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Analysis Comparison of Plate and Beam Formwork Using Semi Conventional Formwork with Aluminium Formwork System in Terms of Cost and Duration on Vasanta Innopark Project

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Abstract

The development of technology in the world of construction in Indonesia marked with the increasing number of innovations used in the construction process, one of which is formwork. Formwork is one of the most influential jobs on construction projects, especially in terms of cost and time. Therefore, modern Formwork innovations continue to emerge, one of which is Aluminium Formworks System. In this study the authors conducted comparative analysis of cost and time among semi-conventional Formwork with Aluminium Forcoand also spread questionnaires to find out if the Aluminium formworks are effective in replacing semi-conventional formworks on the Vasanta Innopark project. The results of the questionnaire will be analyzed using validity tests, realibility, correlation, and regression in SPSS software. The result of this research, the total cost needed for semi-conventional formwork is Rp. 6,577,699,867.20 and the total cost for the aluminium formwork is Rp. 6,985, 970.893.44 where aluminium formwork is more expensive by Rp 408,271,026.44 or 5.84% more expensive. And the time required conventional formwork is for 342 days while for aluminium formwork for 180 days or with a difference of 162 days or about 47.37 percent. And from the results of the questionnaire obtained that the effectiveness of aluminium formwork in replacing semi-conventional formwork is 0.833 or 83.3%.

Keywords
Aluminium Formworks System, Banging, Cost, Effectiveness, Kumkang, Semi Conventional Formwork, Time.

1. Preliminary

Along with the changing times of course we already know together that technology is growing in this digital age. The development of this technology could be an advantage or vice versa could be a boomerang due to resource unpreparedness. The development of technology in the world of construction in Indonesia is characterized by the increasing number of innovations used in the construction process, one of which is form of form. The cost for forming ranges from 40% - 60% of the cost of concrete work or about 10% of the total cost of building construction. Here it appears that there is a large process that is a form of form form that we have to review because so far using conventional systems there are many things that should be maximized in this process.

According to the book Gazali (2018), in 2016 some brand formisting is just starting to emerge. One of them is the use of aluminum form sheeting. The widespread use of aluminum formwork is a big step for the construction industry, but it does not increase efficiency just for the industry but also saves materials, money, labor and human resources time. With the good quality of the construction site, aluminum form sheeting will be increasingly used in future builds.

In Vasanta Innopark Project, PT PP (Persero) Tbk located in Jalan Kalimantan, Industrial Area, Cibitung, using Aluminum Formwork System (kumkang). As for the object of study for the title of My Final Task is a multi-storey building construction project.

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2. Methodology

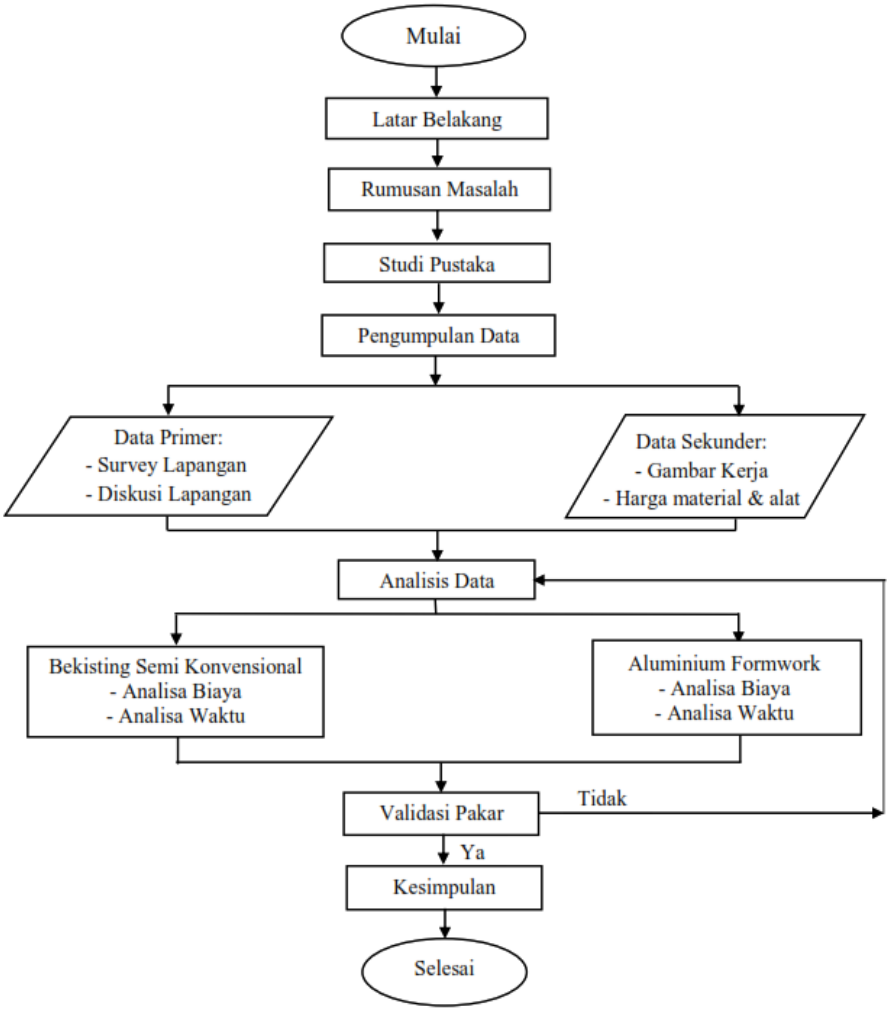

Figure 1. Methodology

According to Sugiyono (2017) variables are an attribute or trait of or value of a person, object or activity that has certain variations set by researchers to be studied and then drawn conclusions.

In determining variables, researchers reviewed the results of previous research journal literature studies and conducted interviews with project staff to obtain variable synchronization relevant to the conditions of the project reviewed. Furthermore, in order for variables to be easy to understand, researchers divide them into 7 important aspects.

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Table 1. Research Variable

No	Indikator	Sub Indikator
1	Material	X1. Delivery of materials
		X2. Material scarcity
		X3. Availibility of construction materials
		X4. Material resistance to field conditions (weather, impact, etc)
		X5. Quality of tools and materials
		X6. Material conditions in storage
2	Labour	X7. Number of manpower
		X8. Labour productivity
		X9. Knowledge and experience of the workers
		X10. Easeof field work supervision
		X11. Labour time discipline
		X12. Communication between labour and supervisory bodies
3	Social environment	X13. Durability in weather conditions (rain, etc.)
		X14. Field accidents
		X15. Impact of residual material on the surrounding environment
		X16. Job security in the field
		X17. Material waste disposal site
4	Execution time	X18. Owner accuracy in making decisions
		X19. Accuracy of sub-contracor schedule on completion
		X20. Added jobs
		X21. Accuracy of report creation and occupation administration
		X22. Accuracy of work in the installation of formwork
		X23. Tool life
		X24. Project schedule assignment by owner
		X25. Explanation of the work to be carried out
		X26. Ease moving tools and materials
		X27. Ease of installing formwork
		X28. Ease of access in working / neater in terms of appearance
		X29. Schedule planning
5	Design	X30. There is a design change by the owner
6	Financial	X31. Aaccuracy in allocating funds
		X32. Price of materials
		X33. Payments to workers
		X34. Late payment by owner
		X35. Delay in requesting payment submission by contractor
		X36. Rising prices and materials
7	Equipment	X37. Availability of work equipment
		X38. Equipment damage
		X39. Delivery of equipment
		X40. Equipment productivity
		X41. Number of items in each series
		X42. Completeness of worker tools
		X43. Lack of equipment operator availability

Source: Processed by Author, 2020

2.1 Questionnaire

Questionnaire is a data collection technique performed by giving a set of questions or written statements to the respondent to answer. This questionnaire was created to find out how effective the use of Aluminum form matter is in lieu of semi-conventional form form. In determining variables in the questionnaire, the authors conducted discussions and interviews with experts, experts in this study numbered 3 people, with the following expert criteria:

1. Work for a construction company.
2. Minimum bachelor's education
3. Minimum experience ≥ 10 years.

2.2 Data Analysis

Data collected in the field through questionnaires will be analyzed using statistical techniques as described below:

Cost Analysis

Cost Anaysis using Unit Price Method. In the unit price method the cost is analyzed based on per unit price, the estimated cost is done by multiplying the number of units of work known to the amount by the unit price. This method is very quick to use but it is very difficult to make accurate estimates because it is difficult to make adjustments to the unit price in the event of a change in the size, shape and quality of the construction type. However, because in the Vasanta Innopark project there is no change or change of panel size, so this method can be used for this research.

Time Analysis

To calculate the time analysis, it is used using the productivity target formula, namely:

$$P = \frac{V}{T\ x\ n}$$

Where:

P : Labor productivity is the amount of work that a workforce can complete every day.

V : Job Quantity

n : Number of workers used

T : Duration of Work

Validity Test

The data validity test was performed using the SPSS software tool using Corrected Item Total Correlation number (r) results through the Scale menu in the Reliability Analysis option. This analysis is done by correlating each item's score with the total score. Testing using two-party test with a significance level of 0.05.

Reliability Test

Reliability analysis points to a sense that an instrument is trustworthy enough to be used as a data collection tool. A commonly used reliability analysis is cornbach alpha analysis. As for testing using cornbach alpha coefficient ≥ 0.6 which is a value that is considered to be able to test the validity of the questionnaire used with the aim of knowing the level of data reability generated by an instrument.

Correlation Test

Pearson correlation is one of the correlation measures used to measure the fund strength of the linear relationship rah of two variables. Two variables are said to correlate when one variable changes accompanied by another variable change.

Regression Test

A simple linear regression test analysis is a linear relationship between one independent variable and a dependent variable. This analysis is to find out the direction of the relationship between independent variables and dependent variables whether positive or negative.

3. Results And Analysis

3.1. Cost Analysis Result

Picture 2 shows that the cost of floor plate and beam form work using semi-conventional form work costs Rp. 3,917,502,468.00 for floor plates and Rp. 2,660,197,399.00 for beams. While using aluminum form matter requires a fee of Rp. 4,160,657,793.60 for floor plates and Rp. 2,825,313,099.84 for blocks. The difference between the two methods is Rp. 243,155,325.60 for floor plate work and Rp. 165,115,700.64 for beam work.

Here it can be seen that using aluminum form sheeting costs more than using semi-conventional formwork.

Figure 2. Cost Comparison
Source : Processed by Author, 2020

3.2 Result Time Analysis

Table 1. Time Comparison

No	Method	Duration
1	Semi Konventional	342 days
2	Aluminium Formwork	180 days
	DIFFERENCE	162 days

Source : Processed by Author, 2020

In table 1 it can be seen that using a semi-conventional formwork method takes 342 days to work for 36 floors while using aluminum form sheeting takes 180 days.

Both formwork methods have a difference of 162 jobs or use aluminum form sheeting faster than 162 days compared to semi-conventional formwork

3.3 Validity Test Result

Table 2. Validity Test Result

No	Code	r table	r hitung (Pearson Correlation)	Description
1	X1	0.312	0.48	Valid
2	X2	0.312	0.424	Valid
3	X3	0.312	0.396	Valid
4	X4	0.312	0.343	Valid
5	X5	0.312	0.455	Valid
6	X6	0.312	0.355	Valid
7	X7	0.312	0.443	Valid
8	X8	0.312	0.477	Valid
9	X9	0.312	0.397	Valid
10	X10	0.312	0.462	Valid
11	X11	0.312	0.366	Valid
12	X12	0.312	0.244	Invalid
13	X13	0.312	0.432	Valid
14	X14	0.312	0.337	Valid
15	X15	0.312	0.517	Valid
16	X16	0.312	0.342	Valid
17	X17	0.312	0.41	Valid
18	X18	0.312	0.375	Valid
19	X19	0.312	0.084	Invalid
20	X20	0.312	0.259	Invalid
21	X21	0.312	0.1	Invalid
22	X22	0.312	0.497	Valid
23	X23	0.312	0.513	Valid
24	X24	0.312	0.381	Valid
25	X25	0.312	0.383	Valid
26	X26	0.312	0.48	Valid
27	X27	0.312	0.411	Valid
28	X28	0.312	0.433	Valid
29	X29	0.312	0.17	Invalid
30	X30	0.312	0.435	Valid
31	X31	0.312	0.473	Valid
32	X32	0.312	0.35	Valid
33	X33	0.312	0.499	Valid
34	X34	0.312	0.155	Invalid
35	X35	0.312	0.083	Invalid
36	X36	0.312	0.455	Valid
37	X37	0.312	0.42	Valid
38	X38	0.312	0.441	Valid
39	X39	0.312	0.355	Valid
40	X40	0.312	0.502	Valid
41	X41	0.312	0.451	Valid
42	X42	0.312	0.345	Valid
1	Y	0.312	0.97	Valid

Source : Processed output SPSS

From table 2 it can be seen that there are 7 invalid free variables (X) due to the r count <r table, so there are only 35 free variables (X) and 1 bound variable (Y) that are declared valid.

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3.4 Reliability Test Results

Table 3. Reliability Statistics

Reability Statistic	
Cronbach's Alpha	N of Items
0.884	36

Source : Processed Output SPSS

Cronbach's Alpha value for the 36 variables tested was 0.884 which means it fell into the Reliabel category due to the 0.884>r table (0.312).

3.5 Correlation Test Results

Table 4. Correlation Results

No	Code	Pearson Correlation	Sig. (2-tailed)	Description
1	X1	0.397	0.011	CORRELATION
2	X2	0.395	0.012	CORRELATION
3	X3	0.402	0.01	CORRELATION
4	X4	0.347	0.028	CORRELATION
5	X5	0.472	0.002	CORRELATION
6	X6	0.358	0.023	CORRELATION
7	X7	0.398	0.011	CORRELATION
8	X8	0.445	0.004	CORRELATION
9	X9	0.348	0.028	CORRELATION
10	X10	0.497	0.001	CORRELATION
11	X11	0.311	0.051	NOT CORRELATION
12	X13	0.418	0.007	CORRELATION
13	X14	0.253	0.115	NOT CORRELATION
14	X15	0.57	0	CORRELATION
15	X16	0.376	0.017	CORRELATION
16	X17	0.312	0.05	NOT CORRELATION
17	X18	0.34	0.032	CORRELATION
18	X22	0.467	0.002	CORRELATION
19	X23	0.542	0	CORRELATION
20	X24	0.399	0.011	CORRELATION
21	X25	0.319	0.045	CORRELATION
22	X26	0.491	0.001	CORRELATION
23	X27	0.482	0.002	CORRELATION
24	X28	0.462	0.003	CORRELATION
25	X30	0.384	0.015	CORRELATION
26	X31	0.428	0.006	CORRELATION
27	X32	0.317	0.046	CORRELATION
28	X33	0.51	0.001	CORRELATION
29	X36	0.349	0.027	CORRELATION
30	X37	0.382	0.015	CORRELATION
31	X38	0.472	0.002	CORRELATION
32	X39	0.386	0.014	CORRELATION
33	X40	0.438	0.005	CORRELATION
34	X41	0.471	0.002	CORRELATION
35	X42	0.351	0.026	CORRELATION

Source : Processed Output SPSS

From table 4 results it can be seen that there are 33 free variables (X) that correlate with bound variables (Y) because they have a value of <0.05" significance.

3.6 Regression Test Result

Table 5. Coefficients

Coefficients[a]						
Model		Unstandardized Coefficients		Coefficients	t	Sig.
		B	Std. Error	Beta		
8	(Constant)	-2.343	0.535		-4.378	0.000
	X27	0.499	0.067	0.544	7.397	0.000
	X31	0.192	0.082	0.184	2.351	0.025
	X5	0.262	0.065	0.317	4.033	0.000
	X1	0.364	0.075	0.367	4.837	0.000
	X39	0.263	0.065	0.293	4.038	0.000
	X38	0.231	0.103	0.177	2.249	0.031
a. Dependent Variable: Y						

Source : Processed Output SPSS

Table 6. Table R Square

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.913[h]	0.833	0.802	0.370
a. Predictors: (Constant), X27, X31, X5, X1, X39, X38				

4. Conclusion

1. a. The implementation fee required for semi conventional form form form method is Rp. 6,577,699,867.20 while if using aluminum formisting amounting to Rp. 6,985,970,893.44. That means using Aluminum formwork costs more, but contractors are considering faster execution times and smaller rework because less structural repairs are required if using aluminum formwork.

b. Based on the data of the implementation time that has been done analysis, the duration of time required for semi conventional form of form is 342 days. While if using aluminum form matter is 180 days. Which means using Aluminum form matter takes less time compared to semi-conventional formwork.

2. a. Percentage difference in cost of both formisting methods is 5.84% or with a difference of Rp. 408,271,026.44. Can be seen in the table below:

Table 7. Table Percentage in cost

Works Item	Unit	VOLUME	CONVENSIONAL		ALUMINIUM FORMWORK	
			Unit Cost	Total	Unit Cost	Total
Floor Plate	m2	24561.144	159,500.00	3,917,502,468.00	169,400.00	4,160,657,793.60
Beam	m2	16678.3536	159,500.00	2,660,197,399.20	169,400.00	2,825,313,099.84
Total				**6,577,699,867.20**		**6,985,970,893.44**
Difference						**408,271,026.24**
Percentage Difference						**5.84%**

b. The percentage of time difference between the two methods of form form is 47.37% or with a difference of 162 days. Can be seen in the table below:

Table 8. Table Percentage of time

Works Item	Floor Total	Volume	Duration (day)	
			Semi Konventional	Aluminium Formwork
Floot Plate and beam	36	1145 m2	342	180
Difference				**162 days**
Percentage Difference				**47.37%**

3. Based on the analysis and discussion that has been presented in the previous chapter obtained a value of R Square of 0.833 or 83.3%. This figure shows that the effectiveness of aluminum formisting in replacing semi-conventional form sheeting is 83.3%.

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