CERUCUK
Volume 6 No. 5 2022 (371-380)

IMPLEMENTATION OF BUILDING INFORMATION MODELING (BIM) ON THE USHULUDIN BUILDING CONSTRUCTION PROJECT CAMPUS 2 UIN ANTASARI BANJARBARU

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ABSTRACT

In a construction project calculating the volume of work is important. The volume of work affects the estimated cost of the project. Errors in calculating the volume of work are very detrimental to the contractor because it can bring in excess material or material that is less of course very influential on construction costs. Along with advances in technology, the calculation of work volume and project cost estimates can be carried out with the application of Building Information Modeling (BIM) to make it faster and more efficient. This study will discuss the comparison of cost estimates using BIM with manual calculations on the structural and architectural sections of the Ushuludin Building Campus 2 UIN Antasari Banjarbaru.

The structural part of the building is in the form of foundations, beams, columns, plates, and steel and architectural structures in the form of masonry walls. The modeling is carried out using the Tekla Structures software with a South-East Asia environment that refers to the plan drawing. The output generated from the Tekla Structures software is in the form of volume and cost estimates which can be exported directly to Microsoft Excel software, and Microsoft Excel software is used for manual calculations.

From the results of the analysis of cost estimates, it is found that the difference between BIM-based calculations and manual calculations is a difference of 0.36%. With this use of Building Information Modeling (BIM) can be applied because it has a slight difference with manual calculations and processing time is faster.

Keywords: Building Information Modeling (BIM), Work Volume, RAB, Tekla Structures

1. INTRODUCTION

The development of technology and information now allows us to model a building by applying the concept of Building Information Modeling (BIM) to describe the building before it is built. The application of BIM in a development project can be utilized starting from the concept planning stage until the project is completed (Hatmoko et al., 2020). In a construction project calculating the volume of work is important. Currently, the conventional method is more often used by contractors in calculating the volume of work, namely by calculating the volume according to the formula for each job based on 2D drawings (Hatmoko et al., 2020). Almost all stages of development use quantity take off, therefore quantity take off work needs to be done accurately (Alshabab, Vysotskiy, & Petrochenko, 2017). One of the factors that influence the construction project is cost. The cost estimate is obtained by multiplying the quantity of work by the Work Unit Price Analysis (AHSP) (Napu et al, 2016). The unit price of work is the price for each unit of construction element work in which there are various costs such as wages, overhead, profit and others (Alghiffari, 2017). Rizaldi (2017) the results of obtaining RAB using BIM are about 10% lower when compared to using conventional/manual methods. The calculation of conventional and BIM-based cost estimates has a percentage of 14% - 20% (Fardian, 2021).

One application of BIM is to use the Tekla Structures software. Tekla Structures allows creating 3D modeling with complex structures up to the volume take off of the project. Tekla Structures is capable of producing drawings, modeling, detailing, reporting and scheduling, and is even capable of performing clash detection (Kurniawan, 2018). Tekla Structures Minawati (2016) is able to calculate project cost estimates automatically and efficiently. This research raises the application of BIM on the Campus 2 Development Project of UIN Antasari Banjarbaru. The object chosen in this research is the Ushuludin Building which consists of a reinforced concrete structure. In this study, we will discuss the comparison of Volume and Cost Estimation by applying the BIM concept using Tekla Structures software with manual calculations.

2. LITERATURE REVIEW

Building Information Modeling (BIM)

BIM is a combination of various models that provide complete building information that helps in construction projects (Basnet, 2016). BIM is considered as a new technology or method in dealing with the development process. BIM levels are divided from 3D to 7D. 3D BIM is in the form of building modeling to the rendering process, 4D is project scheduling, 5D is project cost estimation, 6D is focused on management, 7D is focused on the building life cycle.

Tekla Structures

Tekla is a structural BIM application for structural engineering design, documentation and modeling of structures such as steel detailing, precast concrete detailing, and reinforced concrete detailing. It can automatically generate images and reports according to project needs (Oli, 2017). Tekla Structures software has quite a lot of functions, including 3D modeling, project scheduling, calculating work volumes, to calculating cost estimates.

Level of Development (LOD)

Level of Development is the depth of characteristics applied in a model (Reis, J., 2017). This LOD is not an N-Dimensional, but relates to the construction phase which can be simulated before the project is implemented in the field.

Construction Work Volume

Work volume is the volume of each job according to the unit of each job. The work volume is usually calculated from the detailed project drawings. The volume of work plays a very important role in construction projects where the volume of work affects the project budget plan.

Cost estimation

Cost estimation is important in a project to estimate the cost of the project. The cost analysis is generated by calculating the quantity of work (quantity take-off) and then multiplying it by the Work Unit Price Analysis (AHSP) (Napu et al., 2016).

3. RESEARCH METHOD

The stages in data processing begin with processing the 3D modeling on Tekla Structures based on the shop drawing reference. After that, the take-off quantity is carried out and the unit price input according to the type of work into the Tekla Structures software to get a cost estimate. Furthermore, the calculation of the estimate manually using Microsoft Excel software. After obtaining cost estimates using BIM and manual cost estimates, then the two results are compared and conclusions are drawn. The research flow chart can be seen in Figure 1.

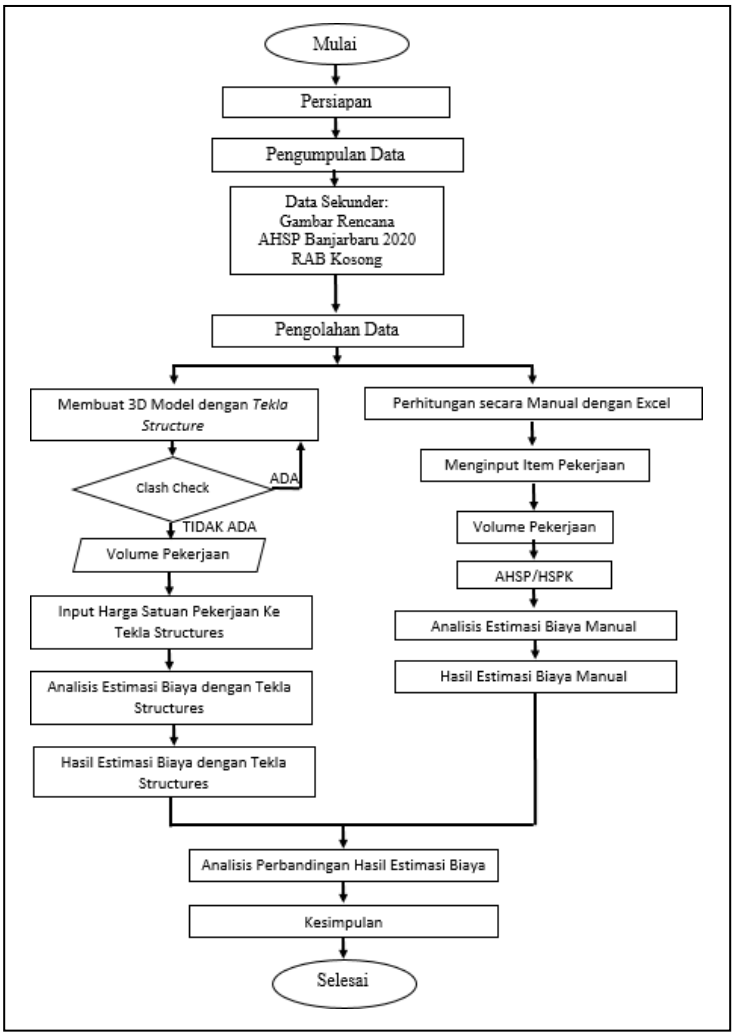

Figure 1. Research Flowchart

4. Results and Discussion

Modeling on Tekla Structures

The 3D modeling of the building is made using Tekla Structures 2020. The 3D modeling of Tekla Structures refers to the shop drawing. The first step in modeling is the creation of a grid and the manufacture of materials into Tekla Structures. The modeling made in this research is modeling of building structures in the form of piles, pile caps, sloof, columns, beams, floor plates, steel structures, and architectural modeling in the form of masonry walls. The image of the modeling results can be seen in Figure 2.

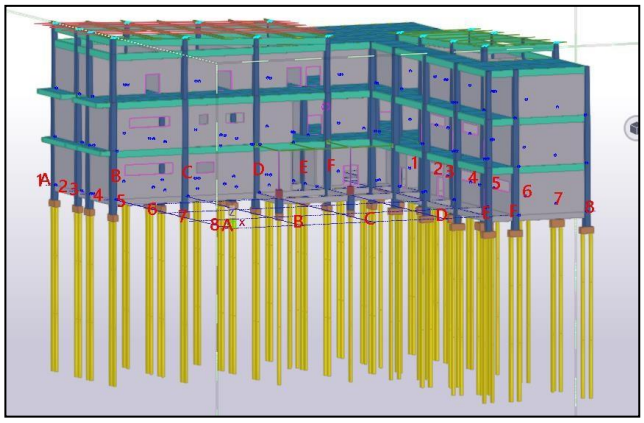

Figure 2. Modeling of Tekla Structures

Input Work Unit Price

Inputting the unit price of work using the User-defined attributes tools that are already available in the Tekla Structures software. Work unit prices are inputted one by one according to the type of work such as pile work, concrete work, iron work, steel structure work, and brick wall installation work. In the User-defined attributes tool, there are many attribute options which are divided into several menus such as Parameters, Workflow, End conditions, Analysis, IFC export, Orientation, Structural information, Unitechnik Mountpart, Rebar set, and Tekla Structural Designer. The unit price of the work is entered into the attribute of one of the menus above which has a numeric format. Attributes with a numeric format are selected so that formulas or formulas can be used to calculate cost estimates. The input for the unit price of work can be seen in Figure 3.

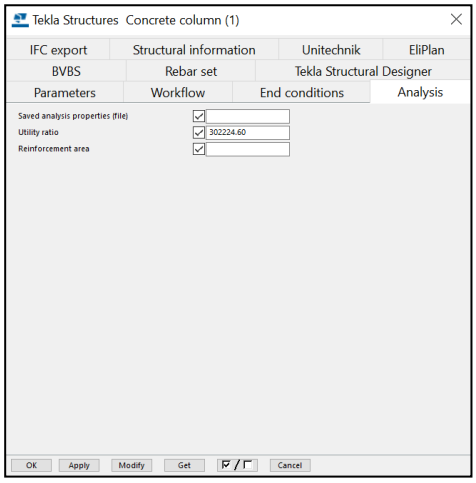

Figure 3. Inputting the Unit Price of Work

Doing Clash Check

After completing the modeling then do a clash check. Clash check aims to ensure that in building modeling there are no colliding building components. Clash check is done by reviewing the model that has been modeled. This is done in order to produce a more optimal volume of work.

Tekla Structures Cost Estimation Output

To produce the cost estimation output, a formula is used, namely by multiplying the volume by the unit price of work. This formula is done on the Tekla Organizer tool. The organizer is able to make a formula for the number of prices that multiplies the volume with the unit price of work, so that the resulting output can be directly in the form of cost estimates. The steps taken to produce cost estimation data output are by clicking the Manage tab, then selecting Organizer. After the Organizer window appears, select Open settings to open the settings window. In the Property template section, select Create a new property template to create a new property data output. Enter a name in the Property template name according to the name of the work group for which the estimated cost will be generated. The estimated cost generated there are 5 types of work so it is necessary to make 5 property templates with the names RAB Concrete, RAB Pembesian, RAB Piles, RAB Steel Profiles, and RAB Wall Pairs. To produce output data that you want to display in the template property, in the Columns section select Add a new columns. Add 4 new columns to input the values of Name,

Volume, Unit Price, and Total Price. An example of the output cost estimation of Tekla Structures concrete work can be seen in Figure 4.

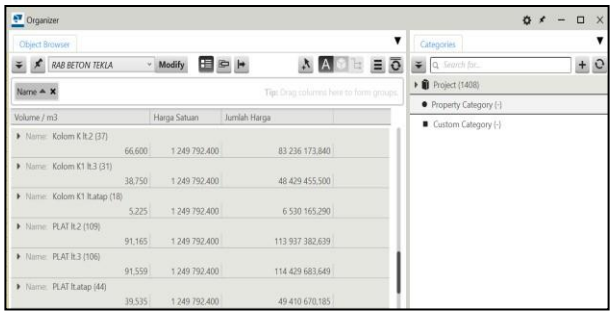

Figure 4. Results of the Estimating Cost of Concrete Casting Organizer

Manual Cost Estimation Calculation

Manual calculations are performed with Microsoft Excel software. Manual cost estimates are obtained by multiplying the volume of work by the unit price of the work. Volume is obtained by calculating the geometric shape of each work item with units according to the work item. Dimensions or dimensions of the geometry area are obtained from manual measurements of the plan drawings.

Tekla Structures Volume Difference and Cost Estimation Comparison with Manual

The comparison of the difference in the volume of each type of work between Tekla Structures and manual can be seen in Table 1. and the comparison between Tekla cost estimates and Manual costs estimates can be seen in Table 2.

Table 1. Comparison of the Volume of Tekla Structures Work Types with Manual Calculations

JENIS PEKERJAAN	Satuan	MANUAL	TEKLA	SELISIH
PEKERJAAN TIANG PANCANG	M	1411	1411	0.00%
PEKERJAAN BETON	M3	825.670	828.257	0.31%
PEKERJAAN PEMBESIAN	Kg	143537.269	139,897.83	2.54%
PEKERJAAN PASANGAN DINDING	M2	1994.254	2,063.02	3.45%
PEKERJAAN STRUKTUR ATAP BAJA	Kg	21886.15	21,870.71	0.07%

Table 2. Comparison of the Difference in Cost Estimation of Tekla Structure with Manual Cost Estimation Calculations

PEKERJAAN	JUMLAH HARGA MANUAL	JUMLAH HARGA BIM	SELISIH HARGA
PONDASI	Rp534,346,383	Rp533,664,959	0.13%
LANTAI 1	Rp1,157,588,651	Rp1,167,497,506	0.86%
LANTAI2	Rp1,621,344,167	Rp1,610,997,673	0.64%
LANTAI3	Rp1,500,859,462	Rp1,495,275,033	0.37%
LANTAI ATAP DAK	Rp593,784,918	Rp578,006,787	2.66%
STRUKTUR ATAP BAJA	Rp1,119,117,640	Rp1,118,327,983	0.07%
TOTAL	Rp6,527,041,221	Rp6,503,769,942	0.36%

Based on the results of the comparison of the difference in the total price between manual calculations and the output of the Tekla Structures application as a whole, it does not show a significant difference, which is only 0.36%. On the foundation work shows a difference of 0.13%. For floor work 1-3, it does not show a much different difference, namely <1%. For roof floor work, it is 2.66% and steel structure is 0.07%.

5. CLOSING

Conclusion

1. Comparison of the volume of manual work with the application of BIM is 0% pile work, 0.31% concrete casting work, 2.54% iron work, 3.45% masonry work, and 0.07% steel roof profile work.
2. The estimated cost of the Ushuludin Building Construction Project Campus 2 UIN Antasari Banjarbaru using the BIM Tekla Structures software was obtained at Rp.6,503,769.942.
3. The difference between the volume and the estimated cost of manual calculations using the BIM Tekla Structures software in the Ushuludin Building Construction Project Campus 2 UIN Antasari Banjarbaru is 0.36%. It can be concluded that the

use of BIM can be applied because the process is faster and the results are not much different from manual.

Suggestion

1. We recommend using the latest version of the software to get better features.
2. It is recommended to use a laptop specification that is high enough to expedite the work.
3. Modeling of reinforcement in Tekla Structures should pay attention to the length of reinforcement in the field so that the volume results are more accurate.
4. Merging BIM 4D and 5D for further research reference.

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