Analysis Of Pavement Condition Remaining Life And Maintenance Costs On The Sumengko – Bandungrejo Road Section Bojonegoro Regency

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ABSTRACT

Bojonegoro Regency is located in East Java Province, west of the provincial capital. This district has an area of 230,706 ha and borders seven other districts (Pemerintah Kabupaten Bojonegoro, n.d.). Having natural resources mostly in the form of oil and gas in the Cepu block makes Bojonegoro a contributor of 25 percent of national production (ExxonMobil, n.d.). In 2025, the Central Government established a National Strategic Program (PSN) to build a bioethanol factory in Gayam District, Bojonegoro Regency and two investors have visited the plant (Suara Banyuurip, n.d.). Following up on this, of course, it is necessary to follow up with the readiness of supporting infrastructure, especially roads. The main access to the planned bioethanol factory location is the Sumengko – Bandungrejo road section at STA 0+000 to 2+770. This road section has existing pavement in the form of rigid and asphalt overlay. During the construction and operation of the plant, the Sumengko – Bandungrejo road section will receive increased vehicle volume and overloaded vehicle loads. Therefore, before entering this period, it is necessary to conduct a Pavement Condition Index (IKP) analysis using Minister of PUPR Instruction 19/SE/M/2016, analysis of the remaining life of the pavement design using AASTHO 1993 method and the 2024 Road Pavement Design Manual as well as an analysis of road rehabilitation costs according to the the Director General of Construction Development Instruction Number. 30/SE/Dk/2025. Furthermore, after the research is completed, it is expected to be a reference for technical planning and a reference for priority road management policies. Suggestions for further research, if deflection test data on the road section is available, can be included in the calculation analysis.

KeyFindings: *Remaining Life, IKP, Road Rehabilitation, Rigid Pavement*

1. INTRODUCTION

Bojonegoro Regency, located in the western part of East Java Province with an area of 230,706 hectares, is known for its abundant natural and cultural wealth[1]. One of its leading sectors is oil and gas, especially since the signing of the Cepu Block Production Sharing Contract (PSC) in 2005 between ExxonMobil Cepu Limited, PT Pertamina EP Cepu, and the local government, which made Bojonegoro a supplier of more than 25% of the national crude oil [2].

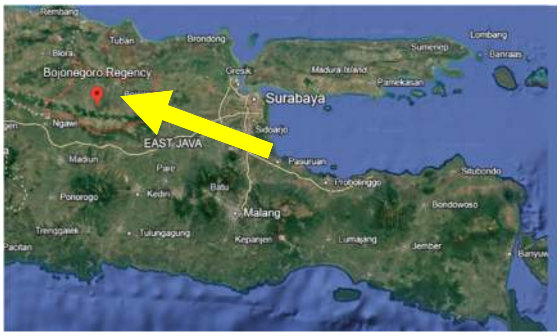

Figure 1. Location of Bojonegoro Regency.

in 2025 Bojonegoro will be the location of the National Strategic Program in the form of the construction of a bioethanol factory by two Japanese investors, namely PT Butonas Petrochemical Indonesia (BPI) in Bandungrejo Village and the Japan International Cooperation Agency (JICA) in Katur Village[3]. The construction of a large-scale bioethanol factory by JICA on 1,400 hectares of land requires the readiness of supporting infrastructure, especially main road access. The 2.77 km Sumengko–Bandungrejo road section is a vital route to the project location, with the existing condition being a 20 cm thick and 5 meter wide rigid pavement. However, increased heavy vehicle activity during the construction and operational periods is expected to significantly increase the road load. Therefore, it is necessary to analyze the condition using Pavement Condition Index (IKP) of the pavement, the Remaining Service Life (RSL) of the road pavement , the projected traffic volume, and the estimated rehabilitation costs to ensure that the road remains sound and suitable to support the success of this national strategic project.

1.1. Impact Of Factory Construction

There are at least four impacts of the factory construction plan, the description of which is in Figure 2.

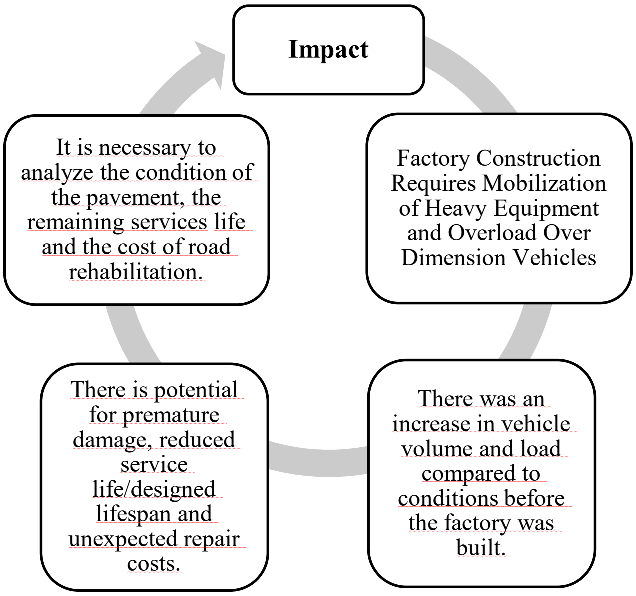

Figure 2. Impact Of Factory Construction

The impact will be felt by the Sumengko - Bandungrejo road section at STA 0+000 to STA 2+770 which is marked in white in Figure 3. Meanwhile, the orange color is a village road section which is not part of the Sumengko - Bandungrejo road section.

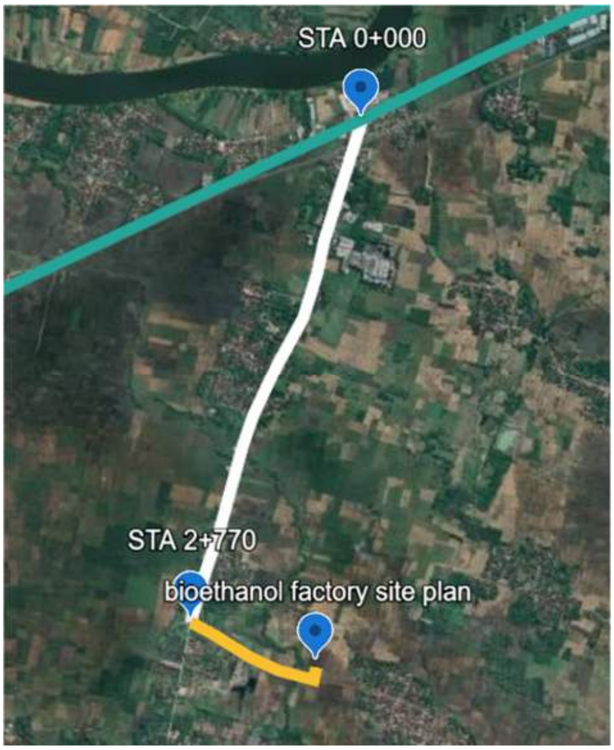

Figure 3. Route To The Factory Location

1.2. Road And Pavement Conditions

The type of pavement on this road section is rigid pavement, some of which has been overlaid using hotmix as shown in Figure 4.

Figure 4. Type Of Road Pavement Leading To The Factory Location

This road section starts from the starting point where it meets the national road. From STA 000+ to 2+770, there is one level crossing with a railway and one bridge. The starting point of this section is shown in Figure 5.

Figure 5. Starting Point Of The Road Section

While the end of the section reviewed by STA 2+770 is in Figure 6.

Figure 6. End Of The Section STA 2+770

2. LITERATURE REVIEW

2.1. Pavement Condition Index (IKP)

To conduct pavement condition analysis using the Pavement Condition Index (IKP) Determination Guidelines (Pd 01-2016-B) issued by Kementerian Pekerjaan Umum Dan Perumahan Rakyat. The Pavement Condition Index (IKP) is a quantitative (numerical) indicator of pavement condition with a value ranging from 0 to 100, with 0 representing the worst possible pavement condition and 100 representing the best possible pavement condition [4]. This assessment range is illustrated in Figure 7.

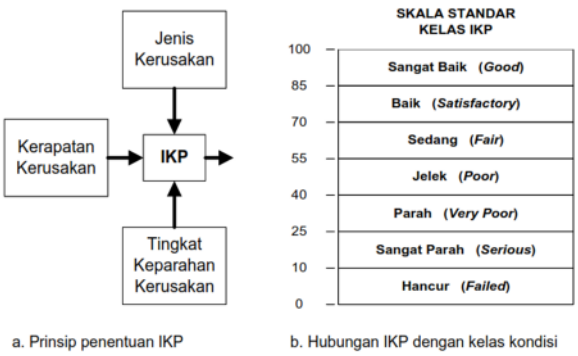

Figure 7. Pavement Condition Index (IKP)

Previously, research on the pavement condition index was conducted on the Limbangan Highway section, from Leuwigong Intersection 3 to Al-Hikmah Mosque, Cibatu District, assessing various types of pavement damage. Of the total 20 types of damage identified on flexible pavement, 7 dominant types were found along the 3.1 km road section. These types of damage show variations in severity that affect the overall PCI value. The analysis results show that the largest type of damage is patches (37.65%), followed by alligator cracks (31.76%), longitudinal and transverse cracks (12.94%), grain detachment (11.76%), potholes (3.53%), and edge and guskur cracks each at 1.18%. Based on these results, recommended treatments include routine maintenance, periodic maintenance, structural upgrades, and reconstruction or recycling. Meanwhile, recommended repair methods include P2, P3, P4, P5, and P6, depending on the level of damage identified [5].

Research on the rigid pavement condition index was also conducted on the access road to and from the Banda Aceh Type A Terminal. The aim was to assess the pavement condition, identify the type of damage, and calculate the percentage of damage using the Pavement Condition Index (IKP) Pd 01-2016-B method. The research was conducted on a 792 meter long road section, divided into 14 sample units with dimensions of 50 × 8 meters each. Of these, 8 sample units were directly analyzed, with a minimum of 3 samples as the basis for the assessment. The research results found 16 types of damage from a total of 18 types of damage commonly found in rigid pavements, including blow up/buckling, corner cracks, divided slabs, D-durability cracks, support, joint plugs, line cracks, shoulder settlement, large and small patches, aggregate wear, popouts, punch outs, corner chips, shrinkage cracks, and chips. The analysis yielded an average IKP of 46.29, indicating that the pavement was in poor condition. This indicates that the roads in the Banda Aceh Type A Terminal area require periodic maintenance or structural rehabilitation to prevent further deterioration and maintain the comfort and safety of road users[6].

2.2. Remaining Services Life

According to AASHTO 1993, Remaining Life (RL) of a pavement is the percentage of remaining service life of a road pavement before it reaches failure or requires major rehabilitation, based on a comparison between the actual traffic load (actual CESAL) and the design load (design CESAL). Conceptually, Remaining Life (RL) indicates how long the pavement can withstand passing traffic loads without experiencing significant structural damage[7]. Therefore, the longer a pavement structure is subjected to loads, the shorter its service life, as shown in Figure 8.

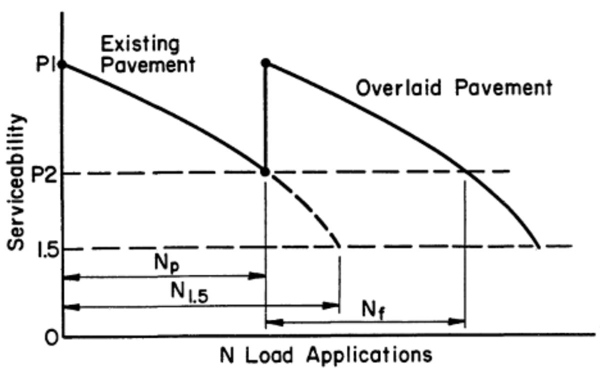

Figure 8. Pavement Serviceability

To determine the remaining service life, the actual amount of traffic that the pavement can withstand until it "fails" must first be determined along with the design traffic load. Both traffic amounts must be expressed in 18-kip ESAL. The difference between these values, expressed as a percentage of the total traffic until it "fails", can then be defined as the remaining service life according to formula (1):

$$RL=100\times\left[1-\frac{N_p}{N_{1,5}}\right] \quad (1)$$

Where:

RL : Remaining Service Life (%)

Np : Tital Traffic to date, (18-kip ESAL)

$N_{1,5}$: Total Traffic to pavement failure (18-kip ESAL)

To analyze the Remaining Service Life of rigid pavement, there is a reference from research on the rigid pavement of the Solo–Ngawi toll road section. The toll road section experienced a decline in function due to damage and an analysis of the remaining life value of the pavement was carried out to determine the appropriate maintenance method. The research method uses a quantitative approach with secondary data, referring to the 1993 AASHTO standard. Based on the analysis results, the design CESAL value was obtained at 22,913,047 ESAL, while the actual CESAL on the Solo–Ngawi route was 8,239,688 ESAL and on the Ngawi–Solo route was 4,270,023 ESAL. From these results, the remaining life of the pavement was 64.04% on the Solo–Ngawi route and 81.37% on the Ngawi–Solo route. This research provides important benefits in determining the level of durability and remaining life of the Solo–Ngawi toll road pavement. The results can be used as a reference for toll road managers to develop preventive maintenance and structural rehabilitation strategies to extend the service life of roads and improve the comfort of toll road users[8].

2.3. Pavement Rehabilitation Cost

To prepare a budget plan, volume calculations and unit price analysis of the work are required. The analysis is influenced by coefficients, wage prices, material prices and equipment prices which are compiled based on the instruction guidelines of the Director General of Construction Development Number: 30/SE/Dk/2025 Concerning Procedures for Compiling Cost Estimates for Construction Work in the Public Works and Public Housing Sector which are adjusted to conditions and data in the field according to the project location. Example of a calculation table for road rehabilitation budget plans as shown in Figure 9

Code	Works	Units	Volume	Unit Price	Cost
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Figure 9. Cost Analysis Form

3. RESEARCH METHODOLOGY

The research flow will be divided into three parts: a flowchart for calculating the pavement condition index, a flowchart for calculating the remaining design life, and a flowchart for calculating road rehabilitation costs. Figure 10 describes the stages of calculating the pavement condition index (IKP).

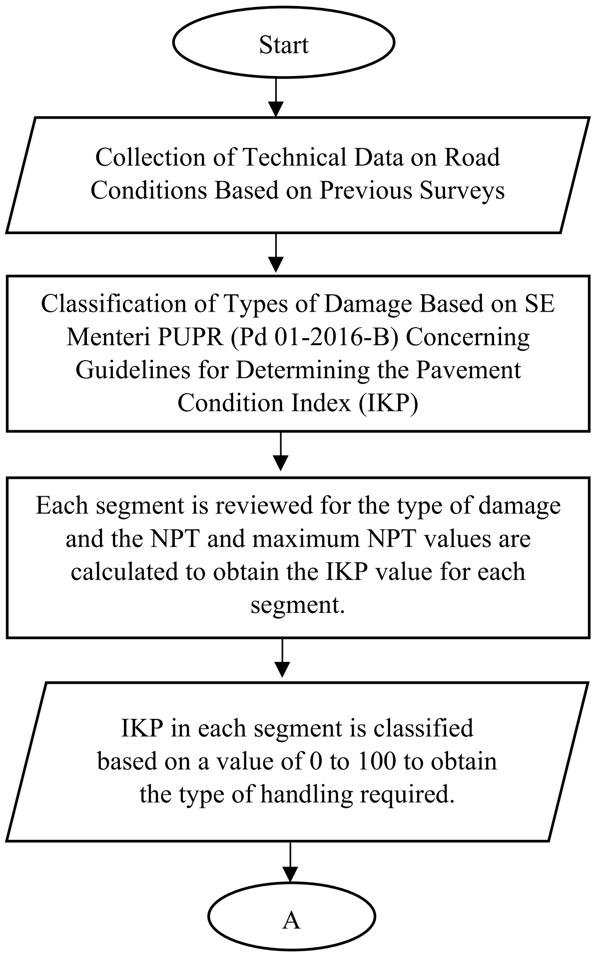

Figure 10. Analys of pavement condition index (IKP).

Meanwhile, Figure 11 is a description of the stages of calculating the remaining life of road pavement.

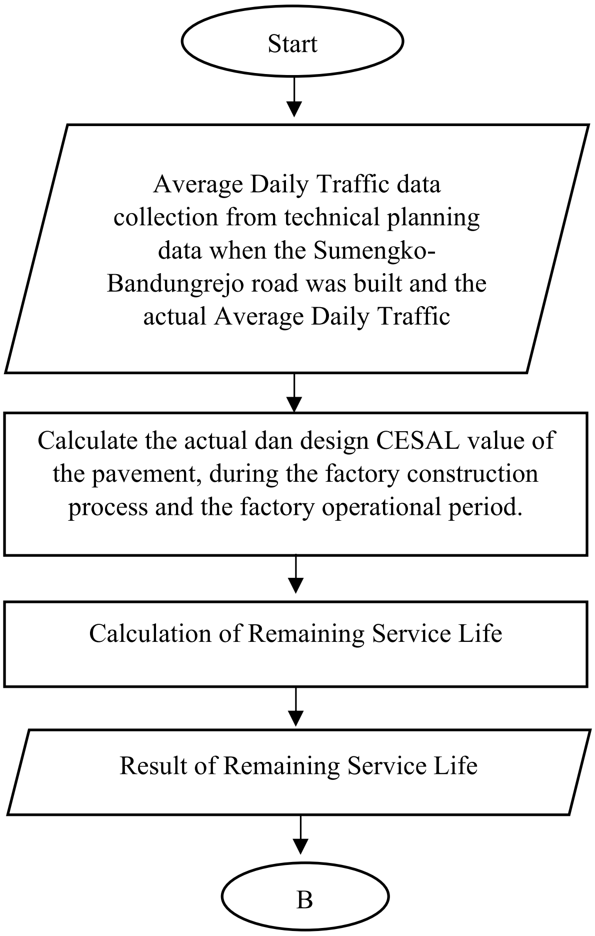

Figure 11. Analys Remaining Services Life

And as a final analysis, namely the analysis of road rehabilitation costs is shown in Figure 12.

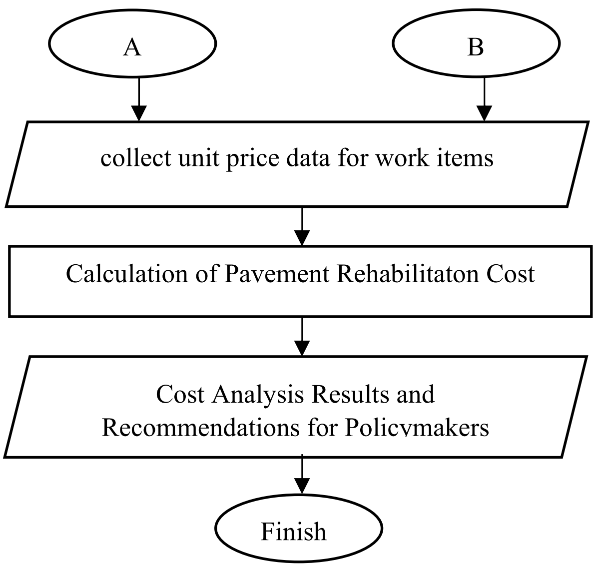

Figure 12. Road Rehabilitation Costs Analys

4. EXPECTED RESULTS

Upon completion of this research, it is expected to produce the following results:

- Road pavement condition index and remaining service life analysis that align with existing conditions.
- This can serve as a reference for policymakers in implementing road structural improvements to Sumengko-Bandungrejo as supporting infrastructure for the National Strategic Project (PSN).
- This can serve as a reference for other researchers in analyzing conditions, remaining design life, and road rehabilitation cost planning.
- The recommendation for further research is that if the deflection test data on this road section is available, it can be included in the calculation analysis.

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