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Ergonomic Evaluation of Scaffold Building

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Abstract

The present study evaluated the ergonomic hazards that are associated with scaffold building/erecting for one of the local construction companies and proposed recommendations for solution/control measures to mitigate those hazards. Ergonomic hazards were identified based on field observation and conversation with workers, superintendents/foremen, and managers. REBA (Rapid Entire Body Assessment) was used to estimate the risks of entire-body injuries and disorders. Building/erecting scaffolds requires lifting/carrying heavy and bulky materials, awkward postures (e.g., reaching and holding overhead, and kneeling on the scaffolds), and repetitive motions (e.g., hammering the cuplocks). Exposure to these hazards lead to a high risk of musculoskeletal injuries and disorders, especially to the back and shoulder, for scaffold builders. Discussion among the researcher and the pertinent personnel of the company was made during presentation of the research findings, so recommendations for control measures could be better communicated. The recommendations include, but are not limited to: installing scaffold hoist pulley system or other hoist assistance systems, training provided to all field personnel on ergonomics of scaffold building/erecting, proper work-rest scheduling, and workplace stretching program.

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Keywords: Ergonomic Hazards; Scaffold Building.

1. Introduction

According to ILO [1], scaffold building/erecting is to provide work platforms on building, industrial and other sites, for temporary structures such as stages and catwalks, and for the purpose of painting, repairing, seating,

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disguising building facades, etc. Scaffold builders check the construction requirements from drawings and written instructions, select materials and set ground levels; fit together steel pipes, support braces and clamps to form bases for scaffolds; lift and position sections of scaffolding and bolt pipes together to build up scaffolding; place planks over horizontal bars to create platforms; check levels in scaffolding structures; use prefabricated scaffolding when available; and dismantle scaffolding at the completion of a job [1].

Scaffold building/erecting and dismantling is one of the toughest jobs in the construction industry [2]. Erecting and dismantling scaffolds requires reaching and lifting, awkward postures (such as twisting and holding overhead, bending), and using force (when attaching cross braces and damaged parts, for example). Exposure to these hazards lead to a high risk of musculoskeletal injuries and disorders, especially to the back and shoulder, for scaffold builders.

The present study exhibited a model of "practice to research to practice." It started with the local construction company's proactive effort to implement sound ergonomics program to address workplace ergonomic hazards and issues. The researcher was invited to employ appropriate research methods to quantify the ergonomic hazards associated with scaffold building. Then, the results of ergonomic evaluation were presented to the pertinent personnel of the company for dissemination of the research findings as well as for identification of the recommendations for control measures.

2. Methods

In the present study, the local construction company's scaffold builders erecting scaffolds at Shell Chemical's Norco facility in Louisiana, USA, were evaluated. Field observation and conversation with workers, superintendents/foremen, and managers, were made on Monday August 11, 2014 from 8:00 AM to 4:00 PM.

REBA (Rapid Entire Body Assessment) was used to estimate the risks of entire-body injuries and disorders [3]. REBA uses a scoring system: Score A - Neck, Trunk, and Legs Posture Score + Load/Force Score; Score B - Upper Arm/Shoulder, Lower Arm/Elbow, and Wrist Posture Score + Coupling Score; and Score C - Score A + Score B. The final REBA Score is determined by adding an Activity Score to Score C, which denotes a certain action level responsible for the estimated risk level. REBA has five action levels where a higher level indicates a higher risk level and requires more and further assessment.

After the field evaluation was complete, the researcher discussed the research findings with the pertinent company personnel, so recommendations for control measures could be better communicated.

3. Results

3.1. Ergonomic hazards

Building/erecting scaffolds required lifting/carrying heavy and bulky materials, awkward postures (e.g., reaching and holding overhead, and kneeling on the scaffolds), and repetitive motions (e.g., hammering the cuplocks). The REBA score was 6, which indicated a medium risk and further investigation and changes need to be implemented soon. Some of the scaffold builders also had improper work-rest scheduling.

Manual lifting and carrying of scaffolding parts and materials are a big part of the work, especially for helpers who usually have fewer craft skills and experiences. Scaffold builders are also required to manually move/transport the scaffolding materials while they are on the scaffolds. The risk of falling from heights greatly increases due to the stability issues. According to the scaffolding material weight sheet provided by the company, many materials weigh more than 25 lbs and some more than 51 lbs which is the safe limit as suggested by National Institute of Occupational Safety and Health (NIOSH). They often have to use awkward postures including elevating arms and twisting trunk in order to reach the materials.

Workers use awkward postures of different body parts while doing most of the scaffold building work. Often the existing structure at the facility provided a very limited access for scaffold builders. For example, one of the workers kneeled on the scaffold plank with a severe flexion of trunk to hammer screws into the scaffold planks. In another crew, the leadman had to squeeze in and out through a very small opening which caused him to crawl.

Scaffold builders are required to repetitively hammer the cuplocks to stabilize the scaffolds. It has been observed that some workers used their hands as hammers to fasten the pieces.

The conversation with field personnel revealed that some of the scaffold builders took lunch break at 1:30 pm. Because of this, workers might end up working a relatively longer period of time without break.

3.2. Recommendations for control

The recommendations to eliminate or reduce the ergonomic hazards included, but were not limited to: installing scaffold hoist pulley system or other hoist assistance systems, training provided to all field personnel on ergonomics of scaffold building/erecting, proper work-rest scheduling, and workplace stretching program.

Two of the crews have been observed to use ropes to hoist the scaffolding materials. While they have reduced the physical burden of manual lifting, it is not the safest or most efficient way to do the job. Workers at the ground level had to tie the materials tightly to the ropes and workers on the scaffold must forcefully drag the rope up to get the materials. The materials could drop inadvertently striking whoever underneath. Only one material could be lifted at once, so the work efficiency is negatively impacted.

It is recommended that the company should consider purchasing and installing the scaffold hoist pulley system. Some of the systems are not expensive and very easy to install and use. For example, Cornerstone Building Materials sell scaffolding hoist pulley & wheel pulley which are about $100 per system, http://www.cbmscaffold.com/Pages/ScaffoldHoistPulley.aspx. For the safest and fastest system, the company should consider the Maxial Track Scaffold Hoist, http://www.betamaxhoist.com/scaffolding/.

All field personnel including scaffold builders, superintendents/foremen, and field managers, should receive ergonomic training to better understand ergonomic hazards and utilize ergonomic principles during scaffold building/erecting. Participatory ergonomics approach could also be used to maximizes the active involvement of workers in implementing ergonomic knowledge, procedures and changes with the intention of improving working conditions, safety, productivity, quality, morale and/or comfort [4].

The ergonomic research and field studies [5] suggested that workers should take 5-10 minutes of break every 2 hours, especially for those who are doing heavy construction work. If the time for lunch could not be changed, workers should be provided with 3 breaks in the morning.

It was learned from one of the superintendents that the scaffold builders exercise an approximately 10-minute pre-job stretching in the morning. It would be necessary to examine how the stretching proceeds to make sure that they are appropriate. It is recommended that a second during-the-job stretching be implemented as needed, especially for those who are exerting high forces. For the best results, worksite stretching sessions shall be included as mandatory component of a comprehensive ergonomics program, along with pre-job safety/ergonomics planning (e.g., pre-shift huddles, toolbox safety talks) [6].

4. Discussion

The present study focused on the evaluation of the ergonomic hazards associated with scaffold erection for a local construction company, so recommendations for solution/control measures could be identified to mitigate those hazards. Typical ergonomic hazards included: lifting/carrying heavy and bulky materials, awkward postures (e.g., reaching and holding overhead, and kneeling on the scaffolds), repetitive motions (e.g., hammering the cuplocks), and improper work-rest scheduling. These findings are consistent with what have been reported previously [2]. The recommendations to eliminate or reduce the ergonomic hazards included, but were not limited to: installing scaffold hoist pulley system or other hoist assistance systems, training provided to all field personnel on ergonomics of scaffold building/erecting, proper work-rest scheduling, and workplace stretching program.

The present study differed from other ergonomic research in that it started with the request for ergonomic evaluation from the industry. The researcher was approached by the local construction company to utilize his expertise and experience in ergonomics to solve the real-life problems and issues. Following standardized ergonomic research protocols, the researcher conducted field observation and conversation with pertinent personnel for qualitative and quantitative evaluation of the ergonomic hazards. After the research was complete, the research findings were presented to the company with the ultimate goal of disseminating and discussing the recommendations for control measures.

As there is high variability in the construction work [7], it is desired that representative samples of work and actual variation of exposure should be captured [8]. However, since the project must be complete on the given scheduled day, the present study lacked the ability to conduct a thorough and in-depth analysis of the ergonomic exposure variability. Rather, it only identified the typical ergonomic hazards as well as the recommendations for control objectively. Future study should be followed up to continue examining the ergonomic exposure during the scaffold building/erecting work to prevent ergonomic injuries and musculoskeletal disorders for scaffold builders.

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