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Research Paper

Analysis of Value Engineering Implementation to the Project of Beam and Column Works of Samarinda Equipment Department (DENPAL VI/I)

Harold Jeffry Kailola[1], Lalu Mulyadi[2], Maranatha Wijayaningtyas[3]
[1,2,3](Department of Civil Engineering, National Institute of Technology, Malang, Indonesia)
Corresponding Author: Lalu Mulyadi

ABSTRACT : *Beam and column structure work has the possibility to be performed with Value Engineering since beam and columns are one prominent aspect to the construction/building system. This research aimed to analyze whether value engineering is applicable on the construction project belongs to Samarinda Equipment Department (Departemen Peralatan Samarinda). Value engineering able to provide positive effects of cost and time efficiency without reducing its main function.*

Value engineering is divided into five stages; the information stage, creative stage, analysis stage, development stage, and recommendation stage. Then, for analyzing alternatives and the proposed criteria, it requires an evaluation matrix. There are three proposed alternatives as a replacement for beam and column work which later will be selected by Value engineering analysis. The first alternative is using WF steel for the beams and concrete for columns, the second alternative is using concrete structure for entire construction, and the third alternative is using WF steel for beams and H beam steel for columns.

From the result analysis which has been successfully carried out, cost saving was obtained from the cost of structure work that initially was Rp.2,970,821,796.68, to be reduced into Rp. 2,820,899,936.98 after implementing Value Engineering method, acquiring cost saving amounted to Rp. 149,921,859.00 or 5.4 %. Meanwhile, the overall cost of the project as stated in the initial plan was Rp.9,479,482,978.28, and after VE has been conducted to the overall cost, the amount was found to be Rp. 9,329,561,118.58, with cost saving of Rp.149,921,859.00 or 1.58% from the entire project.

KEYWORDS: *Value Engineering, Cost Saving, Structural Work*

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I. INTRODUCTION

Along with progress of planning and implementation process over a project, the project owners always search certain ways to do an optimization and efficiency to get a project completion done with a lower cost but without neglecting its quality and function. For a large value project, there are several work segments with cost of work that have a large influence on the overall project costs. Costs for these work segments are influenced by several factors such as factors of material selection, work method, number of workers, implementation time and others. By such financing aspect that becomes so large, the center attention for executing re-analysis was aimed to find reduce cost or cost saving from these large costs. It gave rise to certain alternatives that able to be used as basis to conduct studies without targeting on correcting mistakes made by the construction planners or aimed to correct their calculations, but rather to seek cost saving aspect that possible to obtain from modifications towards the construction/building elements. Therefore, value engineering is needed to make those unnecessary costs and efforts can be eliminated so that cost of project can be reduced. Value engineering is a creative and planned approach aimed for identifying and cutting (make it efficient) unnecessary costs. It is used to search ideas that able to produce lower costs from the previous/initial prices with certain functional limitation and work quality.

II. LITERATURE REVIEW

2.1. Definition of Value Engineering

According to Berawi, Value Engineering is a multidisciplinary, systematic and structured decision-making process that able to perform a function analysis to achieve the best value of a project by defining functions required to achieve the desired value targets, by providing these functions at optimum costs and consistent with the required quality and work performance [1]. Meanwhile, Pontoh, et.al said Value Engineering is an effort systematically organized and applies into a technique that has been recognized, namely the technique of applying a product or service with aims to fulfill the required function at the lowest price [2].

In other words, Value Engineering has an intention to provide optimum value for the amount of money spent by using a systematic technique to analyze and control the total cost of a product/project. Value engineering will help to distinguish and separates aspects that is needed from aspects that is not needed, where certain alternatives can be developed to meet the necessary aspects and exclude the unnecessary aspects at the lowest cost. Meanwhile, Safira et.al. [3] said the Value Engineering is an evaluation method for analyzing techniques and values of a project/product involving the owner, planner, and expert who are experienced in their respective fields through a systematic and creative approach aimed to produce quality matter with lowest cost by implementation of functional boundaries and stages of task plans that able to identify and eliminate not supported/not required costs and efforts.

2.2. Concept of Value Engineering

A Value Engineering method was developed to provide a way to manage value and as a systematic innovation effort to create a competitive advantage for a product. Value engineering focuses on a value to attain an optimum balance between time, cost and quality. This concept emphasizes on relationship between value, function and cost in a broader perspective for creating higher value of the destined project [1].

Berawi [1] explained further about concept of value engineering is a pressing to cost product or service by involving certain engineering principles. This technique is attempting to achieve product quality which at least the same as planned with a minimum possible cost. The planning process conducted in value engineering implementation always be based on functions needed and the value obtained.

According to Zimmerman and Hart, there are some prominent elements called The Key Elements of Value Engineering as listed below.

1. Function Analysis
2. Creative Thinking
3. Cost Model
4. Life Cycle Costing
5. Function Analysis Technique/FAST
6. Cost and Worth Value
7. Habits and Attitude
8. Value Engineering Job Plan
9. Management of Relationship Between Owner/Designer/Value Consultant in VE

4.1.1. Definition of Value

Definition of value is a relationship between cost, time and quality where quality consisted of several number of variables determined from knowledge and experience of an individual or several individuals within a group, explicitly made to elicit a choice among functionally suitable options. Therefore, an explicit value system will represent a picture at a certain time of various variables for all decisions affecting the core business or a project so these can be audited [1].

Meanwhile, according to Suharto, Setiawan and Abduh [4], value has a similar meaning and difficult to differentiate between ‘cost’ and ‘price’. Value owns a subjective meaning, in particular when related to moral, aesthetic, social and economic fields. However, in value engineering method, the preferred value meaning is linked to economic value that divided into four (4) categories:

1. Cost value is total cost for producing a particular item, such as the sum of labor costs, materials, tools and extra cost (overhead).
2. Exchange value is a benefit value/worth value that will be traded or exchanged. Worth is a term for buyer compelled by buyer motivation. This value also determined by the market value at a certain time.
3. Esteem value is a value which causes the owner/user willing to pay for prestige or appearance. This value relates to the needs or desire from the costumer or the user.
4. Use/Usability value is a functional value of a product or process or system which created to fulfill a certain purpose. This value includes the customer or user needs.

4.1.2. Definition of Function

Function is defined as the main element in value engineering method because the goal is to attain required functions from an item at an efficient total cost. According to Crum in Jabbar and Indyani [5], the meaning of function is very important in the Value Engineering study since function will play as the main object in relation to costs. Function is everything that can be given or done by a product that can be used for work. In this study, function is divided into two categories:

1. Basic function, is the basic reason for the system to exist, a basis for reason for the existence of a product and (for the product) to have a usability value.
2. Secondary function, is an indirect usability to fulfill the basic function but is necessary to support the basic function.

By integrating principles of cost efficiency concepts, a value engineering method able to optimize project cost efficiently by analyzing the function of an activity item to simplify or modify planning or its implementation while at the same time keep maintaining or improving the desired quality by considering the selected operations and maintenance.

4.1.3. Definition of Cost

Cost is the sum of all efforts and expenses made for developing, producing and applying a product/project, or with other term is called as a life cycle cost (LCC). LCC is the overall costs begins from initial planning stage to the end of utilization of a facility [1]. Elements of LCC are the investment cost, financing cost, operational cost, maintenance cost, alteration cost, taxes and salvage value (residual value of an item although its economic value has expired).

The product maker/producers or project maker always analyze the impact of decision made on the aspects of quality, reliability and maintenance because these aspects will have effect on cost. When considering the relationship between value, function and cost, then, one cause of low value is a result from the existence of unnecessary costs.

2.3. The Benefit of Value Engineering Application

Application of Value Engineering in construction projects will convince parties involved in the project to ensure their investment in construction will produce valuable assets where the value is approved to be effective for constructing, using and maintaining the project. A certainty for producing more valuable product or able to attain product that has value for money is further explained by [1], where in basic understanding, the application of VE will ensure any product necessities to be always be verified and supported by data, with target projects will be discussed through open and obvious benefit. Engineering value is needed by construction projects in Indonesia to solve construction implementation problems where are in many aspects still found to be less efficient with a lot of unnecessary spending. As strengthened by Connaughton and Green [6], the application of VE will ensure the needs for the project to be always be verified and supported by data, with project objectives that will be discussed through open and clear manner, important decisions in the VE process will be taken in rational, firm and reliable ways, designs will be developed within the framework of agreed project objectives, various alternative options are always be taken into account, and design submissions are evaluated and carefully selected based on predefined performance criteria. Many countries such as United States, England, Australia and Japan, VE application able to solve various problems and able to increase the competitiveness of their construction industry. The ability of Value Engineering method to increase the competitiveness value of construction industry in several countries cannot be separated from benefits offered by VE to construction project. Its ability to make an appropriate planning decision during the design stage is an example of one benefit that able to provide by VE optimally. This appropriate planning decision through VE will increase the efficiency of building construction implementation [1]. Thus, benefit conveys in Value Engineering are able to solve problems of construction implementation in Indonesia, within the aspect of less efficient work and lots of unnecessary spending cost that found in many constructions' implementation in Indonesia.

III. RESEARCH METHOD

3.1. Research Location

The research site of the thesis was taking place on the project of Samarinda Equipment Department (Denpal VI/I Samarinda),

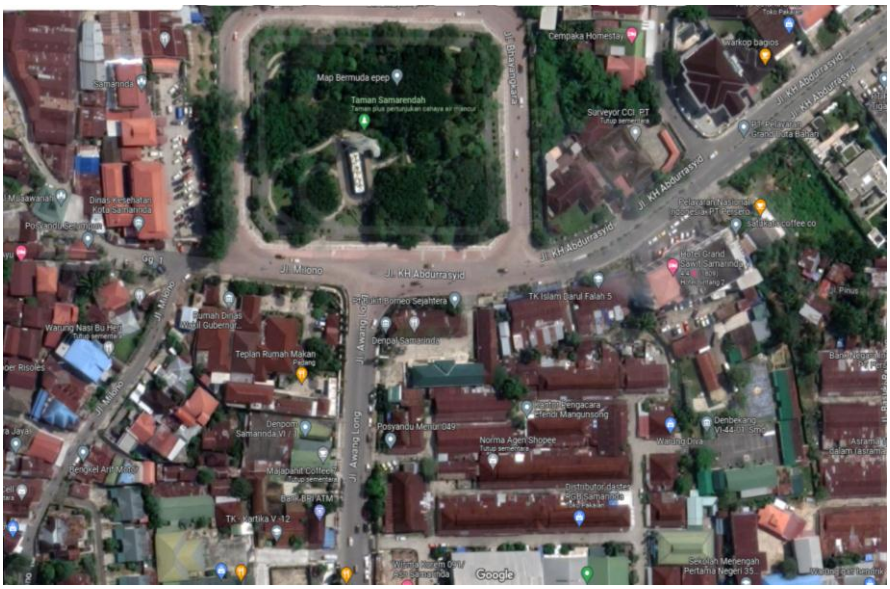

Figure 1: Research Location Site

3.2. Research Stages

For establishing Value Engineering method to be employed according to plan, there are several stages must be conducted as explained below.

1. The Research Site
   Data research is obtained from data source and survey conducted in the project of Samarinda Equipment Department (Denpal VI/I Samarinda).
2. Data Collection Technique
   - Primary Data

   Primary data is an obtainable data from direct observation in the field of research. It was taken through direct interviews and distribution of questionnaires to project managers as well as the people who involved in this project, aimed to find the information about the project required for this research.
   - Secondary Data

   Secondary data is an obtainable data by citing existing data given by project informants or by collecting data from the work office. The data taken were in the forms of working drawings, budget plans, work plans and work requirements.

Next, the following phases were carried out for this research:

1. The Information Phase
   At this stage, information will be collected and begins with data about the project location as well as data regarding the design, background, constraints, and the projected cost of the project. The secondary data were taken from the plan drawings and the budget plan and the primary data were taken from direct observation to site of the research.
2. The Function Analysis Phase
   After finishing the analysis, items with the highest costs were found and will be analyzed by value engineering method, then, a work breakdown will be performed to find out details of work that involved, then, a function analysis is going to be carried out by F.A.S.T method. In the end, this phase will produce primary and secondary functions as well as a value index with functions to show whether it is feasible to do or not.
3. The Creative Phase
   At this stage, there are alternatives presented as comparison to the design previously has been made. The more alternatives presented there, the better solutions will be provided to save costs, time and work method. The alternatives that have been made could be in form of alternative materials, alternative

work method, or alternative in the implementation time. The goal is to reduce costs from the initial plan and the steps taken to attain the goal is to determine the alternative that is going to be used in the project.

4. The Evaluation Phase
   At this stage, alternatives resulted from the creativity phase will be selected then be evaluated through comparing with several alternatives that have been selected prior to creative phase. This comparison aimed for finding which best alternative that able to perform highest saving effect in the form of advantages and disadvantages in terms of cost, quality and project implementation time. To acquire the best result then it is necessary to conduct a tiered filtering.

IV. RESULT AND DISCUSSION

4.1. Initial Condition from The Project

The condition of project in this study is presented in table formats below with explanation from each type of works.

Table 1. A Budget Plan Recapitulation of the Costs of Structural Works for Office Building of Denpal VI/I in Samarinda

NO	DESCRIPTION OF STRUCTURE WORK	COSTS
1	Preparatory work	335.247.228,50
2	Poer plat foundation work	640.144.976,15
3	Tie beam work	208.060.807,68
4	First floor column work	203.636.277,80
5	Second floor column work	187.693.032,95
6	Beam and ring balk work	586.172.322,57
7	Floor work	809.867.151,02
	Amount	**2.970.821.796,68**

4.1.1. Function Analysis

1. Research Analysis for Alternative 1
   The function analysis for alternative 1 is an application of WF steel for beam work and concrete material for column work with a detailed calculation presented in table 2 below.

Table 2. Function Analysis to Alternative Plan 1

NO	TYPE OF WORK	VOLUME	ITEM	UNIT PRICE (Rp.)	WORK PRICE (Rp.)
	CONCRETE COLUMN STRUCTURE AND WF STEEL BEAM				
A.	**FIRST FLOOR COLUMN WORK**				
1	Column -K1 40 x 40 cm				
	- Concrete K - 250	25,84	m3	1.676.757,00	43.327.400,88
	- Threaded Reinforcing Iron	3.748,21	kg	18.720,00	70.166.445,34
	- Plain Reinforcing Iron	905,22	kg	17.277,00	15.639.473,50
	- Form work (*Bekisting)*	264,48	m2	281.696,00	74.502.958,08
				Sub Amount	**203.636.277,80**
B	**SECOND FLOOR COLUMN WORK**				
1	Column -K1 40 x 40 cm				
	- Concrete K - 250	25,84	m3	1.676.757,00	43.327.400,88
	- Threaded Reinforcing Iron	2.936,32	kg	18.720,00	54.967.937,33
	- Plain Reinforcing Iron	862,11	kg	17.277,00	14.894.736,67
	- Form work (*Bekisting)*	264,48	m2	281.696,00	74.502.958,08

				Sub Amount	**187.693.032,95**
C.	**BEAM AND RINGBALK WORK**				
1	Beam - WF 300.150.6,5.9				
	- WF 300.150.6,5.9	1.089,00	m3	35.777,50	38.961.697,50
	- Joint Plate	177,1	kg	35.777,50	6.336.195,25
	- Bolt 5/8	168	kg	2.500,00	420.000,00
2	Beam - WF 200.100.5,5.8				
	- WF 200.100.5,5.8	1.990,40	m3	35.777,50	71.211.536,00
	- Joint Plate	225,71	kg	35.777,50	8.075.220,27
	- Bolt 5/8	460	kg	2.500,00	1.150.000,00
3	Beam - WF 175.90.5.8				
	- WF 175.90.5.8	2.701,65	m3	35.777,50	96.658.282,88
	- Joint Plate	281,74	kg	35.777,50	10.079.893,22
	- Bolt 5/8	704	kg	2.500,00	1.760.000,00
4	Dak Beam - WF 175.90.5.8				
	- WF 175.90.5.8	5.028,98	m3	35.777,50	179.924.153,06
	- Joint Plate	526,41	kg	35.777,50	18.833.484,70
	- Bolt 5/8	1.136,00	kg	2.500,00	2.840.000,00
				Sub Amount	**436.250.462,88**

Table 3. Function Analysis Recapitulation to Alternative Plan 1

TYPE OF WORK	WORK PRICE (Rp.)
Concrete Structure of Preparatory Work	335.247.228,50
Poer Plat Foundation Work	640.144.976,15
Tie Beam Work	208.060.807,68
Column Work for First Floor	203.636.277,80
Column Work for Second Floor	187.693.032,95
Beam and Ringbalk Work	436.250.462,88
Floor Work	809.867.151,02
	2.753.872.756,98

2. Research Analysis for Alternative 2
   The function analysis for alternative 2 is an application of concrete structure for the entire building with its calculation presented in table 4 below.

Table 4. Function Analysis to Alternative Plan 2

TYPE OF WORK	VOLUME	ITEM	UNIT PRICE (Rp.)	WORK PRICE (Rp.)
CONCRETE COLUMN WORK FOR FIRST FLOOR				
Column -K1 40 x 40 cm				
- Concrete K - 250	25,84	m3	1.676.757,00	43.327.400,88
- Threaded Reinforcing Iron	3.748,21	kg	18.720,00	70.166.445,34
- Plain Reinforcing Iron	905,22	kg	17.277,00	15.639.473,50
- Form Work (*Bekisting)*	264,48	m2	281.696,00	74.502.958,08
			Sub Amount	**203.636.277,80**
CONCRETE COLUMN WORK FOR SECOND FLOOR				
Column -K1 40 x 40 cm				
- Concrete K - 250	25,84	m3	1.676.757,00	43.327.400,88
- Threaded Reinforcing Iron	2.936,32	kg	18.720,00	54.967.937,33
- Plain Reinforcing Iron	862,11	kg	17.277,00	14.894.736,67
- Form Work (*Bekisting)*	264,48	m2	281.696,00	74.502.958,08
			Sub Amount	**187.693.032,95**

BEAM & RINGBALK WORK				
Beam - B2 30 x 60 cm				
- Concrete K - 250	2,54	m3	1.676.757,00	4.263.154,67
- Threaded Reinforcing Iron	371,97	kg	18.720,00	6.963.236,28
- Plain Reinforcing Iron	185,4	kg	17.277,00	3.203.140,25
- Form Work (*Bekisting)*	28,25	m2	285.670,00	8.070.177,50
Beam - B3 30 x 50 cm				
- Concrete K - 250	47,5	m3	1.676.757,00	79.641.765,61
- Threaded Reinforcing Iron	12.707	kg	18.720,00	237.884.047,13
- Plain Reinforcing Iron	6.460	kg	17.277,00	111.603.545,82
- Form Work (*Bekisting)*	443,31	m2	285.670,00	126.640.367,70
RingBalk - RB1 25 x 45 cm				
- Concrete K - 250	0,57	m3	1.676.757,00	953.655,54
- Threaded Reinforcing Iron	115,12	kg	18.720,00	2.154.986,98
- Plain Reinforcing Iron	48,55	kg	17.277,00	838.787,55
- Form Work (*Bekisting)*	1,98	m2	285.670,00	565.412,35
RingBalk - RB2 20 x 30 cm				
- Concrete K - 250	0,5	m3	1.676.757,00	833.348,23
- Threaded Reinforcing Iron	65,23	kg	18.720,00	1.221.129,00
- Plain Reinforcing Iron	40,38	kg	17.277,00	697.666,86
- Form Work (*Bekisting)*	2,23	m2	285.670,00	637.901,11
			Sub Amount	**586.172.322,57**

Table 5. Function Analysis Recapitulation to Alternative Plan 2

TYPE OF WORK	WORK PRICE (Rp.)
Concrete Structure of Preparatory Work	335.247.228,50
Poer Plat Foundation Work	640.144.976,15
Tie Beam Work	208.060.807,68
First Floor Column Work	203.636.277,80
Second Floor Column Work	187.693.032,95
Beam & Ringbalk Work	586.172.322,57
Floor Work	809.867.151,02
	2.970.821.796,67

3. Research Analysis for Alternative 3
   The function analysis for alternative 2 is an application of concrete structure for the entire building with its calculation presented in table 6 below.

Table 6. Function Analysis to Alternative Plan 3

NO	TYPE OF WORK	VOLUME	ITEM	UNIT PRICE (Rp.)	WORK PRICE (Rp.)
	H STEEL BEAM AND WF STEEL BEAM STRUCTURAL WORK				
D.	**H BEAM COLUMN WORK FOR FIRST FLOOR**				
1	- Column H Beam 250.250.9.14	11.695,29	kg	35.777,50	418.428.297,60
	- Joint Plate 16mm	763,7	kg	35.777,50	27.323.363,05
	- Anchor bolt 25	84	bh	75.000,00	6.300.000,00
				Sub Amount	**452.051.660,65**
D.	**H BEAM COLUMN WORK FOR SECOND FLOOR**				
1	- Column H Beam 250.250.9.14	11.695,29	kg	35.777,50	418.428.297,60
	- Joint Plate 16mm	763,7	kg	35.777,50	27.323.363,05
	- Anchor Bolt 25	84	bh	75.000,00	6.300.000,00
				Sub Amount	**452.051.660,65**
E.	**BEAM & RINGBALK WORK**				

1	Beam - WF 300.150.6,5.9				
	- WF 300.150.6,5.9	1.191,67	m3	35.777,50	42.634.854,17
	- Joint Plate	177,1	kg	35.777,50	6.336.195,25
	- Bolt 5/8	168	kg	2.500,00	420.000,00
2	Beam - WF 200.100.5,5.8				
	- WF 200.100.5,5.8	2.186,67	m3	35.777,50	78.233.466,67
	- Joint Plate	225,71	kg	35.777,50	8.075.220,27
	- Bolt 5/8	460	kg	2.500,00	1.150.000,00
3	Beam - WF 175.90.5.8				
	- WF 175.90.5.8	3.019,92	m3	35.777,50	108.045.068,54
	- Joint Plate	282	kg	35.777,50	10.079.893,22
	- Bolt 5/8	704	kg	2.500,00	1.760.000,00
4	Dak Beam - WF 175.90.5.8				
	- WF 175.90.5.8	5.542,54	m3	35.777,50	198.298.284,48
	- Joint Plate	526	kg	35.777,50	18.833.484,70
	- Bolt 5/8	1.136	kg	2.500,00	2.840.000,00
				Sub Amount	**476.706.467,29**

Table 7. Function Analysis to Alternative Plan 3

TYPE OF WORK	WORK PRICE (Rp.)
Concrete Structure of Preparatory Work S	335.247.228,50
Poer Plat Foundation Work	640.144.976,15
Tie Beam Work	208.060.807,68
First Floor Column Work	452.051.660,65
Second Floor Column Work	452.051.660,65
Beam & Ringbalk Work	476.706.467,29
Floor Work	809.867.151,02
	3.374.129.951,94

4.1.2. Function Analysis

The cost analysis after the structural works completed and treated with value engineering method through several alternatives is presented in table 8 below.

Table 8. The Result of Cost Optimization After Implementation of VE Method

NO	DESCRIPTION OF STRUCTURE WORK	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3
		WF STEEL and CONCRETE	CONCRETE	H STEEL and WF STEEL
1	Preparatory Work	335.247.228,50	335.247.228,50	335.251.323,40
2	Poer Plat Foundation Work	640.144.976,15	640.144.976,15	640.144.976,15
3	Tie Beam Work	208.060.807,68	208.060.807,68	208.185.130,61
4	First Floor Column Work	203.636.277,80	203.636.277,80	452.051.660,65
5	Second Floor Column Work	187.693.032,95	187.693.032,95	452.051.660,65
6	Beam & Ringbalk Work	436.250.462,88	586.172.322,57	476.706.467,29
7	Floor Work	809.867.151,02	809.867.151,02	742.839.971,02
	Amount	**2.820.899.936,98**	**2.970.821.796,68**	**3.307.231.189,78**

From several table descriptions above, the conclusion of the chosen alternative for this project was the alternative 1 with a cheaper cost of Rp.2.820.899.936,98 with alternative of application of WF steel for column work and concrete for beam work. After choosing the alternative for value engineering, then a comparison is made to the initial cost, to make the cost differences and the obtainable cost saving can be identified. The calculation is presented in the following table 9

Table 9. The Cost Comparison of Before and After VE Implementation

NO	DESCRIPTION OF STRUCTURE WORK	PROJECT INITIAL COST	VALUE ENGINEERING	COST SAVING
1	Preparatory Work	335.247.228,50	335.247.228,50	
2	Poer Plat Foundation Work	640.144.976,15	640.144.976,15	
3	Tie Beam Work	208.060.807,68	208.060.807,68	
4	First Floor Column Work	203.636.277,80	203.636.277,80	
5	Second Floor Column Work	187.693.032,95	187.693.032,95	
6	Beam & Ringbalk Work	586.172.322,57	436.250.462,88	149.921.859,69
7	Floor Work	809.867.151,02	809.867.151,02	
	Amount	**2.970.821.796,68**	**2.820.899.936,98**	**5,4 %**

The construction cost for floor column work, second floor column work, beam & ringbalk work as stated in the initial plan was Rp. 2.970.821.796.68. Then, after the value engineering method implemented into the project, the cost for floor column work, second floor column work, beam & ringbalk work can be reduced into Rp.2.820.899.936.98, with cost saving amounted to Rp.149.921.859.00 (5.4%).

Table 10. Percentage of Overall Cost After VE Implementation

NO.	WORK DESCRIPTION	INITIAL COST	VALUE ENGINEERING
I	OFFICE BUILDING	Rp 2.970.821.796,68	Rp2.820.899.936,98
II	MESS BUILDING	Rp1.679.877.583,29	Rp1.679.877.583,29
III	ARCHITECTURE	Rp4.155.651.505,31	Rp4.155.651.505,31
IV	ELECTRICAL	Rp673.132.093,00	Rp673.132.093,00
COST		**Rp9.479.482.978,28**	**Rp9.329.561.118,58**
Total saving of Cost			**Rp.149.921.859,00**
Percentage of the Cost Saving (%)			**1,58 %**

The project's overall cost in its initial plan was Rp.9.479.482.978,28, then after Value Engineering implemented into the project, the overall cost becomes Rp. 9.329.561.118,58. There is a cost saving amounted to Rp. 149.921.859,00 or 1.58 % of the overall cost of the project.

V. CONCLUSION

1. Based on result of discussion which has been elaborated in the previous section, application value engineering to beam and column work are executed into several alternatives of:
   - The use of WF steel for beam work whereas concrete material still not replaced and will be used for column work.
   - The use of concrete structure for entire construction.
   - The use of H steel beam for column work and WF steel for beam work.

2. According to result discussion above, the obtainable cost saving from implementation of value engineering to the project are:
   - Cost saving from structure work, which according to plan was Rp. 2.970.821.796,68. Then, after value engineering implementation to the project, the cost of structure work becomes Rp. 2.820.899.936,98, with obtainable cost saving of Rp.149.921.859,00 or 5.4 %.
   - The overall cost of the project initially has value of 9.479.482.978,28, then after value engineering implemented to the project, the overall cost becomes Rp 9.329.561.118,58, with obtainable cost saving of Rp.149.921.859,00 or 1,58 % of the project's overall cost.

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