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ERGONOMIC EVALUATION OF MANUAL REBAR BENDING OPERATIONS AND DESIGN IMPROVEMENT FOR CONSTRUCTION WORKERS

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Abstract:

Manual rebar bending is one of the most common operations performed by construction workers during reinforcement work. However, the process often requires repetitive movements, excessive force, and awkward postures, which may lead to work-related musculoskeletal disorders (WMSDs). This study evaluates the ergonomic risks associated with manual rebar bending operations and proposes design improvements to enhance worker safety and efficiency.. Ergonomic assessment was carried out using the Rapid Upper Limb Assessment (RULA) and Rapid Entire Body Assessment (REBA) methods to determine the level of musculoskeletal risk. The results indicated that workers were frequently exposed to high ergonomic risk due to continuous bending, twisting of the trunk, and repetitive arm movements. The average RULA score obtained for the existing bending method was 6, indicating that the posture requires immediate investigation and corrective changes. Similarly, the REBA assessment produced an average score of 10, which falls under the high-risk category, suggesting that prompt ergonomic intervention is necessary. Workers reported discomfort primarily in the lower back (68%), shoulders (55%), and wrists (47%), mainly due to prolonged stooping and application of high manual force during bending operations. To reduce ergonomic strain, an improved rebar bending device with an adjustable lever mechanism and optimized working height was proposed. The modified design allows workers to maintain a more neutral posture and reduces the amount of force required during bending. After implementing the improved design in a simulated working environment, the RULA score decreased from 6 to 3, and the REBA score reduced from 10 to 5, indicating a shift from high-risk to medium/low-risk ergonomic conditions. In addition, the time required for bending a single rebar decreased by approximately 22%, demonstrating improved productivity. Worker feedback also indicated a significant reduction in perceived physical strain and fatigue.



