



Original research article

## Comparison of Formwork use in Building X Project in Surabaya City

Eza Agriansyah\*, Eko Andi Suryo, Eva Arifi

Department of Civil Engineering, Universitas Brawijaya, Malang 65145, Indonesia

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### ABSTRACT

The Value Engineering method is a method that analyzes the problems of a project through a systematic and organized approach by eliminating unnecessary costs without reducing the function, appearance, quality, and reliability of the project. The object x building, which has an estimated project value of IDR 42,812,329,371 in structural work. With the estimated value of the work costing a lot, it is, therefore, necessary to make efforts to streamline costs by using the value engineering method; this study aims to choose an alternative material for it. This research method uses a Pareto chart to find the highest work value. The results of this study indicate that the beam work is priced at IDR 15,088,457,899, floor plate work of IDR 12,530,471,281, column work of IDR 10,228,438,679. The results of the analysis of alternative structural calculations using semi-system formwork and full system formwork, which initially used conventional formwork, were simulated using alternative 1, namely semi-system formwork, and by using alternative two full system formwork. The two alternatives are applied to column, beam and floor plate formwork. So, for this building, it is recommended to replace formwork because the conventional formwork used in this building incurs a large enough price, it is necessary to save on beam parts, and it is recommended to use full system formwork because the cost of beam formwork using full system formwork is IDR 134,950 per square meter. For the floor plate formwork, it is recommended to use a full floor plate formwork system because the cost per square meter is IDR 202,360. And for columns, it is recommended to use full system formwork because the cost of column formwork if using full system formwork is IDR 115,290. And from the use of all the full-system formwork for structural work, a total cost of IDR 40,312,992,291.32.

### 1. Introduction

In construction on buildings needed planned method precise work and attention condition local. On management construction need connection between quality, cost, time, and specifications [1]. There are three main components that need to be designed in construction work because affect success structural work. The third component is Concrete mix, concrete reinforcement, and formwork or among the three components formwork costs a lot of money [2]. The spread of new and creative technologies throughout the world's population has become simple due to globalization, and the transmission of cross-border information has become quicker and more precise. This has led to numerous advancements in building procedures all over the world. A temporary structure called a formwork is used to install concrete into the appropriate shape while bearing the stresses exerted on its stays. It supports wet cement as it cures, an essential stage in concrete development. Formwork is a crucial construction component, accounting for 20–25 percent of the overall cost.

As a result, casting more prominent components faster than usual is made possible by applying modern formwork techniques, which require less time and labor overall [3].

Development in the field in the field of construction in Indonesia from year to year grow increase in a method or system construction Which has been implemented. In general, society need cheap buildings, fast and easy to build, but still secure can works. In this era of intense global competition, many sectors, including the economic sector, are affected. Many companies compete to survive in the competition that occurs. The round has penetrated various existing lines, including the construction sector. This can be seen in the many construction projects of multiple scales, ranging from small to large. The project was carried out due to the increasing needs of the community and companies, such as housing, buildings, and heavy engineering construction. Based on the growing demand, the construction sector must implement efficiency and save construction costs without reducing the quality and duration of time.

\*Corresponding author: Department of Civil Engineering, Universitas Brawijaya, Malang 65145, Indonesia

E-mail address: [ezaagriansyah@student.ub.ac.id](mailto:ezaagriansyah@student.ub.ac.id) (Eza Agriansyah)

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In the implementation in the field, many construction projects require enormous costs because there are costs resulting from inefficient planning and building design. The planning in question is the selection of materials which ultimately affects the quality and method of implementation. Therefore, efforts to streamline costs need to be made. The feasibility can be carried out during the planning process or during the physical work process in the field. The construction costs can be optimized by back analysis based on building planning and design data. The research will produce alternatives that will later be compared with the initial planning as a step in streamlining the cost of the construction. The analysis used to facilitate construction costs is value engineering analysis.

In construction projects, a systematic method is carried out at the design and construction stages, involving a multi-disciplinary team to produce innovations that provide added value in the form of quality/performance/functionality improvements and cost efficiency in the life cycle. The limited knowledge of various stakeholders regarding VE is one of the inhibiting factors to its implementation in Indonesia [4].

Any work that has the potential to provide value efficiency and work effectiveness, then evaluate the value of savings between costs that have used value engineering with the initial costs that have been planned. Implementation of Value Engineering (VE) is an alternative that can maximize project cost efficiency (optimal value for money) in the construction of the North Sulawesi DPRD building as well as being the method of choice in the settlement if indications of inefficiency are found in the use of the project budget [5].

This study will analyze the Value Engineering structural work on the X Building construction project in Surabaya. This project was chosen as the object of research because, for the developer or developer of this building, it will achieve a more effective design and eliminate unnecessary costs but guarantee a better value for money. Inappropriate decision-making during construction activities will result in excessive costs; these costs mean costs that do not contribute to use, age, quality, appearance. The choice of structural work to carry out Value Engineering analysis was because the construction cost of structural work has the highest price, IDR 71,659,316,132.55, which will be corrected by Pareto diagram analysis with Value Engineering stages, namely the information stage, the speculation stage, and the presentation stage, by comparing each alternative. The construction cost of structural work, which has a sizeable nominal value from the cost of other work items, will be streamlined from unnecessary wastage of costs [6].

Because many materials do not provide a function for the user or owner (both part of use and function of aesthetics), this research using Value Engineering will streamline the costs and functions of work in the x building construction project. This research will determine the percentage of cost savings generated through the Value Engineering process.

The materials used for formwork will vary depending on the type of construction, including whether it is a commercial, residential, industrial, or other building. The choice of formwork is a significant undertaking that impacts the project's final cost. It is a critical factor that also impacts the building's design. The formwork materials that should be

used for various architectural typologies will be covered in this essay [7]. Formwork is one of the supporting facilities for molding concrete with dimensions, desired shape, or position. The analysis carried out compares conventional, semi-system, and full system [8].

Formwork is an auxiliary means to print concrete with size and shape or desired position and alignment. The analysis carried out is to compare the formwork method semi-system with the system method on beams and floor plates [9]. Floor plate work is part of the construction need long enough for build it. That is because the floor plate work has a large enough volume of another job. Floor plates in buildings are one part of the structure that has a high price, but can be optimized. In the implementation of construction projects, especially those using concrete structures, usually with a traditional method that will use formwork and wooden supports or scaffolding. With the rapid increase in technology, new innovations to improve the quality and quantity of work [10]. Formworks, which are often made of wood, steel, aluminium, or prefabricated forms, are frequently used to pour concrete. Smaller building elements like stairs are cast using the same formwork that is used to cast bigger building elements like columns, beams, slabs, and shear walls. When selecting formwork for high-rise construction, cost, scheduling, and quality issues must be taken into account [11]. The traditional formwork method is one of the most commonly used techniques in concrete structures. To resist the weight and horizontal force of wet concrete, the classic formwork method typically consists of standard plywood panels fastened together with a wooden frame over their backs [12]. As a result, formwork systems have changed from using traditional formwork to permanent formwork, which can both be removed after usage and integrated into structural members to give the complete system structural strength. In contrast, because of the great strength [13].

The choice of the formwork method for structural work will thus be discussed in this article based on past research by comparing it in terms of the implementation cost per square meter. The purpose of this research is to select a formwork implementation strategy and negotiate the formwork structural work's initial cost. The X Building building project in Surabaya was the subject of this research investigation. To find alternative formwork for structural work that is less expensive, simpler to obtain, more affordable, and effective with a variety of uses, this research compares various formwork options. This will allow for significant efficiency gains without lowering the quality of the concrete itself. Reviewing the price per square meter for each installation is the goal of this study.

## 2. Material and Methods

The research method used is qualitative, and the object of this research is the construction of Building X in the city of Surabaya. The definition of a qualitative method is an observational method based on the philosophy of post-positivism [14]. the qualitative observation method is an observation method that aims to find as well as responding to qualities that cannot be quantified, such as feelings, thoughts, experiences, and others. This method is used to study the condition of natural objects where the observer is the key

instrument. The collection of sample data is purposive, the method of collecting data is by tri-angulation (combined), examining data is inductive and the results of qualitative research that is more concerned with meaning than generalization.

The data obtained at this time comprises primary and secondary data. Preliminary data were obtained from interviews with field practitioners, namely the types of formworks that are most often used in building construction where alternative materials can be replaced without reducing their original function and how many times each formwork alternative can be used repeatedly. Meanwhile, the secondary data used in this study are shop drawings, budget plans, technical specifications, implementation methods and price lists of materials and Surabaya wages.

After obtaining the data, it is then recapitulated to find out the work that generates the largest costs. The next step is to conduct a feasibility test for the application of value engineering, namely Pareto chart analysis, and then carry out a breakdown cost model. The results of the Pareto diagram show that the value of work above 80% of the work is work those results in large costs; work that generates costs above 80% must be carried out by value engineering. Specifically, by replacing the starting material with cheaper alternative materials without changing the quality or strength of the structure, the selection of alternative materials is carried out by interviewing field practitioners, and after finding several alternatives, the costs of the selected alternatives are calculated.

### 3. Result and Discussion

X Building Development Project in the city of Surabaya. This building was built to overcome the problem where students need classroom space. In terms of the structure of the

building construction, the foundation construction of this building uses piles or bore piles, and the superstructure uses reinforced concrete. Then in terms of architecture, for floor coverings on each classroom floor, bathrooms use homogeneous tile material with various sizes according to the room. For ceilings, use gypsum board material and exposed concrete, and for wall and protective work, use walls of light brick protected by paint on external walls. On the internal walls, use lightweight brick material protected by color. The doors and windows use aluminum frame material with clear glass, while the doors use engineering doors. The scope of work carried out by the contractor is preparatory, structural, architectural, mechanical, electrical, and plumbing. The total construction cost for this project is IDR 182,996,248,684.12, with details of the recapitulation of the Budget Plan in [Table 1](#) below.

#### 3.1. Feasibility Test for the Implementation of Value Engineering

The use of value engineering in a construction project is carried out on work with a significant cost contribution so that when it is carried out, it has the potential to experience savings. Therefore, by calculating the weighting of the work costs and comparing them with the costs of one another's work, the structural work has the most significant cost weighting, namely 39.00%. The following details the recapitulation of the cost weights for each job in [Table 2](#).

After recapitulating the work cost weights, the next step is to conduct a feasibility test for the application of value engineering, namely (1) pareto chart analysis, (2) break down cost model. Structural work has the highest cost of all jobs. The next thing is to describe the work in the structural work based on construction costs, from jobs that have the highest costs to jobs with the lowest costs ([Table 3](#)).

**Table 1.** Recapitulation of the Budget Plan

Job Description	Price
Structural work (preparatory work, substructure, superstructure and hallway)	IDR 71,659,316,132.55
Architectural Work	IDR 52,010,666,997.37
Mechanical and Electrical Work	IDR 50,908,171,654.20
Main Equipment System Integration	IDR 8,418,093,900.00
Total	IDR 182,996,248,684.12

**Table 2.** Recapitulation of Work Cost Weights

Job Description	Percentage	Price
Structure Work	39.00%	IDR 71,659,316,132.55
Architectural Work	28.00%	IDR 52,010,666,997.37
Mechanical and Electrical Work	28.00%	IDR 50,908,171,654.20
Main Equipment System Integration	5.00%	IDR 8,418,093,900.00
Total	100.00%	IDR 182,996,248,684.12

**Table 3.** Recapitulation of the Structural Work

Item	Total Price	Percentage of Total Cost Components
Beam	15,088,457,899	35,2%
slab	12,530,471,281	29,3%
column	10,228,438,679	23,9%
stair	1,730,417,822	4%
ramp	1,263,673,901	3%
AREA PODIUM	1,058,411,997	2,5%
CANOPY AS 5-8/B-C	698,801,116	1,6%
LMR Column,	152,491,255	0,4%
MACHINE BEAM ON ROOF FLOOR	61,165,421	0,1%
Total	42,812,32,371	100%

From the recapitulation above, the three most giant jobs will be taken because these jobs can potentially save the following results from the pareto diagram for Floor Covering Work (Figure 1).

The results of the pareto diagram for beam, floor slab and column work are jobs that incur many costs. Therefore, it is necessary to replace materials to reduce costs, from the three of them choose formwork material replacement which will be carried out to analyze formwork material replacement.

3.2. Column Formwork Analysis

3.2.1. Conventional Column Formwork

Alternative 1 is from the initial price analysis used in the X Building construction project in Surabaya. So, the cost of analysis is IDR 180,140,00, and for this formwork, it is used two times as shown in Table 4.

3.2.2. Semi-System Column Formwork

In alternative 2, only replacing the material from alternative 1, which initially used Play Wood and nails, was replaced with phenol film/tego film and Dyna Bolt, resulting in an analysis cost of IDR 146,260.00. And for this formwork, used ten times use as shown in Table 5.

3.2.3. Full System Column Formwork

In alternative three, replacing all the materials from alternative one and alternative two is replaced by renting Perilico System formwork (LICO) is a formwork system whose parts have been made at the fabrication site in large quantities so that all that remains to combine these parts in the field. This alternative produces a cost of IDR 115,290.00 is the price of alternative three, much higher than alternatives one and two. And this formwork is used five times as shown in Table 6.

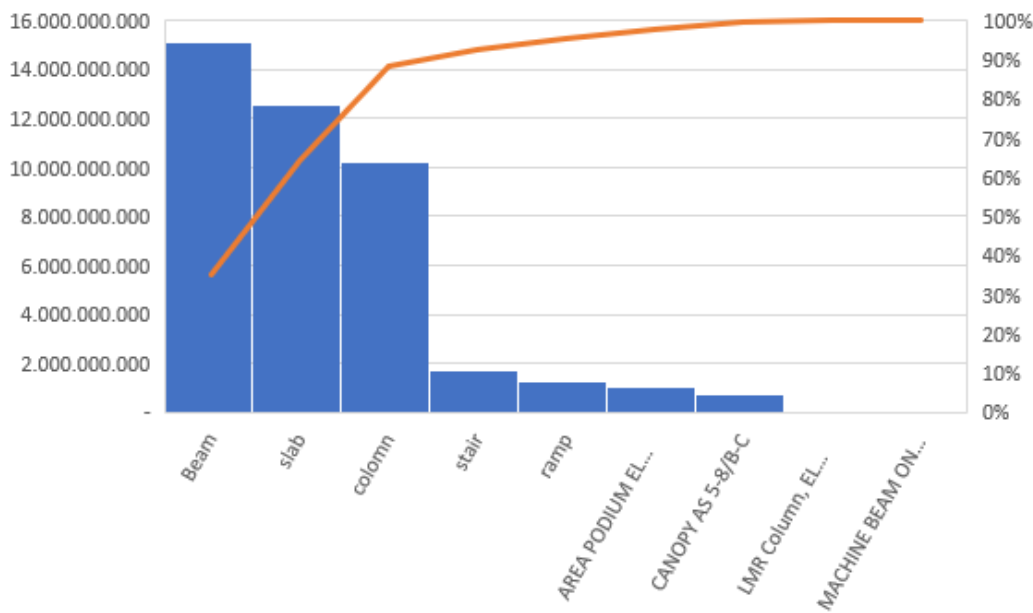


Figure 1. Work Structure Pareto Diagram

Table 4. Analysis Conventional Column Formwork

	coefficient	Unit	Unit Price	Amount
<b>Material:</b>				
Meranti Wood (Blocks)	0.0450	m <sup>3</sup>	3,900,000.00	175,500.00
Nail normal	0.4000	kg	22,000.00	8,800.00
Oil formwork	0.2000	Liter	21,000.00	4,200.00
Plywood 9 mm, 1.20 x 2.40	0.0350	m	221,000.00	7,735.00
Amount Material				196,235.00
For 2 X Use				98,117.50
<b>Wages:</b>				
Worker	0.3000	Oh	125,000.00	37,500.00
Carpenter	0.1500	Oh	135,000.00	20,250.00
Head craftsman	0.0150	Oh	140,000.00	2,100.00
Foreman	0.0150	Oh	145,000.00	2,175.00
Amount Worker				62,025.00
<b>Equipment:</b>				
Scaffolding	1.0000	Ls	20,000.00	20,000.00
Amount Equipment				20,000.00
Amount Materials + Workers + Equipment				180,142.50
rounded				180,140.00

**Table 5.** Analysis Semi-System Column Formwork

	coefficient	Unit	Unit Price	Amount
<b>Material:</b>				
wood rafter's 5/7	0.4000	m <sup>3</sup>	2,200,000.00	880,000.00
phenol/ tegofilm	0.4800	pcs	450,000.00	216,000.00
Oil formwork	0.2000	L	21,000.00	4,200.00
nails 5sd7 cm	0.0460	kg	22,000.00	1,012.00
dynabolt	80000	pcs	5,000.00	40,000.00
Amount Material				1,141,212.00
10x use				114,121.20
<b>Wages:</b>				
Worker	0.0400	Oh	125,000.00	5,000.00
Carpenter	0.0380	Oh	135,000.00	5,130.00
Head craftsman	0.0040	Oh	140,000.00	560.00
Foreman	0.0100	Oh	145,000.00	1,450.00
Amount Worker	0.0560			7,640.00
<b>Equipment:</b>				
Scaffolding	1.0000	Ls	20,000.00	20,000.00
Amount Equipment				20,000.00
Amount Materials + Workers + Equipment				146,261.20
rounded				146,260.00

**Table 6.** Analysis Full System Column Formwork

	coefficient	Unit	Unit Price	Amount
<b>Material:</b>				
Oil formwork	0.2000	liter	15,000.00	3,000.00
Amount Material				3,000.00
<b>Wages:</b>				
Worker	0.0070	Oh	125,000.00	875.00
Carpenter	0.0760	Oh	135,000.00	10,260.00
Head craftsman	0.0080	Oh	140,000.00	1,120.00
Foreman	0.0010	Oh	145,000.00	145.00
Amount Worker	0.0920			12,400.00
<b>Equipment:</b>				
rent lico	1.0000	m <sup>2</sup>	499,486.00	499,486.00
5 times use				99,897.20
Amount Equipment				99,897.20
Amount Materials + Workers + Equipment				115,297.20
rounded				115,290.00

### 3.3. Analysis of Floor Plate Formwork

#### 3.3.1. Floor Plate Formwork conventional

Alternative 1 is from the analysis of the initial price used in the X Building construction project in Surabaya. So that the cost of analysis is IDR 234,950.00, and this formwork is used two times as shown in [Table 7](#).

#### 3.3.2. Semi System Floor Plate Formwork

In alternative two, only replacing the material from alternative one, which initially used Play Wood and nails, was replaced with phenol film/tego film resulting in an analysis cost of IDR 219,640.00. This formwork was used five times as shown in [Table 8](#).

#### 3.3.3. Full System Floor Plate Formwork

In Alternative three, some materials from alternatives one and two were replaced with Kaso wood with U heads, horizontal screws, vertical screws, joint screws and jack base. This alternative generates a cost of IDR 202,360.00, and this formwork is used two times as shown in [Table 9](#).

#### 3.3.4. Bondek Plate Floor Formwork

In alternative four, only replacing the material from alternative one, which initially used Play Wood, was replaced

with Bondek Plate, resulting in an analysis cost of IDR 223,780.00 as shown in [Table 10](#).

### 3.4. Analysis Formwork Beam

#### 3.4.1. Formwork Beam conventional

The alternative is to analyze the initial price used in the X Building construction project in Surabaya. So that the cost of analysis is IDR 220,800.00, and this formwork is used two times as shown in [Table 11](#).

#### 3.4.2. Formwork Semi System Beam

In alternative two, only replacing the material from alternative one, which initially used Play Wood and nails, was replaced with phenol film/tego film and hollow 50.50, which resulted in an analysis cost of IDR 205,400.00. And for this formwork, used five times use as shown in [Table 12](#).

#### 3.4.3. Formwork Beam Full System

In Alternative three, some materials from alternatives one and two were replaced with Kaso wood with U heads, horizontal screws, vertical screws, joint screws and a jack base. This alternative generates a cost of IDR 134,950.00, and this formwork is used five times as shown in [Table 13](#).

Table 7. Analysis Formwork Floor Plate conventional

	coefficient	Unit	Unit Price	Amount
<b>Material:</b>				
Meranti Wood (Blocks)	0.0450	m <sup>3</sup>	3,900,000.00	175,500.00
Nail normal	0.4000	kg	22,000.00	8,800.00
Oil Formwork	0.2000	Liter	21,000.00	4,200.00
Plywood 9 mm, 1.20 x 2.40	0.3500	m	221,000.00	77,350.00
Amount Material				265,850.00
For 2 X Use				132,925.00
<b>Wages:</b>				
Worker	0.3000	Oh	125,000.00	37,500.00
Carpenter	0.1500	Oh	135,000.00	20,250.00
Head craftsman	0.0150	Oh	140,000.00	2,100.00
Foreman	0.0150	Oh	145,000.00	2,175.00
Amount Worker	0.4800			62,025.00
<b>Equipment:</b>				
Scaffolding	2.0000	Ls	20,000.00	40,000.00
Amount Equipment				40,000.00
Amount Materials + Workers + Equipment				234,950.00
rounded				234,950.00

Table 8. Analysis Semi System Floor Plate Formwork

	coefficient	Unit	Unit Price	Amount
<b>Material:</b>				
hollows 50.50	9.3940	kg	84,000.00	789,096.00
wood rafter's 5/7	0.0050	m <sup>3</sup>	2,200,000.00	11,000.00
phenol/ tegofilm	0.0800	pcs	156,250.00	12,500.00
oil formwork	0.2000	l	21,000.00	4,200.00
dynabolt	3.8820	fruit	5,000.00	19,410.00
Amount Material				836,206.00
For 5X Wear				167,241.20
<b>Wages:</b>				
Worker	0.0070	Oh	125,000.00	875.00
Carpenter	0.0760	Oh	135,000.00	10,260.00
Head craftsman	0.0080	Oh	140,000.00	1,120.00
Foreman	0.0010	Oh	145,000.00	145.00
Amount Worker	0.0920			12,400.00
<b>Equipment:</b>				
Scaffolding	2.0000	Ls	20,000.00	40,000.00
Amount Equipment				40,000.00
Amount Materials + Workers + Equipment				219,641.20
rounded				219,640.00

Table 9. Analysis Full System Floor Plate Formwork

	coefficient	Unit	Unit Price	Amount
<b>Material:</b>				
phenol/ tegofilm	0.0800	m <sup>3</sup>	156,250.00	12,500.00
hollows 50.50	1.0000	stick	84,000.00	84,000.00
u heads	1.0000	set	25,000.00	25,000.00
horizontal alignment	1.0000	set	54,500.00	54,500.00
security vertical	1.0000	set	54,500.00	54,500.00
joint security	1.0000	set	25,000.00	25,000.00
base jack	1.0000	set	25,000.00	25,000.00
Amount Material				280,500.00
For 2X Use				140,250.00
<b>Wages:</b>				
Worker	0.0660	Oh	125,000.00	8,250.00
Carpenter	0.0330	Oh	135,000.00	4,455.00
Head craftsman	0.0330	Oh	140,000.00	4,620.00
Foreman	0.0330	Oh	145,000.00	4,785.00
Amount Worker	0.1650			22,110.00
<b>Equipment:</b>				
Scaffolding	2.0000	Ls	20,000.00	40,000.00
Amount Equipment				40,000.00
Amount Materials + Workers + Equipment				202,360.00
rounded				202,360.00

Table 10. Analysis Bondek Plate Floor Formwork

	coefficient	Unit	Unit Price	Amount
<b>Material:</b>				
beam 8/12	0.0089	m <sup>3</sup>	3,250,000.00	28,925.00
rafter's 5/7	0.0014	m <sup>3</sup>	2,200,000.00	3,080.00
Nail normal	0.2300	kg	22,000.00	5,060.00
bondek plate	1.0800	m <sup>2</sup>	120,000.00	129,600.00
Amount Material				166,665.00
<b>Wages:</b>				
Worker	0.0800	Oh	125,000.00	10,000.00
Carpenter	0.0400	Oh	135,000.00	5,400.00
Head craftsman	0.0040	Oh	140,000.00	560.00
Foreman	0.0080	Oh	145,000.00	1,160.00
Amount Worker	0.1320			17,120.00
<b>Equipment:</b>				
Scaffolding	1.0000	Ls	40,000.00	40,000.00
Amount Equipment				40,000.00
Amount Materials + Workers + Equipment				223,785.00
rounded				223,780.00

Table 11. Analysis Formwork Beam conventional

	coefficient	Unit	Unit Price	Amount
<b>Material:</b>				
Meranti Wood (Blocks)	0.0480	m <sup>3</sup>	3,900,000.00	187,200.00
Nail normal	0.4000	kg	22,000.00	8,800.00
Oil Formwork	0.2000	Liter	21,000.00	4,200.00
Plywood 9 mm, 1.20 x 2.40	0.3500	m	221,000.00	77,350.00
Amount Material				277,550.00
For 2 X Use				138,775.00
<b>Wages:</b>				
Worker	0.3000	Oh	125,000.00	37,500.00
Carpenter	0.1500	Oh	135,000.00	20,250.00
Head craftsman	0.0150	Oh	140,000.00	2,100.00
Foreman	0.0150	Oh	145,000.00	2,175.00
Amount Worker				62,025.00
<b>Equipment:</b>				
Scaffolding	1.0000	Ls	20,000.00	20,000.00
Amount Equipment				20,000.00
Amount Materials + Workers + Equipment				220,800.00

Table 12. Analysis Formwork Semi System Beam

	coefficient	Unit	Unit Price	Amount
<b>Material</b>				
wood rafter's 5/7	0.0500	m <sup>3</sup>	2,200,000.00	110,000.00
phenol/ tegofilm	0.0430	pcs	450,000.00	19,350.00
oil formwork	0.2000	l	21,000.00	4,200.00
nail	0.0460	kg	22,000.00	1,012.00
dynabolt	80000	fruit	5,000.00	40,000.00
Amount Material				174,562.00
For 5 X Wear				34,912.40
<b>Wages</b>				
Worker	0.0400	Oh	125,000.00	5000.00
Carpenter	0.0380	Oh	135,000.00	5,130.00
Head craftsman	0.0040	Oh	140,000.00	560.00
Foreman	0.0010	Oh	145,000.00	145.00
Amount Worker	0.0470			10,835.00
<b>Equipment</b>				
Scaffolding	1.0000	Ls	20,000.00	20,000.00
Amount Equipment				20,000.00
Amount Materials + Workers + Equipment				205,397.00
rounded				205,400.00

**Table 13.** Analysis Formwork Beam Full System

	coefficient	Unit	Unit Price	Amount
<b>Material</b>				
phenol/ tegofilm	0.3500	m <sup>3</sup>	156,250.00	54,687.50
Kaso 5/7	1.0000	stick	40,000.00	40,000.00
Hollows 50.50	1.0000	stick	84,000.70	84,000.70
6/12 beam	1.0000	stick	70,000.00	70,000.00
Double elbows	1.0000	set	26,000.00	26,000.00
Tie rod T	1.0000	set	25,000.00	25,000.00
Suri Hollow	1.0000	set	30,000.00	30,000.00
Double wings	1.0000	set	30,000.00	30,000.00
Horizontal stroke	1.0000	set	54,500.00	54,500.00
Security vertical	1.0000	set	25,000.00	25,000.00
Jack base	1.0000	set	25,000.00	25,000.00
Oil formwork	0.2000	liter	21,000.00	4,200.00
Amount Material				464,188.20
For 5 X Wear				92,837.64
<b>Wages</b>				
Worker	0.0660	Oh	125,000.00	8,250.00
Carpenter	0.0330	Oh	135,000.00	4,455.00
Head craftsman	0.0330	Oh	140,000.00	4,620.00
Foreman	0.0330	Oh	145,000.00	4,785.00
Amount Worker	0.1650			22,110.00
<b>Equipment</b>				
Scaffolding	1.0000	Ls	20,000.00	20,000.00
Amount Equipment				20,000.00
Amount Materials + Workers + Equipment				134,947.64
rounded				134,950.00

So based on previous research, this article will discuss the selection of the formwork slab method by comparing it in terms of cost per square meter. This study will compare four formworks, including conventional formwork, semi-system formwork, full-system formwork, and bonded plate formwork. The selection of these four alternatives is based on the results of interviews with fieldwork practitioners based on the frequent use of the four types of formworks in Indonesia, while this study previously only compared two types of formwork, namely conventional formwork and full system formwork. In this study, the aim was to choose a formwork implementation method to negotiate the initial cost of formwork slabs. This research study was conducted on the X Building construction project in the city of Surabaya. This type of building project has the same form between floors to use the same formwork on each floor. The same goes for one floor of a building and another. This time the research moment compares several alternatives because it will look for alternative slab formwork that is cheaper, easier to obtain, affordable, and effective with many uses so that it is possible to achieve significant efficiency and benefits without reducing the quality of the concrete alone. The purpose of this research is to review the rate per square meter of slab formwork for each installation.

#### 4. Conclusions

Based on the analysis of research this has been done can take conclusion as following.

The most significant cost of the project In the X Building Construction Project, there is structural work, and the most significant work item is structural work, namely:

- Beam
- Platform
- Column

Savings on these components can be made by replacing formwork on beams, slabs and columns.

Construction components that have the potential to save (cost savings) by replacing the formwork in the savings are as follows:

- Colum formwork work costs before Value Engineering is IDR 180,140/m<sup>2</sup> if using a semi-system formwork, the total cost will be IDR 146,260/m<sup>2</sup>. If using a full system formwork, the total cost will be IDR 115,290/m<sup>2</sup>. Column work cost savings from using Conventional Column Formwork, Semi System Column Formwork and Full System Formwork resulting in cost savings and a percentage of: Using Bekestin Semi System IDR 38,380. with 21% and using Full System Formwork IDR 115,290 with 36%.
- The cost of floor plate formwork before Value Engineering is carried out IDR 234,950/m<sup>2</sup> if using semi-system formwork, the total cost will be IDR 219,640/m<sup>2</sup>. If using full system formwork, the total cost will be IDR 202,360/m<sup>2</sup>, and if using Bondek plate formwork, the total cost is IDR 223,780/m<sup>2</sup>. Cost savings for floor plate work from using Conventional Floor Plate Formwork, Semi System Floor Plate Formwork and Full System Formwork resulting in cost savings and a percentage of: Using Bekestin Semi System IDR 15,310 with 7%, using Full System Formwork IDR 32,590 with 14% and using Bondek plate IDR 11,170 with 5%.
- The cost of the beam formwork work before Value Engineering is IDR 220,800/m<sup>2</sup> if using a semi-system formwork, the total cost will be IDR 205,400/m<sup>2</sup>. Meanwhile, if you use a full system formwork IDR 134,950/m<sup>2</sup>. Savings on beam work costs from using Conventional Beam Formwork, Semi System Beam Formwork and Full System Formwork resulting in cost



savings and a percentage of: Using Bekestin Semi System IDR 15,400 with 7% and using Full System Formwork IDR 85,850 with 39 %.

So for this building, it is best to use full system formwork for all work (beams, columns, and floor slabs) because using full system formwork is cheaper than using other formwork, and this full system formwork costs IDR 40,312,992,291.32 and results in a cost savings of IDR 2,499,337,079.68.

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### Author Declaration

#### Authors' contributions and responsibilities

The authors made substantial contributions to the conception and design of the study. The authors took responsibility for data analysis, interpretation and discussion of results. The authors read and approved the final manuscript.

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