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COST AND TIME ANALYSIS OF DRAINAGE WORKS USING CONVENTIONAL RIVERSTONE METHOD AND PRECAST U-DITCH METHOD

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ABSTRACT

The aim of this research is to determine the comparison of costs and work time using the conventional river stone method and the precast u-ditch method. So from the two methods mentioned above, we can choose or compare which method can provide benefits in terms of cost and time. This research uses a quantitative method, which explains a process of finding knowledge using data in the form of numbers as a tool for analyzing information about what you want to know in a situation that is the object of study and then analyzed. Comparative analysis of costs and time for drainage channel work using the conventional method with a length of 192 meters takes 55 working days with a cost of Rp 123,617,000.0 while the precast method with a length of 174 meters takes 48 working days with a cost of Rp 78,292,000.0 . The conventional method takes 14% longer to carry out work compared to the precast method. The cost per meter of work using the conventional method is Rp 6,438,385, while work using the method is Rp 4,449,540 with a difference of Rp 1,988,845. The use of precast methods is 30% lower than conventional methods.

Keywords: cost comparison, time, drainage

1. INTRODUCTION

Drainage is an element of the public infrastructure that roads require. This infrastructure serves to drain water from the surface of the road to the final disposal. In general, drainage is a series of water structures that serve to reduce and remove excess water from an area or land, so that the land can function optimally [1]. There are two types of road drainage systems, namely road surface and subsurface drainage systems. Surface drainage systems are generally in the form of open or closed channels[2]

In drainage works, material selection is the most important component that requires attention. Generally, the main material in drainage works is conventional material such as river stone, but it is less efficient on the cost and time of work [3]. Along with the development, it is evident that there is a method of implementing concrete work by using the precast method as an alternative in the construction of drainage channels. The most common difference between the conventional method and the precast method is the manufacture and implementation process. The manufacture and implementation of conventional methods are carried out directly in the area of work. As for the precast method, the manufacture is carried out in a production plant and the implementation is to assemble it into a unified structural unit[4].

[5]on the comparative analysis of the cost and time of construction for drainage channels using conventional methods (Batu Kali) and (U-Ditch), the research results show that the construction of drainage channels with a length of 3187 metres using conventional methods (Batu Kali) costs Rp. 3,894,867,502 while using the precast method (U-Ditch) costs Rp. 4,393,868,783. Where using the precast method (U-Ditch) is 12.8% more expensive when compared to using the conventional method (river stone). The time comparison of the two methods to complete 3187 metres of drainage channel construction if using the conventional method by employing 20 workers can be completed in 133 working days. Meanwhile, if using the precast method (U-Ditch) with 20 workers, it can be completed

in 77 working days. Using the precast method (U-Ditch) is 42.1% faster than using the conventional method (river stone)[5].

The time and cost of drainage construction are key factors in the planning and implementation of stormwater management systems. A thorough planning and efficient resource management is required to minimise negative environmental and financial impacts[6]. The time required for a drainage project involves the construction schedule, including the planning stages, site preparation, construction of the drainage structure, and system testing. In some cases, drainage projects must be completed before the rainy season in order to function properly in controlling the flow of stormwater. Meanwhile, the cost of drainage works includes the cost of materials, labour, equipment, maintenance, and project management.

The conventional drainage system is a stormwater management system that is commonly used in urban areas. These systems focus on the redirection of stormwater from the surface to artificial drainage systems such as ditches, gullies, or pipes, which eventually drain the stormwater to rivers or the sea. This method has been the conventional choice due to its ease of implementation and lower cost compared to more modern and sustainable alternatives. However, conventional drainage has several disadvantages. Firstly, it is likely to result in a faster flow of water into the river, increasing the risk of flooding and erosion downstream, as well as ignoring the potential for stormwater to infiltrate into the soil. Moreover, the use of pipe systems can also create the problem of excessive stormwater discharge into pollution-prone environments[7]. In an era of increased environmental awareness, many have turned to more environmentally sustainable drainage methods, such as stormwater infiltration methods, the use of green roofs, or the construction of rainwater harvesting basins. While conventional drainage is still widely used, understanding the drawbacks of these systems is encouraging innovation in more sustainable and efficient stormwater management.

Drainage channels made from precast concrete, often referred to as " u-ditch" or practical channels, are one of the commonly used methods in the construction of drainage infrastructure. With this method, drainage channels are made from pre-manufactured precast concrete segments of the appropriate size and shape. Then, these segments are attached together to form a sturdy and durable drainage channel. The main advantage of precast concrete drainage channels is efficiency in time and cost[8]. Mass production of precast segments allows for savings in construction time and reduced labour costs. These practical channels also have good resistance to corrosion and extreme weather, so they have a long lifespan and require little maintenance. In addition, precast concrete channels usually have a consistent and precise shape, which can further improve water flow, reduce the risk of flooding, and prevent erosion in urban neighbourhoods. However, it is important to note that the design and installation location of these drainage channels should incorporate environmental aspects such as rainwater recovery and water utilisation to reduce negative environmental impacts. With its efficient construction and long-term durability, precast concrete drainage channels are a frequently used in urban drainage projects.

The aim of this research is to determine the comparison between the cost and time of drainage work using the conventional river stone method and the precast u-ditch method. These two methods are taken as the basis of this research, so that from the two methods above, we can select or compare which method can be beneficial in terms of cost and time so as to reduce the amount needed in the construction of drainage channels.

2. RESEARCH METHODS

1. Research Methods

The research plan used in this study using quantitative approach, which is a method that describes a process of seeking knowledge that uses data in the form of numbers as a means of analysing information about what is wanted to be known in a situation that becomes the object of study and then can be analysed using the help of Microsoft Excel 2013 and also Microsoft Word 2013. The implementation of drainage works using conventional methods with precast methods, by making a Budget Plan and Time Schedule on each method, which was done by calculating the volume and price per work item of a drainage construction project.

2. Research Location

The object of this research is the construction of drainage in Minggir and Gamping sub-districts of Sleman Regency. While the subject of the research is the cost and time analysis of drainage work using the conventional river stone method with the precast u-ditch method.

3. Data Collection

Data is a collection of information obtained from the results of an observation that is beneficial in terms of contributing to the writing of the final project. In this regard, there are two types of data, namely primary data and secondary data.
a. Primary Data
Primary data is data obtained directly from interviews with supervisors of Drainage Construction projects in Minggir District and Gamping District of Sleman Regency[9]. Primary data in this study are the duration of work using precast and conventional methods, the volume of work using conventional methods, the sequence of work as well as work documentation.
b. Secondary Data
Secondary data is data obtained indirectly, in this research it includes price per work analysis, price per work guidelines and the volume of work achieved and the time of the work.
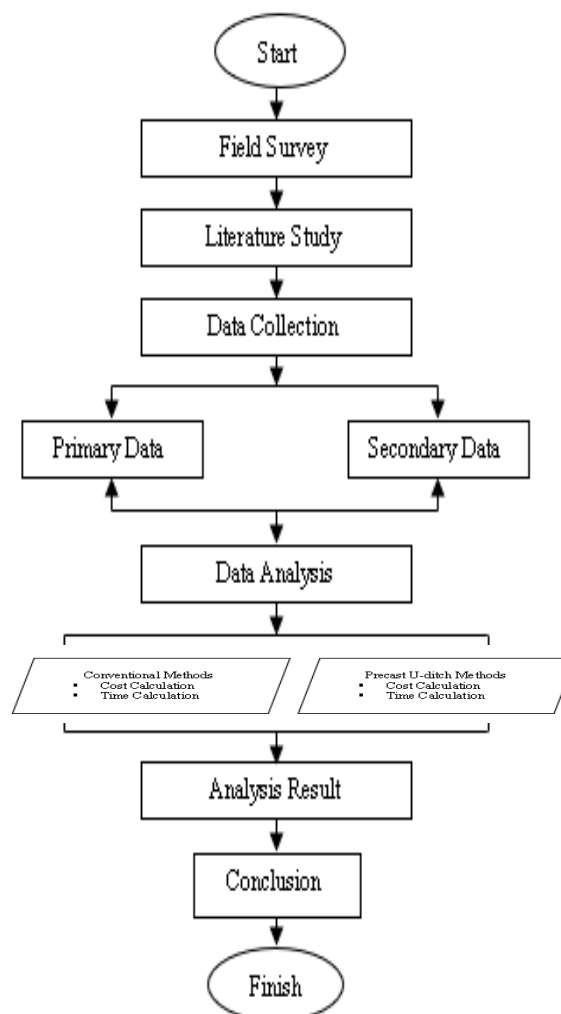
4. Research Flowchart

Figure 2.1 Research Flowchart

3.   RESULT AND DISCCUSION

1. Budget Plan

a. Conventional River Stone Method

The analysis carried out is a recapitulation regarding the price of the work of the conventional river stone method from the project budget plan data. Analysis is carried out on work items so that for the next step, comparative analysis can be carried out.

Table 3.1 Budget Plan for the conventional river stone methods

No		Description	Unit	Vol	Unit Price (Rp)	Total Price (Rp)
A		Earthworks				
	1	Mechanical Earthworks	m³	65,53	46.410	3.041.247,3
	2	Gravel Backfill	m³	23,47	136.670	3.207.644,9
	3	Earthwork Disposal	m³	65,53	24.290	1.519.723,7
B		Structure Work				
	1	Split Stone Masonry 1 Pc 4 Ps	m³	75,57	752.770	56.886.828,9
	2	Plastering/Rendering 1 Pc 3 Ps tebal 15 mm	m²	252,45	70.860	17.888.607
	3	Plastering	m²	252,45	41.690	10.524.640,5
	4	HD Cover Instalation 0,6 m wide	m	80,4	379.060	30.476.424
		Total				123.617.116,3
		Rounding				123.617.000,0

b. Precast U-ditch Method

The analysis carried out is a recapitulation of the work price of the precast u-ditch method from the project budget plan data. Analysis is carried out on work items so that for the next step, comparative analysis can be carried out.

Table 3.2 Precast U-Ditch Method Budget Plan

No		Uraian	Sat	Vol	Satuan Harga (Rp)	Jumlah Harga (Rp)
A		Earthworks				
	1	Mechanical Earthworks	m³	59,19	46.410	2.607.777,9
	2	Gravel Filling	m³	9,60	273.340	1.312.203
	3	Earthwork Disposal	m³	56,19	24.290	1.364.855,1
B		Structure Work				
	1	Lean Concrete	m³	2,34	1.415.560	1.656.205,2
	2	Concrete Fc:21,7 Mpa (K-250)	m³	1,04	2.866.800	993.824
	3	Formwork Pipe 4 connection between U-Ditch	Kg	26,52	119.230	3.161.979,6
	4	Installation U-Ditch 50 x 60 + Cover HD	m	48	818.090	39.268.320
	5	Installation U-Ditch 50 x 60 Without Cover	m	15,5	818.090	12.762.204
	6	Grill Work 40 x 40	unit	13	926.310	12.042.030
	7	Iron Rebar Reinforcement	kg	59,64	13.652	818.205,28
	8	Wall Formwork Installation	m²	14,6	86.480	1.262.608
	9	Formwork Removal	m²	14,6	4.970	72.562
		Total				78.291.519,88
		Rounding				78.292.000,00

Source :[10]

c. Comparison of the Conventional River Stone Method with the Precast U-Ditch Method

The following is a comparison of the Budget Plan of the conventional river stone method with the precast u-ditch method.

Table 3.3 Cost Comparison

No	Methods	Volume	Total Price (Rp)
1	Conventional River Stone Methods	192	123.617.000,0
2	Precast U-Ditch Methods	174	78.292.000,00

Based on table 3.3, the Budget Plan for the conventional river stone method is Rp 123,617,000.0 (One Hundred Twenty Three Million Six Hundred Seventeen Thousand Rupiah) while the u-ditch precast method is Rp 78,292,000.00 (Seventy Eight Million Two Hundred Ninety Two Thousand Rupiah).

2. Working Duration Comparison of Conventional River Stone Method and Precast U-Ditch Method
The following is a comparison of the working time of drainage works using the conventional river stone method with the precast u-ditch method.

Tabel 3.4 Working Duration Comparison

No	Methods	Working Duraton
1	Conventional River Stone Methods	55 Days
2	Precact U-Ditch Methods	48 Days

3. Discussion

a. Budget Plan

Based on table 3.3, the Budget Plan for the conventional river stone method is Rp 123,617,000.0 (One Hundred Twenty Three Million Six Hundred Seventeen Thousand Rupiah) while the u-ditch precast method is Rp 78,292,000.00 (Seventy Eight Million Two Hundred Ninety Two Thousand Rupiah).
The price per metre of the work of both method is:

Conventional River Stone Methods
$$= \frac{Budget\ Plan\ Conventional\ Method}{total\ length}$$
$$= \frac{Rp\ 123.617.000,0}{192}$$
$$= Rp\ 6.438.385$$

Precast U-Ditch Methods
$$= \frac{Budget\ plan\ precast\ u-ditch\ method}{total\ length}$$
$$= \frac{Rp\ 78.292.000,00}{174}$$
$$= Rp\ 4.499.540$$

Cost Difference = Conventional River Stone Method – Precast U-Ditch Method
$$= Rp\ 6.438.385 - Rp\ 4.449.540$$
$$= Rp\ 1.988.845$$

Percentage of Cost Comparison
$$= \frac{Cost\ Difference}{COnventional\ Methods} \times 100\%$$
$$= \frac{1.988.845}{6.438.385} \times 100\%$$

$$= 30\%$$

The cost difference for the price per metre of work using the conventional method and the precast u-ditch method is Rp 1,988,845 (One Million Nine Hundred Eighty Eight Thousand Eight Hundred Forty Five Rupiah). The work budget using the precast u-ditch method is 30% lower than the conventional river stone method.

b. Work Duration

Based on table 3.4, the work duration comparison of the conventional method is 55 working days, while the precast u-ditch method is 48 working days.
The time difference between the two methods is:

Time Difference   = Conventional River Stone Method – Precast U-Ditch Method
$$= 55 - 48$$
$$= 7$$

$$\text{Time Percentage} = \frac{Time\ Difference}{\text{Precast U-Ditch Method}} \times 100\%$$

$$= \frac{7}{48} \times 100\%$$
$$= 14\ \%$$

The difference in working duration between the conventional river stone method and the precast u-ditch method is 7 working days. The conventional method took 14% longer than the precast u-ditch method.

4.   CONCLUSION

From the discussion on the comparison of cost and time analysis, a conclusion is obtained that makes the difference between drainage work using the conventional river stone method and the precast u-ditch method is as follows:

a. The conventional river stone drainage work method requires 55 working days at a cost of Rp 123,617,000.0 (One Hundred Twenty Three Million Six Hundred Seventeen Thousand Rupiah) while the u-ditch precast method requires 48 working days at a cost of Rp 78,292,000.00 (Seventy Eight Million Two Hundred Ninety Two Thousand Rupiah).
b. The result of the costs per metre of work using the conventional river stone method is Rp 6,438,385 (Six Million Four Hundred Thirty Eight Thousand Three Hundred Eighty Five Rupiah) while the work using the precast u-ditch method is Rp 4,449. 540 (Four Million Four Hundred Forty Nine Thousand Five Hundred Forty Rupiah) with the difference between the two methods amounting to Rp 1,988,845 (One Million Nine Hundred Eighty Eight Thousand Eight Hundred Forty Five Rupiah), where the work using the u-ditch precast method is 30% lower than the conventional river stone method.
c. The result of the efficient time required for work using the conventional river stone method for a length of 192 metres is 55 working days, while work using the precast u-ditch method for a length of 174 metres is 48 working days with the difference in time required in the two methods is 7 working days, where the implementation of conventional method work is 14% longer than using the precast u-ditch method.

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