Unit B

Applied Ergonomics: Designing and safety ergonomics, work and health

"Ergonomics (or human factors) is the scientific discipline concerned with the understanding of the interactions among human and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance."

-International Ergonomics Association Executive Council, August 2000

Ergonomics can roughly be defined as the study of people in their working environment. More specifically, an ergonomist designs or modifies the work to fit the worker, not the other way around. The goal is to eliminate discomfort and risk of injury due to work. In other words, the employee is the first priority in analyzing a workstation.

Ergonomic problems at the workplace and bad work organization are part of the contributing risk factors to the occupational safety and health problems. A number of situations within the workplace are conjectured to contribute to the increasing magnitude of musculoskeletal disorders (MSDs) suffered by the workers, including postural stress from prolonged sitting, standing, or awkward position; stereotyped and repetitive tasks leading to chronic injury; peak overload injuries to the axial or peripheral skeleton; environmental factors; and psychosocial factors including psychological stresses, job dissatisfaction, and complex social issues, such as compensation laws and disability system.

The risk is especially noticeable when a job includes exposure to a combination of two or more of these risk factors. Exposures of high intensity or long duration increase the risk of MSDs. Available exposure-response data show that work related MSDs may occur even when workers are exposed to an occupational risk factor on an occasional basis or for a 25% or less of the day (Punnett, 2000). **Adverse ergonomic working conditions can cause visual, muscular and psychological disturbances such as eye strain, headaches, fatigue, MSDs such as chronic back, neck and shoulder pain, Cumulative Trauma Disorders (CTDs), Repetitive Strain Injuries (RSIs) and Repetitive Motion Injuries (RMIs), psychological tension, anxiety and depression**.

Psychosocial factors that result from the organization of work are considered to have impacts on the development of MSDs. Psychological job demands , decision latitude and social support are three key measures of psychosocial factors at the workplace affecting workers' health High psychological job demands in combination with low decision latitude may not only result in residual job strain but also cause chronic adverse health effects such as cardiovascular diseases if exposure is prolonged.

- Ergonomic related injuries and illnesses can be temporary and may disappear when the individual is removed from work or given an opportunity to rest at work, or when the working conditions are improved.
- Ergonomic related injuries and illnesses can also be permanent if exposures to poor ergonomic working conditions are prolonged (Morse et al., 2005; Scientific Committee for MSDs of the ICOH, 1996).
- MSDs are one of the most common health problems caused by adverse ergonomic working conditions affecting tens of millions of workers across all employment sectors.

Example of Application of Ergonomics in designing:

Many people don't realize that a poorly designed computer workstation and/or bad work habits can result in serious health problems. Common symptoms associated with poor design or habits include discomfort in the back, neck and shoulders, hands and wrists, as well as headaches and eyestrain.

Fortunately, the solution can be quite simple. Proper workstation setup and work practices can eliminate discomfort and even prevent it from occurring in the first place! Simple adjustments to office equipment can work wonders, making work more comfortable and more productive.

Chairs

What to Look For In A Chair

Starting from the bottom and moving upwards:

Base

The chair should have at least 5 castors at the base to ensure stability. Chairs with five castors are more stable than four castor chairs. Four castor chairs are easier to tip over.

Seat

The seat should be able to adjust until your thighs are parallel to the ground. Shorter/taller users may need different height cylinders. If you are unable to adjust your chair heigh properly, contact the chair manufacturer for a replacement cylinder. Adjusting the chair too high places more pressure than necessary on the backs of the legs, reducing circulation. If the chair is too low, a smaller portion of the legs is in contact with the chair and the pressure on that area is correspondingly greater.

The seat pan depth should be adjustable to provide a fist-width to three-finger gap between the back of the calf and the front edge of the seat pan. If the seat pan is too shallow, all the pressure from sitting is placed on a small part of the thighs, which may lead to discomfort. If the seat pan

is too deep, it will either be difficult to use the backrest or the front of the seat will put pressure on the back of the nerves and tendons at the backs of the knees.

The seat pan should be able to tilt backwards and forwards. Changing your posture throughout the day is positive because when you change postures, the loads of sitting shift to different parts of the body, allowing your body to recover from extended static postures.

The seat pan should have a waterfall (rounded) front edge. Sharp corners, even when they're made of padding, increase the pressure on the backs of the thighs. A rounded front edge distributes the pressure over a larger area.

Backrest

The backrest height should be adjustable so the lumbar support can be fitted into the low back. The backrest should mirror the shape of your back to provide support. The weight of the upper body is supported by the spinal vertebrae at the bottom of the lumbar curve (curve at the small of your back). These same vertebrae are the most common origins of back pain. Using the backrest to support the lumbar curve relieves some of the pressure on the frequently injured vertebrae.

The backrest should be able to recline independently of the seat pan and be set at a fixed reclined angle. It is acceptable to sit upright or recline slightly in your chair as long as the backrest is designed for reclined seating. A slightly reclined posture opens up the angle between the hips and trunk, which decreases the stress placed on the low back.

Armrests

Firstly, armrests are optional. Even with the range of adjustments found in many of today's armrests, there are some places where armrests will interfere with work.

The armrests should be adjustable in height. If the armrests are too high, you might have to shrug your shoulders in order to use them, which could fatigue your shoulders and back. Conversely, if they are too low, then you might end up leaning on one armrest.

They should be rounded on the edges. Sharp corners, even when they're made of padding, increase the pressure on the arms. A rounded edge distributes the pressure over a larger area.

Optional: most armrests are spaced too widely apart for the user to use them comfortably. Armrests that are width-adjustable to slide over the seat pan until they are right under the elbow or armrests that pivot inwards (the kind that can pivot almost all the way around are preferable) are much more functional than simple height adjustable armrests. If the armrests are spaced too far apart, they will not be directly under the elbows. In order to use the armrests, users have to hold their arms slightly away from the body. This reach can fatigue the shoulder muscles.

Setting Up My Chair

Start out adjusting a chair from the ground up. Start with the height and move up from there. While adjusting the chair, worry first about getting the chair adjusted to fit you. Afterwards, look at things like the height of the desk, keyboard, etc. Too often, people adjust a chair too high so they can reach the keyboard rather than properly adjusting the chair and adding a keyboard tray to move the keyboard to the correct height.

Seat Height

Start by adjusting the height until your thighs are parallel to the floor. Stand in front of the chair and adjust the height until the top of the seat pan is at the height of the bottom of your kneecap. Then, sit in the chair and make small height adjustments until your thighs are parallel to the ground. Sit in this position for a while before making any further changes in seat height. When you have become accustomed to this height, adjust the chair height up/down 1-3 inches until you find a location that is comfortable for you while seated.

Seat Depth

Adjust the seat pan until you have about three fingers to a fist's width of room between the back of your calf and the front edge of the chair when your back is touching the backrest. If the seat pan is not adjustable and the pan is too deep, add padding to the backrest (a towel over the backrest of the chair or a backrest cushion) to shift you forward in the seat while maintaining contact with the backrest. If the seat pan is too shallow, start looking for a new chair.

Seat Angle

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Backrest Height

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Backrest Angle

In the standard posture and forward tilt postures, the backrest should be straight up. If it feels as though the chair is pushing you forward, adjust the backrest back until you feel upright. In the reclined posture, the backrest should be reclined slightly. When seated, the angle between the thighs and back should be more than 90°.

Armrests

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Armrest Height

Sit in the chair with your arm bent 90° and raise the armrest until it is directly under your elbow. Repeat the process with the other arm and then check that the armrests are the same height.

Armrest Width/Pivot

Some armrests pivot or slide inwards, allowing you to change the angle and width of the armrests. Adjust the armrest inwards until it is directly under your elbow while your upper arm/shoulder is relaxed. You should not have to reach your elbows outward to reach the armrests. If the armrests pivot, pivot them slightly inwards so they are underneath your forearms when you reach inwards to the keyboard.

Footrests

Use footrests as a last resort. Footrests are a way to shift postures or provide support for the feet if the chair cannot be lowered. Unfortunately, using a footrest when the chair is too high provides only one place for the feet to rest. The seated person only has the footrest and the castors under the chair as places for their feet and this limits the postures they can shift through throughout the day. The preferred solution is to add a shorter cylinder to the chair (see the chairs section), and lower the desk height until the desk surface is approximately 1 inch above seated elbow height.

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