Comparison of brick wall construction method with light walls

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Abstract. Wall is the element of the non-structural in buildings, single storey building, low-rise, and high-rise that serves as a counterweight and fastening the beams and column. Construction of other structures such as buildings, walls is a part that has developed over time. It is causing this development is to respond to the needs of construction quality, cost, and time of the construction. In this case there are two types of wall construction, red bricks wall which made of clay and other one is a light concrete bricks wall which made of cement, silica, sand and limestone. The purpose of this paper is to determine the method of wall construction is more efficient in terms of cost and time between methods of red bricks wall and light concrete bricks wall. The study was conducted using a survey method, and comparative literature. These results indicate that both methods have advantages and disadvantages of each other. Red bricks wall method is cheaper in the cost of the process while the light concrete bricks wall method much faster in the process.

1. Introduction
Along with the development of construction in Indonesia, the challenge arises how to build a building becomes faster and more efficient. One solution that develops today is the presence of light brick instead of red brick.

Light brick innovation is known for being faster and cheaper but has a deficiency in terms of quality and durability when compared to red brick [1]. This is the basis of our study by comparing the walls arranged with red bricks and walls made using light bricks.

The research was done by the researchers directly researching and observing the construction work of each of the two methods. This study compares the two ways of construction in terms of time and cost.

The goal to be achieved in writing this scientific paper is to know the method of construction of a more efficient wall between the use of red brick or light brick.

2. Research Methodology
The methods used include:

1. Comparative research, this method compares two different work methods, and both work is done in the same city, Jakarta.
2. Literature study, this method is used to obtain the data and information needed in the writing of scientific papers.
3. Research survey, this method is done by doing direct research in the field during the process of wall construction. The data obtained is field data of price and quality of wall construction.

3. Results and Discussion
Cost and time of wall construction with red brick wall method; cost and timing of wall construction by light brick wall method, as well as an overall cost and time analysis.

Red brick is widely used in building houses or low-rise buildings, while light brick is widely used in low to high-rise buildings. The method of work at each stage has its advantages and disadvantages.

| Table 1. Comparison of brick red and light brick method. |
|---------------------------------------------------------|
| **Comparison of red brick wall method and light brick wall** |
| **Red Brick** | **Light Brick** |
| Advantage | Weakness | Advantage | Weakness |
| Water proof | The cost is higher | The cost is cheaper | Water absorbency is high enough |
| Rarely cracked | Construction time is longer | Faster installation | Power crack is big enough |
| Better endurance quality | Heavier | Loads lighter | Quality endurance is less |
| Somewhat difficult to form | Easily formed and worked |

The demand for good quality, low cost, and quick time are considered in choosing the type of wall-forming constituent material. This is the cause of the brick wall is growing rapidly. In addition, light brick walls are structurally lighter than red brick walls, so structural loading can become lighter.

This comparison is based on the Ozone food center construction project at Pantai Indah Kapuk using red bricks and light bricks. Samples taken with 1m2 wall area, comparison will be seen in terms of cost and time.

3.1. Cost and Time of Wall Construction with Red Brick Wall Method
Installation of red brick walls is generally done manually, so the size is not the exact same, depending on the manufacturer [2]. Conventional brick making is still largely done traditionally, and there is often a difference in size between bricks with one another affecting the thickness of the species and plastering. Consequently the use of light concrete as a substitute for conventional brick has an effect on cost and time in the execution of wall pairs.

The need for conventional bricks in large quantities can not necessarily be met, because conventional bricks are made in the traditional way so constrained by the limitations and capabilities of humans [3].

Commonly traded brick generally has a thickness 3-5 cm, wide 7-11 cm, length 17-22 cm and weight 3 kg/each (depending on the brand and area of origin of brick making) [2]. The material used to make 1 m2 of red brick wall consists of red brick, cement and sand.

This comparison is seen based on the construction project of the Ozone food center at Pantai Indah Kapuk which uses red bricks and light brick materials. Samples taken with a wall area of 1m2, the comparison will be seen in terms of cost and time.

Here is the cost and time calculation required in light brick construction:
A. Red bricks material:
   Material usage per m2 for red brick = \(1 \text{ m}^2 \div (0.18 \text{ m} \times 0.07 \text{ m}) = 80 \text{ red bricks}\)
For 80 red bricks = 80 x 0.16 m x 0.05 m = 0.64 m²
1 piece brick = Rp. 450,-
Cost of red bricks per m² = 80 x Rp. 450,- = Rp. 36.000,-

B. Inner plasterwork:
For 80 red bricks, plasterwork area = 1 m² - 0.64 m² = 0.36 m²
1 sack of portland cement = 50 kg
Cement type weight = 50 kg : 0.024 m³ = 2083 kg/m³
For 1 m³ plasterwork (1pc: 7 ps); sands = 1,2; cement = 1/7 x 2083 kg/ m³ = 300 kg/m³
In 1 m² brick wall installation requires plasterwork = 0.36 m² x 0.11 m = ± 0.04 m³ (with ± 2cm thickness)
Cement = 300 kg/m³ = 0.048 m³
Capacity of 1 sack cement = ± 4,17 m³
1 m³ sands = 1,2 x 0.04 m³ = 0.048 m³
Cost of 1 m³ sand = Rp. 220.000,-
Cost of sand per m² = 0.048 x Rp. 220.000,- = 10.560,-
Cost of 1 sack cement (Tiga Roda 50 kg) = Rp. 65.000,-
Cost of cement per m² = 12/50 x Rp. 65.000,- = Rp. 15.600,-
Total cost per m² plasterwork = Rp. 10.560,- + Rp. 15.600,- = Rp. 26.160,-

C. Outer plasterwork& plaster finished:
Mixture of plasterwork (1 Pc: 7 Ps)
Material usage per 1 m² brick installation require plasterwork mixture = 0.01 – 0.02 m³ (thickness 1.5 – 2 cm)
For 1 cm thickness sands = 1.2 x 0.01 m³ = 0.012 m³
Cement = 300 kg/m³ x 0.01 m³ = 3 kg
For 2 cm thickness sands = 1.2 x 0.02 m³ = 0.024 m³
Cement = 300 kg/m³ x 0.02 m³ = 6 kg
For 1 sack cement:
• 1 cm thickness = 16.7 m²
• 2 cm thickness = 8.3 m²
Price for 2 cm thickness:
1 m³ sands = Rp. 220.000,-
Cost of sands per m² = 0.024 x Rp. 220.000,- = Rp. 5.280,-
Cost of cement per m² = 6/50 x Rp. 65.000,-
Total cost for plasterwork per m²:
• 1 side plasterwork = Rp. 5.280,- + Rp. 7.800,- = Rp. 13.080,-
• 2 sides plasterwork = 2 x Rp. 13.080,- = Rp. 26.160,-
Cement covered usages in 1 m²
Brick wall installation required = 0.002 – 0.004 m³ (thickness 2cm)
Cement = 2083 kg/m³ x 0.002 = 4.17 kg
Capacity for 1 sack cement = 11.9 m³
Cement cost per m² for 1 side = 4.17/50 x Rp. 65.000,- = Rp. 5.421,-
Cement cost per m² for 2 sides = 2 x Rp. 5.421,- = Rp. 10.842,-
The total cost for 1m² red brick construction is Rp 99.162,- (exclude manpower).

D. The time takes in red brick construction
Table 2. Time works for red brick wall.

| No. | Description                  | Unit | Time (minute) |
|-----|------------------------------|------|---------------|
| 1.  | Installation and work of red brick species | m²   | 26            |
| 2.  | Plasterwork (2 sides)        | m²   | 20            |
| 3.  | Plaster finished (2 sides)   | m²   | 6             |

Total 52 minute/m²

The total time for the red brick 1m² constructions is 52 minutes (the time outside the drying period as well as the plasterwork and cement covered 2 sides).

Lightweight concrete was first developed in Sweden in 1923 as an alternative building material to reduce deforestation. This lightweight concrete was later developed again by Joseph Hebel in Germany in 1943. In Indonesia alone lightweight concrete began to be known since 1995, when the establishment of PT. Hebel Indonesia in Karawang Timur, West Java. The mixture consists of quartz sand, cement, lime, a bit of gypsum, water, and aluminum pasta as developer ingredients (chemical air fillers). After the mixture is fully mixed, it will expand for 7-8 hours.

Aluminum paste used in dough in addition to functioning as a developer also plays a role in influencing the hardness of concrete. The volume of aluminum paste ranges from 5-8% of the dough made, depending on the desired density. This aerated concrete dough is then cut to size.

The aerated concrete mixture that is still raw is then put into an autoclave chamber which is given steam and high pressure. The temperature in the autoclave chamber is about 183 degrees Celsius. This is done as a drying or ripening process. When mixing quartz sand, cement, lime, water, and aluminum paste then a chemical reaction occurs. The aluminum powder reacts with calcium hydroxide which is in quartz sand and water to form hydrogen. This hydrogen gas forms air bubbles in the concrete mixture. These air bubbles make the volume twice as large as the original volume. At the end of the development or foaming process, the hydrogen will be released into the atmosphere and immediately replaced by air. These air cavities are formed which make this concrete light [4].

Light brick is quite light, smooth, and has a good level of flatness so that it can be directly given an aci without having to be plastered first. The ingredients for pickles usually use instant cement or special cement. This cement is made from silica sand, cement, filler, and additives. The use is only mixed with water, but can also use materials such as brick making. Light brick has a size of 60 cm x 20 cm with a thickness 10 cm.

Here is the cost and time calculation required in light brick construction:

A. Light bricks material:
   Material usage per m² for light brick = 1 m²: (0.6m x 0.1m x 0.2m) = 7.8 light brick
   1 piece light = Rp. 9,500,-
   Cost of light bricks per m² = 8 x Rp. 9,500,- = Rp. 76,000,-

B. Inner plasterwork:
   1 sack of light brick cement = 40 kg (MU 380), and the price Rp. 85,000,-/sack.
   1 sack of light brick cement MU 380 with thickness 3mm can use for±10 m² light brick wall
   1 m² light brick wall use = 1/10 sack cement.
   Price for 1 m² light brick wall cement = 1/10 x Rp. 90,000,- = Rp. 8,500,-.
C. Outer plasterwork & plaster finished:  
1 sack of light brick cement = 40 kg (MU 380), and the price = Rp. 85.000,-/sack.  
1 sack of light brick cement with thickness 1cm can use for ±4 m² light brick wall  
1 m² light brick wall use = 1/4 sack.  
Price for 1 m² outer plasterwork with 2 sides = 2 x 1/4 x Rp. 85.000,- = Rp. 42.500,-.  
1 sack of light brick cement with thickness 1,5mm can use for plaster finished ± 20m² light brick wall.  
Price for 1 m² plaster finished with 2 sides = 2 x 1/20 x Rp. 85.000,- = Rp. 8.500,-.  
The total cost for 1 m² light brick construction is Rp 76.000,- + Rp. 8.500,- + Rp. 42.500,- + Rp. 8.500,- = Rp. 135.000,- (exclude manpower).

D. Here is the time takes in red brick construction:

Table 3. Time works for light brick walls.

| No. | Description                        | Unit | Time (Minute) |
|-----|-----------------------------------|------|---------------|
| 1.  | Installation and work of Light Brick Species | m²   | 9             |
| 2.  | Plasterwork (2 sides)              | m²   | 20            |
| 3.  | Plaster finished (2 sides)         | m²   | 6             |
|     | Total                              |      | 35 minutes/m² |

Time for installation 1m² red brick is 35 minutes (time out of drying period and 2-sided plastering and plasterwork work).

Comparison result of cost analysis and wall construction time between red brick wall and light brick wall:

Table 4. Comparison of the cost of red brick wall and light brick wall per m².

| Type of Material | Red brick/m² | Light brick/m² |
|------------------|--------------|----------------|
| Red brick        | 36.000,-     | 76.000,-       |
| Plasterwork      | 26.160,-     | 8.500,-        |
| Plaster work (2 sides) | 26.160,- | 42.500,- |
| Plaster finished (2 sides) | 10.842,- | 8.500,- |
| Total            | Rp 99.162,-  | Rp 135.000,-   |

In conclusion red brick wall construction method is cheaper than the method of light brick wall construction with price difference Rp 35.838,-/m². In conclusion, the method of light brick wall construction is faster than red brick wall construction method with time difference 17 minutes/m².

Table 5. Time comparison of red brick walls and light brick per m²

| Type of material                  | Red brick (minute/m²) | Light brick (minute/m²) |
|-----------------------------------|-----------------------|-------------------------|
| Time for installation and plasterwork | 26                    | 9                       |
| Plastering (2 sides)              | 20                    | 20                      |
| Plasterwork (2 side)              | 6                     | 6                       |
| Total                             | 52 minutes/m²         | 35 minutes/m²           |
4. Conclusion

Based on the background of this research problem which aims to know the cost and time of implementation and comparison of the use of brick wall method and light brick wall for wall construction, it can be drawn the following conclusion by replacing the construction of light brick wall method wall into red brick method, wall construction becomes 1.17x times (17%). For the execution time, the brick wall method was 1.49 times faster (49% faster) than the brick red brick method. This is due to the material costs incurred for the more expensive light brick wall method and the larger light brick dimensions so that the processing time is faster.

References

[1] Evan H 2012 Perbandingan Produktivitas Pekerjaan Pasangan Dinding Bata Ringan Dan Bata Merah Pada Proyek Perumahan Di Surabaya (Surabaya: Universitas Kristen Petra)

[2] Susant, G 2007 Dinding (Jakarta: Penebar Swadaya)

[3] Kontruksi 2009 Material: Batu Bata Versus AAC Block (Bata Ringan) (Jakarta)

[4] Corinaldesi V 2009 Behaviour of cementitious mortars containing different kinds of recycled aggregate Construction and Building Materials 23