RE-ESTIMATION OF GUNTUNG PAYUNG BANJARBARU COMMUNITY HEALTH CENTER BUILDING PROJECT USING BIM SYSTEM
(BUILDING INFORMATION MODELING) BASED COST ESTIMATION

Ibnu Fathonah, Candra Yuliana
Program Bachelor Degree in Civil Engineering, Faculty of Engineering,
University of Lambung Mangkurat
Netn General A. Yani Km. 36 Banjarbaru
Telp. (0511) 47738568 – 4781730 Fax. (0511) 478130
e-mail:ibnuftnh@gmail.com.com

ABSTRACT

Conventional planning methods that use a lot of software and do not have a connected database so that a lot of data does not match each other which results in cost overruns and a decrease in building quality, from these problems the development of construction technology creates increased effectiveness and efficiency to facilitate the planning process which is called a system BIM (Building Information Modeling), there are many advantages of the BIM system, one of which is BIM Based Cost Estimation which is generated based on 3D modeling so that by implementing the BIM system it is expected to be able to get better results.In this study, the author will raise the comparative analysis of the BIM Based Cost Estimation method with the calculation of conventional cost estimation methods for the Guntung Payung Banjarbaru Health Center building structure.

Calculations were carried out using Tekla Structures with Environment South East Asia for structural work which includes concrete and ironing work referring to Shop drawings and AHSP/HSPK of Banjarbaru City in 2021. The results of the analysis are the processing time for the calculation method and the difference in the cost of structural work which will be compared with the results of the calculation of the estimated cost of the planner with conventional calculations which are calculated using Microsoft Excel and AutoCAD as the self-estimated price (HPS)/Owner Estimate (OE) for the project.

From the results of the two methods, the difference in processing time was 33% and the cost difference was quite large, namely Rp. 34,341,919, - with a percentage of 12% for concrete work and Rp. 144,395,379, - with a percentage of 13% for iron work, based on the results from this it can be concluded that the use of the BIM Based Cost Estimation method produces more efficient and effective cost estimates because the processing time is short and the calculation results are close to the needs in the field compared to conventional methods.

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

1.   PRELIMINARY

The rapid development of construction technology that was created to facilitate the planning process is now increasingly sophisticated which makes it easier in terms of increasing effectiveness and efficiency in planning a construction project. In a project planning, a lot of software is used to increase the effectiveness of a plan. Previously, there were many factors that were lacking in the use of this software, one of which was an unconnected database so that there was a lot of data that did not match each other. Because of these problems, technological innovation in the construction sector has created a system known as Building Information Modeling (BIM).

Applications that were often used for project planning before the advent of BIM systems required more time because they could not integrate with each other. This has an impact on the time, cost and human resources required for project planning using these applications compared to using a BIM system,

BIM is a 3D model-based process of generating and managing data such as geometry, spatial relationships, quantities, component properties, etc. During the life cycle of a building(Ratajczak et al., 2019) One ofPart of the planning is the calculation to estimate the cost of construction, which is carried out by planners who play an important role in the implementation of the tender. Estimated costs calculated by planners can be referred to as engineer estimate (EE). (Ridha & Musakkir, 2019).

The role of the planner in the EE of a project is very important because it contains a Bill of Quantities (BQ) as a basis for checking workload variances in project implementation. This requires the implementation to produce BQ as detailed as possible when implemented in the field.

Volume calculations are usually done manually with reference to the Detail Engineering Design that has been set so that the calculation results can be close to the actual situation in the field.(Napu et al., 2016). ButIn conventional calculations there are times when things cannot be applied in the field, so the volume of work can be inappropriate. Situations like this can affect the overall cost estimate, whether it affects the determination of the HPS or the bid price by the contractor. Inaccuracy in calculating the volume of this work will have an impact on cost overruns if the calculated volume is too large and a decrease in building quality if the calculated volume is too small.

2.   LITERATURE REVIEW

Building Information Modelling (BIM)

Building Information Modelling (BIM) is a digital representation of the physical and functional characteristics of a facility. As such, it serves as a shared knowledge resource for information about a facility that forms a reliable basis for decisions throughout its life cycle from inception onward. The basic premise of this model is collaboration by different stakeholders at different phases of the facility life cycle to include, extract, update or modify information in the modeling process to support and reflect the roles of these stakeholders. Models are shared digital representations founded on open standards for interoperability. The model can be data consisting of a set of related files and not just a single entity.

Budget plan

RAB is made with the function of knowing how much the planned costs are needed in carrying out activities, knowing the volume needed for both tools, materials and labor, as well as a requirement in the proposal document for the proposed implementation of activities. Through the RAB, we can calculate and know exactly how much it will cost to construct the building according to the owner's request. Without an RAB, it is very likely that there will be cost overruns due to the purchase of building materials that are not in accordance with the volume of work, uncontrolled wages for workers, inappropriate procurement of equipment, and various other negative impacts. The best solution is to make a RAB.

Quantity Take Off

Quantity take-off(QTO) is the basis for project cost estimation. They are usually created manually which can lead to a number of inaccuracies and errors. However, there are BIM programs that contain the necessary tools to create a quantity take-off. The focus of this work is the reliability of the quantity take-off carried out through the BIM method. Quantity take-off is created using traditional methods and using BIM tools. The results are compared and the savings are calculated(Bečvarovská & Matějka, nd).

Numl of Quantity(BQ)

Numl of Quantity (BQ) is defined as a list of brief descriptions and estimated quantities. Quantity is defined as an estimate because it can be measured and not

expected to be completely accurate for unknown factors when it occurs in civil engineering work. The purpose of preparing a bill of quantity is to help estimators produce accurate tenders efficiently and assist post-contract administration so that they can be carried out efficiently and cost-effectively. It should be noted that image quality plays a major role in achieving this statement by making it possible to produce an accurate BQ and also by using the planner to make good engineering calculations about work methods.

3. RESEARCH METHODS

1. Learn to use Tekla Structures software and determine the data needed
2. Collecting data based on determining the data needed previously on project implementers, namely in the form of Working Drawings, RAB, HSP and other supporting data.
3. Make 3D modeling based on working drawings referenced by planners.
4. Create Quantity Take Off from previous 3D modeling using the Organizer and adjusting the existing volume report preparation format.
5. Inputting the unit price according to the AHSP and volume calculation results for both methods using Microsoft Excel.
6. Comparison and Conclusion ecost estimation using the Tekla Structure software and manual cost estimation, namely the difference between estimated costs and excess or deficiency in the use of the BIM based cost estimation method and manual calculations.
7.

4. RESULTS AND DISCUSSION

A brief description of the results obtained from the analysis and discussion of the volume calculation research of the BIM Approach Method from the Author and the results of the Conventional Method from Planners which have been recapitulated based on the results of the two calculation methods which can be seen in table 4.43 and table 4.44 below.

Table**Error! No text of specified style in document.**.1*Recapitulation of the calculation of the price of work items between the Conventional Method of the Planner and the BIM Approach Method of the Author based on Building Structure Floors*

No	Item pekerjaan	Jumlah Harga + PPN 10%		Selisih		Bobot
		Konvensional	BIM Tekla	Bertambah	Berkurang	Selisih %
A	STRUKTUR BANGUNAN LANTAI 1					
	Pekerjaan Tiang Pancang	Rp 445.280.000	Rp 445.280.000	Rp -	Rp -	0,00
	Pekerjaan Cor Beton K-250	Rp 232.408.936	Rp 255.106.512	Rp 22.697.577	Rp -	9,77
	Pekerjaan Pembesian	Rp 401.033.218	Rp 435.215.627	Rp 34.182.409	Rp -	8,52
B	STRUKTUR BANGUNAN LANTAI 2					
	Pekerjaan Cor Beton K-250	Rp 239.395.296	Rp 216.599.371	Rp -	Rp 22.795.925	-9,52
	Pekerjaan Pembesian	Rp 371.131.471	Rp 449.541.689	Rp 78.410.217	Rp -	21,13
C	STRUKTUR BANGUNAN LANTAI 3					
	Pekerjaan Cor Beton K-250	Rp 83.296.610	Rp 58.691.727	Rp -	Rp 24.604.883	-29,54
	Pekerjaan Pembesian	Rp 122.224.635	Rp 149.714.742	Rp 27.490.108	Rp -	22,49
D	STRUKTUR BANGUNAN ATAP TANGGA					
	Pekerjaan Cor Beton K-250	Rp 19.579.801	Rp 9.861.113	Rp -	Rp 9.718.687	-49,64
	Pekerjaan Pembesian	Rp 19.328.693	Rp 23.641.339	Rp 4.312.646	Rp -	22,31

Table**Error! No text of specified style in document.**.2*Recapitulation of the calculation of the price of work items between the Conventional Method from the Planner and the BIM Approach Method from the Author based on the type of work item*

No	Item pekerjaan	Jumlah Harga + PPN 10%		Selisih		Bobot Selisih %
		Konvensional	BIM Tekla	Bertambah	Berkurang	
A	Precast					
1	Pekerjaan Tiang Pancang	Rp 445.280.000	Rp 445.280.000	Rp -	Rp -	0
B	Cast in Place					
1	Pekerjaan Cor Beton K-250	Rp 574.680.642	Rp 540.258.723	Rp -	Rp 34.421.919	-5,99
2	Pekerjaan Pembesian	Rp 913.718.017	Rp1.058.113.396	Rp 144.395.379	Rp -	15,80
	Total Pekerjaan Struktur Utama	Rp 1.933.679.000	Rp 2.043.653.000	Rp 144.395.379	Rp 34.421.919	5,69

berbased on the results of the comparison of the difference in the total price as a whole, it shows a quite significant figure, namely 5.69% with a value of Rp. 109,947,000, - greater value than the BIM approach calculation method compared to the conventional method based on the weight of the Main Structure Work.

As for Cast In place Reinforced Concrete Work, it shows a very significant difference, namelyu -5.99% with a price difference of Rp. 34,422,000, - for the K250 Cast Concrete Work item, which means that the value produced by the BIM

Tekla Structures Approach Method is smaller compared to the Conventional Calculation Method. because the columns are not calculated in detail causing swelling of the volume of concrete work, whereas in the Tekla Structures BIM application the calculations are based on detailed modeling and can be adjusted so that they do not overlap with other objects. This is one of the advantages of Tekla Structures in terms of instant calculations and produce detailed output.

Pada The repair work item, the difference in the price of the repair work produced is quite large, namely 15.8% with a value of Rp. 144,395,000 which means a greater value using the calculation method with BIM compared to the conventional calculation method produced by the planner, as a breakdown of the total price difference for each Repair Item from the 1st Floor Structure to the top floor Level, namely the difference in value 23, 67% on the 1st floor structure, 54.30% on the 2nd floor, 19.04% on the 3rd floor and 2.99% on the Rooftop.

*Table**Error! No text of specified style in document.**.3Conclusion Calculation Flow and Accuracy*

Stages	Information	
	Conventional Method	BIM approach
Planning Stage	Adjust predetermined excel formats/formulas to shorten work time	Adjusts the standard of the reinforcement detail
Implementation Stage	Adjusts the standard of the reinforcement detail	Adjusts the standard of the reinforcement detail
accuracy	Sometimes calculations using the manual method cannot be ascertained according to the implementation in the field or not	Can be applied in the field

Calculation of the need for Concrete and Reinforcement Works using the BIM approach method is more recommended because it is more effective and efficient in terms of quality, time and cost. In terms of quality, using the BIM approach method works in more detail, minimal rework and accompanied by accurate detailed drawings. In terms of time, the calculation of the need for reinforcing steel with the BIM approach method is faster than the conventional method.

5. CONCLUSIONS AND SUGGESTIONS
Conclusion

Based on the formulation of the problem and the objectives of this research paper, it can be concluded as follows.

1. The estimated cost of the structure for the Guntung Payung Health Center Development Project using Tekla Structures based on BIM based cost estimation is worth:

    - Piling Work   : IDR 445,280,000, -
    - K-250 Concrete Works   : IDR 540.259.000, -
    - Redemption Work   : IDR 1,058,113,396, -

      Total   : IDR 2,043,653,000, -

2. The difference in the estimated cost of the Main Structure in the Guntung Payung Health Center Development Project based on manual calculations with BIM based cost estimation using Tekla Structures is Rp. 109,974,000, - with a percentage of 5.69%. based on the weight of the previous planning, then based on the previous analysis it can be concluded that the use of BIM Based Cost Estimation can be relied upon because it produces more efficient cost estimates in terms of Method Quality, Processing Time and Cost Output generated through this method.

3. and on the resulting cost between the two methods Cost Efficiency of Works at the planning stage of the Tekla Structures BIM Approach Method. It is far more accurate from a calculation standpoint so as to minimize the occurrence of addendums and errors in implementation and vice versa in conventional calculation methods at the planning stage the resulting costs are less effective at the planning stage thus increasing the potential for addendums to occur because they do not match the reality on the ground.

Suggestion

1. To be able to enter a new era in the world of construction, namely Construction 4.0, that the utilization and development of technology is the

key to being able to compete in this all-sophisticated world of construction. The implementation of BIM 5D related to Based Cost Estimation can be applied to every plan throughout Indonesia based on existing regulations. This can have a positive impact on the sustainability of development in Indonesia because the results are detailed and easy to evaluate.

2. Trimble as a developer considers the price of procuring the application so that it can be used by small construction actors to make it easier for construction work from upstream to downstream.

3. Special research is needed regarding the coefficients or details related to the output issued by Tekla Structures, especially regarding the specific gravity of the reinforcing steel from all sides so as to increase the accuracy of the estimated output.

REFRENCES

BIM Forum. (2019). Level of Development (LOD) Specification Part I & Commentary. *Bim-Bep*. https://bimforum.org/lod/

Kementerian PUPR. (2019). Permodelan 3D, 4D, 5D, 6D, Dan 7D Serta Simulasinya Dan Level of Development (LOD). *Kementerian Pekerjaan Umum Dan Perumahan Rakyat*.

Kementrian PUPR. (2018). *Pelatihan Perencanaan Konstruksi Dengan Sistem Teknologi Building Information Modeling (BIM): Permodelan 3D, 4D, 5D, 6D, dan 7D Serta Simulasinya dan Lecel of Development (LOD)*.

Napu, I. C., Wikarsa, L., & Suwanto, T. (2016). Aplikasi Perhitungan Rencana Anggaran Biaya Pembuatan Rumah Tinggal Berbasis Web. *Aplikasi Perhitungan Rencana Anggaran Biaya Pembuatan Rumah Tinggal Berbasis Web*.

Ratajczak, J., Marcher, C., Schimanski, C. P., Schweikopfler, A., Riedl, M., & Matt, D. T. (2019). BIM-based augmented reality tool for the monitoring of construction performance and progress. *Proceedings of the 2019 European Conference on Computing in Construction*, *1*, 467–476. https://doi.org/10.35490/ec3.2019.202

Ridha, M., & Musakkir, U. M. (2019). Analisis Anggaran Biaya dan Waktu Optimal dengan Metode Least Cost Sheduling. *Jurnal Teknik Sipil Unaya*, *4*(2), 71–78. https://doi.org/10.30601/jtsu.v4i2.35

Bečvarovská, R., & Matějka, P. (n.d.). Comparative Analysis of Creating Traditional Quantity Takeoff Method and Using a BIM Tool. *Construction Maeconomics Conference 2014*. Retrieved April 20, 2022, from http://www.conference.cm.com/podklady/history5/Prispevky/paper_becvarovska.pdf

This page is intentionally left blank