Comparison Analysis of Cost and Time Forming Conventional Method With Semi-System Method for Column Namira Hotel Surabaya

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Abstract

In the implementation of project activities, careful steps are needed and the determination of the right implementation method to obtain cost and time efficiency. In general, there are 3 types of formwork, namely conventional formwork, semi-system formwork, and system formwork. The difference between the three types can be seen from the material used. This study aims to determine the comparison of formwork in terms of method, cost and time in the construction of the Namira Hotel project located on Jl. Pagesangan Surabaya which consists of 9 floors. The cost of formwork is usually between 35% to 60% or more of the total construction cost. Material requirements are usually referred to as the calculation of the volume of work. The volume of a formwork work depends on the planned area. The duration needed to complete a job is influenced by the worker. So in order to determine the success of a project, the factors that must be considered are in terms of labor productivity and the number of workers. In the construction of Hotel Namira Surabaya, the cost of conventional column formwork was IDR 376,052,918.80 and for semi-column formwork it was IDR 214.624.700,00 where the duration of semi-system formwork was faster than conventional formwork.

1. Preliminary
1.1. Background

With the rapid development of infrastructure and economic progress, the services required to produce quality, cost and time efficiency are very much needed. One of them is the construction of the Hotel Namira project located on Jl. Pagesangan Surabaya which consists of 9 floors.

According to Kusumawardhani & Noviani, (2018) Formwork is an auxiliary form of molding concrete with the desired size, shape, or position. This means that this formwork work is only carried out temporarily where the formwork construction can be dismantled and reassembled.

In general, there are 3 types of formwork, namely conventional formwork, semi-system formwork, and system formwork. The difference between the three types can be seen from the material used. In general, conventional formwork uses wooden boards and is supported by wooden beams. Semi-system formwork is a formwork method that is made to resemble the shape of the building and for repeated use and the material itself uses steel plates and is supported by wooden beams. In formwork systems, this method is usually used for large-scale construction work and requires high costs.

1.2. Problem Formulation
1. How much is the cost of conventional formwork and semi-system formwork in the construction project of Hotel Namira Surabaya?
2. How long does it take to implement the conventional method formwork and the semi-system method for the Hotel Namira Surabaya construction project?
3. What is the cost and time comparison between conventional formwork and semi-system formwork in the Namira Hotel Surabaya construction project?

1.3. Scope of Problem
1. The analyzed formwork work is on the 1st floor column to 9th floor.
2. Planning only includes costs and implementation time.
3. The formwork used in the conventional system uses multiplex and wooden scaffolding.
4. The formwork in the semi-system uses hollow beams and tegofilm.
5. Planning does not include the use of heavy equipment methods
6. The strength of the formwork in each method is considered to have met the requirements

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7. The unit prices for labor costs and wages are taken from the Surabaya City Wage Unit Price List

1.4. Purpose

With the formulation of the problem, the expected objectives are as follows:

1. Knowing the cost of formwork using conventional methods and semi-system methods in the implementation of the Namira Hotel Surabaya construction project.
2. Knowing the implementation time of formwork using conventional methods and semi-system methods in the implementation of the Namira Hotel Surabaya construction project.
3. Knowing the cost and time comparison of formwork implementation using conventional methods with semi-system methods in the construction project of Hotel Namira Surabaya.

1.5. Benefit

The benefits of this final project include:

1. Adding the author's insight regarding the comparison of the cost and time of carrying out formwork work with the conventional method with the semi-system method in the construction of high-rise buildings.
2. As a reference material and reference material in determining the method of implementing formwork work in a construction project.

2. Literature Review
2.1. General

Formwork is a work item that must exist in concrete work. In the implementation of project activities, careful steps are needed and the determination of the right implementation method to obtain cost and time efficiency. This formwork determines the shape of the concrete structure to be made.

2.2. Formwork Type

The quality of the formwork also determines the yield and quality of the concrete form. Broadly speaking, according to Wigbout (1992) formwork is divided into 3 types, namely:

1. Conventional formwork is formwork that has been removed and dismantled into separate parts, can be rearranged into its original shape or other forms.
2. Semi-system formwork is a formwork that is devoted to a particular object or form. In principle, this formwork method can be used repeatedly with an irreversible shape. Usually the sizes are adjusted to the shape of the concrete concerned.

System formwork is a formwork in which the elements are made in the factory and most of the components are made of steel. This formwork can be used repeatedly and besides being able to be purchased directly, it can also be obtained by renting from a formwork equipment provider.

2.3. Column Formwork Parts

In general, the formwork parts consist of column shoes, formwork panels, upright reinforcement, flat reinforcement, regulating clamps, supporting beams, holes that clean dirt in the column.
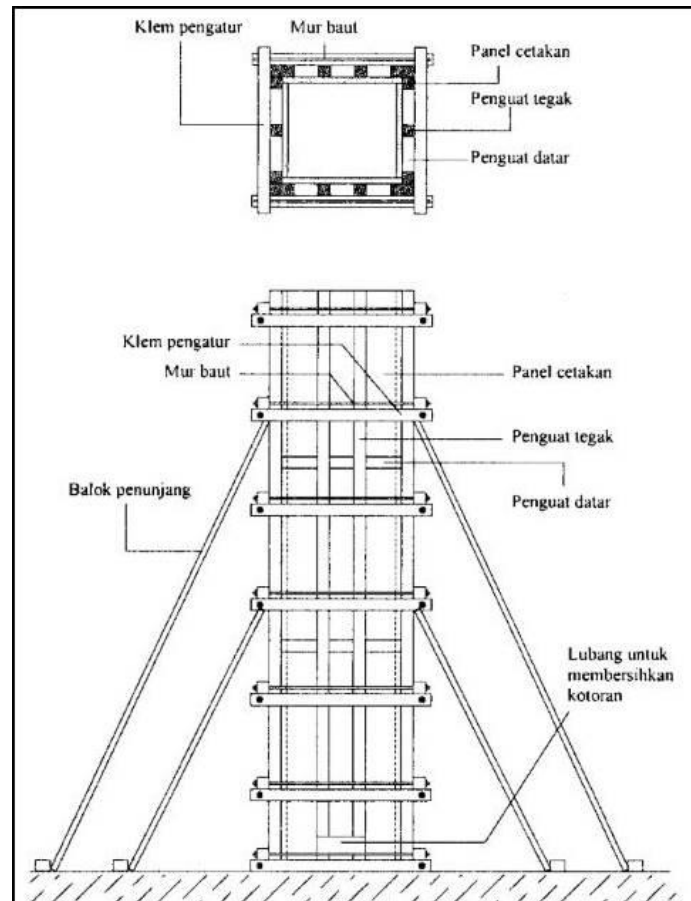
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Figure 2.1 Column Formwork Parts

(Source : www.sitetekniksipil.com)

2.4. Formwork Material

Materials that are generally used in formwork work are:

2.5. Wood

The use of wood materials in the construction world is often found in formwork work. The provisions and requirements are regulated in the 1961 Indonesian Timber Construction Regulation (PKKI).

Table 1. Classification of Indonesian Timber

No	Strong Class	Air Dry Specific Gravity (gr/cm3)	Strong Absolute Bending (kg/cm2)	Absolute Compressive Strength (kg/cm2)
1	I	>0,9	>1100	>650
2	II	0,90 - 0,60	1100 – 725	650 – 425
3	III	0,60 – 0,40	725 – 500	425- 300
4	IV	0,40 – 0,30	500 – 360	300 – 215
5	V	<0,3	<360	<215

Source: Indonesian Timber Construction Regulation (PKKI) 1961

In a good planning calculation, the allowable stress and the modulus of elasticity of the wood material need to be reviewed.

Table 2. Classification of Indonesian Timber

No	Voltage (kg/cm2)	Wood Grade				
		I	II	III	IV	V
1	σ ijin lt	150	100	75	50	-
2	σ ijintk = σ ijintr	130	85	60	45	-
3	σ ijintk	40	25	15	10	-
4	σ ijin	20	12	8	5	-

Source: Indonesian Timber Construction Regulation (PKKI) 1961

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2.6. Multiplex

One of the main materials of concrete formwork is multiplex which is plywood. In general, multiplex is divided into 3 types, namely ordinary multiplex, poly resin multiplex, and film face multiplex (tegofilm). In terms of price, ordinary multiplex is much cheaper than tegofilm multiplex.

3. Methodology

The research methodology is a series of determining procedures and obtaining data in the process of making the final project. The methodology in writing this final project includes all processes of analysis activities to solve the problems that exist in the final project.

3.1. Identification of Problems

The identification stage is one of the initial series before data collection and processing. This stage includes:

1. Determining the Title of the Final Project
2. Making a Final Project proposal
3. Literature study to determine the outline of the Final Project report
4. Determine data requirements
5. Activity schedule planning
6. Job analysis

3.2. Research variable

Research variables are useful for collecting data and for analyzing data. In this study there are 2 variables that will be reviewed, namely the cost variable and the time variable

Table 3. Research Variables Cost

Indicator	Data source	Data collection technique
Cost Wages	Shop drawing Volume	Secondary Data

Table 4. Cost Research Variables

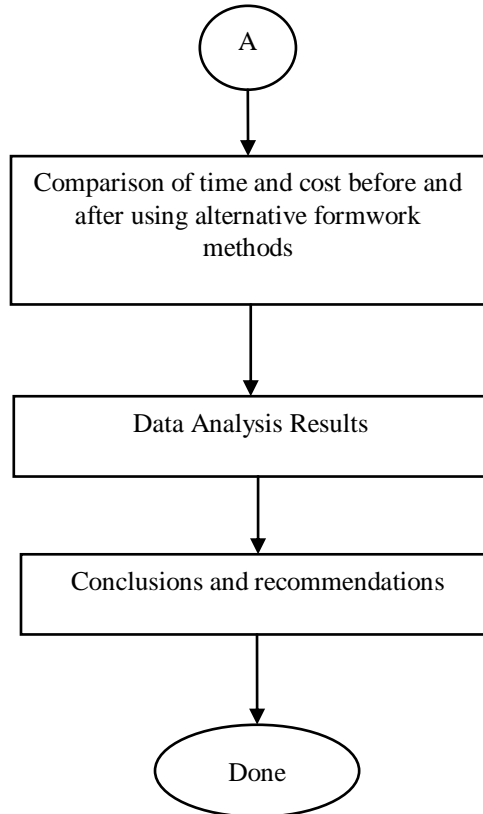| Indicator	Data source	Data collection technique
Productivity Duration	Schedule Calculation of duration Execution method	Secondary Data

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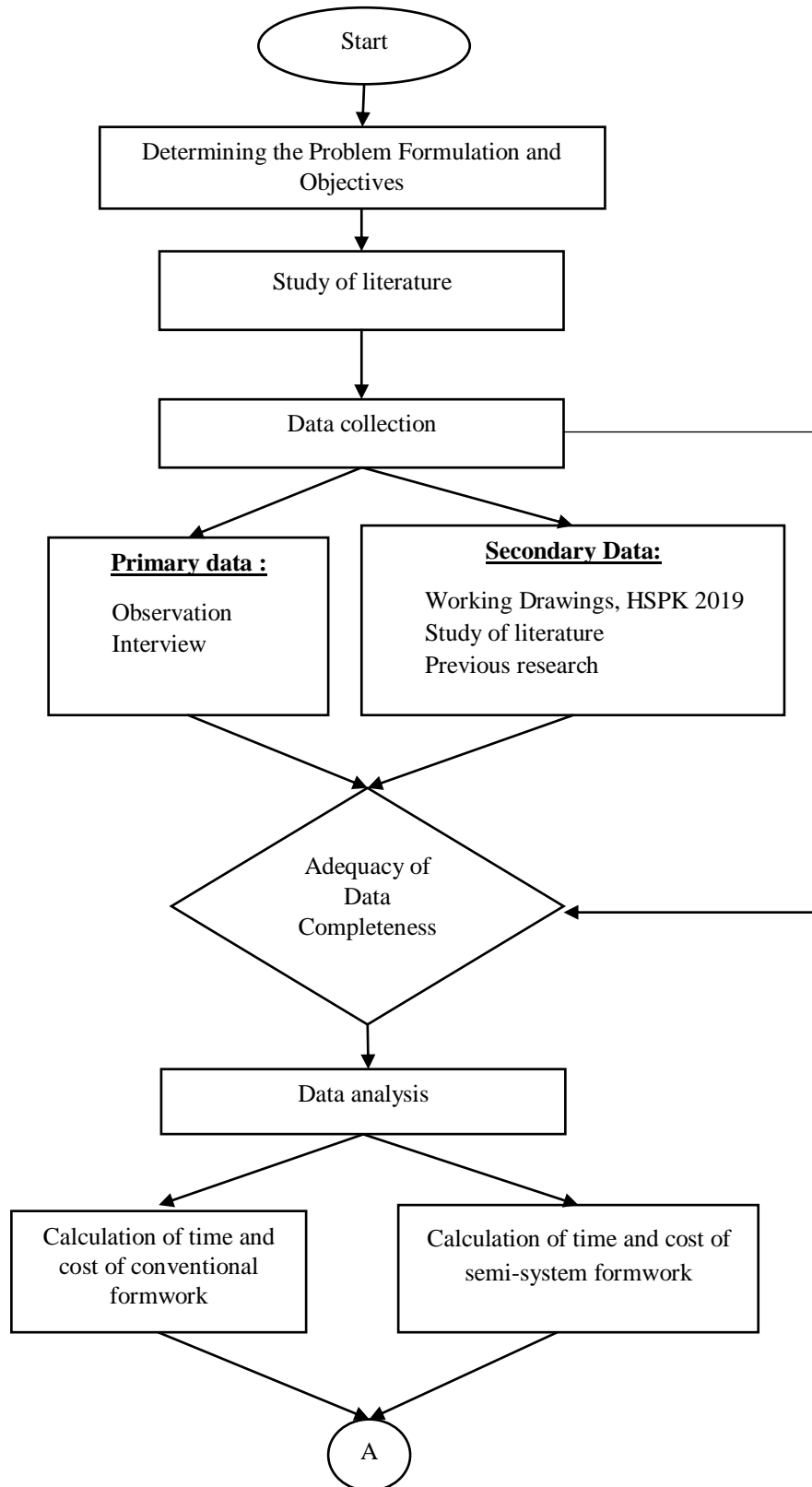
Chart 1 Research Methodology Flowchart

3.3. Data Collection

To get optimal results, data which includes primary and secondary data are needed. The method used in data collection using the method of observation and interview with informants to obtain data which will be reviewed later in the calculation.

4. Results and Discussion

4.1. Data

The column data needed in the calculation of the Namira Hotel column formwork are as follows:

Table 5 Recapitulation of Column Dimensions

Column Details	Number of Columns										Total
	Lt. Base	K1	K2	K3	K4	K5	K6	K7	K8	K9	
K1 (70/70)	12	12	12	12	12	12	12	12	12	4	112
K1a (70/70)										8	8
K2 (50/50)	1	1	1	1	1	1	1	1	1	1	10
K3 (40/60)	4	4	4	4	4	4	4	4	4	4	40

4.2. Calculation of Productivity and Duration of Forms

In column formwork starting from the ground floor, 1 group with 1 foreman, 3 carpenters and 7 workers for fabrication work and 3 carpenters and 5 workers for installation work. In a working day for 7 hours.

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Table 6 Needs of Working Hours in Implementation

Coefficient		Labor	Max quantity	Number of Wear (person)			Working Hours (hours/day)		
				Total	Manufacturing	Install	Manufacturing	Install	Demolish
0.660	Oh	Worker	20	12	7	5	49	40	49
0.330	Oh	Carpenter	10	6	3	3	21	21	24
0.033	Oh	Foreman	1	1	1		7		
		Total		19	11	8	77	61	73

The productivity of each job in one day is:

$$-set = \frac{number\ of\ hours\ worket\ bu\ workers}{working\ hours\ 10m^2} x10m^2$$
$$= \frac{77\ hours}{6\ hours} x10m^2$$
$$= 128.33m^2/day$$
$$-Install = \frac{number\ of\ hours\ worked\ by\ workers}{working\ hours\ 10\ m^2} x10m^2$$
$$= \frac{61\ hours}{3\ hours} x10m^2$$
$$= 203.33\ m^2/day$$
$$-Disassemble = \frac{number\ of\ hours\ worked\ by\ workers}{working\ hours\ every\ 10m^2}$$
$$= \frac{73\ hours}{3,5\ hours} x10m^2$$
$$= 243.33m^2/day$$

For conventional formwork, the 6th floor column uses 20% of the 4th floor, the 7th floor column uses 40% of the 3rd floor formwork and the 8th floor column uses 40% of the 4th floor formwork. The calculation results will be tabled with the same calculation. So that the repairs are carried out with productivity:

$$Repair = \frac{number\ of\ hours\ worked\ by\ wokers}{working\ hours\ every\ 10m^2} x10m^2$$
$$= \frac{77\ hours}{3.5\ hours} x10m^2$$
$$= 220m^2/day$$

4.3. Calculation of Form Costs

Cost of wages for manufacturing workers in one day
a.   Foreman   @ IDR 158,000.00 x 1 person   = IDR 158,000.00
b.   Carpenter   @ IDR 121,000.00 x 3 people   = IDR 363,000.00
c.   Worker   @ IDR 110,000.00 x 7 people   = IDR 770.000,00

Material analysis for 1m2 conventional column formwork
Wood   = 0,059 x IDR 3,3500000.00   = IDR 197,673.60
a.   nail   = 0.387 x IDR 19.000,00   = IDR 7,343.50
b.   Oil   = 0.288 x IDR 29,600,000   = Rp. 8,510.00
c.   Plywood 9 mm   = 0.018 x Rp 121.4000.00   = 2221.62

Material price for semi-column system formwork

Table 7 Semi-system Column Formwork Material Prices

Material name	Unit	Unit price
Tego film 15 mm	Sheet	328,000
Hollow 50x50x1.6	stem	238,500
Screw	Fruit	950
Tie Rod	Fruit	5,000
Wing Nut	Fruit	3000
Push Pull Prop	Fruit	100,000
Kicker Brace	Fruit	75,000

In semi system formwork, support materials and other components are planned to be rented, so the cost of formwork material is the rental fee per month.

4.4. Comparison of the Duration of Conventional Formwork and Semi-System Formwork

In each formwork method using the same productivity, number of groups, and number of workers. With the same volume of work, the duration of the work is as follows:

Table 8 Duration Calculation Results

Work Sub-Item	Conventional Formwork	Semi-System Formwork
Set	20	10
Install	10	10
Open	10	10
repair	3	0

4.5. Cost Comparison of Conventional Formwork and Semi-System Formwork

Table 9 Cost Calculation Results

Conventional Formwork	Rp 376.052.918,80
Semi-system Formwork	Rp 214.624.700,00

In conventional formwork, the material is used 3 times and for semi-system formwork, the material can be reused 5 times. In conventional formwork there are repair costs and additional materials, while in semi-system formwork for floors 3-8 only one fabrication is carried out. Based on the analysis from Table 9, the difference between the cost of conventional formwork and semi-system formwork is IDR 376,052,918.80 - IDR 214.624.700,00 =IDR 161.428.218,80

5. Conclusion

1. Calculation of the cost of conventional formwork of IDR 376,052,918.80 and on semi-system formwork of IDR 214,624,700.00
2. In the calculation of the duration of the work, the duration of fabrication on conventional formwork for 30 days and for semi-system formwork for 20 days is faster.
3. Conventional formwork is more expensive at IDR161,428,218.80 than semi-system formwork. And the duration of conventional formwork is 10 days longer than that of semi-system formwork. In terms of time and cost, the most optimal formwork method is the semi-system formwork method.

References

Wigbout, F. (1992). *Buku pedoman tentang bekisting (kotak cetak)* (Vol. 24). Retrieved from https://inlislite.kalselprov.go.id/opac/detail-opac?id=21899