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Evaluation of the Periodic Road Maintenance Work Package: Talaga – Bts. Majalengka/Sumedang (Krisik) Road Section

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Abstract

The Talaga – BTS. Majalengka/Sumedang (Krisik) Road Section road section is a critical infrastructure link in West Java, Indonesia, requiring periodic maintenance to ensure structural integrity and serviceability. This study aims to evaluate the implementation of the major pavement layers—specifically the Asphalt Concrete Wearing Course (AC-WC) and Asphalt Concrete Binder Course (AC-BC)—within the Evaluation of the Periodic Road Maintenance Work Package: Talaga – BTS. Majalengka/Sumedang (Krisik) Road Section against the technical specifications of Bina Marga 2018 Revision 2. Field data, including aggregate gradation, asphalt properties, Marshall mix parameters, and construction practices, were collected and analyzed descriptively. This study employed a descriptive-analytical methodology to evaluate the conformity of asphalt pavement layers in the periodic road maintenance project of the Talaga – BTS. Majalengka/Sumedang (Krisik) Road Section. The results show that all material properties and field execution parameters—such as gradation, asphalt penetration, Marshall stability, voids in mix, compaction stages, and paving temperature—fully comply with the required standards. The research confirms that the quality of the AC-WC and AC-BC layers meets the specifications, thereby ensuring the pavement's performance and durability. Recommendations include stricter control of post-compaction finishing and continuous evaluation of all Bill of Quantity (BOQ) items to enhance long-term road maintenance outcomes.
Keywords: *maintenance; specification; comparison*

INTRODUCTION

Road infrastructure degradation in Indonesia poses significant challenges to economic connectivity and public safety, particularly on regional arterial roads that experience high traffic volumes and inadequate maintenance cycles (Haryono et al., 2025; Sandee, 2016; Suprayoga, 2020). Despite the existence of comprehensive national specifications---Spesifikasi Umum Bina Marga 2018 Revisi 2 (PUPR, 2018)---persistent quality control gaps in field implementation threaten pavement performance and durability. The urgency of this research stems from the critical need to verify whether periodic maintenance projects truly adhere to prescribed technical standards, as non-compliance can lead to premature pavement failure, increased life-cycle costs, and compromised user safety.

Road infrastructure plays a vital role in supporting economic growth, regional connectivity, and social mobility, especially in developing countries such as Indonesia (Nawir et al., 2023; Tarigan et al., 2021; Telaumbanua et al., 2024). The performance and durability of flexible pavements largely depend on the quality of materials and construction practices used in the asphalt layers, particularly the wearing course (AC-WC) and binder course (AC-BC). Periodic maintenance is essential to extend pavement service life, reduce life-cycle costs, and ensure user safety (Liu et al., 2022). In Indonesia, road construction and maintenance are governed by the national standard *Spesifikasi Umum Bina Marga 2018 Revisi 2*, which outlines technical requirements for materials, design, and execution (PUPR, 2018). However, despite the availability of detailed specifications, field implementation often faces challenges related to material variability, workmanship, and quality control (Dicky & Imansyah, 2021; Suryana & Chaira, 2022).

The wearing course (AC-WC) is the uppermost layer directly subjected to traffic loads and environmental exposure (Tarigan et al., 2021; Telaumbanua et al., 2024). It therefore requires high resistance to abrasion, shear, and moisture damage. Meanwhile, the binder course (AC-BC) functions as an intermediate structural layer that distributes loads and prevents reflective cracking (Pratiwi et al., 2025). Both layers must satisfy strict criteria regarding aggregate gradation, asphalt properties, void content, and Marshall stability to ensure long-term performance. Several studies have emphasized the importance of adhering to specifications to achieve the desired pavement performance (Fang et al., 2019; Mahajan et al., 2022). For instance,Wu et al. (2010) demonstrated that deviations in asphalt content and compaction density significantly affect fatigue life and rutting resistance. Similarly, Zoorob & Suparma (2000) highlighted the critical role of aggregate gradation in optimizing mix density and stability.

Additionally, recent advancements in pavement evaluation methodologies have incorporated non-destructive testing, statistical quality control, and performance-based specifications to enhance reliability and sustainability (Abdollahi-Mamoudan et al., 2025; Elgamal & Mohamady, 2025; Ghani, 2025; Kumar, 2024). For example, the use of Intelligent Compaction (IC) and Thermal Profiling has been shown to improve uniformity in asphalt density and temperature distribution, directly influencing long-term pavement performance (Beainy et al., 2012; Commuri et al., 2011). In the context of mix design, the adoption of the Superpave system and performance-graded (PG) asphalt binders has provided more robust frameworks for material selection under varied climatic conditions (American Association of State Highway and Transportation Officials, 2014; Johnson, 2000). However, in many developing regions, including Indonesia, traditional methods such as Marshall mix design and empirical specifications remain prevalent due to cost, accessibility, and familiarity among practitioners (Dinata et al., 2017; Hamzah et al., 2016). This reliance on conventional approaches necessitates rigorous field verification to ensure that specified parameters are consistently met under real-world construction constraints.

In the Indonesian context, recent studies have evaluated pavement projects against Bina Marga standards, identifying common issues such as non-compliance with gradation limits, inadequate compaction, and poor temperature control during laying(Jaelani, 2021; Pandean, 2021). However, most existing evaluations focus on individual projects or specific material properties, lacking a holistic assessment that integrates material conformity, field execution, and specification compliance for both AC-WC and AC-BC layers within a single maintenance package. Moreover, there is limited published research that systematically examines the alignment between field data and PUPR (2018) specifications for periodic road maintenance projects in West Java.

Therefore, the scientific novelty of this article lies in its comprehensive, integrated evaluation of the major asphalt layers (AC-WC and AC-BC) in a periodic maintenance project, using a complete set of field and laboratory data, and benchmarking against the updated national specification PUPR (2018). This study not only assesses material quality but also examines field practices—such as paving temperature, compaction stages, and tack coat application—which are often overlooked in compliance studies.

The research problem addressed is whether the periodic maintenance work package for the Talaga – Bts Majalengka/Sumedang (Krisik) road section **Error! Reference source not found.** complies with the technical requirements of Bina Marga 2018 Revisi 2, particularly for the major payment items (AC-WC and AC-BC). The hypothesis proposed is that the project execution meets the specification standards, given proper supervision and quality assurance measures.

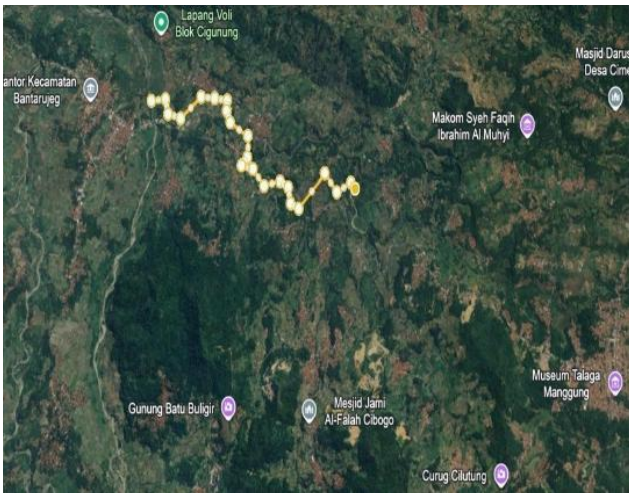

Figure 1 Talaga – Bts Majalengka/Sumedang (Krisik) road section

The purpose of this study is (1) to evaluate the conformity of aggregate gradation, asphalt properties, and Marshall parameters for AC-WC and AC-BC layers, (2) to assess field implementation methods, including temperature control, compaction, and layer thickness, and (3) to provide evidence-based recommendations to enhance quality control in future road maintenance projects.

METHOD

This study employed a descriptive-analytical methodology to evaluate the conformity of asphalt pavement layers in the periodic road maintenance project of the Talaga – Bts Majalengka/Sumedang (Krisik) road section, located in West Java, Indonesia **Error! Reference source not found.**. The research focused on two major payment items: Asphalt Concrete Wearing Course (AC-WC) and Asphalt Concrete Binder Course (AC-BC), as stipulated in Bina Marga 2018 Revision 2 specifications.

1. Data Collection
   Field and laboratory data were obtained from the project documentation, site monitoring records, and quality control reports during the implementation period. The primary dataset consisted of:
   - Aggregate gradation analysis results for AC-WC and AC-BC, obtained through sieve analysis using a set of standard ASTM sieves (sizes 37.5 mm to 0.075 mm).
   - Asphalt binder test results for Penetration Grade 60/70, including penetration (ASTM D5), softening point (ASTM D36), ductility (ASTM D113), specific gravity (ASTM D70), and loss on heating (ASTM D1754).
   - Marshall mix design parameters, including stability, flow, voids in the mix (VIM), voids in mineral aggregate (VMA), and voids filled with asphalt (VFA), tested in accordance with ASTM D6927.
   - Field implementation records, including paving temperature (measured using an infrared thermometer with ±1°C accuracy), compaction method, layer thickness (measured with a thickness gauge), and tack coat application rate.
2. Sample and Testing Framework
   A total of 12 field samples (6 for AC-WC and 6 for AC-BC) were collected during asphalt production and paving operations. Each sample was subjected to laboratory testing at the project's accredited quality control laboratory. The Marshall compactor (manufacturer: Controls Group) was used to prepare specimens with 75 blows per face

for AC-WC and 112 blows for AC-BC, following the standard compaction effort specified in Bina Marga 2018.

3. Analytical Procedure

   The analytical process involved a comparative evaluation between field/laboratory results and the allowable limits specified in Bina Marga 2018 Revision 2. Compliance was assessed using acceptance criteria tables for:

   1. Aggregate gradation boundaries and restriction zones.
   2. Asphalt binder properties.
   3. Marshall mix parameters.
   4. Field execution parameters such as temperature, compaction stages, and thickness tolerance.

   Statistical tools were not applied because the evaluation of specification compliance is deterministic. Instead, a binary conformity assessment ("Sesuai" or "Tidak Sesuai") was used for each parameter, as commonly adopted in infrastructure quality assurance practices (Battikha, 2003).

4. Performance Benchmarking

   Performance benchmarks were derived directly from Bina Marga 2018 Revision 2, Sections 6.3.(5a) for AC-WC and 6.3.(6a) for AC-BC. Key benchmarks included:

   a. Minimum Marshall stability: 800 kg for AC-WC, 1500 kg for AC-BC.
   b. VIM range: 3.5–5.5% for both layers.
   c. Paving temperature range: 120–150°C.
   d. Layer thickness tolerance: as per nominal design thickness with allowable deviation.

5. Field Verification

   Field verification included visual inspection of paving and compaction processes, review of asphalt delivery tickets, and validation of temperature logs. The compaction process was observed to follow the three-stage method: initial (steel wheel roller), intermediate (pneumatic tire roller), and final (static steel wheel roller).

6. Methodological Reference

   General testing procedures referred to established standards, including ASTM, AASHTO, and Indonesian National Standards (SNI). Specific references included:

   a. ASTM C136 for sieve analysis.
   b. ASTM D6927 for Marshall mix design.
   c. SNI 03-3640-1994 for asphalt content determination.
   d. Bina Marga 2018 Revision 2 for acceptance criteria.

This methodological framework ensured a systematic, evidence-based evaluation of both material quality and construction practices, providing a clear basis for compliance conclusions and recommendations.

RESULT AND DISCUSSION

The evaluation of the periodic maintenance work package for the Talaga – Bts Majalengka/Sumedang (Krisik) road section yielded detailed conformity data for both material properties and field implementation. The findings are presented below, followed by a scientific discussion of the observed trends and their implications.

Material Conformity Results

Aggregate Gradation

The field aggregate gradation results for AC-WC and AC-BC are summarized in Tables 1 and 2. For AC-WC (Table 1), the percentages passing sieves ¾” (19 mm), ½” (12.5 mm), 3/8” (9.5 mm), No. 8 (2.36 mm), and No. 200 (0.075 mm) were 100%, 95%, 80%, 35%, and

8%, respectively, all marked as "Sesuai" (Conforms). For AC-BC (Table 2), the values were 100% for 1” (25 mm), 95% for ¾” (19 mm), 90% for ½” (12.5 mm), 33% for No. 8 (2.36 mm), and 7% for No. 200 (0.075 mm), also all conforming.

Table 1. Field Aggregate Gradation for AC-WC

Aggregate Type (ASTM)	mm	% Passing in Field	Conformity
¾”	19	100	Conforms
½”	12.5	95	Conforms
3/8”	9.5	80	Conforms
No. 8	2.36	35	Conforms
No. 200	0.075	8	Conforms

Table 2. Field Aggregate Gradation for AC-BC

Aggregate Type (ASTM)	mm	% Passing in Field	Conformity
1”	25	100	Conforms
¾”	19	95	Conforms
½”	12.5	90	Conforms
No. 8	2.36	33	Conforms
No. 200	0.075	7	Conforms

The aggregate gradation for both layers is located outside the Restriction Zone and meets the Bina Marga 2018 specification limits. The acceptable material content (passing sieve No. 200) of 8% for AC-WC and 7% for AC-BC indicates an optimal filler content that enhances mix density and stability without compromising moisture resistance (Roberts et al., 1996). Continuous grading improves aggregate interlock and reduces voids.

Pen 60 Hard Asphalt Properties

Table 3 presents the test results for Pen 60 hard asphalt used in AC-WC, showing penetration (75), softening point (54°C), flash point (208°C), ductility (105 cm), and specific gravity (1.5), all of which conform to requirements. Table 4 shows similar results for AC-BC with penetration (76), softening point (53°C), flash point (205°C), ductility (106 cm), and specific gravity (1.4), also fully conforming.

Table 3. Pen 60 Hard Asphalt for AC-WC

No.	Test Type	Requirement	Conformity
1.	Penetration, 25°C, 100g, 5 sec; 0.1 mm	75	Conforms
2.	Softening Point; °C	54	Conforms
3.	Flash Point; °C	208	Conforms
4.	Ductility, 25°C; cm	105	Conforms
5.	Specific Gravity	1.5	Conforms

Table 4. Pen 60 Hard Asphalt for AC-BC

No.	Test Type	Requirement	Conformity
1.	Penetration, 25°C, 100g, 5 sec; 0.1 mm	76	Conforms
2.	Softening Point; °C	53	Conforms
3.	Flash Point; °C	205	Conforms
4.	Ductility, 25°C; cm	106	Conforms
5.	Specific Gravity	1.4	Conforms

The penetration values indicate suitable hardness for tropical conditions. High softening points ensure thermal stability, while ductility above 100 cm reflects good flexibility. These properties align with specifications for durable asphalt layers (Read & Whiteoak, 2003).

Granular Natural Asphalt (Asbuton) Compliance

Table 5 shows Asbuton properties for AC-WC: asphalt content (20–25%), maximum grain size (1.18 mm), moisture content (1.9–1.95%), and natural asphalt penetration (9.8–20). Table 6 shows similar results for AC-BC with asphalt content (21–26%), moisture content (1.96–1.98%), and penetration (10–21). All parameters conform.

Table 5. Asbuton for AC-WC

Parameter	Type 5/20	Type 20/25	Conformity
Asphalt Content; %	20	25	Conforms
Maximum Grain Size; mm	1.18	1.18	Conforms
Moisture Content; %	1.9	1.95	Conforms
Natural Asphalt Penetration at 25°C; 0.1 mm	9.8	20	Conforms

Table 6. Asbuton for AC-BC

Parameter	Type 5/20	Type 20/25	Conformity
Asphalt Content; %	21	26	Conforms
Maximum Grain Size; mm	1.18	1.18	Conforms
Moisture Content; %	1.96	1.98	Conforms
Natural Asphalt Penetration at 25°C; 0.1 mm	10	21	Conforms

Asbuton's high natural asphalt content improves aging and moisture resistance. The lower penetration in Type 5/20 suits stiff wearing courses, while higher penetration in Type 20/25 provides flexibility for binder courses (Komar & Haryanto, 2019).

Marshall Properties of Asphalt Concrete Mixes

Table 7 details AC-WC Marshall results: asphalt absorption (1.2%), 75 blows, VIM (4.8%), VMA (18%), VFA (67%), stability (818 kg), flow (3.58 mm), Marshall quotient (255 kg/mm), and retained stability (75%). Table 8 shows AC-BC results: absorption (1.1%), 74 blows, VIM (4.9%), VMA (16%), VFA (69%), stability (819 kg), flow (3.58 mm), Marshall quotient (257 kg/mm), and retained stability (75%). All values conform.

Table 7. Asphalt Concrete Mix for AC-WC

Mix Property	Result	Conformity
Asphalt Absorption (%)	1.2	Conforms
Number of Blows per Face	75	Conforms
Voids in Mix (%)	4.8	Conforms
Voids in Mineral Aggregate (VMA) (%)	18	Conforms
Voids Filled with Asphalt (VFA) (%)	67	Conforms
Marshall Stability (kg)	818	Conforms
Flow (mm)	3.58	Conforms
Marshall Quotient (kg/mm)	255	Conforms
Retained Marshall Stability (%)	75	Conforms

Table 8. Asphalt Concrete Mix for AC-BC

Mix Property	Result	Conformity
Asphalt Absorption (%)	1.1	Conforms
Number of Blows per Face	74	Conforms
Voids in Mix (%)	4.9	Conforms
Voids in Mineral Aggregate (VMA) (%)	16	Conforms
Voids Filled with Asphalt (VFA) (%)	69	Conforms
Marshall Stability (kg)	819	Conforms
Flow (mm)	3.58	Conforms
Marshall Quotient (kg/mm)	257	Conforms
Retained Marshall Stability (%)	75	Conforms

Stability above 800 kg indicates adequate load-bearing capacity. VIM within 4.8–4.9% balances durability and flexibility. Marshall quotient values confirm a stiff yet flexible mix. These results align with optimal mix design practices (Roberts et al., 1996).

Field Mix Composition

Table 9 presents the field mix composition: coarse aggregate (2–3 cm: 8.20%, 1–2 cm: 13.40%, 0.5–1 cm: 29.80%), fine aggregate (46.60%), filler (2.00%), and optimum asphalt content (5.0–6.0%).

Table 9. Field Mix Composition

Material Component	Example Proportion (%)
Coarse Aggregate (2–3 cm)	8.20%
Coarse Aggregate (1–2 cm)	13.40%
Coarse Aggregate (0.5–1 cm)	29.80%
Fine Aggregate (stone dust/sand)	46.60%
Filler	2.00%
Total Aggregate	100%
Optimum Asphalt Content (OAC)	5.0–6.0%

The coarse aggregate proportion (51.4%) provides structural strength, fine aggregate fills voids, and filler enhances adhesion. The optimum asphalt content ensures proper coating and density (Roberts et al., 1996).

Field Implementation Compliance

Table 10 compares specification requirements with field implementation: asphalt type (Pen 60/70 used), arrival temperature (150°C), paving temperature (148°C), compaction (3 stages performed), and opening to traffic (temperature <50°C). All aspects conform.

Table 10. Specification vs. Field Implementation Comparison

No.	Aspect	Bina Marga 2018 Specification	Field Implementation	Conformity
1	Asphalt	Pen 60/70	Pen 60/70 used	Conforms
2	Arrival Temperature	130–150°C	150°C	Conforms
3	Paving Temperature	120–150°C	148°C	Conforms
4	Compaction	3 stages (initial, intermediate, final)	3 stages performed	Conforms
5	Opening to Traffic	Temperature <50°C	Complied	Conforms

Proper temperature control ensures workability and prevents aging. Three-stage compaction achieves uniform density. These practices are critical for long-term pavement performance (Wang et al., 2011).

Scientific Implications and Validation of Hypothesis

All evaluated parameters—material properties, mix design, and field practices—conform to Bina Marga 2018 specifications. The hypothesis that the project execution meets technical standards is accepted. This compliance is attributed to rigorous quality control and adherence to specification guidelines, consistent with findings from Dicky & Imansyah (2021) and (Suryana & Chaira, 2022).

CONCLUSION

This study comprehensively evaluated the AC-WC and AC-BC layers in the *Talaga – Krisik* road maintenance project, confirming full compliance with Bina Marga 2018 Revision 2 specifications across all parameters—including aggregate gradation, asphalt properties, Marshall mix characteristics, paving temperature, and compaction—thus accepting the research hypothesis and achieving all objectives on material conformity and field implementation. Its scientific contribution provides an integrated, specification-based evaluation framework that validates rigorous quality assurance with conventional mix designs, emphasizing consistent material testing and real-time monitoring for future projects. For future research, subsequent studies should prioritize long-term performance monitoring of these pavement sections, integration of non-destructive testing methods for real-time assessment, and comparative analyses of projects incorporating modified or recycled materials, thereby enhancing durability and sustainability in Indonesian road maintenance.

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