

COMPARATIVE ANALYSIS OF COST AND TIME PLANNING BETWEEN CONVENTIONAL CALCULATION AND BUILDING INFORMATION MODELING (BIM) IN THE OFFICE BUILDING CONSTRUCTION PROJECT OF UPTP BLK PRABUMULIH

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Abstract

BIM (Building Information Modeling) is a method in infrastructure construction that integrates virtual models and their technical data and simulates all information on a construction project into 3D, 4D, 5D, 6D, and 7D models. This study aims to model reinforced concrete buildings which are then intended to obtain the volume of work, another objective of this final project is to estimate the cost and time of the work. This study was conducted using a case study on the UPTP BLK Prabumulih Office Building Construction project. The data used in this study were Shop Drawing and RAB data obtained from the relevant contractor, then the data was re-modeled using Tekla Structure software. The results of this study are that the BIM concept can accurately calculate the volume of work and can streamline costs by 6.40% and the work time becomes faster from the initial 115 days to 103 working days.

Keywords : Building Information Modeling (BIM), Volume, Cost, Time, Tekla Structure

Introduction

In the era of the industrial revolution 4.0 which is a stage of industrial evolution marked by the widespread adoption of digital technology, artificial intelligence, connectivity, and system integration in various aspects of production and human life. With the start of the industrial revolution 4.0, it certainly has an impact on the construction industry sector. The development of construction services in Indonesia is marked by the many large-scale projects built by the government and the private sector. This fact is an opportunity and challenge for the business community, especially the construction services business (Rani, Hafnidar.2016).

Industrial era 4.0 is marked with development utilization technology information and communication use reach high efficiency and quality more products Good including in the field service construction . One of the principle base technology construction that must be done is with implementing Building Information Modeling (BIM) or technology construction based industry 4.0.

BIM is a new method for infrastructure construction that integrates virtual models with their technical data or information. In Indonesia itself BIM implementation is regulated in regulations issued by the PUPR Ministry in attachment to PUPR Ministerial Regulation No. 22 of 2018 which states : " State Buildings (BGN) with area above 2000m² and above two floors must start implementing BIM in stages planning until with construction ".

Objects project research that will be reviewed in the design task end This is development building UPTP BLK PRABUMULIH office . With a total budget of cost development amounting to Rp. Rp2,730,470,389 (Two Billion Rupiah) Seven Hundred and Three Ten Million Four Hundred Seven tens Thousand Three Hundred and Eight Twenty Nine Rupiah).

Data and Methods

This study is located on the Prabumulih – Baturaja Highway, Karangan, District Mint Kapak Tengah, Prabumulih City, South Sumatra 31115. The location of the building design can be seen in the image below.



Research Location

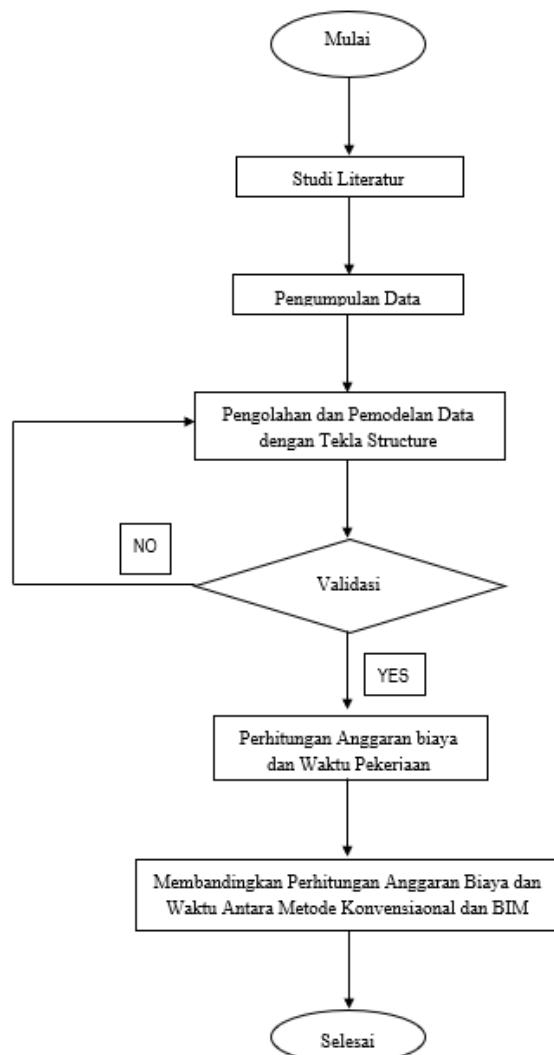


Figure 2 Research Flow Diagram

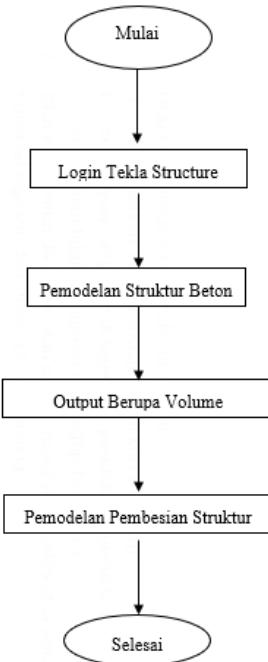


Figure 3 Tekla Structure Flowchart

A. Volume of Work

According to Ministry Work and According to Ibrahim (2012) the volume of a work is count amount the volume of work in One units . Volume is also called as cubication work . So the volume (cubic) of a work , is not is the volume (contents) actually , but volume of parts work in One unity . Not only That According to Maharani and Fajarwati (2006) , the volume of work also influences duration work project construction .

B. Unit Price Analysis Jobs (AHSP)

This analysis is used as a basis for compiling the calculation of the Own Estimated Price (HPS) or *Owner's Estimate* (OE) and the Designer's Estimated Price (HPP) or *Engineer's Estimate* (EE) which is stated as a collection of Unit Prices for all payment items. Analysis price unit can processed manually or use device software . Self-calculation price (HPS) is the result of calculating the entire volume of work multiplied by the Unit Price plus all tax burdens and profits in accordance with the Regulation of the Government Goods/Services Procurement Policy Agency of the Republic of Indonesia Number 12/2021 concerning Guidelines for the Implementation of Government Procurement of Goods and Services Through Providers.

C. Estimate Duration Activity

Estimate cost is a calculation estimated costs can fulfil need in finish a work on a project construction . So in a planning need existence a estimate time to achieve the desired goal can achieved . Failure in manage time will resulting in ineffective planning appropriate time . If planning No appropriate time will have an effect on work next which will be step back too.

$$\text{Bobot Pekerjaan} = \frac{\text{Jumlah Harga Pekerjaan}}{\text{Total harga Pekerjaan}} \quad (1)$$

$$\text{Bobot Pekerjaan Per Hari} = \frac{\text{Bobot Pekerjaan}}{\text{Durasi Pekerjaan}} \quad (2)$$

D. Plan Budget Cost (RAB)

According to the Ministry of Public Works and Public Housing, Human Resources Development Agency, Center for Road, Housing, Settlements, and Regional Infrastructure Development Education and Training written by Dr.Ir. Tri Joko, M.Si, the Cost Budget Plan is a calculation of

the amount of costs required for materials, tools and wages, as well as other costs related to the implementation of the work or project.

$$RAB \text{ (Rencana Anggaran Biaya)} = \sum (Volume \times Harga Satuan) \quad (3)$$

Results and Discussion

1. Volume of Work

Table 1 Volume Comparison

NO	Description Work	Volume	
		Existing	BIM
1	Excavation and Backfill Work	461.93	461.93
2	Work Deep Foundation	7,757.18	6,477.93
3	Concrete Work	17,265.78	11,688.22
4	Floor 1 Work	13,561.88	11,830.22
5	Work 2	7,747.90	10142.39
6	Floor 3 Work	15,118.07	16177.68

2. Plan Budget Cost

Unit Price Analysis Jobs (AHSP 2022)

Table 2 AHSP 2022 Landfill Sand 1 m3

1m3 Sand Fill					
	Need	Unit	Index	Unit Price (Rp)	Total Price (Rp)
Material	Sand Fill	m3	1.2	Rp. 176,000,000	Rp. 211,200.00
Total Material Price					
Labor	Worker	OH	0.75	Rp. 100,000,000	Rp. 30,000.00
	Foreman	OH	0.025	Rp. 160,000,000	Rp. 1,600.00
	Total Labor Wages				Rp. 31,600.00
	Total number				Rp. 242,800.00
	Overhead 8%				Rp. 19,424.00
	Total Unit Price of Work				Rp. 262,200.00

Table 3 Comparison of Total Prices for Concrete Work

N O	Descript ion Work	Project Data				BIM Processing Data				Deviation		
		Volu me	Un it	Unit Price (Rp)	Total Price (Rp)	Volu me	Un it	Unit Price (Rp)	Total Price (Rp)	Volu me	Un it	Total Price (Rp)
1	Mob demob equipme nt stake	-	Ke g	Rp26,68 9,256	Rp-	1.00	Ke g	Rp24,55 4,116	Rp24,554 ,116	-	Ke g	Rp2,135, 140
2	Procure ment Pole SQ 25 4D13 K 450 stake	-	m	Rp244,7 11	Rp-	480. 00	m	Rp225,1 34	Rp108,06 4,477	-	m	Rp9,396, 911
3	Work Erection Pole 25 x 25 cm stake	-	m	Rp209,0 00	Rp-	480. 00	m	Rp192,2 80	Rp92,294 ,400	-	m	Rp8,025, 600
4	Last Joint (Weldin g) / connecti on pole stake	-	uni t		Rp-	80.0 0	uni t	Rp125,3 56	Rp10,028 ,442	-	uni t	Rp872,0 38
5	Bobok (Cutting File) head pole stake	-	uni t	Rp136,2 56	Rp-	40.0 0	uni t	Rp140,0 41	Rp5,601, 622	-	uni t	Rp487,0 98
6	PDA Test (Min 2 points)	-	poi nt	Rp152,2 18	Rp-	2.00	poi nt	Rp8,924, 000	Rp17,848 ,000	-	poi nt	Rp1,552, 000
7	Staruss Pile foundation Ø 30cm h=2m, concrete quality f'c 25 MPa											
	Ready mix concrete	5.66	m3	Rp1,146, 600	Rp6,486, 480	5.00	m3	Rp1,125, 750	Rp5,628, 750	0.66	m3	Rp857,7 30

	F'c 25 MPa											
	Iron reinforcement	1,328 .28	Kg	Rp18,37 5	Rp24,407 ,143	836	Kg	Rp18,04 5	Rp15,086 ,729	492. 22	Kg	Rp9,320, 414
Foundation Borehole Ø 30 h=11 M												
8	Bored Pile Concrete Foundation Excavation Ø30cm h=11 m	440.0 0	m1	Rp517,4 41	Rp227,67 3,987	440. 00	m1	Rp506,4 41	Rp222,83 3,987	-	m1	Rp4,840, 000
	Ready mix concrete F'c 25 MPa	31.11	m3	Rp1,146, 600	Rp35,675 ,640	28.0 9	m3	Rp1,125, 750	Rp31,618 ,501	3.03	m3	Rp4,057, 139
	Iron reinforcement	4,869 .12	Kg	Rp18,37 5	Rp89,470 ,160	4086	Kg	Rp18,04 5	Rp73,727 ,875	783. 35	Kg	Rp15,74 2,285

3. Estimate Duration Work

Table 4 Estimates Duration Work

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors	October 10/1	10/8	10/15	10/22	
1	✓	1 Pekerjaan Galian dan Urug	7 days	Wed 10/11/23	Tue 10/17/23						
2	✓	1.1 Galian Tanah pondasi pi1 day		Thu 10/12/23	Thu 10/12/23						
3	✓	1.2 Galian Tanah Pondasi Strauss Pile Ø 30 cm h=2	1 day	Wed 10/11/23	2						
4	✓	1.3 Galian Tanah Pondasi pi1 day		Thu 10/12/23	Thu 10/12/23	2,3					
5	✓	1.4 Pasir urug bawah lantai , tebal 100 mm	1 day	Fri 10/13/23	Sat 10/14/23	2,3,4					
6	✓	1.5 Pasir Urug Bawah Pilec	1 day	Sun 10/15/23	Sun 10/15/23	5,2,3,4					
7	✓	1.6 Urugan kembali dan Pemadatan Bekas Galian Pondasi	1 day	Sun 10/15/23	Mon 10/16/23	6,2,3,4,5					
8	✓	1.7 Urugan Tanah Peninggian Pile Bangunan	1 day	Mon 10/16/23	Tue 10/17/23	7,2,3,4,5,6					
9		2 Pekerjaan Pondasi Dalam	20 days	Thu 10/19/23	Sun 11/5/23						
10	✓	2.1 Mob demob peralatan pi1 day		Thu 10/19/23	Thu 10/19/23	8					
11	✓	2.2 Pengadaan Tiang pancang SQ 25 4D13 K	1 day	Fri 10/20/23	Fri 10/20/23	10					
12	✓	2.3 Pekerjaan Pemasangan Tiang		Sat 10/21/23	Sat 10/21/23	11,10					
13	✓	2.4 Last Joint Welding / Penyambungan Tiang	2 days	Sun 10/22/23	Mon 10/23/23	12,10,11					
14	✓	2.5 Cutting File Kepala Tiang Pancang	2 days	Tue 10/24/23	Wed 10/25/23	13,11,12					
15	✓	2.6 PDA Test (Min 2 titik)	1 day	Thu 10/26/23	Thu 10/26/23	14,11,12,13					
Project: Tugas Akhir Fadillah Al Date: Mon 8/12/24			Task	Inactive Summary	External Tasks						
			Split	Manual Task	External Milestone						
			Milestone	Duration-only	Deadline						
			Summary	Manual Summary Rollup	Critical						
			Project Summary	Manual Summary	Critical Split						
			Inactive Task	Start-only	Progress						
			Inactive Milestone	Finish-only	Manual Progress						

Conclusion

BIM is one of the breakthroughs in the field of building design or modeling that is being developed and continuously studied because it can help shorten design time and facilitate collaboration between teams. BIM is expected to change the flow of design and tender work in Indonesia. The results of the UPTP BLK Prabamulih building modeling work obtained several results, namely:

1. The volume of work obtained using the BIM method can make the calculation of the volume of work more accurate, as can be seen in Table 6.

Table 6 Comparison of Existing and BIM Volumes

NO	Job description	Existing Volume	BIM Volume
1	Excavation and Backfill Work	461.9	461.9
2	Work Deep Foundation	7757.2	6477.9
3	Concrete Work	17265.8	11688.2
4	Floor 1 Work	13561.9	11830.2
5	Work 2	7747.9	10142.4
6	Floor 3 Work	15118.1	16177.7
Amount		61912.7	56778.4

2. Based on the RAB calculations that have been carried out, the use of the BIM method can reduce the costs that will be incurred during the project work by 6.40% where the costs incurred for the existing contractor method are Rp 2,730,470,389 while the RAB calculation using the BIM method is Rp 2,555,664,600 as can be seen in table 7.

Table 7 Comparison of Total Prices Between Existing and BIM

NO	Job description	Total price	Total price
1	Excavation and Backfill Work	Rp. 68,361,745	Rp. 67,138,341
2	Work Deep Foundation	Rp. 664,573,255	Rp. 607,286,899
3	Concrete Work	Rp. 742,300,712	Rp. 614,317,510
4	Floor 1 Work	Rp. 571,815,306	Rp. 497,087,621
5	Work 2	Rp. 322,560,586	Rp. 369,698,926
6	Floor 3 Work	Rp. 360,858,785	Rp. 400,135,304
Amount		Rp. 2,730,470,389	Rp. 2,555,664,600

3. Then, in terms of efficiency of work implementation time, BIM can shorten the work from the initial 115 days to only 103 days, as seen in the S-Curve attachment.

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