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Analysis of the Budget Plan (RAB) with the Concept of *Building Information Modeling* (BIM) in the Banjarbaru At-Taqwa Mosque Development Project

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ABSTRACT

In the world of construction, the calculation of estimated costs by planning consultants plays an essential role in the implementation of tenders. The cost estimate calculated by the planning consultant after being reviewed by the authorities will be determined as the owner's estimate (OE) as a reference for assessing the fairness of the price to set the highest limit for a valid bid (Malik, 2013). Inaccuracy in calculating the volume of this work will impact cost overruns if the computed volume is too large and a decrease in building quality if the estimated volume is too small. However, with the development of technology, the volume of work can be calculated quickly and efficiently with the application of Building Information Modeling (BIM). This research will raise the comparison of BIM-based cost estimation with manual cost estimation calculations for the structure of the Banjarbaru At-Tawqa Mosque building.

Building structure modeling includes modeling mountain stone foundations, concreting, reinforcement, formwork, and walls. Modeling using Tekla Structures software with the South-East Asia environment referring to the plan drawings. The output of this model is directly in the form of estimated structural work costs, while the At-Taqwa Mosque Development management team has calculated manual cost estimates. The unit price of work used in calculating the estimated cost refers to the AHSP/HSPK for the City of Banjarbaru in 2022.

From the analysis of the two cost estimates, a very small comparison of the difference in costs is produced. The difference between manual cost estimates and BIM-based cost estimates is 25% for rock foundation work, 5% for concrete work, 9% for reinforcement work, 11% for formwork work, and 8% for wall work. Based on these results, it can be said that BIM-based cost estimation is reliable because it produces cost estimates that are more efficient and not far from manual

Keywords: BIM-based cost estimation, Tekla Structures, Building Structures

1. INTRODUCTION

In the world of construction, volume calculations are often done manually with reference to plan drawings. Manual calculations have weaknesses in calculating something that is detailed so it is difficult to apply in the field. Errors in volume calculations that can sometimes be larger or smaller will have an impact on the overall

cost calculation. This will have an impact on increasing costs if the volume is too large and decreasing quality if the calculated volume is too small.

Structural modeling made includes modeling mountain rock foundations, concreting, reinforcement, formwork, and wall work. Modeling was carried out using the Tekla Structures 2022 software which refers to the plans and structural reports of the At-Taqwa Banjarbau Mosque building. By using Tekla Structures, we can detect when in the modeling there is a mismatch of dimensions made according to the plan drawings, so that the output given can be directly applied in the field.

In the advancement of the technology industry and information systems today, there is a method that can facilitate construction work called *Building Information Modeling* (BIM). By using *Building Information Modeling* (BIM) we can combine a building model with other models into a single unit so that the information in buildings is interrelated. One of the capabilities of BIM is that we can shorten the time for making an analysis model which ultimately results in a summary of the building volume. Analysis and design at the same time can accelerate results, thereby sharing better data to drive construction progress.

2. THEORETICAL BASIS

Building Information Modeling (BIM)

Building Information Modeling (BIM) is a form of three-dimensional methodology that is parametric in nature and contains data elements, sequences, stages and specifications of a construction project design. BIM is divided into several stages, namely BIM 3D, 4D, 5D, 6, 7D. By using BIM modeling we can retrieve all the information contained in the model.

According to [1] Building Information Modeling is one or several digital building virtual models.

Tekla Structures

Tekla Structures is an application used to analyze structural models. Using Tekla Structures we can accurately define and analyze a 3D model for all structural work. The Tekla Structures software has quite a lot of functions, from making every important detail when managing the construction process, material volume, types of work, scheduling, to merging models with other programs.

According to [2] Tekla Structures is a multi-material and multi-process modeling software. Modeling using Tekla Structure can be done in a short time and the ability to operate can provide efficient project management results .

Construction Work Volume

The volume of construction work is a detailed breakdown of the volume or cubication of a work. Deciphering means calculating the amount of volume of each work, according to the plan drawings of the project. The volume of work has a very important role for construction project work, where the volume of work will affect the calculation of the project budget plan.

Budget plan

The Budget Plan (RAB) is one of the most important documents in carrying out development. By making RAB we have to estimate or estimate the price of a building that we will make.

According to [3] RAB is an estimate of the monetary value of an activity that has taken into account bestek drawings and work plans, wage lists, material price lists, analysis books, list of cost plan arrangements, and a list of the amount of each type of work.

3. METHOD

The steps in carrying out this research include: (1) Collecting general project data; (2) Create 3D models with Tekla Structures; (3) Perform Clash Check; (4) Entering the Unit Price of Work on tekla structures; (5) Cost Estimation Calculation with Tekla Structures; (6) Data processing and comparison between manual cost estimates and Tekla Strucutres cost estimates. Paragraph 1.

4. RESULTS AND DISCUSSION

Based on the results of a comparison of the difference in volume between manual calculations and the output of the BIM application as a whole, there is a significant difference in foundation work, which is 25%. This is because the manual volume calculation does not pay attention to the spatial details of the mountain stone foundation. By using Tekla Structures objects can be calculated in detail so that the volume can be much more efficient.

In reinforced concrete structure work, there is an insignificant price comparison, which is equal to 5%. The difference in price for reinforced concrete work can be caused by more thorough modeling in the BIM application by cutting concrete that intersects with other objects. For example, in the manual calculation of casting a concrete slab, the part of the plate that is cut off due to columns is not taken into account, while in the BIM modeling application it can be arranged so that it does not collide with other objects.

In the repair work, the price difference range gets a percentage of 9%. This large difference in price difference can be caused by the factor of manual calculation of armor which is carried out only in general, while the modeling of armor which is carried out in applications is more detailed. For example, the lap reinforcement at the end of the beam that should be installed 20d long cannot be applied because the width of the beam is less than 20d. In addition, the reinforcement on the beam supports that is continuously installed in manual calculations is substituted with a hook length of 12d and a bend of 2.5d so that the length is not as precise as that modeled in the application.

In the formwork work, the price difference gets a percentage of 11%. Differences in formwork work can also be caused by manual calculations of formwork areas not taking into account cuts due to other objects, whereas in BIM applications this can be modeled. In addition, the difference in the price of formwork work can also be caused by manual calculations only taking into account the net length which causes formwork to be unaccounted for, especially in castings at the ends, causing the price of the BIM application to be higher because it can model the formwork as a whole.

For wall work, the resulting price difference is not too significant, namely 8%. Wall work can be caused by more thorough modeling in BIM applications by cutting walls that intersect with other objects. For example, manual calculations do not take into account the clear height and width of the wall, whereas in the BIM modeling application you can set them so they don't collide with each other and get a clear span.

Table 1 Comparison of Manual Cost Estimation with Tekla Structures

No	Name	Manuals	Tekla Structures	Comparison
1	Mountain Stone	IDR 265,457,027.25	IDR 199,780,992.36	-25%
2	Concrete	IDR 2,144,209,605.87	IDR 2,041,327,623.13	-5%
3	Repetition	IDR 751,923,032.98	IDR 686,607,380.90	-9%
4	Formwork	IDR 452,830,384.07	IDR 404,154,193.87	-11%
5	Wall	IDR 503,056,868.76	IDR 463,416,060.16	-8%
Total		IDR 4,117,476,918.92	IDR 3,795,286,250.41	-8%

5. CONCLUSION

From the results of the study " Analysis of the Cost Budget Plan (RAB) with the *Building Information Modeling* (BIM) Concept in the At-Taqwa Banjarbaru Mosque Development Project" it can be concluded that the results of the estimated costs consist of mountain stone foundation work, concrete, reinforcement, formwork, and work walls obtained a difference of IDR 322,190,668.51. The difference in estimated costs generated using the Tekla Structure comparison software has a smaller value than the estimated manual costs of -8%.

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