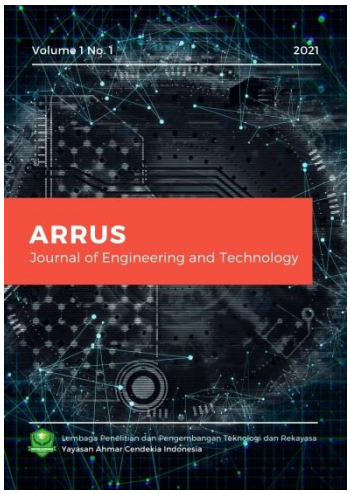
https://doi.org/10.35877/jetech750

OPEN ACCESS

ISSN : 2776-7914 (Print) / 2807-3045 (Online)



*Corresponding author: Mohamad Sobirin, Faculty of Engineering, Mercu Buana University, Jakarta, Indonesia

E-mail: sobirinmkj2018@gmail.com

RESEARCH ARTICLE

Analysis of Types of Occupational Health and Safety Risk (K3) in Erection Work

Mohamad Sobirin*, Almie Noegraha Putra, Novika Candra Fertilla, & Irriene Indah Susanti

Faculty of Engineering, Mercu Buana University, Jakarta, Indonesia

Abstract: Infrastructure Development Certification of Human Resources Deputy Building 3 is planned as one of the supporting facilities to improve the quality of human resources, especially in the environment Badan Siber dan Sandi Negara, Indonesia. The purpose of this study is to find out the results of the analysis of the types of risk of K3 in the erection work in Project Pembangunan Infrastruktur Sertifikasi SDM Badan Siber dan Sandi Negara and know the types of K3 risks that play the most role that occur in erection work in Project Pembangunan Infrastruktur Sertifikasi SDM Badan Siber dan Sandi Negara. Using the research method of the survey method that will be validated by K3 Experts. The survey results from the respondent questionnaire were processed using the SPSS (Statistical Package for Social Science). To analyze risk, use the result of multiplying the average opportunity value and the average impact value.

Keywords: occupational health, safety risk, K3, erection work, hazard type

1. Introduction

According to Sanjaya (2012), Occupational Safety and Health is a problem that grabs the attention of various organizations today because it covers issues in terms of humanity, economic costs and benefits, legal aspects, accountability and the image of the organization itself. All these things have the same level of importance even though there is indeed a change in behavior, both within the environment itself and other factors that enter from the external elements of the industry.

Development projects are activities related to all stages carried out in the workplace. Development project work involves many things including building materials, equipment, labor, and the application of technology. All of these things can be a source of work accidents that can even result in death and material loss.

In this research will discuss about the fishing work seen from K3 science in the Project Pembangunan Infrastruktur Sertifikasi SDM Badan Siber dan Sandi Negara. The project was carried out from 26 August 2019 to 31 December 2019 for 128 calendar days. Because the implementation of the project is in line with time, there are several incidents of work accidents. The first incident was a work accident occurred to the crew of the stake machine due to a splash of battery water and exploded battery cap on the generator engine, resulting in pain in the eyes and trauma to the hand muscles. Then the second incident was the worker who was nudged by the stake when the pole was pulled by the crane to be set to the Hydraulic Static Pile Driver (HSPD).

https://doi.org/10.35877/jetech750

ISSN : 2776-7914 (Print) / 2807-3045 (Online)

2. Literature Review

According to the definition of OHSAS (Occupational Health and Safety Assessment Series) in Wibowo (2019) Occupational Health and Safety are all conditions and factors which can have an impact on the safety and health of workers and other people (contractors, suppliers, visitors and guests) in the workplace.

The risk of construction K3 is a measure of possible losses to public safety, property, the human soul and the environment that can arise from certain sources of danger what happens in construction work. (Permen PU No. 05 of 2014)

Assessment of the risk level of K3 construction can be done by combining values frequency of K3 hazard events with severity/loss/impact the damage it causes. Possible risks to health and occupational safety (K3) greatly affects the cost, time, and quality that will be impact on the smooth construction work. (Permen PU No. 05 of 2014)

Construction Safety Risk consists of: (Permen PU no. 21 of 2019)

a. small,
b. medium and
c. big.

Risk identification is the process of identifying individual project risks by good in accordance with the source of the overall project risk, and documenting characteristics (PMBOK, 2017).

Risk rating analysis is done by multiplying the average impact value by the value average chance/probability of occurrence of factors that cause the risk of work accidents. Next will be given a risk rating based on the results of multiplication of average values opportunity and average impact value. (Fertilia & Aulia, 2020)

To calculate the probability average value using weighting taken from the likert scale, which is as follows. (Muammar, 2018)

1) E : Extreme Risk (activities should not be carried out or continued and controlled).
2) H : High Risk (activities should not be carried out or continued and controlled).
3) M : Moderate risk (action is needed to reduce risk).
4) L : Low Risk (risk can still be tolerated by the company).

1	1-3 = Low Risk Level
2	4-7 = Moderate Risk Level
3	8-11 = High Risk Level
4	12-16 = Very High Risk Level

Figure 1: Risk Value Classification

There are several factors and variables contained in the erection work, which are as follows in table 1.

https://doi.org/10.35877/jetech750

ISSN : 2776-7914 (Print) / 2807-3045 (Online)

Table 1: Piling Job Factors and Variables

Work	NO.	VARIABLES	SOURCE
Heavy equipment.	X1	Exposed to heavy equipment maneuvers.	Eva Olivia Hutasoit (2016).
	X2	Limited work location.	Eva Olivia Hutasoit (2016).
	X3	Noise.	Eva Olivia Hutasoit (2016).
	X4	HSPD leg stuck.	Lisa Alysia (2020).
Pile Placement Setting.	X5	Workers fall in excavation.	Uppit Yuliani (2017).
	X6	Workers crushed by falling piles.	Reny Indrayani (2017).
	X7	Workers hit by piles.	Reny Indrayani (2017).
	X8	Sling disconnected.	Mohammad Indra Arisandi Sabirin (2019).
	X9	Landslide excavation.	Uppit Yuliani (2017).
Pile Joint Welding.	X10	Exposed to sparks.	Fenny Moniaga, et.al. (2019).
	X11	Metal scratched worker connection.	Reny Indrayani (2017).
	X12	Workers exposed to welding fumes or fumes.	Uppit Yuliani (2017).
	X13	Visual disturbance.	Fenny Moniaga, et.al. (2019).
	X14	Exploding gas.	Eva Olivia Hutasoit (2016)
	X15	Get electrocuted.	Fenny Moniaga, et.al. (2019).
	X16	Fire.	Fenny Moniaga, et.al. (2019).
Pile Breaking.	X17	Respiratory disorders.	Muhammad Fuad, et.al. (2018).
	X18	Worker tripping over a pole stake.	Muhammad Fuad, et.al. (2018).
	X19	Workers are injured by work tools (short crowbar and/or bodem).	Reny Indrayani (2017).

3. Research Method and Materials

In this research, the data sources needed were primary data and secondary data. The survey technique in this research was to distribute questionnaires to 44 respondents. This questionnaire consists of 19 questions with the number of answers according to their stance. The questionnaire is a research on an interval measurement scale..

3.1. Primary Data

According to Wibowo (2019). primary sources are data sources that directly provide data to data collectors. This primary source is in the form of notes from direct interviews with the parties involved in the implementation. In determining Respondents, the following considerations need to be taken:

1) Minimum education level is SMK.
2) Minimum 5 years experience in construction.

https://doi.org/10.35877/jetech750

ISSN : 2776-7914 (Print) / 2807-3045 (Online)

In determining the Expert, the following considerations need to be taken :

1) Minimum education level is S1.
2) Minimum 10 years of experience in construction.
3) Have a Certificate of Expertise (SKA Expert) Intermediate or Young K3.

3.2. Secondary Data

According to Alam (2020), secondary data sources are data sources that do not provide information directly to data collectors. Secondary data sources can be obtained from further processing of primary data, previous research or documents related to research.

3.3. Determination of the number of samples

To determine the sampling (if the population is known) is used by using the Slovin formula with the following equation:

$n = N / (1 + N \times e^2)$
$n = 82 / (1 + 82 \times 0{,}1^2) = 44$ sample

where:

n : Number of samples
N : Number of population
e^2 : Precision specified or error tolerance (5%, 10%, 15%)

3.4. Data Processing Techniques

In data processing, researchers used descriptive statistical data analysis techniques. This technique is used by researchers because the data collection by distributing questionnaires and processing them.

3.4.1. Normality Test

Normality Test using SPSS (Statistical Package for Social Science) software used to test whether the regression model meets the assumption of normality. To test it, a normal probability plot is used, which if the graph shows the distribution of data that is around the diagonal line and follows the direction of the diagonal line, the regression it meets the assumption of normality.

3.4.2. Validity Test

Validity test using SPSS (Statistical Package for Social Science) software is useful to find out if there are questions on the questionnaire that should be discarded because considered irrelevant. Calculating the correlation between the data in each statement with a total score, using the product moment correlation formula. Aulia, et al (2014)

3.4.3. Reliability Test

Reliability test using SPSS (Statistical Package for Social Science) software useful for determining whether the instrument, in this case the questionnaire, can be used more than once, at least by the same respondent. In testing the questionnaire list this is because it will test more than two alternative answers, so it is a reliability test using Cronbach's Alpha Test. Aulia, et al. (2014)

3.4.4. Regression Analysis

Regression using SPSS (Statistical Package for Social Science) software is used to predict how far the change in the value of the dependent variable, if the value of the variable independently manipulated / changed or increased - lowered. Waruwu, et al. (2016).

https://doi.org/10.35877/jetech750

ISSN : 2776-7914 (Print) / 2807-3045 (Online)

4. Results and Analysis

In this section will be explained about the data processing analysis stage I, stage II, stage III and analysis of the level of risk.

4.1. Data Collection and Data Analysis Phase I

Phase I data collection aims to validate, add or remove variables found from literature studies. Experts are asked to fill out a questionnaire given by the researcher by providing a checklist in the available column with Yes / No answers, besides that the expert can also provide comments and add variables. Experts provide feedback, improvements and input on the 19 variables proposed by the author. There are experts who give similar responses in filling out the questionnaire so that the authors summarize it into 1 common point. It can be concluded that the experts agree with the 19 variables proposed by the author so that there is no need for variable reduction.

4.2. Data Collection and Analysis Phase II

Phase II data collection (pilot survey) is carried out after obtaining validated variables and obtaining expert approval. These variables are given to several selected prospective respondents to provide input on whether these variables can be understood or there is still required for simplification. This aims to obtain improvements before the questionnaire is submitted to respondents. Based on the results of phase II data analysis (pilot survey), it can be concluded that the description of each variable item that must be filled in by the respondent and how to fill it in, basically can be clearly understood by the prospective respondent. So there's no need for changes or improvements to the variables in the questionnaire.

4.3. Phase III Data

At this Phase, data collection was carried out by distributing questionnaires to employees of Contractors and Management Construction Consultants as respondents. The questionnaire used is in the form of a closed questionnaire with a total of 44 respondents. Respondents were asked to assess the level of occurrence of OHS risk and the influence of the occurrence of OHS risk on the erection of existing variables. The profile data of the respondents in the Phase III questionnaire in this research were then distributed based on the level of education, work experience, and age of the respondents. The following is the distribution of the respondent profiles for Phase III data collection as follows:

4.3.1. Profile of Respondents Based on Education Level

Questionnaire in this research was distributed to 44 respondents. To find out the distribution of respondents based on education level, the explanation can be seen in Table 1 and Figure 2.

Table 1: Distribution of Respondents Education Level

No	Education Level	Total	Percentage
1	S1	26	59%
2	D3	10	23%
3	SMA	5	11%
4	SMK	3	7%
	Total	44	100%

https://doi.org/10.35877/jetech750

ISSN : 2776-7914 (Print) / 2807-3045 (Online)

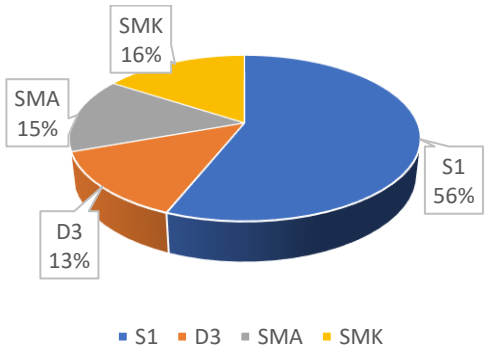


Figure 2: Pie Chart of Respondents Education Level

4.3.2. Profile of Respondents Based on Work Experience

Questionnaire in this research was distributed to 44 respondents. To find out the distribution of respondents based on work experience, the explanation can be seen in Table 2 and Figure 3.

Table 2: Distribution of Respondents Work Experience

No.	Work Experience	Total	Percentage
1	0-5 Years	15	34%
2	6-10 Years	24	55%
3	11-20 Years	5	11%
	Total	44	100%

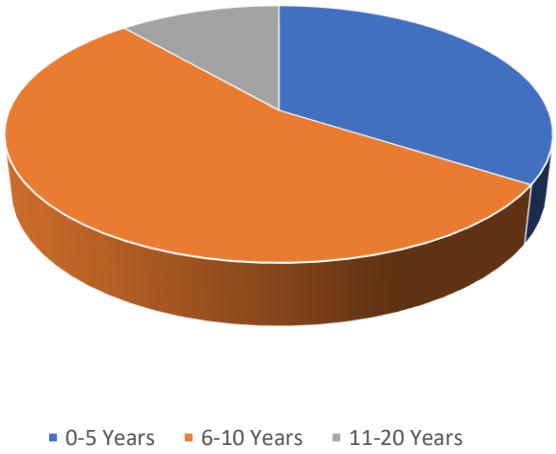


Figure 3: Respondents Work Experience Pie Chart

4.3.3. Profile of Respondents Based on Position

Questionnaire in this research was distributed to 44 respondents. To find out the distribution of respondents by position, the explanation can be seen in Table 3 and Figure 5.

https://doi.org/10.35877/jetech750

ISSN : 2776-7914 (Print) / 2807-3045 (Online)

Table 3: Distribution of Respondents Position (in Indonesia)

Posisi Jabatan	Jumlah	Persentase
KA. Divisi	**1**	2%
KA. Bag. Operasional	**1**	2%
Team Leader	**1**	2%
Administrator MK	**1**	2%
TA. Struktur & Infrastruktur	**3**	7%
TA. Arsitektur	**2**	5%
TA. MEP	**2**	5%
Project Manager	**1**	2%
Pelaksana Struktur	**4**	9%
Pelaksana Arsitektur	**2**	5%
Pelaksana MEP	**2**	5%
Pelaksana K3	**5**	11%
Ka. Logistik	**1**	2%
Ass. Logistik	**4**	9%
Kordinator Pelaksana	**4**	9%
Site Engineering Manager	**1**	2%
Site Operational Manager	**1**	2%
Quality Control	**4**	9%
Ka. Keuangan	**2**	5%
Ass. Ka. Keuangan	**2**	5%
		100%

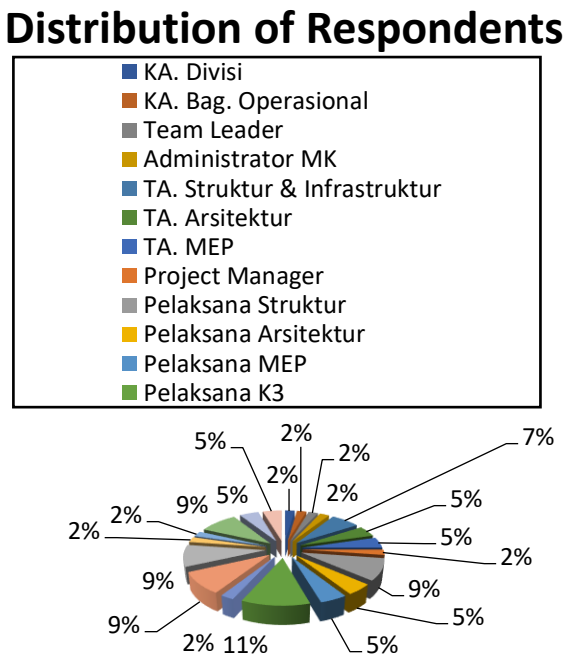


Figure 4: Pie Chart of Respondent Position

https://doi.org/10.35877/jetech750

ISSN : 2776-7914 (Print) / 2807-3045 (Online)

4.4. Risk Analysis

Risk rating analysis was carried out using the results of questionnaire data collection respondents who had previously been tested for validity and reliability tests, and contained about the types of work accidents that have an impact on the risk of work accidents what happened to the Project Pembangunan Infrastruktur Sertifikasi SDM Badan Siber Dan Sandi Negara. The following are the results of collecting respondent questionnaire data :

Table 4: Respondent Questionnaire Results

No.	Risk Event		Possibility of work accidents during erection work					The magnitude of the impact on the type of work accident risk during erection work				
	Activity	Variable	1	2	3	4	n	1	2	3	4	n
1	Heavy Equipment	X1	0	10	25	9	44	0	8	25	11	44
		X2	10	14	10	10	44	5	10	14	15	44
		X3	6	11	14	13	44	2	14	14	14	44
		X4	0	0	26	18	44	0	5	20	19	44
2	Pile Placement Setting	X5	5	6	18	15	44	3	9	22	10	44
		X6	10	12	8	14	44	8	14	8	14	44
		X7	12	3	11	18	44	2	13	11	18	44
		X8	2	19	11	12	44	1	19	11	13	44
		X9	2	7	15	20	44	2	10	17	15	44
3	Pile Joint Welding	X10	0	11	13	20	44	2	11	13	18	44
		X11	4	5	20	15	44	0	5	20	19	44
		X12	2	9	15	18	44	2	10	12	20	44
		X13	8	10	7	19	44	8	10	7	19	44
		X14	9	11	8	16	44	6	11	11	16	44
		X15	5	14	9	16	44	3	14	11	16	44
		X16	1	7	18	18	44	0	6	20	18	44
4	Pile Breaking	X17	2	8	14	20	44	1	5	20	18	44
		X18	3	8	15	18	44	1	11	10	22	44
		X19	7	5	12	20	44	3	9	12	20	44

After obtaining the results from the respondent's questionnaire, then from these results, the average risk probability value and the average risk impact value are calculated which will later be used to find the ranking or sequence of factors or variables that have the most influence or are the most dominant in the occurrence of the type of work accident risk involved. occurred in the work of the Project Pembangunan Infrastruktur Sertifikasi SDM Badan Siber Dan Sandi Negara.

https://doi.org/10.35877/jetech750

OPEN ACCESS

ISSN : 2776-7914 (Print) / 2807-3045 (Online)

Table 5: Calculation of the Average Risk Probability Score

No.	Activity	Risk Event Variable		Probability/Frequency 1	2	3	4	n	Impact Value	Average Impact
1	Heavy Equipment	X1	Exposed to heavy equipment maneuvers.	0	10	25	9	44	131	2.9773
		X2	Limited work location.	10	14	10	10	44	108	2.4545
		X3	Noise.	6	11	14	13	44	122	2.7727
		X4	HSPD leg stuck.	0	0	26	18	44	150	3.4091
2	Pile Placement Setting	X5	Workers fall in excavation.	5	6	18	15	44	131	2.9773
		X6	Workers crushed by falling piles.	10	12	8	14	44	114	2.5909
		X7	Workers hit by piles.	12	3	11	18	44	123	2.7955
		X8	Sling disconnected.	2	19	11	12	44	121	2.7500
		X9	Landslide excavation.	2	7	15	20	44	141	3.2045
3	Pile Joint Welding	X10	Exposed to sparks.	0	11	13	20	44	141	3.2045
		X11	Metal scratched worker connection.	4	5	20	15	44	134	3.0455
		X12	Workers exposed to welding fumes or fumes.	2	9	15	18	44	137	3.1136
		X13	Visual disturbance.	8	10	7	19	44	125	2.8409
		X14	Exploding gas.	9	11	8	16	44	119	2.7045
		X15	Get electrocuted.	5	14	9	16	44	124	2.8182
4	Pile Breaking	X16	Fire.	1	7	18	18	44	141	3.2045
		X17	Respiratory disorders.	2	8	14	20	44	140	3.1818
		X18	Worker tripping over a pole stake.	3	8	15	18	44	136	3.0909
		X19	Workers are injured by work tools (short crowbar and/or bodem).	7	5	12	20	44	133	3.0227

and the following is a table of average impact values:

Table 6: Calculation of the Average Value of Risk Impact

No.	Activity	Risk Event Variable		Impact/Frequency 1	2	3	4	n	Impact Value	Average Impact
1	Heavy Equipment	X1	Exposed to heavy equipment maneuvers.	0	8	25	11	44	135	3.0682
		X2	Limited work location.	5	10	14	15	44	127	2.8864
		X3	Noise.	2	14	14	14	44	128	2.9091
		X4	HSPD leg stuck.	0	5	20	19	44	146	3.3182
2	Pile Placement Setting	X5	Workers fall in excavation.	3	9	22	10	44	127	2.8864
		X6	Workers crushed by falling piles.	8	14	8	14	44	116	2.6364
		X7	Workers hit by piles.	2	13	11	18	44	133	3.0227
		X8	Sling disconnected.	1	19	11	13	44	124	2.8182
		X9	Landslide excavation.	2	10	17	15	44	133	3.0227

https://doi.org/10.35877/jetech750

ISSN : 2776-7914 (Print) / 2807-3045 (Online)

No.	Risk Event			Impact/Frequency					Impact Value	Average Impact
	Activity		Variable	1	2	3	4	n		
3	Pile Joint Welding	X10	Exposed to sparks.	2	11	13	18	44	135	3.0682
		X11	Metal scratched worker connection.	0	5	20	19	44	146	3.3182
		X12	Workers exposed to welding fumes or fumes.	2	10	12	20	44	138	3.1364
		X13	Visual disturbance.	8	10	7	19	44	125	2.8409
		X14	Exploding gas.	6	11	11	16	44	125	2.8409
		X15	Get electrocuted.	3	14	11	16	44	128	2.9091
		X16	Fire.	0	6	20	18	44	144	3.2727
4	Pile Breaking	X17	Respiratory disorders.	1	5	20	18	44	143	3.2500
		X18	Worker tripping over a pole stake.	1	11	10	22	44	141	3.2045
		X19	Workers are injured by work tools (short crowbar and/or bodem).	3	9	12	20	44	137	3.1136

After obtaining the average value of the risk probability and the average value of the impact of the variable risk, the next step is to calculate the risk value to determine the order of the most influential or most dominant variables. To find the risk value, that is by multiplying the average risk probability value with the average risk impact value. Meanwhile, to determine the order of the most influential or most dominant variables using the risk value classification table.

For the calculation of the risk value, which is in the following table 7.

Table 7. Risk Value and Risk Category

No.	Risk Event			Risk Value	Risk Percentage (%)	Risk Level
	Activity		Variable			
1	Heavy Equipment	X4	HSPD leg stuck.	11	71	High
2	Pile Placement Setting	X9	Landslide excavation.	10	61	High
3	Pile Joint Welding	X10	Exposed to sparks.	10	61	High
4	Pile Joint Welding	X11	Metal scratched worker connection.	10	63	High
5	Pile Joint Welding	X12	Workers exposed to welding fumes or fumes.	10	61	High
6	Pile Joint Welding	X16	Fire.	10	66	High
7	Pile Breaking	X17	Respiratory disorders..	10	65	High
8	Pile Breaking	X18	Worker tripping over a pole stake.	10	62	High
9	Heavy Equipment	X1	Exposed to heavy equipment maneuvers.	9	57	High
10	Pile Placement Setting	X5	Workers fall in excavation.	9	54	High
11	Pile Breaking	X19	Workers are injured by work tools (short crowbar and/or bodem).	9	59	High
12	Heavy Equipment	X3	Noise.	8	50	High
13	Pile Placement Setting	X7	Workers hit by piles.	8	53	High

https://doi.org/10.35877/jetech750

ISSN : 2776-7914 (Print) / 2807-3045 (Online)

No.	Risk Event			Risk Value	Risk Percentage (%)	Risk Level
	Activity		Variable			
14	Pile Placement Setting	X8	Sling disconnected.	8	48	High
15	Pile Joint Welding	X13	Visual disturbance.	8	50	High
16	Pile Joint Welding	X14	Exploding gas.	8	48	High
17	Pile Joint Welding	X15	Get electrocuted.	8	51	High
18	Heavy Equipment	X2	Limited work location.	7	44	Medium
19	Pile Placement Setting	X6	Workers crushed by falling piles.	7	43	Medium

From the table 7, regarding the risk value and risk category, it can be seen that there are 17 variables that are included in the High category, because the risk value is in the range of numbers 8-11 and there are 2 variables that are included in the medium category. To determine the type of work accident risk that is dominant, 10 variables will be taken with the results of the calculation of the risk value starting from very high.

5. Conclusion

Based on research analysis with various tests for calculations, then conclusions from the study of K3 risk type analysis on fishing work in Project Pembangunan Infrastruktur Sertifikasi SDM Badan Siber Dan Sandi Negara be:

1) From the results of research the types of risks that can affect work accidents in fishing work in HR Certification Infrastructure Development Project Pembangunan Infrastruktur Sertifikasi SDM Badan Siber Dan Sandi Negara refers to research in Chapter IV it was concluded that from the results of research the type of risk has a risk value that high and has an influence on fishing work, namely:
    a. HSPD legs are projected during heavy equipment work with a risk value of 11 or 71% with high risk type,
    b. Fire during welding work of stake joints with value risk of 10 or 66% with high risk type,
    c. Respiratory disorders during the work of bending the stake with a value risk of 10 or 65% with high risk type,
    d. Workers scratched the joint metal during the connection welding work stake with a risk value of 10 or 63% with this type of risk tall,
    e. Worker stumbles over pole during stake-bending job risk value of 10 or 62% with high risk type,
    f. Landslide of stake excavation during the work of setting the placement of the stake with a risk value of 10 or 61% with a high risk type,
    g. Hit by sparks during stake joint welding work with a risk value of 10 or 61% with a high risk type,
    h. Workers exposed to steam or welding fumes during pole joint welding work stake with a risk value of 10 or 61% with a high risk type,
    i. Workers are injured by work tools (short crowbars and/or bodem) during work stake-breaking with a risk value of 9 or 59% with high risk type,
    j. Exposed to machine maneuvers during heavy equipment work with risk value 9 or 57% with high risk type,
    k. Worker falls in excavation during stake placement setting job with a risk value of 9 or 54% with a high risk type,
    l. Worker hit by digging stake during placement setting job stake with a risk value of 8 or 53% with this type of risk tall,

https://doi.org/10.35877/jetech750

ISSN : 2776-7914 (Print) / 2807-3045 (Online)

m. Exposed to electric shock during welding work of stake joints with a risk value of 8 or 51% with a high risk type,
n. Heavy equipment noise during heavy equipment work with a risk value of 8 or 50% with high risk types,
o. Visual impairment during the work of welding stake joints with a risk value of 8 or 50% with a high risk type,
p. Sling disconnected during the work setting the placement of the stake with value risk of 8 or 48% with high risk type,
q. Gas explodes during welding work of stake joints with risk value of 8 or 48% with high risk type.

2) From the results of the study for the type of risk that the dominant will occur at the time fishing work in Project Pembangunan Infrastruktur Sertifikasi SDM Badan Siber Dan Sandi Negara retrieved 10 variables from the results of the calculation of values risk with the highest number of risk level calculations, namely :

a. HSPD legs are projected during heavy equipment work with a risk value of 11 or 71% with high risk type,
b. Fire during welding work of stake joints with value risk of 10 or 66% with high risk type,
c. Respiratory disorders during the work of bending the stake with a value risk of 10 or 65% with high risk type,
d. Workers scratched the joint metal during the connection welding work stake with a risk value of 10 or 63% with this type of risk tall,
e. Worker stumbles over pole during stake-bending job risk value of 10 or 62% with high risk type,
f. Landslide of stake excavation during the work of setting the placement of the stake with a risk value of 10 or 61% with a high risk type,
g. Hit by sparks during stake joint welding work with a risk value of 10 or 61% with a high risk type,
h. Workers exposed to steam or welding fumes during pole joint welding work stake with a risk value of 10 or 61% with a high risk type,
i. Workers are injured by work tools (short crowbars and/or bodem) during work stake-breaking with a risk value of 9 or 59% with high risk type,
j. Exposed to machine maneuvers during heavy equipment work with risk value 9 or 57% with high risk type.

References

Abadi, R.M.O; Widari, A.L; Zulfhazli, 2018, Analisis Pengaruh Keselamatan Dan Kesehatan (K3) Terhadap Kinerja Pekerja Konstruksi (Studi Kasuss Proyek *the Manhattan Mall & Condominium*), Teras Jurnal, Vol.8, No.1, Maret 2018, E – ISSN 2502 – 1680, P – ISSN 2088 – 0561.

Alysia,L, 2020, Identifikasi Risiko Keselamatan Dan Kesehatan Kerja (K3) Pada Pekerjaan Pemancangan (Studi Kasus Proyek Rusun Ujung Menteng), Tugas Akhir, Universitas Mercu Buana, Jakarta.

Bahri, S ; Purwanto ; Syahputra, Zulfan, 2015, Keselamatan dan Kesehatan Kerja (K3) Pada Proyek Pembangunan Kantor Yonzipur dan Jalan di Makroman Samarinda.

Fertilia, N. C., & Aulia, N. (2020). Analis Risiko Penyebab Keterlambatan Pekerjaan Lift Pada Proyek Pembangunan Rumah Susun Di PT. AB. Jurnal Teknik Sipil, IX(2), 20–28.

Ha, N ; T, Anand, ; Prabhu P, S, ; M, D, 2017, Risk Mitigation of Construction Projects in Hilly Areas.

Indra Arisandi, M, 2017, Analisa Tingkat Risiko Keselamatan dan Kesehatan Kerja (K3) Pada Kegiatan Konstruksi Pembangunan Gedung Laboratorium BBPOM Samarinda.

https://doi.org/10.35877/jetech750

ISSN : 2776-7914 (Print) / 2807-3045 (Online)

Indrayani, R, 2017, Analisis Risiko Keselamatan Kerja Pada Proyek pengembangan Bandara Internasional Juanda Terminal 2 Surabaya, Jurnal IKESMA, Vol. 13 No. 2, September 2017.

Levn, B.C.W.P.S, 2018, Evaluasi Penerapan Keselamatan dan Kesehatan Kerja (K3), (Studi Kasus di PT. Indokon Raya), Laporan Penelitian Universitas 17 Agustus 1945 Surabaya.

Moniaga, F ; Rompis, S.F, 2019, Analisa Sistem Manajemen Kesehatan Dan Keselamatan Kerja (Smk3) Proyek Konstruksi Menggunakan Metode *Hazard Identification And Risk Assessment*, Jurnal Realtech, Vol. 15, No.2, Oktober 2019, ISSN: 1907-0837.

Muammar, F. (2018). ANALISA PERHITUNGAN TINGKAT RISIKO KESELAMATAN DAN KESEHATAN KERJA (K3) PADA PROYEK PEMBANGUNAN MIXED USED SAMARINDA. 3, 1–12.

Muflihah, S ; Setijo Pudjihardjo, H, 2017, Analisis Manajemen Risiko Keselamatan Dan Kesehatan Kerja (K3) Pada Proyek Pembangunan Gedung Di Semarang.

OHSAS (Occupational Health and Safety Assessment Series)18001.

Olivia Hutasoit, E, 2016, Analisa Risiko Kecelakaan Kerja Pada Proyek Pembangunan Jembatan THP Kenjeran Surabaya.

Peraturan Menteri Pekerjaan Umum Nomor: 21/PRT/M/2019 Tentang Pedoman Sistem Manajemen Keselamatan Konstruksi.

Peraturan Pemerintah Republik Indonesia Nomor 50 Tahun 2012 Tentang Penerapan Sistem Manajemen Keselamatan Dan Kesehatan Keria.

Project Management Body of Knowledge (PMBOK). 2017. A Guide to the project Management Body of Knowledge, (PMBOK® Guide)-Sixth Edition.

Ramli, S, 2009, Sistem Manajemen Keselamatan & Kesehatan Kerja OHSAS 18001, Penerbit Dian Rakyat, Jakarta.

Yuliani, U. (2017). Manajemen Risiko Keselamatan dan Kesehatan Kerja (K3) Pada Infrastruktur Gedung Bertingkat. *Jurnal Desain Konstruksi*, *16*(1), 92–100.