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Health and Safety Risk Levels in High-Rise Buildings

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Abstract

Construction projects are jobs that have a high risk of work accidents with the possibility of severe consequences of work accidents. Construction activities have various risks, including occupational safety and health (OHS) risks, as the construction process requires a lot of labour and involves heavy equipment. Hence, it has the potential level of construction OHS risk to the danger of work accidents.

From the data search to the office (PUPR) of the Sub-Department of Bina Konstruksi, related to the data, researchers to the Sub-Coordinator of Construction Services Development discussed the basis of the value of the frequency of occurrence of construction OHS risks; he said that the basis was from several associations invited to the office, to discuss OHS risks, then the values arose, namely 1, 2 and 3, there was no analysis of the calculation referring to these values. The basis of Per-Men of Public Works No. 5 of 2014 issued a frequency value. The objectives of this study are: To find the limit of the frequency value of the occurrence of types of OHS risks to complement Per-Men of Public Works No. 5 / 2014 and can classify contractors for the level of OHS risk in various high-rise buildings, both BUMN contractors and private contractors throughout Indonesia.

The method in this study uses Mamdani fuzzy because this method is more widely used because it has intuitive advantages, has been commonly used in various scientific fields, and is suitable for conducting an environmental analysis. The resulting output is dynamic because the data to be used is in the form of values/numbers, while in fuzzy rules, there needs to be input data in the form of numbers because the output results are also numbers. Besides that, in the questionnaire given to respondents, the answers are in the form of varied values/numbers; it seems appropriate to analyse these numbers using fuzzy logic.

Based on the analysis results, the lowest value is 2.65, while the highest is 7.26. Then the limit value of the frequency of occurrence of the type of construction OHS risk for the value "Rarely" is = 0-2.65, and the value "Sometimes" is = 2.66 -7.99, while for the value "Often" is> 7.99. Furthermore, the novelty in this research is to complement Per-Men of Public Works No. 5/2014, namely the limit of frequency value: 5/2014, namely the limitation of frequency value.

Keywords: *High Rise Building, SPSS, Fuzzy Mamdani, Fuzzy Logic.*

I. INTRODUCTION

Since 2019, Indonesia has been developing and formulating the 2019-2024 National Occupational Safety and Health (OSH) Program. This National OHS Program is part of the commitment of key labour actors, consisting of the Ministry of Manpower, workers'

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organisations, and employers, along with other key stakeholders, to continuously implement and improve the safety culture and prevention of OHS in Indonesia. The Employment Social Security Organizing Agency (BPJS) noted that the number of work accidents in Indonesia was 234,270 cases in 2021. This number increased by 5.65% from the previous year, which amounted to 221,740 cases. If you look at the trend, Indonesia's number of work accident cases has continued to grow in the last five years. Since 2017, the number of work accidents has been recorded at 123,040 cases. The number increased by 40.94% to 173,415 cases in 2018. A year later, work accidents again increased by 5.43% to 182,835 cases. Work accidents in the country increased by 21.28% to 221,740 cases in 2020. Minister of Manpower Ida Fauziyah stated that based on data from the Social Security Administration (BPJS), work accidents in construction increased from 114,000 in 2019 to 177,000 accidents in 2020 (Riska Hastuti et al., 2020). An accident is an unplanned and unexpected event that can disrupt the production/operation process, damage property/assets, injure people, or damage the environment. Accidents do not always cause injuries, but they can also cause damage to existing materials and equipment, but accidents that result in injuries receive greater attention (I. W. G. E. Triswandana et al., 2020). OHS risk is an effort to prevent/avoid/reduce work accidents by stopping/eliminating/eliminating risks (hazard elements) to achieve work targets (Abu Nadhir, 2017), Risk analysis is used to analyse a system and is an efficient tool for identifying risk factors and developing strategies to prevent failure. It includes failure identification, frequency analysis, and consequence analysis (I. W. G. E. Triswandana et al., 2020).

Based on the basic explanation above, the problem formulation of this research is how to complete the Ministry of Public Works Regulation No. 5/2014, related to the K3 risk frequency limit range for construction, how to find the highest OSH risk level in each case study projects such as the University of Malang University of Jember, University of Sultan Ageng Tirtayasa Banten and University of Mulawarman Samarinda, and how to implement the Range of Findings on the Limitation of Frequency Values in Per-Men PU No 5/2014 on project implementation. While the purpose of this study is to be able to find out the range of frequency values that exist in PerMen PU No 5/2014, to able to find out the highest level of OHS risk at each case studies project, such as the University of Malang Project, University of Jember, University of Sultan Ageng Tirtayasa Banten and University of Mulawarman Samarinda, and to be able to find out the application of the findings of the Range of Frequency Boundary Limits in Per-Men PU No 5/2014 on project implementation. From the background description above, the author takes the title Health and Safety Risk Levels in High-Rise Buildings.

II. LITERATURE REVIEW

2.1 Work safety

According to Bennett NB. Silalahi (1995), Occupational health is that occupational safety is an effort to prevent every unsafe act or condition that can result in an accident. Occupational safety is safety related to machines, aircraft, work tools, materials and processing, workplace grounds, the environment, and how to do work. Where the target of work safety is all workplaces, both on land, on the ground, on the surface of the water, in the water, and in the air (Suma'mur, 2018). According to Sri Larasati (2020), occupational safety is the main means of preventing accidents, disability, and death as a result of work accidents.

2.2 Risk Management

According to Soehatman Ramli (2016), OHS risk management in a good system. Meanwhile, according to Djojosoedarso (2003), it is the implementation of management functions in risk management, especially the risks faced by organisations / companies,

families and communities. So, it includes the activities of planning, organizing, compiling, leading, coordinating, and supervising (including evaluating) risk management programs. Meanwhile, according to (Wiliam et.al, 1995) Risk Management is an application of general management that tries to identify, measure and deal with the causes and consequences of uncertainty in an organization.

2.3 Hazard Identification Risk Assessment and Risk Control (HIRARC)

According to Soehtman Ramli (2016), The first element of the OHS risk management process. Hazard Identification Risk Assessment and Risk Control (HIRARC) is a method of preventing or minimizing work accidents. HIRARC is a method that starts by determining the type of work activity, which then identifies the source of the hazard so that the risk is determined. then risk assessment and risk control will be carried out to reduce exposure to hazards contained in each type of work.

2.4 Hazard Indentification and Risk Assesment Determining Control (HIRADC)

The definition of HIRADC is a method of assessing the risk of a job in a company so that it can get an overview of which job priorities we must control the danger. According to OHSAS 18001, HIRADC must be carried out in all organizational activities to determine organizational activities that contain potential hazards and have a serious impact on occupational safety and health.

2.5 Hazard Identification

According to Soehatman Ramli (2016), the success of a process OHS risk management is very much determined by the ability to determine or identify all the hazards in activities. If all hazards are successfully identified, it means that the company will be able to carry out comprehensive management. However, if the hazard identification effort is only able to reach a portion of the existing potential hazards, it means that there is still a chance for unwanted things to happen.

2.6 Risk Identification Process

According to Soehatman Ramli (2016), Risk identification is a systematic effort to find out the hazards that exist in the work environment. By knowing the nature and characteristics of hazards, we can be more careful and vigilant and take steps to safeguard against them. However, not all hazards can be recognized easily, such as fire hazards.

2.7 Occupational Hazards

According to Qomariyatus Sholihah, (2018), "hazard" is a situation or any condition that may occur that is harmful to the safety or health of workers. Hazards can be grouped into 3 categories: physical hazards, chemical hazards, and psychological hazards.

2.8 Work Accidents

According to Desles, Sibarani Mutiara, (2012), suggests that there are three common causes of accidents, namely by chance (chance occurance), unsafe conditions (unsafe codition), and unwanted attitudes (unsafe acts on the part of employees).

2.9 Fuzzy logic

Fuzzy logic is an extension of Boolean logic by Lotfi Zadeh in 1965 based on the mathematical theory of fuzzy sets, which is a generalization of classical set theory. Fuzzy logic has been used in the fields of transportation management, sentiment analysis, information retrieval, and information extraction. The advantage of the Mamdani Fuzzy Method is that it is more specific, meaning that in the process the Mamdani Fuzzy Method pays more attention to the conditions that will occur for each fuzzy region, resulting in more accurate decision results (Sri Kusumadewi and Hari Purnomo, 2010).

2.10 Matlab (Matrix Laboratory)

Matlab (Matrix Laboratory) is software used as a high-level programming language. Matlab is used for computing, visualization and programming.

2.11 Relevant Research Results

W. G. E. Triswandana, N. K. Armaeni (2020), in the research "Construction OHS Risk Assessment with the Hirarc Method". Researching with a focus on knowing the potential hazard value of construction work. Research linkage I. W. G. E. Triswandana 1, N. K. Armaeni 2 with this research is the similarity in finding the OHS Risk Rating.

Uppit Yuliani (2017), in the research "Occupational Safety and Health (OHS) Risk Management in Multi-storey Building Infrastructure". Researching with a focus on examining OHS risk identification. The relationship between Uppit Yuliani's research and this research is the similarity in finding negative impacts. Or risk index or risk level

Beryl Adityanto and Sony Irawan (2013), in the research "Occupational Safety and Health (OHS) Risk Management in the Lower Structure and Upper Structure Work of Multi-Story Buildings".Research with a focus on examining the risks at the Construction project stage. The relationship between Beryl Adityanto and Sony Irawan's research and this research is the similarity in looking for types of OHS risks.

Reny Indrayani (2017), in the research "Occupational Safety risk analysis on the development project of Juanda International Airport Terminal 2 Surabaya". Researching with a focus on risk prioritization, risk control and hazards. The relationship between Reny Indrayani's research and this research is the similarity in finding hazards and prioritizing OHS risks and controlling OHS risks.

Retna Kristiana and Slamet (2018), in the research "Identification of Causes of Work Accidents in High-rise Building Construction Projects". Researching with a focus on the dominant indicators that cause work accidents and how to mitigate OHS against these dominant indicators with this research is similar in finding the cause of accidents or looking for hazards that occur at the work location.

Muhammad Nurudin, Miftahul Huda² (2020), in the research "Risk Identification of the Construction of Multi-Storey Buildings Owned by the Surabaya City Government".Researching with a focus on identifying, analyzing OHS risks with this research is similar in identifying OHS risks in multi-storey building projects.

Ghiffari Halim Istiqlal , Trijeti (2020), in the research "Risk Identification of Work Accidents in Building Construction". Researching with a focus on identifying the risk of work accidents with this research is similar in identifying the risk of accidents in the construction of multi-storey buildings.

III. METHODOLOGY

The method in this study uses Mamdani fuzzy because this method is more widely used because it has intuitive advantages, has been widely used in various scientific fields, is suitable for conducting an environmental analysis. The resulting output is dynamic because the data to be used is in the form of values or numbers, while in fuzzy rules there needs to be input data in the form of numbers because the output results are also numbers. Besides that, in the questionnaire to respondents, the answers from respondents are in the form of varied values/numbers, it seems that it is suitable to analyze these numbers using fuzzy logic.

IV. RESULTS AND DISCUSSION

4.1 How to complement the Ministry of Public Works Regulation No. 5/2014. Related to the Range of Construction OHS Risk Severity Value Limits

To complete the fuzzy logic output, the data in table 1 is grouped and the lowest and highest values are determined, If the average result of the frequency value has a comma value, the researcher attempts to find a solution by selecting one of the range values for each type of occupational health and safety risks (OHS). The researcher uses a triangle function or triangle curve based on the value of the fuzzy output (Figure 1). In this case, the reference taken is "sometimes,", because it can form a triangular curve (Figure 2). Researchers assigned the following value to one of the counts, in this instance the X72 variable:

X72	5	5	2	5	2	5	5	5	5	5	5	5	5	5	5	5	5	8	5	5

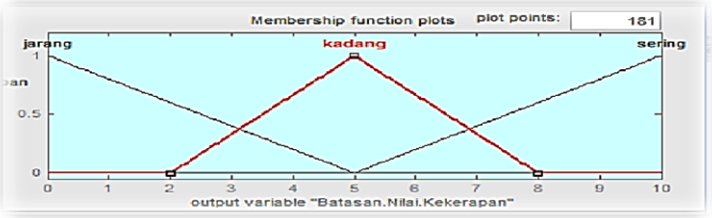

Figure 1. Fuzy output Triangle Curve

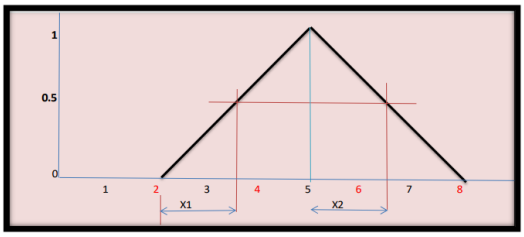

Figure 2. Triangle Curve

Y = X1 -2/5-2

3Y = X1 -2

Where the value of Y

3 x .0,5 0.5

1,5 = X1 -2

1,5+2 = X1

3,5 = X1

Y = 8 - X2 / 8-5

Y = 8 - X2 /3

3Y = 8 - X2

Where the value of Y

3 x .0,5

1,5 = 8 - X2

X2 = 8 -1,5

X2 = 6.5

For further calculations can be seen in Table 1.

Table 1. Triangular Curve Calculation Results

Code	Type of OHS Risk	Limitation of Hardness Value		
		X1 (Rare)	X2(Sometimes)	>(Often)
X1	Site cleaning, worker bitten by wild animal	0 - 2,65	2,66 - 4,14	>4,14
X2	Site cleaning, workers tripping, falling from the same height	0 - 3,57	3,68 - 6,57	>6,57
X3	Site cleaning, workers scratched or cut by sharp materials	0 - 3,43	3,44 - 6,71	>6,71
X4	Worker hit by heavy equipment	0 - 3,35	3,36 -6,35	>6,35
X5	Workers exposed to dust	0 - 2,71	2,72-5,72	>5,72
X6	Other materials or equipment are hit by heavy equipment	0 - 3,29	3,30-6,29	>6,29
X7	Worker crushed by building debris	0 - 3,36	3,37-6,36	>6,36
X8	Worker hit by excavator arm	0 - 2,72	2,73-5,72	>5,72
X9	Workers' eyes are exposed to debris	0 - 3,07	3,08 - 6,07	>6,07
X10	Workers are scratched or cut by sharp materials	0 - 3,42	3,43 - 6,42	>6,42
X11	Workers are hit by hoes or other digging tools	0 - 3,28	3,29 - 6,28	>6,28
X12	Workers slip or fall	0 - 3,28	3,29 - 6,28	>6,28
X13	Worker impaled on bendrat iron	0 - 4,26	4,27 - 7,26	>7,26
X14	Worker pinched by bending machine	0 - 3,28	3,29 - 6,28	>6,28
X15	Worker is pinched by a working tool (pliers) or pinched by an iron.	0 - 3,73	3,74 - 6,74	>6,74
X16	Worker hit by collapsed piles	0 - 3,00	4,00 - 6,00	> 6,00
X17	Worker hit by a pile	0 - 3,07	3,08 - 6,07	> 6,07
X18	Workers injured by work tools (short crowbar/bodem)	0 - 3,28	3,29 - 6,28	>6,28
X19	Workers scratched by metal joints	0 - 2,71	2,72 - 5,71	>5,71
X20	Worker is crushed by the material being lifted	0 - 0, 30	0,4 - 0,60	> 0,60
X21	Worker hit by lifted material	0 - 2,85	2,86 - 5,85	>5,85
X22	Damage to materials that have fallen or been hit by a collapsed tower crane	0 - 3,28	3,29 - 6,28	>6,28
X23	Falling while climbing a tower crane	0 - 3,54	3,55 - 6,54	>6,54
X24	Worker scratched by formwork material (wood or metal)	0 - 3,35	3,36 - 6,35	>6,35
X25	Worker pierced by a nail	0 - 3,47	3,48 - 6,47	> 6,47

Code	Type of OHS Risk	Limitation of Hardness Value		
		X1 (Rare)	X2(Sometimes)	>(Often)
X26	Worker hit by hammer	0 - 3,64	3,65 - 6,64	>6,64
X27	Scaffolding collapsed	0 - 3,21	3,22 - 6,21	>6,21
X28	Worker falls from height (above 2 meters)	0 - 3,64	3,65 - 6,64	> 6,64
X29	Scratched by iron material	0 - 3,35	3,65 - 6,36	>6,36
X30	Worker pinched by metal material	0 - 3,52	3,53 - 6,52	>6,52
X31	Electrocution	0 - 3,28	3, 29 - 6,29	> 6,29
X32	Worker hit by steeldeck	0 - 3,5	3,66 - 6,50	>6,50
X33	Workers are scratched by iron or iron bendrat	0 - 3,64	3,65 - 6,64	> 6,64
X34	Worker is pinched by a working tool (pliers) or pinched by an iron.	0 - 3,69	3,70 - 6,69	>6,69
X35	Worker falls from a height	0 - 3,29	3,30 - 6,29	> 6,29
X36	Skin irritation from cement splashes	0 - 3,08	3,09 - 6,07	>6,07
X37	Workers' eyes are exposed to concrete splashes	0 - 3,43	3,44 - 6,43	>6,43
X38	Worker falls from bucket	0 -3,43	3,44 - 6,43	> 6,43
X39	Worker falls from scaffolding	0 - 3,43	3,44 - 6,43	> 6,43
X40	Short circuit or short circuit (power cable)	0 - 3,76	3,77 - 6,76	>6,76
X41	Worker exposed to LPG cylinder explosion (LPG welding)	0 - 4,05	4,06 -7,05	>7,05
X42	Fire caused by sparks	0-3,64	3,65-6,64	>6,64
X43	Worker's eye hit by debris (gram)	0-3,74	3,75-6,74	>6,74
X44	Worker's skin exposed to welding sparks	0-2,71	2,72-5,71	>5,71
X45	Eye Irritation Exposure or welding fumes	0-3,5	3,51-6,5	>6,5
X46	Worker electrocuted (electrode welding)	0-3,29	3,30-6,29	>6,29
X47	Worker scratched by formwork material (wood or metal)	0-3,36	3,37-6,36	>6,36
X48	Worker pierced by a nail	0-2,86	2,87-5,86	>5,86
X49	Worker hit by hammer	0-2,71	2,72-5,71	>5,71
X50	Worker falls from a height	0-3,43	3,44-6,43	>6,43
X51	Workers lack oxygen (GWT formwork)	0-3,29	3,30-6,29	>6,29
X52	Worker falls from a height (>5 meters)	0-2,86	2,87-5,86	>5,86
X53	Workers crushed by steel and other materials	0-2,71	2,72-5,71	>5,71
X54	Workers injured by work tools	0-3,07	3,08-6,07	>6,07
X55	Workers' eyes are exposed to debris from drilled material	0-2,86	2,87-5,86	>5,86

Code	Type of OHS Risk	Limitation of Hardness Value		
		X1 (Rare)	X2(Sometimes)	>(Often)
X56	Worker injured by drill bit	0-2,93	2,94-5,93	>5,93
X57	Workers electrocuted, short-circuit (short circuit)	0-2,71	2,72-5,71	>5,71
X58	Worker falls from a height	0-2,79	2,80-5,79	>5,79
X59	Eyes hit by ceiling debris	0-3,5	3,51-6,5	>6,5
X60	Workers scratched by materials	0-2,93	2,94-5,93	>5,93
X61	Worker electrocuted	0-3,36	3,37-6,36	>6,36
X62	Worker falls from a height	0-2,71	2,72-5,71	>5,71
X63	Noise during ramset nail installation	0-2,88	2,89-5,88	>5,88
X64	Workers' eyes are exposed to cement splashes	0-3,43	3,44-6,43	>6,43
X65	Skin irritation from cement splashes	0-2,71	2,72-5,71	>5,71
X66	Worker hit by collapsed hebel	0-3,29	3,30-6,29	>6,29
X67	Worker falls from a height (<2 m)	0-2,93	2,94-5,93	>5,93
X68	Eyes exposed to cement splashes	0-3,21	3,22-6,21	>6,21
X69	Skin irritation from cement splashes	0-3,43	3,44-6,42	>6,42
X70	Worker falls from a height	0-3,29	3,30-6,28	>6,28
X71	Worker cut by ceramic cutting tool	0-3,29	3,30-6,28	>6,28
X72	Eye contact with ceramic chips	0-3,43	3,44-6,42	>6,42
X73	Skin irritation from cement splashes	0-2,79	2,80-5,78	>5,78
X74	Ear disorders due to noise	0-2,93	2,94-5,92	>5,92
X75	Worker injured by drill bit	0-3,5	3,51-6,50	>6,50
X76	Electric shock short circuit (short circuit)	0-3,29	3,30-6,28	>6,28
X77	Eyes exposed to debris	0-2,93	2,94-5,92	>5,92
X78	Fire (melamine)	0-3	3,01-6,00	>6,00
X79	Workers are scratched or cut by glass	0-3,21	3,22-6,21	>6,21
X80	Falling from a height	0-3,21	3,22-6,21	>6,21
X81	Workers' eyes are exposed to splashes of paint or paint solvents	0-3,43	3,44-6,42	>6,42
X82	Skin irritation from paint splashes or paint solvents	0-2,79	2,80-5,78	>5,78

The data is then filtered using an Excel application based on the information in Table 1; the lowest number is 2.65 and the highest is 7.26. Based on the findings of the analysis, the limit is the frequency of occurrence of the kind of construction occupational health and safety risks (OHS) is between 0 and 2.65 for the value "Rarely," between 2.66 and 7.26 for "Sometimes," and greater than 7.26 for "Often". For convenience, the Table 2 below has been created.

Table 2. Limitation of Stiffness Value

Nama	Limitation of Frequency Value
Rare	**0 - 2.65**
Sometimes	**2.66 - 7.99**
Often	**>7,99**

To ensure that these values are valid, researchers asked sources such as from government agencies, from projects related to the construction of projects above 8 floors, to help validate data related to the research being compiled by researchers. The source data can be seen in Table 3.

Table 3. Respondent Name Occupational health and safety risks (OHS)

No	Name	Description
1	EKO BUDIANTO General OHS Expert, Heart Hospital Project Harapan Kita, 8 floors	Total Variables 82 Items, Respondents stated the data was valid
2	RATIH SUGIARTI General OHS Expert, Louvin Apartment Project Jatinangor, 29 floors	Total Variables 82 Items, Respondents stated the data was valid
3	ALDY HUMISAR MARTUA SIMANULANG Construction OHS Expert, BRI Gatsu Tower Project Subroto 42 Floor	Total Variables 82 Items, Respondents stated the data was valid
4	FRIANDIKA AULIA Green Kamala Lagoon Project,42	Total Variables 82 Items, Respondents stated the

	Floor	data was valid
5	SHIYAMI RAMADHONA AL FITRIYAH Construction OHS Junior Expert, Project Ismail Marzuki, 12 Floors	Total Variables 82 Items, Respondents stated the data was valid
6	RACHMADI AKBAR DHARMAWAN, SKM Head of SHE Section, OHS Intermediate Expert Construction, Jakarta Tower Project	Total Variables 82 Items, Respondents stated the data was valid
7	DR. RATIH FITRIANI Head of OHS Bureau of CENTRAL PUPR	Total Variables 82 Items, Respondents stated the data was valid
8	NUR ACHMAD EKO S. SHE Manager PT Wika Gedung, Project Kediri Airport	Total Variables 82 Items, Respondents stated the data was valid
9	HARYADI SUL ISTYAWAN University Project HSE Manager UNMUL	Total Variables 82 Items, Respondents stated the data was valid
10	IR. H. L AZUARDI NURDIN, IPU Chairman of the All Indonesia OHS Association	Total Variables 82 Items, Respondents stated the data was valid
11	ISTIANI NURAN, SH Ministry of Manpower Banten Region Div. Licensing	Total Variables 82 Items, Respondents stated the data was valid
12	IR. YUNIAR RAHMIANA Head of Planning and OHS Bureau	Total Variables 82 Items, Respondents stated the data was valid
13	IR. H. YAYAH ROPANDI, S.T., M.Si., CSP, IPU, ASEAN Eng. OHS Auditor	Total Variables 82 Items, Respondents stated the data was valid
14	ASEP SHAEFULLAH HSE Manager of PT PP (Persero)	Total Variables 82 Items, Respondents stated the data was valid
15	IMAN ABDUL DJAWAS P General OHS Expert, Transmart Project Pekalongan, 5 Floors	Total Variables 82 Items, Respondents stated the data was valid
16	RA. INTAN DWI SARASWATI General OHS Expert, Jakarta Project International Stadium	Total Variables 82 Items, Respondents stated the data was valid
17	MOENARDI PEDRO General OHS Expert, Prosecution Project Agung, 24 floors	Total Variables 82 Items, Respondents stated the data was valid
18	MULTAZAM OHS Utama PT Firama Karya Consultant	Total Variables 82 Items, Respondents stated the data was valid
19	FIRMAN AFRIANTO Construction OHS Junior Expert, Project MRT, Hub, Jakarta (Stop)	Total Variables 82 Items, Respondents stated the data was valid
20	HANA KATERINA, S.T. Construction OHS Junior Expert, Project Unmul University Samarinda	Total Variables 82 Items, Respondents stated the data was valid
21	LAODE MUHAMMAD ZALMIN Construction OHS Junior Expert. Project Tranmart Semarang, 6 Floors	Total Variables 82 Items, Respondents stated the data was valid

From the number of respondents above, all respondents stated that they were valid with Table 2.

4.2 How to identify the highest level of OHS risk in each case study project, such as those at the University of Malang, the University of Jember, Sultan Ageng Tirtayasa University Banten, and Mulawarman University Samarinda.

The results of the analysis of the classification of the occupational health and safety risks (OHS) level of the PT Hutama Karya contractor show that from the total number of work items of 82, there are several classifications of risk level, such as low, medium, and high, as well as the classification of low, medium, and severe severity values for more details, which can be seen in the Table 4 below.

Table 4. Percentage of OHS Risk Level of PT Hutama Karya

Classification of OHS risk level	Total	Percentage
Low	25	30,49%
Medium	18	21,95%
High	39	47,56%

The results of the analysis of the classification of the occupational health and safety risks (OHS) level of the PT.PP.Persero contractor, from the total number of work items of 82, there are several classifications of occupational health and safety risks (OHS) levels, such as low, medium, and high, and the percentage of severity value for light, medium, and heavy can be seen more clearly in the Table 5 below.

Table 5. Percentage of OHS Risk Level of PT PP Persero Contractors

Classification of OHS risk level	Total	Percentage
Low	64	78,05%
Medium	9	10,98%
High	9	10,98%

The results of the analysis of the classification of the occupational health and safety risks (OHS) risk level of PT Adhi Karya contractors, from the total number of work items of 82 there are several classifications such as low, medium and high, more details can be seen in the Table 6 below.

Table 6. Percentage of OHS Risk Level of PT.Adhi Karya Contractor

Classification of OHS risk level	Total	Percentage
Low	27	32,93%
Medium	15	18,29%
High	40	48,78%

The results of the analysis of the classification of the occupational health and safety risks (OHS) level at the contractor PT.NUSA KONSTRUKSI ENJINIRING, Tbk, from the number of work items as many as 82 show several classifications such as low, medium, and high, and the percentage of severity values such as light, medium, and heavy, for more details, can be seen in the Table 7 below.

Table 7. Percentage of OHS Risk Level of PT NKE

Classification of OHS risk level	Total	Percentage
Low	29	35,37%
Medium	10	12,20%
High	43	52,44%

The highest level of OHS risk in each case study project, such as the University of Malang Project, Jember University, Sultan Ageng Tirtayasa University Banten, and Mulawarman University Samarinda. From the classification results, the highest OHS Risk Level is PT NKE with a percentage of 52.44%.

4.3 How is the Implementation of the Findings of Range Limitation of Severity Value in Per-Men of Public Works No. 5/2014 on the Implementation in the Project

To increase the confidence and trust of project owners as well as consultants and state-owned and private contractors. The researcher will implement the researcher's findings by taking an example on one of the contractors from the case study, namely the contractor PT.NKE.

From the results of implementing the findings of the range of limitations on the frequency value of Per-Men of Public Works No. 5 / 2014 on project implementation are as follows: 1: 5 / 2014 on the implementation of the Project is as follows: That the researcher's findings are very beneficial to the contractor in reporting OHS, both quarterly OHS reporting to the relevant Office, because the results of the classification of frequency value limits differ significantly from using Per-Men PU No. 5 / 2014. For clarity, the researcher made Table 8, as shown below.

Table 8. Implement Research Findings with Minister of Public Works Regulation No 5/2014

Classification of Severity Value Limits	Total Accuracy Score Based on Researcher Findings	Percentage	Total Severity Value Based on Public Works Regulation No. 5/2014	Percentage
Rarely occurs in construction activities	37	45%	28	34%
Occasionally occurs in construction activities	39	48%	10	12%
Frequently occurs in construction activities	6	7%	44	54%
Total	82	100%	82	100%

The classification of the frequency value based on the researcher's findings that "Rarely" occurs in construction activities has a percentage of 45% with a total of 37 occurrences. Meanwhile, if using Per-Men of Public Works No. 5/2014, the classification rarely occurs in construction activities and has a percentage of 34%, with a total of 28 occurrences. For the researcher's findings, sometimes it occurs in construction activities has a percentage of 48%, with a total number of occurrences of 39. In contrast, with the Regulation above, sometimes it occurs in construction activities has a percentage of 12%, with a total number of occurrences of 10. Furthermore, "often occurs in construction activities" has a percentage of 7% with a total number of occurrences of 6. When using the Regulation, "Often occurs in construction activities" has a percentage of 54% with a total number of occurrences of 44. From the explanation above, it really relieves and benefits the contractors if they use the results of the researcher's findings, compared to using Per-Men PU No. 5/2014. By using the researcher's findings, of course, the calculation of the OHS

risk level will provide a very low classification and will certainly alleviate OHS reporting.

This was conveyed in internal discussions with the contractor's HSE and OHS experts, who have SKA OHS (Expert Certificate), especially Mr Ir.H. Lazuardi, Chairman of the Association of Construction Occupational Safety and Health Experts—Indonesia (A2K4—Indonesia). They argue that this finding is beneficial for contractors and consultants in making OHS reports, both OHS quarterly reports to the relevant office, with detailed and clear frequency value limits. Per-Men No: 5/2014. According to the information provided by Mr Ir.H. Lazuardi, Per-Men No. 5/2014 has been replaced with Per-Men No. 10 in the Year 2021.

V. CONCLUSION

Based on the results of the analysis, it is concluded that the lowest frequency value is 2.65, while the highest is 7.26. Then the OHS value limit for the occurrence of this type of construction OHS risk for the value "Rarely" is = 0-2.65, and the value "Sometimes" is = 2.66 -7.99 while for the value "Often" is > 7.99. Furthermore, the novelty in this study is to complement the Minister of Public Works Regulation No: 5/2014, namely the frequency limit as shown in the Table 8 below:

Table 8. Limitation of Stiffness Value

Nama	Limitation of Frequency Value
Rare	**0 - 2.65**
Sometimes	**2.66 - 7.99**
Often	**>7,99**

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