Comparison Analysis of A Red Brick Wall With M-Cast Wall, Assessed from The Strength of Press, Time and Cost

Catur Prayogo, Novika Candra Fertilia
Mercu Buana University, Bekasi, Indonesia
catursuper@gmail.com, Novikacandraf@yahoo.com

Abstract

Currently there are several technologies and materials in the construction sector as substitutes for conventional building wall materials, including M-Cast and red brick. This study aims to determine the comparison of compressive strength, time and unit cost of wall work using M-Cast material and red brick based on conventional methods and SNI. Productivity data in this study were obtained by directly observing the speed of work in the field. The method used in this research is the Daily Record Sheet method and the SNI method. The job coefficient to calculate the work unit price analysis is obtained by calculating yourself based on the productivity value obtained.The results of the productivity analysis show that M-Cast has twice the strength compared to red brick, it can be seen from the final results of the compressive strength test at the age of the sample to 28 days where the red brick only has a strength of 53.92 - 58.50 Kg / cm² while M- Cast has a strength of 118.06 - 127.18 kg / cm², and the productivity value of M-Cast wall work in each type of observation is that the installation time required is 3 hours to install 1 piece of M-Cast with an area of -12m² where the time is 1 hour of installation and 2 hours of finishing Meanwhile, the red brick wall work time is 36 hours, where the installation time is 12 hours, plaster is 12 hours and finishing is 12 hours. The unit cost of the M-Cast wall works per 12m² is Rp. 7,690,000, and the red brick wall is Rp. 4,434,000.

Keywords

Comparative Analysis of Red Brick Walls with M-Cast Walls in Terms of Compressive Strength, Time and Cost.

1. Introduction

The wall is one of the building structures that serves to protect occupants from wild animals, wind, sun or rain. Making a wall usually uses red bricks, concrete blocks, boards, or plywood.

In writing this Final Project, the author reviewed the fabrication construction in the PT Duta Sarana Perkasa site plant area (DUSASPUN), which will later be called the DSP 9 Plant, the construction of the DSP 9 will focus on the production of precast panels, and after it is done the survey is known where the implementation of the DSP Plant 9 development project will use the M-Cast method. The M-Cast wall mounting process uses a vertical mounting system and M-Cast walls are installed in a different finishing condition from the general mounting system that uses a horizontal mounting system and is installed in a non-finishing condition.

Project for building DSP 9 PT. Duta Sarana Perkasa (DUSASPUN) is interesting to study because besides in accordance with the title that the writer took, the author feels that he will get a lot of new knowledge and experience in the study of the construction of the DSP Plant 9, where the author can get many theories and systems for making M-Cast that more diverse and can do a comparison of compressive strength test, time and cost directly in the field (Retna Kristiana, 2016).

1.1. Identification of problems

This research focuses on the desires of a very diverse market because it is seen from the advantages and disadvantages of using the M-Cast system and the manufacturer's red bricks, where the use of M-Cast will take less time but more expensive costs are inversely proportional to the red bricks which take more time but with lower costs, besides the compressive strength of M-Cast and different red bricks, it becomes a market comparison in the choice of using the M-Cast or red brick system (I et al., 2014).

1.2. Research Purpose and Objectives

The aims and objectives of this research are:

1. To find out the comparison of the compressive strength of the red brick wall press Karawang with the M-Cast wall method.
2. To find out the time needed to complete the installation of red brick wall press Karawang and M-Cast walls per 12 m².
3. To find out the costs required in completing the installation of Karawang red brick walls and M-Cast walls per 12 m².

2. Methodology

This chapter will discuss the methods of collecting data from journals that support this research and consult with the supervisor to determine what type of methodology will be used in this scientific writing system, and the type of methodology that can represent the desired modeling.

The second stage of data collection is done by the method of field surveys and interviews with related workers. In addition, the authors also interviewed field workers to find out what constraints were experienced in the running process of the construction project.

The third stage of data collection will be continued by surveying respondents directly involved in the construction project.

2.1. Work steps for making samples
2.1.1. Red brick

Red brick sample composition

To determine the composition of the mortar in this study using a 2: 1 volume ratio using a 200 ml measuring cup.
1. Prepare 1 kg of mortar.
2. Prepare 500 ml of water.
3. Mix evenly the mortar mixture in the container using a mixer.
4. Mortar is ready to be printed.

Print a red brick sample

After the mortar mixture is ready, the next step is to print the mortar with red brick measuring 160 x 80 x 40 mm.
1. Prepare the mortar stir
2. Cover the red brick that has been prepared with the mortar mixture, repeat until the sample height is 20 cm, the same as the M-Cast sample that the author made.
3. Let stand for 1 x 24 hours until the sample dries.When the mortar has dried, give a date (according to the date of manufacture).

Soaking the red brick sample
1. Put all the test items into the soaking tub.
2. At this stage the test specimen is treated (curing), by immersion in water. Wait until the age of the test object matches the test, (the age of the test being tested is 7 days, 14 days and 28 days).

2.1.2 M-Cast

M-Cast sample composition

To determine the composition of the mortar in this study using a 2: 1 volume ratio using a 200 ml measuring cup.
1. Prepare 2 kg of mortar.
2. Prepare 1000 ml of water.
3. Mix evenly the mortar mixture in the container using a mixer.
4. Mortar is ready to be printed.

Print M-Cast samples

After the mortar mixture is ready, the next step is to print the mortar with M-cast measuring 200 x 200 x 120 mm.
1. Prepare the mortar stir
2. Cover the M-cast with the mortar mortar, 30 mm thick.
3. Let stand for 1 x 2 hours until the sample dries.
4. After drying, refill it with the RM-160 acian, with a thickness of 5 mm.
5. Let stand for 1 x 24 hours until the sample dries.
6. When dry, give a date (according to the date of manufacture).

M-Cast sample drying process
At this stage the test specimen is left standing until the test specimen is in accordance with the test.

2.2. Compressive Strength Testing
2.2.1. Red Brick

Compressive strength testing on red bricks is done by means of the red bricks coated with mortar on both sides as the red bricks are attached to the wall. There is one type of brick that will be tested for its compressive strength, namely the red brick produced by the Karawang press factory. The dimensions of the red brick are 160 x 80 x 40mm. To get the value of the compressive strength of the red brick must go through laboratory testing.

The red bricks to be tested are stacked vertically into 4 piles where each of the red bricks is coated using 1.5 cm thick mortar which will be used in planning, namely Rapi RM-115 mortar with a ratio of 2: 1. Top and bottom surfaces must also be mortared to provide a flat surface. After all the test pieces are ready, a pressure test is carried out. The brick is pressed until it has cracked, then the maximum compressive strength achieved is recorded.(Redha Sadhu Leksono, Data Iranata, 2012)

Figure 1. RedBrick Sample

2.2.2. M-Cast

Compressive strength testing of M-cast coated mortar on both sides as well as attached M-cast Wall. There are 6 M-cast samples that will be tested for compressive strength, with the size of 200 x 200 x 120mm. To get the compressive strength of the M-cast Wall must be tested in a laboratory. The M-Cast wall reinforcement to be tested was coated using 1.5 cm thick mortar which will be used in the planning, namely the RM-130 Neat Mortar with a ratio of 2: 1.
M-Cast is pressed until it cracks, then the maximum compressive strength achieved.

Figure 2. M-Cast Sample

2.2.3. Steps for testing the sample

In the compressive strength testing step on the sample of the red brick wall and the M-cast wall have the same method, the following are the steps for testing the specimen:
a. Drying and weighing process
    1. Remove the test object (age 7 days) from the soaking tub, wait until it is completely dry.
    2. Then weigh the test specimen.
b. Compressive strength testing
    1. Compressive strength testing is carried out after the specimen reaches 7 days, 14 days and 28 days from the time of mixing.
    2. For each age 2 pieces are made, so that in total there are 6 pieces that will be compressed.

Red Brick Sample

M-Cast Sample

Figure 3. Compressive Strength Testing

2.3. Measurement of Work Productivity

During the work, the amount of achievement must be recorded so that it can be compared with the initial plan as an effort to evaluate the amount of productivity that has been achieved. Monitoring (monitoring) means conducting observations and testing at each particular interval to check performance and unexpected side effects.

In general, productivity can be interpreted as a comparison between output and input. Productivity is expressed by Formulas.

Productivity $= \frac{Output}{Input}$

As for the measurement of worker productivity, what is used is:

Worker Productivity (m²/hour) $\frac{Hasil\ Kerja\ (m^2)}{Jam/Durasi\ kerja}$

2.4. Calculation of M-Cast and Red Brick Wall Costs

The calculation of the cost of a project is also a determining factor in the smooth running of a project, where if the calculation of costs in a project has been prepared carefully, the project will go according to plan, because all work depends on the costs that have been determined in one project. In calculating the cost of the case study in this study, the authors divide into 3 basic parts in the construction of this project, where the 3 parts included in the calculation of costs become one of the supporting factors in the smooth running of this project, the 3 fundamental parts of this project are the costs on material usage, costs on labor usage, and equipment costs where the author uses the reference / 12m² for each variable

3. Result and Discussion
3.1. Result
1. The compressive strength test results obtained from the test samples that have been made have the same strength increase in each age, but M-Cast has twice the strength compared to red brick.
2. The comparison result of the installation of M-cast walls and red brick is that the installation of M-Cast walls is much faster with red brick walls.
3. The result of the comparison of the total cost of work based on this research is that the cost of red brick wall work is cheaper than M-Cast wall work, while the labor wage for M-Cast wall work is cheaper than red brick wall work because of the shorter work time fast.

3.2. Discussion
a. For construction service providers (planners and executors), wall works on large projects such as high-rise buildings should use M-Cast walls because they are faster in carrying out the work so that they can reduce costs outside of implementation (staff salaries, rented beds, rented warehouses, rent. tools, workers' salaries), especially with a lighter weight so that if it is used in high rise building construction, a more economical building structure can be obtained.
b. choose the wall material according to your needs. If you need fast work and high productivity without paying too much attention to the cost of wall work, you can use M-Cast material because its productivity is the fastest compared to others. If you need materials with lower costs for business reasons or private homes, it is advisable to use conventional brick materials.
c. Construction service companies (contractors) can provide training on work methods and knowledge of materials to their workers, because mpanel wall works are still rarely used compared to red bricks and require special skills in the implementation of their work.

3.3. Compresive Strenght

Table 1. Mortar Compressive Test Results

| LABORATORY DUSASPUN									DUSASPUN
Kp. Kedep, Ds. Tlajung Udik									Setting the Quality
Gn. Putri - BOGOR, Ph. 8672308									
TRIAL DESIGN DRY MIX MATERIAL									
Project: Sample									
Characteristic : -									
Sample : Bata Merah & M-Cast									
No	Application For	Trade Mark & Type	Date of Casting	Jenis Sample	Umur Sample (Days)	Date of Test	Load (kN)	Compr.Strength (kg/cm2)	Review
1	Shootcrete	Bata Merah Press 20x20cm	15-Mei-20	Sample 1	7	22-Mei-20	176.7	45.05	OK
					14	29-Mei-20	184.45	47.02	OK
					28	12-Jun-20	229.5	58.50	OK
				Sample 2	7	22-Mei-20	162.7	41.48	OK
					14	29-Mei-20	173.36	44.19	OK
					28	12-Jun-20	211.54	53.92	OK
2	Shootcrete	M-cast 200x200x120mm	15-Mei-20	Sample 1	7	22-Mei-20	381.53	97.26	OK
					14	29-Mei-20	476.13	121.37	OK
					28	12-Jun-20	498.9	127.18	OK
				Sample 2	7	22-Mei-20	346.96	88.70	OK
					14	29-Mei-20	433.98	110.50	OK
					28	12-Jun-20	463.63	118.06	OK
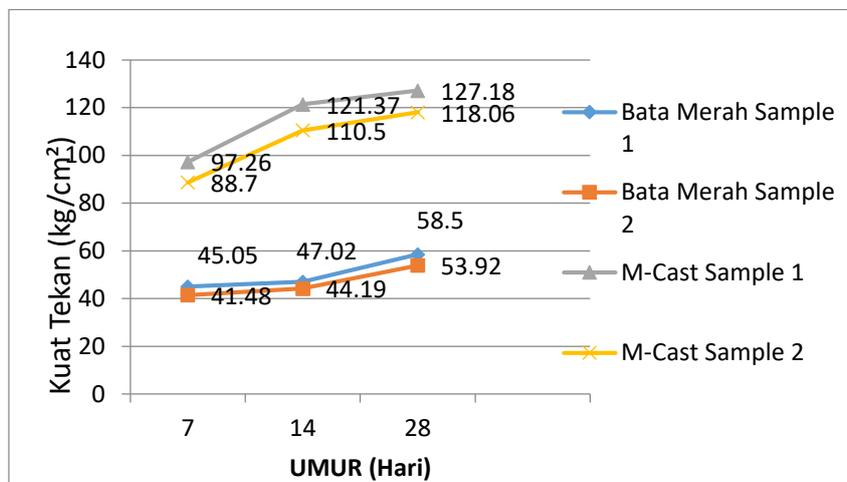
Figure 4. Mortar Compressive Test Results Graphic

The compressive strength test results obtained from the sample trials that have been made are divided into 3 sample age periods, namely 7 days, 14 days and 28 days, and after comparing the compressive strength test results of red brick and M-Cast both experience an increase in strength. In each age, however, seen from the strength results, M-Cast walls are stronger when compared to red bricks which can be seen from the final results of the compressive strength test at the age of 28 days where the red brick only has a strength of 53.92 - 58.50 Kg / cm² while M-Cast has a strength of 118.06 - 127.18 kg / cm²

3.4. Time

Table 2. Result of Red Brick Installation Using Daily Record Sheet Method

No	Dimensi Dinding (m)			Waktu Pasang			Produktivitas	Tenaga Kerja (OH)			
				Mulai	Selesai	Jam		Pekerja	Tukang Batu	Kepala Tukang	Mandor
	Panjang	Tinggi	Luas	Jam : Menit	Jam : Menit		(m²/jam)				
PEMASANGAN BATA MERAH											
1	3	4	12	8.00	12.00	4.00	1	2.6	0.8	0.08	0.12
2	3	4	12	13.00	17.00	4.00	1	2.6	0.8	0.08	0.12
PLESTER											
1	3	4	12	8.00	12.00	4.00	1	2.6	-	0.08	0.12
2	3	4	12	13.00	17.00	4.00	1	2.6	-	0.08	0.12
FINISHING											
1	3	4	12	8.00	12.00	4.00	1	2.6	-	0.08	0.12
2	3	4	12	13.00	17.00	4.00	1	2.6	-	0.08	0.12

Refer to SNI 6897-2008

Table 3. Observation Results of M-Cast Installation Using the Daily Record Sheet Method

No	Dimensi Dinding (m)			Waktu Pasang			Produktivitas	Tenaga Kerja (OH)	
				Mulai	Selesai	Jam			
	Panjang	Tinggi	Luas	Jam : Menit	Jam : Menit		(m²/jam)	Mandor	Tukang
PEMASANGAN PANEL									
1	3	4	12	8.00	9.00	1.00	12	1	3
FINISHING									
1	3	4	12	8.00	10.00	2.00	6	1	1

for a comparison of the installation times of red brick and M-Cast that have been carried out in the field, it can be concluded that the installation of M-Cast walls is much faster with red brick walls, when viewed from the installation time of red bricks which refers to SNI 6897-2008 on the installation of red bricks with an area of 12m² from the installation stage, plastering to finishing requires 36 hours of work while for the installation of an M-Cast wall with an area of 12m² it only takes 3 hours of work from installation to finishing.

3.5. Cost
3.5.1. Calculation of M-Cast Wall Costs

Table 4. Calculation of M-Cast Wall Costs

Bahan Perbadingan	Variable	Estimasi Biaya
Biaya	Matrial	M-cast uk. 1m x (3,5cm + 5cm +3,5cm)x1m = Rp. 580.000,-/m²
		RM-130 Kamprot RAPI
		RM-160 Acian Premium
	Tenaga Kerja	Mandor = Rp. 200.000,-/hari
		Tukang = Rp. 150.000,-/hari
	Peralatan	Penyewaan Crane = Rp.350.000/jam

a. Calculation of fees for matrial usage

The installation of M-Cast walls with an area of 12m² requires the following costs:

Price of M-cast size 1m x (3,5cm + 5cm + 3,5cm) x1m Rp.580,000, - / m² which includes matrial costs for mortar raw materials.

Total cost of Matrial = M-cast size 1m x (3,5cm + 5cm + 3,5cm) x1m x 12
= Rp.580,000 x 12
= Rp.6,960,000

Thus it can be concluded that in the installation of M-Cast walls with an area of 12m² a matrial cost of Rp. 6,960,000.

b. Calculation of costs on labor usage

The installation of the M-Cast wall with an area of 12m² takes 1 day to install with a workforce of 4 people consisting of 1 foreman and 3 craftsmen, the details of which are as follows:

1 Foreman / day = Rp. 200,000
1 worker / day = Rp. 150,000
The total cost of using labor = 1 foreman + 3 workers
= Rp.200,000 + 3 (Rp. 150,000)
= Rp.650,000

The total cost required in the use of labor is Rp. 650,000

c. Equipment cost calculation

M-cast installation requires Over Head Crane equipment with a capacity of 50 tons, where the cost of renting the crane is Rp.350,000 / hour and the installation time required is 1 hour / pcs.

After calculating all the variables to get the total cost, the following formula is obtained:

Total Total M-cast Wall Cost = Matrial Cost + Labor Costs + Equipment Costs
= 6,960,000 + 650,000 + 350,000
= Rp. 7,690,000.

3.5.2 Calculation of the Cost of a Red Brick Wall

Table 5. Calculation of the Cost of a Red Brick Wall

Bahan Perbadingan	Variable	Estimasi Biaya
Biaya	Matrial	Bata Merah Uk.160 x 80 x 4 cm dengan harga = Rp.450/pcs
		RM-115 Pasangan Bata + Plester @40kg = Rp. 65.000/sak
		RM-160 Acian Premium @40kg = Rp. 120.000/sak
	Tenaga Kerja	Pekerja = Rp. 100.000,-/hari
		Tukang Batu = Rp. 100.000,-/hari
		Mandor = Rp. 200.000,-/hari
		Kepala Tukang = Rp. 175.000,-/hari
	Peralatan	-

a. Calculation of fees for matrial usage

In the installation of red brick walls with an area of 12m² requires a mixture of the following composition:

RM 115 pairs of bricks + plaster as much as 800 kg or the equivalent of 20 bags

MYR 160 premium premium as much as 80 kg or equivalent to 2 bags

The total cost of Matrial = the price of 840 pcs of red brick + the price of the mix + the price of acian

= Rp. 378,000 + Rp. 1,300,000 + Rp. 240,000

= Rp. 1,918,000

Thus it can be concluded that in the installation of a red brick wall with an area of 12m², a matrial cost of Rp. 1,918,000.

b. Calculation of costs on labor usage

Installation of red brick walls with an area of 12m² takes 3 days to install with a workforce of 4 people consisting of 1 foreman, 1 mason, 1 foreman and 1 head mason, where the details are as follows:

1 Worker / day   = Rp. 100,000
1 Mason / day   = Rp. 100,000
1 Foreman / day   = Rp. 200,000
1 Head of Artisan / day = Rp. 175,000

Total labor cost = (5.2 OH workers x 3 days) + (1.6 OH masons x 1 day) + 0.96 foreman + 0.48 head masons

 = Rp.2,080,000 + Rp.160,000 + Rp. 192,000 + Rp. 84,000

 = Rp.2,516,000

The total cost required in the use of labor is Rp. 2,516,000

After calculating all the variables to get the total cost, the following formula is obtained:

Total Total Red Brick Wall Costs = Matrial Costs + Labor Costs + Equipment Costs

 = 1,918,000 + 2,516,000 + 0

 = Rp. 4,434,000.

After seeing the results of the calculation of all costs required on the red brick wall and M-cast it can be concluded that the use of red brick walls is much cheaper than the use of M-cast walls.

4. Conclussion

From the results of research and testing obtained the following results:

a. The compressive strength test results obtained from the sample trials that have been made are divided into 3 sample age periods, namely 7 days, 14 days and 28 days, and after comparing the compressive strength test results of red brick and M-Cast both experience an increase in strength. In each age, however, seen from the strength results, M-Cast walls are stronger when compared to red bricks which can be seen from the final results of the compressive strength test at the age of 28 days where the red brick only has a strength of 53.92 - 58.50 Kg / cm² while M-Cast has a strength of 118.06 - 127.18 kg / cm². So it can be concluded that M-Cast has twice the strength compared to red bricks.

b. And for a comparison of the installation times of red brick and M-Cast that have been carried out in the field, it can be concluded that the installation of M-Cast walls is much faster with red brick walls, when viewed from the installation time of red bricks which refers to SNI 6897-2008 on the installation of red bricks with an area of 12m² from the installation stage, plastering to finishing requires 36 hours of work while for the installation of an M-Cast wall with an area of 12m² it only takes 3 hours of work from installation to finishing.

c. The total cost of red brick wall works is Rp. 4,434,000, - / 12m² and a M-Cast wall of Rp. 7,690,000, - / 12m². The difference between wall work and M-Cast is Rp. 3,256,000, -. This is due to the high cost of

M-Cast material per square meter and equipment rental prices due to the use of Over Head Cranes in the installation of M-Cast compared to red bricks whose installation is still manual using human resources.

d. The material cost for red brick wall work is cheaper than M-Cast wall work, while the labor wage for M-Cast wall work is cheaper than that for red brick wall work because of the faster work time

5. Acknowledgements

References

I, M. I. A., Hasyim, M. H., Eng., M., & Unas, S. El. (2014). Analisa Produktivitas Pemasangan Dinding Dengan Menggunakan Material M-Panel (Studi Kasus : Proyek Pembangunan "Watermark Hotel & Spa" Di Bali). Universitas Brawijaya.

Redha Sadhu Leksono, Data Iranata, dan H. K. (2012). Studi Pengaruh Kekuatan dan Kekakuan Dinding Bata Pada Bangunan Bertingkat. Teknik, 1(1).

Retna Kristiana, A. pujiandi. (2016). Analisa Produktifitas Dinding Bata Ringan Dan Dinding Precast Pada Bangunan Gedung Tinggi Hunian. Jurnal Rekayasa Sipil, 5(2), 81–92.

Biography

Catur Prayogo is a student and a private employee at a company engaged in precast. He is a senior student at Mercubuana University, Bekasi with a civil engineering study program. He also works at one of the large companies engaged in precast concrete, namely PT. Duta Sarana Perkasa, is one of the staff in the engineering division as a senior drafter who is in charge of designing precast products at the company.

The last child of 4 siblings graduated from SMK Budi Utomo Cilacap, Central Java, then he continued his education by taking a course in design using Auto Cad and after graduating he worked at the Krakatau Stell company as a Drafter before finally working at a pioneer company. precast concrete.