VALUE ENGINEERING OF TOP STRUCTURE WORKS TO INCREASE BUDGET EFFICIENCY IN THE MALANG TRANSMART DEVELOPMENT PROJECT

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Abstract:Value engineering is a creative approach that is systematically organized in analyzing the function of an item in order to be able to optimize costs by reviewing project stages and eliminating unnecessary costs. By applying value engineering, it is expected to produce lower cost alternatives without reducing the quality that has been determined. This study aims to determine the alternative design of efficient work methods, safety control on the design structure, and cost savings in the construction project of the Transmart Malang building. The value engineering analysis applied in this research includes the information stage, the speculation stage, the analysis stage, the development stage, and the final recommendation presentation stage. The analysis carried out on the Transmart Malang building construction project resulted in the work of the superstructure having a large enough cost, therefore it is necessary to do an alternative design and calculation of cost efficiency. After analyzing the Transmart Malang building construction project, it was found that the largest costs were on the work of columns, beams, and floor slabs. In column work, an alternative is the use of the fabrication precast column method with savings ofRp 304,040,832.00 or 3.431%from the initial design. In beam work, an alternative is the use of the precast beam fabrication method with savings ofRp 994.312.116.00 or 7.757%from the initial design. While on the floor slab work, an alternative is the use of the half slab slab method with a savings of Rp. 794,344,675.00 or 2,055% from the initial design. So that in the final analysis, the results of the savings on all structural work are Rp. 2,092,697,624.00 or 3.119% of the initial design.

Keywords: Value Engineering, Floor Plates, , Beams, Columns, Cost Savings.

1. INTRODUCTION

The development of shopping centers today is growing with progress infrastructure and the increasing needs of the community in various regions. According to Ma'ruf(2005). The Transmart Malang building is planned to be built in the MX Mall Building area which is no longer functioning. The old building was completely demolished on the grounds that it did not meet design standards, where this building has a distinctive feature, namely the Kids City area or called Trans Studio Mini which is positioned on the top floor of the building. This building is planned to consist of 6 floors with a land area of 10,276 m2 and a building area of 54,171 m2. These buildings can be categorized into high-rise buildings, which one The construction process requires a large amount of time and money.

According to (Azis, 2016) in making a project cost budget plan there are work items that have the highest costs. After analyzing the RAB (Cost Budget Draft), especially in the initial planning civil works, it was found that the overall structural work cost wasRp 199.406.635.007, with the largest expenditure on the upper structure work, which is Rp. 67,097,544,214. After further analysis, it was found that the three highest values were found in the work of floor slabs, beams, and columns with a total cost of Rp. 60,332,932,123. After examining the results of the RAB, the owner feels that the required expenditure has exceeded the funds prepared for development, which is Rp. 198,000,000.00. The large contract value is a concern so that an evaluation is carried out to find cost savings. Meanwhile, in terms of structure, after being analyzed, the dimensions and number of items on the work of plates, beams and columns are deemed too wasteful so that it is still possible to redesign without reducing the quality of the standard that has been planned.

The value engineering method is one method for saving costs and project implementation time without compromising the quality and requirements that have been set, value engineering is an evaluation of the function of a product or service that aims to fulfill the function at the lowest or most efficient price (Kumendong, 2017). .

Based on the references obtained, the application of value engineering by changing conventional designs and methods to precast methods can increase the efficiency of a work item, so the author will conduct research with alternative precast slabs, beams and columns to produce new alternatives that are expected to shorten construction time and provide cost effective on the work of the upper structure without reducing the quality of the building.

2. METHOD

Value engineering is a creative approach that is systematically organized inanalyzefunction of an item in order to be able to optimize costs by reviewing the stages of the project and reducing unnecessary expenses. By applying value engineering, it is hoped that it can provide an alternative that is much lower in cost but does not reduce the quality that has been determined.

The stages in value engineering are:

(1) Information Stage
(2) Speculation Stage
(3) Analysis Stage
(4) Development Stage
(5) Presentation Stage

3. RESULT

3.1 Information Stage Results

Breakdown cost of the model is made to describe the costs incurred on the work to be carried out by value engineering analysis, starting from the work item that has the highest cost to the lowest cost for the entire job. Breakdown cost model can be seen in table 1 as follows:

Table 1. Overall Project Work Cost Model

Information Stage		
Cost Model		
Work	Sub-Job	Cost
	Consultancy	Rp 14,299,690,817
	Utilities	Rp 8,478,379,956
	Site Management	Rp 2,189.934,431
	Project Insurance	Rp 3,935,979,299
Preparation	Equipment	Rp 130,598,986
	Soil	Rp 542,023,085
	Bottom Structure	Rp 23,130,307,658

Structure	Upper Structure	***Rp 67,097,544,214***
Architecture	Finishing Works	Rp 17,764,287,893
	Floor Finishes	Rp 11,922,582,049
	Floor Hardener & Epoxy	Rp 797,021,217
	Rolling Doors	Rp 312,905,914
Installation	HVAC Works	Rp 15,977,486,100
	Plumbing Works	Rp 2,330,093,191
	Gas Installation	Rp 771,747,674
	Fire Fighting	Rp 2,411.597,149
	Electrical Works	Rp 14,895,232,493
	Energy Management System	Rp 512.013.114
	Vertical Transportation	Rp 6,309,694,138
	Generator	Rp 3,321,232,044
	deep well	Rp 357,555,054
Finishing	Earth Works & Access Road	Rp 1,918,728,531
	TOTAL	**Rp 199,406.635.007**

Table 1 can prove that the largest RAB is in the work of the superstructure.Then a deeper analysis is carried out on the work plan of the superstructure by analyzing the RAB listed in table 2:

Table 2. Breakdown Cost Upper Structure Model

		Information Stage		
		Breakdown Cost Model		
No	**Work**	**Work item**	**Cost**	**Sub-Total**
1	Floor plate	Formwork & Bondek	Rp16,240,667,977,79	***Rp38,653,083,424.29***
		Reinforcing	Rp13.371.156.105.70	
		Casting	Rp 9,041,259,340,80	
2	Beam	Formwork	Rp 2,412.456,203.99	***Rp12,818,807,719.13***
		Reinforcing	Rp 6,633,950,364.86	
		Casting	Rp 3,772,401,150.28	
3	Column	Formwork	Rp 1,741,660,947.81	***Rp.8.861.040.979.62***
		Reinforcing	Rp 4,752,428,503.14	
		Casting	Rp 2,366,951,528.67	
4	Ladder	Formwork	Rp120.809.000	Rp5.787.026.380
		Reinforcing	Rp2,645,277,470	
		Casting	Rp3.020.9399.910	
5	Wall		Rp977,585,711	Rp977,585,711
	TOTAL			**Rp67,097,544,214.04**

In Table 2 it can be seen that the work of beams, columns, and floor slabs is ranked in the top 3 for superstructure work with a fairly high cost of work. Therefore, alternative work is focused on the structural design of beams, columns and floor slabs in order to provide the right solution.

3.2 Results of the Speculation Stage

After finding 3 jobs that have a large expenditure value, it can be concluded that the alternative design is structural work. Value engineering analysis that can be carried out on structural work can be in the form of changes in the shape of the size of the structure such as columns, beams and plates to compare usage building materials that have an economical price. The following is a recapitulation of the alternative designs shown in table 3:

Table 3. Alternative Design

Initial Design	Alternative 1	Alternative 2	Selected Alternative Analysis
Bondek Plate	Half slab method plate.	Full slab method plate (Hollow Core Slab)	Prefabricated Floor Plate
Precast Beam off-site fabrication method and manufacturing method	Precast beam off-site fabrication method	Precast beam manufacturing method	Precast Beam
Conventional Column	Off-site fabrication method precast column	Precast column fabrication method	Precast Column

3.3 Results of the Analysis Phase

The analysis carried out is to calculate the volume of material requirements and safety control in each alternative design of the building structure. One way is to use the ETABS application. The following is the result of the recapitulation of the work of plates, beams, and columns from the initial design to the alternative designs described in Tables 4 to 6:

Table 4. Recapitulation of the Plate Methodology

No.	Information	Bondek Plate	*Half Slab*	*Hollow Core Slab*
1	biggest dimension	8mx9m	8mx9m	8mx9m
2	concrete quality	25MPa	30 MPa	30MPa
3	concrete needs	4,627 m³	4,627 m³	4,627 m³
4	steel quality	fy 400	fy 400	fy 400
5	reinforcement requirement	968,440 kg	944,819 kg	27,766 kg

Table 5. Recapitulation of the Block Methodology

No.	Information	Initial Method	Manufacturing Site-Off Method	Manufacturing Method
1	biggest dimension	500mm/700mm	550mm/300mm	550mm/300mm
2	concrete quality	25 MPa	30 MPa	30 MPa
3	concrete needs	1,930 m³	1,010 m³	1,010 m³
4	steel quality	fy 400	fy 400	fy 400
5	reinforcement requirement	404.931.38 kg	439,107 kg	500,505 kg
6	reinforcement diameter	22,19,13	22,18,10	22,18,10
7	Mn value	588,546 Nmm	570,564 Nmm	570,564 Nmm
8	Vu nilai value	1,620,897 kg	11,189.05 kg	11,189.05 kg
9	your value	44,158,087 kg.m	18,709,242.00 kg.m	18,709,242.00 kg.m

Table 6. Methodology Recapitulation Column

No.	Information	Initial Method	Manufacturing Site-Off Method	Manufacturing Method
1	dimensions	70cm x 70cm	60cm x 60cm	60cm x 60cm
2	concrete quality	K-300	K-350	K-350
3	concrete needs	1,394,00 m³	1,026.00 m³	1,026.00 m³
4	steel quality	fy 400	fy 400	fy 400
5	reinforcement requirement	290.084.69kg	205,200.00 kg	15,390 kg
6	reinforcement diameter	22, 19, 13	22, 18, 10	22, 18, 10
7	Mn value	375,991,634 Nmm	315,547,318 Nmm	315,547,318 Nmm
8	Pn value	8,790.487 kN	7,799,320 kN	7,799,320 kN
9	your value	87,281.57 kNm	85,999.5 kNm	85,999.5 kNm
10	Pu nilai value	80,760.62 kNm	80,186.46 kNm	80,186.46 kNm

Table 7. Recapitulation of Sturdy Control of the Whole Structure

No	Structural Robustness Control	Preferred Job Alternative	Permission Limit	Analysis results	Information
1	Natural Vibration Time	• Half Slab Plate • BeamFabrication • Manufacturing Column	1.182115631 s	0.910259 s	Oka
2	Whole Structure Concrete Stress	• Half Slab Plate • Manufacturing Beams • Manufacturing Column	30,000 MPa	27.023 MPa	Oka
3	Deviation per floor	• Half Slab Plate • Manufacturing Beams • Manufacturing Column	5,000 mm	0.243 mm	Oka
4	Total Deviation	• Half Slab Plate • Manufacturing Beams • Manufacturing Column	5,000 mm	0.344 mm	Oka
5	Deflection per floor	• Half Slab Plate	16,667 mm	7,614 mm	Oka
6	Beam Tension per-floor	• Manufacturing Beams	30,000 MPa	23,028 MPa	Oka
7	Column Tension	• Column	30,000 MPa	27,064 Mpa	Oka

3.4 Development Stage

The development stage is in the form of a function analysis that aims to:to determine the percentage of the function of each work item so that it can find out the comparison between the initial design costs and the benefits of alternative designs. The following is a recapitulation of the results of the cost analysis for column, beam, and floor slab work in tables 8 to 10:

Table 8. Final Recommendations for Floor Plate Design

Work Item: Floor Plate			
No	**Design Type**	**Description**	**Cost**
1	**Initial Design**	bondek method	Rp 38,653,083.424.00
2	**Alternative Design**	Half Slab method	Rp 37,858,738,749.00
3	**Big Savings**		Rp 794,344,675.00
% Savings			2.055%

Table 9. Final Recommendation of Beam Design

Work Item : Block			
No	**Design Type**	**Description**	**Cost**
1	**Initial Design**	method conventional	Rp 12,818,807,719.00
2	**Alternative Design**	fabrication method	Rp 11,824,495,602.00
3	**Big Savings**		Rp 994.312.116.00
% Savings			7.757%

Table 10. Final Recommendations for Column Design

Work Item : Column			
No	**Design Type**	**Description**	**Cost**
1	**Initial Design**	Column with conventional method	Rp 8,861,040,979.00
2	**Alternative Design**	Reinforced concrete column with precast method *fabrication*	Rp 8,557,000.147.00
3	**Big Savings**		Rp 304,040,832.00
	% Savings		3.431%

3.5 Presentation Stage

In table 11, it can be seen the final design recommendations to find out the most efficient design combination.

Table 11. Recapitulation of Total Alternative Costs

No	Design Type	Description	Cost
	Work Item: Upper Structure		
1	**Initial Design**	1. adhesive plate 2. conventional beam 3. conventional column 4. stairs + conventional wall	Rp 67,097,544,214.00
2	**Alternative Design**	*1.* half slab plate 2. fabricated beam 3. fabricated column 4. stairs + conventional wall	Rp 65.004.846.589.00
3	**Big Savings**		Rp 2,092,697,624.00
	% Savings		3,119%

The total initial design cost of the superstructure is Rp. 67,097,544,214.00 and the total cost of the alternative design is Rp. 65,004,846,589.00. So that the resulting savings of Rp. 2,092,697,624.00 or 3,119% of the initial design.

4. CONCLUSION

Based on the value engineering stages carried out on the structure of the Transmart Malang Building project, the following conclusions can be drawn.

1. a) The proposed alternative to replace the bondek plate work method is the Half Slab precast method.
   b) Alternative The proposed method to replace the conventional beam work method is the precast fabrication method.
   c) The proposed alternative to replace the conventional column work method is the precast fabrication method.
2. a) Natural vibration time control analysis has met the requirements of the permit limit.
   b) Control analysis of the maximum concrete stress has met the requirements of the permit limit.
   c) Analysis of deviation per floor has met the requirements of the permit limit.
   d) Analysis of deflection control per floor meets the requirements of the permit limit.
   e) Control analysis of the column stress per floor has met the requirements of the permit limit.

f) Control analysis of the beam per-floor stress has met the requirements of the allowable limits.

3. a) The cost savings obtained from the value engineering stage in the floor slab work is 2.055% of the initial design cost of the floor slab work.
   b) The large cost savings obtained from the value engineering stage
   on beam work is 7.757% of the initial design cost of beam work.
   c) The cost savings obtained from the value engineering stage on column work is Rp. 3,431% of the initial design cost of column work.
   d) The cost savings obtained from the value engineering stage in the total structure work is 3,119% of the total initial design cost of the structure.

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