BRIDGE CONDITION ASSESSMENT SYSTEM USING THE BRIDGE MANAGEMENT SYSTEM (BMS) METHOD (CASE STUDY OF 5 BRIDGES IN PALI DISTRICT, SOUTH SUMATRA PROVINCE)

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Abstract.
Bridge Management System or BMS is the evaluation system of bridge condition to get accuracy in management maintenance that is the purpose of maintaining the bridge age and preventing damage that could happen to the bridge structure. This research was implemented in 5 bridges in PALI district, South Sumatra Province, namely Rejosari Bridge, Penukal River Bridge, Kapur Hantu Bridge, Talang Akar Bridge, and Penukal River steel truss bridge with the input method and analyzed inspection bridge result data in location by utilizing the information bridge management system ibMS. Based on the ibMS method, the general condition value of each bridge is, such as the Rejosari bridge gets condition value 2. Penukal River Bridge obtained condition value 2, which means the condition needs damage monitoring or upcoming maintenance. Limau Hantu Bridge obtained condition value 3, which means necessary maintenance immediately. Talang Akar Bridge was acquired with condition value 2. Meanwhile for Penukal River Steel Truss Bridge obtained condition value 1. Appropriate with the average results of bridges assessment still in condition good

Keywords: Bridge Management System (BMS), Bridge Condition Assessment.

1 Introduction

1.1 Background

Bridges have a very important role in the smoothness of traffic. if the structured bridge is not safe, it could collapse, which will hinder the smoothness of traffic, consequences bother mobility, smooth flow of goods and services, and most importantly endanger the public user. Bridges condition in Indonesia are almost 40% in conditions not enough good consequence bridge age factor [1] and many bridge yet monitored the damage, resulting countermeasures the damage impressed slowly. That thing based because yet applied the bridge management system overall at each region, including the PALI District, All the time, the bridge evaluation system is still executed manually so the bridge database is not yet available. According to PUPR data at least there are 124 bridges in South Sumatra Province, not all bridges in good condition, and some bridges in the category of repair proper [2]. Bridge condition handling still

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not yet be held directly Because the local government has reasoned that can't repair causes constrained by data and funds [3]. Bridge structure evaluation is very important to anticipate the damaged bridges so that bridges in PALI get further maintenance so that still avoid collapse that can't predicted. Nowadays it is a very necessary system that can be used to keep all bridge data that integrate, then needs to apply a bridge management system in PALI District to keep all bridge databases, so maintenance and handling of bridges damaged quickly resolved. Therefore, the application of Bridge condition evaluation is very important to do. Currently, the application of bridge condition evaluation can be done by the Bridge Management System (BMS) method. This method can be used to maintain conditions through bridge inspection periodically to determine the maintenance and repair stage. This research focuses on bridge condition assessment using the BMS method by taking studies of the case of 5 bridges in the PALI district. This research aims to evaluate the bridge condition by properly inspecting the bridge and analyzing the damage. The results obtained are value bridge condition evaluation that indicated the level of bridge damage.

2 Literature Review

Based on previous research that has been carried out, on the research "Development and Practical Application of a Bridge Management System (J-BMS) in Japan", the article explains a Bridge Management System (J-BMS), which is the rating integration system for concrete bridge conditions which is commonly used to evaluate concrete bridge services. The purpose of J-BMS create rehabilitation strategies based on maintenance, minimizing maintenance costs, and maximizing the quality of bridge services. The method uses genetic algorithm techniques which are commonly used to find estimates of maximum treatment planning. The comparison results show that this system can accurately predict the optimal maintenance of bridges. According to Leidy Magrid's research Rompas (2020) in the research entitled "Design System Information Road and Bridge Data Base Management GIS Based in Kep District. Siau Tagulandang Biaro", This research explains System Information Road and Bridge Data Base Management GIS-based. To efficiently and improve service to the Community.

Bridge Management System (BMS)
BMS is a bridge management system issued by the Directorate Functioning General of Highways for planning, implementation, and monitoring activity bridges. With System Management Bridge, activities can be managed systematically by survey bridge periodically and analyzed using a computer program system information. The inspection and assessment condition part bridge, according to BMS was divided into 5 (five) levels, the fifth level was shared based on code and assessment of damaged parts, for system evaluation, degree damage, and function component bridge is evaluated with inspection structure, damage, number, function and influence. The evaluation structure for condition dangerous is condition value 1, and condition not dangerous has a value 0. The damage critical value is 1, whereas the condition No critical value 0. For a larger amount of 50 marks, the condition is 1, and for a smaller quantity

of 50 marks, the condition is 0. The condition value obtained with add mark conditions on structure, damage, quantity, function, and effects

3 Research Method

This Research was carried out on five bridges in the PALI district, South Sumatra Province, namely Rejosari Bridge, Penukal River Bridge, Limau Hantu Bridge, Talang Akar Bridge, and Penukal River Steel Truss Bridge. Data is used in the form of primary data and secondary data. Secondary data was obtained from agencies such as the Indonesian Ministry of Public Works and Public Housing, and PUPR Bina Marga Service. the data included books module inspection bridge in the field, map location, and administrative data bridge. Secondary data is obtained from inspection directly in the field, that is in the form of inventory data bridge as well as documentation, both data are then input and analyzed with the ibMS program through a screening process.

Evaluation condition bridge is done with the use bridge management system ibMS which is guided by the BMS regulations issued by the Directorate of General Highways in 1993, according to BMS there are five levels, each of which has a code element.

Data Collection Stage

Condition data collection bridge done with how to survey directly in the field. As for condition data bridge taken during the survey conditions in the field, namely:

a. Details in administration are bridge name, bridge number, and construction year.
b. All dimensions of the bridge like total length and quantity span.
c. Dimensions, type of construction, and the condition of main components of every span bridge and bridge elements individually.
d. Other data.
e. Bridge data collected from various types of different checks in scale and intensity, frequency, and manner properties of each element bridge.
f. main types of inspection in the system information management bridge are as follows: (1) Inspection inventory; (2) Detailed inspection; (3) Inspection routine; (4) Inspection special (if required).

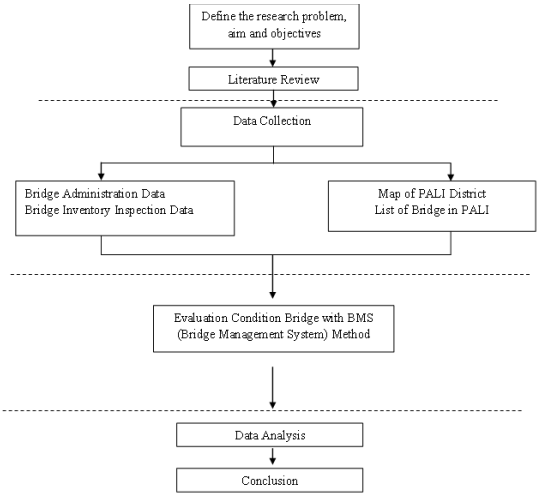

Fig 1. Research Flow

4 Discussion

Bridge Condition Inspection

Bridge management started with the Inspection team doing the entire data collection of bridge information by survey inspection of bridge inventory, and the examiner filling in the form inspection of bridge inventory. Inventory inspection is done by recording the base data of administration, geometry, materials, and additional data on each bridge, including bridge location, length of span, and type of main structure for every span for charging from the inspection inventory bridge, the examiner bridge must know system coding components and main elements of the bridge, with notice type of upper bridge building (TBA), material type of upper bridge building (BHN) and characteristic of upper bridge building (SBA), as well as type support. Besides that, it must also understand the type and materials of the building down, in the foundation head bridge or pillar. In this research, five bridges in the PALI District that inspected the conditions, namely the Rejosari Bridge, Penukal River Bridge, Limau Hantu Bridge, Talang Akar Bridge, and Penukal River Steel Truss Bridge.

Table 1. Information Data of Bridge Inventory

No	Bridge Name	Section Name	River	Dimension				
				STA	Long	LT	Wide	Qty. Spam
					(m)	(m)	(m)	(bh)
1	Rejosari Bridge	Sp. 5 Pendopo-Talang Akar(MUB	Abab	01+600	50	1	6	1

		A District Boundary)						
2	Penukal River Brigde	Sp. 5 Pendopo-Talang Akar(MUB A District Boundary)	Penukal	03+450	30	1	6	1
3	Limau Hantu Bridge	Sp. 5 Pendopo-Talang Akar(MUB A District Boundary)	Limau Hantu	04+110	15	-	4.5	1
4	Talang Akar Bridge	Talang akar-Simpang 4 Sungai Ibul	Talang Akar	02+040	15	-	6	3
5	Penukal River Steel Truss Bridge	Simpang 4 Sungai Ibul-Simpang 4 Babat	Penukal	01+770	90	1	7	1

(source: survey results, 2022)

Before filling in the bridge inventory form, fill in the form administration bridge first, where the administration form contains the number of bridges, bridge name, district/city, bridge location, year of construction, and date of inspection. Number of bridges filled by using code, then fill the technical data of bridge. The next stage of bridge inspection is the inspection inventory carried out by noting the geometric data, materials, and other additional data on each bridge, including bridge location, span length, and type of main structure for each span.

Inventory inspection according to the bridge information system is carried out as follows:

a. Measure and record overall bridge dimensions;
b. Note the type of bridge, the track, the main component, and the date or year of construction;
c. Note load limits or other functional limitations;
d. Interpret and take notes influence of bridge width on traffic;
e. Notes down details about existing detours in the event of a bridge closure;
f. notes down the highest flood data known, date of occurrence, and sources of information;
g. take notes, if there is a picture of the completed bridge. (As-built drawing) and whether the bridge is a standard type
   During the bridge inspection, the form is filled in by coding. This research examines five bridges in PALI district, each bridge carries out a bridge inventory inspection.

Therefore, to fill out the bridge inventory inspection form, the bridge inspector has to know the component coding system and the main elements of the bridge, by watching the type of bridge superstructure (TBA), type of bridge material (BHN), and the na-

ture of the bridge superstructure (SBA), as well as the type of backrest. Besides that, we must understand the type and materials of the substructures, both foundations and bridgeheads or pillars [8]. The result of the bridge inventory inspection is written in the table below:

Table 2. Table of Bridge Inventory Inspection Results

No	Bridge Name	Bridge Length	Bridge Width	Sidewalk width	Upper Structure Building				Floor			Backrest		
					type	material	origin	condition	material	material	condition	material	material	condition
1	Rejosari	50	6	1	m	B	I	2	Q	A	1	B	B	1
2	Penukal River	30	6	1	m	B	I	2	Q	Q	1	B	B	1
3	Limau Hantu	15	4,5		G	T	i	3	T	T	3	B	B	1
4	Talang Akar	15	6		R	Y	i	2	Y	B	2	B	B	1
5	Penukar River Steel Frame	90	7	1	B	Q	A	1	Q	Q	1	B	B	1

(source: survey results, 2022)

As well as results of bridge inventory inspection for bridge substructures.

Table 3. Table of Inventory Inspection Results in Substructure Bridge

No	Bridge Name	Bridgehead or Pillar	Substructue					
			Fundation			Bridgehead or Pillar		
			type	material	condition	type	material	condition
1	Rejosari	Head Jbt 1				B	Q	1
		Head Jbt 2				B	Q	1
2	Penukal River	Head Jbt 1				B	Q	1
		Head Jbt 2				B	T	1
3	Limau Hantu	Head Jbt 1				B	T	1
		Head Jbt 2				B	T	1
4	Talang Akar	Head Jbt 1				Y	B	1
		PILLAR 1				T	B	1
		PILLAR 2				T	B	1
		Head Jbt 2				Y	B	1
5	Penukar River Steel Frame	Head Jbt 1				B	Q	1
		Head Jbt 2				B	Q	1

(source: inspection results, 2022)

Bridge Inventory Inspection Results

Based on the condition inspection by the bridge management system, the condition value results of 5 bridges in PALI district are as follows:

Table 4. Result Condition Value Bridge

No	Name of Bridge	Upper Structure Building		Pilar		Abutement		Parapet		Foundation		Slab		Landfill		River FLow	Condition Value Bridge
		Type	Condition	Type	Condition	Type	Condition	Type	Condition	Type	Condition	Type	Condition	Type	Condition	Condition	
1	Reiosari Bridge	MBI	2	-	-	BT	1	BB	1	LL	-	TA	1	1	1	1	2
2	Sungai Penukal bridge	MBI	2	-	-	BT	1	BB	1	LL	-	TT	1	2	1	1	2
3	Limau Hantu Bridge	GTI	3	-	-	BT	1	BB	1	LL	-	TT	3	2	1	1	3
4	Talang Akar Bridge	RYI	2	TB	1	YB	1	BB	1	LL	-	YB	2	2	1	1	2
5	Rangka Baja Sungai Penukal Bridge	BTA	1	-	-	BT	1	BB	1	LL	-	TT	1	1	1	1	1

(source: results data processing, 2022)

Analysis of Bridge Condition Value Results

Based on the results analysis that has been used by use bridge management system ibMS, has is known condition damage to each element bridge. On the Rejosari bridge, the bridge experienced damage to the structure building above in the section pavement road expansion joint, according to results value evaluation is 2 meanings necessary damage monitoring or get maintenance upcoming. Whereas part floor, backrest, and substructure value 1, meaning experience damage small. On the Penukal River bridge according to the evaluation condition experience damage to the structure building above in section pavement road and some part hole as well as pavement near *expansion joint* experience A little decrease, results evaluation condition bridge value evaluation is 2 meanings necessary damage monitoring or get maintenance upcoming, in the part floor, backrest and substructure value 1, meaning experience damage small. Furthermore, according to the evaluation condition

Limau Hantu Bridge experienced damage to the structure building above in section pavement road Lots separation details so that reinforcement is visible, there is several part bridge floor holes and pavement near Expansion joints experienced a little decrease, according to the results evaluation condition bridge value evaluation is 3 meaning necessary damage action as soon as possible For part building top and floor bridge. Whereas part backrest and substructure value 1, meaning experience damage small. Talang Akar Bridge experienced damage to the structure building above in a section made of the floor of spliced steel pipes, based on the inspection results evaluation condition bridge there is a gap between the floor bridge with optrit, acc results evaluation condition bridge value evaluation is 2, and part backrest and substructure value 1.

The evaluation condition For the Penukal River Steel Truss Bridge value evaluation is 1 meaning experienced damage in the structure building on the bridge, in part floor Lots of overgrown moss and wild plants. Whereas part backrest and substructure value 1, meaning experience damage small. Based on from inventory survey results bridge and value condition of five bridges in PALI District is still in the category of no damage yet serious, the damage occurred Still in the value range of 1-3 where repair category 3 must be quickly repaired, but yet until stage damaged heavy. Evalu-

ation conditions in category 1 and so on structure are Still safe for Can passed vehicle light.

5 Conclusion

According to the results of the field inspection of 5 bridges in PALI District, there are several components damaged like damaged components or lost, changes from components, loss of concrete, growing plants around bridges, cracks and surfaces rough or holes in the surface layer, as well decline quality from paint and galvanized. From the inspection results and assessment use ibMS method determines the general condition value of each bridge, such as the Rejosari bridge gets condition value 2. Penukal River Bridge obtained condition value 2, which means the condition needs damage monitoring or upcoming maintenance. Limau Hantu Bridge obtained condition value 3, which means necessary maintenance immediately. Talang Akar Bridge was acquired with condition value 2. Meanwhile for Penukal River Steel Truss Bridge obtained condition value 1. Appropriate with the average results of bridges assessment still in good condition.

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