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Research Paper

Implementation of Value Engineering For Optimization of Road Reconstruction Project Financing Case Study: Cibadak – Padasuka Road Section Project, Lebak Regency, Banten Province

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ABSTRACT: *Road reconstruction is one of the important infrastructure projects in supporting economic growth and community mobility. However, such projects are often faced with budget constraints, which require the application of effective methods for cost management. One method that can be used is Value Engineering (VE), which aims to optimize costs without reducing the quality or function of the project. This study focuses on the implementation of VE in the Cibadak - Padasuka road reconstruction project in Lebak Regency, Banten. The study was conducted through an analysis of several project components that have the potential to be optimized, using methods such as Pareto analysis, and Life Cycle Cost (LCC) analysis. The results of the study indicate that 1. The work item that is the subject of Value Engineering study in this study is Road Paving work; 2. The Value Engineering study obtained 3 alternatives, namely the Rigid Pavement Method PPCP, SPRigWP & Flexible Pavement; 3. The construction cost value of Value Engineering is: • Alternative 1 PPCP Method against alternative 0 (Conventional Concrete/Cast In Situ) experienced an increase in construction costs of Rp. 324,545,518.51 or 3.30%, • Alternative 2 SPRigWP Method against alternative 0 (Conventional Concrete/Cast In Situ) experienced an increase in construction costs of Rp. 2,693,845,581.45,- or 30.75%, • Alternative 3 Flexible Pavement compared to alternative 0 (Conventional Concrete/Cast In Situ) experienced a decrease in construction cost of Rp. 1,368,807,868.21, or 15.63%; 4. The Life Cycle Cost (LCC) value from Value Engineering is: • Alternative 1 PPCP Method compared to alternative 0 (Conventional Concrete/Cast In Situ) experienced a decrease in Life Cycle Cost (LCC) of Rp. 1,020,655,389.33,- or 9.55%, • Alternative 2 SPRigWP Method against alternative 0 (Conventional Concrete/Cast In Situ) experienced an increase in Life Cycle Cost (LCC) of Rp. 1,375,850,167.98 or 12.87%, • Alternative 3 Flexible Pavement against alternative 0 (Conventional Concrete/Cast In Situ) experienced an increase in Life Cycle Cost (LCC) of Rp. 10,697,757,430.34 or 100.07%. So that in the study conducted on the Cibadak - Padasuka Road Reconstruction Project, Warunggunung District, Lebak Regency, Banten Province Alternative 1 Precast Prestressed Concrete Pavement (PPCP) Rigid Pavement Method is the recommendation with the lowest LCC value.This research is expected to provide practical recommendations that can be applied to similar projects in the future, as well as contributing to the development of science in the field of civil engineering and project management.*

KEYWORDS: *Value Engineering, Road Reconstruction, Cost Savings, Life Cycle Cost, Lebak Regency*

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I. INTRODUCTION

The development and maintenance of road infrastructure is a fundamental element in supporting economic growth and community mobility. Good roads not only increase logistics efficiency and strengthen connectivity between regions, but also play an important role in reducing transportation costs and accelerating the distribution of goods and services[1]. In Indonesia, the need for adequate road infrastructure is increasingly urgent along with the increasing volume of traffic and rapid economic development. Severely damaged road conditions require immediate reconstruction measures to ensure that the road can function optimally again. However, like many other infrastructure projects, road reconstruction is faced with major challenges in the form of budget constraints [1], [2], [3]. Limited budget is one of the biggest obstacles in road construction projects. High costs for materials, labor, and equipment often cause road construction projects to fail to be completed on time or according to expected specifications. Therefore, methods and strategies are needed that can help optimize budget use without reducing project quality [4], [5]. One approach that can be implemented to overcome budget problems is Value Engineering (VE). VE is a systematic method that aims to increase the value of a project by identifying and eliminating unnecessary costs without reducing its quality, performance, or reliability [6]. VE can help reduce project costs by evaluating the function of each project component and finding cheaper but still effective alternatives [3].

Referring to the Circular issued by the Ministry of Public Works and Public Housing, Directorate General of Highways No. II/SE/Db/2022 concerning Guidelines for the Implementation of Value Engineering, road or bridge infrastructure projects have sufficient basis for the implementation of Value Engineering. In 2023, the Governor of Banten issued Governor Decree No. 620/Kep.16-Huk/2023 Concerning the Determination of the Status, Function and Class of Banten Provincial Roads and the Determination of the Function of Regency/City Roads in the Banten Province Area Outside the Primary Arteries and Primary Collectors In this Decree, Many Roads in the Banten Area Experienced Changes in Road Function and Were Reconstructed, One of Which is the Cibadak-Padasuka Road Reconstruction Project Which Will Be the Project Study in This Research, The Application of VE to the Cibadak-Padasuka Road Reconstruction Project Is Expected to Generate Cost Savings, Through Detailed Analysis, VE Enables the Identification of Project Components That Can Be Changed or Replaced with More Economical Alternatives The Use of Local Materials That Are Cheaper But Still Meet Quality Standards Can Be One Way to Reduce Costs [7], [8], [9]. In addition, VE can also help in optimizing the use of resources With systematic analysis, VE can identify steps that can be eliminated or simplified without affecting the final outcome of the project. This not only reduces costs but can also speed up the project completion time, which ultimately reduces the total project cost[1], [10], [11], [12]. The implementation of VE can help reduce the financial risks associated with road construction projects By identifying and eliminating unnecessary costs, projects can become more cost-effective and more resilient to budget fluctuations This is especially important in the context of infrastructure projects that often face budget uncertainty and pressure to complete projects on time. The implementation of VE can also contribute to increased transparency and accountability in project management The VE process involving various stakeholders, including contractors, engineers, and project managers, can ensure that every decision taken is based on detailed analysis and accurate data. This can increase stakeholder confidence in the project and reduce potential conflicts related to cost and quality[6], [13], [14]. This study aims to implement VE in the Cibadak-Padasuka road reconstruction project with a focus on cost savings. The case study on this road section is expected to provide comprehensive data and analysis on the effectiveness of VE in optimizing project costs without sacrificing quality. This study will also identify factors that influence the success of VE implementation and provide practical recommendations that can be applied to similar projects in the future. Thus,This study not only aims to provide practical solutions for the Cibadak-Padasuka road reconstruction project, but is also expected to make a significant contribution to the development of science in the field of civil engineering and project management. The results of this study can be a reference for various parties in making decisions related to road construction projects, so that it is expected to help overcome budget challenges that are often faced in infrastructure projects in Indonesia.

Overall, the background of this study highlights the importance of implementing VE in government projects, especially road reconstruction projects to optimize costs and improve quality. Challenges in project budget management can be overcome with a systematic and effective approach such as VE. This study aims to provide empirical evidence on the benefits of VE in the Cibadak-Padasuka road reconstruction project, as well as providing practical recommendations that can be applied to similar projects in the future.

II. RESEARCH METHODOLOGY

The comparative analysis method is a comparative study. This study was conducted to compare the similarities and differences of two or more facts and properties of the objects studied based on a certain framework of thought that is more creative and profitable[15]. In this study, the variables are still independent but for samples that are more than one or at different times. Several data collection methods to analyze value engineering in the Cibadak - Padasuka Road Reconstruction Project, Warunggunung District, Lebak Regency, Banten Province:

a. Primary Data

Is a source of data obtained directly from the original source or first party. Which is done by interviewing, recording and field surveys.

b. Secondary Data

Secondary data obtained directly from the company that built the Cibadak - Padasuka Road Reconstruction Project, including the data in question such as the Cost Budget Plan (RAB), Unit Price of Workers' Wages, Unit Price of Materials, BOQ and other references.

This study uses Value Engineering research which is guided by circular letter No. 11/SE/Db/2022 concerning guidelines for implementing value engineering techniques (Value Engineering) which aims to reduce costs as much as possible without reducing quality, quality and function. The following is a picture of the stages of this research.

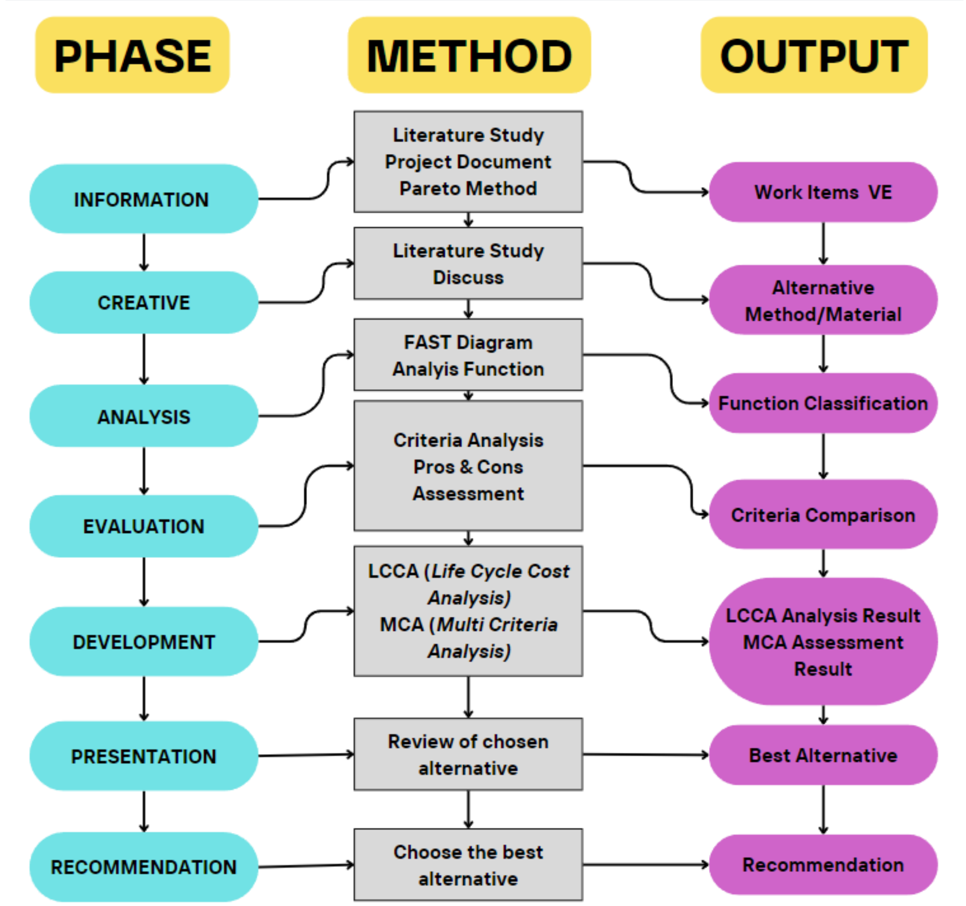

Figure 1. Research Stages

III. RESULTS AND DISCUSSION

3.1 Project Overview

The Cibadak - Padasuka road reconstruction project in Lebak Regency, Banten Province is one of the roads that has experienced an increase in status to a provincial road through the governor's decree number 620 / Kep.16-Huk / 2023 which was previously a district / city road. The following is general project data:

• Project Name : Reconstruction of the Cibadak - Padasuka Road Section
• Work Location : Warunggunung District, Lebak Regency, Banten Province
• Project Owner : Banten Provincial Government, Public Works and Spatial Planning Service, Highways Sector
• Project Value : 13,032,975,378.02 Billion
• Road Length : 1968 m

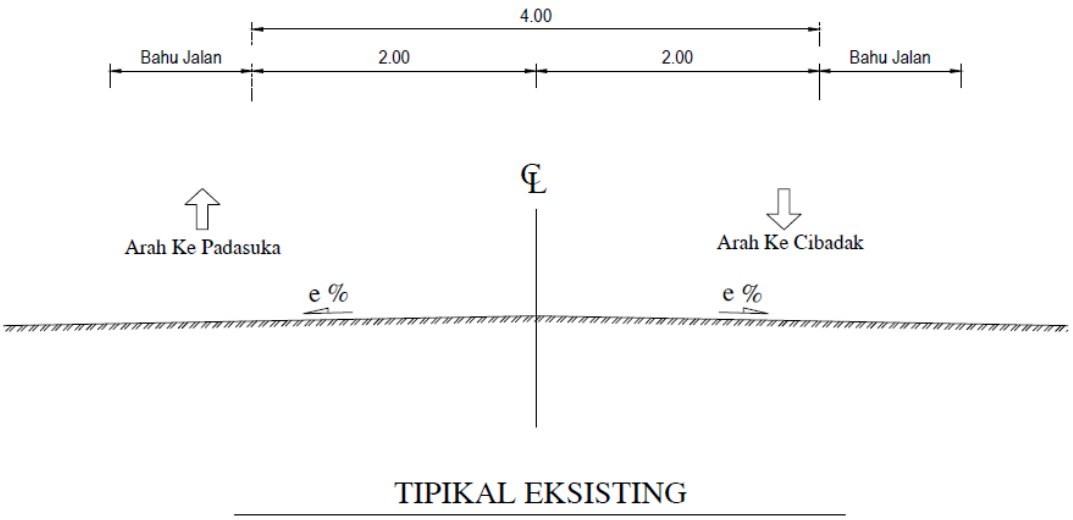

Figure 2. Existing Road Design

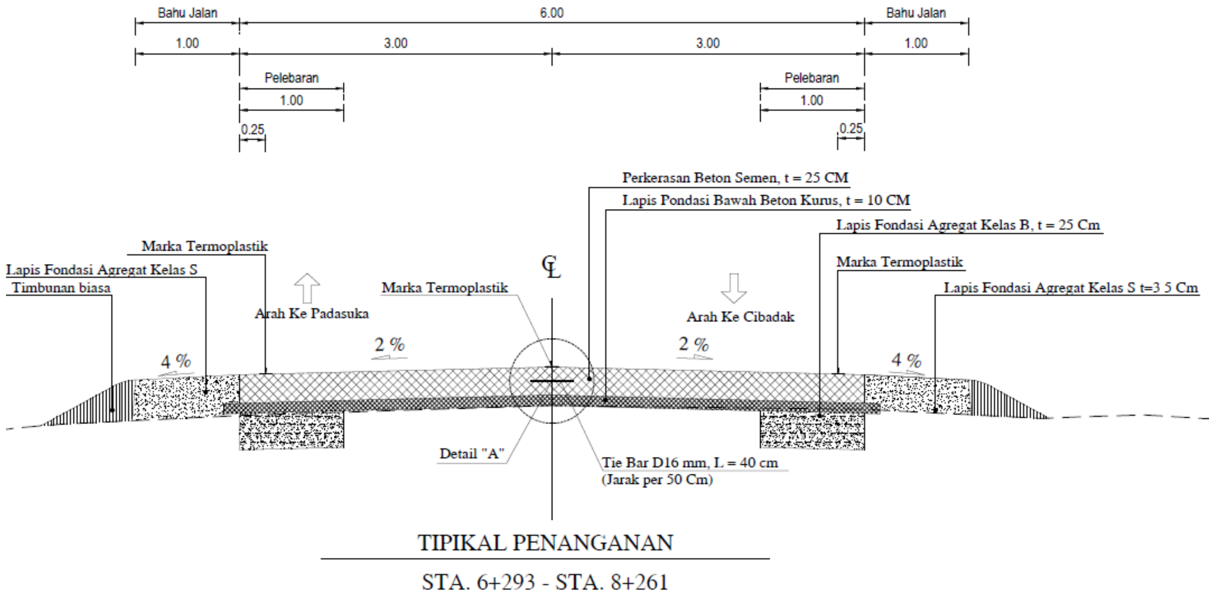

Figure 3. Road Reconstruction Design Plan

3.2 Information Stage

Based on the work plan in Value Engineering, the initial stage that must be passed in the Value Engineering study is to collect as much information as possible about the project planning design starting from general data to the design limitations needed in the project. Then continue to identify work items using Pareto analysis.

Table 1. Summary of the Cibadak – Padasuka Road Reconstruction Project, Warunggunung District, Lebak Regency, Banten

No	Job description	Amount
1	General	Rp. 364,864,864.86
2	Drainage	Rp. 911,171,173.68
3	Earthworks and Geosynthetics	Rp. 531,181,911.26
4	Rigid Pavement	Rp. 8,759,914,418.55
5	Structure	Rp. 2,285,651,119.02
6	Daily Work and Others	Rp. 180,191,891.02
	Amount	Rp. 13,032,975,378.38
	PPn	Rp. 1,433,627,291.62

	Total Value	Rp. 14,466,602,670.01
	Rounding	Rp. 14,466,602,000.00

Source: Personal Processing

3.2.1 Cost Breakdown

Cost breakdown is achieved by creating a work chart grouped by each work element. The chart also contains a cost budget plan for each work item, sorted from the largest to the smallest nominal. This cost model was created to select which work will be included in the value engineering by looking at the work chart process. We can see the cost variance for each work element, which we use as a guide for value engineering analysis. Systematically, the cost model illustrates the progress of the project in the form of project milestones in a global format. As a result, by illustrating the cost model, we can better understand the progress of the project in detail. In addition, the function of this cost model is very important in ensuring that the business or project can run efficiently, meet its financial goals, and operate profitably.

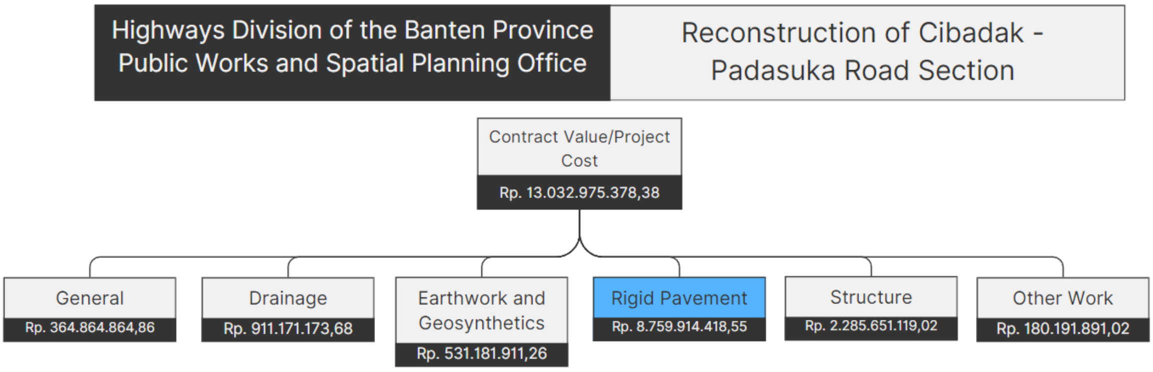

Figure 4. Cost Model Project Cost Recapitulation

3.2.2 Testing Pareto's Law

Pareto analysis is done to find out the highest cost on work that has the potential to be analyzed for value engineering. Steps in testing the Pareto law:

1. Sort the cost of the work from the largest to the smallest
2. The total cumulative cost of the work.
3. Calculate the percentage of the cost of each job.
4. Calculate cumulative percentage
5. Create cumulative presentation placement

The Pareto results of the total overall costs can be seen in table 2 below:

Table 2. Pareto Level 1 Test Results

No	Job description	Price	Price Percentage	Cumulative Percentage
1	Rigid Pavement	Rp. 8,759,914,418.55	67.21%	67.21%
2	Structure	Rp. 2,285,651,119.02	17.54%	84.75%
3	Drainage	Rp. 911,171,173.68	6.99%	91.74%
4	Earthworks and Geosynthetics	Rp. 531,181,911.26	4.08%	95.82%
5	General	Rp. 364,864,864.86	2.80%	98.62%
6	Daily Work and Others	Rp. 180,191,891.02	1.38%	100.00%
	Amount	Rp. 13,032,975,378.38		

Source: Personal Processing

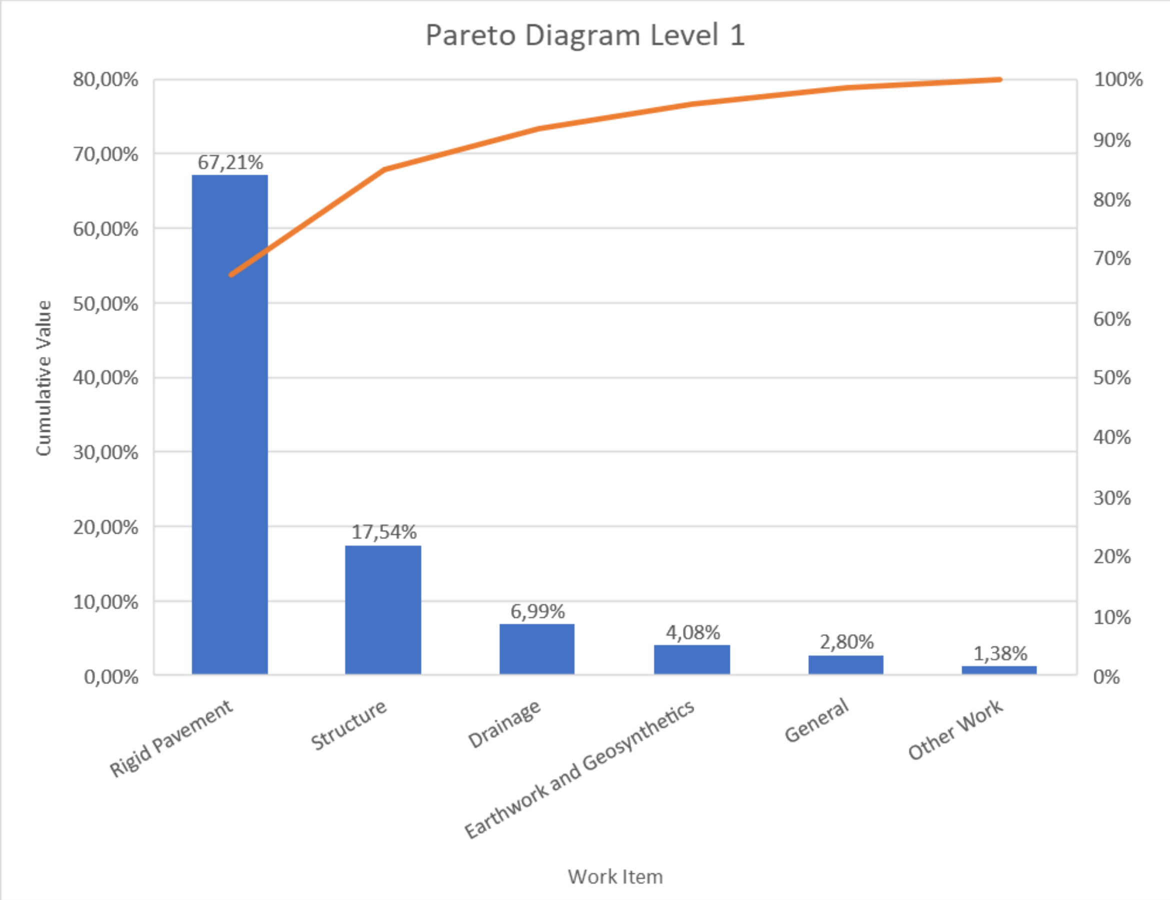

Figure 5. Pareto diagram level 1

From the overall Pareto results of the project costs, it can be seen that in this project the work that has the largest weight is the Rigid Pavement Work at 67.21%. This work component will be analyzed again with Pareto at the next level, namely level 2.

Table 3. Pareto Level 2 Test Results

No	Job description	Unit	Estimated Quantity	Unit Price (Rp.)	Total Price (Rp.)	Weight	Pareto
1	Cement Concrete Pavement Fs 4.5 Mpa	M3	3135	1,959,459.46	6,142,905,407.10	70.13%	70.13%
2	Skinny Concrete Base Layer	M3	1295.8	1,238,738.74	1,605,157,659.29	18.32%	88.45%
3	Class B Aggregate Foundation Layer	M3	1045	522,522.52	546,036,033.40	6.23%	94.68%
4	Class S Aggregate Foundation Layer	M3	869	536,036.04	465,815,318.76	5.32%	100.00%
				Amount	8,759,914,418.55		

The last Pareto calculation is level 2 with the Concrete Pavement work item being the dominant result of the Rigid Pavement work item breakdown of 70.13%. This figure is quite large compared to other jobs that have a much smaller percentage. Therefore, the Cement Concrete Pavement work Fs 4.5 Mpa. Will be discussed in this VE study.

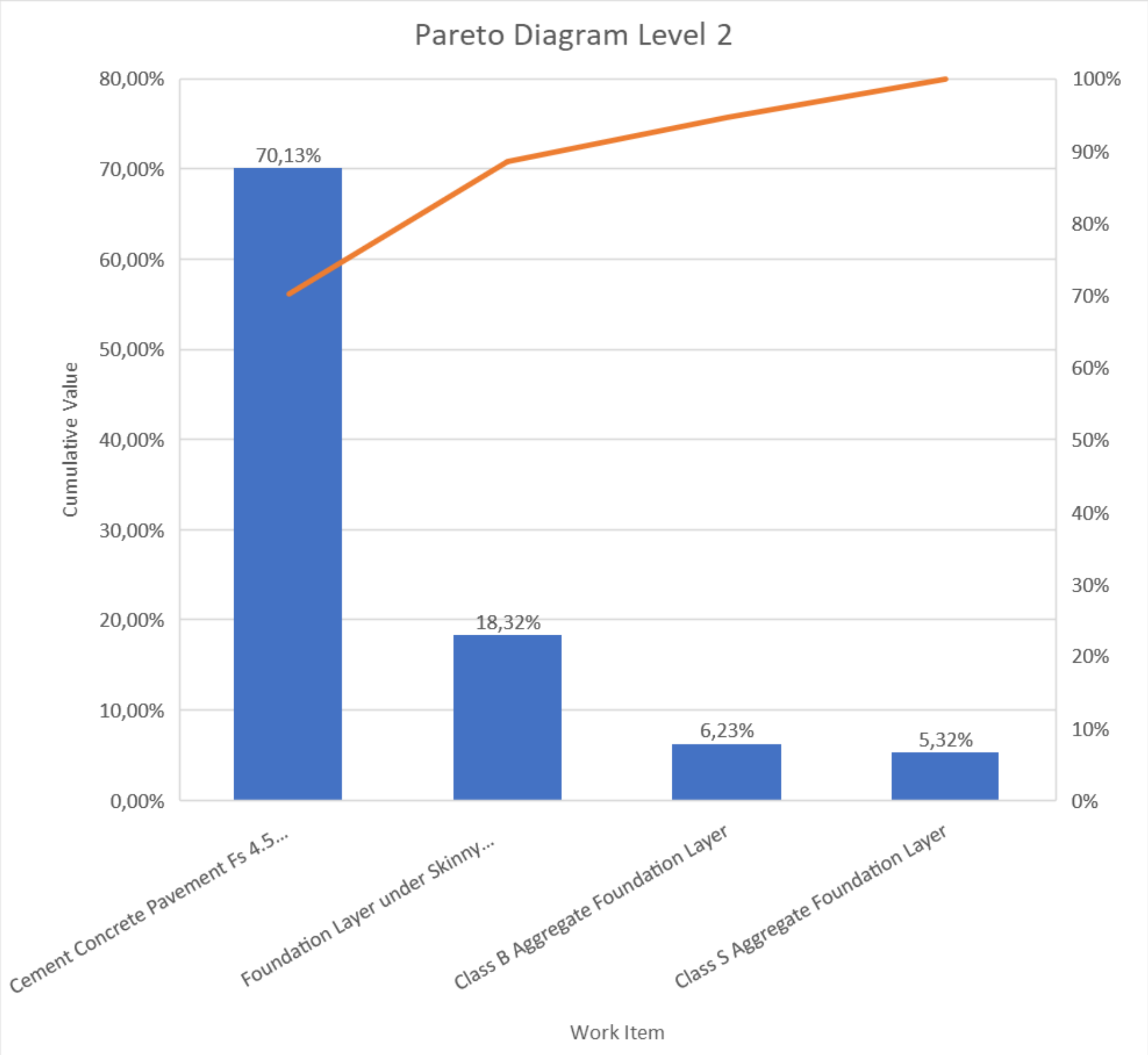

Figure 6. Pareto Chart Level 2

3.4 Creative Stage

The creative stage aims to obtain alternative designs that can fulfill the basic function of the item. Alternative methods are obtained through previous research or by following the development of existing technology which is certainly supported by field studies on productivity and the possibility of implementing the method at the relevant location. These results are then used as evaluation material to select the alternative chosen in the next stage.

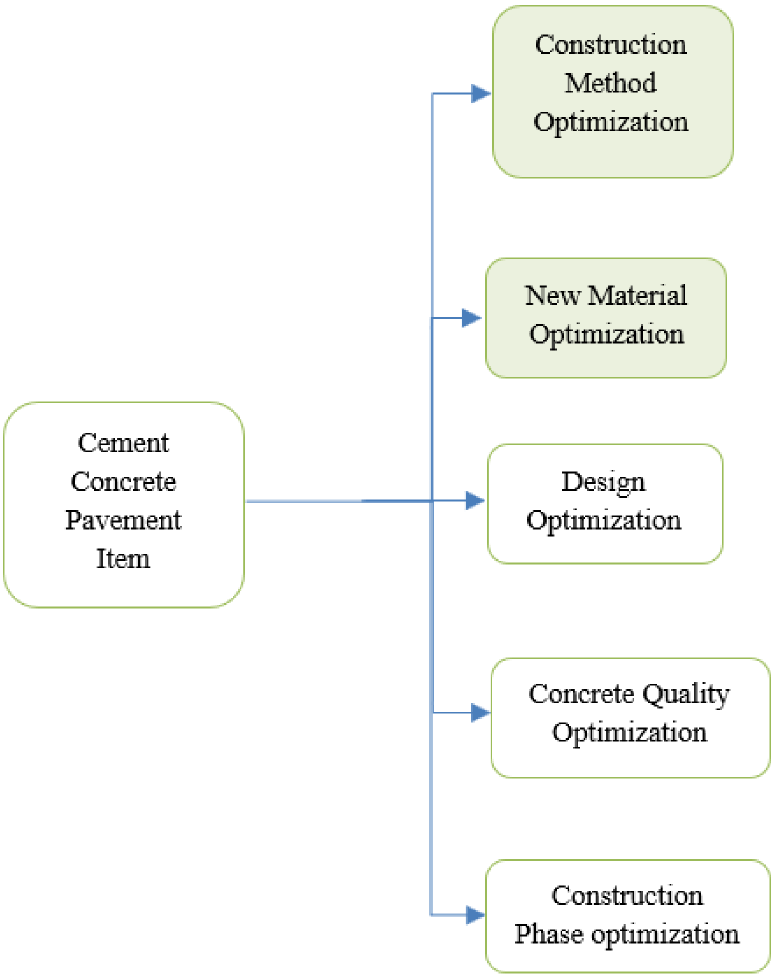

Figure 7. Creative Phase of Cement Concrete Paving Work

Of the five methods that can be implemented in this VE Job Plan, optimization of the construction phase is not an option due to the project deadline that does not allow it to be applied to the construction zone. Therefore, the pavement construction method is chosen. Based on research that has been conducted on previous studies, alternative 1 uses PPCP Precast Concrete as a substitute material, alternative 2 uses SPRigWP Precast Concrete & alternative 3 Flexible Pavement.

Table 4.Selection of Alternative Methods for Cement Concrete Pavement Work

No	Method Code	Concrete Type
1	Alternative 0	Cast In Situ (CIS) Concrete Pavement Method
2	Alternative 1	Prestressed Concrete Pavement (PPCP) Method
3	Alternative 2	Precast Concrete Pavement Method SPRigWP
4	Alternative 3	Flexible Pavement

The basis for selecting the precast concrete method in construction projects, precast concrete has been used in many projects such as building projects, bridge projects, docks, etc. Precast concrete is known as an effective method in terms of work time and maintenance which is relatively easier than conventional concrete, the age of precast concrete can also be achieved the same as the planned age of the project.

3.4.1 PPCP Precast Concrete

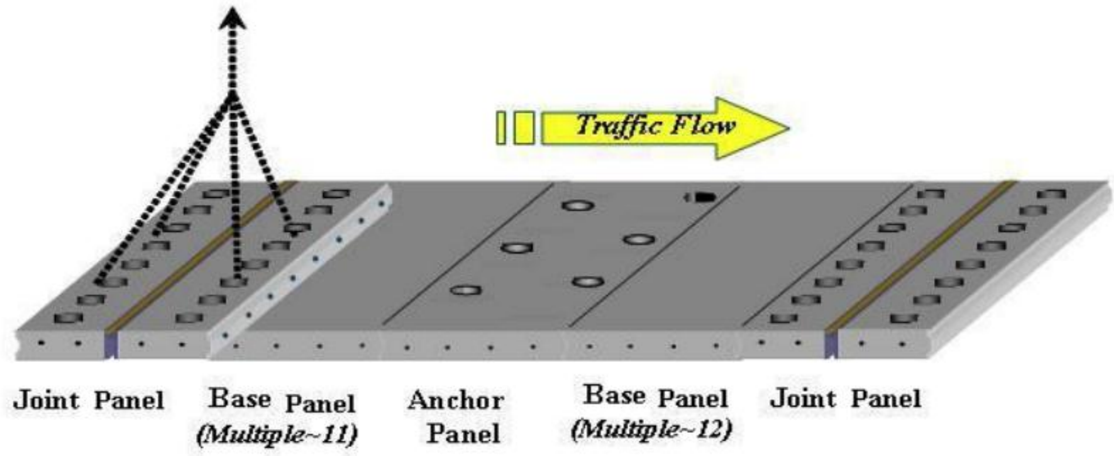

Figure 8. PPCP Precast Concrete (Adhi Beton)

Concrete pavement with the PPCP (Precast Prestressed Concrete Pavement) method is a concrete pavement without reinforcement but uses prestressed cables to reduce the effects of shrinkage, expansion and elasticity of the pavement due to changes in temperature and humidity. In this pavement, concrete is formed according to dimensions based on the existing planning design and documentation. The concrete is then given prestressing pressure, which can be used to press one molded concrete against another, so that each molded concrete becomes a single unit. In this case, prestressing is done using a combination of post-tension systems and transverse reinforcement. This prestressing provides many benefits to long-term pavement performance, and creating compressive stress on the slab helps reduce or even eliminate cracks and reduces the required slab thickness.

3.4.2 Precast Concrete SPRigWP

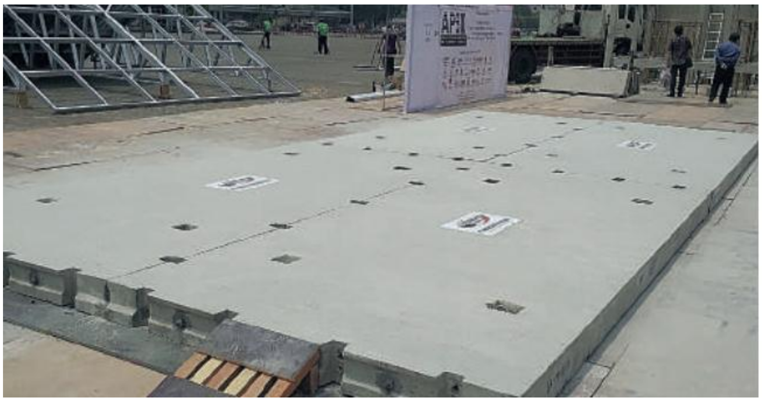

Figure 9. Precast Concrete SPRigWP (waskitaprecast.co.id)

Next, for alternative 2, a new innovation precast concrete was chosen, namely precast concrete SPRigWP, which is a precast prestressed unbonded continuous reinforced concrete pavement system, a new innovation of Continuously Reinforced Concrete Pavement (CRCP) with Unbonded Prestressing made in the form of precast panel modules. The precast panels arranged into this continuous rigid pavement use a special connection system resulting from the latest innovation called the dowel activator.

3.4.3. Flexible Pavement

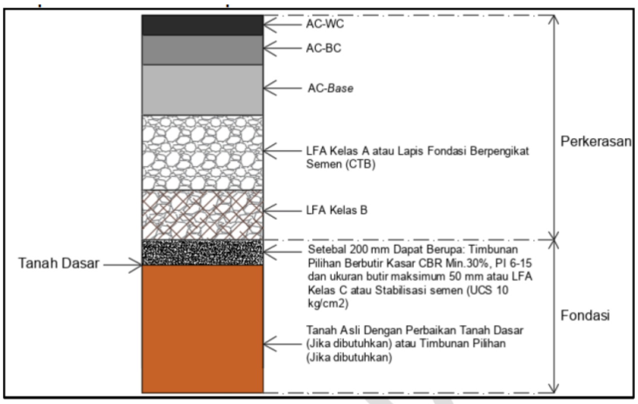

Figure 10. Flexible Pavement Layer Structure (Pavement Design Manual 2024)

Flexible pavement is a road pavement system that uses a bituminous binder, such as asphalt, to bind the aggregate and form a flexible surface layer. According to Huang (2004), this pavement is designed to distribute traffic loads evenly to the underlying soil layer, reducing stresses that can cause cracking. The main characteristic of flexible pavement is its flexibility, which allows it to adapt to deformations and changes in the subgrade (Huang, YH Pavement Analysis and Design. 2004).

Flexible pavements offer advantages in terms of flexibility and adaptability to environmental conditions and traffic loads. Proper material selection, careful design, and proactive maintenance are key factors in improving the performance and longevity of flexible pavements. Recent research and innovation continue to focus on improving the efficiency and effectiveness of these pavement systems, making them a popular choice in road construction in many countries.

3.5 Evaluation Stage

At this evaluation stage, a deeper analysis of alternative 0 and other alternatives is carried out. The evaluation stage consists of selecting design criteria, calculating each criterion, and finally calculating the weight of the criteria, scoring, and calculating the total value.

3.5.1. Design Criteria

At this stage, several criteria are selected that are considered to have importance (priority) in selecting alternatives. The criteria selected based on references are cost, quality and time (Steven & Tamtana, 2020). Cost is defined as the total cost of Granular Pavement work for the entire project. And time is defined as the total duration of the Pavement item work.

3.5.2. Costs

At this stage, cost calculations are carried out on each type of pavement to determine the amount of initial costs which are then used as a reference for calculating the total cost of each method. Calculations are carried out on pavement work STA. 6+293 – STA. 8+261.

Figure 11. Existing Road STA.8+261

A. Cast In Situ (CIS) Cement Concrete Pavement

In CIS concrete pavement work, several stages of work are carried out before reaching the pavement layer, namely making the foundation layer first, the following is a budget plan for the cast in situ (CIS) method of pavement work.

Table 5. CIS Cost Estimate

No	Job description	Unit	Estimated Quantity	Unit Price (Rp.)	Total Price (Rp.)
1	Cement Concrete Pavement Fs 4.5 Mpa	M3	3135	1,959,459.46	6,142,905,407.10
2	Skinny Concrete Base Layer	M3	1295.8	1,238,738.74	1,605,157,659.29
3	Class B Aggregate Foundation Layer	M3	1045	522,522.52	546,036,033.40
4	Class S Aggregate Foundation Layer	M3	869	536,036.04	465,815,318.76
				Amount	8,759,914,418.55

Based on the budget plan above, it is known that for cast in situ pavement, the unit price is Rp. 1,959,459.46 per m3, if totaled with other work, the CIS pavement work costs Rp. 8,759,914,418.55.

B. PPCP (Precast Prestress Concrete Pavement) Concrete Pavement Method

In PPCP concrete work, the work method applied is different from CIS, because PPCP is precast concrete, meaning that the concrete is made and molded in advance and sent to the job site, unlike CIS, concrete casting is done at the job site/location. The application of the PPCP method is carried out with installation, which means that installation costs are required, for more details, see the following table.

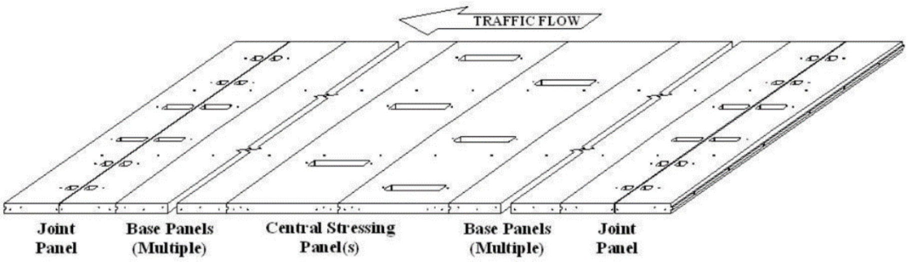

Figure 12. PPCP Composition

Table 6. PPCP Cost Estimate

No	Job description	Unit	Estimated Quantity	Unit Price (Rp.)	Total Price (Rp.)
1	Skinny Concrete Base Layer	M3	1295.8	1,238,738.74	Rp1,605,157,659.29
2	Class B Aggregate Foundation Layer	M3	1045	522,522.52	Rp546,036,033.40
3	Class S Aggregate Foundation Layer	M3	869	536,036.04	Rp465,815,318.76
4	PPCP Panel				
	Joint Panel	unit	63	3226195	Rp. 203,172,856.32
	Base Panel	unit	1197	4015432	Rp. 4,804,641,067.01
	Central Panel	unit	31	6418452	Rp. 202,104,216.58
5	Installation			13660079	
	Install the panel	unit	1291	327048.19	Rp. 422,221,829.68
	Stressful Jobs	segment	31	35525934	Rp. 1,118,640,609.79
	Grouting Work	segment	31	1001980	Rp. 31,550,346.24
					Rp 9,399,339,937.06

Based on the budget plan above, it is known that the PPCP method has various panel components to be used as segments if totaled with other work, it is obtained that the PPCP paving work has a cost of Rp. 9,399,339,937.06

C. SPRigWP Concrete Pavement Method (Waskita Precast Rigid Pavement System)

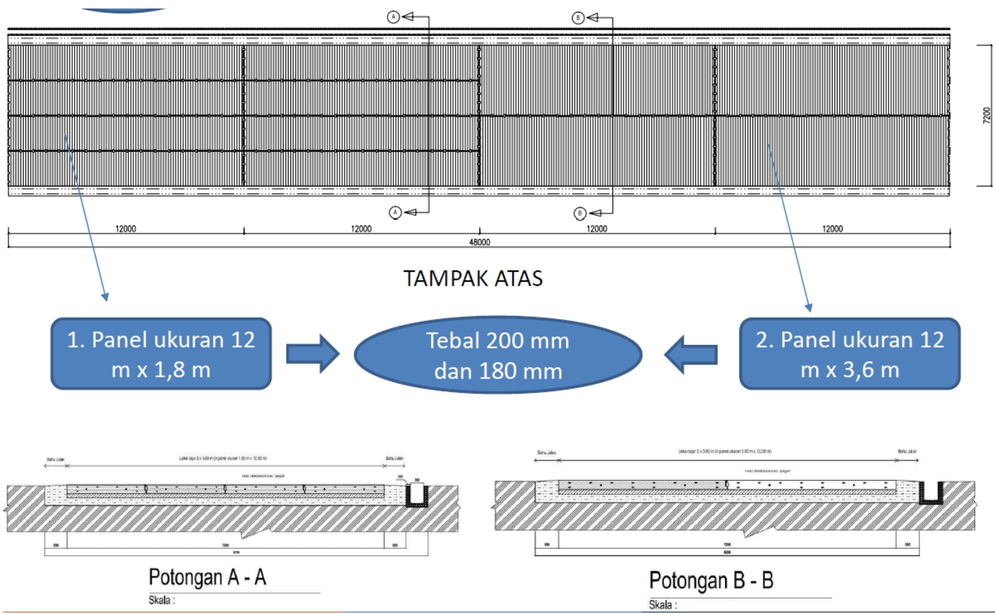

Figure 13. SPRigWP Panel

It can be seen from Figure 13 that the Sprigwp panel has larger dimensions so that fewer panels are needed than PPCP. The precast concrete pavement costs below are the total costs (installed materials) obtained from the manufacturer Waskita Karya.

Table 7. SPRigWP Cost Estimate

No	Job description	Unit	Estimated Quantity	Unit Price (Rp.)	Total Price (Rp.)
1	SPRigWP Pavement	M2	11808	970,000.00	11,453,760,000.00

D. Flexible Pavement

Flexible pavement is a type of road pavement that uses asphalt as the main binding material. This type of pavement is known for its flexibility in adjusting to changes in traffic loads and weather conditions. In planning flexible pavement construction costs, several main components that need to be taken into account include material costs such as asphalt and aggregate, labor costs for spreading and compacting, and construction equipment costs. In addition, factors such as traffic volume, subgrade conditions, and drainage systems also affect the total construction cost. The following is a flexible pavement cost budget plan:

- Road Length: 1968 m
- Road Width: 6 m
- Shoulder: 1 m
- AC – WC : 40 mm
- AC – BC: 60 mm
- AC Base: 245 mm
- LPA Class B : 150 mm

Table 8. Flexible Pavement Cost Estimation

BUDGET PLAN					
No	**General**	**Sat**	**Quantity**	**Unit Price (Rp)**	**Total Price (Rp)**
A.	**GRANULAR PAVEMENT**				
1	Class B Aggregate Foundation Layer	M3	2952.00	551100,00	1626847200,00
B.	**ASPHALT PAVEMENT**				
1	Binder Absorbent Layer (AC-Base to LPA)	Lt	2361.60	10865.00	25658784.00
2	Adhesive Layer 1) AB - BC To AC - Base 2) AC - WC To AC – BC	Lt	2952.00	9875.00	29151000,00
3	Laston AC – WC	Ton	1086.34	1058750,00	1150162475.00
4	Laston AC – BC	Ton	1629.50	1013320.00	1651204940.00
5	Laston AC- Base	Ton	2653.81	1095814.00	2908082151.34
C.	**TOTAL**				Rp7,391,106,550.34

3.6 Development Stage

This stage aims to prepare the final means in writing for the selected alternative by considering the possibilities of all technical and economic factors to answer the main points of all stages, whether the selected alternative meets all requirements. Next we will try to calculate the Life Cycle Cost (LCC), then the costs during the construction period must be known, such as routine maintenance costs and periodic maintenance costs. The components that will be calculated for the Life Cycle Cost Analysis (LCCA) are as follows:

Table 9. LCC Calculation Value Components

It is known	Index	Unit	Source
Road Plan Age	40	Year	Road Pavement Design Manual No.03/MB/2024
Interest rate	6.25%	Year	https://www.bi.go.id/id/publikasi/ruang-media/news-release/Pages/sp_268024.aspx
Inflation	2.51%	Year	https://www.bi.go.id/id/statistik/indikator/data-inflasi.aspx
Material Price Increase	0.16%	Year	https://www.bps.go.id/id/pressrelease/2024/03/01/2313/pada-februari-2024--bahan-index-harga-perdagangan-besar--ihpb--umum-nasional-tahun -on-year-by-3-23-percent.html
Concrete Price Increase	0.16%	Year	

Overview of maintenance and care in the table above shows the age and percentage of replacement of Concrete Pavement in the Cibadak-Padasuka Road Reconstruction project, Bantent. To calculate the estimated component costs using the inflation rate and average interest rate (i) 8.76% (based on Core Inflation data for July 2024 and BI credit interest rate/SBDK for July 2024). Present Worth which includes the costs of maintenance and care of concrete pavement.

3.6.1 Life Cycle Cost (LCC)

As with road works in general that have a planned life, based on the manual design of road pavement, the planned life of the road is 40 years before replacement. Where during the 40-year period routine maintenance and periodic maintenance are carried out, by considering this, in this Value Engineering study it is necessary to analyze several costs that occur during the 40-year planned life or Life Cycle Cost Analysis (LCCA). From this analysis, several potential savings will also be known during the planned life. The results of the Life Cycle Cost Analysis (LCCA) Analysis of the CIS, PPCP, SPRigWP & Flexible Pavement paving methods can be seen in the table below:

Table 10. LCC Road Paving Method

Project LCC (Years)	40 Years	LIFE CYCLE COST (Rp)			
Interest Rate	bank 6,25%	Alt. 0 Original Design	Alternatif 1	Alternatif 2	Alternatif 3
	Inflation 2,51%	Cast In Situ	Precast Prestressed concrete pavement (PPCP)	Sistem perkerasan rigid waskita precast (SPRigWP)	Sistem perkerasan Lentur (Aspal)
		Estimate Cost	Estimate Cost	Estimate Cost	Estimate Cost
INITIAL COST (IC)					
1. Construction cost :					
Perkerasan Jalan		Rp8.759.914.418,55	Rp9.084.459.937,06	Rp11.453.760.000,00	Rp7.391.106.550,34
2. Redesign Cost					
Total Initial Cost Impact (IC)			**Rp9.084.459.937,06**	**Rp11.453.760.000,00**	**Rp7.391.106.550,34**
Inicial Cos PW Savings			-Rp324.545.518,51	-Rp2.693.845.581,45	Rp1.368.807.868,21
REPLACEMENT COST (100)					
1. Pekerjaan Perkerasan		-	-	-	Rp7.631.251.742,40
2. Replacement Interval		40	40	40	20
3. Present of Future Replacement Cost		-	-	-	Rp1.423.022.615,31
Total Replacement Cost		-	-	-	Rp1.423.022.615,31
OPERATIONAL + MAINTENANCE					
1. Percentage Cost of Initial Cost		1.5 % / years	9% / 10 years	8% / 10 years	11% / 2 years
2. Annual Operation + Maintenance		Rp175.198.288,37	Rp817.601.394,34	Rp916.300.800,00	Rp800.169.554,13
3. Present of Annual Operational + Maintenance Cost		Rp1.930.436.760,38	Rp585.235.852,54	Rp612.441.346,90	Rp12.573.979.443,62
Total O/M		**Rp1.930.436.760,38**	**Rp585.235.852,54**	**Rp612.441.346,90**	**Rp12.573.979.443,62**
SALVAGE VALUE					
1. Present of Future Salvage Value Cost		-	-	-	-
Total Present Salvage Value Cost		-	-	-	-
Total Present Worth Life Cycle Cost		**Rp10.690.351.178,93**	**Rp9.669.695.789,60**	**Rp12.066.201.346,90**	**Rp21.388.108.609,27**
Life Cycle Saving			**Rp1.020.655.389,33**	**-Rp1.375.850.167,98**	**-Rp10.697.757.430,34**
Prosentase Life Cycle Saving to the total Original Cost			**9,55%**	**-12,87%**	**-100,07%**
Total Present Worth Construction Cost		**Rp8.759.914.418,55**	**Rp9.084.459.937,06**	**Rp11.453.760.000,00**	**Rp7.391.106.550,34**
Construction Cost Saving			**-Rp324.545.518,51**	**-Rp2.693.845.581,45**	**Rp1.368.807.868,21**
Prosentase			**-3,70%**	**-30,75%**	**15,63%**

3.7 Recommendation Stage

The recommendation for the value engineering study topic for the Cibadak – Padasuka Road Reconstruction, Warunggunung District, Lebak Regency, Banten Province is the application of an alternative method in the form of precast concrete pavement.*Precast Prestressed Concrete Pavement*(PPCP) to achieve longer road life and less maintenance.

IV. CONCLUSION

The conclusion of this study is as follows: 1. The work item that is the subject of Value Engineering study in this study is Road Paving work; 2. The Value Engineering study obtained 3 alternatives, namely the Rigid Pavement Method PPCP, SPRigWP & Flexible Pavement; 3. The construction cost value of Value Engineering is: • Alternative 1 PPCP Method against alternative 0 (Conventional Concrete/Cast In Situ) experienced an increase in construction costs of Rp. 324,545,518.51 or 3.30%, • Alternative 2 SPRigWP Method against alternative 0 (Conventional Concrete/Cast In Situ) experienced an increase in construction costs of Rp. 2,693,845,581.45,- or 30.75%, • Alternative 3 Flexible Pavement compared to alternative 0 (Conventional Concrete/Cast In Situ) experienced a decrease in construction cost of Rp. 1,368,807,868.21, or 15.63%; 4. The Life Cycle Cost (LCC) value from Value Engineering is: • Alternative 1 PPCP Method compared to alternative 0 (Conventional Concrete/Cast In Situ) experienced a decrease in Life Cycle Cost (LCC) of Rp. 1,020,655,389.33,- or 9.55%, • Alternative 2 SPRigWP Method against alternative 0 (Conventional Concrete/Cast In Situ) experienced an increase in Life Cycle Cost (LCC) of Rp. 1,375,850,167.98 or 12.87%, • Alternative 3 Flexible Pavement against alternative 0 (Conventional Concrete/Cast In Situ) experienced an increase in Life Cycle Cost (LCC) of Rp. 10,697,757,430.34 or 100.07%.

So that in the study conducted on the Cibadak - Padasuka Road Reconstruction Project, Warunggunung District, Lebak Regency, Banten Province Alternative 1 Precast Prestressed Concrete Pavement (PPCP) Rigid Pavement Method is the recommendation with the lowest LCC value.

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