

	Chapter 21
	Temporal Ergonomics

	Reducing Fatigue
	<ul style="list-style-type: none"> ■ Maintains or increases work productivity ■ Provides “optimal” stress, such that health and safety not compromised and fatigue is not accumulated between shifts ■ Consider and optimize both goals.

	Kinds and Locations of Fatigue
	<ul style="list-style-type: none"> ■ General body fatigue (systemic, cardiovascular, physiological fatigue) ■ Muscular fatigue (localized, physiological) ■ Mental fatigue (brain, psychological/physiological)

	Factors that can lead to Fatigue
	<ul style="list-style-type: none"> ■ Physical exertion – warm, sweaty, out of breath, heavy breathing, palpitation. ■ Physical discomfort – aching, numbness, stiff joint, tense muscles ■ Lack of energy (physical + mental) – worn out, drained, exhausted ■ Lack of motivation (mental – uninterested, lack of initiative) ■ Sleepiness (mental – yawning, drowsy, sleepy, lazy) <p>Jobs may have different combinations of fatigue varying within the shift. Recovery of fatigue is obtained by rest.</p>

	Factors in Recovery Value of Rest
	<ul style="list-style-type: none"> ■ How fatigued the muscle or cardiovascular system or brain is when the rest begins ■ The length of the rest ■ What happens to the muscle or cardiovascular system or brain during rest.

	Axioms
	<ul style="list-style-type: none"> ■ Most jobs have peaks and valleys of demand. ■ Fatigue increases exponentially with time. ■ Rest is more beneficial when it occurs prior to “too much” fatigue. ■ The value of rest decreases exponentially with time. ■ Different parts of the body have different recovery rates. ■ Active rest and working rest are alternatives to passive rest. ■ There is “output” during work and “no output” during rest?

Cardiovascular System

- Fatigue occurs during heavy work.
For 8 hours shift, acceptable limits 30% of ones max VO_2 (Eastman Kodak), 5 kcal/min, Avg HR 110 bpm, 1 L/min VO_2 consumption.
- Percent of capacity depends on work duration (Figure 4.27 page 56)- shorter the duration of work, higher % of VO_2 max can be tolerated without accumulation of fatigue.

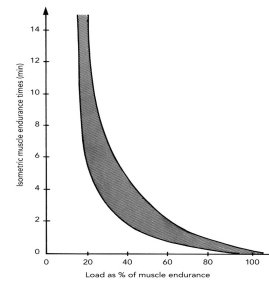
Musculoskeletal System

- Static work
- Dynamic work
- VDT work

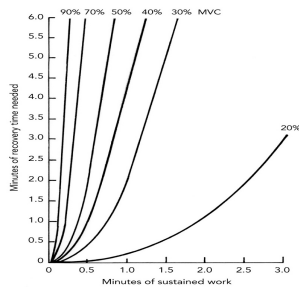
Muscle Fatigue

- Types of muscles:
 - Slow -twitch – small, mostly depends on aerobic metabolism, brownish, sustained activities, postural load
 - Fast-twitch- mostly depends on anaerobic metabolism, light colored, provides short burst of high exertion.
- Strength training increases the thickness of fibers. Endurance training increases muscles ability to store and use oxygen.
- Static work is more fatiguing than dynamic work.

Effect of Load



Muscle Recovery Time



VDT Work

- Time before a break
- Break length
- Microbreaks
- Active/working/passive rest

Guideline 1

Have a Work Scheduling Policy

- Problem is insufficient rest.
- Avoid too many hours.
- Avoid work hours at the “wrong time.”

Guideline 2

Optimize Stimulation During Work

- Problem is too much or too little stimulation.
- For too much stimulation, reduce environmental stimulation.
- For too little stimulation:
 - Add physical activity.
 - Add task variety.
 - Add environmental stimulation.

Guideline 3

Minimize the Fatigue Dose

- Problem is that fatigue may become too great.
- Reduce high stress levels.
- Permit rest before fatigue becomes excessive. Fatigue increases exponentially.
 - Schedule a break.
 - Use part-time workers.

Guideline 4

Use Work Breaks

- Problem is that there is no productivity during break.
- Work with a different part of the body to rest the fatigued part.
- Rest during the automatic part of a machine cycle.
- Consider job rotation.

Guideline 5

Give Frequent Short Breaks

- Problem is how to divide break time.
- Remember that fatigue recovery is exponential.
- Give breaks in small segments, during the work period.
- Permit operator-controlled breaks if possible.

Guideline 6

Maximize the Recovery Rate

- Problem is to recover as quickly as possible.
- Reduce contact with environmental stressors.
- Provide good blood circulation for muscle recovery.
- Take active rest.
- Consider working rest.

	Guideline 7
	Increase the Recovery/Work Ratio <ul style="list-style-type: none">■ The problem is insufficient time to recover.■ Increase the recovery time or decrease the work time.■ Moonlighting and 12-h shifts can cause problems.■ Encourage rest on holidays, weekends, and vacations.