Study of Drywall Systems in Wall Work as An Alternative Innovation in Value Engineering

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Abstract. Currently, wall construction predominantly uses red bricks, lightweight bricks, concrete blocks, and panels. Research related to value engineering also focuses on these materials. In terms of cost, red bricks are cheaper than lightweight bricks and precast panels. Innovations in construction are continuously evolving, one of which is the use of the drywall system for walls. Drywall is a wall system installed without mortar and water, using light steel frames and cement or gypsum boards. Drywall offers a lighter system compared to conventional walls. The main components of drywall include gypsum board frames, J Track, and E-Stud, with additional components such as compound, sealant, insulation, and spindle pin. The use of drywall components is tailored to the installation area. For wet areas like bathrooms, kitchens, and exterior walls, a water-resistant gypsum board is used. This system facilitates room arrangement and allows for quick layout changes. This study analyzes the cost, time, and installation methods of drywall. The result is an alternative selection of wall materials for value engineering. The cost of drywall installation varies by function and location, with prices at IDR 798,623 per m² for room partitions, IDR 998,641 for toilet partitions, and IDR 1,174,705 for exterior walls.

Keywords: Cost, Drywall, Time, Work Method

1 Introduction

Wall materials continue to evolve along with the demands of the need to achieve the most costly, time-effective, and efficient (Rori et al., 2020). Currently, various types, brands, and building material products are circulating on the market. This is an alternative so that it is easier for people to determine the type of building materials to be used and also easier to control costs in the process of building a house or building. The emergence of several brands with diverse specifications is solely aimed at producing better buildings at optimal cost, time, and time. In the past, people tended to use bricks or red bricks for wallwork, but now people are familiar with light bricks and *precast panels* (Nurmaidah & Cristiani, 2019). The selection of wall-building materials is important to consider because the decline in the foundation structure is also due to the weight of the wall load (Rafik et al., 2018). A wall is a solid structure that destricts and sometimes protects an area. Walls can be made from an assortment of materials

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according to their needs, including artificial stone walls (brick), natural stone walls, wooden walls, wood, and concrete walls (Herianto & Malingkas, 2020). When comparing the installation time of brick walls for 16 days and light brick walls for 73 days (Lestari et al., 2022). Another wall material is precast, and the results show variations in the level of efficiency of precast and conventional wall work methods (Yulistianingsih & Trijeti, 2014). The large number of workers must be maximized to minimize the budget and project completion time (Ajar & Dofir, 2021). The price analysis of wall pair work according to field analysis showed that the results were smaller than SNI (Handayani et al., 2021). Inaccuracies in estimates can harm the entire construction process. In addition to the BOW (Burgerlijke Openbare Werken) method, SNI (Indonesian National Standard), and contractors (Permadi et al., 2018). In the implementation of construction projects, the availability of labor affects the completion of construction projects (Waluyo & Aditama, 2017). The average productivity value of workers obtained from the analysis results for the work of light brick wall pairs is 10,3797m²/day or a worker coefficient of 0.135), builder 0.045, head builder 0.005, foreman 0.007 (Hilda Rahsa Pramesti & Budi Priyanto, 2023). However when compared to the cost of carrying out light masonry work of IDR 284,208.00/m², while the cost of red masonry work is IDR 251,085.54/m². In terms of wall installation speed per m², light brick materials are faster than red brick materials (Sumartin, 2021).

2 Methodology

2.1 Research Design

This research employs a quantitative descriptive method, which involves determining the cost of work, execution time, work methods, and tasks. The research method used includes field observations to obtain field data on material needs, tools, labor, and work methods used. The interview method is used to obtain data on the quality of materials used, and field surveys are conducted to obtain data on material prices, wages, and tools. Dalam pelaksanaan proyek konstruksi, ketersediaan tenaga kerja berpengaruh terhadap penyelesaian proyek konstruksi (Waluyo & Aditama, 2017). If you look at the research that has been carried out, the implementation time, for the installation of red brick walls is needed for 12 days while the installation of brick walls is 3 days so a comparison of the implementation time between the two is obtained for 8 days with the same number of craftsmen, namely 4 people per day (Harahap, 2021). The comparison in terms of installation time per m² of wall from MU adhesive light brick is 1.7 times faster than that of red brick with a mixture of 1 PC : 5 PS (Prapto & Haryadi, 2017).

2.2 Research Data

This research uses primary data from field observations, surveys, and interviews to assess labor productivity, materials, tools, and work methods. Observations focus on field conditions, while surveys gather material and contract prices, and interviews explore material quality and maintenance methods. Secondary data includes shop drawings for work volume calculations, time schedules for project duration, and brochures for material references. The study is conducted at the Japanese Resto project in -Badung, Bali, to provide practical context for the drywall system application. The

emergence of lightweight brick technology as a wall matching material has had a positive impact on society in general and the construction world in particular (Anam & Sugiyanto, 2022). In the implementation of wall work, the quality of the work is greatly influenced by the work method used (Asmaroni, 2020).

3 Result and Discussion

3.1 Result

Type for outside area walls. Figure 1 type of detail is used on external walls that are directly connected to the terrace area. The details required according to these conditions are using a double frame on 2 sides, using soundproof gypsum (sound stop) with a thickness of 12 mm, installing insulation (rock wool), and weather-resistant gypsum with a thickness of 12.7 mm (USG Boral Durock).

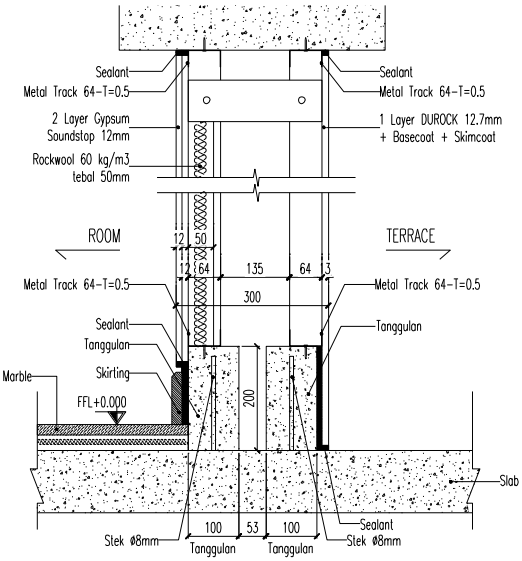

Figure 1. Drywall details for exterior walls

Type for room dividing area walls. Figure 2 type of detail is used on walls that divide rooms. The details required according to these conditions are using a double frame on 2 sides, using soundproof gypsum (sound stop) with a thickness of 12 mm, and installing insulation (rock wool). For partitions between rooms, drywall is installed more simply, without the addition of weather-resistant gypsum.

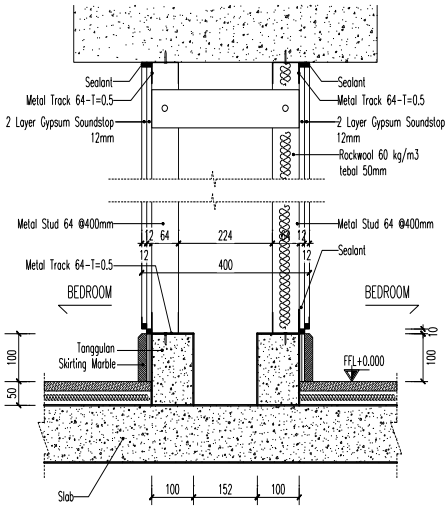

Figure 2. Drywall details for room divider walls

Type for toilet area walls. Figure 3 type of detail is used on toilet walls that are directly related to water use. The details required according to these conditions are using a double frame on 2 sides, using weather/water resistant gypsum with a thickness of 12.7 mm, and installing insulation (rock wool).

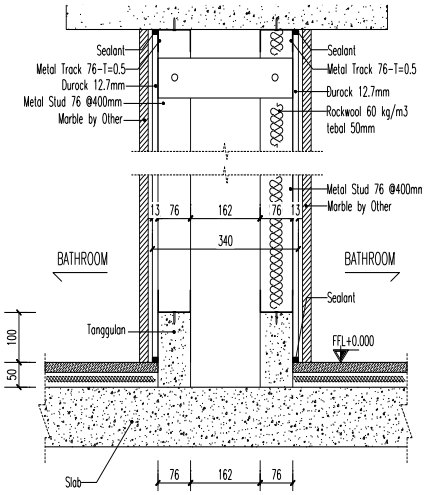

Figure 3. Drywall details for toilet area walls

3.2 Discussion

Calculating Drywall Material Requirements

The drywall studied in this research is for covering walls in the outer areas of buildings with the following specifications: Wall thickness 250 mm, a double frame system with a frame distance of 400 mm, installation of 2-sided gypsum, 2 faces and 1 layer, using gypsum soundstop 12 mm thick on the inside, using 12 mm GRC on the outside and rockwool soundproofing.

Calculating frame material requirements, based on field observations, wall work with a 6 mm × 3mm module. The results of calculating frame material requirements can be seen in Table 1.

Table 1. Drywall frame material components per 1 m²

No	Frame material components	Volume (m²)	Amount	Unit
1	Bullet nails	1	2	pcs
2	Hanging elbow	1	2	pcs
3	Metal track 64 0.50 mm BMT @ 3m	1	0.43	bar
4	Metal stud 64 0.50 mm BMT @ 3m	1	1.58	bar
5	Deflection head track 64 0.50 mm BMT @ 3m	1	0.21	bar
6	Screws 6 3/8	1	20	pcs
7	3 cm concrete nails	1	0.06	box
8	Screws 6×1	1	13	pcs
9	Sika sealent	1	0.01	tubes

Calculating internal gypsum material needs, the requirement for internal wall gypsum material components for 1 m² of internal wall work. The results of calculating internal gypsum material can be seen in Table 2.

Table 2. Internal wall gypsum material components per 1 m²

No	Frame material components	Volume (m²)	Amount	Unit
1	12 mm Soundstop gypsum board	1	0.4	sheet
2	Screw 6 mm × 1 inch	1	15	pcs
3	Screw 6 mm × 2 inches	1	15	bar
4	Paper tape @ 75m	1	0.03	bar
5	Compound 2 in 1 @ 20 kg	1	0.05	bar
6	Sandpaper	1	0.04	pcs
7	Sika sealant	1	0.4	tubes

Calculating the need for sound-dampening material from rock wool. The required dampening material components for 1 m² of internal wall work. The results of calculating the need for sound-dampening material from rock wool rial can be seen in Table 3.

Table 3. Rockwool sound dampening material per 1 m²

No	Sound dampening material	Volume (m²)	Amount	Unit
1	Rockwool dencity 60 kg/m^3 t=5 cm	1	1.46	sheet
2	Spindle pin + glue	1	6	pcs

Calculating Labor Coefficient. Labor requirements are calculated per square meter, with the labor index provided.

Labor coefficient for installing drywall wall frames. The average productivity per hour of installing a drywall frame using materials as described in the frame component table using 1 worker, 1 craftsman, and 1 foreman is 2,250 m²/hour. Next is the calculation of the labor coefficient. Unit price analysis coefficients are the figures for the amount of materials and energy needed to do a job in one particular unit. The coefficient calculation can be seen as follows: Frame with Modules 6,000 × 3,000 mm × 2 sides. Average Productivity is 2.25 m²/hour, and average productivity in 8 hours is 18 m²/day; Workers: 1/18 = 0.055 man-day × 2 = 0.111 man-day; Handyman: 1/18 = 0.055 man-day × 2 = 0.111 man-day; Foreman: 1/18 = 0.055 man-day × 2 = 0.111 man-day × 30% = 0.08 man-day.

Labor coefficient for installing internal wall with gypsum. The average productivity per hour of installing internal walls with gypsum using 2 workers, 2 craftsmen, and 1 foreman is 2,250 m²/hour. Next is the calculation of the labor coefficient. Unit price analysis coefficients are the figures for the amount of materials and energy needed to do a job in one particular unit. The coefficient calculation can be seen as follows: Frame with 6 x 3 mm. Average Productivity is 2.25 m²/hour, Average productivity in 8 hours is 18 m²/day; Workers: 2/18 = 0.111 man-day; Handyman: 2/18= 0.111 man-day; Foreman: 1/18 = 0.055 man-day.

Labor coefficient for installing walls with GRC including Installing Rockwool Dampers. Average productivity per hour of external wall installation with GRC using 2 workers, 3 craftsmen, and 1 foreman is 2,250 m²/hour. Next is the calculation of the labor coefficient. Unit price analysis coefficients are the figures for the amount of materials and energy needed to do a job in one particular unit. The coefficient calculation can be seen as follows: Frame with 6 x 3 mm; Average Productivity is 2.25 m²/hour, average productivity in 8 hours is 18 m²/day; Workers: 2/18 = 0.111 man-day; Handyman: 3/18 = 0.167 man-day; Foreman: 1/18 = 0.055 man-day.

Unit Price Analysis of Work . Based on the unit price analysis in Table 5 until Table 9, the price for each type of drywall can be calculated according to the installation location and function can be seen in Table 4.

Table 4. Analysis of 1 m² drywall installation work for room dividers

Description	Unit	Coefficient	Unit price (IDR)	Amount price (IDR)
1 M² Partition 2 Sides 2 Face, Double Layer Soundstop 12 mm				
2 Sides Of Rangka Jaya BMS Metal Stud/Track 64 0.5 BMT, With A Distance Between Vertical MS Studs Of 400 mm And BMS Track Nogings Per Distance Of 3000 mm And 2 Pcs Gypsumboard Bracing	m²	2	101,608.45	203,216.89
2 Face 2 Layer Gypsumboard Soundstop 12 mm With Flushjoint Installation System And Finishing Compound	m²	4	99,568.10	398,272.40
Rockwool Density 60 Kg/m³ Thickness 50 Mm Ex Firerock, Installation System With Spindle Pin	m²	1	99,545.60	99,545.60
Paid Wages	m²	1	97,588.89	97,588.89
			Total	798,623.78

Table 5. Analysis of 1 m² drywall installation work for toilet baffles

Description	Unit	Coefficient	Unit price (IDR)	Amount Price (IDR)
1 M² Partition 2 Sides 2 Face, 2 Soundstop Layers, 1 Durock Layer				
2 sides of Rangka Jaya BMS Metal Stud/Track 76 0.5 BMT, with distance between, MS Stud vertically 400 mm and BMS Track noging per distance 3000 mm and 2 pcs gypsum board bracing	m²	2	113,144.51	226,289.02
Rockwool Density 60 kg/m³ thickness 50 mm ex Firerock, installation system with spindle pin	m²	1	99,545.60	99,545.60
1 Face 1 Layer USG Boral Durock 12.7 mm + Tyvex, with system, flushjoint installation and baseflex jointing compound finishing, Durock acian by others	m²	1	531,518.10	531,518.10
Paid wages	m²	1	141,288.89	141,288.89
			Total	998,641.60

Table 6. Analysis of 1 m² drywall installation work for exterior walls

Description	Unit	Coefficient	Unit price (IDR)	Amount price (IDR)
1 M² Partition 2 Sides 2 Face, 2 Soundstop Layers, 1 Durock Layer				
2 sides of Rangka Jaya BMS Metal Stud/Track 64 0.5 BMT, with distance between, MS Stud vertically 400 mm and BMS Track noging per distance 3000 mm and 2 pcs gypsumboard bracing	m²	2	101,608.45	203,216.89
1 Face 2 Layer USG Boral Soundstop 12 mm with system, flushjoint installation and finishing compound	m²	2	99,568.10	199,136.20
Rockwool Density 60 kg/m³ thickness 50 mm ex Firerock, installation system with spindle pin	m²	1	99,545.60	99,545.60
1 Face 1 Layer USG Boral Durock 12.7 mm + Tyvex, with system, flushjoint installation and baseflex jointing compound finishing, Durock acian by others	m²	1	531,518.10	531,518.10
Paid wages	m²	1	141,288.89	141,288.89
			Total	1,174,705.68

Based on Table 10 until Table 12 of the analysis for wall work those functions as a room divider obtained a price of IDR 798,623 per m², for toilet dividers IDR 1,197,777, and for external walls IDR 1,174,705. This price difference is influenced by the type of construction and the materials that make up the wallwork.

Drywall Installation Working Method. Fieldwork begins with creating a field plan and preparing project resources. Shop drawings are made as references for field implementation and must be approved by the supervisory consultant. The working method for drywall depends on the design type. Generally, it includes; a. Shop Drawing Creation, used as a field reference and requires supervisory approval, b. Preparation for frame installation involves materials like metal track 64 and 75 (0.5 mm thickness), bullet nails, hanging elbows, screws, concrete nails, and sika sealant.

4 Conclusion

The cost of drywall installation varies depending on the function and location of the installation area. Based on the research, the estimated costs per square meter for various applications are as follows: a. Room Partition: IDR 798,623 per m²; b. Toilet Partition: IDR 998,641 per m², and c . Exterior Wall: IDR 1,174,705 per m². These costs include materials and labor and they may different based on project specifications and location.

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