

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).

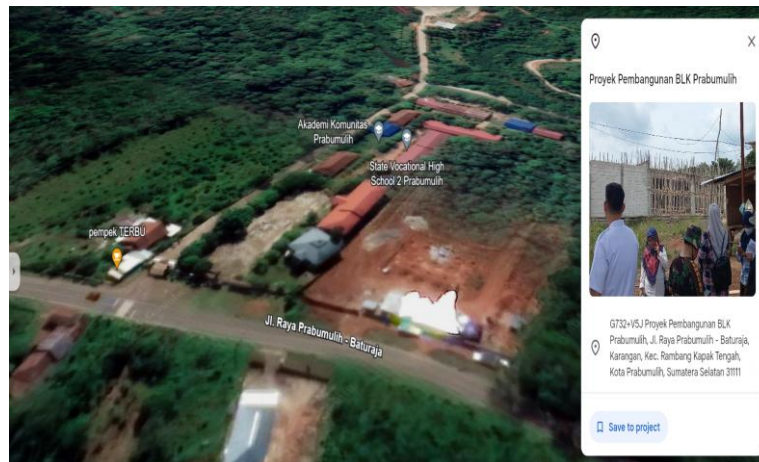
industrial era 4.0 is marked with development utilization technology information and communication use reach high efficiency and quality more products Good including in the field service construction . One of the principle base technology construction that must be done is with implementing Building Information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

Study This 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

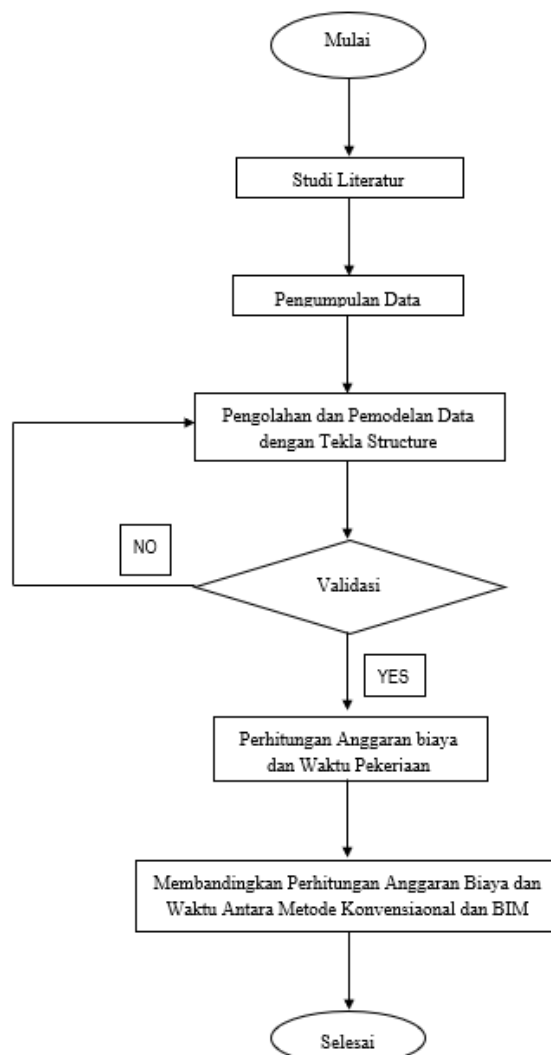


Figure 2 Research Flow Diagram

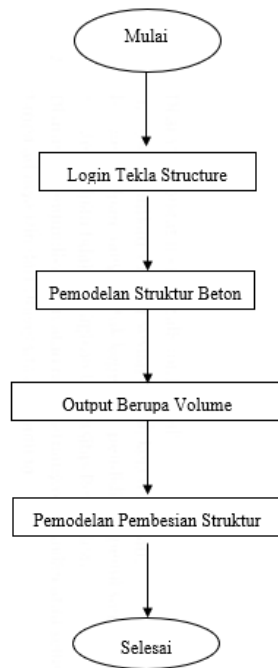


Figure 3 Tekla Structure Flowchart

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.

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

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

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.

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

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 | | | | |
| | | | | 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 | Rp18,375 | Rp24,407,143 | 836 | Kg | Rp18,045 | Rp15,086,729 | 492.22 | Kg | Rp9,320,414 |
| 8 | Foundation Borehole Ø 30 h=11 M | | | | | | | | | | | |
| | Bored Pile Concrete Foundation Excavation Ø30cm h=11 m | 440.00 | m1 | Rp517,441 | Rp227,673,987 | 440.00 | m1 | Rp506,441 | Rp222,833,987 | - | m1 | Rp4,840,000 |
| | Ready mix concrete F'c 25 MPa | 31.11 | m3 | Rp1,146,600 | Rp35,675,640 | 28.09 | m3 | Rp1,125,750 | Rp31,618,501 | 3.03 | m3 | Rp4,057,139 |
| | Iron reinforcement | 4,869.12 | Kg | Rp18,375 | Rp89,470,160 | 4086 | Kg | Rp18,045 | Rp73,727,875 | 783.35 | Kg | Rp15,742,285 |

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 p1 | 1 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 | Wed 10/11/23 | 2 | | | | |
| 4 | ✓ | 1.3 Galian Tanah Pondasi p1 | 1 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 Pilecap | 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 p1 | 1 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 Pemancangan Tiang | 1 day | 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, Manual Task, Duration-only, Manual Summary Rollup, Manual Summary, Start-only, Finish-only

Milestone: Inactive Milestone

External Tasks: External Milestone, Deadline, Critical, Critical Split, Progress, Manual Progress

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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 Prabumulih 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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