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THE COST ANALYSIS OF CONSTRUCTION SAFETY AND EVALUATION OF WORK METHODS OF ROAD CONSTRUCTION PROJECT AT SIMPANG 4 GATOT SUBROTO – SOUTH LINGKAR DALAM

Fitria Desy Yolanda & Candra Yuliana, ST, MT
Civil Engineering Study Program, Faculty of Engineering, Lambung Mangkurat University
Jl. A. Yani Km. 35.8 South Kalimantan, Indonesia
E-mail: desyolandaa@gmail.com

ABSTRACT

The project construction is said to be successful if it has a low work accident rate, completed on time with good quality as planned. Therefore, the cost analysis of construction safety and evaluation of work methods needs to be done. The case study used is Road Construction Project At Simpang 4 Gatot Subroto – South Lingkar Dalam. This research was conducted based on literature studies and data provided directly by the related agencies. Data obtained is the cost budget plan of K2, analyzed with direct calculations and making comparisons based on SE Menteri PUPR No 11 Tahun 2019. Time Schedule S-Curve analyzed based on realization calculation of work progress. Evaluation of work methods is collected through interviews with project workers. Based on the results of research, the cost of K2 used for project implementation is Rp. 11,000,000.00. K2 cost percentage based on SE Nomor 11/SE/M/2019 the value is greater than field price percentage with a difference of 0.09%, this is because there are several K2 items based on regulations that are not included in the field cost budget in order to adjust to the needs of the work in the implementation of development projects. The results analysis of Time Schedule Kurva-S, there are several components of the work is delayed because of weather factors and causing the negative deviation value that on the sixth week until the ninth week with a value of -1.05%, -1.05%, -1.05%, and also -0.99%. The delay that happened can be anticipated with a good management and maximum productivity.

***Keywords**:* road, construction safety, s-curve analysis, job evaluation

1. INTRODUCTION

Management is an effort to achieve goals efficiently. Project is a plan work with achievement targets and completion within a certain timeframe. With less than optimal management a project can potentially fail.

Construction safety is a factor important influence on success project. Both national and international, the largest contributor to the construction sector in the number of work accidents. For minimize this, it is necessary construction safety management.

Therefore, it is necessary to discuss regarding cost calculation analysis construction safety and evaluation implementation of work in the field optimize policy making regarding the development of similar projects.

2. LITERATURE REVIEW

2.1 General

Management is necessary applied to keep a project running according to the proper rules. Because based on the outline of management is the act of compiling, planning, and controlling an activity so that achieve a success.

According to George Robert Terry, a figure known as the pioneer of the term management function. In his book which entitled “Principle of Management”, figure it concludes that the function management is about how the process planning, controlling and actuating organizing.

2.2 Construction Project Management

The objectives of project management are obtain optimum results, managed from efficient and effective resources.

2.2.1 General Stages of Project Management

a. Project definition
b. Project initialization
c. Project planning
d. Project implementation
e. Monitoring & control project
f. Project closure

2.2.2 Time Management

Time management covers all processes needed to ensure the project finished on time.

a. Activity Identification
b. Preparation of the Sequence of Activities
c. Estimated Project Time
d. Compilation timetable
e. Control Schedule

1.2.2 Cost Management

Cost management is a process carry out a job that includes planning, estimation, budget & cost control, so work can be completed properly, both in terms of the time and budget specified.

1.3 Construction Safety

Implementation program Safety Construction (K2) is an important aspect in ensuring the smooth running of the project and minimize work accidents. Management K2 program is not good will cause a number of losses for company (Husen, 2008).

Government Indonesia through Ministry of Public Works and Housing The people have issued a Circular Number 11/SE/M/2019 which regulates technical instructions for operating the system construction safety management. As for details of the implementation of SMK2 Construction includes:

1. RKK setup
2. Socialization and Promotion of K2
3 Work Protective Equipment
4. Personal Protective Equipment
5. Insurance and Licensing
6. Facilities, infrastructure, medical equipment
7. Signs
8. Expert Consultation
9. Others related to Risk Control

1.4 Job Evaluation

As for the summary of the scope of work divisions are as follows:

Division 1. General

Division 3. Earthworks & Geosynthetics

Division 5. Grained Pavement Works and Cement Concrete Pavement

Division 6. Asphalt Pavement Works

Division 7. Structural Works

Division 9. Daily Work and more

3. RESEARCH METHODOLOGY

The research method used is collect, read and study literature materials, research reports and scientific essays related to subject matter in order to carry out the process data collection in the form of:

1. Primary data

It is supporting data, obtained by survey or direct interview at field. Primary data used in the form of evaluation of work implementation on the Project Construction at Simpang 4 Gatot Subroto – South Lingkar Dalam.

2. Secondary data

Is the main data, obtained from relevant agencies, project owners and contractor. Secondary data used namely the Budget Plan (RAB) Construction Safety and *Time Schedule* S-Curve.

After primary and secondary data obtained, then the data analysis is carried out on RAB Construction Safety. Perform analysis of realization calculations work progress to find out deviation that occurs between the S-Curve. As well as reviewing evaluation of work implementation methods that have been done.

4. RESULTS AND DISCUSSION

4.1 General Overview

Perform analysis to find out what is the cost of K2 required on the project and the comparison between regulatory costs and field. Knowing how to perform time spent on the project. From evaluation related to the implementation of work in the field there are also obstacles that arise, so that alternative improvements can be made to obstacles that occur.

4.2 Project Data

The data obtained from the project are Safety Budget Plan Construction and Time Schedule S–Curve.

4.2.1 Plan Budget Cost Construction Safety

Safety budget plan construction in this project is Rp. 11,000,000.00 includes 10% PPN. You can see the recapitulation of the cost budget below in Table 1.

Table 1. Recapitulation of Safety Costs Construction

No.	Description	Total price (Rp)
1.	Setup RK3K Tool	750.000,00
2.	Personal Protector	5.250.000,00
3.	Insurance & Licensing	-
4.	Facility means Health	-
5.	Signs	-
6.	Power	5.000.000,00
Total		**11.000.000,00**

Source: Project Data

4.2.2 S-Curve Time Schedule

1. Length of time for each implementation activity project work can be seen on Time S-Curve Schedule.

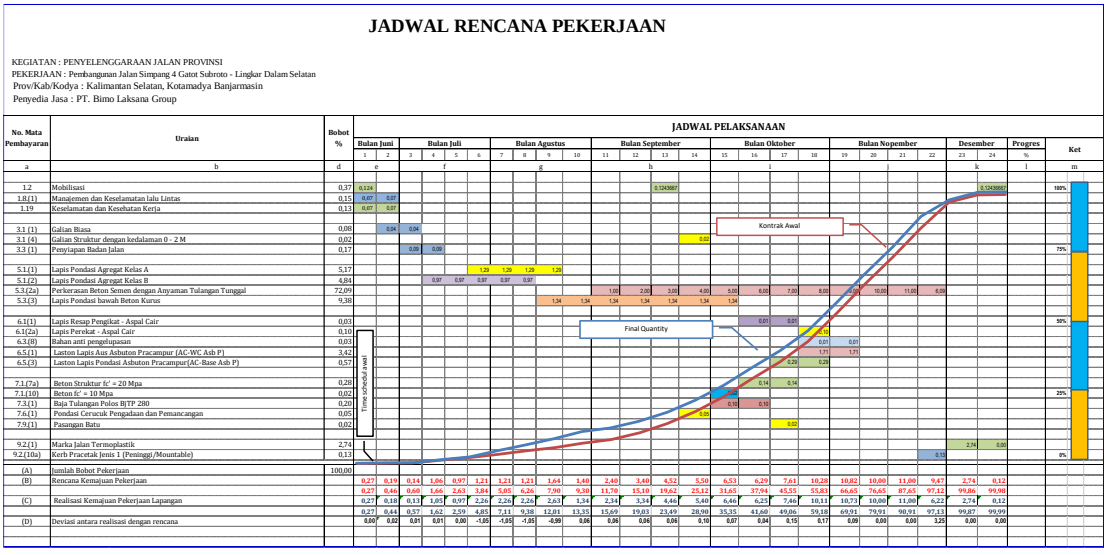

Figure 1. Time Schedule Curve–S Figure 1. Time Schedule Curve–S

4.3 Budget Plan Analysis Construction Safety

Analysis of the differences between RAB Construction Safety Contract with the has been implemented in the field, namely there are several the scope of K2 items that don't go into field implementation budget. As Insurance Guarantee items, Facilities Health and there are several Sign items removed sign. This is because RAB Construction Safety Contract made during a pandemic situation. So, on real implementation in the field, the funds that given at the beginning of the job less and not according to the original plan.

4.3.1 Safety Cost Calculation Construction based on Field Prices

Construction Safety RAB Calculation At Simpang 4 Gatot Subroto – South Lingkar Dalam based on the price list obtained through a shop near the location profession. The results of the calculation of RAB Construction Safety can be seen in Table 2.

Table 2. Safety Implementation Costs Construction

No.		Description	Total Price (Rp)
1.		**RK3K preparation consists of:**	
	a	Making manuals, Procedure, Instructions Work, Permit work and Making Card	-
	b	Identity Workers (KIP);	750.000,0
			750.000,0
2.		**Personal Protective Equipment consists of:**	
	a	Hat Protector;	750.000,0
	b	Protector Eye;	0,0
	c	Face Shield;	
	d	Breathing Apparatus;	
	e	Ear Plug, Ear Muff;	
	f	Masker;	**1.500.000,0**
	g	Safety Gloves;	**1.500.000,0**
	h	Safety Shoes;	**750.000,0**
	i	Full Body Harness;	**0,0**
	j	Life Vest;	**0,0**
	k	Safety Vest;	**750.000,0**

No.		Description		Total Price (Rp)
	l	Apron/Coveralls;	**0,0**	
	m	Fall Arrester;	**0,0**	
				5.250.000,0
3.		**Insurance and Licensing consist of On:**		
	a	BPJS & Manpower Occupational Health;		0,00
	b	Eligibility Permit Tool;		0,0
	c	Operator Permit;		0,0
	d	License Endorsement Advisory Commite Safety Construction (P2K2);		
				0,0
4.		**Health facilities:**		
	a	First aid kit (First aid kit, stretcher, Oxygen tube, Wound Medicine, bandage, etc)		0,0
	b	First aid room (Bed Patient, Stethoscope, Weight scales Body, etc)		0,0
	c	Equipment Fumigation (Fogging);		0,0
				0,0
5.		**Signs consist of:**		
	a	Sign barrier;		500.000,0
	b	Sign Ban;		100.000,0
	c	Sign Warning;	**200.000,0**	
	d	Sign Obligation;	**0,0**	
	e	Sign Information;	**0,0**	
	f	Sign Work Temporary;	**0,0**	
	g	Warning Lights Stick;	**0,0**	
	h	Cone Then Cross;	**0,0**	
	i	Rotary Lamp;	**0,0**	
	j	Pipe lamp Traffic;	**0,0**	

No.		Description	Total Price (Rp)
			800.000,0
		Power:	
6.	a	K2 Expert	0,0
	b	K2 Officer	4.200.000,0
			4.200.000,0
Source : Project Data		**Total =**	**11.000.000,0**

The total price is obtained from the multiplication between unit price and volume. Example calculation:

RK3K setup:

- Making Worker Identity Card (KIP)

  Total Price = Unit Price x Volume

  Total Price = 50.0000.0 x 15

  Total Price = 750.0000.0

4.3.2 Calculation of Safety Costs Construction with SE Number 11/SE/M/2019

Calculations that are in SE Number 11/SE/M/2019 is carried out using the method the same as the cost calculation based on price field. Which distinguish that there is a safety item construction based on SE No. 11/SE/M/2019 which is not included in cost budget on Project implementation Construction At Simpang 4 Gatot Subroto – South Lingkar Dalam. The calculation results The Construction Safety RAB can be seen below in Table 3.

Table 3. Cost Calculation (K2) with SE No.11/SE/M/2019

No.		Description	Total Price (Rp)
1.		**RK3K preparation consists of:**	
	a	Making manuals, Procedure, Instructions Work, Permit work and	-
	b	Making Card Identity Workers (KIP);	750.000,0
			750.000,0
2.		**Personal Protective Equipment consists of:**	

No.		Description	Total Price (Rp)
	a	Hat Protector;	750.000,0
	b	Protector Eye;	0,0
	c	Face Shield;	
	d	Breathing Apparatus;	
	e	Ear Plug, Ear Muff;	
	f	Masker;	1.500.000,0
	g	Safety Gloves;	1.500.000,0
	h	Safety Shoes;	750.000,0
	i	Full Body Harness;	
	j	Life Vest;	
	k	Safety Vest;	750.000,0
	l	Apron/Coveralls;	0,0
	m	Fall Arrester;	0,0
			5.250.000,0
3.		**Insurance and Licensing consist of On:**	
	a	BPJS & Manpower Occupational Health;	5.625.000,00
	b	Eligibility Permit Tool;	0,0
	c	Operator Permit;	0,0
	d	License Endorsement Advisory Commite Safety Construction (P2K2);	
			5.625.000,0
4.		**Health facilities:**	
	a	First aid kit (First aid kit, stretcher, Oxygen tube, Wound Medicine, bandage, etc)	1.500.000,0
	b	First aid room (Bed Patient,	1.500.000,0

No.		Description	Total Price (Rp)
		Stethoscope, Weight scales Body, etc)	
	c	Equipment Fumigation (Fogging);	1.000.000,0
			4.000.000,0
		Signs consist of:	
	a	Sign Barrier;	500.000,0
5.	b	Sign Ban;	100.000,0
	c	Sign Warning;	200.000,0
	d	Sign Obligation;	100.000,0
	e	Sign Information;	100.000,0
	f	Sign Work Temporary;	100.000,0
	g	Stick Warning Lights Stick;	50.000,0
	h	Traffic Cone;	150.000,0
	i	Rotary Lamp;	200.000,0
	j	Pipe lamp Traffic;	700.000,0
			2.200.000,0
		Power	
6.	a	K2 Expert	6.000.000,0
	b	K2 Officer	0,0
			6.000.000,0
		Total =	**23.825.000,0**

Source: Unit Price based on SE No. 11/SE/M/2019

4.3.3 Results Ratio Cost Construction Safety (K2)

The difference in the calculation of RAB K2 between SE No. 11/SE/M/2019 with implementation in fields, namely in Insurance and Licensing, existing safety protection guarantee on SE Number 11/SE/M/2019 no included in the budget for implementation in the field. This is because the implementation of the project is almost hampered due to the pandemic situation causing funds are not in accordance with the plan previously. In exchange, the guarantee that carried out at the beginning of the project only in the form of only a statement from the related party so that it can always urges his workers to work

with alertness and care. Items are also not health facilities included in the budget implementation on the project. However, on the implementation that occurs in the field precautions are taken to avoid work accidents such as doing Observation of hazards in the workplace before starting work, implementing SOP correctly and increase knowledge workforce to K2. signage items, only part of it is included in implementation cost budget such as signs barriers, prohibition signs and signs warning. In addition to the power item, on SE Number 11/SE/M/2019 using the services of an expert related to construction safety according to scope work while in the implementation at The field only uses K2 officers. This is because it adapts to needs on the project implementation cost budget Construction At Simpang 4 Gatot Subroto – South Lingkar Dalam.

The results of the calculation of K2 costs based on field prices and SE No. 11/SE/M/2019, Next, the percentage comparison is carried out these costs with the contract value project. The contract value used is Rp 14,004,021,598.00 including PPN 10%. As for the results calculations are shown in Table 4.

Table 4. Weight of K2 Cost to Value Contract

No	Description	Mark (Rp)	Weight (%)
1.	K2 fee Price Field	11.000.000,0	0,08
2.	K2 fee based on SE No.11/SE/M/2019	23.825.000,0	0,17

Example of weight calculation:

1. Comparison of the percentage cost of K2 prices field with project contract value

$= \frac{Harga\ Lapangan}{Nilai\ Kontrak}$ x 100

$= \frac{11.000.000}{14.004.021.598}$ x 100

= 0,08 %

The difference in percentage weight between field prices and SE No. 11/SE/M/2019,

Formula:

$= \frac{\text{Rule Weights} - \text{Field Weights}}{\text{Rule Weights}}$ (%)

$= \frac{0,17 - 0,08}{0,17}$ (%)
= 0,53 %

So, based on the calculation, we get percentage difference between safety costs construction (K2) field prices with SE No. 11/SE/M/2019 against contact value by 0.53%. Quite a big difference This is because there are several items optional construction safety on SE No. 11/SE/M/2019 and not entered into in the cost budget on project implementation Construction At Simpang 4 Gatot Subroto – South Lingkar Dalam to customize type of project undertaken and needs work at outdoor.

4.4 Performance Analysis on Project

4.4.1 Review Based on Time Schedule S - Curve

The focus of the discussion is to calculate the total realization of each item work carried out in the field in every week to find out what is the percentage deviation that occurs with how to reduce plan weight with weight realization of work progress. From this, Later it will be concluded how time performance analysis on projects in each the week.

4.4.2 Stages of Realization Calculation Progress Work For know the deviation that occurs Between S - Curve Based on Plan and Realization

Table 5. Cost Recapitulation Total Job

No.	Description Work	Total price Job (Rp)
1.	Work General	83.340.000,00
2.	Work Land & Geosynthetics	93.878.581,73
3.	Work Pavement grained & Pavement Cement Concrete	11.119.402.474,11
4.	Work Pavement Asphalt	937.601.126,77
5.	Work Structure	130.466.153,81
6.	Work daily & other	366.240.389,04
Total		12.730.928.725,54
PPN 10%		1.273.092.872,55
Total Price		14.004.021.598,01

Source: Project Data

According to table 8, the total price work used to calculate realization weight i.e. the total cost work amounting to Rp 12,730,928,725.54 (not including PPN 10%)

Table 6. Weekly reports
(1st week)

No.	Description	Unit price
I.	GENERAL	
1.	Mobilization	47.500.000,00
2.	Management and Safety Traffic	18900000
3.	Safety and Health Work	16940000

Source: Project Data

No.	Last Week		This Week		Until This Week	
	Vol	Weights	Vol	Weights	Vol	Weights
I.						
1.			0,33	0,12	0,33	0,12
2.			0,5	0,07	0,5	0,07
3.			0,5	0,07	0,5	0,07
Progress this week			= 0,27 %			
Realization up to this week			= 0,27 %			
Plans up to this week			= 0,27 %			
Deviation			= 0,00 %			

Source: Project Data

Weight Realized work progress up to this week (first week) by 0.27%. Is the sum total of all the weight of the realization of the work carried out in the week, consisting of work items:

- Mobilization with the weight of work realization up to this week (1st week) by 0.12%
- Traffic management and safety with the weight of work realization up to week this (first week) by 0.07%
- Occupational safety and health with weight of work realization up to this week (first week) by 0.07%.

Based on table 9. Weekly report (first week), example calculation:

- Mobilization

Weight of realization up to this week

= Last week's weight + this week's weight

= 0+ [$\frac{Work\ Item\ Volume\ x\ Unit\ Price}{Total\ Price\ of\ Work}$]

= 0 + [$\frac{0{,}34\ x\ 47.500.000}{12.730.928.725{,}54}$]

= 0,12%

- Traffic management and safety

Weight of realization up to this week

= Last week's weight + this week's weight

= 0 + [$\frac{Work\ Item\ Volume\ x\ Unit\ Price}{Total\ Price\ of\ Work}$]

= 0 + [$\frac{0{,}5\ x\ 18.900.000}{12.730.928.725{,}54}$]

= 0,07%

- Occupational Health and Safety

Weight of realization up to this week

= Last week's weight + this week's weight

= 0 + [$\frac{Work\ Item\ Volume\ x\ Unit\ Price}{Total\ Price\ of\ Work}$]

= 0 + [$\frac{0{,}5\ x\ 16.940.000}{12.730.928.725{,}54}$]

= 0,07%

So the weight of the total work realization of the first week based on *Time Schedule*, with scope work that includes work items mobilization, management and safety then traffic and construction safety are by 0.27%. Total work realization weight of the next weeks attached on the Time Schedule Curve – S below

Figure 4.2.

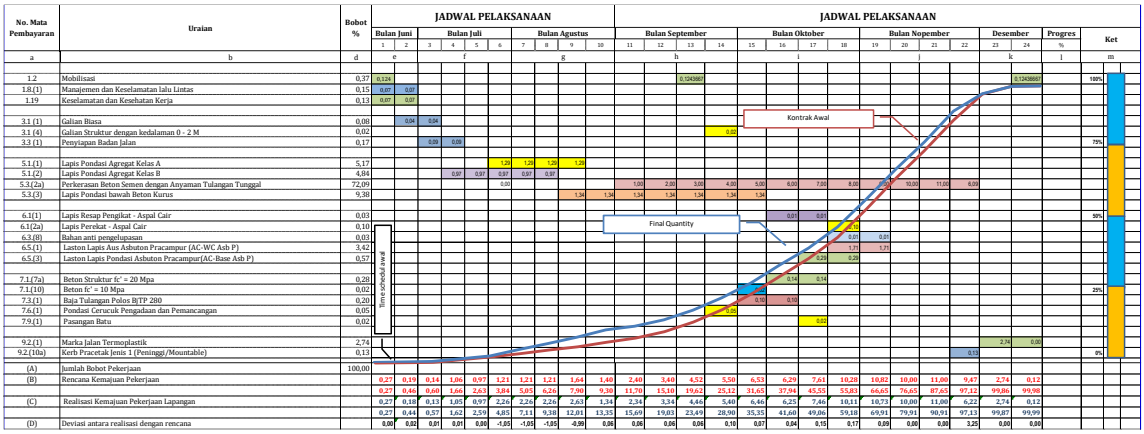

Figure 2. Time Schedule Curve – S

4.4.3 Results of Time Performance Analysis on Project

Time performance analysis results based on *Time Schedule* Curve–S At Simpang 4 Gatot Subroto – South Lingkar Dalam, in practice The project did not experience any major problems quite significant. Nonetheless, there some components of pending work because factor weather so that causes a negative deviation value in 4th week of July to 3rd week in August, namely –1.05%, –1.05%, –1.05%, and –0.99% respectively.

But in the weeks can further be improved with good management and productivity maximum of each job executor the. So that at the end project Construction 4 Gatot Subroto – South Lingkar Dalam can be finished precisely in time.

4.5 Evaluation of Work Implementation in field on Project

4.5.1 Implementation Method

1. Division 1 – General

a. Mobilization

In the field implementation, the activities mobilization brings in equipment, materials and project site personnel using tools transport such as trucks, trailers and others.

b. Traffic Management and Safety

Past safety management implementation

Traffic in the field includes the presence of officers specifically directing drivers past traffic to avoid traffic jams as well as accidents. Half body closure road with barricades is also carried out on the project with the aim of being able to limiting the path that has traffic flow with the work area.

c. Construction Safety

One of the K2 programs that were run At Simpang 4 Gatot Subroto – South Lingkar Dalam i.e. before start work, related parties carry out hazard identification to find out the

potential hazards in each profession. Hazard identification carried out using new techniques such as check list, what if, hazard and so on. Para project workers already use some Personal Protective Equipment (PPE) in accordance with what is listed in the description of Table 2. Construction Safety like a Hat Protector, Masker, Safety Shoes, as well as Safety Vest. But there are still some items Inadequate PPE is used. So, as a further evaluation so that in the future expected by the workers on the project development so that they are always obedient and check the completeness of Personal Protective Equipment (PPE) to avoid hazards and things unwanted.

2. Division 3 – Earthworks & Geosynthetics

a. Ordinary Digging

Implementation method:

- Soil excavated by Excavator , power human (worker) tidying parts the edge.
- Excavated products are transported to locations that have been approved by the field supervisor.

b. Excavation Structure Depth 0 – 2 M

The work is carried out using heavy equipment. The work implementation method is as follows:

- Excavator using Excavator, results excavation dumped by Dump Truck outside the work location that is safe and not interfere with traffic. Worker then tidy up the excavation with a tool help.

c. Road Body Preparation

Work execution method:

- Before work begins, work area which is included in the Road Owned Area (Damija) cleaned. Then compacted with Vibratory Rollers.
- Road bodies are formed in accordance with slope on the plans. Before starting work, the Contractor must notify the supervisory consultant one day before work starts.

3. Division 5 – Grained Pavement Works & Cement Concrete Pavemen

a. Class A . Aggregate Foundation Layer

This work is carried out on Aggregate

class B. The working method is as follows:

- Material (JMF) Class A Aggregate to be used First tested so that when it is implemented according to specifications Required technique.

- Aggregate material A is mixed at Base camp using a wheel loader with composition according to the approved JMF then aggregate material A is brought to job site using a dump truck .
- Aggregate material A is spread using Motor Grader with width and thickness solid according to plan drawings.
- Aggregate A is doused with water with using a Water Tank Truck and compacted using a tandem roller.
- During compaction, workers will smoothing overlay edges and levels surface using tools.

b. Class B . Aggregate Foundation Layer

This work is spread over the existing road as base layer Aggregate for pavement Road.

The working method is as follows:

- Material (JMF) Class B Aggregate to be used First tested so that when it is implemented according to specifications Required technique.
- Aggregate B material is mixed at Base camp using a wheel loader with composition according to the approved JMF. Aggregate B material is brought to the site work using a dump truck.
- Aggregate B material is spread using Motor Grader with width and thickness solid according to plan drawings.
- Aggregate overlays are watered with using Water Tank Truck and compacted using Tandem Rollers. During compaction, workers will smooth the edges overlay and surface level using Device.

c. Cement Concrete Work with Matting Single Reinforcement

Carried out on the bottom layer of foundation

Skinny Concrete.

- Using concrete with a quality f' c = 20 MPa or equivalent to K – 250.
- The material used is aggregate coarse aggregate, fine aggregate, cement and water.
- Location of work adjusted to plan drawing.
- Stages of Work:
  1. Formwork Installation
  2. Ironing

3. Foundry

d. Thin Concrete Base Layer

This work is carried out above Class A Aggregates. Working method:

- Using concrete with quality f' c = 10 MPa or equivalent to K – 125.
- The material used is aggregate coarse aggregate, fine aggregate, cement and water.
- Location of work adjusted to plan drawing.
- Stages of work:
  1. Formwork Installation
  2. Foundry

If the casting, the concrete foundation layer is thin finished, continued with cement concrete work after obtaining supervisor's approval field.

4. Division 6 – Asphalt Pavement

a. Binder impregnation layer – Liquid Asphalt

This work includes providing and laying of asphalt material on the surface pre-prepared for installation of the next asphalt layer.

b. Adhesive Coating – Liquid Asphalt

Its working method is to provide & spread asphalt material on a smooth surface prepared for the next asphalt layer.

c. Anti Peeling Ingredients

These ingredients are mixed in AMP together with asphalt on Lapis Aus Laston work Premix Asbuton, Foundation Lapis Laston Premix Asbuton, Foundation Lapis Laston Grader with a mixed composition of 0.3% of asphalt weight.

d. Laston Lapis Aus Asbuton Premix (AC–WC Asb P)

Executed after layer work adhesive is finished, spread over a layer of AC–Base. Process:

- Materials submitted must have been tested and according to its composition with Specifications the required technique.
- Before the work is carried out, it is done trial first so you can find out thickness and density.
- Laston Lapis . hot mix material mixing wear Asbuton Premix Processed using AMP.
- After that the material is loaded directly into the in a dump truck and transported to the site profession.

- The material is spread with asphalt finisher tool , compacted with a tool tandem roller with minimum passes according to specifications. Then compacted back to using pneumatic tires roller with a track according to trial results. Compacted finishing with tandem tools rollers.

e. Laston Lapis Foundation Asbuton Premix (AC–Base Asb P)

Working method as follows:

- Clean location with Compressor.
- Hot asphalt (AC–Base) is transported to job site with dump truck .
- Truck from AMP with mix (JMF) have been mutually agreed.
- Sprinkle the Tack Coat with Asphalt Sprayer until blended according to condition. Hold a Paper Test .
- Transfer hot Asphalt from Dump Truck to in Asphalt Finisher .
- Spread hot Asphalt with Asphalt Finisher until the loose thickness is approved according to the design thickness and Measure the asphalt temperature hot then.
- Perform initial compaction of 4 passes with Tandem Roller
- After the temperature drops do compaction between, with the Pneumatic Tire Roller up to 12 tracks.
- Perform final compaction with Tandem Rollers.

5. Division 7 – Structur

a. Concrete Structure f' c = 20 MPa

Work execution method:

- Concrete is mixed using Concrete pum.
- Lali was brought to the job site by mixer trucks.
- The composition of the mixture according to specifications established technique.
- Before casting, do the Slump test to check the water level.
- If it meets the requirements, the foundry can next.
- When casting, do compaction using Concrete Vibrator agar the concrete mix is completely even.
- The concrete cube test object is made with materials foundry to carry out tests laboratory.

After casting, the contractor is obliged to maintain concrete surface so as not to be crossed by vehicles up to the concrete age limit determined.

b. Concrete f' c = 10 MPa

Used in foundation work Underneath the Skinny Concrete. Execution method work:

- By using Concrete Pum, concrete mixing is carried out.
- Then take it to the job site with mixer trucks.
- Adjust the mix composition with Technical Specifications.
- Before casting, do the Slump Test to check the water level
- If it meets the requirements, the foundry can next.
- Perform compaction with the Vibrator when casting is done so that the mixture equally.
- During casting, make test objects concrete cubes for testing in laboratory.

c. BjTP Plain Reinforcement Steel 280

Done before the concrete pouring stage cement with single reinforcement. Implementation method:

- Perform Rigid Pavement repetition first on the formwork that has been installed.
- Rigid reinforcement materials and dimensions Pavement according to plan drawings.
- Cut reinforcing steel with tools barbending set, then arrange accordingly set image.

d. Cerucuk Foundation for Procurement and Erection

Do more ironing work at first. Point measurement and determination erection according to working drawings. Before start work, contractor control stock of materials to be used with ironwood stake size 10x10 cm. Method work:

- Piling chimney using energy humans, pincers or with Back Hoe .
- Work floor with a high enough water level can be backfilled with local materials.
- On the foundation of a given wooden crevice the head of the pile, the shape of the road embankment.

e. Stone Installation

The implementation method is carried out:

- Work is done manually.
- A group of workers smoothing the edges of the ground and make a bouwplank.
- Cement, sand & water are mixed into a mortar with Concreate Mixer .
- Clean the mountain stone / river, wet the entire surface before installation.

- Then install the stone using mortar as a binder then trim

6. Division 9 – Daily Work and more

a. Thermoplastic Road Marking

Working method as follows:

- Put the thermoplastic marking paint into the preheater little by little, so that the paint in the tank does not burn.
- Raise the preheater temperature gradually until 150℃ so that the paint is ready to use.
- If the temperature reaches 150℃, add more paint in the preheater to taste, keep stirring preheater every 3 minutes for manual mixer, approximately 50–70 revolutions per minute for mixer mixer.
- Raise the preheater temperature to reach the ideal in accordance with the specifications of the marking paint used.
- If the paint is quite runny, pour it in applicator tank. When pouring paint into the applicator tank, open the door paint removal from the preheater slowly. The goal is to avoid where is the work accident if the paint is already reaches the first ideal temperature that comes out will flow slowly while 3 until 5 seconds later the paint will flowprofusely as a result the paint will flows out of the paint guide reel.
- After the paint is poured, keep the heat stable in the applicator tank for easy stirring. Pour the marking paint on the Applicator shoe enough, the paint is ready to use. When application, paint filter mounted on top shoes, the goal is to avoid material solid entry.

b. Kerb Prefabricated Kerb Type 1 (Raise/Mountable)

The work implementation method is as follows:

- Kerb is made according to the plan drawing using Concrete K – 275 by workers
- When finished, the kerb is transported to the location using a dump truck
- The point where the Kerb will be installed is excavated by the employees
- Masons do foot casting Kerb with special concrete Workers tidy up the rest of the Kerb installation.

4.5.2 Evaluation Results of Field Work on Projects

Results Evaluation profession related implementation of work on Development Projects At Simpang 4 Gatot Subroto – South Lingkar Dalam obtained through interviews

with related parties and workers who directly involved with project development in the field.

1. Division 1. General

a. Traffic Management & Safety

This work starts on week 1 June and finished in the 2nd week of the month the same one. Evaluate this job that done on the project is good. Covers there is a special officer who directs traffic drivers to avoid traffic jams and accidents dangerous. Halfway closure also done in order to limit the path which has traffic flow with the work area to increase security.

b. Construction Safety

This job starts at first week on June and finish on next week. The workers are already using some Personal Protective Equipment such as Safety shoes, Safety vest , masks and eye protection. But there are still PPE items that are lacking complete that is not using Safety helmet. So, as an expected evaluation In the future, development project workers so that always obey and check the completeness of the tools Personal Protective Equipment (PPE) to avoid danger.

2. Division 3. Earthworks & Geosynthetics

a. Ordinary digging

The start time for this work item is on the 2nd week of June and time completion in the 1st week of July. As an evaluation, the method of implementation it is appropriate for the stage of work that planned. This can be seen from the result of the percentage of work deviation based on start to finish time, on Time Schedule S-curve is positive.

b. Excavation of structures with a depth of 0–2 meters

This work starts on 4th week September and also finish on that week. Evaluate this work item, the implementation work method is appropriate as planned work. Could seen in the results of the percentage of work deviation based on start to finish time, on Time Schedule The S-curve is positive.

c. Road body preparation

Starting on the 1st week of July and finished the next week. Evaluation in field for this, implementation method the work is already like the stage of work that planned.

3. Division 5. Grained Pavement Works and Cement Concrete Pavement

a. Class B . aggregate foundation layer

Starting on the 2nd week of July, finished on the 2nd week of August. Evaluation in the field, the first Sunday of this work is not encountered significant obstacles. But on The last 3 weeks of implementation, Lapis aggregate foundation A has a delay caused by the work component delayed due to weather factors.

b. Grade A . aggregate foundation layer

This work starts on 4th week of July and finishes in the 3rd week of August. As an evaluation, this job implemented to support pavement work the road, and spread over the Aggregate class B. Realization, due to late 3 Last week of foundation work aggregate B then it also affects implementation of the work of the aggregate foundation layer A. As a countermeasure, last week performance of aggregate A work, workers projects work together maximize time by doing 2 work items at once i.e. completing the overlay and compaction of aggregate A, after that if compaction has been completed then immediately proceed with starting layer work thin concrete foundation. During maximize the work, workers also minimize rest time to get the job done on time.

c. Skinny concrete foundation layer

Starting on the 3rd week of August and completed in the 1st week of October. This job has been delayed in first week of implementation. That matter because in the previous job experienced obstacles.

d. Cement concrete pavement with matting

single reinforcement

The start time for this work item is on the 1st week of September and completion time in the 4th week of the month November. Evaluation in the field for cement concrete pavement work with webbing reinforcement single, method implementation in the field is appropriate such as the stages of work planned. It can also be seen on the S–Curve Time Schedule that work it finished on time.

4. Division 6. Asphalt Pavement Works

a. Binder impregnation layer – liquid asphalt

This work starts on 2nd week of October and finishes in the 3rd week of October. Evaluation in the field for this work, the method of carrying out its work it was as planned. Case This can be seen from the percentage results work deviation by start time to completion, on the Time Schedule Curve–S positive value

b. Adhesive coating – liquid asphalt

The start time for this work item is on the 4th week of October and time completed on the 4th week of the month October. On-site evaluation for work adhesive layer – liquid asphalt, method of execution the work is in accordance with the stages planned work. That matter can also be seen from the results of the percentage deviation jobs by time from start to finished, on the Time Schedule the S-curve is worth positive.

d. Anti-peeling ingredients

The start time for this work item is on the 4th week of October and time completed on the 1st week of the month November. For field evaluation, method of carrying out work of antimaterials work exfoliation is appropriate as the stages planned work. That matter can also be seen from the results of the percentage deviation jobs by time from start to finished, on the Time Schedule the S-curve is worth positive.

e. Laston Lapis Aus Asbuton Premix (AC WC Asb P)

The start time for this work item is on the 4th week of October and time completed on the 1st week of the month November. Evaluation in the field for pre-mixed asbuton layered lastton work (AC–WC Asb P), implementation method the work is in accordance with the stages planned work. That matter can also be seen from the results of the percentage deviation jobs by time from start to finished, on the Time Schedule the S-curve is worth positive.

f. Laston Lapis Foundation Asbuton Premix (AC–Base Asb P)

The start time for this work item is on the 3rd week of October and time completed on the 4th week of the month October. Evaluation in the field, methods implementation of foundation work pre-mixed asbuton (AC–Base Asb P) has been according to the stages of work planned. It can also be seen from the result of the percentage of work deviation based on start to finish time, on Time Schedule The S-curve is positive.

5. Division 7. Structural Works

a. Concrete structure f' c = 20 MPa

The start time for this work item is on the 2nd week of October and time completed on the 3rd week of the month October. Evaluation of structural concrete work f' c = 20 MPa, the method of implementation in the field it is appropriate for the stages of work planned. It can also seen from the results of the percentage of work deviation based on start to finish time, on Time Schedule The S-curve is positive.

b. Concrete f' c = 10 MPa

The start time for this work item is on the 1st week of October and completed at the same time. On-site evaluation for work Concrete f' c = 10 MPa, implementation method the work is in accordance with the stages planned work. That matter can also be seen from the results of the percentage deviation jobs by time from start to finished, on the Time Schedule the S-curve is worth positive.

c. BjTP plain reinforcing steel 280

Start on the 1st week of October and completed on the next week. Evaluation of reinforcing steel work plain BjTP 280, implementation method in the field is in accordance with the stages planned work. That matter can also be seen from the results of the percentage deviation jobs by time from start to finished, on the Time Schedule the S-curve is worth positive.

d. The foundation of the procurement niche and erection

The start time for this work item is on the 4th week of September and the completion time in the 4th week is also in September. Evaluation in the field for procurement niche foundation work and erection, methods of carrying out work done in accordance with the steps planned work. That matter can also be seen from the results of the percentage deviation jobs by time from start to finished, on the Time Schedule the S-curve is worth positive.

e. Stone couple

The start time for this work item is on the 3rd week of October and time finish on the 3rd week of October also. Evaluation of work implementation methods in field for masonry work items it is appropriate for the stages of work planned. It can also seen from the results of the percentage of work deviation based on start to finish time, on Time Schedule The S-curve is positive.

6. Division 9. Daily Work and more

a. Thermoplastic road marking

Start time of this job on week 1st of December and finishes in the next week. Method of execution of work it is appropriate for the stage of work that planned. It can also be seen on the S–Curve Time Schedule that work it finished on time.

b. Precast Kerb type 1 (Upper/Mountable)

This work starts on 4th week of November and also finish at the same week. As evaluation, method the implementation is in accordance with the stages planned work. That matter can be seen from the results of the percentage deviation work start to finish time, on Time Schedule The S-curve is positive.

5. CONCLUSION AND SUGESTION

5.1 Conclusion

Based on the analysis and research conducted has been carried out, conclusions can be drawn as follows:

1. K2 costs used for implementation of the Road Construction Project At Simpang 4 Gatot Subroto – South Lingkar Dalam of IDR 11,000,000.00 (Eleven million Rupiah). Based on the results of the analysis, The percentage difference between the safety costs construction (K2) field prices with SE No. 11/SE/M/2019 against contact value by 0.53%. Quite a big difference This is due to the presence of several optional construction safety item on SE No. 11/SE/M/2019 which is not included in the budget for implementation project development in the field to adjust the type of project carried out as well as the needs of the work in field.
2. Results of time performance analysis based on Time Schedule S-Curve on Project Construction At Simpang 4 Gatot Subroto – South Lingkar Dalam, for implementation in the field did not experience quite a significant obstacle. Even so, there are several components delayed work due to factors weather so that it causes the value of deviation negative in the 4th week of July until the 3rd week of August by –1.05%, –1.05%, –1.05%, and –0.99% consecutive. But on Sunday can further be improved with good management and productivity maximum of each job executor. So, at the end of this project can stay finished on time.
3. As an evaluation, work implementation method in the field of aggregate foundation layer work class B does not experience any significant problems significant. But in the last 3 weeks execution of work, Aggregate foundation layer A has a delay. Caused by the pending work component due to weather factors. As a result, work aggregate foundation layer A and foundation layer under the skinny concrete also experienced a little lateness. So, week 4 July to the 3rd week of August seen from the Project S-Curve Time Schedule Construction of Simpang 4 Gatot Subroto – South Lingkar

Dalam Ring has negative percentage deviation value of –1.05, –1.05, –1.05, and –0.99 respectively. This is because layer work Class A aggregate foundation is carried out for support pavement work on road and spread over Aggregate B. Concrete sub-base work carried out on aggregate A. Even so, the delay that had happened in the middle of the activity project development can be overcome by countermeasures carried out in the field that is the last week of work class A aggregate, project workers work the same as maximizing time with do at the same time 2 work items, namely complete overlay as well as compaction of class A aggregates, after that if compaction of aggregate A has been done then immediately proceed with the start sub-basework of thin concrete. While maximizing the work, project workers also minimize rest time for moderate work progress can be completed properly time.

5.2 Suggestion

Suggestions for cost calculation analysis construction safety and evaluation implementation of work on Development Projects At Simpang 4 Gatot Subroto – South Lingkar Dalam as follows:

1. As an evaluation, it is hoped that in the future development project workers so that always obey and check the completeness of the tools Personal Protective Equipment (PPE) to avoid dangers and undesirable things.

In future research, it is recommended that take documentation on the entire scope of work, not only only part of it. So that you can attach complete documentation.

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