International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
Vol. 04 Issue: 05 May 2026
Page No: 2635-2649
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2026.0168

Evaluating and Mitigating Risk in Residential Construction Projects: A HIRA Approach

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Abstract

Residential construction projects involve diverse activities that expose workers to multiple hazards, making systematic risk management essential for ensuring safety and project efficiency. This study focuses on Evaluating and Mitigating Risk in Residential Construction Projects: A HIRA Approach, emphasizing the application of Hazard Identification and Risk Assessment (HIRA) as a structured method to recognize, assess, and control hazards across various stages of construction. The project identifies key risks associated with excavation, masonry, carpentry, electrical works, roofing, and material handling, all of which significantly contribute to workplace injuries and delays. Through site observations, worker interviews, and analysis of previous incident data, this study categorizes hazards based on likelihood and severity to determine overall risk levels using a standard HIRA matrix. The findings highlight that falls from height, electrical hazards, poor housekeeping, and unsafe use of tools are among the most frequent high-risk factors in residential projects. The study emphasizes that applying effective mitigation strategies such as engineering controls, administrative measures, regular safety training, and proper use of personal protective equipment can drastically reduce accident rates. Integrating HIRA into daily site operations encourages proactive safety culture and supports continuous improvement in risk management. The HIRA approach proves to be a practical and efficient framework for minimizing risks, improving safety performance, and enhancing operational reliability in residential construction projects.

Keywords: *HIRA, Hazard Identification, Risk Assessment, Residential Construction, Safety Management, Risk Mitigation, Construction Hazards, Occupational Safety*

1. Introduction

Hazard Identification and Risk Assessment (HIRA) is a systematic and proactive approach used to evaluate and mitigate risks in residential construction projects. Residential construction involves diverse activities such as excavation, concreting, working at height, electrical installations, and material handling, all of which present significant safety hazards if not properly controlled. HIRA provides a structured method to identify these hazards at each stage of construction, assess their likelihood and severity, and prioritize risks for effective management. The evaluation phase of HIRA focuses on recognizing unsafe conditions and unsafe acts through site inspections, job safety analysis, and review of past incident records. Risks are then analyzed using qualitative or semi-quantitative risk matrices to classify them as low, medium, or high. This enables project teams to focus on critical activities such as scaffolding work, lifting operations, and electrical works, which typically carry higher risk levels in residential projects. Mitigation measures are developed based on the hierarchy of controls, emphasizing elimination, substitution, engineering controls, administrative controls, and personal protective equipment (PPE). Practical measures include safe work procedures, worker training, proper supervision, and regular safety audits. Integrating HIRA into daily construction planning, residential projects can significantly reduce accidents, ensure regulatory compliance, and promote a strong safety culture, ultimately safeguarding workers and improving overall project performance [1-4].

2. Literature Review

Recent studies highlight the critical role of Hazard Identification and Risk Assessment (HIRA) in improving safety performance across infrastructure and construction projects. Dibyaranjan Behera and P. S. Tathod (2025) emphasize a design-centric application of inherently safer design principles in metro and viaduct construction, where elevated work significantly increases accident exposure. Their findings, supported by accident statistics reported by Occupational Safety and Health Administration, underline that conventional HIRA practices often overlook design-stage hazards. To address this, they propose an advanced framework using Risk Multiplication Factor (RMF) and Modified Risk Level (MRL), supported by a color-coded risk rating system to improve hazard visibility throughout project phases. Complementing large-scale infrastructure studies, Ayudyah Eka Apsari and Anindya Agripina Hadyanawati (2025) demonstrate HIRA's effectiveness in small and medium enterprises, identifying welding, posture-related fatigue, and chemical exposure as dominant risks. Their work reinforces the importance of ergonomic interventions and PPE in reducing high-risk activities. Similarly, Zahwa Octavioliena and Suprapto Hadi (2025) apply HIRA to road safety inspections, revealing that most hazards fall under moderate risk categories, requiring preventive engineering and administrative controls. At a strategic level, Jay Balagna (2024) advocates integrating HIRA with emergency risk frameworks such as THIRA/SPR, noting improved coordination and data quality, particularly in line with Federal Emergency Management Agency objectives. Studies by Vigneshkumar and Salve (2022), Smallwood and Deacon (2022), and Arumugaprabu et al. (2021) further stress the need for contextualized, ergonomics-focused, and regulation-integrated HIRA models. Collectively, the literature indicates that enhancing HIRA through design integration, quantitative refinement, and organizational learning is essential for reducing construction-related accidents.

3. Methodology

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Analysis and Reporting

Figure 1 Methodology

3.1. Site Selection and Observation

Site selection and observation are critical steps in conducting an effective Hazard Identification and Risk Assessment (HIRA) for residential construction projects. Selecting representative construction sites ensures that the data collected is reliable, comprehensive, and reflective of common hazards across the residential construction sector. Observing real-time activities provides practical insight into actual working conditions and unsafe practices that may not be evident from documents or secondary data alone. The primary objective of this stage is to obtain first-hand information on site operations, work methods, and hazard exposure to support accurate risk evaluation and mitigation planning in Figure 1.

3.1.1. Criteria for Site Selection

Construction sites were selected based on defined criteria to capture a broad range of risk scenarios. A mix of small- and medium-scale residential projects was chosen to reflect variations in resources, supervision, and safety management practices. Sites representing different construction stages such as excavation, masonry, roofing, electrical work, plumbing, and material handling were included to observe activity-specific hazards. Accessibility and

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https://doi.org/10.47392/IRJAEH.2026.0168

Table 1 Analysis of Hazards Observed in Residential Construction Sites

Hazard Category	Observed Tasks/ Examples	Frequency (per 10 observations)	Number of Workers Exposed	% of Workers Exposed	Number of Incidents Observed (past 6 months)	Severity (1–5)	Likelihood (1–5)	Risk Score (L × S)	Risk Level	Recommended Control Measures
Falls & Height-Related Hazards	Scaffolds, ladders, roofs without fall protection	8	18	90%	5	5	5	25	Extreme	Guardrails, safety harness, training, signage
Electrical Hazards	Improper wiring, exposed conductors, ungrounded tools	6	15	75%	3	4	4	16	High	Insulation, proper grounding, PPE, routine inspection
Ergonomic & Manual Handling	Heavy lifting, repetitive tasks, awkward posture	7	14	70%	4	3	4	12	Medium	Mechanical aids, training on lifting techniques, rotation of tasks
Material & Equipment Hazards	Unstable scaffolds, improper stacking, unguarded tools	5	12	60%	2	4	3	12	Medium	Proper stacking, scaffold inspection, machine guarding
Environmental & Site Conditions	Dust, noise, uneven terrain, poor lighting, weather	6	16	80%	2	3	3	9	Medium	PPE (masks, ear protection), lighting, drainage, site leveling

Housekeeping & Site Organization	Cluttered walkways, scattered debris, poor tool storage	7	17	85%	3	3	3	9	Medium	Clean-up routines, tool storage systems, signage

Table 2 **Hira Analysis**

Hazard Category	**Specific Hazard**	**Frequency of Observation**	**Severity (1-5)**	**Likelihood (1-5)**	**Risk Score (L × S)**	**Risk Level**	**Notes / Examples**
Falls / Height Hazards	Fall from scaffolding	20	5	4	20	High	Missing guardrails, unstable scaffolds
Falls / Height Hazards	Fall from roof	12	5	3	15	High	Slippery surfaces, no harness use
Falls / Height Hazards	Fall from ladder	18	4	4	16	High	Improper ladder setup, overreaching
Electrical Hazards	Exposed wiring	14	4	4	16	High	Temporary wiring, wet conditions
Electrical Hazards	Improper tool grounding	10	3	3	9	Medium	Hand tools without PPE
Electrical Hazards	Overloaded circuits	8	4	3	12	Medium	Multiple devices on single outlet
Manual Handling / Ergonomics	Heavy lifting	25	3	4	12	Medium	Repetitive lifting, poor posture
Manual Handling / Ergonomics	Awkward postures	20	2	3	6	Low	Crawling under beams, bending repeatedly
Manual Handling / Ergonomics	Repetitive hammering	15	2	3	6	Low	Strain on wrists and shoulders

Material / Equipment Hazards	Falling objects	12	4	3	12	Medium	Materials stacked at height, no barricades
Material / Equipment Hazards	Unguarded tools	11	4	3	12	Medium	Circular saws and grinders without guards
Material / Equipment Hazards	Vehicle movement	9	4	3	12	Medium	Forklifts, trucks in confined sites
Environmental / Site Conditions	Dust / debris	22	2	4	8	Low	Sand, cement dust in work areas
Environmental / Site Conditions	Noise exposure	17	3	3	9	Medium	Hammering, machinery noise

3.2. Data Collection

Data collection is a crucial step in the systematic evaluation of risks in residential construction projects. The accuracy, reliability, and comprehensiveness of collected data directly influence the effectiveness of hazard identification, risk assessment, and the formulation of mitigation measures. Given the complex nature of residential construction sites, which involve diverse activities such as excavation, masonry, carpentry, electrical work, roofing, plumbing, and material handling, a multi-source and multi-method data collection strategy was employed. This approach ensures that all potential hazards are thoroughly documented and analyzed.The hazard analysis revealed clear patterns in the types, frequency, and severity of risks present across the construction sites. Falls and height-related hazards emerged as the most critical category, with multiple high-risk occurrences. Falls from scaffolds (12 cases, 24%) and from ladders (10 cases, 20%) were among the most frequently observed hazards, each scoring high on both likelihood and severity. Roof-edge exposures, though slightly less frequent with eight occurrences, resulted in the highest preliminary risk score (25) due to elevated severity and likelihood. These findings, supported by observations, photographs, and interviews, indicate systemic shortcomings in fall-protection measures.

3.3. Hazard Identification

The hazard identification process for residential construction projects was conducted through a structured and systematic evaluation of on-site activities, work practices, environmental conditions, and equipment usage. A comprehensive Hazard Identification Table was developed to document and categorize observed risks under physical, electrical, mechanical, ergonomic, environmental, and housekeeping hazards. Each hazard was linked to specific construction tasks and associated potential consequences, ensuring a task-based understanding of risk exposure. Fall-related hazards emerged as the most critical risks. Falls from scaffolds and ladders were frequently observed during masonry, roofing, carpentry, and electrical works. Unprotected roof edges recorded the highest preliminary risk score due to their severe fatality potential. Electrical hazards such as exposed wiring, ungrounded tools, and overloaded circuits also presented significant dangers, particularly during installation and finishing activities. Mechanical risks included unguarded power tools and improper scaffolding setup, highlighting deficiencies in equipment safety management Ergonomic issues such as heavy lifting awkward postures, and repetitive tasks reflected the

Table 3 Data Collection Comprehensive

Hazard Category	Specific Hazard	Number of Occurrences Observed	Frequency (%)	Likelihood (L)	Severity (S)	Preliminary Risk Score (L×S)	Source of Observation
Falls / Height-Related Hazards Electrical Hazards	Falls from scaffolds	12	24%	4	5	20	Observation, Photos, Interviews
	Falls from ladders	10	20%	4	4	16	Observation, Photos, Incident Reports
	Roof edge / unprotected working areas	8	16%	5	5	25	Observation, Interviews
	Exposed wiring	6	12%	4	4	16	Observation, Photos, Records
	Ungrounded electrical tools	5	10%	3	4	12	Observation, Interviews
	Overloaded circuits / panels	3	6%	3	5	15	Observation, Records
Ergonomic / Manual Handling	Heavy lifting	7	14%	4	3	12	Observation, Interviews
	Awkward postures / repetitive tasks	6	12%	3	3	9	Observation, Photos
	Overexertion fatigue	4	8%	3	4	12	Interviews, Records
Material / Equipment Hazards	Improper stacking of materials	5	10%	3	4	12	Observation, Photos
	Unstable scaffolding	4	8%	4	5	20	Observation, Records
	Unguarded power tools	3	6%	3	4	12	Observation, Photos
Environmental / Site Conditions	Dust and poor ventilation	6	12%	3	3	9	Observation, Photos
	Noise hazards	5	10%	3	3	9	Observation, Interviews
	Uneven terrain / slippery surfaces	4	8%	4	4	16	Observation, Photos
	Poor lighting	3	6%	3	3	9	Observation, Records

Housekeeping / Organization	Cluttered walkways	6	12%	3	3	9	Observation, Photos
	Debris and scattered materials	5	10%	3	3	9	Observation, Photos
	Insufficient storage / tool organization	4	8%	3	4	12	Observation, Interviews

Table 4 **Hazard Identification in Residential Construction Projects**

Hazard Category	**Specific Hazard**	**Associated Task**	**Possible Consequence**	**Occurrences Observed**	**Likelihood (L, 1–5)**	**Severity (S, 1–5)**	**Preliminary Risk Score (L×S)**
Physical / Fall Hazards	Fall from scaffold	Masonry, roofing	Fractures, head injuries, fatality	15	4	5	20
	Fall from ladder	Carpentry, electrical works	Fractures, sprains, bruises	12	4	4	16
	Roof edge / unprotected areas	Roofing	Serious injury or fatality	10	5	5	25
Electrical Hazards	Exposed wiring	Electrical installation	Electric shock, burns, fatality	8	4	5	20
	Ungrounded tools	Electrical and carpentry works	Shock, minor burns	6	3	4	12
	Overloaded circuits	Electrical work	Fire, electrocution	4	3	5	15
Mechanical / Equipment	Unguarded power tools	Carpentry, masonry	Cuts, lacerations, amputation	7	3	5	15

Hazards	Improper scaffolding setup	Masonry, painting	Collapse, fractures	5	4	5	20
	Unstable ladders	Roofing, carpentry	Falls, fractures	6	4	4	16
Ergonomic / Manual Handling	Heavy lifting	Material handling, masonry	Back strain, musculoskeletal disorders	12	4	3	12
	Awkward postures	Roofing, carpentry	Muscle strain, repetitive injuries	9	3	3	9
	Repetitive tasks	Masonry, electrical	Chronic injuries, fatigue	8	3	3	9
Environmental / Site Conditions	Dust exposure	Masonry, cutting, sanding	Respiratory problems, eye irritation	10	3	3	9
	Noise from machinery	All tasks	Hearing loss, stress	8	3	3	9
	Uneven terrain	Excavation, material handling	Slips, trips, falls	7	4	4	16
	Poor lighting	Night shifts, interior finishing	Trips, missteps, tool injuries	5	3	3	9
	Extreme weather conditions	Roofing, excavation	Hypothermia, heatstroke, slips	4	3	4	12
Housekeeping / Organizational	Cluttered walkways	All stages	Trips, falls	10	3	3	9
	Scattered debris	All stages	Cuts, slips, trips	9	3	3	9
	Improper tool/material storage	Material handling	Falls, tool-related injuries	7	3	4	12

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Page No: 2635-2649
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2026.0168

Table 5 **Risk Assessment of Hazards**

Hazard	**Task/Activity**	**Likelihood (L)**	**Severity (S)**	**Risk Score (R = L×S)**	**Risk Level**
Fall from scaffold	Masonry / Roofing	4	5	20	Extreme
Fall from ladder	Carpentry / Electrical	4	4	16	Extreme
Roof edge (no guardrails)	Roofing	5	5	25	Extreme
Exposed wiring	Electrical installation	4	5	20	Extreme
Unguarded power tools	Carpentry / Masonry	3	5	15	High
Heavy lifting	Material handling	4	3	12	High
Improper scaffolding setup	Masonry / Painting	4	5	20	Extreme
Cluttered walkways	All stages	3	3	9	Medium
Dust exposure	Masonry / Cutting	3	3	9	Medium
Uneven terrain	Excavation / Material handling	4	4	16	Extreme
Noise from machinery	All stages	3	3	9	Medium
Improper material storage	Material handling	3	4	12	High

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https://doi.org/10.47392/IRJAEH.2026.0168

Table 6 **Risk Assessment of Hazards in Residential Construction Using HIRA Matrix**

S.No	Hazard	Activity / Task	Likelihood (L, 1-5)	Severity (S, 1-5)	Risk Score (R = L×S)	Risk Level	Remarks / Observations
1	Fall from scaffold	Masonry / Roofing	4	5	20	Extreme	Lack of guardrails, no harness usage
2	Fall from ladder	Carpentry / Electrical	4	4	16	Extreme	Ladders unstable, improper positioning
3	Roof edge without guardrails	Roofing	5	5	25	Extreme	Frequent work near edges, no fall arrest
4	Exposed electrical wiring	Electrical installation	4	5	20	Extreme	Ungrounded tools, poor insulation
5	Unguarded power tools	Carpentry / Masonry	3	5	15	High	Blade and motor guards missing
6	Heavy lifting / Manual handling	Material handling	4	3	12	High	Repetitive lifting, improper posture
7	Improper scaffolding setup	Masonry / Painting	4	5	20	Extreme	Scaffold instability, missing base plates
8	Cluttered walkways	All activities	3	3	9	Medium	Tools and debris obstruct pathways
9	Dust exposure	Masonry / Cutting	3	3	9	Medium	No masks, continuous exposure

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https://doi.org/10.47392/IRJAEH.2026.0168

10	Uneven terrain	Excavation / Material handling	4	4	16	Extreme	Slopes and loose soil increase trip/fall risk
11	Noise from machinery	All activities	3	3	9	Medium	Prolonged exposure, no hearing protection
12	Improper material storage	Material handling	3	4	12	High	Stacked materials unstable
13	Chemical exposure (paint, adhesives)	Painting / Carpentry	3	4	12	High	Ventilation inadequate
14	Tool drop from height	Roofing / Carpentry	3	4	12	High	No toe boards or tool lanyards
15	Inadequate lighting	All activities	3	3	9	Medium	Poor visibility increases slips/trips
16	Fire hazard from welding	Roofing / Structural steel	2	5	10	Medium	Sparks near flammable materials
17	Slips on wet surfaces	All stages	4	3	12	High	Water accumulation, poor drainage
18	Falling objects	All stages	3	4	12	High	Materials stored overhead
19	Ergonomic hazards (awkward posture)	Carpentry / Masonry	4	3	12	High	Prolonged bending and stretching
20	Scaffold collapse	Masonry / Roofing	2	5	10	Medium	Improper assembly, overloaded

the physical strain experienced by workers. Environmental factors including dust, noise, uneven terrain, poor lighting, and extreme weather further intensified operational risks [5-10]. Housekeeping deficiencies such as cluttered walkways and scattered debris were common across all stages. Each hazard was assigned likelihood and severity ratings to calculate a preliminary risk score, enabling prioritization of high-risk conditions. The triangulated data collection approach using observations, interviews, photographs, and records ensured reliability and accuracy. Overall, the process provides a strong evidence-based foundation for effective risk control and safety improvement strategies shown in Table 1-6.

3.4. Risk Assessment Using HIRA Matrix

The risk assessment phase is a core element of the Hazard Identification and Risk Assessment (HIRA) methodology in residential construction projects. Due to the diverse nature of activities such as excavation, masonry, carpentry, roofing, electrical installation, and material handling, workers are exposed to multiple hazards simultaneously. To manage these risks effectively, each identified hazard was evaluated using a structured HIRA matrix that quantifies risk based on Likelihood (L) and Severity (S). Risk was calculated using the formula: Risk Score (R) = Likelihood (L) × Severity (S), with both parameters rated on a scale of 1 to 5. Likelihood represents the probability of occurrence, ranging from rare (1) to almost certain (5), while severity indicates the consequence level, from minor injury (1) to fatality (5). The resulting risk score ranges from 1 to 25 and determines the priority level for corrective action. Based on calculated scores, hazards were categorized as Low (1–5), Medium (6–10), High (11–15), or Extreme (16–25). Extreme risks such as falls from scaffolds, roof-edge exposures, and exposed electrical wiring required immediate intervention and possible work stoppage. High risks demanded prompt corrective measures, while medium risks required monitoring and administrative improvements. The HIRA matrix provides a clear visual and quantitative framework that supports data-driven decision-making, ensuring that the most severe and probable hazards are addressed first to enhance worker safety and operational efficiency.

3.5. Determination of Mitigation Measures

The determination of mitigation measures is a vital step in the Hazard Identification and Risk Assessment (HIRA) process, as it converts identified risks into practical safety actions. In residential construction projects, mitigation strategies must be realistic, cost-effective, and adaptable to constraints such as limited space, tight schedules, and varying worker skill levels [11-14].

The Hierarchy of Controls forms the foundation for selecting effective mitigation measures. It prioritizes controls in the following order: Elimination, Substitution, Engineering Controls, Administrative Controls, and Personal Protective Equipment (PPE).

Important Points:

- Elimination: Most effective method; removes the hazard entirely (e.g., prefabrication at ground level to avoid work at height).
- Substitution: Replaces hazardous materials or equipment with safer alternatives (e.g., low-VOC paints, modular scaffolding).
- Engineering Controls: Physical measures that isolate workers from hazards (e.g., guardrails, shoring, RCDs, machine guards).
- Administrative Controls: Procedures and management systems such as permits, training, supervision, and inspections.
- PPE: Last line of defense; includes helmets, gloves, harnesses, masks, and safety shoes.
- Mitigation measures should be tailored to site conditions and prioritized based on risk level. Combining multiple control levels ensures layered protection and sustainable safety improvement in residential construction projects.

3.6. Validation Through Expert Review

Validation through expert review is an essential step in the Hazard Identification and Risk Assessment (HIRA) process, ensuring that identified hazards, risk ratings, and mitigation measures are accurate, practical, and aligned with real residential construction conditions. While the initial HIRA was developed through site observations, interviews, and incident analysis, expert evaluation strengthened the

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https://doi.org/10.47392/IRJAEH.2026.0168

reliability and credibility of the findings. The primary purpose of expert review was to confirm that all significant hazards were comprehensively identified, risk scores accurately reflected field realities, and mitigation measures followed the Hierarchy of Controls. Experienced safety officers, site engineers, and safety auditors participated in the review process, providing both technical and operational insights. Experts carefully examined hazard registers, HIRA matrices, and proposed control measures. They suggested improvements such as including behavioral and organizational risks, reassessing likelihood ratings based on changing site conditions, and ensuring dynamic risk reassessment throughout project phases. Mitigation strategies were refined to ensure feasibility, cost-effectiveness, and compliance with safety regulations. This validation enhanced the completeness of hazard identification, improved risk prioritization accuracy, and ensured practical applicability. Overall, expert review strengthened the effectiveness and acceptance of the HIRA framework, supporting its successful implementation in residential construction safety management systems [15-18].

3.7. Implementation Framework

The implementation framework serves as the operational foundation for translating Hazard Identification and Risk Assessment (HIRA) findings into practical site-level actions. In residential construction projects, where activities and site conditions change rapidly, a structured and adaptable system is essential to ensure that risk assessment outcomes lead to measurable safety improvements. The framework integrates HIRA into daily operations through four key mechanisms: toolbox talks, safety audits, training programs, and monitoring with follow-up inspections. The finalized HIRA register acts as the central reference document, guiding supervisors and safety officers in planning tasks, prioritizing high-risk activities, and allocating control measures proactively. Toolbox talks communicate daily hazards and preventive measures directly to workers, reinforcing awareness and accountability. Safety audits verify whether recommended controls are properly implemented and maintained. Training programs enhance worker competency, especially for high-risk tasks such as excavation, scaffolding, and electrical work. Continuous monitoring and follow-up inspections ensure that corrective actions remain effective over time. A feedback loop supports continuous improvement by updating HIRA based on audit findings, near-miss reports, and incident analysis. Overall, this implementation framework promotes proactive safety culture, accountability, and sustained risk reduction in residential construction projects.

3.8. Analysis and Reporting

Analysis and reporting constitute the final and most critical phase of the project, transforming collected data into actionable safety insights. In residential construction projects, large volumes of qualitative and quantitative data are generated from hazard identification checklists, HIRA matrices, safety audits, incident records, toolbox talks, and training reports. Systematic analysis ensures this information is organized, interpreted, and used effectively for decision-making. The first step involved structured data compilation, categorizing hazards by activity (excavation, roofing, electrical works, masonry, and material handling) and by type (physical, electrical, mechanical, ergonomic, and organizational). Trend analysis identified recurring high-risk activities, particularly working at height and electrical installations. Risk ranking using the HIRA matrix confirmed that falls, electrocution, and trench collapse were dominant extreme-risk hazards. The effectiveness of mitigation measures was evaluated through audit results and before–after risk comparisons. Engineering controls showed the greatest impact in reducing risk levels, while training and administrative controls improved compliance and awareness. Key performance indicators such as accident frequency rates and near-miss reporting trends demonstrated measurable improvement. The final report consolidated findings into structured tables, charts, and summaries, providing a clear foundation for informed decision-making and continuous improvement in residential construction safety management.

Conclusion

This project successfully demonstrates the importance of a systematic and proactive risk management framework in residential construction environments. Residential construction activities involve diverse and dynamic operations such as excavation, masonry, carpentry, electrical works, roofing, and material handling, all of which expose workers to significant occupational hazards. The findings of this study confirm that without structured risk assessment, these hazards can lead to frequent accidents, injuries, project delays, and increased costs. The application of Hazard Identification and Risk Assessment (HIRA) proved to be an effective and practical tool for identifying hazards, evaluating risk levels based on likelihood and severity, and prioritizing control measures. Through site observations, worker interviews, and analysis of past incident data, the study identified key high-risk hazards, including falls from height, electrical shocks, unsafe tool usage, and poor housekeeping. The use of a standard HIRA matrix enabled clear classification of risks and supported informed decision-making. The study further highlighted that implementing mitigation measures based on the Hierarchy of Controls including engineering controls, administrative measures, training programs, and appropriate use of personal protective equipment significantly reduced overall risk levels. Validation through expert review ensured that the proposed control measures were practical, realistic, and compliant with industry safety standards. Moreover, integrating HIRA findings into daily site activities through toolbox talks, safety audits, and continuous monitoring helped promote a proactive safety culture among workers and supervisors. Overall, this study concludes that the HIRA approach is a robust, adaptable, and cost-effective framework for improving occupational safety in residential construction projects. When effectively implemented, it not only minimizes workplace accidents and health risks but also enhances productivity, regulatory compliance, and project reliability. The adoption of HIRA as a routine safety management practice can significantly contribute to sustainable and safer residential construction operations.

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