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Cost and Time Comparison Analysis on Waterproof Material Aluminium Foil and Combination Cement Board and Asphalt Membrane in Roof Construction

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Abstract

Existence consumer complaints regarding the quality of the building, especially related to the problem of leakage on the roof during the rainy season, made PT. Toyota Housing Indonesia improvised waterproof material in the underlayer position from conventional waterproofing (aluminum foil) to waterproofing a combination of cement board and asphalt membrane. Therefore the author will analyze the effectiveness of the two materials to overcome the problem of leakage that often occurs in roof construction.This study aims to implement the creation of "zero complaints", and be able to reduce the number of consumer complaints, especially in leaks. As well as to find out the quality of the quality and costs that need to be incurred by the owner related to changes in the type of material to be used in the Housing Project Image of Garden Castle. The method used in this research is using qualitative methods, namely research that is descriptive and tends to using analysis. This research was conducted by collecting data according to conditions in the field by means of observations, project technical data, discussions and interviews with parties involved in the project. It can be concluded that the use of a combination of cement board and asphalt membrane material is more effective in overcoming leakage. And for the cost of waterproofing work on 9 roof units using a combination of cement board and asphalt membrane, it costs Rp.254,067,200 while using aluminum foil material costs Rp.232,011,800, so the use of a combination of cement board and asphalt membrane is more expensive. Rp.22,055,400. The time needed to complete the waterproofing work on 9 roofs measuring 38.8 m2/unit using a combination of cement board and asphalt membrane material is also 2 days longer than the use of aluminum foil material which only takes 14 days.

Keywords
Roof, Time, Waterproofing

1. Introduction

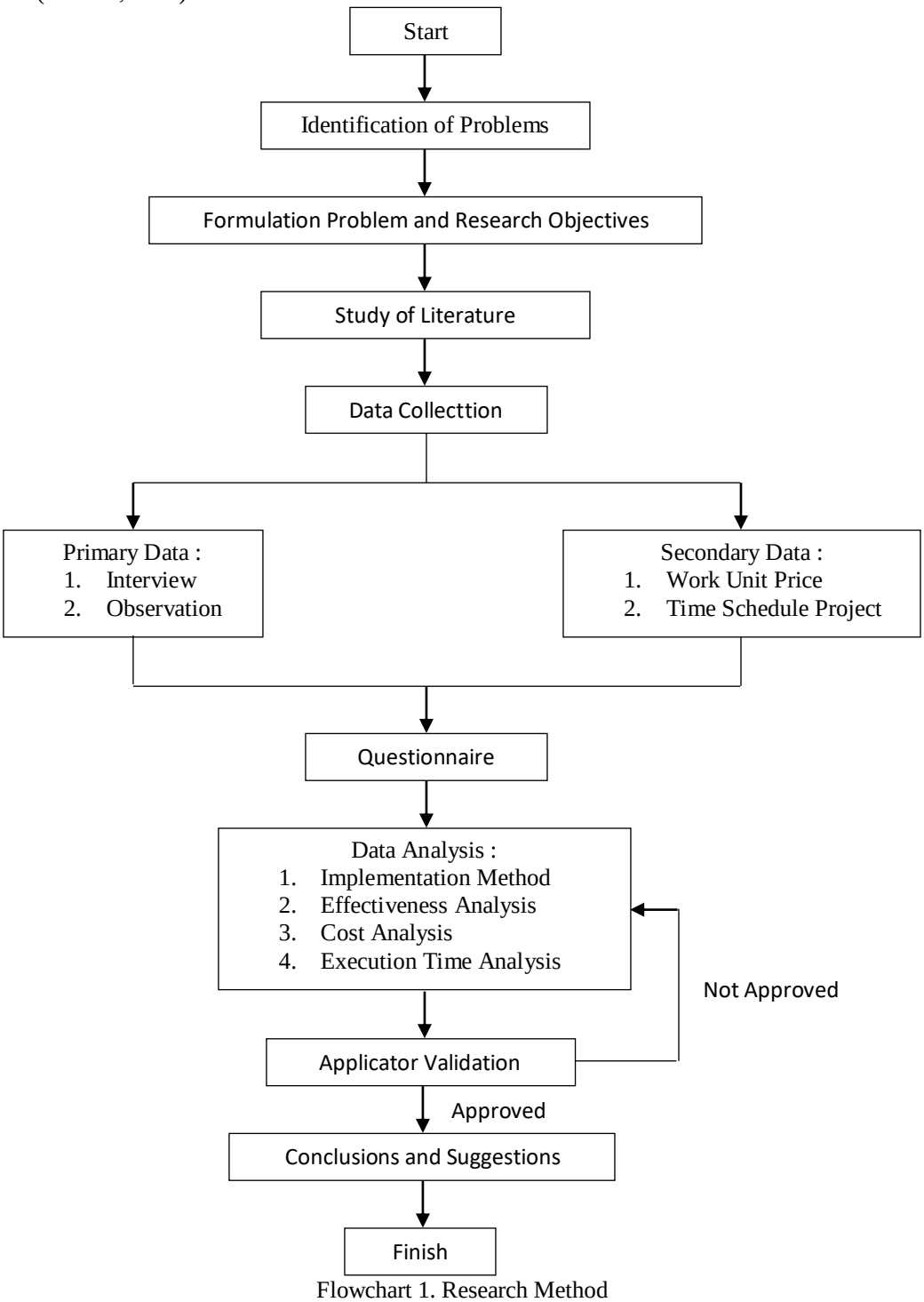
Citra Garden Puri Housing Development Project is the latest offering from Ciputra Group, a new residential development located in the Puri Semanan area, West Jakarta. Along with the Citra Garden Puri Housing Development Project, Ciputra Residence appointed PT Graha Perkasa Abadi and PT Karya Cipta Bangun Mandiri as Contractors. Over time, from the beginning of construction which began at the end of September 2019 until now, from several housing units that have been inhabited starting from March 2020, Ciputra has made a data recap of all the complaints from these residents. Of the 105 housing units that are already inhabited and based on the "Record of Service Customers" data from the after sales division, from the results of the data recap, it is concluded that around 67% of consumers tend to complain related to leaks on the roof. From the observations carried out by seeing a decrease in quality, among others, the number of complaints from residents of the house regarding the quality of the building, especially related to the problem of leaks on the roof during the rainy season.

Thus, Ciputra Residence cooperates with PT Toyota Housing Indonesia to work together, especially on roof construction work, because previously they had also collaborated on the Bali Dwipa housing development project, Citra Raya, Tangerang. The choice of cement board material and asphalt membrane as a waterproof material in the underlayer position before the roof covering process is an option that is rarely used in residential roof constructions. Therefore, the author will analyze the effectiveness of the material without reducing the resistance of the construction itself and of course the quality of the use of these materials against leakage problems that often occur in roof construction in this project.

2. Methodology

The method in this study uses qualitative methods to discuss work methods and quantitative methods to compare cost and time analysis on residential roof construction work using waterproof aluminum foil material and combined with cement cement board and asphalt membrane using primary data and secondary data so that

the research is more comprehensive. specific, systematic, planned and also structured from the beginning to the conclusion.(Hikmah, 2019)



Flowchart 1. Research Method

In this study, we will compare the waterproofing material of aluminum foil and the combination of cement board and asphalt membrane. Here are the waterproof materials :

Figure 1. Waterproofing Aluminium Foil

Figure 2. Material Cement Board Figure

Figure 3. Material Asphalt Membrane

3. Result and Discussion

3.1. Time Comparison Analysis Results

From the analysis results, it can be seen that it takes 12 days to work on 9 housing units with aluminum foil waterproofing work, while the work with a combination of cement board and asphalt membrane waterproofing takes 14 days. The time difference between the two work methods is 2 days. Then after obtaining the total duration of the work of the two waterproofing methods, it can be concluded in the table below.

Table 1. Recapitulation of Time Comparison Waterproofing Works Aluminum Foil and Combinations Material

Type of Waterproofing	Time/Unit	Total Unit	Work Time
Aluminium Foil	645 minutes	9	12 days
Cement Board and Asphalt Membrane	735 minutes	9	14 days

3.2. Cost Comparison Analysis Results

In research analysis, there are 2 costs that are calculated, namely direct and indirect costs. Direct costs are costs that are required directly to obtain resources that will be used for project completion. Direct costs can be obtained by multiplying the volume/quantity of a job by the unit price of the job. Meanwhile, indirect costs are costs related to supervision, work mobilization and general expenses other than construction costs that are paid for a predetermined period of time, these costs are also called overhead costs. This fee does not depend on the period of execution of the work. Indirect costs will increase or swell if the time for completing the work is longer than the time schedule made because costs for employee salaries, fixed office general fees and other costs are also paid regularly and periodically.(Alwanda, 2019)

Table 2. Recapitulation of Direct Cost Waterproofing Aluminium Foil

Work Item	Volume	Unit Price	Total
Unit AC-01	38,8 m²	Rp 407.000	Rp 15.791.600
Unit AC-02	38,8 m²	Rp 407.000	Rp 15.791.600
Unit AC-03	38,8 m²	Rp 407.000	Rp 15.791.600
Unit AC-04	38,8 m²	Rp 407.000	Rp 15.791.600
Unit AC-05	38,8 m²	Rp 407.000	Rp 15.791.600
Unit AC-06	38,8 m²	Rp 407.000	Rp 15.791.600
Unit AC-07	38,8 m²	Rp 407.000	Rp 15.791.600
Unit AC-08	38,8 m²	Rp 407.000	Rp 15.791.600
Unit AC-09	38,8 m²	Rp 407.000	Rp 15.791.600
Total	349,2 m²	Rp 3.663.000	Rp 142.124.000

Table 3. Recapitulation of In-direct Cost Waterproofing Aluminium Foil

Work Item	Total
Unit AC-01	Rp 4.970.000
Unit AC-02	Rp 4.970.000
Unit AC-03	Rp 4.970.000
Unit AC-04	Rp 4.970.000
Unit AC-05	Rp 4.970.000
Unit AC-06	Rp 4.970.000
Unit AC-07	Rp 4.970.000
Unit AC-08	Rp 4.970.000
Unit AC-09	Rp 4.970.000
Total	Rp 44.730.000

Table 4. Recapitulation of Direct Cost Waterproofing Combinations Cement Board and Asphalt Mmbrane

Work Item	Volume	Unit Price	Total
Unit AC-01	38,8 m²	Rp 469.000	Rp 18.197.200
Unit AC-02	38,8 m²	Rp 469.000	Rp 18.197.200
Unit AC-03	38,8 m²	Rp 469.000	Rp 18.197.200
Unit AC-04	38,8 m²	Rp 469.000	Rp 18.197.200
Unit AC-05	38,8 m²	Rp 469.000	Rp 18.197.200
Unit AC-06	38,8 m²	Rp 469.000	Rp 18.197.200
Unit AC-07	38,8 m²	Rp 469.000	Rp 18.197.200
Unit AC-08	38,8 m²	Rp 469.000	Rp 18.197.200
Unit AC-09	38,8 m²	Rp 469.000	Rp 18.197.200
Total	349,2 m²	Rp 4.221.000	Rp 163.774.800

Table 5. Recapitulation of In-direct Cost Waterproofing Combinations Cement Board and Asphalt Mmbrane

Work Item	Total
Unit AC-01	Rp 5.083.900
Unit AC-02	Rp 5.083.900
Unit AC-03	Rp 5.083.900
Unit AC-04	Rp 5.083.900
Unit AC-05	Rp 5.083.900
Unit AC-06	Rp 5.083.900
Unit AC-07	Rp 5.083.900
Unit AC-08	Rp 5.083.900
Unit AC-09	Rp 5.083.900
Total	Rp 45.755.100

Table 6. Recapitulation of the Time and Cost Comparison of Each Waterproofing Method

Research Review			Aluminium Foil		Cement Board and Asphalt Membrane		
Total Unit	Volume (m^2)	Duration Time (Days)	Direct Cost	In-direct Cost	Duration Time (Days)	Direct Cost	In-direct Cost
9 unit	349,2	12	Rp 142.124.000	Rp 44.730.000	14	Rp 163.774.800	Rp 45.755.000
Sub Total			Rp 186.854.000			Rp 209.529.800	
Deviation			Rp 22.675.800				
Percentage			12,14 %				

Based on the above analysis, it can be concluded that using a combination of cement board and asphalt membrane waterproofing takes a longer time and is also more expensive than aluminum foil waterproofing. Meanwhile, by using aluminum foil waterproofing, the processing time is faster and the cost is also cheap compared to combination waterproofing.

But in this case we also consider in terms of the characteristics of each material. Of course this is greatly influenced by the quality of work and material durability in the long term. In practice, combined waterproofing materials have better characteristics than aluminum foil waterproofing in terms of material quality, work quality results, work cycles, work processes, material waste, implementation methods, and maintenance. In order for the purpose of this research to be achieved, namely to implement the creation of "zero complaints", and be able to reduce the number of consumer complaints, especially on roof leaks. As well as to find out the quality and costs that need to be incurred by the owner related to changes in the type of material to be used. (Furqon, 2016)

Table 7. Comparative Results of the Characteristics of Each Waterproofing Method

Characteristics	Type of Waterproofing	
	Aluminium Foil	Cement Board and Asphalt Membrane
Material Quality	Thin and easy to tear	Strong and thick
Work Quality Results	Slobbery	Neater
Work Cycles	Requires less mobility processes	Requires more mobility processes
Work Process	Lightweight materials, making the installation process more difficult because it is easily blown by the wind	Heavy materials make the installation process easier because it is not easily blown by the wind
	Does not cause dust pollution in the aluminum foil installation process	Generate dust pollution in the GRC cement board cutting process
	Requires extra caution during the batten installation process due to the lack of footing from the land area	It is easier during the process of installing the battens because there is a GRC cement board as a footing
Material Waste	Generates garbage that is easily scattered and flying	Does not cause garbage that is easy to scatter and fly
Implementation Method	Do not perform leak tests (only rely on random supervision of the work)	Carry out a leak test
Maintenance	Generate maximum leakage (based on after sales recap data and questionnaires) compared to combined waterproofing	Causes minimal leakage (based on after sales recap data) compared to aluminum foil waterproofing
	Repair process after maintenance does not last long, then another leak arises or a new point of leakage arises	Repair process after maintenance lasts a long time

4. Conclusion

From the results of the study obtained the following results :

1. The results of the cost analysis on residential roof construction work using the waterproofing method of a combination of cement board and asphalt membrane worth Rp. 209,529,800.00- while the aluminum foil waterproofing method is worth Rp. 186,854,000.00-, thus the combined waterproofing method is more expensive. around Rp. 22,675,800,000- or 12.14%.
2. The results of time analysis on residential roof construction work using the aluminum foil waterproofing method takes 12 days with a review of 9 housing units, while using the waterproofing method with a combination of cement board and asphalt membrane takes 14 days from a review of 9 housing units.

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The author realizes that this Final Project, there are still shortcomings. Therefore, suggestions and constructive criticism are expected for the perfection of this Final Project. Hopefully this Final Project is useful for fellow Civil Engineering students as well as for all interested parties.

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Biography / Biographies

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