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MORALITY BEFORE KNOWLEDGE

Risk analysis in concrete structure work using the hiradc method on the Hermina Ciawi Hospital project

RIVALDO WIJAYA[1]*
[1] *Department of Civil Engineering; Universitas Mercu Buana*
*Correspondence: rwijaya59@gmail.com

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ABSTRACT
In the construction projects, a high risk of work accidents was found. Therefore, risk identification is very important to reduce the risk of work accidents afterwards. Risk identification begins with collecting research variables. These variables are then distributed to obtain probability and impact values from respondents. The method used in this research is HIRADC (Hazard Identification Risk Assessment & Determining Control) which is assessed based on its frequency (probability) and the impact of the hazard (consequence/severity). This research aims to determine potential dangers and high-level risks. as well as risk control measures and the control of the risk. The research results show that there are 39 potential hazards with 10 high risks with determining control as per hierarchy for each hazard.

KEYWORDS: building project; hospital; risk management; HIRADC

1. Introduction

Construction work is one of the fields that has the greatest risk compared to other industries. The number of work accidents in Indonesia tends to increase every year, moreover, 32% of work accident cases in Indonesia occur in the construction sector (Alamsyah et al., 2022). This is because the work carried out is quite complex and requires high expertise Therefore, it is important to identify hazards, assess risks, and determine the type of risk control in areas where work accidents are found (Cholil et al., 2020). It is necessary to identify the risks that may occur and determine controls so that these risks can be minimized (Nnaji et al., 2022; Yuni et al., 2021). Occupational safety and health is an issue that is currently attracting a lot of attention from various organizations because it includes issues from the humanitarian aspect, economic costs and benefits, legal aspects, accountability and the image of the organization itself (Harahap et al., 2022). Occupational safety also has quite a large impact, namely that the source of occupational hazards can be physical, chemical, biological and psychological factors or human actions themselves which are the cause of accidents which must be handled early (Moniaga & Rompis, 2019).

Earlier research indicate that the root of the accidents can often be found in the early phases of the project process (Åsgård & Jørgensen, 2019). Risk management indicators in construction project can be identified by identifying potential hazards in the upper structure indicators including column work, beam work, floor plate work, stair work, ring beam work, concrete base work, wall work, door and window work , floor work, sanitation

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work, electrical work to finishing work (Siswanto et al., 2021). However, currently quite a few contractors underestimate Occupational Safety and Health (K3) on construction projects (Manurung et al., 2021). In workplaces where workers experience one or more types of OHS vulnerability, having a supportive supervisor may play an important role in reducing the risk of injury and protecting workers (Yanar et al., 2019).

In the construction process for the construction of the Hermina Ciawi Hospital, there were potential dangers where construction workers did not really understand the implementation of K3 by not using personal protective equipment (PPE) and work accident data was found on concrete structures in the construction of other Hermina Hospitals. Based on this, researchers obtained data related to work accidents on concrete structure work from several Hermina hospital projects in 2022 which can be seen in the table 1. In this study, risks were identified based on the Hazard Identification, Risk Assessment, and Determining Control (HIRADC) approach. Risk identification is carried out based on project documents. After that, the risk is assessed for its level of likelihood and impact, and then a risk level assessment is carried out (Jannah et al., 2017).

Table 1. Work accident of Hermina Hospital in 2022

Work Accident Type	Project	Year
Worker have moderate injuries due to being pricked by a nail	RS Hermina Tasikmalaya	2022
Workers suffered scratches from mining ropes when shredding material	RS Hermina Soreang	2022
Workers suffered scratches during iron fabrication	RS Hermina Tasikmalaya	2022
Worker's eye irritation due to dust and cement particles	RS Hermina Tasikmalaya, RS Hermina Soreang, Renovation of RS Hermina Arcamanik Bandung.	2022

This problems happened at another construction project, the employees do not use complete Personal Protective Equipment (PPE), such as not using project helmets, safety shoes, masks, glasses and earplugs (Ariswa et al., 2020). This construction activity really requires safety and health aspects, a good and efficient work environment for employees when carrying out work, so that this hospital can continue to move and develop in advancing and competing with other hospitals.

2. Methods

Data collection started by collecting potential hazards as research variables. This variable was validated by the first expert and distributed to respondents to obtain probability and impact values . The results of the data obtained were then tested for validity and reliability. Validity testing is carried out to determine how precisely the questionnaire measures questions related to the level of risk for each risk event. There were 30 respondents and the r table used was 0.306.

The probability and impact of variable data that has been tested for validity and tested for reliability to determine the extent to which the results of the questionnaire assessment can be trusted. If invalid data is obtained, the reliability test is eliminated. This test was carried out by calculating the Cronbach's alpha value via the SPSS application. If the Cronbach's alpha value is above 0.6 then the questionnaire is declared reliable. Then an the risk assessment of the potential danger is carried out using a calculation formula:

Risk Ratio (RR) = Likelihood Rarting (LR) x Severity Rating (SR) (Eq. 1)

Table 2. Likelihood rating

Likelihood	Description	Rating
Almost Certain	Very common and frequent	5
Likely	Large probability of occurring and is common.	4
Possible	It may happen in the future at some time.	3
Unlikely	It has not been identified as occurring after several years.	2
Rare	Happens Practically impossible and has never happened.	1

(*Australian/New Zealand Standard Risk Management*, 2004)

Table 3. Severity rating

Severity	Description	Rating
Extreme Disaster	Causing worker deaths and serious losses and can even stop project activities forever.	5
Major	Causing serious injuries and permanent disability and huge financial losses, it has a serious impact on the viability of the project.	4
Moderate	Serious injury and hospitalized, does not cause permanent disability, moderate financial loss	3
Minor	Causes minor injuries, minor losses and does not have a serious impact on the project.	2
Negligible	Incidents do not cause harm or injury to workers.	1

(*Australian/New Zealand Standard Risk Management*, 2004)

Table 4. Risk assessment matrix

Risk Frequency	Risk Severity				
	1	2	3	4	5
1	H	H	E	E	E
2	M	H	H	E	E
3	L	M	H	E	E
4	L	L	M	H	E
5	L	L	M	H	H

(*Australian/New Zealand Standard Risk Management*, 2004)

3. Results and Discussion

In this study, there were 39 potential dangers from 44 risk events that had been validated by the first expert. Of the 39 potential hazards, the level of risk has been identified from the data from the respondent's questionnaire and passed the validity and reliability test, there are 10 high risks from preparation work, reinforcement, formwork and concrete casting.

After determining the risk level for each potential hazard, a risk control analysis is carried out regarding its handling. There are potential hazards with a high risk value, namely operators being careless in operating lifting equipment and workers not keeping their distance from each other heavy equipment in operation.

Table 5. Hazard identification

No	Work	Hazard	Code
1	Preparatory work	Use of sharp materials	X1.1
		Unsuitable work tools and electrical materials	X1.2
		Unsuitable work tools and electrical materials	X1.3
		Bamboo scaffolding is not carried out by experts	X1.4
		Bamboo scaffolding work that does not standardized.	X1.5

		Improper storage of materials	X1.6
2	Beam and plate column reinforcement work	Workers do not use the correct work tools	X2.1
		Workers do not know the use and safety of tools.	X2.2
		Lack of worker concentration	X2.3
		Unsuitable work tools and electrical materials	X2.4
		Improper storage of materials	X2.5
		There are no markings on the field	X2.6
		Excessive working hours in the sun	X2.7
		Do not use protective glasses when cutting metal	X2.8
3	Formwork Work, Beam Columns and Floor Plates	do not use safety shoes in the work area	X3.1
		There are no barricades in material loading work.	X3.2
		Hit by formwork material when shunting the material	X3.3
		Workers do not know work methods well or lack supervision in the field	X3.4
		not using PPE (gloves)	X3.5
		There is no toolbox meeting every time before starting work	X3.6
		Lack of worker concentration	X3.7
		Do not use protective glasses when cutting wood	X3.8
		absence of cleaning after formwork assembly	X3.9
		Lack of worker concentration	X3.10
4	Column, Beam and Floor Plate Casting Work	The operator is careless in operating the lifting equipment	X4.1
		Workers do not keep their distance from each other heavy equipment in operation	X4.2
		Workers do not keep their distance from each other heavy equipment in operation	X4.3
		Workers do not keep their distance from each other heavy equipment in operation	X4.4
		Lack of worker concentration	X4.5
		there are no barricades in the casting work	X4.6
		Material is not well organized	X4.7
		The wrong perspective and behavior of workers will have	X4.8
		Lack of disciplined supervision on casting work	X4.9
		lack of lighting during night casting	X4.10
		work tools are in poor condition	X4.11
4	Column, Beam and Floor Plate Casting Work	there is a formwork quality that is not good	X4.12
		work tools are in poor condition	X4.13
			X4.14
		There are no markings on the field	X4.15

Table 6. Risk assessment

Work	Code	(LR)	(SR)	*Risk Rating (LR) x (SR)*	
Preparatory work	X1.1	3	3	9	Moderate
	X1.2	3	4	12	High
	X1.3	2	5	10	High
	X1.4	2	3	6	Moderate
	X1.5	3	3	9	Moderate
	X1.6	3	1	3	Low
Beam and plate column reinforcement work	X2.1	4	3	12	High

	X2.2	2	5	10	High
	X2.3	2	3	6	Moderate
	X2.4	1	4	4	Moderate
	X2.5	2	4	8	Moderate
	X2.6	2	2	4	Moderate
	X2.7	3	3	9	Moderate
	X2.8	3	3	9	Moderate
Formwork Work, Beam Columns and Floor Plates	X3. 1	3	4	12	High
	X3. 2	1	4	4	Moderate
	X3. 3	2	3	6	Moderate
	X3. 4	4	1	4	Moderate
	X3. 5	1	5	5	Moderate
	X3. 6	3	2	6	Moderate
	X3. 7	4	3	12	High
	X3. 8	1	3	3	Low
	X3. 9	1	3	3	Low
	X 3. 10	2	3	6	Moderate
Column, Beam and Floor Plate Casting Work	X4.1	2	3	6	Moderate
	X4.2	1	4	4	Moderate
	X4.3	2	4	8	Moderate
	X4.4	2	4	8	Moderate
	X4.5	1	5	5	Moderate
	X4.6	2	4	8	Moderate
	X4.7	3	4	12	High
	X4.8	2	4	8	Moderate
	X4.9	3	5	15	High
	X4.10	2	5	10	High
	X4.11	3	4	12	High
	X4.12	2	3	6	Moderate
	X4.13	1	2	2	Low
	X4.14	1	3	3	Low

Tabel 7. Determining control

Code	Risk Analysis	Determining control
X1.2	High	1. Making electrical work permits. 2. Minimizes the potential for spreading electric current. 3. Use complete PPE as an isolator

X1.3	High	1. Making work permits to work at height 2. Preparation of preparatory material plans. 3. use of full body harness PPE.
X2.1	High	1. Explanation of work during tool box meeting. 2. Use complete PPE such as gloves. 3. Provision of first aid
X2.2	High	1. Explanation of work during tool box meeting. 2. Use complete PPE such as gloves. 3. Use of bending and cutting machines (Substitution).
X3. 1	High	1. Explanation of work during tool box meeting. 2. Use complete PPE such as gloves. 3. Replacement of wooden formwork to modern / knockdown formwork.
X3.7	High	1. Explanation of work during tool box meeting. 2. Use complete PPE such as gloves. 3. Provision of first aid
X4.7	High	1. Explanation of work during tool box meeting. 2. Making a work permit for working at height (Lifting). 3. Create barricades in the loading area 4. Use of Complete PPE
X4.10	High	1. Creation of a construction safety management system (CSMS). 2. Procurement of lighting. 3. Implementation of the hazard control hierarchy in every work permit documentation. 4. making barricades/markings in vulnerable areas.
X4.11	High	1. Explanation of good work behavior during tool box meetings. 2. Create barricades and markings in high areas. 3. Create good lighting when supporting work. Use of Complete PPE
X4.12	High	1. Explanation of work during tool box meeting. 2. Heavy equipment condition checklist and work permits for working at height (Lifting). 3. Create barricades in the casting area. 4. Use of Complete PPE

4. Conclusions

From the results of Hazard Identification and Risk Assessment, 6 potential hazards were found in the preparatory work with 2 high risk levels. 8 potential dangers in steel work with 2 high risk levels. 10 potential dangers in formwork work with 2 high risk levels. 15 potential hazards in foundry work with 4 high risk levels. The risk control steps that need to be prioritized are casting work with 4 potential hazards with high risk, then preparation work, reinforcement and formwork. Risk control based on the risk control hierarchy is carried out by providing sufficient lighting, making checklist forms for work equipment, materials and heavy equipment according to the job, making work permits. Making material plans, evacuation routes and use of personal protective equipment (PPE).

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Author Contribution

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Biographies of Author

RIVALDO WIJAYA, Department of Civil Engineering; Universitas Mercu Buana, Indonesia.
- Email: rwijaya59@gmail.com
- ORCID: -
- Web of Science ResearcherID: -
- Scopus Author ID: -
- Homepage: -