COMPARATIVE ANALYSIS OF THE WEIGHT AND COSTS OF BUILDING A LIVING HOUSE USING CONVENTIONAL AND FERROCEMENT METHODS IN THE CITY OF PALANGKA RAYA

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ABSTRACT

One of the latest engineering innovations, namely the ferrocement method for housing, supports the implementation of the Extreme Poverty Alleviation Program under the leadership of the President of the Republic of Indonesia. This is realized through Presidential Instruction Number 4 of 2022 which emphasizes the importance of the Ministry of Public Works and Public Housing in accelerating the eradication of extreme poverty. One step is to repair uninhabitable into habitable houses, utilizing ferrocement technology to meet structural resilience indicators in improving housing quality. This research aims to measure the weight of the house and analyze the difference cost of a livable house using the conventional method and the type 45 ferrocement method. The research was carried out from January to August 2023. The research location is in Palangka Raya City. The descriptive analysis will be used to determine the weight of the house and the planned budget for the cost of a habitable house using conventional and the ferrocement method. The results are that the weight of a type 45 habitable house using the conventional method is 87,220.56 kg and the weight of a type 45 habitable house using the ferrocement method is 82,306.52 kg. This shows a weight difference of 5,897.03 kg or 6 % and the cost of a type 45 habitable house using the conventional method is IDR. 322,696,812.10 and the cost of a habitable house type 45 using the ferrocement method is Rp. 272,539,766.29 shows a cost difference of Rp. 50,157,045.81 or amount 16 %.

Keywords: Budget Plan, Conventional, Ferrocement, House Weight, Livable House.

1. INTRODUCTION

Extreme poverty still occurs in Indonesia. [1] stated that the issue of housing suitability is related to poverty. The President of the Unitary State of the Republic of Indonesia, Mr. Joko Widodo, announced through Presidential Instruction Number 4 of 2022 concerning the Acceleration of the Alleviation of Extreme Poverty that the Ministry of Public Works and Public Housing must provide support in accelerating the eradication of extreme poverty, including repairing Uninhabitable Houses (RTLH) into Decent Houses Occupy (RLH).

UU No. 12011 concerning Housing and Settlement Areas Article 24 letter A regulates that habitable houses must meet building safety and occupant health standards as well as minimum building area requirements. It will then be updated according to Circular Number: 3/SE/Dr/2021 which outlines the four indicators that must be met for a house to be considered habitable. These indicators include: adequacy of minimum living space, strong building structure resilience, adequate sanitation facilities for residents, and the availability of safe drinking water for

residents. The minimum living space requirement, based on the minimum mobility space per person for comfortable living according to Indonesian standards, is calculated at 9 m² with a minimum building height of 2.8 meters, ventilation 5% of the room area, and lighting 10% of the room area. The strength of a building's structure includes meeting standards for structural components and the quality of non-structural building components. Structural components include roof frames, ring beams, columns, beams and foundations. The quality of structural components includes size, building materials or mixture thereof, and the relationship between structural components. Non-structural building components include roof coverings, window panels, door panels, frames, walls and floors. Sanitation facilities should be located inside the house, within easy reach, or in the yard, with disposal facilities that meet the needs of all family members. The availability of safe drinking water includes meeting the need for drinking water that is not contaminated which could endanger health, and ensuring that water sources are easy to reach both in terms of time and distance.

According to Sari and Oetomo Conventional houses are residential buildings that still use red brick for the walls and concrete for the columns, beams, cantilever plates, and the roof frame uses wood [2]. On the other hand, innovative houses using the ferrocement method have several advantages. The ingredients that make up ferrocement are easy to obtain, and the ferrocement structure is easy to apply. In addition, ferrocement is thinner and lighter, making it suitable for fabrication because of its light weight. This also leads to material savings in the casting process, and if damage occurs, repairs can be easily carried out [3].

According to him Helmi the application of ferrocement technology in Indonesia continues to be developed for various types of construction [4]. Initially used in coastal buildings, after 1978 its development expanded to irrigation, mosque domes, prefabricated buildings, monumental buildings and prefabricated houses. If defined simply, ferrocement is a thin reinforced concrete wall made of wire mesh, sand, water and cement. Ferrocement is different from reinforced concrete. Physically thinner, the reinforcement is distributed throughout its thickness, and is reinforced in two directions. Ferrocement is weak against very high temperatures, but has relatively high resistance to impact forces [5].

The Plan Budget represents the anticipated costs, including labor and material costs, in a construction project. This list includes quantities, unit prices, and total costs based on various types of materials and labor costs expected for the implementation of a construction project.[6]

This research aims to determine the difference in weight and analyze differences in the cost of ferrocement method houses in Palangka Raya City and was carried out because studies of livable houses using the ferrocement method in Central Kalimantan have never been carried out on 1st floor houses in Palangka Raya City using Unit Price Analysis in 2022. The unit price is based on the 2022 Palangka Raya City Price Base.

This research was carried out by calculating the weight of the house and analyzing the cost difference between the conventional method and ferrocement, which is outlined in the book "Building an Earthquake Resistant House with Ferrocement Layers" [7]. Calculation of the weight of a habitable house is carried out using the method of the Indonesian Loading Regulations for Buildings-1983 (Indonesian Loading Regulations for Buildings-1983) to obtain the weight of a type 45 house.

2.THEORY AND METHODS

1.2 Methods

The livable house in this research was carried out from January 2023 to August 2023. The research location was in a type 45, 1st floor house in Palangka Raya City. prepared in CIRCULAR LETTER Number: 3/SE/Dr/2021 with the criteria of meeting 4 indicators which include, adequacy of residential land, durability of building structures, adequate sanitation facilities and availability of adequate drinking water.

1. Adequate living space
   Area per person = 4 people x 9 m^2
   calculated = 36 m^2
   AC = 45 x 5%
   = 2.25 m^2
   Description = 45 x 10%
   = 4.5 m^2

2. Resilience of building structures
   Standard components for the durability of ferrocement house structures do not use reinforcement in the office, ring beam, column and sloof sections.

3. Adequate sanitation facilities
   Adequate sanitation facilities include toilets, toilets, septic tanks, sewerage and a good wastewater disposal system.

4. Availability of proper drinking water
   Fulfillment The availability of drinking water that is easily accessible both over time and distance is part of the availability of sufficient drinking water.

The method of making ferrocement building structures is different from reinforced concrete, it is very easy to repair, does not require special skills, and the construction costs for its application are cheaper because ferrocement materials are easier to find compared to reinforced concrete, wood and composite materials. The ferrocement method in the structural parts is replaced using ram-ram wire, the placement of the ram-ram wire can be seen in the picture below:

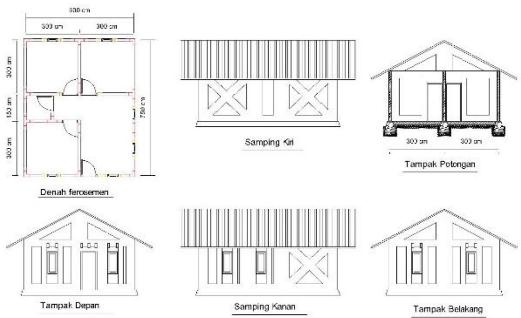

Figure 1. Ferrosement House Plans

1. Sloof

Calculation of the cost of the sloof structure uses the price resulting from the unit price analysis of work that was in effect at the time of planning. The known amount of work is then multiplied by the weight per square meter and the reference price.

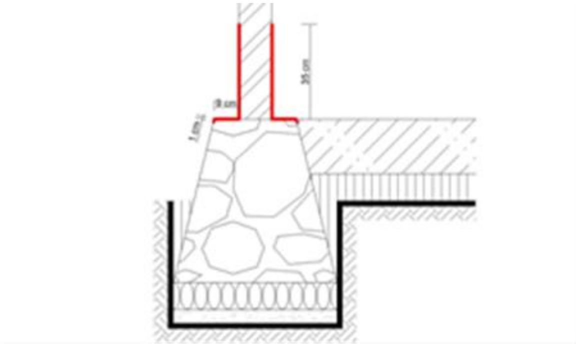

Figure 2. Sloof

Width = Sloof length x Sloof width
= 25.35 x 0.9
= 22.82 m ^{2}

2. Column

Calculation of column structure costs uses prices resulting from analysis of work unit prices in effect at the time of planning. The known amount of work is then multiplied by the weight per square meter and the reference price .

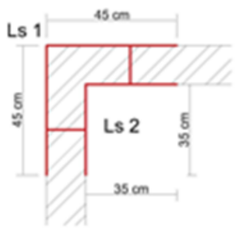

Figure 3. Column Type 1

Ls 1 = Column length x Column width
= 2.8 x 0.9
= 2.52 m ^{2}
Ls 2 = Column length x Column width
= 2.8 x 0.7
= 1.96 m ^{2}
Ls Type 1 = (Ls 1+Ls 2)x amount
= (2.52+1.96)x 5
= 22.40 m ^{2}

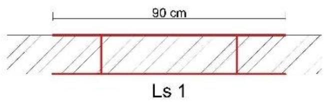

Figure 4 . Column Type 2

Ls 1 = Column length x Column width
= 2.8 x 0.9
= 2.52 m ^{2}
Ls 2 = Column length x Column width
= 2.8 x 0.9
= 2.52 m ^{2}
Ls Type 2 = (Ls 1+Ls 2) x amount
= (2.52+2.52) x 3
= 15.12 m^{2}

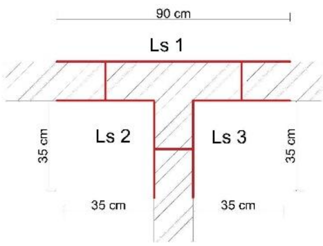

Figure 5. Column Type 3

L s 1 = Column length x Column width
= 2.8 x 0.9
= 2.52 m^2
Ls 2 = Column length x Column width
= 2.8 x 0.7
= 2.13 m^2
Ls 3 = Column length x Column width
= 2.8 x 0.7
= 2.13 m^2
Ls Type 3 = (Ls 1+Ls 2+Ls 3) x amount
= (2.52+2.13+2.13) x 5
= 33.90 m^2

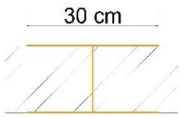

Figure 6. Column Type 4

Ls 1 = Column length x Column width
= 0.3 x 0.9
= 0.84 m^2
Ls 2 = Column length x Column width
= 0.3 x 0.9
= 0.84 m^2
Ls Type 4 = (Ls 1+Ls 2) x amount
= (0.84+0.84) x 14
= 23.52 m^2

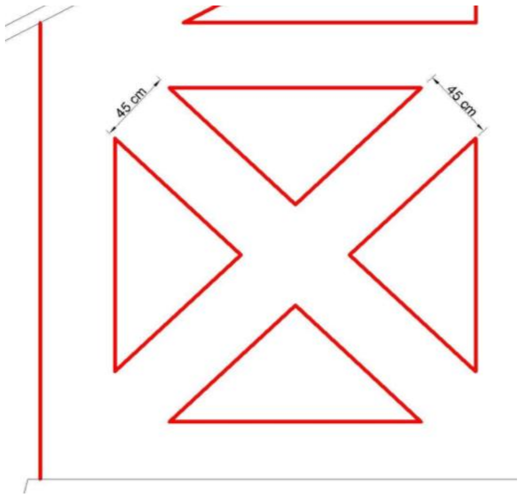

Figure 7. Diagonal Column

Ls 1 = Column length x Column width
= 3.67 x 0.9
= 3.3 m^2
Ls 2 = Column length x Column width
= 3.67 x 0.9
= 3.3 m^2
Ls x = (Ls 1+Ls 2)x amount
= (3.3+3.3)x 5
= 33.03 m^2

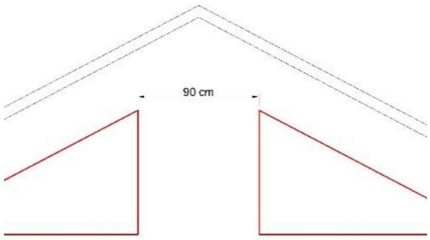

Figure 8. Middle part of the easel

Ls 1 = Column length x Column width
= 0.92 x 0.9
= 0.84 m^2
Ls 2 = Column length x Column width
= 0.92 x 0.9
= 0.84 m^2
Ls = (Ls 1+Ls 2)x amount
= (0.84+0.84)x 3
= 4.97 m^2

Total area= Type 1 + Type 2 + Type 3 + Type 4 + x + Ls
= 22.40 m^2 + 15.12 m^2 + 33.90 m^2 + 23.52 m^2 + 33.03 m^2 + 4.97 m^2
= 132.94 m^2

3. Ring beam

Calculation of the cost of the ring beam structure uses the price resulting from the unit price analysis of work that was in effect at the time of planning. The known amount of work is then multiplied by the weight per square meter and the reference price.

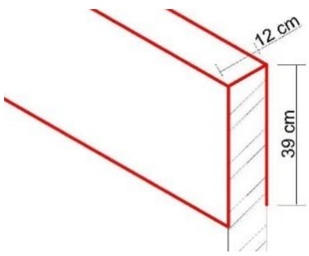

Figure 9. Beam Ring

Area = Ringblock Length x Ringblock Width
= 24.46 x 0.9
= 22.01 m^2

4. Sofi-sofi

Calculation of the cost of the Sofi-sofi structure uses the price resulting from the unit price analysis of work that was in effect at the time of planning. The known amount of work is then multiplied by the weight per square meter and the reference price.

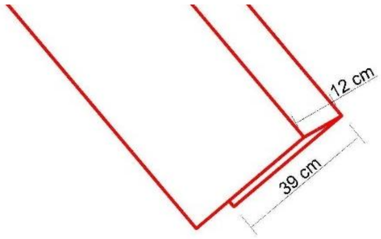

Figure 10. Sofi-Sofi

Area = Length of Sofi-sofi x Width of Sofi-sofi
= 24.46 x 0.9
= 22.01 m ^{2}

2. RESULTS AND DISCUSSION

The weight ratio required for a conventional method house is 87,220.56 kg, while for a ferrocement method house it is 82,306.52 kg with a difference of 4,914.04 kg or 6%. The results of this comparison will show the weight of the building work which has differences in weight which can be seen in the explanation in the table below:

Table 2. House Weight Comparison

Component type	Conventional	Ferrocement
Column	2,577.6 Kg	2,831.62 Kg
Sloof	3,109.68 Kg	486.06 Kg
Beam Ring	3,109.68 Kg	566.58 Kg
Sofi-Sofi	408 Kg	399.16 Kg
Roof truss	3,465.6 Kg	3,465.6 Kg
Base	17,617.5 Kg	17,625 Kg
Sand	2,088 Kg	2,088 Kg
Floor	7,002 Kgs	7,002 Kgs
Wall	47,842.5 Kg	47,842.5 Kg
Total	87,220.56 Kg	82,306.52 Kg

In determining costs using Unit Price Analysis, the unit price of materials, unit price of labor, and unit price of equipment must first be known and then multiplied by the coefficient specified in AHSP.

The AHSP formulation is as follows:

1. Wage Costs = (wage unit price) x (wage analysis coefficient)
2. Material Cost = (material unit price) x (material analysis coefficient)
3. Equipment Cost = (equipment unit price) x (tool analysis coefficient)

The cost comparison is obtained from the cost budget plan, namely by comparing the difference in the cost of making a habitable house using conventional methods worth IDR 322,696,812.10 and ferrocement worth IDR 272.539,766.29 with a difference of IDR 50,157,045.81 or 16%. This comparison will reveal differences in construction costs for various jobs which you can see in detail in the table below:

Table 3. Home Cost Comparison

Work	Conventional	Ferrocement
Preparation	IDR 3,881,710.00	IDR 3,881,710.00
Land	IDR 2,298,696.19	IDR 2,298,696.19
Foundation	IDR 10,607,240.97	IDR 10,607,240.97
Structure	IDR 45,333,530.63	IDR 18,884,422.22
Wall	IDR 95,681,791.20	IDR 71,973,853.80
Door frame	IDR 15,727,387.45	IDR 15,727,387.45
Roof	IDR 39,784,733.69	IDR 39,784,733.69
Floor	IDR 25,288,308.83	IDR 25,288,308.83
Palate	IDR 12,105,385.88	IDR 12,105,385.88
Bathroom	IDR 10,011,691.85	IDR 10,011,691.85
Electricity	IDR 1,190,152.21	IDR 1,190,152.21
Painting	IDR 22,095,060.70	IDR 22,095,060.70
Dirt tank	IDR 20,172,373.51	IDR 20,172,373.51
Water tower	IDR 18,518,748.99	IDR 18,518,748.99
Total	IDR 322,696,812.10	IDR 272,539,766.29

3. CONCLUSIONS

From the research results, it can be suggested that a type 45 house with a design that meets habitable standards in terms of weight ratio, the conventional method house weighs 87,220.56 kg, while the ferrocement method house weighs 82,306.52 kg with a difference of 4,914.04 kg or 6% and the results of the comparison of conventional method house costs are IDR 322,696,812.10 and ferrocement is IDR 272.53 9766.29 with a difference of IDR 50,157,045.81 or 16%. By considering this, it can be said that the house built meets the criteria as a habitable residence. Ferrocement is easier to apply during implementation because it uses ram-ram wire which is widely available in the community.

4. ACKNOWLEDGEMENTS

I would like to thank the Directorate General of Housing of the Ministry of Public Housing and Public Housing, Self-Help, Public and Commercial Housing as a partner in the Certified Independent Study and Internship (MSIB) program and the Adventist Development and Relief Agency (ADRA) humanitarian program and organization which has provided job training for retrofit about ferrocement house.

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