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CONSTRUCTION MANAGEMENT OF JATI WEIR REHABILITATION (CHANNEL MADIUN IRRIGATION AREA) MAGETAN REGENCY WITH VALUE ENGINEERING & SCHEDULING IMPLEMENTATION MANAGEMENT PLANNING

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KEYWORDS
Value Engineering, Scheduling Management Planning, Weir Rehabilitation

ABSTRACT
One of the infrastructure developments in the region that will soon be implemented is the construction of the Jati Weir rehabilitation construction project which is the main dam in the Madiun Irrigation Area (DI SIM) Main Channel in Magetan Regency. In order to maximize the results of cost and time, it is necessary to have a flexible technique or management in the work of this project. The method used to determine alternative types of construction that are efficient and effective in terms of cost and time is the application of Value Engineering in the Jati Weir rehabilitation planning work. Then to get the most effective and efficient time needed for the construction of the rehabilitation of the Jati Weir is done by analyzing the needs of time, labor and tools and the results of the analysis are included in the preparation of a work schedule with the help of Microsoft Project Manager 2021 software. The results of the Value Engineering analysis are the work items that can be done are the still pond items; The existing construction is a random pile of concrete blocks in the form of 1x1x0.5 m blocks with alternatives given to replace the existing construction are 1000 kg tetrapod concrete blocks and 1000 kg dolos concrete blocks; the selected alternative is 1000 kg dolos concrete blocks with a manufacturing and installation cost of Rp. 16,239,115,273.27. 16,239,115,273.27; The cost value of making and installing 1000 kg of dolos concrete blocks is reduced by Rp. 6,252,816,421.53 from the existing construction value; The overall total cost changes from Rp. 62,420,557,268.77 (excluding VAT/VAT) to Rp. 56,167,740,847.24 (excluding VAT/VAT) after Value Engineering. For the implementation schedule plan, the time for Preparatory Work takes a total of 42 working days and for the Jati Weir Rehab Work takes a total of 185 working days. The work is planned to start from March 01, 2023 and end on November 29, 2023.

INTRODUCTION

Value Engineering must be applied to every completion of planning planning . This is intended to be able to provide direction to planners and ensure that considerations in terms of value and cost have been presented to the project owner to get attention in making decisions. The VE should also apply at the design development stage and follow the results from this development stage. At this stage the planning results are planned in shape, size and specifications to provide certainty in determining costs in terms of the architecture and structure used.

The Teak Weir Rehabilitation Project spent Rp. 62,420,557,268.77 (before tax) with the value of the energy damper work item in the downstream stilling pond of Rp.

22,491,931,694.80 (concrete block construction 1 x 1 x 0.5 m) or about 36.03% of the total cost of the teak Rehabilitation dam. For this reason, the authors are interested in researching what alternatives are the most effective and efficient of several types of energy damping construction materials downstream of the still pond, by first calculating the RAB so that they can find out the most cost-effective and necessary to do a Pareto diagram first, then proceed with analyzing the level of feasibility, with the hope that the work can be carried out in a timely manner, maximally and cost-effectively. Planning and controlling payment and time are part of construction management in totality.

The assessment that will be carried out in research in this case is to use the Microsoft Project Manager 2021 program to overcome dependencies between activities, these activities link many supporting factors, of course while maintaining quality and costs it still needs to be adjusted, controlled and adjusted as needed, regulated, and extended project time, and determine how to most cost and time effectively fit the optimized project schedule.

RESEARCH METHODS

A. Information Stage

In this stage, collect information regarding the location of energy dampers, problems that arise when planning.

The output of this stage is to obtain information on field conditions where the rehabilitation of the Teak Weir is carried out and an estimate of the ease of implementation later.

B. Function Analysis Stage

At this stage a functional analysis is carried out by identifying work elements that have the potential to have a high level of costs by first carrying out a breakdown cost which refers to Pareto's law. Pareto's law reads 20% of the total work items represent/is located in 80% of the total project budget. In other words, it is necessary to carry out the process of selecting work items that have the greatest potential cost in a project.

C. Stage Speculation (Creative)

At this stage, a creative approach is taken using ideas for alternative uses of energy absorbing building structures that will be analyzed. Several alternatives are made of

(1) Concrete cube pile structure with dimensions of 1 x 1 x 0.50 m (existing),
(2) Tetrapod stack structure,
(3) Dolos pile structure.

The data needed in this analysis is the work method data used for each alternative that will be used.

The output of this stage will be obtained several alternative effective pile structures built in energy absorbers at the Teak Dam

D. Stage Evaluation

The evaluation phase aims to reduce the number of ideas generated during the creativity phase to the one idea that has the most potential to add value to the project. At this stage an analysis of the calculations of the proposed alternatives will be carried out, so that results are obtained in terms of cost and time to be able to provide a reference in determining recommendations at the next stage. This stage answers questions about what creative ideas can be developed to increase the value of the project and at what cost (Berawi, 2013).

E. Stage Analysis Decision

The steps of this work in the analysis stage are as follows:

1) Determine Assessment Criteria

The aspects assessed in this alternative comparison are those that are in accordance with the value guidelines in value engineering

2) Profit and loss analysis

Profit and loss analysis is the most crude screening stage among the methods used in the appraisal stage.

In analyzing the advantages and disadvantages of this, what is calculated is the total assessment of each criterion, then each criterion is given a ranking in the most efficient and effective order.

3) Determining Alternative Ratings

In this study the investment assessed was the most economical. This is because these projects are government projects where these projects are carried out for the public interest and for the economic welfare of the community which is in line with the rehabilitation objectives of the Jati Bendung.

4) Feasibility Analysis

In the feasibility analysis the value is obtained based on the assessed criteria:

a. Criterion A 10 = Cheap 1 = Expensive
b. Criterion B 10 = Fast 1 = Slow
c. Criterion C 10 = Easy 1 = Difficult
d. Criterion D 10 = Simple 1 = Difficult

Table 1
Analysis Appropriateness

No	Structure Alternatives	Criteria				Total	Rank	Choose
		a	**b**	**c**	**d**			
1	Alternatives A							
2	Alternatives B							
3	Alternatives C							

Source: Analysis Results, 2022

F. Stage Presentation and Action Continue (Recommendation)

At this stage, reporting and recommendations from the selected alternative are carried out. The things reported are regarding all the final results:

a. Design models
b. Alternative Options
c. The savings that occur

Planning Management Implementation Scheduling

Qdataq analysis is carried out q after all the required data has been collected, so that all data can be processed properly then the data analysis stage begins as follows:

1. In this study, 2 alternatives will be included which are differentiated in the duration of the duration of processing to see the difference in cost so that which alternative is more efficient can be chosen.
2. Determine the estimated duration (days) of work for each job.

3. Material and human *resources* in the amount of work which must be carried out are analyzed by calculating the *resource coefficient* with the total amount of work. The following are the steps to calculate the resource requirements analysis:
   1) Determining the type of workers and materials for each job in SNI PUPR Ministerial Decree No. 11 Cipta Karya 2016.
   2) Determining labor and material coefficients in SNI PUPR Ministerial Decree No. 11 Cipta Karya 2016.
   3) Calculating worker productivity using the formula $= \frac{1}{koefisien}$
   4) Calculate the number of workers using

   $$\text{Number of Workers} = \frac{Volume}{Durasi \times produktivitas}$$

   5) Calculating the amount of material

   $$\text{Number of materials} = \frac{Volume \times Koefisien}{Durasi}$$

4. The dependency relationships of an activity on a project are defined by the job dependency logic. By illustrating the dependency logic of each work activity the management will get a detailed project planner. For more details in compiling the steps to create job dependency logic
5. Project scheduling (*rescheduling*) for each work unit which has been analyzed and has found time and dependency relationships and then *rescheduled* by applying *Microsoft Project Manager 2016* Choose each *activity* in the *project*, by filling in each job in the *Task Name column*.
   5) Classify work.
      a. Choose the duration of each *activity*, by filling in the duration of each job in the *Duration column*.
      b. Selects the relationship between each *activity*.
      c. Inputting all the necessary *resources* so that the project can be completed on the *Resource Sheet* .
      d. Determine the type of resource required for each job.
6. S-Curve, makes the overall project implementation schedule *(Time Schedule)* which is described in the "S" Curve.
7. done.

RESULTS AND DISCUSSION

A. Stage Information

data that was successfully collected is data from the SID Planning work - IN THE CENTRAL AUTHORITY (IPDMIP) with the owner of the work from the Bengawan Solo River Basin carried out by PT. Indra Karya – PT. Great Fortune – KSO. The Madiun Main Canal Irrigation Area has an area of 10,860 Ha and a canal length of 27,022 m in the primary canal that passes through Madiun, Magetan, Ngawi and Madiun Municipalities.

The data we have obtained is data:

1. Job Description Data
2. Work Implementation Schedule
3. Cost Budget Recapitulation
4. Plan Drawing

B. Function Analysis Stage

Some of the basic principles that are carried out at the information stage are the cost model and function analysis. One way is to use the Pareto Distribution Law. The law of the Pareto distribution states that 80% of total costs normally occur in 20% of work items. With the law of the Pareto distribution, it can be determined that 80% of the total costs come from 20% of work items that have high costs. Functional analysis is only carried out on 20% of the work items. The remaining work items only have low costs, so no study is carried out on these work items. Below is shown the table and graph of the Pareto distribution

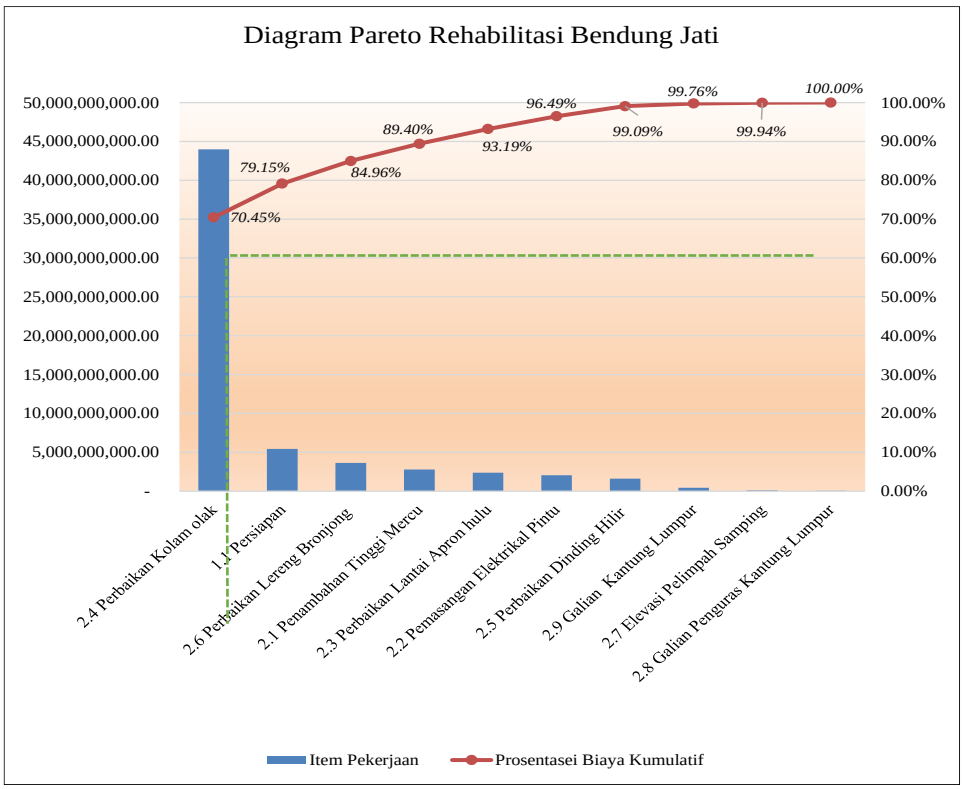


Figure 1
Pareto Graph of Teak Weir Rehabilitation Costs
Source: Analysis Results, 2022

From the picture above, it is obtained that in order to comply with the 80/20 Pareto law, there are 2 work items that must be carried out by *value engineering* , namely:

1. Olak Pool Repair
2. Preparation

To find items that can be done is *value engineering* , the two work items above need to be done with a Pareto diagram:

1) Pareto Chart of Olak Pond Repair Work
   Below is a Pareto table and diagram for the repair of Olak Ponds

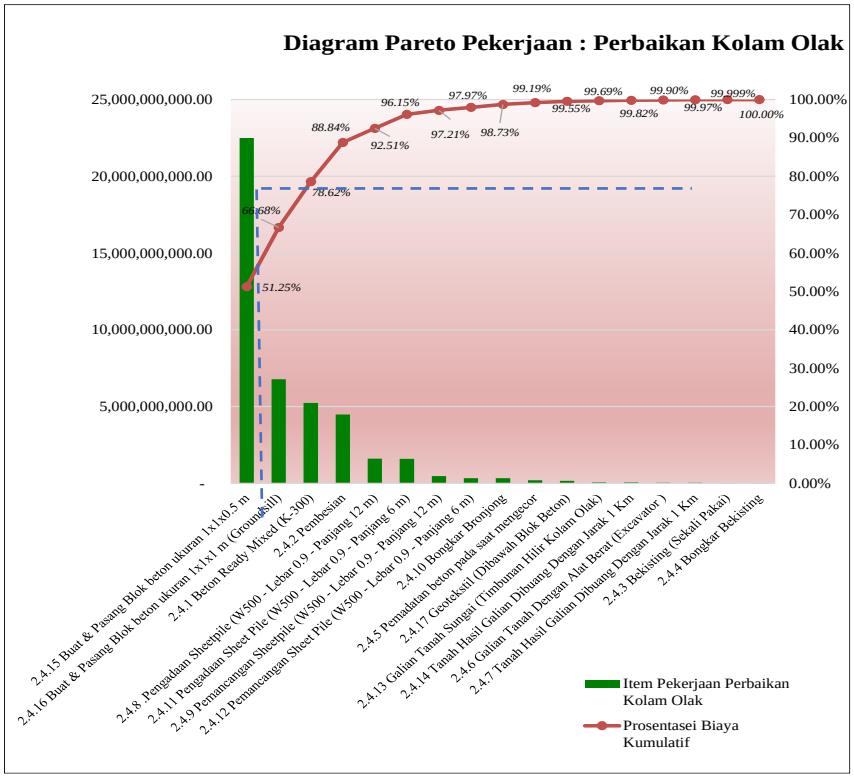


Figure 2
Pareto Chart of Fixed Pool Repair Costs
Source: Analysis Results, 2022

From the picture above, it is obtained that in order to comply with the 80/20 Pareto law, there are 3 work items that must be carried out by *value engineering* , namely:

1. Production & installation of concrete blocks measuring 1 x 1 x 0.5 m (stilling pool energy damper)
   This item is random concrete block installation for energy absorbing after stilling pond. This item can be *value engineering* by providing an alternative form of construction other than concrete blocks
2. Manufacture & Installation of concrete blocks measuring 1x1x1 m (Groundsill)
   For concrete blocks, this is done by regularly installing groundsills. This construction cannot be replaced because technically, this concrete block construction is the most suitable for the conditions at the work site
3. Ready Mixed Concrete (K-300)
   The quality of ready mix concrete (K-300) can't be changed to lower its quality.

2) Pareto Chart of Preparatory Work
   Below is a Pareto table and diagram for the repair of Olak Ponds

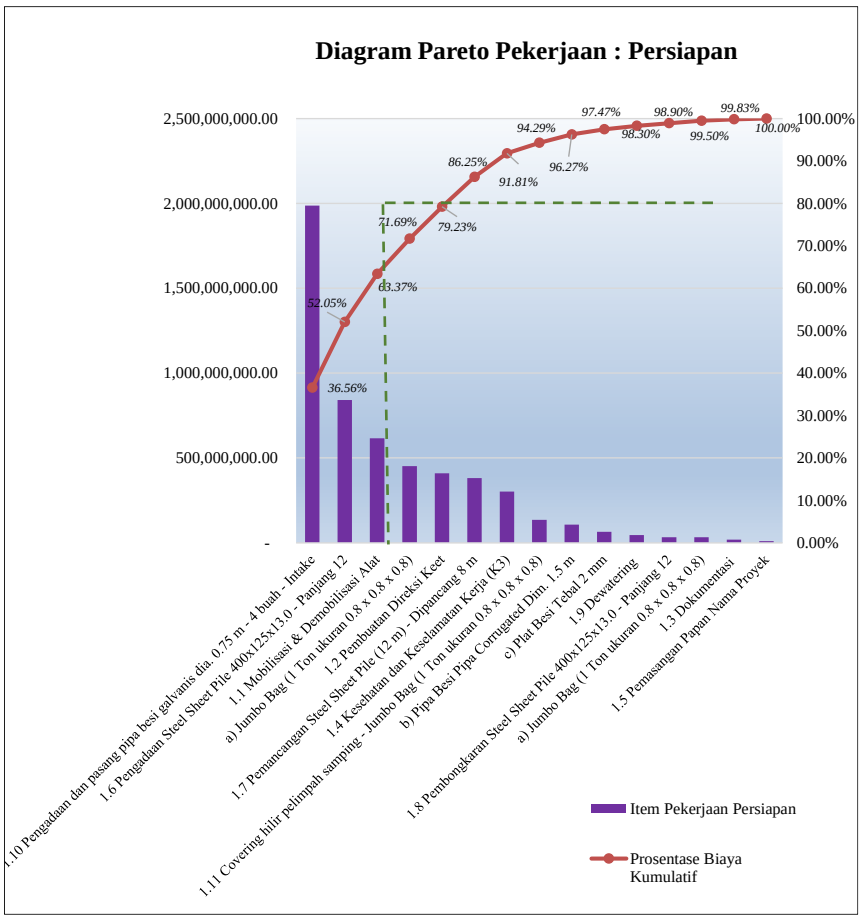


Figure 3
Pareto Chart of Preparation Costs
Source: Analysis Results, 2022

From the picture above, it is obtained that in order to comply with the 80/20 Pareto law, there are 5 work items that must be carried out by *value engineering* , namely:

1. Supply and installation of galvanized steel pipes. 0.75 m - 4 pieces – Intake
   This item cannot be replaced because to drain water from the river you have to use galvanized iron pipes
2. Procurement of Steel Sheet Pile 400x125x13.0 - Length 12
   This item is for the coverdam during the construction of the Teak Weir rehabilitation so it must be available and in terms of construction steel sheet pile is the most appropriate because later it can be taken back when the rehabilitation work is complete
3. Equipment Mobilization & Demobilization
4. This item is a mandatory item that cannot be left behind
   Construction of Embankment & Access Roads for Piling Steel Sheet Pile Jumbo Bag (1 Ton size 0.8 x 0.8 x 0.8)
   This item is for coverdam reinforcement during the construction of the Teak Weir rehabilitation and is also used for heavy equipment access when carrying out steelsheet pile erection.
5. Making of Directors Keet

This item has been adapted to existing needs so that the building area cannot be reduced

Conclusion of the function analysis (pareto diagram):

Items that can be *value engineered* in the Jati Weir rehabilitation work are: Manufacture & Installation of concrete blocks measuring 1 x 1 x 0.5 m (still pond energy damper)

C. Stage Speculation (Creative)

At this stage, a creative approach is taken using ideas for alternative uses of energy absorbing building structures that will be analyzed. Several alternatives are made of

(1) Concrete block pile structure with dimensions of 1 x 1 x 0.50 m (existing),

(2) Tetrapod stack structure,

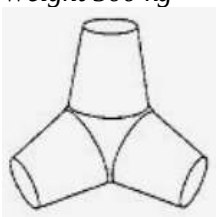
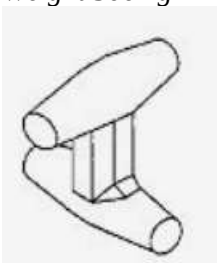
(3) Dolos pile structure.

1) Profit and loss analysis

Profit and loss analysis is the most crude screening stage among the methods used in the appraisal stage.

In analyzing the advantages and disadvantages of this, what is calculated is the total assessment of each criterion, then each criterion is given a ranking in the most efficient and effective order.

Table 2
Profit and loss analysis

No	Alternative	Potential Profit	Potential Losses
1	Concrete Block Pile Structure (A) *Weight 500 kg* 	– Easier to manufacture	– The binding between the cubes is less strong – Manufacturing costs are more expensive
2	Tetrapod Stack Structure (B) *Weight 500 kg* 	– Binding between tetrapods is strong – Often used in Indonesia	– The manufacturing process is more difficult
3	Dolos Pile Structure (C) *Weight 500 kg* 	– The binding between dolos is stronger when compared to concrete beams	– The manufacturing process is more difficult

Source: Analysis Results, 2022

2) Determine Assessment Criteria

The aspects assessed in this alternative comparison are those that are in accordance with the value guidelines in value engineering, namely:

- **a.** Implementation Cost Aspect
- **b.** Aspects of implementation time
- **c.** Aspects of material availability
- **d.** Aspects of the Use of Human Power
- **e.** Aspects of Implementation Methods
- **f.** Aspects of Building Stability
- **g.** Energy Dissipation Effectiveness Aspect

D. Stage Evaluation

The steps in the evaluation stage are as follows:

a. Implementation Cost Aspect

Table 3
Recapitulation of Evaluation Results of Implementation Cost Aspects

No	Alternative Construction	Volume	Unit price	Total cost
1	Manufacture and installation of concrete blocks measuring 1x1x0.5 m	**10,465.00**	**2,149.252.91**	**22,491,931,694.80**
2	Manufacturing and installation of 1000kg tetrapod concrete blocks	**12,312.00**	**1.392,055.16**	**16,363,327,076.55**
3	Manufacture and installation of 1000kg dolos concrete blocks	**12.312.00**	**1,318.966.48**	**16,239,115,273.27**

Conclusion Evaluation Results:

By having a different value for each alternative, the Implementation Cost Aspect can be used as an assessment for decision making. The lowest cost is obtained from the manufacture and installation of 1000 kg Dolos concrete blocks

b. Aspects of implementation time

Table 4
Recapitulation of the Evaluation Results of the Implementation Time Aspect

No	Alternative construction	Number of days
1	Manufacture and installation of concrete blocks measuring 1x1x0.5 m	50.00
2	Manufacturing and installation of 1000kg tetrapod concrete blocks	59.00

3	Manufacture and installation of 1000kg dolos concrete blocks	55.00

Conclusion Evaluation Results:
By having a different value for each alternative, the Implementation Time Aspect can be used as an assessment for decision making. The shortest implementation time is the manufacture and installation of concrete blocks measuring 1x1x0.5 m

c. Aspects of material availability
For the three alternatives, because they use precast concrete, there are no problems with the availability of materials. Materials for the construction of the three alternatives above are available in abundance because they are made in factories (fabrication).
Conclusion Evaluation Results:
From the aspect of material availability, the three alternatives above did not experience problems with the availability of materials, so they could not be used as material for evaluating decision making because they had the same conditions.

d. Aspects of the Use of Human Power
For these three alternatives, because they use precast concrete, the use of human labor is very small because the work is more on manufacturing
Conclusion Evaluation Results:
From the aspect of the use of manpower for the three alternatives above, they both experience no problems so they cannot be used as material for evaluating decision making because they have the same conditions.

e. Aspects of Implementation Methods
For the three alternatives because they use precast concrete, the implementation method is carried out in the same way
Conclusion Evaluation Results:
From the aspect of the implementation method for the three alternatives above it is almost the same, namely using an excavator to install it randomly so it cannot be used as material for evaluating decision making because it has conditions

f. Aspects of Building Stability
For the three alternatives, based on the Coastal Engineering Planning Book, Bambang Traitmodjo, 2012, each construction pile has a stability coefficient value. The stability coefficient is based on the shape and bonding strength between constructions so that it has a different coefficient value. Stability coefficient values can be seen in the table below:

Table **Error! No text of specified style in document.**-2Stability Coefficient for various types of grains

Lapis lindung	n	Penem-patan	Lengan Bangunan K_D		Ujung (kepala) Bangunan K_D		Kemi-ringan
			Gelomb. Pecah	Gelomb. Tidak Pecah	Gelomb. Pecah	Gelomb. Tidak Pecah	Cot θ
Batu pecah							
Bulat halus	2	Acak	1,2	2,4	1,1	1,9	1,5-3,0
Bulat halus	>3	Acak	1,6	3,2	1,4	2,3	*2
Bersudut kasar	1	Acak	*1	2,9	*1	2,3	*2
Bersudut kasar	2	Acak	2,0	4,0	1,9	3,2	1,5
					1,6	2,8	2,0
					1,3	2,3	3,0
Bersudut kasar	>3	Acak	2,2	4,5	2,1	4,2	*2
Bersudut kasar	2	Khusus *3	5,8	7,0	5,3	6,4	*2
Paralelepipedum	2	Khusus	7,0-20,0	8,5-24,0	-	-	
Tetrapod dan Quadripod	2	Acak	7,0	8,0	5,0	6,0	1,5
					4,5	5,5	2,0
					3,5	4,0	3,0
Tribar	2	Acak	9,0	10,0	8,3	9,0	1,5
					7,8	8,5	2,0
					6,0	6,5	3,0
Dolos	2	Acak	15,8	31,8	8,0	16,0	2,0
					7,0	14,0	3,0
Kubus modifikasi	2	Acak	6,5	7,5	-	5,0	*2
Hexapod	2	Acak	8,0	9,5	5,0	7,0	*2
Tribar	1	Seragam	12,0	15,0	7,5	9,5	*2

(CERC, 1984)

Source: Triatmodjo, Bambang . *Coastal Engineering Planning*, 2012 (p. 186)

Conclusion Evaluation Results:

From the aspect of construction stability, it is found that the three alternatives have different stability values so that they can be made as one of the assessments for decision making. From the table above, the highest stability value is Dolos.

g. Aspects of the Level of Energy Dissipation

The level of energy dissipation for concrete blocks in the form of blocks has the lowest level of energy dissipation compared to Tetrapod and Dolos due to lower bonding strength between constructions. From this justification, the level of energy dissipation of the Tetrapod and Dolos construction will be checked through research conducted by Maratus Khasanah Humairah, Sugeng Widada, Rikha Widiaratih Widada, Widiarati, 2021 with the title Physical Model Simulation of the Effectiveness of the Tetrapod and Dolos Breakwaters. The simulation results are as follows:

Based on the results of this study, it can be concluded that in:

- scenario I obtained a damping percentage of 87.45%,
- scenario II of 86.00%,
- scenario III of 87.75%,
- scenario IV of 84.91%.

From the experimental tests conducted in this study, it was found that tetrapods were more effective in reducing wave energy

Conclusion Evaluation Results:

From the aspect of the level of energy dissipation, it is found that the three alternatives have different stability values so that they can be used as an assessment

for decision making. From this study, it was found that the highest damping effectiveness was obtained from the tetrapod construction

E. Stage Decision Making

One form of analysis of creative ideas is discussed very subjectively because it is difficult to get an ideal value. Therefore, the alternative ranking of the structure used is taken into account. The aspects to be considered are in accordance with the results of the evaluation, namely as follows:

In the feasibility analysis the value is obtained based on the assessed criteria:

e. Cost 10 = Cheap 1 = Expensive
f. Execution Time 10 = Fast 1 = Slow
g. Stability 10 = Great 1 = Low
h. Energy Dissipation 10 = High 1 = Low

Table 5
Feasibility Analysis

No	Alternative	Criteria				Total	Rank
		A	B	C	D		
1	concrete blocks 1x1x0,5	7	10	4	3	24	3
2	Tetrapod 1000 kg	9	8	5	9	31	2
3	Dolos 1000 kg	10	9	10	6	35	1

Of the selected alternatives, then look for the weight of each criterion using *Zero One* as follows:

Table 6
***Zero One* method for determining weight**

Aspect Criteria	Criteria number	Criteria number				Total	Rank
		A	B	C	D		
Implementation cost	**A**	**X**	**1**	**1**	**1**	**3**	**1**
3execution time	**B**	**1**	**X**	**0**	**0**	**1**	**3**
Stability	**C**	**1**	**0**	**X**	**1**	**2**	**2**
Energy dissipation level	**D**	**0**	**0**	**0**	**X**	**0**	**4**

With: 1 = very important, 0 = less important, x = same function

The way to implement the Zero-One method is to collect functions of the same level, then arrange them in a Zero-One matrix in the form of a square. After that, an assessment of the functions is carried out in pairs, so that the matrix will be filled with X. The values in the matrix are then summed up by row and collected in the amount column.

Table 7
Weighting

Criteria	No	Rank	Weight
Implementation cost	**A**	**1**	**100**
Stability	**B**	**2**	**75**
Execution time	**C**	**3**	**50**
Energy dissipation level	**D**	**4**	**25**

According to Hutabarat (1995) in Ustoyo (2007) determine the weight by taking a total weight scale of 100 and the weight is calculated by the formula:

(rank number held/total number rank) X 100

Table 8
Relative Weighting of Alternative Selection

Krieria Aspek	Nomer Kriteria				Total	Rangking	Terpilih
	A	B	C	D			
	100	50	75	25			
Balok Beton 1x1x0.5 m	7 700	10 500	4 300	3 75	**1575**	**3**	
Tetrapod 1000 kg	9 900	8 400	5 375	9 225	**1900**	**2**	
Dolos 1000 kg	10 1000	9 450	10 750	6 150	**2350**	**1**	**1**

Sumber : Hasil Analisa, 2022

From the table above, it is found that the alternative selection table is the manufacture and installation of 1000 kg concrete blocks for Dolos construction

F. Stage Presentation and Action Continue (Recommendation)

From the results of the analysis that has been carried out, it is obtained that the *engineering value* of the Teak Weir rehabilitation work is as follows:

1. The work item that can be done is a stilling pond damper
2. The existing construction is in the form of random piles of concrete blocks in the form of blocks measuring 1x1x0.5 m
3. The alternatives given to replace the existing construction are 1000 kg tetrapod concrete blocks and 1000 kg dolos concrete blocks.
4. The results of the analysis obtained are 1000 kg dolos concrete blocks with a manufacturing and installation cost of Rp. 16,239,115,273.27
5. The value of the cost of making and installing a 1000 kg dolos concrete block is reduced by Rp. 6,252,816,421.53 of the existing construction value
6. The percentage reduction is 27.80% of the existing cost of stilling pond damper items
7. The overall total cost changed from IDR 62,420,557,268.77 (not yet VAT) to IDR 56,167,740,847.24 (not yet VAT) after *value engineering was carried out*

Table 9
Value Engineering Results for the Rehabilitation of Teak Weirs

No	JENIS PEKERJAAN	JUMLAH	JUMLAH TOTAL
I	PEKERJAAN PERSIAPAN		Rp 5,434,571,311.71
II	PEKERJAAN REHAB BENDUNG JATI		Rp 50,733,169,535.53
	2.1 Penambahan Tinggi Mercu	*Rp 2,772,746,676.29*	
	2.2 Pengadaan dan Pemasangan Elektrikal Pintu	*Rp 2,058,509,974.17*	
	2.3 Perbaikan Lantai Apron hulu	*Rp 2,368,721,038.30*	
	2.4 Perbaikan Kolam olak	*Rp 37,721,147,353.08*	
	2.5 Perbaikan Dinding Hilir Bendung Sebelah Kanan	*Rp 1,618,527,664.98*	
	2.6 Perbaikan Lereng Bronjong Saya Hilir Sebelah Kiri	*Rp 3,622,434,625.72*	
	2.7 Penyesuaian Elevasi Pelimpah Samping	*Rp 114,740,730.76*	
	2.8 Galian Sedimen Penguras Kantung Lumpur	*Rp 36,905,732.95*	
	2.9 Galian Sedimen Kantung Lumpur	*Rp 419,435,739.28*	
A	JUMLAH		Rp 56,167,740,847.24
B	PPN	11%	Rp 6,178,451,493.20
C	TOTAL (A + B)		Rp 62,346,192,340.43
D	TOTAL (Dibulatkan)		Rp 62,346,192,000.00
Terbilang : **Enam Puluh Dua Milyar Tiga Ratus Empat Puluh Enam Juta Seratus Sembilan Puluh Dua Ribu Rupiah**			

Sumber ; Hasil Analisa, 2022

scheduling Work

The project reviewed in this study is the Teak Weir construction project after *value engineering was carried out* with the construction of an energy damper from the Dolos Construction.

A. Time Requirement Analysis, Labor and Equipment Requirements

Below is shown an analysis of the needs of labor and equipment for each work item:

A. PREPARATORY WORK
- 1.1 Equipment Mobilization & Demobilization
- 1.2 Making the Board of Directors Keet
- 1.3 Documentation
- 1.4 Occupational Health and Safety (K3)
- 1.5 Installation of the Project Nameplate
- 1.6 Procurement of Steel Sheet Pile 400x125x13.0 - Length 12
- 1.7 Steel Sheet Pile (12 m) - Pile 8 m
- 1.8 Dismantling Steel Sheet Pile 400x125x13.0 - 12 Length
- 1.9 Dewatering
- 1.10 Procurement and installation of galvanized iron pipe dia. 0.75 m - 4 pieces – Intake
- 1.11 Side spillway downstream cover - Jumbo Bag (1 Ton size 0.8 x 0.8 x 0.8
- 1.12 Construction of an access road to the Teak Weir Disposal Area
- 1.13 Construction of Embankment & Access Roads for Steel Sheet Pile Piling

B. TEAK WEIR REHABILITATION WORK
- 2.1 Lighthouse Height Increase
- 2.2 Procurement and Installation of Electrical Doors
- 2.3 Upstream Apron Floor Repair
- 2.4 Repair of stilling pond
- 2.5 Repair of the Downstream Wall of the Right Side of the Weir
- 2.6 Repair of My Gabion Slope Downstream Left
- 2.7 Side Spill Elevation Adjustment
- 2.8 Sediment Excavation of the Mudbag Drain

2.9 Excavation of the Mudbag Sediment

One example of calculating the need for time, labor and tool requirements can be seen in the table below:

Table 10
Calculation of time requirements, labor and tool requirements Job: Making Directors Keet

No.	Permen PU 01 th 2022	Kode	Uraian pekerjaan	Koef.	Sat	Harga Satuan (Rp.)	Jumlah Harga (Rp.)
1	2	3	4	5	6	7	8 = (6) x (7)
f			**Pembuatan Direksi Keet**	1	m2		
			TENAGA		A		135,800.00
			Pekerja	1.200	OH	70,000.00	84,000.00
			Tukang	0.400	OH	90,000.00	36,000.00
			Kepala Tukang	0.040	OH	95,000.00	3,800.00
			Mandor	0.120	OH	100,000.00	12,000.00
			BAHAN		B		2,833,837.10
			Kaso 5/7 cm	0.350	m3	6,122,270.00	2,142,794.50
			Dinding triplek 4 mm	1.000	Lbr	80,000.00	80,000.00
			Fondasi pasangan batu	0.170	m3	-	-
			Plafon asbes 3 mm	1.240	Lbr	82,000.00	101,680.00
			Paku	0.750	kg	15,850.00	11,887.50
			Asbes gelombang	0.300	Lbr	56,603.00	16,980.90
			Paku asbes	0.100	kg	43,442.00	4,344.20
			Floor lantai (Beton lantai kerja)	0.150	m3	-	-
			Pintu Double teakwood rangka kayu	0.100	m2	425,000.00	42,500.00
			Jendela kaca nako	1.000	daun	17,850.00	17,850.00
			Cat Dinding	16.500	kg	25,200.00	415,800.00
			ALAT		C		-
			Jumlah A + B		D		2,969,637.10
			OVERHEAD & PROFIT 15%		E		445,445.57
			Harga Satuan Pekerjaan (D+E)		F		3,415,082.67
Volume				(a)	m2		120.00
Produktifitas Tenaga Kerja				(b)	m2/OH		0.83
Kebutuhan Sumber Daya Manusia				(c) = (a) / (b)	OH		144.00
Rencana Jumlah Pekerja					OH		7.00
Kebutuhan Total Hari					Hari		20.57
Kebutuhan Total Hari (Pembulatan)					Hari		21.00

Source: Analysis Results, 2022

B. Recapitulation Requirements for Time, Labor and Equipment Requirements

From the analysis above, the recapitulation of time, labor and equipment requirements for each work item for the rehabilitation of the teak weir obtained the following results:

Table 11
Recapitulation of Time, Labor and Tool Needs

No	TYPE OF WORK	Sat.	Execution Time (Days)	Power Requirement (Person)	Tool Requirement (Fruit)
I	**PREPARATORY WORK**				
1.1	Equipment Mobilization & Demobilization	Ls	7.00	1.00	0.00
1.2	Making of Directors Keet	M2	21.00	3.00	7.00
1.3	Documentation	Set	7.00	1.00	0.00

No	TYPE OF WORK		Sat.	Execution Time (Days)	Power Requirement (Person)	Tool Requirement (Fruit)
	1.4	Occupational Health and Safety (K3)	Ls	7.00	1.00	0.00
	1.5	Installation of Project Nameplate	Bh	2.00	1.00	0.00
	1.6	Procurement of Steel Sheet Pile 400x125x13.0 - Length 12	Bh	4.00	1.00	0.00
	1.7	Steel Sheet Pile (12 m) - Pile 8 m	M	11.00	2.00	1.00
	1.8	Demolition of Steel Sheet Pile 400x125x13.0 - Length 12	Bh	7.00	1.00	2.00
	1.9	Dewatering	M3	12.00	2.00	35.00
	1.10	Supply and installation of galvanized steel pipes. 0.75 m - 4 pieces - Intake	M	6.00	1.00	12.00
	1.11	Side spillway downstream cover - Jumbo Bag (1 Ton size 0.8 x 0.8 x 0.8)	Bh	7.00	1.00	12.00
	1.12	Construction of an access road to the Teak Bendung Disposal Area				
		a. Jumbo Bag (1 Ton size 0.8 x 0.8 x 0.8)	Bh	7.00	1.00	3.00
		b. Steel Pipe Corrugated Dim Pipe. 1.5m	M	7.00	1.00	3.00
		c. Iron Plate Thickness 2 mm	M2	14.00	2.00	15.00
	1.13	Construction of Embankments & Access Roads for Steel Sheet Pile Piling				
		a. Jumbo Bag (1 Ton size 0.8 x 0.8 x 0.8)	Bh	14.00	2.00	20.00
II	**TEAK WEIR REHABILITATION WORK**					
	2.1	**Lighthouse Height Increase**				
	2.1.1	Ready Mixed Concrete (K-300)	M3	14.00	2.00	67.00
	2.1.2	Bracing (Reinforcement & Anchor D28-400)	kg	18.00	2.00	250.00
	2.1.3	Formwork	M2	16.00	3.00	30.00
	2.1.4	Unload Formwork	M2	8.00	2.00	12.00
	2.1.5	Compaction of concrete at the time of pouring	M3	15.00	3.00	15.00
	2.1.6	Unload Stone Pairs With Tools	M3	7.00	1.00	2.00
	2.1.7	Stone Pairing With Mortar (Mix 1PC : 4PP)	M3	2.00	1.00	40.00
	2.1.8	Broadcast With Mortar (Mix 1PC : 2PP)	M2	14.00	2.00	4.00

No	TYPE OF WORK		Sat.	Execution Time (Days)	Power Requirement (Person)	Tool Requirement (Fruit)
	2.2	**Door Electrical Procurement and Installation**				
	2.2.1	Old Door Demolition	Bh	6.00	1.00	15.00
	2.2.2	Supply and Installation of Intake Electrical Doors (1.80 mx 3.00 m)	Set	21.00	3.00	10.00
	2.2.3	Supply and Installation of Drain Electrical Doors (2.50 mx 3.00 m)	Set	14.00	2.00	10.00
	2.2.4	Procurement and installation of 30 kVA generators and accessories	Set	14.00	2.00	10.00
	2.3	**Upstream Apron Floor Repair**				
	2.3.1	Unloading Concrete With Tools	M3	13.00	2.00	48.00
	2.3.2	Mixed Concrete Work Floor 1PC : 2PB : 3Kr	M3	7.00	1.00	20.00
	2.3.3	Ready Mixed Concrete (K-300)	M3	15.00	2.00	34.00
	2.3.4	Reinforcing	kg	15.00	2.00	210.00
	2.3.5	Formwork (One Use)	M2	1.00	1.00	5.00
	2.3.6	Unload Formwork	M2	1.00	1.00	1.00
	2.3.7	Compaction of concrete at the time of pouring	M3	16.00	3.00	8.00
	2.3.8	Soil Excavation With Heavy Equipment (Excavator)	M3	17.00	3.00	17.00
	2.3.9	Excavated Soil Is Discarded With A Distance Of 1 Km	M3	21.00	3.00	0.00
	2.3.10	Procurement of Sheet Pile (W500 - Width 0.9 - Length 6 m)	Bh	7.00	1.00	0.00
	2.3.11	Sheet Pile Piling (W500 - Width 0.9 - Length 6 m)	M	14.00	2.00	3.00
	2.4	**Stilling pond repair**				
	2.4.1	Ready Mixed Concrete (K-300)	M3	20.00	3.00	167.00
	2.4.2	Reinforcing	kg	18.00	2.00	230.00
	2.4.3	Formwork (One Use)	M2	5.00	1.00	4.00
	2.4.4	Unload Formwork	M2	4.00	1.00	1.00
	2.4.5	Compaction of concrete at the time of pouring	M3	20.00	3.00	41.00
	2.4.6	Soil Excavation With Heavy Equipment (Excavator)	M3	7.00	1.00	30.00

No	TYPE OF WORK		Sat.	Execution Time (Days)	Power Requirement (Person)	Tool Requirement (Fruit)
	2.4.7	Excavated Soil Is Discarded With A Distance Of 1 Km	M3	8.00	2.00	0.00
	2.4.8	Sheetpile Procurement (W500 - Width 0.9 - Length 12 m)	Bh	7.00	1.00	0.00
	2.4.9	Sheetpile Piling (W500 - Width 0.9 - Length 12 m)	M	7.00	1.00	17.00
	2.4.10	Unload Gabion	Bh	16.00	2.00	200.00
	2.4.11	Procurement of Sheet Pile (W500 - Width 0.9 - Length 6 m)	Bh	7.00	1.00	0.00
	2.4.12	Sheet Pile Piling (W500 - Width 0.9 - Length 6 m)	M	24.00	4.00	5.00
	2.4.13	Soil Excavation (Olak Pond Downstream)	M3	25.00	4.00	15.00
	2.4.14	Excavated Soil Is Discarded With A Distance Of 1 Km	M3	25.00	4.00	0.00
	2.4.15	Production & installation of concrete blocks measuring 1x1x0.5 m	Bh	39.00	12.00	20.00
	2.4.16	Manufacture & Installation of concrete blocks measuring 1x1x1 m (Groundsill)	Bh	30.00	4.00	0.00
	2.4.17	Geotextile (Under Concrete Block)	M2	14.00	2.00	40.00
	2.5	**Repair of the Right Lower Wall of the Weir**				
	2.5.1	Cyclops Concrete	M3	8.00	2.00	70.00
	2.5.2	Ready Mixed Concrete (K-300)	M3	6.00	1.00	17.00
	2.5.3	Reinforcing	kg	7.00	1.00	100.00
	2.5.4	Formwork	M2	6.00	1.00	2.00
	2.5.5	Unload Formwork	M2	2.00	1.00	1.00
	2.5.6	Compaction of concrete at the time of pouring	M3	6.00	0.00	4.00
	2.5.7	Broadcast With Mortar (Mix 1PC : 2PP)	M2	5.00	0.00	15.00
	2.5.8	Unload Stone Pairs With Tools	M3	6.00	1.00	2.00
	2.5.9	Procurement of Sheetpile W-500/90/12	Bh	7.00	1.00	0.00
	2.5.10	Sheetpile erection	M	6.00	1.00	7.00
	2.5.11	Urugan Sirtu	M3	7.00	1.00	150.00
	2.6	**My Gabion Slope Repair Downstream Left**				
	2.6.1	Unload Gabion	Bh	14.00	2.00	70.00

No	TYPE OF WORK		Sat.	Execution Time (Days)	Power Requirement (Person)	Tool Requirement (Fruit)
	2.6.2	Procurement of Minipile (20 cm x 20 cm, W = 3 m)	Bh	7.00	1.00	0.00
	2.6.3	Minipile erection	M	7.00	1.00	6.00
	2.6.4	Installation of New Gabions (2 mx 1 mx 0.5 m)	Bh	15.00	2.00	50.00
	2.6.5	Installation of demolition stone gabions (2 m x 1 m x 0.5 m)	Bh	22.00	3.00	50.00
	2.6.6	Sheetpile Procurement (W500 - Width 0.9 - Length 12 m)	Bh	7.00	1.00	0.00
	2.6.7	Sheetpile Piling (W500 - Width 0.9 - Length 12 m)	M	21.00	3.00	5.00
	2.6.8	Ready Mixed Concrete (K-300) (for Capping Beam)	M3	3.00	1.00	9.00
	2.6.9	Reinforcing	kg	7.00	1.00	30.00
	2.6.10	Formwork (one time use)	M2	2.00	1.00	25.00
	2.6.11	Unload Formwork	M2	1.00	1.00	9.00
	2.6.12	Compaction of concrete at the time of pouring	M3	3.00	1.00	2.00
	2.7	**Side Spill Elevation Adjustment**				
	2.7.1	Unloading Concrete With Tools	M3	14.00	2.00	39.00
	2.7.2	Plastering With Mortar (Mix 1PC : 3PP)	M2	5.00	1.00	2.00
	2.8	**Sediment Excavation of Mudbag Drainage**				
	2.8.1	Soil Excavation With Heavy Equipment (Excavator)	M3	4.00	1.00	30.00
	2.8.2	Excavated Soil Is Discarded With A Distance Of 1 Km	M3	9.00	2.00	0.00
	2.9	**Excavation of the Mudbag Sediment**				
	2.9.1	Soil Excavation With Heavy Equipment (Excavator)	M3	20.00	2.00	66.00
	2.9.2	Excavated Soil Is Discarded With A Distance Of 1 Km	M3	33.00	4.00	0.00

C. Preparation Timetable Work

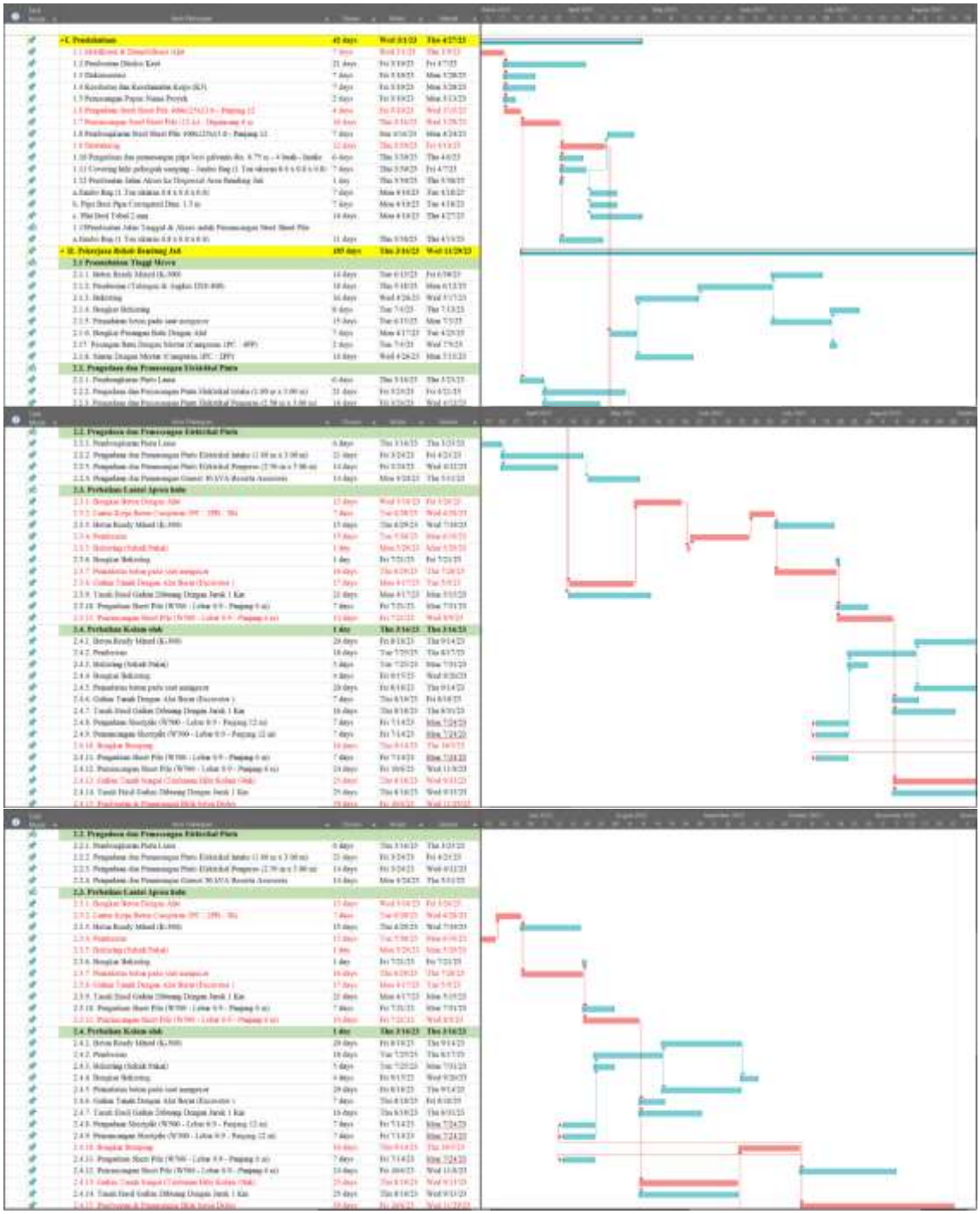
Preparation of work schedules using the help of Microsoft Project Manager 2021 to make preparation easier. Planned preparation:

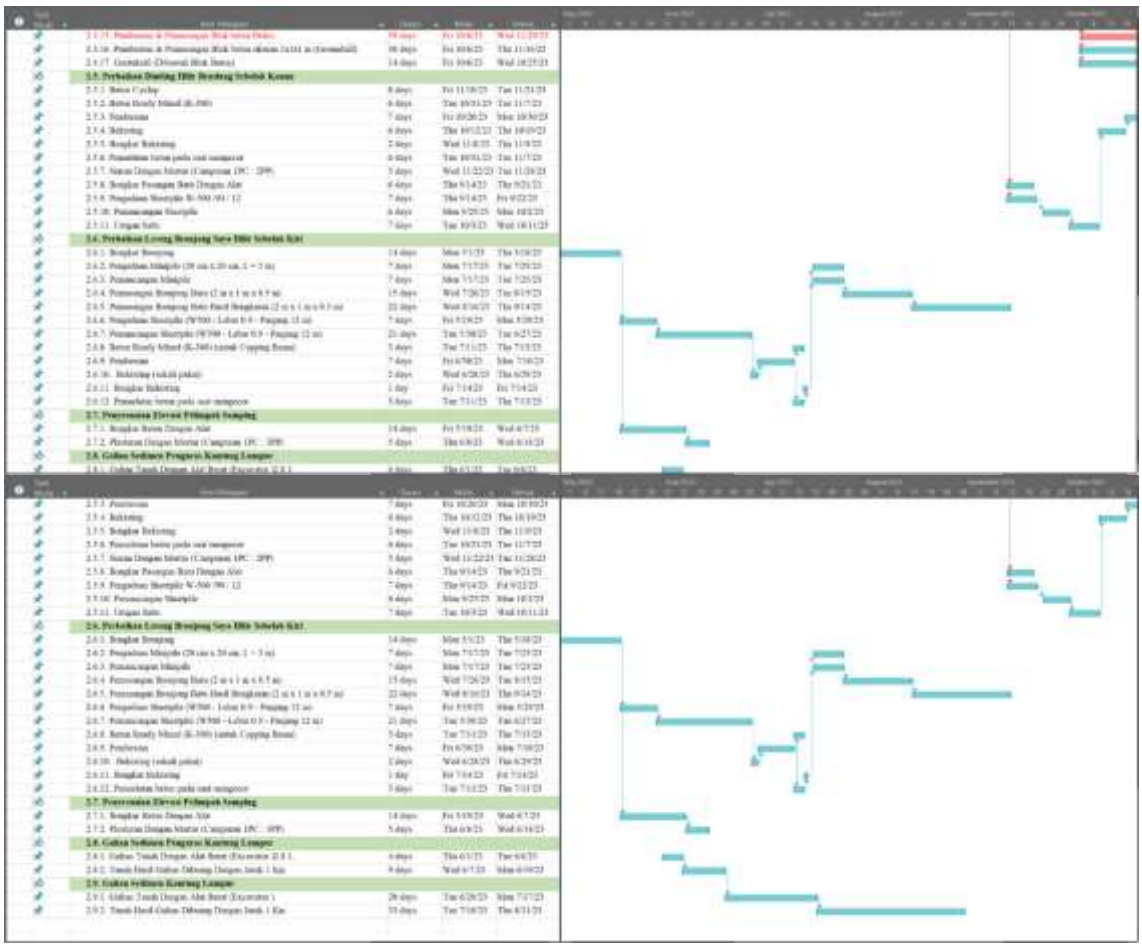
- Working Hours from 08.00 to 17.00 with lunch break from 12.00 to 13.00
- Working Days from Monday to Friday

- Total working hours 8 hours per day
- The number of working days is 20 days in a month

The results of the preparation of the work schedule can be seen in the image below:

Table 12
Plan Timetable Work Rehabilitation Weir Teak





CONCLUSION

1. The results of value engineering analysis are as follows:
   - The work item that can be done is a stilling pond damper
   - The existing construction is in the form of random piles of concrete blocks in the form of blocks measuring 1x1x0.5 m
   - The alternatives given to replace the existing construction are 1000 kg tetrapod concrete blocks and 1000 kg dolos concrete blocks.
   - The results of the analysis obtained are 1000 kg dolos concrete blocks with a manufacturing and installation cost of Rp. 16,239,115,273.27
   - The value of the cost of making and installing a 1000 kg dolos concrete block is reduced by Rp. 6,252,816,421.53 of the existing construction value
   - The percentage reduction is 27.80% of the existing cost of stilling pond damper items
   - The overall total cost changed from IDR 62,420,557,268.77 (not yet VAT) to IDR 56,167,740,847.24 (not yet VAT) after *value engineering was carried out*
2. Recapitulation of the Teak Weir Rehabilitation Work Plan Schedule is planned with:
   - Working Hours from 08.00 to 17.00 with lunch break from 12.00 to 13.00
   - Working Days from Monday to Friday
   - Total working hours 8 hours per day

- The number of working days is 20 days in a month

With this plan, a work schedule plan for Teak Weir Rehabilitation is obtained:

- For Preparatory Work takes a total of 42 working days
- For Teak Weir Rehab Work it takes a total of 185 working days
- Work starts from 01 March 2023 and ends on 29 November 2023

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