HAZARD IDENTIFICATION AND RISK CONTROL ON THE NICU-PONEK BUILDING CONSTRUCTION PROJECT OF TABANAN REGIONAL GENERAL HOSPITAL

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Abstract In the implementation of construction projects, management of the project work time so that the project is completed on time, but in reality on the ground there are still many things that can hamper the work of the project, one of which is a work accident that occurs to project workers.. In the process of building the NICU-Ponek Building, workers on the project are very rarely using Personal Protective Equipment, even though it has been provided by the company. Based on this, the authors devised this plan with the aim of minimizing the risk of work accidents through the process of hazard identification, risk assessment, and continued risk control. This planning method was done by qualitative method by explaining variables at the hazard identification stage and processing data at the risk assessment stage. Quantitative methods are also used against questionnaire results at the risk assessment stage including validity tests. The results of planning at the hazard identification stage through the "Expert Test" questionnaire resulted in 74 variables and 290 indicators that will be influential and continue to the end of the risk assessment questionnaire. At the risk assessment phase through a risk assessment questionnaire produces 3 types of risk levels, namely low risk rating, moderate and high risk rating which is further controlled by advanced risk controlling. Based on the results of the risk assessment questionnaire, there are 32 variables and 38 indicators that have a high rating of risk carried out by means of technical control and administrative control.

***Index Terms*—risk controlling, project accident, risk assessment, hazard, project.**

I. INTRODUCTION

Accident is an unplanned and an unexpected event that can disrupt operation process, damage property, injured people or damaging the environtment so that, it required greater attention [1]. The result from National Safety Council stated that work accident was caused 88% due to unsafe behaviors where this can occur of the worker's perception that believe they were expert in their field and they never encounter with any accident whatsoever resulting their concern about safety matter was reduced [2][3]. Meanwhile, work safety means to prevent accident that can cause loses in injury, disability even death, property loss, and damaging the environtment [4]. So to prevent that matter, it is necessary to implement a management system for occupational safety and health on every project that runs like the result that comes from top 100 at Korean construction company between year 2006 – 2011 that implemented that system, be able to reduced up to 67% of work accident and 10,3% of that on fatal accident [5].

The work accidents in Indonesia is still relatively high according to data that provided by BPJS, the number of cases from 2016 to the end of 2018 continues to increase [6]. To overcame this matters, the government issued regulation related to construction safety plan PUPR Minister Regulation No. 21/PRT/M/2019 regarding construction safety management system guidelines and regulation No. 14/PRT/M/2020 regarding standards and guidelines for procurement of construction services through providers. Construction workers from the level of managers to builders must follow the program in the form of a construction safety management system that will be implemented and comply with applicable regulations related to Occupational Safety and Health, by complying with and implementing these regulations it is expected that workers' own awareness will grow to reduce the number of work accidents. Efforts to minimize work accidents that may occur by conducting hazard identification, risk assessment, risk control, which is part of the RKK.

The focus of this study is NICU-PONEK building located in Tabanan Regional General Hospital because of the existing work items, it is estimated that several construction

hazards will emerge, so risk assessment and determination are needed to assist management so that the construction process will run smoothly.

II. LITERATURE REVIEW

The main goal of construction safety is to reduce accident to zero. For this reason, a study is needed that can classify the types of accident that can happen and condition that have the potential to cause work accidents.

Several studies have been conduct so as to present the causes of accidents in the construction industry in malaysia, where this study concludes that there are several types of accidents that occur, including worker neglience, poor management, extreme site elevation differences, inappropiate work equipment, failure to comply with work procedures, and not using personal protective equipment [7]. Whilst the other studies state that falling object or sting by something majority happens in istanbul-turki [8][9].

Hazard Identification Risk Assessment And Risk Controlling (HIRARC) is a process that can occur in both routine an non-routine activities which is then carried out an assessment process based on the identified hazard or risk in order to determine its rating so that can help on the controlling process [12]erick ukarst. In clause 4.3.1 of OHSAS 18001:2007 requires an organisation or companies that will implement work safety management system to prepare HIRARC for every activities [13] and in the risk assessment phase, a standard risk control matrix can be use, such as the Australian-New Zealand AS/NZS 4360:2004 risk assessment matrix [14].

TABLE I
AS/NZS 4360:2004 PROBABILITY SCALE

Tingkat	**Kriteria**	**Explanation**
1	*Rare*	May happen only in special condition once.
2	*Unlikely*	It may occur in certain condition, but it is unlikely.
3	*Posibble*	May occur under certain condition.
4	*Likely*	May occur in almost all condition.
5	*Almost Certainly*	Can happen in all condition.

TABLE II
AS/NZS 4360:2004 SEVERITY SCALE

Tingkat	Kriteria	Penjelasan
1	*Insignifican*	No loss, very small material damage
2	*Minor*	Minor injuries, treatment can handled immediately at scene, moderate material lose
3	*Moderate*	Missing workdays, requiring medical treatment, material losses quite large.
4	*Major*	Injuries result in disabilities or total loss body function, major material losses
5	*Extreme*	Produce fatality, disastrous material losses

TABLE III
AS/NZS 4360:2004 MATRIX TABLE

AS / NZS 4360 : 2004		**SEVERITY**					
		Insignificant	Minor	Moderate	Major	Extreme	
PROBABILITY	Almost Certainly	Moderate	High	High	V. High	V.High	5
	Likely	Moderate	Moderate	High	High	V.High	4
	Possible	Low	Moderate	High	High	High	3
	Unlikely	Low	Low	Moderate	Moderate	High	2
	Rare	Low	Low	Moderate	Moderate	High	1
		1	2	3	4	5	

From table 2, it is known that the AS/NZS Matrix divide a risk rating into 4 category, namely the low rating which has a green colour with the highest value of 4. For the moderate rating, yellow has the highest value of 8 and for the hight rating, orange coloured has the highest value of 16, while for very high rating that highlighted in red has the highest value of 25.

III. RESEARCH METHOD

This research carried out using qualitative method by explaining variables at the hazard identification stage and processing data at the risk assessment or rating stage. Quantitative methods are also used against questionnaire results at the risk assessment stage and include the cost planning stage of implementing construction safety. Then the process is carried out to achieve the objectives of this plan, including literature studies, data collection, and data processing.

The data that used to conduct this research divided into 2 parts namely, primary data that obtained by interviewing the occupational safety expert, meanwhile secondary data obtained by requesting to company that running the NICU-PONEK Building.

Data processing is the process that compiled every data that has been collected before. Start from hazard identification until risk controlling phase, . The method used is a semi-proactive method by getting information from experts by spreading the questionnaire "Expert Test" (the contents of the questionnaire in question related to the assessment or perception of hazard identification, especially the determination of variables and indicators). Then the results of the variables and indicators that have been determined in advance will be the design of the questionnaire that will be disseminated and filled out at the stage of the risk assessment questionnaire. After risk has been assessed, the advance controlling will be use to control the indicator that shown as the highest risk on this project to produce the zero accident environtment.

IV. Result and Discussion

After collecting secondary data, a questionnaire was compiled to be distributed to occupational safety experts to validate the type of hazards that might occur and then given an assessment.

A. Hazard Identification

The hazard identification questionnaire contains work breakdown structures, construction methods, source and types of hazards, and initial control over hazard posed by each indicators. As an illustration, the expert test questionnaire for rooftop frame works generate 13 variables with 52 indicators that will affect the risk assessment phase that can be shown on the following table

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TABLE IV
HAZARDS IDENTIFICATION ON ROOFTOP FRAME WORKS

NO	DESCRIPTION OF RISK	
	JOB DESCRIPTION	TYPES OF DANGERS
1	2	3
1	ROOF FLOOR WORK Roof floor beam repair work	Hands cut off grinding when cutting iron Eyes exposed to splash of iron ore during cuts Head hit by falling device Falling from the height of the roof floor (approximately 12 meters)
2	Roof floor beams formwork	Hands cut off grinding when cutting triplets Blunt force traumatized hand hit by hammer Head hit by falling device Falling from the height of the roof floor (approximately 12 meters)
3	Roof floor beam casting work	Hit by cast concrete pipes during tool mobilization Falling due to collapsed formwork Eyes exposed to cast concrete splashes Electrocuted vibrator
4	Roof floor plate repair work	Hands scratched when lifting wiremesh Hit by wiremesh due to any time of laying Falling from the height of the roof floor (approximately 12 meters) Foot pierced iron tip
5	Roof floor plate formwork	Hands cut off grinding when cutting triplets Blunt force traumatized hand hit by hammer Hands scratched by chainsaw Falling from the height of the roof floor (approximately 12 meters)
6	Roof floor plate casting job	Hit by cast concrete pipes during tool mobilization Falling due to collapsed formwork Eyes exposed to cast concrete splashes Electrocuted vibrator
7	Work on clearing columns (roof neck) and beams (roof frame runway)	Hands cut off grinding when cutting iron Eyes exposed to splash of iron ore during cuts Scratched wire Falling from the height of the roof floor (approximately 12 meters)
8	Work of column formwork (roof neck) and beams (roof frame runway)	Hands cut off grinding when cutting triplets Blunt force traumatized hand hit by hammer Hands scratched by chainsaw Falling from the height of the roof floor (approximately 12 meters)
9	Work casting columns (roof neck) and beams (roof frame runway)	Hit by cast concrete pipes during tool mobilization Falling due to collapsed formwork Eyes exposed to cast concrete splashes Electrocuted vibrator
10	Roof frame runway installation work	Impaired vision due to exposure to welding rays Hands burned due to heat from welding Respiratory distress due to welding fumes Falling from the height of the roof floor (approximately 12 meters)
11	Installation work of roof frame horses	Hit by the roof frame during installation Scratched hands due to moving lift pulley Hit by a falling device Falling from the height of the roof floor (approximately 16 meters)
12	Roof frame gording installation work	Impaired vision due to exposure to welding rays Hands burned due to heat from welding Respiratory distress due to welding fumes Falling from the height of the roof floor (approximately 12 meters)
13	Work on the installation of ribs and roof frame reng	Falling due to a broken reng Hand scratched screw during the installation of screws Hands cut off during light steel cutting Fell from the height of the 2nd floor (approximately 16 meters)

B. Risk Assessment

The risk assessment is phase to assess risk rating from the indicators before that have been validate by the occupational safety experts as the scoring of probability and severity refers to AS/NZS Standard.

To get a rating, the probability value (P) of a work accident is multiplied by severity value (S) if the accident occurs. After getting value from multiplication result (R), the number will be matched with the matrix that is reference to

determine the rating of each indicators. The result can be shown on the following table

TABLE V
HAZARDS IDENTIFICATION ON ROOFTOP FRAME WORKS

NO	DESCRIPTION OF RISK		RISK ASSESSMENT			
	JOB DESCRIPTION	TYPES OF DANGERS	P	S	R	(RATE)
1	2	3	4	5	6	7
1	Rooftop Floor Works	Hands cut off grinding when cutting iron	2	1	2	Low
	Roof floor beam repair work	Eyes exposed to splash of iron ore during cuts	3	2	6	Moderate
		Head hit by falling device	3	1	3	Low
		Falling from the height of the roof floor (approximately 12 meters)	4	3	12	High
2	Roof floor beams formwork	Hands cut off grinding when cutting triplets	3	1	3	Low
		Blunt force traumatized hand hit by hammer	3	1	3	Low
		Head hit by falling device	3	1	3	Low
		Falling from the height of the roof floor (approximately 12 meters)	4	3	12	High
3	Roof floor beam casting work	Hit by cast concrete pipes during tool mobilization	2	2	4	Low
		Falling due to collapsed formwork	4	3	12	High
		Eyes exposed to cast concrete splashes	3	1	3	Low
		Electrocuted vibrator	3	1	3	Low
4	Roof floor plate repair work	Hands scratched when lifting wiremesh	3	1	3	Low
		Hit by wiremesh due to any time of laying	3	1	3	Low
		Falling from the height of the roof floor (approximately 12 meters)	4	3	12	High
		Foot pierced iron tip	3	1	3	Low
5	Roof floor plate formwork	Hands cut off grinding when cutting triplets	3	1	3	Low
	Roof floor beam repair work	Blunt force traumatized hand hit by hammer	3	1	3	Low
		Hands scratched by chainsaw	3	1	3	Low
		Falling from the height of the roof floor (approximately 12 meters)	4	3	12	High
6	Roof floor plate casting job	Hit by cast concrete pipes during tool mobilization	2	2	4	Low
		Falling due to collapsed formwork	4	3	12	High
		Eyes exposed to cast concrete splashes	2	2	4	Low
		Electrocuted vibrator	2	2	4	Low
7	Work on clearing columns (roof neck) and beams (roof frame runway)	Hands cut off grinding when cutting iron	3	1	3	Low
		Eyes exposed to splash of iron ore during cuts	4	1	4	Low
		Scratched wire	3	1	3	Low
		Falling from the height of the roof floor (approximately 12 meters)	4	3	12	High
8	Work of column formwork (roof neck) and beams (roof frame runway)	Hands cut off grinding when cutting triplets	3	1	3	Low
		Blunt force traumatized hand hit by hammer	3	1	3	Low
		Hands scratched by chainsaw	3	1	3	Low
		Falling from the height of the roof floor (approximately 12 meters)	4	3	12	High
9	Work casting columns (roof neck) and beams (roof frame runway)	Hit by cast concrete pipes during tool mobilization	2	2	4	Low
		Falling due to collapsed formwork	4	3	12	High
		Eyes exposed to cast concrete splashes	4	1	4	Low
		Electrocuted vibrator	2	2	4	Low

NO	DESCRIPTION OF RISK		RISK ASSESSMENT			
	JOB DESCRIPTION	TYPES OF DANGERS	P	S	R	(RATE)
1	2	3	4	5	6	7
10	Runway installation	Impaired vision due to exposure to welding rays	4	3	12	High
		Hands burned due to heat from welding	4	3	12	High
		Respiratory distress due to welding fumes	3	2	6	High
		Falling from the height of the roof floor (approximately 12 meters)	4	3	12	High
11	Main roof frame Installation	Hit by the roof frame during installation	4	3	12	High
		Scratched hands due to moving lift pulley	3	1	3	Low
		Hit by a falling device	4	3	12	High
		Falling from the height of the roof floor (approximately 16 meters)	4	3	12	High
12	Gording installation	Impaired vision due to exposure to welding rays	3	3	9	High
		Hands burned due to heat from welding	4	3	12	High
		Respiratory distress due to welding fumes	3	3	9	High
		Falling from the height of the roof floor (approximately 12 meters)	4	3	12	High
13	Reng Instalation	Falling due to a broken reng	4	3	12	High
		Hand scratched screw during the installation of screws	3	1	3	Low
		Hands cut off during light steel cutting	3	1	3	Low
		Fell from the height of the 2nd floor (approximately 16 meters)	4	3	12	High

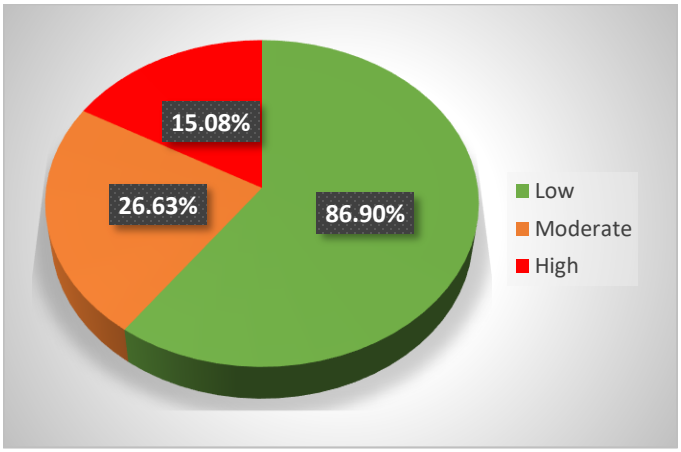

Fig. 1. Risk Rating Percentage of all work items on NICU-PONEK

Based on that result of risk assessment, the recorded variables and indicators have the lowest score of 2 points, while the score for high has the highest of 12 points.

From the total of all existing jobs, the percentage of each variable and indicators can be seen in the following figure.

Based on data processing, a total of 290 indicators were identified, 38 were found or 15,08% of total indicators that had the highest risk score with a value of 12 which were automatically classified into high rating.

These 38 indicators will be further controlled at control phase so that can reduce the level of risk from each item on this construction project.

C. Advance Risk Control

Risk control was divided into 2 parts, initial control and advanced control. Initial control was previously carried out at the hazard identification phase. Previously, initial control was functioned so that the type of hazard that has a low and moderate risk rating can be controlled, while specifically for the type of danger that has a high risk rating will be controlled with furthered control. Based on the results of risk assessment for maximum moderate risk rating there are 4 types of indicators (types of hazards) as follows:

- Falling from a height
- Falling due to collapsed formwork
- Impaired vision due to welding rays
- Hands burned hot due to welding heat

Those four types of indicators (types of hazards) will then be carried out further control with technical control and administrative control. Advance control from technical approach such as:

- Installing safety equipment such as Work Protective Equipment (APK)
- Equipment addition (using safer, more effective, and efficient equipment)

Whilst, advance control from technical approach such as:

- Training, directing, and workshop for workers related

to occupational safety and adjustable work methods.
- Tighten supervision and regulation for every work that has high rating.

V. CONCLUSION

Based on the discussion and results of data processing, the following conclusions were obtained even though initial control has been carried out, there are still 38 indicator that shows the risk of accident with a high rating so that further control is needed. The managerial role to reduce the number of accidents is very important for that is necessary to be disciplined in implanting occupational safety plan in hope of getting consistent result for achieving zero accident environtment.

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