Jurnal Muara Sains, Teknologi, Kedokteran, dan Ilmu Kesehatan
Vol. 6, No. 2, Oktober 2022: hlm 191 - 200

ISSN 2579-6402 (Versi Cetak)
ISSN-L 2579-6410 (Versi Elektronik)

EFECTIVITY OF UNIT WALL FINISHING WITH STICK ON WALL METHOD IN CATTLEYA TOWER SAKURA GARDEN CITY APARTMENT PROJECT, EAST JAKARTA

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Masuk: 26-03-2022, revisi: 07-04-2022, diterima untuk diterbitkan: 30-10-2022

ABSTRAK

Dalam konstruksi bangunan, pekerjaan finishing dinding interior biasanya menggunakan metode konvensional yaitu plesteran dan nat grout. Di Cattleya Tower Sakura Garden City Apartment, Jakarta Timur, finishing dinding unit menggunakan metode yang lebih modern: Stick on wall. Metode Stick on wall menggunakan bahan finishing alternatif selain plaster dan nat grout sebagai penutup dinding hebel yang terbuat dari papan besar yang dilapisi kertas tebal yang harus direkatkan dengan bahan sejenis lem pada dinding hebel. Penggunaan metode ini pada kasus apartemen tersebut bertujuan untuk mempercepat proses konstruksi proyek karena di Cattleya Tower tersebut unit yang telah terjual sebesar 90%, sehingga penyelesaian proyek tersebut harus segera direalisasikan. Studi ini dilakukan untuk mengevaluasi efektivitas dari segi biaya dan waktu dari metode pekerjaan finishing dinding Stick on wall dibandingkan dengan metode plesteran dan nat grout. Dengan menghitung menggunakan metode SNI dan mempertimbangkan aspek lain seperti transportasi dari pemasok ke lokasi proyek, diketahui bahwa pekerjaan finishing dinding menggunakan stick on wall lebih murah 0,74% dibandingkan pekerjaan finishing dinding menggunakan plesteran dan nat grout. Sedangkan untuk perbandingan waktu pengerjaan, pekerjaan menggunakan stick on wall lebih cepat 74,58% dibandingkan pekerjaan finishing dinding menggunakan plesteran dan nat grout dengan selisih waktu kerja adalah 52 hari.

Kata Kunci: Stick on wall; finishing dinding; biaya plesteran; nat grout.

ABSTRACT

In building construction, interior wall finishing work usually uses conventional methods, namely plastering and nat grout. At Cattleya Tower Sakura Garden City Apartment, East Jakarta, the unit wall finishing uses a more modern method: Stick on wall. The Stick on wall method uses alternative finishing materials other than plaster and nat grout as a hebel wall covering made of large boards covered with thick paper which must be glued with a glue-like material to the hebel walls. The use of this method in the apartment case aims to speed up the project construction process because 90% of the units in Cattleya Tower have been sold, so the completion of the project must be realized immediately. This study was conducted to evaluate the effectiveness in terms of cost and time of the Stick on wall finishing method compared to the plastering and nat grout method. By calculating using the SNI method and considering other aspects such as transportation from the supplier to the project site, it is known that wall finishing work using stick on wall is 0.74% cheaper than wall finishing work using plaster and nat grout. As for the comparison of work time, work using stick on wall is 74.58% faster than wall finishing work using plaster and nat grout with a difference in working time of 52 days.

Keywords: *Stick on wall; wall finishing; plastering cost; nat grout.*

1. INTRODUCTION

The city of Jakarta is the capital city of Indonesia which is significantly developed in various aspects, ranging from government, offices, and trade. The city of Jakarta is also the economic center of Indonesia. The highest contribution to the trade and service industry sector for Indonesia is in the city of Jakarta. As a more developed area, Jakarta is a destination for other people outside Java to start their careers. That is one of the reasons why many people decide to move to Jakarta. One of the efforts to minimize the buildup of residential houses in East Jakarta is to build an apartment with a superblock concept called the Sakura Garden City Apartment.

Sakura Garden City is built on 10 hectares which will be filled by 12 condominium towers, shopping centers, shop houses, premier hotels, office buildings, and F&B centers.

With Indonesia's high infrastructure needs and limited available resources, innovation is needed to meet time and cost-efficiency (Konior & Szóstak, 2020). One of them is in the process of finishing walls. Wall finishing materials continue to develop, and the need to achieve cost efficiency and work time. With this background, a method of wall finishing called stick on wall was created (Masyhuda, 2018). Stick on wall is an alternative finishing material besides grout and plaster (Tam, 2011). as a wall covering made of large boards covered with thick paper, which must be glued with a glue-like material to the Hebel walls. In general, the finishing work of unit walls in apartments uses the plaster and nat grout method. Plaster itself is a building material used as a protective or decorative coating for walls made of a mixture of sand and cement. At the same time, nat grout is one of the building walls that cover the pores or smoothes the plaster. The grout work is done after plastering and before painting the walls.

Comparing the two wall finishings between plaster and nat grout with stick on wall in the Sakura Garden City Apartment project located in East Jakarta are two very different methods that use other materials and equipment (Allen & Iano, 2019). Plastering and nat grout work is a standard method commonly used in buildings in Indonesia because the raw materials for the work are relatively easy to obtain (Laksono, 2010). It is different with wall finishing work using stick on wall as a new method in Indonesia. The stick on wall work is not evenly distributed in Indonesia except for Jakarta and its surroundings due to raw materials and labor. This dramatically affects the work time and project budget costs. The supply of goods is the main thing that significantly affects the cost and time if the project is far from the supplier (Hidayat, 2010; Hiola, 2017).

The construction project for the Cattleya Tower Sakura Garden City Apartment in the case of this study, was in progress to finishing walls for all units from floors 20 to 28, and 90% of the unit sales in the Cattleya tower have been sold. The residence must be realized immediately, and one way to speed up the progress is the use of a more modern wall finishing method, namely stick on wall. In addition to being fast, the excess of pasting on the wall is neater, and there are no lumps like plastering work. Concerning aspect of HSE (Health Safety and Environment), wall finishing work using stick on wall can be categorized as environmentally friendly work because it does not cause a lot of garbage and puddles in the work area (Park et al, 2019).
The objective of this study is to evaluate the effectiveness of the stick on wall method compare to the method of plaster and nat grout in the Cattleya Sakura Garden City Apartment tower project in terms of in execution time and cost-effectiveness.

2. RESEARCH METHOD

A construction project is a series of activities carried out only once and are generally short-term. In this series of activities, there is a process of managing project resources resulting from actions in the form of buildings (Ervianto, 2005). The characteristics of construction projects can be viewed in three dimensions: unique, involving several resources, and requiring organization. Then, the completion process must adhere to three constraints (triple constraints): according to the specified specifications, the schedule, and the planned costs. All three were completed simultaneously. The characteristics above make the construction service industry different from other industries, such as manufacturing.
In high-rise building construction projects such as apartments, the completion of construction on time needs to be carried out in an effective manner. The aspect of time and cost is an important part in determining the effectiveness in the completion of a construction project. In the case of the construction project for the Cattleya Tower Sakura Garden City Apartment, one of the works that is considered to be able to accelerate project completion is finishing work. Conditions at the time this study was carried out were the need to immediately complete the finishing on floors 20

https://doi.org/10.24912/jmstkik.v6i2.18148

ISSN 2579-6402 (Versi Cetak)
ISSN-L 2579-6410 (Versi Elektronik)

to 28 because 90% of the apartment units had been sold. One of the steps to accelerate the realization of the apartment is to use a more modern wall finishing method, namely stick on wall. Stick on wall is an innovation in the construction world in finishing the walls of apartment units using quality materials, and experienced experts in the field carry out the work. The materials are consisted of gypsum board, jointing tape, and compound (Husna, 2016). Gypsum board consists of a core of gypsum material wrapped with reinforcing paper around it. The thickness of the gypsum varies with the average in the market is 9 mm, 12 mm, and 15 mm for the standard type of gypsum. Jointing tape serves as a sealing material for the connection gap between gypsum to get the best results and performance. Material of jointing tape is a synthetic material sheet precisely for wall connections gypsum with varying widths according to the desired needs. The shape of the material jointing tape is elongated in a roll, just like the paper "tape" in general. Compound is the material for finishing the final cover of the joint gap between gypsum and adhesive material gypsum to lightweight bricks. The compound material is a unique instant fine powder, and these products can usually be found at all suppliers' gypsum.

The stick on wall work process can be seen in Figure 1 as follow. The stick on wall steps of work such as ensure wall verticality, mix the GL bond with water, gluing, installing GL bond, preparing gypsum supports on the floor, installing stick on wall, and make sure the stick on wall flat.

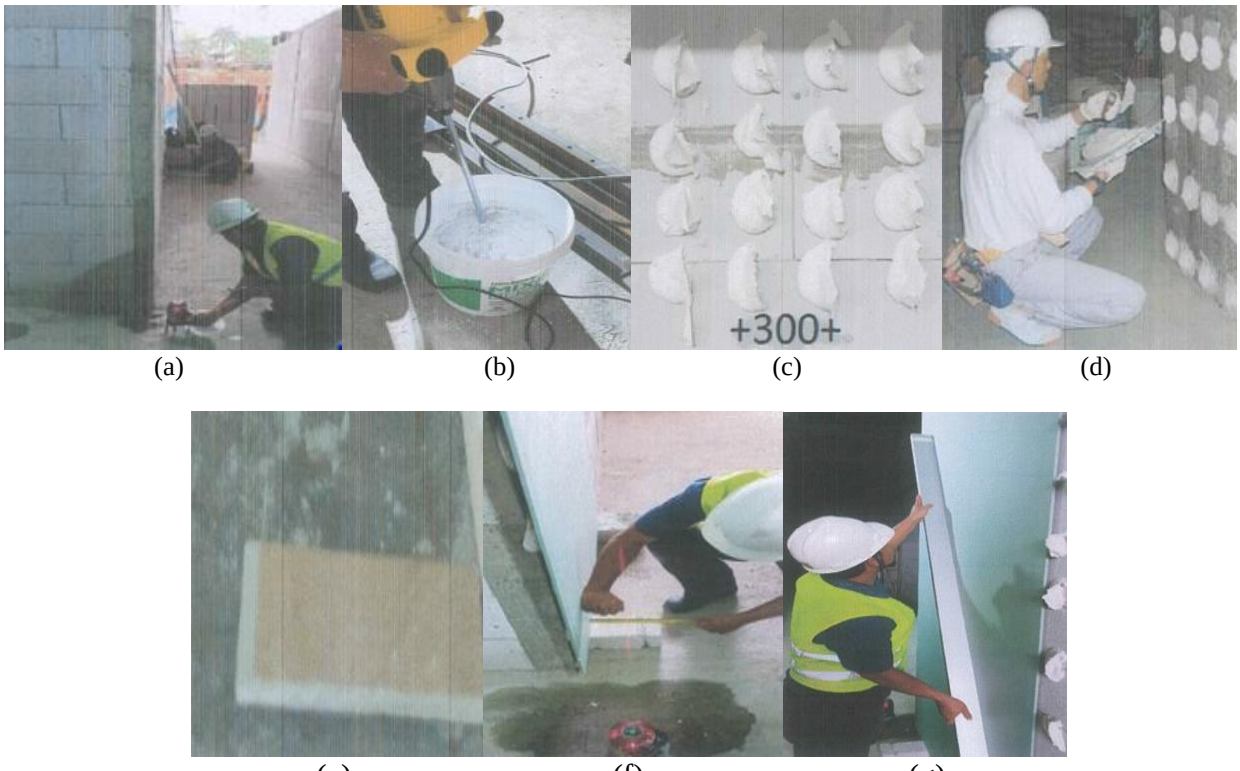

Figure 1. The stick on wall method: (a). Ensure verticality, (b). Mix the GL bond with water, (c). Start gluing, (d) Installing GL bond, (e) Gypsum supports on the floor, (f) Installing stick on wall, (g) Make sure the stick on wall flat. (Source: PT Total Bangun Persada)

In this study, SNI (Indonesian National Standard) No. 2837 of 2008 was used in the procedure for calculating the unit price of wall finishing work for the construction of buildings. The rationale of

the SNI method is to list the coefficients of materials, wages, and equipment to analyze the price or costs required to determine the price of one building unit. The calculation of the material needs, the analysis of wages, and the total of the necessary tools are generated from the three coefficients. The composition of wages, materials, work, and equipment are determined, multiplied by materials, wages, and tool prices prevailing in the market (Abdullah et al, 2019). Analytical products are formed from activity data confirmed as the Indonesian National Standard (SNI). Below is the SNI (2008) for plastering work (Table 1), nat and grout installation (Table 2), and stick on wall installation (Table 3), where OH is a unit of wages for one working day.

Table 1. SNI for plastering 1 m^2 of plaster 1pc: 3pp, with a thickness of 15 mm

	Items	Unit	Index
Materials	PC	kg	7.776
	PP	m^3	0.023
Manpower	Worker	OH	0.300
	Builder	OH	0.150
	Head of builder	OH	0.015
	Foreman	OH	0.015

Table 2. SNI for install 1 m^2 nat grout

Items		Unit	Index
Materials	PC	kg	3.250
Manpower	Worker	OH	0.150
	Builder	OH	0.100
	Head of builder	OH	0.010
	Foreman	OH	0.008

Table 3. SNI for install 1 m^2 stick on wall

	Items	Unit	Index
Materials	Plaster Bonding Compound (20 kg)	kg	4.330
	Yoshino gypsum board (1200x 2400mm)	sheet	0.365
	Joint Tape	m	0.263
	Joint Compound (20 kg)	kg	0.736
	Sandpaper	m	0.026
	Corner Bead (35x35x0.3x3 m)	m	0.290
Manpower	Worker	OH	0.100
	Head of builder	OH	0.005
	Builder	OH	0.100
	Foreman	OH	0.005

In order to evaluate the effectiveness in terms of in execution time and cost-effectiveness of the stick on wall method in the Cattleya Sakura Garden City Apartment tower project, it is compared to the method of plastering and nat grout. To find out the comparison in terms of costs of the two finishing methods (Ehlen, 1997; Gao et al, 2019), a calculation of Build of Quantity (BOQ) is carried out concerning the applicable regulations in Indonesia, namely using the Indonesian National Standard (SNI). The unit price is used in this calculation based on the Sakura Garden City apartment construction project, Cipayung, East Jakarta, for the materials and wages. The

https://doi.org/10.24912/jmstkik.v6i2.18148

ISSN 2579-6402 (Versi Cetak)
ISSN-L 2579-6410 (Versi Elektronik)

price of plastering work and stick on wall work are showed in Table 4 and Table 5, respectively. For the calculation of effectiveness in terms of transportation costs, refer to the vehicle specifications of colt diesel trucks (Table 6), price of truck rental in Table 7, and capacity for transportation in Table 8.

Table 4. The price of plastering work
Source: PT Total Bangun Persada

No.	Items	Unit	Price (IDR)
1	Cement	kg	50,000.00
2	Sand	m^3	160,000.00
3	Worker	OH	70,000.00
4	Builder	OH	80,000.00
5	Head of builder	OH	95,000.00
6	Foreman	OH	120,000.00

Table 5. The price of stick on wall work
Source: PT Total Bangun Persada

No.	Items	Unit	Price (IDR)
1	Gypsum Yoshino board (1200x2400mm)	sheet	95,000.00
2	GL Bond compound Yoshino 20 kg/bag	kg	55,000.00
3	Joint compound cornice 2in1Yoshino 20kg/bag	kg	50,000.00
4	D'tape	m	10,000.00
5	Corner Bead (25x25x0.3x3m)	m	20,000.00
6	Sandpaper	m	10,000.00
7	Worker	OH	75,000.00
8	Builder	OH	95,000.00
9	Head of builder	OH	105,000.00
10	Foreman	OH	125,000.00

Table 6. Specification of Colt Diesel

Capacity 1 Mitsubishi colt diesel, Fuso 74 long		
Capacity of GVW	7500	kg
Cement weight one sack	50	kg
1x transport capability	150	sacks
Vessel Dimension	8.778	m^3
Sand hauling ability	8	m^3

Table 7. Price of Truck Rental
Source: PT Total Bangun Persada

No.	Items	Price (IDR)	
1	Truck	550,000.00	
2	Driver	125,000.00	
3	Solar	300,000.00	
4	Transportation fee	1,000.00	/sack
5	Wages for hauling sand	50,000.00	

Table 8. Capacity for transportation of stick on wall materials
Source: PT Total Bangun Persada

No.	Materials	Capacity
1	Yoshino board gypsum board (1200 x 2400mm)	250 pcs
2	Plaster Bonding Compound (20 kg)	340 sacks
3	Joint Compound (20 kg)	340 sacks

This study object focuses in the Cattleya Tower Sakura Garden City Apartment project on floors 20-28 (7 floors). It has three different units, namely studio (24 units with a unit area of 44.13 m^2), 1-bedroom (6 units with a unit area of 76.74 m^2), 2-bedroom (6 units with a unit area of 108.078 m^2), and the total of the unit for one floor is 36 units.

3. RESULTS AND DISCUSSION

The cost comparison analysis results of wall finishing methods using stick on wall with plastering and nat grout as follows. The calculation of Build of Quantity (BOQ) is carried out for the plastering work of studio unit with a total wall finishing work area of 44.13 m^2 (Table 9), the plastering work of 1-bedroom unit with a total area of 76.74 m^2 (Table 10), and the plastering work of 2-bedroom unit with a total area of 108.078 m^2 (Table 10). Meanwhile the BOQ for nat grout work for the types of studio unit, 1-bedroom unit, and 2-bedroom unit, are presented in Table 11, Table 12, and Table 13, respectively. Concerning the Build of Quantities for stick on wall works for the types of studio unit, 1-bedroom unit, and 2-bedroom unit are shown in Table 14, Table 15, and Table 16, respectively.

Table 9. BOQ for plastering (studio unit)

Items		Unit	Index	Area (m^2)	Unit Price (IDR)	Materials	Price (1 unit)
Materials	PC	kg	7.776	44.13	50,000.00	6.86 sack	343,154.88
	PP	m^3	0.023	44.13	160,000.00	1.015 m^3	162,398.40
Manpower	Worker	OH	0.300	44.13	70,000.00		926,730.00
	Builder	OH	0.150	44.13	80,000.00		529,560.00
	Head	OH	0.015	44.13	95,000.00		62,885.25
	Foreman	OH	0.015	44.13	120,000.00		79,434.00
					Total:		**2,104,162.53**

Table 10. BOQ for plastering (1-bedroom)

Items		Unit	Index	Area (m^2)	Unit Price (IDR)	Materials	Price (1 unit)
Materials	PC	kg	7.776	76.74	50,000.00	11.93 sack	596,730.24
	PP	m^3	0.023	76.74	160,000.00	1.765 m^3	282,403.20
Manpower	Worker	OH	0.300	76.74	70,000.00		1,611,540.00
	Builder	OH	0.150	76.74	80,000.00		920,880.00
	Head	OH	0.015	76.74	95,000.00		109,354.50
	Foreman	OH	0.015	76.74	120,000.00		138,132.00
					Total:		**3,659,039.94**

Table 11. BOQ for plastering (2-bedroom)

Items		Unit	Index	Area (m^2)	Unit Price (IDR)	Materials	Price (1 unit)
Materials	PC	kg	7.776	108.078	50,000.00	16.81sack	840,414.53
	PP	m^3	0.023	108.078	160,000.00	2.486 m^3	397,727.04
Manpower	Worker	OH	0.300	108.078	70,000.00		2,269,638.00
	Builder	OH	0.150	108.078	80,000.00		1,296,936
	Head	OH	0.015	108.078	95,000.00		154,011.15
	Foreman	OH	0.015	108.078	120,000.00		194,540.40
					Total:		**5,153,267.12**

Table 12. BOQ for nat grout (studio unit)

https://doi.org/10.24912/jmstkik.v6i2.18148

ISSN 2579-6402 (Versi Cetak)
ISSN-L 2579-6410 (Versi Elektronik)

	Items	Unit	Index	Area (m^2)	Unit price (IDR)	Materials	Price (1 unit)
Materials	PC	kg	3.250	44.13	50,000.00	2.87 sacks	143,422.50
Manpower	Worker	OH	0.150	44.13	70.000.00		463,365.00
	Builder	OH	0.100	44.13	80.000.00		353,040.00
	Head	OH	0.010	44.13	95.000.00		41,923.50
	Foreman	OH	0.008	44.13	120.000.00		38,834.40
						Total:	**1,040,585.40**

Table 13. BOQ for nat grout (1-bedroom)

	Items	Unit	Index	Area (m^2)	Unit price (IDR)	Materials	Price (1 unit)
Materials	PC	kg	3.250	76.74	50,000.00	4.99 sacks	249,405.00
Manpower	Worker	OH	0.150	76.74	70.000.00		805,770.00
	Builder	OH	0.100	76.74	80.000.00		613,920.00
	Head	OH	0.010	76.74	95.000.00		72,903.00
	Foreman	OH	0.008	76.74	120.000.00		73,670.40
						Total:	**1,815,668.40**

Table 14. BOQ for nat grout (2-bedroom)

	Items	Unit	Index	Area (m^2)	Unit price (IDR)	Materials	Price (1 unit)
Materials	PC	kg	3.250	108.078	50,000.00	7.03 sacks	351,253.50
Manpower	Worker	OH	0.150	108.078	70.000.00		1,134,819.00
	Builder	OH	0.100	108.078	80.000.00		864,624.00
	Head	OH	0.010	108.078	95.000.00		102,674.10
	Foreman	OH	0.008	108.078	120.000.00		103,754.88
						Total:	**2,557,125.48**

Table 15. BOQ for stick on wall (studio unit)

	Items	Unit	Index	Area (m^2)	Materials	Price (1 unit)
Materials	Plaster Bonding Compound (20 kg)	kg	4.330	44.13	9.554	525,477.98
	Yoshino gypsum board (1200 x2400mm)	sheet	0.365	44.13	16.107 sheet	1,530,207.75
	Joint Tape	m	0.263	44.13	11.606 m	116,061.90
	Joint Compound (20 kg)	kg	0.736	44.13	1.624 sack	81,199.20
	Sandpaper	m	0.026	44.13	1.147 m	11,473.80
	Corner Bead (35x35x0.3x3m)	m	0.290	44.13	12.798 m	255,954.00
Manpower	Worker	OH	0.050	44.13		255,954.00
	Head of builder	OH	0.005	44.13		23,168.25
	Builder	OH	0.100	44.13		330,975.00
	Foreman	OH	0.005	44.13		27,581.25
					Total:	**3,111,716.63**

Table 16. BOQ for stick on wall (1-bedroom)

	Items	Unit	Index	Area (m^2)	Materials	Price (1 unit)
Materials	Plaster Bonding Compound (20 kg)	kg	4.330	76.74	16.615	913,781.55
	Yoshino gypsum board (1200x2400mm)	sheet	0.365	76.74	28.01 sheet	2,660,959.50
	Joint Tape	m	0.263	76.74	20.18 m	201,826.20
	Joint Compound (20 kg)	kg	0.736	76.74	2.82 sack	141,201.60
	Sandpaper	m	0.026	76.74	2.00 m	19,952.40
	Corner Bead (35x35x0.3x3m)	m	0.290	76.74	22.25 m	445,092.00
Manpower	Worker	OH	0.050	76.74		364,515.00
	Head of builder	OH	0.005	76.74		40,288.50
	Builder	OH	0.100	76.74		575,550.00
	Foreman	OH	0.005	76.74		47,962.50
					Total:	**5,411,129.25**

Table 17. BOQ for stick on wall (2-bedroom)

Items		Unit	Index	Area (m^2)	Materials	Price (1 unit)
Materials	Plaster Bonding Compound (20 kg)	kg	4.330	108.078	23.40	1,286,938.79
	Yoshino gypsum board (1200x2400mm)	sheet	0.365	108.078	39.45 sheet	3,747,604.65
	Joint Tape	m	0.263	108.078	28.42 m	284,245.14
	Joint Compound (20 kg)	kg	0.736	108.078	3.98 sack	198,863.52
	Sandpaper	m	0.026	108.078	2.81 m	28,100.28
	Corner Bead (35x35x0.3x3m)	m	0.290	108.078	31.34 m	626,852.40
Manpower	Worker	OH	0.050	108.078		513,370.50
	Head of builder	OH	0.005	108.078		56,740.95
	Builder	OH	0.100	108.078		810,585.00
	Foreman	OH	0.005	108.078		67,548.75
					Total:	**7,620,849.98**

For comparative analysis of the time for finishing walls using plastering and nat grout with stick on wall, the results as follows. In wall finishing work using plaster and grout, on one floor there are 6 groups of workers, each group consists of 3 people (2 workers, 1 head of builder) who can work 12 m^2 in 1 day, therefore the total number of workers for 7 floors is 126. Then for studio unit plastering, work can be done within 15 days, 1-bedroom type within 6 days, and 2-bedroom type within 9 days. The nat grout work is done after the plastering is dry, and the nat grout work is two times faster than the stick on wall work, so the grout work for studio units can be done within 7 days, 1-bedroom type within 4 days, two-bedroom type within 5 days. Then the total plastering and grout work for one floor can be done within 30 days. For the next floor work, it is not necessary to wait for the the floor currently being worked on is complete. The next floor work based on field observations was carried out on the 7^{th} day of working ongoing floor, so for 7 floors work can be done within 67 days.

In wall finishing work using stick on wall method on one floor, there are 6 groups of workers; each group consists of 3 people (2 workers, 1 head of builder). Each group can work on two units in a day, so the total number of workers for 7 floors is 126. Then the work on one floor can be done within three days, and the work on the next floor based on field observations was done on the 3^{rd} day of working ongoing floor, so the total work time for seven floors is 15 days. Based on this comparison, the wall finishing work using stick on wall method is faster as working time of 52 days.

In case of material transportation from supplier to project site for the plastering work and nat grout, the material is transported using a Mitsubishi Colt diesel Fuso 74 long with a GVW capacity of 7500 kg. At one time transporting cement from the supplier to the project site can transport 150 bags. As for transporting sand with the vessel truck dimensions of 8,778 m^3, the truck can carry 8 m^3 of sand one time. In this case one, truck can go back and forth twice. Counting the total of the stick on wall materials for 7 floors, it yields to the bonding compound plaster (@20 kg per sack) material of 2588 sacks, the Yoshino board gypsum requirement (1200 x 2400 mm) of 5539 sacks, and the joint compound material (@20 kg per sack) of 558 sacks.

Transportation of materials for wall finishing using stick on wall from the supplier to the site can be carried out in 14 days with a total cost of IDR.40,446,000.00. While the transportation of materials for wall finishing work using plastering and nat grout can be done for 16 days with a total cost of IDR.36,095,000.00.

All above BOQs are for the wall finishing work calculation of 1 unit for studio type, 1-bedroom, and 2-bedroom type. One floor consists of 24 units of studio type, 6 units of 1-bedroom type and 6 units of 2-bedroom type. A total wall finishing work of 7 floors are counted in Table 18. Considering the profit and overhead of 15%, the total calculation of BOQ wall finishing work for both methods is shown in Table 18. In addition to calculating the BOQ wall finishing work, the transportation costs are also included in Table 18.

https://doi.org/10.24912/jmstkik.v6i2.18148

ISSN 2579-6402 (Versi Cetak)
ISSN-L 2579-6410 (Versi Elektronik)

Table 18. The BOQ comparison

	BOQ	Transportation	Total	Days
Stick on wall	IDR.1,230,628,248.52	IDR.40,446,000.00	IDR.1,271,074,248.52	15
Plastering & nat grout	IDR.1,244,405,675.38	IDR.36,095,000.00	IDR.1,280,500,675.38	67

The comparison results show that the wall finishing work using the stick on wall cheaper than wall finishing work using the plastering and nat grout with the price of IDR. 1,271,074,248.52 for stick on wall and IDR.1,280,500,675.38 for plastering and nat grout work with a cost difference of IDR.9,426,426.86 or 0.74%.

In terms of processing time, the wall finishing work using stick on wall is 77.61% faster than wall finishing work using the plastering and nat grout work with details of work time for seven floors, namely 15 days for the stick on wall work, and 67 days for plastering and nat grout work. So, the difference in working time is 52 days.

4. CONCLUSION AND RECOMMENDATION

In this study, the effectiveness in terms of cost and time of the stick on wall finishing method compared to the plastering and grout method on the construction of the Cattleya Tower Sakura Garden City Apartment project, East Jakarta, has evaluated with the following conclusions.

In terms of work costs, wall finishing work using the stick on wall method is 0.74% cheaper than wall finishing work using the plastering and nat grout method. For the aspect of processing time, wall finishing work using the stick on wall method is 77.61% faster than wall finishing work using the plastering and nat grout work. The difference in working time is 52 days.

Through this study, it is hoped that it will provide a view of the effectiveness of the stick on wall method, although it was a limited to the Cattleya Sakura Garden City apartment tower project from floors 20 to 28. As a note for further evaluation, it is necessary to pay attention to factors such as the supply of goods from the supplier to the project site, which greatly affects the price of the distance for transportation of the material.

Acknowledgement

The authors would like to thank the project management of Cattleya Tower Sakura Garden City Apartment, East Jakarta, for providing study opportunities and data related to the writing of this study.

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https://doi.org/10.24912/jmstkik.v6i2.18148