Safety and Ergonomics Study for High Rise Construction Project

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Abstract*: Construction jobs are so demanding physically on a person's body, a variety of injuries can occur. Therefore it is important for employers to provide a safe environment for their construction workers. Ergonomics is a significant factor in achieving and maintaining high level of worker productivity and healthy. Ergonomics is the study of improving the fit between the worker and the physical demands of the workplace. Ergonomics can be used to reduce injuries, improve productivity and reduce the costs of doing business. The further study could be on the application of research on ergonomics and safety on the construction site facing the problems and give suggestions to them for increasing the output of the overall project.*

Keywords: Ergonomics, output, safe environment, worker productivity, workplace

1.0 INTRODUCTION

Construction industry is one of the largest industries in Palestine, It is about 10 % of the nation product and there are a lot of workers employed in construction industry. construction employee work in cleaning and preparing the sites ,digging ,operating power tool ,loading and unloading of material, mixing and placing concrete and also work at different times, evening weekend or holidays, to finish his work. These factors lead him to ergonomic risk and serious injures such as strains , sprains and work related to musculoskeletal disorders that caused by carrying heavy loads, repetitive movement, awkward postures and contact stress vibration .Ergonomics one of the procedures that eliminate the hazards and risk in construction industry.

Ergonomics, as defined by the Board of Certification for Professional Ergonomists (BCPE), is a body of knowledge about human abilities, human limitations and human characteristics that are relevant to design. Ergonomics design is the application of this body of knowledge to the design of tools, machines, systems, tasks, jobs and environments for safe, comfortable and effective human use.

Ergonomics is a significant factor in achieving and maintaining high level of worker productivity and healthy. Ergonomics is the study of improving the fit between the worker and the physical demands of the workplace. Ergonomics can be used to reduce injuries, improve productivity and reduce the costs of doing business.

Construction industry is one of the largest industries and there are a lot of workers employed in construction industry. construction employee work in cleaning and preparing the sites ,digging ,operating power tool ,loading and unloading of material, mixing and placing concrete and also work at different times, evening weekend or holidays, to finish his work. These factors lead him to ergonomic risk and serious injures such as strains , sprains and work related to musculoskeletal disorders that caused by carrying heavy loads, repetitive movement, awkward postures and contact stress vibration .Ergonomics one of the procedures that eliminate the hazards and risk in construction industry.

The term ergonomics is derived from the Greek word ergos meaning 'Work' and nomos meaning 'Natural laws' or 'study'.

Construction-workers are the 'human capital' of the construction industry, and need particular care. This, related to the need for continuous improvement of skills (training), reduction of health risks and actualizing capacity and productivity (input/output) makes the construction worker appear as the centre of the construction industry. Ergonomics combines knowledge of human abilities with that of tool design, equipment, and work organization.

Ergonomics is the procedure that eliminates the hazards and the risks in the construction industry.

This study perhaps provides some valuable insights into the aspects of safety management that are crucial towards improvement of safety of high-rise building occupants. Moreover, this study will be conduct in order to suggest a few solutions for a better management of safety in high-rise building for future generation.

The aim of this study is about the essential aspects of Safety Management in high-rise buildings and to identify to improve the safety of high-rise building occupants. To achieve these aims, the objectives of the study must be identified first;

1. To study & understand the various risks involved, and the safety issues related to construction.
2. To evaluate the existing safety procedures, policies, regulations & accident prevention with respect to construction industry.
3. To formulate & effectively maintain the accidents prevention program of the project by using safety and ergonomics.
4. To find out level of importance by comparing two residential building by using questionnaire survey.

2.0 LITERATURE REVIEW

There have been various studies performed on the Safety & Ergonomics in the field of construction

Panchal Varsha G., Dodiya Parth I. (2013) The aim of this study is to study the attitude of construction companies towards the awareness of safety on construction site, and to establish whether there is any relationship between safety provisions for worker and worker productivity on site. he conclude that the factors such as safety at workplace, types and causes of accidents, economic impact of accidents were basically focused during study by author. [1]

Harold et al., (2013) This ergonomic research reviewed the hazards of Work-related Musculoskeletal Disorders from load-lifting in building construction. They conclude that enhancing the good health of the workers, improve productivity, drastically reduce the risks of the spread of musculoskeletal disorders among the workforce, as well as work-related injuries. [2]

Shabin.S, Ramesh Babu.T (2014) The purpose of this project is to overview the ergonomics risk factors in construction industry. Failure mode and effect analysis is a step-by step approach for identifying various potential failure modes and estimating their corresponding failure effects. [3]

Selvam A, Krithika Priyadarshini The study explores the various safety and control measures of accidents in building projects to minimize accidents' occurrence and consequent waste generation. They conclude that The field survey reveals different control measures in place and their rate of usage on building projects. [4]

Ayat Al swaity, Adnan Enshassi (2012) The aim of this paper is to assess and understand the level of ergonomics awareness in the construction industryand to identify current safety practices. They conclude that the findings of this study could still provide helpful direction and insights into ergonomic work practices. [5]

3.0 METHODOLOGY

a) The survey technique is significant in gathering information from site supervisors and the workers on the construction sites by use of interviews.

b) Descriptive research is used for this study since it helps to identify the nature of the health and safety measures used on the construction sites and evaluate their enforcement mechanisms on construction sites as practiced.

c) Implementation of preventive measures to reduce the risk of accident on current site by case study.

d) Conducting field research using questionnaire survey.

4.0 DATA COLLECTION

4.1 Health & Safety Risks in Construction:

The construction industry accident casualty rate stands at more than double that of the all sector average – more minor accidents are almost incalculably more. Put simply, construction sites are a health and safety nightmare –

almost every possible hazard exists within this constantly changing working environment.

Working at Height: The construction of buildings – or indeed, demolition works – frequently requires tradesmen to work at height. The risks associated with working at a height are often increased by added access and mobility restrictions. Training, including safety awareness training is essential for employees required to work at height.

Moving Objects: A construction site is an ever changing environment; hazards are inherent to this industry and only increase as a construction project progress, as things rise and expand.

Slips and fall: When you consider the diverse range of activities going on at a construction site at any one time it seems hardly surprising slips and falls happen on an almost daily basis.

Noise: Noise is a major hazard within the construction industry. Repetitive, excessive noise causes long term hearing problems and can be a dangerous distraction, the cause of accidents.

Material & Manual Handling: Materials and equipment is being constantly lifted and moved around on a construction site, whether manually or by the use of lifting equipment. Different trades will involve greater demands, but all may involve some degree of risk.

Where employee's duties involve manual handling, then adequate training must be carried out.

Collapse: Not exactly a hazard, more a risk – an accident in waiting.

Every year excavations and trenches collapse bury and seriously injure people working in them – precautions need to be planned before the work starts.

Airborne Fibers & Materials – Respiratory Diseases: Construction sites are a throng of activity and kick up a lot of dust an often invisible, fine, toxic mixture of hazardous materials and fibers that can damage the lungs, leading to diseases such as chronic obstructive pulmonary, asthma and silicosis.

Electricity: On an average, three construction industry workers are electrocuted each year during refurbishment work on commercial and domestic buildings. People working near overhead power lines and cables are also at risk.

4.2 Hazards & Solutions:

1. Scaffolding:

Hazard: When scaffolds are not erected or used properly, fall hazards can occur. About 2.3 million construction workers frequently work on scaffolds. Protecting these workers from scaffold-related accidents would prevent an estimated 4,500 injuries and 50 fatalities each year.

Solutions:

1) Scaffold must be sound, rigid and sufficient to carry its own weight plus four times the maximum intended load without settling or displacement. It must be erected on solid footing.
2) Unstable objects, such as barrels, boxes, loose bricks or concrete blocks must not be used to support scaffolds or planks.
3) Scaffold must not be erected, moved, dismantled or altered except under the supervision of a competent person.

2. Fall Protection:

Hazard: Each year, falls consistently account for the greatest number of fatalities in the construction industry. A number of factors are often involved in falls, including unstable working surfaces, misuse or failure to use fall protection equipment and human error. Studies have shown that using guardrails, fall arrest systems, safety nets, covers and restraint systems can prevent many deaths and injuries from falls.

Solutions:

1) Consider using aerial lifts or elevated platforms to provide safer elevated working surfaces;
2) Erect guardrail systems with toe boards and warning lines or install control line systems to protect workers near the edges of floors and roofs

3. Ladders:

Hazard: Ladders and stairways are another source of injuries and fatalities among construction workers. OSHA estimates that there are 24,882 injuries and as many as 36 fatalities per year due to falls on stairways and ladders

used in construction. Nearly half of these injuries were serious enough to require time off the job.

Solutions:

1) Use the correct ladder for the task.
2) Make sure that ladders are long enough to safely reach the work area.
3) Mark or tag ("Do Not Use") damaged or defective ladders for repair or replacement, or destroy them immediately.

4. Stairways*:*

Hazard: Slips, trips and falls on stairways are a major source of injuries and fatalities among construction workers.

Solutions:

1) Stairway treads and walkways must be free of dangerous objects, debris and materials.
2) Slippery conditions on stairways and walkways must be corrected immediately.
3) Make sure that treads cover the entire step and landing.

5. Trenching:

Hazard: Trench collapses cause dozens of fatalities and hundreds of injuries each year. Trenching deaths rose in 2003.

Solutions:

1) Never enter an unprotected trench.
2) Always use a protective system for trenches feet deep or greater.
3) Employ a registered professional engineer to design a protective system for trenches 20 feet deep or greater.

6. Cranes:

Hazard: Significant and serious injuries may occur if cranes are not inspected before use and if they are not used properly. Often these injuries occur when a worker is struck by an overhead load or caught within the crane's swing radius. Many crane fatalities occur when the boom of a crane or its load line contact an overhead power line.

Solutions:

1) Check all crane controls to insure proper operation before use.
2) Inspect wire rope, chains and hook for any damage.
3) Know the weight of the load that the crane is to lift.
4) Ensure that the load does not exceed the crane's rated capacity.

7. Hazard Communication:

Hazard: Failure to recognize the hazards associated with chemicals can cause chemical burns, respiratory problems, fires and explosions.

Solutions:

1) Maintain a Material Safety Data Sheet (MSDS) for each chemical in the facility.
2) Make this information accessible to employees at all times in a language or formats that are clearly understood by all affected personnel.
3) Train employees on how to read and use the MSDS.

8. Forklifts:

Hazard: Approximately 100 employees are fatally injured and approximately 95,000 employees are injured every year while operating powered industrial trucks. Forklift turnover accounts for a significant number of these fatalities.

Solutions:

1) Train and certify all operators to ensure that they operate forklifts safely.
2) Do not allow any employee under 18 years old to operate a forklift.
3) Properly maintain haulage equipment, including tires.

9. Head Protection:

Hazard: Serious head injuries can result from blows to the head.

Solution:

Be sure that workers wear hard hats where there is a potential for objects falling from above, bumps to their heads from fixed objects, or accidental head contact with electrical hazards.

4.3 Safety Checklists

The following checklists may help you take steps to avoid hazards that cause injuries, illnesses and fatalities. As

always, be cautious and seek help if you are concerned about a potential hazard.

Personal Protective Equipment (PPE)

Eye and Face Protection:

a) Safety glasses or face shields are worn anytime work operations can cause foreign objects getting into the eye such as during welding, cutting, grinding, nailing (or when working with concrete and/or harmful chemicals or when exposed to flying particles).
b) Eye and face protectors are selected based on anticipated hazards.

Foot Protection:

a) Construction workers should wear work shoes or boots with slip-resistant and puncture-resistant soles.
b) Safety-toed footwear is worn to prevent crushed toes when working around heavy equipment or falling objects.

Hand Protection:

a) Gloves should fit snugly.
b) Workers wear the right gloves for the job (for example, heavy-duty rubber gloves for concrete work, welding gloves for welding, insulated gloves and sleeves when exposed to electrical hazards).

Head Protection:

a) Workers shall wear hard hats where there is a potential for objects falling from above, bumps to their heads from fixed objects, or of accidental head contact with electrical hazards.
b) Hard hats are routinely inspected for dents, cracks or deterioration.

Scaffolding:

a) Scaffolds should be set on sound footing.
b) Damaged parts that affect the strength of the scaffold are taken out of service.
c) Scaffolds are not altered.
d) All scaffolds should be fully planked.
e) Scaffolds are not moved horizontally while workers are on them unless they are designed to be mobile and workers have been trained in the proper procedures.
f) Employees are not permitted to work on scaffolds when covered with snow, ice, or other slippery materials.
g) Scaffolds are not erected or moved within 10 feet of power lines.

Electrical Safety:

a) Work on new and existing energized (hot) electrical circuits is prohibited until all power is shut off and grounds are attached.
b) An effective Lockout/Tagout system is in place.
c) Frayed, damaged or worn electrical cords or cables are promptly replaced.
d) All extension cords have grounding prongs.
e) Protect flexible cords and cables from damage. Sharp corners and projections should be avoided.

Floor and Wall Openings:

a) Floor openings (12 inches or more) are guarded by a secured cover, a guardrail or equivalent on all sides (except at entrances to stairways).
b) Toe boards are installed around the edges of permanent floor openings (where persons may pass below the opening).

Elevated Surfaces:

a) Signs are posted, when appropriate, showing the elevated surface load capacity.
b) Surfaces elevated more than 48 inches above the floor or ground have standard guardrails.
c) All elevated surfaces (beneath which people or machinery could be exposed to falling objects) have standard 4-inch toe boards.
d) A permanent means of entry and exit with handrails is provided to elevated storage and work surfaces.

Hazard Communication:

a) A list of hazardous substances used in the workplace is maintained and readily available at the worksite.
b) There is a written hazard communication program addressing Material Safety Data Sheets (MSDS), labelling and employee training.

c) Each container of a hazardous substance (vats, bottles, storage tanks) is labeled with product identity and a hazard warning(s) (communicating the specific health hazards and physical hazards).

Crane Safety:

a) Cranes and derricks are restricted from operating within 10 feet of any electrical power line.
b) The upper rotating structure supporting the boom and materials being handled is provided with an electrical ground while working near energized transmitter towers.
c) Rated load capacities, operating speed and instructions are posted and visible to the operator.
d) The operator understands and uses the load chart.
e) The operator can determine the angle and length of the crane boom at all times.
f) Crane machinery and other rigging equipment is inspected daily prior to use to make sure that it is in good condition.
g) Accessible areas within the crane's swing radius are barricaded.
h) Tag lines are used to prevent dangerous swing or spin of materials when raised or lowered by a crane or derrick.
i) Illustrations of hand signals to crane and derrick operators are posted on the job site.

Forklifts:

a) Forklift truck operators are competent to operate these vehicles safely as demonstrated by their successful completion of training and evaluation.
b) No employee under 18 years old is allowed to operate a forklift.
c) Forklifts are inspected daily for proper condition of brakes, horns, steering, forks and tires.
d) Written approval from the truck manufacturer is obtained for any modification or additions which affect capacity and safe operation of the vehicle.
e) Capacity, operation and maintenance instruction plates, tags or decals are changed to indicate any modifications or additions to the vehicle.
f) Battery charging is conducted in areas specifically designated for that purpose.
g) Material handling equipment is provided for handling batteries, including conveyors, overhead hoists or equivalent devices.

5.0 CONCLUSION

This paper concluded that consideration of Safety, Health and Environment leads to healthy and safe working environment and safety work practices. The various types of accidents that exits on construction site and their respective control measures revel in this study. Awareness about safety, health and environment can be created in every individual associated with the project. It can be also concluded that there are several control factors that significant to be taken into consideration in order to improve the implementation of ergonomics and reduced the ergonomics risk factors. More research work is still required in this field, so great scope of research is accessible for new researchers in this field.

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