

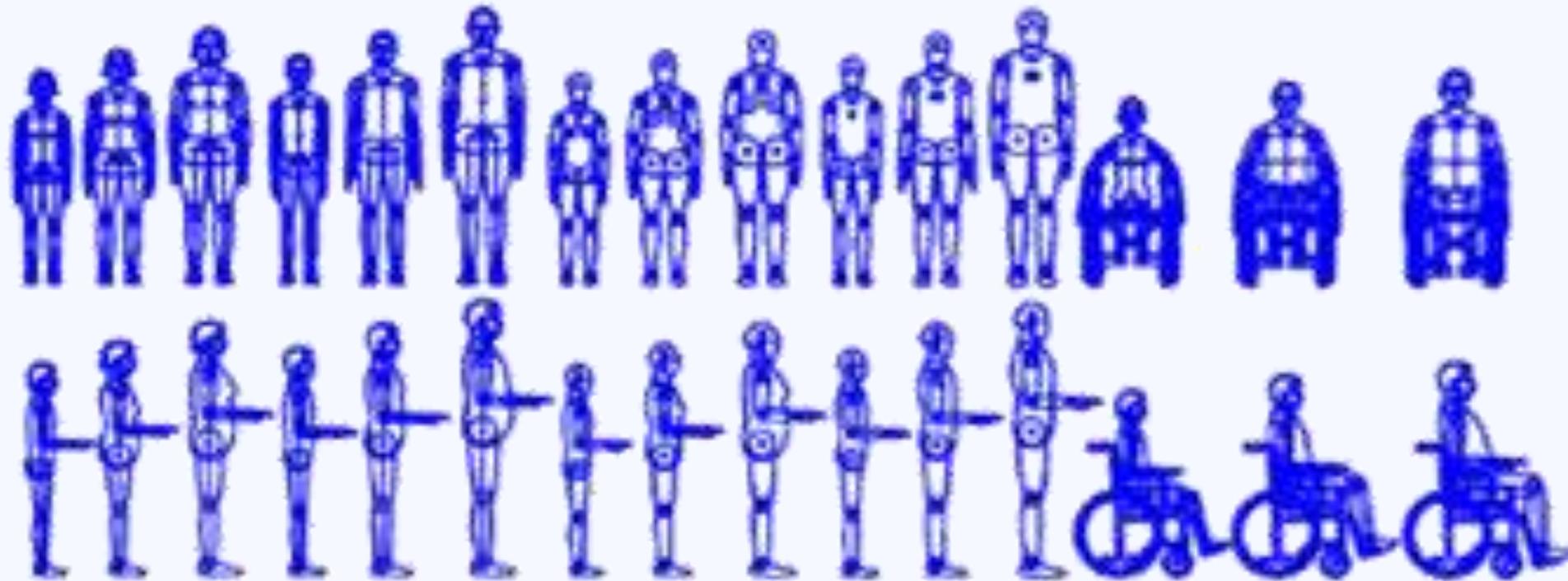
A stylized, colorful illustration of a landscape. The foreground features rolling green hills with a brown path. In the middle ground, there are several trees and flowers: a large green tree, a purple flower, and an orange flower. A red bird is flying in the sky. The background consists of wavy blue lines representing a sky or water.

#7 Anthropometry

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Diversity in the human body





Definition of Anthropometry

Anthropos
= human

Metron =
measure

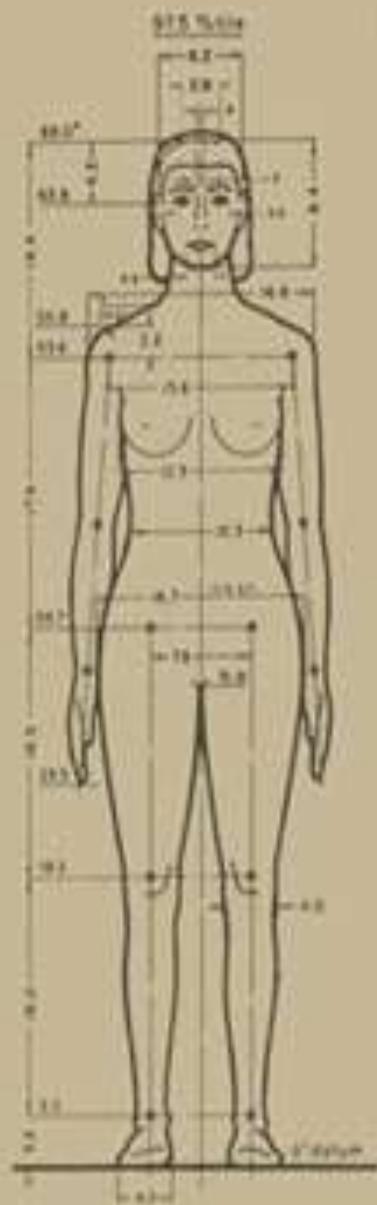
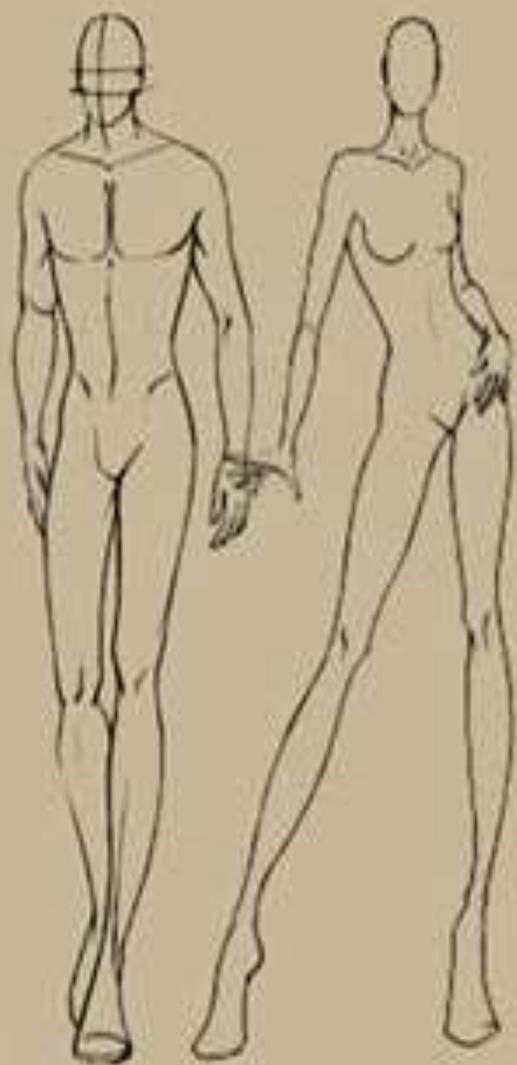
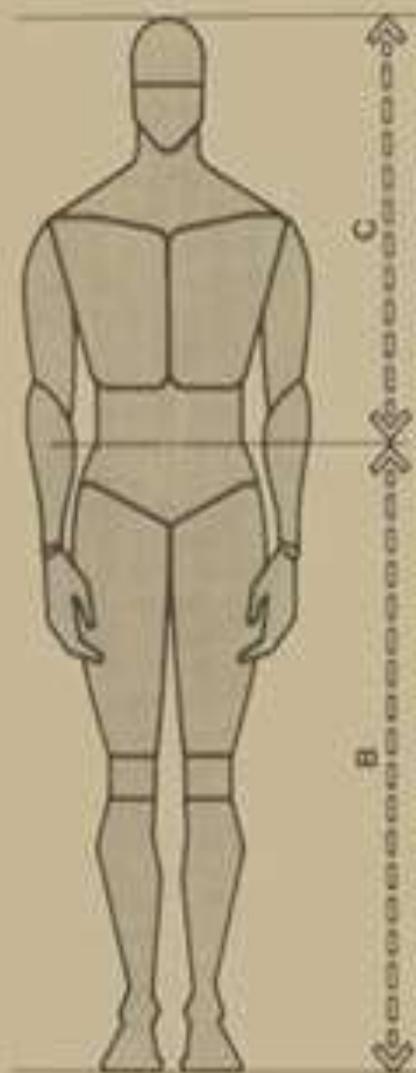
- The part of anthropology (study of humans) having to do with **measurements of the human body** to determine differences in races, individuals, etc... (Webster's New 20th Century Dictionary, 1970).
- Anthropometry is a science that deals with **the measurement of size, weight, and proportions of the human body**. It is empirical (experimentally derived) in nature and has developed quantitative methods to measure various physical dimensions. (Chaffin, 1984)

Engineering Anthropometry

The application of anthropometric data to equipment, workplace, and job design to enhance the efficiency, safety and comfort of the operator.



What is the difference of products developed by fashion designer and industrial designer ?



Application of Anthropometric Data

1. To specify the physical dimensions of :

- ❖ Workspaces
- ❖ Equipment
- ❖ Furniture
- ❖ Clothing
- ❖ So on...

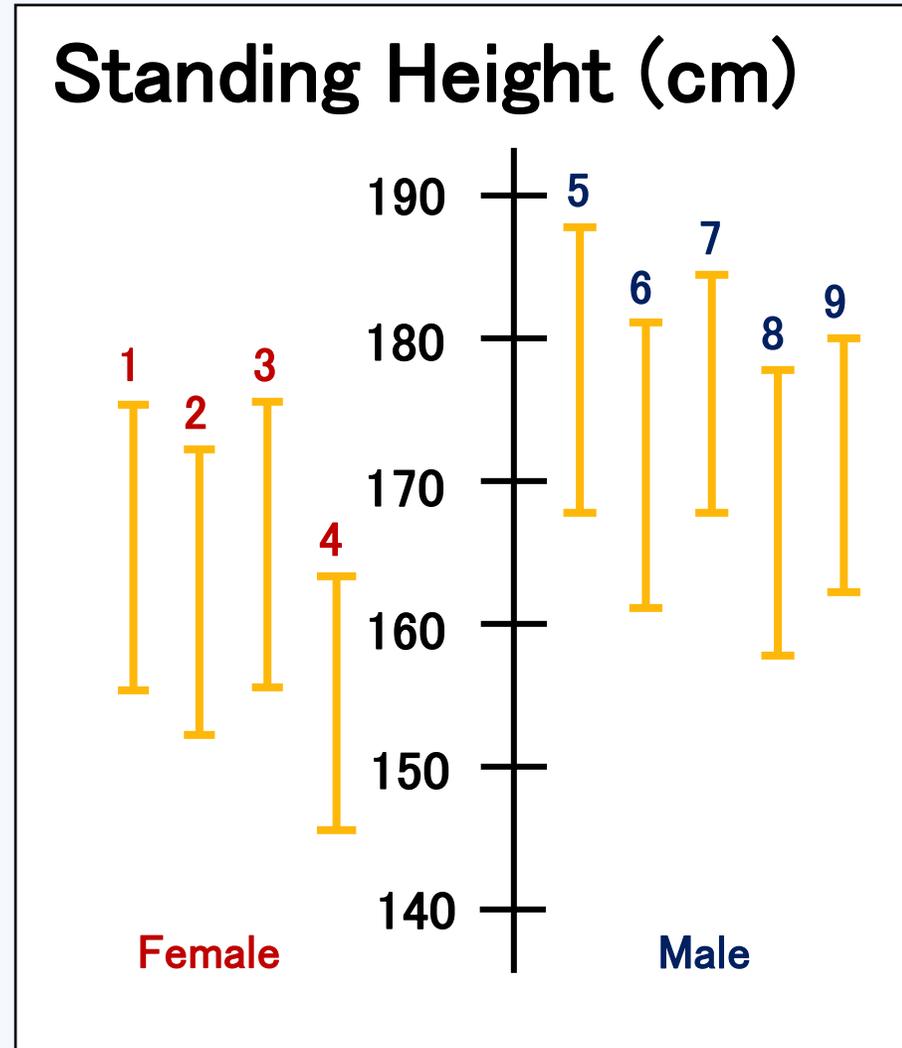


**Fit the task
to the man
(Grandjean,
1980)**

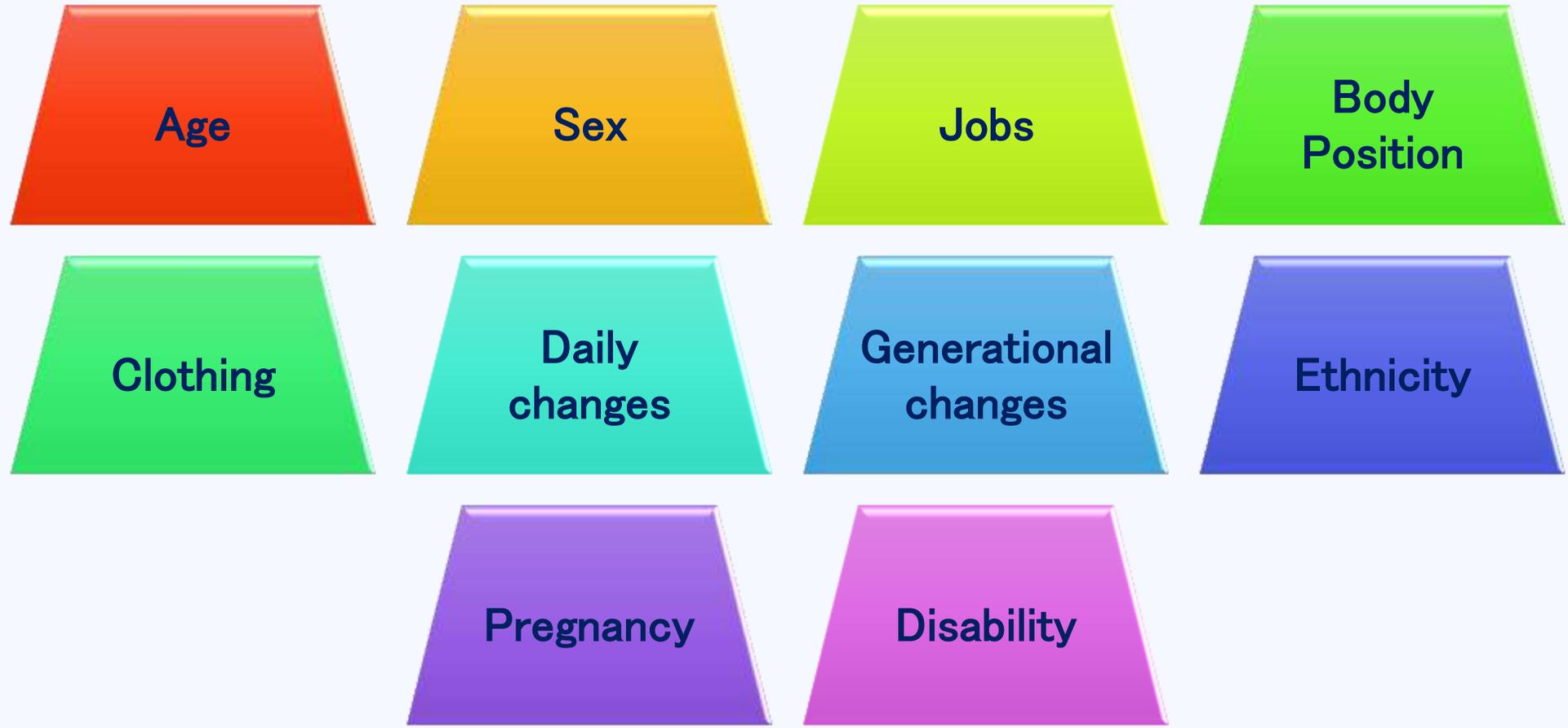
2. To ensure that physical mismatches between the dimensions of equipment / products and the user are avoided.

Human Variability

1. US Civilians
2. British Civilians
3. Swedish Civilians
4. Japanese civilians
5. US Air Force Fliers
6. Italian Military
7. French Fliers
8. Japanese Civilians
9. Turkish Military



Factors affecting anthropometry data



Type of anthropometric data

- **Structural body dimension**

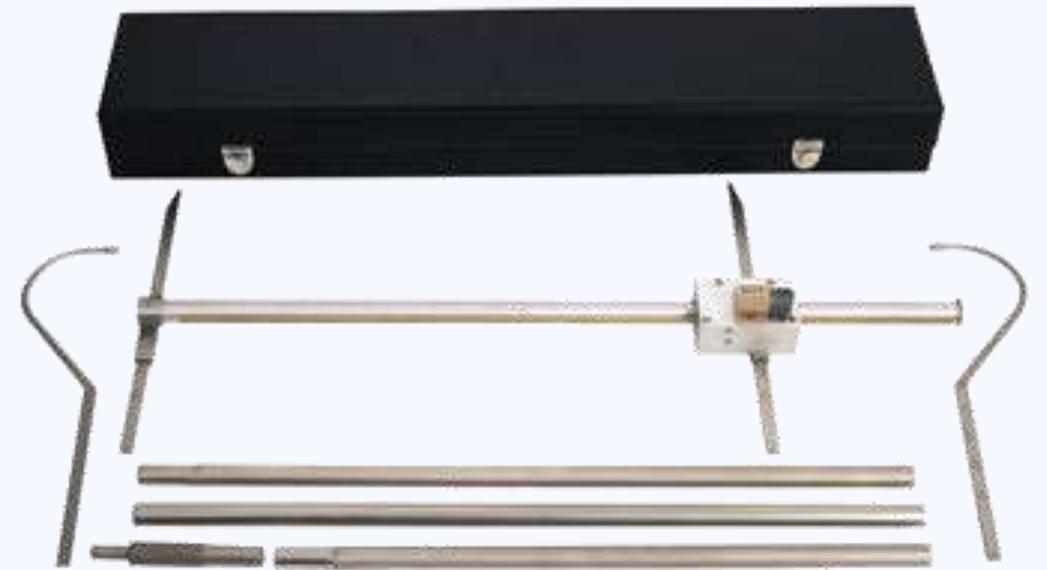
- Measure the body dimensions of subjects in **fixed (static) positions**.
- Measurement are made from one clearly identifiable anatomical landmark to another or to a fixed point in space.
- Example : height of the popliteal above the floor.
- What are the applications of structural anthropometric data in design?

- **Functional body dimension**

- Measure the body dimensions of subjects in **dynamic positions**.
- Measure the movement of a body part with respect to a fixed reference point.
- Example : maximum forward reach of standing subjects.
- What are the applications of functional anthropometric data in design?

Measurement tools

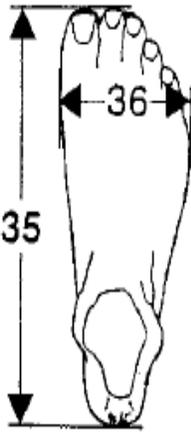
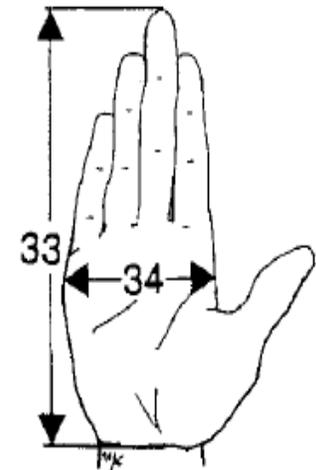
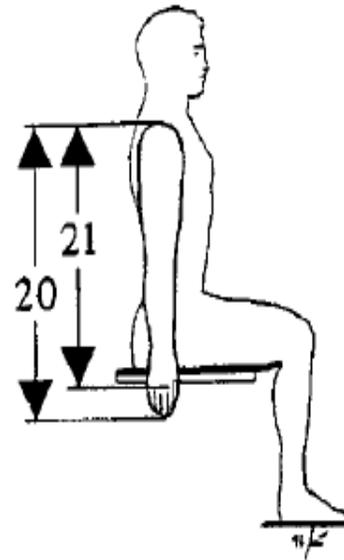
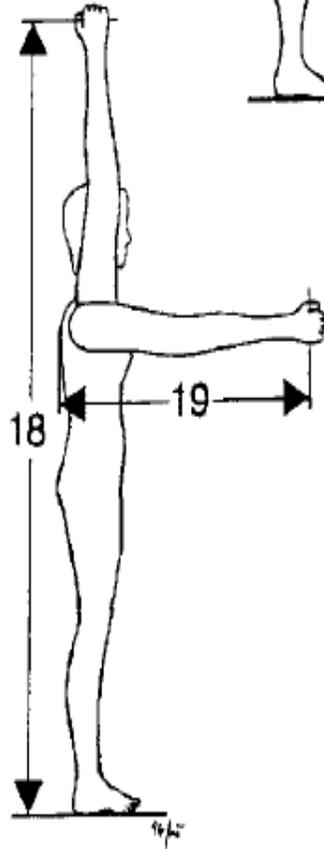
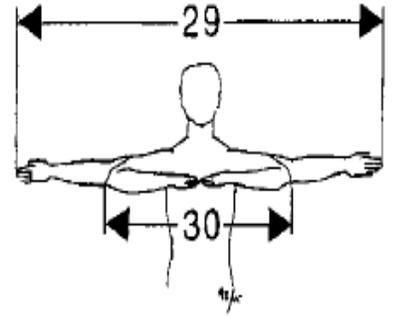
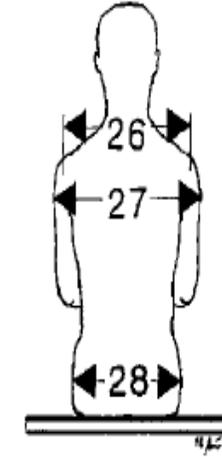
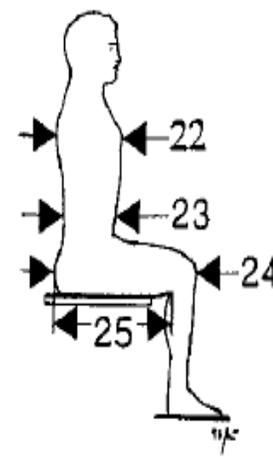
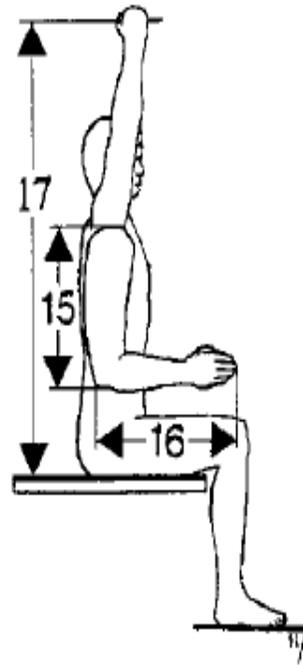
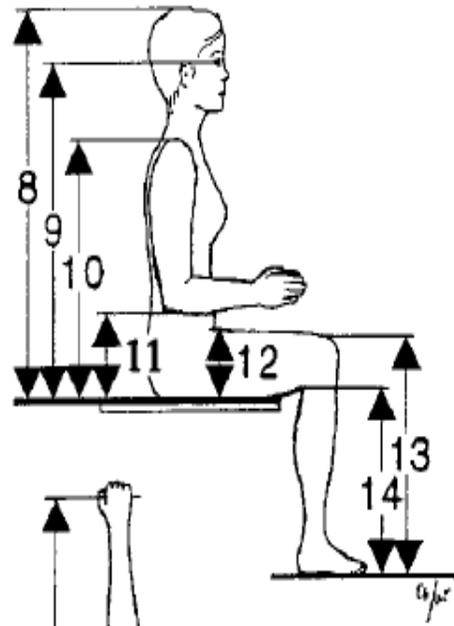
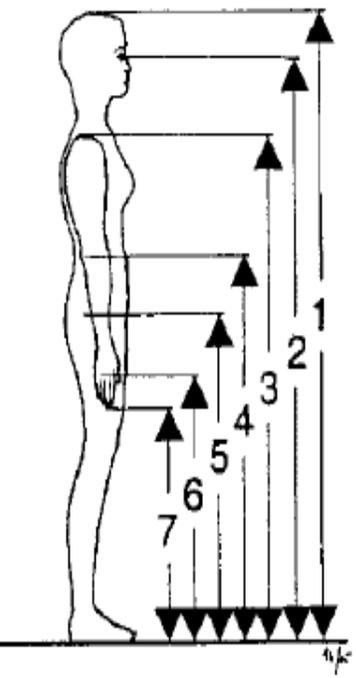
- Spreading and sliding calipers
- Anthropometer
- Segmometer
- Head board
- Anthropometric Tape



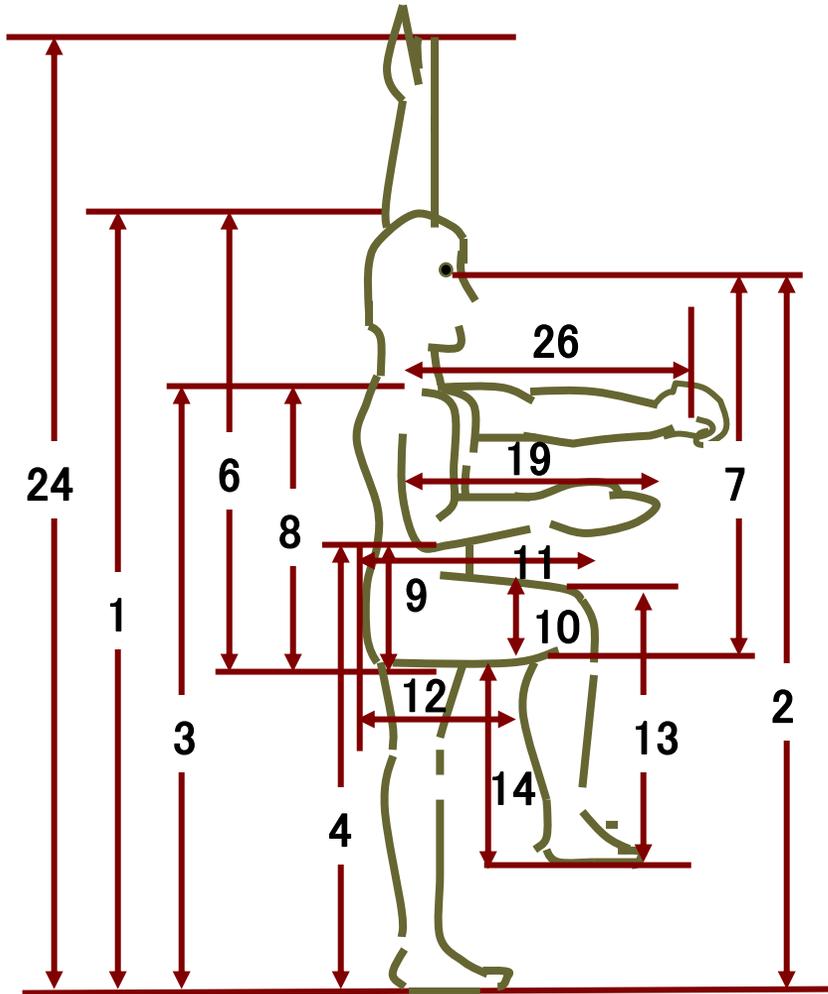
Body Dimensions in Anthropometry

Author	Book	Measurement
Kroemer et.al (1997)	Engineering Physiology Bases of Human Factors/Ergonomics	Body : 36 dimensions
Pheasant & Haslegrave (2006)	Body Space: Anthropometry, Ergonomics, and the Design of Work	Body : 36 dimensions
Wignjosoebroto (2008)	Ergonomi, Studi Gerak dan Waktu	Body : 26 dimensions Hand : 20 dimensions Head : 14 dimensions
Nurtjahyo (2012)	Technical Note : Anthropometric Study using Anthroscan	Body : 54 dimensions

Kroemer et.al (1997)



Wignjosoebroto (2008)



1	Tinggi tubuh posisi berdiri tegak (stature height, standing)	13	Tinggi lutut (knee height, sitting)
2	Tinggi mata (eye height)	14	Tinggi lipat lutut (popliteal height)
3	Tinggi bahu (shoulder height, standing)	15	Lebar Bahu (biacromial breadth)#
4	Tinggi siku (elbow height, standing)	16	Lebar panggul (Hip breadth, sitting)
5	Tinggi genggam tangan pada posisi rileks ke bawah (knuckle height-normal)#	17	Tebal dada (chest depth)#
6	Tinggi badan pada posisi duduk (sitting height)	18	Tebal perut (abdominal depth)#
7	Tinggi mata pada posisi duduk (eye height, sitting)	19	Jarak ujung siku ke ujung jari (elbow-thumb tip length)
8	Tinggi bahu pada posisi duduk (shoulder height, sitting)	20	Lebar kepala (head breadth)#
9	Tinggi siku pada posisi duduk (elbow rest height, sitting)	21	Panjang tangan (hand length)#
10	Tebal paha (thigh clearance, sitting)	22	Lebar tangan (hand breadth)#
11	Jarak dari pantat ke lutut (buttock-knee length)	23	Jarak bentang dari ujung jari tangan kanan ke kiri (horizontal tip to tip hand)#
12	Jarak dari lipat lutut ke pantat (buttock-popliteal length)	24	Tinggi pegangan tangan pada posisi tangan vertikal keatas, berdiri (vertical reach)
		25	Tinggi pegangan tangan pada posisi tangan vertikal keatas, duduk #
		26	Jarak genggam tangan ke punggung (grip reach)

How to get and use the anthropometric data ?

Preparation

- Sample of objects (By age? By ethnic? By job?)
- Measurement tools
- Recording table

Measurement

- Read the instructions carefully!
- Person who measure should be understand the standard of body dimension.

Data Tabulation (1)

- Re-check the data (have followed the normal distribution or not).
- Calculate mean per dimension.
- Calculate standard deviation per dimension.

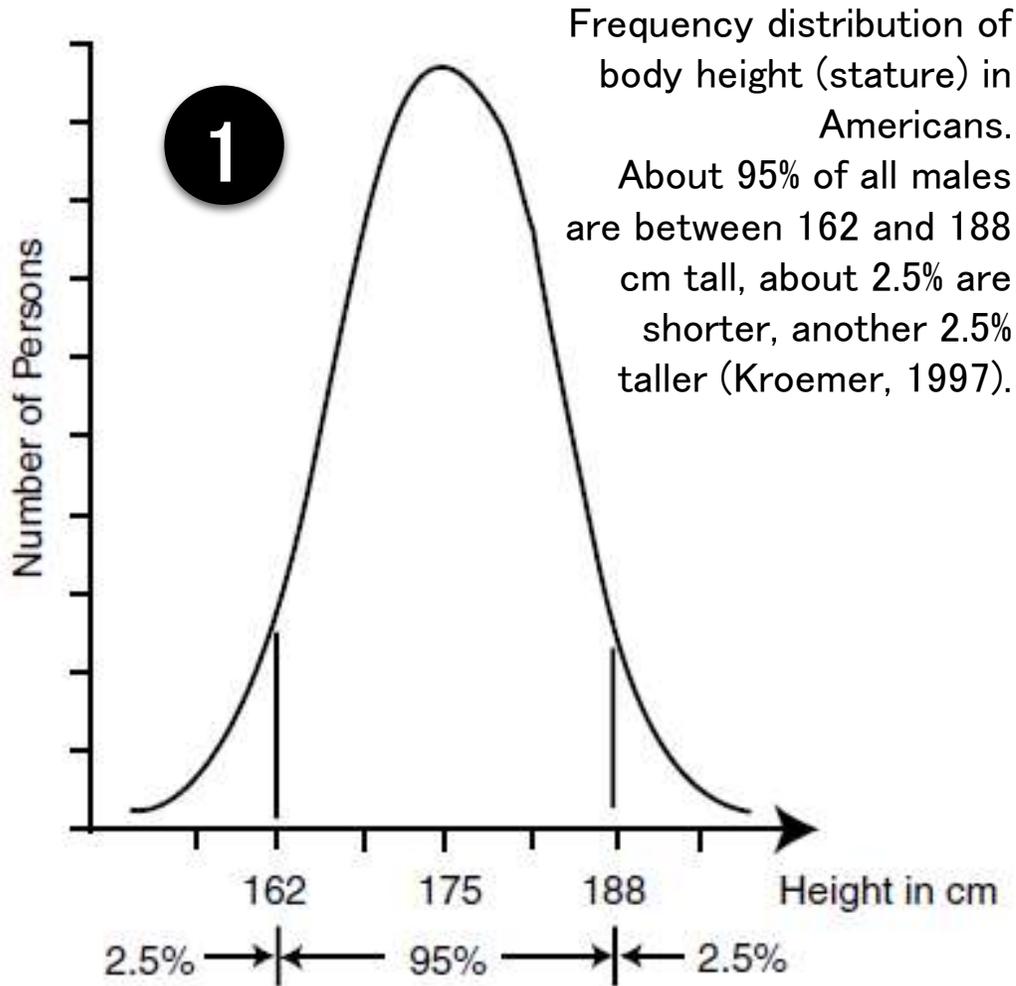
Data Tabulation (2)

- Select required percentile factor.
- Calculate data with its percentile factor.

Application to Design

- Select body dimension appropriate with product dimension.
- Add adjustment / allowance (if needed).

Data Tabulation (1-2)



2

$$\text{mean} = \bar{X} = \frac{\sum_{i=1}^n X_i}{n} \quad \text{SD} = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1}}$$

3

Percentile is a value that indicates the percentage of a group who have the same value or under.

Percentile $<50^{\text{th}}$: lower percentile

Percentile $>50^{\text{th}}$: upper percentile

Percentile	Factor
1 st	- 2,32
2,5 th	- 1,96
5 th	- 1,64
10 th	- 1,28
50 th	0
90 th	1,28
95 th	1,64
97,5 th	1,96
99 th	2,32

Percentile	Tabulation
1 st	X - 2,32 SD
2,5 th	X - 1,96 SD
5 th	X - 1,64 SD
10 th	X - 1,28 SD
50 th	X
90 th	X + 1,28 SD
95 th	X + 1,64 SD
97,5 th	X + 1,96 SD
99 th	X + 2,32 SD

Case Study :

Dari hasil pengukuran tubuh manusia Indonesia (dewasa, laki-laki, usia 19 – 40 tahun) diperoleh data yang berdistribusi normal dengan tinggi rata-rata 170 cm dgn standar deviasi 7 cm. Berapakah ukuran 95th dan 5th percentile?

95th percentile :

$$= X + 1,64 \text{ SD}$$

$$= 170 + 1,64 (7)$$

$$= 182 \text{ cm}$$

5th percentile

$$= X - 1,64 \text{ SD}$$

$$= 170 - 1,645 (7)$$

$$= 159 \text{ cm}$$

What is the meaning of the results?



The Story of Lacy and Andrew

Does one size fit all?

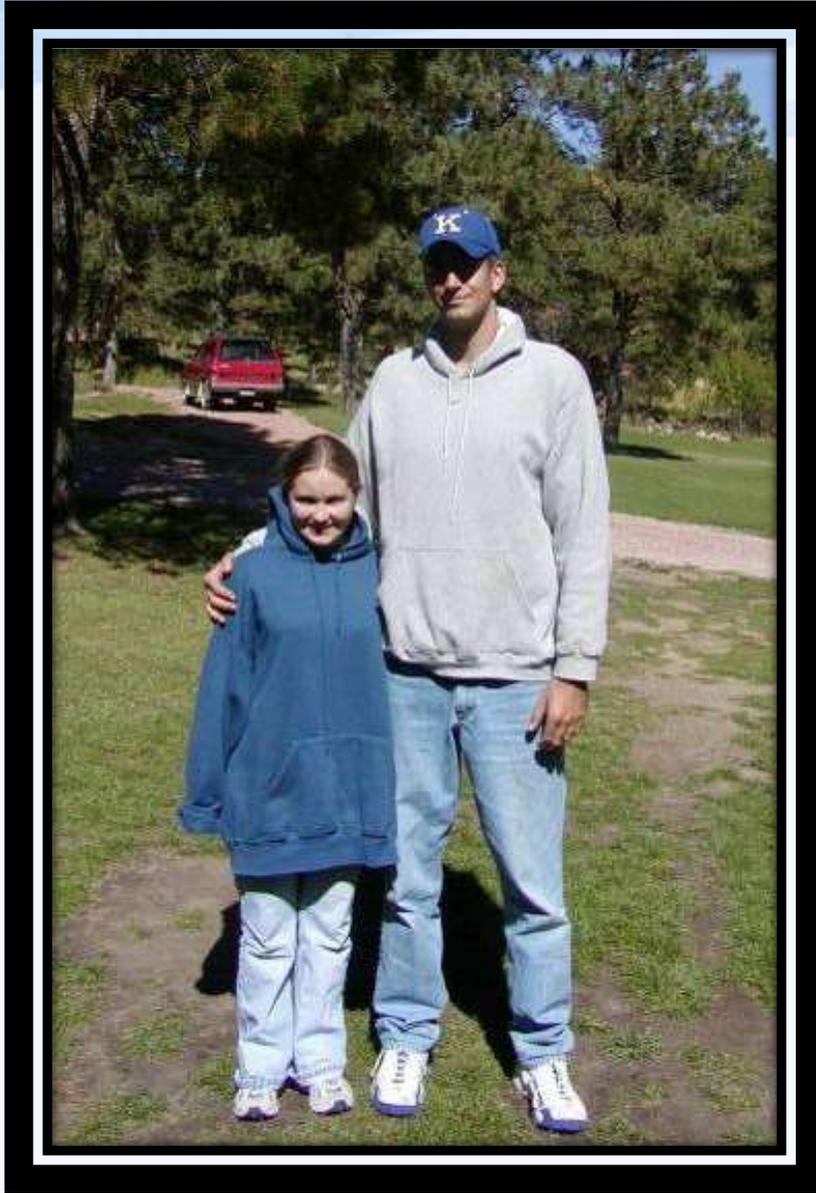
Lacy is 4' 10" (147 cm)

Andrew is 6' 10" (208 cm)









*Love conquers all –
even anthropometry!*





Thank you...

**Have an enjoy study and
see you next week...**