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COMPARATIVE ANALYSIS OF COSTS AND TIMES OF RED BRICK AND LIGHT BRICK WORK ON THE MADRASAH MALLIMIN MUALLIMAT TAMBAK BERAS JOMBANG BUILDING PROJECT

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Abstract

The problem in implementing the construction of the Madrasah Muallimin Muallimat Tambak Beras Jombang Building is that the available funds and time are limited. The approach regarding the material needed for this building work is light brick compared to other work items. In wall masonry work using light brick/hebel, it is necessary to analyze whether the work time can be faster and whether the price comparison obtained is cheaper. The research method used is Value Engineering analysis to produce cost savings. The results of this research include: a) Based on the results of cost and time analysis for wall items, namely by proposing alternative materials as replacements for the initial materials, resulting in cost savings of Rp. 28,298,995.61, and b) When compared with productivity, a builder is able to complete a red brick wall in 133 days, whereas with light brick wall material a builder is able to complete the work in 66 days. So, in terms of work speed, lightweight bricks are faster than red brick walls.

Keywords: *Funds And Time, Projects Saving, Value Engineering*

1. INTRODUCTION

Provisions or requirements related to buildings and facilities in detail include conditions; qualification; environmental monitoring; floor condition; walls and fittings; division of work areas; and cleaning actions refer to meeting the quality management system for school buildings (Abdullah 2018). To obtain the quality of madrasah buildings according to applicable standards and guidelines, the construction of school buildings must take into account space requirements, size of space, quantitative and qualitative requirements for space as well as accessibility and circulation between spaces. It is hoped that the development carried out will be able to accommodate learning process activities that are supported by comfortable space, accessibility and adequate space circulation.

When constructing a building, the Planned Cost Budget (RAB) is calculated after building construction calculations. This is related to the selection of designs and materials used in planning the construction of the building (Rusman 2017). Budget Plan Building project costs are prepared as optimally and efficiently as possible with quality and quality that remains guaranteed. Multi-storey building construction consists of an upper structure and a lower structure. The wall element is part of the room divider. Some building elements have large costs, but these elements can still be optimized by making them more efficient.

In the budget for a project that has a large value, there are several work segments whose work costs have a large influence on the overall project cost. Costs for these work

segments are influenced by several aspects, including looking at materials, work methods, number of workers, implementation time and so on (Hidayat and Ardianto 2011).

The selected work item for the construction of the Madrasah Muallimin Muallimat Tambakberas Jombang building is wall masonry with light brick/hebel material. From a technical perspective, the availability of materials for wall masonry work in current developments is more than 1 material, including concrete panels (which are only used for large volumes, for example the construction of multi-storey apartments and other high-rise buildings), red brick, light brick and partitions (use for interior work). With this, the approach regarding the material needed for this building work is light brick compared to other work items (Witjaksana, B., Oetomo, W., & Toha 2018). In wall masonry work using light brick/hebel, it is necessary to analyze whether the work time can be faster and whether the price comparison obtained is cheaper (Jumroh 2018).

The problem in implementing the construction of the Madrasah Muallimin Muallimat Tambak Beras Jombang Building is that the available funds and time are limited. From the results of this value engineering research, it is hoped that if the work items match the initial design after changes have been made to alternative designs, they will be more efficient in terms of cost planning and time allocation required.

2. LITERATURE REVIEW

2.1. Understanding Value Engineering

In general, the meaning of value engineering is a technique that uses an approach by analyzing the value of its function. The process taken is to emphasize reducing costs as far as possible while maintaining the desired quality and reliability.

2.2. Key Elements of Value Engineering

Value Engineering has several capabilities that can be used as a tool for Value Analysis. (Ahmed and Pandey 2016) These capabilities are known as the main elements of Value Engineering, the main elements are as follows:

1) Selection of projects for Value Engineering Study
2) Pricing for Value
3) Life Cycle Costing (The Life Cycle Costing)
4) Functional Approach (The Functional Approach)
5) Functional Analysis System Technique (FAST)
6) Value Engineering Work Plan
7) Creativity
8) Establish and maintain Value Engineering
9) Human Dynamics (habits, barriers, and attitudes)
10) Relationship between Assignee, Planning Consultant, and Value Engineering Consultant.

Each of the elements above is used in the Value Engineering Study or these elements need to be directed when leading the Value Engineering Study for a project.

2.3. Wall

A wall is a solid structure that limits and sometimes protects an area. Generally, walls limit a building and support other structures, limit the space within a building into rooms, or protect or limit a space in the open air. The three main types of structural walls are building walls, boundary walls and retaining walls. The wall structure is one of the building elements that functions to separate and form rooms. Technology presents new functions for walls and presents various types of finishes (Day 2012).

3. RESEARCH METHODS

3.1. Research Object

The object taken in this research is the Madrasah Muallimin Muallimat Tambak Beras Jombang Building Construction Project (Sesaria 2013). The application of value engineering is specifically for wall installation work at the Madrasah Muallimin Muallimat Tambak Beras Jombang Building.

3.2. Research data

The data used in the research is grouped into 2, namely:

a) Primary data

Primary data is the main data used in conducting Value Engineering analysis. Primary data can be technical data from the project, such as drawings, Cost Budget Plan (RAB).

b) Secondary Data

Secondary data is supporting data that can be used as input and reference in carrying out Value Engineering analysis. According to the Big Indonesian Dictionary (KBBI), secondary data is data obtained by a researcher not directly from the object, but through other sources, both oral and written. Secondary data is a collection of information that previously existed and is used to complement research data needs. Secondary data, including data regarding unit price lists and labor analysis, data on materials or building materials used, labor data, building regulations from the Department of Public Works and other data that can be used as a reference in analyzing Value Engineering (Berawi et al. 2011).

3.3. Data Collection Methods

Data collection can be done by:

a. Primary Data Collection Method is a method by conducting a direct survey on consultants and implementers handling the project. Apart from that, researchers also made direct observations.
b. Secondary Data Collection Method is a method by conducting direct surveys on agencies or companies that are considered interested. These companies can include building materials companies, consultants, contractors, labor contractors, agencies that handle building services and construction issues and other companies that can be used as reference material.

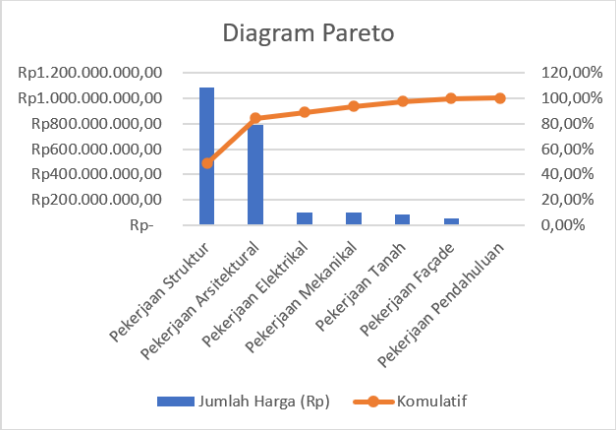
3.4. Data Analysis

From the data that has been collected, a Value Engineering analysis is carried out to produce cost savings (Atabay and Galipogullari 2013).

4. RESULTS AND DISCUSSION

4.1. Cost and Time Analysis of Walls

Working walls are building bodies that have a very important role in a residence. Not only does it function as a space divider, but the wall also provides privacy to residents and provides comfort and beauty. The general function of walls is: a) As a barrier to wind, light and water, b) As a separator between rooms that have different functions, and c) As a barrier to noise. The following is the Pareto diagram of the wall work analysis:



Source: Author's analysis

Figure 1. Pareto diagram

Wall work is the main work with a cost of 80% of the total work items.

4.1.1. Information Stage

Table 1. General Information and Design Criteria for Existing Walls

No	Description	Data Project Technical
1	KDesign criteria	½ 1Pc red brick: 4PP
2	Vtotal volume of brick masonry	663.21 m^2
3	PeCost estimates Pework	Paagainst a brick wall = 663.21 m^2 x Rp. 147,169.74 = Rp. 97,604,440.61

Source: Researcher Processed Data (2023)

4.1.2. Innovation Stage

At this stage, we propose alternative designs to replace bricks using hebel/light bricks. Light brick/hebel has a lighter weight and a smoother surface. The size of the lightweight brick is 60 cm x 20 cm with a thickness of 8-10 cm.

Calculation of light brick walls for 1m2 as follows:
Instant cement = 0.105 sacks
Light bricks = 8 pieces
Water = 0.15-0.16 liters

Table 2. Advantages and disadvantages of lightweight brick/hebel

Excess	Tolack
1) Installation time is relatively faster 2) The stiffening concrete frame is wider, between 9-12 m2 3) Has water-resistant properties so there is very little chance of water seepage 4) Lightweight, fireproof, and	1) Because it is a new type, not all builders have ever installed lightweight bricks 2) Still rarely found in small building materials shops and only sold in quantities of 1m3

Source: Researcher analysis data (2023)

4.1.3. Analysis Stage

Next, the analysis stage is carried out after the innovation stage. At this stage, an analysis of the calculations for light brick/hebel masonry work will be carried out, to determine recommendations for the next stage.

The cost analysis method used is cost analysis using the SNI method. The basic regulations used are SNI 2008 which has been modified and adapted to conditions in the field for material coefficients. Meanwhile, the work coefficient is the same. The basis for calculating the SNI method is to first find the unit price of each job by multiplying the coefficient by the unit price of the materials/workers' wages used. After obtaining the unit price for each job, we can find/calculate the required budget plan or what is often called the Bill of Quantity (BQ) by multiplying the unit price for each job by the total volume for each job on the project. The following is an analysis of the cost calculation for walls using light brick/hebel masonry:

a. Calculation of light bricks per m²:

The size of the light bricks used is 60 cm x 20 cm x 7.5 cm. In 1 m² with 3 mm specs there are:

$$\frac{10{,}000\ cm^2}{(60cm + 0.3cm) \times (20cm + 0.3cm)} = 8.16 \text{ light bricks}$$

From the calculation above, we get 8.16 light bricks to make a wall pair which is equivalent to the size of a ½ brick wall.

b. Calculation of cost requirements for every 1 m²:

Wall Area

The total wall area minus doors and windows
Main Building 1st Floor Wall Area = 315.41 m2
Main Building 2nd Floor Wall Area = 347.80 m2
Total Wall Area = 663.21 m2

c. Wall price estimate

Total price of walls with light brick:
= (663.21 m2 x IDR 104,500)
= Rp. 69,305,445.00

4.1.4. Implementation Stage

The cost of the existing wall is Rp. 97,604,440.61 while the cost of wall work with an alternative replacement for hebel is Rp. 69,305,445.00 so the total savings on wall work is Rp. 28,298,995.61.

Table 3. Wall Work Savings

No	Work	Volume	Unit	Duration (Day)
1	Red Brick Wall Pair	663.21	m2	132,642
2	Light Brick Wall Pair	663.21	m2	66,321

Source: Researcher analysis data (2023)

Based on this table, it can be concluded that a craftsman is able to complete a red brick wall in 133 days. Meanwhile, the duration of light brick wall installation work for 1 craftsman is 66 days. So, the duration of light brick masonry is faster than red brick masonry.

a) Cost Savings

By using starting materials, the total cost of wall work is Rp. 97,604,440.61 and if you use alternative materials using lightweight brick/hebel then the total cost of wall work is Rp. 69,305,445.00. There is a difference in cost savings when using alternative materials, namely IDR. 28,298,995.61.

b) Time Savings

By using alternative materials, the implementation time will be faster than using the initial material because the material is light and practical, making the work easier. When compared with productivity, a builder can complete a red brick wall in 133 days. Meanwhile, the duration of light brick masonry work for 1 mason is 66 days. So, in terms of work speed, lightweight bricks are faster than red brick walls. If a construction project experiences a time crunch, then using lightweight bricks can potentially save overall project costs. So, judging from the time effectiveness of alternative materials, alternative materials are more effective.

There are several other points of view that can be outlined in the table as follows:

Table 4. Comparison of Red Brick Work with Light Brick Work

No	Description	Initial Wall Work	Alternative Wall work
1	Time Implementation	Long, takes 133 days/person (craftsman)	Faster, takes 66 days/person (craftsman)
2	Financing	It is quite expensive because it requires quite a lot of bricks per m2, namely 70 pieces/m2	It's cheaper because it only requires 8 pieces of furniture per 1m2 and the process is relatively fast and practical
3	Availability of materials	Requires free space to move around	Doesn't require a lot of free movement space
4	Supervision Criteria and control	Relationf difficult because there are many workers and need more supervision	It's relatively easy because installing the hebel is faster and doesn't require too many workers
5	Labor	Lots	Less because of the ease and lightness of the material used

Source: Researcher Processed Data (2023)

5. CONCLUSION

From the results of the comparative analysis of costs and time for the construction of madrasah buildings above, several conclusions can be drawn:

a. Based on the results of cost and time analysis for wall items, namely by proposing alternative materials as replacements for the initial materials, resulting in cost savings of Rp.28,298,995.61.
b. When compared with productivity, a builder can complete a red brick wall in 133 days, whereas with light brick wall material a builder can complete the work in 66 days. So, in terms of work speed, lightweight bricks are faster than red brick walls

Based on the author's analysis, what should be done in relation to value engineering efforts to construct a building with an optimization theme is that there needs to be integrated coordination between Value Engineering specialists, Project Owners and Planners who examine in depth and comprehensively all the requirements so that the Value Engineering effort can be done well and perfectly.

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