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Literature Review: Analysis of Potential Work Accidents in Construction Projects Using the *Hazard Identification, Risk Assessment, and Risk Control* Method

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ABSTRACT

Along with advances in science and technology, the development of the building sector is also increasing. Multi-storey buildings are an alternative to meet the needs of big cities with very limited land. The rapid development of construction project development, in addition to providing benefits, can also cause the risk of accidents that can cause disruption or cessation of project work activities. The literature review aims to review the potential for work accidents and risk assessments on construction projects. A literature review is based on issues, methodologies, similarities and research proposals. Based on the result of 8 studies, it was found that the high-risk category is the risk of falling from a height, workers buried by avalanches during excavation work, the risk of being hit by material, and being electrocuted during excavation work with tools and equipment accidents. Based on the identification and assessment, it was found that the work of the upper structure has more risk, and the average risk index is greater than that of the lower structure.

Keywords: HIRARC, JSA, Work Accidents.

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INTRODUCTION

Building projects are one of the biggest contributors to the number of work accidents in Indonesia, the bigger the project being built, the greater the risk of work accidents that can occur. Occupational safety and health are important for the company because the impact of occupational accidents and diseases harms employees and the company, either directly or indirectly.

Construction K3 problems which in general are the cause of many workplace accidents, such as low understanding and sensitivity to the dangers of construction risks, not mastering personal safety equipment and correct construction work methods, not fulfilling K3 requirements and standards, still weak laws and K3 sanctions, not yet available the implementation of the accurate OHS Management System, the lack of company awareness of the importance of OHS, and the lack of OHS education and training for construction HR. Based on data sourced from BPJS Employment, the number of work accident cases in 2017 reached 123,041, and 32% of the accident cases were construction accidents.

In general, every construction project must have a way to identify, analyse, and evaluate hazards in the workplace. One of the ways to identify hazards is with a work safety analysis or Job Safety Analysis (JSA). JSA is a technique that identifies all accident prevention tailored to the part of the job or work activity area and behavioural factors when they significantly affect whether the measurement is taken or not. This approach is both diagnostic and descriptive. JSA is a hazard analysis technique to identify hazards in a person's work and develop appropriate controls to reduce risks. However, the JSA form has a drawback. Namely, it cannot assess the dangers of these risks, so it is necessary to use the Hazard Identification Risk Assessment and Risk Control (HIRARC) method.

HIRARC is a hazard identification process to prevent and reduce the risk of work accidents or as an analysis of potential work accidents. HIRARC is a series of processes to identify hazards that can occur in routine or non-routine activities in the company then carry out a risk assessment of these hazards, and then create a hazard control program so that the risk level can be minimised to a lower level to prevent accidents. Based on the stages, HIRARC is divided into three: hazard identification, risk assessment, and risk control (OHSAS, 2007).

METHOD

This study uses a literature review method with a qualitative descriptive research design. A literature review is a literature review and research that can be done by reading various books, journals, and other publications related to the research topic, to identify research results and ideas that previous researchers have generated. A literature review aims to produce an article on a particular topic or issue to find space for research to be carried out. The data source from this research comes from the literature obtained through the internet in the form of research journals relevant to this research topic. In searching for the topic of previous research, the researcher used Google Scholar with the keyword "HIRARC Construction" and found 546 journals and then narrowed it down with a period of 2017-2022 to 502 findings.

RESULT AND DISCUSSION

A work accident is an unplanned, uncontrolled and unexpected event at work caused directly or indirectly by an unsafe activity or unsafe condition that causes the cessation of work activities. According to the International Labor Organization (ILO), three factors cause work accidents, namely:

1. Human Factors, workers do not know or apply safe procedures or dangerous actions such as being unable to meet work requirements so that substandard actions occur, knowing all work regulations and requirements but not complying with them.
2. Work environment factors, the workplace's physical environment that does not meet the standards and the wider social psychological environment.
3. Equipment factor, usually equipment used by machines unsuitable for use or not by how they are used.

The following is an example of one of the research results related to the factors

causing work accidents in building construction projects using a descriptive approach with the method of distributing questionnaires to 23 workers who have experienced work accidents.

Table 1. Factors Causing Work Accidents

No.	Statement	False (%)	True (%)
1.	Unsafe behaviour cannot cause work accidents	39,1	60,9
2.	Work accidents can cause material and non-material losses	78,3	21,7
3.	Working by the Standard Operating Procedure (SOP) can reduce the potential for work accidents	21,7	78,3
4.	Working while "chatting" with coworkers does not affect work safety	8,7	91,3
5.	Working excessively or exceeding normal working hours (> 8 hours/day) can increase the potential for work accidents	52,5	47,8
6.	Noise is unwanted sound and exceeds 85 Db	26,1	73,9
7.	Working in an environment with high noise sources must wear Ear Protector	26,1	73,9
8.	The function of Personal Protective Equipment in the form of a safety helmet is to protect the head from falling objects	21,7	78,3
9.	Work accidents that occur can harm the workers who experience them	8,7	91,3
10.	Scattered work equipment can trigger work accidents	8,7	91,3

(*Source: Martiwi, 2017*)

The Result of the Literature Review

This study took a sample from 8 previous studies that have discussed the potential for workplace accidents in construction projects.

The first study was conducted by Beryl & Sony (2013). This study used quantitative methods by distributing questionnaires to 30

respondents with HSE Manager, Safety Officer, HSE Admin, and Engineering positions. Respondents have an average of 5-10 years of experience with an average bachelor's education, most of which come from BUMN employees. Risk assessment based on 30 respondents is formulated as a function for probability and consequences. Based on probability and consequences, it is processed into a risk index, and the results are used as a grouping of risk categories based on AS/NZS 4360. The results of the calculation of the risk index in this study that received a high-risk assessment were the preparation of formwork beams that could be at risk of falling from a height, excavation work that caused workers to be buried by avalanches and electrocuted, scaffolding can cause falling from a height, lifting material is at risk for workers being crushed by material, installation of column formwork is at risk of falling from a height. Based on the results of the study identified seven risks that occupy high risk, namely five upper structural risks and two lower structural risks; the medium risk rating has 43 risks, namely 26 upper structural risks and 17 lower structural risks; the low-risk rating there are ten risks, namely two structural risks, upper and eight lower structure risks.

The second study was conducted by Williams Opeyemi et al. (2017). This study uses a descriptive analysis of 30 fatal accidents at Malaysian construction sites within 14 months (September 2015 and October 2016). Based on the 30 accident cases, there were seven accidents, namely falls from height in 17 cases, struck-by 4 cases, electrocution in 3 cases, drowning in 2 cases, trench 2 cases, crane 1 case, and machine-related 1 case. The cause of the accident is lack of or non-compliance with safe work procedures, lack of or shortage of PPE, lack of edge protection, lack of supervision, material failure, the unsafe act of worker, no hazard identification, no warming sign, floor opening not covered, equipment failure, unsafe working condition.

The third study was by Nyoman Martha Jaya et al. (2021). This study uses a brainstorming method with the SHE Officer and is based on similar research. This study used 18 respondents with 80 risks identified and then formulated into probability and consequences based on AS/NZS 4360. Based on the research, 80 risks were grouped into three categories, namely 21 high risks, 32 medium risks, and 27 low risks. The average risks identified as high risk are workers falling, workers being hit, falling by materials, being electrocuted, and sparks on machines.

The fourth research was conducted by Uppit Yuliani (2017). This study uses the observation method and distributes questionnaires, after which the data is formulated as a function of likelihood and impact with the AS/NZS 4360 standard. The results of this study are 6 extreme risks, 17 high risks, 8 medium risks, and 9 low risks.

The fifth research was conducted by Ramadhan & Andi (2020). This study uses a quantitative method by distributing questionnaires to 39 respondents working at PT. Hutama Karya Infrastruktur, based on the results of this study, there are 5 high risks, 41 medium risks, and 19 low risks. 5 high risks,

namely the occurrence of fuel fires, being hit by gas/water pipe utilities, falling materials, workers being hit by a concrete pump, and falling from a height.

The sixth study was conducted by Hendra Alexander et al. (2019). This study uses quantitative methods by conducting surveys and observations, then processed into HIRADC. Based on the results of the research on the work of building beams and plates, the identified hazards are falling, pinching, puncturing, scratching, crushing, inhaling dust, tripping, and electrocution.

The seventh study was conducted by Mega et al. (2017). This study uses a descriptive analysis method by distributing questionnaires to 15 respondents, including QHSE, Quality Control, and Site Operation staff. This study identified light masonry work, plaster and plaster wall work, gypsum partition wall work, glass masonry work, and ladder work. Based on the identification of each job with a high risk, namely glasswork and ladder work, the highest possible risk is falling from a height and being electrocuted.

The eighth study was conducted by Triswandana & Armaeni (2020). This study uses a quantitative descriptive method by distributing questionnaires to owners, supervisory consultants, planning consultants, job directors, engineers, supervisors, and heads of community representatives. This research was conducted on the F3 Building construction project at the Faculty of Medicine and Health Sciences, Warmadewan University. This study identified five jobs: fabrication of reinforcement, dismantling and installing formwork, dismantling and installing scaffolding, cleaning dust and dirt with a compressor on plate work, and casting. Based on the research results, that has a high risk, namely scaffolding and casting work, with the potential for accidents to falling from a height and being hit by material.

Based on the results of previous research, the potential for workplace accidents that often occur, namely falling from a height, buried workers, the risk of being hit by material, and electric shock, can be identified. The following is a presentation of household work's risk identification and assessment results using the AS/NZS 4360:2004 standard risk assessment matrix.

Table 2. AS/NZS Risk Assessment Table 4360: 2004

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	

(Source: Triswandana & Armaeni, 2020)

Table 3. Stair Work Risk Assessment

No	Activity	Risk	Probability	Severity	Risk Rating
1.	Install / dismantle Scaffolding	Fall from a height	2	4	Moderate
		Struck by material	3	3	High

2.	Install / dismantle Form work	Fall from a height	3	4	High
		Punctured	3	2	Moderate
		Struck by material	3	3	High
		Injured by tools	3	3	High
		Pinched	3	2	Moderate
3.	Reinforcing	Pinched	3	2	Moderate
		Electrocution	3	2	Moderate
		Punctured	3	2	Moderate
		Electrocution	2	4	Moderate
		Injured by tools	2	3	Moderate
4.	Casting	Fall from a height	3	4	High
		Struck by material	2	2	Low
		Skin irritation	2	2	Low
		Punctured	2	3	Moderate
		Injured	2	2	Low
		Electrocution	2	4	Moderate

(Source: Jannah et al., 2017)

From the table above, it is necessary to carry out the third stage, namely controlling the risk and determining control efforts considering the basic hierarchy of control: elimination, substitution, technical, administrative control, and provision of safety equipment. By adjusting the project completion time, organisational conditions, availability of operational costs and the environment. In the aspect of controlling workers, namely wearing PPE (helmets, vests, gloves, glasses, safety shoes and body harnesses), providing work implementation procedures, and certification of workers. A safety talk briefing, safety induction, safety patrol, HSE meeting evaluation, toolbox meeting, and provision of signs were held for communication. Finally, for the aspect of tools and control work locations that can be done to secure the location of the cable, monitoring the cleanliness of the location, equipment maintenance, testing the feasibility of tower cranes, and providing fire extinguishers and panel boxes. (Jannah et al., 2017)

CONCLUSION

From the eight studies presented, it was found that the average research shows that the upper structure work has more risk variables than the lower structure. The researcher also provides a risk assessment where the upper structure work is riskier than the lower structure

work. Some of the jobs that have the highest risk and often occur are:

1. Fall from a height,
2. Electrocuted,
3. Crushed by the material.

Based on the accident rate is still high. Far from the goal of achieving occupational safety and health, therefore it is important to make JSA and HIRARC on each job to identify the job and find ways to control these hazards to minimise workplace accidents so that workers have a sense of security while working to achieve the K3 goal of zero accident.

RECOMMENDATION

This study only presents the highest occupational accident rating and the research methods. Future research will explore the causes of work accidents with other methods to gain new knowledge regarding and prevention of occupational accidents in the construction sector.

REFERENCES

Williams, O. S., Hamid, R. A., & Misnan, M. S. (2017). Analysis of fatal building construction accidents: cases and causes. *work, 4*(8).

Jaya, N. M., Dharmayanti, G. C., Retnoyasa, D. A., & Mesi, U. (2021). MANAJEMEN RISIKO K3 (KESELAMATAN DAN KESEHATAN KERJA) PADA PROYEK PEMBANGUNAN RUMAH SAKIT BALI MANDARA. *JURNAL SPEKTRAN, 9*(1), 29-37.

Yuliani, U. (2017). Manajemen Risiko Keselamatan dan Kesehatan Kerja (K3) Pada Infrastruktur Gedung Bertingkat. *Jurnal Ilmiah Desain & Konstruksi, 16*(1).

Sy Syahriadi, R., & Tenriajeng, A. T. (2020). Analisis manajemen risiko keselamatan dan kesehatan kerja lingkungan mutu proyek jalan tol dan jembatan pada PT. Hutama Karya Infrastruktur di Kota Depok. *Jurnal TESLINK: Teknik Sipil dan Lingkungan, 2*(2), 18-28.

Alexander, H., Nengsih, S., & Guspari, O. (2019). Kajian Keselamatan dan Kesehatan Kerja (K3) Konstruksi Balok Pada Konstruksi Bangunan Gedung. *Jurnal Ilmiah Poli Rekayasa, 15*(1), 39-47.

Jannah, M. R., El Unas, S., & Hasyim, M. H. (2017). *Analisis risiko Keselamatan dan Kesehatan Kerja (K3) melalui pendekatan HIRADC dan metode job safety analysis pada studi kasus proyek pembangunan menara x di jakarta* (Doctoral dissertation, Brawijaya University).

Triswandana, I. W. G. E., & Armaeni, N. K. (2020). Penilaian Risiko K3 Konstruksi Dengan Metode Hirarc. *vol, 4,* 2581-2157.

Martiwi, R., Koesyanto, H., & Pawenang, E. T. (2017). Faktor Risiko Kecelakaan Kerja pada Pembangunan Gedung. *HIGEIA (Journal of Public Health Research and Development), 1*(4), 61-71.

Syafiq, U., & Perdhana, M. S. (2018). Kecelakaan Kerja pada Perusahaan Konstruksi: Sebuah Telaah Literatur. *Diponegoro Journal of Management, 7*(2), 351-359.

Rifani, Y., Mulyani, E., & Pratiwi, R. (2018). Penerapan K3 Konstruksi Dengan Menggunakan Metode Hirarc Pada Pekerjaan Akses Jalan Masuk (Studi Kasus: Jl. Prof. Dr. H. Hadari Nawawi). *JeLAST: Jurnal PWK, Laut, Sipil, Tambang, 5*(2).

Firmansyah, F., Sidi, P., & Amrullah, H. N. (2018, December). HIRARC pada Proses Erection Tower Crane di Perusahaan Konstruksi Proyek Pembangunan Apartemen dan Mall. *In Seminar K3* (Vol. 2, No. 1, pp. 723-728).

Sari, K. P., Chairi, M., & Helin, R. P. (2022). Analisis Risiko K3 Pada Proyek Gedung Rsud Pasaman Barat Dengan Metode Hirarc. *JURNAL RIVET, 2*(01), 25-31.

Simarmata, C. F., & Setiawannie, Y. (2021). ANALISA PENERAPAN SISTEM MANAJEMEN KESEHATAN DAN KESELAMATAN KERJA (SMK3) PROYEK KONTRUKSI JALAN TOL

DENGAN METODE HAZARD IDENTIFICATION AND RISK ASSESSMENT RISK CONTROL (HIRARC) DI PT. HUTAMA KARYA PERSERO. *IESM Journal (Industrial Engineering System and Management Journal), 2*(1), 87-97.

Arman, U. D., Sari, A., & Nasmirayanti, R. (2021). Analisis Resiko Keselamatan Konstruksi Pada Proyek Pembangunan Gedung Asrama Haji Padang Pariaman. *Rang Teknik Journal, 4*(1), 168-179.

Yuniastuti, T., Devitasari, D., & Rupiwardhani, I. (2021, December). KAJIAN FAKTOR PENGETAHUAN PEKERJA CV. PAKIS INDAH PADA KESELAMATAN DAN KESEHATAN KERJA SEBAGAI BAGIAN PENCEGAHAN FAKTOR RESIKO METODE HIRARC. *In Conference on Innovation and Application of Science and Technology (CIASTECH)* (pp. 563-570).

Dewantari, N. M., Mariawati, A. S., & Listiana, N. (2022). Analisis Keselamatan dan Kesehatan Kerja Menggunakan HIRARC di PT XYZ Cilegon-Banten. *JUMINTEN, 3*(3), 25-36.

AFIFUSSOLIH, M. ManajemenRisiko K3 Pemasangan Pipa Petragas Dengan Hazard Identification Risk Assessment and Risk Control (HIRARC)(Studi Kasus: Area Bojonegoro km 112–126 Kecamatan Kalitidu Kabupaten Bojonegoro).

Asih, T. N., Mahbubah, N. A., & Fathoni, M. Z. (2021). Identifikasi Bahaya Dan Penilaian Risiko Keselamatan Dan Kesehatan Kerja (K3) Pada Proses Fabrikasi Dengan Menggunakan Metode Hirarc (Studi Kasus: Pt. Ravana Jaya). *JUSTI (Jurnal Sistem Dan Teknik Industri), 1*(2), 272-303.

Dewantari, N. M., Umyati, A., & Falah, F. (2022). Hazard identification risk assessment and risk control (HIRARC) pada pembangunan gedung business center. *Journal Industrial Servicess, 8*(1), 1-6.

Yolanda, E., Lusiana, L., & Indrayadi, M. PERENCANAAN KESELAMATAN DAN KESEHATAN KERJA (K3) KONSTRUKSI PADA PROYEK KONSTRUKSI PERBAIKAN BERAT STASIUN PANDU JUNGKAT. *JeLAST: Jurnal PWK, Laut, Sipil, Tambang, 9*(3).