



Analysis of the Impact of Occupational Safety and Health Success in the Case of Horse Racing Grandstands in Central Aceh Regency Using the JSA Method

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Abstract. This study examines the impact of Occupational Safety and Health (OSH) implementation on the construction of the horse racing grandstand in Central Aceh Regency. The research applies the Job Safety Analysis (JSA) and Hazard Identification, Risk Assessment, and Determining Control (HIRADC) methods to identify potential hazards, assess risk levels, and establish appropriate control measures. A descriptive qualitative approach was used, involving field observations, interviews, and documentation with project stakeholders. The analysis revealed that the systematic application of JSA and HIRADC effectively minimizes the risk of accidents and enhances overall safety performance on construction sites. The implementation of OSH programs also improves worker awareness, discipline, and productivity while maintaining project efficiency and quality standards. The findings emphasize the importance of integrating safety management systems into every stage of construction work, particularly in culturally significant public infrastructure projects.

Keywords: Occupational Safety and Health (OSH), Job Safety Analysis (JSA), Hazard Identification Risk Assessment and Determining Control (HIRADC).

1 Introduction

Occupational safety and health (OSH) plays a vital role in ensuring the protection of workers, particularly in the construction sector, which is prone to high accident rates (ILO,2022). In Indonesia, the increasing number of workplace accidents highlights the need for effective safety management systems and preventive measures (Ministry of Manpower & ILO, 2019). One of the key approaches in identifying and controlling workplace hazards is through the application of Job Safety Analysis (JSA) and Hazard Identification, Risk Assessment, and Determining Control (HIRADC). These methods help recognize potential hazards in every stage of construction activities and establish appropriate risk control strategies. In addition, the combined application of JSA and HIRADC enables a more systematic evaluation of work activities by identifying hazards before work begins, assessing their potential impacts, and determining appropriate control measures based on the hierarchy of controls (Sa'adati & Widharto, 2023). Furthermore, the implementation of systematic risk control through the

HIRADC approach has been shown to reduce occupational risks and improve the effectiveness of occupational safety management in construction projects (Marliana et al., 2024).

The study focuses on analyzing the impact of implementing OSH principles in the construction of the horse racing grandstand in Central Aceh Regency. The research aims to evaluate the effectiveness of JSA and HIRADC methods in identifying hazards, reducing the likelihood of accidents, and improving worker safety and productivity. The findings are expected to contribute to the development of safer construction practices and strengthen the application of OSH standards in infrastructure projects across Indonesia.

2 Materials and Methods

This study applied a descriptive qualitative approach supported by quantitative risk assessment, conducted at the horse-racing tribune construction site in Pegasing District, Central Aceh Regency, Indonesia, from August to September 2025. Primary data were obtained from direct field observations, structured interviews with workers and supervisors, as well as safety documentation such as Job Safety Analysis (JSA) forms, accident registers, and near-miss records. Secondary data included project blueprints, construction maps, and relevant Indonesian occupational safety regulations. The research procedure consisted of systematic steps: (i) literature review and site survey; (ii) breakdown of high-risk construction activities (excavation, bore pile drilling, formwork, space frame erection, roofing); (iii) hazard identification using JSA; (iv) risk assessment following the HIRADC framework; and (v) determination of risk controls based on the hierarchy of elimination, substitution, engineering controls, administrative controls, and personal protective equipment (PPE) as recommended in previous HIRADC-based studies (Harahap et al., 2022; Khaidir et al., 2025). The risk value (R) for each hazard was calculated using the formula.

$$R=P \times S \times E \quad (1)$$

Where.

P : probability

S : severity

E : exposure frequency

All equipment and materials used in the study were specified to ensure reproducibility. Personal Protective Equipment (PPE) included SNI-standard helmets, reflective vests, gloves, and full-body safety harnesses, while construction machinery consisted of crawler cranes (50-ton capacity), bore pile drilling rigs, concrete mixers, and aluminum scaffolding (load capacity 250 kg/m²). Data processing was conducted using Microsoft Excel 2021 for tabulation and visualization, and IBM SPSS Statistics version 27 for statistical analysis. No custom computer code was developed, and all analyses employed built-in software functions. Data sheets, JSA forms, and processed files are available upon request from the corresponding author. Ethical approval was granted by PT. Waskita Karya (Persero) Tbk. and supported by the Central Aceh local government, with all research procedures adhering to national OSH regulations.

2.1. Hazard Identification

Hazard identification was carried out on several critical activities in the construction of the horse-racing tribune, including excavation, bore pile drilling, tie-beam installation, space frame erection, and roofing. The Job Safety Analysis (JSA) revealed potential hazards such as falling from height, being struck by heavy loads, contact with sharp or hot objects, inhalation of dust, and exposure to welding sparks. For example, during bore pile activities, eight hazards were identified in drilling, four in concrete casting, and six in mobilization. In roofing works, hazards included three findings in main truss installation, two in rafter installation, and three in roofing sheet installation. These results confirmed that each stage of construction carried multiple hazard potentials, emphasizing the importance of systematic risk identification (Pratama, 2019).

Table 1. Identified hazards in selected construction activities.

Activity	Hazards identified	Risk category (qualitative)
Bore pile drilling	8	High
Bore pile casting	4	Medium
Bore pile mobilization	6	Medium
Space frame erection	8	High
Roofing installation	8	High
Tie-beam works	9	Medium

As shown in Table 1, the space frame work had the highest number of identified risks, with a total of eight risk findings, consisting of two high-risk, two medium-risk, and four low-risk hazards. This was followed by foundation excavation work, which had two identified risks, both classified as medium risk, while no high-risk or low-risk hazards were identified.

2.2. Risk Assessment

Risk assessment using the HIRADC method quantified the probability, severity, and exposure of each identified hazard. The calculated risk values indicated that space frame erection had the highest risk level, with eight hazard findings consisting of two high-level, two medium-level, and four low-level risks. Excavation and backfilling activities carried medium to high risks, particularly related to potential collapse and worker entrapment. The overall distribution of risk levels from three key activities showed three high risks, five medium risks, and four low risks. This classification highlighted the need for immediate preventive measures, especially in tasks involving work at height and heavy lifting operations.

2.3. Evaluation of OSH Implementation

Evaluation of OSH practices revealed a strong safety culture. PPE compliance reached 97%, with 340 of 350 workers wearing full protective gear. All major construction machinery was found to be in good condition (100%). Statistical analysis confirmed zero accident occurrence during the project, indicating that JSA and HIRADC implementation significantly contributed to accident prevention.

Table 2. PPE usage among construction workers

PPE usage	Number of workers	Percentage (%)
Complete	340	97
Incomplete	10	3
Total	350	100

Table 2 presents the distribution of PPE usage among construction workers. The results indicate that 340 out of 350 workers (97%) used complete personal protective equipment, while only 10 workers (3%) used incomplete PPE. This high level of compliance reflects a strong safety culture during project implementation. Similar findings were reported by Siregar et al. (2024), who emphasized that strengthening safety culture through effective safety management, worker competence, and appropriate work methods contributes to improved safety performance and greater compliance with occupational safety standards in construction projects. Furthermore, all major construction machinery was found to be in good condition (100%), and no occupational accidents were recorded throughout the project (Siregar et al. 2024)

3 Result And Discussion

The findings of this study demonstrate that the implementation of Job Safety Analysis (JSA) and Hazard Identification, Risk Assessment, and Determining Control (HIRADC) significantly contributed to improving occupational safety in the construction of the horse-racing tribune in Central Aceh. High-risk activities such as space frame erection and roofing were effectively controlled by systematic hazard identification and risk reduction measures, resulting in zero accident cases during the project. This outcome is consistent with previous studies showing that structured safety management systems can reduce accident frequency and improve safety compliance in the construction sector (Pramadi et al., 2020; Harahap & Purwandito, 2022).

The integration of JSA with local cultural contexts, such as a public facility used for horse racing, provides additional novelty. Unlike standard construction projects, this study highlighted that safety risks extend beyond the workforce to include the protection of spectators and the surrounding community. Similar perspectives were reported by Nindyaningrum (2022), who emphasized the importance of adapting occupational safety practices to specific social and environmental contexts. Nevertheless, this study has certain limitations. The risk assessment was conducted within a limited time frame and covered only selected construction activities, which may not fully represent the entire project lifecycle. Additionally, the absence of long-term monitoring restricts the ability to evaluate sustained safety performance over time.

Despite these limitations, the study offers practical implications. First, the combination of JSA and HIRADC provides a replicable framework for safety management in culturally embedded infrastructure projects. Second, the demonstrated high compliance with PPE usage and effective machinery control suggests that worker safety behavior can be significantly improved when supported by systematic safety inspections and training. Future research could expand this approach by conducting

longitudinal studies, integrating digital monitoring systems, and comparing safety outcomes across different cultural settings. This would strengthen the evidence base for adapting OSH practices to diverse construction contexts and contribute to broader discussions on occupational safety in developing regions.

4 Conclusion

This study concludes that the integration of Job Safety Analysis (JSA) and Hazard Identification, Risk Assessment, and Determining Control (HIRADC) is effective in improving occupational safety in construction projects with high-risk activities. The systematic identification of hazards and quantitative risk assessment enabled project managers to prioritize preventive measures, particularly in critical tasks such as space frame erection, bore pile drilling, and roofing. The implementation of safety controls, combined with high compliance in the use of personal protective equipment (PPE), resulted in zero accident records throughout the project, thereby confirming the effectiveness of the applied methods. Furthermore, the novelty of this research lies in adapting OSH practices to the construction of a facility embedded in local cultural traditions, highlighting the broader relevance of contextualized safety management. While limited by the short observation period and focus on selected activities, the findings provide valuable insights for future occupational safety studies and serve as a practical reference for construction projects in similar socio-cultural environments.

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