

The Comparison between Semi Conventional and Peri Scaffolding: Cost and Time Comparison at Tunjungan Plaza 6 Project in Surabaya

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Abstract

The average costs of formwork is ranging from 40% - 60% of the total cost in concreting work on a project, in which it provides a substantial contribution in terms of cost. There are various methods of formwork used in the project with different installation time and cost. The aim of this article is to compare between the use of semi-conventional methods and PERI formwork in terms of time and cost for structural work columns, beams, plates and shearwall project 6 Surabaya Tunjungan Plaza Condo area. Since every formwork method usage has different performance, the implementation of certain method will have a direct impact on time or budget allocation for the project cost. From a comparative analysis on the project Surabaya Tunjungan Plaza 6 produces costing Rp. 45,876,905,652.52 on the formwork with semi conventional method, while using the PERI system costs Rp. 51,823,081,342.71. This shows that the use of PERI formwork systems 12.96% is more expensive than the formwork with semi conventional method. Nevertheless, the duration of semi conventional formwork method takes as long as 932 days, and the use of PERI system takes only 706 days. This shows that the use of PERI formwork systems is faster 24% than the formwork with semi conventional method.

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1. Introduction

Construction business is now increasingly widespread development, so that competition among contractors can not be inevitable. On the other hand requires a level of expertise and high accuracy for contractors in choosing the type of materials, estimate costs, and determine the method of execution in order to offer cost can be cheaper and shorter implementation time with the quality that can be justified so as to save costs. One important component that can optimize efficiency in the execution of the project structure, especially the construction of multistory building is supplying formwork. Factors that influence the selection of the formwork methods include the cost of procurement of materials, degree of safety and quality, the level of difficulty in terms of installation and pembongkarannya, scale of the project, the duration of the project, and other factors. The cost factor and the effectiveness of the installation time and dismantling the formwork method selection plays an important role in the overall value of the project. The calculations were performed include the cost of materials and labor.

With this background, the writer would like to review from the technical point of view, namely: 1). Faktor what needs to be considered in the selection method using formwork? 2). What is the difference between the conventional method and peri formwork semi terms of time and cost to the project Tunjungan Plaza 6 Surabaya? 3). Which are the most efficient formwork methods of in terms of time and cost to the project Tunjungan Plaza 6 Surabaya? Limitation of problem in this research

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are 1). Scope of work only area Condo and 2). Formwork being simulated at the top of the building structure that consists of columns, beams, plates and Shearwall

2. Review of Literature

In essence a construction formwork serving three functions: a). Formwork determine the shape of the concrete formwork akandibuat. A simple form of a concrete construction formwork modest demands; b). Formwork must be able to safely absorb the loads generated by concrete species and various external loads and vibration is. In this case the resulting deformation and shear-shear can be allowed as long as it does not exceed the specified tolerances; c). Formwork must be a simple way installed, removed and relocated.

There are three important objectives that should be considered in designing pembangunan formwork, namely (Nawy, 1997):

1. **Quality:** Formwork shall be designed and manufactured with rigidity (stiffness) and accuracy so that the shape, size, position and penyelesaian dari casting can be carried out in accordance with the tolerance yang diinginkan.
2. **Safety:** Formwork should be established with the power cukup dan adequate safety factor that could hold / sustain entire live and dead loads without collapse atau berbahaya for workers and konstruksibeton.
3. **Economical:** Formwork be made efficiently, meminimalisasi waktu and costs in the implementation process and schedule demikeuntungan contractor and the owner (the owner).

There are some several factors into pertimbangan untuk take a decision on the method to be used, namely formwork (Wigbout, 1987):

- a) **The condition of the structure will be done**
This is a major consideration because the system perkuatan bekisting be a key component of success for menghasilkan kualitas dimensional structure as planned in the guidelines. Formwork method is applied to buildings with large dimensions of the structure would not be efficient when applied to small-dimensional structure.
- b) **The area of the building that will be used**
Formwork job is a job of re bersifat pakai material (cyclical displacement of material) .Therefore, the building area is becoming one of the main considerations for the determination of material usage cycle nx formwork. This will also affect the high and low filing unit price.
- c) **The availability of materials and tools**
Another factor to consider is the ease or difficulty in obtaining materials or tools of system formwork to be applied.

2.3 Type of Formworks

In general, the formwork is broadly divided into three types: (Wigbout, 1987):

2.3.1 Traditional Formwork (Conventional)

What is meant by traditional formwork is formwork that each time after being released and disassembled into parts of the base, can be rearranged into another form.

In general, contact formwork consists of a wooden board or plate material, while the cantilever construction composed of wooden beams and (on the floor) of the seals steel. This traditional formwork allows the provision of any desired shape in concrete work.

2.3.2 Formwork half system (Semi Conventional)

What is meant by half formwork system formwork units are larger, planned for a the particular object they are primarily used to repeatedly in shape is not changed.

In general, contact formwork is composed of material plat.Konstruksi cantilever composed of components that are made in the plant or steel-girder wooden girder arranged. Once completed, these components can be rearranged into a half formwork system for an object to another. For example: Elements of wall panels.

2.3.3 Formwork system

What is meant by the formwork system is a formwork elements made in the factory, most of the components are made of steel.

Formwork system is intended for repeated use times.This means that the type of formwork can be used for a number of jobs. Formwork system can also be rented from the dealer tools bekisting. Contoh: panel formwork for tunnels, formwork for concrete pre-cast.

2.4 PERI Formwork Systems

PERI is a company name that is derived from the Greek meaning "around". PERI formwork systems are put in the "about" concrete or scaffolding surrounding the building. PERI formwork systems established in Weissenhorn, Bavaria, Germany in 1969 with the idea of making the formwork process faster and safer. Over time, the PERI products began to spread in many countries one of Indonesia. Corporate users PERI product there is a direct import their products from the factory some are buying a product license and produce it themselves. (PERI, 2012).

Bekisitng PERI systems are reference materials and materials arranged in manufacturing scaffolding for a project that size is adjusted to the desired shape of the concrete. Use of the formwork system is due to the possibility to be used repeatedly. Once the casting process is complete, these components can be rearranged into a formwork system for other objects.

3. Research methodology

The use of literature that support among other books about the construction of wood and steel, journals, thesis or research earlier on formwork, manual rotation of the installation and dismantling of formwork is a way to learn that is expected to support the resolution of the issues discussed as formwork (Box Print), author F. Wigbout, (Concrete Formwork System) author Awad S Hanna,

(Concrete Construction Engineering Handbook) author Dr. Edward G Nawy, P.E, C.Eng, PKKI and others.

To obtain optimum results from the writing of this final project, it would require secondary data as follows (Saputra & Rahmawati, 2014):

- a. Image building structure
- b. Volume of work
- c. The price list of materials for formwork
- d. Specifications formwork used
- e. Formwork working methods used

Table 3.1 Project Data Tunjungan Plaza 6 Surabaya

Type Data	Sources
Picture Project building structure	Project Tunjungan Plaza 6 Surabaya
Project work volume	Project Tunjungan Plaza 6 Surabaya
Specifications formwork used	Project Tunjungan Plaza 6 Surabaya
Project formwork component material prices	Project Tunjungan Plaza 6 Surabaya
The working methods used	Project Tunjungan Plaza 6 Surabaya

From all the data needed can be obtained from the main contractor concerned. The data that has been obtained will be the object of study and as a basis for planning and calculation.

3.1 Identification of components Formwork

From the data available , to identify the formwork components such as reinforcing component , stiffeners and support which is then used as a reference for the next operation . Scaffolding components commonly used is schafolding and Polyfilm for parts in direct contact with concrete . For components on PERI formwork system can be seen from a brochure or catalog provided by the service provider or subcontractor of the project Tunjungan Plaza 6 Surabaya .

3.2 Calculation of Reinforcement Formwork

Calculation reinforcement formwork includes the calculation of each method , namely formwork girder in the method of calculation reinforcement system PERI formwork and reinforcement calculation schafolding on conventional semi formwork methods (Saputra & Rahmawati , 2014) .

Table 3.2 The basic formula calculations reinforcement formwork (Sajekti , 2009)

Count control	Beam 2 Pedestal Beam	Continuous Beam	Cantilever Beam
Momen	$M = \frac{1}{8} qL^2$	$M = \frac{1}{10} qL^2$	$M = \frac{1}{2} qL^2$
Tegangan Lentur	$\sigma = \frac{M}{W}$	$\sigma = \frac{M}{W}$	$\sigma = \frac{M}{W}$
Lendutan	$\delta = \frac{5}{384} \times q \times \frac{L^4}{E \times I}$	$\delta = \frac{1}{145} \times q \times \frac{L^4}{E \times I}$	$\delta = \frac{1}{8} \times q \times \frac{L^4}{E \times I}$

3.3 Method of Implementation Formwork

In one tower will be divided into four sectors per floor. Each floor construction will be completed every week covering the installation and dismantling of formwork. Workers should complement the need for sector 1 floor formwork 1 to completion. After that it will begin the installation of the formwork sector 1 and sector 2 floor 4 floor 1. Then proceed on the 2nd floor of sector 1 and so on. Formwork for material removal is done by making terminal as a place to put the material on the floor that has been cast and will be casted and removed using a tower crane. Formwork for material removal is done by making terminal as a place to put the material on the floor that has been cast and will be casted and removed using a tower crane (Saputra & Rahmawati, 2014).

3.4 Analysis of Cost and Material Requirements Formwork

Before knowing the cost of a project analyzing the volume is something that needs to be known in advance (Listya, 2011). To calculate the volume of the formwork is using the unit m². Material requirement calculations performed on the individual components of the formwork based analysis.

4. Data Analysis and Discussion

4.1 Requirement Cost Semi Conventional Formwork

Table 4:26 : The need for a conventional semi formwork costs

Type of Structure	Material	Labour	Total Costs
Pelat	14.594.609.450,11	3.558.954.370,19	18.153.563.820,30
Balok	10.215.379.789,02	1.664.552.319,95	11.879.932.108,97
Kolom	4.528.330.731,40	1.188.769.412,60	5.717.100.144,00
Shearwall	8.660.268.352,77	1.466.041.226,47	10.126.309.579,25
Jumlah :	37.998.588.323,31	7.878.317.329,22	45.876.905.652,52

Thus , the total cost semi- conventional formwork is **Rp. 45.876.905.652,52**

Ratio per m² = Rp. 45.876.905.652,52 : 169.316,94 m² = Rp. 270.952,84

4.2 Requirement System Cost PERI

Table 4.27: Needs costs PERI formwork systems

Type of Structure	Material	Labour	Total Costs
Pelat	16.326.028.328,00	4.168.558.202,78	20.494.586.530,78
Balok	10.981.806.010,50	1.949.669.061,63	12.931.475.072,12
Kolom	4.773.012.238,17	1.392.390.564,94	6.165.402.803,11
Shearwall	10.514.461.406,02	1.717.155.530,69	12.231.616.936,70
Jumlah :	42.595.307.982,68	9.227.773.360,03	51.823.081.342,71

Thus , the total cost is a PERI formwork systems Rp. 51.823.081.342,71

Ratio per m2 = Rp. 51.823.081.342,71 : 169.316,94 m2 = Rp. 306.071,45

4.3 Comparison of Costs

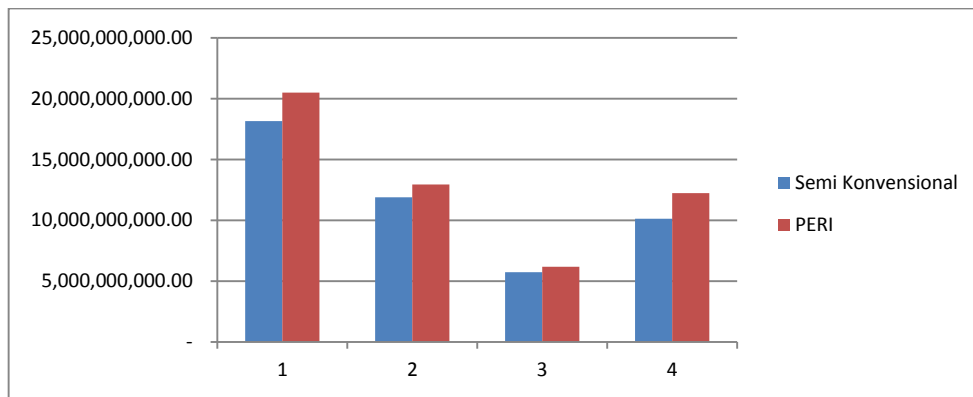


Fig. 4.1 Diagram column price comparisons for each type of structure .

The total time required when using conventional semi formwork is 932 days or 2.59 years , while using the PERI system only takes 706 days or 1.96 years . From these results it can be concluded that the use of PERI system faster time required 226 days .

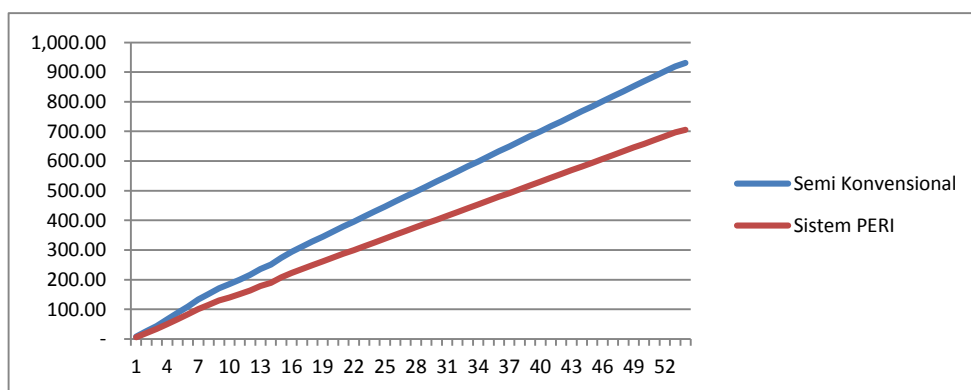


Fig. 4.2 Diagram of line work time comparison of each floor .

5. Conclusion

The use of semi-conventional formwork methods cheaper in terms of cost than the use of the method PERI formwork systems. But in terms of time use PERI systems faster. Factors to consider in choosing a method of formwork is the availability of cost, time required and the amount of work scope. Comparison between two methods of formwork on 6 Surabaya Tunjungan Plaza project in terms of cost on the method of semi-conventional formwork is Rp. 45,876,905,652.52 with the ratio of costs per m² Rp. 270,952.84, and the method of PERI system is Rp. 51,823,081,342.71 with the ratio per m² Rp. 306,071.45. So the use of the method PERI formwork 12.96% more expensive than conventional semi formwork methods. While the comparison in terms of time, semi-conventional formwork method takes 932 days and the PERI system is 706 days. So use a faster method PERI formwork 226 days, or 24% of the conventional spring. From the results of these calculations it can be concluded that the use of more efficient formwork methods is to use PERI systems because it can speed up time by 24% rather than have to save as much as 12.96%.

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