International Journal of Civil Engineering and Infrastructure
Vol. 4, No. 1, October 2024

TIME AND COST MANAGEMENT ANALYSIS OF THE FORMWORK AND REINFORCEMENT WORK (COLUMNS, BEAMS, AND SLABS) FOR THE 2ND FLOOR AMENITIES IN THE OFFICE BUILDING DEVELOPMENT PROJECT OF THE KNOWLEDGE HUB BSD CITY

Leonardus Nosi[1], Sempurna Bangun[2], Kristina Sembiring[3], Pio Ranap Tua Naibaho[3]
[1]Civil Engineering Study Program, Tama Jagakarsa University, TB. Simatupang Street No.152, Indonesia
Correspondence email: eonardus061192@gmail.com
[1]Civil Engineering Study Program, Tama Jagakarsa University, TB. Simatupang Street No.152, Indonesia
Email: sempurnabangun76@gmail.com
[1]Civil Engineering Study Program, Tama Jagakarsa University, TB. Simatupang Street No.152, Indonesia
Email: kristinasembiring70@gmail.com
[1]Civil Engineering Study Program, Tama Jagakarsa University, TB. Simatupang Street No.152, Indonesia
Email: piorthnaibaho@gmail.com

Received May 14, 2020 | Accepted July 02, 2024

ABSTRACT

A project is a business activity that is complex, non-routine in nature, has limited time, budget and resources and has its own specifications for the product to be produced. With the existence of several limitations in working on a project, an organization in the project is needed to manage the resources (equipment, budget, and workforce) owned so that they can carry out synchronous activities so that the project objectives can be achieved. In construction projects every building material uses concrete material, which in practice, especially in the last 10-20 years, concrete has been increasingly used. To obtain the planned concrete shape and to harden it, we need formwork or moulds. The Knowledge Hub BSD City office building project is built on an area of 1.1 hectares covering a building area of 54,956 m2 consisting of 11 floors. This location is located on Jalan Raya BSD Barat, Sampora, Cisauk District, Tangerang Regency, Banten Province. The research objective for the analysis of these calculations starts from calculating the duration of each job based on cost and time calculations obtained from existing technical drawing data. The research method used is the calculation of formwork (columns, beams and slabs) through the Microsoft Excel application.

Keywords: *Formwork, Reinforcement Work, Budget, Workforce*

1. PRELIMINARY

A project is a complex business activity, is not routine, has limitations on time, budget, and resources and has its own specifications for the products to be produced. With several limitations in working on a project, an organization in the project is needed to manage the resources (equipment, budget, and workforce) owned in order to carry out synchronous activities so that project objectives can be achieved.

The Knowledge Hub office construction project is being carried out in the BSD City area, Cisauk District, South Tangerang, Banten Province. BSD City is also currently transforming itself into a smart integrated digital city (Smart Integrated Digital City) to develop a special commercial area for the technology industry called Digital Hub BSD City. This area will also later be used as a community, educational institution, start-up, and multinational company in the fields of technology, digital, and creative industries.

The construction of high-rise buildings cannot be separated from concrete construction work. In concrete construction work itself, there are three components that must be considered, namely concrete mixture, concrete reinforcement, and formwork. A formwork construction must meet the requirements of strength, stiffness, and stability. This requirement must be met considering that concrete molding/formwork is a job that is done repeatedly on multi-storey buildings and requires large costs to make (American Concrete Institute).

Problem Statement

The problem formulations concluded from this proposal include:

a. How is the calculation of time and cost for formwork and reinforcement work (columns, beams, and plates) on the 2nd floor of amenities in the Knowledge Hub office building?
b. Factors that affect the process of formwork and reinforcement work (columns, beams, and plates) on the 2nd floor of amenities in the Knowledge Hub office building?

Purpose of Writing

The objectives obtained from the formulation of the problem in writing this report include:

a. Knowing the time and cost for formwork and reinforcement work (columns, beams, and plates) on the 2nd floor of the Knowledge Hub office building amenities.
b. Knowing the factors that influence the process of formwork and reinforcement work (columns, beams, and plates) on the 2nd floor of the Knowledge Hub office building amenities.

Research Significance

The benefits of this research for readers and writers include:

a. Can be used as a guideline in knowing the time and cost management of the formwork and reinforcement work process (columns, beams, and plates).
b. Can be the basis for conducting more in-depth research on the topic of systems in the formwork and reinforcement work process (columns, beams, and plates).

Problem Boundaries

In order for this discussion to be more focused and the results obtained to be more accurate, the problem limitations in this writing include::

a. The sources in this study are parties directly involved in the construction project of the Knowledge Hub BSD City office building.
b. The work observed is the formwork and reinforcement work (columns, beams, and plates) of the 2nd floor of amenities.
c. The formwork and reinforcement work method used in the field is the conventional method with wood material.
d. The object of the study is the location of the Knowledge Hub BSD City office building construction project.

2. LITERATURE REVIEW

Definition of Analysis

Analysis is an activity to examine or investigate an event through data in order to

find out the actual situation. Generally, analysis is usually used in the context of research or data processing, and the results of the analysis are expected to he

lp improve understanding and encourage decision-making. Another definition of analysis according to KBBI is an investigation of an event (essay, action, and so on) to find out the actual situation which includes the cause, the facts of the case, and so on. Analysis is also the breakdown of a topic into its various parts and the study of the parts themselves.

Construction Project Management

a. Definition
   Project management is a science about how to lead an organization which includes planning, implementing, and controlling limited resources in an effort to achieve goals and objectives effectively and efficiently.
b. Project Objectives and Constraints in the Project

   In the process of achieving a project's goals, there are three constraints that must be met or known as the Trade-off Triangle or Triple Constraint. Triple Constraint itself is an effort to achieve goals based on 3 (three) limitations, including:

   1) On Budget

      The project must be carried out at a cost that does not exceed the established budget, be it the cost of each work item, the cost of each implementation period, or the total cost until the end of the project.

   2) On Time

      The project must be completed within a time frame that is in accordance with the planned process implementation schedule, which is shown in the form of work progress.

   3) On Quality

      Product quality or what is called performance must meet several specifications and criteria at the level/standard required by the owner of the work so as to produce good quality work.

Formwork

a. Definition

   Formwork is a temporary mold used to hold concrete while it is poured and formed according to the desired shape (Zainullah et al., 2012). Another definition of formwork is an auxiliary construction for the concrete mold of a building structure (beams, plates, and columns) with the desired shape design. After a certain time has passed and it has been ensured that the concrete has hardened and supports its own weight, the natural formwork fabrication is removed and then reassembled in another part.

b. Terms and Conditions of Formwork Work

   The requirements for formwork work include the following:

   1) Must be strong and sturdy so that it can produce the desired cross-sectional shape without experiencing changes in shape (size, shape, and cross-sectional elevation).
   2) The formwork structure must be able to withstand the working load in addition to withstanding the concrete mixture such as vibrations, impacts from tools used during work, wind, and also humans.
   3) The formwork must be tight so that the cement paste liquid and fine aggregate grains cannot escape from the gaps in the formwork joints.
   4) For planning, it must be at a relatively cheap price because it is a temporary building..

In addition to the requirements for formwork work, there are also things that

are the targets of concrete formwork work, namely:

1) Produce good quality, carefully designed and built.
2) Guaranteed safety level, built solidly and strongly so that it can support all dead and live loads.
3) Economical, built efficiently, saves costs and time so that it provides benefits for both the implementing contractor and the building owner.

Formwork Planning

For concrete construction work, molds and forms must first be calculated and drawn specifically. In the calculation system, we must first review the strength and curvature (deflection) to determine whether the working stress is in accordance with the desired working stress provisions.

The calculation of the distance between the reference girders is considered as a girder supported by many bearing points. The maximum moment at divided loading is taken as 1/10 ql2, while the bending (diflection) is taken as ql4/100EI, where q itself is the evenly distributed load from concrete, formwork, workers, and so on (Safudin & Djamaludin, 1999).

Formwork Specifications

Formwork and other supporting equipment are temporary constructions with 3 (three) main functions, namely:

a. Giving shape to a concrete construction.
b. Obtaining the expected surface structure.
c. Carrying the concrete load so that the construction is strong enough to carry its own load, work equipment, and labor.

The formwork work must first be planned in such a way that the resulting concrete construction can meet the requirements, such as:

a. Quality
b. Security
c. Economical (Practical)

To achieve the three requirements above, the formwork work must be carried out in such a way that it refers to the standard technical procedures for formwork construction so that the formwork produces:

a. Right size, rigid enough to withstand the load and force applied.
b. Stable and strong enough to maintain the shape, alignment, and size of the structure that loads it.
c. Strong enough to maintain or guard against changes in surface, shape, and size when transported, used, or reused.

Formwork Method

In carrying out construction, the formwork work itself is divided into 3 (three) types of implementation methods, including:

a. Non-System Formwork

   This formwork is a formwork that is often found in building construction and is made of wood material and produced by manual labor. The advantage of this formwork is its high flexibility. However, the disadvantage of this formwork is that it takes a long time to work and the material must be repurchased.

b. Semi-System Formwork

   This formwork is a combination of system formwork and non-system formwork. The material used to make this formwork is wood supported by other materials. The advantage of this formwork is that it is cost-effective because wood is not the main material in this type of formwork, where wood is only used in certain parts using plywood or often called plywood.

c. System Formwork

   System formwork is a formwork whose formwork elements are manufactured in a factory, modular in size with standard spans and can generally be found in rental services. The use of this formwork is designed repeatedly, where after its use is complete it can be

reused without the need to be assembled when the dismantling is complete.

Formwork Materials

a. Wood

1) Wood Quality Classification

According to Ariestadi (2008), there are 3 types of wood quality in trade, namely A quality, B quality, and C quality. C quality wood is wood that is not included in the A and B quality wood groups.

According to PPKI (Indonesian Timber Construction Regulations), A and B grade wood must meet the following requirements:

a) A Grade A Wood Requirements

Wood must be air dry (moisture content ≤ 15%).

The size of the knot does not exceed 1/6 the width of the face of the wood or cannot be larger than 3.5 cm.

Wood must not contain sapwood (wanvlak) that is greater than 1/10 of the width of the face of the wood.

Maximum tangent fiber direction slant 1/10.

Cracks in the radial direction must not be larger than 1/4 of the wood thickness and cracks in the growth circle direction must not be larger than 1/5 of the wood thickness.

b) Grade B Wood Requirements

Air-dried wood with a moisture content of 15% to 30%.

The size of the knot does not exceed 1/4 of the width of the face of the wood, or cannot be larger than 5 cm.

Wood must not contain sapwood (wanvlak) that is greater than 1/10 of the width of the face of the wood.

Maximum tangent fiber direction slant 1/7.

Cracks in the radial direction must not be larger than 1/3 of the wood thickness and cracks in the growth circle direction must not be larger than 1/4 of the wood thickness.

2) Wood Grading Classification

For wood strength classification is based on flexural strength and compressive strength in air-dry wood conditions. Flexural strength is determined based on the maximum flexural stress received by the wood until it breaks (absolute flexural stress). Wood classification according to the Indonesian Wood Construction Regulation (PKKI) is classified into 5 strength classes, namely strength classes I, II, III, IV, and V according to the magnitude of the stress and specific gravity of each.

Tabel 1. Wood Classification Based on Bending Strength, Compressive Strength, and Specific Gravity

Kelas Kuat	Tegangan Lentur Mutlak (kg/cm3)	Tegangan Tekanan Mutlak (kg/cm3)	Berat Jenis (BJ)
I	≥ 1100	≥ 650	≥ 0,90
II	1100 – 725	650 – 425	0,90 – 0,60
III	725 – 500	425 – 300	0,60 – 0,40
IV	500 – 360	300 – 215	0,40 – 0,30
V	≤ 360	≤ 215	≤ 0,30

Source: PKKI

3) Wood Durability Classification

The grouping of wood durability is based on the influence of humidity, climate, termites, and insects. According to PKKI (Indonesian Wood Construction Regulations), wood durability is classified into 5 classes, namely durability classes I, II, III, IV, and V.

Table 2. Wood Durability Class Based on Bending Stress, Compressive Stress, and Specific Gravity

SIFAT PEMAKAIAN	KELAS KEAWETAN				
	I	II	III	IV	V
Selalu berhubungan dengan tanah lembab.	8 th	5 th	3 th	sangat pendek	sangat pendek
Hanya dipengaruhi cuaca, tetapi dijaga supaya tidak terendam air dan tidak kekurangan udara.	20 th	15 th	10 th	beberapa tahun	sangat pendek
Di bawah atap, tidak berhubungan dengan tanah lembab dan tidak kekurangan udara.	tidak terba-tas	tidak terba-tas	sangat lama	beberapa tahun	pendek
Seperti di atas tetapi dipelihara dengan baik dan dicat dengan teratur.	tidak terba-tas	tidak terba-tas	tidak terba-tas	20 th	20 th
Serangan rayap tanah.	tidak	jarang	cepat	sangat cepat	sangat cepat
Serangan bubuk kayu.	tidak	tidak	hampir tidak	tidak berarti	sangat cepat

Source: Department of Public Works (PU)

b. Plywood

The material for plywood consists of several wood veneers that are bonded crosswise, one on top of the other. Generally, the veneer layers are peeled from a round log, and the veneered layers are carefully inspected for any small cracks on their surface.

c. Supporting Material (Scaffolding)

The most important demands expected from a support in formwork construction work include:

1) Light weight must be able and capable of moving various relatively heavy loads
2) Resistant to rough use
3) Simple installation and adjustment
4) Able to minimize the number of loose components
5) Easy to control
6) Can be used repeatedly

Execution of Formwork Work

The process of providing formwork and concrete is an absolute integration. All the amount of expenditure for the type of formwork work is classified into 3 (three) work sequences, namely:

a. Build

The earliest formwork manufacture before use (prefabrication) is a practical activity with various types of molds, where the shape of the mold depends on the initial prefabrication of the formwork and further expenditure and is included in the installation and reinforcement work.

b. Erection

The average productivity level of workers in the formwork installation process is sufficient to cover the installation of all forms of formwork including the installation of external reinforcement systems.

c. Strip

Dismantling itself includes moving, dismantling, cleaning, lubricating with lubricants, temporary storage and repair of the finished formwork which is then ready to be used again for the next operation.

In the implementation of formwork work is also influenced by several factors, namely:

a. Land availability
b. Structure form
c. Work method
d. Work schedule
e. Resource availability

Financing of Formwork Work

Reducing the quality of formwork materials will have an impact on decreasing the quality of concrete, both in terms of strength and appearance. By planning a flexible and easily dismantled formwork structure, the formwork can be used for various purposes and types of structures. For the manufacture of structural or architectural components using the precast method, the use of formwork that can be used repeatedly must be optimized. Another important thing is the process of removing/opening and maintaining the formwork. Incorrect opening methods will shorten the service life, conversely, good maintenance will extend the service life while increasing the number of repeat uses and reducing work costs. The factors that influence the relationship in calculating the cost of formwork work include:

a. Type of method used. This relates to the selection of material types, tools, and other types of reinforcement
b. Selection of labor
c. Methods of fabrication, installation, reinforcement, dismantling, and relocation

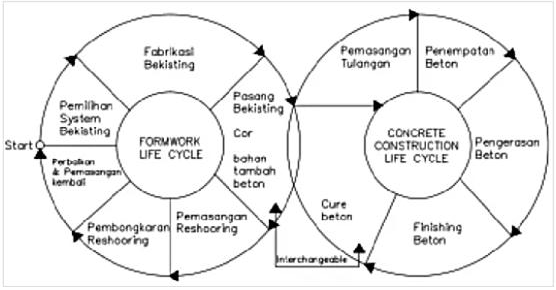
Dismantling of Formwork

Dismantling the formwork (mold) is a job that determines the success of a concrete job. For its dismantling must be done carefully and requires careful calculation because it greatly affects the quality of the concrete. There are several things that must be considered in removing or dismantling the formwork, including:

a. Pay attention to the procedures so as not to have a detrimental impact on the strength and performance of the building.
b. Formwork (scaffolding) is dismantled when the concrete strength has reached the strength determined from the previous calculation.
c. Must be based on test data from the components to be dismantled.
d. Must pay more attention to the load on it by not exceeding the capacity of the components being dismantled.
e. Must be approved by the person in charge of the project in the field.

Formwork Work Cycle

The implementation of formwork work is an integrated part of a construction process.



(Source: Google)

Figure 1. Formwork Work Cycle

The image above shows the formwork and concrete work cycle. The cycle on the left illustrates the formwork work cycle, while the cycle on the right is the concrete work cycle. The formwork cycle begins with the selection of the formwork method and for the formwork cycle activities with the following stages:

a. Fabrikasi bekisting
b. Pemasangan
c. Pembongkaran

The purpose of this cycle is to provide the needs of the structure in different shapes and sizes. While the function of the concrete work cycle is to provide the needs of the structure for strength, durability, and surface shape.

3. RESEARCH METHODOLOGY

Project Data

a. General Data

Knowledge Hub BSD City is an office building construction project carried out in the BSD City area, Cisauk District, South Tangerang, Banten Province. The following is the data on the Knowledge Hub office building construction project in the BSD City area:

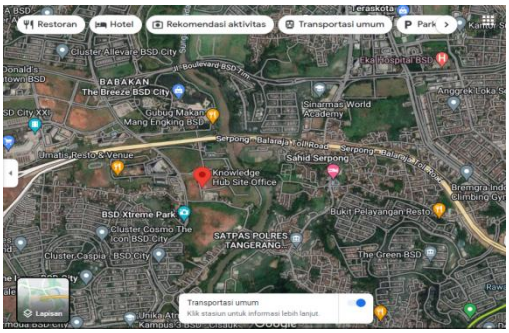
1) Project Name: Knowledge Hub Building Work
2) Project Owner: BSD City
3) Planning Consultant:
   PT. Anggara Architeam
   PT. VNW Optima Enjiniring
   PT. Sigma Tech Tatakarsa
   Alt Clading Inc
   Salad Dressing Dempsey
4) Supervising Consultant: Sinarmas Land
5) Implementing Contractor: PT. Tatamulia Nusantara Indah
6) Location: BSD City, Cisauk District, South Tangerang, Banten Province
7) Implementation Time: June 14, 2022 – September 15, 2023

b. Project Location

The location of the Knowledge Hub BSD City project is on the BSD Raya Barat highway, Sampora, Cisauk District, Tangerang Regency, Banten Province. This location is also close to the Serpong KRL Station and Rawabuntu KRL Station. The following are the boundaries of the Knowledge Hub BSD City project location, including:

1) North: Empty red land
2) West: BSD City highway
3) East: Knowledge Hub Marketing Office
4) South: Empty red land

To reach the location is very easy, it only takes 15 minutes from Serpong and Rawabuntu KRL Stations. It only takes 5 minutes via the BSD Timur and Serpong Balaraja toll roads.

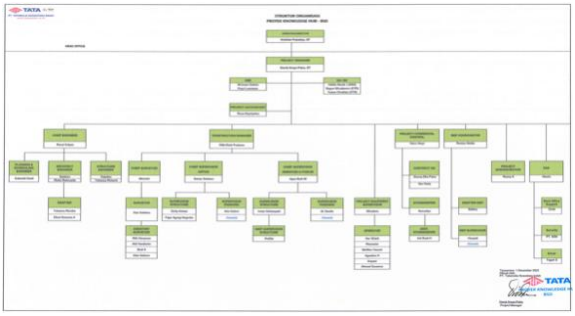


(Source: Google Maps Place)

Figure 2. Project Location

c. Organizational Structure

The purpose of forming a project organizational structure is so that the implementation of a project can run smoothly without any overlap or imbalance between authority and obligations within the work units of the organizational structure itself.



(Source: PT. Tatamulia Nusantara Indah, 2022)

Figure 3. Organizational structure

d. Knowledge Hub Building Site Plan

Site plan is an important part of a building, housing, and property development project. Site plan itself is usually used by developers before work begins. Not only for developers, buyers will also feel assured when choosing a property with a site plan.

(Source: PT. Tatamulia Nusantara Indah, 2022)

Figure 4. Site Plan Knowledge Hub BSD City

e. Technical Data

The following is the technical data of the BSD City Knowledge Hub building construction project:

1) Building Dimensions
   Planning land area: 260,000 m2
   Building perimeter: 482 m
   Building height: 39.40 m
   Total building area: 54,956 m2
   Number of floors: 11 floors
2) Building Function
   Floor 1-2: Basement
   Floor 3: Ground floor
   Floor 4-10: Multipurpose room
   Floor 11: Roof top
3) Building Structure
   Struktur atas bertulang

Scope of work

a. Preparatory Work
   1) Cleaning of project site
   2) Re-measurement of site
   3) Installation of basic reference monuments
   4) Basic implementation board (Bouwplank)
   5) Provision of electricity and water for work
   6) Provision of fire extinguishers
   7) Contractor office work, work booths, and K3

b. Structural Work
   1) Column work
   2) Beam work
   3) Plate work

Research Flow Diagram

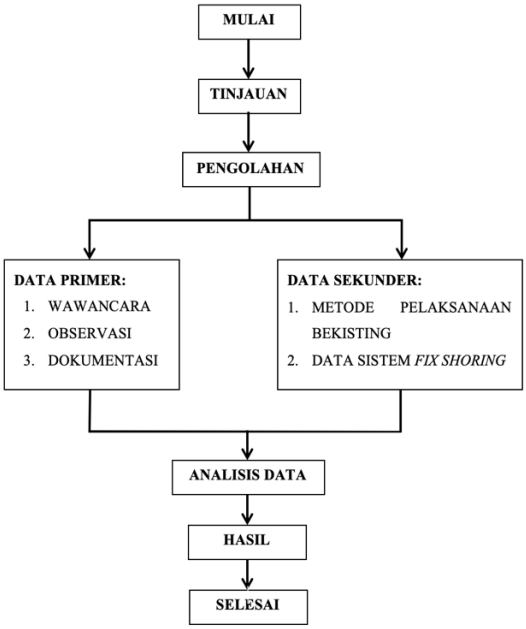
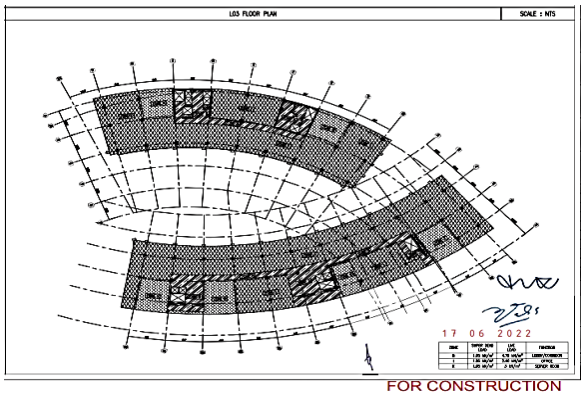


Figure 5. Research Flow Diagram

4. RESEARCH RESULTS AND DISCUSSION

Perhitungan Pekerjaan Struktur Lantai 3 Amenities Gedung Knowledge Hub BSD City

Column, Beam, and Slab Formwork Floor 3 Amenities
Column, Beam, and Plate Reinforcement of 3rd Floor Office



(Sumber: PT. Tatamulia Nusantara Indah, 2022)

Figure 5. Floor Plan Structure 3 Knowledge Hub BSD City

a. Column, Beam, and Floor Plate Formwork Work 3 Amenities

1) Column Formwork Work 3 Amenities

Data:

Volume = 156 m^2

Berdasarkan data pekerjaan bekisting kolom diperoleh lama kerja tiap cetakan 10 m^2 adalah:

1) Penyetelan $= \frac{4 \text{ jam} + 8 \text{ jam}}{2} = 6$ jam/10 m^2

2) Pemasangan $= \frac{2 \text{ jam} + 4 \text{ jam}}{2} = 3$ jam/10 m^2

Labor requirements for implementation in the field:

Based on SNI 7392-2008, in the formwork work of the 3rd floor column,

1 group is used with details of 1 foreman, 3 carpenters, 6 workers, and working hours of 7 hours per day.

Working hours required for implementation in the field:

a) Working hours of workers in 1 day
b) Productivity of each job in 1 day

Formula: "number of worker working hours" / "working hours per 10 m^2" x 10 m^2

Tabel 4 1 Jam Kerja dalam 1 Hari

Jam kerja tenaga kerja dalam 1 hari					
Pekerja		Tukang Kayu		Mandor	
Jmlh	Waktu Kerja (jam)	Jmlh	Waktu Kerja (jam)	Jmlh	Waktu Kerja (jam)
6	7	3	7	1	7
Total	42	Total	21	Total	7

Tabel 4 2 Produktivitas Tiap Pekerjaan dalam 1 Hari

Uraian Pekerjaan	Total Jam		Koefisien (m2)	Jumlah (m2/hari)
	Pekerja	Jam Kerja		
Penyetelan	70	6	10	116.6666667
Pemasangan	70	3	10	233.3333333

a) Duration of each job

Formula: "Volume" / "Productivity"

Tabel 4 3 Durasi Tiap Pekerjaan

Uraian Pekerjaan	Durasi		Total (Hari)
	Volume (m2)	Produktivitas	
Penyetelan	156	116.7	1.336760925
Pemasangan	156	233.3	0.668666952

a) Penyetelan $= \frac{\text{Volume}}{\text{Produktivitas}} = \frac{156\ m2}{116,7} = 1,38 = 2\ \text{hari}$

b) Pemasangan $= \frac{\text{Volume}}{\text{Produktivitas}} = \frac{156\ m2}{233,3} = 0,67 = 1\ \text{hari}$

So, the time needed for fabrication of the 3rd floor column formwork is 2 days, while for installation of the 3rd floor column formwork is 1 day.

Price Analysis:

The table below is a table of basic unit price analysis for formwork work.

Tabel 4 4 Analisa Harga Satuan Dasar Pekerjaan Bekisting Kolom Lantai 2 Amenities

No	Uraian Pekerjaan	Satuan	Koefisien		Harga Satuan (Rp)	Jumlah Harga (Rp)
A	TENAGA					
	Pekerja	OH	0.006	@	80000	480
	Tukang Kayu	OH	0.003	@	100000	300
	Mandor	OH	0.001	@	135000	135
	JUMLAH TENAGA KERJA					915
B	BAHAN					
	Kayu Bekisting	m3	0.059	@	3500000	206500
	Paku Usuk	kg	0.39	@	15000	5850
	Minyak Bekisting	m3	0.29	@	8500	2465
	Plywood	lbr	0.02	@	82600	1652
	JUMLAH BAHAN					216467
C	PERALATAN JUMLAH HARGA ALAT					
D	Jumlah (A+B+C)					217382
E	Overhead & Profit		10%			21738.2
F	Harga Satuan Pekerjaan					239120.2

a) Labor costs during work:

Fabrication: Rp 915,000 x 2 days = Rp 1,830,000

Installation: Rp 915,000 x 1 day = Rp 915,000Total biaya pekerja = Rp 2.745.000

b) Material cost = Volume x Quantity of materials

= 156 m2 x Rp 216,467 = Rp 33,768,852

c) Total cost:

= Wage costs + material costs

= Rp2,745,000 + Rp33,768,852

= Rp36,513,852

The unit price for ground floor column formwork is:

"Total Cost" /"Volume" = "36,513,852" /"156 m2" = Rp 234,063.15

2) Formwork Work for Floor 3 Amenities Beam

Data:

Volume = 173,62 m^2

Berdasarkan tabel pekerjaan bekisting balok diperoleh lama kerja tiap cetakan 10 m^2 adalah:

1) Penyetelan $= \frac{6 \text{ jam} + 10 \text{ jam}}{2} = 8$ jam/10 m^2

2) Pemasangan $= \frac{3 \text{ jam} + 4 \text{ jam}}{2} = 3{,}5$ jam/10 m^2

Labor requirements for implementation in the field:

Based on SNI 7392-2008, in the formwork work of the 3rd floor column, 1 group is used with details of 1 foreman, 3 carpenters, 6 workers, and working hours of 7 hours per day.

Working hours required for implementation in the field:

a) Labor working hours in 1 day:

Tabel 4 5 Jam Kerja dalam 1 Hari

Jam kerja tenaga kerja dalam 1 hari					
Pekerja		Tukang Kayu		Mandor	
Jmlh	Waktu Kerja (jam)	Jmlh	Waktu Kerja (jam)	Jmlh	Waktu Kerja (jam)
6	7	3	7	1	7
Total	42	Total	21	Total	7

The total working hours of the entire workforce in 1 day is 70 hours/day.

b) Productivity of each work item in 1 day:

Tabel 4 6 Jam Kerja Produktivitas Tiap Item Pekerjaan dalam 1 Hari

Uraian Pekerjaan	Total Jam		Koefisien (m2)	Jumlah (m2/hari)
	Pekerja	Jam Kerja		
Penyetelan	70	8	10	87.5
Pemasangan	70	3.5	10	200

c) Duration of each job:

a) Penyetelan $= \frac{\text{Volume}}{\text{Produktivitas}} = \frac{173{,}62 \text{ m2}}{87{,}5 \text{ m2}} = 1{,}98 = 2$ hari

b) Pemasangan $= \frac{\text{Volume}}{\text{Produktivitas}} = \frac{173{,}62 \text{ m2}}{200 \text{ m2}} = 0{,}86 = 1$ hari

Tabel 4 7 Durasi Tiap Pekerjaan

Uraian Pekerjaan	Durasi		Total (Hari)
	Volume (m2)	Produktivitas	
Penyetelan	173.62	87.5	1.984228571
Pemasangan	173.62	200	0.8681

So, the time needed for fabricating the 3rd floor beam formwork is 2 days, while the time needed for installing the 3rd floor beam formwork is 1 day.

Analisa Harga:

The price of wages and materials is based on the provision of PT. Tata Nusantara Indah, including:

Tabel 4 12 Analisa Harga Satuan Dasar Pekerjaan Bekisting Plat Lantai 2 Amenities

No	Uraian Pekerjaan	Satuan	Koefisien		Harga Satuan (Rp)	Jumlah Harga (Rp)
A	TENAGA					
	Pekerja	OH	0.008	@	80000	640
	Tukang Kayu	OH	0.003	@	100000	300
	Mandor	OH	0.001	@	135000	135
	JUMLAH TENAGA KERJA					1075
B	BAHAN					
	Kayu Bekisting	m3	4.41	@	3500000	1543500
	Paku Usuk	kg	28.27	@	15000	424050
	Minyak Bekisting	m3	24.16	@	8500	205360
	Plywood	lbr	1.54	@	82600	127204
	JUMLAH BAHAN					16191614
C	PERALATAN JUMLAH HARGA ALAT					
D	Jumlah (A+B+C)					16192689
E	Overhead & Profit		10%			1619268.9
F	Harga Satuan Pekerjaan					17811957.9

a) Labor costs during work

Fabrication: Rp 915,000 x 2 days = Rp 1,830,000

Installation: Rp 915,000 x 1 day = Rp 915,000

Total labor cost:

Rp 2,745,000

b) Material cost = Volume x Quantity of materials

= 173.62 m2 x Rp 216,467

= Rp 37,583,000

c) Total cost:

= Wage costs + material costs

= Rp2,745,000 + Rp37,583,000

= Rp40,328,000

The unit price for ground floor column formwork is:

"Total Cost" /"Volume" ="40,328,000" /"156 m2" = Rp 232,277.39

3) Formwork Work for Floor Plate 3 Amenities

Data:

Volume plat lantai 2 amenities = 84,02 m^2

Berdasarkan tabel pekerjaan bekisting lantai diperoleh lama kerja tiap cetakan 10 m^2 adalah:

1) Penyetelan = $\frac{3\text{ jam} + 8\text{ jam}}{2}$ = 5,5 jam/10 m^2

2) Pemasangan = $\frac{2\text{ jam} + 4\text{ jam}}{2}$ = 3,5 jam/10 m^2

Manpower requirements for implementation in the field:

Based on SNI 7392-2008, in the formwork work of the 3rd floor column, 1 group is used with details of 1 foreman, 3 carpenters, 8 workers, and working hours of 7 hours per day.

Working hours required for implementation in the field:

a) Labor working hours in 1 day

Tabel 4 9 Jam Kerja Tenaga Kerja dalam 1 Hari

Jam kerja tenaga kerja dalam 1 hari					
Pekerja		Tukang Kayu		Mandor	
Jmlh	Waktu Kerja (jam)	Jmlh	Waktu Kerja (jam)	Jmlh	Waktu Kerja (jam)
8	7	3	7	1	7
Total	56	Total	21	Total	7

The total working hours of the workforce in 1 day is 84 hours.

b) Productivity of each job in 1 day.

Tabel 4 10 Produktivitas Tiap Pekerjaan dalam 1 Hari

Uraian Pekerjaan	Total Jam		Koefisien (m2)	Jumlah (m2/hari)
	Pekerja	Jam Kerja		
Penyetelan	84	5.5	10	152.7272727
Pemasangan	84	3.5	10	240

c) Duration of each job:

a) Penyetelan $= \frac{\text{Volume}}{\text{Produktivitas}} = \frac{84.02}{152,7\text{ m2}} = 0,55 = 1$ hari

b) Pemasangan $= \frac{\text{Volume}}{\text{Produktivitas}} = \frac{84,02}{280\text{ m2}} = 0,30 = 1$ hari

Tabel 4 11 Durasi Tiap Pekerjaan

Uraian Pekerjaan	Durasi		Total (Hari)
	Volume (m2)	Produktivitas	
Penyetelan	84.02	152.7	0.550229208
Pemasangan	84.02	280	0.300071429

So, the amount of time required for the slab formwork fabrication is 1 day and the time for the floor slab formwork installation is 1 day.

Price Analysis:

The price of wages and materials according to the provision of PT. Tata Nusantara Indah.

Tabel 4 12 Analisa Harga Satuan Dasar Pekerjaan Bekisting Plat Lantai 2 Amenities

No	Uraian Pekerjaan	Satuan	Koefisien		Harga Satuan (Rp)	Jumlah Harga (Rp)
A	TENAGA					
	Pekerja	OH	0.008	@	80000	640
	Tukang Kayu	OH	0.003	@	100000	300
	Mandor	OH	0.001	@	135000	135
	JUMLAH TENAGA KERJA					1075
B	BAHAN					
	Kayu Bekisting	m3	4.41	@	3500000	1543500
	Paku Usuk	kg	28.27	@	15000	424050
	Minyak Bekisting	m3	24.16	@	8500	205360
	Plywood	lbr	1.54	@	82600	127204
	JUMLAH BAHAN					16191614
C	PERALATAN JUMLAH HARGA ALAT					
D	Jumlah (A+B+C)					16192689
E	Overhead & Profit		10%			1619268.9
F	Harga Satuan Pekerjaan					17811957.9

a) Labor costs during work

Fabrication: Rp1,075,000 x 1 day = Rp1,075,000

Installation: Rp1,075,000 x 1 day = Rp1,075,000

Total cost: Rp2,150,000

b) cost = Volume x Quantity of materials

= 84.02 m2 x Rp 16,191,614 = Rp 1,360,402,268.2

c) Total cost:

= Wage cost + Material cost

= Rp 2,150,000 + Rp 1,360,402,268.2

= Rp 1,362,569,408.28

The unit price of the formwork work for the 3rd floor slab amenities is:

"Total Cost" /"Volume" =1,362,569,408.28/"84.02 m2" =

Rp 16,217,203.14

5. CONCLUSION AND SUGGESTIONS

Conclusion

From the research conducted by the researcher entitled "Analysis of Time Management and Cost of Formwork and Reinforcement Work (Columns, Beams, and Plates) on the 2nd Floor of Amenities in the Knowledge Hub BSD City Office Building Development Project", and based on the data obtained by the researcher using the method of yield value, documentation, project data collection, it is concluded that:

a. The total unit price required for formwork work (columns, beams, and plates) on the 2nd floor of amenities in 1 day is IDR16,683,543.54 (Sixteen Million Six Hundred Eighty Three Thousand Five Hundred Forty Three Point Fifty Four Rupiah) and the duration of the work required is 2 days.
b. The total unit price required for reinforcement work (columns, beams, and plates) per 1 m3 in 1 day is IDR38,694.67 and the implementation time required is 2-3 days.

Recommendation

From the results of the research that has been conducted, the following suggestions can be concluded:

a. From the results of the data analysis of the budget for the implementation of formwork and reinforcement work (columns, beams, and plates), the duration of the work must be given more attention so that the work can be maximized and the time is more efficient.
b. Supervision is carried out on time or cost issues for each work item so as to create good and efficient work results.

REFERENCES

[1] Asmaroni, D., & Setiawan, A. (2020). The Use of Earned Value Analysis Method on Cost and Time in Housing Construction Projects. Journal of Planning and Engineering, Vol 3, 33-36.

[2] Faza, N. S. (2019, December Tuesday). Project Time Management. Retrieved from NidaSF-0216104058: http://nida.blog.widyatama.ac.id/2019/10/15/manajemen-waktu-proyek/

[3] Ghabis, S. S. (2019, September Sunday). PROJECT ORGANIZATIONAL STRUCTURE. Retrieved.ShillaSG-0216104058: http://shillaghabis.blog.widyatama.ac.id/2019/09/29/struktur-organisasi-proyek/

[4] Jahja, T. (2016). ANALYSIS OF TIME MANAGEMENT IMPLEMENTATION IN BY-PASS ROAD STRUCTURE IMPROVEMENT PROJECT. Journal of Science, Engineering and Technology Civilization, Vol. 6(2), 47-48.

[5] Nudja, I. K. (2015). Control of Construction Project Implementation in the Construction of Concrete Bridge Superstructures with the Earned Value Concept. Journal Paduraksa, Vol. 6, 141-146.

[6] Komaruddin, Management Encyclopedia, Vol. 5 (Jakarta: Bumi Aksara, 2001)

[7] Makinuddin & Tri H. Sasongko, Social Analysis: Testifying in Irrigation Advocacy (Bandung, AKATIGA Foundation, 2006), p.40

[8] Roni Habibi & Raymana Aprilian, Tutorial and Explanation of WEB-Based E-Office Applications Using the RAD Method (Bandung: Kreatif Industri Nusantara, First Edition, 2019), p.80

[9] Nurhayati, Project Management (Yogyakarta: Graha Ilmu, 2010)

[10] Agus B. Siswanto & M. Afif Salim, Project Management (Semarang: CV. Pilar Nusantara, 2020), p.1Mudjanarko, et al., Concrete Panel Manufacturing Guide (Surabaya: Narotama University Press, 2021), p.2