**RISK MANAGEMENT OF OCCUPATIONAL HEALTH AND SAFETY ON MECHANICAL, FORMWORK, AND REINFORCING IRON WORK PROCESS AT X BUILDING**

**PROJECT 2020**

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**ABSTRACT**

Risk management is a work process included recognizing, identifying, and assessing risk hazards. This program is one of the components that illustrates the fundamental of occupational health and safety in a company. The purpose was to identify the category of each risks and find the most accurate way to control. This research is semi-quantitative with descriptive design, using interview guidelines, observation checklist, and self-assessing risk based on AS/NZS 4360:2004. Result showed highest risks for mechanical work are risk of workers could had an electric shock while repairing electrical tools; formwork are risk of workers can fall while doing a job on column (over 2 meters) and risk of workers can inhale wood dust while working on wood’s fabrication; lastly, reinforcing iron work are risk of workers can be breathing on particles of irons or concrete dust while doing an iron fabrication. Corona virus was also highest risk for workers. Therefore, researcher gave recommendation by: (1) Installation of barrier around electrical panels area plus cable hanger; (2) Using cross brace scaffolding for activities on the edge of building; (3) Application of dry exhaust system for dusts on formwork area; (4) Using an on-tool extraction for manual grinder on iron fabrications area.

***Key Words:*** *Building Project, Construction, Risk Management*

1. **INTRODUCTION**

Each year it is estimated that thousands of working hours are lost due to accidents occur at the workplace. All workers should have implement and maintain the work environment that are safe and has no risks at the very best way [1]. On present time, the unfavorable and uncertainty labor conditions plus high rates of work accidents have encourage various sectors to be involved in making efforts to reduce the number of work accidents, one of which is by OHS Management System [2]. According to Presidential Decree Number 50 at the year of 2012 describing OHS Management System as one of the system that had been used to control risks in every part of work and help to reach the goals for a safe, productive and efficient workplace.

According to ILO (2013), it is estimated that every year there are around 250 million cases of work accident and more than 160 million workers are exposed by biological hazard at work. The numbers not included with around 1.2 million workers that died due to work accident or by occupational disease. On the year of 2014, Global Burden of Disease Study estimating there are 2.78 million cases of death related to work on every country in Asia. The fact makes Asia as the highest number with total cases are 2/3 from the world cases. In Asia, the most deathly common cases are comes from work related disease with a presentation of 86.3%, and the rest 13.7% comes from fatal accident [3]. On the other hand, Indonesia, as it stated by Social Security Administrator for Workers, reporting that by the year of 2015 there are 105.182 cases of accident at work with 2.375 of it are high impact accident and about 30% of the total cases occurred in the construction sector [4].

There are many factors and models that could be known as a driving force of an accident. The models are described by the theory of loss causation model. All of the risks and hazard that show up because of those factors could be identified by JSA (Job Safety Analysis) method. JSA is one way of conducting a risk assessment. Risk assessment is a part of risk management that illustrates the fundamental of occupational health and safety in a company [5]. There are multiple standard that can be use on conducting a risk management, some of them are ACT 2004, AS/NZS 2004, Committee 2004, DGQ 2007, FAA 2007, HB 2004, IEC 2008, ON 2008, Rio Tinto 2007, Treasury Board of Canada 2001.

Based on the result of observation on project X owned by Y company holdings, there are three work parts that considered as the most dangerous as it required a lot of risks. These are the three work parts: (1) Mechanical; (2) Formwork; and (3) Reinforce. According to *Law on Safety and Health at Work* stated on [6], risk is the chance of injury, illness, or damage to workers arising from an exposure to hazard. Meanwhile the hazard itself is a source of damage that can have a negative impact on people and the environment or even the organization [7]. The hazards that will be identified are include all hazard categories; physical, mechanical, chemical, biological, ergonomic and psychological hazard.

Based on the result of interview with HSE staff on project X, most of the workers have known that the hazard risk category in project X can be categorized as a high risk level. Meanwhile during the construction process, the auditor of the project site usually uses JSA method to identify hazards. On the result of JSA method, the dominant-identified hazard was safety-related hazard such as physical and chemical. While health-related hazards such as biological hazards were almost never identified. Therefore, the authors wish to conduct a more detailed and comprehensive research related to all hazards and risks in the construction sector.

Occupational Health and Safety (OHS) is considered as an applied science. Thus, implementing risk management and providing concrete recommendations for companies are kind of research that is most in accordance with OHS. With this, researcher hope that this study can also be a useful reference and give feedback for project X management to improve the quality of Occupational Health and Safety in the project area. According to the background above, author set the title "Occupational Health and Safety Risk Management in Mechanics, Formwork, and Ironing Work in Project X Year 2020" as the focus of research.

1. **METHODS**

This research was conducted to identify hazard and risks in every work process of mechanical, formwork, and reinforcing, also to describe the category of each hazards and find the most accurate way to control. This study taking place in one of the site projects at South Tangerang. The type of this study is semi-quantitative with descriptive design. Research are held from March to June 2020. Data collected by observation and interviews.

On this study, quantitative data for risk assessment are being processed with an Australian Standard AS/NZS 4360:2004. And for data validation author uses 2 steps of data triangulation included data source (secondary source is from company JSA) and data method using observation checklist and interviews.

1. **RESULTS**

On the phase of observation and hazard identification, researcher successfully identified around 57 hazards, all categorized on 6 hazard categories known as physical, mechanical, biological, chemical, ergonomic, and psychological hazard. At the final result, hazard and risks are categorized on a particular level such as *Low Risk, Moderate Risk, High Risk, and Extreme High Risk,* all still refers to Australian Standard AS/NZS 4360:2004.

**Table 1** List of Hazard and Risks Categorized on Extreme High Risk Level in Mechanical, Formwork, and Iron Work Process in Project X

|  |  |  |
| --- | --- | --- |
| **Work Part** | **Type of Hazard** | **Risk** |
| Mechanical Work | Mechanical Hazard | Risk of workers could have an electric shock while repairing electrical tools |
|  | Biological Hazard | Workers who work during the Covid-19 pandemic are at risks of being exposed to Corona virus. |
| Formwork | Mechanical Hazard | Risk of workers can fall while doing a job on column (over 2 meters) |
|  | Chemical Hazard | Risk of workers can inhale wood dust while working on wood’s fabrication |
|  | Biological Hazard | Workers who work during the Covid-19 pandemic are at risks of being exposed to Corona virus |
| Iron Work | Chemical Hazard | Risk of workers can be breathing on particles of irons or concrete dust while doing an iron fabrication |
|  | Biological Hazard | Workers who work during the Covid-19 pandemic are at risks of being exposed to Corona virus |

Table 1 above are showing risks and types of hazards with highest category from all work process on 3 work section.

Those risk categorizing are done after passing the risk assessment phase and the value of likelihood and consequences were found. Both values were then analyzed by using matrix method from AS/NZS 4360:2004.

**Table 2**. Matrix Method Based on AS/NZS 4360:2004

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ***Likelihood*** | ***Consequences*** | | | | | | |
| 1 | | 2 | | 3 | 4 | 5 |
| A | **H** | **H** | | **E** | | **E** | **E** |
| B | **M** | **H** | | **H** | | **E** | **E** |
| C | **L** | **M** | | **H** | | **E** | **E** |
| D | **L** | **L** | | **M** | | **H** | **E** |
| E | **L** | **L** | | **M** | | **H** | **H** |

Source: Australian Standard AS/NZS 4360:2004 on [8]; [9]; and [10]

Beside managing a risk assessment, data can be obtained from interviews. The following are the points from researcher’s interviews with management and related workers:

1. Project management has a strong OHS commitment and is firm in its implementation.
2. Systematic approach and good communication are use on implementation of OHS program.
3. Workers are generally aware and understand all hazard and risks that are exist on the job.
4. Project management is considered good enough at controlling hazards and is responsible if any kind of work accident occur.
5. Most of the hazard control focuses only on PPE (Personal Protective Equipment) without maximizing all the phase that are above according to hierarchy control.
6. **DISCUSSION**

**Highest Risk of Mechanical Work, Formwork, and Reinforcing Iron Work at Project X**

In the result of risk management, there are several jobs in each division that are categorized as an extreme high risk category.According to *Safe Work Australia*, high risk work could be define as a job that requires a Safe Work Method Statement in the process, or commonly known as a Work Permit [11]. The extreme high risk category that has been identified by the author is in accordance with the list of highest risks issued by Safe Work Australia, which includes the risk of falling from a height (2 meters), the risk of asbestosis to occur, the risk of electrical hazards, and the risk of exploding objects [12]. The following is a list of the highest risks in the work of mechanical parts, formwork, and ironing in project X in 2020:

1. Mechanical
2. Risk of workers got electrical shock during mechanical reparation on tools

In the results of risk management carried out on mechanical parts work, it is known that the highest hazard is on electric current of mechanical equipment with the risk of electric shock. The danger of electric current creates the risk of being electrocuted whether by directly or indirectly (through a panel) is strangely common for mechanical workers. Direct electric shock occurs when workers are directly exposed to an electric current without any safety equipment and indirectly occur if workers are exposed to electric current through the conducting material (pole made of steel and cables under water) in the area near the electric panel.

Electric current is a common cause of fire, shock or electric shock, and most cases of thermal burns in construction work [13]. In the United States, OSHA (Occupational Safety and Health Administration) states that electrical hazards are one of the four fatal hazards in the construction sector and studies show that worker’s behavior and habits have a major influence on the occurrence of accidents related to electrical hazards [14].

The National Fire Protection and Association (NFPA) data reveals that based on cases of fatal incidents due to electric current by type of work, the construction work being ranked first with 923 total fatal cases in the United States. More than half of the total cases (47%) of workers were injured in explosive incidents which is a directly caused by electricity occurred on the construction sector (119 out of 255 people) at the year of 2011-2013 [15].

1. Workers who work during the Covid-19 pandemic are at risks of being exposed to Corona virus.
2. Formwork
3. Workers could fall from height (above 2 meters) while working on columns

The highest risk level found on formwork area are workers could fall while working at height (above 2 meters). Author sees that almost every formwork in project X are working at height because it relates to work on columns, scaffolding, and timber. On the previous data, working at height are estimated to cause about 50-60 fatal cases (more than any other type of work) and causes 4,000 cases of injury each year [16].

Formwork workers spent a whole day and night to work with total 2 times break per day. Each break duration for about an hour and so. Dense working hours plus strenuous work activities had an effect to formwork workers often being negligent and careless in their work. An earlier study in Brazil and Uruguay showed that the average worker who worked at heights (including formwork) relied on confidence and experience in work, so they did not prioritize hazard warnings or safety procedures. Therefore, more effective risk management and more efficient controls are needed for workers [17].

1. Workers can inhale wood dust that are floating in the air during cutting process (can cause lung disease if exposed repeatedly)

Formwork is closely related to wood dust. Exposure to wood dust is felt by workers at any formwork activities. Starting from the installation of scaffolding braces, fabrication processes, column work, and other processes. The whole process involves wood cutting and crushing tools, which of course, will create wood dust. In terms of health, long term dust inhalation can cause a lot of adverse effect on human, such as skin diseases, respiratory problems and rhinitis, asthma, even several types of nose cancer. Meanwhile, in terms of safety, in certain conditions, wood dust are known as one of the cause of fires and explosions due to its flammability [18].

Previous studies have been carried out in Brazil to observe the spread of dust in construction work. The results show that wood dust in the process of cutting wood using a grinder is considered to exceed the Threshold Limit Value (TLV) that have been state on ACGIH (American Conference of Governmental Industrial Hygienists). [19]. Another study conducted in Australia using an experimental method on 6 wood workers showed that all workers experienced changes in activity and lung function, where 2 workers who were active smokers and had a history of asthma showed an adverse-significant change after exposing to wood dust. [20].

1. Workers who work during the Covid-19 pandemic are at risks of being exposed to Corona virus.
2. Iron Work
3. Workers can breathe in concrete and fine metal dust during the fabrication process, which in the long term can cause lung disease.

While carrying out a fabrication work, workers are very susceptible to inhaling concrete and fine metal dust from grinding tools and cutter bars. The masks that have been provided by management are not always worn by workers. With thus, researcher gave recommendation to control the hazards by engineering control*.*

Studies that have been conducted in Netherland show that there are many construction workers exposed to silica dust above the established National Threshold Value of 0.075 mg / m³, the study also confirms that there are significant errors in the reported number of silica dust cases in the world and the quality of their measurements. Another study in the UK came with the same conclusion, where construction workers were shown to have a high to extreme risk of exposure to excess silica dust. [21].

Silica dust are found most on sand, stone, clay, concrete, ceramics, brick and cement-based materials. The highest risk of inhalation to silica dust is found in fabrication work which includes cutting, sawing, drilling, polishing, and milling [22].

1. Workers who work during the Covid-19 pandemic are at risks of being exposed to Corona virus.

**Biological Hazard (Covid-19 Pandemic) and Project Site Program**

According to the result of survey conducted by IAMPI (Indonesian Project Management Expert Associationand IPMA (International Project Management Association) Indonesia on 3 phase of construction work in Indonesia, the results in the planning phase show that 43% of respondents answered Corona virus was very impactful and 26% answered that it had an impact; result of construction phase show that 55% of respondents said it was very impactful and 27% said it had an impact; result of operational phase show that 51% of respondents said it was very impactful and 23% said it had an impact [23].

Project X itself is one of the projects that is considered to have had a significant impact due to the Covid-19 virus, since it was announced to be in the red zone, on April 22 the project management decided to stop most of the work process and return the workers to their hometowns. The work process is slowly continuing to start again on June 2, 2020. During the period from April to the present, project X management has implemented several Occupational Health programs specifically in handling Covid-19. The following are some of the work programs launched by project management related to Covid-19:

1. Measurement of temperature in workers
2. Spraying disinfectant on workers mess and project area
3. Provide vitamin C to all workers
4. Restricted access for visitor around the project area.

In March 2020, the Occupational Safety and Health Administration (OSHA) issued guidelines for workers who were still working during the Covid-19 pandemic. The following is the contents of the manual guidelines (OSHA, 2020):

1. Develop preparedness for infectious diseases and plan response actions
2. Prepare all the basic prevention needs of infectious diseases
3. Develop policies and regulations for workers who are indicated to be sick, such as isolation or partial quarantine
4. Communicate and implement the protective measures to all workers
5. Implementing the principle of hierarchy control while dealing with viruses in the work area.

The results of researcher’s observations regarding the occupational health program carried out by the project management in an effort to deal with Covid-19 are quite good and in accordance with the guidelines made by the Occupational Safety and Health Administration (OSHA).

**Recommendation to Control the Highest Risk of Mechanical Work, Formwork, and Reinforcing Iron Process at Project X**

Recommendation that researcher gave to project management are categorized as engineering control on the theory of hierarchy control. The following are list of recommendations for each work:

1. Mechanical Parts Work
2. Installation of barrier around electrical panels area plus cable hanger
3. Formwork Work
4. Using cross brace scaffolding for activities on the edge of building
5. Application of dry exhaust system for dusts on formwork area
6. Iron Work
7. Using an on-tool extraction for manual grinder on iron fabrications area
8. **CONCLUSION**

Out of the 57 risks identified in the three sections of work, the following are risks with the highest category (extreme high risk): (1) Mechanical part work, namely the risk of workers being electrocuted while doing mechanical work. (2) Formwork is the risk of workers falling from a height on column work above 2 meters and the risk of workers being able to breathe in wood dust that was felled during the wood cutting process. (3) The highest risk for ironwork is the risk of workers being able to breathe in concrete and fine metal dust in the fabrication process which in the long run can cause lung disease. Meanwhile, workers who work during the Covid-19 pandemic are at risks of being exposed to Corona virus was the highest risk to all workers.

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