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ANALYSIS OF THE VALUE OF ENGINEERING COST AND TIME OF REPLACEMENT OF RED BRICK WITH LIGHT BRICK ON PROJECT BUILDING CONSTRUCTION OF BLOOD TRANSFUSION UNIT IN PASURUAN

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ABSTRACT

The problem in the development of the blood transfusion Unit of Pasuruan building is the cost and time available are limited so the need to do value engineering. Value engineering is used to seek out alternatives or ideas aimed at generating a better or lower cost than the previously planned price with functional restrictions and job quality. So that the results of this value engineering research are expected, that if the work item is following the initial design after the change with an alternative design will be obtained more efficiently in terms of cost plan and time allocation required. The results of the analysis of engineering values for wall items by proposing alternative material instead of initial material, resulting in cost savings of Rp. 7.343.228,77,-from the initial cost. Value engineering can be applied at any time of the project, from the beginning to completion of the project development.

Keywords: *Building Construction Blood Transfusion Unit Pasuruan City, Value Engineering*

INTRODUCTION

Terms or conditions relating to buildings and facilities in detail include conditions; Qualification Environmental surveillance; Floor conditions; Walls and fittings; Division of work area; and cleaning measures refers to meeting the quality management system for the blood supply unit. To get the quality of building blood transfusion Unit according to the standard and the prevailing guidelines, the construction of the building blood transfusion Unit should take into account the needs of space, space, quantitative requirements and qualitative space as well as Accessibility and circulation between spaces. The development is expected to be able to provide the activities of blood transfusions

supported by the comfort of space, accessibility and the circulation of adequate space.

On the construction of a building, the budget plan is calculated after the calculation of building construction. It is related to the design selection and materials used in the construction planning of the building. Budget plan project building cost is structured as optimal and efficient as possible with the quality and quality that remains guaranteed. The construction of high-rise buildings consists of the upper structure and bottom structure. Wall elements are part of the room separator. In some elements building buildings, there are large costs, but the elements can still be optimized employing efficiency. The cost budget of a project that has a large value there is several job segments whose workmanship costs have a big influence on the overall project cost. The cost of the work segments is influenced by several aspects, among others, in terms of materials, how it works, the number of workers, the time of implementation and others.

The large aspect of financing is the center of attention to re-analyze to seek savings. This brings together many alternatives that are used as the basis of thinking to conduct a study that does not correct the mistakes made by the planner or corrects the calculations but more leads to the cost savings that will be gained from modifications to the part of the building elements. Therefore, it is necessary to have a value engineering for costs and unnecessary or unsupportive efforts to be eliminated so that the project's value or costs may be reduced.

In the selected work item to Rekasaya value on the construction of the building of blood transfusion Unit Pasuruan City is a wall pair with light brick or Hebel material, in terms of technical availability of wall pair work material in the current development there are more than 1 material, among them are concrete panels (which are only used for large volumes, for example, the construction of terraced apartments and other tall buildings), red brick, light brick and partitions (use of interior work). With this approach related materials needed in the work of this building is a light brick compared with other job items, on the job of the wall pair using light brick or Hebel is assessed to have a fairly fast working time and has a cheaper price comparison.

The problem in the development of the blood transfusion Unit of Pasuruan building is the cost and time available are limited so the need to do value engineering. Value engineering is used to seek out alternatives or ideas aimed at generating a better or lower cost than the previously planned price with functional restrictions and job quality. From the results of engineering research. This value is expected, that if the work item is based on the initial design after the change with the alternative design will be obtained more efficiently in terms of the cost plan and allocation of time required.

LITERATURE REVIEW

Value Engineering

The Indonesian government seeks to operate the efficiency Program, wanting the savings or efficiency to use the ever-increasing development costs. The Government's efforts to hold development cost savings include the application "value engineering and Analysis" is one tool that plays an important role in its efforts to achieve the efficiency of the use of reduced funds This.

Value engineering is a systematically organized business and applies a recognized technique, which is a technique identifying the function of a product or service that aims to fulfill the necessary functions at the lowest price (most Economical). (Imam Suharto, 1995 quoted from the Society Of American Value Engineers).

According to Donomartono (1999), value engineering is an evaluation method that analyzes the techniques and values of a project or product involving owners, planners, and experts who are experienced in their respective fields with the approach and creative aims to produce quality and possible costs, namely with the functional constraints and stages of the task plan that can identify and eliminate costs and efforts that are not required or not Support.

In addition to the definition of value engineering above, according to Zimmerman and Hart, the definition of value engineering is as follows:

1. System Oriented
2. Multidisciplinary Team Approach

3. Life Cycle Oriented
4. A Proven Management Technique
5. Function Oriented

Some of the things underlying value engineering are very important to understand by each project planner and implementers so that it can cause unnecessary costs to arise every project activity progresses, such as (1) Lack of time; (2) Lack of information; (3) Lack of idea; (4) Misconceptions; (5) Temporary circumstances that inadvertently become permanent; (6) Habits; (7) Attitude; (8) Politic; and (9) Fee.

According to Zimmerman and Hart, it says that engineering values do not have the following meanings: (1) A design Review; (2) A Cheapening Process; (3) Quality Control; and (4) A Requirement Done All Design

Key Elements Of Value Engineering

Value engineering has several capabilities that can be used as a tool for Value Analysis. That ability is known as the main elements of value engineering, as well as the main elements are as follows: (a) The selection of projects for the engineering value Study; (b) Pricing for Value; (c) Life cycle Costing; (d) The Functional Approach; (e) Functional Analysis System Technique (FAST); (d) Value engineering work plan; (f) Creativity; (g) Establish and maintain value engineering (h) Human Dynamics (habits, barriers, and attitudes); and (i) the relationship between a duty-giver, a planner consultant and a value engineering consultant.

According to Dr. Ir. S. Chandra (1987) in his book "Value Engineering Application & Analysis on planning and implementation to achieve the Efficiency Program", that study has proved where each design there is a cost item that is not needed, regardless However good the design team. It is not possible to bring all the details of the planning so much of a project to achieve the best functional balance between cost, appearance, reliability without the conduct of value engineering Review.

Causes Of Unnecessary

There are some reasons why unnecessary costs or poor value arises in the design. Project owners influence the value of a project, as they define the main criteria of the design, as they operate and control the facilities.

According to Dr. Ir. S. Chandra (1987) in his book "Value Engineering Application & Analysis on planning and implementation to achieve the Efficiency Program", the occurrence of unnecessary costs or less value, is generally caused by some things that the following: (1) lack of time; (2) lack of information; (3) lack of ideas; (4) Temporary state of being Permanent; (5) Misconceptions; (6) shortage of planning costs; (7) attitudes; (8) Politics; (9) Habitual Thinking; (10) Reluctance to seek Advice; and (11) Poor Human Relation.

Time to apply value engineering

The value engineering Program can be applied at any time of the project, from the beginning to completion of the project's construction. More practical if value engineering can be applied at a certain moment in the planning phase to achieve maximum results. Time is very important, in general, that the Value Engineering Program should start early at the concept stage and continued at intervals until the completion of the planning.

1. Planning stage

   Value engineering applications must be cultivated at the planning concept stage. Because at this time, we have the utmost flexibility to make changes without incurring costs for the redesign. With the development of the planning process, the cost to make changes will increase, until it finally reaches a point where there is no saving can be achieved. At this planning phase, the project owner establishes goals; Requirements; applicable criteria; and Designer.

2. Late Design Stage

   With planning progress from concept, programming, schematic, design development, final design, engineering value needs to

accompany this planning progress. At this stage, the results of the planning concept have been decided, shapes and sizes have been known which makes it possible to provide more thorough assurance in determining the costs of the system architecture and structures to be used.

3. Preconstruction-Construction Stage
   Engineering value analysis can be applied at the auction stage and the implementation stage. This can occur and is possible in situations: (1) When an item or system has been examined by the engineering value study in the previous stage, which requires further research before it is decided; (2) If there is a planning phase has not been held engineering value analysis, then the application of value engineering that implemented at this stage can provide the potential cost savings and the improvement of the enormous quality; and (3) If contractors examine a field of work that can be improved in quality and or lower its costs. This situation often arises when in the contract of the contractor or contracts there is an article engineering value Incentive Clause which contractors with the help of the engineering value Consultant will get the division of the savings that can be It generates (savings sharing).

Engineering grades at the planning stage

Applications of functional analysis are required in certain parts of the planning phase, starting with the criteria and continuing on the preliminary and final design. Results of the Value Engineering study provides continuous guidance on the planning team. It should be noted that the efforts of this kind of engineering value must be made by the personnel who are completely separate from the planning team. If in the company the planner does not have experts who understand value engineering, it needs to conduct training or get help from the value consultant.

At the end of this planning phase, planners are usually required to deliver a report on the overall saving effort. The costs paid for these activities are based on their business level, except for training, exceeding and above normal business and planning costs. Please be

aware that planning by providing this value engineering Program, usually requires an additional fee for the engineering value team, of course, this depends on the trust of the project owner that it will get better results by applying value engineering.

Engineering values at the implementation stage

Planners may also include a value engineering Incentive Clause in its prepared contract documents. This idea to provide benefits to the project owner from the experience of practice owned by the contractor and encouraged him with the help of the value engineering consultant to deliver the Value Engineering Change Proposals (VECPs) which will save cost without compromising and affecting both the scope of work and the quality of the project. As an incentive, contractors with the help of value engineering Consultants acquire 50% of the saving results it can produce. Planners should also understand that it performs complete control of the planning and should be in line with the proposed changes.

The Wall and The Function of Wall

The wall is a solid structure that restricts and sometimes protects an area. Generally, walls restrict a building and support other structures, limiting space in buildings to rooms, or protecting or restricting space in the outdoors. The three main types of structural walls are building, boundary, as well as retaining.

The walls of the building have several functions, namely supporting the roof and ceiling, dividing the room, and protecting it from the weather. The barrier wall includes a privacy wall, a boundary marker wall, and a city wall. These types of walls are sometimes difficult to distinguish from fences. Retaining Walls functions as a roadblock of land, rock, or water movements and can be either an external or internal part of a building. Judging by the value of comfort, health value, and safety value, the function of Wall among others: (1) as a separator between the rooms; (2) as a space separator that is personal, and is public; (3) As a restraint of light, wind, rain, flood, etc. sourced from nature; (4) as a barrier and retaining structure; (5) as a noise holder for space requiring certain sound thresholds such as

recording studios or broadcast studios; (6) As a restraint to radiation rays or certain substances such as radiological Chambers, operating chambers, laboratories, etc.; and (7) as a certain artistic function and depository of securities such as safes in banks and others.

Wall Materials

1. Redbrick

Redbrick is a material made of clay that is then burned. Bricks are probably the longest known material and until now it is still used as a wall filler material. Before the invention of the skeletal structure system, which relies on the power of beams and columns in favor of structural strength, bricks are used as materials to support wall structures (without poles and beams). Because the power of the supporting wall structure system rests on the cross-section of the wall, to obtain sufficient wall width, the bricks are arranged transversely with the length of the bricks on the width of the wall.

2. Light Brick Hebel

A light brick is a brick that has a type of weight lighter than the bricks in general. Light bricks are known to have 2 (two) types: Autoclaved Aerated Concrete (AAC) and Cellular lightweight Concrete (CLC). The difference of the AAC light brick with CLC in terms of the AAC drying process is subjected to drying in the high-pressure aeration oven While the light brick CLC undergoes the natural drying process. The light brick wall is a wall using aeration technology. The product was developed by Joseph Hebel in Germany in 1943 and became known in Indonesia in the year 1995.

The light brick or Hebel has a lighter weight which can reduce the loading of the structure underneath to save on the foundation. The lightweight brick is suitable for use in terraced buildings or buildings because it is very important to reduce costs. Hebel has a larger dimension of red brick that is 60cm x 20cm with a thickness of 7 to 10 cm, which makes the wall work faster than the red brick and in the installation process does not require a thick pair, but it is glued with a thin-thin instant or mortar only. The light brick or Hebel is

more flame resistant for approximately 4 hours because it has the capability of heat and sound insulation, so for special rooms requiring flame retardant or heat-resistant and sound, the use of Hebel will be more beneficial. For Hebel, the price of the material unit looks more expensive than bricks, but the use of cement, the time of execution, the burden to be borne structure, will be more efficient when using aerated concrete block (one brand Hebel). Execution time affects the wages of the repairman to be paid, and if it is faster it means that it will be more efficient in spending expenses.

3. Batako

Batako is a material made from a mixture of cement and coarse sand that is printed solid or depress. Besides, there is also making it from a mixture of lime and water. Even now also circulating bricks from cement, sand and coal mixture. With the creation material as mentioned, the brick has a weakness of strength is lower than red brick, so it tends to occur cracks, especially if the empty part is not filled with a spec. The use of brick materials for walls also makes the building warmer even tend to be lukewarm and hot, unlike the red brick made of soil material. Batako tends to be lighter than red brick. The size is larger than the bricks, so the number of needs is only fewer. Because the size is large then the installation is faster. The texture also looks smoother than the red brick.

4. The Panel Wall

The panel wall is a new method wall that uses Wiremesh and polystyrene as the main constituent which is then adopted with a special tool. This technology originated in Italy. Wall panels provide many advantages for the use of internal and external walls. With efficient installation (one group or 2 workers can install approximately 35 m2 per day) and save, wall panels provide greater space efficiency due to its thickness of only 7.5 cm. Available also thickness 10 cm, 12.5 cm, or according to a requirement (Hebel, 2014).

RESEARCH METHODS

The object taken in this research is the project for building construction of the Pasuruan City blood transfusions Unit in Pasuruan. The application of value engineering is specific to the work of the wall pair of Pasuruan City blood transfusion Unit.

Methods applied to the analysis of building values of the blood transfusion Unit of Pasuruan City is the analysis of the use of materials, dimensions, and costs that are applied to the operation of the computer as a tool without changing the quality and appearance A project. As well as value engineering analysis to find out how much it costs to cost-saving.

The data sources used in this study are primary data and secondary data. Primary data is the technical data of the project, such as images, a budget plan by conducting a direct survey of consultants and executors who handled the project. Secondary data, including data on unit price lists and employee analysis, data on materials or building materials used, labor data, building regulations from the Ministry of Public Works and other data that can be be used as references in analyzing value engineering.

The analytical techniques selected for analyzing data are value engineering analysis to generate saving costs. Analysis of value engineering conducted five stages, namely:

a. Information Stage

In the early stages, attempts to obtain information relevant to the study object will be evaluated, where the data and information are processed according to the needs at a later stage. In the process of further evaluation, the information data can be used as a collection of data needed and compiled in a description of the problem and objectives of your savings.

b. Creative Stage

In value engineering, creative thinking is very important in developing ideas to bring up alternatives of elements that still fulfill the function, and then be compiled systematically. These alternatives can be reviewed from various aspects, including (1) material or material; (2) Implementation method; and (3) Job

execution time. Each job in a project would already have a scheduled implementation in the planning schedule. Sometimes with a fixed weight of work, the job execution time can be reduced, as long as the work is not on a critical path. There are many ways to achieve this, including changing the method of implementation, increasing the number of workers and others. Thus, alternative implementation time reduction can be used as a guideline because it will affect the budget calculation of costs.

c. Phase Analysis

The objectives of this stage are:

1. Conduct an evaluation, file criticism and test alternatives that arise during speculative stages.
2. Estimate the value of money for each alternative.
3. Determine the alternatives that will provide the greatest capability for cost savings.

The formulated alternatives then eliminated the less practical ideas and assessed the creative ideas in terms of their gains and weaknesses by finding the cost-saving potential for each evaluated idea.

d. Recommendation Stage

Prepare recommendations that have been supplemented by the information and the calculation in writing from the chosen alternatives by considering the implementation technically and economically. In the recommendation phase, it can also contain recommended alternative proposals and basic considerations.

E. Serving Stage

If previously there is already preliminary design. Then the design alternatives are selected above compared to the initial design. Usually in terms of project costs.

The reason is the value engineering of the walls using light brick or Hebel because it has a lighter weight that can minimize the loading of the structure underneath to save on the foundation. The lightweight brick is suitable for use in terraced buildings or buildings because it is very important to reduce costs. Hebel has a larger dimension of red brick that is 60 cm x 20cm with a thickness of 7 to 10 cm, which makes

the wall work faster than the red brick and in the installation process does not require a thick pair.

The light brick or Hebel is more flame resistant for approximately 4 hours because it has the capability of heat and sound insulation, so for special rooms requiring flame retardant or heat-resistant and sound, the use of Hebel will be more beneficial.

For Hebel, the price of the material unit looks more expensive than bricks, but the use of cement, the time of execution, the burden to be borne structure, will be more efficient when using aerated concrete block. Execution time affects the wages of the repairman to be paid, and if it is faster it means that it will be more efficient in spending expenses.

RESULT AND DISCUSSION

Value engineering analysis on walls

Information on design criteria and Existing wall Material

The working wall is a building body that has a very important role in a dwelling. Not only serves as a barrier of space, but the wall also provides privacy to the residents and provides comfort and beauty.

Table 1. Information on Design Criteria and Existing Wall Material

No	Description	Project Technical Data
1	Design criteria	½ Redbrick 1Pc: 4PP
2	Total Volume of Bricks	1093.11 m^2
3	Employment cost estimates	Bricks Wall Couple Rp. 121.573.224.00,-

Innovation Stage

At this stage, propose alternative design as a substitute for brick using Hebel or light brick. The light brick or Hebel has a lighter weight and a smoother surface. The size of the light brick is 60 cm x 20 cm with a thickness of 8-10 cm. Calculation of light brick wall for 1m2 as follows:

Instant cement = 0.105 Sak
Light Brick = 8 pieces
Water = 0.15-0.16 liter

Table 2. Advantages And Disadvantages Of Light Brick Or Hebel

Advantages	Disadvantages
• Installation time is relatively faster • The concrete frame of the confessor wider, between 9-12 m^2 • Has water-resistant properties	• Because of the new types, not all builders ever put on a light brick • Still rarely found in small building

Analysis phase

At this stage will be analyzed calculation of light brick or Hebel pair work, as a determination of recommendation in the next stage. The cost Analysis method used is cost analysis using the SNI method. The basic regulation used is SNI 2008 which has been modified and adjusted to the condition in the field for its material coefficient. As for the same work coefficient.

The basic calculation of the SNI method is to look for the unit price of each job first by way of coefficient multiplied by the unit price of the worker or wage used. Once the unit price has been obtained each job we can find or calculate the required cost budget plan or which is often called the Bill of Quantity (BQ) by how to multiply the unit price of each job with the total volume for each work on the project.

Analysis of wall cost calculation with a pair of light brick or Hebel.

1. Estimate the work price of a light brick wall or Hebel.

   Specifications

   - Type : Block AAC
   - Length : + 600 mm
   - Width : + 200 mm
   - Height : + 750 mm
   - Per-piece price: Rp 750.000,00/m^3 (every 1m there are 111 pieces) or Rp. 6.756,75/Piece

   A) Calculation of light bricks per m2:

   The red brick size is 60 cm x 20 cm x 7.5 cm. In 1 m^2 with a spec of 3 mm:

$$\frac{10.000\ cm^2}{(60cm + 0,3cm)\ x\ (\ 20cm+0,3cm)} = 8,16 \text{ pieces of light bricks}$$

From the above calculation obtained 8,16 light brick to make a wall pair equal to the wall size of 1/2 bricks, but in the price calculation of the material will be taken 9 pieces as a correction factor. Calculation of cost requirement every 1 m^2:

Wall Area
Wall area entirely minus doors and windows
First-floor wall area main Building = 306,31 m^2
Second-floor wall Area main buildings = 396,00 m^2
Post-Wall Area guard = 36,08 m^2
Wall area fence = 226,57 m^2
Total Wall area = 1.093,11 m^2

B) Wall Price estimation
The total price of the wall with light brick:
= (1.093,11 m^2 x Rp 104.500)
= Rp. 114.229.995,00

Implementation phase

The existing wall fee is **Rp. 121.573.224,00**,-while the cost of wall work with alternate replacement Hebel is **Rp. 114.229.995,00**,-so the total saving work wall is **Rp. 7.343.228,77**,-

When compared with productivity, the builders can finish the pair of lightweight brick walls of ± 23 m^2 in just one day, while the red brick wall material can complete the work area of ± 7 m^2 a day. At the speed of the deployment, the lighter brick is faster 3,286 times than the red brick wall pair.

A. Cost savings

By using the original material then the total cost of the wall work is Rp. 121.573.224,00,-and when using the alternative material using light brick or Hebel then the total cost of the wall work is Rp. 114.229.995,00,. There is a difference in the cost of

savings when using alternative materials amounting to Rp. 7.343.228,77,-

B. Time-saving

By using alternative materials, the time of execution will be faster 2:3 than using the original material because the weight of the material is lightweight and practical to facilitate the workmanship. When compared with productivity, the builders can finish the pair of lightweight brick walls of ± 23 m^2 in just one day, while the red brick wall material can complete the work area of ± 7 m^2 a day. At the speed of the deployment, the lighter brick is faster 3,286 times than the red brick wall pair. If a development project experienced a time crisis, the use of light brick could potentially save the overall cost of the project. Then seen from the effectiveness of alternative material time is more effective. Some other viewpoints can be poured out in the table as follows:

Table 4. Comparison Of Red Brick Work With Light Brick Work

No	Description	Early Wall Work	Alternate Walls Work
1	Execution time	Long-time, it took 360,95 days/person	Faster, it took 109,86 days/person (handyman)
2	Funding	Quite expensive because it requires a lot of bricks that are enough for each m^2 is	Cheaper because it only requires 8 Hebel pieces per 1m^2 and its relatively fast and practical workmanship
3	Material availability	Requires free-motion space	No need for a lot of free-motion space
4	Supervision and control criteria	Relatively difficult because many workers and need more supervision.	Relatively easy because the installation of Hebel is faster and does not require many workers
5	Labor	Plenty	Less because of the ease and light ability of

CONCLUSION

From the results of the analysis of value engineering for building construction of blood transfusion Unit Pasuruan city above, can be taken several conclusions:

1. Based on the results of the value engineering analysis for wall items by proposing alternative material in place of the initial material, resulting in a cost savings of Rp. 7.343.228,77,-from the initial cost for the wall of Rp. 121.573.224,00,-
2. Value engineering can be applied at any time of the project, from the beginning to completion of the project development. When compared with productivity, the builders can finish the pair of lightweight brick walls of ± 23 m^2 in just one day, while the red brick wall material can complete the work area of ± 7 m^2 a day. At the speed of the deployment, the lighter brick is faster 3,286 times than the red brick wall pair.

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