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Occupational Safety and Health (OSH) Risk Assessment for Construction Workers in the Construction of a Four-Story Boarding House on Andong Barat Street

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Abstract

The rapid growth of modern industry requires employees to work with maximum performance and productivity in the midst of a busy work schedule. Occupational safety and health (K3) is important to protect workers from physical, mental, and emotional dangers and risks at work. This study aims to evaluate the application of Occupational Safety and Health (K3) in the Four-Floor Boarding House Construction Project on Jalan Andong Barat. The research method uses a quantitative descriptive approach by collecting data through observation of the use of personal protective equipment (PPE) for 14 days. Data were analysed using SPSS to identify the level of compliance, the trend of PPE use, and the factors influencing K3. Based on the calculation of the average compliance level of PPE use in the work structure of lightweight steel roof frame structures in the four-storey boarding house on Jalan Andong Barat for 14 days, the compliance level was 70%. Based on PU/PR Regulation No. 09/2008, this figure is included in the category of moderate compliance (60-85%), while the types of PPE with a very good usage rate (≥85%) are helmets (95%), goggles (86%), boots (95%), and work clothes (100%), while PPE with a fairly good usage rate (60-85%) includes gloves (41%), safety belts (51%), ear protectors (51%), and full body harnesses (34%). The results show that the use of PPE such as helmets (95%), safety shoes (95%), and work clothes (100%) has met the standard, while full body harnesses (34%) and masks (41%) are still low. Conclusion This study emphasises the importance of increasing OHS training and strict supervision of the use of PPE, especially for equipment with low compliance levels.

Keywords: Occupational safety, personal protective equipment, construction, job risk, compliance, worker health

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INTRODUCTION

The rapid growth of modern industry requires employees to work with maximum performance and productivity in the midst of a busy work schedule. Safety and health in the workplace (K3) are important to protect

workers from the dangers and risks at work, both physical, mental, and emotional. To reduce the risk of accidents and diseases, it is necessary to identify and control risk sources at work [1]

In Indonesia alone, the number of work accidents continues to increase from year to year.

with 234,270 cases of work accidents in 2021. Although there is no specific data on accidents in the construction sector, this sector is known as the biggest contributor to work accidents, accounting for around 30% of the total work accidents that occur [2].

K3, which consists of the words "Safety and Occupational Health", refers to a system designed to ensure the safety, health, and welfare of workers in the work environment, as well as to prevent diseases and accidents. The K3 concept includes various elements, such as identification and risk control, provision of personal protective equipment, as well as training and education that aims to increase workers' awareness of the potential hazards they may face. By applying OHS principles, the company not only tries to meet the applicable regulations, but also commits to creating a safe and healthy work environment, which in turn can increase employee productivity and satisfaction. K3 efforts require cooperation between management, workers, and other related parties, and require periodic monitoring and evaluation to ensure the effectiveness of the programme implemented.

Infrastructure development in Indonesia has a positive impact on the economy, but construction workers face risks. Construction projects often experience delays and accidents that result in casualties, which is evidence of a lack of attention to occupational safety and health at work (K3). In construction work, safety and health elements (K3) must be applied to reduce the risk of accidents and ensure that the project is completed on time. [3]

Construction project development requires efforts to achieve efficiency, safety, and a healthy work environment. Construction work is often carried out in open spaces affected by bad weather, within a limited time frame, and with unstructured workers and high-risk equipment.

Two dominant factors that trigger work accidents are workers' behaviour that deviates from work safety rules and dangerous work environment conditions. Lack of anticipation of workers on the potential hazards and weakness of supervision also worsens the situation, so it is necessary to improve a more effective K3 management system and the application of appropriate risk evaluation methods to reduce the number of accidents and improve workers' welfare in the field.

The factors causing work accidents in construction projects are often related to the special properties of the project. Various factors can affect the flow of work processes, such as different workplaces, open and exposed to weather, limited working hours and constantly changing conditions, which also require great physical strength and demands. Many workers are not so strong as a result, forcing them to use more dangerous construction methods [5].

The primary function of occupational safety and health (OSH) is to protect all workers from the risk of injury, illness, or other hazards related to work and the work environment. Occupational safety and health is an important aspect that

must be considered in all companies, especially in construction companies. Based on the National Occupational Research Agenda, the construction industry is a sector where the number of accidents is quite high. This is because the type of activity in construction companies is more manual and is classified as severe.

Construction companies need to pay close attention to occupational health and safety (K3). Every year, hundreds of people are killed and injured due to work accidents that could actually be prevented. Each construction project must implement an effective K3 management system, as shown [6].

The number of work accidents is still quite high in Indonesia. According to data from the Social Security Organising Agency (BPJS), there were 177,161 cases of work accidents in 2020, an increase from 114,235 cases in 2019. The National Safety and Health (K3) Programme 2019-2024 was designed and determined by the Indonesian government to overcome this problem. However, this still requires management compliance and workers to adhere to K3 regulations and policies to ensure there are no accidents in the company.

Work accidents are defined as sudden or unexpected incidents that cause injury. Work accidents are a problem in the construction industry, and the number of work accidents continues to increase. These accidents not only impact workers individually, but also management, the government, and the environment. According to the ILO in 2017, the number of worker deaths and occupational diseases worldwide increased from 2.3 million to around 2.78 million. In addition, around 374 million people suffered injuries and occupational diseases. Non-fatal accidents occur every year around the world, many of which cause work attendance issues. As the incidence increases in the workplace, financial burdens have also increased, with total disease costs, injuries, and deaths reaching 3.94% of global GDP, or 2.99 trillion USD [7].

Based on the data, in the last five years, the number of work accidents has continued to increase, with 234,370 work accidents in 2021. Although there are no specific statistics for the construction sector, this sector is the main contributor to work injuries, with work accidents in the construction sector reaching 30% of all work accidents. The construction industry is one of the industries with the highest risk of injury and death due to work accidents [7].

The construction of a four-storey boarding house on Jl Andong Barat, Malang involves important aspects that need to be considered in order to create a comfortable and functional residence. This building has an area of around 300 m^2 with a planned building area of 226.03 m^2 and has four floors including the rooftop. The planned room requirements include bedrooms, bathrooms, kitchens, cafes, lobby rooms, travel offices, security posts, washing and drying areas, and parking areas. This development consideration must pay attention to the impact on the surrounding environment, including good planning so as not to interfere with the comfort of surrounding residents, as there are residences around the project site.

Judging from the research location, there are several factors that become obstacles in the work process, including the lack of use of PPE such as boots, which causes wounds to the feet, and the lack of use of harnesses, which causes workers to fall from heights. There is also scaffolding that is not properly installed, resulting in workers being injured by falling materials. This has an impact on the progress of

work, which will take relatively longer to complete and can involve the CV in the event of a very serious injury.

This research is crucial because it focuses on the lack of worker experience and the use of inappropriate personal protective equipment, thereby increasing the risk of workplace accidents. It is vital for worker health and reducing workplace accidents, as this type of occupational hazard is highly likely to occur in construction projects.

There are several significant problems related to occupational safety and health experienced by construction workers in the four-storey boarding house construction project on Jalan Andong Barat. In this project, there are a number of workers who do not wear complete PPE when working. Therefore, the purpose of this study is to see how Occupational Safety and Health (K3) is applied to the Four-Floor Boarding House Construction Project on Jalan Andong Barat. This study is relevant to support national OHS policies and reduce the number of work accidents in the construction sector.

METHOD

The location of this study is on Jalan Andong Barat, Malang City. The investigation at this location is considered important because it is in the process of working on the construction of a four-story boarding house carried out by CV. Light of Pratama Construction. This study uses descriptive methods that have quantitative properties. Primary and secondary data are two types of data collected in this study, with primary data collection methods including interviews, direct observations, and questionnaires to employees and direct project management are shown to the project site. The process of obtaining this secondary data involves gathering information and other sources, such as literature, documents, and data collected by others with specific objectives. Direct observation involves recording the use of workers' PPE every day for 14 specific days in the work structure of lightweight steel roof frame structures. Data analysis in this study includes: the average use of PPE, days with the highest use, use trends from time to time, and comparison of each type of PPE.

Figure 1 Research Location

RESULTS AND DISCUSSION

Assessment of K3 application is an important step to understand the extent to which safety and health standards are applied in a work environment. Through

this assessment, we can find potential risks, deficiencies in work procedures, as well as improvement steps needed to create a safer and healthier workplace. The following are some assessments that can be used to process and analyse data on the use of personal protective equipment (PPE).

1. Average use of PPE

Calculate the average number of PPE used per day to evaluate overall compliance. Based on research conducted for 14 consecutive days, it was found that the average use of personal protective equipment (PPE) for mild steel roof work every day for 14 consecutive days was 66.5%.

This finding is lower compared to research [8] which analyses the correlation between knowledge and compliance with the use of personal protective equipment (PPE) in construction workers at EMC Alam Sutera Hospital, South Tangerang City. This research was conducted using correlational and cross-sectional quantitative methods, involving 70 construction workers as a sample. Data was collected through observation of compliance with the use of PPE and the PPE knowledge questionnaire. The results showed that most workers (65.7%) had good knowledge about PPE and 78.6% of workers complied with the use of PPE. Statistical analysis revealed a correlation between the importance of knowledge and compliance with PPE use ($p = 0.001$), where workers with less knowledge had an 8,885 times higher risk of not complying with PPE use than workers with good knowledge. The study confirmed the importance of increasing knowledge as an effort to increase compliance with PPE use for the safety of construction workers. In research [9], the more knowledge workers had and the more positive their attitudes were about the use of masks as personal protective equipment, the more obedient they were in using them while working in sandstone mines. Therefore, positive knowledge and attitudes help workers to be more obedient in wearing masks.

However, this result is in line with studies in Indonesia by [10] who found the level of PPE use was only 65% among informal workers, due to comfort factors and lack of supervision. This difference in numbers may be influenced by the duration of the research.

The results of research [11] showed that compliance with PPE increased with a longer time for workers who had worked for more than three years, namely 23 people (67.6%), compared to 14 workers who worked less than three years (38.9%). The P value of 0.035 was found from the Chi Square test with continuity correction. The results indicate that employees with more than three years of work experience are 3.286 times more likely to comply with PPE compared to employees with less than three years of work experience (OR value = 3.208 with a 95% confidence interval between 1.773 and 8.604).

Table 1 Average use of PPE for 14 days

No	Day/ Date	Amount used
1	Monday 26 May 2025	61
2	Tuesday 27 May 2025	78
3	Wednesday 28 May 2025	72
4	Thursday 29 May 2025	61
5	Friday 30 May 2025	53

6	Saturday 31 May 2025	73
7	Monday 2 June 2025	71
8	Tuesday 3 June 2025	60
9	Wednesday 4 June 2025	71
10	Thursday 5 June 2025	58
11	Friday 6 June 2025	66
12	Saturday 7 June 2025	78
13	Monday 9 June 2025	68
14	Tuesday 10 June 2025	61
Average		66.5

1. Day with the highest PPE usage

Identify the days where PPE use reaches the highest number. This can reveal certain factors that affect use, such as the type of work or the number of workers. From the results of the study, it was found that the days with the highest use of personal protective equipment (PPE) were Tuesday, 27 May 2025 and Saturday, 7 June 2025, with a percentage of 78%. This finding is higher than the study by [12], which reported that PPE compliance peaked at only 72% on weekends (Saturdays) in Malaysian construction projects, due to routine inspections on that day. However, this result is in line with research [13], which found that PPE compliance increased significantly (> 75%) on certain weekdays (Tuesday -grabu) due to the socialisation of weekly safety. This daily variation is allegedly related to work schedule and supervision factors. Studies by [14] show that workers tend to be more obedient on days with sudden inspections or incentive divisions. Meanwhile, work fatigue is a problem that must be thoroughly overcome because fatigue can cause loss of skills, decreased health conditions that can lead to work accidents, and decreased productivity and work performance [15].

Table 2: Days with the highest use of PPE

No	Day/date	Highest number of uses
1	Tuesday, 27 May 2025	78
2	Saturday, 7 June 2025	78

Table 2 shows that there are two days with the highest level of PPE use, namely Tuesday, 27 May 2025 with a figure of 78 and Saturday, 7 June 2025 with a figure of 78.

1. TRENDS IN USE OVER TIME

Observe the trend of PPE usage during the specified time period to determine whether there is an increase or decrease in usage. The results found are: The number of trends in PPE usage during the 14-day construction period of lightweight steel roof frames shows that daily usage varies; on some days, the amount of PPE used is quite high, while on other days it is lower. On the 2nd and 12th days, PPE use reached the highest number of 78, while on the 5th day, the number of PPE used was only 53, which was the lowest use. This pattern indicates

that compliance with PPE is inconsistent and is influenced by various situational factors. This finding is in line with research [16] which reports daily variations in the use of PPE in construction projects, with a sharp decline in the mid-week days due to accumulation of fatigue. Increased compliance on the second day may be associated with the effects of refresher safety training at the beginning of the project [17], while the surge on the twelfth day may be triggered by increased worker alertness ahead of the project deadline [18]. The decrease on the fifth day This reinforces findings [19] about the "Hump Day" phenomenon, where worker motivation tends to decline midweek.

Table 3 Trends of Use over time

No	Day/date	Number used
1	Monday, 26 May 2025	61
2	Tuesday, 27 May 2025	78
3	Wednesday, 28 May 2025	72
4	Thursday, 29 May 2025	61
5	Friday, 30 May 2025	53
6	Saturday, 31 May 2025	73
7	Monday, 2 June 2025	71
8	Tuesday, 3 June 2025	60
9	Wednesday, 4 June 2025	71
10	Thursday, 5 June 2025	58
11	Friday, 6 June 2025	66
12	Saturday, 7 June 2025	78
13	Monday, 9 June 2025	68
14	Tuesday, 10 June 2025	61

Source : Research Location: Boarding Houses in Malang City, 2025

Figure 4 Trend in PPE Usage

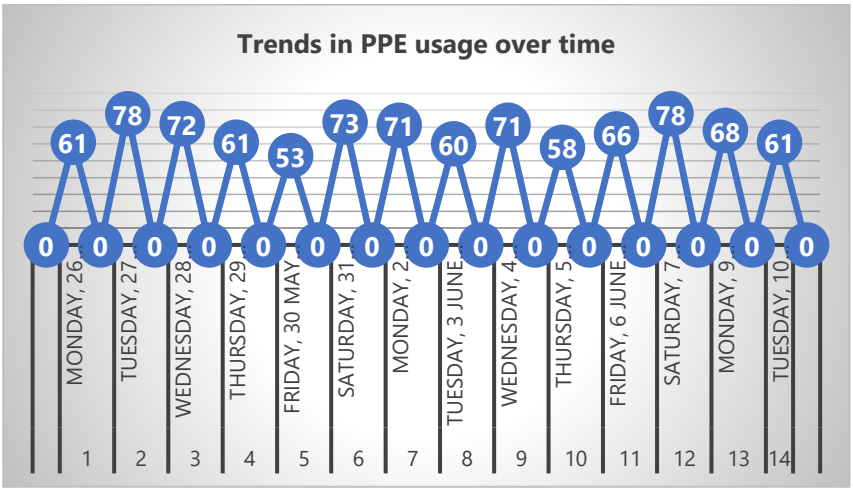

Figure 2 Trend in PPE Usage

Figure 2 shows that the trend in PPE usage over time during the 14-day construction of the lightweight steel roof frame shows that daily usage varies. On some days, the amount of PPE used is quite high, while on other days it is lower. On days 2 and 12, PPE usage reached its highest level at 78, while on day 5, the number of PPE used was only 53, indicating the lowest usage.

1. Comparison of PPE Types

Analysing the most frequently used types of PPE (e.g., helmets and goggles) compared to other types helps identify further training needs. The results obtained in the field are the total number of uses for each type of Personal Protective Equipment (PPE) in construction work. The most frequently used PPE was work clothes (148 times), safety shoes and helmets (141 times each), followed by goggles (128 times) and gloves (112 times). The use of masks, safety belts, and ear protectors was lower (76, 75, and 60 times), while full body harnesses were used the least (50 times). This indicates the highest compliance in the use of work clothes, helmets, and safety shoes, as well as the need for improvement in the use of full body harnesses. These findings are consistent with previous research by[20] , which reported that construction workers tend to be more compliant in using basic PPE such as helmets than specialised equipment. According to the Health Belief Model theory[21] , the low use of full body harnesses may be due to workers' perceptions of the complexity of use and a lack of awareness of the risks of falling from heights. The percentage of PPE usage for helmets (95%), goggles (86%), boots (95%), and work clothes reached 100%. This figure indicates significant usage of other PPE and is classified as very good because it is > 85%. Gloves (76%) are in the fairly good category because they are > 60% and < 85%, while the use of other PPE, namely full body harnesses (34%), ear protectors (51%), safety belts (51%), and masks (41%), is the lowest and is categorised as poor because it is < 60%. Based on Minister of Public Works Regulation No. 09/2008, these figures fall into the moderate compliance category (60–85%), while PPE types with a very good usage rate (≥85%) are helmets (95%), goggles (86%), boots (95%), and work clothes (100%), while PPE types with a fairly good usage rate (60–85%) are gloves (76%) and PPE types with a poor usage rate (<60%) are masks (41%), safety belts (51%), ear protectors (51%), and full body harnesses (34%).

Here is the explanation of the calculation:

- Goggles

Compliance Percentage = (Number of workers using PPE) / (Total number of workers required to use PPE) × 100%
= 128/148 × 100%
= 86% (Excellent category as it is >85%).

- Mask

Compliance Percentage = (Number of workers using PPE) / (Total number of workers required to use PPE) × 100%
= 60/148 × 100%
= 41% (Category: Poor because <60%).

- Gloves

Compliance Percentage = (Number of workers using PPE) / (Total number of workers required to use PPE) × 100%
= 112/148 × 100%
= 76%. (Category: Fairly good because > 60% and < 85%)

- Safety Belt

Compliance Percentage = (Number of workers using PPE) / (Total number of workers required to use PPE) × 100%
= 76/148 × 100%
= 51%. (Category: poor because < 60%.)

- Ear Protection

Compliance Rate = (Number of workers using PPE) / (Total number of workers required to use PPE) × 100%
= 148/148 × 100%
= 51%. (Category: very good because < 60%.)

- Safety Shoes

Compliance Percentage = (Number of workers using PPE) / (Total number of workers required to use PPE) × 100%
= 141/148 × 100%
= 95%. (Excellent category as > 85%.)

- Full Body Harness

Compliance Percentage = (Number of workers using PPE) / (Total number of workers required to use PPE) × 100%
= 50/148 × 100%
= 34%. (Category: Poor because < 60%.)

- Work Clothing

Compliance Percentage = (Number of workers using PPE) / (Total number of workers required to use PPE) × 100%
= 50/148 × 100%
= 100%. (Very good category because > 85%.

Table 4 Comparison of PPE Types

No	Type of PPE	Number Workers	ly used by workers PPE	Percentage PPE usage %
1	Helmet	148	141	95
2	Glasses	148	128	86
3	Mask	148	60	41
4	Gloves	148	112	76
5	Safety belt	148	76	51
6	Ear protection	148	75	51
7	Safety shoes	148	141	95
8	Full body harness	148	50	34
9	Workwear	148	148	100

Research Location Source: Boarding Houses in Malang City 2025

Table 5 Overall Average Percentage

No	Type of PPE	**Percentage %**
1	Helmet	95
2	Glasses	86
3	Mask	41
4	Gloves	76
5	Safety Belt	51
6	Ear Protection	51
7	Safety shoes	95
8	Full body harness	34
9	Workwear	100
Average Percentage%		70

Research Location Source: Boarding Houses in Malang City 2025

Table 5 shows the average results of the analysis of PPE compliance levels in accordance with the Occupational Health and Safety (OHS) Management System Guidelines stipulated by Minister of Public Works Regulation No. 09/Per/M/2008, specifically for the public works sector, compliance levels can be categorised into three categories, namely good compliance (≥85%), moderate compliance (60–85%), and poor compliance (<60%). In the bar chart above, it can be seen that the level of compliance with the use of PPE is as follows: (Helmets, 95%), (Goggles, 86%), (Masks, 41%), (Gloves, 76%), (Safety belts, 51%), (Ear protectors, 51%), (Safety shoes, 95%), (full body harness, 34%) and work clothes 100%. Thus, the overall average compliance in light steel roof frame construction work and the implementation of PPE use at the Four-Storey Boarding House on Jalan Andong Barat is still classified as moderate compliance with a total average of 70%.

CONCLUSION

Based on research conducted over 14 consecutive days, it was found that the average use of personal protective equipment (PPE) for light steel roofing work each day over 14 consecutive days was 66.5%. The days with the highest use of personal protective equipment (PPE) were Tuesday, 27 May 2025 ( ) and Saturday, 7 June 2025, with a percentage of 78%. The use of PPE per day varied; on some days, the amount of PPE used was quite high, while on other days it was lower. On the 2nd and 12th days, PPE usage reached its highest level at 78%, while on the 5th day, the number of PPE used was only 53, which was the lowest. This pattern indicates that compliance with PPE is inconsistent and influenced by various situational factors. Based on Ministerial Regulation PU/PR No. 09/2008, this figure falls into the category of moderate compliance (60–85%), while the types of PPE with very good usage rates (≥85%) are helmets (95%), goggles (86%), boots (95%), and work clothes (100%), while PPE types with a fairly good usage rate (60–85%) are gloves (76%) and PPE types with a low usage rate (<60%) are masks (41%), safety belts (51%), ear protectors (51%), and full body harnesses (34%).

RECOMMENDATIONS

Future researchers should use more complex and multivariate analysis methods to gain a deeper understanding of the relationship between OSH variables and their impact on safety, health, satisfaction, performance, and the work environment. Future research can be conducted using multivariate statistics such as Structural Equation Modelling (SEM) or multiple regression.

Expansion of Sample Size and Research Location Variation To make the research results more generalisable and representative, it is recommended to expand the sample size and conduct research in various construction project locations with different characteristics. This will help identify differences and similarities in the implementation of OSH and the factors influencing it under various conditions.

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