

Assessing Occupational Hazards for Tiling Works at Construction Site

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Abstract

Occupational hazards in construction are a significant concern, especially for specialized tasks such as tiling, where workers face several risks. These hazards frequently arise from the physically intensive nature of the labor, the utilization of hazardous substances, and the unstable conditions of construction sites. This study seeks to carefully evaluate the occupational hazards linked to tiling work, emphasizing the identification of potential hazards, performing risk assessment and recommending appropriate control measures for mitigating hazards. The study used a mixed-approaches approach, integrating both quantitative and qualitative methods for gathering data such as field observations, hazard identification techniques, and systematic interviews with construction employees and executives that were performed at several locations at construction sites. The research additionally encompasses an evaluation of safety protocols and adherence to current occupational safety and health regulations. Significant data indicates that tiling workers often encounter physical hazards, such as falls from height, exposure to sharp tools and machinery, and injuries resulting from slips, trips, and falls. Chemical hazards are considerable, as employees frequently manage adhesives, grout, and cleaning solvents without sufficient personal protective equipment (PPE), resulting in skin irritation and respiratory problems. Moreover, inadequacies in safety training, insufficient implementation of safety protocols, and an absence of ergonomic gear enhance the total potential hazards for tiling workers. This research offers a comprehensive review of the occupational hazards encountered by tiling workers and suggests practical solutions, thereby enhancing safety standards within the construction sector.

1. Introduction

The construction site is hazardous by all definitions, and characterized by all kinds of activities, heavy machines, high-risk tasks, and complex workflows. Tiling-work offers unique occupational hazards not normally considered within the different trades of the construction industry. The tile flooring installer faces exigencies such as musculoskeletal injuries caused by repetitive motions, exposure to hazardous materials like adhesives

and grout, slips, and trips and falls. If not controlled effectively, these hazards can cause serious injuries, impaired productivity, and long-term health problems.

Although occupational health and safety regulations have improved up to this point, workplace incidents in the tiling industry still occur. Without considering research on tiling hazards, safety studies in the construction industry have mostly focused on high-risk tasks like scaffolding, excavation, and electrical work. This study will assess and analyze the occupational hazards related to tiling work on construction sites, to understand significant risk factors and assess current safety measures. In so doing, the aim of this research is to recommend measures for improving safety protocols, educating workers, and reducing occupational injuries. This research will thus help in providing safer working conditions and enhance good practices related to tiling operations within the construction industry [1].

2. Methodology

2.1 Research Design

Data collecting in a case study often involves a methodical approach where many sources of evidence are used to ensure coordination and improve the research's quality. This multifaceted approach enables a more detailed and thorough understanding of the situation, encompassing various views and aspects. Table 1 shows the research design based on objectives.

Table 1: Research Design based on Objectives

Research Objectives	Research Method	Data
To identify potential safety hazards and health hazards associated with tiling works.	Qualitative method by monitoring and observation through field observation and GEMBA walk for focused group.	Site inspection checklist, interview and site monitoring and observation.
To evaluate the likelihood and severity of identified hazards to determine their risk level using risk matrix.	Semi-quantitative method by assessing risk level in determining likelihood and severity using the risk matrix in HIRARC (Hazard Identification, Risk Assessment, and Risk Control)	Risk matrix quantifies the likelihood and severity of hazards.
To recommend appropriate control measures for eliminating or minimizing hazards.	Qualitative method by observation and document analysis of current control measures and recommend suitable control measures based on hierarchy of control.	Reviewing current control measures and recommend appropriate control measures.

2.2 Data Collection Method

2.2.1 Interview

Interviews can be unstructured, semi-structured, or structured, and they enable researchers to obtain comprehensive data directly from participants [2]. In this study, semi-structured interviews are used to determine qualitative data from observations and interviews. Besides, surveys and questionnaires are also helpful tools for gathering standardized or quantitative data from a greater number of people.

2.2.2 GEMBA Walk

Another important method is observational research, in which researchers methodically document interactions, events, and behaviors in the situation in order to gather data in real time and offer contextual understanding [3]. One of the examples is GEMBA walk. Focus groups are useful for examining interactions between individuals and collective viewpoints because they involve several participants in facilitated interactions [4].

2.2.3 Document Analysis

It is the process of looking over all of the case's current records, including emails, documents, reports, and official papers that provide background and context. Throughout the data collection process, ethical considerations, such as getting permission from the management, maintaining confidentiality of the findings, and being aware of biases are crucial.

2.3 Data Collection Instrument

2.3.1 Hazard Identification, Risk Assessment, and Risk Control (HIRARC)

HIRARC approaches are utilized to evaluate and assess the risk or hazard throughout the entirety of the tiling activities at the construction site, beginning with the very first step and continuing until the very last one. The Department of Safety and Health (DOSH) guidelines and the company's safety manual are the sources of the guidelines that are used for the HIRARC approach.

The process starts with hazard identification, whereby potential causes of injuries or unwanted safety and health consequences linked to workplace activities are identified [5]. This stage entails a comprehensive analysis of the work environment, responsibilities, and procedures in order to identify potential risks and hazards. In the risk assessment section, the hazards that have been identified are carefully examined to determine the probability of their likelihood and the severity of their potential outcomes. This process involves assessing the hazards in order to prioritize them according to their influence on safety and health [6]. The risk control step involves executing measures to entirely eliminate or minimize the risks to a level that is considered acceptable. These measures encompass elimination, substitution, engineering controls, administrative controls, and personal protective equipment (PPE) [7]. The HIRARC procedure is crucial for establishing a proactive safety culture and reducing workplace hazards occurrences by systematically managing and controlling hazards.

3. Results and Discussion

Presented in this section are the findings of the study, which evaluated hazards associated with the tiling operations that took place at the construction site. Data collected and case study results are based on findings and assessments from several methods done to ensure the accuracy and reliability of the data. With consistent efforts in field observations, engagement with the workers, and analyzing documents, there are several hazards that relate to the installation of tile. The findings are classified into several relative risk values determined by their risk score and shown in the HIRARC table in Table 2, 3, and 4 below. There were six hazards identified, and all hazards are categorized under medium risk level.

Table 2: Hazard Identification

No.	Work Activity	Hazard	Effect
1	Tile installation at height.	Fall from height.	- Fractures. - Paralysis. - Concussion. - Fatal.
2	Using electrical tools and machinery.	Electric shock.	- Burns. - Organ Damage. - Electrocutation. - Nerve damage.
3	Cutting and trimming tiles.	Exposed to sharp tools and machinery.	- Minor cuts. - Lacerations. - Puncture wounds. - Bruises.
4	Lifting and moving tiles.	Slip, trip, and fall hazards.	- Bruises. - Sprain and strain. - Fracture. - Cuts and abrasions.
5	Surface preparation for tile installation.	Inhalation of silica dust.	- Respiratory irritation. - Eye irritation, - Silicosis. - Lung cancer.
6	Handling of chemical solvents.	Exposure to harsh chemicals.	- Skin irritation. - Respiratory irritation. - Eye irritation. - Dizziness.

Table 3: Risk Assessment

No.	Hazard	Likelihood	Severity	Risk Rating
1	Fall from height.	3	4	3 x 4 = 12
		Conceivable, might occur at some time in the future.	Fatal, approximately one single fatality.	12, Medium Risk
2	Electric shock.	3	3	3 x 3 = 9
		Conceivable, might occur at some time in the future.	Serious, non-fatal injury but permanent disability.	9, Medium Risk
3	Exposed to sharp tools and machinery.	3	2	3 x 2 = 6
		Conceivable, might occur at some time in the future.	Minor, disabling but not permanent injury.	6, Medium Risk
4	Slip, trip, and fall hazards.	3	3	3 x 3 = 9
		Conceivable, might occur at some time in the future.	Serious, non-fatal injury but permanent disability.	9, Medium Risk
5	Inhalation of silica dust.	4	3	4 x 3 = 12
		Possible, has a good chance of occurring and is not unusual.	Serious, non-fatal injury but permanent disability.	12, Medium Risk
6	Exposure to harsh chemicals.	3	2	3 x 2 = 6
		Conceivable, might occur at some time in the future.	Minor, disabling but not permanent injury.	6, Medium Risk

Table 4: Risk Control

No.	Work Activity	Hazard	Recommended Control Measures
1	Tile installation at height.	Fall from height.	<p><u>Engineering Control</u></p> <ul style="list-style-type: none"> - Install guardrail around edges and openings on scaffolds. - Install fall protection systems. - Installation of safety net <p><u>Administrative Control</u></p> <ul style="list-style-type: none"> - Provide training to workers regarding safe working procedures, use of equipment and emergency procedures. - Provide warning signs for potential fall hazards. - Ensure adequate supervision from supervisor. <p><u>PPE</u></p> <ul style="list-style-type: none"> - Use of safety harness, lanyards, and anchor points. - Use safety vest, safety helmet, safety boots, safety mask, safety goggles, knee pads, and safety gloves.
2	Using electrical tools and machinery.	Electric shock.	<p><u>Substitution</u></p> <ul style="list-style-type: none"> - Use battery-operated tools instead of electric-operated tools. <p><u>Engineering Control</u></p> <ul style="list-style-type: none"> - Ensure tools and machinery have automatic shut-off,

			<p>blade guards, and anti-kickback devices.</p> <p><u>Administrative Control</u></p> <ul style="list-style-type: none"> - Provide training on the safe use of electric tools. - Establish a maintenance schedule for tools inspection and servicing. <p><u>PPE</u></p> <ul style="list-style-type: none"> - Use safety vest, safety helmet, safety boots, safety mask, safety goggles, knee pads, and safety gloves (rubber insulating gloves).
3	Cutting and trimming tiles.	Exposed to sharp tools and machinery.	<p><u>Engineering Control</u></p> <ul style="list-style-type: none"> - Ensure tools and machinery have automatic shut-off, blade guards, and anti-kickback devices. <p><u>Administrative Control</u></p> <ul style="list-style-type: none"> - Provide training on the safe use of cutting and trimming tools. - Use signage or barriers to restrict access to areas where cutting tools are being used. <p><u>PPE</u></p> <ul style="list-style-type: none"> - Use safety vest, safety helmet, safety boots, safety mask, safety goggles, knee pads, and safety gloves (cut-resistant gloves)
4	Lifting and moving tiles.	Slip, trip, and fall hazards.	<p><u>Elimination</u></p> <ul style="list-style-type: none"> - Use mechanical instruments such as lifting devices, trolleys, and forklifts instead of manual handling. <p><u>Substitution</u></p> <ul style="list-style-type: none"> - Use lighter weight tiles for easier handling. <p><u>Engineering Control</u></p> <ul style="list-style-type: none"> - Design workspace to minimize the need of bending, twisting, and reaching in handling tiles. <p><u>Administrative Control</u></p> <ul style="list-style-type: none"> - Provide training for workers in safe manual handling techniques. - Establish strict housekeeping practices to minimize unsafe conditions. <p><u>PPE</u></p> <ul style="list-style-type: none"> - Use safety vest, safety helmet, safety boots, safety mask, safety goggles, knee pads, safety gloves, and back support belt.
5	Surface preparation for tile installation.	Inhalation of silica dust.	<p><u>Engineering Control</u></p> <ul style="list-style-type: none"> - Provide portable ventilation fan unit at the work area to remove dust at source. - Use water to suppress dust during grinding and sanding work. <p><u>Administrative Control</u></p> <ul style="list-style-type: none"> - Provide training for workers regarding dust-generating activities and the hazard of dust inhalation. - Implement a periodical housekeeping schedule to clean up dust regularly.

			<ul style="list-style-type: none"> - Conduct monitoring related to air quality to ensure dust level does not exceed occupational exposure limits. <p><u>PPE</u></p> <ul style="list-style-type: none"> - Use safety vest, safety helmet, safety boots, safety mask (N95 or higher), safety goggles, knee pads, and safety gloves.
6	Handling of chemical solvents.	Exposure to harsh chemicals.	<p><u>Substitution</u></p> <ul style="list-style-type: none"> - Use water-based adhesives or low volatile organic compound (VOC) products instead of solvent-based adhesives. <p><u>Engineering Control</u></p> <ul style="list-style-type: none"> - Provide portable ventilation fan unit at the work area to remove chemical fumes at source. <p><u>Administrative Control</u></p> <ul style="list-style-type: none"> - Provide training for workers regarding hazards of chemical solvents and safe chemical handling practice. - Establish safe operating procedures (SOP) for safe handling of chemical solvents. - Schedule a job rotation to minimize the exposure to chemical solvents for a long period of time. - Assure that all chemical containers are labeled accordingly with warning signage indicating the presence of hazardous chemicals. <p><u>PPE</u></p> <ul style="list-style-type: none"> - Use safety vest, safety helmet, safety boots, safety mask, safety goggles, knee pads, and safety gloves.

Tile installation at height poses a significant risk of fall from height, which can result in severe injuries or fatalities. Moreover, bone fractures, spinal injuries, paralysis, concussion, and damage to internal organs are some other examples of the effect or the consequences of falls from height. In this risk assessment, the highest risk rating score for safety hazards and most critical safety hazards is fall from height with a risk score of 12 (Medium). Based on the risk assessment, fall from height is likely to occur at some time in the future, conceivable, with a likelihood rating of 3 and severity rating of 4 which approximately one single fatality if hazard occurred. By implementing control measures based on hierarchy of control measures, this hazard could be minimized resulting in a lower probability for this hazard to occur. Starting with engineering control, fall from height hazard could be mitigated by installing guardrails around edges and openings on scaffolds. Moreover, installation of fall protection systems such as safety nets is also beneficial. Next control measure is administrative control measures such as scheduling work to avoid bad weather and ensure adequate supervision from supervisor when doing work. The last control measure is the use of personal protective equipment (PPE) such as the use of safety harnesses, lanyards, and anchor points. By implementing these control measures, all parties involved could mitigate this hazard resulting in safer working environments.

When doing surface preparation works such as grinding and sanding before tile installation, it produced concrete dust and debris that contain silica. Inhalation of silica dust can have several consequences including respiratory irritation, eye irritation, silicosis, lung cancer, and Chronic Obstructive Pulmonary Disease (COPD). In this risk assessment, the highest risk rating score for health hazards and most critical health hazards is inhalation of silica dust with a risk score of 12 (Medium). Based on the risk assessment, inhalation of silica dust has a good chance of occurring and is not unusual with a likelihood rating of 4 and severity rating of 3 which could cause serious non-fatal injury with permanent disability if hazard occurred. By implementing control measures based on hierarchy of control measures, this hazard could be minimized resulting in a lower probability for this hazard to occur. Firstly, engineering control by providing portable ventilation fan unit at the work area to remove dust at source and use water to suppress dust during grinding and sanding work could minimize the exposure to silica dust. Next is administrative control. Supervisors should schedule dust-generating activities when fewer workers are present and conduct monitoring related to air quality to ensure dust level does not exceed occupational exposure limits. The last one is personal protective equipment (PPE)

where workers should wear safety vest, safety helmet, safety boots, safety goggles, knee pads, safety gloves, and safety mask, grade N95 or higher.

4. Conclusion

This study thoroughly evaluated the occupational hazards linked to tiling work at construction sites, including the identification of possible hazards, risk assessment utilizing the HIRARC framework, and the recommendation of suitable hierarchy control measures to reduce these risks. Tiling work is a crucial yet perilous part of the construction industry, subjecting workers to numerous hazards such as physical injury, chemical exposure, ergonomic strain, and emotional strain. The hazards are frequently amplified by insufficient safety protocols, inadequate training, and a deficiency of appropriate personal protective equipment (PPE), hence creating significant hazards to the safety and health of tiling workers.

The research data underscores the frequency of physical hazards including slips, trips, and falls, frequently linked to uneven surfaces, insufficient lighting, or obstructed access or workspace. Chemical hazards such as exposure to adhesives, grout, and cleaning solvents, can lead to skin irritation, respiratory problems, and other chronic health issues, especially when personal protective equipment is not provided or used. The risk assessment performed in this study indicates that although certain control measures exist, numerous locations inside the construction site do not adequately enforce comprehensive safety regulations. The absence of systematic safety training, irregular compliance with safety standards, and restricted availability of PPE intensify the hazards encountered by workers. Furthermore, it was clear that a substantial number of tiling-related risks can be eliminated or mitigated through the appropriate use of control measures in line with the hierarchy of control, including elimination, substitution, engineering controls, administrative controls, and personal protective equipment (PPE).

This study provides significant insights for enhancing safety standards in the construction industry. Recommendations encompass the establishment of regular safety training, the augmentation and enforcement of personal protective equipment (PPE) usage, the adoption of ergonomic tools and methodologies, and the implementation of administrative policies aimed at mitigating stress and boosting worker coordination. Moreover, technical interventions, such as enhanced lighting, surface treatment, and machinery safety protocols, can substantially mitigate physical hazards. Consistent inspections and audits, coupled with a strong safety culture, are essential for maintaining sustainable changes.

In conclusion, the systematic assessment of occupational hazards in tiling work at construction sites establishes a framework for risk mitigation and improved safety outcomes. By rectifying the identified weaknesses in existing procedures and implementing the suggested control measures, stakeholders can provide safer working conditions, minimize the frequency and severity of accidents, and enhance the overall well-being of tiling workers. This study's findings enhance the understanding of occupational safety and provide guidance for legislators, employers, and professionals to improve safety standards in the construction sector. Ongoing research and proactive measures are crucial to maintain the viability of these initiatives and to adjust to emerging issues in the constantly evolving construction industry.

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Author Contribution

All Authors of this study have contributed data collection, data analysis and manuscript writing.

Conflict of Interest

Authors declare that there is no conflict of interest regarding the publication of the paper.

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Appendix

Appendix A: WCT Land Sdn. Bhd. Weekly Safety & Health Inspection Report

WCT LAND SDN. BHD.

WEEKLY SAFETY & HEALTH INSPECTION REPORT

DATE OF INSPECTION:	TIME: AM/PM
LOCATION INSPECTED:	
CONTRACTOR:	
CONDUCTED BY: 1) 2) 3)	

No.	Inspection Items	OK	Need Action	Comments	No.	Inspection Items	OK	Need Action	Comments
1	Access / Egress				19	Scaffold Safety			
2	Safety Signage				20	Catch Platform			
3	Information Display at Notice Board				21	Rubbish Chute			
4	Emergency Preparedness & Response				22	Fall Protection / Working At Height			
5	First Aid Box				23	Loading Platform			
6	Housekeeping				24	Permit To Work			
7	Material Storages/ Arrangement/ Handling				25	Confine Space Safety			
8	Chemical Safety / Flammable Material Storage				26	Fogging & Larvaciding			
9	Formwork Safety				27	Open Burning			
10	Pile Drilling / Piling work				28	Worker Quarters/Canteen			
11	Slope Protection / Excavation & Shoring				29	Awareness Training (Induction / Tool box)			
12	Barricades / Protections (Floor /Stairs way Opening /Building Edge)				30	Action taken for comments written in Authority Log Book			
13	Power Tools/ Electrical Safety				31	Debris Disposal Management			
14	Ladder Safety				32	Silt Trap /Silt Fence Maintenance			
15	Machineries / Equipments Guarding /Inspection				33	Domestic Waste Management			
16	Vehicle Control / Traffic Management				34	Schedule Waste Management			
17	Warning sound/ buzzer of vehicle				35	Competency Personnel / Machine Operation Certificate (PMA / PMT)			
18	Public Safety				36	PPE Usage			
					37	Others:			

Conclusion:

Reviewed By: (PM, CM/ HOD)

Date: