



# **SOUTHERN AFRICA SOCIETY FOR QUALITY**

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**Eliminating ergonomic-related illnesses  
via basic human factors engineering (HFE)**

**Barnes Sookdeo**

*Unisa*

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# Introduction

*Why do we suffer aches, pains, injuries and stress despite the most up-to-date, expensive "ergonomic" furniture?*

- The problems we deal with daily in staying comfortable and therefore productive, are not new.
- They have, however, been highlighted and intensified by the advent of computer technology.
- We all already know about the desirability of good posture, relaxation, and the absence of tension.

- Rather than looking at the problem from the outside, in terms of:

- Good chairs,
- The right position, or
- The correct way to lift,

.....what about considering the more fundamental internal aspects of how we organise our balance and co-ordination?

- These are the things which influence:
  - how comfortable we stay,
  - how tired we get,
  - how alert or mentally "sharp" we are and
  - how prone to injury or stress we become.
- They are also the elements over which we can learn to have a direct and instant personal control.

# Human Factors Engineering (HFE)

- The discipline of applying what is known about human capabilities and limitations to the design of products, processes, systems, and work environments.
- It can be applied to the design of all systems having a human interface, including hardware and software.
- Its application to system design improves:
  - ease of use,
  - system performance & reliability, &
  - user satisfaction,

*whilst*

reducing operational errors, operator stress, training req'ments, user fatigue, & product liability.

## HFE.....contd.

- Terms used interchangeably with human factors engineering are:
  - Ergonomics,
  - Workplace engineering,
  - Biotechnology, and
  - Human engineering.
- HFE can be applied anywhere & everywhere where work is being performed.

# Ergonomics

- Ergonomics is currently a hot topic. It has been called the health & safety issue of the 1990's (*MacLeod 1995:04*).
- *So..... what do we know about the human body & mind at work?*
- ***Given what we know.....***

How then should we design the work, the tools, the machines, & the work procedures so that humans can perform safely, efficiently & with satisfaction,

***– or perhaps, even enjoy working?***



# Ergonomics

ILO (1995:149), which defines ergonomics as:

*“Fitting the job to the worker”*

and

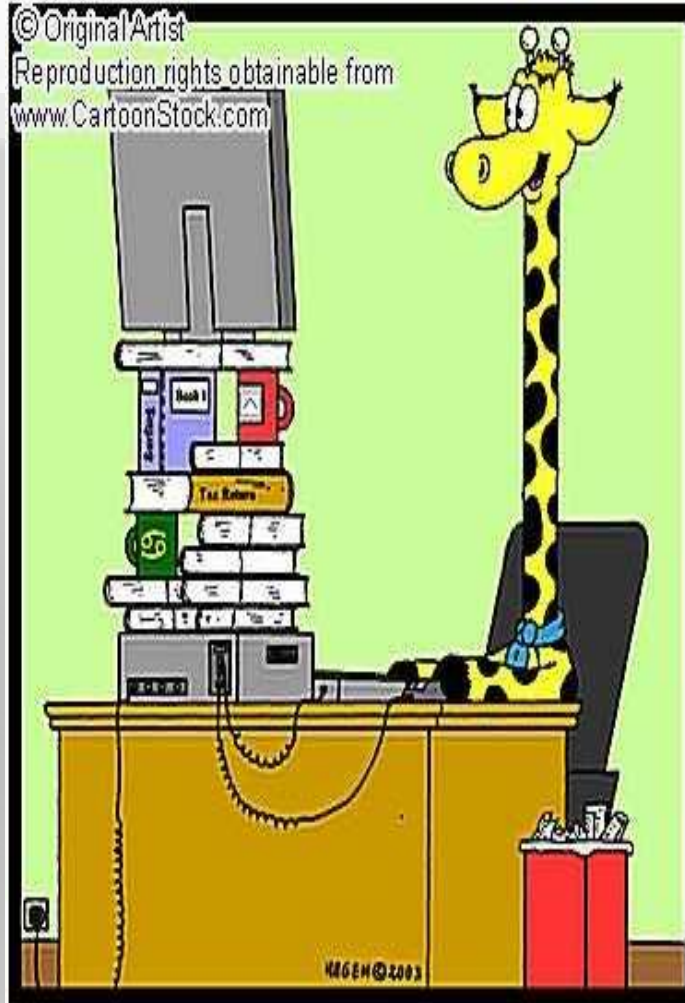
*“The study of the relationship between a worker & the environment in which he/she works”.*

- MacLeod (1995:08) states that in essence,

*Ergonomics is all about understanding human beings and human behaviour.*

- Ergonomics is the application of scientific information concerning humans to the design of:
  - objects,
  - systems &
  - the environment .....for human use.
- It is commonly thought of as how companies design tasks & work areas to maximize the efficiency & quality of their employees' work.

**Ergonomics relates to everything which involves people.**



Now, that's more ergonomic...

# Purpose

- This paper focuses on the basic factors in the workplace that **you** have control over & can successfully change, such as:
  - The adjustment of workstations,
  - Basic workplace layout,
  - Lighting and
  - Glare.

It highlights the application of human factors engineering towards eliminating ergonomic-related injuries.

# Aim of HFE

To design workstations, work processes, equipment & tools to fit YOU, the worker.

Preventing injuries by controlling the risk factors such as:

- force,
- repetition,
- posture &
- vibration.....that can cause injuries to develop.

Ensuring a good fit between workers & their jobs, thereby maximising worker comfort, safety, productivity & efficiency.

# The necessity for HFE

**“All workers are not the same size & everyone has limitations”**

As a worker, it is important that you know how to adjust your office workstation to suit you.

If a job does not fit a worker, the worker is more likely to be exposed to risk factors that may lead to musculoskeletal injury.

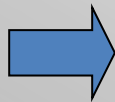
HFE focuses on how people interact with tasks, machines & equipment, & the environment with the consideration that humans have **limitations** and **capabilities**.

HF engineers evaluate.....*Human to **Human**, Human to **Group**, Human to **Organizational**, & Human to **Machine*** interactions in order to better understand these interactions & to develop a framework for evaluation & ultimately.....to eliminate injuries.

# Ergonomic-related illnesses

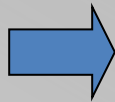
Poorly-designed workstations

*contribute to*



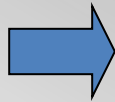
Cumulative Trauma Disorders (CTD's)

*such as:*



Musculoskeletal Disorders  
of the neck, shoulder & upper limb,

*collectively known as:*



Repetitive Strain/(*Stress*) Injuries (RSI)

# Problem Statement

*“In the South African context, wherever work is being performed, very little has been done to create awareness & to curb ergonomic-related injuries in a constructive way”.*

- According to information gained from the medical profession, people who fall ill or get injured are simply given relief medication when they visit their industry clinics and/or GP's.
- Their injuries are not always recorded, monitored or analysed.
- There are minimal investigations into the causes of their respective illnesses.
- There is minimal management intervention or commitment .

- Currently, GP's do not divulge information regarding their patients due to the confidentiality clauses and the stigma attached to the Aids pandemic.
- Each year, poorly designed products & workplaces account for thousands of injuries & skyrocketing costs.

Due to HFE, the human factor in product & workplace design, is fast becoming a major concern for manufacturers. *(Gross 1996: xi)*

Why do we suffer aches, pains, injuries and stress despite the most up-to-date, expensive "ergonomic" furniture?

# Seating

*Niels Diffrient's chair designs satisfy the various seating requirements of the workplace. From Freedom's revolutionary features and ease of use, to Liberty's advanced mesh technology, our seating line has garnered 14 international design awards and counting...*

*liberty*



Office Seating



Side Seating

*freedom*



Task Seating



Saddle Seat

# Risk factors

- **Repetition:**  
Tasks or body movements carried out over & over again.
- **Awkward postures:**  
Body positions that are not considered neutral or "ideal" such as twisting your neck to view your monitor or reaching forward or to the side to use your mouse.
- **Static forces:**  
Maintaining a position for a long period of time (i.e. prolonged sitting, viewing the monitor with a bent neck, or reaching for the keyboard).

- As early as the 18th century, doctors noticed that workers whose jobs required them to maintain certain body positions for long periods of time developed musculoskeletal problems.
- In the last 20 years, research has clearly established the connection between certain job tasks & repetitive stress injuries (RSI's).
- Every person responds to ergonomic risk factors in different ways.

***Example:***

One worker may have symptoms of an injury whilst another performing the same task may not.

- Risk factors should be identified & then reduced to lower the risk of injury.

# Fundamental HFE principles

- Use proper tools  
“Bend the tool not the wrist!”
- Keep repetitive motions to a minimum
- Avoid awkward postures
- Use safe lifting procedures
- Get proper rest

# Principles of HFE

- **Posture:**

All work activities should permit the worker to adopt several different, but equally healthy and safe postures.

- **Use proper tools:**

Tools should be appropriate for the specific tasks being performed. Tools should allow you to keep your hands & wrists straight – the position they would be in if they were hanging relaxed at your side.

- **Bend the tool not the wrist:**

The tool should fit comfortably into your hand. If the grip size is too large or too small it will be uncomfortable & will increase the risk of injury.

Tools should not have sharp edges, create contact stresses in your hand, or vibrate.

- **Keep repetitive motions to a minimum:**

Workstations or tasks can often be redesigned to reduce the number of repetitive motions that must be performed.

# Principles....contd.

## Activity:

Screwdriver:

*How can one reduce the number of twisting motions of the arm?*

Some tasks can be automated or redesigned to eliminate repetitive movements & musculoskeletal injuries.

- **Use safe lifting procedures**

- Avoid lifting heavy objects.
- Get help or use a mechanical device to lighten the load.
- Your workstation should not require you to lift objects above your head or twist your back while lifting.
- Keep the load close to your body & get a good grip.
- Heavy & frequently lifted objects should be stored between knee & shoulder height – not on the ground or above your head.

# Principles....contd.

- **Avoid awkward postures**
  - Your job should not require you to work with your hands above shoulder height on a regular basis.
  - Arms should be kept low & close to your body.
  - Bending & twisting of your wrists, back & neck should also be avoided.
- **Get proper rest**
  - Rest your body and mind in order to prevent injuries.
  - Rest your muscles during coffee breaks, lunches & weekends by doing something different from the norm.

# Focus areas for improvement

*"Preferred"* sitting posture for computer work:

- **Wrists:** Naturally straight position; not bent up, down, or from side to side
- **Elbows:** Bent approximately between 90 and 100 degrees (right angle), close to your body, & supported if possible
- **Shoulders:** Relaxed (not slouched or raised)
- **Neck:** Facing forward & not looking up, down, or to either side
- **Hips:** Bent around 90 degrees with your thighs roughly parallel to the floor

- Lower back: Supported to maintain its natural curve
- Knees: Bent at approximately 90 degrees with enough space between the back of your knees & the chair to place your fist.
- Feet: Placed flat on the floor or supported by a footrest.
- Short breaks: Many are better than fewer long breaks - called "Micro-Breaks", from 2 to 90 seconds & should be taken throughout the day.

Look away from the computer & focus on other objects, remove your hands from the keyboard and/or gently stretch muscles.

**FIGURE 5-10**

Properly adjusted workstation.

**Arms:** When operator's hands are on keyboard, upper arm and forearm should form right angle; hands should be lined up with forearm; if hands are angled up from the wrist, try using attached to front of keyboard; optional arm rests should be adjustable.

**Backrest:** Adjustable for occasional variations; shape should match contour of lower back, providing even pressure and support.

**Posture:** Sit all the way back into chair for proper back support; back, neck should be as comfortably straight ahead; knees should be slightly lower than hips; do not cross legs or shift weight to one side; give joints, muscles a chance to relax; periodically, get up and walk around.

**Desk:** Thin work surface to allow leg room and posture adjustments; adjustable surface height preferable; table should be large enough for books, files, telephone while permitting different positions of screen, keyboard, mouse pad.

**Telephone:** Cradling telephone receiver between head and shoulder can cause muscle strain; headset allows head, neck to remain straight while keeping hands free.

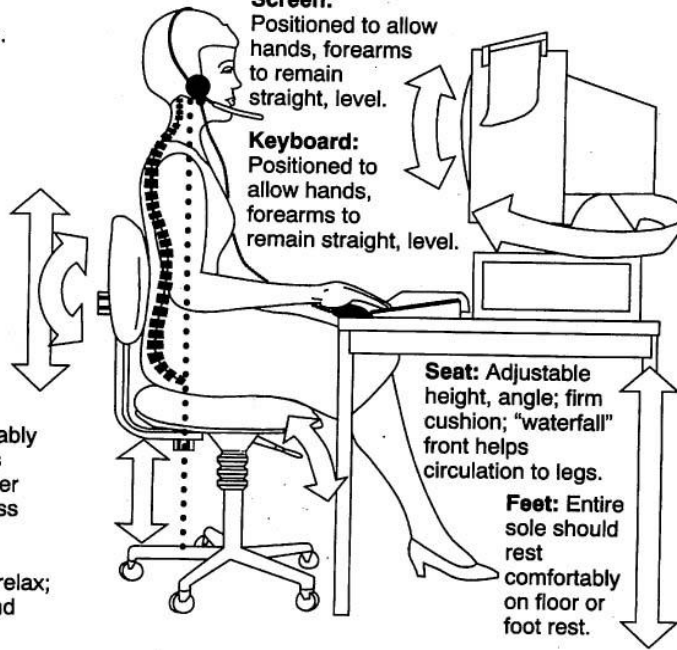
**Document holder:** Same height and distance from user as the screen, so eyes can remain focused as they look from one to the other.

**Screen:** Positioned to allow hands, forearms to remain straight, level.

**Keyboard:** Positioned to allow hands, forearms to remain straight, level.

**Seat:** Adjustable height, angle; firm cushion; "waterfall" front helps circulation to legs.

**Feet:** Entire sole should rest comfortably on floor or foot rest.



**Avoiding eye strain:**

1. Getting glasses that improve focus on screen; measure distance before visiting eye doctor.
2. Try to position screen or lamps so that lighting is indirect; do not have light shining directly at screen or into eyes.

3. Use a glare-reducing screen.
4. Periodically rest eyes by looking into the distance.

# Your chair

**“The chair should be one of the most expensive pieces of office furniture that you purchase ”.**

A chair is only "ergonomic" if you can adjust it to fit you.

Get to know your chair by experimenting with the controls, so you can make adjustments quickly & confidently.

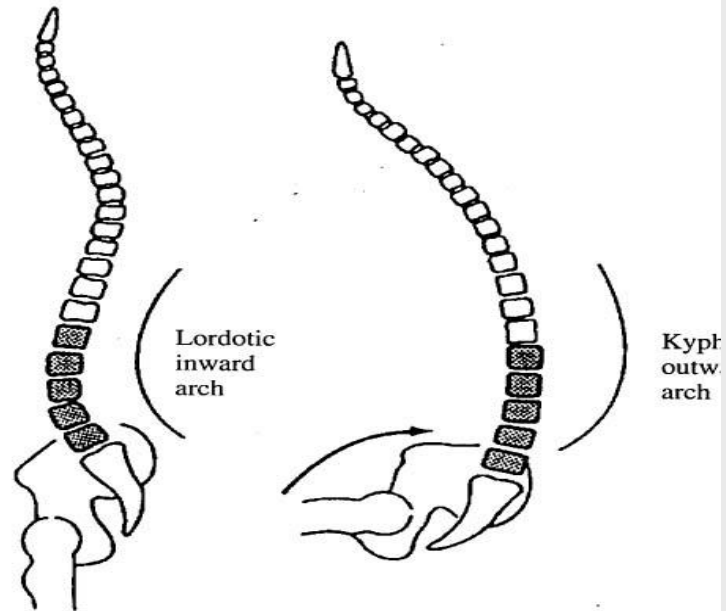
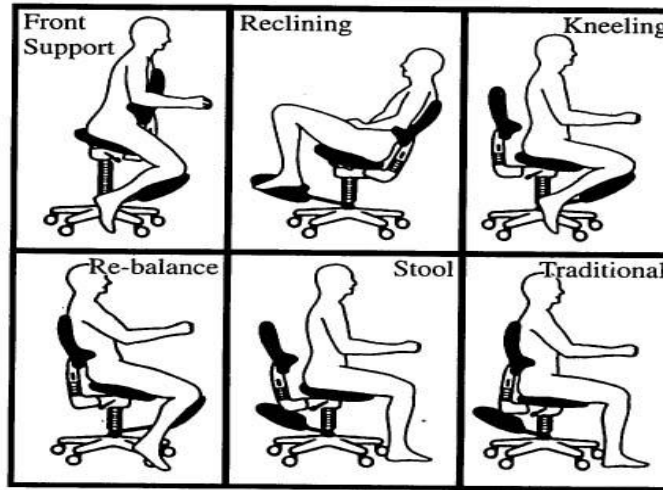
Adjustments can be made easily while sitting in the chair;

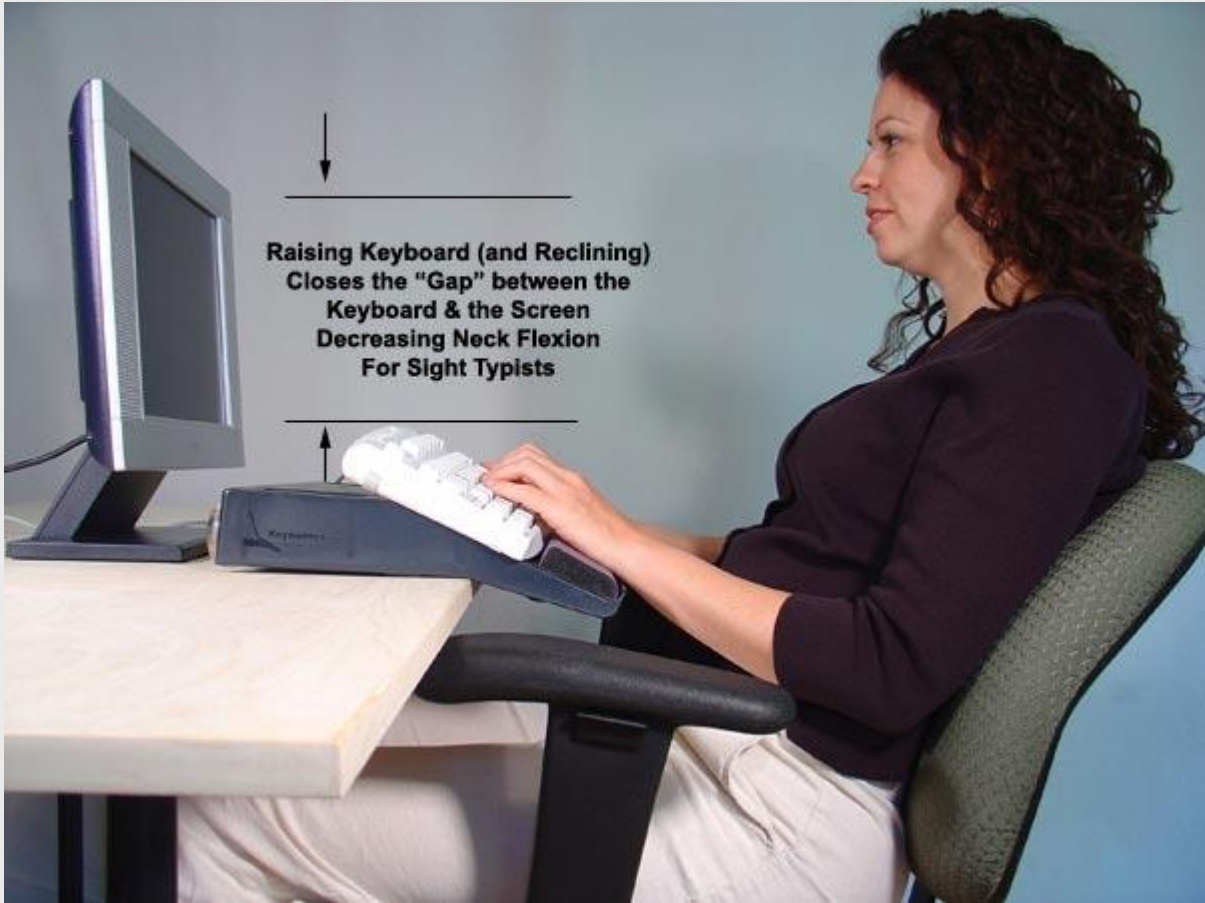
Rounded front edge;

Wide enough & deep (long) enough to fit you comfortably;

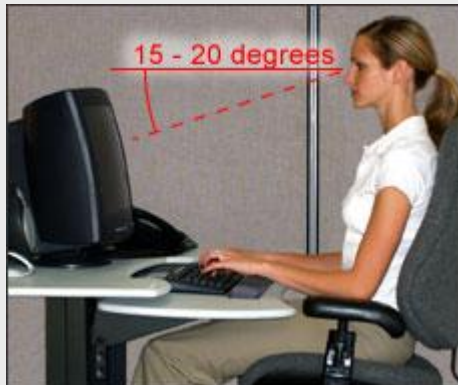
Adjustable in angle□;

Firm padding covered with non-slip, breathable fabric.





**Raising Keyboard (and Reclining)  
Closes the "Gap" between the  
Keyboard & the Screen  
Decreasing Neck Flexion  
For Sight Typists**



# Your Workstation

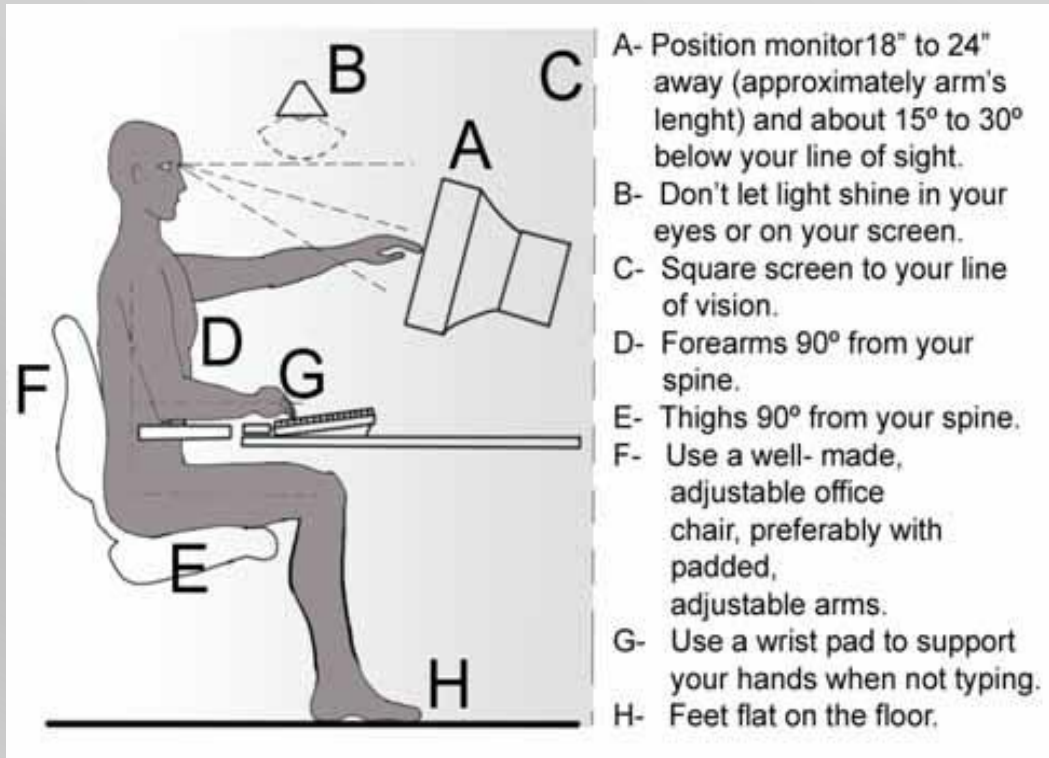
If you buying a new desk you may want one with adjustability included.

You can purchase a complete workstation that allows for both regular desk work & space for the computer.

The computer section should have an adjustable portion for the keyboard & mouse and a separate adjustable portion for the monitor.

The portion of the desk designed for the keyboard should have enough space for the mouse to be placed at its side.

You can use a smaller separate computer workstation and continue to use your desk for regular work.



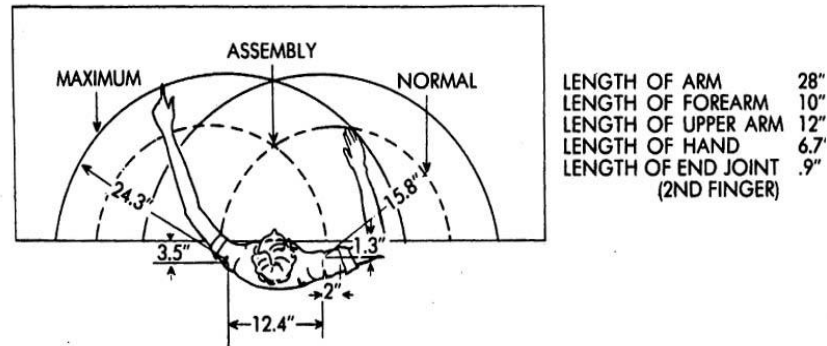
- A- Position monitor 18" to 24" away (approximately arm's length) and about 15° to 30° below your line of sight.
- B- Don't let light shine in your eyes or on your screen.
- C- Square screen to your line of vision.
- D- Forearms 90° from your spine.
- E- Thighs 90° from your spine.
- F- Use a well-made, adjustable office chair, preferably with padded, adjustable arms.
- G- Use a wrist pad to support your hands when not typing.
- H- Feet flat on the floor.

# Your workplace

- If you have shelves above the workstation, ensure they do not interfere with adjusting the monitor height or block overhead lights. □
- Sit with your arms hanging straight at your side. □
- Adjust the writing surface to be level with your elbows □.
- Raise forearms to create approximately a 90-degree angle at the elbow.

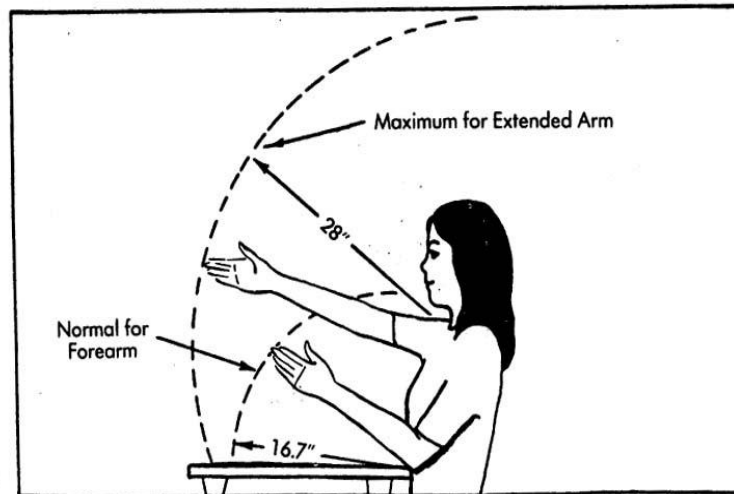
**FIGURE 5-12**

Normal and maximum working areas in the horizontal plane for women (for men, multiply by 1.09).

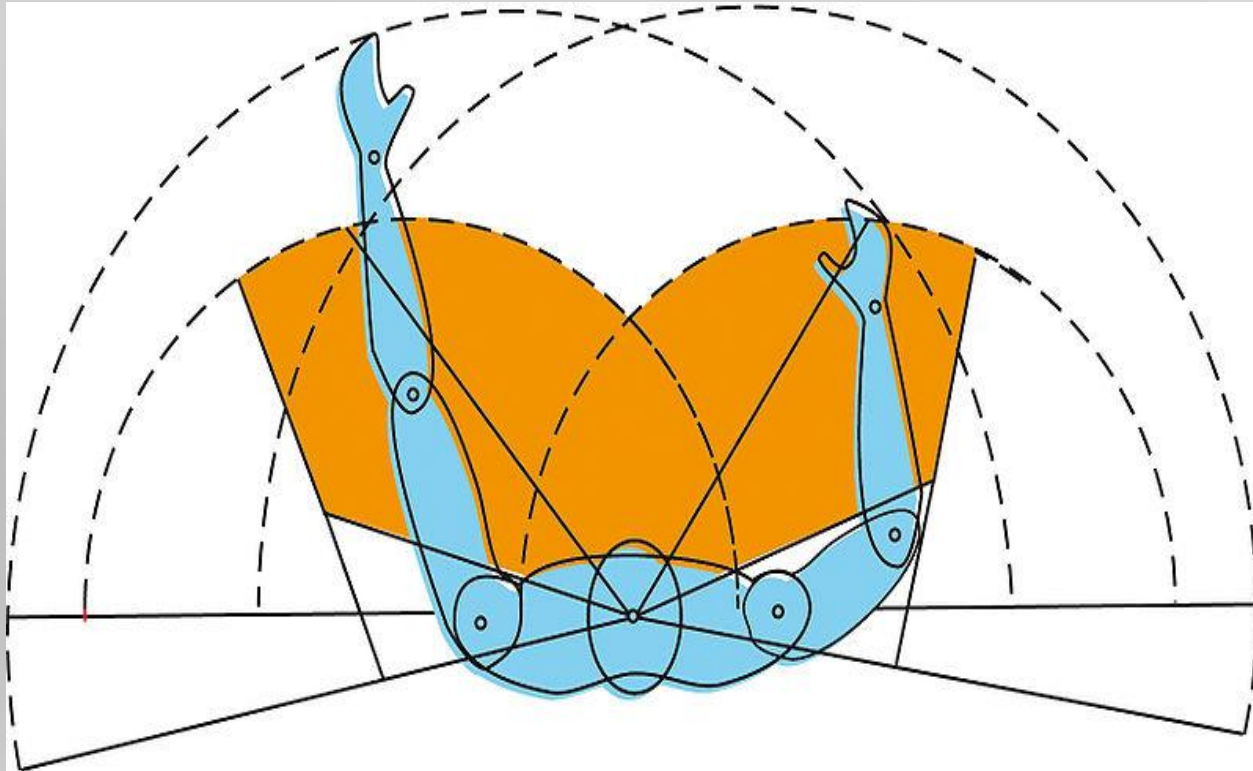


**FIGURE 5-13**

Normal and maximum working areas in the vertical plane for women (for men, multiply by 1.09).



tively and applies pressure to the area where the driver knows the foot pedal is located. If the location of the brake foot pedal varied, the driver would need considerably more time to brake the car. Similarly, providing fixed locations for all tools and materials at the workstation eliminates, or at least minimizes, the short hesitations required to search for and select the objects needed to do the work. These are the ineffective "search" and "select" therbligs discussed in Chapter 4 (see Figure 5-14).



# Your computer

See *diagram*....slide number 25.

Things to look into if you are thinking of changing your keyboard: □

- The adjustability of the keyboard.
- Some “ergonomic” keyboards are unadjustable & rely on a one-size-fits-all theory.
- This may not be appropriate for all users since people often have different sized hands.

# Positioning your keyboard



- Wrist/palm rests encourage neutral wrist postures

# Your monitor

The monitor and keyboard should be directly in front of you. □

- The top of the monitor & document holder should be around eye level whilst you are seated. □
- The monitor should be about arm's length away from you at a comfortable reading distance. □
- The monitor should be angled slightly up toward your eyes.
- Angling the monitor up too high can increase glare.

# Vision problems

***Vision problems can lead to eye strain and headaches.***

If you work in an office, you should have regular eye examinations to correct vision problems.

Inform the doctor you work with computers;

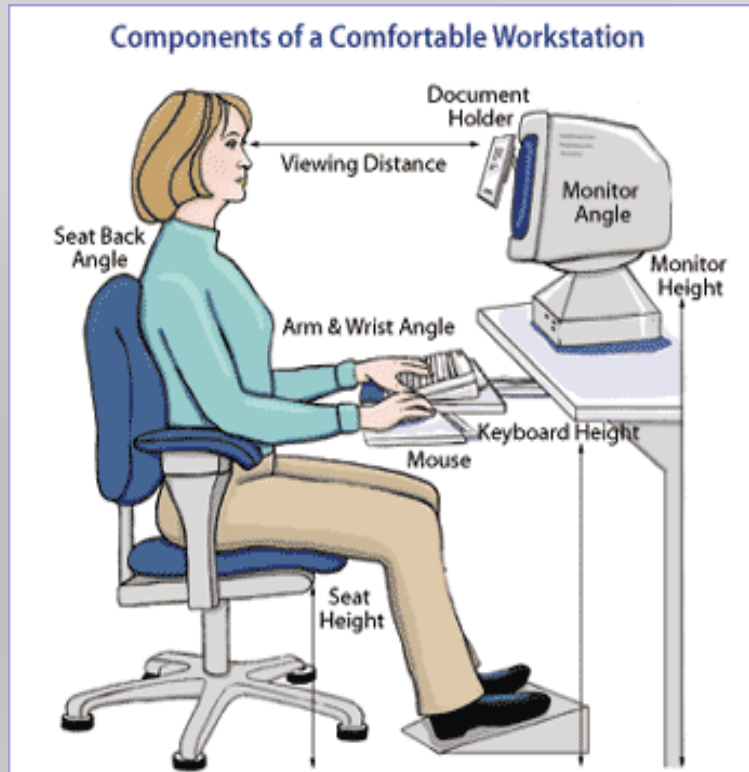
Bifocals: you may have trouble when working on computers since the lenses are designed for reading at a viewing distance of 40 to 50 cm & a downward gaze of about 25 degrees.

The monitor should be lower & closer to a person who wears bifocals depending on which portion of the glasses is used to read the monitor.

# Positioning your monitor

- Longer cables allow you to position your monitor wherever necessary. □
- CPUs can be placed on their side.
- Ask a colleague to observe you to determine if you are working in an awkward position. It is often difficult to tell if your neck is slightly bent. Your neck & shoulder muscles may ache & tire faster if slightly bent vs ideal position.
- Your monitor & document holder should be at eye level or slightly lower. When sitting, your eyes should fall naturally on the middle of the screen. □
- Bifocal wearers: bottom readers tend to look up at a screen. If your neck is bent back, try lowering your monitor further. The monitor should be lower & slightly angled up towards your eyes
- When the monitor is angled up, it may be affected by glare from overhead lights. An anti-glare screen can be used to reduce glare.

### Components of a Comfortable Workstation



# Office Lighting

## The amount of light affects eye strain & postures.

- Light levels must be bright enough for paper work, but not too bright for computer work.
- If light levels are too low, the eye muscles are strained & awkward postures are used to see the paper.
- When light levels are too high, you may be forced into an awkward posture in order to see the screen.
- Since computer & paper work are performed at the same time in most offices, light levels must suit both types of work.
- You can also redirect a desk lamp when working on the computer.

# Glare

**Glare is a common problem with lighting in offices.**

One of the leading causes of eye strain & sub-optimal vision is glare. Yet with a little ergonomic knowledge and technology we can fight glare & improve our vision and productivity.

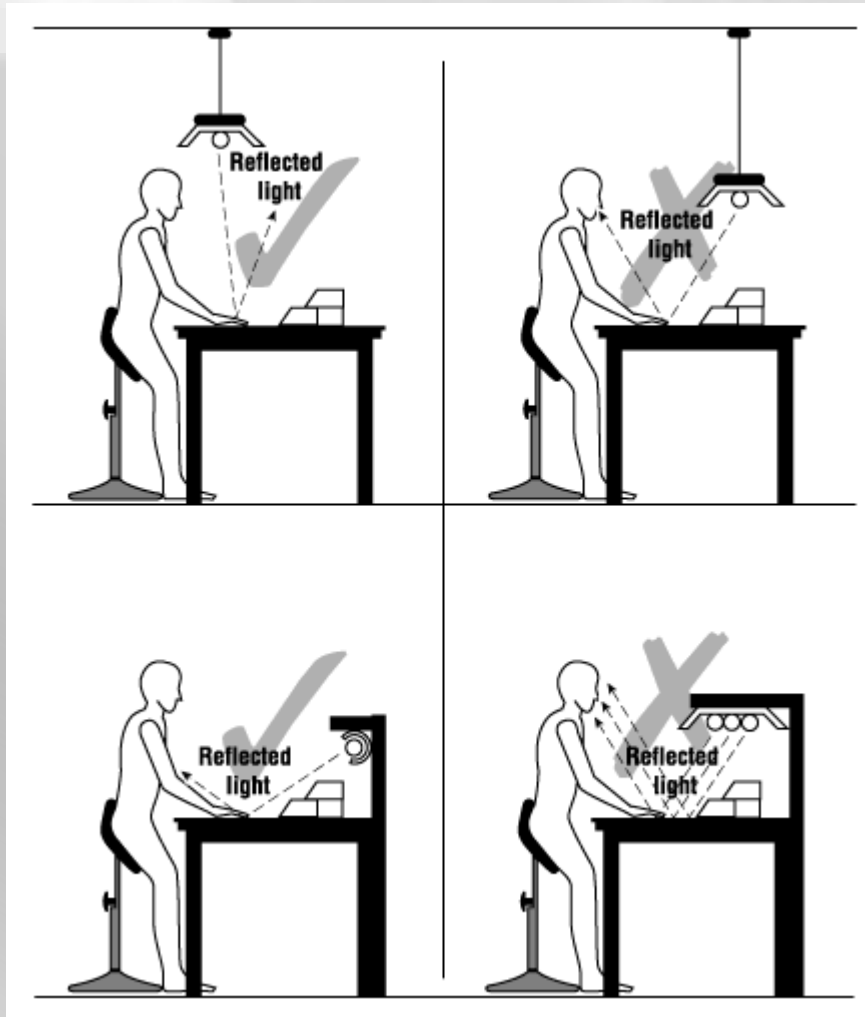
- It makes it difficult to see the computer screen & strains the eyes. In order to see the screen, you may move into awkward postures.
- There are two forms of glare: ***direct and indirect***.
- Direct glare occurs when light shines directly in your eyes.

*Eg. an overhead light in front of your monitor.*

- Indirect glare occurs when light is reflected from a surface.

*Eg. sunlight from a window behind your desk.*





# Muscle Recovery

- Stand up & get away from your desk and/or computer regularly throughout the day.
- A five minute break away from the computer every hour allows your eyes, neck, back, shoulders, & arms to rest.
- Do not remain in any one position (seated or otherwise) for long periods of time.
- Changing positions helps to reduce the stress & strain.  
  
Eg. adjusting the angle of the back rest of your chair even slightly will help change the position of your spine, giving certain muscles a "break".
- Movement is also necessary to reduce stress that builds up from sitting.
- Get up & walk around - improves circulation.

# Arranging your office

- Printers, faxes etc. should not obstruct movement.
- Adequate space should be available for maintenance on any piece of equipment.
- Filing cabinets should have a locking system so that no more than one drawer can be opened at once.
- If more than one drawer is opened there is a risk of the cabinet tipping. □
- Files and books that are used most often should be kept within easy reach. □
- Files should be arranged in a filing cabinet so frequently used files are in the middle drawer or closest to elbow level. This reduces the amount of bending & reaching.
- Locate filing cabinets so you have to stand up from your chair & walk to them. This forces you change position & eliminates twisting you body to reach it.
- There should be enough space between the cabinet & the wall to pull open the drawers (approx. 107 cm for vertical files & 81 cm for lateral files). □





# Indoor Air Quality

- Office environmental concerns include indoor air quality, thermal comfort, electromagnetic fields & noise.
- Poor indoor air quality causes many health problems.

## ***Common concerns include:***

- Eye, nose & throat irritations
- Headache
- Dry mucous membranes
- Mental fatigue, trouble concentrating
- Nausea and dizziness
- Increased incidence of respiratory infections

# Noise

**“Noise is any unpleasant sound”.**

We tend to call it "sound" when it is not annoying & "noise" when it is! Noise levels in your office are probably not high enough to damage your hearing, but noise may still cause problems.

## **Noise may:**

- Interfere with communication. □
- Annoy or distract people nearby. □
- Increase the level of concentration required and in turn, increase the level of fatigue. □
- Cause stress.

# POINTS TO REMEMBER

- Ergonomic equipment is only valuable if used correctly.
- Learn how to use your equipment! □
- Reduce repetitive movements, awkward postures & static forces.
- Be conscious of your body positions & movements! □
- Take a break: move away from your computer at least once every hour. Remember to keep moving! □
- All aspects of your office interact to affect your health (workstation design, stress, air quality noise, etc.).

**Keep the communication lines open!**

## Close up picture of how you should type.





# CONCLUSION

Management commitment, in terms of attitude, managing in a diversified workplace & the allocation of resources is essential to the process of ergonomic management in SA.

Through simple, innovative & creative thinking, the status in commerce & industry can be improved through the application of ergonomic principles.

The implementation of ergonomic improvements in the workplace must take the form of a project by project approach using a systematic method of application.

***“TAKE CARE OF YOURSELF, NOBODY ELSE WILL”***

# Questions?



***“Be the change you wish to see in the world”  
MK Gandhi***