APPLICATION OF ANALYTIC HIERARCHY PROCESS METHOD IN DETERMINING THE PRIORITY WEIGHTS OF ROAD PAVEMENT PLANNING CRITERIA ON THE PROJECT PRESERVATION OF RECONSTRUCTION OF THE ROAD SIDOARJO – PANDAAN – P

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Krismana Yudo Prahastyo, Nusa Sebayang, Lies Kurniawati Wulandari

Abstract – Preservation of the reconstruction of a national road in Indonesia, has become full attention by the government through the Ministry of Public works and Housing, Directorate General of Highways. So that the assets belong to the country can serve as an infrastructure with better and its role widely enough to meet the needs of the community. Through a series of studies using the method of Analysis Hierarchy Process (AHP) to determine priority of criteria in the plan the type of road pavement project, and on the Preservation of the Reconstruction of the Road Sidoarjo, Pandaan – Purwosari– Malang – Kepanjen. The result analysis state that, the criteria of safety and comfort of road users its weight (0,2122); then the criteria of resistance on the daily traffic and average load to the path with weights (0,1587); followed the criteria of cost of implementation of pavement construction with weights (0,1578); furthermore, the criteria of resistance on the climate and weather around the path with weights (0,1325); criteria ease of implementation methods of pavement with weights (0,1286); criteria ease of maintenance after the maintenance period with weights (0,1208); and the criteria of convenience (availability) material pavement with weights (0,0894).

Keywords – Criteria Planning of Road Pavement, Analysis Hierarchy Process

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1. INTRODUCTION

In Indonesia, the construction, repair and improvement of roads needed attention and workmanship better and optimal. Various kinds of criteria for planning the type of pavement are needed by the government so that the physical work of the pavement types is more focused and effective for the needs of all parties. One of them is in the Sidoarjo - Pandaan - Purwosari - Malang - Kepanjen Road Reconstruction Preservation project.

Treatment that was implemented previously, is based on some interests, such as the limited allocation of funds for road work in the area, the interests of the several parties which are not in accordance with the socio-economic conditions that exist at the project location, and other interests that dominate the decision-makers at the level of the central government. For these reasons, it is necessary a method scientific approach that can be used as material to deciding planning the type of pavement, so that it can reduce the element of subjectivity of the decision maker. One of the scientific methods contemplated is a method of *Analytical Hierarchy Process* (AHP), a method that has been known and widely used in the field of decision-making and management (Nurtanto, 2015)

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1.1 Preservation of Reconstruction of The Road

Road preservation is an attempt to perform the activities of maintenance, rehabilitation or reconstruction on the road. The maintenance which to prevent some damage can be done on the roads due to the influence of weather and climate, also because the traffic is heavy. So the damage can be minimalized   According to the Civil Engineering site   in   his   blog https://www.situstekniksipil.com/2018/03/rekonstruksi-pemeliharaan-preservasi.html. In accordance with Ministerial Regulation (Permen) of the Ministry of Public Works Number 13/PRT/M/2011, on procedures for Maintenance and Inspection of the Road. Road preservation is the activity of handling the street, the form of prevention, maintenance, and repairs necessary to maintain road conditions to remain functioning optimally serving traffic so that the life of the plan set can be achieved. Road preservation is done to keep the road conditions in standard and steady condition. The activities of road preservation consist of routine maintenance, periodic maintenance, rehabilitation, and reconstruction of roads and buildings complement the street.

Road preservation program is based on regard to regulations applicable in Indonesia, which are as follows:

1) Ministerial Regulation (Permen) of the Ministry of Public Works Number 13/PRT/M/2011 about procedures for Maintenance and Inspection of the Road.

2) Ministerial Regulation (Permen) of the Ministry of Public Works Number 19/PRT/M/2011 about Technical Requirements of Roads and Planning Criteria Technical Way.

3) Ministerial Regulation (Permen) of the Ministry of Public Works Number 13.1/PRT/M/2015 about Strategic Plan of the Ministry of Public works And Public Housing in the Years 2015-2019.

According to the Civil Engineering site in his blog https://www.situstekniksipil.com/2018/03/rekonstruksi-pemeliharaan-preservasi.html can be described about as follows :

A. Road Management Concept with Long Segment Scheme The Long Segment is the implementation of the road preservation within the limits of the segment of one-unit length of a continuously (can be more than one segment) and implemented with the goal to get the road conditions are uniform. Long Segment applying performance indicators to the components of the path, including:

1) Approach in implementation delivery system of road preservation.
2) Sharing to the Service Providers implementer of road maintenance work.
3) The increased ability of Service Providers in both equipment and personnel.

B. Optimization of Road Maintenance
Applying the technology of pavement with low maintenance cost, although the initial cost may be quite high, but in the long term the total cost (life-cycle cost) will be low compared with pavement conventional.

Further, the policy of road preservation should be paramount with the way to do routine maintenance (functional) in a timely manner and if forced to, the work of overlay/ reconstruction (structural) expensive done until the necessary budget available.

1.2 The Main Factors Causing Road Damage

1) Rain and Groundwater
2) Overloading Vehicle
3) Job quality: types & levels of asphalt, the temperature of the workmanship asphalt, density, type and gradation of aggregate, water content and density of the soil base.
4) The environment (the pavement temperature, climate and weather, LHR).
5) Maintenance Strategy (the cost of construction is cheap, but the total cost of construction is high).

1.3 The Purpose of Road Preservation

In accordance with the Module Road Conservation Training 1 (2019), the purpose of road preservation is
1. Maintaining the Road Condition
   Road maintenance (routine and periodic) are prioritized on the National road that are in good condition or not in order to provide optimal transportation services
2. Lowering Transportation Cost
   Road conditions which are maintained in a good condition can provide benefits to reduced transportation cost
3. Increase Economic Growth
   Good road transportation infrastructure services, will affect the economic development of the region through the activity-economic activity and improve the investment climate

1.4 The Activities of Road Preservation

According to the Module Road Conservation Training 1 (2019), efforts that can be done is:
1. Road handling activities is, in the form of prevention, maintenance and repair necessary to maintain road conditions to remain functioning optimally serving traffic so that the life of the plan set can be achieved.
2. The implementation of the road Preservation must pay attention to the safety of road users and smooth traffic with the placement of the traffic signs are clear, safe, and stable.
3. Road preservation includes routine maintenance, periodic maintenance, road rehabilitation, and road reconstruction

1.5 Type of Road Preservation

In accordance with the Module Road Conservation Training 1 (2019), can be distinguished:

1. Corrective maintenance, which is maintaining a routine way actively throughout the life of the plan
2. Preventive maintenance, which is preservation of pavement by maintaining the stability of road condition
3. Rehabilitation, which is done when damage occurs due to a special cause
4. Reconstruction, which is done when the condition of the road severely damaged

1.6 Road Elements To Be Carried Out Maintenance

1. Pavement (The Road)
   Pavement maintenance work is intended to maintain a steady service conditions is done throughout the year.
2. Roadside and Drainage

Roadside maintenance work aims to maintain or repair the surface of the road shoulder existing so that the slope remains consistent with the provisions as required

3.   Road Equipment
Roadside maintenance work aims to maintain or repair the surface of the roadside existing so that the slope remains consistent with the provisions as required

4.   Bridge
Bridge maintenance job is to maintain the condition of the bridge remain steady and ensure that the decline in the condition of the bridge can be restored on the condition of stability according to the performance required

1.7 Type of Pavement Construction

According Saodang (2004), based on the binding material, pavement construction can be distinguished on:

A.   Flexible Pavement, is a road pavement using asphalt as a binder. And road pavement layers are forward and spread the traffic load from the top to the ground base.

B.   Rigid Pavement, is a road pavement using cement (Portland Cement) as a binder. The traffic load is mostly carried by concrete slabs.

C.   Composite Pavement, is a combination of flexible pavement on top of the rigid pavement construction.

1.8 Flexible Pavement

Pavement construction (flexible pavement), is a road pavement using asphalt as a binder.

Fig. 1 : Cross Sections Of The Pavement Bending
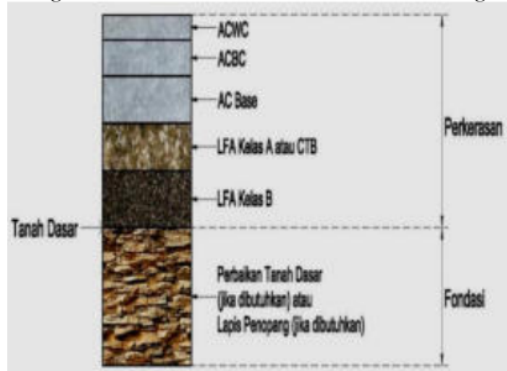
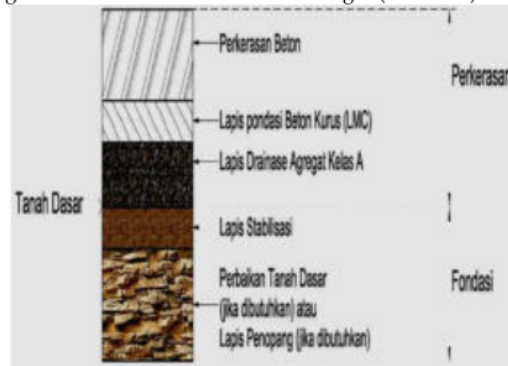Source: MDPJ No. 02/M/BM/2017

1.9 Rigid Pavement

The structure of the concrete road or also called cement concrete pavement is the pavement using cement as a fastening material so that the level of rigidity is relatively high, especially when compared with asphalt pavement

(Aly, 2004) the Value of the modulus of elasticity for concrete structures approximately 10-fold compared with the modulus of elasticity of the asphalt pavement.

In Indonesia there are several types of concrete road pavement structure that is already in common use, which is, (SNI Pd-T-14-2003) :

1.   Cement concrete pavement "*tanpa tulangan dengan sambungan*" jointed unreinforced concrete pavement.

2.   Cement concrete pavement "*dengan tulangan dengan sambungan*" jointed reinforced concrete pavement.

3.   Cement concrete pavement "*bertulang tanpa sambungan*" continously reinforced concrete pavement.

4.   Cement concrete pavement "*prategang*" or prestressed concrete pavement

5.   Cement concrete pavement "*bertulang fiber*" or fiber reinforced concrete pavement.

Fig. 2 : Cross Sections Of Pavement Rigid (Concrete)

Source: MDPJ No. 02/M/BM/2017

1.10 Road Pavement of Planning Criteria

The criteria that are part of the planning aspects, used to solve the problem that will eventually produce the answers of the questions (Nurtanto, 2015) In order to provide a sense of safety and comfort to road users, then the pavement construction must meet criteria design of the road pavement (Sukirman, 1999) the terms of the traffic on the road should pay attention to some of the criteria that have been specified in the Road Pavement of Design Manual No. 02/M/BM/2017 include:

1.   Climate and Weather criteria
2.   The criteria of allotment daily traffic and average loads for the road;
3.   Criteria for the safety and comfort road users

So, criteria in the planning of road pavement, is the terms of the specific earmarked in the plan for a pavement construction, so the construction of the road according to the final goal.

1.11 The method of Analytic Hierarchy Process (AHP)

Analysis Hierarchy Process or abbreviated as AHP (Saaty, 1993) is an approach about decision making that are designed to help the search for solutions of various problems of multi-criteria complex in a number of applications. This method is provided as an approach that is practical and effective which can consider decisions that are not structured and complicated (Partovi, 1994) the final Result of AHP is a ranking or weighting the priority of each alternative decision or called elements. Fundamentally, there are three steps in decision-making with the AHP, namely: build the hierarchy, the determination of priority; and synthesis of priorities (Falatehan, 2016).

1.12 AHP Procedure

There are three main principles in the solution of the problem in the AHP according to Saaty & Vargas (2001), which are: Decomposition, Comparative Judgement, and the Logical Concistency. In outline of the procedure AHP includes the following stages:

1) Decomposition to a problem;
2) Scaling to compare the elements;
3) Drafting the matrix and consistency test;
4) Establishment of each priorities in each hierarchy;
5) The determination of a decision (synthesis)

Explanation as follows:

1). Decomposition to a problem

Is step goal-setting (goal) that has been established and further elaborated into the structures that compose the series of the system (Mulyono, 2007)

2) Scaling to compare elements.

After identifying the problem and determining the desired solution, then arrange up a hierarchy from the problems faced. Then carried out the assessment of pairwise comparison (weighting) in each hierarchy based on the level of interest of their relative. As for the scale/ paired score comparison is as follows:

Table 1.
The scale of assessment of pairwise comparison in AHP

Scale	Definition
1	Both element/alternatives just as important (equal)
3	Elements A bit more essential than the Element B (moderate)
5	Element A is more essential of Elements of B (strong)
7	Elements A clearly more essential than the Element B (very strong)
9	Elements A absolute essential than the Element B (extrem)
2,4,6,8	The value between two balance is adjacent

Source: Saaty & Vargas, 2001

In weighting level of importance or assessment of the pairwise comparison is valid legal axiom reciprocal, meaning that if an element A is considered more essential (5) compared to element B, then B is essential 1/5 compared with the element A. If the A element of equal importance with B then each value=1. In data collection, for example by using questionnaires/ questionnaire, the procedure of comparison of multiple can be done by using questionnaires in the form of a matrix or differential semantic. So, the questionnaire format the semantic differential are as follows:

Table 2. Differential Semantic Questionnaire Format

Kriteria/ Alternatif	Bobot Tingkat Kepentingan Berpasangan																	Kriteria/ Alternatif
1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	2
1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	3
1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	n
2	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	3
2	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	n
3	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	n
n	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	n_i

Source: Processed by researchers, 2020

On this type of questionnaire, the edge of the screen with a circled/ cross based on the numbers that indicate the weight, if the left side is more important than the right side then the numbers that are circled are 9-1 on the left side and vice versa. Or a questionnaire in the form of a Matrix as follows:

Table 3.
Example Of The Matrix

Kriteria/ Alternatif	1	2	3	n
1		...../.....	...../.....	...../.....
2			...../.....	...../.....
3				...../.....
n				

Source: Processed by researchers, 2020

The number of cells that must be filled is n(n-1)/2 because the matrix of reciprocal elements of the diagonal value = 1, so no need to condition. In the above example 4(4-1)/2 = 6, so parts of the white sector which is filled.

3) Drafting the matrix and consistency test;

If the process of weighting or filling the questionnaire has been completed, the next step is the preparation of the matrix in pairs to do the normalization weights the level of importance on each element in the hierarchy respectively. At this stage the analysis can be done manually or by using computer programs. There are several kinds of tool to analyze the Analytic Hierarchy Process such as Superdecision, Criterium and Expert Choice (Falatehan, 2016) Values are

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obtained subsequently compiled into a matrix of pairwise similar to the matrix used in the questionnaire matrix above. Only on the matrix preparation for the analysis of this data, all the boxes should be filled.

1) **First step**: arrange the comparison matrix.
2) **Second step**: normalize the Matrix, calculate the value of the priority vector and test the consistency.

Before stepping into the stage of the iteration for the determination of priority on the choice of an alternative or a determination of the level of importance of the criteria, then the previously performed first consistency test. Consistency test is performed on each questionnaire/ questionnaires that assess or provide weighting. Questionnaires or experts who are not eligible can consistently disallowed or suspended for repairs. The basic principle of the consistency test is when A more important than B, then B more important than C, then a is not possible C is more important than A. The benchmark which used is the CI (Consistency Index) is directly proportional to RI (Random Index) is the CR (Consistency Ratio). Random Index (RI) are commonly used for each of the order of the matrix is as follows:

Table 4.
The random index for any size of the order of the matrix

Urutan Matriks	1	2	3	4	5	6	7	8	9	10
RI	0,00	0,00	0,58	0,90	1,12	1,24	1,32	1,41	1,45	1,49

Source: Saaty & Vargas, 2001

3) **The third step**: the consistency test is performed first with compiling the level of relative importance to each criterion or alternative, expressed as the normalized relative weight (*bobot relatif ternominalisasi*). Relative weight which normalized is a weighting of the relative value for each element in each column which is compared with the number of each of the following elements:

Table 5.
Example of The Matrix Order

Kriteria/ Alternatif	1	2	3	N
1	1	GM₁₂	GM₁₃	GM₁ₙ
2	GM₂₁	1	GM₂₃	GM₂ₙ
3	GM₃₁	GM₃₂	1	GM₃ₙ
n	GMₙ₁	GMₙ₂	GMₙ₃	1
Σ	GM₁₁₋ₙ₁	GM₁₂₋ₙ₂	GM₁₃₋ₙ₃	GM₁ₙ₋ₙᵢ

Source: Saaty & Vargas, 2001

Then the normalized relative weight is:

Table 6.
Normalized Matrix Order

Kriteria/ Alternatif	1	2	3	N
1	1/GM₁₁₋ₙ₁	GM₁₂/GM₁₂₋ₙ₂	GM₁₃/GM₁₃₋ₙ₃	GM₁ₙ/GM₁₃₋ₙ₃
2	GM₂₁/GM₁₁₋ₙ₁	1/GM₁₂₋ₙ₂	GM₂₃/GM₁₃₋ₙ₃	GM₂ₙ/GM₁₃₋ₙ₃
3	GM₃₁/GM₁₁₋ₙ₁	GM₃₂/GM₁₂₋ₙ₂	1 GM₁₃₋ₙ₃	GM₃ₙ/GM₁₃₋ₙ₃
n	GMₙ₁/GM₁₁₋ₙ₁	GMₙ₂/GM₁₂₋ₙ₂	GMₙ₃/GM₁₃₋ₙ₃	1 GM₁₃₋ₙ₃

Source: Saaty & Vargas, 2001

Next then can be calculated **Eigen Vector** the results of the normalization by averaging the sum of each row in the matrix above.

Table 7.
Normalized Eigen Vector and Matrix Order

Kriteria/ Alternatif	1	2	3	N	Eigen Faktor Utama
1	1/GM₁₁₋ₙ₁	GM₁₂/GM₁₂₋ₙ₂	GM₁₃/GM₁₃₋ₙ₃	GM₁ₙ/GM₁₃₋ₙ₃	Rerata row1/4 $(\bar{X}_1)$
2	GM₂₁/GM₁₁₋ₙ₁	1/GM₁₂₋ₙ₂	GM₂₃/GM₁₃₋ₙ₃	GM₂ₙ/GM₁₃₋ₙ₃	Rerata-row2/4 $(\bar{X}_2)$
3	GM₃₁/GM₁₁₋ₙ₁	GM₃₂/GM₁₂₋ₙ₂	1 GM₁₃₋ₙ₃	GM₃ₙ/GM₁₃₋ₙ₃	Rerata-row3/4 $(\bar{X}_3)$
n	GMₙ₁/GM₁₁₋ₙ₁	GMₙ₂/GM₁₂₋ₙ₂	GMₙ₃/GM₁₃₋ₙ₃	1 GM₁₃₋ₙ₃	Rerata-rown/4 $(\bar{X}_n)$

Source: Saaty & Vargas, 2001

Next specify the value of CI (consistency Index) by the equation:

$$CI = \frac{\lambda\ maksimum - n}{n-1}$$

Where CI is the consistency and Lambda maximum value of the eigen values of the largest of the matrix order n.

The eigen values of the largest is the number of times of multiplication the number of columns with the eigen vector of the main. So, can be obtained by the equation:

$$\lambda maksimum = \left(\sum GM_{11-n1} \times \bar{X}1\right) + \cdots + \left(\sum GM_{1n-nl} \times \bar{X}n\right)$$

After obtaining the maximum value of lambda then it can determine the value of CI. If the value of CI is zero (0) it means matrix is consistent. If the value of CI yag obtained is greater than 0 (CI>0). Furthermore, the tested limits of inconsistency applied by Saaty & Vargas (2001), which is testing the measured by using Consistency Ratio (CR), i.e. the value of the index, or the ratio between CI and RI:

$$CR = \frac{CI}{RI}$$

The RI value used is in accordance with the order n matrix. If CR of the matrix is smaller 10% (0,10), it means that the inconsistency of opinion is still considered acceptable.

Table 8.
The value of the reception range for CR

No.	Matrix Size	Consistency Ratio (CR)
1.	≤ 3 x 3	0.03
2.	4 x 4	0.08
3.	> 4 x 4	0.10

Source: Saaty & Vargas, 2001

4) Establishment of each priorities in each hierarchy;

The establishment of the priorities in each hierarchy is done through a process of Iteration (matrix multiplication). The first step is to change the shape of the fraction values of the weighting into decimal form.

5) Collection/determination of a decision (synthesis)

The synthesis used to obtain the device priority to a thorough for a problem decision. How to do it is by weighting and summing to produce a number of single shows the priority of each element (Falatehan, 2016)

2. METHODE

This research using Quantitative methods, where the objective is to examine a problem in planning the type of road pavement in a road section connecting Sidoarjo, Pandaan – Purwosari – Malang – Kepanjen, which will appear the analysis of the priority criteria for planning of pavement and the results will be used for planning the type of road pavement.

2.1 Determination of Criteria in Road Pavement Planning

Based on research, the object or project under study is a project of the Preservation of the Reconstruction of the Road Sidoarjo, Pandaan – Purwosari – Malang – Kepanjen, which is an arterial road (National Road) in the East Java province. Road pavement planning involves several criteria, related to the determination of the alternative types of pavement running. Consideration of the selection criteria in pavement planning in the project Preservation Reconstruction of the Road Sidoarjo, Pandaan – Purwosari – Malang – Kepanjen, is:
1. Geographical and demographic considerations of the East Java province
2. Natural resources consideration,

3. Consideration of annual road maintenance costs.

Then the criteria in the road pavement planning is proposed in accordance with the considerations and the provisions of the Ministry of public works PR Directorate General of Highway and in accordance with the planning of the Great Hall of the Implementation of the National Road X which in this case was held by the Planning and Supervision of the National Road (P2JN), is as follows :

A. Availability (Ease) Criteria of Road Pavement Material

Material selection should be based on several considerations, such as: requirements of the pavement structure, economical, durability, ease of working and experience local. The materials for flexible and rigid pavement, include: material granular or aggregate rock, asphalt, concrete and steel reinforcement. Aggregate is a collection of granules of crushed stone, gravel sand or other material, either natural material or artificial. System road pavement generally contains 90 – 95% of aggregate based on percent by weight or 70 – 75% percent by volume. In accordance with the Regulations of the Governor of East Java No. 69 Year 2018 About the Regulation of the Implementation of the Regional Regulation of East Java Province Number 1 (2014), About the Implementation of the Road Safer. In this case the government of East Java province decided, so that the quality and material specifications for the constituent materials of the pavement for a worthy function in accordance with the General specifications of PU Highways service of the Provincial government of east Java in 2018, and according with National Standard of Indonesia 1999 – 2012, Specification of Common PU Highways service Revision 3 Division 6 (2010), which explains all the ordinances of the testing materials for the road pavement.

B. Road Pavement Construction Implementation Costs Criteria

These financing criteria are in accordance with the Road Pavement Work Analysis, both for flexible pavement and rigid pavement / composite pavement.

C. Road Pavement Construction Implementation Method Criteria

The general methods of implementing flexible and rigid pavement works as well as composite must be in accordance with the regulations of the Ministry of Public Works, Directorate General of Highways, General Specifications Revision 3, Division 6, (2010). Where there are explained as the procedure for each road pavement construction work in several divisions.

D. Ease of Maintenance Criteria after the Road Maintenance Period

The road pavement planning criteria that allows minimizing excessive costs in maintaining existing pavements after the completion of the maintenance period of the implementing contractor.

Where there are two kinds of implementation of the pavement, which are pavement pliable and pavement rigid. And according to the Circular Letter No.07/ SE/ Db/ 2017 Ministry of Public works and Housing Highway Director General September 13, 2017. Based on the Circular Letter, as reference for planning and implementation of technology options preventive maintenance pavement. So that it can support limiting the spread of further damage.

E. Criteria for resistance to daily traffic and road use loads

The criteria according to specifications and regulations determination of the pavement for both flexible and rigid as required in the Ministry of Public Works Directorate General of Highways (Road Pavement of Design Manual) No. 02/M/BM/2017. And refers to the Ministerial Regulation (Permen) of the Ministry of Public Works Nomor : 19/PRT/M/2011, Regarding the Technical Requirements of the Road and Planning Criteria Technical Way.

F. Criteria for Resistance to Climate and Weather around the Road

The planning criteria of road pavement that view from the side of the Weather Data and the Climate in the vicinity of the research project of Preservation Reconstruction of the Road Sidoarjo, Pandaan – Purwosari – Malang – Kepanjen. Which is the data weather and climate conditions from the report of the Meteorology, Climatology and Geophysical Station Meteorological Juanda, Meteorological Station Tretes, the Meteorological Station of Karangploso and the Meteorological Station of Karangkates.

G. Safety and Comfort Criteria for Road Users

The criteria of pavement road planning, which refers to the side of the safety and comfort of road users. And of course, in planning a road pavement should be based on Road Pavement of Design Manual No. 02/M/BM/2017, the Regulation of Governor of East Java No. 69 Year 2018 About the Regulation of the Implementation of the Regional Regulation of East Java Province No. 1 Year 2014 Concerning the Implementation of the Safer Road. And Regulation of the Minister of Public Works Number 19 / PRT / 2011 concerning Road Technical Requirements and Road Technical Planning Criteria.

2.2 Data Collection, Determination of The Respondents and The Format of The Questionnaire

1. Data Collection

Primary data collection is done by submitting questionnaires or interviews to obtain direct assessments from respondents. In terms of interviews or questionnaires, how data collection is done as follows:

a.   Done the design of the respondents who will be questioned and asked for information about the factors related to the performance of inter-city roads. Among the respondents who entered in the list of interviews is PU Highway Service, the Expert/ experts in the field of road construction or teacher/ Lecturer, and Consultant.

b.   Data collection from respondents can be done by direct interview or through a questionnaire given to the respondents adapted to the conditions of the respondents and ease of data retrieval. For respondents from the Department or agency selected by questionnaire system, and to experts in the field of highway/ community selected also using the questionnaire-the questionnaire.

c.   The draft contents of the questions to the respondents include questions representing the criteria in the planning of road pavement.

2.   Respondents Determination

The selected respondents are people who are competent in the field of road works. In terms of both theory and practice field. So, understood well the subject of pavement construction. As for experience in terms of work pavement construction of these respondents must at least 10 (ten) years, so it can give a proper assessment on the questionnaire-the questionnaire submitted. In this study, the selected respondents are:

a.   Commitment-making officer (PPK) 3.6 Ministry of public works PR Highway Directorate General

b.   Planner and Supervisor of the National Road (P2JN) Great Hall of the Administration National Road (BPJN) VIII East Java

c.   The department of Public works Highways Sidoarjo districts

d.   The department of Public works Highways pasuruan districts

e.   The department of Public works Highways Malang municipality

f.   The department of Public works Highways Malang districts

g.   Lecturers of public and private universities in Malang and outside the city of Malang

h.   East Java Province Road and Bridge Planning Consultant

3.   Questionnaire Format

The form of assessment of questions asked to the respondents in the questionnaire are as follows:

For each criteria pair comparison in the Planning of Road Pavement. Which is more important and how much level of Importance?

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Table 9.
Form Questionnaire of Pairwise Comparison Road Planning Criteria

| No	CRITERIA	SCALE OF INTEREST	CRITERIA
1	(Code A)	9-8-7-6-5-4-3-2-1-2-3-4-5-6-7-8-9	(Code B)
2	(Code A)	9-8-7-6-5-4-3-2-1-2-3-4-5-6-7-8-9	(Code C)
3	(Code A)	9-8-7-6-5-4-3-2-1-2-3-4-5-6-7-8-9	(Code D)
4	(Code A)	9-8-7-6-5-4-3-2-1-2-3-4-5-6-7-8-9	(Code E)
5	(Code A)	9-8-7-6-5-4-3-2-1-2-3-4-5-6-7-8-9	(Code F)
6	(Code A)	9-8-7-6-5-4-3-2-1-2-3-4-5-6-7-8-9	(Code G)
7	(Code B)	9-8-7-6-5-4-3-2-1-2-3-4-5-6-7-8-9	(Code C)
8	(Code B)	9-8-7-6-5-4-3-2-1-2-3-4-5-6-7-8-9	(Code D)
9	(Code B)	9-8-7-6-5-4-3-2-1-2-3-4-5-6-7-8-9	(Code E)
10	(Code B)	9-8-7-6-5-4-3-2-1-2-3-4-5-6-7-8-9	(Code F)
11	(Code B)	9-8-7-6-5-4-3-2-1-2-3-4-5-6-7-8-9	(Code G)
12	(Code C)	9-8-7-6-5-4-3-2-1-2-3-4-5-6-7-8-9	(Code D)
13	(Code C)	9-8-7-6-5-4-3-2-1-2-3-4-5-6-7-8-9	(Code E)
14	(Code C)	9-8-7-6-5-4-3-2-1-2-3-4-5-6-7-8-9	(Code F)
15	(Code C)	9-8-7-6-5-4-3-2-1-2-3-4-5-6-7-8-9	(Code G)
16	(Code D)	9-8-7-6-5-4-3-2-1-2-3-4-5-6-7-8-9	(Code E)
17	(Code D)	9-8-7-6-5-4-3-2-1-2-3-4-5-6-7-8-9	(Code F)
18	(Code D)	9-8-7-6-5-4-3-2-1-2-3-4-5-6-7-8-9	(Code G)
19	(Code E)	9-8-7-6-5-4-3-2-1-2-3-4-5-6-7-8-9	(Code F)
20	(Code E)	9-8-7-6-5-4-3-2-1-2-3-4-5-6-7-8-9	(Code G)
21	(Code F)	9-8-7-6-5-4-3-2-1-2-3-4-5-6-7-8-9	(Code G)

Source: Processed by researchers, 2020

Description :

Code A : Availability (Ease) Criteria of Road Pavement Material

Code B : Road Pavement Construction Implementation Costs Criteria

Code C : Road Pavement Construction Implementation Method Criteria

Code D : Ease of Maintenance Criteria after the Road Maintenance Period

Code E : Criteria for resistance to daily traffic and road use loads

Code F : Criteria for Resistance to Climate and Weather around the Road

Code G : Safety and Comfort Criteria for Road Users

Processing the order/ ranking from Analysis Hierarchy Process method which became the basis of this research, the hierarchy can be described as follows:

Fig. 3: Hierarchy Research Process
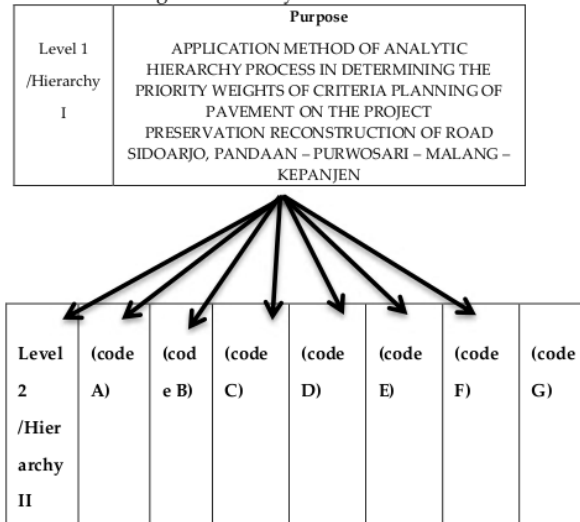
Source: Processed by researchers, 2020

4. RESULT AND DISCUSSION

The primary data in the form of questionnaires for the respondents (an sample), this number using the Slovin Formula as follows:

$$n = N/N(d)^2 + 1$$

n = sample; N = population; d = precision value 95% or an error rate 5%

For this research, the number of population is 30, and the error rate which desired is 5%. And then the number of used samples is:

$$n = 30 / 30 (0,05)2 + 1 = 27,906, \text{changed to } 28$$

219

The research involves a minimum of 28 respondents. And finally, researchers using the samples/ respondents as many as 30 people who know the theory and practice as well as competent in the field of highway public works. As described in the following table:

Table 10.
Recapitulation of Respondents Distribution for the Research Questionnaire data

No	Agency / Position	PL	Number of Samples	Samples Name
1	PPK 3.6 PU PR Public Hall of the National Road Implementation VIII	1	1	Respondent (1)
2	PPK 3.6 PU PR Public Hall of the National Road Implementation VIII	1	1	Respondent (2)
3	PPK 3.6 PU PR Public Hall of the National Road Implementation VIII	1	1	Respondent (3)
4	PPK 3.6 PU PR Public Hall of the National Road Implementation VIII	1	1	Respondent (4)
5	PPK 3.6 PU PR Public Hall of the National Road Implementation VIII	1	1	Respondent (5)
6	National Road Supervisor Planner VIII	2	1	Respondent (11)
7	National Road Supervisor Planner VIII	2	1	Respondent (12)
8	National Road Supervisor Planner VIII	2	1	Respondent (13)
9	National Road Supervisor Planner VIII	2	1	Respondent (14)
10	Highway public works agency Sidoarjo District (Planning section)	3	1	Respondent (22)
11	Highway public works agency Sidoarjo District (Planning section)	3	1	Respondent (23)
12	Highway public works agency Pasuruan District (Planning section)	4	1	Respondent (27)
13	Highway public works agency Pasuruan District (Planning section)	4	1	Respondent (28)
14	Highway public works agency Pasuruan District (Planning section)	4	1	Respondent (29)
15	Highway public works agency Malang Municipality (Planning section)	5	1	Respondent (19)
16	Highway public works agency Malang Municipality	5	1	Respondent (20)
17	Highway public works agency Malang Municipality (Planning section)	5	1	Respondent (21)
18	Highway public works agency Malang District (Planning section)	6	1	Respondent (15)
19	Highway public works agency Malang District (Planning section)	6	1	Respondent (16)
20	Highway public works agency Malang District (Planning section)	6	1	Respondent (17)
21	Highway public works agency Malang District (Planning section)	6	1	Respondent (18)
22	Lecturer at State University of Malang	7	1	Respondent (6)
23	Lecturer at State University of Malang	7	1	Respondent (7)
24	Lecturer at Private University of Malang	7	1	Respondent (8)
25	Lecturer at Private University of Malang	7	1	Respondent (9)
26	Lecturer at Private University of Malang	7	1	Respondent (10)
27	Lecturer at State University of Jember	7	1	Respondent (24)
28	Lecturer at State University of Jember	7	1	Respondent (25)
29	Lecturer at State University of Jember	7	1	Respondent (30)
30	East Java Province Road and Bridge Consultant	8	1	Respondent (26)

Source: Processed by researchers, 2020

3.1 Determination of Weighting Planning Criteria and Consistency Test

The calculation of matrix eigen and values and the value of Priority Vector (PV) as well as test the consistency on the questionnaire-a questionnaire distributed to 30 respondents who are competent in this research, the result is as follows :

Table 11.
The average weights results of the Road Pavement Planning Criteria in the AHP method

| No.	The Planning Road Pavement of Criteria	Weight Average	Weight Average (%)
1	Availability (Ease) of Road Pavement Material	0.0894	8.9365
2	Road Pavement Construction Implementation Costs	0.1578	15.7797

3	Road Pavement Construction Implementation Method	0.1286	12.8578
4	Ease of Maintenance Criteria after the Road Maintenance Period	0.1208	12.0847
5	Resistance to daily traffic and road use loads	0.1587	15.8736
6	Criteria for Resistance to Climate and Weather around the Road	0.1325	13.2453
7	Safety and Comfort Criteria for Road Users	0.2122	21.2224
	TOTAL	1.0000	100

Source: The Analysis Results, 2020

So that it can also described in the form of a chart, as follows:

Fig. 4
The graph average weights results of the Road Pavement Planning Criteria in the AHP method
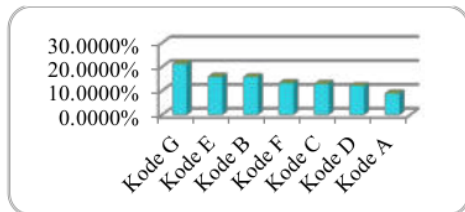
Source: The Analysis of Result, 2020

5. CONCLUSION

Based on the results, it can be concluded that, the research on the project Preservation of Reconstuction of The Road Sidoarjo – Pandaan – Purwosari – Malang – Kepanjen, finally obtained the conclusion of the priority weights criteria which becomes a consideration materil for planning road pavement is:

I. Safety and Comfort Criteria for Road Users, the weight: 0.2122
II. Criteria for resistance to daily traffic and road use loads, the weight is: 0.1587
III. Road Pavement Construction Implementation Costs Criteria, the weight is: 0.1578
IV. Criteria for Resistance to Climate and Weather around the Road, the weight is: 0.1325
V. Road Pavement Construction Implementation Method Criteria, the weight is: 0.1286
VI. Ease of Maintenance Criteria after the Road Maintenance Period, the weight is: 0.1208
VII. Availability (Ease) Criteria of Road Pavement Material, the weight is: 0.0894

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APPLICATION OF ANALYTIC HIERARCHY PROCESS METHOD IN DETERMINING THE PRIORITY WEIGHTS OF ROAD PAVEMENT PLANNING CRITERIA ON THE PROJECT PRESERVATION OF RECONSTRUCTION OF THE ROAD SIDOARJO – PANDAAN – P