

Review of the Implementation of Road Preservation and Road Side Widening on SP. Lempake - SP3. Sambera - Santan Project

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Abstract – The main road is a crucial transportation facility that plays a significant role in various community activities in a region, both in urban and rural areas. The total length of this road improvement project is 52.71 km. The enhancement of the SP. Lempake - SP3. Sambera-Santan Road is expected to help improve services and facilitate upgrading road facilities for transportation purposes, benefiting the local community and existing industries. This study utilizes the participatory observation method. Participatory observation is a data collection method that directly involves a researcher in the research location, allowing them to participate in observational activities. The purpose of observation here is for the researcher to be directly engaged in supervising the road preservation and road side widening project of the SP. Lempake-SP3. Sambera - Santan Road. Data collection involves primary data, including on-site observation methods, interviews, documentation, and secondary data used in this report, such as plan drawings, time schedules, and organizational structure. The widening of the SP. Lempake - SP3. Sambera - Santan Road consists of several tasks, including preparatory work, excavation, spreading and compacting of Class A aggregates, structural work, and the final finishing work. The most significant constraint affecting the project is adverse weather conditions (rain), which lead to work postponements and delays. It would be advantageous to consider an extension of working hours (overtime) to ensure that the project proceeds on schedule.

Keywords: concrete, infrastructure, preservation, shoulder widening

Submitted: 22 Agustus 2023 - Revised: 30 Agustus 2023 - Accepted: 17 September 2023

1. Introduction

Highways are essential transportation infrastructures that play a crucial role in various community activities within both urban and rural areas [1]. In Indonesian Law No. 38 of 2004, Article 1, Paragraph (4), a road is defined as a land transportation infrastructure that encompasses all road sections, including supplementary buildings and their accessories intended for traffic on the surface of land and/or water, and above the surface of water, except for railway tracks, truck roads, and cable roads [2] [3]. Roads are a fundamental component in facilitating the movement of people and goods. Quality road infrastructure helps smooth the distribution of goods and transport, subsequently enhancing a country's competitiveness. With the growth of the economic and industrial sectors, the demand for well-constructed and safe transportation facilities and infrastructure increases, which provides value and benefits for the future. In this regard, supporting infrastructure such as road widening is highly needed. Expanding road infrastructure has the potential to mitigate traffic congestion and enhance the overall service quality of road

networks. Nevertheless, this endeavor necessitates a larger footprint and may exert various influences on the surrounding environment. Primarily, road expansion initiatives may result in the demolition of existing structures [4]. Road shoulders on the sides of traffic lanes are pathways designed to manage water runoff from the road surface and possess a normal gradient of 3% to 5%. In accordance with [5], road preservation is the activity of road management, which includes prevention, maintenance, and necessary repairs to maintain the road's condition so that it can continue to function optimally in serving traffic, thus ensuring that the planned lifespan is achieved. Road preservation involves activities aimed at maintaining road conditions optimally to serve traffic and attain the designated lifespan [6]. Transportation infrastructure development is a part of the national development plan outlined in the five-year plan. To realize this plan, the government constructs a network of highways. The Implementing Unit oversees the construction of this highway network for National Roads, Region II, East Kalimantan Province, a part of the East Kalimantan Implementing Unit for National Roads. This

includes rehabilitation, maintenance, improvement, and new construction of roads. In the pursuit of enhancing transportation services for the communities around SP. Lempake-SP3. Sambera – Santan, the municipal government of Kutai Kartanegara, through the Implementing Unit for National Roads, Region II, East Kalimantan Province, a part of the East Kalimantan Implementing Unit for National Roads, aimed to improve road quality at various points in Kutai Kartanegara in the 2021 fiscal year. One such endeavor is the improvement of the SP. Lempake-SP3.Sambera – Santan road. The total length of this road improvement project is 52.71 km, employing both rigid pavement for road side widening and flexible pavement. The enhancement of the SP. Lempake - SP3. Sambera - Santan Road is expected to enhance services, facilitate the modernization of road facilities for transportation purposes (carriage) for the existing community and industries, and improve accessibility for all vehicles passing through.

This article aims to understand the implementing method of road preservation and road shoulder widening of the SP. Lempake - SP3. Sambera – Santan project which connects Samarinda City and Kutai Kartanegara Regency.

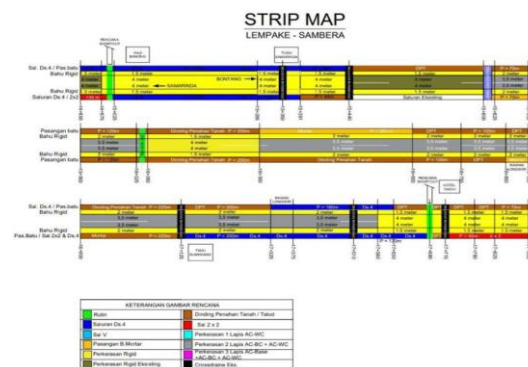
2. Research Method

In conducting the analysis related to the scientific issue, the author employed various methods to acquire the necessary data. The methods used to gather data in this research consist of two types: primary data and secondary data [7]. Primary data includes on-site observation methods carried out directly on the activities in the field, involving direct participation in and observation of the project activities. Directly observed aspects include the stages of implementation within the SP. Lempake - SP3. Sambera - Santan road preservation and road shoulder widening project. Additionally, interviews were conducted in this research, involving direct interviews with all parties involved in the project, such as on-site supervision, contractors, and workers at the project site. This method involved asking questions related to the project to the relevant parties, such as those involved in excavations and road shoulder widening. Documentation was also employed in this research, capturing photos during the project implementation, such as photos of earth excavation work and concrete pouring. Furthermore, the author also collected secondary data directly from the relevant contractor (PT.Bumi Karsa). Examples of secondary data include plan drawings, time schedules, and organizational structures that were deemed necessary. The availability of various sources and references contributed to the successful development of this scientific article.

3. Result and Discussion

The method of implementing a construction project fundamentally involves the elucidation of procedures and techniques for executing tasks, which constitute the essence of all activities within the construction management system. The implementation is a process in the form of a series of activities, starting from policies to achieve a goal. These policies are then translated into a program and project. [8] defines 'method' as an organized and well-considered way to achieve a purpose. It's a systematic way of working to facilitate activity in achieving its intended purpose. According to [9], 'implementation is a series of follow-up activities to implement a school program or policy, consisting of decision-making, strategic and operational steps, to make policies a reality and achieve the originally set program goals. Projects usually have constraints and risks related to cost, schedule, or performance outcomes. Project consists of activities and tasks with specific goals to be accomplished within a start and end time, budget constraints, using available resources (both human and non-human), and being multifunctional.

The stages of implementing the road preservation and road shoulder widening project in SP.Lempake-SP3.Sambera-Santan is based on work plans, specifications (RKS), and work drawings. In road shoulder work, environmental conditions, including weather and soil conditions, must also be considered. The implementation phases of the road side widening project in SP. Lempake - SP3. Sambera - Santan consists of preparatory work, excavation, spreading and compaction of Class A aggregates, structural work, and finishing work as can be seen in Picture 1. Based on these implementation work items, explanations related to each item of road side widening are provided.



Picture 1. Plan Drawing
(Source: Secondary Data, 2023).

1. Preparatory work
Preparatory work is the initial task undertaken when the construction process begins. Preparatory work is carried out to ensure that construction requirements are available and the construction site is ready for work. Furthermore, preparatory work ensures the safety and security of all components around the



construction project. The tasks encompassed within preparatory work include the following:

a. Field survey

A field survey is crucial to understand the potential obstacles that might disrupt the project's execution, whether directly or indirectly. Therefore, conducting a field survey is essential to ascertain the condition of a road shoulder to be constructed.

b. Tool mobilization

Tool mobilization Mobilization of equipment is carried out to ensure no obstacles during the field implementation work. The equipment mobilized for the road side work includes an excavator, dump truck, vibration roller, truck mixer, grooving equipment, dynamic cone penetrometer, and sand cone. As can be seen in the Picture 2.



Picture 2. Excavator

(Source: Personal documentation, 2023).

2. Excavation work

Earth excavation work is a permanent soil-related activity that serves as a structural foundation [10]. The main thing to consider is the stability of excavation, whether using slopes or retaining walls. The excavation slope should be designed according to the soil conditions present. Strengthening the slope can be done by planting vegetation or using asphalt on sandy soil slopes. For excavation processes using retaining walls, the retaining wall should also be designed according to the soil characteristics in the project area [11] [12]. Earth excavation can be performed manually or with heavy equipment. For large-scale earthworks, heavy machinery like excavators is employed for digging, and dump trucks are used for transporting excavated materials. The steps involved in earth excavation work are as follows:

- a. Earth excavation work is carried out based on the slope, lines, and elevations specified in the drawings or indicated by the project direction. It involves the removal of excavated materials in any form encountered, including soil, rocks, organic matter, and old pavement materials no longer in use.
- b. Soil excavation is performed using heavy machinery, namely an excavator, for this earth excavation work.

- c. Load the excavated materials onto dump trucks, transport them, and dispose of them outside the work area.
- d. Push and level the excavated soil using a vibration roller.
- e. Repeat the excavation and disposal process until the designated excavation limit and elevation are reached
- f. Quality control, it is a crucial component of the construction process aimed at ensuring that the final product conforms to design specifications and performs effectively throughout its service life. Given the recent rapid escalation in traffic loads and the numerous pavement failures linked to the inadequacies of natural subgrade soils, subbase layers, and base layers, quality control has gained even greater significance in the successful execution of road pavement construction [13][14][15]. In terms of quality control, Dynamic Cone Penetrometer (DCP) is conducted to check the soil density. It measures the soil's resistance to penetration for a calibrated amount of impact energy provided by a falling weight. Analysis of the data defines layers within the test depth, estimate the strength, pavement condition and variability of granular bases and subgrade soils of pavements amongst other uses [16]. DCP is carried out following the steps below:
 - 1) Choose the designated testing point.
 - 2) Install the DCP equipment and ensure all connections are secure.
 - 3) Place the DCP in a vertical position so that the cone is above the compacted soil base.
 - 4) Adjust the measuring rod or scale to read 0 and record in centimeters.
 - 5) Raise the sliding hammer until it touches the bottom of the handle and release it freely so that the hammer hits the anvil or base, ensuring it doesn't tilt. Record the number of blows and the penetration depth (cm) with 5 blows in total.
 - 6) Repeat the above steps until obtaining soil density.
 - 7) Remove the equipment by raising the sliding hammer to touch the bottom of the handle so that the steel rod is lifted from the soil. Repeat until the steel rod is at the surface of the soil [17] as described in Picture 3.





Picture 3. Soil density testing using DCP (Dynamic Cone Penetrometer)
(Source: Personal documentation, 2023)

7) Fill the excavated hole back in.



Picture 4. Spreading and Compaction of Class A Aggregate
(Source: Personal documentation, 2023)

3. Job spreading and compaction aggregate class A The spreading and compaction of Class A aggregates as depicted in Picture 4 is a requirement for constructing a road shoulder using rigid pavement. Aggregates serve as a supporting layer for the road side body and a load distributor from the top, transmitting it downward through the soil layers. The stages of implementing the foundation layer of Class A aggregate are as follows:

- a. Spreading aggregate material should not be done when the weather is unfavorable, such as during rain, due to high water content.
- b. Compaction should be performed only when the water content of the material falls within the range of 3% below the optimum water content to 1% above the optimum.
- c. Transporting materials from the quarry to the site using dump trucks.
- d. Discharging materials from the dump truck to spread them. Spreading Class A aggregate above the compacted subbase layer with the appropriate slope using a vibration roller for a height of 35 cm and width of 3 m.
- e. The vibration roller mechanically compacts the coarse aggregate by repeatedly passing over the stone pile, achieving the desired density.
- f. A sand cone test is performed to check the density of Class A aggregate. The steps are as follows:
 - 1) Prepare all the equipment and materials needed for the test, such as the sand cone apparatus, weighing scale, plastic bags for storing samples, a shovel for excavating aggregate, a ruler, a tape measure, and a tray.
 - 2) Weigh the bottle + funnel.
 - 3) Dig a hole for the sand cone apparatus to a 10 – 15 cm depth.
 - 4) Place the sand cone over the hole and open the sand cone valve until the sand inside it no longer falls downward.
 - 5) After the sand stops falling, close the sand cone valve.
 - 6) Weigh the sand cone again to determine its weight.

4. Structure work

The structural work carried out for road shoulder widening includes, among others:

a. Lean Concrete (LC) Work

The lean concrete work with a thickness of 20 cm involves the following stages of implementation:

1) Formwork installation

Formwork, also known as shuttering or moulds, is a temporary structure that holds the concrete in place while it is poured and shaped according to the desired form. Formwork must be erected with sufficient strength and an adequate safety factor to withstand or support all live and dead loads without collapsing or posing risks to workers and the concrete structure. A formwork is a tool that assists in shaping the concrete structure according to the planned dimensions, shape, appearance, or position. The formwork itself refers to the portion of the shuttering that functions as a mold for creating the desired concrete shape or the part that comes into direct contact with the concrete. In this project, formwork is made from plywood moulds. As can be seen in Picture 5.



Picture 5. Installation of Formwork
(Source: Personal documentation, 2023)

2) Installation of plastic sheets

A plastic sheet can serve as a working surface for pouring concrete in contact with the ground. Its function is to prevent the leakage of cement-water mix into the soil. Plastic is considered an innovation, replacing the previous materials used for the working surface, such as low-quality screed or concrete. Of course, there are advantages and disadvantages associated with using plastic. It's important to consider the potential benefits while ensuring that it aligns well with the specific project condition. As depicted in Picture 6.



Picture 6. Installation of plastic sheet
(Source: Personal documentation, 2023)

3) LC Fc 20 MPa (lean concrete) work

Lean concrete as described in Picture 7, or LC, is the working layer for rigid pavement construction. Thus, this layer is not part of the structural layers but is a necessary precursor to the rigid concrete layer. Its purpose is to serve as a working surface to prevent cement-water mix from penetrating into the underlying layers. The thickness used is 20 cm. LC is essentially made of concrete with a strength of 20 MPa. The concrete is poured from a truck mixer and then levelled by workers using a straightedge. The maximum capacity of the concrete truck mixer is 7-8 m³; however, due to the relatively long route, the truck mixer only carries 5-6 m³ of concrete to avoid spillage on the road. To calculate the required volume of concrete, the following formula is used:

$$V = P \times L \times T$$

Information:

V = The required volume (m³)

P = The length of the area to be cast (m)

L = The width of the area to be cast (m)

T = Concrete thickness (m)

The concrete casting was executed with intervals of 100 meters in each section, a width of 3 meters, and a concrete thickness of

0.20 meters, then the required concrete volume for 100 meters length is:

$$\begin{aligned} V &= P \times L \times T \\ &= 100 \times 3 \times 0,20 \\ &= 60 \text{ m}^3 \end{aligned}$$

If the capacity of the concrete truck mixer is 6 m³, then it will require approximately 10 concrete truck mixers.



Picture 7 Lean Concrete Floor
(Source: Personal documentation, 2023)

b. Reinforcing steel work

In rigid pavement, the strength against traffic loads is expressed by the tensile flexural strength of concrete. Reinforcement in rigid pavement is used to control cracking, not to carry traffic loads [18][19]. The stages of implementation for this work are as follows:

- 1) Cutting reinforcement steel according to the planned dimensions using a 16 cm diameter steel cutter (grinder).
- 2) Bending all reinforcement steel manually using human labour to achieve the desired shape.

c. The rigid pavement work using FS 45 with a thickness of 35 cm.

The stages of implementation for this work are as follows:

- 1) Installation of formwork and tie bar Dowels are straight steel bars installed at each transverse joint in the rigid and composite pavement. Their purpose is to transfer loads, ensuring that adjacent concrete slabs do not experience differential settlement. Dowels with a diameter of 32 cm are used. Tie bars are threaded steel bars installed at each longitudinal joint in the rigid and composite pavement. Their purpose is to restrain the movement of concrete slabs, preventing horizontal movement. The tie bars are installed at longitudinal joints and have a diameter of 16 cm.
- 2) Installation of dowels and tie bars should be neat, accurate in location, and not overlapping. For dowels, the exposed half-length should be coated with asphalt or wrapped in plastic to prevent bonding with the concrete, ensuring proper sliding.



3) Pouring of rigid FS 45 concrete Casting work involves pouring fresh concrete into the moulds of a structural element that has been fitted with reinforcement bars. The process of casting concrete with planned strength FS 45, which ranges from 30 MPa to 35 MPa, has been tested in the laboratory of PT. Bumi Karsa, involves placing a uniformly mixed concrete mixture using a mixer, commonly referred to as a concrete mixer, and pouring it into the formwork. The concrete casting work was performed at intervals of 100 meters, a width of 3 meters, and a concrete thickness of 0.35 meters, then the required concrete volume for 100 metres length is:

$$V = P \times L \times T$$

$$= 100 \times 3 \times 0,35$$

$$= 105 \text{ m}^3$$

If the capacity of the concrete truck mixer is 6 m³, then it will require approximately 18 concrete truck mixers. The installation of plastic on dowels and tie bars can be seen in the picture 8 below.



Picture 8. Plastic Placement on Dowels and Tie Bars
(Source: Personal documentation, 2023)

For the FS 45 grade mix comparison with 30% sand from Palu, 2/3 coarse aggregate from Palu, and 30% coarse aggregate from Palu 1/2, the proportions are as follows in Table 1:

Table 1. FS 45 Grade Comparison

No	Description	Unit	Cement	Water	Fine aggregate from palu	Coarse aggregate from palu 2/3	Coarse aggregate from palu 1/2
1	Trials after correction per cubic meter	Kg	500	195	510	725	510
2	Comparison of cement with bags	Kg	50	19.500	61.000	72.500	51.000
3	Volume of mixture	Cm ³	40.000	19.500	33.561	47.959	33.725
4	Volume ratio	Cm ³	1.000	0.488	0.839	1.199	0.844

For the mix comparison for one cubic meter of concrete, the proportions used are as follows in Table 2:

Table 2. Cubic Meter Concrete Mix

Cement	10	zak
Water	195	Liter
Fine aggregate from palu	20 x (20 x 30 x 28)	Cm ³
Coarse aggregate from palu 2/3	30 x (20 x 30 x 27)	Cm ³
Coarse aggregate from palu 1/2	20 x (20 x 30 x 28)	Cm ³

d. Finishing work

This work creates a non-slip surface (macrotexture) on the concrete by creating transverse grooves. The tool used to create these transverse grooves is a grooving tool as can be seen in Picture 9.



Picture 9. Grooving Tool for Concrete
(Source: Personal documentation, 2023)

Project quality control

The quality plan is a method or guideline that outlines the work processes to achieve outcomes that meet the specified requirements for the upcoming project. In the road widening project, one of the aspects that is closely monitored is the quality of the concrete used. Good quality ensures the project's durability and strength to withstand vehicle traffic, including cars and motorcycles. The quality of concrete utilized is FS 45, attaining a compressive strength of 30 – 35 MPa for flexural tests, as verified by PT. Bumi Karsa.

In road preservation, the assessment of pavement condition is also crucial for evaluating pavement performance over time. Pavement condition is primarily assessed based on apparent stress levels [20][21][22]. Commonly, distresses are examined through visual and/or quantitative methods. Fundamental structural impairments encompass fatigue cracking (alligator cracking), longitudinal cracking, and transverse cracking. A selection of representative road segments is typically made, spanning diverse traffic volumes and underlying conditions, and pertinent data is gathered, processed, and analyzed across multiple years, serving as a valuable resource for future performance assessments and strategic planning.



Issues that Occurred and Proposed Solutions

There are several issues that have occurred within the project. First, the inconsistent weather conditions occasionally hinder the workforce from performing at their best, resulting in work not being carried out according to the plan. To address this, the solution is to have the workforce put in overtime hours to catch up on the progress that has fallen behind the intended schedule, thereby maintaining the stability of the S curve. Second, the limited availability of materials has caused disruptions in the project's progress. To ensure the work continues smoothly, the solution is to make purchases from sources that offer the same materials in order to align with the initial work plan. Third, discrepancies between the actual work and the planned drawings have been observed, such as insufficient depth in excavated areas. To rectify this, the solution involves carrying out additional excavation work to achieve the intended depth as initially planned.

4. Conclusion

Based on the description discussed in the above article regarding the road preservation and widening project of SP. Lempake - SP3. Sambera - Santan that connects Samarinda and Bontang, the following conclusions can be drawn:

1. Based on the description discussed above, the road widening project of SP. Lempake-SP3.Sambera-Santan consists of several tasks: preparation, excavation, spreading and compaction of class A aggregate, structural work, and finishing.
2. The method employed for widening the road of SP. Lempake – SP3. Sambera – Santan utilizes FS 45 concrete quality with a range of 30 MPa – 35 MPa, which aligns with the initial plan for the intended quality. The use of steel in the structural work involves 32 cm diameter dowels and 16 cm diameter tie bars.
3. Adverse weather conditions, specifically rainfall, present a substantial challenge to the road preservation and road side widening project of SP. Lempake - SP3. Sambera - Santan. Rainfall disrupts ongoing work, resulting in suboptimal progress. To mitigate this issue and maintain a consistent work trajectory, the implementation of overtime work is recommended to offset any backlog.

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