

Value Engineering Construction Of The Unisa Campus Saintek Building 2

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Abstract

This Value Engineering analysis is carried out to analyze or organize a construction of the SAINTEK UINSA 2 building which aims to produce appropriate quality that does not change the function and also there are no unnecessary costs considering that the construction of this building has a building area of $40 \times 19 = 760$ m² which cost Rp. 37,108.056,260.81.

In this analysis, an analysis is carried out or to identify the function of a product or service that aims to fulfill the required function at the lowest price by providing an alternative from the creative ideas obtained to give to the owner so that there is no need for an increase in costs.

From the VE analysis on the construction of the SAINTEK UINSA 2 building, the total initial cost savings on the slab work were initially Rp. 624,429,524.15 and after applying Value Engineering analysis using alternative 2, the cost is Rp. 527,876,352.19 which is more economical worth Rp. 96,553,171.96 or 15.46% of the initial price.

On the 1st floor work (1st floor) EL. -0.05 in which there is a formwork slab which is considered to have a high cost, which initially used nails and wooden blocks, which was changed to 50.50 hollow iron and bendrat wire.

Keywords

Building, Cost Management, Cost Saving, Value Engineering.

1. Introduction

Value Engineering / VE or commonly called Value Engineering can be applied in development to analyze or organize a construction of the SAINTEK UINSA 2 building, which aims to ensure that the quality / quality is as planned by identifying the benefits / functions of the product or service, so that the services or products provided with the most economical price and according to the initial construction structure planned.

The problems encountered in the field during the construction, according to the author, were the occurrence of a technical error that broke the Surabaya PDAM channel when drilling soil for pile foundations. In addition to the construction project stopping progress, it also has an impact on the community and PDAM due to the collapse of the channel.

According to Zimmerman and Hart (1982), VE is not A Design Review, that is, correcting mistakes made by planners; A Cost Cutting Process the process of lowering costs by reducing unit costs and sacrificing the quality, reliability and appearance of the resulting product; A Requirement Done All Design provisions that must exist in every design, but are more oriented to the actual cost and function analysis; Quality Control is the control of the quality of a product because it is more than just reviewing the reliability status of a design.

In this paper, the author focuses more on the usefulness of the Value Engineering method in the application of the cost function in the construction of the SAINTEK UINSA 2 building.

Value Engineering, if understood by all parties, is very useful in optimizing construction costs. Indeed, not many people know about Value Engineering, especially in construction activities in Indonesia, but the author hopes for the future that Value Engineering is applied to development so that no one receives losses for owners, consultants, and contractors due to implementation errors, especially in the building cost plan (RAB).).

The construction of the SAINTEK UINSA 2 building will cost a total of Rp. 37,108.056,261.00.

Based on the problems above, the formulation of the problem can be formulated as follows:

1. How much is the cost savings after Value Engineering has been carried out on the SAINTEK UINSA 2 building construction project?
2. What kind of work can VE do on the UINSA 2 building project and what alternatives do you get?

2. Literature Review

2.1. Project

2.1.1. Definition of Value Engineering

1. Value Engineering is an effort that is systematically organized and applies a recognized technique, namely the technique of identifying the function of a product or service that aims to fulfill the required function at the lowest price.
2. Value Engineering is the systematic evaluation or engineering design of a project to get the most value for every dollar spent. Furthermore, this engineering examines and considers various components of activities such as procurement, manufacturing, and construction as well as other activities in relation to costs to their functions, with the aim of getting a reduction in overall project costs. (E.R. Fisk 1982).
3. Value Engineering is a management technique using a systematic approach to find the best functional balance between cost, reliability and performance of a project. (Dell'Isola).
4. Value Engineering is an organized and creative approach that aims to identify unnecessary costs. These unnecessary costs are costs that do not provide quality, usability, something that brings good looks or characteristics desired by consumers.
5. Value Engineering is the systematic application of a number of techniques to identify the functions of an object and service by assigning a value to each of the existing functions and developing a number of alternatives that allow the achievement of these functions with minimal total cost.
6. Value Engineering is an evaluation method that analyzes the technique and value of a project or product involving voters, planners and experts who are experienced in their respective fields with a systematic and creative approach that aims to produce the lowest quality and cost, namely with functional limitations. and stages of a task plan that can identify and eliminate unnecessary or unsupported costs and efforts.
7. Value Engineering is a creative and systematic approach with the aim of reducing, eliminating unnecessary costs. (Zimmerman and Hart 1982), Value Engineering is not:
 - a. A Design Review, which is to correct the mistakes made by the planner, or to do a re-calculation that has been made by the planner.
 - b. A Cost Cutting Process, namely the process of reducing costs by reducing unit costs and sacrificing the quality, reliability, and appearance of the resulting product.
 - c. A Requirement Done All Design is a requirement that must exist in every design, but is more oriented to the actual cost and function analysis.
 - d. Quality Control, namely quality control of a product because it is more than just reviewing the reliability status of a design. Some things that underlie Value Engineering are very important to be understood by every planner and project implementer so that it can cause unnecessary costs to arise every time the project activity takes place, these include: lack of time, lack of time, lack of information, lack of information, lack of ideas. lack of ideas, misconceptions, temporary circumstances that are not intentional but become permanent temporary circumstances that inadvertently become permanent, running out of habits, attitudes, political politics, lack of fees.

2.1.2. Effect of VE

The VE analysis method is applied to get the best balance of functions between cost, reliability and project performance. The value engineering method is a cost reduction that is limited but still within functional limits without losing its quality values by providing an alternative at a cheaper price for work so that there are no unnecessary costs to be incurred.

2.1.3. Basic Concepts of VE

For the implementation of Value Engineering, there are main flows / elements so that the analysis process can be carried out. The plots / elements are:

- a. Gather alternative ideas.

Combining and improvising ideas.

The ideas that have been obtained do not need to be evaluated with other ideas because every idea that arises will be used for comparison of each alternative obtained.

2.1.4. VE system components

The application of VE is carried out in different ways according to what is considered suitable for each condition. In the VE system there are several alternatives for each of the existing components, then these components are combined and become a VE system.

2.1.5. Function Definition

The first step in implementing VE is to define a function to determine the proper identification of functions in a construction project. This clarification uses 1 noun and 1 verb (1 noun and 1 verb).

2.1.6. Definition of Project Functions

The definition of project functions is carried out by looking at the project in general/as a whole, for what the construction project was made. An example is a school building that has a function to educate children.

2.1.7. Definition of Space function

The definition of project function is carried out by looking at the project in terms of the spaces needed and which will be formed in the project, to get the space functions needed in the construction project, which can be seen in the example of a classroom that serves as a place for teaching.

2.1.8. Definition of Elemental Functions

The definition of project functions is carried out by looking at the project elemental elements that are needed and which will be formed in a construction project, which can be seen in the example of a room door to open access or close access.

2.1.9. Function Evaluation

The function evaluation stage is carried out to obtain the alternatives used. Determination of the alternative used in accordance with the expected function and the lowest cost.

a. FAST Diagram

FAST diagram is done to see the identification of basic functions and complementary functions. The workings of this diagram start from determining the main function and how to achieve it (how), and it will be explained why it is done (why). This diagram also divides the design scope and construction scope to achieve the analysis made. The FAST diagram explains the concept of thinking in the design phase and the construction phase. In the design phase, it explains how to solve problems that will arise. Meanwhile, during the construction period, it is explained how to solve the problems that arise.

2.2. Causes of Unnecessary Costs

The existence of unnecessary costs is due to the lack of application of VE in the initial planning. If it can be recognized and understood, then prevention can be done. Some of the causes of unnecessary costs include the following:

1. Individual/individual errors

This is a common/basic human error that causes the inability to understand how to solve the problem. The important elements that need to be applied to humans / individuals in order to achieve success to get good grades, among others:

a. Information

Information basic things in doing any job. This can be applied so as not to incur unnecessary costs. Deficiencies may occur because of the unavailability of the required information or because there is no effort from the individual to obtain the required information. Due to the lack of information, it can lead to wrong decision making and result in expensive redesign costs. In addition, the lack of understanding of the needs of consumers so that there is a failure to analyze mistakes that have been made is one of the factors that causes unnecessary costs in planning which will later be used for implementation and for presentation to project owners/consumers.

b. Communication

Communication is something that is very much needed in VE analysis. Because communication is also done to consult with the experts involved. So that the implementation of Value Engineering analysis in the team concept will avoid unnecessary costs due to lack of communication.

c. Idea

The application of Value Engineering emphasizes the organization to look for new ideas freely. The search and release of ideas will provide many alternatives which will later be presented to the owner. Because the lack of ideas will cause product design to be less competitive because they do not know the data updates that will be used to be presented.

2. Human Weaknesses

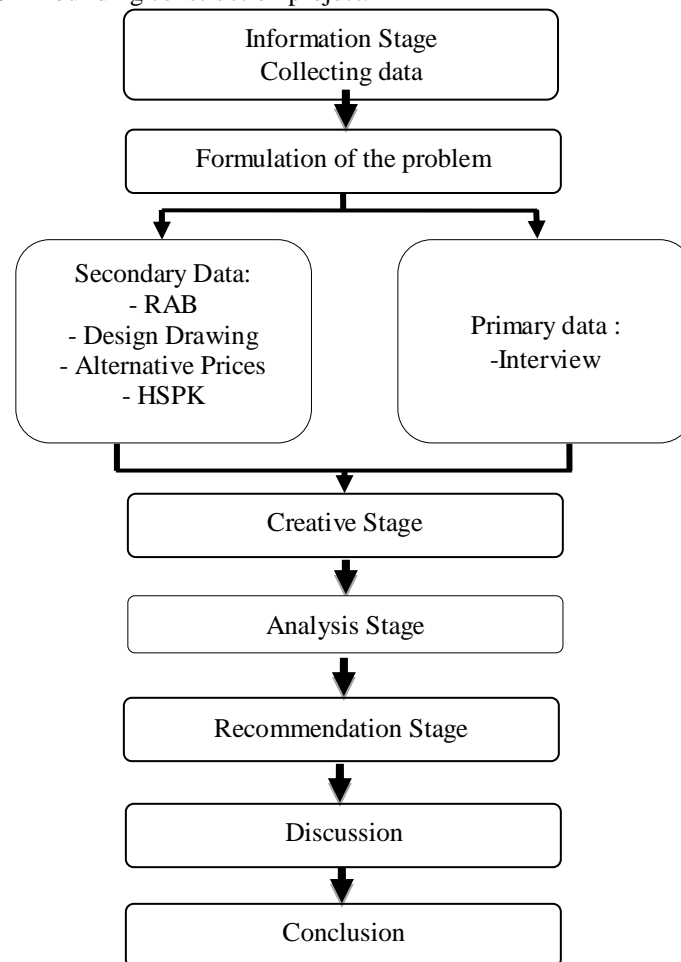
This weakness is human nature can cause unnecessary costs that will have an impact, such as:

- a. Trust will be reduced due to a budget plan that either increases in price.
- b. A person's habits and attitudes, someone tends to be too quick to make decisions because of his attitude/character.
- c. It's too risky in a cost-intensive design, because the use of materials exceeds the strength of the product required.
- d. Lack of time on the work carried out, resulting in hasty work so that the results obtained are not as expected which will later result in repair work or rework
- e. It's too risky in a cost-intensive design, because the use of materials exceeds the strength of the product required.
- f. Lack of time on the work carried out resulting in hasty work so that the results obtained are not as expected which will later result in repair work or rework.

3. Research Methodology

3.1. Research Stage

The Value Engineering research phase of the SAINTEK UINSA 2 Building Construction project basically aims to explain systematic steps to continue the implementation of the research that will be analyzed on the SAINTEK UINSA 2 building construction project.



Flowchart 1. Research Stage

3.2. Information Stage

Collecting data as material for analysis, namely:

1. Primary data

Collect original data used in the field which will later be used as value engineering analysis. This data contains RAB Budget Plan data, project design drawings, and alternative prices.

2. Secondary Data

This data is supporting data for research. This data is obtained from price brochures or from survey results on the internet and interviews with experts in the field of value engineering. This secondary data is used as an alternative as a comparison of the initial price in order to obtain a new cheaper price, time efficiency, and implementation efficiency in the field.

The implementation of secondary data search used several preparation tools, namely:

- a. Stationery, used to record results.
- b. Computer/laptop, used to input the data obtained.
- c. Internet Network. used to find alternatives from the internet that is connected to a computer/laptop device.
- d. Resource persons as interview.

3.3. Creative Stage

This Creative Stage collects new design alternatives from each of the work items which will later be used for price comparisons on the initial design that has a high price. Analysis Phase.

Perform an analysis using a comparison of the cost value with the worth value (C/W) obtained from the unit price of the type of work, if the result is >2 then there are costs that are not needed for the work. In addition, this stage is carried out in order to obtain the best alternative. At this stage, what will be analyzed is only

focusing on the highest implementation price of the type of work contained in the work unit price recapitulation data contained in the RAB that has been carried out on the construction of the SAINTEK UINSA building 2. The analysis steps are as follows:

1. The highest value (Value) was found in the 1ST FLOOR El. job - 0.05. These results are obtained from the analysis of the cost/worth calculation.

Calculation formula to determine the highest percentage value (Value) for each type of work.

$$\frac{c}{w}$$

Information :

C = is the initial cost cost

W = is worth the alternative price and the initial price applied

3.4. Recommendation Stage

Convince the owner by presenting the alternative results obtained and providing detailed data on the alternatives that have been obtained and have been analyzed for submission and of course these alternatives have cost-effective advantages that do not involve unnecessary costs.

3.5. Value Engineering Concept

Value engineering uses the VE method of value processing which was developed as a way of managing value and systematically increasing innovation in order to provide a competitive advantage for a product. According to the SAVE (2007) standard, value is a statement of the relationship between functions and resources.

$$\text{Value} = \text{Function/Source}$$

4. Results and Discussion

Table 1. Data Collectiontable Initial Recapitulation

No.	Recapitulation	Price (Rp)	Weight Of All Jobs
Fac Of Science And Technology Lab. Building (F1)			
I	Structure Works		
1	Preparation	12.035.100,00	0,032%
2	Sub Structure Works		
	Earth Works	523.516.375,66	1,411%
	Piling	6.692.661.222,58	18,036%
	Foundation (Pile Cap, Tie Beam)	1.868.510.059,61	5,035%
3	Upper Structure Works		
	Hall Way	874.506.733,97	2,357%
	1st Floor El.- 0.05	2.391.133.913,09	6,444%
	2nd Floor El.+ 4.950	1.343.105.398,11	3,619%
	3rd Floor El +9.20	1.200.865.697,31	3,236%
	4th Floor El +13.45	1.200.865.697,31	3,236%
	5th Floor El + 17.70	1.200.865.697,31	3,236%
	Roof Floor, El +21.95	891.764.726,50	2,403%
	Machine Room El +22.58	79.746.576,76	0,215%
	Roof Lift El +25.70	69.602.037,78	0,188%
ii	Architecture Works		
1	1st. Floor	2.034.417.536,83	5,482%
2	2nd. Floor	1.746.994.939,92	4,708%
3	3rd. Floor	1.697.375.281,98	4,574%
4	4th. Floor	1.733.977.306,47	4,673%
5	5th. Floor	1.604.545.521,02	4,324%
6	Roof Floor	417.179.224,19	1,124%
7	Facade Works		
	Front Elevation	796.098.268,00	2,145%
	Back Elevation	736.098.364,50	1,984%
	Right Elevation	455.205.695,00	1,227%
	Left Elevation	450.536.622,50	1,214%

Iii	Mechanical Works		
A	Plumbing Works	544.634.164,80	1,468%
B	Fire Fighting Installation Works	413.295.800,00	1,114%
C	Air Conditioning & Ventilation Mechanism System	1.253.280.599,60	3,377%
D	Elevator System	663.834.000,00	1,789%
Iv	Electrical Works		
E	Electrical System	2.383.682.600,00	6,424%
F	Fire Alarm Installation	539.480.400,00	1,454%
G	Sound System	34.879.800,00	0,094%
H	Network Integration Installation	970.126.200,00	2,614%
I	Building Management System Works	283.234.700,00	0,763%
	Sub Total	37.108.056.260,81	100,000%

In primary data, there are jobs that have high prices, namely pilling and 1st floor El jobs. -0.05 (table 1), but the VE analysis was carried out on the work on the EL 1st floor structural work. -0.05/ structure works 1st floor EL.- 0.05 which has a work cost of Rp. 2,391,133,913.09.

1. Project Data From Pictures

- a. The area of the SAINTEK UINSA 2 building: $40 \times 19 = 760 \text{ m}^2$
- b. Area of 1st floor slab = 760 m^2
- c. The thickness of the slab on the 1st floor of SAINTEK UINSA building (Table 4.5).

4.1. Slab Plan (Floor Plate) on the 1st floor

In the area where there is an arrow bordered by a line in Figure 4.1 is the area that will be analyzed by VE.

Table 2. Slab Thickness Floor 1 EL. -0.05

Type Slab	T slab (mm)
S2	250
S2A	250
S2B	250
S2B	250
S3	600

4.2. Creative Stage

From the data that has been obtained from the data carried out on the UINSA 2 building construction project and obtained work items that are suitable for VE analysis contained in the work items on the 1st floor EL. 0.005, then we need creative data for comparison at the analysis stage later.

4.3. Alternative Stage

At this stage the author provides an alternative that aims to provide a cheaper price than the initial implementation price so that unnecessary expenses are not incurred.

Alternative 1 is from the initial price analysis used in the UINSA 2 building construction project, only the cost of the Scaffolding tool is omitted because the tool should not need to be included in the Formwork Slab work analysis where the slab work on the 1st floor is above the landfill surface. So the cost of analysis becomes Rp 194,950.00.

Table 3. Alternative 2 using conventional formwork

Description Of Activities	Koef.	Units	Unit Price	Price
Wages:				
Foreman	0,0150	OH	Rp 145.000,00	Rp 2.175,00
Chief Carpenter	0,0150	OH	Rp 140.000,00	Rp 2.100,00
Carpenter	0,1500	OH	Rp 135.000,00	Rp 20.250,00
Worker	0,3000	OH	Rp 125.000,00	Rp 37.500,00
Total wages of workers				Rp 62.025,00
Material:				
Nails	0,4000	Kg	Rp 22.000,00	Rp 8.800,00
Plywood Uk .122x 244 x 9 mm	0,3500	Lbr	Rp 221.000,00	Rp 77.350,00
Meranti Wood Beam 4/6, 5/7	0,0450	Cu.m	Rp 3.900.000,00	Rp 175.500,00
Formwork Oil	0,2000	Ltr	Rp 21.000,00	Rp 4.200,00
The amount of material				Rp 265.850,00
2 times use				Rp 132.925,00
Total				Rp 194.950,00

Table 4. Alternative 2 using semi system formwork

Description Of Activities	Koef.	Units	Unit Price	Price
Wages:				
Foreman	0,0150	OH	Rp 145.000,00	Rp 2.175,00
Chief Carpenter	0,0150	OH	Rp 140.000,00	Rp 2.100,00
Carpenter	0,1500	OH	Rp 135.000,00	Rp 20.250,00
Worker	0,3000	OH	Rp 125.000,00	Rp 37.500,00
Total wages of workers				Rp 62.025,00
Materials :				
Bendrat Wire	0,4000	Kg	Rp 15.350,00	Rp 6.140,00
Plywood UK .122x 244 x 9 mm	0,3500	Lbr	Rp 221.000,00	Rp 77.350,00
Hollow 50.50	1,0000	Pcs	Rp 84.000,00	Rp 84.000,00
Formwork Oil	0,2000	Ltr	Rp 21.000,00	Rp 4.200,00
The amount of material				Rp 171.690,00
2 times use				Rp 85.845,00
Total				Rp 147.870,00

In alternative 2, only replacing the material from alternative 1 which initially used wood and nails replaced with 50.50 Hollow Iron and Bendrat Wire by producing an analysis fee of Rp. 147.870.00.

Table 5. Alternative 3 using formwork system

Description Of Activities	Koef.	Units	Unit Price	Price
Wages:				
Foreman	0,0150	OH	Rp 145.000,00	Rp 2.175,00
Chief Carpenter	0,0150	OH	Rp 140.000,00	Rp 2.100,00
Carpenter	0,1500	OH	Rp 135.000,00	Rp 20.250,00
Worker	0,3000	OH	Rp 125.000,00	Rp 37.500,00
Total wages of workers				Rp 62.025,00
Bahan:				
Plywood Uk .122x 244 x 4 mm	0,3500	Lbr	Rp 221.000,00	Rp 77.350,00
Hollow 50.50	1,0000	Pcs	Rp 84.000,00	Rp 84.000,00
U-head	1,0000	Set	Rp 25.000,00	Rp 25.000,00
Sekur horizontal	1,0000	Set	Rp 54.500,00	Rp 54.500,00
Sekur vertikal	1,0000	Set	Rp 54.500,00	Rp 54.500,00
Sekur joint	1,0000	Set	Rp 25.000,00	Rp 25.000,00
Jack base	1,0000	Set	Rp 25.000,00	Rp 25.000,00
The amount of material				Rp 345.350,00
2 times use				Rp 172.675,00
Total				Rp 234.700,00

In alternative 3 this replaces all materials from alternative 1 and alternative 2 except Plywood because the plywood is used as side formwork that holds the side/cast thickness. From this alternative it generates a cost of Rp. 234,700.00 where the price of alternative 3 is much greater than alternative 1 and alternative 2.

4.4. Analysis Stage

4.4.1. Re-analyzing the calculation data obtained from the field

From the calculation of the cost budget plan on the 1st Floor EL work. -0.05 the construction of the SAINTEK UINSA 2 building which has the highest price in the S2A Slab Formwork (Table 4.1) of Rp. 171,083,541.50.

Table 6. Initial HSPK

Uraian Kegiatan	Koef.	Satuan	Harga Satuan	Harga
Wages:				
Foreman	0,0150	OH	Rp145.000,00	Rp 2.175,00
Chief Carpenter	0,0150	OH	Rp 140.000,00	Rp 2.100,00
Carpenter	0,1500	OH	Rp 135.000,00	Rp20.250,00
Worker	0,3000	OH	Rp125.000,00	Rp 37.500,00
Total wages of workers				Rp 62.025,00
Material:				
Nails	0,4000	Kg	Rp 22.000,00	Rp 8.800,00
Plywood Uk .122x 244 x 9 mm	0,3500	Sheet	Rp221.000,00	Rp77.350,00
Meranti Wood Beam 4/6, 5/7	0,0450	Cu.m	Rp3.900.000,00	Rp 175.500,00
Formwork Oil	0,2000	Ltr	Rp 21.000,00	Rp 4.200,00
Total wages of workers 2x pakai				Rp 265.850,00 Rp 132.925,00
Peralatan				
Perancah/ Scaffolding	1,0000	Ls	Rp 40.000,00	Rp 40.000,00
The amount of material				Rp40.000,00
Total				Rp 234.950,00

From the analysis of the work units used in the construction of the UINSA 2 building, there are unnecessary costs for formwork slab work for the 1st floor (Table 4.8), namely scaffolding which should be eliminated, except for the unit cost of formwork on the top floor (storeys) so that in the calculation of the volume of work Slab formwork is Rp.234.950.00.

It is known that the planned cost of work (RAB) on the 1st floor which has a high price is on Formwork Slab Type S2A (Table 4.1) of Rp. 171,083,541.50. In addition, the unit price / Unit Price for the 1st floor slab formwork work uses the price contained in the item cost of scaffolding / scaffolding.

Table 7. initial RAB of 1st floor slab work EL -0.05 before VE

Descriptoin	Unit	Quantity	Unit Price	Amount
Slab EL -0.05				
Slab Type S2	sq.m	242,55		
- Concrete f'c 35 Mpa	Cu.m	60,64	1.165.200,00	70.654.815
- Wiremesh M8-150 double Layer	sq.m	242,55	165.800,00	40.214.790,00
- Formwork Slab	sq.m	121,28	234.950,00	28.493.561
- Rebars D10-100/150	Kg	1.449,92	14.906,00	21.612.455,07
Slab Type S2A	sq.m	364,09		
- Concrete f'c 35 Mpa	Cu.m	91,02	1.165.200,00	106.057.960,50
- Wiremesh M6-150 double Layer	sq.m	364,09	99.400,00	36.190.049,00
- Formwork Slab	sq.m	728,17	234.950,00	171.083.541,50
Slab Type S2B	sq.m	75,10		
- Concrete f'c 35 Mpa	Cu.m	18,78	1.165.200,00	21.876.921,30
- Wiremesh M8-150 double Layer	sq.m	75,10	165.800,00	12.451.745,80
- Rebars D10-100/150/350	Kg	644,02	14.906,00	9.599.832,43
- Formwork Slab	sq.m	150,20	234.950,00	35.289.959,90
Slab Type S3	sq.m	54,57		
- Concrete f'c 35 Mpa	Cu.m	32,74	1.165.200,00	38.150.978,40
- Wiremesh M7-150 double Layer	sq.m	54,57	130.300,00	7.110.471,00
- Formwork Slab	sq.m	109,14	234.950,00	25.642.443,00
TOTAL Slab				624.429.524,15

4.4.2. Cost Calculation and Size of the Slab Formwork Under Review

- a. Sub. Total 1st floor EL.- 0.05 = Rp 2,391,133,913.09
- b. Sub. Total Slab Work on the 1st floor = Rp 624,429,524.15
- c. Initial 1st floor formwork work unit price = Rp. 234.950.00
 - 1) Slab size under review:
 - a) S2 type slab with a thickness of 250 mm = 0.25 m
The total length is 485.1 m, then the required formwork area is calculated using the formula below (4.1):
 $S2 = p \times t$
 $S2 = 485.1 \times 0.25$
 $S2 = 121.28 \text{ m}^2$
 - b) S2A type slab with a thickness of 250 mm = 0.25 m
 $S2A = p \times t$
 $S2A = 1,456.34 \times 0.25$
 $S2A = 364.09 \text{ m}^2$
 - c) S2B type slab with a thickness of 250 mm = 0.25 m
 $S2B = p \times t$
 $S2B = 2912.68 \times 0.25$
 $S2B = 728.17 \text{ m}^2$
 - d) S3 type slab with a thickness of 600 mm = 0.60 m
 $S3 = p \times t$
 $S3 = 181.90 \times 0.60$
 $S3 = 109.14 \text{ m}^2$
From the calculation of the need for formwork, it is known as follows:
 $S2 = 121.28 \text{ m}^2$
 $S2A = 364.09 \text{ m}^2$
 $S2B = 728.17 \text{ m}^2$
 $S3 = 109.14 \text{ m}^2$

4.4.3. Cost Calculation Results

1. Initial RAB on 1st Floor Slab Works EL. 0.05
From the analysis that has been done that the unit price of the 1st floor framework work there is an unnecessary cost, namely scaffolding (Table 4.9) which can cause cost overruns. Initial cost data from the project:
 - a. Sub. Total 1st floor EL.- 0.05 = Rp 2,391,133,913.09
 - b. Sub. Total initial 1st floor slab work = IDR 624,429,524.15
 - c. Initial 1st floor formwork unit price = IDR 234.950.00
2. Savings Obtained Using Alternatives
Cost savings on 1st EL Floor Slab work. -0.05 from the initial price by using alternative 1, alternative 2, and alternative 3 resulting in cost savings and a percentage of:
 - a. Using alternative 1 of Rp. 40,000.00 with 17.02%
 - b. Using alternative 2 of Rp 87,080.00 with 37.06%
 - c. Using alternative 2 of Rp. 250.00 with 0.11%
 After calculating the costs in the Budget plan (RAB) which was originally the price for the 1st floor slab work worth Rp 624,429,524.15 using the prices from alternative 1, alternative 2, and alternative 3 has provided savings on the work of the 1st floor slab whose results are as following :
 - a) The total cost of alternative 1 is Rp. 580,078.044.15 which is more cost-effective, which is Rp. 44,351,480.00 or 7.10% of the total initial price.
 - b) The total cost of alternative 2 is Rp. 527,876,352.19 which is more cost-effective, which is Rp. 96,553,171.96 or 15.46% of the total initial price.
 - c) The total cost of alternative 3 is Rp. 624,152,327.40 which is more cost-effective, which is Rp. 277,196.75 or 0.04% of the total initial price.

4.5. Recommendation Stage

From the analysis stage that has been carried out, it can be concluded that the work carried out by the VE analysis in the construction of the SAINTEK UINSA 2 building is the work of plate formwork (fromwork slab) located on the 1st floor (1st floor) EL. -0.05. In the formwork work, an alternative which is considered by the author is cheaper which can save work costs and the alternative applied is alternative 2 by using a semi system

formwork which replaces the initial materials using nails and wooden blocks into bendrat wire and 50.50 Hollow iron. Because alternative 2 has been proven to be more cost effective than the initial cost.

From the calculations that have been carried out on the slab work, the total initial price is Rp. 147.870.00 which is cheaper than the initial planning price of Rp. 624.152.327.40. After doing VE using alternative 2, it will cost Rp. 527,876,352.19 which is more efficient at Rp. 96,553,171.96 or 15.46% of the initial price.

5. Conclusion

5.1. Conclusions

From the results of the VE analysis that has been carried out on the construction of the SAINTEK UINSA 2 building, namely:

The total initial cost for the slab work, which was initially Rp. 624,429,524.15 and after applying Value Engineering analysis using alternative 2, the cost is Rp. 527,876,352.19 which is more economical worth Rp.96,553,171.96 or 15.46% of the initial price.

In the construction project of the SAINTEK UINSA 2 building, what VE can do is work on the 1st floor (1st floor) of EL. -0.05 in which there is a formwork slab which is considered to have a high cost, which initially used nails and wooden blocks, which was changed to 50.50 hollow iron and bendrat wire.

5.2. Suggestions

After doing this VE analysis, the suggestions that can be given are:

- a. 6. Reference There needs to be thoroughness and patience in calculating costs, especially in large-scale development projects.
- b. It is necessary to have VE before the calculation results are recommended to the owner so that unnecessary costs are not obtained.

References

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