JURNAL ONLINE SKRIPSI
MANAJEMEN REKAYASA KONSTRUKSI POLINEMA

Journal homepage: http://jos-mrk.polinema.ac.id/ **ISSN: 2722-9203 (media online/daring)**

DEFECTS IDENTIFICATION OF SOEKARNO-HATTA BRIDGE

Yuda Nureksa[1], Suhariyanto[2], Sumardi[3],
Student Of Construction Engineering Management, Civil Engineering Department, State Polytechnic of Malang[1].Lecturer of Civil Engineering Department, State Polytechnic of Malang [2]. Lecturer of Civil Engineering Department, State Polytechnic of Malang [3]
nureksa.y06@gmail.com [1], *suhariyanto@polinema.ac.id* [2] , *sumardi@polinema.ac.id*[3]

ABSTRACT

Soekarno-Hatta Bridge is a bridge that connects Blimbing and Dinoyo Subdistricts, Malang City, as well as an alternative route from Malang City to Batu City. The bridge is 35-year-old, and was built in 1988. The last bridge inspection was carried out in 2014, therefore it is necessary to conduct another inspection to determine the Condition Value of the bridge. By considering the ease of conducting inventory, detailed, and routine inspections, The 2022 National Bridge Inspection Standards *(Pedoman Pemeriksaan Jembatan tahun 2022)* was used as a reference. Meanwhile, to determine the type of deffect and the Rating Condition of the bridge, the visual analysis method was used. The results of the bridge inspection analysis showed that the Rating Condition of the Soekarno-Hatta steel truss bridge was "1". The number reflects current condition of the bridge that is in a state of minor damage, and the overall condition of the bridge has minor damage and has not expanded. The bridge currently needs indicative maintenance in the form of routine maintenance. From the results of the analysis it was also known that the Rating Condition of the Soekarno-Hatta concrete girder bridge was "2". In a state of moderate damage, an indicative maintenance that should to be done is periodic maintenance.

Keywords : Rating Condition; Maintenance; *Pedoman Pemeriksaan Jembatan Tahun* 2022

1. INTRODUCTION

The bridge inspection is required to determine the physical condition of the bridge elements and to ensure that the bridge is in a safe condition. Soekarno-Hatta Bridge was built in 1988 with an estimated age of 35 years. Based on data obtained from the Bina Marga Public Works Office in 2022, the Average Daily Traffic (ADT) value of the bridge is 120,414 and will continue to increase every year. The last inspection of the Soekarno-Hatta-Malang Steel Frame Bridge was conducted in 2014, and the inspection results indicated that the bridge was in good technical condition..

The BMS'92 Bridge Inspection Manual states that inspections shall be conducted every 5 years or may be conducted earlier (every 3 years). This is the basis for conducting condition inspection research on Soekarno Hatta steel frame bridge and concrete girder bridge with the aim of knowing the type of damage to each bridge element, knowing the overall condition value of the bridge, and being able to provide recommendations for handling each damaged bridge element. The existence of this research is expected to help related parties in providing references for handling actions in bridge maintenance.

2. METHODE

This research was conducted on two bridges on the Soekarno-Hatta-Malang road, namely the steel frame bridge and the concrete girder bridge. The data used in the research are secondary data and primary data.

Secondary data are data obtained from related agencies or sources of literature and journal studies. The data obtained from the submission of secondary data requests is in the form of ADT data.

Primary data is data obtained directly from the field to obtain bridge condition data, bridge geometry data, element types and types of bridge damage.

The bridge inspection method refers to the 2022 Bridge Inspection Guidelines using inventory, routine inspection and detailed inspection forms. Inspection of bridge conditions is carried out by visual inspection methods in stages from inspection of safety building structures, substructure, superstructure, and bridge auxiliary structures.

The results of the bridge inspection are in the form of bridge element type, bridge damage type, damage size and bridge element damage shape. Each damage condition and bridge element condition is accompanied by a photo documentation.

Data processing methods, the inspection results are carried out using condition value analysis in accordance with Pedoman Pemeriksaan Jembatan tahun 2022.Damage measurement criteria in the form of Structure (S), Damage (R), quantity (K), function (F), Affect (P), with a condition value of 0-5.

Table 1. Element Rating System

No	Scoring system	Criteria	Rating
1	Structure (S)	Dangerous	1
		Not Dangerous	0
2	Rating (R)	Critical	1
		Not Critical	0
3	Quantity (K)	More than x%	1
		Less Than x%	0
		X = 30 % for structural elements and 50% for the value of non-structural elements	
4	Function (F)	Not Working	1
		Working	0
5	Affect (P)	Affects other elements	1
		Not Affect other elements	0
6	Condition Rating	NK = S+R+K+F+P	0-5

(Source: Pedoman Pemeriksaan Jembatan)

Table 2. Screening Technic Criteria

Condition Rating	Condition State	Indicative Maintenance
5	Total Collapse, not working	Replacement of new components/bridges
4	Critical Condition	Rehabilitation
3	Severe Condition	Repair
2	Medium Damaged	Preventive repair / Periodic / monitoring
1	Minor Damaged	Routine maintenance
0	Good Condition	

3. RESULTS AND DISCUSSION

Inspection of Soekarno-Hatta Steel Truss Bridge Malang

Figure 1. Side View of Steel Truss Bridge

Based on the inventory inspection, the results are as follows:

1. Bridge Name : Terusan BorobudurBridge / Soekarno Hatta Truss Bridge
2. Serviceable Period : -
3. Bridge Number : -
4. Location : Jl. Soekarno-Hatta
5. Road Section : Soekarno Hatta Maijen Panjaitan (Dinoyo)
6. Year of Construction : 1988
7. Type of superstructure: Australian Steel Truss type A
8. Initial coordinate poin :7º56’56.1” S ;112º36’58.6’’E
9. End coordinate point :7º56’59.6’’ S ; 112º36’55.8’’ E
10. Long span : 100 meter
11. Wide span : 9 meter
12. Number of span : 2
13. Type of path : Mender River (SM)

Result Of Inspection Condition Rating

The results of level 3 assessment are obtained by identifying the highest value among the elements of level 4 elements, then from the level 3 assessment it can be concluded for each group of elements at level 2, then from the group of elements it can be concluded that the conditions for level 1, namely the overall condition value of the bridge.

Table 3. Analysis Result Condition Value of Steel Truss Bridge

LEVEL 3		CONDITION RATING					
CODE	**ELEMENT**	**S**	**R**	**K**	**F**	**P**	**NK**
3.130	Soil Retaining Structure Approach road	1	0	0	0	0	1
3.210	Waterway	1	0	0	0	0	1
3.220	Scouring Protection	1	0	0	0	0	1
3.320	Abutments Wall /Pier	1	0	0	0	0	1
3.410	Girder	0	0	0	1	0	1
3.450	Trusses	1	0	0	0	0	1
3.500	Floor System	0	1	0	0	0	1
3.600	Expansion Joint	0	1	1	0	0	2
3.610	Bearing	1	0	0	0	0	1
3.620	Safety User	0	1	0	0	0	1
3.710	Services	0	0	0	1	0	1

LEVEL 2		CONDITION RATING					
CODE	**ELEMENT**	**S**	**R**	**K**	**F**	**P**	**NK**
2.100	Approach	1	0	0	0	0	1
2.200	Waterway	1	0	0	0	0	1
2.300	Substructure	1	0	0	0	0	1
2.400	Superstructure	1	0	0	0	0	1
2.700	Services	0	0	0	1	0	1

LEVEL 1		CONDITION RATING					
CODE	ELEMENT	S	R	K	F	P	NK
1.000	Bridge						**1**

Source: Result of Analysis

Based on the results of the condition assessment analysis, it is found that:

- The overall bridge value or Level 1 rating is "1", which means the bridge is in a state of minor damage.
- The results of the analysis of the highest condition value at Level 3, which is the compensator. The condition value of "2" means that the condition is moderately damaged.

Results of damage analysis

- The results of the assessment with the highest Condition Value of Level 3 are in the element 3,600 joints/expansion rays with 803 loose parts. A condition score of "2" was obtained.

- There is a gap of 45 mm between expansion joints based on U.S. Department of Transportation regulations. In 2015, the allowable gap is 25 mm.

Table 4. Assessment of damage 803. Loose adhesion of expansion. Element 4.603

Assessment system	Condition	Measurement	Rating
Structure (S)	Not Dangerous	Check for loose parts and clearance between expansion joints	0
Rating (R)	Significant		1
Quantity K)	4,5 cm^2	Calculate total loose adhesion of expansion joints loose attachment, Distance / Gap max 2.5 cm	1
Function (F)	Functional	Facilitates expansion/expansion and contraction/shrinkage movements of the bridge	0
Effect (P)	No influence	Influence on the function of other elements	0
		Condition Value	2

Source: Result of Analysis

Figure 2. Damage Loose pieces in expansion joints. Element 3,600

Maintenance Analysis Result

Table 5. Condition identification and recommendations for handling level 3 - level 1 Steel Truss Bridges

LEVEL 3				
Code	**Element**	**NK**	**Condition**	**Maintenance recommendation**
3.130	Soil Retaining Structure Approach road	1	Minor Damage	Routine Maintenance
3.210	Waterway	1	Minor Damage	Routine Maintenance
3.220	Scouring Protection	1	Minor Damage	Routine Maintenance
3.320	Abutments Wall /Pier	1	Minor Damage	Routine Maintenance
3.410	Girder	1	Minor Damage	Routine Maintenance
3.450	Trusses	1	Minor Damage	Routine Maintenance
3.500	Floor System	1	Minor Damage	Routine Maintenance
3.600	Expansion Joint	2	Medium Damage	Periodical Maintenance
3.610	Bearing	1	Minor Damage	Routine Maintenance
3.620	Safety User	1	Minor Damage	Routine Maintenance
3.710	Services	1	Minor Damage	Routine Maintenance
LEVEL 2				
Code	**Element**	**NK**	**Condition**	**Maintenance recommendation**
2.100	Approach	1	Minor Damage	Routine Maintenance
2.200	Waterway	1	Minor Damage	Routine Maintenance
2.300	Substructure	1	Minor Damage	Routine Maintenance
2.400	Superstructure	1	Minor Damage	Routine Maintenance
LEVEL 1				
Code	**Element**	**NK**	**Condition**	**Maintenance recommendation**
1.000	Bridge	1	Minor Damage	Routine Maintenance

Source: Result of Analysis

The results of the maintenance analysis indicate that

- The condition value at Level 1 is "1", which means that the overall condition of the bridge is in a state of minor damage or has minor damage and has not expanded on each element as a whole the proposed results of bridge handling is routine maintenance.
- The highest condition value at Level 3 is Element 3.600, a condition value of "2" means that the condition of the element is in a state of damage requiring handling, or moderate damage, or minor damage that has expanded, or major damage that has not expanded. Items with this condition require monitoring. The purpose of monitoring is usually to ensure that repairs or maintenance are performed in the future.

Inspection of Soekarno-Hatta Steel Truss Bridge Malang

Figure 3. Side View of Concrete Girder Bridge

Based on the inventory inspection, the results are as follows:

1. Bridge Name : Terusan Borobudur Bridge/ Soekarno-Hatta Concrete Girder Bridge
2. Serviceable Period : -
3. Bridge Number : -
4. Location : Jl. Soekarno Hatta
5. Road Section : Soekarno Hatta – Maijen Panjaitan (Dinoyo)
6. Year of Construction : 1988
7. Type of superstructure: Permanent Prestressed Concrete Girders/ Gelagar Beton Pratekan Permanen (GPA).
8. Initial coordinate point: 7o56’56.1” S; 112o36’58.6’’E
9. End coordinate point : 7o56’59.6’’ S; 112o36’55.8’’ E

10. Long span : 100meter
11. Wide span : 9meter
12. Number of span : 5
13. Type of path : Sungai Mender (SM)

Result Of Inspection Condition Rating

Girder Bridge

LEVEL 3		CONDITION RATING					
CODE	**ELEMENT**	**S**	**R**	**K**	**F**	**P**	**NK**
3.130	Soil Retaining Structure Aproach Road	1	0	0	0	0	1
3.210	Waterway	1	0	0	0	0	1
3.320	Abutment/ Pier	1	1	0	0	0	2
3.410	Girder	0	0	0	0	0	0
3.500	Floor System	1	0	0	0	0	1
3.600	Expansion Joint	0	1	1	0	0	2
3.610	Bearing	1	0	0	0	0	1
3.620	Safety User	0	0	0	0	0	0
3.710	Services	0	1	0	0	0	1

LEVEL 2		CONDITION RATING					
CODE	**ELEMENT**	**S**	**R**	**K**	**F**	**P**	**NK**
2.100	Approach	1	0	0	0	0	1
2.200	Waterway	1	0	0	0	0	1
2.300	Substructure	1	1	0	0	0	2
2.400	Supersructure	1	0	0	0	0	1
2.700	Services	0	1	0	0	0	1

LEVEL 2		CONDITION RATING					
CODE	**ELEMENT**	**S**	**R**	**K**	**F**	**P**	**NK**
1.000	Birdge						2

Source: Result of Analysis

Based on the results of the condition assessment analysis, it is found that:

- The overall bridge rating or Level 1 rating is "2", which means the bridge is in a moderate condition.
- Results The highest condition value at Level 3 is the expansion joint element and the bridge head/pylon element. The condition value of "2" means that the element is in a state of moderate damage.

Results of damage analysis

- The assessment result with the highest Condition Value of Level 3 is an element with 3,600 joints/expansion rays and 804 loose attachments. A condition score of "2" was obtained.

Table 6. Assessment of damage 804. Loose of Adhesion Element, 4.603.

Assessment system	Condition	Measurement	Rating
Structure (S)	Not Dangerous	Check for loose or stretched expansion broadcast area (>25%)	0
Rating (R)	Significant		1
Quantity K)	7 m	Calculate loose expansion joints loose broken/missing attachments	1
Function (F)	Function	Facilitates expansion/expansion and contraction/shrinkage movements of the bridge	0
Effect (P)	No influence	Influence on Service. And other elements	0
		Condition Value	2

Source: Result of Analysis

Figure 4. Damage 804. Loose of rubber adhesion. Element 4.603

- The assessment result with the highest condition value at Level 3 is element 3.320 f pillar head beam (pile cap) with damage 205 broken or partial loss of concrete (loose). A condition score of "2" was obtained.
- Damage to element 4.323 f is damage to structural elements that directly affect the failure or collapse of the bridge. So this damage requires regular monitoring, and maintenance.

Table 7. Assessment of damage 205. Rupture Damage or partial loss of the concrete Element 4.323.f

Assessment system	Condition	Measurement	Rating
Structure (S)	Dangerous	Check the structure of the pile cap area.	1
Rating (R)	Significant		1
Quantity K)	50% Concrete Surface	Measure the area of ruptured concrete elements or missing parts	0
Function (F)	Functional	Transfer load from the bridge superstructure trough the substructure to the foundation-supporting material	0
Effect (P)	No influence	Influence on other main elements	0
		Condition Value	2

Source: Result of Analysis

Figure 5. Rupture Damage or partial loss of the concrete

Maintenance Analysis Result

Table 8. Condition identification and recommendations for handling level 3 - level 1 Concrete Girder Bridges

LEVEL 3				
Code	**Element**	**NK**	**Condition**	**Maintenance Recomendation**
3.130	Soil Retaining Structure Aproach Road	1	Minor Damage	Routine Maintanance
3.210	Waterway	1	Minor Damage	Routine Maintanance
3.320	Abutment/ Pier	2	Medium Damage	Periodical Maintanance

LEVEL 3				
Code	**Element**	**NK**	**Condition**	**Maintenance Recomendation**
3.410	Girder	0	Good	Routine Maintanance
3.500	Floor System	1	Minor Damage	Routine Maintanance
3.600	Expansion Joint	2	Medium Damage	Periodical Maintanance
3.610	Bearing	1	Minor Damage	Routine Maintanance
3.620	Safety User	0	Good	Routine Maintanance
3.710	Services	1	Minor Damage	Routine Maintanance
LEVEL 2				
Code	**Element**	**NK**	**Condition**	**Maintenance Recomendation**
2.100	Approach	1	Minor Damage	Routine Maintanance
2.200	Waterway	1	Minor Damage	Routine Maintanance
2.300	Substructure	2	Medium Damage	Periodical Maintanance
2.400	Supersructure	1	Minor Damage	Routine Maintanance
2.700	Services	1	Minor Damage	Routine Maintanance
LEVEL 1				
Code	**Element**	**NK**	**Condition**	**Maintenance Recomendation**
1.000	Bridge	**2**	Medium Damage	Periodical Maintanance

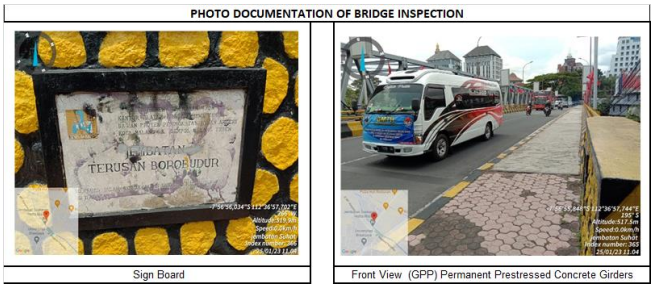
Source: Result of Analysis

The results of the handling analysis indicate that

- The condition value at level 1 is "2", which means that the overall condition of the bridge is in a state of moderate damage, or minor damage that has spread, or major damage that has not spread. Elements in this condition require monitoring. Monitoring is usually aimed at future repair or maintenance.
- The highest condition values at Level 3 are Element 3.600 Expansion Joints and Element 3.320 Bridge/pillar heads. A condition value of "2" means that the condition of the element is in a state of damage requiring treatment, or moderate damage, or minor damage that has expanded, or major damage that has not expanded. Items with this condition require monitoring. Monitoring is usually for the purpose of future repair or maintenance.

EXISTING CONDITION

Existing Condition of Steel Concrete Girder Bridge



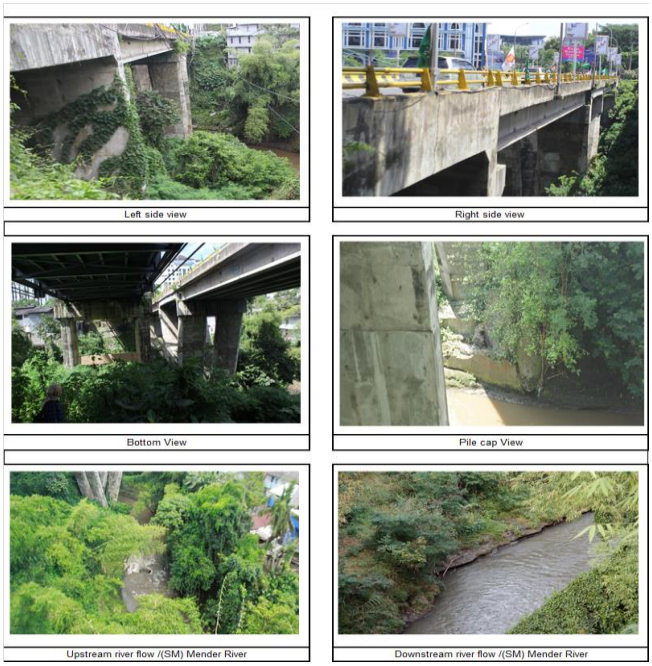


Figure 6. Existing Condition of concrete girder bridge inventory

Existing Condition of Steel Truss Bridge

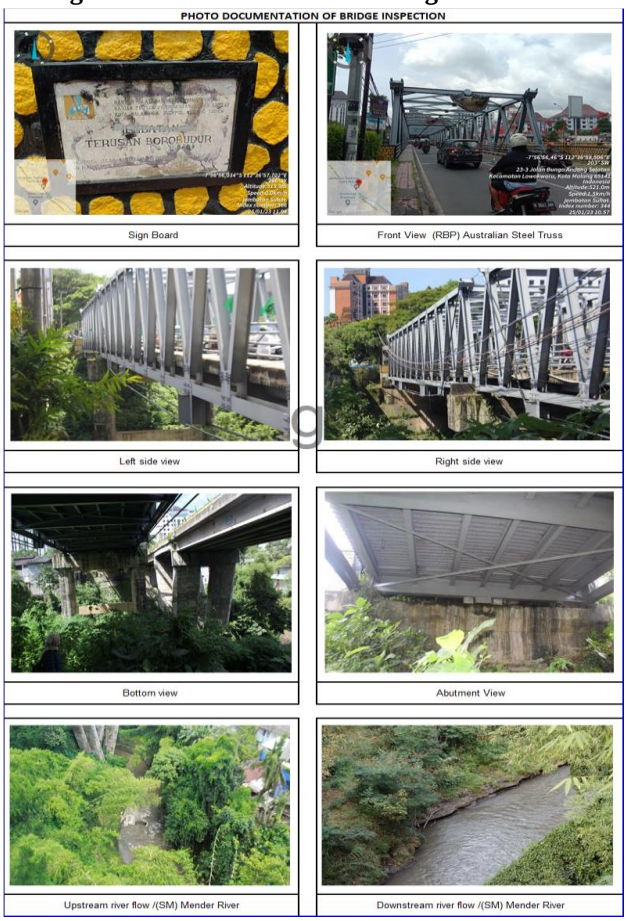


Figure 7. Existing Condition of inventory inspection of steel truss bridges

4. CONCLUSION

Soekarno-Hatta Steel Truss Bridge

1. Condition Value

- The condition value of the bridge as a whole or at level 1 is "1", which means that the bridge is in a state of minor damage, or the overall condition of the bridge has minor damage and has not spread to only a few parts of the element.

2. The type of damage that occurs and affects the overall condition value of the bridge is damage to the expansion joint, namely the occurrence of looseness in the expansion joint. This damage occurs because there is a gap in the expansion joint of 4.5 cm from the maximum gap of 2.5 cm. A condition value of "2" means that the element is in a state of moderate damage with major damage that has not yet expanded.
3. Indicative treatment at a condition value of "1" on the bridge as a whole is routine maintenance.

Soekarno-Hatta concrete girder bridge

1. Condition Value
   The condition value of the bridge as a whole or at level 1 is "2", which means that the bridge is in a state of moderate damage, or the overall condition of the bridge has major damage and has not spread to several parts of the element.
2. The types of damage that occur and affect the overall condition value of the bridge are damage to the expansion joint and damage to the bridge pile cap.

- Pile cap damage is the occurrence of spalling or cracking and/or partial loss of concrete on the pile cap. This damage occurs due to the impact of external forces, with a condition value of "2" meaning that the element is in a state of moderate damage with major damage that has not yet expanded.
- Expansion joint damage is the loosening of the rubber pad attachment to the expansion joint. This damage occurs because the rubber pads on the compensator are detached and lost, the damage occurs along the span of the compensator. where a condition value of "2" means that the element is in a state of moderate damage with major damage that has not yet expanded.

3. Indicative handling at a condition value of "2" on the bridge as a whole is to perform periodic maintenance and require monitoring.

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