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Human Factors and Ergonomic Studies

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Abstract: Ergonomics is primarily concerned with improving the performance of man or man-machine systems. Although many applications have produced evident improvements, the terms of reference and the results are not often expressed in measures that are easily converted into financial savings. Cases are cited of increases of productivity resulting from equipment redesign and of savings achieved from the reduction of accidents, and from improvements in the working environment. It is suggested that the use of ergonomic data in a design program should not necessarily be based on the prediction of financial benefits but based on human factors.Most incidents can be prevented by taking simple ergonomic efforts. To outline important issues on safety and health that should be paid attention to, on work places and in Industrial sites for easy reference to the workers, the need for further studies is debated. If we work carefully and take appropriate safety measures, there will definitely be fewer work injury cases and our sites will become a safe and secure place to work in.
Keywords: Ergonomics, Musculoskeletal disorders, Lifting postures, Power zone, safety

I. INTRODUCTION

Ergonomics is the science of fitting the work-place conditions and job demands to the capabilities of the working population. The goal of Ergonomics is to make the work place more comfortable and to improve both health and productivity. To meet these goals, the capabilities and limitations of workers and the human factors are considered in conjunction with how they relate to particular tasks. Most people have heard of ergonomics and think it is something to do with seating or with the design of car controls and instruments. It is, but it is much more. Ergonomics is the application of scientific information concerning humans to the design of objects, systems and environment for human use. Ergonomics comes into everything which involves people. Work systems, sports and leisure, health and safety should all embody ergonomics principles and well designed. In the wider context, ISO 26800 presents the general ergonomics approach and specifies basic ergonomics principles and concepts applicable to the design and evaluation of tasks, jobs, products, tools, equipment, systems, organizations, services, facilities and environments. Ergonomists often work in particular economic sectors or application domains, which are not mutually exclusive and change over time.

II. METHODOLOGY

Ergonomic study on ,the manual material handling and the human factors influencing it, are done.The theory, principles, methods and data to design are studied and linked with the human factors in order to optimize human well-being and overall system performance. The most primary problem is the work related musculoskeletal disorder (WMSD). The symptoms and the causes for the work related musculoskeletal disorders are seen in detail. The risk factors and postures that contribute to the WMSD are studied and analysed to recommend better practices. The main goal is to eliminate the WMSD hazard. That can be achieved by employing better practices will possibly give us better recommendations and guidelines for the workers and will improve the working atmosphere and human well-being.

A. Material Handling Ergonomic

Manual handling of containers may expose workers to physical conditions (e.g., force, awkward postures, and repetitive motions) that can lead to injuries, wasted energy, and wasted time. Manual material handling tasks may expose workers to physical risk factors. If these tasks are performed repeatedly or over long periods of time, they can lead to fatigue and injury.
The main risk factors, or conditions, associated with the development of injuries in manual material handling tasks include:

1) Awkward postures (e.g., bending, twisting).
2) Repetitive motions (e.g., frequent reaching, lifting, carrying).
3) Forceful exertions (e.g., carrying or lifting heavy loads).
4) Pressure points (e.g., grasping [or contact from] loads, leaning against parts or surfaces that are hard or have sharp edges).
5) Static postures (e.g., maintaining fixed positions for a long time).

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III.HAZARDS AND RISK FACTORS

The injuries which occur are called as Work related musculoskeletal disorders(WMSD). The WMSDs affect the soft tissues of the body - the muscles, tendons that connect muscles to bones, ligaments that connect bone to bone, nerves, blood vessels, pretty much every part of your body that's not a bone or internal organ.These are the parts of your body that are prone to injury when demands on them go beyond what they can handle. Typically these injuries occur in your body's joints, the moving parts of the body like your low back, wrist, shoulder, elbow and knee. These are the parts of your body that get used the most and that are placed under the most stress during the day.Often these injuries start out small, as a little muscle pull or a slightly irritated tendon. However, if a small injury isn't given a chance to heal, it can become aggravated, especially if you keep doing the activity that caused the injury in the first place. Over time, these small injuries can build until they become chronic, and at this point they become a WMSD.

A. Risk factors in Material Handling

The risk of injury depends upon 3 major factors which are duration of exposure, frequency of exposure , intensity of exposure . The combination of the risk factors leads to WMSD. Just because the job has risk factors, does not mean that the worker is going to have a WMSD. In fact, a little bit of exposure to some risk factors can actually be good. Occasionally moving into awkward postures like reaching or bending will help to stretch and exercise your muscles. Also, if you occasionally do some lifting, especially if you do it properly, it can help to strengthen your muscles.Whether or not a risk factor will result in a WMSD depends on the duration, or how long you are exposed to it; The frequency or how often the worker is exposed to it and how much rest is taken in between; and the intensity or how much of the risk factor there is (for example, how heavy is the object, or how far over the worker has to bend to pick it up), and combinations of risk factors, where the worker is exposed to more than one risk factor at a time. The injury is most likely to occur with more risk factors at once.

Most people are aware that lifting heavy objects increases the risk for injury. The load on the low back when lifting something heavy can strain the muscles and damage the disks in the spine. The load can strain the muscles in the shoulders and upper back as well.Fewer people know that repetitive lifting can be just as hazardous because of the fatigue it causes. Lifting frequently tires out the muscles, making them more prone to injury. If the muscles cannot handle the load, the strain can be shifted to the joints and the disks in the spine, placing them at risk for injury, too.Lifting even moderate loads while bent over or reaching up or out can also place you at risk of injury, to eitherthe back or shoulders. When you bend over to pick something up from below your knees, not only does your back have to lift the object, but it also has to lift the weight of your upper body. Something else to keep in mind, the same stresses are there when lowering something while lifting it.Awkward postures such as extended reaching, bending or twisting of trunk, working with arms away from the body contribute to WMSD.

IV.SAFE LIFTING

Manual material handling tasks is the work that involves the use of force for lifting, lowering, pushing, pulling, carrying, moving, holding any package, load or item. Manual material handling tasks in industrial workplace include tasks that have repetitive actions, sustained postures and may involve concurrent exposure to vibration.

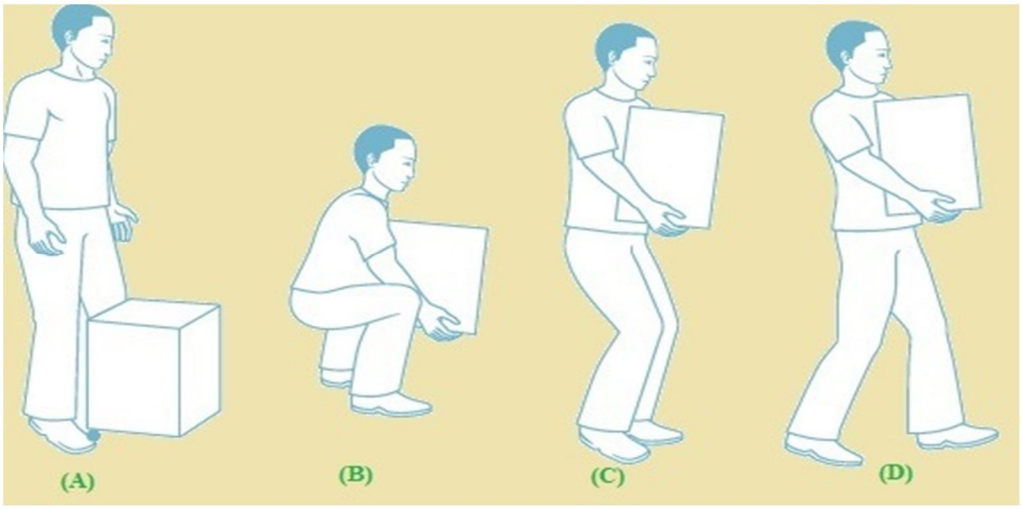

Figure.1.SAFE LISTING POSTURES

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1) *STEP 1:* The posture in the figure 1(A) is called as the "lazy S" which ensures healthy, neutral round disc position. There are 24 discs between the vertebrae and spine that could be injured by an improper lift. The improper lift can cause bulged or herniated disc. So to avoid these injuries an upright "lazy S" posture must be maintained.

Figure. 2. The Lazy S posture

Figure. 3(a). CATCHER'S POSITION

Figure. 3(b).

Before taking the ergonomic effort. We need to know two terms. "Power zone" and "Catcher's position". The" Power zone" is the area between the sternum and the belt buckle, as you can see in figure 2. The "Catcher's position" is the posture used in the game of baseball, where the catcher catches the ball. As seen in the Figures 3(a) and 3(b).

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2) *STEP 2:* Go to the "Catcher's position" which enables a neutral healthy round disc position. The ergonomic effort demands the lifter to go to the "Catcher's position" and lift the load to the "Power zone". To accomplish this go to the catcher's position, keep your legs in wide stance of shoulder width with the feet being in diagonal position for better balance. Lift the load to the power zone and stand up with your head always looking ahead.Look ahead and never down NOTE : If you cannot bring the load of the power zone, get help.
3) *STEP 3:* Transport the load by stepping in the direction you wish to go. Lead with the right foot to go right and left foot to go left. Keep head straight, never look down. And once you reach the destination point, go back to the "Catcher's position" and release the load when balanced and ready.

CAUTION : Never keep the load side-ways because it might affect your spine disc .

A. Improvement Options To Make Lifting Easy

1) Redesign the container so it has handles, grips, or handholds.
2) Wear proper size gloves that fit. Gloves with rubber dots on the surface can increase grip stability on slippery surfaces.
3) Increase the size of the bucket or pail handle with padding or a clamp-on handle.
4) Pad the shoulder. Support the container on one shoulder and alternate between shoulders.

B. Usage of Mechanical Aid

1) Platform truck can be used for carrying multiple loads and drum dolly can be used to transport drums.
2) Designing a proper conveyor system of different types for delivering containers.
3) Forklift moves pallets for long distances.
4) Portable hoist or cranes which are manually operated can be used for occasional spot lifting of heavy loads over short distances.

C. Points To Consider

1) See whether the load can be lifted using mechanical aid.
2) Seek assistance while lifting manually.
3) Report signs and symptoms as early as possible.
4) Talk to your employer regarding any issues.

V. SCHEME OF HUMAN FACTORS

Human factors play a very important role in the workplace. The occupational psychology is focused on fitting the person to the task. Whereas the focus on human factors is more on fitting the task to the person. Since ergonomics is human-centred approach, there should a proper balance between human factor and occupational psychology.

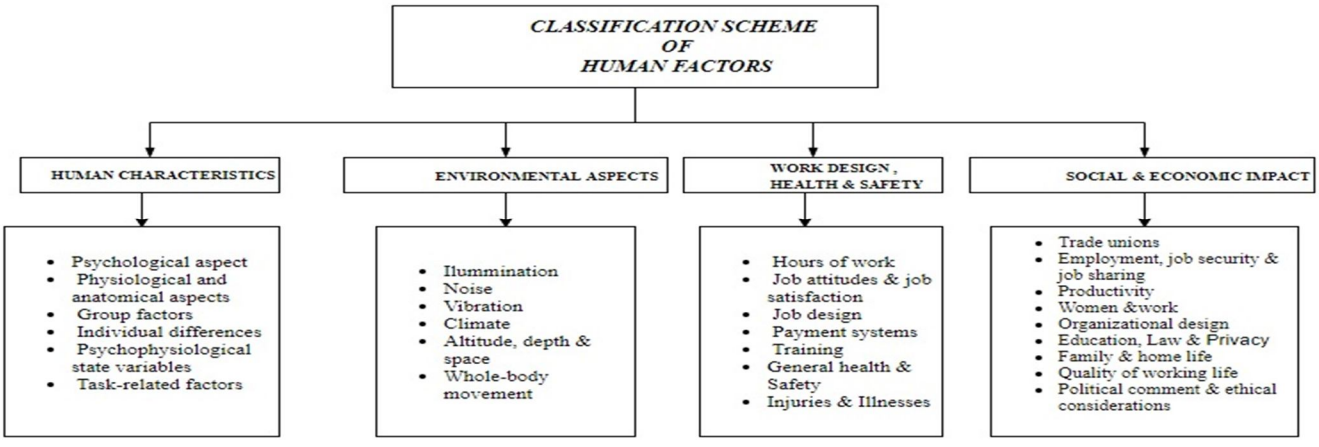

Figure. 4. HUMAN FACTORS CLASSIFICATION CHART

In the figure 4, The human factors related to various schemes are listed out. The compatibility between the worker and these schemes are compared and analyzed to see how well they co-exist to ensure safe, productive, comfortable and effective use of human resources.

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VI. CONCLUSIONS

Preventing work related musculoskeletal disorders in the Industrial workplace is a major safety challenge all over the world. There is no single approach which can eliminate these injuries. Remember, OSHA does not have regulations to address ergonomics, it only gives recommendations and guidelines. Effective and safe practices and guidance which will avoid the such hazards,are needed. The right approach is putting ergonomic efforts to make changes to the workplace, and that is always the best approach. It is the role of the safety officer to ensure that the right safe practices are employed. Ensure the workers wear personal protective equipment. Reported symptoms must be looked into immediately. Provide the right training to the workers to educate them and to test their competency and to test their safety awareness. Talk and communicate with the workers regarding all the issues related to work and also related to the schemes of the human factors. Always try maintain an awesome safety culture, which falls within the brackets of ergonomics. Ergonomics can be more than a one-time fix. It is an on-going process that we, the safety officers along with the management can use to make things better and safe.

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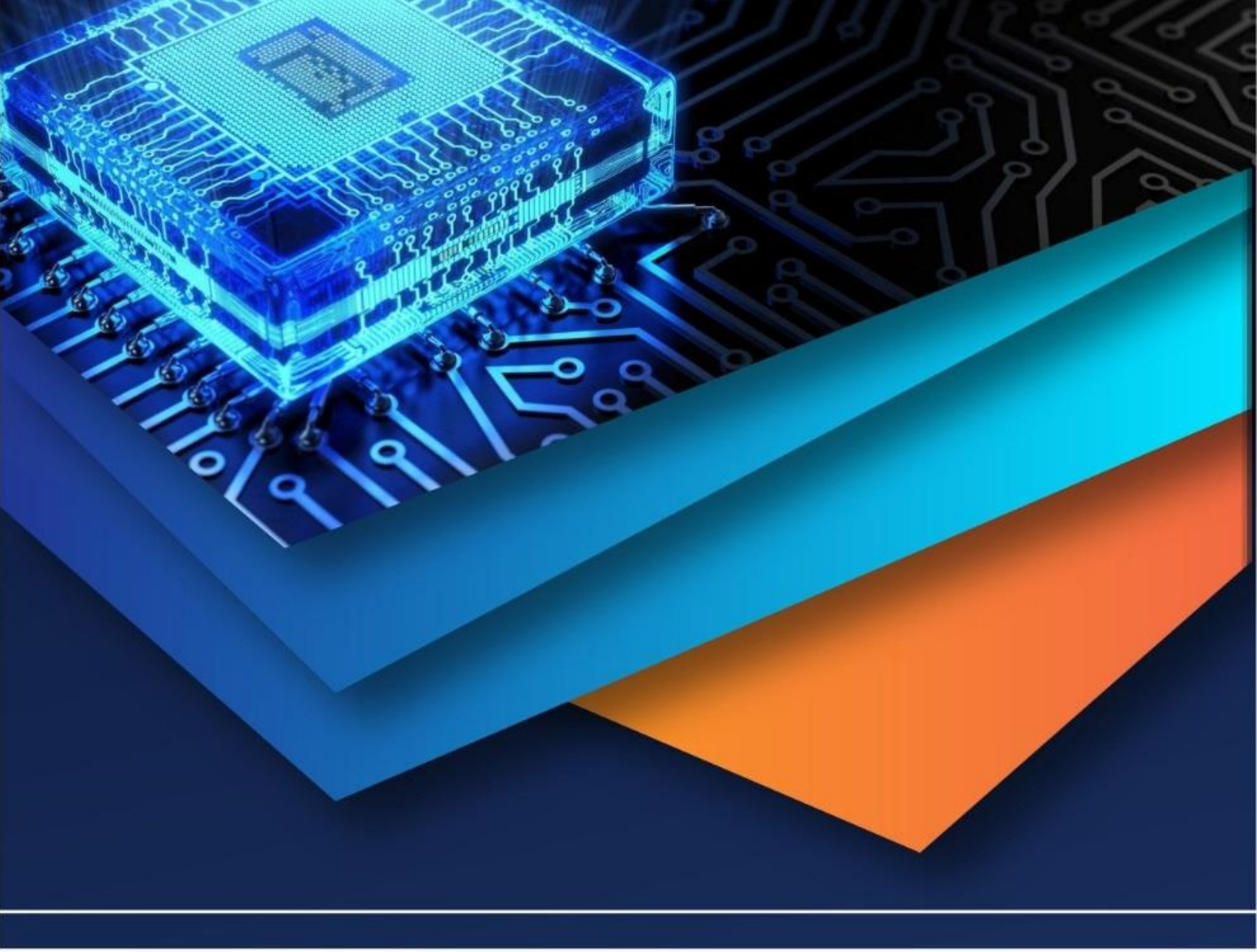

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