HUMAN CENTERED DESIGN

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CHAPTER OUTLINE

- Introductory Note

- Anthropometric Data & analysis

- Design Principles

- Human Centered Design Principles

- Human Centered Automation

- Fitting Person to Job & Fitting Job to Person

INTRODUCTION

"HUMAN ORIENTED DESIGN"

CHALLENGES AND THEIR SOLUTIONS

- What is meant by when we hear a product is ergonomically designed?

- An ergonomically designed product should be focused to ~90% of the user population.

- "Population" refers to the group of similar people.

- Similarity may be in user's ……….

✓ Job

✓ Age groups

✓ Ethnicity (culture, language, customs etc.)

✓ Geographical locations and so on.

DESIGN TO FIT FOR EVERYONE

- The approach of ergonomics is to consider product dimensions having constraints on their design by human variability.

- Because of human variability, Anthropometric study in the product/system design, comes into picture.

What are the sources of human variability ???

Source: Ashby (1979), Ergonomics Handbook I: Body size and strength. SA Design institute, Private Bag X191, Pretoria 001

- Body size and proportion vary greatly between different populations.

- Size variation is due to overall natural growth of human being on the passage of time.

- Human vary due to genetic differences.

- Human vary due to climatic conditions.

- Human vary due to better living conditions.

Designer has to analyze in what ways anthropometric mismatches might occur and decide which anthropometric data might be appropriate to the problem.

ANTHROPOMETRY

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ANTHROPOMETRY

Empirical science concerned with the physical measurements of the human body, such as height, range of joint movements, and weight

- Derived from the Greek words anthropos (man) and metron (to measure)

- Usually considered a branch of anthropology

- Strength characteristics also sometimes included in the scope of anthropometry

# ANTHROPOMETRIC ANALYSIS AND DATA

1. Static dimensions – body measurements while in a fixed position

   – Data are more easily determined, so much more static data are available

2. Dynamic dimensions – body measurements while performing some physical activity

   – Probably more relevant in design

HUMAN VARIABILITY

- Differences in body dimensions exist among people because of:
    - Ethnicity and Nationality
    - Heredity
    - Diet
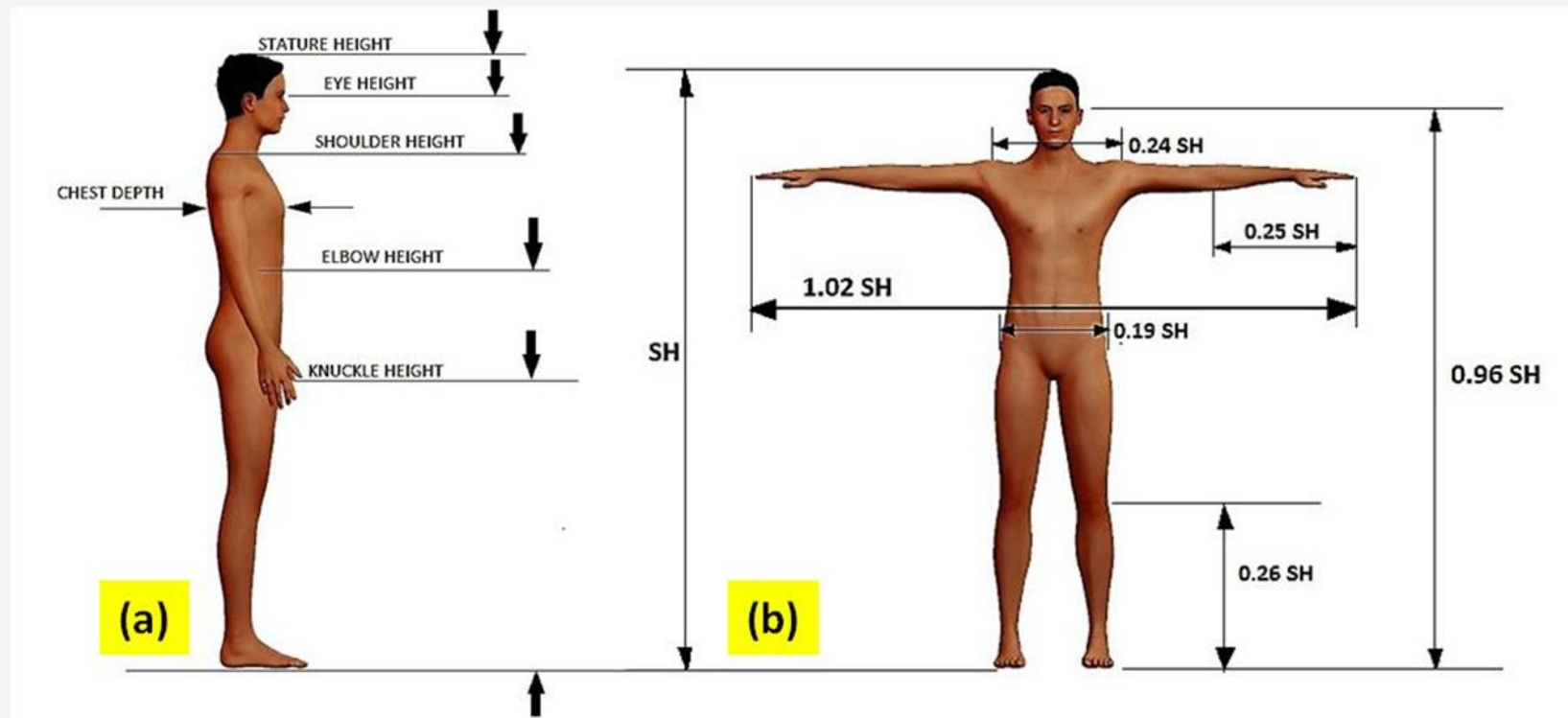   - Health
    - Sex
    - Age
    - Living conditions

Static Dimensions of Human Body
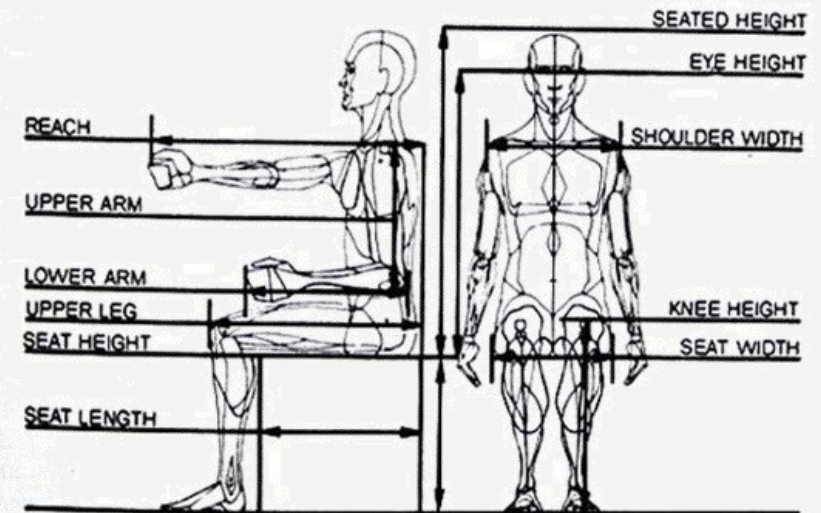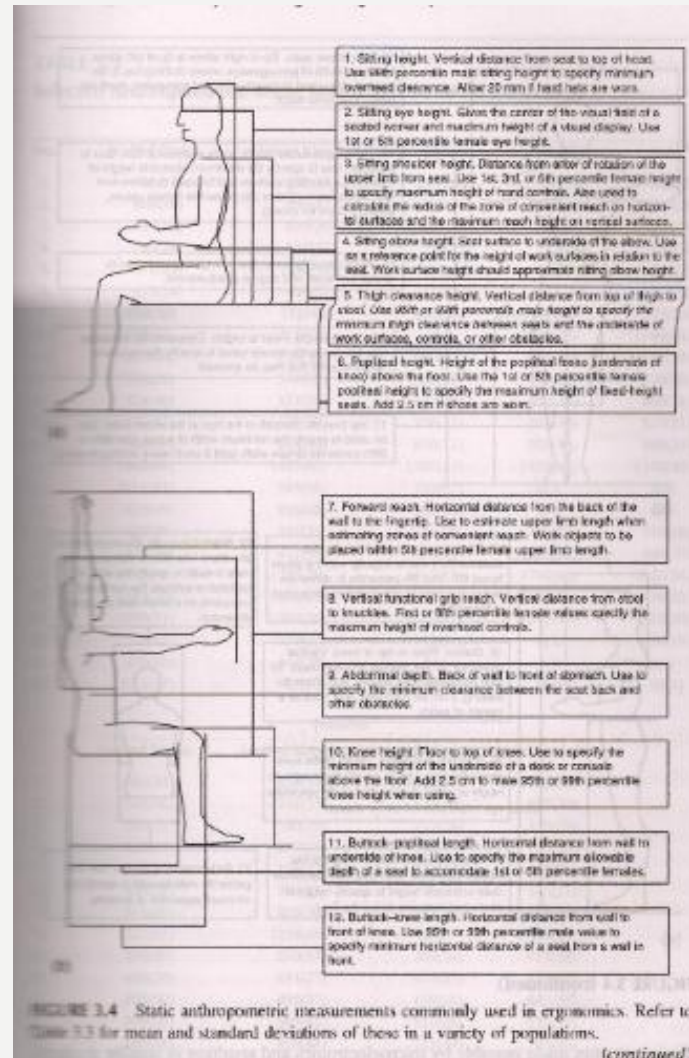

Standing
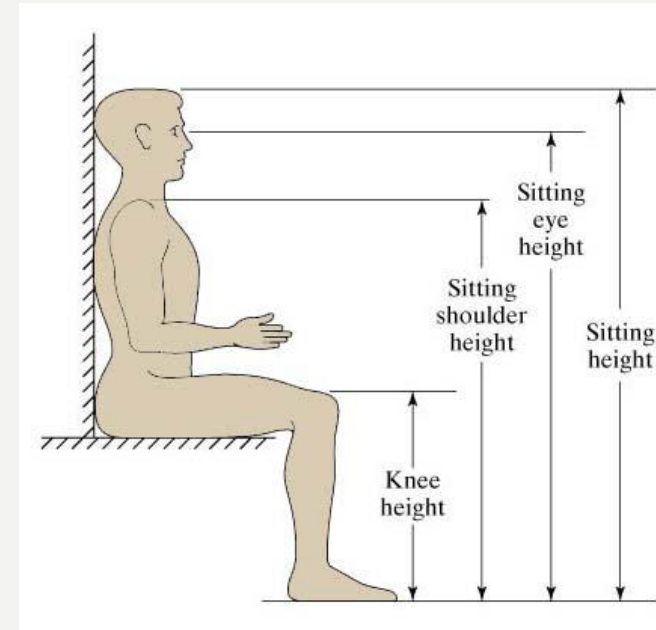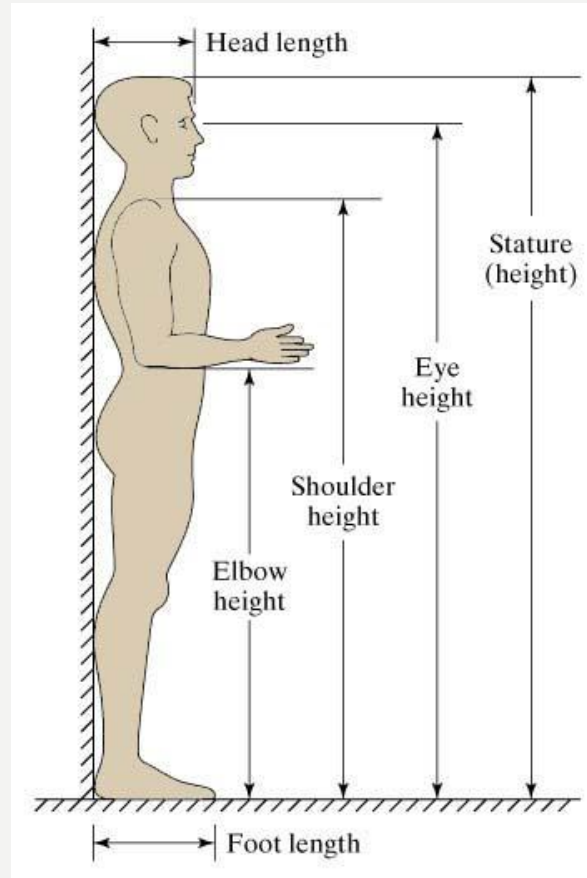
Seated
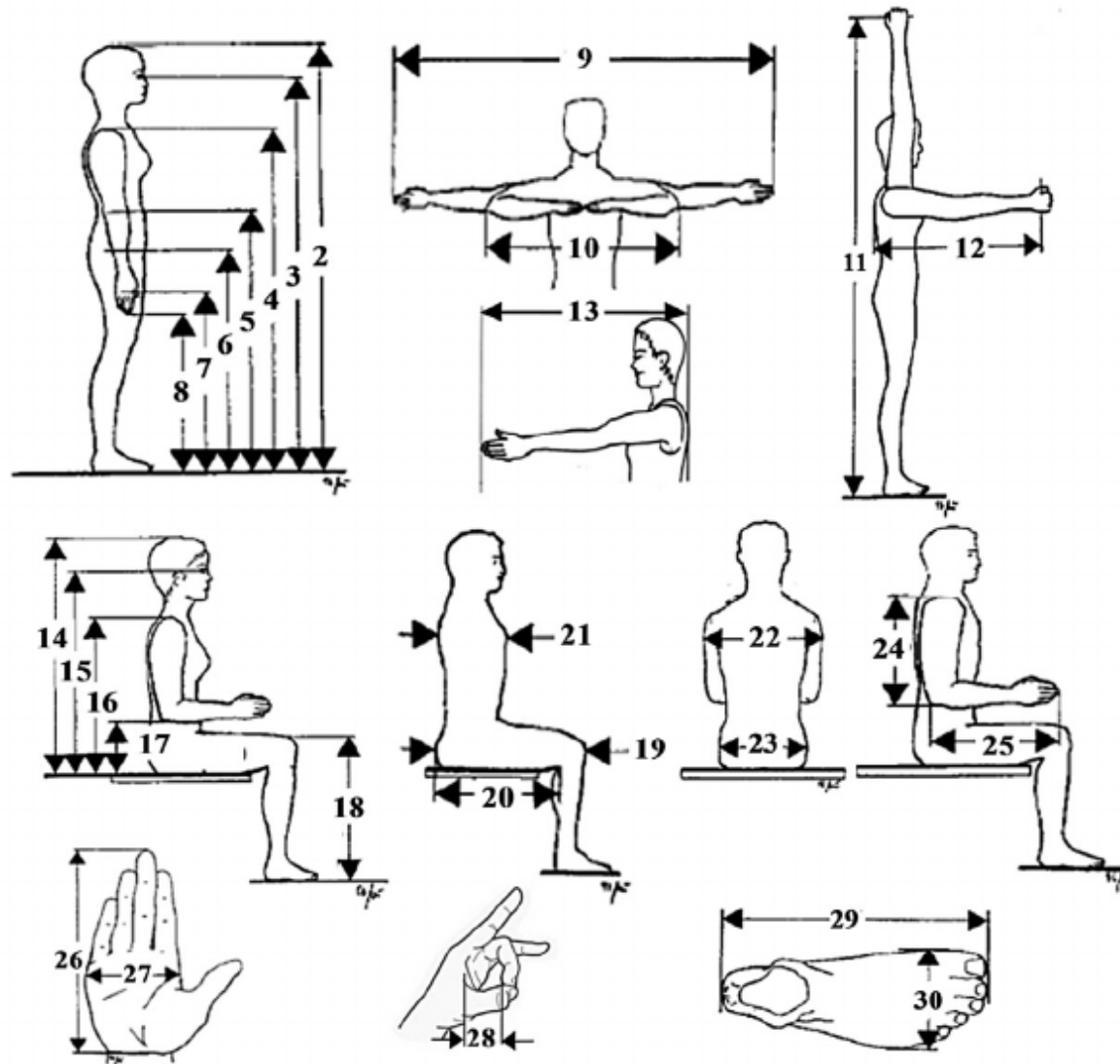
Static Dimensions of Human Body

TYPES OF ANTHROPOMETRIC DATA USED IN ERGONOMICS

- Structural data: Measurement of bodily dimensions of subjects in static postures

- Functional data: Collected from subjects who are allowed to move one or more limbs in one or more planes with respect to affixed point.

- Newtonian data: This included both body segments mass data and data about the forces that can be exerted in different tasks.

The measurements taken on human body with the subjects in rigid, standardized position. They are typically length, width, height and circumferences. These measurement includes standing height, seated height, seated eye height, upper leg length, knee height, seat length, upper and lower arm length, reach (total arm length), shoulder width, hip or seat width, weight, etc.

FIGURE 3.4 Static anthropometric measurements commonly used in ergonomics. Refer to Table 3.3 for mean and standard deviations of these in a variety of populations.

(continued)

1	Weight (kg)
2	Stature
3	Eye height
4	Shoulder height
5	Elbow height
6	Waist height
7	Knuckle height
8	Fingertip height
9	Arm span
10	Elbow span
11	Vertical grip reach
12	Forward Grip Reach
13	Forward fingertip reach
14	Sitting height
15	Sitting eye height
16	Sitting shoulder height
17	Sitting elbow height
18	Knee height
19	Buttock-knee length
20	Buttock popliteal length
21	Cest (Bust) depth
22	Shoulder breadth
23	Hip breadth
24	Upper-arm length
25	Forearm hand length
26	Hand Length
27	Hand breadth
28	Grip diameter (inside)
29	Foot length
30	Foot breadth

HOW TO USE OF ANTHROPOMETRIC DATA

Minimum Dimensions

- A high percentile value of an appropriate anthropometric dimension is chosen.

- Example: while designing a doorway, sufficient head room for very tall people has to be provided and 95-99 percentile stature could be used to specify the minimum height. Doorway should not be lower than this minimum value .

- Additional allowance also would be taken care for the increase in height cause by heels of shoes, protective headgear etc.

- Example: Seat breadth is also determined using a minimum dimension.

Maximum Dimensions

- A low percentile is chosen as in determining the maximum height of a door latch so that smallest adult in a population will be able to reach it.

Some minimum dimensions
(a) Height of doorway must be no lower than the stature of tall man (plus allowance of clothes and shoes etc.)
(b) Width of a chair must be no narrower than the breadth of human being.
(c) A tooth brush must be long enough to reach the back molars of someone with a deep mouth.
(d) A door handle must not be lower than the highest standing knuckle height of the
Population of users
(e) Length of wheel brace must provide sufficient leverage for a weak person to generate sufficient torque
To loosen the wheel nuts.
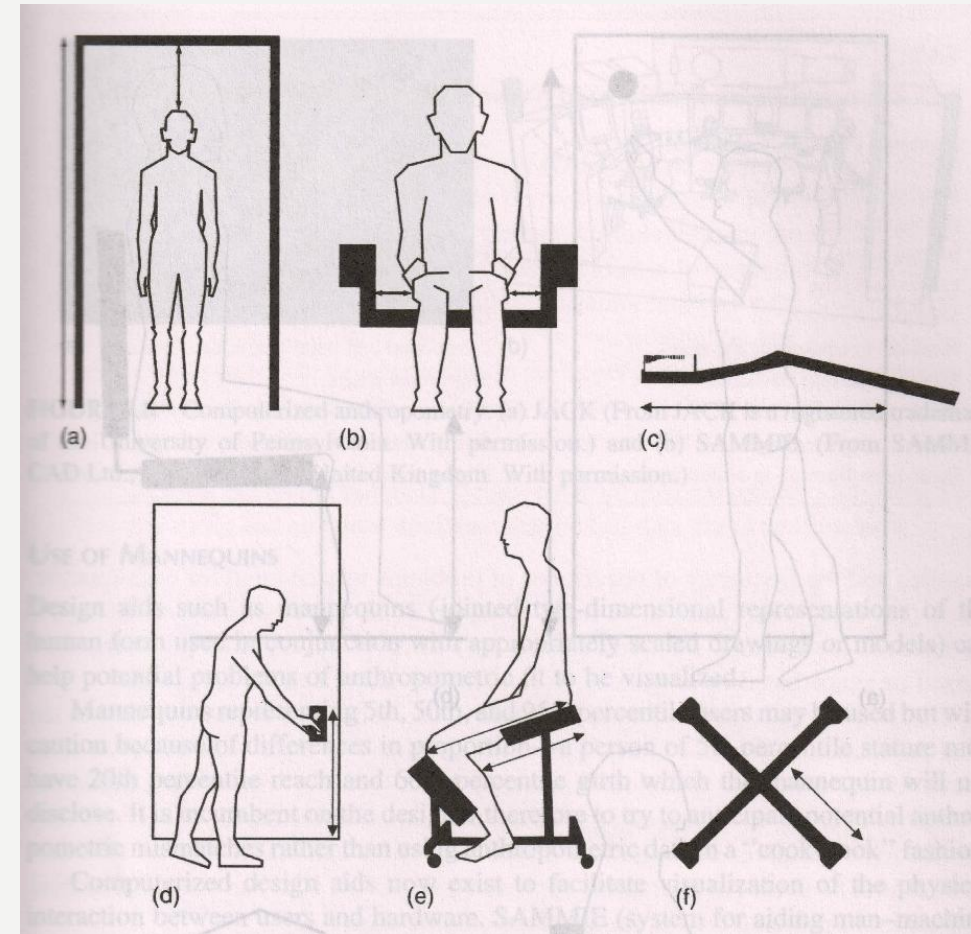
Some maximum allowable dimensions:

(a) A door lock must not be no higher
than the maximum vertical reach of small person.

(b) Seat heights
© depths must not exceed the popliteal height
And lower portion to knee lengths of small users.

(d) Screw top lids must be wide enough
To provide a large contact area with the skin of hand to provide
Adequate friction. Also they must not exceed
Grip diameter of small person though.
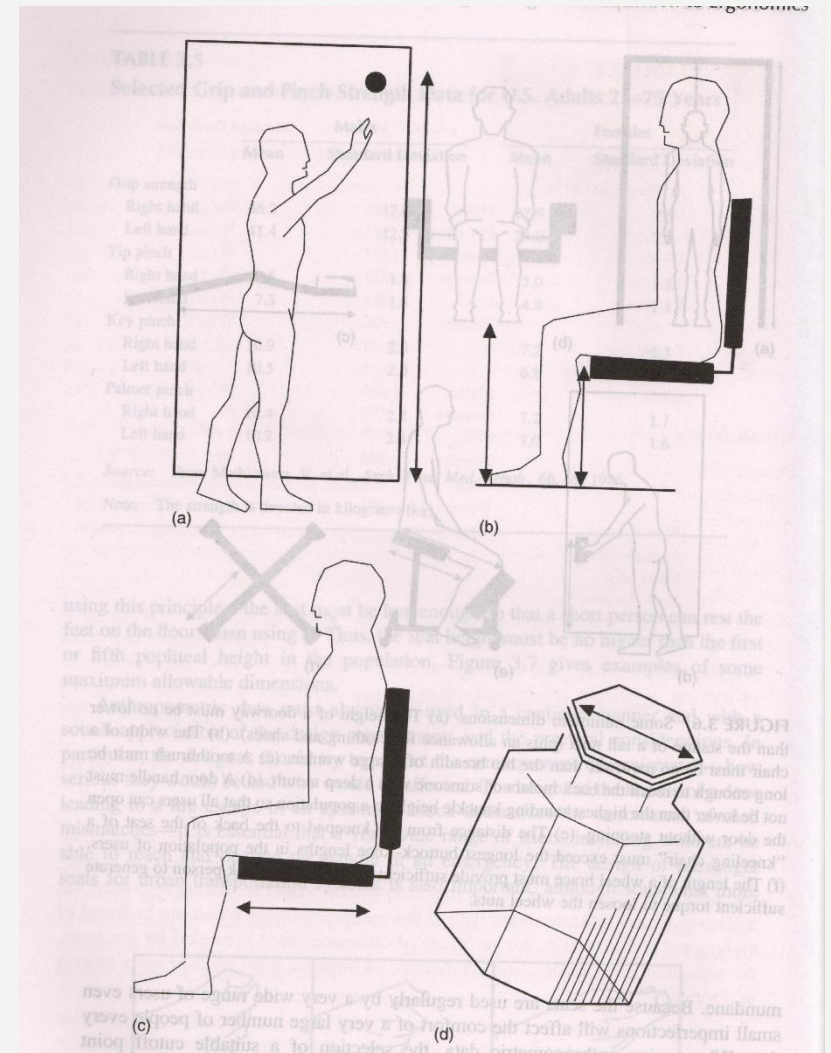
APPLICATIONS OF ANTHROPOMETRY IN DESIGN

- Design adjustable products

- Fit for use surveys

- Anthropometry and personal space

- Workstation design and reach

- Make different size

- Ashby (1979) illustrated the extent of anthropometric variability as follows:

" If a piece of equipment was designed to fit 90 % of the male population,, it would fit roughly 90 % of the Germans, 80% of the Frenchman, 65 % of the Italians, 45 % of Japanese, 25 % of Thais, and 10 % of the Vietnamese.