

FACTFILE: GCE TECHNOLOGY & DESIGN

ERGONOMICS AND ANTHROPOMETRICS



1.7 Product Analysis and Improvement: Ergonomics and Anthropometrics

Learning outcomes

Students should be able to:

- analyse, evaluate and produce redesign proposals for existing products under the following headings:
 - ergonomics and anthropometrics.

Course content

Ergonomics

Ergonomics is the study of the interaction between the human body, products and the surrounding environment. It is a key factor in the design of all products from furniture to handheld gadgets. It is an essential part of the design process.

The main objective for ergonomists is to improve consumer's lives by increasing their comfort when using products.

When ergonomics is incorporated into industrial machinery and tooling it can increase efficiency, productivity and reduce errors and accidents.

The principles of ergonomics involve designers understanding how humans interact and with products. The methods of focussing on human performance take either a quantitative approach or a qualitative approach.

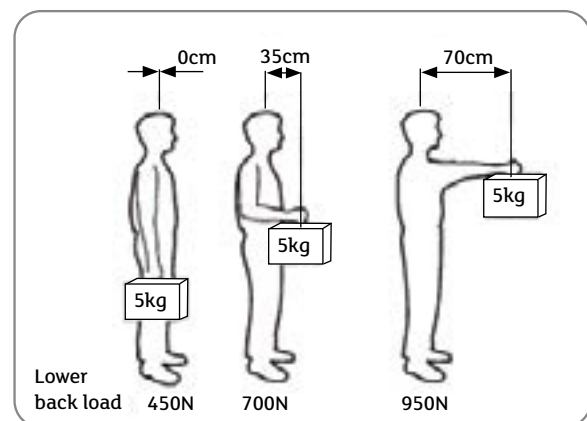
The quantitative approach relates to the physical fit of the human body in relation to speed of performance and workload.

The qualitative approach relates to the overall comfort experienced by the user.

Everyday situations can be hazardous to health by persistently subjecting the human body to positions and situations that are not comfortable. In western countries, musculoskeletal system (e.g. lower back pain) and psychological illness (e.g. stress) lead to the greatest significance of absenteeism from work. These conditions can be caused by poor quality ergonomic design of equipment.

Therefore in the workplace, improved ergonomics can increase productivity.

Ergonomics related to posture and movement

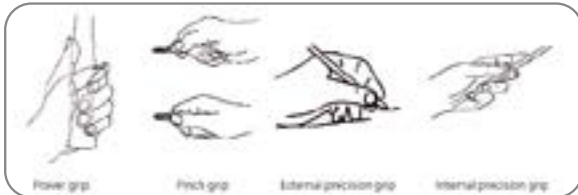


Posture and movement are two of the most important factors in considering ergonomic design. Success of everyday tasks is closely related to good posture and efficient movement. Ligaments, tendons and muscles of the body constantly adapt to positions that the body subjects them to. Quite often, products that possess poor ergonomic characteristics subject the user to mechanical stress on joints and muscles.

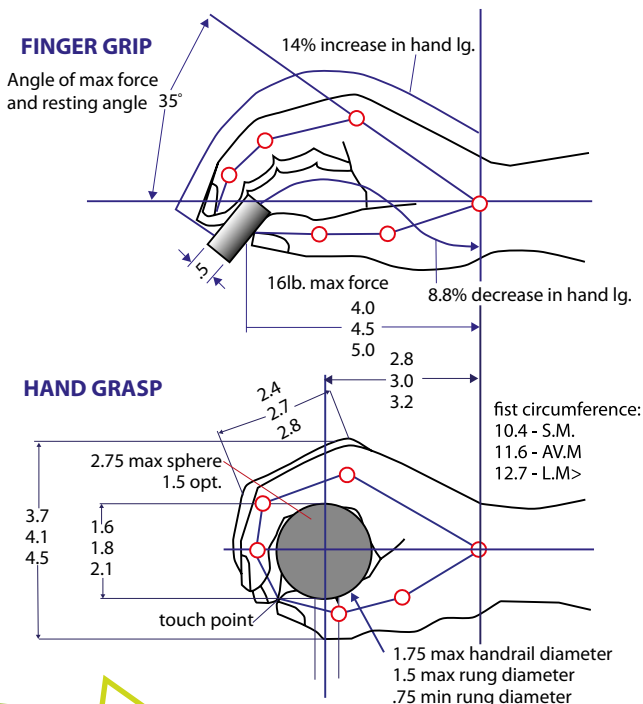
Some ergonomics in school-based projects are often associated with handheld objects or improving the comfort of the holding part of a product. Hand position, wrist angle and arm elevation are usually taken into account when designing products in schools.



The main types of hand grips are shown below:



This diagram shows the amount of research that goes into finding average grip sizes for different handheld pieces.



The following are some environmental factors that can influence ergonomics:

- noise;
- illumination;
- vibration;
- climate; and
- chemical substances.

Anthropometrics

Anthropometrics is the use of body measurements to determine the optimum size for products for comfortable and efficient use. Examples of anthropometric data include:

- how far people can reach;
- how much space people need;
- how much force they can exert;
- height of a person; and
- length of arms/legs etc.

Many production companies use anthropometric data when designing. The designer's aim is to achieve as good an anthropometric match for as many potential consumers as possible.

British Standards Institute (BSI) (www.bsi.org.uk/education) provide data charts relating to measurements for men, women and children.

Statistical data supplied by the BSI is associated with average heights. In this data, 5% of people are below average height and 5% are above average height. Therefore, this anthropometric data covers 90% of the population. For example, if a chair is designed and bought by 100 people, statistically, it will be anthropometrically suited to 90 of the people who purchased it.

This principle is adhered to in the designing of most products.

Biomechanical and anthropometrical data are closely linked when designing products. A number of areas and factors must be considered when planning size and shape of products, especially those related to posture and movement.

For the design of work-based products, some of the main biomechanical principles of importance to ergonomics and anthropometrics are listed below:

- joints must be in a neutral position;
- keep the work close to the body;

- a twisted trunk strains the back and upper body;
- sudden movements produce peak stresses;
- alternate postures as well as movements and positions;
- limit the duration of continuous movement;
- prevent muscular fatigue;
- frequent short breaks are preferred to one long break;
- limit energy expenditure in individual tasks; and
- after heavy tasks, rest is essential.

The background of anthropometrics

Anthropometry is related to the size and proportions of the human body. Important anthropometric principles are listed below:

1. Be aware of differences in body size.

Designers of various products must bear in mind the differences in body shape and size of users. For example a table height that is suitable for an average person might be unsuitable for a tall or short person. A solution might be to make the height of the table adjustable to cater for the comfort of a wider range of sizes of users.

Sometimes products must be designed to suit the extremes of human size, e.g. a control panel that has to be reached should be reachable by a user with the shortest arms. Another example might be that seating in a plane must cater for the leg space of the tallest passengers.

2. Use anthropometric tables that are appropriate for specific populations.

Data related to some population groups is not always relevant to other population groups, e.g. the average height of an adult in the UK is relatively tall compared with average world population.

Height data of humans will often refer to unshod persons and therefore 3-5cms will need to be added if relevant to the design of a specific product.

Example of anthropometric data

The table below provides data on the body sizes of short, average and tall British adults. All measurements are in centimetres apart from body weights, which are in kilograms.

Body position	short	average	tall
Standing stature	150.5	167.5	185.5
Forward grip reach	65.0	74.3	83.3
Eye height	140.5	156.8	174.5
Shoulder height	121.5	136.8	153.5
Sitting height	79.5	88.0	96.5
Sitting eye height	68.5	76.5	84.5
Sitting elbow height	18.5	24.0	29.5
Body weight	44.1	68.5	93.7

There are many other anthropometric average measurements; however, this table provides us with more relevant information for products related to the overall size of the human form.

Revision Questions

1. What is meant by the term ergonomics?

2. Give **two** main reasons why the implications of ergonomics are important to the designer.

3. With reference to fig. 6, select **two** different aspects of the product and briefly explain how the designer has considered ergonomics.



Fig. 6

4. Identify and explain **three** aspects of a mobile phone which show that the designer has considered ergonomics.

