Optimization of Cost and Time of Repair and Rounding of Roads With Way Pavement Design Manual Method 2013

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Abstract: Smoothness, safety, and comfort of traffic depend on road pavement conditions. If the width of the road is narrow, damaged, hollow, the traffic will disrupted; the travel time will increase, fuel consumption increases, the risk of damage to high vehicles and so on, if there is no immediate improvement in the form of an increase, the damage will increase. To deal with this problem, it is necessary to research and plan road improvements with widening, an increase in existing pavements with overlays, the need for cost and time of implementation. The Mojokerto - Ploso road segment is an alternative route connecting the cities of Mojokerto - Jombang, and Lamongan. Based on the status of the road is the provincial road, and based on the function is the Collector's road. Furthermore, for the planning of improvement and widening required subgrade CBR data, for overlay planning, a Test Pit data is needed to determine the existing pavement structure and traffic data. In determining the road widening plan, the 2015 revised Road Pavement Design Manual (MDP) method for overlaying was used with the Planning Guidelines for Pt-T-01-2002-B Bending Pavement Thickness and calculating the Budget using Work Unit Price Analysis (AHSP) 2013, creating a Schedule of Work (Time Schedule), as well as calculating the critical path to find out the critical path in carrying out the work. To planning data analysis is needed - traffic data, land investigation, layer thickness calculation on widening, overlay layer thickness, cost requirements, execution time and critical track path. From the calculation results, the road widening obtained AC = 5 cm pavement arrangement, ATB = 14 cm, CTB = 30 cm, Class B Aggregate = 20 cm, the optional load support layer = 85 cm, using geogrid as the selected urine separator with subgrade, in the old pavement repair (overlay) with an overlay, the AC = 5 cm arrangement, ATB = 14 cm, at a cost of Rp. 19,200,000,000.00 (Nineteen billion two hundred million rupiahs) with a 20-year plan life, as well as a 6-month implementation time.

Keywords: tabal pavement, overlay, schedule, critical path.

1. Introduction

1.1. Background

The Mojokerto - Ploso Regency boundary road is an alternative road to Jombang Ploso - Surabaya, and Jombang - Lamongan which is a reliable route for industrial vehicles, material, and private transportation. The existence of this road is close to the Jombang - Kertosono toll road access and the Gedeg toll road - Mojokerto - Surabaya. Industries that are close to this road are PT. Chield Jedang Indonesia that produces animal feed. As well as many large vehicles overloaded/overloaded. The width of the existing pavement is between 4.7 - 5.5 meters, not meeting the provincial road standard of 7 meters [1]. Road conditions currently have many holes and cracks. If large vehicles pass traffic, it becomes slow, causing road users to inconvenience.
Besides, this project activity was carried out to connect the width of the existing road pavement, namely 7 meters of pavement width.

Of the things mentioned above, the road service needs to be improved to provide comfort and safety for road users, namely by making improvements/improvements to existing road pavements and holding road paving widening. The purpose of the Mojokerto Ploso Regency boundary road planning is needed to produce road designs that are by the Bina Marga road design standards and criteria which aim to provide comfort and safety for the community. In addition to supporting the traffic that arises due to economic development in the area concerned.

1.2. Formulation of the problem

The problem formulation formulated in the following questions:
1. What is the thickness of the pavement layer for widening?
2. What is the increase in the thickness of the pavement layer on the existing road (overlay)?
3. How much does it cost to complete the work?
4. How much time is needed to complete the job?

1.3. Research purposes

1. To find out / calculate the thickness of the pavement layer on widening.
2. To find out / calculate the thickness of the increased layer in the existing road (overlay).
3. To find out / calculate the costs needed to complete the work.
4. To find out / estimate how much time is required to finish the job.

2. Literature

2.1. Previous Research

Thesis Analysis of the Need for Road Repair Costs Using CTB as Aggregate Substitute A and Aggregate B on Roads on Situbondo Street - Ketapang Banyuwangi by Syamsul Hadi Wibowo, Universitas 17 August 1945 Civil Engineering Master Program in 2011 in Surabaya. The analysis in the thesis is: Repair of old pavement with overlay and repair of pavement reconditioning using CTB as a substitute for aggregate A and aggregate B, pavement design with DPU Component Analysis Method 1997[2], with the result that the cost requirement of using CTB material is more economical than using aggregate A and Aggregate B[3].

Thesis Engineering Value of Material Replacement (AC Base, Aggregate A, and Aggregate B) to CTB on Widening Km Road. Sby. 217 + 500n- 230 + 000 Maintenance Maintenance Package Jalan Probolinggo - Situbondo - Banyuwangi by Solikin, University of Civil Engineering Master Program 17 August 1945 Surabaya in 2011. The analysis in the Thesis is: On widening the road the calculation of pavement design with flexible pavement calculation based on the Guidelines for Planning Thickness of Pt T-01-2002-B Pavement Pavement, with the result that the cost requirement of using CTB is more efficient than using Aggregate A and Aggregate B.

2.2. Basic Theory

Roads are land transportation infrastructure that includes all parts of the road, including complementary buildings and equipment that are intended for traffic, which is on the surface of the ground, above ground level, below the surface of the soil and / or water, above the water
surface, except railroad tracks. lorry roads and cable roads (RI Law No. 38 of 2004 concerning Roads) [4] [5].

Road grouping based on its allotment consists of Public and Special Roads. Whereas based on the network system, it grouped on the Primary Network System and Secondary Network System. For a grouping of Public Roads, the cluster based on Functions, Status, and Class of Roads. The legal basis for road development and maintenance in Indonesia is the Road Law no. 38 of 2004 concerning Roads[4][5].

3. Data Analysis and Discussion

3.1. Calculation Subject

Subjects Calculation in this thesis discusses and analyzes the planned thickness of flexible road pavement, plans for overlay thickness, calculate the need for implementation costs and makes a schedule for the execution of work and preparation of critical track schedules[6][7].

3.2. Location and Time of Research

The research location is the Mojokerto - Plaso Km road. Sbaya. 66 + 200 - 69 + 400 = 3,200 Km, the status of the Provincial highway is under the authority of the Public Works Office of the Bina Marga of East Java Province[8][9][6].

3.3. Calculation Instrument

The research instrument used in the planning of flexible pavement thicknesses is a 2015 Pavement Design (MDP) Manual: Number of 02 / M / BM / 2013 Revised by the Ministry of Public Works Directorate of Highways [10][11]. Calculation of the determination of the thickness of the existing road overlay with the approach based on the Pavement Thickness Index contained in the Bending Pavement Planning (Pt T-01-2002-B). Calculation of Work Unit Price Analysis uses the Guidelines for Work Unit Price Analysis (AHSP) from the Ministry of Public Works Ministry and the development in 2013[12][6]. Schedule of work execution with S Curve, with assumptions of production capacity per day, and calculating critical trajectories from the Project Management book and Construction in Temporary Organizations by [13][14][15].

3.4. CBR Value Analysis

CBR analysis uses Component Analysis Method from the Department of Public Works. Analysis of the results of CBR testing is needed to obtain test results that can represent all the results of the subgrade testing on CBR throughout all sections of the road that have divided into segments.

Table 1. Value of R for segment CBR calculations

| Number of Observation Points | R value |
|------------------------------|---------|
| 2                            | 1.41    |
| 3                            | 1.91    |
| 4                            | 2.24    |
| 5                            | 2.48    |
### Number of Observation Points vs R value

| Number of Observation Points | R value |
|-----------------------------|---------|
| 6                           | 2.67    |
| 7                           | 2.83    |
| 8                           | 2.96    |
| 9                           | 3.08    |
| 10                          | 3.18    |

*Source: Component Analysis (SKBI 2.3.26.1987)*

### 3.5. Calculation of Planning Roads on Road Widening

From the results of the Road Planning calculation on the road widening the Road Improvement Package. Kab. Mojokerto - Ploso [16] (Link. 166) obtained the following pavement arrangement:

![Figure 1 Road Pavement Arrangement (in Indonesia)](image)

### 3.6. Calculation of Overlay Thickness on Existing Pavement

From the results of the calculation of the thickness of the overlay on the existing pavement, the increase in the boundary road of Kab. Mojokerto - Ploso [17] (Link. 166) obtained the following pavement arrangement:

![Figure 2 Overlay Thickness on Existing Pavement (in Indonesia)](image)
3.7. Calculation of Critical Track Schedules

The critical path is the work on the path that has the longest time marked with the event has the same time, the fastest time (EET) and the slowest time occurs (LET).

From the results of the calculation of the Critical Road Package for the Bts Road Improvement Schedule. Kab. Mojokerto - Ploso (Link. 166) Critical pathway that passes through work activities: (B) Widening, (C) Paching, (D) ATBL, (E) AC, (F) Shoulder road, and (G) Road markings[18].

4. Conclusions and Suggestions

4.1. Conclusion

Based on the analysis and discussion of the improvement and widening of the road, the budget, the time of execution of the work, and the critical track path, in the Case Study of the Improvement of Bts Road. Kab. Mojokerto Ploso, it can be concluded that the following handling is:

The thick arrangement of the pavement layer on the widening
Laston (AC) = 5 cm, Laston (ATBL) = 14 cm, CTB = 30 cm, Class B aggregate = 20 cm, Support layer = 85 cm, Geogred for separator / separator between subgrade and selected land.

The thickness of the overlay in the old pavement (existing pavement).
Laston (AC) = 5 cm, Laston (ATBL) = 14 cm
The cost of carrying out the work from the calculation of the work unit price analysis is Rp. 19,200,000,000.00 (Nineteen billion two hundred thousand rupiahs).

From the calculation of the critical path, the critical path is the path that has the longest time with a total float equal to zero (0) that is that it passes through the work activities: (B) Widening, (C) Paching, (D) ATBL, (E) AC, (F) Shoulder of the road, and (G) Road markings.

4.2. Suggestions

From the results of calculations, analysis of the discussion and conclusions, in road planning must consider the ease of carrying out the work in the field, using location material to the maximum extent possible, taking into account the factors of road user safety and environmental sustainability and good drainage, because the main enemy of asphalt pavement is water.

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