Comment

• There is no lecture, rather the online video and ergonomic evaluation project.
• These lecture notes cover what would be in a regular lecture – without the exercise in evaluating your workstation.
• I encourage you to read these notes as well as visit the ergonomics web pages produced by NIOSH and OSHA.

What is ergonomics?

• Ergonomics is the study of physical and mental stresses on workers resulting from operation or interaction with machines.

What are the goals of ergonomics?

• Prevent accidents: good design of machine guards; design of slip-resistant surfaces.
• Prevent fatigue: design of a VDT workstation to limit eye fatigue; evaluate metabolic demands of a job in a hot environment.
What are the goals of ergonomics?

- Prevent musculoskeletal disorders: evaluate lifting tasks, to determine strain levels and redesign job if needed; evaluate work station layout, to determine potential for cumulative trauma disorder; evaluate repetitive manual operations, to reduce risk for cumulative trauma disorders.

Ergonomic deficiencies

- Extreme Posture
  - Excessive Force
  - Concentration of stress
  - Static Loading
  - Awkward lifting, pushing, pulling, carrying
  - Vibration to the hand/arms or whole body.
  - Repetitive tasks
  - Physical exertion and temperature extremes

Ergonomic evaluations

- Inspection of injury/illness reports for back injuries, muscle pains, cumulative trauma disorders. Evaluation of incidence of potentially ergonomically-related disorders to particular departments or jobs.

Ergonomic evaluations

- Evaluate potential 'problem jobs' for ergonomic deficiencies: extreme reach; excessive force; static posture; stress concentration; faulty machine interface; extreme environmental conditions; repetitive motion.
Ergonomic evaluations

- Prepare adequate training that explains why ergonomic design is needed, so worker can apply knowledge rather than follow simple rules that may not be applicable in all situations.

Sub disciplines of Ergonomics

Human Factors Engineering (www.baddesigns.com)
- Concerned with information processing aspects of work. Intent is to design procedures, equipment and work environments to minimize likelihood of accident due to human error.

Examples from baddesigns.com
Human Factors Engineering

- Failure to perceive or recognize a hazardous condition or situation
- Failures in the information processing or decision-making processes.
- Failures in motor actions following correct decisions.

Human Factors Engineering

Human Factors research pays a great deal of attention to design of labels, signs, controls, displays, etc. Focus on readability and minimizing errors.
Work physiology

- Studies the stresses that occur during biochemical energy (food) to mechanical work. Too much physiologic stress results in fatigue. Fatigue may affect individual muscle groups or the whole body.

Work physiology

- Static work: when a muscle or muscle group remains contracted for an extended period of time.
- Extreme static loading can increase cardiovascular stress: increases in blood pressure and heart rate can occur. This could be a danger for persons with cardiovascular disease.

Work physiology

- Usually, dynamic work activities will cause less strain than static loading: unless repetitive motion is severe.
- Dynamic work and whole-body fatigue
- Intense work can lead to exhaustion and heat stress. Heat stress will be discussed by itself next week.

Biomechanics

- Biomechanics is the sub discipline of ergonomics concerned with the mechanical properties of the human body.
Biomechanics

• Low Back Pain: one of the most common causes of lost time injury; most commonly associated with manual lifting.

NIOSH Lifting Equation

• NIOSH guidelines are available that present suggested work practices for manual lifting, and a way to determine if a lifting operation may be hazardous.
  • Look at how load is moved:
    • Horizontal position hands from center of body,
    • vertical position hands from floor,
    • travel distance,
    • angular displacement,
    • frequency factor,
    • coupling accounts for
  • RWL = LC x HM x VM x DM x AM x FM x CM

Biomechanics

• Awkward trunk posture
• Prevention
  • Hands do not have to reach below 10 inches from the floor
  • Forward reach should be minimized.
  • All reaches should be in front of the body,
• Uncomfortable seating
  • Proper lighting and arrangement of computer terminals is more easily accomplished, but often not considered.

Cumulative Trauma Disorders

• Cumulative Trauma Disorders are a major cause of lost time injury and workers compensation: Carpal Tunnel Syndrome, tendinitis, bursitis, tenosynovitis, De Quervain’s disease (tenosynovitis of the thumb), trigger finger, Guyon tunnel syndrome among them.
Cumulative Trauma Disorders

• Prevention of CTS:
  – Provide jigs and fixtures to allow assembly activity to occur within normal range of arm movement.
  – Provide cushioned arm rests to support the arm.
  – Store parts in containers designed for reaches with minimal hand flexion.

Cumulative Trauma Disorders

– Provide for downward force to be applied through flanged surfaces (for example, a flange on a screwdriver).
– Provide for vibration damping of power tools and work surfaces.
– Provide rounded or curved fixtures to minimize point-source pressure on hands and arms.

Cumulative Trauma Disorders

– Provide training to employees on CTDs and prevention
– Select tools that spread force out over wide area of hands (larger handles)
– Maintain power tools are proper torque, consider selecting tools that will disconnect when proper torque is reached.
– Many other options area available, with the design principle of reducing pressure and stress to the hands, arms and wrists.

Vibration White Finger

• Vibration White Finger: also known as secondary Raynaud's phenomenon.
Vibration White Finger

- Stages of illness:
  - Earliest stages involve tingling and numbness in the fingers. Symptoms must be persistent and result from stimulus such as cold.
  - Condition progresses to more severe tingling and numbness to blanching of a fingertip. (Skin becomes white due to loss of blood flow.)
  - Blanching beyond fingertip(s), during winter. Interferes with nonwork activities, does not interfere with work activity.
  - Extensive blanching of fingers, occurs during summer and winter. Interferes with work and recreational activity.
  - Extensive blanching of most fingers; occurs during summer and winter. Person has to change occupation. Necrosis of fingers may occur.
  
  Prevention:
  - NIOSH has published a Criteria for a Recommended Standard for Occupational Exposure to Hand-Arm Vibration (Pub NO 89-106). Find the Current Intelligence Bulletin here.
  - NIOSH recommends exposure monitoring (measuring vibration from power tools), medical monitoring, medical removal protection, and reduction of vibration exposure to the lowest feasible level.

- Work Practice Controls to reduce vibration include:
  - Minimize number of hours per day vibrating hand tool is used.
  - Minimize number of days per week vibrating hand tool is used.
  - Arrange work tasks so vibrating and non vibrating tools can be used alternately.
  - Schedule regular maintenance of the vibrating tools.
  - Select tools with minimal vibration.
  - Reduce grip force on the tools.
  - Incorporate vibration-damping material into palms and fingers of gloves, and the handles of equipment.