

FINAL PROJECT

**ANALYSIS OF OCCUPATIONAL HEALTH AND
SAFETY (OHS) PROJECT USING CSA
METHODS IN JOGJA-BAWEN TOLL ROAD**

**A Thesis Presented to the Universitas Islam Indonesia Yogyakarta as
Partial Fulfillment of the Requirements to Obtain the Bachelor
Degree in Civil Engineering Department**



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FINAL PROJECT

ANALYSIS OF OCCUPATIONAL HEALTH AND SAFETY (OHS) PROJECT USING CSA METHODS IN JOGJA-BAWEN TOLL ROAD

Prepared by

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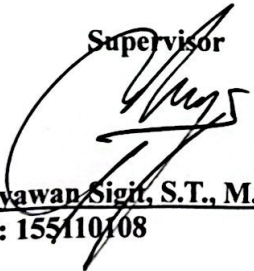
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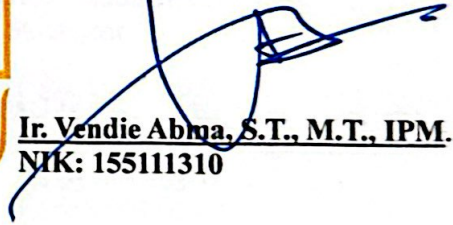
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PLAGIARISM FREE STATEMENT

I hereby declare that the Final Project report that I have compiled as a requirement for the completion of the Bachelor's program in the Civil Engineering Study Program, Faculty of Civil Engineering and Planning, Islamic University of Indonesia, is my own work. Certain parts of the Final Project report that I have quoted from the work of others have been clearly cited in accordance with the norms, rules, and ethics of scientific writing. Should it be discovered at a later date that all or part of this Final Project Report is not my own work or that there is plagiarism in certain parts, I am willing to accept sanctions, including the revocation of my academic degree, in accordance with applicable laws and regulations.

Yogyakarta, 26 September 2025
The Person Making the
Statement



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PREFACE

Praise be to Allah SWT for His divine guidance and blessings, which have enabled the author to complete this Final Project, entitled “Analysis of Occupational Health and Safety (OHS) Project Using CSA Method in Jogja-Bawen Toll Road.” This Final Project is submitted as a partial fulfillment of the academic requirements for the Civil Engineering Undergraduate Program, Faculty of Civil Engineering and Planning, Universitas Islam Indonesia, Yogyakarta.

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Finally, the author realizes that this Final Project is far from perfect due to the limitations of knowledge and ability. Therefore, the author sincerely welcomes constructive criticism and suggestions for improvement in future writings. The author hopes that this Final Project can be beneficial to its readers and serve as additional information for interested parties.

Yogyakarta, 26 September 2025



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ABSTRACT

To ensure worker safety, large scale infrastructure development, such as toll highways, requires a methodical and planned building procedure. The Jogja–Bawen Toll Road project has a high level of risk because it involves the use of heavy equipment, especially during girder erection. The implementation of occupational safety and health systems is an important factor in preventing accidents, protecting workers, and minimizing their impact on the surrounding environment. Risks such as falling materials, extreme weather, and equipment failure must be anticipated through appropriate risk management.

This study aims to analyze the potential hazards and risk control in girder erection work using the Construction Safety Analysis (CSA) method. The CSA approach was used to identify work stages, assess risk levels, and formulate control measures. The research was conducted observationally on the Jogja–Bawen Toll Road Project Package 1 using data collection methods through field observations, interviews, and literature studies. The data were analyzed with reference to the applicable construction safety management standards and national regulations, including direct inspection at the site.

The results show that there are 138 different types of possible risks. The biggest risks are workers being struck by heavy equipment, cranes moving uncontrollably, and girder falls. The use of full PPE throughout the entire work process is the most used control measure. The CSA approach has been successfully used to improve OHS performance and identify possible accidents during girder operations for this toll road project.

Keyword: Occupational Safety and Health, Toll Road, Erection Girder, Construction Safety Analysis (CSA), Risk Management

CHAPTER I

INTRODUCTION

1.1 Background of the Study

Infrastructure encompasses technical facilities, physical structures, systems, hardware, and software essential for delivering public services and supporting networks to ensure smooth economic and social growth Government Regulation No 17 (2022). The development of public infrastructure in a country plays a strategic role in achieving sustainable and inclusive development. Furthermore, well-developed infrastructure can expand market share while creating new employment opportunities for the community. In addition, adequate infrastructure fosters a more competitive environment that drives economic progress. By enhancing societal connectivity to various opportunities, infrastructure also contributes significantly to building a better future Amalia, et al., (2021).

One type of infrastructure that continues to evolve is toll roads. The development of toll roads in Indonesia represents a strategic effort to enhance the efficiency of the transportation system. Toll roads serve not only to alleviate congestion on primary routes but also to accelerate the distribution of goods and services. This development has a particularly significant impact on economically advanced regions Azka, (2024).

The Jogja-Bawen Toll Road is one of the toll road projects currently under construction, with a total length of 75.82 km and is being worked on by PT Adhi Karya (Persero) Tbk. Karya, (2022). This toll road construction project is included in the category of projects with a high level of risk and potential for work accidents, which can result in serious injury or death. However, these risks can be minimized through the implementation of effective risk management. The risk management process includes the stages of identification, analysis, and implementation of strategies aimed at reducing the potential risks that have been

identified L&G, (2022). Referring to PUPR Government Regulation Number 10 of 2021 concerning the Construction Safety Management System (CSMS) guidelines, CSMS is part of the construction implementation management system designed to ensure safety in every stage of construction work PUPR, (2024).

The implementation of occupational safety and health systems requires special attention, especially in large-scale projects such as toll road construction. One of the critical stages in the toll road construction process that requires more supervision is girder erection. As one example, there was an accident that occurred on the Depok - Antasari Toll Road project, the accident was in the form of a girder rod falling on a dump truck underneath due to imperfect maneuvering of heavy equipment when lifting the girder. Therefore, a thorough check of the condition of the heavy equipment used and the readiness of workers is an important step to prevent similar accidents Anwar, (2020).

The Construction Safety Analysis (CSA) method is one approach that can be used to identify and control potential hazards in construction projects in order to prevent and minimize the risk of work accidents during project implementation. In the context of girder installation work, occupational safety and health inspections can be applied using this method Adyuta, (2023). Therefore, the application of the CSA method in analyzing potential hazards and their management in the Jogja-Bawen toll road project is necessary, especially in the girder erection process.

1.2 Problem Statement

1. How many potential accidents could occur during the girder erection process?
2. Is the implementation of occupational health and safety (OHS) properly implemented during girder erection?

1.3 Research Objectives

This study aimed to determine the role of Construction Safety Analysis (CSA) in identifying and controlling potential hazards during girder erection in the Jogja-Bawen toll road project.

1.4 Significant of Research

1. For Students: As a reference for determining the level of work safety through the application of the Construction Safety Analysis (CSA) method.
2. For the office: To provide information regarding work safety, especially in the process of working on the Erection Girder, to maximize the process of checking the safety and security of the workers concerned.

1.5 Scope and Limitation of Research

1. The research was conducted on the Jogja-Bawen Toll Road Project Package 1.
2. This research focuses on the girder erection process.
3. The research only focuses on the occupational safety and health process in girder erection work.
4. Research using the Construction Safety Analysis (CSA) method.
5. The research uses Government Regulation No. 10 of 2021 about occupational safety and health regulations in project work.
6. The research will be verified by the K3 team from PT. PT Adhi Karya (Persero) Tbk,

CHAPTER II LITERATURE REVIEW

2.1 Overview

The purpose of this overview is to provide references to existing research as examples or references for current research. This review is conducted by searching for literature that has the same or similar topics to facilitate the research process.

2.2 Previous Research

The following is previous research.

1. Febriyanto, (2022) in his research, using the hierarchical method which is a quantitative descriptive method by providing a clear picture of the dangers that occur in the erection girder work process. This study aimed to identify the potential and dangers of the erection girder work process using a HIRARC method. The results of this study show that erection girder work is very dangerous, and this activity is dominated by high-risk work with medium risk, if the OHS process is not carried out properly, the risks faced are in the form of serious injuries to death.
2. Nugraha and Rohman, (2022) conducted a study using the Task Demand Assessment (TDA) to quantify the potential risk of work accidents with work activity characteristic factors and worker behavior factors on the project. The purpose of this study is to quantify the risk behavior of the identified risk factors based on the range of project durations from each risk source. The results of the study indicate that the highest risk source is crane collapse during girder erection work, worker health, worker movement, wind speed at the location, worker credibility, and the settings of heavy equipment on the project greatly affect the level of work risk.
3. Cutnyadin, et al., (2024) conducted a study using the HIRADC method by determining risk variables based on previous research. The risk variables are

included in a questionnaire that will be filled in by the HSE contractor and the consultant. The purpose of this study is to identify the risk of erecting girders, determine the results of the risk assessment with reference to Government Regulation No. 10 of 2021, and determine further control in high-risk work. The results obtained from this study were that 16 (28.07%) risks were found out of 57 risks that existed during the Erection Girder work process.

4. Ramdani, (2023) in his research to identify and control potential hazards using the Construction Safety Analysis (CSA) method for bore piles. The purpose of this study is to identify hazards and control risks on bore piles using the Job Safety Analysis (JSA) method. The results obtained from the study were 31 types of potential hazards in bore pile work and the hazard controls used, such as substitution, engineering control, administration, and the use of Personal Protective Equipment (PPE).

Table 2. 1 Comparison Table

No	Aspect	Febriyanto (2022)	Nugraha and Rohman (2022)	Cutnyadin, et al., (2024)	Ramdani (2023)	Current Research (2025)
1.	Title	Occupational Health and Safety Management of Erection Girder Work Using the Hierarchy Method Case Study of Semarang – Demak Toll Road Package 2	Analysis of Work Accident Risks in PCI Girder Erection Work, Tuntang Bridge, Semarang-Demak Toll Project Section 2 Using the Task Demand Method	Study of the Application of Occupational Safety and Health in Girder Work Using the Hiradc Method	Work Accident Risk Analysis on Bore Pile Road Construction Projects Using Construction Safety Analysis Method	Analysis of Work Accidents That Occur During the Girder Erection Process at Jogja-Bawen Toll Road Development with Crane Heavy Equipment
2.	Methods	Quantitative descriptive method by providing a clear picture of the dangers that occur in the erection girder	Task Demand Assessment (TDA), used to quantify the potential risk of work accidents with work activity	Hiradc method by determining risk variables based on previous research	Identify and control potential hazards using the Construction Safety Analysis (CSA) method on bore	Identify the high risk in Erection Girder process using CSA Method

Table 2. 1 Continue of Comparison Table

No	Aspect	Febriyanto (2022)	Nugraha and Rohman (2022)	Cutnyadin et al., (2024)	Ramdani (2023)	Current Research (2025)
		work process	characteristic factors and worker behavior factors on the project		piles	
3.	Purpose	Identify the potential and dangers of the erection girder work process using the hierarchical method	Quantify the risk behavior of the identified risk factors based on the range of project duration from each risk source	Identify the risk of erection girders, find out the results of the risk assessment with reference to Government Regulation No. 10 of 2021, and determine further control in high-risk work.	Identify hazards and control risks on bore piles using the Job Safety Analysis (JSA) method	Hazard identification and risk control in girder erection work using the Construction Safety Analysis (CSA) method

Table 2. 1 Continue of Comparison Table

No	Aspect	Febriyanto (2022)	Nugraha and Rohman (2022)	Cutnyadin et al., (2024)	Ramdani (2023)	Current Research (2025)
4.	Results	Erection girder work is very dangerous, this activity is dominated by high-risk work with medium risk, if the OHS process is not carried out properly, the risks faced are in the form of serious injuries to death	The highest risk source is crane collapse when carrying out girder erection work. Worker health, worker movement, wind speed at the location, worker credibility and the settings of heavy equipment on the project greatly affect the level of work risk	16 (28.07%) risks were found out of 57 risks that existed during the Erection Girder work process	31 types of potential hazards in bore pile work and the hazard controls used, such as substitution, engineering control, administration, and also the use of Personal Protective Equipment (PPE).	There are 138 types of potential hazards found during girder installation work. Many potential hazards were found during girder installation work, and fewer potential hazards were found during preparation work.

Based on the table above, the differences are in the methods used in the research process, the table above shows the Hiradc and TDA methods carried out in the research process on the girder erection process. The research used the CSA method was carried out on Bore Pile work. In the research being conducted, the Construction Safety Analysis (CSA) method is used in the girder erection work process. The research process itself is located on the Jogja-Bawen Toll Road Package 1.

CHAPTER III THEORITICAL FRAMEWORK

3.1 Occupational Health and Safety

Occupational Safety and Health in Construction refers to a series of activities aimed at ensuring and protecting the safety and health of workers. This is done through various efforts to prevent work accidents and diseases that can arise from activities in construction work Permen PUPR No 10 tahun 2021, (2021).

Based on Human Resources Development Agency (2019), every work accident has a cause that is generally unidentified or unplanned. The following are factors that cause accidents:

1. Unsafe actions by employees: This factor can come from the employer, such as Supervisors, Foremen, Superintendents, or Managers, or from the actions of the employees themselves.
2. Unsafe working conditions: This cause includes equipment or machines operating in unsafe conditions and a work environment that is uncomfortable or does not meet safety standards.
3. Factors beyond human control (Act of God): Accidents caused by this factor occur due to God's will or destiny. The percentage is very small, a maximum of 2%, and is often considered unreasonable so that it is difficult to explain scientifically.

The results of the study show a graph of the proportion of causes of work accidents, where unsafe actions by employees account for 88%, unsafe working conditions for 10%, and factors beyond human control (Act of God) for 2%. This data was obtained from statistics on work accidents in industrial companies in general, not limited to the mining sector. These findings indicate that human factors are the main cause of most work accidents.

3.2 Risk

Risk is a concept that has been defined by experts in various disciplines, including economics, management, finance, and social sciences Sholeh, (2023). According to ISO 45001:2018, risk is defined a combination of the likelihood of hazardous events or exposures related to work, and the degree of injury and health problems that can be caused by those events or exposures. According to Sholeh (2023) In construction projects, risks can come from various sources, including:

1. Technology and design: Limited design quality, changes in technical specifications, or the complexity of the technology applied in the project.
2. Environment: The influence of natural factors such as extreme weather, earthquakes, or unstable environmental conditions.
3. Human factors: Limited skills and worker performance, ineffective project management, or conflicts between parties involved in the project.
4. Finance: Uncertainty in material and labor costs, currency exchange rate fluctuations, or economic instability.
5. Laws and regulations: Changes in government regulations, difficulty in obtaining permits, or changing legal requirements.

3.2.1 Risk Management

According to Vorst, et al., (2018), risk management is defined as a series of coordinated activities to direct and control an organization in the face of risk. The main objective of risk management is to create and protect organizational value, which ultimately improves performance, drives innovation, and supports the achievement of strategic objectives.

The essential elements required for effective risk management implementation include the following:

1. Integrated
Risk management should be an integral part of all organizational activities, including strategic planning, operations, and decision-making.
2. Structured and Comprehensive

A structured and comprehensive approach to risk management supports consistency in risk identification, analysis, and control, resulting in more reliable results.

3. Customized

The risk management framework and process need to be customized to the external and internal context of the organization and aligned with its strategic objectives.

4. Inclusive

Timely involvement of relevant stakeholders enables the integration of their knowledge, views, and perceptions into the risk management process, thereby increasing awareness and effectiveness of risk management.

5. Dynamic

Risk management should be able to anticipate, detect, and respond to changes in risks that emerge, develop, or disappear as the external and internal context of the organization changes.

6. Best Available Information

The risk management process should be based on historical data, current information, and future projections, considering the limitations and uncertainties in that information. This information must be clear, relevant, and accessible to all relevant stakeholders.

7. Human and Cultural Factors

Human behavior and organizational culture have a significant impact on all stages and levels of risk management. Therefore, these elements must be considered in depth.

8. Continuous Improvement

Risk management must be continuously improved through learning from experience, evaluation, and development of best practices.

These elements form the foundation of effective risk management, as illustrated in the following illustration.

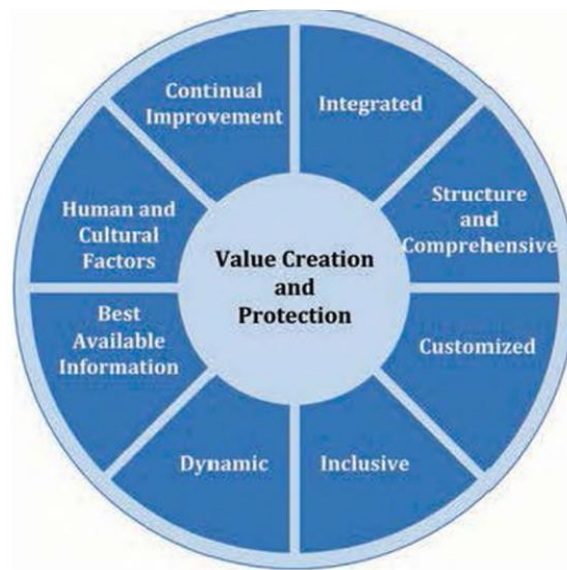


Figure 3. 1 Value Creation and Protection of Risk Management
(Source: ISO 31000:2018)

3.2.1 Risk Assessment

Based on ISO 45001:2018, risk assessment is the process of assessing risks and controls must be prioritized against the identified risk levels of hazards in the workplace. The primary goal of risk analysis is to understand the characteristics and nature of risk, including the level of risk, if applicable. This process includes a thorough analysis of uncertainties, sources of risk, consequences, likelihood of occurrence, scenarios, existing controls, and their effectiveness.

Risk analysis is influenced by a variety of factors, such as differences of opinion, bias, risk perception, and individual judgment. Additional factors include the quality of the information used, the assumptions and exceptions made, the limitations of the techniques used, and the way the techniques were implemented. All these influences need to be considered, documented, and communicated to decision makers.

The results of the risk analysis provide a basis for evaluating risk, determining the risk treatment required, and selecting the most appropriate mitigation strategy or method. In addition, the analysis provides important

insights for decision making, especially in situations involving multiple options with varying levels of risk.

3.3 Work Accident

According to the Regulation of the Minister of Manpower of the Republic of Indonesia Number 10 of 2016, Work accidents refer to incidents that occur in the context of employment relationships, including incidents that occur during the journey to and from the workplace, as well as diseases caused by work environment conditions.

According to BPJS, work accidents can occur due to several main factors, as follows:

1. Negligence of safety procedures

High-risk jobs, such as work at heights, have safety procedures that must be followed, including the use of Personal Protective Equipment (PPE). Failure to comply with these procedures can endanger the safety of workers and others around them.

2. Lack of training and education

Training and education before starting work aims to ensure that workers understand safe working methods, such as the use of heavy equipment or sharp objects. Workers who do not receive adequate training tend to have a higher risk of work accidents.

3. Suboptimal physical condition

Physical health factors, such as lack of sleep or fatigue, can affect concentration and the ability to work safely. Poor physical condition increases the likelihood of work accidents.

4. Inconsistency of work equipment with safety standards

Work equipment must meet safety standards, such as being in good condition and free from damage. The use of unsafe or non-standard equipment can increase the risk of accidents during work.

These factors indicate the importance of implementing comprehensive occupational safety to prevent accidents in the workplace.

3.4 Erection Girder

Girder is a structural element in the form of a beam that functions to support the load on the bridge structure and channel it to the lower structure, such as piers or abutments. Girder is installed lengthwise between two main supports. The girder installation process usually takes about a week, including several stages of work such as stressing, grouting, to girder installation (girder erection). Girder erection is the stage of placing the girder beam precisely at its support position Putra, (2023).

3.4.1 Work Method for Erection Girder

The following are the steps explained by ADHI regarding the erection girder process.

1. The girder will be loaded onto the boogie using 2 cranes which are on the left and right sides of the girder rod. The time required is 10 minutes.
2. The girder is tied to the tentable, the time required is 10 minutes.
3. The boogie moves to the Erection area, the time required is 10 minutes.
4. Install the lifting frame, the time required is 5 minutes.
5. The crane does the lifting, the time required is 5 minutes.
6. The crane will swing, the time required is 5 minutes.
7. The crane will move, the time required is 5 minutes.
8. The girder is on the top of the bearing pad, the time required is 15 minutes.
9. After the girder is installed, bracing is carried out using profile steel to stabilize the standing girder. Only on girder no. 1.
10. Placing the 2nd Girder on the bearing pad.
11. The middle girder bracing uses profile iron installed above the girder and diagonal wooden bracing next to the girder, this bracing is done on the 2nd girder and so on.

3.5 Crane

Crane is a heavy equipment used to lift and move large amounts of material with significant weight. This tool has an elongated design, high lifting capacity, and the ability to rotate up to 360 degrees with a range of tens of meters. Crane operations generally use oil-based hydraulic systems, although some types are also equipped with air-based pneumatic systems. This tool is designed to lift loads vertically and horizontally and move them to certain locations with predetermined working mechanisms.

3.5.1 Types of Crane Heavy Equipment

Here are some types of cranes that are commonly used in girder erection work:

1. Tower Crane

Tower cranes are one of the tools that are often used in large-scale construction projects. This tool has a high lifting capacity and is able to reach a wide work area. However, the installation of tower cranes takes quite a long time because it requires a strong foundation to ensure operational stability and safety. With its wide reach and large lifting ability, tower cranes are the mainstay tool in high-rise building construction projects and other large infrastructure.



Figure 3. 2 Tower Crane
(Sources: Google)

2. Crawler Crane

Crawler cranes are equipped with chain wheels that allow this tool to move on difficult or uneven terrain. This crane is ideal for construction projects in areas with unstable soil conditions, such as muddy land or undulating surfaces. Although its lifting range is not if a tower crane, the advantage of a crawler crane lies in its flexibility in operating on difficult terrain and hard-to-reach areas.



Figure 3. 3 Crawler Crane
(Sources: Personal Documentation)

Overall, the variety of crane types reflects the importance of specialization in meeting various operational needs in the field. Continuous technological innovation and design development make cranes more efficient and safer in supporting lifting and moving activities Fehabutar, (2023).

3.6 Construction Safety Analysis

Construction Safety Analysis (CSA), also known as Job Safety Analysis (JSA), is a safety management method that aims to identify potential hazards associated with each stage of work or task performed. This technique focuses on analysing the interactions between workers, tasks performed, the work

environment, and the equipment used, to ensure overall work safety Cheatham, (2023).

Based on PT. Kualitas Indonesia System (2021) The implementation of occupational health and safety (OHS) in a company is a crucial aspect to create a safe working environment while reducing the risk of work accidents. The benefits of implementing Job Safety Analysis (JSA) are:

1. Supporting the identification of the need for personal protective equipment (PPE) required, such as earmuff, safety glasses, gloves, safety shoes, helmets, body harness, and equipment for manual handling assistance.
2. Helping to identify hazardous energy sources in the work environment, including heat sources, electricity, hydraulic energy, pneumatics, chemicals, kinetic energy, mechanics, centrifugal, and gravity, through the Lockout Tagout (LOTO) procedure.
3. Encouraging active participation of workers in the implementation of the occupational safety and health system, thereby creating awareness and shared responsibility.
4. Strengthening communication and building trust between management and employees, which ultimately increases cooperation in the implementation of OHS.

3.6.1 Identifying CSA method.

The steps for preparing a Construction Safety Analysis (CSA) in accordance with PUPR Regulation No. 10 of 2021, guidelines for Construction Safety Management Systems, are as follows:

1. Construction service providers must prepare a Construction Safety Analysis, which is part of the application for a work permit for medium- and high-risk work.
2. The CSA must include a description of the sequence of work steps according to the implementation method.

3. Hazard identification is conducted based on a multi-hazard analysis that covers potential hazards at each stage of the work.
4. Establish the necessary risk control measures to prevent or reduce identified hazards.
5. A person responsible for risk control should be appointed during the implementation of the work.
6. The PPE is included in the documents that must be attached when applying for a work permit and is part of the work-implementation plan.
7. Conduct a pre-construction meeting to discuss and approve work safety documents, including the PPE.
8. This process aims to ensure construction safety in accordance with the standards set out in the Construction Safety Management System.

These steps ensure that safety risks are identified and controlled systematically before construction work begins, in accordance with the official regulations of the Ministry of Public Works and Public Housing.

PT. Ahli K3 Umum		JOB SAFETY ANALYSIS		No Dokumen : 001-HKSE/SA/2014
				Revisi : 01
				Terbit : 12 Juli 2014
				Departemen : Produksi
				Pelaksana : Operator Gerinda
No JSA	: 001-HKSE/SA/2014	Terbit	: 12 Juli 2014	
Nama Pekerjaan	: Gerinda Hasil Besi Cor	Departemen	: Produksi	
Pengawas	: Supervisor Produksi	Pelaksana	: Operator Gerinda	
APD	: 1. Kacamata Keselamatan 2. Sepatu Keselamatan 3. Masker kain		4. Sarung tangan kulit 5. Stoking lengan	
No	Urutan Kerja	Potensi Bahaya	Upaya Pengendalian	
1.	Mengambil hasil batang besi cor di sisi kanan mesin gerinda dan memasangkannya di ujung roda batu gerinda.	Tangan tergores ujung batang besi cor yang tajam. Batang besi cor jauh mengenai kaki.	Menggunakan APD sarung tangan kulit, sepatu keselamatan dan stoking lengan yang disediakan.	
2.	Memasukkan batang besi cor ke roda batu gerinda yang berputar untuk menghaluskan batang besi cor.	Tangan tergores roda batu gerinda yang berputar. Percikan api mengenai muka/badan. Asap mengganggu pernafasan.	Menggunakan APD sarung tangan kulit, masker kain, kacamata keselamatan dan stoking lengan yang disediakan. Memastikan exhaust ruangan sudah dinyalakan. Memastikan kaca penahan percikan api pada mesin gerinda terpasang dengan benar.	
3.	Meletakkan batang besi cor yang sudah dihaluskan ke sisi kiri mesin gerinda.	Tangan tergores ujung batang besi cor yang tajam. Batang besi cor jauh mengenai kaki.	Menggunakan APD sarung tangan kulit, sepatu keselamatan dan stoking lengan yang disediakan.	
Disusun Perugas K3		Diperiksa Kabag HRD	Disetujui Kabag Produksi	Ditinjau
Nama : _____		Nama : _____	Nama : _____	
Tanggal : _____		Tanggal : _____	Tanggal : _____	

Figure 3. 4 Example of CSA form
(Sources: PT. Ahli K3 Umum)

3.6.2 Construction Safety Analysis (CSA) Method

According to Friend and Kohn (2006), the JSA method is divided into several techniques that can be used:

1. Observation method

In this method, Job Safety Analysis is carried out through observation interviews to determine work steps and potential hazards encountered with the aim of collecting data related to the place, environment, time, and implementation of OHS at the workplace.

2. Discussion method

This method is used for tasks that are rarely performed and is usually applied to workers who have completed a task and are allowed to exchange knowledge about the work steps and potential hazards involved in that task.

3. Reviewing existing procedures method

This method is used when the work process is ongoing, and workers cannot be met. Everyone involved in this process can provide ideas related to the steps and potential hazards in the observed work.

CHAPTER IV RESEARCH METHOD

4.1 Type of Analysis

This research is observational, where the process is carried out through direct observation at the project site. The research was conducted on the Jogja-Bawen Toll Road Project Package 1 with the main focus on the implementation of Occupational Health and Safety during the erection girder implementation. Field observations allow researchers to directly observe the implementation of Occupational Health and Safety in accordance with the regulations set by the project. In addition, this study also applies the Construction Safety Analysis (CSA) method as the main approach in analysing occupational risks and safety.

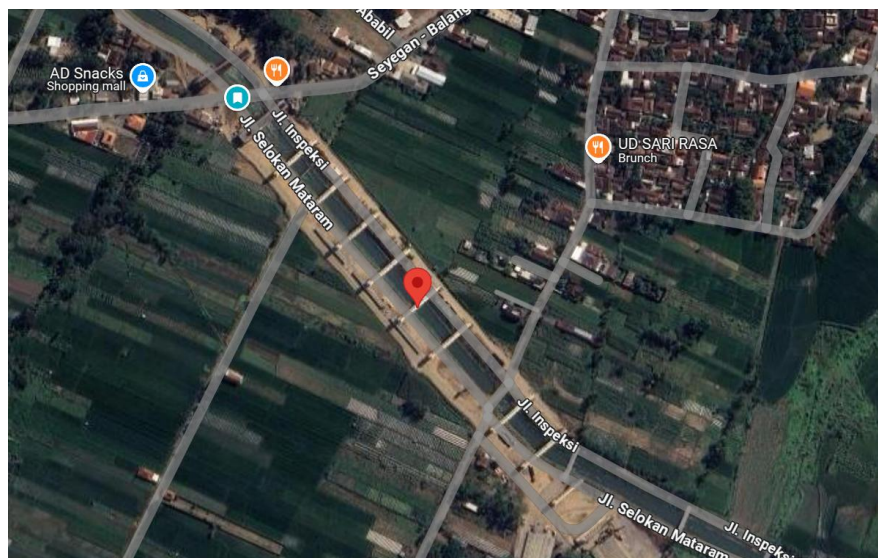


Figure 4. 1Project Site Location
(Sources: Google Maps)



Figure 4. 2 Site Location
(Sources: Personal Documentation)

4.2 Data Collect

Data collection in this study will be carried out through two methods, namely primary data, and secondary data:

1. Primary data

Primary data is data collected directly by researchers at the research location through observation, interviews, and questionnaire distribution (Syafnidawaty, 2020). The primary data needed in this study include:

- a. Field observation results using the Construction Safety Analysis (CSA) method.
- b. Interview with HSE to validate data related to occupational safety and health by comparing existing policies with implementation in the field.
- c. Documentation in the form of photos as supporting evidence in the study.

2. Secondary data

Secondary data is data obtained by researchers indirectly through intermediary sources Syafnidawaty, (2020). In this study, the secondary data used include:

- a. Regulation of the Minister of Public Works and Public Housing No. 10 of 2021 concerning Guidelines for the Construction Safety Management System.
- b. Regulations related to occupational safety and health that apply on that site project.
- c. Literature study was conducted to explore literature related to work accidents, girder erection process, and occupational safety and health aspects. This study aims to obtain theoretical understanding that supports the analysis in the study.

4.3 Data analysis

The analysis stages in this study were carried out in depth and in detail to ensure results that are in accordance with the research objectives. The research analysis steps are arranged systematically as follows.

- 1. Collecting data through literature studies, such as data related to work accidents in girder erection work.
- 2. Conducting direct observation of the girder erection work in depth by documenting ongoing activities. In addition, interviews with consultants or contractors from HSE are conducted to understand work methods that have the potential to cause work accident risks.
- 3. Conduct data analysis based on documentation obtained from the field, which includes identification of potential hazards and control measures to address these risks.
- 4. Compiling an analysis table using the Construction Safety Analysis (CSA) method that is adjusted to research needs and refers to the provisions in PUPR Ministerial Regulation No. 10 of 2021.
- 5. Conduct verification of the table that has been prepared based on the data obtained. The verification process is carried out by respondents, especially HSE officers, to ensure its compliance with the needs in controlling potential hazards. The results of this verification can be used to improve

the process of identifying and controlling hazards that have been carried out.

6. The repair results that have passed the verification stage are re-entered into the Construction Safety Analysis (CSA) table that has been prepared previously.
7. Discussions and adjustments related to occupational health and safety aspects are carried out with reference to applicable regulations, especially PUPR Ministerial Regulation No. 10 of 2021. This adjustment aims to ensure that the implementation of the construction safety system is in accordance with established standards, so that the risk of work accidents can be minimized effectively.

4.4 Flowchart

The research flow diagram or research flowchart, including the flow for making a Construction Safety Analysis (CSA), can be seen in Figure 4.1 below.

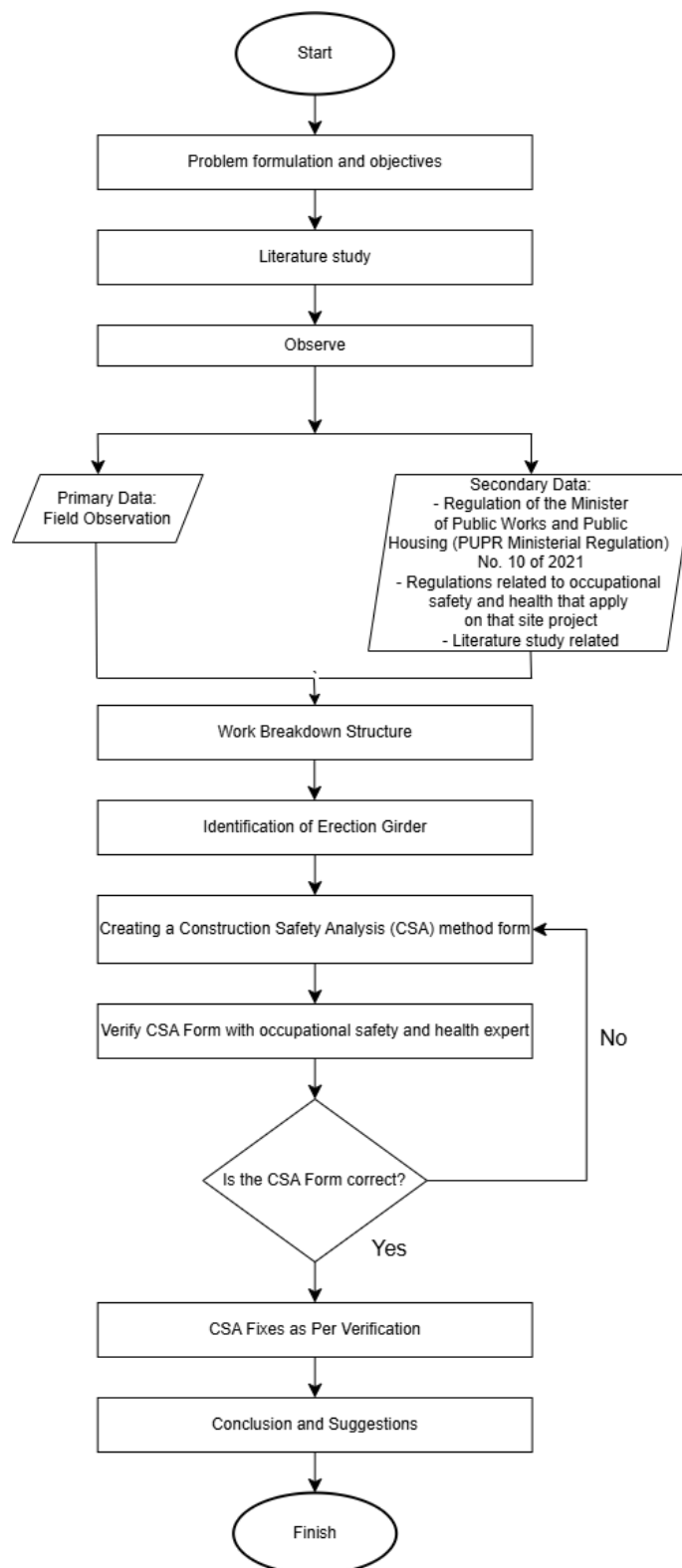


Figure 4. 3 Flowchart

CHAPTER V

ANALYSIS AND DISCUSSION

5.1 Research Implementation

This research was conducted on the Jogja-Bawen Toll Road Construction Project Section 1 located in STA 71+731. This project consists of various stages of construction work, one of which is the girder erection process. Data collection was carried out through direct observation methods at the location when the girder erection activity was taking place. The results of the observation were used as a basis for identifying potential hazards and risks that existed during the implementation of the work. The data obtained were then used as a reference in compiling the Construction Safety Analysis (CSA) form systematically.

Data collection in this study refers to the international standard ISO 45001:2018. The standard provides general guidelines related to risk management that apply in various contexts, including in the construction work environment. ISO 45001:2018 covers aspects of identification, assessment, treatment, and monitoring and review of risks.

5.2 General Project Data

5.2.1 Project Profile

The Jogja-Bawen Toll Road construction project is a strategic project that is currently still in the implementation stage of Section 1. The location of the construction of this section is in the Yogyakarta area, precisely in the Banyurejo area. Below is the general profile of the project:

1. Project name : Yogyakarta-Bawen Toll Road
2. Project location : D.I. Yogyakarta & Central Java
3. Highway length : 75.12 km
4. Contractor : PT Adhi Karya (Persero) Tbk.

5.2.2 Project Location

The following are the locations where the STA project data collection was carried out.

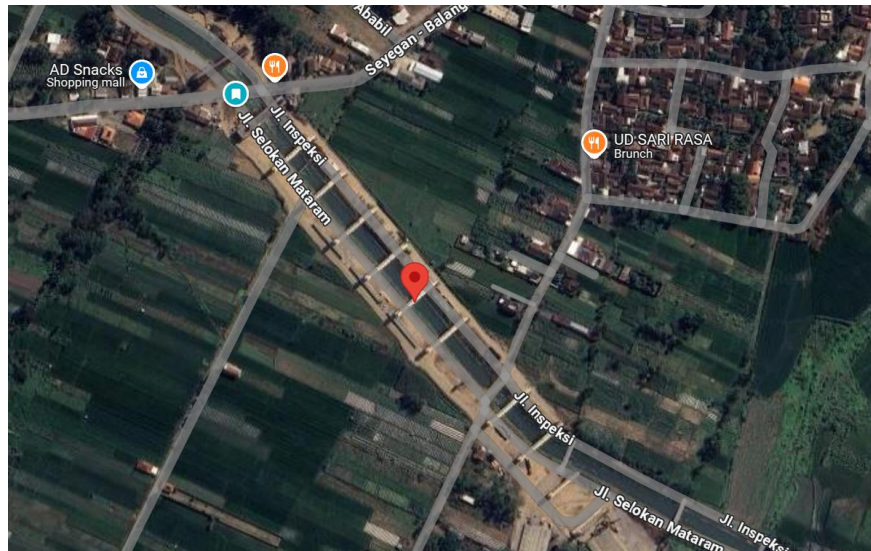


Figure 5. 1 Project Location STA 71+731
(Source: Google Maps)

5.3 Data Analysis

The data analysis in this study was conducted after the data collection process through direct field observations was completed. Data analysis was conducted using the Construction Safety Analysis (CSA) method as the primary approach. This method is used to identify potential hazards, assess risk levels, and formulate control measures during girder erection activities.

5.3.1 Identify the sequence work Erection girder

The girder erection process on the Jogja–Bawen Toll Road project was carried out using two methods, one of which was crane lifting. This work consisted of several critical stages that must be carried out to ensure safety and successful implementation in the field. The following details the girder erection stages used in the project.

Table 5. 1 Job description

No	Job	Job Sequence
1	Preparation Work	1. Worker condition check 2. Worker coordination 3. Provide sign in required areas
2	Loading Girder	1. Traffic management 2. Sling attachment to girder 3. Girder placed in boogie
3	Moving Girder	1. Boogie moves to erection area 2. Attach girder to crane
4	Erection Girder	1. Install lifting frame 2. Lifting girder using crane 3. Anchor Installment 4. Crane swing 5. Crane will be moving 6. Girder will be placed on the bearing pad
5	Bracing	1. Girder end bracing 2. Girder center bracing

5.3.2 Identify Potential Hazards

After outlining the work stages in the girder erection process, the next step is to identify potential hazards in each job description. This identification is conducted using the Construction Site Analysis (CSA) method, Data were collected from direct observations in the field using observation and discussion methods. Observations were made on 14 girders that underwent the erection process over three days. The discussion method was carried out in the field by asking questions of the HSE and workers who were directly involved.

The Preparation Work phase of the girder erection process consists of three main activities: worker condition checks, worker coordination, and providing

sign-in to required areas. These three stages have potential hazards that must be identified to ensure occupational safety and health during the activity.

1. In the Preparation Work, there are several important steps directly related to the workers' condition, one of which is the worker condition check. At this stage, workers undergo a comprehensive health check to ensure their physical and mental readiness before entering the work area. More details are below:
 - a) Workers who fail health screenings, such as blood pressure, balance, and physical exams, must be replaced by another worker who meets occupational health criteria. Workers who fail these standards must be given adequate rest until they are deemed fit to return to work. Unpreparedness not only can negatively impact the quality of their work but can also endanger the safety of themselves and their coworkers.
2. The worker coordination stage is a crucial part of the work preparation process, ensuring all workers understand their respective roles and responsibilities. During this stage, workers are given detailed and in-depth instructions regarding work procedures and potential hazards that could occur during the task.
 - a) A lack of worker understanding of tasks and work procedures can increase the risk of operational errors in the field. This situation has the potential to lead to dangerous incidents that endanger not only the worker but also other workers in the project area.
 - b) Workers who lack work permits, such as an Operational Permit (SIO) and an Operational Eligibility Permit (SILO), are a potential hazard during project implementation. The lack of these permits indicates that workers lack the necessary competence or expertise to safely operate equipment. This can lead to errors in equipment operation, which risks damage to the equipment and endangers surrounding workers.
3. Providing signs in required areas is a preventative measure to increase awareness and safety at project sites. These signs serve as information to alert workers and related parties about potential hazards, restricted areas, and safety procedures that must be followed.

- a) Placing safety signs in inappropriate locations can reduce the effectiveness of risk awareness in the work area. Certain areas are required to be equipped with warning signs in accordance with applicable safety standards to accurately communicate potential hazards. If signs are not put in designated locations, this can endanger workers in the field and the public surrounding the construction project area.
- b) The availability of adequate and appropriate safety signs in construction areas is crucial for preventing workplace accidents. A shortage of signs can lead to a lack of information about potential hazards, increasing the risk of accidents for both workers and the surrounding community. If signs are not installed in these areas, people can easily enter hazardous construction zones, potentially leading to fatal accidents.

Each stage of the work, from the preparation to the bracing girder, is described along with the sequence of activities and hazard risks. Therefore, a table is needed to provide a detailed overview of the sources of danger to facilitate the planning of occupational safety and health control measures for construction projects. The following are the details related to each potential hazard that may occur at each stage of girder erection work.

Table 5. 2 Identification of Hazards in Girder Erection Work

No.	Job	Job Sequence	Hazard Potential
1.	Preparation Work	Comprehensive Condition Examination	1. Workers fail health screenings 2. Worker has a high level of alcohol in his body 3. Working area do not ready 4. Heavy equipment in a worst condition 5. Bad weather
		Worker coordination	1. Workers do not understand their work. 2. Worker do not understand the rules
		Provide sign in required areas	1. Workers placed signs in inappropriate places 2. Lack of signs provided
2.	Loading Girder	Traffic Management	1. Workers get hit by heavy equipment 2. Heavy machinery going haphazardly 3. The heavy equipment slip while passing by
		Sling attachment to girder	1. Workers stuck between sling and girder 2. Sling ripped and broken 3. Girder fell because sling was not strong enough.

Table 5.2 Continuation Identification of Hazards in Girder Erection Work

No.	Job	Job Sequence	Hazard Potential
	Loading Girder	Girder placed in boogie	1. Poor worker coordination 2. Worker crushed by girder 3. Worker hit by boogie 4. Worker struck by webbing sling 5. Worker crushed by boogie 6. Boogie improperly positioned 7. Boogie slipped 8. Girder broken during loading 9. Girder fell during loading 10. Girder not properly secured to the boogie board

Table 5.2 Continuation Identification of Hazards in Girder Erection Work

No.	Job	Job Sequence	Hazard Potential
3.	Moving Girder	Boogie moves to erection area	1. The road to the erection area is poor 2. Girder falls in route 3. Girder breaks in route 4. Boogie goes the wrong way 5. Boogie slips 6. Boogie loses control 7. Worker hit by boogie 8. Worker crushed by falling girder 9. Worker crushed by boogie 10. Worker dragged by boogie 11. Unauthorized worker gets too close to girder being lifted 12. Girder webbing sling breaks 13. Residents entering the road area towards erection area

Table 5.2 Continuation Identification of Hazards in Girder Erection Work

No.	Job	Job Sequence	Hazard Potential
		Attach girder to crane	1. Workers getting lifted by girders 2. Workers getting hit by crane 3. Worker crushed by girder
4.	Erection Girder	Install lifting frame	1. The girder webbing sling broke 2. Worker was crushed by the girder 3. The lifting frame equipment was missing 4. The worker did not understand the frame installation process 5. The girder fell during lifting 6. The girder broke during lifting 7. The girder rolled during lifting 8. The girder was lifted incorrectly by the crane 9. The girder frame was no longer suitable for use

Table 5.2 Continuation Identification of Hazards in Girder Erection Work

No.	Job	Job Sequence	Hazard Potential
		Anchor installment	<ul style="list-style-type: none"> 1. Girder broke 2. Girder fell during lifting 3. Girder broke during lifting 4. Girder webbing sling broke 5. Worker trapped between boogie and girder 6. Worker not understanding their job 7. Worker crushed by girder 8. Worker lifted during girder lifting 9. Worker crushed by boogie 10. Unauthorized worker gets too close to lifted girder 11. Boogie suddenly moves during installation 12. The anchor installed on the bearing pad is not strong enough causes fall/break/disappear 13. People enter the erection area while the girder is being lifted

Table 5.2 Continuation Identification of Hazards in Girder Erection Work

No.	Job	Job Sequence	Hazard Potential
		Lifting girder in crane	1. Worker crushed by girder 2. Worker not skilled in crane operation 3. Unauthorized worker entering girder lifting area 4. Crane slips 5. Crane suddenly moves 6. Girder webbing sling breaks 7. Girder falls during lifting 8. Girder breaks during lifting 9. People enter area when girder lifting occurs

Table 5.2 Continuation Identification of Hazards in Girder Erection Work

No.	Job	Job Sequence	Hazard Potential
		Crane Swing	<ul style="list-style-type: none"> 1. Crane rotated in the wrong direction 2. Crane derailed 3. Worker hit by crane 4. Worker crushed by girder 5. Worker crushed by crane 6. Unauthorized worker in swing girder area 7. Girder fell while swinging 8. Girder broke due to incorrect rotation direction 9. Girder webbing sling became loose 10. Crane rotation position was incorrect 11. People were passing by in swing area

Table 5.2 Continuation Identification of Hazards in Girder Erection Work

No.	Job	Job Sequence	Hazard Potential
		Crane moving	<ul style="list-style-type: none"> 1. The crane went in the wrong direction while moving 2. The crane derailed while moving 3. Worker was hit by the crane 4. Worker was crushed by the girder 5. Worker was crushed by the crane 6. Unauthorized worker was in the area where the crane was moving 7. Girder fell while moving 8. Girder broke due to the two cranes rotating in the wrong direction 9. Girder webbing sling came loose 10. Crane was in an incorrect position 11. People were passing by in the area where the crane was moving

Table 5.2 Continuation Identification of Hazards in Girder Erection Work

No.	Job	Job Sequence	Hazard Potential
		Girder placed in bearing pad	<ol style="list-style-type: none"> 1. Crane went in the wrong direction while moving 2. Crane slipped during the girder installation process 3. Worker was hit by the crane 4. Worker was crushed by the girder 5. Worker was crushed during the girder installation 6. Worker's hand was caught between the girder and the bearing pad 7. Worker was crushed by the crane 8. Unauthorized worker was entering the crane area 9. Girder fell while the girder was being installed 10. Girder broke due to the two cranes rotating in the wrong direction

Table 5.2 Continuation Identification of Hazards in Girder Erection Work

No.	Job	Job Sequence	Hazard Potential
		Continuation Girder placed in bearing pad	11. Girder end was damaged while being installed on the bearing pad 12. Girder webbing sling came loose 13. Crane was in an incorrect position 14. People were passing by in the crane's moving area
5.	Bracing	Girder end bracing	1. Girder fell during bracing 2. Girder buckled and broke 3. Worker did not understand the work 4. Worker did not wear a harness at high height 5. Bracing installation was not secure 6. Worker was thrown by the lifting frame being released 7. Worker was pulled by the lifting frame being dropped down 8. Worker got caught in the bracing girder

Table 5.2 Continuation Identification of Hazards in Girder Erection Work

No.	Job	Job Sequence	Hazard Potential
		Continuation Girder end bracing	10. Tools fell 11. People entered the work area 12. People were crushed by the lifting frame 13. People were crushed by the broken girder
		Girder center bracing	1. Girder fell during bracing 2. Girder buckled and broke 3. Worker did not understand the work 4. Worker did not wear a harness at high height 5. Bracing installation was not secure 6. Worker was thrown by the lifting frame being released 7. Worker was pulled by the lifting frame being dropped down 8. Worker got caught in the bracing girder 9. Worker fell while going to the center of the girder

Table 5.2 Continuation Identification of Hazards in Girder Erection Work

No.	Job	Job Sequence	Hazard Potential
		Continuation Girder center bracing	10. Worker got caught in the center of the girder bar 11. Girder was not securely attached to the bearing pad 12. Tools fell from the height 13. People entered the work area 14. People were crushed by the lifting frame 15. People were crushed by the broken girder

After analyzing each potential hazard identified during the girder erection process, the next step is to develop a control strategy to prevent potential risks. This hazard control strategy aims to minimize the likelihood of work-related incidents through the implementation of appropriate safety procedures. Each identified potential hazard will be further assessed to determine the most effective control measures.

5.3.3 Hazard Control

Hazard control is implemented after the hazard identification process at each stage of work activities. This step aims to systematically minimize risks to occupational safety and health. Hazard control methods are determined based on the provisions of the international standard ISO 45001:2018, which emphasizes a proactive approach to risk management. Furthermore, the assessment also considers the effectiveness of previously implemented controls.

The hierarchy of controls is used in hazard control, which ranks methods from most to least effective, including elimination, substitution, engineering controls, administrative controls, and the use of Personal Protective Equipment (PPE). Elimination is considered the most effective method because it aims to eliminate the source of the hazard through design changes. However, the implementation of this method depends on field conditions and various other supporting factors. Substitution is the replacement of hazardous materials, equipment, or machinery with safer ones. Engineering controls include the implementation of physical protection, such as machine. Meanwhile, administrative controls and PPE concentrate on establishing work procedures, providing training, organizing work schedules, installing safety signs, and providing and maintaining appropriate protective equipment.

After detailing each potential hazard in every step of the work, a recapitulation of each type of potential hazard mentioned is carried out.

Table 5. 3 Recapitulation of Potential Hazards in Hazard Identification

No	Potential Hazard Details
1	Workers fail health screenings
2	Worker has a high level of alcohol in his body
3	Working area not ready
4	Heavy equipment in worst condition
5	Bad weather
6	Workers do not understand their work
7	Workers do not have work permits
8	Worker does not understand the rules
9	Workers placed signs in inappropriate places
10	Lack of signs provided
11	Workers get hit by heavy equipment
12	Crane and boogie moving in/out haphazardly
13	Heavy equipment slips while passing
14	Workers stuck between sling and girder
15	Sling ripped/broken
16	Girder falls due to weak sling
17	Poor worker coordination
18	Worker crushed by girder
19	Worker hit by boogie
20	Worker struck by sling
21	Boogie improperly positioned or slipped
22	Girder broken or fell during loading
23	Girder not properly secured to boogie
24	Road to erection area is poor
25	Girder falls or breaks
26	Boogie goes wrong way, slips, or loses control
27	Worker hit/crushed/dragged by boogie or girder
28	Unauthorized worker near lifted girder

Table 5.3 Continuation Recapitulation of Potential Hazards in Hazard Identification

No	Potential Hazard Details
29	Girder sling breaks
30	Residents entering road area
31	Worker lifted or hit by crane/girder
32	Crane slips or moves suddenly
33	Girder rolls, falls, or breaks during lifting
34	Lifting frame missing/unsuitable
35	Worker lacks skill or understanding of process
36	Anchor not strong enough, causes fall/break
37	People enter erection/lifting/swing area
38	Crane rotated/went in wrong direction
39	Crane derailed
40	Girder fell or broke during swinging/moving
41	Sling loosened
42	Worker's hand caught between girder and pad
43	Girder end damaged during installation
44	Worker did not wear harness at height
45	Bracing installation not secure
46	Worker thrown/pulled by lifting frame
47	Worker caught in bracing girder/center bar
48	Worker fell while accessing center of girder
49	Tools fell from the height
50	People crushed by lifting frame or broken girder

Next, risks and opportunities are used to analyze the identified potential hazards. To avoid workplace accidents, all types of hazards must be monitored. Different types of risks that workers may face include fatigue, dehydration, sudden medical conditions, and the risk of hands being trapped by metal frames. After summarizing the identification results, potential threats are classified for easier understanding and management. Potential accidents are classified based on the worker, equipment or materials, construction elements, and the work environment. This classification applies specifically to the hazard identification results conducted while working on the erection girder. The following is a classification of work accidents based on the hazard identification of girder erection work.

1. Being struck by falling materials, work tools, and machinery

The danger of being struck by a significant falling object occurs in almost every sub-task of erection girder work. This is because the activity is carried out at height, where elevation directly increases the risk of accidents. Furthermore, in this work, materials are transported using heavy equipment such as cranes and boogie boards, especially during the girder moving. Being struck by a falling object is a very high risk, ranging from small work equipment to large girder beams. Each type of hazard can cause serious harm, from minor injuries to death, below the severity full explanation.

- a. To ensure that lifting equipment does not experience damage that could endanger workers, slings and cranes are regularly inspected. Article 131 of Minister of Manpower Regulation No. 8 of 2020 prohibits the use of slings that are defective or do not meet safety standards during work activities. Damage must be immediately repaired by replacing or repairing them before reuse. The goal of this measure is to reduce the number of workplace accidents that can occur due to lifting equipment failure.
- b. To ensure that all employees understand the applicable safety procedures, safety instructions are given to them before starting work.

In addition, the work area is restricted in accordance with PER.01/MEN/1980 Article 31 to prevent unauthorized parties from entering high-risk zones, especially the moving girder area also the area where the girder rods begin erection. To increase worker awareness, hazardous areas such as the span area are marked with signs and safety fences. This effort reduces the risk of accidents caused by human error.

- c. According to Article 13 of Law No. 1 of 1970, workers must use personal protective equipment (PPE) such as safety helmets, safety shoes, and reflective vests. Safety helmets protect the head from impacts and also small debris that may fall from the girder rods that have been installed above. While safety shoes prevent injury to the feet, and reflective vests increase worker visibility in the project area. For PPE to function properly, all PPE must be used correctly and in good condition. The purpose of implementing disciplined use of PPE is to reduce the risk of injury experienced by workers during the girder installation process.
2. Being scratched, punctured, or caught by materials, heavy equipment, and tools.

When workers are trapped between the girder and bearing pad or in contact with work equipment during bracing installation, these hazards can appear. Workers are often unaware of the danger zones in the workplace. The risk of accidents at this stage also increases if the operator mishandles the lifting equipment. More details on these risks are provided below.

- a. To prevent injuries from direct contact with sharp objects in the workplace, such as bracing on girders, it is crucial to install safety guards or covers over sharp parts. Article 42 of Regulation PER.01/MEN/1980 stipulates that any hazardous machine components or materials must be protected in an appropriate manner. The guards must be made of strong material and permanently fastened to prevent them from easily coming loose or moving. During the

girder bracing process, the exposed bracing parts can be protected first with plastic or paper available in the area at the time. In addition, regular inspections should be carried out to ensure that all safety protection is functioning properly during the work process.

- b. Before work begins, job instructions must be delivered during a safety talk to provide an understanding of potential hazards and how to prevent them. This procedure follows Minister of Manpower Regulation Number 5 of 2018 concerning Occupational Safety and Health in the Workplace, which emphasizes the importance of workers understanding the risks. Direct supervision or oversight of the workplace is also necessary to ensure all safety procedures are properly implemented.
3. Falling, slipping, and tripping

This risk often occurs during the girder bracing or when workers move at height without adequate safety equipment. These conditions increase the potential for accidents resulting from falls. Therefore, it is essential to implement safe work procedures and use fall protection systems in accordance with occupational safety standards.

- a. To prevent workers from falling from high work sites, especially when bracing girders and when merge the ends of girders to bearing pads, safety lines and full body harnesses must be installed. This is in accordance with Regulation PER.01/MEN/1980 Article 67, which regulates the use of safety equipment when working above ground level. Full body harnesses must be properly installed at a sturdy and strong anchorage location. In addition, to avoid damage that could reduce the effectiveness of protection, safety ropes and harnesses must be checked regularly.
- b. Before use, work equipment used in construction activities must be routinely inspected to ensure its stability and safety. Inspections include structural strength, completeness of supports, and the condition of surfaces that are not damaged or slippery. Minister of

Manpower Regulation No. 5 of 2018 concerning Occupational Safety and Health in the Workplace stipulates that risk control must be carried out on the work equipment used. To reduce the risk of accidents due to collapse or slipping, only equipment that has been declared suitable and safe may be used during work activities.

4. Equipment and heavy equipment damaged during work.

Crane or boogie damage can potentially cause girder lifting failures, disrupting the smooth progress of construction work. These failures not only cause project delays but also increase the risk of fatal workplace accidents. Therefore, regular lifting equipment maintenance and technical feasibility checks are crucial to ensuring safety and smooth work.

- a. The substitution method, replacing risk sources with safer ones, is a way to control hazards by replacing aging heavy equipment with newer ones. Heavy equipment that has been in use for more than five years tends to be less efficient, has a higher risk of technical failure, and does not meet the latest occupational safety standards. In this case, the boogie and crane used must always undergo a diligent inspection phase, this is because cranes are very important equipment in the process of lifting girders. Consequently, in accordance with Article 5 of Regulation of the Minister of Manpower No. 8 of 2020, lifting and transport equipment used in the workplace must meet technical feasibility requirements, which include a maximum operational life. Replacing old heavy equipment with new, more efficient ones can significantly reduce the risk of workplace accidents.
- b. Administrative hazard control is carried out by monitoring lifting equipment used in the workplace. The purpose of this action is to ensure that all lifting equipment is in good working condition and complies with applicable occupational safety standards. According to Article 45 of PER.01/MEN/1980, all lifting, and transport equipment must undergo regular inspections and have a certificate issued by an authorized agency. These inspections and certifications prevent

equipment damage and ensure compliance with national occupational safety regulations.

5. Equipment losing control/balance and collide with each other.

Improper crane rotation or the slipping of a boogie board on an unstable track can potentially cause collisions between equipment in the work area. This can cause damage to construction equipment and increase the risk of injury to nearby workers. Therefore, strict operational controls and adequate work track maintenance are necessary to prevent such incidents.

- a. Traffic management controls the movement of cranes and boogie to prevent accidents caused by uncontrolled interactions between heavy equipment and workers or other vehicles. Accessibility, visibility, and high-risk active work areas are all factors that must be considered when establishing dedicated lanes. In strategic locations, these arrangements must also be equipped with safety signs, lane markings, and traffic directors. Minister of Manpower Regulation No. 5 of 2018 concerning occupational safety and health in the workplace, this traffic management is part of risk control.
- b. Operators of heavy equipment such as cranes and cranes must hold an Operator's License (SIO) and an Operating Permit Certificate (SILO) to demonstrate their competency in operating lifting and hauling equipment. To obtain these certificates, candidates must undergo formal training and competency tests conducted by authorized and government-recognized institutions. Article 148 of Minister of Manpower Regulation No. 8 of 2020 stipulates that certification is an absolute requirement for operating heavy equipment. To ensure occupational safety and prevent accidents caused by human error in equipment operation, compliance with these regulations is crucial.

6. Being exposed to materials

Uncontrolled crane rotation or the slipping of the boogie on uneven tracks can cause collisions between heavy equipment in the work area. This situation risks serious mechanical damage and compromises the safety of

nearby workers. Proper crane rotation control and regular boogie track maintenance are essential to ensure stability and safety during lifting operations.

- a. To protect workers from exposure from hazardous materials and dust, personal protective equipment (PPE) such as masks and eye protection must be used. Masks filter harmful particles in the air, and eye protection prevents injuries from splashes. Minister of Manpower Decree No. 333/MEN/1989 concerning Personal Protective Equipment in the Workplace regulates the mandatory use of PPE. PPE must be provided by the company, according to standards, and monitored to ensure that all staff use it regularly.
 - b. To inform new workers or visitors about potential hazards, including exposure to hazardous materials, a mandatory initial activity is safety training. Induction materials include proper methods for handling hazardous materials and emergency actions in the event of exposure. This step aligns with the prevention principle emphasized in Minister of Manpower Regulation No. 5 of 2018 concerning Occupational Safety and Health in the Workplace, which emphasizes the importance of providing information and education to workers. With induction of safety, it is hoped that employees will be able to recognize risks early on and independently take preventive measures in their work environment.
7. Materials and equipment falling due to broken/loose webbing sling
- Defective slings or errors in installation can potentially cause lift failure, resulting in the girder falling during the lifting process. These incidents not only endanger worker safety but can also cause significant material damage. Sling inspections and installation procedures must be strictly conducted in accordance with applicable safety standards.
- a. Unsuitable slings can lead to lifting failures and serious workplace accidents. Slings must be repaired immediately before being reused for lifting. According to Article 131 of Minister of Manpower

Regulation No. 8 of 2020, employers must ensure that lifting equipment and equipment are in good condition and safe for use. Recording sling condition and regular inspections are essential components of an OHS management system in construction projects.

- b. To ensure proper girder fastening and balanced weight distribution, sling installation must be carried out under direct supervision by competent personnel. This supervision is crucial to avoid technical errors that could cause the load to fall or the sling to break during lifting. Article 20 of Minister of Manpower Regulation No. 8 of 2020 stipulates that risk control must be carried out through supervision and responsibility for lifting and transporting equipment. Direct supervision reduces the risk of accidents.
8. Residents, children, and unauthorized persons at the project site
 Girder erection work located near residential areas potentially increases the risk of residents entering hazardous lifting zones. This can occur due to inadequate work area demarcation or a lack of public awareness of potential hazards around the project. These conditions not only endanger residents' safety but can also disrupt the smooth operation of the project. Strict access controls are required through the installation of safety fences, warning signs, and safety education for the surrounding community.
 - a. The purpose of installing safety signs and guardrails in project areas is to restrict access to hazardous areas and provide visual warnings of potential risks, especially in the area around the span where the girder erection is in the process. Signs must be clear, easy to read, and installed in strategic locations. Fences must also be strong and high to prevent unauthorized access. This step is part of the risk control measures stipulated in Article 8 of Minister of Manpower Regulation No. 8 of 2020, which requires employers to identify and manage workplace hazards. External accidents can be minimized by adequate work area security.

- b. Active security surveillance is implemented to prevent residents or unauthorized parties from entering high-risk project areas. At main access points, security personnel must be on standby and screen everyone entering the worksite. Part of the access control system is this measure to prevent accidents caused by the presence of people without adequate training or protection in the workplace. This policy is supported by Minister of Manpower Regulation No. 5 of 2018, which deals with risk control in the workplace, particularly by restricting access to hazardous areas.

5.4 CSA Form

After identifying potential hazards based on observations and previous research, including those by Febriyanto (2022), Nugraha and Rohman (2022), Cutnyadin et al. (2024), and Ramdani (2023), the next stage is compiling a CSA form based on the analyzed data. A CSA form is prepared for each type of work included in the overall Girder Erection project. The following is an example of a CSA form in accordance with PUPR Regulation No. 10 of 2021.

Table 5. 4 CSA Form Preparation Work

Name Work Permit Applicant : Salma Novisa No :

Job : Preparation Work Job Supervisor :

Job Date : Department :

Personal Protective Equipment Required to Carry Out Work ☐ Safety Vest ☐ Face Shield

☐ Safety Helmet ☐ Full Body Harness ☐ Earmuffs☐ Safety Gloves ☐ Safety Glasses ☐ Ear Plug☐ Mask ☐ Apron ☐ Other

No	Sequence Work Steps	Identify Potential Hazards				Control	Person in Charge
		Worker	Quality	Equipment	Environment/Public Safety		
1.	Worker Condition Check	a. Workers fail health test				a. Physical examination and alcohol level test on workers b. Workers who do not pass the health test must be replaced.	

Table 5.4 Continuation CSA Form Preparation Work

No	Sequence Work Steps	Identify Potential Hazards				Control	Person in Charge
		Worker	Quality	Equipment	Environment/Public Safety		
	(Continuation Worker Condition Check)					c. Make sure there are medical equipment and ambulance on standby.	
2.	Worker Coordination	a. Workers do not understand the job b. Workers do not comply with existing regulations		a. No work permit	a. Residents enter the work area b. The work area is not ready yet c. Work does not comply with work methods or SOPs	a. Conduct safety induction before work begins b. Explanation of work methods to workers c. Checking work permits for each worker d. Make sure the	

Table 5.4 Continuation CSA Form Preparation Work

No	Sequence Work Steps	Identify Potential Hazards				Control	Person in Charge
		Worker	Quality	Equipment	Environment/Public Safety		
	(Continuation Worker Coordination)					<p>area where the work will be carried out, especially heavy equipment, is ready and safe.</p> <p>e. Ensure that every worker uses complete PPE according to the work being done.</p> <p>f. Ensure that the work area can only be entered by workers or people with needs.</p>	

Table 5.4 Continuation CSA Form Preparation Work

No	Sequence Work Steps	Identify Potential Hazards				Control	Person in Charge
		Worker	Quality	Equipment	Environment/Public Safety		
3.	Provide Sign in Required Area			a. Lack of safety signs b. Signs installed in the wrong location		a. Installation of signs according to procedures and places b. Ensure that the work area can only be entered by workers or people with needs.	

Table 5. 5 CSA Form Moving Girder

Name Work Permit Applicant : Salma Novisa No :
 Job : Moving Girder Job Supervisor :
 Job Date : Department :
 Personal Protective Equipment Required to Carry Out Work ☐ Safety Vest ☐ Face Shield
☐ Safety Helmet ☐ Full Body Harness ☐ Earmuffs
☐ Safety Gloves ☐ Safety Glasses ☐ Ear Plug
☐ Mask ☐ Apron ☐ Other

No	Sequence Work Steps	Identify Potential Hazards				Control	Person in Charge
		Worker	Quality	Equipment	Environment/Public Safety		
1.	Loading Girder to Boogie	a. Worker hit by girder b. Worker hit by boogie c. Workers dragged into		a. Boogie slip b. Girder falls or breaks during loading c. Webbing sling comes off	a. Residents see the loading process up close b. Residents pass through the work area during the process	a. Boogie track inspection b. Closure of work area c. Using a Flagman	

Table 5.5 Continuation CSA Form Moving Girder

No	Sequence Work Steps	Identify Potential Hazards				Control	Person in Charge
		Worker	Quality	Equipment	Environment/Public Safety		
	(Continuation Loading Girder to Boogie)	boogie boarding		d. Webbing slings used are not suitable for use e. Crane carrying girder in wrong position		d. The webbing sling used is in good condition	
2.	Boogie Moves to Erection Area	a. Worker hit by girder b. Worker hit by boogie c. Workers dragged into boogie boarding d. Worker		a. Boogie slip b. Girder falls or breaks during moving c. Webbing sling comes off d. Webbing slings used are not suitable for use	a. Residents see the moving process up close b. Residents pass through the work area during the process	a. Boogie track inspection b. Closure of work area c. Using a Flagman d. The webbing sling used is in good condition	

Table 5.5 Continuation CSA Form Moving Girder

No	Sequence Work Steps	Identify Potential Hazards				Control	Person in Charge
		Worker	Quality	Equipment	Environment/Public Safety		
	(Continuation Boogie Moves to Erection Area)	crushed by moving boogie				e. Make sure that no people or workers pass by when the boogie is passing.	

Table 5. 6 CSA Form Erection Girder

Name Work Permit Applicant : Salma Novisa No :
 Job : Erection Girder Job Supervisor :
 Job Date : Department :
 Personal Protective Equipment Required to Carry Out Work

☐ Safety Helmet	☐ Safety Vest	☐ Face Shield
☐ Safety Gloves	☐ Full Body Harness	☐ Earmuffs
☐ Mask	☐ Safety Glasses	☐ Ear Plug
	☐ Apron	☐ Other

No	Sequence Work Steps	Identify Potential Hazards				Control	Person in Charge
		Worker	Quality	Equipment	Environment/Public Safety		
1.	Install Lifting Frame	a. Worker crushed by girder b. Worker trapped while installing frame c. Workers do		a. Crane slips b. Crane webbing sling broke c. Girder damaged during lifting	a. Residents enter the work site carelessly b. Unauthorized workers approach the area of work in progress	a. Safety meeting before work b. Regular inspection of slings and cranes c. Strict supervision of	

Table 5.6 Continuation CSA Form Erection Girder

No	Sequence Work Steps	Identify Potential Hazards				Control	Person in Charge
		Worker	Quality	Equipment	Environment/Public Safety		
	(Continuation Install Lifting Frame)	not wear PPE (helmets, safety shoes, vests) d. Worker gets stuck while girder is being lifted e. The worker is caught and lifted along with the girder		d. Crane in poor condition f. The frame is in a condition that is not suitable for use g. Girder lifting web sling in poor condition		work areas d. Ensure the work area is clean from the public and unauthorized workers. e. Always ensure workers use complete PPE f. Put up signs in hazardous areas g. Make sure the frame used is in good condition and with complete equipment	

Table 5.6 Continuation CSA Form Erection Girder

No	Sequence Work Steps	Identify Potential Hazards				Control	Person in Charge
		Worker	Quality	Equipment	Environment/Public Safety		
2.	Anchor Installment	a. Worker crushed by girder b. Worker trapped while installing anchor c. Workers do not wear PPE (helmets, safety shoes, vests) d. Worker gets stuck while girder is being lifted e. The worker is		a. Crane slips b. Crane webbing sling broke c. Girder damaged during lifting d. Crane in poor condition e. Anchor used in poor condition f. Girder lifting web sling in poor condition	a. Residents enter the work site carelessly b. Unauthorized workers approach the area of work in progress	a. Regular inspection of slings and cranes b. Strict supervision of work areas c. Ensure the work area is clean from the public and unauthorized workers. d. Always ensure workers use complete PPE e. Put up signs in hazardous areas f. Make sure the anchor used is in	

Table 5.6 Continuation CSA Form Erection Girder

No	Sequence Work Steps	Identify Potential Hazards				Control	Person in Charge
		Worker	Quality	Equipment	Environment/Public Safety		
	(Continuation Anchor Installment)	caught and lifted along with the girder				good condition and with complete equipment	
3.	Lifting Girder in Crane	a. Worker crushed by girder b. Worker trapped while in girder c. Workers do not wear PPE (helmets, safety shoes, vests) d. Worker gets stuck while		a. Crane slips b. Crane webbing sling broke c. Girder damaged during lifting d. Crane in poor condition e. Crane moving in the wrong	a. Residents enter the work site carelessly b. Unauthorized workers approach the area of work in progress	a. Regular inspection of slings and cranes b. Strict supervision of work areas c. Ensure the work area is clean from the public and unauthorized workers. d. Always ensure workers use complete PPE	

Table 5.6 Continuation CSA Form Erection Girder

No	Sequence Work Steps	Identify Potential Hazards				Control	Person in Charge
		Worker	Quality	Equipment	Environment/Public Safety		
	(Continuation Lifting Girder in Crane)	girder is being lifted		direction f. Girder lifting web sling in poor condition		d. Put up signs in hazardous areas e. Make sure the crane used is in good condition f. Make sure there is a Flagman to monitor the crane movement.	
4.	Crane Swing	a. Worker crushed by girder		a. Crane slips b. Crane webbing sling broke c. Girder damaged during	a. Residents enter the work site carelessly b. Unauthorized workers approach the area of work in progress	a. Regular inspection of slings and cranes b. Strict supervision of work areas	

Table 5.6 Continuation CSA Form Erection Girder

No	Sequence Work Steps	Identify Potential Hazards				Control	Person in Charge
		Worker	Quality	Equipment	Environment/Public Safety		
	(Continuation Crane Swing)	b. Worker trapped while installing frame c. Workers do not wear PPE (helmets, safety shoes, vests) d. Worker gets stuck while girder is being lifted e. Worker was hit by girder while swinging		lifting d. Crane in poor condition e. Crane moving in the wrong direction f. Girder lifting web sling in poor condition		c. Ensure the work area is clean from the public and unauthorized workers. d. Always ensure workers use complete PPE e. Put up signs in hazardous areas f. Make sure the crane used is in good condition g. Make sure there is Flagman	

Table 5.6 Continuation CSA Form Erection Girder

No	Sequence Work Steps	Identify Potential Hazards				Control	Person in Charge
		Worker	Quality	Equipment	Environment/Public Safety		
5.	Crane Moving	a. Worker crushed by girder b. Worker trapped while installing frame c. Workers do not wear PPE (helmets, safety shoes, vests) d. Worker gets stuck while girder is being lifted e. Worker		a. Crane slips b. Crane webbing sling broke c. Girder damaged during lifting d. Crane in poor condition f. Girder lifting web sling in poor condition	a. Residents enter the work site carelessly b. Unauthorized workers approach the area of work in progress	a. Regular inspection of slings and cranes b. Strict supervision of work areas c. Ensure the work area is clean from the public and unauthorized workers. d. Always ensure workers use complete PPE e. Put up signs in hazardous areas g. Make sure the crane used is in good	

Table 5.6 Continuation CSA Form Erection Girder

No	Sequence Work Steps	Identify Potential Hazards				Control	Person in Charge
		Worker	Quality	Equipment	Environment/Public Safety		
	(Continuation Crane Moving)	crushed by moving crane				condition h. Make sure there is a Flagman to monitor the crane movement.	
6.	Girder Place in Bearing Pad	a. Worker crushed by girder b. Worker trapped while installing frame c. Workers do not wear PPE (helmets, safety shoes, vests)		a. Crane slips b. Crane webbing sling broke c. Girder damaged during lifting d. Crane in poor condition lifting web	a. Residents enter the work site carelessly b. Unauthorized workers approach the area of work in progress	a. Regular inspection of slings and cranes b. Strict supervision of work areas c. Ensure the work area is clean d. Always ensure workers use complete PPE	

Table 5.6 Continuation CSA Form Erection Girder

No	Sequence Work Steps	Identify Potential Hazards				Control	Person in Charge
		Worker	Quality	Equipment	Environment/Public Safety		
	(Continuation Girder Place in Bearing Pad)	d. Worker gets stuck while girder is being lifted		e. Girder sling in poor condition		e. Put up signs in hazardous areas g. Make sure the crane used is in good condition h. Make sure there is a Flagman to monitor the crane movement.	

Table 5. 7 CSA Form Bracing Girder

Name Work Permit Applicant : Salma Novisa No :
 Job : Bracing Girder Job Supervisor :
 Job Date : Department :
 Personal Protective Equipment Required to Carry Out Work

☐ Safety Helmet	☐ Safety Vest	☐ Face Shield
☐ Safety Gloves	☐ Full Body Harness	☐ Earmuffs
☐ Mask	☐ Safety Glasses	☐ Ear Plug
	☐ Apron	☐ Other

No	Sequence Work Steps	Identify Potential Hazards				Control	Person in Charge
		Worker	Quality	Equipment	Environment/Public Safety		
1.	Girder End Bracing	a. Worker fell from a height b. Worker trapped in bracing girder		a. Frame stuck in girder b. Girder fell/broken during bracing c. The pedestal was in poor condition so the anchors could not be installed.	a. People enter the work area	a. Use full body harness b. Install safety net c. Limit the	

Table 5.7 Continuation CSA Form Bracing Girder

No	Sequence Work Steps	Identify Potential Hazards				Control	Person in Charge
		Worker	Quality	Equipment	Environment/Public Safety		
	(Continuation Girder End Bracing)					<p>work area</p> <p>d. The PPE used by workers must be in complete condition</p> <p>e. Ensure that the PPE used is always in good condition and fit for use.</p>	

Table 5.7 Continuation CSA Form Bracing Girder

No	Sequence Work Steps	Identify Potential Hazards				Control	Person in Charge
		Worker	Quality	Equipment	Environment/Public Safety		
2.	Girder Center Bracing	a. Worker fell from a height b. Worker trapped in bracing girder c. Worker fell while approaching the middle girder bracing d. Worker caught in middle girder bracing		a. Girder fell/broken during bracing	a. People enter the work area	a. Use a full body harness b. Install a safety net c. Limit the work area d. The PPE used by workers must be in complete condition e. Ensure that the PPE used is always in good condition and fit for use.	

5.5 Data Form Verification and Correction

In the data form verification and correction steps, the identification of potential hazards and hazard controls are verified after the author has compiled them. Verification is performed by submitting the prepared data form to a construction professional. Next, corrections are made to the data form, which represents improvements to the CSA form.

In this study, Mr. Didik Mudoko, Head of HSE at PT. Adhi Karya Jogja-Bawen, confirmed and revised the CSA form. Discussions with him indicated that the Construction Safety Analysis (CSA) was well-designed to identify potential hazards and had appropriate control measures in place. However, several recommendations and additions were needed to improve the quality of the CSA. Further details on additional information and improvements to the CSA can be found here.

5.5.1 Details of work steps

In some work phases, some steps could be written in more detail and their names changed to better encompass the various potential hazards and how they are performed. For example, in the detailed process, there are loading girder and moving girder work breakdowns. The girder loading process is now part of a more detailed work process, such as the field survey.

Some job description have also been changed. For example, in the job preparation, the job condition inspection was initially called the worker condition inspection. After discussion, the process was changed to the comprehensive condition inspection. This name change will broaden the hazard identification and control process.

Table 5. 8 Form CSA Preparation Work After Verification

Name of Work Permit Applicant : Salma Novisa No :
 Work : Preparation Work Job Supervisor :
 Date of Employment : Department :
 Personal protective equipment required to perform the job
☒ Safety Helmet ☒ Full Body Harness ☐ Face Shield
☒ Safety Gloves ☐ Safety Glasses ☒ Safety Shoes
☐ Mask ☐ Apron ☐ Other

No	Job	Identify Potential Hazards				Hazard Control	Person	Hazard Control
	Description	Worker	Material	Equipment	Environment/ Public Safety		In Charge	Compliance Checklist
1.	Comprehensive Condition Check							
	Worker health	Tired and sick workers				Conduct physical examination and alcohol level tests on workers	All Person	

Table 5.8 Continuation Form CSA Preparation Work After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
	(Continuation Worker health)					Workers who do not pass a health inspection must be replaced.	All Person	
	Weather				Bad weather	Make sure that the weather condition is suitable		
						Cease work immediately if weather condition deteriorate		

Table 5.8 Continuation Form CSA Preparation Work After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
	Heavy machinery preparation			Equipment used (Crane and Boogie) is damaged before use			All Person	
	Inspection of the work area		The girder rod does not meet specifications		The work area is not yet ready	A detailed and thorough inspection of the work area must be done		
			Broken girder					

Table 5.8 Continuation Form CSA Preparation Work After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
	PPE Preparation	Workers do not utilize comprehensive PPE				Thoroughly PPE inspection	All Person	
						Ensure medical equipment and ambulances are on standby.		
2.	Worker Coordination							
	Explanation to worker	Workers don't understand the assigned task			Work is not in accordance with work methods or SOPs	Conduct a toolbox meeting before work begins	- HSE Supervisor	

Table 5.8 Continuation Form CSA Preparation Work After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
						Clearly explain work methods and specific responsibilities	- HSE Supervisor	
		Employees do not comply with applicable regulations						
		Employees are difficult to work with Jobs assigned						

Table 5.8 Continuation Form CSA Preparation Work After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
	PPE Availability					Ensure that each worker uses complete PPE according to the work being done.	- HSE Supervisor	
3.	Provide Signs in Areas Needed							
	Preparation of signs	Workers placed signs haphazardly	The signs are not sturdy and fall easily.	Lack of safety signs		Installation of signs according to procedures and locations	- HSE Supervisor Contractor - Worker	

Table 5.8 Continuation Form CSA Preparation Work After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
				Signs are placed in the wrong location		Ensure the existing signs are of good quality	- HSE Supervisor Contractor - Worker	
	Socialization regarding traffic signs	Workers do not understand the meaning of the existing signs			The civilian does not understand the signs that have been put up.	Workers and civilian were explained the meaning of the signs		

Table 5.8 Continuation Form CSA Preparation Work After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
	(Continuation Provide Signs in Areas Needed)	Workers place signs on evacuation routes or emergency access routes					- HSE Supervisor	
	Provision of alternative routes					Ensure that the work area can only be accessed by workers or people who have a need to be there.	Contractor - Worker	

Table 5. 9 Form CSA Loading Girder After Verification

Name of Work Permit Applicant : Salma Novisa No :
 Work : Loading Girder Job Supervisor :
 Date of Employment : Department :
 Personal protective equipment required to perform the job
☒ Safety Helmet ☒ Full Body Harness ☐ Face Shield
☒ Safety Gloves ☐ Safety Glasses ☒ Safety Shoes
☒ Mask ☐ Apron ☐ Other

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
1.	Traffic Management							
	Heavy equipment inspection			Heavy equipment broke down during use		Regular inspection of heavy vehicles to be used	- HSE Supervisor - Flagman - Boogie Operator - Crane Operator	

Table 5.9 Continuation Form CSA Loading Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
	Heavy equipment moves to working area	Workers hit by passing vehicles		Heavy equipment entering and exiting without traffic control	Civilian getting hit by a passing heavy machine	Placement of flagmen at several points along the movement of heavy equipment	- HSE Supervisor - Flagman - Boogie Operator - Crane Operator	
		Workers are dragged by passing vehicles		Boogie slip while passing	Civilian stuck in heavy equipment passing by	Create a temporary alternative route for civilians to cross		

Table 5.9 Continuation Form CSA Loading Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
				Crane slip when crossing	Civilian dragged by heavy machine	Ensure that the area where heavy equipment passes is safe from civilians	- HSE Supervisor - Flagman - Boogie Operator - Crane Operator	
2.	Girders are connected using slings							
	Sling quality		The attached sling broke			Ensure that the sling is in good condition.		
			Sling torn					

Table 5.9 Continuation Form CSA Loading Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
	Sling attachment	Worker stuck on sling				Ensure that the equipment for attaching the girder to the sling is complete.	- HSE Supervisor - Worker - Crane Operator	
		Worker's hand was tangled in the sling						
		Worker's hand caught between sling and girder						

Table 5.9 Continuation Form CSA Loading Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
	Heavy equipment	Worker fell from boogie		The crane used is damaged	Civilian observed the loading process from a close distance.	Close the work area from civilians	- HSE Supervisor - Worker - Crane Operator	
				The crane carrying the girder is in the wrong position	Civilians pass through the work area while work is in progress.	Ensure that the area where vehicles pass is safe from civilians		
				Crane slips				

Table 5.9 Continuation Form CSA Loading Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
	Girder	Worker trapped under girder during lifting	The girder broke while being lifted.			Ensure the girder in a good condition	- HSE Supervisor - Worker - Crane Operator	
		Worker crushed when girder was lifted	The girder cracked when lifted.					
			The girder slipped while being lifted.					

Table 5.9 Continuation Form CSA Loading Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
3.	Loading the Girder onto the Boogie							
	Girder	Worker hit by girder	Girder cracks when lifted				- HSE Supervisor - Boogie Operator - Crane Operator	
		Workers lifted along with the girder	Girder broke while being lifted.					
			Girder Rolling					
	Heavy equipment	Worker hit by boogie		Boogie slips	Civilians pass through the work area while work is in progress.	Closure of work area		

Table 5.9 Continuation Form CSA Loading Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
	(Continuation Heavy equipment)	Workers dragged by boogie			Civilians watch the loading process up close	Ensure that the boogie used to transport the girders is in good condition.	- HSE Supervisor - Boogie Operator - Crane Operator	
		Workers dragged by boogie			The surface of the boogie track is uneven	Boogie track inspection		
		Worker hit by crane		The crane carrying the girder is in the wrong position	The surface of the crane track is uneven	Ensure that the crane used to transport the girders is in good condition		

Table 5.9 Continuation Form CSA Loading Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
		Workers dragged by crane		Crane slips		Crane track inspection	- HSE Supervisor - Boogie Operator - Crane Operator	
		Workers dragged by crane		The crane used is damaged				
	PPE					Ensure workers wear complete PPE		

Table 5. 10 Form CSA Moving Girder After Verification

Name of Work Permit Applicant : Salma Novisa No :
 Work : Moving Girder Job Supervisor :
 Date of Employment : Department :
 Personal protective equipment required to perform the job
☒ Safety Helmet ☐ Full Body Harness ☐ Face Shield
☒ Safety Gloves ☐ Safety Glasses ☐ Ear Muffs
☒ Mask ☐ Apron ☐ Other

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
1.	Boogie Heading to the Erection Area							
	Girder	Workers trapped under girder	Girders broke or damaged on the way			Ensure the girder in a good condition		

Table 5.10 Continuation Form CSA Moving Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
			Girder slips and fells				- HSE Supervisor - Flagman - Boogie Operator	
	Transferring a girder with a bogie	Worker hit by bogie		Boogie slips	The surface of the bogie track is uneven.	Boogie track inspection		
		Worker dragged by bogie		Broken sling	Civilians pass through the work area during the relocation process	Ensure that no people or workers are passing by when the bogie is passing.		

Table 5.10 Continuation Form CSA Moving Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
		Worker runs over by moving boogie				Closure of work areas to the public		
		Worker falls in the boogie crossing area						
	PPE					Ensure workers wear complete PPE		

Table 5.10 Continuation Form CSA Moving Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
2.	Attach Girder to the Crane							
	Girder	Workers trapped under girder during lifting	The girder broke when it was lifted.			Ensure the girder in a good condition	- HSE Supervisor - Flagman - Boogie Operator - Crane Operator - Worker	
		Worker hit by girder during lifting	The girder cracked when lifted.			Ensure that the equipment for attaching the girder to the sling is complete.		
		Worker caught in sling	The girder cracked when lifted.			Ensure that the sling used is in good condition.		

Table 5.10 Continuation Form CSA Moving Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
		Worker's hand caught between sling and girder	The girder slipped while being lifted.				- HSE Supervisor - Flagman - Boogie Operator - Crane Operator - Worker	
		Worker falls while standing on girder						
	Heavy equipment	Worker falls from boogie		The crane used was broken.	Uneven ground surface along crane route	Crane track inspection		

Table 5.10 Continuation Form CSA Moving Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
				The crane carrying the girder is in the wrong position.	Civilians pass through the work area while the process is ongoing	Ensure that the crane used to transport the girders is in good condition.	- HSE Supervisor - Flagman - Boogie Operator - Crane Operator - Worker	
				Crane slips	Civilians observe the loading process closely	Ensure that the area where heavy equipment pass is safe from civilians.		
						Close off the work area from civilians		

Table 5. 11 Form CSA Erection Girder After Verification

Name of Work Permit Applicant : Salma Novisa No :
 Work : Erection Girder Job Supervisor :
 Date of Employment : Department :
 Personal protective equipment required to perform the job
☒ Safety Helmet ☐ Full Body Harness ☐ Face Shield
☒ Safety Gloves ☐ Safety Glasses ☐ Ear Plug
☒ Mask ☐ Apron ☐ Other

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
1.	Lifting Frame Installation							
	Lifting Frame	Worker trapped in lifting frame		Lifting sling in poor condition				

Table 5.11 Continuation Form CSA Erection Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
	Lifting frame	Workers trapped while installing frame structure	The lifting frame used does not meet the specifications	Frame in unusable condition		Ensure that the frame used is in good condition and equipped with all necessary tools.	- HSE Supervisor - Flagman	
	Girder	Workers hit by girders	Girder cracks when lifted	Damaged girder during lifting		Ensure the girder in a good condition	- Worker - Crane Operator	
		Workers trapped as girder lifted	Girder broke when being lifted.					

Table 5.11 Continuation Form CSA Erection Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
		Workers trapped and lifted along with the girder	Girder slipped while being lifted.				- HSE Supervisor	
	Crane			Crane Slip	The ground surface of the crane path is uneven	Inspect crane tracks regularly	- Flagman - Worker - Crane Operator	
				Crane in poor condition		Regular inspection of cranes		

Table 5.11 Continuation Form CSA Erection Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
	Unauthorized person				Civilians entered the work site without permission	Strict supervision of the work area		
					Unauthorized workers entering the work area	Ensure that the work area is free from the civilian and unauthorized workers.		
						Install signs in dangerous areas		
	PPE					Always ensure workers use complete PPE		

Table 5.11 Continuation Form CSA Erection Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
2.	Lifting Girder in Crane							
	Crane			Crane Slip	The ground surface of the crane path is uneven	Regularly inspection of cranes	- HSE Supervisor - Flagman - Crane Operator	
				Crane in poor condition		Ensure that the crane used is in good condition.		
				The crane is moving in the wrong direction.		Ensure that there is a flagman to monitor the crane's movements.		

Table 5.11 Continuation Form CSA Erection Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
						Inspect the crane track regularly	- HSE Supervisor - Flagman - Crane Operator	
	Girder	Workers hit by girders	Girder cracks when lifted	The girder was damaged during lifting				
		Workers trapped and lifted along with girder	Girder broke during lifting					
		Worker trapped while girder being lifted	Girder slipped while being lifted					

Table 5.11 Continuation Form CSA Erection Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
	Unauthorized person				Civilians entered the work site without permission	Strict supervision of the work area	- HSE Supervisor - Flagman - Worker	
					Unauthorized workers entering the work area	Ensure that the work area is free from the public and unauthorized workers.	- Crane Operator	
						Place signs in dangerous areas.		
	PPE					Always ensure workers use complete PPE		

Table 5.11 Continuation Form CSA Erection Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
3.	Anchor Installation							
	Girder	Workers hit by girders	Girder cracks when lifted	The girder was damaged during lifting		Ensure the girder in a good condition	- HSE Supervisor - Flagman - Worker - Crane Operator	
		Worker trapped while girder being lifted	Girder broke during lifting					
		Workers trapped and lifted along with the girder	Girder slipped while being lifted					

Table 5.11 Continuation Form CSA Erection Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
		Worker's hand was caught between the anchor and the girder.					<ul style="list-style-type: none"> - HSE Supervisor - Flagman - Worker - Crane Operator 	
	Crane			Crane Slip	The ground surface of the crane path is uneven	Regular inspection of cranes		

Table 5.11 Continuation Form CSA Erection Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
				Crane in poor condition		Inspect crane tracks regularly	- HSE Supervisor - Flagman - Crane Operator	
	Anchor	Workers got stuck while installing anchors	The anchor broke during installation.	Anchors used in poor conditions		Ensure that the anchor used is in good condition and equipped with all necessary equipment.		
	Unauthorized person				Civilians entering the work site indiscriminately	Strict supervision of the work area		

Table 5.11 Continuation Form CSA Erection Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
					Unauthorized workers entering the work area	Ensure that the work area is free from the public and unauthorized workers.	- HSE Supervisor - Flagman - Crane Operator	
						Put up signs in hazardous areas		
	PPE					Always ensure workers use complete PPE		
4.	Crane Swing							
	Crane			Crane broke	The ground surface of the crane path is uneven	Regular inspection of cranes		

Table 5.11 Continuation Form CSA Erection Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
				Crane Slip		Ensure that the crane used is in good condition.	- HSE Supervisor - Flagman - Crane Operator	
				Crane in poor condition		Ensure that there is a flagman to monitor the crane's movements.		
				The crane moved to the wrong direction.		Check the crane path regularly		

Table 5.11 Continuation Form CSA Erection Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
	Girder	Workers hit by girders	Girder cracks when lifted			Ensure the girder in a good condition	- HSE Supervisor - Flagman - Crane Operator	
		Worker caught on crane as girder swung	Girder broke when lifted					
		Worker hit by girder while swinging	Girder slipped while being lifted.					

Table 5.11 Continuation Form CSA Erection Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
	Unauthorized person				Civilians entering the work site indiscriminately	Strict supervision of the work area	- HSE Supervisor - Flagman - Crane Operator	
					Unauthorized workers entering the work area	Ensure that the work area is free from the public and unauthorized workers.		
						Put up signs in hazardous areas		
	PPE					Always ensure workers use complete PPE		

Table 5.11 Continuation Form CSA Erection Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
5.	Crane Moving							
	Crane			Crane broke	The ground surface of the crane path is uneven	Regular inspection of cranes	- HSE Supervisor - Flagman - Crane Operator	
				Crane Slip		Ensure that the crane used is in good condition.		
				Crane in poor condition		Ensure that there is a flagman to monitor the crane's movements.		

Table 5.11 Continuation Form CSA Erection Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
				The crane moved to the wrong direction.		Check the crane path regularly	- HSE Supervisor - Flagman	
	Girder	Workers hit by girders	Girder cracks when lifted			Ensure the girder in a good condition	- Crane Operator	
		Worker caught on crane as girder swung	Girder broke when lifted					

Table 5.11 Continuation Form CSA Erection Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
		Worker hit by girder while swinging	Girder slipped while being lifted.				- HSE Supervisor - Flagman - Crane Operator	
	Unauthorized person				Civilians entering the work site indiscriminately	Strict supervision of the work area		
					Unauthorized workers entering the work area	Ensure that the work area is free from the public and unauthorized workers.		

Table 5.11 Continuation Form CSA Erection Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
						Put up signs in hazardous areas		
	PPE					Always ensure workers use complete PPE		
6.	Girder placed on the Pedestal							
	Crane			Crane broke	The ground surface of the crane path is uneven	Regular inspection of cranes	- HSE Supervisor - Flagman - Worker	
				Crane Slip		Ensure that the crane used is in good condition.	- Crane Operator	

Table 5.11 Continuation Form CSA Erection Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
				Crane in poor condition		Ensure that there is a flagman to monitor the crane's movements.	- HSE Supervisor - Flagman - Worker	
				The crane moved to the wrong direction.		Check the crane path regularly	- Crane Operator	
	Girder	Workers hit by girders	Girder cracks when lifted			Ensure the girder in a good condition		

Table 5.11 Continuation Form CSA Erection Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
		Worker caught on crane as girder swung	Girder broke when lifted				- HSE Supervisor - Flagman - Worker - Crane Operator	
		Worker hit by girder while swinging	Girder slipped while being lifted.					
		Worker stuck between girder and bearing pad						
	Unauthorized person				Civilians entering the work site indiscriminately	Strict supervision of the work area		

Table 5.11 Continuation Form CSA Erection Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
					Unauthorized workers entering the work area	Ensure that the work area is free from the public and unauthorized workers.	- HSE Supervisor - Flagman - Worker - Crane Operator	
						Put up signs in hazardous areas		

Table 5. 12 Form CSA Bracing Girder After Verification

Name of Work Permit Applicant : Salma Novisa	No :
Work : Bracing Girder	Job Supervisor :
Date of Employment :	Department :
Personal protective equipment required to perform the job	☒ Safety Vest ☒ Face Shield ☒ Safety Helmet ☒ Full Body Harness ☐ Earmuffs ☒ Safety Gloves ☒ Safety Glasses ☐ Ear Plug ☒ Mask ☒ Apron ☐ Other

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
1.	Girder End Bracing							
	Full body harness and PPE	Worker falls from height			Risk of fire due to heat sources from welding	Wear complete personal protective equipment (PPE)		

Table 5.12 Continuation Form CSA Bracing Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
		Workers stuck in bracing girder				Ensure that PPE is always in good condition and fit for use.	- HSE Supervisor - Flagman - Worker - Welder	
		Workers affected by sparks				Wear an apron and goggles when welding.		
		Worker was scratched by the bracing				Training in working at heights and strict work safety procedures.		
		Worker stabbed by bracing				Prepare fire extinguishing equipment		

Table 5.12 Continuation Form CSA Bracing Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
		Workers slipped at height				Ensure that PPE for welding work (helmets and gloves) is available.	- HSE Supervisor - Flagman - Worker - Welder	
	Damaged material and tools		Girder falls/breaks	Pedestal in poor condition		Ensure all equipment is in good condition before taking it onto the pier.		
			Rusty Bracing	Damaged welding equipment				

Table 5.12 Continuation Form CSA Bracing Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
2.	Center Girder Bracing							
	Full body harness and PPE	Worker falls from height			Risk of fire due to heat sources from welding	Wear complete personal protective equipment (PPE)	- HSE Supervisor - Flagman - Worker - Welder	
		Workers stuck in bracing girder				Ensure that PPE is always in good condition and fit for use.		
		Workers affected by sparks				Wear an apron and goggles when welding.		

Table 5.12 Continuation Form CSA Bracing Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
		Worker was scratched by the bracing				Training in working at heights and strict work safety procedures.	- HSE Supervisor - Flagman - Worker - Welder	
		Worker stabbed by bracing				Prepare fire extinguishing equipment		
		Workers slipped at height				Ensure that PPE for welding work (helmets and gloves) is available.		

Table 5.12 Continuation Form CSA Bracing Girder After Verification

No	Job Description	Identify Potential Hazards				Hazard Control	Person In Charge	Hazard Control Compliance Checklist
		Worker	Material	Equipment	Environment/ Public Safety			
		Worker falls while heading to the center of the bracing					- HSE Supervisor - Flagman - Worker - Welder	
	Damaged material and tools		Girder falls/breaks	Pedestal in poor condition		Ensure all equipment is in good condition before taking it onto the pier.		
			Rusty Bracing	Damaged welding equipment				

5.6 Discussion

Once the CSA form is confirmed by the PT. Adhi Karya's HSE department, it is certain that the form is valid. Direct observation in the field shows that workers comply with existing regulations, especially the use of PPE.



Figure 5. 2 Workers Conduct Health Checks
(Source: Personal Documentation)



Figure 5. 3 Provision of Signs in Specific Areas
(Source: Personal Documentation)



Figure 5. 4 Use of PPE as Required
(Source: Personal Documentation)



Figure 5. 5 Track Crane Inspection
(Source: Personal Documentation)

The output from the CSA form itself are obtained:

1. List of potential hazards: contains all potential hazards that may occur during each work activity.
2. Risk assessment: This assesses the likelihood and impact of risks, such as accidents, injuries, or damage.
3. Control measures: Provides recommendations for prevention and control.
4. Safe work procedures: Develop safe work procedures as guidelines for implementation in the field.
5. Documentation of analysis results: serves as a reference for OHS socialization and supervision.

The output from the CSA form can help the project site reduce the risk of future accidents.

CHAPTER VI

CONCLUSION AND SUGGESTIONS

6.1 Conclusion

Based on the results of the analysis and discussion conducted previously, the results of the analysis of occupational accident prevention in girder erection work on the Jogja-Bawen toll road construction project using the Construction Safety Analysis method can be summarized as follows

1. There are 138 types of potential hazards found during girder installation work. Many potential hazards were found during girder installation work, and fewer potential hazards were found during preparation work.
2. The implementation of OHS in the Jogja-Bawen toll road project was carried out effectively. One example of this can be seen in the condition of the workers, who are quite compliant with always using PPE.

6.2 Suggestion

Based on the analysis and discussion conducted, the following are several suggestions for construction service providers and for further research.

1. Construction Service Providers
Some suggestions to improve the Construction Safety Management System on projects are as follows:
 - a. Establish a Construction Safety Unit to oversee and be accountable for the implementation of the SMKK on the project.
 - b. Occupational Health and Safety induction for workers needs to be improved to increase knowledge, insight, and awareness of OHS on projects so that workers develop safe work habits.
 - c. Sanctions and firm action are necessary for workers, suppliers/distributors, guests, or anyone involved in construction who fails to implement construction safety measures.
2. Further Research

Further research could be conducted using different subjects and objects. Because this study likely has shortcomings, including inaccurate observations, using different subjects and objects could provide a broader perspective. Furthermore, this research could be strengthened by verification or validation with Health, Safety, and Environment (HSE) staff to increase the effectiveness and accuracy of potential hazard control measures.

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APPENDIX

Appendix 1 S Curve

No.	Description	Working Hour	I				II				III				IV				V			
			W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4
1.	Preparation																					
	Literature Study	18	3	3	3	3	3	3														
	Licensing	4					2	2														
2.	Data Collecting																					
	Field Observation	5						2,5	2,5													
	Collecting Primary Data	27							9	9	9											
	Validation with OHS	16									4	5	7									
	Collecting Secondary Data	25										8	8	9								
3.	Analysis and Data Processing																					
	OHS Analysis	17											3	3	3	4	4					
	Risk Identification	18												5	5	4	4					
	Comparison with Previous Analysis	16														4	4	4	4			
4.	Report Arrangement																					
	Temporary Report	15																	5	5	5	
	Final Report	22																		6	6	10
Weekly Planning (Hour)		183	3	3	3	3	5	7,5	11,5	9	13	13	18	17	8	12	12	4	9	11	11	10
Cumulative Working Hour (Hour)		183	3	6	9	12	17	24,5	36	45	58	71	89	106	114	126	138	142	151	162	173	183

Appendix 2 Related Regulations Government Regulation No 10, 2021



MENTERI PEKERJAAN UMUM DAN PERUMAHAN RAKYAT
REPUBLIK INDONESIA

PERATURAN MENTERI PEKERJAAN UMUM DAN PERUMAHAN RAKYAT
REPUBLIK INDONESIA
NOMOR 10 TAHUN 2021
TENTANG
PEDOMAN SISTEM MANAJEMEN KESELAMATAN KONSTRUKSI

DENGAN RAHMAT TUHAN YANG MAHA ESA

MENTERI PEKERJAAN UMUM DAN PERUMAHAN RAKYAT
REPUBLIK INDONESIA,

- Menimbang : a. bahwa untuk melaksanakan ketentuan Pasal 84AK Peraturan Pemerintah Nomor 14 Tahun 2021 tentang Perubahan atas Peraturan Pemerintah Nomor 22 Tahun 2020 tentang Peraturan Pelaksanaan Undang-Undang Nomor 2 Tahun 2017 tentang Jasa Konstruksi, perlu menetapkan Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat tentang Pedoman Sistem Manajemen Keselamatan Konstruksi;
- Mengingat : 1. Pasal 17 ayat (3) Undang-Undang Dasar Negara Republik Indonesia Tahun 1945;
2. Undang-Undang Nomor 39 Tahun 2008 tentang Kementerian Negara (Lembaran Negara Republik Indonesia Tahun 2008 Nomor 166, Tambahan Lembaran Negara Republik Indonesia Nomor 4916);
3. Undang-Undang Nomor 2 Tahun 2017 tentang Jasa Konstruksi (Lembaran Negara Republik Indonesia Tahun 2017 Nomor 11, Tambahan Lembaran Negara Republik Indonesia Nomor 6018);

Appendix 3 ISO 45001:2018

STANDAR INTERNASIONAL SISTEM MANAJEMEN

ISO 45001:2018

**Occupational health and safety
management system
Requirements with guidance for use**

**Sistem manajemen kesehatan dan
keselamatan kerja
Persyaratan dan pedoman penggunaan**

**DUAL LANGUAGE (ENGLISH – BAHASA INDONESIA)
FOR TRAINING PURPOSE**

Dokumen ini memuat informasi persyaratan-persyaratan standar ISO 45001:2018 berikut terjemahannya dalam bahasa Indonesia dengan maksud tidak merubah makna atau maksud dari persyaratan-persyaratan tersebut.

Versi 02. 06-2018

Appendix 4 PUPR Government Regulation No 17, 2022



PRESIDEN
REPUBLIK INDONESIA

SALINAN

PERATURAN PEMERINTAH REPUBLIK INDONESIA

NOMOR 17 TAHUN 2022

TENTANG

PENDANAAN DAN PENGELOLAAN ANGGARAN DALAM RANGKA PERSIAPAN,
PEMBANGUNAN, DAN PEMINDAHAN IBU KOTA NEGARA SERTA
PENYELENGGARAAN PEMERINTAHAN DAERAH KHUSUS
IBU KOTA NUSANTARA

DENGAN RAHMAT TUHAN YANG MAHA ESA

PRESIDEN REPUBLIK INDONESIA,

- Menimbang : bahwa untuk melaksanakan ketentuan Pasal 24 ayat (7), Pasal 25 ayat (3), Pasal 26 ayat (2), Pasal 35, dan Pasal 36 ayat (7) Undang-Undang Nomor 3 Tahun 2022 tentang Ibu Kota Negara, perlu menetapkan Peraturan Pemerintah tentang Pendanaan dan Pengelolaan Anggaran dalam rangka Persiapan, Pembangunan, dan Pemindahan Ibu Kota Negara serta Penyelenggaraan Pemerintahan Daerah Khusus Ibu Kota Nusantara;
- Mengingat : 1. Pasal 5 ayat (2) Undang-Undang Dasar Negara Republik Indonesia Tahun 1945;
2. Undang-Undang Nomor 17 Tahun 2003 tentang Keuangan Negara (Lembaran Negara Republik Indonesia Tahun 2003 Nomor 47, Tambahan Lembaran Negara Republik Indonesia Nomor 4286);
3. Undang-Undang Nomor 1 Tahun 2004 tentang Perbendaharaan Negara (Lembaran Negara Republik Indonesia Tahun 2004 Nomor 5, Tambahan Lembaran Negara Republik Indonesia Nomor 4355);
4. Undang-Undang . . .

Appendix 5 Verification Sign for CSA Form