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Study of selecting floor cover by using the value engineering method in the housing project

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Abstract. Value engineering is an attempt to get the lowest possible cost without eliminating the main functions in a product, process, or service. The way is to identify and overcome the factors that cause costs without contribution or effort. Housing projects have a lot of construction work. Floor work is one of the jobs that has high costs and has the possibility to do value engineering. This project is a housing project, located in the South Tangerang area with 118 units. The goal is to get the best material choices for flooring. Alternative flooring materials in this study are vinyl, carpet, laminate wood, and ceramics. Floor materials in the initial design of the project are granite and ceramics. In the process, this research uses value engineering analysis with a value engineering job plan approach that is assisted by an expert choice program. After analyzing the data using expert choice, the result of urutan ranking criteria is material availability by 30.9%, ease of installation by 22.0%, strength by 18.2%, price by 16.5%, and design by 12.5%. While the alternative weight of vinyl is 26.5%, laminate wood 19.4%, ceramics 32.1%, and carpets 22.0%. The construction cost owned by the initial floor work is IDR 3,105,164,536.61, thus saving the initial design cost of IDR 511,533,875.30. It can be stated that vinyl and ceramics are the best alternatives in this two-story housing project.

1. Introduction

Development in Indonesia have ultimately influenced the mindset of the people. Gradually, the community demands performance and mindset that is fast and appropriate to solve various problems in work that arise along with the existence of development. This also happened in the construction sector. In physical development (construction projects) there is a great deal of attention and supervision of the quality of work, saving of budget costs, and controlling the time of its implementation. Therefore, good planning is needed before the construction project is carried out [5].

The project's budget plan must be planned efficiently. Many things can be done before making the budget plan including the selection of designs and materials to be used. The choice of design and materials is very influential on the quality and quality of the building. Sometimes the budget plan still contains several working items that have a budget that is too high. In construction management there is a civil engineering discipline that can be used to streamline costs. This knowledge is known as value engineering.

What is value engineering, anyway? Value engineering is a systematic evaluation of a project design to obtain the most value for every dollar of cost. By carefully investigating costs, availability of materials, construction methods, shipping costs of physical limitations, planning and organizing,



cost/benefit values, and similar cost influencing items an improvement in the overall cost of a projet can be realized [3]. Another meaning, value engineering is a complete system for identifying and overcoming the factors that cause costs without contribution or effort in a product, process, or service. This system uses all the technology, knowledge and skills to effectively identify costs or businesses that do not contribute to the wants and needs of the customer [4].

The advantages of this method are systematic, neat and organized approach to analyzing the value of the subject matter to its function or usefulness, but it remains consistent with the needs for the appearance, reliability, quality and maintenance of the project [2]. A cost reduction that sacrifices the usefulness of the product, that is what actually reduces the value of the tool in front of the owner. However, the costs incurred to provide an increase in the capacity of the function but in excess (more than needed), it will only give a little added value in the eyes of the owner.

2. Method

The flow of this research begins by recognizing the problem of literature studies obtained through books, e-books and e-journals. Followed by finding project data through interviews, and distributing questionnaires (google form). After all the data has been collected and checked that the data can be used, than we need to identify the function. One way is to use the diagram function analysis system technique (FAST).

Next we will look for the criteria that must be owned by the floor covering and alternatives for the material. In using this value engineering method, for the analysis of criteria and alternatives an Analytical Hierarchy Process (AHP) method will be used with the application of expert choice. With the features in the expert choice, we can see the strengths and weaknesses of each alternative.

After the alternative is chosen, next is to make the price details, the price difference with the material previously used, and further explanations so that the chosen alternative can be trusted and used by the owner on subsequent projects.

3. Result and discussion

The data used is the budget plan for housing projects in the southern Tangerang area. Each house has 2 floors totaling 118 units. The cost of each type of work can be seen in Table 1.

Table 1. Recapitulation of costs

Work Items	Cost (Rp.)	Cost Percentage (%)
Site Works	355,890,044.28	0.75
Cut and Fill	840,339,482.79	1.77
Wall/Concrete	23,756,321,373.75	50.04
Door and Frame	7,268,069,933.79	15.31
Floor	3,105,164,536.61	6.54
Ceiling	1,194,604,315.78	2.52
Sanitary	3,369,371,389.08	7.1
Electrical and Mechanical	1,778,026,761.16	3.75
Paint	3,174,569,030.92	6.69
Roof Cover	1,690,762,517.40	3.56
Other Works	936,880,594.22	1.97

(Source: Amelia. "Value Engineering Analysis In Djajakusumah Residence Housing Project". Civil Engineering. Tarumanagara University. Jakarta. 2019.).

Worth gives an indication of the value means the lowest cost required to carry out a particular function. For this reason, no great accuracy is needed. Like the calculation in Table 2.

Table 2. Calculation of cost/worth on floor works.

Work Item	Verb	Noun	Primer/ Secondary	Cost	Worth
Soil Compaction	Compacting	Soil	S	178,437,194	-
Sand Fill (5 cm thick)	Reach	Elevation	S	126,553,221	-
Lean Concrete 1:3:5 t.5 cm	-Level -Lay	-The ground -Ceramic	S	454,288,664	-
Granite Tile 60x60	-Bear -Make	- Load - Room space	P	1,068,233,198	1,068,233,198
Ceramic Tiles 30x30	-Bear -Make	- Load - Room space	P	360,252,418	360,252,418
Stairs Ceramic	-Hold -Make	-Weight -Room space	P	221,301,994	221,301,994
Stairs Plint	Protect	Stairs	S	22,263,113	-
Granite Plint 10x60	Protect	Wall	S	189,693,586	-
Ceramic Plint 10x30	Protect	Wall	S	80,177,184	-
Carport Ceramic Tiles 60x60	-Bear -Make	- Load - Room space	P	284,721,013	284,721,013
Maid Bathroom Ceramic 20x20	-Bear -Make	- Load - Room space	P	19,177,607	19,177,607
Bathroom Ceramic Tiles 30x30	-Bear -Make	- Load - Room space	P	100,065,337	100,065,337
Total				3,105,164,536	2,053,751,571
Cost/Worth				1.51	

Because the cost/worth ratio on floor work is more than 1, it means that there are unnecessary costs (saved) on the work items and value engineering will be carried out.

In the creative stage, there are 10 alternative choices and then in this probability technique, it will be assessed whether or not an alternative can be implemented in the floor work. Rating with probability techniques can be seen in Table 3.

Table 3. Rating with *Probabilities Technique*.

No.	Alternative for floor cover	Value
1	Ceramics	1
2	Laminate wood	1
3	Carpet	1
4	Marmer	0
5	Granite	0

6	Teraso	0
7	Vinyl	1
8	Tegel	0
9	Solid wood	0
10	Glass	0

(Value of 0 means cannot be implemented as a floor covering on this project. Value of 1 means can be implemented as a floor covering on this project).

After analyzing the data using expert choice, the results of ranking criteria are material availability by 30.9%, ease of installation by 22.0%, strength by 18.2%, price by 16.5%, and design by 12.5%. As for the alternatives, Vinyl by 26.5%, laminate wood by 19.4%, ceramics by 32.1%, and carpet by 22.0%. As in Figure 1 and Figure 2.

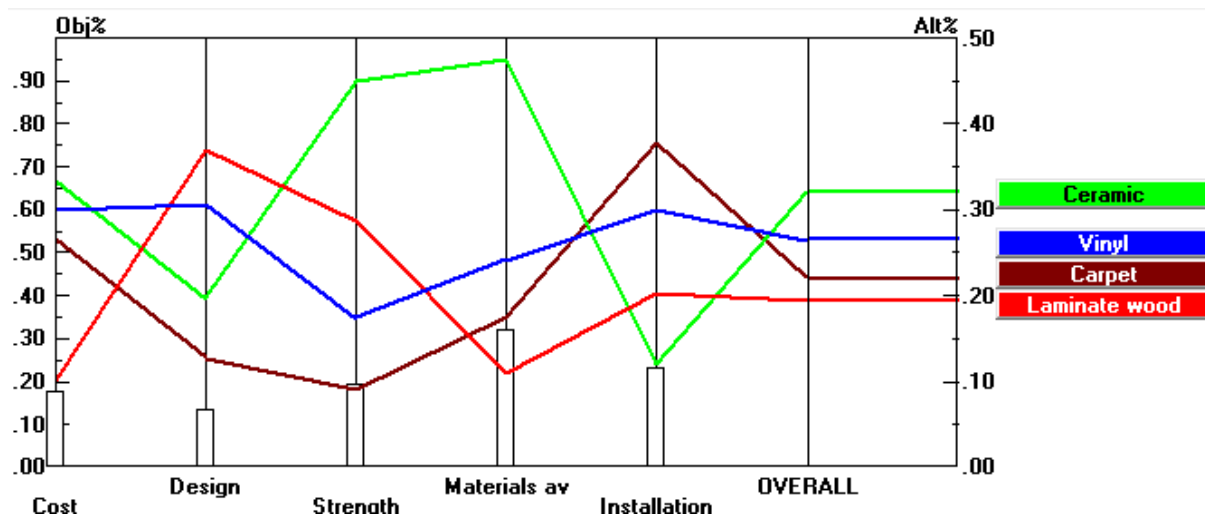


Figure 1. Alternative performance sensitivity Graph.

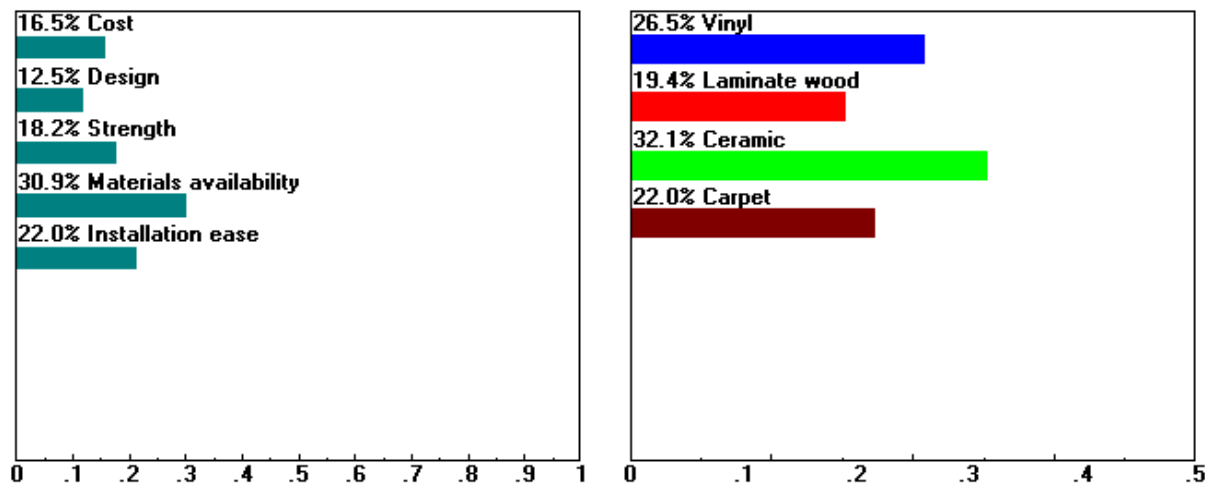


Figure 2. Alternative dynamic sensitivity

After selecting new alternatives, the calculation of the cost of implementing each work component is made and also the author's judgment. Implementation costs are calculated by the unit price of the work

which includes the cost of materials and labor costs needed to carry out the work. Material prices are calculated by changing material prices in 2020 to material prices in 2016-2017.

Where as the wage for labor is taken from the lowest and highest average wages for workers in Java in 2016, based on the Sub-Directorate of Construction Statistics manuscript published by the Central Statistics Agency (BPS). Next, a comparison of initial costs and final costs is made, can be seen in Table 4.

Table 4. Cost comparison of floor work before and after value engineering.

No.	Work Item	Cost (Rp.)	Work Item Changes	Cost After VE (Rp.)
1	Soil Compaction	178,437,194.09	Fixed	178,437,194.09
2	Sand Fill (5 cm thick)	126,553,221.46	Fixed	126,553,221.46
3	Lean Concrete 1:3:5 t.5 cm	454,288,664.79	Fixed	454,288,664.79
4	Granite Tile 60x60	1,068,233,198.57	Vinyl Floor	710,260,530.72
5	Ceramic Tiles 30x30	360,252,418.95	Fixed	360,252,418.95
6	Stairs Ceramic	221,301,994.91	Stairs Vinyl	221,507,048.84
7	Stairs Plint	22,263,113.60	Stairs Plint (Ceramic)	13,103,162.50
8	Granite Plint 10x60	189,693,586.84	Ceramic Plint	120,611,990.18
9	Ceramic Plint 10x30	80,177,184.44	Fixed	80,177,184.44
10	Carport Ceramic Tiles 60x60	284,721,013.62	Carport Ceramic 30x30	209,196,300.00
11	Maid Bathroom Ceramic 20x20	19,177,607.45	Fixed	19,177,607.45
12	Bathroom Ceramic Tiles 30x30	100,065,337.90	Fixed	100,065,337.90
Sub Total		3,105,164,536.62		2,593,630,661.32
TOTAL SAVINGS				511,533,875.30

4. Conclusions

Based on the results of the analysis conducted in this study, it can be concluded that:

1. In the selection of floor coverings, the criteria that gets first rank is ease of installation. Meanwhile, the criteria that gets the last rank is design. Although design ranks lowest of the five existing criteria, but that does not mean design is not important.
2. The alternative floor coverings chosen for flooring work on this housing are vinyl and ceramics with a percentage of 26.5% and 32.1% out of 100% in the analysis.
3. From new design obtained saving cost of Rp. 511,533,875.30 compare to the initial design.

5. References

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