CHAPTER 102

Optimizing Ergonomics in Construction: A REBA Assessment Approach

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ABSTRACT

In the dynamic and physically demanding environment of the construction industry, ensuring worker safety and efficiency through ergonomics is paramount. This study explores the application of the Rapid Entire Body Assessment (REBA) method to identify ergonomic risk factors that contribute to musculoskeletal disorders (MSDs) among construction workers. By systematically evaluating postural strain, repetitive movements, and physical exertion, the research highlights key risk areas and recommends interventions to mitigate ergonomic hazards. The study incorporates technology-driven solutions such as the ErgoDroid application, which facilitates real-time posture monitoring and ergonomic assessment. Findings indicate that ergonomic interventions, including optimized workstations, mechanical lifting aids, and targeted training programs, significantly reduce the risk of injuries, enhance worker productivity, and improve overall workplace efficiency. The research underscores the economic and organizational benefits of integrating ergonomics into construction workflows, advocating for a structured approach to risk identification, assessment, and intervention. Ultimately, this study contributes to the growing discourse on workplace safety by demonstrating the critical role of ergonomics in fostering a healthier and more sustainable construction industry.

Keywords: Ergonomics; REBA assessment; Construction safety; Musculoskeletal disorders; ErgoDroid; Workplace wfficiency; Ergonomic interventions.

1.0 Introduction

In the ever-evolving landscape of the construction industry, efficiency and worker safety remain critical concerns. One key factor that significantly influences both is ergonomics—the science of designing work environments, tools, and tasks to fit the capabilities and limitations of the human body. Construction work is physically demanding, involving repetitive motions, heavy lifting, awkward postures, and prolonged periods of exertion. If ergonomic principles are neglected, workers face a high risk of musculoskeletal disorders (MSDs), chronic injuries, and diminished productivity. Given the physically intensive nature of construction sites, prioritizing ergonomic interventions is crucial to ensuring worker well-being, reducing workplace injuries, and improving overall operational efficiency.

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Despite advancements in technology and safety regulations, the construction sector continues to grapple with occupational health challenges, making ergonomic optimization an urgent necessity. One of the most effective methods for assessing ergonomic risks is the Rapid Entire Body Assessment (REBA), a comprehensive tool designed to evaluate posture-related hazards across different body parts, including the trunk, neck, lower limbs, and upper extremities. Developed by Sue Hignett and Lynn McAtamney, the REBA method provides a structured approach to identifying high-risk postures that contribute to MSDs and workplace injuries. Unlike other assessment techniques, REBA considers dynamic construction activities, making it particularly suitable for evaluating postural risks in an industry characterized by variability in tasks and work environments. By systematically categorizing postural risks into different levels, the REBA assessment enables construction managers, ergonomists, and safety officers to implement targeted interventions, such as redesigning workstations, incorporating mechanical lifting aids, and educating workers on proper body mechanics.

Incorporating digital tools such as the ErgoDroid application further enhances ergonomic assessments in construction. ErgoDroid integrates real-time posture monitoring, data analytics, and ergonomic evaluation features that streamline risk assessment processes. By leveraging artificial intelligence and wearable technology, ErgoDroid helps detect high-risk postures, monitor worker movements, and recommend corrective measures. Such innovations bridge the gap between traditional ergonomics and modern construction safety, fostering a proactive approach to workplace well-being.

This study aims to evaluate the effectiveness of REBA in identifying and mitigating ergonomic hazards in construction settings. By analyzing ergonomic risk factors, implementing targeted interventions, and assessing their impact on worker safety and productivity, this research contributes to the growing discourse on occupational health in the construction sector. The findings will offer valuable insights into the role of ergonomic assessments in reducing injury rates, optimizing performance, and promoting a culture of safety in construction projects. Ultimately, by integrating ergonomics into everyday construction practices, the industry can move toward a safer, more efficient, and sustainable future.

2.0 Literature Review

Ergonomics in the construction industry has gained increasing attention due to its direct impact on worker safety, efficiency, and overall productivity. Numerous studies have explored the role of ergonomic assessments, particularly using methods such as the Rapid Entire Body Assessment (REBA) and the Rapid Upper Limb Assessment (RULA), to identify and mitigate risks associated with musculoskeletal disorders (MSDs) in construction settings. This section reviews key literature relevant to ergonomic risk assessment in construction, focusing on the implementation and effectiveness of the REBA method. Kibria (2023) conducted an ergonomic analysis of construction workers' postures using both the RULA and REBA methods to assess the risk of MSDs. The study involved data collection from 35 workers engaged in various

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construction activities, including column and beam casting, masonry, and material handling. The findings indicated that workers in these tasks exhibited high-risk postures, necessitating urgent ergonomic interventions such as workstation modifications, proper training, and the use of lifting aids to reduce injury risks. Similarly, Vachhani, Sawant, and Pataskar (2016) examined ergonomic risks among construction workers, employing REBA and Quick Exposure Check (QEC) methods. Their research revealed that nearly 40% of workers fell into the high-risk category, emphasizing the critical need for ergonomic improvements in construction activities such as bricklaying, bending reinforcing bars, and leveling concrete.

Another study by Norhidayah *et al.* (2016) applied the REBA tool to analyze postural loads in the Malaysian mining sector, highlighting the high probability of MSDs due to poor work posture and prolonged exposure to physically demanding tasks. The findings underscored the necessity of implementing ergonomic interventions, including workstation modifications, improved work practices, and ergonomic training programs. Similar results were observed in research conducted by Kathiravan & Gnarani (2018), who assessed ergonomic risks in residential construction projects across Tamil Nadu using REBA and RULA. Their findings demonstrated that more than half of the workers exhibited postures that placed them in the highest risk category, necessitating immediate intervention.

Hita-Gutiérrez *et al.* (2020) conducted a global review of REBA applications, highlighting its effectiveness in assessing ergonomic risks across various industries, including construction, manufacturing, and agriculture. The study emphasized the advantages of using REBA in construction settings, where physically demanding tasks such as lifting, pulling, and repetitive motions contribute to a high prevalence of work-related injuries. The study also pointed out the growing adoption of REBA in developing countries, where construction safety measures are still evolving. Similarly, Purnomo & Apsari (2016) analyzed construction workers' postures in Indonesia using REBA and identified high-risk postures that contributed to fatigue and discomfort, particularly in the lower back, legs, and shoulders. The study proposed ergonomic interventions such as raising materials to comfortable heights and using lifting aids to improve worker safety.

Moreover, Kee (2022) conducted a systematic comparison of REBA, RULA, and the Ovako Working Posture Analysis System (OWAS), evaluating their reliability in ergonomic risk assessment. The study found that while RULA is particularly effective for upper limb assessments, REBA provides a more comprehensive evaluation of full-body postural risks, making it more suitable for construction-related ergonomic studies. Additionally, Damaj *et al.* (2016) explored the implementation of ergonomics in construction projects and found that resistance to change, financial constraints, and lack of awareness were major barriers to ergonomic adoption. Their research advocated for the integration of ergonomic planning with lean construction principles to enhance safety, reduce variability, and optimize workforce productivity.

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3.0 Objectives of the Study

- Evaluate the difficulties and present practices of ergonomics in the building sector.
- Determine the effectiveness of the Rapid Entire Body Assessment (REBA) technique in detecting ergonomic hazards on construction sites.
- Identify widespread ergonomic hazards that affect construction workers' health, safety, and efficiency.

4.0 Research Methodology

This study employs a systematic approach to evaluating ergonomic risks in the construction industry, with a particular focus on the Rapid Entire Body Assessment (REBA) method. Given the physically demanding nature of construction work, this research aims to identify high-risk postures, assess ergonomic hazards, and propose effective interventions. The study begins with an initial assessment and task identification, wherein high-risk construction activities such as heavy lifting, repetitive motions, and awkward postures are identified through direct observation, worker interviews, and analysis of injury records. Following this, a questionnaire survey is conducted among construction workers to gather data on their ergonomic awareness, work-related discomfort, and perceived impact of ergonomic interventions. The survey includes questions related to job roles, experience, ergonomic training, frequency of injuries, and existing workplace safety measures.

To ensure comprehensive data collection, real-time posture monitoring and ergonomic assessments are conducted using the REBA method. Workers performing various construction tasks, such as material handling, masonry, and beam casting, are observed, and their postures are analyzed using REBA scoring. This step involves recording joint angles, body movements, and force exertion levels, with scores assigned based on the severity of postural risks. Additionally, the study integrates technology-driven solutions such as the ErgoDroid application, which facilitates real-time posture monitoring and data-driven analysis to enhance the accuracy of ergonomic assessments. By leveraging artificial intelligence and digital tools, the study ensures objective and efficient risk evaluations. The next phase involves intervention planning and implementation, wherein ergonomic solutions tailored to construction tasks are developed. These solutions include redesigning workstations, incorporating mechanical lifting aids, introducing job rotation, and providing ergonomic training programs. Once the interventions are implemented, a post-intervention REBA assessment is conducted to evaluate their effectiveness in reducing ergonomic risks. Worker feedback is also collected to assess improvements in comfort, safety, and productivity. To measure the long-term impact of ergonomic interventions, a follow-up study and monitoring phase is carried out, tracking changes in injury rates, absenteeism, and worker performance over time. Additionally, economic feasibility analysis is conducted to determine the cost-benefit ratio of integrating ergonomic improvements into

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construction workflows. The study also explores barriers to ergonomic implementation, such as resistance to change, financial constraints, and lack of training, providing insights into strategies for overcoming these challenges.

5.0 Data Analysis and Interpretation

Table 1: Demographic and Work Experience of Respondents

Category	Percentage (%)
Less than 5 years of experience	30%
5–10 years of experience	45%
More than 10 years of experience	25%
Manual laborers	60%
Machine operators	25%
Supervisory staff	15%

Table 2: Awareness and Training on Ergonomics

Training Frequency	Percentage (%)
Regular training (quarterly)	10%
Occasional training (annually)	25%
No ergonomic training	65%

Table 3: Work-Related Discomfort and Musculoskeletal Disorders (MSDs)

Type of Discomfort/MSD	Percentage of Workers Affected (%)
Back pain	70%
Muscle strain	60%
Joint pain	50%
Workers with work-related MSDs	40%

Table 4: REBA Score Categorization for Workers

REBA Score Range	Risk Level	Percentage of Workers (%)
8–11	High Risk (Immediate intervention required)	40%
5–7	Medium Risk (Modifications needed soon)	45%
1–4	Low Risk (Acceptable posture)	15%

6.0 Data Analysis

The data analysis of this study provides insights into the ergonomic risks faced by construction workers and the effectiveness of interventions using the Rapid Entire Body Assessment (REBA) method. The demographic analysis revealed that 45% of workers had 5–10

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years of experience, while 30% had less than five years, and 25% had over ten years. The workforce primarily comprised 60% manual laborers, 25% machine operators, and 15% supervisory staff. Awareness and training on ergonomics were found to be lacking, with 65% of workers never receiving any ergonomic training, while only 10% underwent regular quarterly training and 25% received annual training.

Table 5: Impact of Ergonomic Interventions

Parameter	Before Intervention (%)	After Intervention (%)	Change (%)
High-risk postures	40%	25%	-35%
Medium-risk postures	45%	30%	-25%
Back pain cases	70%	40%	-30%
Muscle strain cases	60%	40%	-20%
Work efficiency	-	+15%	+15%
Absenteeism reduction	-	-20%	-20%
Estimated healthcare cost reduction	-	-	10-15%

An assessment of work-related discomfort and musculoskeletal disorders (MSDs) showed that 70% of workers experienced frequent back pain, 60% reported muscle strain, and 50% suffered from joint pain. Additionally, 40% of workers had been diagnosed with work-related MSDs, requiring medical attention. The REBA evaluation of different construction tasks categorized 40% of workers as high risk (requiring immediate intervention), 45% as medium risk (modifications needed soon), and 15% as low risk (acceptable posture). These findings highlighted the urgent need for ergonomic improvements in construction work environments.

Following the implementation of ergonomic interventions such as workstation redesign, mechanical lifting aids, and posture training, a post-intervention REBA assessment showed a 35% reduction in high-risk postures and a 25% decline in medium-risk postures. Reported cases of back pain decreased by 30%, while muscle strain cases dropped by 20%. Additionally, work efficiency improved by 15%, absenteeism due to injuries reduced by 20%, and an estimated 10–15% reduction in healthcare costs was projected due to improved workplace ergonomics.

These results underscore the importance of ergonomic assessments in identifying and mitigating workplace risks in the construction industry. The study confirms that implementing structured ergonomic interventions not only enhances worker safety and reduces injuries but also leads to increased productivity and economic benefits. Moving forward, continued monitoring, training programs, and the integration of digital ergonomic assessment tools like ErgoDroid can further improve ergonomic practices and ensure long-term sustainability in construction work environments.

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7.0 Conclusion and Recommendations

The integration of ergonomics in the construction industry is not merely an enhancement but a necessity for ensuring worker safety, efficiency, and long-term sustainability. Construction sites are characterized by physically demanding tasks, heavy machinery, and repetitive movements, all of which contribute to a high prevalence of work-related musculoskeletal disorders (WMSDs). This study highlights the effectiveness of the Rapid Entire Body Assessment (REBA) method in identifying and mitigating ergonomic risks. The findings reveal that a significant proportion of construction workers are at medium to high ergonomic risk, requiring immediate intervention. By implementing targeted ergonomic solutions such as workstation redesign, the use of mechanical lifting aids, job rotation, and ergonomic training programs, the study demonstrates substantial improvements in worker safety and productivity.

The integration of technology-driven tools like ErgoDroid further enhances ergonomic assessments, enabling real-time monitoring and data-driven decision-making to optimize workplace ergonomics. Despite the evident benefits of ergonomic interventions, several challenges persist, including resistance to change, financial constraints, lack of awareness, and limited access to ergonomic training. To overcome these barriers, organizations must adopt a structured approach to integrating ergonomics into standard safety protocols. It is recommended that construction firms implement regular ergonomic assessments, provide mandatory training programs, and invest in technological solutions to enhance workplace safety. Additionally, strong management commitment and stakeholder engagement are essential for fostering a culture of safety and continuous improvement. By prioritizing ergonomics, companies can not only reduce injury rates, absenteeism, and healthcare costs but also enhance overall efficiency and workforce well-being. Moving forward, further research should explore the long-term economic impact of ergonomic optimization and the scalability of interventions across different construction projects. Ultimately, ergonomics should be viewed as a strategic investment in worker health, productivity, and the long-term success of the construction industry.

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