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RISK ANALYSIS OF THE BEHAVIOR OF STEEL ARCH BRIDGE STRUCTURES ON MELAHAM BRIDGE

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ABSTRACT
Risk analysis is a systematic process with the primary goal of providing risk information thereby reducing its impact and not even occurring risk. This development is an effort of the Mahakam Ulu Regency Government to improve accessibility between regions and to facilitate transportation and economic wheels in Mahakam Ulu Regency. Many risks include the unreleased bridge access, the floor of the bridge that has not yet been paved and the pedestrian access to the bridge. There are 4 major components to risk analysis, namely risk identification, risk analysis, risk response, risk monitoring. In risk analysis, there are 32 variables, consisting of 14 low risk variables, 1 medium risk variable, and 17 high risk variables. Risk management is carried out at the bottom of the bridge, top of the bridge, and complement of the bridge. Other countermeasures include the construction of bridge elements such as Kerb/Gabions, Abutment, Retaining Wall, Traffic Sign, Earth Hoard (oprit), Level of Bridge, Sidewalk, Pedestrian, Etc. From the results of the correlation testing between variables and the method of linear regression multiplied in risk variables, it was concluded that the hypothesis is a strong influence between X variables (cause and impact variables) simultaneously on Y variables (risk variables). The high-risk category between 0.24 and 0.72 consists of the risk of erosion around the local scouring of the bridge, the lowest risk category of 0.01 - 0.05 consisting of the bridge above.

Keywords:
Risk Analysis, Uppersctructure Bridge, Substructure Bridge, Complementary Buildings, Alternative Solution

INTRODUCTION
A bridge is a construction that serves to connect the two roads that are cut off by an obstacle whose surface is lower. This obstacle can be in the form of deep valleys, river channels, lakes, irrigation channels, railroads, highways that cross not in line and others. Bridges are the highest investment of all elements that can be found on the highway system. Any damage to bridge construction can cause disruption in the smooth rotation of the wheels of the economy and can cause accidents for humans. The bridge is used as an access that connects the West Kutai Regency - Mahakam Ulu Regency axis road which is located on the Melaham River in Long Melaham Village, this construction is an effort by the Mahakam Ulu Regency Government to improve accessibility between regions and to facilitate transportation and the economy in the Mahakam Ulu Regency area.
The bridge built is a curved steel frame type with a span of 60 meters and a width of 8 meters. In early 2023 the bridge was completed but could not be fully utilized and functioned due to many risks that occurred, including

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the access road connecting the bridge that had not been freed, the bridge floor that had not been given an asphalt surface layer and the pedestrian access had not been connected to the bridge oprit. From the results of observations in the field during bridge work, there were also several bridge materials that experienced rust and bending between joints / joints and several elements of the bridge structure that experienced cracks and water seepage. Based on this, an effort or detection of risks that may occur is needed, so that these risks can be minimized or eliminated by making a risk analysis. Risk analysis is a systematic process with the main objective of providing risk information so that existing risks can reduce their impact or even the risk does not occur. In the implementation of risk analysis, there are 4 (four) main components, namely (i) risk identification, (ii) risk analysis, (iii) risk response and (iv) risk monitoring.

METHODOLOGY

In this research, the methods used in the research are: Pearson Product Moment validity testing method and reliability using Cronbach alpha then carried out risk analysis and after that compiled risk mitigation that must be done. Risk analysis is used to determine the risks that are considered very influential and proceed to the risk response, one of which is carried out by direct observation in the field and then formulating the risk response faced. Risk responses that can be carried out with the help of tools and techniques are mitigation (reducing) the probability and / or impact of negative risk events received. Risk analysis and assessment is carried out on the damaged part of the bridge, namely the condition of the bridge superstructure, the condition of the construction material / concrete condition, the expansion joint, the condition of the building under the bridge in this case the bridge abutment, as well as complementary buildings such as bridge oprites, soil retaining gabions, box culverts / culverts, traffic signs. Furthermore, bridge risk analysis and assessment are carried out after the bridge is completed or after the first handover of work by the provider. The steps for taking risks are risk identification through document review, checklist analysis, assumption analysis which can be checked by risk classification, risk analysis, risk treatment, and risk response. Qualitative risk analysis is carried out by assessing the impact and likelihood of risks that have been identified, the process is to arrange risks based on their impact on objectives, to find out this can be done by estimating the risks that might occur by investigating each risk, then using a probability and impact matrix that is arranged based on a priority scale which is a matrix between probability (possibility) and impact can be determined by the combination of probability and impact generated. Risk categorization can be done by determining risks that can be determined which areas are affected or other useful categories to limit which parts have an impact from uncertainty. The analysis methods include the non-parametric Mann Whitney Method Validity Test, Multiple Correlation Test, Multiple Linear Regression F Test and Reliability Test. This research was conducted by first determining the research background; Formulating problems, setting research objectives and limitations; Searching for literature sources and literature studies; Secondary data obtained from bridge construction planning data, contract documents, journals, books and references related to research; Primary data obtained from observations at the research site by identifying bridge conditions to obtain risk variables. After that, make a questionnaire design and determine 32 risk variables, causes and impacts to be distributed to 50 (fifty) respondents who work in the construction / supervisor / construction work planning sector to obtain significant risk variables (risk frequency values, causes and impacts); Conduct a nonparametric test with the mann u whitney method on respondents' perceptions based on 2 variables of length of work and educational background; Frequency and impact data obtained are then processed to obtain risk values, then tested by validity and reliability testing using the SPSS application; After the risk value is obtained and the variable instrument is tested, the data is analyzed to find the risk level and risk category, then proceed to formulate appropriate risk handling; Make conclusions and suggestions.

RESULTS AND DISCUSSION

Non-parametric Test

The purpose of this test is to determine whether there is a statistically significant difference between two independent samples. The Mann-Whitney test can be used to test the null hypothesis that two independent samples come from the same population, or that the distribution of the two samples is the same.

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Two Free Samples Test Based on Length of Work Experience
Based on the questionnaire data submitted, there are 7 (seven) respondents with a category of 0-5 years and 43 (forty-three) respondents with a length of work of 6-20 years. The number of respondents with length of work experience is as follows:

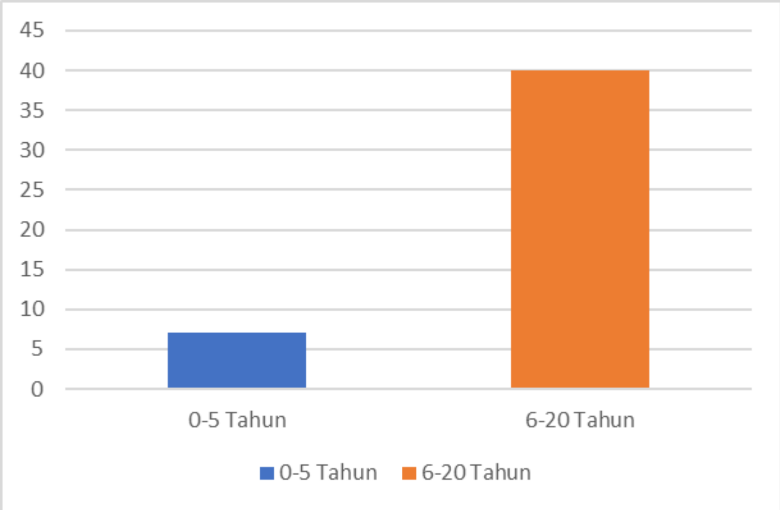

Figure 1. Number of respondents by length of work experience

Furthermore, the analysis is carried out with the following hypotheses:

a. H0: there is no difference in perception between the 2 existing respondent groups (H0 is accepted if the value in the Asymp.Sig (2-tailed) column > 0.05);
b. H1: there is a difference in perception between the 2 existing respondent groups (H1 is accepted if the value in the Asymp.Sig (2-tailed) column <0.05).
Mann Whitney test results u length of work experience.

Table 1. Nonparametric Test Results of Work Experience

Test Statistics[a]

	Length of Service
Mann-Whitney U	101.000
Wilcoxon W	1047.000
Z	-1.387
Asymp. Sig. (2-tailed)	.165
Exact Sig. [2*(1-tailed Sig.)]	.174[b]

a. Grouping Variable: Score

b. Not corrected for ties.

From the test results using the SPSS application, the Asymp.Sig (2-tailed) value is 0.165> 0.05 so it can be concluded that there is no difference in perception between the length of work experience of the respondents in answering the questionnaire (hypothesis H0).

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Testing two free samples based on Educational Background

This test is to test the difference in answers from respondents based on educational background. respondents' educational background is divided into 2 (two) groups, namely:

a. Group with education with a Bachelor of Engineering (ST) or Diploma in Engineering (D3) background;
b. Group with non-Bachelor of Engineering (ST) or Diploma of Engineering (D3) education.

Based on questionnaire data submitted to 50 (fifty) respondents, there are 37 (thirty-seven) respondents with non-graduate engineering (ST) or Diploma in Engineering (D3) education categories and 13 (fourteen) respondents with Bachelor of Engineering (ST) or Diploma in Engineering (D3) education. With the following graph:

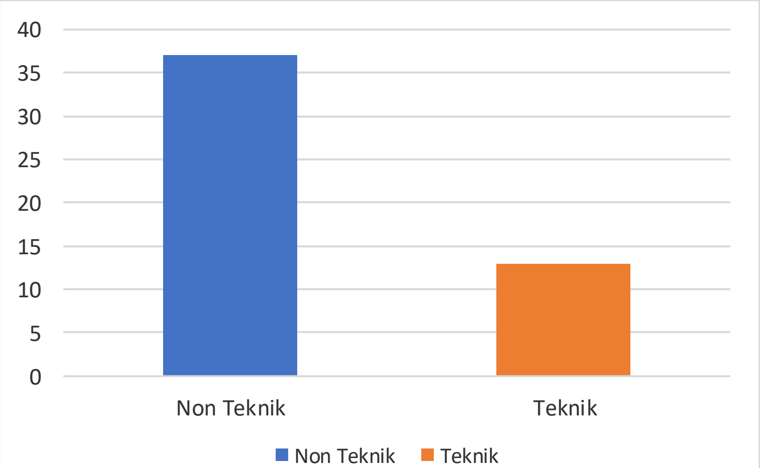

Figure 2. Number of respondents based on educational background

Furthermore, the analysis is carried out with the following hypotheses:

a. H0: there is no difference in perception between the 2 existing respondent groups (H0 is accepted if the value in the Asymp.Sig (2-tailed) column > 0.05)
b. H1: there is a difference in perception between the 2 existing respondent groups (H1 is accepted if the value in the Asymp.Sig (2-tailed) column <0.05).

Table 2 Nonparametric test results of educational background

Test Statistics[a]

	Hasil
Mann-Whitney U	240.000
Wilcoxon W	943.000
Z	-.011
Asymp. Sig. (2-tailed)	.991

a. Grouping Variable: ST_NonST

From the test results using the SPSS application, the Asymp.Sig (2-tailed) value is 0.991> 0.05 so it can be concluded that there is no difference in perception between educational backgrounds on respondents in answering the questionnaire (hypothesis H0).

Validity and Reliability Test

The validity test was carried out using the bivariate pearson method by correlating each value of the question item with the total value score of the questionnaire item. The tested variable is declared valid comparing the calculated r value from SPSS with the predetermined r table. The r table value determined in this study is 0.2787

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Tabel 3 r Tabel Pearson

df = (N-2)	Tingkat signifikansi untuk uji dua arah				
	0,1	**0,05**	**0,02**	**0,01**	**0,001**
46	0.2403	0.2845	0.3348	0.3683	0.4601
47	0.2377	0.2816	0.3314	0.3646	0.4557
48	0.2353	**0.2787**	0.3281	0.361	0.4514
49	0.2329	0.2759	0.3249	0.3575	0.4473
50	0.2306	0.2732	0.3218	0.3542	0.4432

(Source: Value r product moment, Sugiyono 2013)

Validity Testing of Cause Variables

This test is conducted to ensure that the measured causal variables truly represent the factors that influence the risk variables. To evaluate whether the analysis results are valid or not, you can use the r table value and compare it with the Pearson correlation coefficient (r) value. The above calculation is the same as the results of the calculation using the SPSS application where the P1 variable has a calculated r value of 0.3210. Of the 88 (eighty-eight) causes of risk, there are 33 (thirty-three) invalid variables and 55 (fifty-five) valid variables. The variable is declared valid if it has a calculated r value above the r table value (r count> 0.2787) and a sig. value below the sig degree. (sig. ≤ 0.05) (Sugiyono, 2013).

Testing the Reliability of the Cause Variable

The reliability test was carried out using the Crobach's alpha method. This test is carried out to assess the extent to which the items in a measurement instrument are correlated and together measure the same construct and provide a measure of the reliability of the measurement instrument. From this table, all cause variables are considered reliable because they have a Cronbach's alpha value above 0.6. Of the 32 (thirty-two) cause items, all are reliable with a Crobach's alpha value of 0.916> 0.6.

Table 4 Reliability test values of cause variables

Reliability Statistics

Cronbach's Alpha	N of Items
.916	32

The results of the calculation using the SPSS application where 32 cause variables have a reliability value of 0.916.

Validity Testing of Impact Variables

This test is carried out for the same calculation method on the cause variable with a total of 75 (seventy-five) impact variables and comparing the Pearson correlation coefficient (r) value with the r table value, can evaluate whether the analysis results are valid or not. Of the 75 (seventy-five) risk impacts, there are 18 (eighteen) invalid variables and 57 (fifty-seven) valid variables in blue, from the 57 valid causal variables, 1 impact variable was selected based on the highest total value of respondents' answers to the possible impact on each risk variable, then 32 valid impact variables were continued with Cronbach alpha reliability testing.

Testing the Reliability of the Impact Variable

The reliability test conducted using the Crobach's alpha method is the same as the previous test on the cause reliability item. All impact variables are considered reliable because they have a Cronbach's alpha value above 0.6. Of the 32 (thirty-two) impact items, all are reliable with an alpha crobach's value of 0.848> 0.6.

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Table 5 Reliability value of impact variables

Reliability Statistics

Cronbach's Alpha	N of Items
.848	32

Analisis Frekuensi Risiko dan Dampak

This test is carried out to determine the level of possible risks and impacts that occur from the results of respondents' answers to the questionnaire given. From the results of the calculation between the possibility of risk occurrence and the level of impact fatality that occurs from the risk, there are 3 (three) risk categories, namely red in the high-risk category, yellow in medium risk and green in low risk. Based on the table above, risks X29 and X31 are risks in the high category which means that immediate handling of these risks is needed. From this table there are several categories of risk levels with the following explanation:

a. High risk between the values of 0.24 - 0.72: this refers to conditions/situations where the possibility of damage/failure/negative impact on the bridge is large enough to affect the safety, function and life of the bridge, so that intensive efforts/handling of the occurrence of risks and impacts is needed.
b. Medium risk between 0.06 - 0.20: refers to a situation where the possibility of damage/failure to the bridge exists, but the impact is not as great as high risk and can be managed with appropriate mitigation measures. If failure or damage occurs, the impact may not be as great as the impact of high risk.
c. Low risk between values 0.01 - 0.05: a situation where the possibility of damage or failure to the bridge is relatively small, and the impact is also minimal. If damage / failure occurs, the impact will be relatively small and can be overcome by carrying out routine maintenance according to standards so that potential risks or impacts can be detected and corrected before they become significant.

Multiple Correlation Test

The multiple correlation test is a test that correlates the correlation between risk, cause and impact variables with. This test is conducted to determine how much the relationship and the strength of the influence between the independent variables (causes and impacts) on the dependent variable (risk).

The results of testing the relationship between risk, cause and impact variables using the SPSS application obtained the following results:

Table 6 Correlation results between risk, cause and impact variables

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.610[a]	.371	.328	22.54139	.371	8.571	2	29	.001

a. Predictors: (Constant), Impact, Causes

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Impact, Causes	.	Enter

a. Dependent Variable: Risk
b. All requested variables entered.

Based on this test, the R value is 0.610 and the Sig.F Change value is 0.001 <0.05 where this value shows that the risk, cause and impact variables have a strong relationship.

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Multiple Linear Regression

Multiple regression analysis aims to determine whether or not there is an influence of two or more independent variables (X) on the dependent variable (Y). in this study, the independent variable (X) is determined from the cause variable and the impact variable, while the dependent variable (Y) is determined from the risk variable. The hypothesis sought is whether there is a simultaneous influence of the cause and impact variables on the risk variable with a confidence level of 95%, $\alpha = 0.05$.

Basis for decision making in the F Test:

a. If the sig value <0.05, or the value of F count> F table, then there is a simultaneous influence of variable X on variable Y

b. If the sig value> 0.05, or the value of F count < F table, then there is no simultaneous influence of variable X on variable Y.

Table 7 Table F

Percentage Points of the F Distribution for Probability = 0.05						
df for denominator (N2)	**df for numerator (N1)**					
	1	**2**	**3**	**4**	**5**	**6**
21	4.32	3.47	3.07	2.84	2.68	2.57
22	4.30	3.44	3.05	2.82	2.66	2.55
23	4.28	3.42	3.03	2.80	2.64	2.53
24	4.26	3.40	3.01	2.78	2.62	2.51
25	4.24	3.39	2.99	2.76	2.60	2.49
26	4.23	3.37	2.98	2.74	2.59	2.47
27	4.21	3.35	2.96	2.73	2.57	2.46
28	4.20	3.34	2.95	2.71	2.56	2.45
29	4.18	3.33	2.93	2.70	2.55	2.43
30	4.17	3.32	2.92	2.69	2.53	2.42

The results of testing the F test are carried out by summing the value of the respondent's answer vertically on each risk variable, cause and impact variable with the following results:

Table 8 Data of independent and dependent variables

n	Risiko (Y)	Penyebab (P)(X1)	Dampak (D) (X2)
1	83	153	114
2	119	158	114
3	136	165	120
4	130	166	125
5	134	173	119
6	115	177	83
7	92	166	92
8	146	160	114
9	143	178	132
10	151	178	112
11	117	162	118

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n	Risiko (Y)	Penyebab (P)(X1)	Dampak (D) (X2)
12	135	168	138
13	98	158	164
14	133	177	83
15	112	176	90
16	117	185	122
17	83	191	133
18	92	182	135
19	159	178	181
20	155	176	173
21	149	171	167
22	126	165	164
23	103	169	168
24	136	161	151
25	167	178	178
26	170	173	174
27	159	178	195
28	175	169	184
29	186	170	214
30	139	156	183
31	172	172	198
32	125	173	163

The following are the results of data processing from table 4.13 with the SPSS application:

Table 9 Results of F Test with SPSS

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8709.656	2	4354.828	8.571	.001[b]
	Residual	14735.312	29	508.114		
	Total	23444.969	31			

a. Dependent Variable: Risk

b. Predictors: (Constant), Impact, Causes

Based on the results of the output above, it is known that the significance value for the simultaneous influence of variable X on variable Y is 0.001 <0.05 and the calculated F value is 8.571> F table 4.18, so it can be concluded that the hypothesis is accepted, namely that there is a simultaneous influence of variable X on variable Y.

Cause Analysis and Risk Response

After obtaining the ranking and category of risk, then proceed with the analysis related to the cause and handling of risk. Measures or actions to reduce or control identified risks, with the aim of reducing the likelihood of damage or failure to bridge construction or to reduce the impact if the risk occurs and 23 (twenty three) risk

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variables required monitoring with the aim of conducting continuous observation and measurement of the condition and performance of the bridge to detect potential problems or changes that can increase the risk of damage or failure with the function of ensuring the condition of the elements in each bridge remains safe and functioning properly.

Risk Handling Analysis

In handling this risk, the method or method of mitigation comes from literature (books/journals) related to the risks that occur. Before risk management is carried out, first group the parts and elements of the bridge from the results of the risk assessment as follows:

1. Bridge Upper Structure

Table 10 Risk Categories of Bridge Superstructure

No	Bridge Section	Bridge Elements	Risk Code	Risk Level Value	Risk Rating	Risk Category
1	Bridge Uppersctructure	Bridge Floor	X9	0.084	15	Medium
2	Bridge Uppersctructure	Sidewalks	X12	0.082	16	Medium
3	Bridge Uppersctructure	Backrest	X13	0.077	17	Medium
4	Bridge Uppersctructure	Bridge Truss	X5	0.072	18	Medium
5	Bridge Uppersctructure	Bridge Truss	X4	0.072	19	Medium
6	Bridge Uppersctructure	Bridge Truss	X3	0.069	20	Medium
7	Bridge Uppersctructure	Bridge Floor	X8	0.069	21	Medium
8	Bridge Uppersctructure	Bridge Floor	X10	0.067	22	Medium
9	Bridge Uppersctructure	Bridge Drainage	X18	0.057	23	low
10	Bridge Uppersctructure	Expantion stream	X16	0.056	24	low
11	Bridge Uppersctructure	Bridge Floor	X11	0.055	25	low
12	Bridge Uppersctructure	Bridge Truss	X2	0.053	26	low
13	Bridge Uppersctructure	Bridge Drainage	X17	0.042	27	low
14	Bridge Uppersctructure	Bridge Floor	X14	0.038	28	low
15	Bridge Uppersctructure	Bridge Truss	X1	0.035	29	low
16	Bridge Uppersctructure	Siar Muai	X15	0.033	30	low
17	Bridge Uppersctructure	Bridge Truss	X6	0.031	31	low
18	Bridge Uppersctructure	Hanger	X7	0.027	32	low

2. Bridge Subsctructure

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The bridge upper structure section consists of 5 (five) bridge elements, namely the bridge frame, bridge floor, hanger / suspension, expansion streab and bridge drainage. With 8 risk variables in the medium category and 10 risk variables in the low category.

Table 11 Risk categories of under-bridge structures

No	Bridge Section	Bridge Elements	Risk Code	Risk Level Value	Risk Rating	Risk Category
1	Bridge Subsctructure	Abutment	X19	0.206	5	Medium
2	Bridge Subsctructure	Abutment	X20	0.173	8	Medium
3	Bridge Subsctructure	Abutment	X21	0.155	10	Medium
4	Bridge Subsctructure	Abutment	X22	0.113	11	Medium

The bridge superstructure section consists of one bridge element, namely the bridge abutment with 4 risk variables in the moderate category.

3. Bridge Complementary Buildings

Table 12 Risk categories of bridge accessory buildings

No	Bridge Section	Bridge Elements	Risk Code	Risk Level Value	Risk Rating	Risk Category
1	Bridge Complementary Buildings	Kerb/Gabions	X29	0.345	1	High
2	Bridge Complementary Buildings	Kerb/Gabions	X31	0.262	2	High
3	Bridge Complementary Buildings	Culverts	X27	0.233	3	Medium
4	Bridge Complementary Buildings	Culverts	X28	0.224	4	Medium
5	Bridge Complementary Buildings	Retaining Wall	X25	0.192	6	Medium
6	Bridge Complementary Buildings	Retaining Wall	X26	0.180	7	Medium
7	Bridge Complementary Buildings	Kerb/Gabions	X30	0.171	9	Medium

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No	Bridge Section	Bridge Elements	Risk Code	Risk Level Value	Risk Rating	Risk Category
8	Bridge Complementary Buildings	Traffic Signs	X32	0.110	12	Medium
9	Bridge Complementary Buildings	Backfill (oprit)	X24	0.101	13	Medium
10	Bridge Complementary Buildings	Oprit/approach road	X23	0.092	14	Medium

The bridge complementary building section consists of 6 bridge elements, namely kerb/gabions, culverts, retaining walls, traffic signs, embankment/oprit and oprit/approach road. With 2 risk variables in the high category and 8 risk variables in the medium category

From the risk level table that has been analyzed above, it is known that of the 18 risk variables in the bridge superstructure section, there are 8 risks in the moderate category that need mitigation and 10 risks in the low category that need monitoring. Risks X13, X5, and X4 are in the moderate category even though they have a small impact but have a frequent risk possibility, Risks X18, X16, X11, X2, X14, X1, X15, X6 are in the low category because they have a small impact, risk X7 is in the low category because it has a very small impact, risk X17 is in the low category even though it has a large impact, but the possibility of risk occurs very rarely, as well as risks X9 and X12 even though they are in the category of very rare risk possibilities, but have a very large impact.

Table 13 Risk level of building under the bridge

Frekuensi	Nilai	Dampak				
		Sangat Kecil	Kecil	Sedang	Besar	Sangat Besar
		0.05	0.10	0.20	0.40	0.80
Sangat sering	0.90	0.05	0.09	0.18	0.36	0.72
Sering	0.70	0.04	0.07	X20 X21 0.14	0.28	0.56
Kadang-Kadang	0.50	0.03	0.05	X22 0.10	X19 0.20	0.40
Jarang	0.30	0.02	0.03	0.06	0.12	0.24
Sangat Jarang	0.10	0.01	0.01	0.02	0.04	0.08

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Table 14 The level of risk of overbuilding

Frekuensi	Nilai	Dampak				
		Sangat Kecil	Kecil	Sedang	Besar	Sangat Besar
		0.05	0.10	0.20	0.40	0.80
Sangat sering	0.90	0.05	X23 0.09	X25 X26 0.18	0.36	0.72
Sering	0.70	0.04	0.07	X30 0.14	X29 X31 0.28	0.56
Kadang-Kadang	0.50	0.03	0.05	X32 X24 0.10	X27 X28 0.20	0.40
Jarang	0.30	0.02	0.03	0.06	0.12	0.24
Sangat Jarang	0.10	0.01	0.01	0.02	0.04	0.08

From the risk level table above, it is known that of the 10 risk variables in the complementary building section of the bridge there are 2 risks in the high category and 8 risks in the low category. At the risk of X23, X25 and X26 in the moderate category because the possibility of risk is very frequent even though it has a small and medium impact, risk X30 in the moderate category because the possibility of risk is frequent and has medium impact, risks X32, X24, X27 and X28 in the moderate category because the possibility of risk sometimes occurs and has a medium and large impact. For risks X29 and X31, they are in the high category because the possibility of risk occurs frequently and has a large impact. There are 14 risk variables with low priority handling scale, 1 risk variable with medium priority handling scale, and 17 risk variables with high priority handling scale.

Risk management measures

For Bridge Complementary Buildings, creating a plate around the location of the river flow with the function of reducing the scour depth around the gabion with the aim of deflecting the direction of the vertical flow of the river, so that the water flow does not carry much material around the base of the gabion. Sheet piles are made of steel, concrete, or wood and are embedded into the riverbed around bridge pillars or abutments. These structures help contain the flow of water that erodes material around the bridge, providing more permanent physical protection with Kerb/Gabions and Culverts. Repair of mossy retaining walls and the presence of water seepage can be done by patching, reinforcing the structure with FRP material, protective painting on concrete structural elements, If the seepage / water leakage on the retaining wall is caused by the lack of wall drainage holes or clogged wall drainage holes can be repaired / cleaning of drainage holes or water disposal to reduce water pressure behind the wall and also reduce water evaporation through the concrete wall. Calculate the number of traffic sign elements required for the clarity of information provided, install traffic control devices including portals, signs and signs to provide important traffic information, Compact the backfill soil on the bridge oprit to the optimum density, apply a layer of flexible pavement (asphalt) over the compacted backfill surface layer.

For Substructure Bridge, repair of cracks in the structure can be done with liquid adhesives (epoxy resin), sealing materials (sealants), Repair of cracks with adhesive / epoxy materials can be done if the crack width ranges from 0.1mm to 0.25 mm and covers an area of less than 30% of the area of the element concerned, Repair of cracks with epoxy material injection coupled with steel plate reinforcement or FRP material can be done if the crack covers an area of approximately 50% of the element area, no seepage or water leakage has

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occurred and the concrete quality is not less than 20 MPa, Geometric measurements need to be taken to determine the vertical alignment, and the cross section of the bridge including checking if there is deformation in the bridge abutment.

For Bridge Upper structure, It is necessary to repair the damaged surface layer with Aus layer lataston (HRS-WC), Make pedestrian access to the sidewalk safe and comfortable with a minimum concrete quality fc' 20 MPa, Replace damaged / missing parts or can repaint the backrest element if the paint starts to fade, Repair of incorrectly installed elements can be done by repairing steel structural elements by straightening, If the wrong element causes problems then it must be replaced or strengthened. If the faulty steel element is reinforced, proper attention must be paid to welding techniques, installation of bolts and rivets, Repairs can be made by removing the force by drilling a hole at the end of the crack, welding, making a cover plate, and reinforcing or replacing, Repairs to deformed components can be made by straightening steel components using pressure or heating to a certain permissible heat or a combination of both, Immediately overlaid on the concrete floor of the bridge with wear layer laston (AC-WC), Repair can be done by replacing the deck drain, If the rust damage is less than 15% then the element can be repaired by painting, if the damage area exceeds 15% then repairs can be made by reshaping with appropriate welding techniques, strengthening weak parts by adding steel plates or additional girders.

CONCLUSION

Based on the research results, it can be concluded that:

1. Based on the results of the risk analysis, there are 2 risk variables with a high priority handling scale, 20 risk variables with a medium priority handling scale, and 10 risk variables with a low priority handling scale with handling recommendations for immediate mitigation because they have a significant level of impact, namely erosion around the bridge (local scouring) by making plates around the location of the river flow, flooding by normalizing river flow through dredging / cleaning debris in the river basin, cracked concrete repairs can be done by reinforcing with additional concrete layers, Mossy and water seepage repairs can be done by patching, reinforcing structures with FRP materials, protective painting on concrete structural elements, and demolition of prestressed concrete, hollow concrete repairs can be done removing all damaged parts of the concrete then installing and forming new concrete to get a concrete blanket that is as good as its origin using approved materials, abutment deformation (decline) / shift needs to take geometric measurements to ascertain whether there is a shift in the bridge abutment.
2. Based on the results of testing the correlation between variables with multiple linear regression methods on variables (X and Y), namely risk and causes to impact, the regression value is 0.610 and the significance value $\alpha = 0.001 < 0.005$ so it can be concluded that the hypothesis is accepted, namely that there is a strong influence between variable X (cause and impact variables) simultaneously on variable Y (risk variable).
3. The high-risk category between the values of 0.24 - 0.72 consists of the risk of erosion around the bridge (local scouring) (X29) with a risk level value of 0.345 and flooding (X31) with a risk level value of 0.262 on the bridge complementary building, medium risk category between values of 0.06 - 0.20, The lowest risk category between the values of 0.01 - 0.05 consists of the bridge superstructure

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