International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

http://gssrr.org/index.php?journal=JournalOfBasicAndApplied

Identification of Early Damage Road Pavement Using AHP Method (Case Study: Road Province Technical Service Unit Road Management and Bridge in Jember)

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Abstract

The transportation system in Java is dominated by land transportation modes that use the highway as a infrastructure. The development of community activities in the island of Java to meet economic needs has led to a higher demand for goods transportation and an effect on road pavement conditions. The government can work to improve the existing road network system that can serve the movement of freight transportation as manifested in Minister of Public Works Decree No. 58 / KPTS / M / 2012 concerning the determination of road classes based on carrying capacity to receive the heaviest axle loads and dimensions of motor vehicles. In fact, many of the roads in Java have experienced premature damage before the planned age. Theoretically, road damage is divided into 3 types based on the stages of procurement of the road itself, namely the error of road planning, mistakes in the implementation of road construction, and errors in the function of the road when it has begun to operate. There are several methods that can be used to determine the factors of early damage on the road, one of them is the AHP (Analytical Hierarchy Process) method. The use of the AHP method for determining strategies for handling road damage has been carried out by Zulfikar W and his colleagues (2013) and Saleh M Sofyan and his colleagues (2013). The results of the analysis show the factors that influence the damage to the road pavement, namely road planning (0.362), road conditions (0.297), usage (0.164) and environment / climate (0.176).

Keywords: Analytical Hierarchy Process; Damage; Pavement.

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1. Introduction

The transportation system on the island of Java is dominated by land transportation modes that use the highway as a infrastructure. To be able to meet the movement of economic needs that increase from year to year, the government seeks to improve the existing road network system and is realized by issuing regulations contained in Minister of Public Works Decree No. 58 / KPTS / M / 2012 concerning the determination of road classes based on carrying capacity to receive the heaviest axle loads and dimensions of motor vehicles in Java and Sumatra [1]. The determination of road classes is also regulated in Law no. 22 of 2009 concerning Road Traffic and Transport [2]. In reality, the streets of Java have experienced early damage before reaching the planned age. Damage to the pavement itself is grouped theoretically into [3], namely road planning errors, errors in the implementation of road construction, and when the road is already functioning. This condition also occurs on the East Java Province road section under the authority of the Jember Bina Marga UPT, which has 35 roads with a total length of 21.32 Km and the width of the road varies between 6-16 meters. The existence of limited road maintenance funds required a strategy in handling road damage properly. There are several methods that can be used in the strategy of handling road damage, one of which uses the Analytical Hierarchy Process (AHP). Several studies on the determination of strategies for handling road damage using AHP have also been carried out by Zulfikar W and his colleagues (2013) and Saleh M Sofyan and his colleagues.

2. Methods

- Formulate the problem and determine the desired solution so that an appropiate questionnare model can be
- Create a hierarchical structure that starts with general objectives, followed by sub-objectives, criteria, and possible alternatives at the lowest criteria level
- Make a pairwise comparison matrix that illustrates the relative contribution or influence of each element on each of the goals or criteria above it. Comparisons are made based on the judgment of the decision maker by assessing the level of importance of an element compared to other elements.
- Perform pairwise comparisons so that overall judgment of n [(n - 1) / 2] is obtained, where n is the number of elements compared.
- Calculate eigenvalues and test their consistency. If it is not consistent then the data retrieval is repeated.
- Conclusion

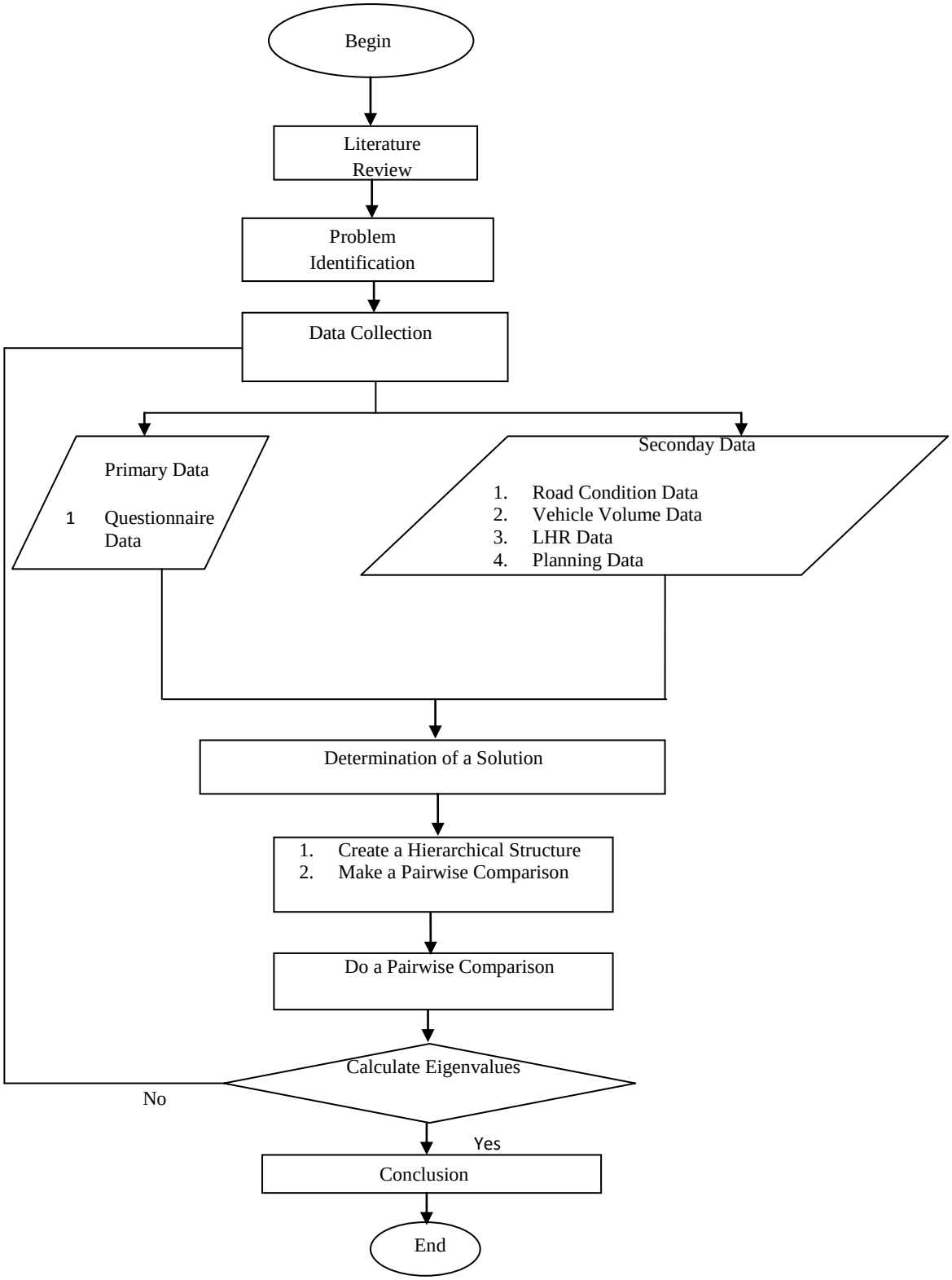

Figure 2: Flow chart research

3. Result and Discussion

This research was conducted on [3] provincial road sections of the UPT Bina Marga Jember with a total length of 31.31 km. For the first section, namely the Lumajang - pondokdalem district boundary, the second segment is the Lumajang - Kencong Regency boundary, and for the third segment, the Kencong - Kasian road

Table 1: Description and Technical Data of The Surveyed Roads

No	Segment Name	Segment Length (Km)	Segment Condition			
			Good	Average	Lightly Damage	Heavy Damage
201	Lumajang Border – Pondokdalem	9,220	-	3,9	5,3	0,020
202	Lumajang Border – Kencong	6,760	-	4,860	1,9	-
203	Kencong - Kasian	15,330	1,7	-	8,7	4,930

Source: Bina Marga Jember, 2019

3.1. Collecting damage data from the road

Identifying damage to roads is obtained directly from field surveys. The following data is damage from the surveyed road sections

- Cracking
- Distortion
- Surface defects
- Worn out
- Bleeding

3.2. Condition index number

In this research we use Analytical Hierarchy Process method to get the value of condition index number on road that we have done survey. In AHP there are goals, criteria, and alternatives. The purpose of this research is to get the value of each component and element on the road that is used as the object of research. In this research we only use criteria on factors that influence early damage to pavement. As for the alternative, the damage road section looks for priority factors that affect the early damage to the pavement. The stages in using the AHP method we first determine the hierarchy that we will use, after that use a comparison matrix of components, sub components, elements, and sub elements to be used as a questionnaire. After that, conducting interviews with respondents in the UPT environment in the management of roads and bridges. The data from the respondents we then use with help of expert choice version 11 application to get component weights and we collaborate with the percentage of damage to get the value of the condition index value.

3.3. Respondent data

In the AHP method selected respondents who are considered competent and understand in the field. In this study, researchers took 5 respondents by purposive sampling to provide an assessment of the weight of each element of the road section. The parties chosen as respondents are parties who are usually connected and have authority in the maintenance and repair of roads and bridges.

3.4. Calculation of component weights on survey roads

In calculating the weight of the components of the road used the value of the comparative importance of each criteria. The comparison value is obtained from the results of the questionnaire that has been assessed by the respondents. Using the Analytical Hierarchy Process (AHP) method. Calculation of component weights using the assistive program, Expert Choice version 11. Component factors that affect road damage consist of road planning, road conditions, usage, and environment / climate. The results of weighting the components obtained from the questionnaire. From the questionnaire obtained a value comparison of the interests between road planning, road conditions, usage, and the environment / climate which is processed using the Expert Choice version 11 application. Based on the results of the questionnaire obtained a comparison value of

- Road Planning : Road Conditions = 1: 3 means the value of road conditions is slightly more important than the value of road planning

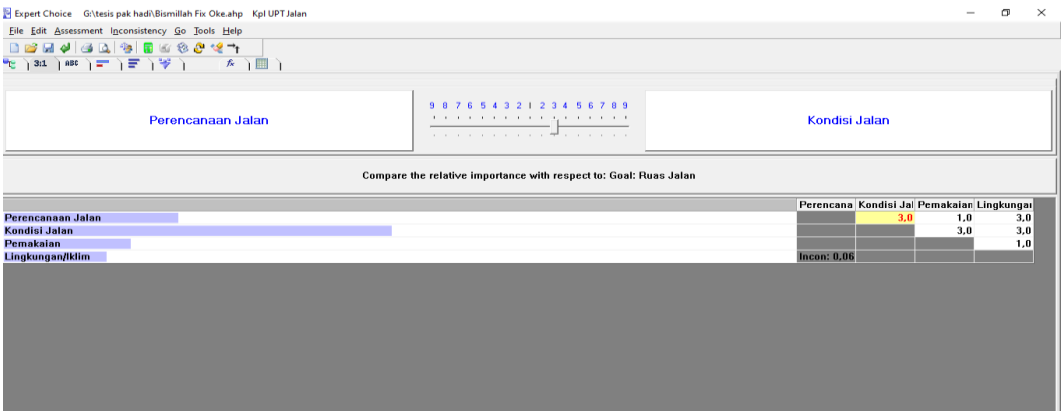

Figure 3.1: Input of questionnaire results level of interest factors that influence

From the results of the questionnaire answers that have been processed using Expert Choice version 11, obtained a consistency ratio value (CR) 0,06<0,1in the validity of the answers from the questionnaire can be accepted. The weight value for each component shows its importance. From the data processing above, we get weight values from road planning, road conditions, usage, and environment / climate. The planning component for road weights is slightly more important, 0.362 than the weight of road conditions, 0.297, usage 0.164, and environment / climate 0.176. Shows that road planning has a very high importance compared to road conditions, usage and environment / climate. Because in the planning of roads that are not good and right will affect the age of the road itself. So it is a very influential factor compared to other supporting factors. Next is the hierarchy of factors that become the priority scale for damage to roads.

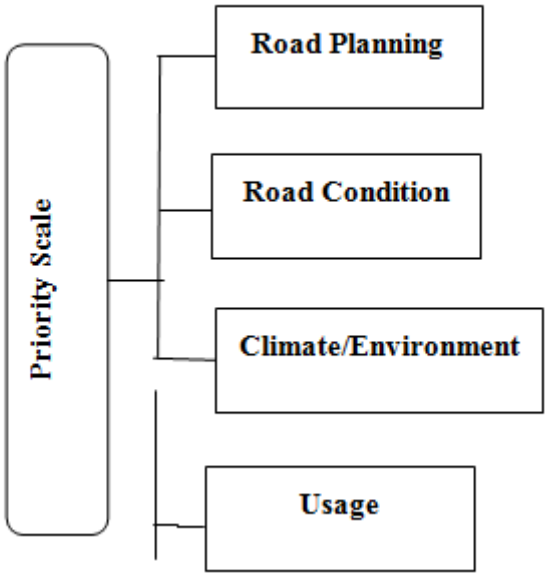

Figure 3.2: Priority scale hierarchy

4. Conclusion

From the results of the discussion of the analysis of factors that affect the damage to roads using the Analytical Hierarchy Process (AHP) it can be concluded as follows:

- Factors that influence road pavement damage are road planning, road conditions, usage and environment / climate
- The type of damage that occurs in the surveyed road sections are cracks, distortion, surface defects, wear and tear
- Priority factors in influencing road damage are road planning

Acknowledgements

We thank our colleagues from civil engineering department of Jember University who provided insight and expertise that greatly assisted the research.

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