JACEP

Journal of Applied Civil Engineering and Practices

Online (e-ISSN): e-ISSN 3109-2551 || 2026, Volume 2, No. 1, pp.54-67

Application of the HIRADC Method for Hazard Identification and Risk Reduction in a Workshop Construction Project: A Case Study of the AFI 3 Shoe Workshop Development Project, Tegal Regency

Ivan Adiyatma Pramana[a]*, Abdul Malik[a]

[a]Universitas Negeri Yogyakarta, Faculty of Vocational, Department of Applied Civil Engineering, Indonesia
*Corresponding Author: adiyatmapramanajogja@gmail.com

To cite this article:
Pramana, I.A., Malik, A. (2025). Application of the HIRADC Method for Hazard Identification and Risk Reduction in a Workshop Construction Project: A Case Study of the AFI 3 Shoe Workshop Development Project, Tegal Regency. *Journal of Applied Civil Engineering and Practice*, 2(1), Pp. 54-67. doi: 10.21831/jacep.v2i1.1293

To link to this article:
http://doi.org10.21831/jacep.v2i1.1293

Journal of Applied Civil Engineering and Practice by Department of Applied Civil Engineering, Faculty of Vocational, Universitas Negeri Yogyakarta.

2026, Volume 2, No 1, pp.54-67, e-ISSN 3109-2551

Journal of Applied Civil Engineering and Practice

Journal homepage: https://journal.uny.ac.id/publications/jacep/index

Research paper

Application of the HIRADC Method for Hazard Identification and Risk Reduction in a Workshop Construction Project: A Case Study of the AFI 3 Shoe Workshop Development Project, Tegal Regency

Ivan Adiyatma Pramana[a*], Abdul Malik[a]
[a]Universitas Negeri Yogyakarta, Faculty of Vocational, Department of Applied Civil Engineering, Indonesia
*Corresponding Author: adiyatmapramanajogja@gmail.com

ARTICLE INFO

Article History:
Received: April 24, 2025
Accepted: June 4, 2026
Published: June 10, 2026

Keywords:
HIRADC, occupational health and safety, hazard identification, risk assessment, construction project, workplace safety

How To Cite:
Pramana, I.A., Malik, A. (2025). Application of the HIRADC Method for Hazard Identification and Risk Reduction in a Workshop Construction Project: A Case Study of the AFI 3 Shoe Workshop Development Project, Tegal Regency. *Journal of Applied Civil Engineering and Practice*, 2(1), Pp. 54-67. doi: 10.21831/jacep.v2i1.1293

ABSTRACT

Purpose: The rapid growth of the construction sector in Indonesia has increased the need for effective occupational health and safety (OHS) management to prevent workplace accidents and minimize material and non-material losses. Despite the implementation of safety regulations, unsafe actions and unsafe conditions remain common in construction projects. This study aims to identify potential hazards, assess risks, and determine risk controls for workplace accidents during workshop construction.

Method/Design: This study employed a qualitative case study approach at the AFI 3 Shoe Workshop Development Project in Tegal Regency, Indonesia. Data were collected through direct field observations, document reviews, and interviews with occupational health and safety (OHS) experts and Quality, Health, Safety, and Environment (QHSE) managers. Risk levels were determined based on the likelihood and severity of identified hazards

Findings: The results revealed that various hazards were associated with construction activities, including unsafe worker behaviour and hazardous workplace conditions. A total of 65 hazards were identified. Initial risk assessment showed 20% extreme, 58% high, and 23% low risk. After control measures, risks decreased to 11% moderate and 89% low, with no extreme or high-risk levels remaining.

Practical Implication: The study provides practical guidance for contractors, project managers, and safety practitioners in implementing systematic hazard identification and risk control strategies. The HIRADC method effectively reduces workplace accident risks in construction projects. The findings can guide contractors and safety professionals in prioritizing hazard controls, especially in workshop construction settings.

INTRODUCTION

The construction sector in Indonesia has experienced a significant increase, evidenced by the rise in the national construction budget allocation to IDR 423.4 trillion (Direktorat Jenderal Bina Konstruksi - Kementerian Pekerjaan Umum, 2024). From 2023 to 2024, the budget grew by 7.84 percent. This growth reflects the government's commitment to enhancing infrastructure connectivity across the country. However, along with this increase, the implementation of the Occupational Safety and Health Management System (SMK3) in construction projects must be enforced in accordance with the regulations stipulated in Law No. 1 of 1970 concerning Occupational Safety. The construction sector is one of the largest contributors to work accidents in Indonesia. According to data from the Ministry of Public Works of the Republic of Indonesia, the construction sector and the manufacturing industry contributed the highest number of work accidents in Indonesia, accounting for 32% of total incidents (Marliana, Salma and Hakim, 2024) . Research confirms that risk management practices in Indonesian construction projects remain inconsistent, requiring systematic hazard evaluation to prevent accidents.

A proper construction work method begins from the project preparation stage through to project handover, following structured phases that meet prevailing standards and are consistently accompanied by construction occupational safety and health (K3). Workplace accidents are caused by two main factors: unsafe actions (*unsafe acts*) and unsafe conditions (*unsafe conditions*). Unsafe actions include worker negligence, non-compliance in using Personal Protective Equipment (PPE), and risky behaviors during work, while unsafe conditions include inadequate lighting, unguarded machinery, and unsafe physical environmental factors. Based on statistical data, 85% of work accidents in Indonesia are caused by unsafe actions, while 15% are caused by unsafe conditions (Marliana, Salma and Hakim, 2024). Machfudiyanto et al. (2023) further identified that the most frequent unsafe behaviors in Indonesian construction projects include workers putting tools and materials in random places, workers not attaching safety lines at provided places, and moving work tools and materials in ways not in accordance with procedures (Machfudiyanto *et al.*, 2023). Therefore, to address and minimize workplace accidents, prevention and systematic risk assessment are essential.

Risk assessment is a step in the analytical process that includes determining the level of risk, deciding whether the risk is acceptable to the company, and determining what risk control measures need to be implemented. The likelihood of work-related accidents in a company will decrease when hazards are evaluated and risk controls are applied. The four categories used as the basis for risk assessment are low, moderate, high, and very high or extreme risk. The level of risk can be calculated by multiplying the probability of occurrence (likelihood) by the severity of consequences (Marliana, Salma and Hakim, 2024). A study by Fuad et al. (2015) at a building construction project in Pontianak demonstrated that HIRADC effectively identifies hazards and determines risk levels for each work activity, with high-risk activities then receiving priority treatment (Fuad, Indrayadi and Nuh, 2019). Research at the Tambak Lorok Power Plant in Semarang on overhaul activities involving heavy plate installation (1500 kg plate weight) showed that the HIRADC method successfully identified risks and enabled appropriate control implementation (Riandini, Sagaf and Syakhroni, 2023). Sutapa et al. (2022) further confirmed that systematic risk identification, applied to borepile, pilecap, pedestal column, sloof, and roof frame work items, can produce risk assessments that help construction projects achieve "good" SMK3 implementation status (Sutapa *et al.*, 2022).

HIRADC (Hazard Identification, Risk Assessment, and Determining Control) is a technical method for identifying hazards, analyzing risks, and determining controls, used to systematically review processes or operations within a system. The HIRADC process consists of three main stages: first, hazard identification to find all activities with potential to cause accidents; second, risk assessment using likelihood and severity matrices to determine risk levels (Extreme/High/Moderate/Low); and third, determining controls using a hierarchy approach: elimination, substitution, engineering, administrative control, and PPE (Marliana, Salma and Hakim, 2024). This study was conducted at a factory construction project located in Tegal Regency, Indonesia. The factory is built using a mixed structural system: a concrete substructure and a steel superstructure using Pre-Engineered Building (PEB) material. The project covers a land area of 11.1 hectares and consists of 19 buildings. The construction process is supported by two mobile cranes for steel structure erection. During this work, the risk of workplace accidents is very high, including work at heights, falling materials, and hazardous supporting equipment.

According to information obtained from the QHSE department, several workplace accidents have occurred at the project site, including crushed fingers and torn lips caused by falling materials, resulting from worker negligence and failure to comply with occupational safety operational standards. Munang & Nurisusilawati (2022) emphasized that SMK3 implementation and decision-making often come from project actors with different experience levels, causing decisions to be less systematic and affecting project performance, thus requiring systematic risk management approaches (Munang and Nurisusilawati, 2022). These accidents occurred partly due to workers' low understanding and compliance with Standard Operating Procedures (SOPs). Therefore, in this case study, it is essential to systematically identify hazards, assess risks, and implement controls using the HIRADC method to minimize workplace accidents. The findings are expected to provide valuable information and evaluation for similar future construction activities, particularly for workshop and factory projects.

METHODS/DESIGN

The qualitative approach employed in this research is expected to create an in-depth description of discourse, attitudes, and observable behaviors from specific groups, communities, or organizations studied from a comprehensive, equitable, and holistic perspective (Diona, Sifai and Anto, 2024). This study integrates qualitative methods with direct field observation to produce descriptive data in the form of written or spoken discourse and observed human behavior (Susanto *et al.*, 2024). In qualitative analysis, descriptive terms or scales are used to characterize the severity of potential outcomes and their probability of occurrence. The HIRADC method (Hazard Identification, Risk Assessment, and Determining Control) serves as a comprehensive procedure that provides complete data regarding potential hazards, risk probabilities, and controls in the work environment (Abbas and Herawati, 2024). Risk assessment is measured using two parameters: likelihood and consequence or severity level. The matrix approach used in HIRADC employs a 5x5 scale to determine risk levels ranging from low to extreme (Putri *et al.*, 2023). According to Susanto (2024), the HIRADC process consists of three main stages: hazard identification, risk assessment using likelihood and severity matrices, and determining controls using the hierarchy of control approach (elimination, substitution, engineering, administration, and PPE) (Susanto *et al.*, 2024).

The research was conducted at the Adonia Footwear Indonesia 3 factory construction project located on Jl. Raya Tegal – Pemalang, Kedungkelor, Warurejo District, Tegal Regency, Central Java, Indonesia. The research subjects encompass both persons and places, where persons serve as data sources providing written or oral responses through interviews, while places represent data sources displaying both static and dynamic conditions including rooms, equipment completeness, object shapes, and colors (Diona, Sifai and Anto, 2024). Data collection utilized primary and secondary data sources, with primary data obtained through direct observation, systematic surveys, and interviews, while secondary data was gathered from books, government reports, and relevant documents including AS/NZS 4360:2004 risk management guidelines, OHSAS 18002:2008 SMK3 requirements, ISO 45001:2018 regarding occupational health and safety management systems, and Indonesian government regulations concerning occupational safety and health (K3) (Austalian Standart/New Zealand Standart, 2004; ISO 45001, 2018).

This research applies the HIRADC (Hazard Identification Risk Assessment Determining Control) method to analyze risks and provide alternatives during work processes, thereby minimizing workplace accident risks in the construction project (Fuad, Indrayadi and Nuh, 2019). Research instruments are tools used to collect, process, analyze, and present data methodically and objectively to solve research problems (Prastowo *et al.*, 2024). The research instruments implemented include: collecting information in the form of sources and regulatory guidelines relevant to the research topic; conducting direct observation of items under investigation to identify hazard sources; developing the Hazard Identification Risk Assessment and Determining Control (HIRADC) worksheet; interviewing professional informants with knowledge of project hazard risks; and analyzing interview results using NVivo software (Diona, Sifai and Anto, 2024). The final output involves developing risk assessment analysis, hazard identification, and hazard risk management methods into a structured HIRADC table using current standards, followed by discussion, conclusions, and recommendations (Abbas and Herawati, 2024) The research was conducted from February to July 2024 with a systematic observation survey approach, where observers used guidelines as observation tools to address difficulties related to policy formulation (Austalian Standart/New Zealand Standart, 2004).

FINDINGS

Hazard Identification in Workshop Construction Projects

The initial stage of HIRADC implementation involved systematic hazard identification across eleven work activities at the AFI 3 Shoe Workshop Development Project. The analysis revealed three risk categories: Extreme (E), High (T), and Moderate (M), with no Low (R) risks identified across all work items. Except for formwork installation, all work activities contained Extreme-risk hazards. These extreme risks primarily arose from falls from heights due to improperly installed safety lines, being struck by sharp or heavy objects from above, and using unsuitable work equipment that could cause worker injuries (Pratama, Setiono and Setyawan, 2025).

The High-risk category was present in all work items, emerging when workers failed to use mandatory Personal Protective Equipment (PPE) and when equipment was operated without proper Standard Operating Procedures (SOP) or operator licenses (SIO). Six of eleven work items contained Moderate-risk hazards, typically originating from poorly maintained workspaces and scattered waste materials that could injure workers. Interviews with the QHSE Manager revealed that work accidents frequently resulted from worker negligence, including non-compliance with PPE regulations, smoking during work, and horseplay. Using NVivo software analysis of interview data confirmed that negative worker behaviors represent a critical factor requiring attention during hazard identification, consistent with findings that unsafe acts account for approximately 85% of workplace accidents in Indonesia (Situmorang *et al.*, 2023).

In the interview with the QHSE Manager, it was also explained that in the hazard identification process, work accidents are caused by workers' negligence in not complying with regulations regarding the use of PPE, smoking while working, joking while working, this can cause accidents and this can be fatal.

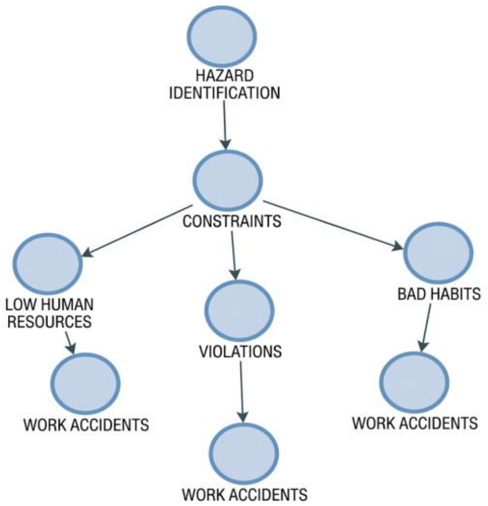

Figure 1. Hazard identification based on Nvivo analysis

Figure 1 shows that bad habits and employee violations can lead to potential workplace accidents. This data was obtained using Nvivo software, which facilitates drawing conclusions from the interview data. This allows us to conclude that negative employee behavior is crucial for identifying hazards.

Risk Assessment After Control is Implemented

The results of the risk level on work items after risk control is carried out are presented in Table 1.

Table 1. Risk Level of Work Activities After Control Implementation

No	Scope of Work Activity	Risk Category				Total Hazards
		E	H	M	L	
1	Foundation Work	0	0	0	17	17
2	Lean Concrete (LC) Work	0	0	1	5	6
3	Pile Cap Breaking	0	0	0	5	5
4	Steel Fabrication	0	0	1	3	4
5	Timber Fabrication (Formwork Material)	0	0	1	3	4
6	Formwork Installation	0	0	0	4	4
7	Reinforcement (Rebar) Installation	0	0	1	4	5
8	Concrete Casting / Pouring	0	0	0	9	9
9	Formwork Dismantling / Striking	0	0	0	4	4
10	Steel Structure Erection	0	0	3	1	4
11	Finishing Work	0	0	0	3	3
Total Risk per Work Activity		**0**	**0**	**6**	**58**	**65**

Risk Category Legend:

E = Extreme Risk　　M = Moderate Risk
H = High Risk　　L = Low Risk

Table 2. Risk Assessment Results Using HIRADC Method

No	Type of Work Activity	Hazard	Risk Level			Category
			L	S	RS	
1	**Excavation Work**					
	Manual excavation using hoe or crowbar	Foot punctured by sharp object from soil	3	3	9	H
	Heavy equipment inspection for excavation	Hand injury	4	2	8	H
	Heavy equipment operation for excavation	Slip/trip	3	2	6	M
		Engine fire injuring operator	4	4	16	E
		Buried by soil	3	3	9	H
		Worker struck by backhoe	3	3	9	H
		Backhoe stuck	3	2	6	M
	Excavation operation	Buried by landslide	3	3	9	H
		Worker falls into excavation	3	3	9	H
		Slope collapse	3	3	9	H
		No drainage ditch during rain	2	3	6	M
		Unsuitable heavy equipment	3	2	6	M
2	**Lean Concrete Work**					
	Site clearing	Respiratory irritation	3	3	9	H
		Eye irritation	3	3	9	H
		Struck by falling material	4	4	16	E
	Lean concrete	Skin irritation	3	3	9	H
		Exposed to concrete spill	3	3	9	H
		Pinched/crushed	3	3	9	H
3	**Pile Cap Breaking**					
	Securing pile for breaking	Struck by pile	4	4	16	E
		Rope/strap breaks	4	4	16	E

No	Type of Work Activity	Hazard	Risk Level L	Risk Level S	Risk Level RS	Category
	Breaking process	Concrete fragments injure body	4	2	8	H
		Hammer head strikes body	3	4	12	H
		Hand abrasion	3	2	6	M
4	**Steel Fabrication using Bar Cutter & Bar Bender**					
	Reinforcement fabrication	Abrasion/scrape	3	3	9	H
		Pinched/crushed	3	3	9	H
		Finger cut by gear/blade	3	3	9	H
		Electrocution	4	4	16	E
5	**Timber Fabrication**					
	Formwork plywood material	Struck by saw/hammer	3	3	9	H
		Struck by falling object from above	4	4	16	E
		Stepping on nail	3	2	8	H
		Hand cut by sharp object	3	2	6	M
6	**Formwork Installation**					
	Formwork installation process	Struck by tools and materials	3	3	9	H
		Struck by hammer	4	2	8	H
		Scraped by material	3	2	6	M
		Pinched/crushed	3	3	9	H
7	**Reinforcement (Rebar) Installation**					
	Material placement	Hand pinched/crushed	3	3	9	H
		Foot injury/trip	3	2	6	M
		Worker struck by falling material	4	4	16	E
	Rebar installation	Hand pinched/crushed	3	3	9	H
		Finger laceration	3	3	9	H
8	**Concrete Casting / Pouring**					
	Concrete truck mixer	Sunk/stuck	3	3	9	H
	Concrete pump	Sunk/stuck	3	3	9	H
	Foundation casting	Foot trip, struck by rebar, injury	3	2	6	M
		Struck by pump discharge hose	3	3	9	H
	Column casting at height $\geq$ 3 m	Worker falls from concrete bucket	4	4	16	E
		Foot trip, struck by rebar, injury	3	2	6	M
		Struck by pump discharge hose	3	3	9	H
	Slab casting	Foot trip, struck by rebar, injury	3	2	6	M
		Struck by pump discharge hose	3	3	9	H
9	**Formwork Dismantling / Striking**					
	Removing formwork from concrete	Fall from height	4	3	12	E
		Struck by falling material from above	3	4	12	E
		Puncture wound from nail	4	2	8	H
		Struck by nail during removal	4	2	8	H
10	**Steel Structure Erection**					
	Workshop steel erection	Fall from height	4	4	16	E
		Heavy equipment collapse	4	4	16	E
		Pinched/crushed	3	3	9	H
		Falling material	4	4	16	E
11	**Finishing Work**					
	Workshop finishing	Electrocution	3	2	6	M
		Skin irritation	3	2	6	M
		Pinched/crushed	3	2	6	M

A reduction in the number of hazard risks occurred across all types of work activities after potential hazards were controlled and prevented, with the following results achieved following control implementation: six hazards fell into the moderate category (M), specifically hazards related to steel fabrication, timber fabrication, rebar installation, steel erection, and lean concrete work; fifty-eight hazards fell into the low-risk category (L), covering all activities from excavation through steel erection; and no work activity hazards remained in the high (H) or extreme (E) categories for any scope of work. The percentage distribution of risk levels after control implementation is presented as follows.

Risk Control

Table 3. Risk Control Measures Implemented in HIRADC

No	Type of Work Activity	Required Control Measures	L	S	RS	Risk Level
1	**Excavation Work**					
	Manual excavation using hoe or crowbar	Use safety shoes, stay focused while working	1	1	1	L
		Limit work area for number of workers, stay alert, do not work if physically unfit	1	2	2	L
		Use gloves, position hands in safe area	1	1	1	L
		Install "Caution: Open Hole" signs, stay aware while walking	1	2	2	L
		Use safe hoe handle that does not cause hand abrasion/injury	1	1	1	L
		Inspect conditions before work, install retaining wall if excavation depth exceeds 1 meter	1	2	2	L
	Heavy equipment inspection for excavation	Use gloves and protective equipment	1	2	2	L
		Use body harness, safety shoes	1	1	1	L
		Perform routine machine condition checks, use PPE, stay focused	2	2	4	L
	Heavy equipment operation for excavation	Install "Caution: Landslide" signs, use stepped excavation system, provide signalman	2	2	4	L
		Install barricade at heavy equipment operation area, prohibit work within backhoe danger zone, install lights at rear of equipment	1	3	3	L
		Provide stable base for backhoe operation	1	1	1	L
	Excavation operation	Install "Caution: Landslide" signs	2	2	4	L
		Install barricade at operation area	1	3	3	L
		Install retaining wall or sheeting	1	1	1	L
		Install drainage ditch (for water collection) before pumping out	1	3	3	L
		Conduct OHS inspection of heavy equipment fitness	1	1	1	L
2	**Lean Concrete Work**					
	Site clearing	Use mask	2	1	2	L
		Use safety glasses	2	1	2	L

No	Type of Work Activity	Required Control Measures	L	S	RS	Risk Level
		Use helmet, pay attention to surrounding work area, install "Caution: Falling Material Hazard" signs	2	3	6	M
	Lean concrete	Use safety gloves, stay focused, clean body immediately after work	2	1	2	L
		Inspect work area before work, inspect concrete bucket before pouring	2	1	2	L
		Use safety gloves	2	1	2	L
3	**Pile Cap Breaking**					
	Securing pile for breaking	Ensure pile to be cut is secured with strong rope ties, use correct work method, cutting performed with attention to cutting direction	2	2	4	L
		Ensure rope ties are strong and made from suitable material	2	2	2	L
	Breaking process	Use PPE, wear helmet, and wear appropriate work clothing to protect body	1	1	1	L
		Hammer head must be firmly attached to handle	2	1	2	L
		Use safe hammer handle to prevent hand injury, use gloves when performing work	1	1	1	L
4	**Steel Fabrication using Bar Cutter & Bar Bender**					
	Reinforcement fabrication	Operated by trained and designated workers, provide first aid kit in work area, use standard PPE	1	2	2	L
		Rotating machine covers must always be maintained, install OHS operation signs	1	2	2	L
		Pay attention to hand/body position, provide first aid kit in work area	1	2	2	L
		Perform equipment checks before use, electrical cables must be neatly arranged, connections covered with insulation, panels protected by weatherproof box	2	3	6	M
5	**Timber Fabrication**					
	Formwork plywood material	Use gloves	1	1	1	L
		Wear helmet, install safety net, install "Caution: Hazard from Above" signs, do not store items/tools above	2	3	6	M
		Use safety shoes, stay focused, clean work area before starting work	1	1	1	L
		Do not use an axe for hammering, use gloves	1	1	1	L
6	**Formwork Installation**					
	Formwork installation process	Use safe method during formwork installation	2	2	4	L
		Be careful when driving nails into plywood	1	1	1	L
		Work area must be clean and free from other residual materials	1	1	1	L

No	Type of Work Activity	Required Control Measures	L	S	RS	Risk Level
		Maintain good communication among workers, ensure ergonomic factors during installation	1	1	1	L
7	**Reinforcement (Rebar) Installation**					
	Material placement	Use suitable gloves	2	1	2	L
		Use safe work shoes (safety shoes)	1	1	1	L
		Work carefully, install "Caution: Hazard from Above" signs, use head protection/helmet	2	3	6	M
	Rebar installation	Use suitable gloves	2	1	2	L
		Use suitable gloves	2	1	2	L
8	**Concrete Casting / Pouring**					
	Concrete truck mixer	Use base that extends beyond rear tire width for access road, cover ground with steel plate to prevent sinking	2	2	4	L
	Concrete pump	Use base that extends beyond rear tire width for access road, cover ground with steel plate to prevent sinking	2	2	4	L
	Foundation casting	Use safety shoes	1	1	1	L
		Follow safe work instructions, do not stand in front of concrete pipe	1	1	1	L
	Column casting at height ≥ 3 m	Use body harness when working at height	1	2	2	L
		Use safety shoes	1	1	1	L
		Follow safe work instructions, do not stand in front of concrete pipe	1	1	1	L
	Slab casting	Use safety shoes	1	1	1	L
		Follow safe work instructions, do not stand in front of concrete pipe	1	1	1	L
9	**Formwork Dismantling / Striking**					
	Removing formwork from concrete	Keep work area clean before and after work	2	2	4	L
		Use complete PPE	2	2	4	L
		Materials must be immediately collected in designated area	1	1	1	L
		Maintain communication among workers, safe routes must be provided	1	1	1	L
10	**Steel Structure Erection**					
	Workshop steel erection	Must use complete PPE, full body harness, stay focused while working	2	3	6	M
		Inspect equipment regularly, use safest erection method, provide steel plate for standby heavy equipment	2	3	6	M
		Ensure wire rope has passed inspection, do not exceed rope strength capacity, ties must be tight, adjust to required lifting load	2	3	6	M
11	**Finishing Work**					
	Workshop finishing	Must use complete PPE, full body harness, stay focused while working	2	1	2	L
		Install electrical hazard signs	2	1	2	L
		Use safety gloves, stay focused while working	2	1	2	L

Among the three control activities, it was found that engineering controls, administrative controls, and personal protective equipment (PPE) had been implemented across the examination of all 11 work activities; to align with the prescribed measures for these 11 work items, the control actions were categorized accordingly, where in accordance with the actions listed in the HIRADC analysis, engineering controls included preventing worker injuries from residual materials, proper placement of work equipment, installation of hazard warning signs, implementation of safe work practices, and conducting maintenance and inspections of the equipment and tools to be used.

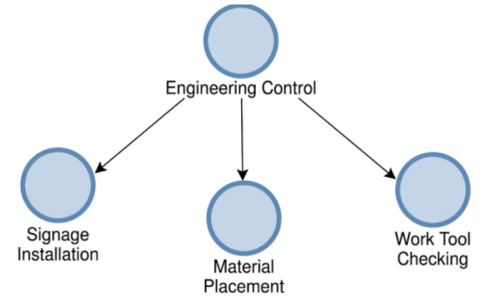

Figure 2. Engineering Based on Invivo Analysis

Figure 2 illustrates the engineering controls implemented in the case study, and these data are supported by the interview with the QHSE Manager, who also emphasized the importance of material grouping, proper placement of work tools, and installation of warning signs according to each work item; furthermore, the NVivo analysis based on input from two sources indicated that the appropriate engineering control measures required material placement, work equipment inspection, and sign installation, which were subsequently analyzed using NVivo software, while the administrative control action plan, based on the HIRADC analysis, mandated the implementation of standard operating procedures (SOPs), safety patrols, health checks, and tool box meetings before commencing any work.

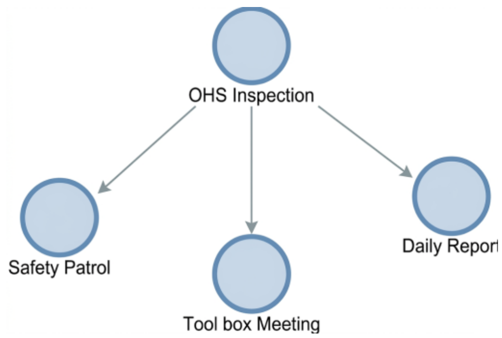

Figure 3. K3 inspection based on Nvivo analysis

Based on interviews with the QHSE Manager, the administrative measures implemented on the AFI 3 project included Safety Patrols, Tool Box Meetings (TBM), and Daily Reports; furthermore, in accordance with the steps outlined in the HIRADC analysis, the following actions were taken regarding Personal Protective Equipment (PPE), namely the mandatory use of safety helmets and body harnesses when working at heights above 1.8 meters, due to the significant risk of falling objects or materials striking workers from above, with helmets, safety shoes, vests, and safety gloves being mandatory for all project work. Based on the above statistics, no elimination or substitution controls were applied because the work must be performed correctly despite its hazardous nature, and PPE was frequently used to reduce the likelihood of hazards; however, PPE is actually the last option in planning since it has only a limited effect on reducing the severity level should an accident occur, and reducing hazards solely through PPE is not recommended as it represents the lowest level in the risk control hierarchy, although PPE cannot be ignored due to its significance in worker protection, higher-level controls must be prioritized.

PRACTICAL IMPLICATION

The following findings were obtained from the research conducted using the HIRADC approach on 11 work items: a total of 65 distinct types of hazards were identified through the hazard identification process across the 11 work activities, with human factors being a primary cause of hazards, particularly when worker behavior or work practices deviated from established safety protocols, followed by situational components that emerged when workers had to face conditions presenting unexpected hazards due to the high potential for danger inherent in construction project workplaces. Following risk assessment of the 65 distinct hazard types, 13 were classified as extreme (E) representing 20%, 37 were classified as high (T) representing 58%, 15 were classified as moderate (M) representing 23%, and there were no low-risk hazard types. The risk control action plan for this research, which utilized engineering controls, administrative controls, and personal protective equipment (PPE), complied with the OSH hierarchy of controls, and after risk control implementation, there were no longer any hazards in the extreme (E) or high (T) risk categories, with 58 hazards falling into the low-risk (L) category representing 89% and 6 hazards falling into the moderate-risk (M) category representing 9% of the total 65 hazards.

ACKNOWLEDGMENT

The authors would like to thank PT Adhi Persada Gedung for providing access to the data for this research, and to Mr. Muhammad Rizki Rafsanjani for his assistance and valuable input during this research.

DISCLOSURE STATEMENT

The author states and guarantees that the research on the HIRADC Method Approach in Identifying and Reducing the Risk of Work Accidents in Workshop Construction Projects has no conflict of interest related to the authorship and publication of this journal.

NOTES ON CONTRIBUTOR

Mr. Ivan Adiyatma Pramana is a recent graduate of Universitas Negeri Yogyakarta majoring in Applied Civil Engineering, Faculty of Vocational. His main areas of expertise include K3, Bridge Structure. For the past four years, Mr. Ivan Adiyatma Pramana has been an intern at PT Adhi Persada Gedung with the task of implementing contractors and K3 construction supervisors. During his studies, he was also active in the Student Work Unit of the Design and Construction Division. He served as Deputy Chair for 1 period. Therefore, he has experience in working together in a team, communicating in a team, and being able to collaborate with other members. Abdul Malik is a lecturer in the Department of Applied Civil Engineering Faculty of Vocational, Yogyakarta State University.

REFERENCES

Abbas, M.M.S. and Herawati, D. (2024) ‘Analysis of Occupational Health and Safety Risk using Hiradc Method in Medical Record Installation at Nganjuk Hospital’, *Journal of Health Policy and Management*, 09(03). Available at: https://doi.org/10.26911/thejhpm.2024.09.03.01.

Austalian Standart/New Zealand Standart (2004) ‘AS/NZS 4360/2004 Risk Management’, *Computer Law*, 18(6).

Diona, D., Sifai, I.A. and Anto, A.M. (2024) ‘Analisis Potensi Bahaya dan Upaya Pengurangan Tingkat Risiko Kecelakaan Kerja Menggunakan Metode HIRADC Pada Poli KIA UPTD Puskesmas Candilama Kota Semarang’, *Journal Occupational Health Hygiene and Safety*, 2(2). Available at: https://doi.org/10.60074/johhs.v2i2.11768.

Direktorat Jenderal Bina Konstruksi - Kementerian Pekerjaan Umum (2024) *Kementerian PUPR Kembali Gelar Konstruksi Indonesia 2024*, *PU-NET*. Available at: https://binakonstruksi.pu.go.id/informasi-terkini/kementerian-pupr-kembali-gelar-konstruksi-indonesia-2024/.

Fuad, M., Indrayadi, M. and Nuh, S.M. (2019) ‘Penerapan K3 (Keselamatan Dan Kesehatan Kerja) Menggunakan Metode HIRADC (Hazard Identification, Risk Assesment, and Determining Control) Dan JSA (Job Safety Analysis) Pada Proyek Pembangunan Gedung Direktorat Reserse Kriminal Khusus Polda Kalbar’, *JeLAST : Jurnal Teknik Kelautan , PWK , Sipil, dan Tambang*, 6(2). Available at: https://doi.org/https://doi.org/10.26418/jelast.v6i2.35913.

ISO 45001 (2018) ‘Occupational Health and Safety Management System-Requirements with guidance for use’, *International Organization for Standardization* [Preprint].

Machfudiyanto, R.A. *et al.* (2023) ‘Applying Association Rule Mining to Explore Unsafe Behaviors in the Indonesian Construction Industry’, *Sustainability (Switzerland)* , 15(6). Available at: https://doi.org/10.3390/su15065261.

Marliana, W., Salma, S.A. and Hakim, B.P. (2024) ‘Work Accident Risk Control in Road Construction Projects with the Hiradc Approach’, *Jurnal Indonesia Sosial Teknologi*, 5(7). Available at: https://doi.org/10.59141/jist.v5i7.1149.

Munang, A. and Nurisusilawati, I. (2022) ‘Modeling Underlying Pattern Making Construction Safety Risk Mitigation Decisions Using Dynamic Systems’, *Jurnal Ilmiah Teknik Industri*, 21(1). Available at: https://doi.org/10.23917/jiti.v21i1.17429.

Prastowo, T.Y. *et al.* (2024) ‘Risk Analysis of Occupational Safety and Health (K3) Using the HIRADC Method on Chiller Replacement Works: A Case Study’, *Civilla : Jurnal Teknik Sipil Universitas Islam Lamongan*, 9(2). Available at: https://doi.org/10.30736/cvl.v9i2.1266.

Pratama, W.S., Setiono, S. and Setyawan, A. (2025) ‘Analisis Pengendalian Risiko Keselamatan Dan Kesehatan Kerja (K3) Dengan Metode Hazard Identification and, Risk Assesment Dan Determening Control (HIRADC) (Studi Kasus : Pembangunan Eka Hospital MT Haryono Jakarta)’, *Cerdika: Jurnal Ilmiah Indonesia*, 5(9). Available at: https://doi.org/10.59141/cerdika.v5i9.2675.

Putri, S.L. *et al.* (2023) ‘Meningkatkan Safety Awareness pada Karyawan di Teaching Factory Engineering Crerative Corner (TeFa ECC): Increasing Safety Awareness for Employees at the ...’, *NaCosVi: Polije* ... [Preprint].

Riandini, A.H., Sagaf, M. and Syakhroni, A. (2023) 'Penerapan Majemen Risiko Keselamatan dan Kesehatan Kerja dengan Metode HIRADC Pada PLTGU Tambak Lorok Semarang', *JURNAL DISPROTEK*, 14(1). Available at: https://doi.org/10.34001/jdpt.v14i1.3657.

Situmorang, H. *et al.* (2023) 'The Analysis of Occupational Health and Safety Risks in Engineering Workshop Using the Hazard Identification Risk Assessment and Determining Control (HIRADC) Method', in. Available at: https://doi.org/10.4108/eai.20-10-2022.2328846.

Susanto, A. *et al.* (2024) 'Identifikasi bahaya, penilaian risiko dan penentuan pengendalian pada operasi pertambangan: systematic literature review hazard', *Jurnal Manajemen Kesehatan Yayasan RS. Dr. Soetomo*, 10.

Sutapa, I.K. *et al.* (2022) 'Analysis of SMK3 Implementation Level and Accident Risk In The Administration Office Building Development Project at Gusti Ngurah Rai Airport Bali', *Logic : Jurnal Rancang Bangun dan Teknologi*, 22(2). Available at: https://doi.org/10.31940/logic.v22i2.167-173.