian Tanah Keras	12 days	Tue 15/08/23	Wed 30/08/23	32SS	
	1.1.2.2.2.2 Buang tanah, max 50 mtr	12 days	Tue 15/08/23	Wed 30/08/23	32SS	
	1.1.2.2.2.3 Plester Lantai Kerja, t : 5 cm	12 days	Tue 15/08/23	Wed 30/08/23	32SS	
	1.1.2.2.2.4 Pasangan Bata Ringan (t : 7,5 cm)	12 days	Tue 15/08/23	Wed 30/08/23	32SS	
	1.1.2.2.2.5 Beton K-300 (Ready Mix)	12 days	Tue 15/08/23	Wed 30/08/23	32SS	
	1.1.2.2.2.6 Pembesian Ulir D 16 mm U40 - 100/200 mm	12 days	Tue 15/08/23	Wed 30/08/23	32SS	
	1.1.2.2.2.7 Pembesian Ulir D 13 mm U40 - 100/200 mm	12 days	Tue 15/08/23	Wed 30/08/23	32SS	
	1.1.2.2.2.8 Pembesian Ulir 1 D 13 mm U40	12 days	Tue 15/08/23	Wed 30/08/23	32SS	
	1.1.2.2.3 Pile Cap - PC3, uk 150 x 135 x 60 cm (3 Bor Pile Ø 30					
	1.1.2.2.3.1 Galian Tanah Keras	12 days	Wed 23/08/23	Thu 07/09/23	41FS-6 days	
	1.1.2.2.3.2 Buang tanah, max 50 mtr	12 days	Wed 23/08/23	Thu 07/09/23	43FF	
	1.1.2.2.3.3 Plester Lantai Kerja, t : 5 cm	12 days	Wed 23/08/23	Thu 07/09/23	44FF	
	1.1.2.2.3.4 Pasangan Bata Ringan (t : 7,5 cm)	12 days	Wed 23/08/23	Thu 07/09/23	45FF	
	1.1.2.2.3.5 Beton K-300 (Ready Mix)	12 days	Wed 23/08/23	Thu 07/09/23	46FF	
	1.1.2.2.3.6 Pembesian Ulir D 19 mm U40 - 100 mm	12 days	Wed 23/08/23	Thu 07/09/23	47FF	
	1.1.2.2.3.7 Pembesian Ulir D 16 mm U40 - 200 mm	12 days	Wed 23/08/23	Thu 07/09/23	48FF	
	1.1.2.2.3.8 Pembesian Ulir 1 D 13 mm U40	12 days	Wed 23/08/23	Thu 07/09/23	49FF	
	1.1.2.2.4 B.2.4 Pile Cap - PC7, uk 240 x 210 x 90 cm (7 Bor Pile Ø 30 cm)					
	1.1.2.3 Pekerjaan Pondasi Tapak					
	1.1.2.3.1 Pondasi Tapak PT-1, uk 120 x 120 x 30 cm					
	1.1.2.3.2 Pondasi Tapak PT-2, uk 150 x 150 x 40 cm					
	1.1.2.3.3 Pondasi Tapak PT-3, uk 170 x 170 x 50 cm					
	1.1.3 Pekerjaan Beton					
	1.1.3.1 Pekerjaan Ground Beam					
	1.1.3.1.1 Ground Beam GB-1, uk 30 x 50 cm					
	1.1.3.1.1.1 Galian Tanah Keras	18 days	Thu 31/08/23	Mon 25/09/23	79FS-12 days	
	1.1.3.1.1.2 Buang tanah, max 50 mtr	18 days	Thu 31/08/23	Mon 25/09/23	90SS	
	1.1.3.1.1.3 Plester Lantai Kerja, t : 5 cm	18 days	Thu 31/08/23	Mon 25/09/23	91SS	
	1.1.3.1.1.4 Pasangan Bata Ringan (t : 7,5 cm)	18 days	Thu 31/08/23	Mon 25/09/23	92SS	
	1.1.3.1.1.5 Beton K-300 (Ready Mix)	18 days	Thu 31/08/23	Mon 25/09/23	93SS	
	1.1.3.1.1.6 Pembesian Ulir 8 D 16 mm U40	18 days	Thu 31/08/23	Mon 25/09/23	94SS	
	1.1.3.1.1.7 Pembesian Polos 2 Ø 10 mm U40	18 days	Thu 31/08/23	Mon 25/09/23	95SS	

Source: Results of Data Analysis, 2024

Figure 3. Example of Floor Activity List - Basement (Continued)

Task Mode	Task Name	Duration	Start	Finish	Predecessor	Cost
	1.1.3 Pekerjaan Beton					
	1.1.3.1 Pekerjaan Ground Beam					
	1.1.3.1.1 Ground Beam GB-1, uk 30 x 50 cm					
	1.1.3.1.1.1 Galian Tanah Keras	18 days	Thu 31/08/23	Mon 25/09/23	79FS-12 days	
	1.1.3.1.1.2 Buang tanah, max 50 mtr	18 days	Thu 31/08/23	Mon 25/09/23	90SS	
	1.1.3.1.1.3 Plester Lantai Kerja, t : 5 cm	18 days	Thu 31/08/23	Mon 25/09/23	91SS	
	1.1.3.1.1.4 Pasangan Bata Ringan (t : 7,5 cm)	18 days	Thu 31/08/23	Mon 25/09/23	92SS	
	1.1.3.1.1.5 Beton K-300 (Ready Mix)	18 days	Thu 31/08/23	Mon 25/09/23	93SS	
	1.1.3.1.1.6 Pembesian Ulir 8 D 16 mm U40	18 days	Thu 31/08/23	Mon 25/09/23	94SS	
	1.1.3.1.1.7 Pembesian Polos 2 Ø 10 mm U40	18 days	Thu 31/08/23	Mon 25/09/23	95SS	
	1.1.3.1.1.8 Pembesian Polos Ø 8 mm U24 - 100/150 mm	18 days	Thu 31/08/23	Mon 25/09/23	96SS	
	1.1.3.1.2 Ground Beam GB-2, uk 20 x 30 cm					
	1.1.3.1.2.1 Galian Tanah Keras	26 days	Thu 31/08/23	Thu 05/10/23	97SS	
	1.1.3.1.2.2 Buang tanah, max 50 mtr	26 days	Thu 31/08/23	Thu 05/10/23	99SS	
	1.1.3.1.2.3 Plester Lantai Kerja, t : 5 cm	26 days	Thu 31/08/23	Thu 05/10/23	100SS	
	1.1.3.1.2.4 Pasangan Bata Ringan (t : 7,5 cm)	26 days	Thu 31/08/23	Thu 05/10/23	101SS	
	1.1.3.1.2.5 Beton K-300 (Ready Mix)	26 days	Thu 31/08/23	Thu 05/10/23	102SS	
	1.1.3.1.2.6 Pembesian Ulir 8 D 13 mm U40	26 days	Thu 31/08/23	Thu 05/10/23	103SS	
	1.1.3.1.2.7 Pembesian Polos Ø 8 mm U24 - 100/150 mm	26 days	Thu 31/08/23	Thu 05/10/23	104SS	
	1.1.3.2 Pekerjaan Kolom Pedestal					
	1.1.3.2.1 Kolom Pedestal KP-1, uk. 35 x 65 cm					
	1.1.3.2.2 Kolom Pedestal KP-2, uk. 35 x 55 cm					
	1.1.3.2.3 Kolom Pedestal KP-3, uk. 35 x 35 cm					
	1.1.3.2.4 Kolom Pedestal KP-3, uk. 30 x 30 cm					
	1.1.3.3 Pekerjaan Kolom Komposit					
	1.1.3.3.1 Kolom Komposite KK-1, uk. 35 x 65 cm					
	1.1.3.3.2 Kolom Komposite KK-2, uk. 35 x 55 cm					
	1.1.3.3.3 Kolom Komposite KK-3, uk. 35 x 35 cm					
	1.1.3.3.4 Kolom Komposite KK-4, uk. 30 x 30 cm					
	1.1.3.4 Pekerjaan Plat Lantai Beton Bertulang					
	1.1.3.4.1 Plat Lantai S-1, t : 15 cm					
	1.1.3.4.2 Plat Lantai S-2, t : 10 cm					
	1.1.3.4.2.1 Beton K-300 (Ready Mix)	12 days	Mon 20/11/23	Tue 05/12/23	165FF	
	1.1.3.4.2.2 Wiremash M-6 (Double Layer)	12 days	Mon 20/11/23	Tue 05/12/23	167FF	

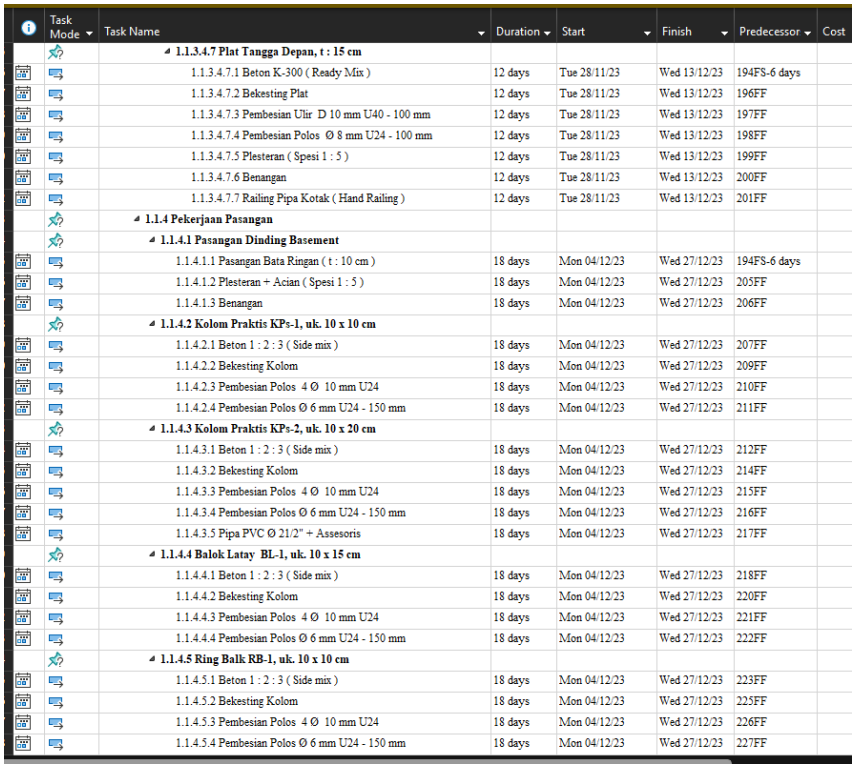
Source: Results of Data Analysis, 2024

Figure 4 Example of Floor Activity List - Basement (Continued)

Task Mode	Task Name	Duration	Start	Finish	Predecessor	Cost
	1.1.3.4.1 Plat Lantai S-1, t : 15 cm					
	1.1.3.4.2 Plat Lantai S-2, t : 10 cm					
	1.1.3.4.2.1 Beton K-300 (Ready Mix)	12 days	Mon 20/11/23	Tue 05/12/23	165FF	
	1.1.3.4.2.2 Wiremash M-6 (Double Layer)	12 days	Mon 20/11/23	Tue 05/12/23	167FF	
	1.1.3.4.2.3 Plastik cor	12 days	Mon 20/11/23	Tue 05/12/23	168FF	
	1.1.3.4.2.4 Floorhardener (5 kg / m2)	12 days	Mon 20/11/23	Tue 05/12/23	169FF	
	1.1.3.4.3 Plat Lantai S-3A, t : 10 cm (Layer Dasar)					
	1.1.3.4.3.1 Beton K-300 (Ready Mix)	12 days	Mon 20/11/23	Tue 05/12/23	170FF	
	1.1.3.4.3.2 Wiremash M-6 (Single Layer)	12 days	Mon 20/11/23	Tue 05/12/23	172FF	
	1.1.3.4.3.3 Plastik cor	12 days	Mon 20/11/23	Tue 05/12/23	173FF	
	1.1.3.4.3.4 Waterproofing Integral 2,0 ltr / M3	12 days	Mon 20/11/23	Tue 05/12/23	174FF	
	1.1.3.4.4 Plat Lantai S-3B, t : 10 cm (Layer Atas)					
	1.1.3.4.4.1 Beton K-300 (Ready Mix)	12 days	Mon 20/11/23	Tue 05/12/23	175FF	
	1.1.3.4.4.2 Wiremash M-6 (Single Layer)	12 days	Mon 20/11/23	Tue 05/12/23	177FF	
	1.1.3.4.4.3 Pengecatan Waterproofing (Cat Saja)	12 days	Mon 20/11/23	Tue 05/12/23	178FF	
	1.1.3.4.4.4 Karung Goni	12 days	Mon 20/11/23	Tue 05/12/23	179FF	
	1.1.3.4.4.5 Floorhardener (5 kg / m2)	12 days	Mon 20/11/23	Tue 05/12/23	180FF	
	1.1.3.4.4.6 Dilatasi Lantai + Sealent	12 days	Mon 20/11/23	Tue 05/12/23	181FF	
	1.1.3.4.5 Pekerjaan Ramp, t. 15 cm					
	1.1.3.4.5.1 Beton K-300 (Ready Mix)	30 days	Wed 25/10/23	Tue 05/12/23	182SS-18 days	
	1.1.3.4.5.2 Wiremash M-6 (Double Layer)	30 days	Wed 25/10/23	Tue 05/12/23	184FF	
	1.1.3.4.5.3 Floorhardener (5 kg / m2)	30 days	Wed 25/10/23	Tue 05/12/23	185FF	
	1.1.3.4.5.4 Garis Sersan (groove line)/tali air	30 days	Wed 25/10/23	Tue 05/12/23	186FF	
	1.1.3.4.6 Pekerjaan Dinding Retaining Wall W-1, t : 15 cm					
	1.1.3.4.6.1 Beton K-300 (Ready Mix)	32 days	Mon 23/10/23	Tue 05/12/23	187FF	
	1.1.3.4.6.2 Pasangan Bata Ringan (t : 7,5 cm)	32 days	Mon 23/10/23	Tue 05/12/23	189FF	
	1.1.3.4.6.3 Bekesting Plat	32 days	Mon 23/10/23	Tue 05/12/23	190FF	
	1.1.3.4.6.4 Pembesian Ulir	32 days	Mon 23/10/23	Tue 05/12/23	191FF	
	1.1.3.4.6.5 Plesteran + Acian (Spesi 1 : 5)	32 days	Mon 23/10/23	Tue 05/12/23	192FF	
	1.1.3.4.6.6 Waterproofing Integral 2,0 ltr / M3	32 days	Mon 23/10/23	Tue 05/12/23	193FF	
	1.1.3.4.7 Plat Tangga Depan, t : 15 cm					
	1.1.3.4.7.1 Beton K-300 (Ready Mix)	12 days	Tue 28/11/23	Wed 13/12/23	194FS-6 days	
	1.1.3.4.7.2 Bekesting Plat	12 days	Tue 28/11/23	Wed 13/12/23	196FF	
	1.1.3.4.7.3 Pembesian Ulir D 10 mm U40 - 100 mm	12 days	Tue 28/11/23	Wed 13/12/23	197FF	

Source: Results of Data Analysis, 2024

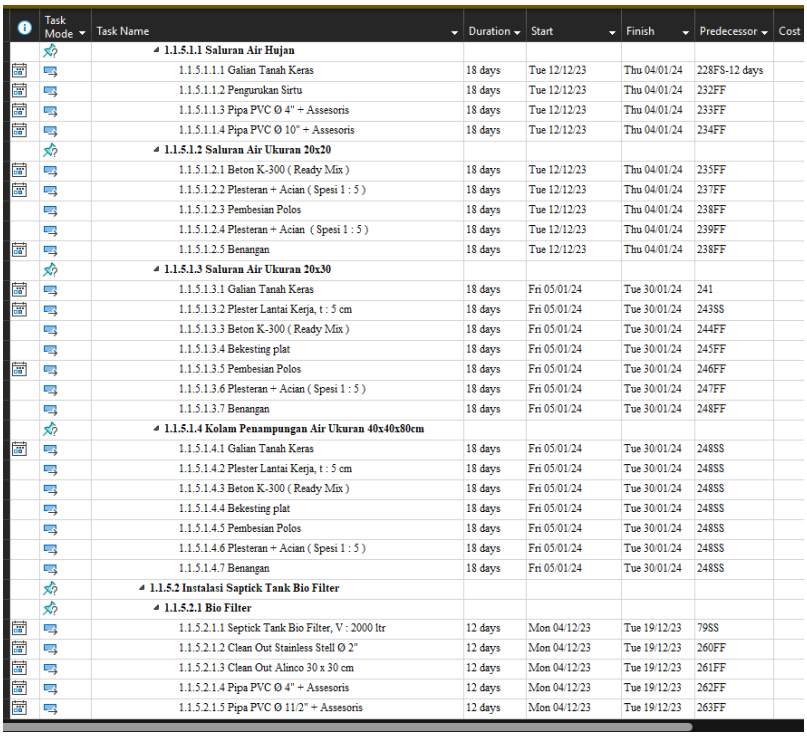
Figure 5. Example of Floor Activity List - Basement (Continued)



Task Mode	Task Name	Duration	Start	Finish	Predecessor	Cost
	1.1.3.4.7 Plat Tangga Depan, t : 15 cm					
	1.1.3.4.7.1 Beton K-300 (Ready Mix)	12 days	Tue 28/11/23	Wed 13/12/23	194FS-6 days	
	1.1.3.4.7.2 Bekesting Plat	12 days	Tue 28/11/23	Wed 13/12/23	196FF	
	1.1.3.4.7.3 Pembesian Ulir D 10 mm U40 - 100 mm	12 days	Tue 28/11/23	Wed 13/12/23	197FF	
	1.1.3.4.7.4 Pembesian Polos Ø 8 mm U24 - 100 mm	12 days	Tue 28/11/23	Wed 13/12/23	198FF	
	1.1.3.4.7.5 Plesteran (Spesi 1 : 5)	12 days	Tue 28/11/23	Wed 13/12/23	199FF	
	1.1.3.4.7.6 Benangan	12 days	Tue 28/11/23	Wed 13/12/23	200FF	
	1.1.3.4.7.7 Railing Pipa Kotak (Hand Railing)	12 days	Tue 28/11/23	Wed 13/12/23	201FF	
	1.1.4 Pekerjaan Pasangan					
	1.1.4.1 Pasangan Dinding Basement					
	1.1.4.1.1 Pasangan Bata Ringan (t : 10 cm)	18 days	Mon 04/12/23	Wed 27/12/23	194FS-6 days	
	1.1.4.1.2 Plesteran + Acian (Spesi 1 : 5)	18 days	Mon 04/12/23	Wed 27/12/23	205FF	
	1.1.4.1.3 Benangan	18 days	Mon 04/12/23	Wed 27/12/23	206FF	
	1.1.4.2 Kolom Praktis KPs-1, uk. 10 x 10 cm					
	1.1.4.2.1 Beton 1 : 2 : 3 (Side mix)	18 days	Mon 04/12/23	Wed 27/12/23	207FF	
	1.1.4.2.2 Bekesting Kolom	18 days	Mon 04/12/23	Wed 27/12/23	209FF	
	1.1.4.2.3 Pembesian Polos 4 Ø 10 mm U24	18 days	Mon 04/12/23	Wed 27/12/23	210FF	
	1.1.4.2.4 Pembesian Polos Ø 6 mm U24 - 150 mm	18 days	Mon 04/12/23	Wed 27/12/23	211FF	
	1.1.4.3 Kolom Praktis KPs-2, uk. 10 x 20 cm					
	1.1.4.3.1 Beton 1 : 2 : 3 (Side mix)	18 days	Mon 04/12/23	Wed 27/12/23	212FF	
	1.1.4.3.2 Bekesting Kolom	18 days	Mon 04/12/23	Wed 27/12/23	214FF	
	1.1.4.3.3 Pembesian Polos 4 Ø 10 mm U24	18 days	Mon 04/12/23	Wed 27/12/23	215FF	
	1.1.4.3.4 Pembesian Polos Ø 6 mm U24 - 150 mm	18 days	Mon 04/12/23	Wed 27/12/23	216FF	
	1.1.4.3.5 Pipa PVC Ø 21/2" + Assesoris	18 days	Mon 04/12/23	Wed 27/12/23	217FF	
	1.1.4.4 Balok Latay BL-1, uk. 10 x 15 cm					
	1.1.4.4.1 Beton 1 : 2 : 3 (Side mix)	18 days	Mon 04/12/23	Wed 27/12/23	218FF	
	1.1.4.4.2 Bekesting Kolom	18 days	Mon 04/12/23	Wed 27/12/23	220FF	
	1.1.4.4.3 Pembesian Polos 4 Ø 10 mm U24	18 days	Mon 04/12/23	Wed 27/12/23	221FF	
	1.1.4.4.4 Pembesian Polos Ø 6 mm U24 - 150 mm	18 days	Mon 04/12/23	Wed 27/12/23	222FF	
	1.1.4.5 Ring Balk RB-1, uk. 10 x 10 cm					
	1.1.4.5.1 Beton 1 : 2 : 3 (Side mix)	18 days	Mon 04/12/23	Wed 27/12/23	223FF	
	1.1.4.5.2 Bekesting Kolom	18 days	Mon 04/12/23	Wed 27/12/23	225FF	
	1.1.4.5.3 Pembesian Polos 4 Ø 10 mm U24	18 days	Mon 04/12/23	Wed 27/12/23	226FF	
	1.1.4.5.4 Pembesian Polos Ø 6 mm U24 - 150 mm	18 days	Mon 04/12/23	Wed 27/12/23	227FF	

Source: Results of Data Analysis, 2024

Figure 6. Example of Floor Activity List - Basement (Continued)



Task Mode	Task Name	Duration	Start	Finish	Predecessor	Cost
	1.1.5.1.1 Saluran Air Hujan					
	1.1.5.1.1.1 Galian Tanah Keras	18 days	Tue 12/12/23	Thu 04/01/24	228FS-12 days	
	1.1.5.1.1.2 Pengurukan Sirtu	18 days	Tue 12/12/23	Thu 04/01/24	232FF	
	1.1.5.1.1.3 Pipa PVC Ø 4" + Assesoris	18 days	Tue 12/12/23	Thu 04/01/24	233FF	
	1.1.5.1.1.4 Pipa PVC Ø 10" + Assesoris	18 days	Tue 12/12/23	Thu 04/01/24	234FF	
	1.1.5.1.2 Saluran Air Ukuran 20x20					
	1.1.5.1.2.1 Beton K-300 (Ready Mix)	18 days	Tue 12/12/23	Thu 04/01/24	235FF	
	1.1.5.1.2.2 Plesteran + Acian (Spesi 1 : 5)	18 days	Tue 12/12/23	Thu 04/01/24	237FF	
	1.1.5.1.2.3 Pembesian Polos	18 days	Tue 12/12/23	Thu 04/01/24	238FF	
	1.1.5.1.2.4 Plesteran + Acian (Spesi 1 : 5)	18 days	Tue 12/12/23	Thu 04/01/24	239FF	
	1.1.5.1.2.5 Benangan	18 days	Tue 12/12/23	Thu 04/01/24	238FF	
	1.1.5.1.3 Saluran Air Ukuran 20x30					
	1.1.5.1.3.1 Galian Tanah Keras	18 days	Fri 05/01/24	Tue 30/01/24	241	
	1.1.5.1.3.2 Plester Lantai Kerja, t : 5 cm	18 days	Fri 05/01/24	Tue 30/01/24	243SS	
	1.1.5.1.3.3 Beton K-300 (Ready Mix)	18 days	Fri 05/01/24	Tue 30/01/24	244FF	
	1.1.5.1.3.4 Bekesting plat	18 days	Fri 05/01/24	Tue 30/01/24	245FF	
	1.1.5.1.3.5 Pembesian Polos	18 days	Fri 05/01/24	Tue 30/01/24	246FF	
	1.1.5.1.3.6 Plesteran + Acian (Spesi 1 : 5)	18 days	Fri 05/01/24	Tue 30/01/24	247FF	
	1.1.5.1.3.7 Benangan	18 days	Fri 05/01/24	Tue 30/01/24	248FF	
	1.1.5.1.4 Kolam Penampungan Air Ukuran 40x40x80cm					
	1.1.5.1.4.1 Galian Tanah Keras	18 days	Fri 05/01/24	Tue 30/01/24	248SS	
	1.1.5.1.4.2 Plester Lantai Kerja, t : 5 cm	18 days	Fri 05/01/24	Tue 30/01/24	248SS	
	1.1.5.1.4.3 Beton K-300 (Ready Mix)	18 days	Fri 05/01/24	Tue 30/01/24	248SS	
	1.1.5.1.4.4 Bekesting plat	18 days	Fri 05/01/24	Tue 30/01/24	248SS	
	1.1.5.1.4.5 Pembesian Polos	18 days	Fri 05/01/24	Tue 30/01/24	248SS	
	1.1.5.1.4.6 Plesteran + Acian (Spesi 1 : 5)	18 days	Fri 05/01/24	Tue 30/01/24	248SS	
	1.1.5.1.4.7 Benangan	18 days	Fri 05/01/24	Tue 30/01/24	248SS	
	1.1.5.2 Instalasi Saptick Tank Bio Filter					
	1.1.5.2.1 Bio Filter					
	1.1.5.2.1.1 Septick Tank Bio Filter, V : 2000 ltr	12 days	Mon 04/12/23	Tue 19/12/23	79SS	
	1.1.5.2.1.2 Clean Out Stainless Stell Ø 2"	12 days	Mon 04/12/23	Tue 19/12/23	260FF	
	1.1.5.2.1.3 Clean Out Alinco 30 x 30 cm	12 days	Mon 04/12/23	Tue 19/12/23	261FF	
	1.1.5.2.1.4 Pipa PVC Ø 4" + Assesoris	12 days	Mon 04/12/23	Tue 19/12/23	262FF	
	1.1.5.2.1.5 Pipa PVC Ø 11/2" + Assesoris	12 days	Mon 04/12/23	Tue 19/12/23	263FF	

Source: Results of Data Analysis, 2024

Figure 7. Example of Floor Activity List - Basement (Continued)

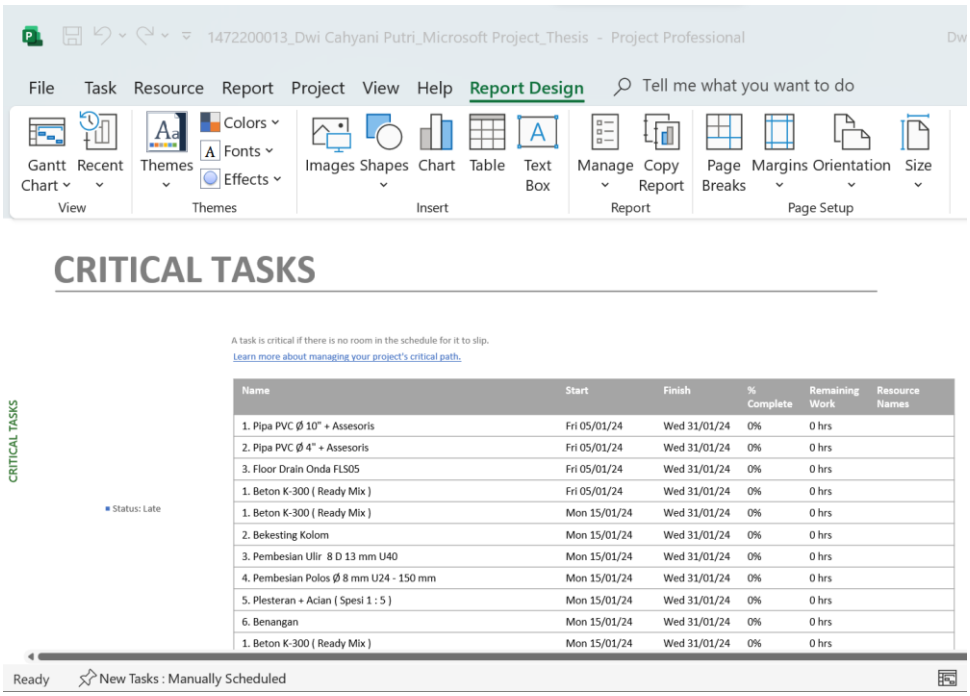
Task Mode	Task Name	Duration	Start	Finish	Predecessor	Cost
	1.1.5.2 Instalasi Saptick Tank Bio Filter					
	1.1.5.2.1 Bio Filter					
	1.1.5.2.1.1 Septick Tank Bio Filter, V : 2000 ltr	12 days	Mon 04/12/23	Tue 19/12/23	79SS	
	1.1.5.2.1.2 Clean Out Stainless Stell Ø 2"	12 days	Mon 04/12/23	Tue 19/12/23	260FF	
	1.1.5.2.1.3 Clean Out Alinco 30 x 30 cm	12 days	Mon 04/12/23	Tue 19/12/23	261FF	
	1.1.5.2.1.4 Pipa PVC Ø 4" + Assesoris	12 days	Mon 04/12/23	Tue 19/12/23	262FF	
	1.1.5.2.1.5 Pipa PVC Ø 11/2" + Assesoris	12 days	Mon 04/12/23	Tue 19/12/23	263FF	
	1.1.5.2.1.6 Pipa PVC Ø 11/2" + Assesoris	12 days	Mon 04/12/23	Tue 19/12/23	264FF	
	1.1.5.2.1.7 Pasangan Bata 1 Batu (Spesi 1 : 5)	12 days	Mon 04/12/23	Tue 19/12/23	265FF	
	1.1.5.2.1.8 Galian Tanah Keras	12 days	Mon 04/12/23	Tue 19/12/23	266FF	
	1.1.5.2.1.9 Buang tanah, max 50 mtr	12 days	Mon 04/12/23	Tue 19/12/23	267FF	
	1.1.5.2.1.10 Beton K-300 (Ready Mix)	12 days	Mon 04/12/23	Tue 19/12/23	268FF	
	1.1.5.2.1.11 Bekesting Pondasi	12 days	Mon 04/12/23	Tue 19/12/23	269FF	
	1.1.5.2.1.12 Pembesian Polos Ø 10 mm U24 - 100 mm	12 days	Mon 04/12/23	Tue 19/12/23	270FF	
	1.1.5.2.2 Sumur Resapan					
	1.1.5.2.2.1 Galian Tanah Keras	12 days	Mon 04/12/23	Tue 19/12/23	271FF	
	1.1.5.2.2.2 Buang tanah, max 50 mtr	12 days	Mon 04/12/23	Tue 19/12/23	273SS	
	1.1.5.2.2.3 Sumuran Dia 100 Cm	12 days	Mon 04/12/23	Tue 19/12/23	274SS	
	1.1.5.2.2.4 Beton K-300 (Ready Mix)	12 days	Mon 04/12/23	Tue 19/12/23	275SS	
	1.1.5.2.2.5 Bekesting Pondasi	12 days	Mon 04/12/23	Tue 19/12/23	276SS	
	1.1.5.2.2.6 Pembesian Polos Ø 10 mm U24 - 100 mm	12 days	Mon 04/12/23	Tue 19/12/23	277SS	
	1.1.5.2.2.7 Clean Out Alinco 30 x 30 cm	12 days	Mon 04/12/23	Tue 19/12/23	278SS	
	1.1.5.3 Instalasi Air Kotor					
	1.1.5.3.1 Pipa PVC Ø 4" + Assesoris	12 days	Mon 04/12/23	Tue 19/12/23	205SS	
	1.1.5.3.2 Pipa PVC Ø 3" + Assesoris	12 days	Mon 04/12/23	Tue 19/12/23	281SS	
	1.1.5.3.3 Pipa PVC Ø 1" + Assesoris	12 days	Mon 04/12/23	Tue 19/12/23	282SS	
	1.1.5.4 Aksesoris Sanitary					
	1.1.5.4.1 Klosed Duduk Toto CW421 / CW660	12 days	Mon 04/12/23	Tue 19/12/23	283SS	
	1.1.5.4.2 Shower Spray Toto TX403SB	12 days	Mon 04/12/23	Tue 19/12/23	285SS	
	1.1.5.4.3 Kran air engkol Onda	12 days	Mon 04/12/23	Tue 19/12/23	286SS	
	1.1.5.4.4 Floor Drain Onda FLS05	12 days	Mon 04/12/23	Tue 19/12/23	287SS	

Source: Results of Data Analysis, 2024

Figure 8. Example of Floor Activity List - Basement (Continued)

4.3. Critical Path Activities

Of all project activities, the only activities that can be crashed are those on the critical trajectory. In this study, the critical path was obtained using the Microsoft Project 2019 program, see Figure 9 as follows:



Source: Results of Data Analysis, 2024

Figure 9. Critical Path Activities

Figure 9 is only part of the activities that are included in the critical trajectory obtained from Microsoft Project. Activities included in other critical trajectories will be presented in table 2 as follows:

Table 2. List of Critical Path Activities

No.	Job Name	Start	Finish
1	Pipes PVC Ø 10" + Accessories	Fri 05/01/24	Wed 31/01/24
2	Pipes PVC Ø 4" + Accessories	Fri 05/01/24	Wed 31/01/24
3	Floor Drain Onda FLS05	Fri 05/01/24	Wed 31/01/24
4	Concrete K-300 (Ready Mix)	Fri 05/01/24	Wed 31/01/24
5	Concrete K-300 (Ready Mix)	Mon 15/01/24	Wed 31/01/24
6	Column Formwork	Mon 15/01/24	Wed 31/01/24
7	Screw Fixing 8 D 13 mm U40	Mon 15/01/24	Wed 31/01/24
8	Plain Castings Ø 8 mm U24 - 150 mm	Mon 15/01/24	Wed 31/01/24
9	Plastering + Shavings (*acian*) (Mix 1: 5)	Mon 15/01/24	Wed 31/01/24
10	Plastering and Smoothing (*Benangan*)	Mon 15/01/24	Wed 31/01/24
11	Concrete K-300 (Ready Mix)	Mon 15/01/24	Wed 31/01/24
12	Column Formwork	Mon 15/01/24	Wed 31/01/24
13	Screw Fixing 6 D 13 mm U40	Mon 15/01/24	Wed 31/01/24
14	Plain Fixing Ø 8 mm U24 - 150 mm	Mon 15/01/24	Wed 31/01/24
15	Concrete K-300 (Ready Mix)	Mon 15/01/24	Wed 31/01/24
16	Column Formwork	Mon 15/01/24	Wed 31/01/24
17	Screw Fixing 4 D 13 mm U40	Mon 15/01/24	Wed 31/01/24
18	Plain Fixing Ø 8 mm U24 - 150 mm	Mon 15/01/24	Wed 31/01/24
19	Concrete K-300 (Ready Mix)	Tue 23/01/24	Thu 08/02/24

No.	Job Name	Start	Finish
9	Plastering + Shavings (*acian*) (Mix 1: 5)	Mon 15/01/24	Wed 31/01/24
10	Plastering and Smoothing (*Benangan*)	Mon 15/01/24	Wed 31/01/24
11	Concrete K-300 (Ready Mix)	Mon 15/01/24	Wed 31/01/24
12	Column Formwork	Mon 15/01/24	Wed 31/01/24
13	Screw Fixing 6 D 13 mm U40	Mon 15/01/24	Wed 31/01/24
20	Floor hardener (5 kg / m2)	Tue 23/01/24	Thu 08/02/24
21	Finish Trowel Machine	Tue 23/01/24	Thu 08/02/24
22	Beton K-300 (Ready Mix)	Tue 23/01/24	Thu 08/02/24
23	Floor hardener (5 kg / m2)	Tue 23/01/24	Thu 08/02/24
24	Sergeant Line Sergeant Line (groove line)/ water rope	Tue 23/01/24	Thu 08/02/24
25	Concrete K-300 (Ready Mix)	Tue 23/01/24	Thu 08/02/24
26	Box Pipe Railing	Tue 23/01/24	Thu 08/02/24

Source: Microsoft Project Analyzed Data, 2024

Table 2. List of Critical Path Activities (Continued)

No.	Job Name	Start	Finish
27	Lightweight Brick Masonry (t : 10 cm)	Wed 31/01/24	Mon 26/02/24
28	Plastering + Shavings (*acian*) (Mix 1: 5)	Wed 31/01/24	Mon 26/02/24
29	Plastering and Smoothing (*Benangan*)	Wed 31/01/24	Mon 26/02/24
30	Concrete 1 : 2 : 3 (Side mix)	Wed 31/01/24	Mon 26/02/24
31	Column Formwork	Wed 31/01/24	Mon 26/02/24
32	Plain Castings 4 Ø 10 mm U24	Wed 31/01/24	Mon 26/02/24
33	Plain Castings Ø 6 mm U24 - 150 mm	Wed 31/01/24	Mon 26/02/24
34	Concrete 1 : 2 : 3 (Side mix)	Wed 31/01/24	Mon 26/02/24
35	Column Formwork	Wed 31/01/24	Mon 26/02/24
36	Plain Castings 4 Ø 10 mm U24	Wed 31/01/24	Mon 26/02/24

No.	Job Name	Start	Finish
37	Plain Castings Ø 6 mm U24 - 150 mm	Wed 31/01/24	Mon 26/02/24
38	Pipes PVC Ø 21/2" + Accessories	Wed 31/01/24	Mon 26/02/24
39	Concrete 1 : 2 : 3 (Side mix)	Fri 16/02/24	Mon 26/02/24
40	Column Formwork	Fri 16/02/24	Mon 26/02/24
41	Plain Castings 4 Ø 10 mm U24	Fri 16/02/24	Mon 26/02/24
42	Plain Castings Ø 6 mm U24 - 150 mm	Fri 16/02/24	Mon 26/02/24
43	Concrete 1 : 2 : 3 (Side mix)	Thu 08/02/24	Mon 26/02/24
44	Column Formwork	Thu 08/02/24	Mon 26/02/24
45	Plain Castings 4 Ø 10 mm U24	Thu 08/02/24	Mon 26/02/24
46	Plain Castings Ø 6 mm U24 - 150 mm	Thu 08/02/24	Mon 26/02/24
47	Pipes PVC Ø 10" + Accessories	Wed 31/01/24	Mon 26/02/24
48	Pipes PVC Ø 4" + Accessories	Wed 31/01/24	Mon 26/02/24
49	Floor Drain Onda FLS05	Wed 31/01/24	Mon 26/02/24
50	Concrete K-300 (Ready Mix)	Wed 31/01/24	Mon 26/02/24
51	Concrete K-300 (Ready Mix)	Wed 31/01/24	Fri 16/02/24
52	Floor hardener (5 kg / m2)	Wed 31/01/24	Fri 16/02/24
53	Finish Trowel Machine	Wed 31/01/24	Fri 16/02/24
54	Beton K-300 (Ready Mix)	Wed 31/01/24	Fri 16/02/24
55	Floor hardener (5 kg / m2)	Wed 31/01/24	Fri 16/02/24
56	Sergeant Line (groove line) / water rope	Wed 31/01/24	Fri 16/02/24
57	Concrete K-300 (Ready Mix)	Wed 31/01/24	Fri 16/02/24

No.	Job Name	Start	Finish
58	Concrete K-300 (Ready Mix)	Thu 08/02/24	Fri 15/03/24
59	Plate Formwork	Thu 08/02/24	Fri 15/03/24
60	Water proofing Painting With Fiber Membrane	Thu 08/02/24	Fri 15/03/24

Source: Microsoft Project Analyzed Data, 2024

Table 3. List of Critical Path Activities (Continued)

No.	Job Name	Start	Finish
61	Concrete K-300 (Ready Mix)	Thu 08/02/24	Fri 15/03/24
62	Lightweight Brick Masonry (t : 10 cm)	Thu 07/03/24	Tue 02/04/24
63	Alm Frame/Door/Window + Glass, PJ-2	Thu 07/03/24	Tue 02/04/24
64	Downlight 4" + Bulb 14 Watt	Mon 25/03/24	Fri 05/04/24
65	Lamp TL 2 X 36	Tue 16/04/24	Wed 24/04/24
66	Contact Stops	Tue 16/04/24	Wed 24/04/24
67	Box MCB 8 Group	Tue 16/04/24	Wed 24/04/24
68	Lamp TL 2 X 36	Mon 22/04/24	Tue 30/04/24
69	Contact Stops	Mon 22/04/24	Tue 30/04/24
70	Box MCB 8 Group	Mon 22/04/24	Tue 30/04/24
71	Lamp TL 2 X 36	Mon 22/04/24	Tue 30/04/24
72	Contact Stops	Mon 22/04/24	Tue 30/04/24
73	Box MCB 8 Group	Mon 22/04/24	Tue 30/04/24
74	Lamp TL 2 X 36	Mon 22/04/24	Tue 30/04/24
75	Contact Stops	Mon 22/04/24	Tue 30/04/24

Source: Microsoft Project Analyzed Data, 2024

Table above shows activities with critical paths in conditions before the acceleration of time using the overtime work method. It can be seen that there are 75 activities that are on the critical path. The longest duration is 26 days, on job number 58 to number 61, namely the S-4 t = 12cm floor plate work located on the 4th floor, while the shortest duration is 6 days, on job number 68 to number 75, namely the work of lighting points on

the 1st floor to the 4th floor. These critical activities are obtained from data that has been processed using Microsoft Project 2019 (Wibowo & Rozy, 2020; Yuliarty et al., 2020).

5. CONCLUSION

After data processing, data analysis and discussion of the results of this final project research are activities included in critical trajectory activities there are 75 work items, with code 368-369-370-372-380-381-382-383-384-385-387-388-389-390-392-393-394-395-398-399-400-402-403-404-406-412-415-416-417-419-420-421-422-424-425- 426-427-428-430-431-432-433-435-436-437-438-441-442-443-445-471-472-473-475-476-477-479-526-527-528-530-535-621-628-629-630-633-634-635-638-639-640-643-644.

Based on the research that has been done and the conclusions above, the authors provide the following suggestions The acceleration method used in this study only uses the overtime work method, it would be better if it is added with other methods such as the labor addition method, the sift system method and so on. So that this research can be used as a reference and source of reference for civil engineering students and improved in writing methods. In order for a project to run according to plan and on schedule, tracking of each job should be done, especially work that is on a critical trajectory.

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