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Modeling And Cost Planning For The Tanjungpandan District Court Building Project Using Building Information Modeling (BIM) Method

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ABSTRACT

Infrastructure development in Indonesia is currently in a fairly massive development phase. To support this, the government of the Republic of Indonesia improves the quality of national development by continuing to adapt to existing technological developments, one of which is Building Information Modeling (BIM). In this case, the use of BIM in planning and designing a construction object becomes easier because it can be done simultaneously. In addition, the design produced through the BIM method also contains data and information that can be used in other phases of construction. One of the data produced is the quantity of materials that can be used to estimate construction costs. In this study, the use of the BIM method is intended to determine the comparison of the costs generated to the cost of conventional methods of the project. The results of the cost calculation obtained by the BIM method are cumulatively -2,06% lower than the conventional method. There is a varying cost deviation for each work item, with the smallest cost deviation being +0,48% for beam structure work and the largest cost deviation being +126,26% for stair work.

INTRODUCTION

Infrastructure development in Indonesia is currently in a fairly massive development phase. This is shown as a form of improving public services by the Government of the Republic of Indonesia. One of the areas that has been improved is the field of community services related to law and justice for the community in criminal and civil matters through judicial institutions. Through the Annual Report of the Supreme Court of the Republic of Indonesia in 2023, based on Presidential Decrees Number 13 to Number 18 of 2016 concerning the Establishment of New Courts in various regions in Indonesia, it is recorded that in 2023 there will be as many as 85 new court buildings that are being built in stages. In addition to the construction of a new courthouse, there are also several renovations of existing court buildings, one of which is the Renovation and Expansion of the Tanjungpandan District Court Office Building.

Currently, the construction industry in Indonesia is influenced by the progress of the industrial era 4.0 which prioritizes the integration of construction processes through digital systems to create better productivity and growth (Fadhilah et al., 2022). To support this, the government of the Republic of Indonesia improves the quality of national development by continuing to adapt to existing technological developments, one of which is Building Information Modeling (BIM). BIM is a breakthrough in the world of construction in the form of improvement and efficiency based on data integration between multidisciplines that allows every party involved in a construction activity to coordinate with each other in the same scope without being limited by

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space and time. The challenges in the application of BIM that are widely found today are the limited competent workforce, changes in work culture, and the amount of investment required in the application of this BIM method. In addition, there are no applicable standards and regulations so that the implementation of this method has not been carried out properly (Pantiga & Soekiman, 2021). Through the Regulation of the Minister of Public Works and Public Housing Number 22 of 2018, it is mandatory to apply Building Information Modeling (BIM) to the construction work of state buildings with an area of more than 2.000 m^2 and more than two floors.

Building Information Modeling (BIM) is a set of technologies, processes, and policies with each stage integrated with each other in the form of digital models (Albab & Erizal, 2021). BIM is also one of the promising developments in the field of AEC (Architecture, Engineering, and Construction) which produces virtual modeling of buildings digitally (Irawan et al., 2021). The application of BIM allows the design, procurement, and construction stages to be interconnected and cross-referenced information including manuals, spesifications, commisioning data, photos, and warranty details (Lavanya & Prasad, 2017). In terms of construction planning, the difference in the duration of the time needed in the planning stage using the BIM method is 50% faster than the conventional method (Berlian P. et al., 2016). In the design stage, BIM is very important because the majority of decision-making is made at the design stage which will simplify the process and efficiency (Nugrahini & Permana, 2020). The basis for using the BIM method is to model a construction object into a 3-dimensional (3D) form to obtain the working drawings needed for quantity calculation and cost estimation which simplifies the planning stage (Adhitama et al., 2020). BIM can be classified into several dimensions of the model based on its function. Currently, BIM can accommodate 2-dimensional (2D) models for 2D working drawing design, 3-dimensional (3D) models for coordination and clash detection, 4-dimensional (4D) models for planning and tracking project activities, 5-dimensional (5D) models for cost estimation, 6-dimensional (6D) models for energy analysis, and 7-dimensional (7D) models for building life cycle analysis (Sangadji et al., 2019).

In this study, the modeling carried out is a 5-dimensional (5D) model with a quantity take off material generated through the BIM method used as the basis for calculating cost estimates. Estimating the quantity of construction take off is an important component in the implementation of a construction project. So it needs to be done in detail so that the volume of work produced is more accurate (Apriansyah, 2021). However, in its application, this quantity estimation does not take into account other factors such as labor, licensing, insurance, equipment, or other incidental things (Ardiansyah, 2024). In general, Quantity Take Off (QTO) work on projects is done manually so that there are often errors in dimension readings, data input, and so on (Ramdani et al., 2022). So that the use of BIM in the aspect of QTO calculation is considered more effective because it is carried out automatically through a 3-dimensional modeling database which can make it easier to monitor the results of volume calculations (Saputra, 2023). The calculation of the volume of a work is carried out through a measurement system in the field for the purpose of estimating costs and workloads. The result of the volume measurement is commonly known as the Bill of Quantity (BOQ) (Ikhwan & Herzanita, 2024).

Cost planning is the main basis in the financing system offering and the budget framework that will be issued includes the many costs required for materials, wages, and other costs related to the implementation of construction (Budi et al., 2018). The amount of the planned budget based on the unit price of work to the volume of work is in accordance with the design plan. The amount of the planned construction cost budget can vary in each region. This is due to the difference in material prices and labor wages in each region. For that reason, the government of the Republic of Indonesia through the Ministry of Public Works and Public Housing has made a Work Unit Price Analysis (AHSP). AHSP is a calculation of the need for labor, materials, and equipment costs to get the unit price for certain work listed in the Regulation of the Minister of Public Works and Public Housing (PUPR) (Siregar et al., 2022).

The purpose of this study is to plan costs through 3D modeling using the BIM method and obtain QTO materials that will be used in cost calculations. Then the amount of cost obtained through the BIM method will be compared with the project cost to find out the difference between

the BIM method and the project. The application of BIM method in cost planning obtained lower results of 1,88% compared to conventional methods (Suasira et al., 2021). In another study, the use of the BIM method can result in cost savings of 12,07% for concrete and rebar work (Pratama et al., 2024). The research is limited to structural and architectural work based on secondary data from the project in the form of shop drawings and Bill of Quantity (BoQ) with the price of the work unit equalized using AHSP.

RESEARCH METHODS

In this study, the method used is the quantitative method. The quantitative method is a research method with data obtained in the form of numbers or qualitative data converted into numerical parameters which are then analyzed using a processing method through the calculation stages of the data as a form of solution to a problem being reviewed (Sugiyono, 2013). Research was conducted on the Renovation and Expansion of the Tanjungpandan District Court Office Building project located on Jalan Sriwijaya No.1, Tanjungpandan, Belitung Regency, Bangka Belitung.

Figure 1. Research Location

In this research, the secondary data obtained was then learned and 3D modeling of structures and architectures was carried out using the Autodesk Revit application. Revit is a Building Information Modeling application developed by Autodesk for the purpose of calculation and structural engineering with integrated features for detailers, fabricators, manufacturers, and constructors (Anjani et al., 2022). 3D modeling using Autodesk Revit includes creating 3D visuals and Detailed Engineering Design (DED). The choice of the Autodesk Revit application for BIM modeling is because the application is a commonly used application and there is a lot of information related to its operation. In addition, Autodesk Revit can also generate data in the form of material quantity take off which will later be used in cost budget planning. The steps in BIM modeling are carried out through the following stages:

1. Determination of units used in modeling.
2. Creating a grid and determining the elevation to be used.
3. Modeling of structural elements in the form of sloofs, columns, beams, plates and other structural elements.
4. Modeling of architectural elements in the form of walls, doors, windows, ceilings, and other architectural elements.
5. Create a Detail Engineering Design (DED) drawing using sheets in Autodesk Revit.
6. Create a material quantity take off by using the material schedule view in Autodesk Revit.

Figure 2. Autodesk Revit

After going through the modeling stage in Autodesk Revit, the next stage is the preparation of a Cost Budget Plan (RAB) using the volume of material quantity take off that has been generated. Cost budget planning is carried out using the Microsoft Excel application. The steps in the preparation of the Cost Budget Plan are carried out through the following stages:

1. Prepare supporting data in the form of basic price of wages and materials for the Bangka Belitung area, Work Unit Price Analysis (AHSP), and material volume quantity take off.
2. Buat harga satuan kerja dengan menghitung biaya pekerja, biaya bahan, dan biaya alat untuk setiap item kerja sesuai dengan RAB proyek.

   Labor cost = worker analysis coefficient x worker wages (1)

   Material cost = material analysis coefficient x material price (2)

   Tool cost = tool analysis coefficient x tool price (3)

   Unit price = labor cost + material cost + tool cost (4)
3. Calculate the cost for each work item by multiplying the volume of work from the Revit take off material by the unit price of the work generated from AHSP.

   Work unit cost = unit price x work unit volume (5)
4. Create a recapitulation of the cost value generated from each work item.

Figure 3. Microsoft Excel

The Cost Budget Plan generated through the BIM method is then analyzed by comparing the project cost obtained from the project. A comparison is made of the volume of work produced by the BIM method to the volume of work of each work item contained in the project cost and the amount of the cost budget generated. The analysis was carried out to find out the factors that cause the difference in work volume and the value of the costs generated between the BIM method cost and the project cost.

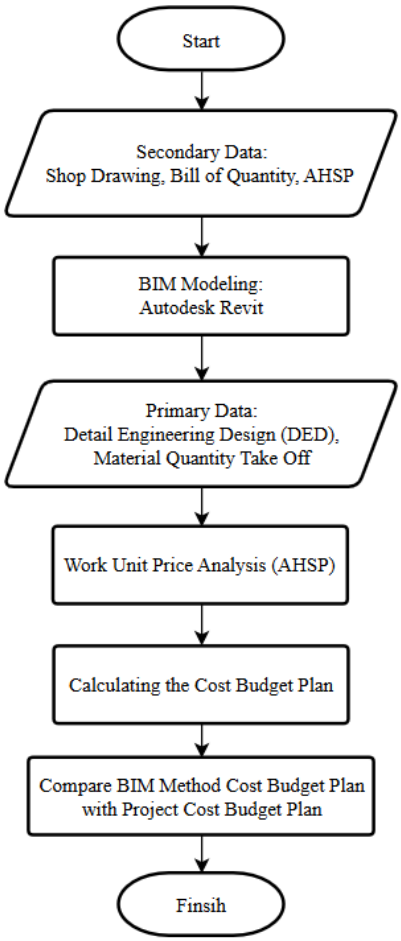

Figure 4. Research Flow Chart

RESULTS AND DISCUSSION

BIM Modeling

Building Information Modelling (BIM)-based modeling is a form of visualization of the design of a construction work in the form of a three-dimensional (3D) model that can be integrated with two-dimensional (2D) drawings. In addition to three-dimensional and two-dimensional models, BIM-based modeling also contains data and information related to the materials used, classification of construction elements, material quantity, and other data that can be useful for other planning scopes. In this study, modeling was carried out on secondary data in the form of shop drawings of structures and architectures modeled into three-dimensional (3D) form using the Autodesk Revit application.

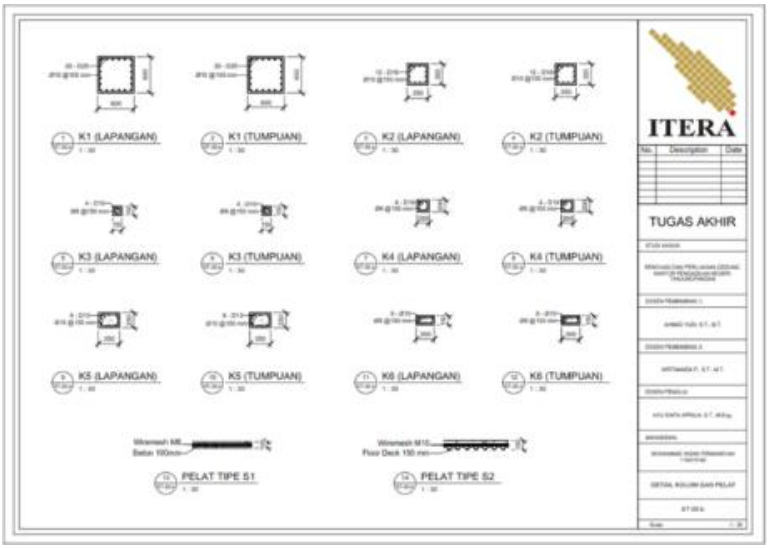

Figure 5. Structure Details

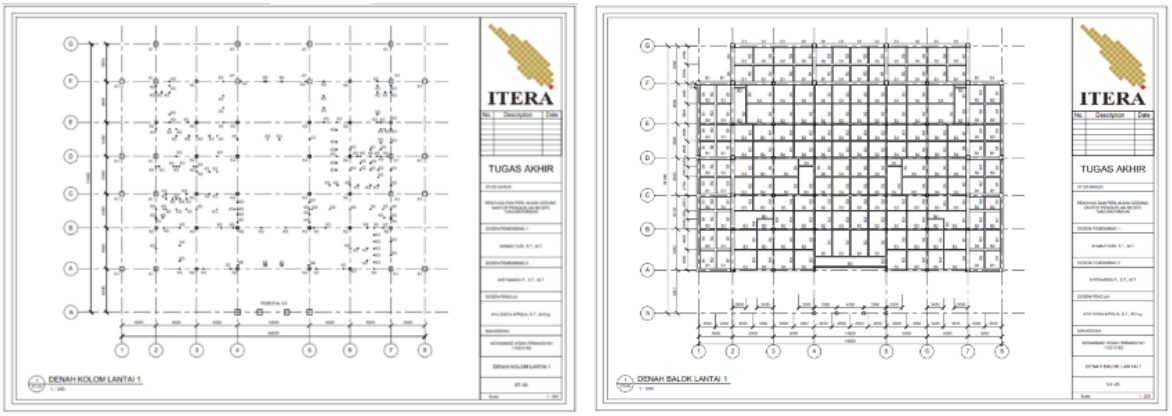

Figure 6. Structural Plan

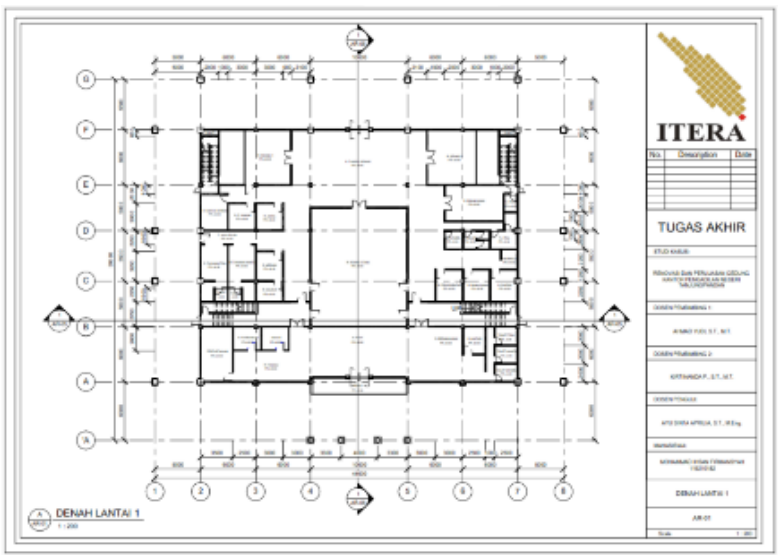

Figure 7. Architectural Plan

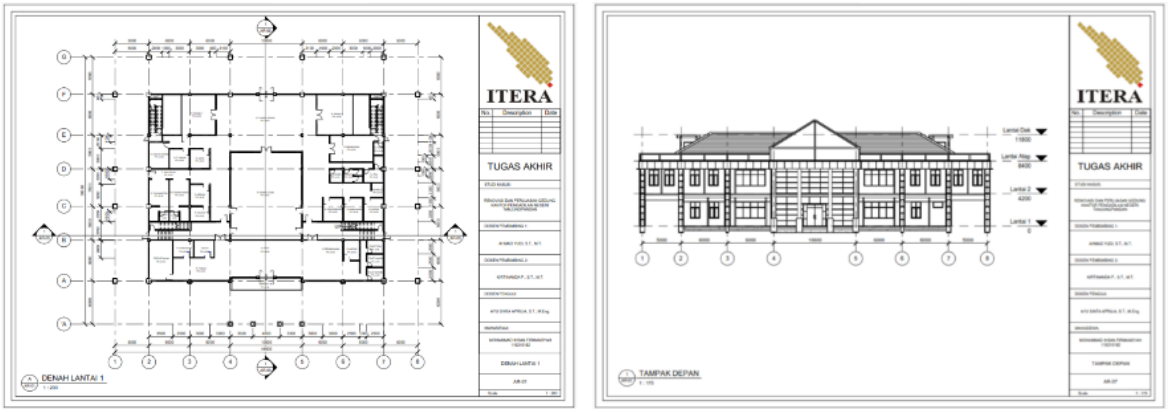

Figure 8. Architectural Section and View

Figure 9. 3D Architectural

Quantity Take Off (QTO)

The advantage of using the BIM method in construction planning is the availability of a construction model based on data and information. This allows the construction model that has been created to be developed up to several dimensions of analysis. In this case, BIM modeling is carried out is a 5-dimensional (5D) model to calculate cost estimates. So that the data required from this BIM modeling is quantity take off (QTO) with the following results:

Table 1. Structural Volume

Job Description	BIM Method		Project Method	
	Volume	Unit	Volume	Unit
Rebar				
Sloof	7.027,88	kg	10.868,55	kg
Column	27.248,42	kg	26.032,00	kg
Beam	56.568,88	kg	64.613,71	kg
Floor Plate	78.082,07	kg	113.059,55	kg

Stair	3.168,11	kg	691,01	kg
Formwork				
Sloof	539,48	m^2	413,02	m^2
Column	1.637,12	m^2	1.447,05	m^2
Beam	2.167,09	m^2	1.704,20	m^2
Floor Plate	3.574,99	m^2	2.519,24	m^2
Stair	129,14	m^2	46,97	m^2
Concrete				
Sloof	32,83	m^3	39,72	m^3
Column	120,18	m^3	121,47	m^3
Beam	210,82	m^3	240,32	m^3
Floor Plate	481,65	m^3	324,05	m^3
Stair	11,27	m^3	10,53	m^3

Table 2. Architectural Volume

Job Description	BIM Method		Project Method	
	Volume	Unit	Volume	Unit
Wall				
Brick Wall	3.023,54	m^2	4.966,10	m^2
Wall Plaster	6.047,08	m^2	9.029,28	m^2
Wall Finish Coat	6.047,08	m^2	9.029,28	m^2
Roof				
Truss	1.104,96	m^2	981,99	m^2
Roof Finish	1.104,96	m^2	981,99	m^2
Ridge	151,90	m	118,90	m
Fascia	189,25	m	128,00	m
Gutter	91,80	m	128,00	m
Door, Window, and Aluminium Composite Panel (ACP)				
Door	72,00	unit	69,00	unit
Window	111,00	unit	109,00	unit
Partition Wall	34,00	unit	37,00	unit
ACP	418,90	m^2	532,67	m^2

Floor				
Floor Tiles	2.156,38	m^2	2.018,40	m^2
Toilet Floor Tiles	73,02	m^2	101,64	m^2
Disabled Floor	19,31	m^2	35,85	m^2
Wall Tiles	302,94	m^2	198,70	m^2
Skirting Tiles	441,79	m	178,00	m
Ceiling				
Frame	2.659,18	m^2	2.593,90	m^2
Ceiling Finish	2.659,18	m^2	2.593,90	m^2
Ceiling Lis	2.039,62	m	396,88	m
Painting				
Primer	6.047,08	m^2	2.089,50	m^2
Waterproofing	1.108,73	m^2	728,50	m^2
Interior	1.511,77	m^2	2.178,60	m^2
Exterior	4.535,31	m^2	2.089,50	m^2

Cost Budget Plan

The cost budget plan is a calculation carried out on an object which in this case is construction work to determine the amount of budget needed to carry out construction work based on existing supporting data such as work drawings, technical specifications, work unit prices, and other necessary supporting data. Cost budget planning is carried out on the volume of material quantity take off obtained from Autodesk Revit modeling and Work Unit Price Analysis (AHSP) in 2022.

Table 3. Recapitulation of the Cost Budget Plan

Job Description	BIM Method Cost Budget		Project Cost Budget		Deviation
Structural					
Sloof	Rp	396.327.920,45	Rp	475.062.278,45	-16,57%
Column	Rp	1.733.497.679,08	Rp	1.653.425.464,82	+4,84%
Ring Beam	Rp	2.956.784.286,07	Rp	2.942.540.202,70	+0,48%
Concrete Plate	Rp	5.403.864.917,26	Rp	4.839.670.627,35	+11,66%
Architectural					
Wall	Rp	2.624.432.720,00	Rp	4.140.827.808,00	-36,62%
Roof	Rp	768.418.124,00	Rp	682.345.316,03	+12,61%
Door, Window, Accessory, and ACP	Rp	1.509.610.322,35	Rp	1.590.550.836,55	-5,09%
Floor and Wall Ceramic	Rp	1.139.210.880,00	Rp	1.030.652.420,00	+10,53%
Ceiling	Rp	1.162.392.284,65	Rp	1.067.151.826,60	+8,92%

Painting and Waterproofing	Rp	451.726.940,00	Rp	267.570.000,00	+68,83%
Stair	Rp	279.876.714,62	Rp	123.697.605,38	+126,26%
Cost Budget Value	Rp	18.426.142.788,48	Rp	18.813.494.385,87	
PPN (11%)	Rp	2.026.875.706,73	Rp	2.069.484.382,45	**-2,06%**
Total	Rp	20.453.018.495,21	Rp	20.882.978.768,32	
Rounding of Values	**Rp**	**20.453.018.496,00**	**Rp**	**20.882.978.769,00**	

CONCLUSION

Based on the results of the analysis, it was concluded that the cost budget plan calculated using the BIM method obtained a value of Rp 20.453.018.496,00 with a deviation in the cost value obtained between the calculation using the BIM volume to the BOQ volume cumulatively of -2,06%. The smallest deviation obtained was the beam structure work of +0,48% and the largest deviation was obtained in the staircase work of +126,26%.

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REFERENCES

Adhitama, A. R., Ratnaningsih, A., & Kriswardhana, W. (2020). Penerapan Metode Building Information Modeling (BIM) Pada Pembangunan Gedung Integrated Laboratory for Natural Science and Food Technology Universitas Jember. *Jurnal Rekayasa Sipil Dan Lingkungan*, *4*(2), 113–119. https://doi.org/10.19184/jrsl.v4i2.11683

Albab, A. U., & Erizal. (2021). Analisis Kinerja Waktu dan Penerapan Building Information Modeling pada Proyek Pembangunan Jasmine Park Apartment Bogor. *Jurnal Teknik Sipil Dan Lingkungan (JSIL)*, *6*(1), 11–22. https://doi.org/10.29244/jsil.6.1.11-22

Anjani, A., Bayzoni, Husni, H. R., & Niken, C. (2022). Penerapan Building Information Modeling (BIM) Menggunakan Software Autodesk Revit Pada Gedung 4 Rumah Sakit Pendidikan Perguruan Tinggi Negeri (RSPTN) Universitas Lampung. *Journal Rekayasa Sipil Dan Desain (JRSDD)*, *10*(1), 87–98.

Apriansyah, R. (2021). *Implementasi Konsep Building Information Modeling (BIM) Dalam Estimasi Quantity Take Off Material Pekerjaan Struktural*.

Berlian P., C. A., Adhi, R. P., Hidayat, A., & Nugroho, H. (2016). Perbandingan Efisiensi Waktu,Biaya dan Sumber Daya Manusia Antara Metode Building Information Modeling (BIM) dan Konvensional (Studi kasus : Perencanaan Gedung 20 Lantai). *Jurnal Karya Teknik Sipil*, *5*(2), 220–229.

Budi, M. R. S., Suhartinah, & Manggala, A. S. (2018). Perbandingan Estimasi Anggaran Biaya dan Schedule Proyek Pembangunan Rumah Sakit Al Huda Banyuwangi Menggunakan Metode SNI dan Metode BOW. *Jurnal Rekayasa Infrastruktur Hexagon*, *3*(2), 27–35. https://doi.org/https://doi.org/10.32528/hgn.v3i2.2914

Fadhilah, A., Purwanto, E., & Basuki, A. (2022). Aplikasi Building Information Modeling (BIM) Dalam Perancangan Bangunan Gedung. *Jurnal Matriks Teknik Sipil*, *10*(3), 264–271. https://doi.org/10.20961/mateksi.v10i3.55999

Ardiansyah, I. P. (2024). *Implementasi Konsep Building Information Modeling (BIM) 5D Pada Perencanaan Konstruksi Jembatan (Studi Kasus : Jembatan Sungai Kampar Tol Rengat - Pekanbaru)*.

Ikhwan, N. A. H., & Herzanita, A. (2024). Implementasi Konsep BIM Dalam Perhitungan Volume Pada Struktur Atap Untuk Pekerjaan Beton dan Baja Studi Kasus : Lantai 5 Proyek Gedung Extension Fakultas Ilmu Komunikasi , Universitas Pancasila. *Jurnal Artesis*, *4*(2), 147–155.

Irawan, D. O. P., Trisiana, A., & Sukmawati, S. (2021). Penerapan Building Information Modeling (BIM) Dalam Analisis Waktu Dan Anggaran Biaya Struktur dan Arsitektur (Studi Kasus : Gedung Fakultas Ilmu Komputer Universitas Jember). *Journal of Applied Civil Engineering And Infrastructure Technology (JACEIT)*, *2*(1), 35–39. http://journal.isas.or.id/index.php/JACEIT

Lavanya, N., & Prasad, D. S. V. (2017). 3D Modeling and Clash Deduction of PBS-Television Center Hawaii. *World Journal of Research and Review (WJRR)*, *4*(6), 19–24.

Saputra, M. (2023). *Penerapan Konsep Building Information Modeling (BIM) Dalam Perancangan DED dan Estimasi Quantity Take Off Pada Gedung Bertingkat (Studi Kasus : Proyek Pembangunan Gedung dan Pagar Kantor Wilayah DJBC Sumatera Bagian Barat)*.

Nugrahini, F. C., & Permana, T. A. (2020). Building Information Modelling (BIM) dalam Tahapan Desain dan Konstruksi di Indonesia, Peluang Dan Tantangan : Studi Kasus Perluasan T1 Bandara Juanda Surabaya. *AGREGAT*, *5*(2), 459–467. https://doi.org/10.30651/ag.v5i2.6588

Pantiga, J., & Soekiman, A. (2021). Kajian Implementasi Building Information Modeling (BIM) di Dunia Konstruksi Indonesia. *Rekayasa Sipil*, *15*(2), 104–110. https://doi.org/10.21776/ub.rekayasasipil.2021.015.02.4

Pratama, R. E., Hendriyani, I., & Pratiwi, R. (2024). Implementasi Konsep Building Information Modelling (BIM) 5D Pada Pekerjaan Struktur Untuk Efisiensi Biaya Proyek. *Jurnal Teknologi Terpadu*, *12*(2).

Ramdani, I., Paikun, Rozandi, A., Budiman, D., & Vladimirovna, K. E. (2022). Implementasi Building Information Modeling (BIM) Pada Proyek Perumahan. *Jurnal TESLINK : Teknik Sipil Dan Lingkungan*, *4*(1), 1–15. https://doi.org/10.52005/teslink.v4i1.105

Sangadji, S., Kristiawan, S. A., & Saputra, I. K. (2019). Pengaplikasian Building Information Modeling (BIM) Dalam Desain Bangunan Gedung. *Matriks Teknik Sipil*, *7*(4), 381–386. https://doi.org/10.20961/mateksi.v7i4.38475

Siregar, H. K. A., Harahap, S., & Puspita, N. R. (2022). Analisa Perbandingan Nilai Harga Satuan Pekerjaan (AHSP) Dengan Nilai Harga Standar Nasional Indonesia (Sni) Pada Pekerjaan Pembangunan Gedung / Ruang Baru Puskesmas Padangmatinggikota Padangsidimpuan. *Statika*, *5*(1), 60–70.

Suasira, I. W., Tapayasa, I. M., Santiana, I. M. A., & Wibawa, I. G. S. (2021). Analisis Komparasi Metode Building Information Modeling (BIM) Dan Metode Konvensional Pada Perhitungan RAB Struktur Proyek (Studi Kasus Pembangunan Pasar Desa Adat Pecatu). *Jurnal Teknik Gradien*, *13*(01), 12–19.

Sugiyono. (2013). *Metode Penelitian Kuantitatif Kualitatif Dan R&D*. Alfabeta.