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ANALYSIS OF OCCUPATIONAL HEALTH AND SAFETY RISK MANAGEMENT USING THE HAZARD IDENTIFICATION RISK ASSESSMENT AND DETERMINING CONTROL METHOD IN SECTION SP BRIDGE REPLACEMENT PROJECT. COKROAMINOTO – SP. TOHPATI DENPASAR

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ABSTRACT
This study aims to determine the hazard and risk factors that cause work accidents, assess the risk of work accidents, and know how to control work risks in substructure and foundation work on the Sp. Section Bridge Replacement Project. Cokroaminoto – Sp. Tohpati Denpasar. The data analysis technique used in this study was the HIRADC (Hazard Identification, Risk Assessment, and Determining Control) method. The research data was collected through Project OSH documents, field observations, interviews, and the distribution of questionnaires to 20 respondents using a purposive sampling technique. From the research results, it can be seen that (1) from the results of hazard identification, 25 hazard numbers and 20 risk numbers are obtained. (2) from the results of the initial risk assessment, it was found that 11 hazards were classified as low (low risk), 56 hazards were classified as medium (medium risk), 85 hazards were classified as high (high risk), and eight hazards were classified as extreme (extreme risk). In the residual risk assessment by distributing questionnaires, there was a decrease in risk values after the initial control was carried out, with 158 hazards classified as low (low risk) and two as medium (medium risk). (3) from the results of risk control, 18 total controls were obtained for 19 types of substructure and foundation work at the Penatih Bridge. Control is carried out based on the control hierarchy: elimination, substitution, engineering, administration, and personal protective equipment (PPE).

Keywords: OHS Risk Management, HIRADC, Hazard Identification, Risk Assessment, Determining Control.

INTRODUCTION
Often, in construction projects, the construction process has several risks of work accidents that can disrupt project work activities, even though the implementation of construction projects is required to produce a good quality project with the right time and cost according to the predetermined project budget, but with many risks of work accidents and work-related diseases that occur in the construction project industry can slow down project implementation time and result in increased project costs [1]. According to Darmawi, risk relates to the possibility of adverse or detrimental consequences, such as the possibility of injury, fire, and so on [2].

Meanwhile, according to Suma'mur, in general, the risk of work accidents is caused by two factors, namely human actions that do not fulfil work safety (unsafe acts) and unsafe environmental conditions (unsafe conditions) [3]. The high risk of accidents in Indonesia's construction sector can harm workers in the industry [4]. This can be seen from the still high number of work accident cases in Indonesia based on BPJS Employment data, 2019 which recorded 114,235 work accident cases, and in 2020 in the January to October period recorded 177,161 work accident cases and 53 cases of work-related diseases [5]. The bridge building consists of groups of the superstructure, foundation, substructure, foundation, barrier, and bridge safety structures, according to the Department of Public Works (Introduction and Principles of Planning for Bridge Foundations, 1988) [6]. One method for identifying these potential risks is the Hazard Identification Risk Assessment and Determining (HIRADC) method [7]. HIRADC consists of 3 steps: hazard identification, risk assessment, and determining control [8]. This is evidenced by the research by Fauzi Hidayat (2022), where in this study, it was found from the HIRADC method that jobs that are prone to risk are architectural work on the 8th floor with a risk value of 5.95 in the M category (Middle) is in rank 1 of all stages existing work on the Project as well as non-standard structural work with a risk value of 3,431 in the category R (Low) at rank 89 [9].

The bridge building consists of groups of the superstructure, foundation, substructure, foundation, barrier, and bridge safety structures, according to the Department of Public Works (Introduction and Principles of Planning for Bridge Foundations, 1988) [10]. As for the research conducted by Mega Raudhatin (2017), five jobs were observed in the Tower X construction project in Jakarta [11]. Occupational safety and health (K3) risk management is an effort to manage OHS risks in a structured and planned manner into a system to prevent work accidents [12]. K3 risk management is an obligation that must be carried out by companies where the application of K3 can guarantee worker protection [13]. The implementation of OSH will positively impact workers in the work environment; this is supported by research conducted by Hidayat (2016), who found an analysis of 205 cases of construction work accidents from news articles from 2005 to 2015[14].

The problem to be answered from this study is determining the hazard and risk factors that cause work accidents, providing a work accident risk assessment, and determining how to control work risk in substructure and foundation work on the Sp. Segment Bridge Replacement Project. Cokroaminoto – Sp. Tohpati Denpasar [15].

METHOD

This study uses a research design with quantitative methods and a descriptive approach. Location of the Sp. Sp. Bridge Replacement Project. Cokroaminoto – Sp. Tohpati is at the National Road Implementation Unit Region III Prov. Bali, which is located at Jalan Gatot Subroto Timur [16]. The data that must be sought to conduct this research is in the form of primary data and secondary data. Preliminary data in conducting interviews, distributing questionnaires, and direct field observations [17]. Secondary data include K3 report documents, RAB, previous research, theories, references: journals, papers, articles, and internet media. In this study, questionnaires are made using a purposive sampling technique based on specific considerations or criteria [18]. In this study, the number of respondents was as many as 20. In preparing the questionnaire, a validity test was carried out to test the validity of the questionnaire, and a reliability test was carried out to test the trustworthiness or reliability of the questionnaire [19]. The research instruments used in this study were interview sheets, questionnaire sheets, SPSS applications, HP cameras, Microsoft Excel, and Microsoft Word [20]. Stages and research procedures In this study, the authors conducted direct surveys in the field, interviews, and distributed questionnaires to find information, identify job risks, attempt to control risks, then analyze the data, and draw conclusions and suggestions.

RESULTS AND DISCUSSION

The results of the research that will be presented are regarding the OHS risk analysis in the Project.

Replacement of Section Bridge Sp. Cokroaminoto – Sp. Tohpati Denpasar uses the HIRADC (Hazard Identification, Risk Assessment, and Determining Control) method through risk identification, likelihood, and severity analysis with a risk matrix and risk assessment. Then proceed with work risk control.

1. Hazard Identification

In this study, the collection of hazard identification data was carried out by interviewing. Based on the results of the interviews, 25 natural hazards, and 20 risks were found at the Penatih Bridge, namely: Existing hazards: falling from a height, being hit by heavy equipment, being hit by heavy equipment, manual handling, stone and gravel materials, careless placement of the material, pieces of tree trunks that fall on workers, being hit by splashed concrete material, being hit by moving test material, cutting reinforcing steel with welding tools and cutters, poor lighting, heavy equipment slings cut off, hit by a crowbar or hammer, hit by sparks from the welding tool, the material fell while being moved, cables crossed on the road, leftover concrete scattered, crushed iron material, rainy weather, exposure sunlight, exposure to dust, dug holes, floods from rivers, landslides, and passing vehicles. Existing risks: cuts, bruises, back pain, burns, torn wounds, scratches, electric shock, punctures, broken bones, respiratory problems, drifting and drowning, decreased endurance, dehydration, equipment/vehicles cannot be used, equipment short circuit exposed to water, scattered material, bitten by wild animals, traffic congestion and traffic accidents.

2. Risk Assessment Before Controlling

After collecting various data from hazard identification, proceed with determining the value of the hazard risk level. The following is the level of risk in the work of the foundation and understructure of the bridge before being controlled, which can be seen in the table below.

Table 1: Risk Level Before Control Is Done

No	Type of work	Risk Level Category				Hazard Amount
		L	M	H	E	
1	Mobilization (tools and materials)	2	4	7	1	14
2	Bored pile pillar drilling (D1000 mm)	0	4	10	0	14
3	Bored pile abutment and secant pile drilling (D800 mm & D600 mm)	0	4	9	1	14
4	Relocation of utilities (Dismantling of utility steel bridges, utility poles, and cables)	0	4	4	1	9
5	Excavation for drainage ditches and drainage ditches	0	1	3	0	4
6	Laying stones with mortar	1	1	4	1	7
7	Making U-shaped Channel Type DS 4 100 x 100 x 120 (precast)	1	1	4	0	6
8	Excavation structure with a depth of 0 - 6 meters	1	1	6	0	8
9	Ordinary Stockpiles and a selection of excavated products	0	1	2	1	4
10	Cutting selected trees in diameter from 15 cm to above 75 cm	0	1	6	0	7
11	Structural concrete fc 30 Mpa, fc 15 Mpa, and fc 10 Mpa (casting piers, abutments, and secant piles)	1	16	10	1	28
12	Provision of Type I Girder Precast Units Span 15.6 m, 20.6 m, 35.6 m, and 40.6 m	0	9	0	0	9
13	Plain Reinforcing Steel - BjTP 280 and BjTP 420B	0	0	4	0	4
14	D600 mm primary and secondary secant piles, D1000mm and D800mm concrete piles	0	4	0	0	4
15	PDLT (Pile Dynamic Load Testing) and PIT (Pile Integrated Test) types of Dynamic Loading Tests	1	3	1	0	5
16	Demolition of masonry	1	0	5	1	7
17	Concrete Demolition (D1000mm concrete pillar head)	1	1	7	0	9
18	Directional benchmark	1	0	1	0	2
19	Demolition of existing tiles on sidewalks or medians	1	1	2	1	5
Total		11	56	85	8	160

Based on the table above, there are 160 hazard risks with 11 levels of risk low (Low), 56 moderate risks (Medium), 85 high-level risks (High), and eight extreme level risks (Extreme).

3. Risk Control (Determining Control)

After carrying out the hazard identification and initial risk assessment, the next step is to determine the initial control; there are 18 controls available at this Penatih Bridge, namely the use of PPE (masks, helmets, shoes, gloves, life jackets if necessary, body harnesses if in high places), installation of warning signs, traffic management, placement of Flagman, diversion of traffic flow, traffic engineering, plates for uneven ground, implementation of work shifts, drinking supplies at each post, regular administration of vitamin C, an inspection of heavy equipment/project vehicles periodically, using waterproof covers for work tools, making material stock shelves, making safe felling paths, providing centralized disposal sites, making wire gabions for landslide-prone areas, being swift in cleaning/evacuating the rest of the work material, providing fire extinguishers (Light Fire Extinguisher).

4. Risk Assessment After Controlling

In the next stage, the goal is to determine how much the risk of harm has been reduced after implementing the controls. The assessment is carried out at this stage by distributing questionnaires to 20 respondents and determining the purposive sampling method. The following is the level of risk in the work of the foundation and understructure of the bridge after the control is carried out, which can be seen in the table below.

Table 2: Risk Level Before Control Is Done

No	Type of work	Risk Level Category				Hazard Amount
		L	M	H	E	
1	Mobilization (tools and materials)	14	0	0	0	14
2	Bored pile pillar drilling (D1000 mm)	14	0	0	0	14
3	Bored pile abutment and secant pile drilling (D800 mm & D600 mm)	14	0	0	0	14
4	Relocation of utilities (Dismantling of utility steel bridges, utility poles, and cables)	9	0	0	0	9
5	Excavation for drainage ditches and drainage ditches	4	0	0	0	4
6	Laying stones with mortar	7	0	0	0	7
7	Making U-shaped Channel Type DS 4 100 x 100 x 120 (precast)	6	0	0	0	6
8	Excavation structure with a depth of 0 - 6 meters	8	0	0	0	8
9	Ordinary Stockpiles and a selection of excavated products	3	1	0	0	4
10	Cutting selected trees in diameter from 15 cm to above 75 cm	7	0	0	0	7
11	Structural concrete fc 30 Mpa, fc 15 Mpa, and fc 10 Mpa (casting piers, abutments, and secant piles)	28	0	0	0	28
12	Provision of Type I Girder Precast Units Span 15.6 m, 20.6 m, 35.6 m, and 40.6 m	9	0	0	0	9
13	Plain Reinforcing Steel - BjTP 280 and BjTP 420B	4	0	0	0	4
14	D600 mm primary and secondary secant piles, D1000mm and D800mm concrete piles	4	0	0	0	4
15	PDLT (Pile Dynamic Load Testing) and	5	0	0	0	5

	PIT (Pile Integrated Test) types of Dynamic Loading Tests					
16	Demolition of masonry	6	1	0	0	7
17	Concrete Demolition (D1000mm definite pillar head)	9	0	0	0	9
18	Directional benchmark	2	0	0	0	2
19	Demolition of existing tiles on sidewalks or medians	5	0	0	0	5
Total		158	2	0	0	160

After the control has been carried out on the risk of hazards at work, the result is a decrease in the level of hazard risk for all types of work. No hazard risk exists in 19 jobs with extreme or high-risk groups. There are two hazards with a moderate level of risk in ordinary embankment work; the choice of excavation results is one hazard, and masonry demolition work is one hazard. There are 158 hazards in the low-level risk category for every 19 jobs.

5. Compile the HIRADC Table

After collecting various data from hazard identification, controlling risk values before and after the control, initial hazard risk control, and residual risk control, and then compiling HIRADC tables, the HIRADC table is made more detailed to get more precise results. In compiling the HIRADC table, the author asks for assistance from K3 experts in the field of bridges and experts related to bridge structure work. Work items, hazards, risk variables, risk assessments before and after control, initial control, and laws and requirements are in each substructure and project foundation work item. In the HIRADC table, advanced controls are also needed to better optimize the rules that have been done before.

Table 3: HIRADC Method

No	Activity		Initial Risk Level Assessment					Initial Risk Control	Residual Risk Assessment				Advanced Risk Control
	Hazard Variable	Risk Variable	Legislation or Requirements	L	S	L x S	Initial Risk Level		L	S	L x S	Residual Risk Level	
I	DIVISION 1. GENERAL												
1	Tool Mobilization												
	The workers are stuck.	Wounds, bruises	- Law 1/1970 concerning work safety	2	2	4	Medium	Traffic management	1	1	1	Low	Traffic management
	Heavy equipment manoeuvres	Wounds, bruises	Permenaker RI No 38 of 2016 Article 8 (power & production aircraft)	4	2	8	High	Installation of hazard signs	1	2	2	Low	Installation of hazard signs
	Passing vehicles	Traffic density	- Law 22/2009 concerning Traffic	3	3	9	High	- Placing Flagman during the measurement process - Traffic management in collaboration with the police	1	1	1	Low	- Perform traffic opening and closing - Diversion of vehicle flow
		Traffic accident		3	5	15	Extreme		1	1	1	Low	
	uneven ground surface	Damaged vehicle (financial loss)	- Law 2/2017 concerning Construction Services	1	2	2	Low	Placing the Plate on an uneven ground surface	1	2	2	Low	Levelling uneven ground surfaces with heavy equipment
		Material is damaged and scattered.		3	3	9	High		1	1	1	Low	

	dust exposure	Respiratory disorders		4	2	8	High	Using a mask	1	1	1	Low	Cleaning dusty roads with water
	Material Mobilization												
	The workers are stuck.	Wounds, bruises	- Law 1/1970 concerning work safety	2	2	4	Medium	Traffic management	1	1	1	Low	Installation of guardrail/MCB
	Heavy equipment manoeuvres	Wounds, bruises	Permenaker RI No 38 of 2016 Article 8 (power & production aircraft)	4	2	8	High	Installation of hazard signs	1	1	1	Low	Maintain distance from heavy equipment
	Material falls when being moved	Wounds, bruises	- Law 2/2017 concerning Construction Services - Keppres 22/1993	3	2	6	Medium	Using PPE	1	1	1	Low	Don't move things excessively
		Scattered materials		3	2	6	Medium		1	1	1	Low	
	Uneven ground surface	Damaged vehicle (loss financial)		1	2	2	Low	Place the Plate on an uneven ground surface	1	2	2	Low	Levelling uneven ground surfaces with heavy equipment
		Material damaged & scattered		3	3	9	High	Using PPE	1	1	1	Low	
	Dust exposure	Respiratory disorders		4	2	8	High	Using a mask	1	1	1	Low	Clean dusty roads with water
2	**Pengeboran bored pile pilar (D1000 mm)**												
	Heavy equipment manoeuvres	Wounds, bruises	- Permenaker RI No 38 of 2016 Article 8 (power & production aircraft)	4	2	8	High	- Installation of hazard signs - Regular inspection of heavy equipment	1	1	1	Low	- Installation of hazard signs - Regular inspection of heavy equipment
	The sling rope for the bored pile tool broke.	Wounds, bruises		3	3	9	High		1	1	1	Low	
		Heavy equipment cannot be used.		3	3	9	High		1	1	1	Low	
		Scattered materials		3	2	9	Medium	Immediately carry out cleaning/evacuation of material	1	1	1	Low	Immediately carry out cleaning/evacuation of material
	Insufficient explanation	Wounds, bruises(worker fell / mired)	- Law No. 1/1970 - Law 2/2017 - Permenaker No 1/1980 - PP No. 50/2012 - Presidential Decree 22/1993	2	2	4	Medium	Add a light source	1	1	1	Low	Add a light source
	Holes in drilled bored piles	Wounds, bruises(slips into the hole)		3	3	9	High	Placing the Plate on the surface of the hole	1	1	1	Low	Placing the Plate on the surface of the hole
		Heavy equipment mired can not be used (financial loss)		2	2	4	Medium		1	1	1	Low	
	Flood from the river	Drifting and sinking		3	3	9	High	- Installing hazard signs around the river - Use essential PPE and a life	1	1	1	Low	Stop the job process if it is not possible

								jacket						
	Wild animals	Bitten and stung by wild animals		3	3	9	High	Using PPE	1	1	1	Low	Using PPE
	Sun exposure	Decreased body resistance, dehydration		3	3	9	High	- Implement work shifts - supply of drinking water at each post	1	1	1	Low	- Provide medical personnel - Giving Vit. C periodically
	Dust exposure	Respiratory disorders		4	2	8	High	Using a mask	1	1	1	Low	Cleaning dusty roads with water
	Rainy weather	Decreased body resistance.		3	3	9	High	Temporarily stop work	1	2	2	Low	Temporarily stop work
		Wounds, bruises(slips into the hole)		3	3	9	High		1	2	2	Low	
		Short circuit equipment exposed to water		3	2	6	Medium	Protect equipment with a waterproof cover	1	1	1	Low	
3	**Bored pile abutment and secant pile drilling (D800 mm & D600 mm)**													
	Heavy equipment maneuvers	Wounds, bruises	- Permenaker RI No 38 of 2016 Article 8 (power & production aircraft)	4	2	8	High	- Installation of hazard signs - Regular inspection of heavy equipment	2	1	2	Low	- Installation of hazard signs - Regular inspection of heavy equipment
	The sling rope for the bored pile tool broke	Wounds, bruises		3	3	9	High		1	1	1	Low	
		Heavy equipment cannot be used.		3	3	9	High		1	1	1	Low	
		Scattered materials		3	2	9	Medium	Immediately carry out cleaning/evacuation of material	1	1	1	Low	Immediately carry out cleaning/evacuation of material
	Passing vehicles	Traffic density	- Law 22/2009 concerning Traffic	3	3	9	High	- Placing Flagman during the measurement process - Traffic management in collaboration with the police	1	2	2	Low	- Perform traffic opening and closing - Diversion of vehicle flow
		Traffic accident		3	5	15	Extreme		1	1	1	Low	
	Insufficient explanation	Wounds, bruises(worker fell / mired)	- UU No 1/1970 - UU 2/2017 - Permenaker No 1/1980	2	2	4	Medium	Add a light source	1	1	1	Low	Add a light source

	Holes in drilled bored piles	Wounds, bruises(slips into the hole)	- PP No 50/2012 - Keppres 22/1993	3	3	9	High	Placing the Plate on the surface of the hole	1	1	1	Low	Placing the Plate on the surface of the hole
		Heavy equipment mired can not be used (financial loss)		2	2	4	Medium	Conduct periodic inspections of equipment	1	1	1	Low	
	Sun exposure	Decreased body resistance, dehydration		3	3	9	High	- Implement work shifts - supply of drinking water at each post	1	1	1	Low	- Provide medical personnel - Giving Vit. C periodically
	Dust exposure	Respiratory disorders		4	2	8	High	Using a mask	2	1	2	Low	Cleaning dusty roads with water
	Rainy weather	Decreased body resistance.		3	3	9	High	Temporarily stop work	1	1	1	Low	Temporarily stop work
		Wounds, bruises(slips into the hole)		3	3	9	High		1	1	1	Low	
		Short circuit equipment exposed to water		3	2	6	Medium	Protect equipment with a waterproof cover	1	1	1	Low	
4	**Dismantling of utility steel bridges**												
	Fall from a height	Wounds, broken bones	- Law 1/1970 concerning work safety - PP No 50/2012	3	5	15	Extreme	Use additional PPE Full Body Harness at height	1	2	2	Low	Use additional PPE Full Body Harness at height
	Squashed iron material	Wounds, bruises		3	3	9	High	Using PPE	1	1	1	Low	Using PPE
	Got sparks from the welding tool	Burns electrocuted		2	2	4	Medium		1	1	1	Low	
	Use of cutters	Abraded		2	2	4	Medium		1	1	1	Low	
	Dismantling utility poles and cables												
	Got hit by a utility pole	Wounds, bruises	- UU No 1/1970 - UU 2/2017 - Permenaker No 1/1980 - PP No 50/2012 - Keppres 22/1993	3	3	9	High	- Using PPE - Installation of hazard signs	1	1	1	Low	- Using PPE - Installation of hazard signs - Maintain distance when heavy equipment is operating
	Hit by a crowbar or hammer	Wounds, bruises		3	3	9	High		1	1	1	Low	
	Hit heavy equipment	Wounds, bruises		2	2	4	Medium		1	1	1	Low	
	Cables across the road	Wounds, bruises, and Burns got an electric shock.		2	2	4	Medium		1	2	2	Low	
		Traffic accident		2	4	8	High		2	1	2	Low	
2	**Provision of Type I Girder Precast Units Span 15.6 m, 20.6 m, 35.6 m, and 40.6 m**												
	Uneven roads	Wounds, bruises(work er falls)	- UU No 1/1970	3	2	6	Medium	Placing plates/boards on uneven roads	2	1	2	Low	Placing plates/boards on uneven

		Heavy equipment slipped, and broken tools.		3	2	6	Medium		2	2	4	Low	roads
		Scattered materials		3	2	6	Medium	Immediately carry out cleaning/evacuation of material	2	2	4	Low	Immediately carry out cleaning/evacuation of material
	Heavy equipment carrying girder material	Wounds, bruises	- Permenaker RI No 38 of 2016 Article 8 (power & production aircraft)	3	2	6	Medium	- Installation of hazard signs - Regular inspection of heavy equipment - Using PPE - Immediately carry out cleaning/evacuation of material	2	2	4	Low	- Installation of hazard signs - Regular inspection of heavy equipment - Using PPE - Immediately carry out cleaning/evacuation of material
	Lifting of Precast Girder	Wounds, bruises(hit by material)		3	2	6	Medium		2	2	4	Low	
		Precast girders fell on public facilities.		3	2	6	Medium		2	2	4	Low	
	The sling broke during the lifting of the girder	Wounds, bruises(hit by material)		2	3	6	Medium		2	2	4	Low	
		Heavy equipment cannot be used.		2	3	6	Medium		2	2	4	Low	
		Scattered materials		3	2	6	Medium		2	2	4	Low	
3	**Plain Reinforcing Steel - BjTP 280 and BjTP 420B**												
	Trucks carrying Reinforcing Steel	Wounds, bruises(Injured by a car being hit by	- UU No 1/1970 - PP No 50/2012 - Permenaker	3	3	9	High	Installation of hazard signs	2	2	4	Low	Installation of hazard signs
	material	another truck)	No 1 th 1980										
	Improper placement of materials by workers	Wounds, bruises, scratched/punctured		3	3	9	High	Create material stock racks	2	2	4	Low	Create material stock racks
	Reinforcing steel cutting with a welder and cutter	Burns, Abraded, got an electric shock		3	3	9	High	Using PPE	2	2	4	Low	Using PPE
		Nearby equipment caught fire.		3	3	9	High	Prepare fire extinguishers	2	2	4	Low	Prepare fire extinguishers
4	**D600 mm primary and secondary secant piles, D1000mm and D800mm concrete piles**												
	Uneven roads	Wounds, bruises(worker falls)	- UU No 1/1970	3	2	6	Medium	Placing plates/boards on uneven roads	2	2	4	Low	Placing plates/boards on uneven roads
		Heavy equipment slipped, and broken tools.		3	2	6	Medium		2	1	2	Low	
	The sling disconnected during tool preparation.	Wounds, bruises(hit by drilled pole)	- Permenaker RI No 38 of 2016 Article 8 (power & production aircraft)	2	3	6	Medium	Regular inspection of heavy equipment	2	2	4	Low	Regular inspection of heavy equipment
	Equipment is broken	Material loss		2	3	6	Medium		2	2	4	Low	
5	**PDLT (Pile Dynamic Load Testing) and PIT (Pile Integrated Test) types of Dynamic Loading Tests**												
	Material pinch point	Wounds, bruises, fracture(stuck material)	- UU No 1/1970 - PP No 50/2012 - Permenaker	2	2	4	Low	- Using PPE - Maintain a distance from the test	2	1	2	Low	- Using PPE - Maintain a distance from the test

	Hit by moving test material	Wounds, bruises	No 1 th 1980	2	3	6	Medium	equipment	2	2	4	Low	equipment
	Rainy weather	Wounds, bruises (slipped because of the slippery road)		3	3	9	High	Temporarily stop work	2	1	2	Low	Temporarily stop work
		Short circuit equipment exposed to water		3	2	6	Medium	Protect equipment with a waterproof cover	2	1	2	Low	
	Equipment is broken	Material loss		2	3	6	Medium	Regular inspection of heavy equipment	2	2	4	Low	Regular inspection of heavy equipment
6	**Demolition of masonry**												
	Hit by a crowbar or hammer	Wounds, bruises	- UU No 1/1970 - UU 2/2017 - Permenaker No 1/1980 - PP No 50/2012 - Keppres 22/1993	3	3	9	High	- Using PPE - Provide signs regarding the dangers of working at heights	2	2	4	Low	- Using PPE - Provide signs regarding the dangers of working at heights
	Fall from a height	Wounds, broken bones		3	5	15	Extreme		2	1	2	Low	
	Sun exposure	Decreased body resistance, dehydration		3	3	9	High	- Implement work shifts - supply of drinking water at each post	2	1	2	Low	- Provide medical personnel - Giving Vit. C periodically
	Manual Handling	Back Pain		2	2	4	Low	Use tools for lifting	2	2	4	Low	Use tools for lifting
	Rainy weather	Wounds, bruises (slipped because of the slippery road)		3	3	9	High	Temporarily stop work	2	2	4	Low	Temporarily stop work
	Stone and gravel materials	Wounds, bruises, ripped.		4	2	8	High	Provide centralized disposal	3	2	6	Medium	Provide centralized disposal
	Dust exposure	Respiratory disorders		4	2	8	High	Using a mask	2	2	4	Low	Cleaning dusty roads with water
V	**DIVISION 9. DAILY WORK AND OTHER WORK**												
1	**Directional benchmark**												
	Manual Handling	Back Pain	- UU No 1/1970 - PP No 50/2012 - Permenaker No 1 th 1980 - Keppres 22/1993	2	2	4	Low	Use tools for lifting	2	2	4	Low	Use tools for lifting
	Sun exposure	Decreased body resistance, dehydration		3	3	9	High	- Implement work shifts - supply of drinking water at each post	2	2	4	Low	- Provide medical personnel - Giving Vit. C periodically
2	**Demolition of existing tiles on sidewalks or medians**												
	Heavy equipment manoeuvres	Wounds, bruises	- Permenaker RI No 38 of 2016 Article 8 (power & production aircraft)	4	2	8	High	Make warning signs and keep your distance	2	2	4	Low	Make warning signs and keep your distance

	Scattered materials	Wounds, scratches	- UU No 1/1970 - PP No 50/2012 - Permenaker No 1 th 1980 - Keppres 22/1993 - UU 22/2009	3	2	6	Medium	Provide centralized disposal	2	2	4	Low	Provide centralized disposal
		Traffic accident		3	5	15	Extreme		2	2	4	Low	
	Manual Handling	Back Pain		2	2	4	Low	Use tools for lifting	2	2	4	Low	Use tools for lifting
	Dust exposure	Respiratory disorders		4	2	8	High	Using a mask	1	2	2	Low	Cleaning dusty roads with water

CONCLUSION

1. From the results of hazard identification, 25 natural hazards and 20 risks were found in 19 types of substructure and foundation work at the Penatih Bridge, namely:

- Existing hazards, namely falling from a height, being hit by heavy equipment, being hit by heavy equipment, manual handling, stone and gravel materials, careless placement of the material, pieces of tree trunks that fall on workers, being hit by splashed concrete material, being hit by moving test material, cutting steel reinforcement with welding tools and cutters, inadequate lighting, heavy equipment slings broken, hit by crowbars or hammers, hit by sparks from welding equipment, materials fell when moving, cables crossed on the road, leftover concrete scattered, crushed iron material, rainy weather, exposure to sunlight, exposure to dust, dug holes, flooding from rivers, landslides, and passing vehicles.
- Existing risks, namely cuts, bruises, back pain, burns, torn wounds, scratches, electric shock, punctures, broken bones, respiratory problems, drifting and drowning, decreased endurance, dehydration, equipment/vehicle cannot be used, short circuit equipment exposed to water, scattered materials, bitten by wild animals, traffic congestion and traffic accidents.

2. In this study, two risk assessment processes are carried out: risk assessment before control is carried out and risk assessment after control is carried out.

- In the initial assessment, it is known that the level of hazard risk is classified as low (low risk) with as many as 11 hazards. The hazard risk level classified as medium (medium risk) is as many as 56 hazards; 85 are classified as high, and eight are classified as extreme risks.
- In the final assessment, there was a decrease in the value of the risk level, where a low-risk group of 158 hazards was obtained and a medium-risk level of 2 threats. In addition, the entire job has no high- or extreme-risk categories.

3. In this study, 18 controls were found on the Penatih Bridge: using PPE (masks, helmets, shoes, gloves, life jackets if necessary, body harnesses if in high places), installing hazard signs, traffic management, placing Flagman, and diverting traffic. Traffic management, traffic engineering, plates for uneven ground, implementation of work shifts, drinking supplies at each post, periodic provision of vitamin C, periodic inspection of heavy equipment/project vehicles, use of waterproof covers for work tools, making material stock racks, making safe felling paths, providing centralized disposal sites, making wire gabions for landslide-prone areas, being swift in cleaning/evacuating work material remains, providing APAR (Light Fire Extinguisher).

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