


# Risk Analysis of Occupational Safety and Health (OSH) in the Brick Molding Process in Tungkaran Village Based on the Guidelines of OSH Risk Management for Small and Medium Enterprises in ASEAN Member States

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| Article Info   | ABSTRACT   |
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| <b>Keywords:</b><br>OSH Risk Analysis,<br>Batako Printing,<br>HIRARC,<br>Potential Hazards.  | The implementation of Occupational Safety and Health (OSH) is crucial in the manufacturing industry, including the brick molding process, given the high potential for hazards that can disrupt operations and workers' well-being. Although previous research has analyzed hazards in similar industries, there has been no comprehensive study applying the HIRARC method to all stages of the brick molding process in Tungkaran Village, Martapura. This study aims to identify, assess, and control OSH risks based on the OSH Risk Management guidelines for ASEAN SMEs. A qualitative descriptive approach was used, with data collected through direct observation and structured interviews with 5 respondents. The HIRARC analysis identified 40 potential hazards. A total of 10% were categorized as high risk, 82.5% as moderate, and 7.5% as low. The highest risks were found in the raw material measuring, mixing, transportation, and brick arrangement stages. Other significant hazards include dust exposure, non-ergonomic work postures, and an untidy work environment. The brick molding process has a significant level of OSH risk. Comprehensive control through the use of PPE. |
| This is an open access article under the <a href="https://creativecommons.org/licenses/by-nc/4.0/">CC BY-NC</a> license<br> | <b>Corresponding Author:</b><br>Restiana Kartika Mantasti Hapsari<br>Departemen Kesehatan dan Keselamatan Kerja, Universitas Lambung Mangkurat<br>Jalan A.Yani No.36.Banjarbaru<br><a href="mailto:restianahapsari@ulm.ac.id">restianahapsari@ulm.ac.id</a>  |

## INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs) are a form of productive economic activity run by individuals and business entities according to certain established criteria. In managing their business, companies need human resources who play an important role in the operational continuity. However, in practice, workers are not free from risks related to occupational safety and health (OSH). The guarantee of OSH is an important factor that can boost employee morale, considering that every worker has the right to a safe and healthy work environment, as regulated by laws and regulations (Kamesha et al., 2024).

A work accident is an unexpected and uncontrolled event that can disrupt work effectiveness. The causes can come from various aspects, such as human factors, tools or machines, materials, work methods, and the work environment. Based on Government Regulation No. 50 of 2012 on the implementation of the OSH Management System, companies with at least 100 workers and a high potential hazard level are required to implement this system. In general, work accidents are triggered by two main factors, namely physical and human factors. A work accident is an unexpected incident that can cause losses to people, disruption of the production process, and damage to property in the industrial environment. The impacts of work accidents include physical injuries, occupational diseases, material losses, economic losses, and broader social impacts. To minimize these risks, various prevention efforts can be made, such as implementing work safety standards, fulfilling OSH requirements, providing training to workers, conducting regular supervision, and building a work culture that prioritizes safety. The Indonesian government is also actively formulating policies and regulations to reduce the number of work accidents and create a safe and productive work environment (Mauluddin et al., 2022).

One brick molding facility in the Tungkaran, Martapura, South Kalimantan area, is part of the small-scale industrial sector that plays an important role in the supply of local building materials. However, the implementation of occupational safety and health (OSH) at this site is still low. Some high-risk working conditions include the raw material measuring process, material mixing, transportation, and brick arrangement (Irawan et al., 2025). Workers are at risk of serious accidents such as being hit by vehicles during transportation of materials, as well as respiratory problems and eye irritation due to high exposure to cement and sand dust. Uneven working environments and the lack of auxiliary transportation equipment also cause workers to frequently lift heavy loads manually, increasing the risk of back and leg injuries. (Sari et al., 2022). Repetitive work activities and awkward postures, such as bending over or lifting without aids, cause musculoskeletal complaints such as muscle pain, joint tension, and body stiffness. In addition, a slippery and untidy work environment further increases the possibility of accidents such as slipping or being hit by bricks. Workers in this industry also generally do not use adequate Personal Protective Equipment (PPE), making them more vulnerable to the risk of work accidents and occupational diseases (Romas & Kumala, 2024).

Efforts to prevent work accidents and occupational diseases can be made by analyzing existing risks. Risk analysis can be applied to various activities or operations in a company. Several studies have been conducted on risk analysis in the brick molding sector. The first study by Humairo and Wirahadikusuma (2022) analyzed the effect of using Personal Protective Equipment (PPE) on the prevalence of work accidents among brick factory workers in Tulungagung. The results showed that 68% of respondents used incomplete PPE, and 68% of respondents had experienced work accidents. Simple logistic regression analysis showed that the use of complete PPE had a significant effect on reducing the incidence of work accidents ( $p\text{-value } 0.000 < 0.05$ ) (Humairo & Wirahadikusuma, 2022). It is recommended that workers use complete PPE, including boots, gloves, and glasses, and create an ergonomic work environment to minimize work accidents. Furthermore, Farid and Claudia Anggraini

(2021) conducted an occupational safety and health (OSH) analysis using the Hazard and Operability Study (HAZOP) method on hollow brick production at PT. Igarar. (Farid & Claudia Anggraini, 2021). The results showed that there were 6 types of work accidents with 4 main sources of danger, namely worker attitude, work equipment, foreign objects, and wet floors. Worker attitude has an extreme risk level, work equipment has a low risk, foreign objects have a medium risk, and wet floors have a high risk. From 2015 to 2019 data, the most work accidents occurred in 2019 with 13 employees involved (Farid & Claudia Anggraini, 2021). Another study by Noor, Setyaningrum, and Azmi (2018) assessed work risk among brick workers in Gudang Tengah Village, Sungai Tabuk District, Banjar Regency. The results showed that workers face risks such as falling, slipping, stumbling, and drowning, especially when fatigue causes loss of concentration and stability, which can lead to work accidents (Noor et al., 2018).

Although previous studies have analyzed the use of PPE among brick workers, identified hazards with the HAZOP method in similar industries, and assessed work risks in different locations, there is a significant research gap (Farid & Claudia Anggraini, 2021; Humairo & Wirahadikusuma, 2022; Siregar et al., 2020). These studies have not specifically and comprehensively analyzed OSH risks using the HIRARC method across all stages of the brick molding process in Tungkaran Village, Martapura, South Kalimantan. The application of the HIRARC method itself has been proven effective in risk analysis in production areas and as a preventive effort against accidents (Mauluddin et al., 2022; Siregar et al., 2020). Furthermore, although hazards related to work posture and manual handling have been identified in similar workers, no study has integrated all these potential hazards into one comprehensive risk analysis using HIRARC at this specific research location (Haryanti & Ramdan, 2015). Thus, this study aims to fill that gap by conducting a detailed identification, assessment, and control of risks at an unresearched location, while also following up on suggestions from previous studies to identify and control hazards comprehensively to minimize work accidents and occupational diseases (Mesin et al., 2025).

Based on the background of the problem previously described, it is necessary to conduct research on risk analysis in the brick printing industry in order to implement preventive measures against workplace accidents and occupational diseases. The method that can be used in this study is the HIRARC method (Hazard Identification, Risk Assessment, and Risk Control). This method consists of a series of occupational health and safety (OHS) implementations, including hazard identification, risk assessment, and the determination of control measures based on the data collected.

## METHODE

This study uses a qualitative descriptive research type, which aims to provide a systematic, factual, and accurate description of the facts and characteristics of a particular population or area, namely the brick molding process in Tungkaran Village, Martapura. With a qualitative approach, this research aims to describe in depth the various potential hazards and analyze the existing Occupational Safety and Health (OSH) risks.

Data collection was carried out through a combination of several techniques to obtain comprehensive information. First, direct observation was conducted at each stage of the brick-making production process, from raw material measuring to the arrangement of the final product. This observation focused on identifying work activities, environmental conditions, equipment usage, and potential hazards. Second, structured interviews were conducted with five respondents, consisting of one business owner and four workers. The respondents were selected purposively, as all workers directly involved in the production process were included. This decision was based on the limited number of workers operating in this home-based industry, making each individual considered representative in providing comprehensive data from both the workers' and the owner's perspectives. These interviews aimed to gather information related to accident experiences, health complaints, and their perceptions of work-related risks. Third, a document study was conducted to collect supporting data in the form of references from journals, government regulations, and literature related to occupational health and safety (OHS).

Operational risk analysis was systematically conducted using the HIRARC method (Hazard Identification, Risk Assessment, and Risk Control). The analysis procedure followed these stages: The first stage is Hazard Identification, in which each work activity was analyzed to identify potential hazards, including physical (e.g., dust and heat), chemical (materials), ergonomic (work posture), and mechanical (equipment) factors. All findings were recorded and documented. The second stage is Risk Assessment, carried out by calculating the Risk Score of each identified hazard. This assessment was based on a risk matrix that combines two main parameters: Likelihood (the probability of the hazard occurring) and Severity (the severity of the impact). Values for both parameters were determined based on a predefined scale. Based on the assessment results, risks were classified into three categories: High Risk, Moderate Risk, and Low Risk. The third stage is Risk Control, where control measures were proposed for the assessed risks, particularly those in the high and moderate categories. These controls were suggested based on the risk control hierarchy, starting from elimination, substitution, engineering controls, administrative controls, to the use of Personal Protective Equipment (PPE). All proposed control measures were adjusted to the operational conditions and capacities of the home-based brick-making industry.

## RESULTS AND DISCUSSION

This section presents the results of the OSH risk analysis using the HIRARC method, starting with the assessment procedure used, followed by the results of hazard identification, and concluding with proposed control measures.

### **Risk Assessment Procedure**

Before presenting the results of the hazard analysis, it is important to explain the assessment matrix used in this study. The risk assessment was performed by measuring the likelihood and severity of each identified hazard, using the following assessment scales:

**Tabel 1.** Likelihood Level Scale

| Likelihood    | Description   | Rating |
|---------------|---|--------|
| Very likely   | The most likely outcome of a hazard/event occurring | 5      |
| Likely        | Has a high chance of occurring and is not unusual   | 4      |
| Conceivable   | Might happen sometime in the future                 | 3      |
| Remote        | No known recurrence for many years                  | 2      |
| Inconceivable | Practically impossible and has never happened       | 1      |

After determining the likelihood level, the assessment continued using the severity level scale to measure the impact of the hazard.

**Tabel 2.** Severity Level Scale

| Severity      | Description  | Rating |
|---------------|--|--------|
| Catastrophic  | Death, multiple serious body injuries, multiple serious body injuries or multiple life-threatening occupational diseases (e.g., work-related cancer or acute poisoning)                        | 5      |
| Major         | Serious physical injury involving permanent disability or a life-threatening occupational disease involving one person (e.g., work-related cancer, acute poisoning)                            | 4      |
| Moderate      | Injury involving temporary disability or ill health requiring medical treatment (including lacerations, burns, sprains, minor fractures, and dermatitis and work-related upper limb disorders) | 3      |
| Minor         | Injury or ill health requiring only first aid (including minor cuts and bruises, irritation, temporary discomfort)   | 2      |
| Insignificant | Negligible injury  | 1      |

After obtaining the values from both tables, the calculation to determine the risk score was performed using the formula Risk = Likelihood x Severity. The results of the risk score calculation are presented in a matrix that classifies risks into high, moderate, and low categories.

**Table 3.** Risk Level Scale

| Severity Level      | Likelihood Level     |               |                    |               |                    |
|---------------------|----------------------|---------------|--------------------|---------------|--------------------|
|                     | Inconceivable<br>(1) | Remote<br>(2) | Conceivable<br>(3) | Likely<br>(4) | Very likely<br>(5) |
| Catastrophic<br>(5) | 5                    | 10            | 15                 | 20            | 25                 |
| Major (4)           | 4                    | 8             | 12                 | 16            | 20                 |
| Moderate (3)        | 3                    | 6             | 9                  | 12            | 15                 |
| Minor (2)           | 2                    | 4             | 6                  | 8             | 10                 |
| Insignificant (1)   | 1                    | 2             | 3                  | 4             | 5                  |



: High



: Medium





 : Low





### Analysis of Potential Hazards and Risks



Based on the analysis, here is a breakdown of the potential hazards identified at each stage of the brick production process, along with their risk assessment.

**Tabel 3.** Analysis of Potential Hazards

| Activity Details                                    | Potential Hazard          | Risiko   | Akibat                           | Tingkat     |            | Tingkat at Risiko | Dokumentasi   |
|---|---------------------------|--|----------------------------------|-------------|------------|-------------------|---|
|   |                           |  |                                  | Kemungkinan | Keseriusan |                   |   |
| <b>Raw Material Preparation Stage</b>               |                           |  |                                  |             |            |                   |   |
| Providing raw materials such as cement, sand, water | Location of raw materials | Worker could be hit by a vehicle when crossing active lane | Injury, serious injury, or death | 2           | 5          | 10                |    |
|   |                           | Excessive exposure to cement                               | Skin irritation                  | 2           | 2          | 4                 |   |
|   | Raw material dust         | Inhalation of dust   | Respiratory problems             | 3           | 4          | 12                |   |
|   |                           | Gets into eyes   | Eye irritation                   | 3           | 2          | 6                 |   |
| Water   | Slipping                  | Leg injury/sprain  | 3                                | 2           | 6          | M                 |   |
| <b>Raw Material Mixing Stage</b>                    |                           |  |                                  |             |            |                   |   |
| Measuring raw materials (cement and sand)           | Wheelbarrow               | Tripping   | Leg injury/sprain                | 3           | 2          | 6                 |  |
|   | Ground surface            | Slipping   | Leg injury/sprain                | 3           | 2          | 6                 |   |
|   | Shovel                    | Stabbed  | Bruise/laceration                | 3           | 3          | 9                 |   |
|   |                           | Inhalation   | Respiratory problems             | 3           | 4          | 12                |   |

|   |                   |                             |                      |   |   |   |   |   |
|---|-------------------|-----------------------------|----------------------|---|---|---|---|---|
|   | Raw material dust | Gets into eyes              | Eye irritation       | 3 | 2 | 6 | M |   |
|   | Heavy materials   | Crushed by a falling object | Injury               | 2 | 2 | 4 | L |   |
| Initial mixing of dry materials with a shovel | Shovel            | Stabbed                     | Bruise/laceration    | 3 | 3 | 9 | M |    |
|   | Repetitive motion | Non-ergonomic activity      | MSDs                 | 3 | 2 | 6 | M |   |
|   | Raw material dust | Inhalation                  | Respiratory problems | 3 | 4 | 1 | M |   |
|   |                   | Gets into eyes              | Eye irritation       | 3 | 2 | 6 | M |   |
| Adding water with a bucket                    | Slippery floor    | Slipping                    | Injury               | 2 | 2 | 4 | L |   |
| Mixing until evenly blended with a shovel     | Shovel            | Tertanap                    | Bruise/laceration    | 3 | 3 | 9 | M |  |
|   | Repetitive motion | Non-ergonomic activity      | MSDs                 | 3 | 2 | 6 | M |   |
|   | Heavy materials   | Crushed by a falling object | Injury               | 2 | 2 | 4 | L |   |
| Molding Stage                                 |                   |                             |                      |   |   |   |   |   |
| Preparing hand protection                     | Hammer            | Hit                         | Bruise/laceration    | 2 | 2 | 4 | L |  |
|   | Mold              | Scratched                   | Minor cut            | 3 | 2 | 6 | M |   |
|   |                   | Pinched                     | Bruise/laceration    | 3 | 2 | 6 | M |   |
| Putting raw material into the                 | Hoe               | Stabbed                     | Bruise/laceration    | 1 | 3 | 3 | L |   |
|   |                   | Inhalation                  | Respiratory problems | 3 | 4 | 1 | M |   |
|   |                   |                             |                      |   |   | 2 |   |   |

|   |                       |                      |                   |   |   |   |   |   |
|---|-----------------------|----------------------|-------------------|---|---|---|---|---|
| mold using a hoe  | Raw material dust     | Gets into eyes       | Eye irritation    | 3 | 2 | 6 | M |    |
|   | Uneven ground surface | Tripping             | Leg injury/sprain | 3 | 2 | 6 | M |   |
| Compacting the raw material in the mold using a compactor | Compactor             | Hit                  | Bruise/laceration | 3 | 2 | 6 | M |    |
|   | Mold                  | Scratched            | Minor cut         | 3 | 2 | 6 | M |   |
|   |                       | Pinched              | Bruise/laceration | 3 | 2 | 6 | M |   |
|   | Uneven ground surface | Tripping             | Leg injury/sprai  | 3 | 2 | 6 | M |   |
| Moving the molded brick to the stack                      | Brick                 | Crushed while moving | Injury            | 2 | 2 | 4 | L |   |
|   | Mold                  | Scratched            | Minor cut         | 3 | 2 | 6 | M |   |
|   |                       | Pinched              | Bruise/laceration | 3 | 2 | 6 | M |   |
|   | Uneven ground surface | Tripping             | Leg injury/sprain | 3 | 2 | 6 | M |   |
| Taking the brick out of the mold using a hammer           | Hammer                | Hit                  | Bruise/laceration | 2 | 2 | 4 | L |  |
|   | Mold                  | Scratched            | Minor cut         | 3 | 2 | 6 | M |   |
|   |                       | Pinched              | Bruise/laceration | 3 | 2 | 6 | M |   |
|   | Uneven ground surface | Tripping             | Leg injury/sprain | 3 | 2 | 6 | M |   |
| Drying Stage  |                       |                      |                   |   |   |   |   |   |

|   |       |                        |                          |   |   |   |   |  |
|---|-------|------------------------|--------------------------|---|---|---|---|--|
| Stacking the molded bricks in the drying area until completely dry (using sunlight or a drying oven if available) | Brick | Crushed while stacking | Leg or whole body injury | 3 | 3 | 9 | M | <br> |
|---|-------|------------------------|--------------------------|---|---|---|---|--|

Based on the research conducted on Friday, April 18, 2025, a total of 40 potential work hazards were identified across various production stages. Of these, 32 potential hazards (80%) fall into the moderate risk category, and 8 potential hazards (20%) fall into the low risk category. High-risk categories in the brick molding process are commonly found in stages such as raw material measuring, mixing and stirring, transportation, and brick arrangement. This finding indicates that most stages in the brick production process contain potential hazards with a moderate risk level, which still requires serious attention in the implementation of OSH control efforts.

One of the most significant risks is exposure to dust from cement and sand that spreads in the air, especially during the mixing and material transfer processes. This dust has the potential to be inhaled by workers, triggering respiratory problems and eye irritation. This finding is in line with Siregar et al.'s (2020) research, which found a significant relationship between dust exposure and respiratory complaints among brick-making workers (Siregar et al., 2020). In addition, there is a risk of being hit by vehicles, such as motorcycles passing through the work area, which can cause serious injury (Pratama et al., 2022). An unsafe working environment, such as an uneven ground surface, also contributes to accidents such as slipping or stumbling (Wibisono et al., 2023).

Heavy physical activity, such as lifting and moving materials without auxiliary tools, further increases the risk of muscle and bone injuries, especially to the back and legs. This finding is reinforced by Rudyarti and Purba's (2025) research, which identified that non-ergonomic work postures in manual handling of bricks can cause musculoskeletal complaints (Rudyarti & Purba, 2025). This is consistent with the finding that various work activities in the brick molding process are often performed without proper ergonomic principles, which can lead to musculoskeletal disorders. This condition risks causing complaints such as lower back pain, muscle tension, and joint disorders which can develop into chronic injuries if left unchecked. In addition, another potential hazard that often occurs is injury from being crushed

by bricks during the stacking process, especially if done without aids or safe techniques. A slippery work environment due to spilled materials or poor arrangement also increases the possibility of workers slipping, which can lead to serious injury. The lack of supervision and minimal application of safety procedures worsen this risk, making working conditions more vulnerable to accidents (Irawan et al., 2025).

To reduce potential hazards in the brick molding process, comprehensive risk control measures are needed. These efforts include the mandatory use of Personal Protective Equipment (PPE) by all workers, such as masks, safety glasses, gloves, and safety shoes. The importance of using PPE is also emphasized in Humairo and Wirahadikusuma's (2022) research, which showed that the use of complete PPE can significantly reduce the incidence of work accidents (Humairo & Wirahadikusuma, 2022). In addition, an ergonomic arrangement of the work area and the provision of auxiliary tools such as wheelbarrows or trolleys are very important to reduce physical strain and prevent injuries from awkward work positions (Rudyarti & Purba, 2025; Sari et al., 2022).

Considering that most of the potential hazards are in the moderate risk category, and some are in the high category, it can be concluded that the brick molding process has a significant level of OSH risk (Robbidi et al., 2024). This finding is consistent with the results of research by Noor, Setyaningrum, and Azmi (2018) in Banjar Regency, who also identified falling, slipping, and stumbling as major hazards for brick molding workers (Noor et al., 2018). Therefore, the implementation of planned and sustainable risk control efforts is crucial to create a safe and healthy work environment that supports optimal work productivity.

## CONCLUSION

Based on the hazard identification of the brick molding process, a total of 40 potential work hazards were found, with 80% of them falling into the moderate risk category and 20% in the low-risk category. These findings indicate that the brick molding process has a fairly significant level of occupational safety and health risk. The highest risks were found in the measuring, mixing, transportation, and stacking stages of the bricks, especially those related to dust exposure, heavy physical activity, uneven work surfaces, and minimal application of ergonomic principles. The lack of use of auxiliary tools, a disorganized work area, and low awareness of the use of personal protective equipment also contribute to worsening working conditions, making workers vulnerable to serious injuries and long-term health problems. To create a safe and healthy work environment in the brick production process, integrated and sustainable risk control is needed. Several steps that can be applied include increasing compliance with the use of Personal Protective Equipment (PPE) such as masks and safety glasses; arranging the work area ergonomically; providing auxiliary work tools such as trolleys to reduce physical strain; and conducting regular safety training and supervision. In addition, it is necessary to relocate or secure worker crossing lanes to avoid the risk of being hit by vehicles. Future research is expected to expand its focus by conducting a quantitative health analysis of workers, particularly related to the prevalence of respiratory disorders and musculoskeletal complaints, to obtain more comprehensive data. Furthermore, subsequent

research can also design and test prototypes of ergonomic and efficient work tools that can be applied in the small-scale brick industry to reduce the physical strain on workers, thereby making a greater practical contribution to similar industries.

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