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Analysis of Effective Scheduling and Financing Embung Sawah Lului Boncah Godang Construction Project

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Abstract
The construction project of the Embung Sawah Lului Boncah Godang realization of the implementation of 189 calendar days. For the effectiveness of scheduling the implementation of this work, it is necessary to conduct a study with the scheduling method. The objective is to review project scheduling using the Precedence Diagram Method (PDM) and Critical Path Method (CPM) methods as well as technical analysis of the duration of work items using the 2022 Work Unit Price Analysis (AHSP) and work acceleration using the Overlapping method. An analysis of financing flows was carried out from the results of the scheduling method with the payment system. Work Breakdown Structure (WBS) planning is based on interviews with Service Providers and job productivity is obtained for each duration of the work item. Furthermore, a dependency analysis of WBS was carried out using PDM and CPM methods using the Microsoft Project 2019 application. In the CPM method, one condition is used, namely Finish to Start (FS), which cannot overlap work. The PDM method uses 4 countermeasures, namely FS, SS, SF and FF, then the analysis begins with determining the Predecessor with work items that can overlap. The results of the analysis obtained are Gantt charts and Network Diagrams along with critical trajectories. The duration of the actual PDM method work was obtained 189 days, the modified PDM method with the overlap of the predecessor scheduling was 166 days and the CPM method was 280 days. Cashflow analysis starts with a 20% down payment and a term for each progress in multiples of 25%. Billing is carried out 4 times, namely Dp 20%, Term I 50%, Term II 75% and Term III 100%. From the analysis, it was obtained that with the actual PDM, a maximum cost support is needed in week XVII of IDR 3,237,924,656.00, the modified PDM method in week IX is IDR 2,706,839,037.00 and the CPM method in week XXXII is IDR 2,954,946,773.00

1. Introduction
Project implementation activities generally have time limitations (deadlines), meaning that the project must be completed faster or on time that has been determined (Kerzner, 2025). In this regard, the successful implementation of the project can be completed on time is an important goal for both

the project owner and the contractor for the smooth implementation of the work of a project, management management is needed from the beginning to the end, namely project management. One of the media used for project time management is work scheduling planning during the project (Martins et al., 2022). Project scheduling can use one of several commonly used methods including Bar Chart, Network Diagram, and Linear Scheduling Method (Sheikhkhoshkar et al., 2023). Project management is an engineering system, with all resources in the form of time, funds, equipment, human technology and materials in the construction process arranged and organized to form a sequence of activities in a logical framework that will form a management system (Igberaese, 2022). Several previous studies have been conducted to discuss avoiding delays with the aim of efficiency and optimization of the duration of construction project implementation with various methods (Guo & Zhang, 2022). Project Scheduling uses acceleration (Crashing) and parallel methods. To shorten the duration of scheduling activities of a project, the work activities carried out by acceleration are on a critical path to determine the optimal duration (Yaqin et al., 2023).

The acceleration method with the parallel method is an analysis method that aims to optimize the duration of project work implementation and optimal implementation costs on the project (Le et al., 2021). The analysis for the evaluation of project implementation time is not only limited to projects that will and are ongoing, but can be carried out on projects that have been completed (Durlak et al., 2022). Evaluation of the duration of construction work implementation can aim to contribute the lowest cost with a more optimal completion duration (Luong et al., 2021). One of the projects that has been completed is the work of the Lului Boncah Godang Rice Field Embung in 50 City Regency which was carried out for 189 (One Hundred and Eighty-Nine) calendar days and the implementation cost was Rp 9,844,171,000.00,-.

In this study, a scheduling evaluation was carried out using the Precedence Diagram Method (PDM) and the Critichal Path Method (CPM) with parallel acceleration (crahsing) using Microsoft project 2019 (Rankovic et al., 2024). The duration of each work item is analyzed technically based on the 2022 Work Unit Price (AHSP) (Zuhdi & Putra, 2024). The use of the tini method is based on the needs and results to be achieved on the scheduling performance. The research is equipped with a cashflow simulation with the support of a down payment and payment of each multiple of 25% proress so that the minimum capital required for the sustainability of the project work can be determined (Dorrah & McCabe, 2024).

2. Materials and Method

Research Location

The research was carried out on the construction project of the Lului Boncah Godang Rice Field Reservoir located in 50 Kota Regency which is shown in Figure 4 and the work was carried out for 189 calendar days with a financing of Rp.9,844,170,000,-(Nine billion eight hundred and forty four million one hundred and seventy thousand rupiah). Reservoirs are used as water storage for irrigation and water management systems have an important role in development (Beça et al., 2023).

Figure 1. Location of Embung Sawah Lului Boncah Godang Project

Data Collection

Data collection is actual RAB, AHSP 2022, time schedule, weekly report, monthly report and documentation (Scarpa & Bianco, 2023). Furthermore, compile data sources, technically analyze the duration of work items guided by AHSP 2022, determine the Work Breakdown Structure (WBS), prepare a predestor, accelerate the parallel method, and prepare a payment term with 25% progress, then from the data with PDM and CPM methods using Microsoft project 2019. Table 1 shows the arrangement of work. WBA is an activity or target of the scope of a project that is organized and is usually made using project management tools.

Table 1. List of actual WBS jobs and AHSP Evaluation 2022

No	Uraian Pekerjaan	Durasi Aktual (hari)	Durasi AHSP 2022 hari)
1	**PEKERJAAN PERSIAPAN**		
2	Pengukuran Ulang dan Rencana Kerja	21	21
	Pengukuran Ulang dan Pembuatan Gambar Purna Bangunan	13	13
3	Mobilisasi Alat Berat	14	12
	Demobilisasi Alat Berat	28	12
4	Kisdam dan Dewatering	21	90
5	Pembuatan dan Pemasangan Slogan dari Rangka / Plat Baja	14	24
6	Pengadaann, Penanaman, Pemupukan dan Pagar Tanaman Penghijauan	21	48
7	Pembuatan dan Pemasangan Nomenklature	21	18
8	Penyelenggaraan K3 dan Keselamatan Konstruksi	175	165

No	Uraian Pekerjaan	Durasi Aktual (hari)	Durasi AHSP 2022 hari)
	PEKERJAAN KONSTRUKSI		
1	Galian Tanah dengan Alat Berat (Type I)	84	29
2	Galian Tanah dengan Alat Berat (Type 2)	98	51
3	Galian Tanah dengan Tenaga Manusia / Manual	35	50
4	Timbunan Tanah Bekas Galian dipadatkan	56	83
5	Urugan Sirtu dan Dipadatkan	56	80
6	Beton Cor Camp. 1pc: 3ps: 5Kr	63	40
7	Beton Mutu K.175	63	60
8	Beton Mutu K.225	56	19
9	Pengadaan dan Pemasangan Pipa Resapan PVC 2 inch + ijuk	56	21
10	Besi Tulangan (Pembesian)	112	112
11	Cetakan Lantai Beton (Bekisting) Multipleks tebal 12 mm	112	60
12	Cetakan Dinding Beton (Bekisting) Multipleks 12 mm	112	53
13	Pasangan Batu Kali Camp 1pc : 4ps	56	64
14	Plesteran Camp 1 pc: 3ps + Acian	56	51
15	Peng & Pemas, Pintu Sorong Stang Ganda b=0,8 M, h = 1,00 M	14	5
16	Pembuatan dan Pemasangan Atap Rumah Pelindung Pintu	14	14
17	Penyediaan dan Pemasangan Atap Gebalan Rumput	14	37
18	Wiremesh dia.8 mm jarak 15 cm	56	16
19	Pengadaan dan Pemasangan Pipa Sandaran	21	31
20	Pengadaan dan Pemasangan Gorong-Gorong Dia.60 cm	28	35
21	Pengadaan dan Pemasangan Gorong-Gorong Dia.40 Cm	28	20
22	Pengadaan dan Pemasangan Cerucuk 8 - 10 cm	84	46
23	Pengadaan dan Pemasangan Pintu angkat tekan	14	12
24	Pengadaan.Penanaman dan Pemupukan Tanaman	14	24
25	Pengadaan dan Pemasangan Paving block Tb.6 cm	21	35

Data Processing

WBS was obtained from AHSP 2022 technical analysis and interviews with contractors by calculating the productivity of their workers along with the duration of the work items and continued with a dependency analysis of each job. Subsequently, the list and duration data were analyzed and each work item in the Table.1 and the analysis was carried out using PDM and CPM methods using the Microsoft Project 2019 application to adapt the outputs:

a) The optimal duration of scheduling project work.

b) Cashflow requires minimum financial support for the implementation of work in multiples of 25% progress.

A review was carried out on the duration of the implementation of two groups of work, namely Preparatory work consisting of 7 work items and Construction work 25 work items. The acceleration of work is carried out in parallel, so that it does not burden implementation costs (Allen & Ge, 2021). The comparison of the PDm method data input with the CPM method in Microsoft project software is shown in Table 2.

Table 2. List of Relationships Between Actual PDM Method Project Activities 189 days

No.	PDM	CPM
1.	Work items described with Node	Work items described with arrows
2.	There are four constrains (FS, SS, SF, FF)	There is one constrain (FS)
3.	Doesn't have a Dummy/Pseudo-job	Has a Dummy/Pseudo-job item
4.	Can do overlapping work.	Unable to do overlapping work
5.	Caption displayed (ES,	Caption displayed (EET,

3. Results and Discussions

The relationship between dependencies and relationships between work can be seen in the bar chart in the Microsoft Project 2019 scheduling program which is based on the principle of PDM and CPM calculations.

Actual PDM Method Scheduling Outputs

In Table 3. It shows the relationship of work dependence on the input of actual scheduling data of the PDM method with a duration of 189 days.

Table 3. List of Relationships Between Project Activities and Ganttchart Diagrams with PDM Methods Actual 189 days

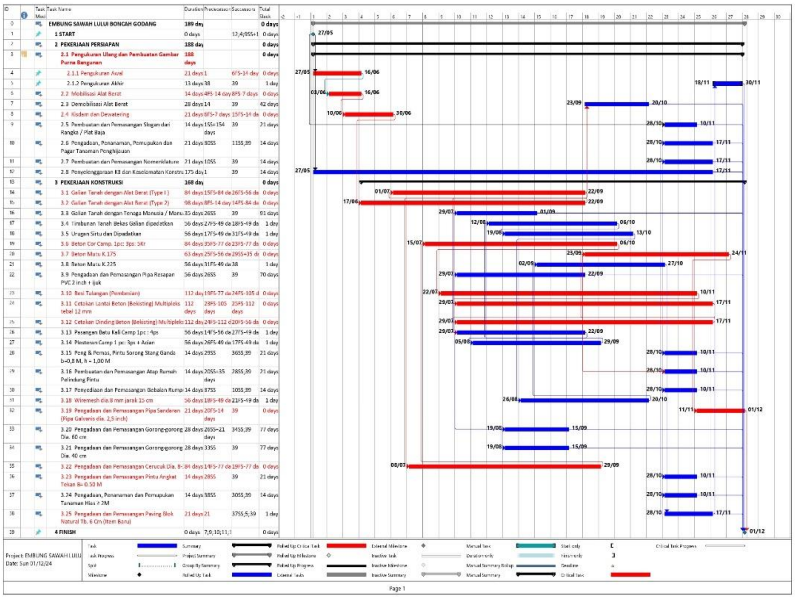
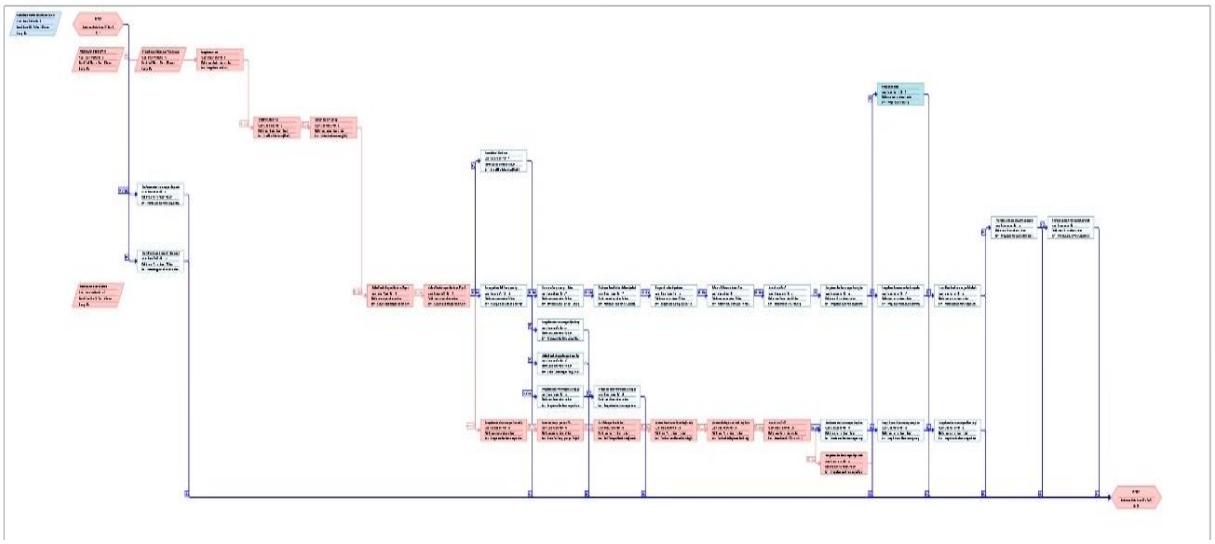


Figure 2. Output of the Work Network Diagram with the actual PDM Method 189 days



And the critical work with the actual PDM method is obtained 9 critical work items shown in Figure 2, including:

1) Re-Measurement and Drawing Creation of After-Building Drawings
2) Heavy Equipment Mobilization
3) Excavation of Soil with Heavy Equipment (Type I)
4) Concrete Cor Camp. 1pc: 3ps: 5Kr
5) Wiremesh dia.8 mm spacing 15 cm
6) Reinforced Iron (Iron)
7) K.225 Quality Concrete
8) Procurement, Planting and Fertilizing of Ornamental Plants ≥ 2M
9) Procurement and Installation of Paving Natural Block Tb. 6 Cm (New Item)

The results of the analysis of the financing flow (cashflow) from the Microsoft Project 2019 software withthis actual PDM method are obtained as shown in Table 4, based on the initial calculation of the 20% down payment. Term I is carried out On the progress of work (progress) of 50% in the 17th week (M17) a term of 50% of = IDR 3,547,697,006.00 is obtained and is used to pay off financing debts of a maximum of IDR 3 237,924,656.00 and the remaining *term I funds* are IDR 309,772,350.00.

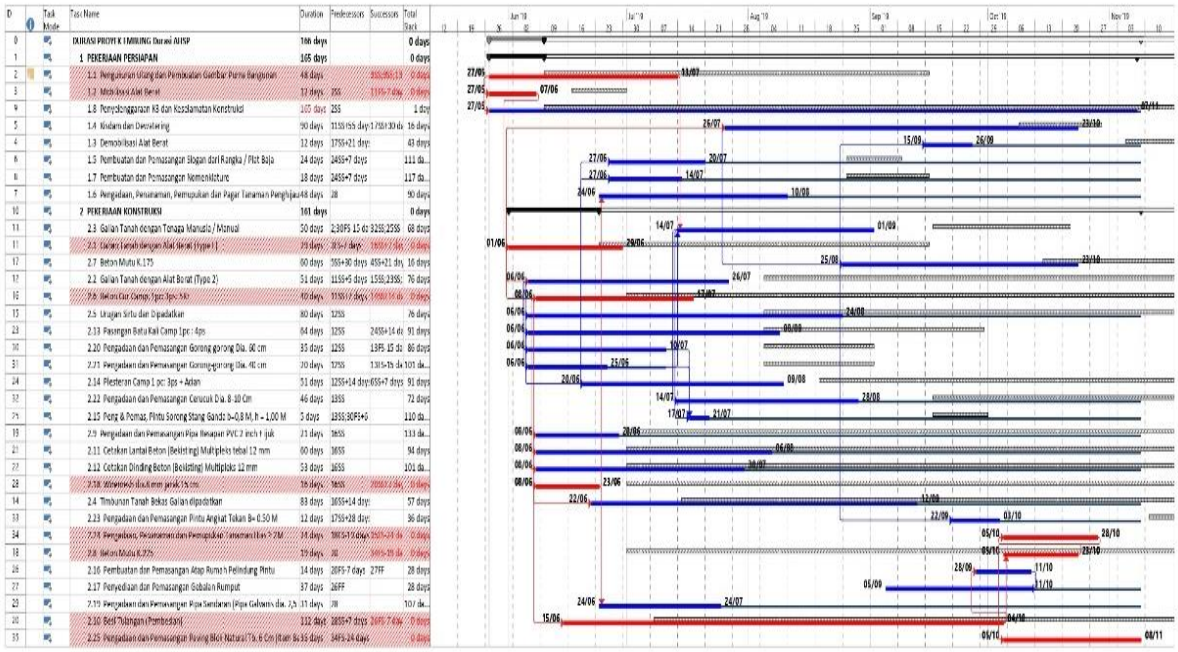
Table 4. Results of Maximum Financing Flow Analysis (Cashflow) with Actual PDM Method 189 Day in Week 17

Week 17 Fees	**Rp787.420.987,00**
Cumulative Costs	**Rp5.011.773.159,00**
Weight up to M17	56,51%
Dana Termyn I	**Rp3.547.697.006,00**
Net Cash Flow	**Rp309.772.350,00**
Funding up to M17	-Rp3.237.924.656,00

Output Scheduling of Modified PDM Method

Table 4 shows the relationship of job dependence on the actual scheduling data input of the modified PDM method with a duration of 166 days.and Figure 6 shows a work network diagram.

Table 5. List of Relationships Between Project Activities and Ganttchart Diagrams with PDM Methods Modification Duration: 166 days



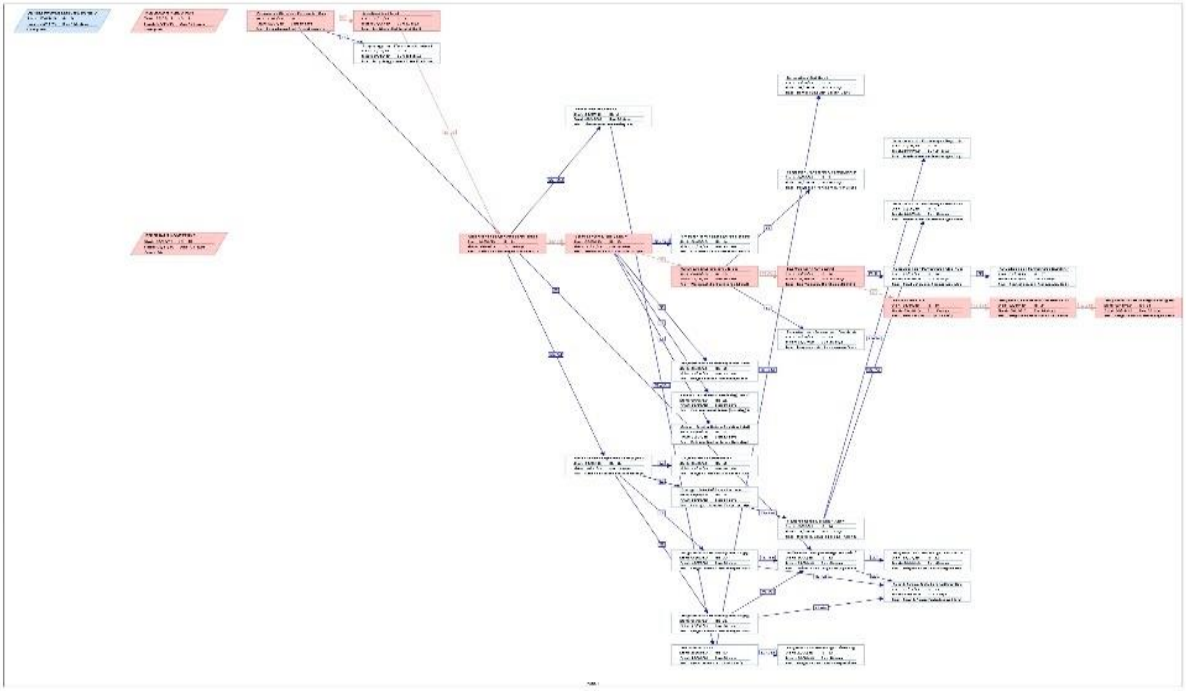


Figure 3. Output of Work Network Diagram with Modified PDM Method 166 days

And critical work with this modified PDM method can be 12 critical work items, including:

1) Initial Measurement
2) Heavy Equipment Mobilization
3) Kisdam and Dewatering
4) Excavation of Soil with Heavy Equipment (Type 2)
5) Excavation of Soil with Heavy Equipment (Type I)
6) Procurement and Installation of Piles Dia. 8-10 cm
7) Concrete Cor Camp. 1pc: 3ps: 5Kr
8) Reinforced Iron (Iron)
9) Multiplex Concrete Floor Mold (Bekisting) 12 mm thick
10) 12 mm Multiplex Concrete Wall Formwork
11) Quality Concrete K.175
12) Procurement and Installation of Backing Pipe (Galvanized Pipe dia. 2.5 inch)

The results of the analysis of the financing flow (cashflow) from the Microsoft Project 2019 software withthis actual PDM method are obtained as shown in Table 6, based on the initial financing of the 20% down payment. Term I is carried out on the progress of work (progress) of 50% in the 9th week (M9) a term of 50% = IDR 3,547,697,006.00 and is used to pay off financing debts of up to IDR 2 706,839,037.00 and the remaining term I funds of IDR 840 857 969,-

Table 6. Results of Maximum Financing Flow Analysis (Cashflow) with Modified PDM Method 166 days at week 33

Mingg uke cost 33	**Rp382.011.889**
Cumulative Costs	Rp4.480.687.540,00
Weight up to M33	50,52%
Dana Termyn I	**Rp3.547.697.006,00**
Net Cash Flow	**Rp840.857.969,00**
Funding up to M33	-Rp2.706.839.037,00

Modified Cpm Method Scheduling Outputs

Table 7 shows the relationship of job dependence on the actual scheduling data input of the modified CPM method with a duration of 280 days.and Figure 7 shows a work network diagram.

Table 7. List of Relationships Between Project Activities and Ganttchart Diagrams with CPM Methods Modification Duration: 280 days

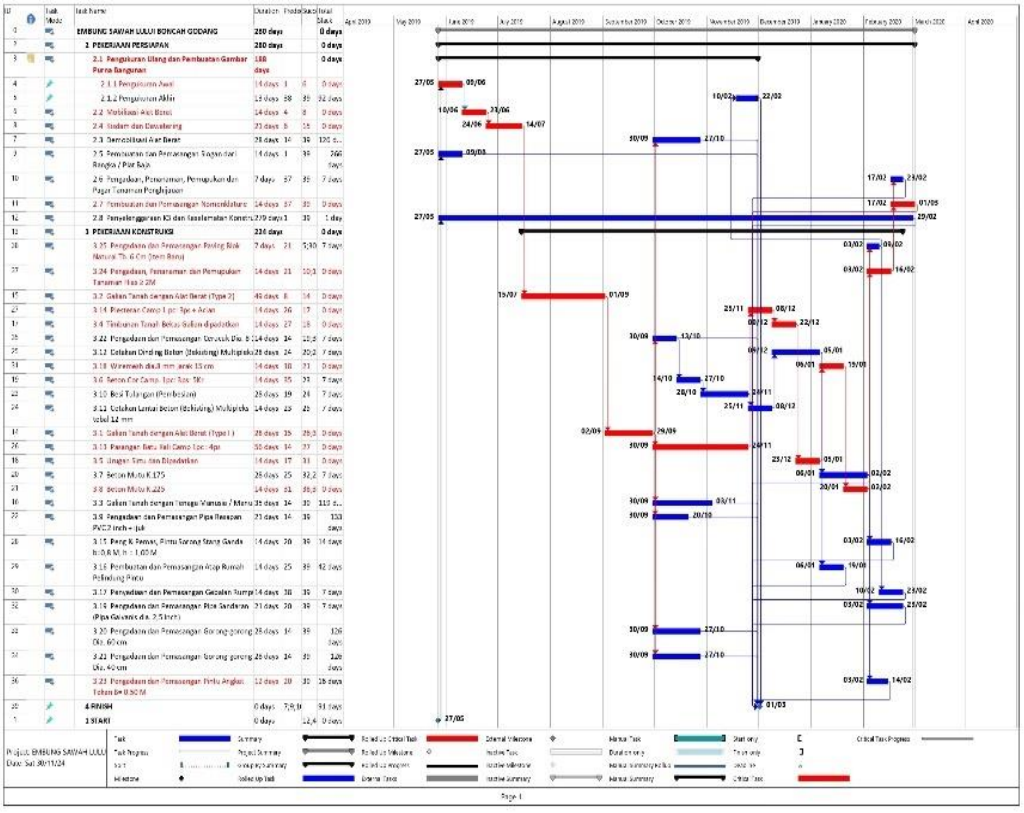
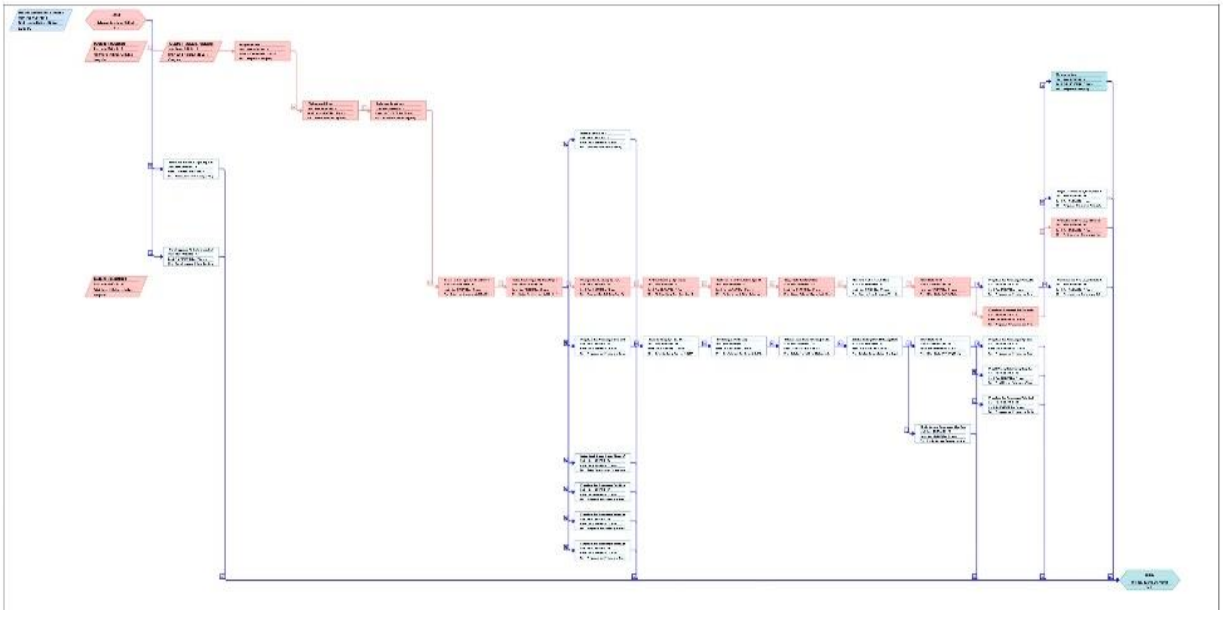


Figure 4. Job Network Diagram Output with 280-day actual CPM Method



And critical work with this modified CPM method can be 12 critical work items, including:

1) Initial Measurement
2) Heavy Equipment Mobilization
3) Kisdam and Dewatering
4) Excavation of Soil with Heavy Equipment (Type 2)
5) Excavation of Soil with Heavy Equipment (Type I)
6) Batu Kali Camp 1pc Pair : 4ps
7) Plastering Camp 1 pc: 3ps + Acian
8) Compacted Excavated Former Soil Pile
9) Sirtu Urugan and Compacted
10) K.225 Quality Concrete
11) Procurement, Planting and Fertilizing of Ornamental Plants ≥ 2M
12) Nomenklature Fabrication and Installation

The results of the analysis of the financing flow (cashflow) from the Microsoft Project 2019 software with the modified CPM method are obtained as shown in Table 8, based on the initial financing of the 20% down payment. Term I is carried out on work progress of 50% in the 33rd week (M33) a term of 50% = Rp 3,547,697,006.00 and is used to pay off debts of Rp 2 706,839,037.00 and the remaining term I funds are Rp 592 750 233,-

Table 8. Results of Maximum Financing Flow Analysis (Cashflow) with Modified PDM Method 166 days at week 33

Mingg uke cost 33	**Rp311.497.492,00**
Cumulative Costs	**Rp4.728.795.276,00**
Weight up to M33	53,32%
Dana Termyn I	**Rp3.547.697.006,00**
Net Cash Flow	**Rp592.750.233,00**
Funding up to M33	-Rp2.954.946.773,00

4. Conclusion

From the research problem with the implementation of the Embung construction work with an actual duration of 189 calendar days with a critical trajectory, there are 12 work items. With the analysis with the PDM and CPM methods for the evaluation of the scheduling and duration of each work item with AHSP 2022 as well as interviews about the contractor's capabilities, it can be concluded as follows: Plotting the actual duration of the implementation of the work of Embung Sawah Lului Boncah Godang for 189 calendar days with the PDM method obtained a critical trajectory of 12 work items Rescheduling with the duration of work items guided by AHSP 2022 and interviews on equipment capabilities, workforce, then using Microsoft Project 2019, the PDM method is used, the scheduling duration is obtained = 166 days with a critical trajectory of 9 work items, while using the CPM method, the scheduling duration is obtained = 280 days with a critical trajectory of 12 work items. Analysis of cash flow with down payment capital and term capital obtained the maximum financing of the actual PDM method in the 17th week of IDR 3,237,924,656.00, for the PDM method

of modified financing the maximum financing in the 9th week of IDR 2,706,839,037.00 and for the CPM method of modified financing the maximum financing in the 33rd week of IDR 2,954,946,773.00

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