

ARCH114-Human and Socio-Cultural Factors in Design

L.3



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Human Dimension: Anthropometrics

1. History of
Anthropometry
Studies

2. Capabilities
of Human Body

2.1
Thermal Comfort

2.2
Lighting

2.3
Sound Control

3. Human
Dimensions and
Space Requirements

Built environment is expected to provide certain levels of bodily comfort.

There are **differences in perception** of how comfortable the environment should be. Some people demand high levels of comfort, others believe that this is decadent. This depends on **expectations and habituation levels**.

Usually **we are unaware of being comfortable**. We are more aware when **we feel uncomfortable**.

Like when the environment is subjectively too hot or too cold, or smelly or noisy.



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HUMAN DIMENSION:
ANTHROPOMETRICS

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Although designing for human comfort seems a **fundamental goal of designers**, people are prepared to quit claim bodily comfort to attain other design goals.



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The chairs by Mies van der Rohe are a symbol of elegance and good taste but they are exceedingly difficult to get into and out, and they are not particularly comfortable for a seated person.

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Most buildings were built to cover users activities and needs.

Buildings should function in such a way that anybody can realize that the designed space is suitable place for such activities.



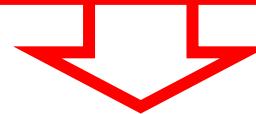
Architecture is about space and people. To design a successful architectural building, designer should be aware of the link between space and inhabitants of that space.



The link has to be established in many ways such as physical, psychological, emotional and etc.

Physical link related to physical comfort and the needs of users. All outdoor and indoor related spaces should fulfill users needs.

Although designing for human comfort seems a fundamental goal of design, designers sometimes just try to attain other design goals such as aesthetics.



The other example is in Chandigarh, India. The buildings are set in large open spaces for symbolic reasons.

Getting from one to another is difficult especially in summer. Even though the technology and resources were available to build buildings that afford greater bodily comfort.

**Anthropometry is the science that studies on
human physical dimensions, capabilities,
and limitations.**

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The term is originated from Greek:

HUMAN DIMENSION:
ANTHROPOMETRICS



anthropos
“human”

+



metron
"measure"

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The science of anthropometrics uses data on **human dimensions and ranges of motion** (how far various body parts can move).

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HUMAN DIMENSION:
ANTHROPOMETRICS



Researchers usually measure subjects from a particular group (older, adult, females), then calculate the averages.

They also study differences between groups (e.g., comparing young women to very old ones).

For the environment and behavior fit, it must be remembered that the **physiological capabilities of people differ from each other.**

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HUMAN DIMENSION:
ANTHROPOMETRICS

From infancy to adulthood and elderly, physiological capabilities changes all the time.

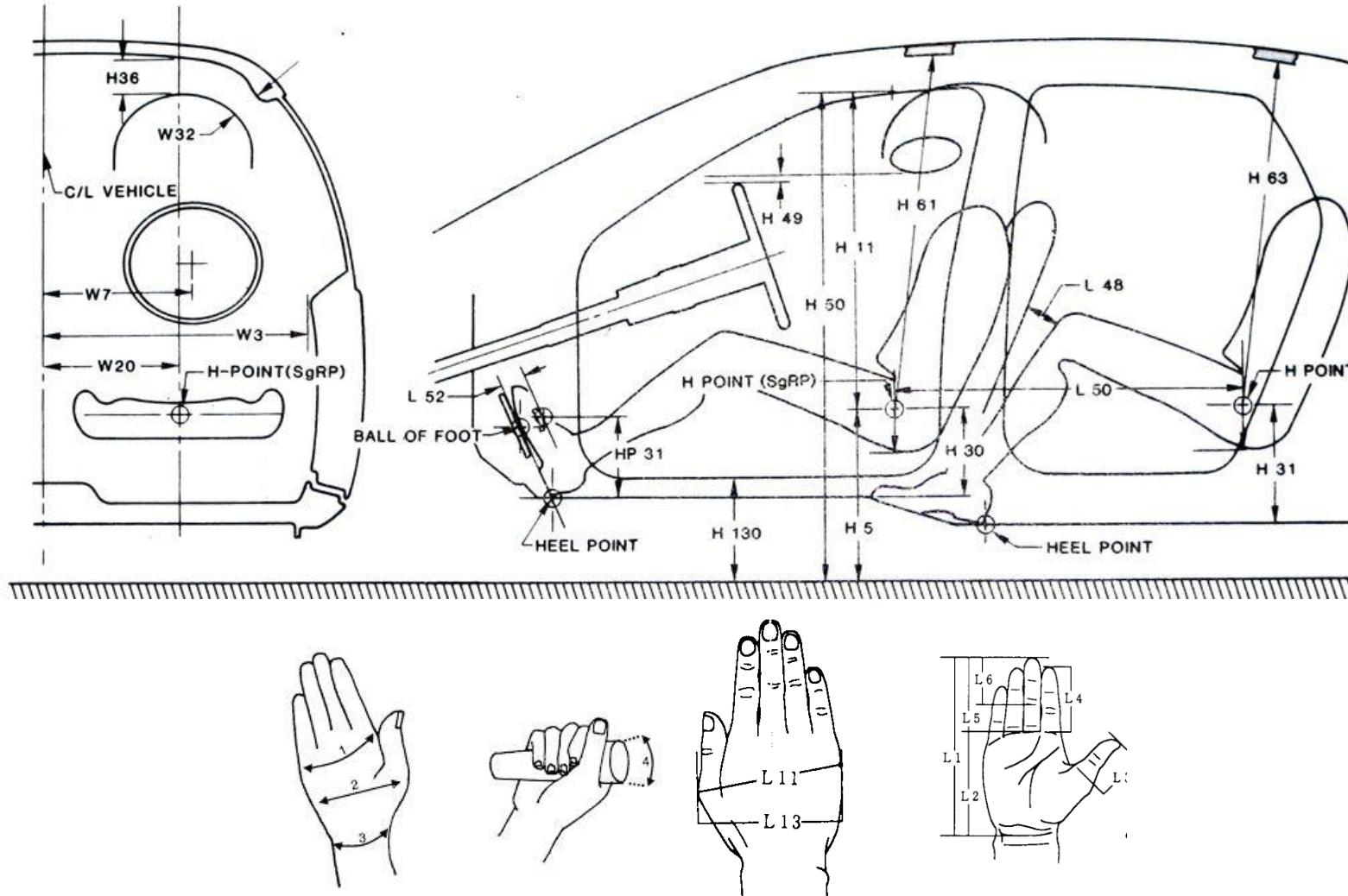
Physiological capabilities also vary by gender and race.

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The anthropometric assessments could include highly complex systems, such as a manned space vehicle or simple equipment.

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HUMAN DIMENSION:
ANTHROPOMETRICS



Different User Groups: Different user groups have different needs and use patterns.

Age

Sex

Race

Occupational Groups

Socioeconomic Factors

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HUMAN DIMENSION:
ANTHROPOMETRICS



The physiological capabilities of people differ. They go through rapid change from infancy to adulthood (**age**) and they vary in **gender**.

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The **statistical sizes** vary with age the average height for an elderly person would be up to 80mm lower than that for a younger person.

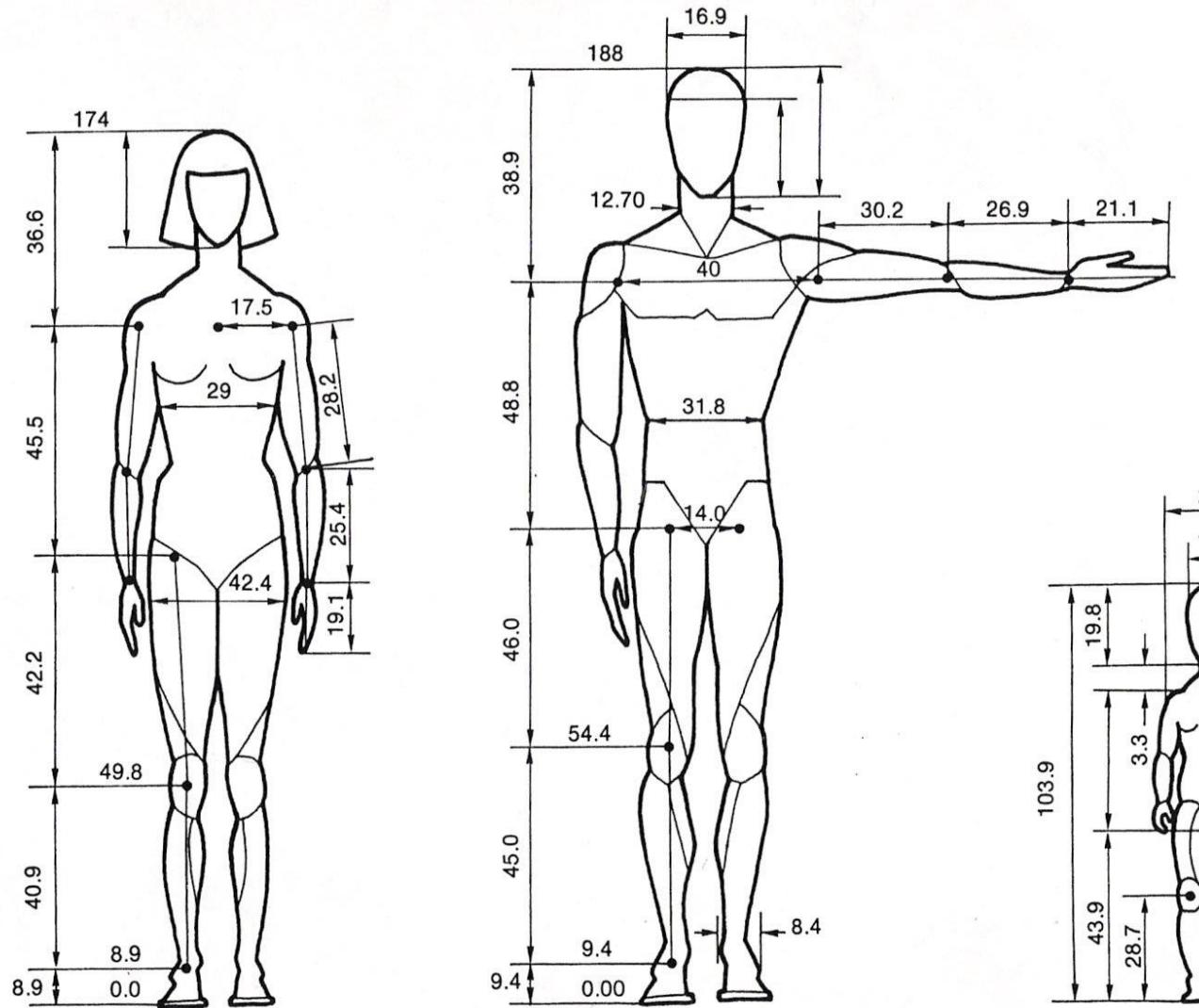
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HUMAN DIMENSION:
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Human physical dimensions, capabilities, and limitations vary by **age**.

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Human physical dimensions, capabilities, and limitations vary by **gender**.

Gender – based study over time

Over time the average sizes of people change.

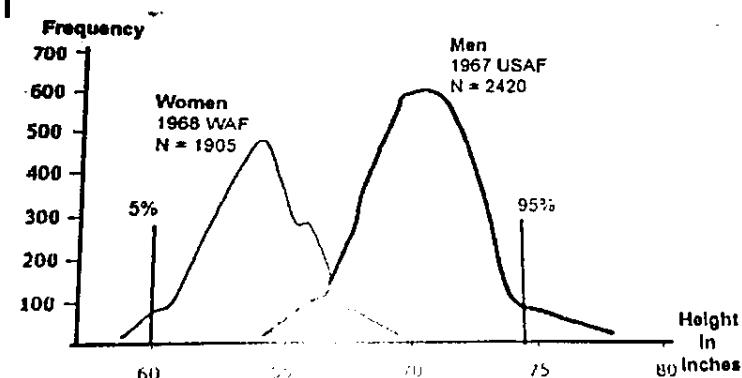
MALE			FEMALE		
1981	BODY COMPOSITION	2007-2009	1981	BODY COMPOSITION	2007-2009
173.0 cm (5'8")	Height	175.3 cm (5'9")	161.5 cm (5'4")	Height	162.3 cm (5'4")
77.4 kg (171 pounds)	Weight	86.6 kg (191 pounds)*	63.2 kg (139 pounds)	Weight	68.4 kg (151 pounds)*
25.7 kg/m ² - overweight	Body mass index	27.9 kg/m ² * - overweight	24.1 kg/m ² - normal weight	Body mass index	25.8 kg/m ² * - overweight
90.6 cm (35.7") - low risk	Waist circumference	97.0 cm (38.2")* - increased risk	76.3 cm (30.0") - low risk	Waist circumference	83.4 cm (32.8")* - increased risk
99.0 cm (39.0")	Hip circumference	102.7 cm (40.4")*	98.5 cm (38.8")	Hip circumference	102.5 cm (40.4")*
0.91	Waist-to-hip ratio	0.95*	0.77	Waist-to-hip ratio	0.81*
FITNESS TESTS			FITNESS TESTS		
104 kg - very good	Grip strength	94 kg* - good	62 kg - very good	Grip strength	56 kg* - good
23.1 cm - fair	Sit-and-reach	26.7 cm* - good	30.2 cm - good	Sit-and-reach	31.5 cm - good
-	Predicted maximal aerobic power (VO ₂ max)	39.2 ml·(kg·min) ⁻¹ - good	-	Predicted maximal aerobic power (VO ₂ max)	32.8 ml·(kg·min) ⁻¹ - good

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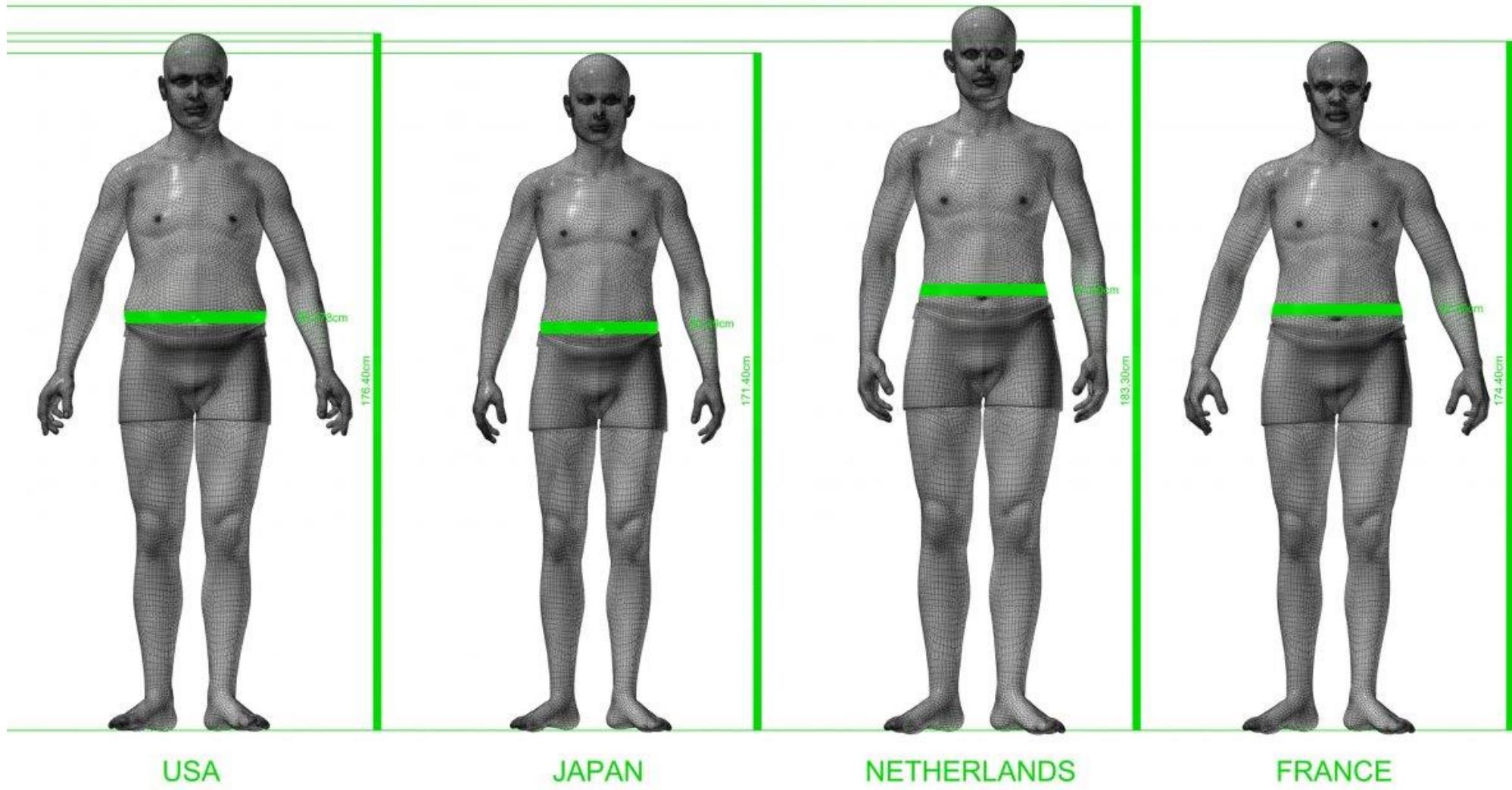
The expression “**to design for the 5 percentile female and 95 percentile male**” . This means that for the selected anthropometric measure such as height, the lower limit of our range is the height of a 5th percentile female and the upper limit is the height of 95th percentile

This range accommodates 90% of the population for that one selected measure.



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HUMAN DIMENSION:
ANTHROPOMETRICS



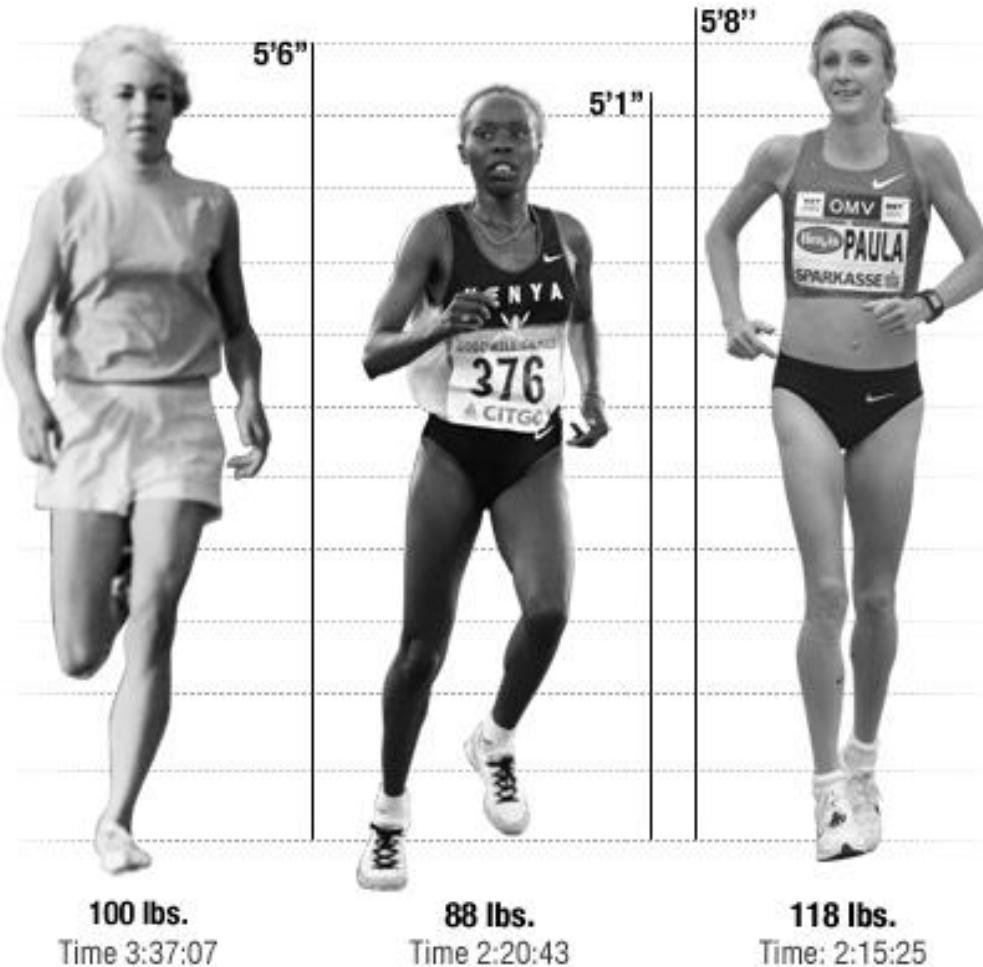
Human physical dimensions, capabilities, and limitations vary by **race**.

The Athletes

1963

1998

2003



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HUMAN DIMENSION: ANTHROPOMETRICS

Human physical dimensions, capabilities, and limitations vary by **profession**.

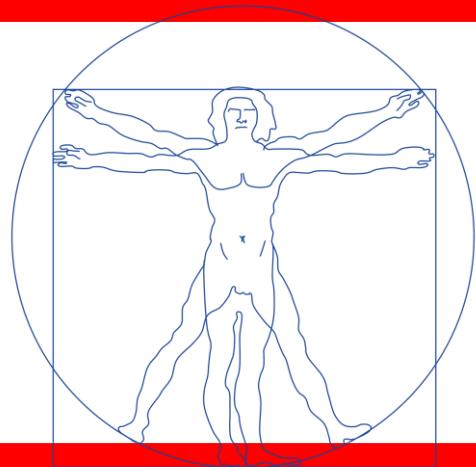
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- The science of anthropometrics uses data on human dimensions and ranges of **motion** (how far various body parts can move).
- Researchers usually measure subjects from a particular group (older, adult ,females), then calculate the **averages**.
- They also study **differences** between groups (e.g., comparing young women to very old ones)

There are two basic types of human body dimensions:

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Structural (static)



Functional (dynamic)

Include measurements of head, torso, and limbs in standard positions.

... is concerned with the basic dimension of human body Skeletal dimensions -
Doesn't include clothing

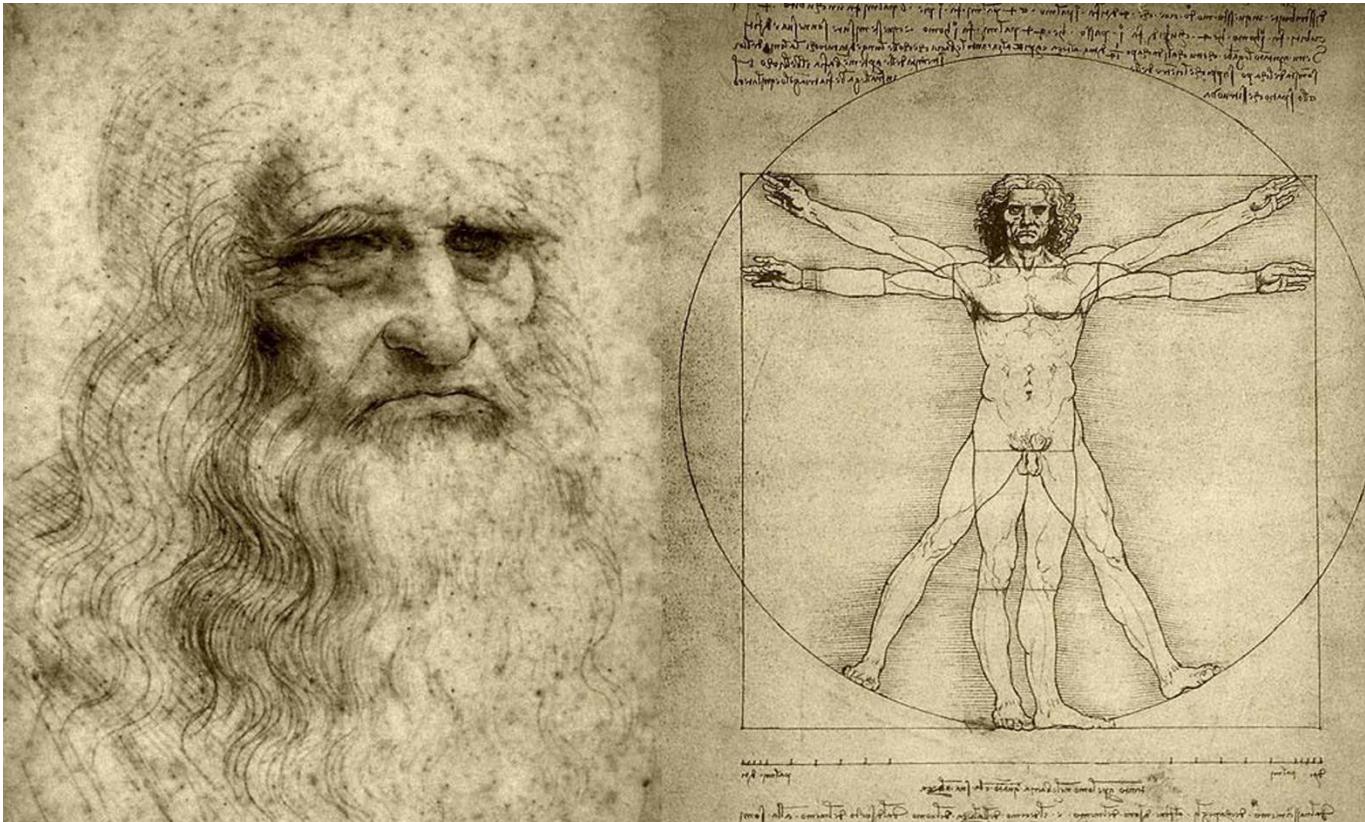
Measurements taken in working positions or during movements associated with certain tasks.

....is concerned with the capabilities of human body in doing such things.
Distances are measured when the body is in motion or engaged in a physical activity

HUMAN DIMENSION:
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1. History of Anthropometry Studies



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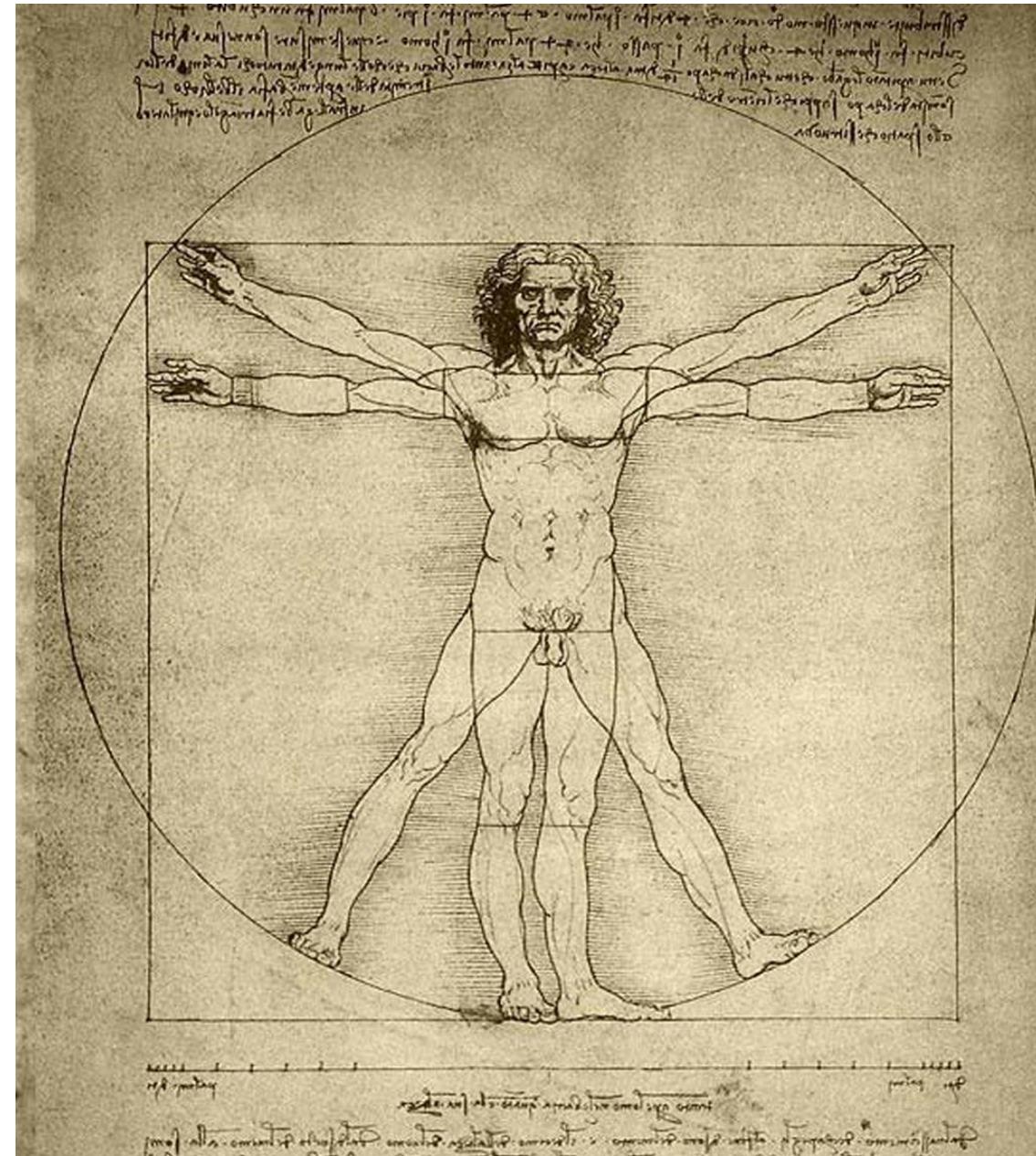
The **Vitruvian man** by **Leonardo da Vinci** is the earliest examples of anthropometry studies.

1. History of Anthropometry Studies

The Vitruvian Man is translated from Italian to English as "The proportions of the human body according to Vitruvius".

Vitruvius was a Roman architect (and author, civil & military engineer) who discussed about perfect proportion in architecture.

Vitruvius's studies influenced Da Vinci to discover the rules of proportions between the parts of the human body.



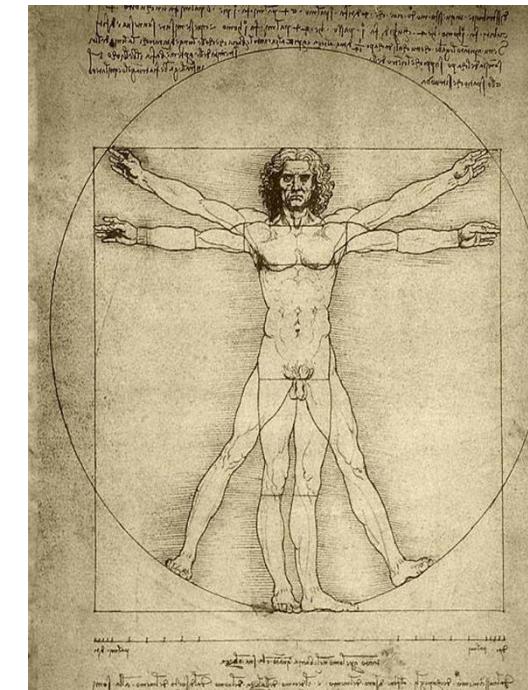
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1. History of Anthropometry Studies

The drawing, which is in pen and ink on paper, depicts a male figure in two superimposed positions with his arms and legs apart and simultaneously inscribed in a circle and square.



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HUMAN DIMENSION:
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Study of arms and hands another drawing by Leonardo da Vinci.



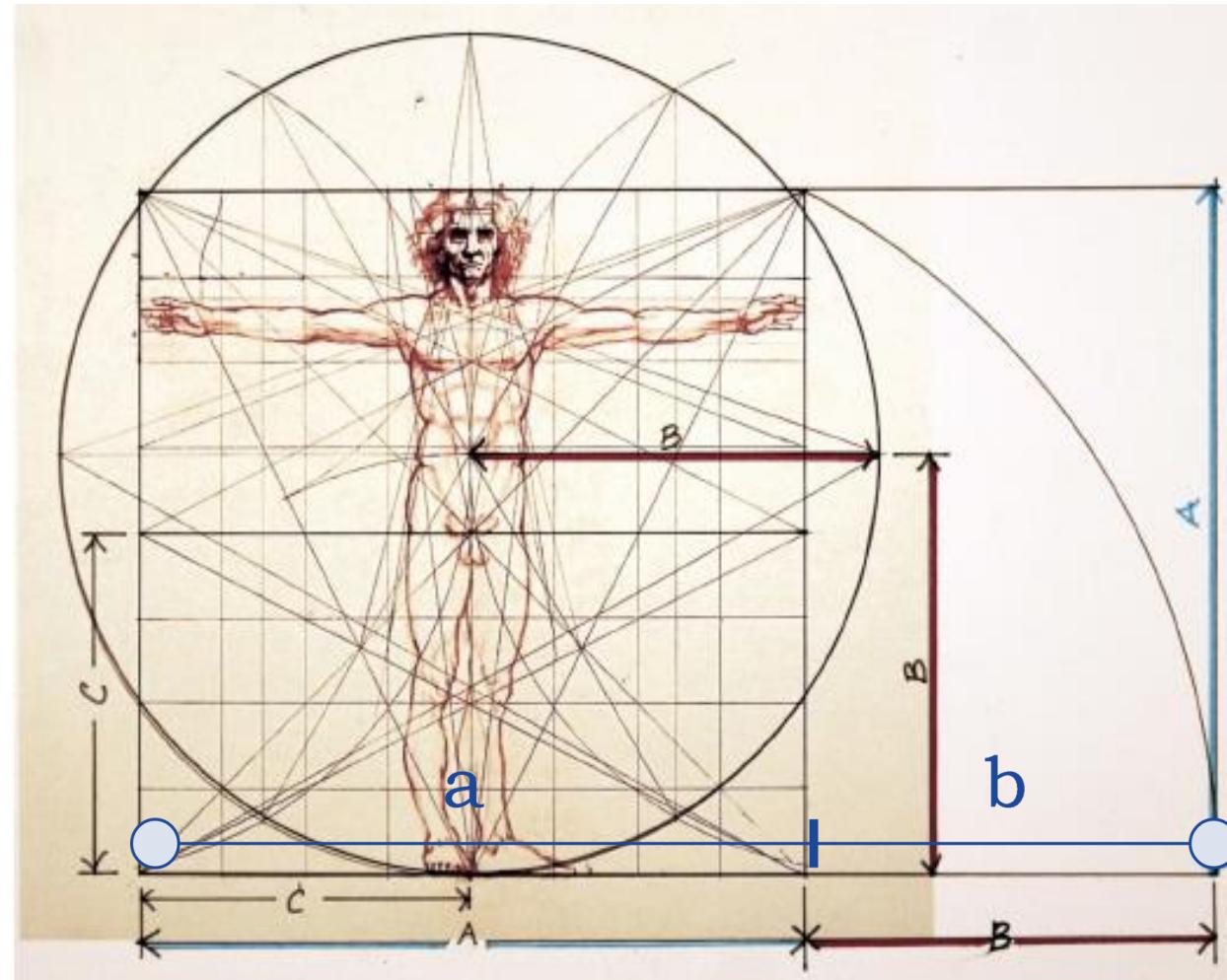
The oldest known code of dimensional relationships of man were found in burial chamber of pyramids near Memphis.

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1. History of Anthropometry Studies

Da Vinci believed that the ideal human proportions were determined by the harmonious proportions that he believed governed the universe

To him, the ideal man would fit cleanly into a circle as depicted in his famed drawing of Vitruvian man.



$$\frac{a+b}{a} = \frac{a}{b} \sim 1.618$$

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HUMAN DIMENSION:
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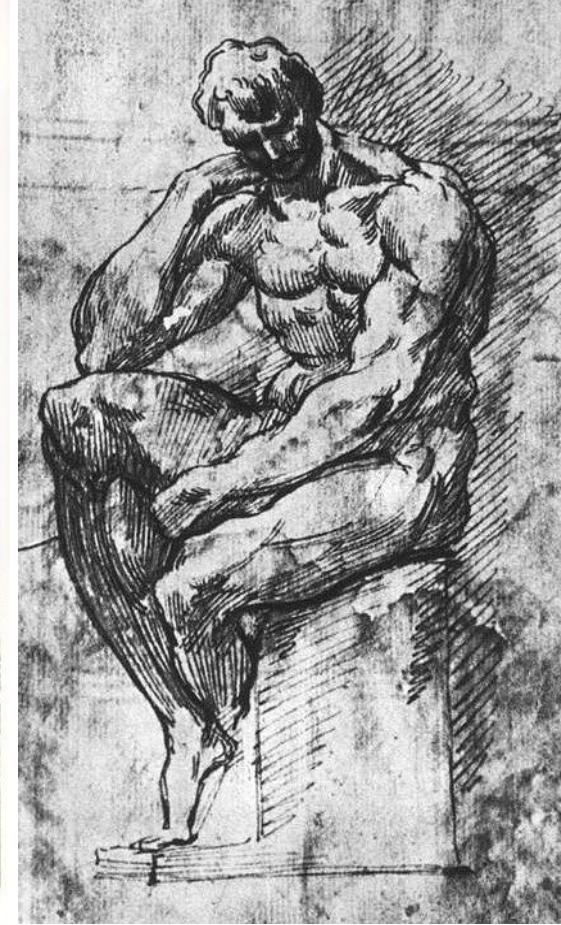
1. History of Anthropometry Studies

Leonardo da Vinci



Born: April 15, 1452, Italy
Died: May 2, 1519, France

Michelangelo



Born: March 6, 1475, Italy
Died: February 18, 1564, Italy

Albrecht Durer



Born: May 21, 1471, Germany
Died: April 6, 1528, Germany

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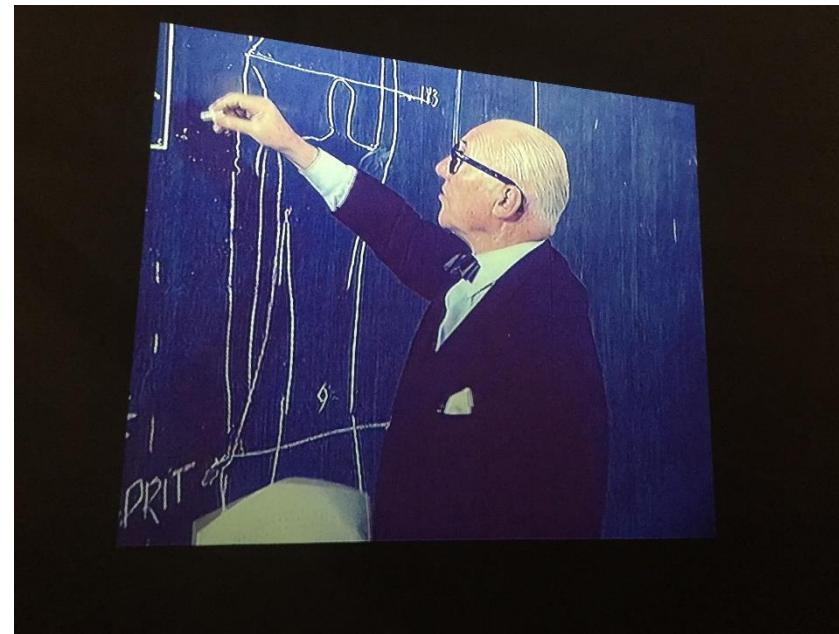
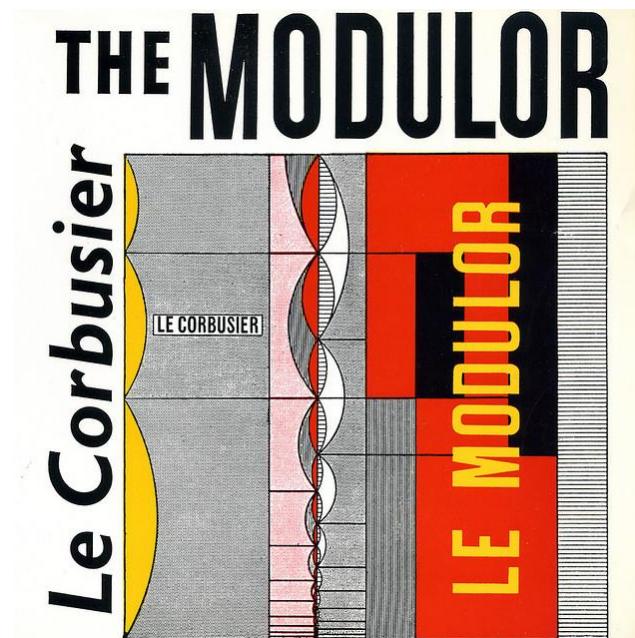
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ANTHROPOMETRICS

Adolf Zeising (1810-1876, Germany): extended his research to the skeletons of animals and the branching of their veins and nerves, to the proportions of chemical compounds and the geometry of crystals, even to the use of proportion in artistic endeavors.

1. History of Anthropometry Studies

Like Da Vinci, **Le Corbusier** also searched for harmonic proportions of human body that were an appropriate means of design.

He dedicates a whole chapter in his book named '**Vers une architecture**' to the theme of regulating lines and observed in his arguments prefacing this.



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HUMAN DIMENSION:
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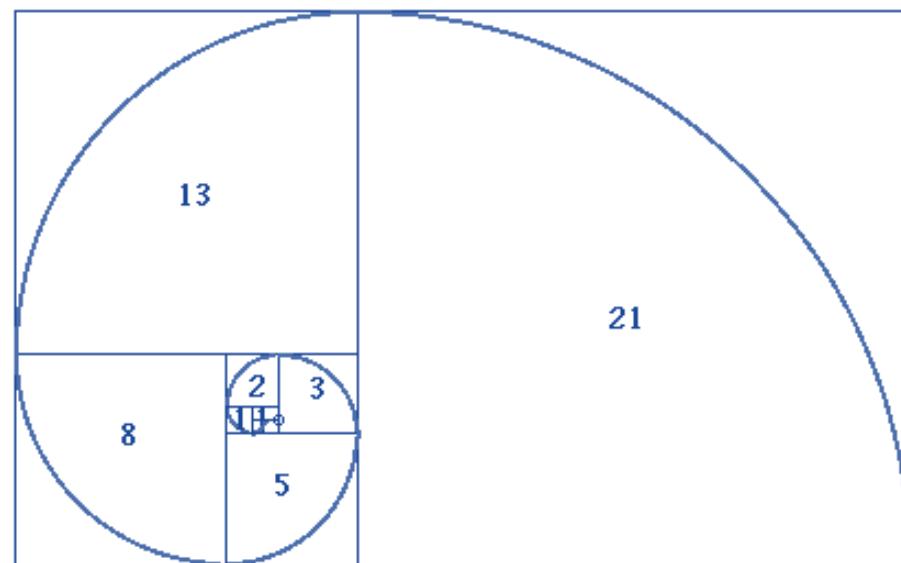
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- The Modulor was based on the **Golden Section** and on the measurements of the human body.

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HUMAN DIMENSION:
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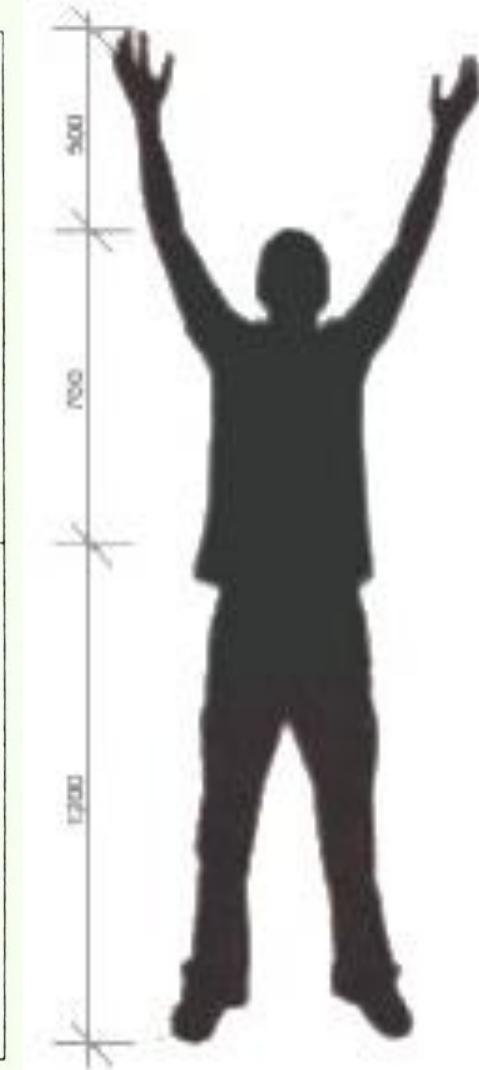
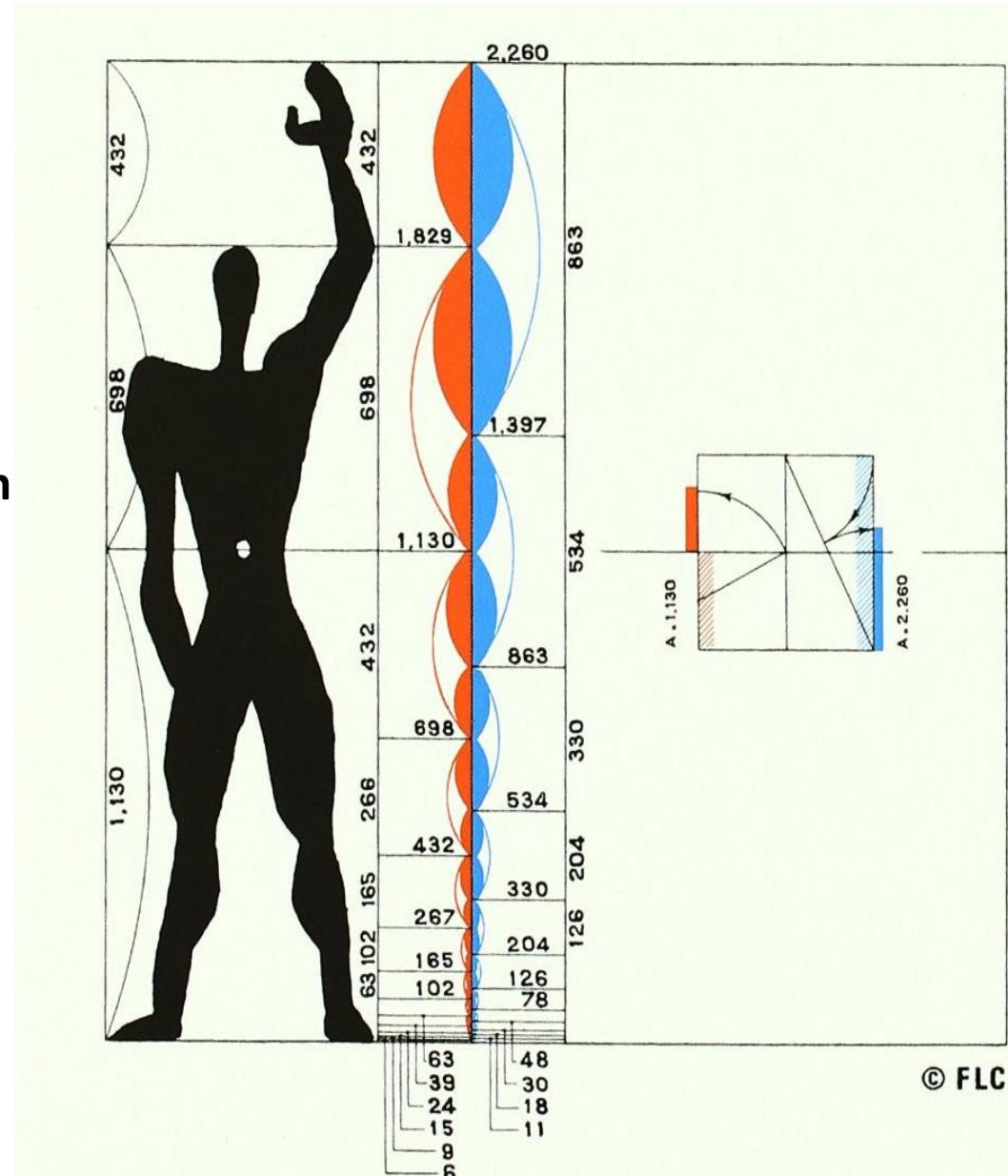
Golden section (a figure in which the relationship of the smaller part to the larger part is the same as that between the larger part and the whole).



$$\frac{a+b}{a} = \frac{a}{b} \sim 1.618$$

1. History of Anthropometry Studies

Le Corbusier took a person 6 feet (1.83 m) tall as his norm, the height of the navel being 1.13 m and that of the outstretched hand 2.26 m above the ground.



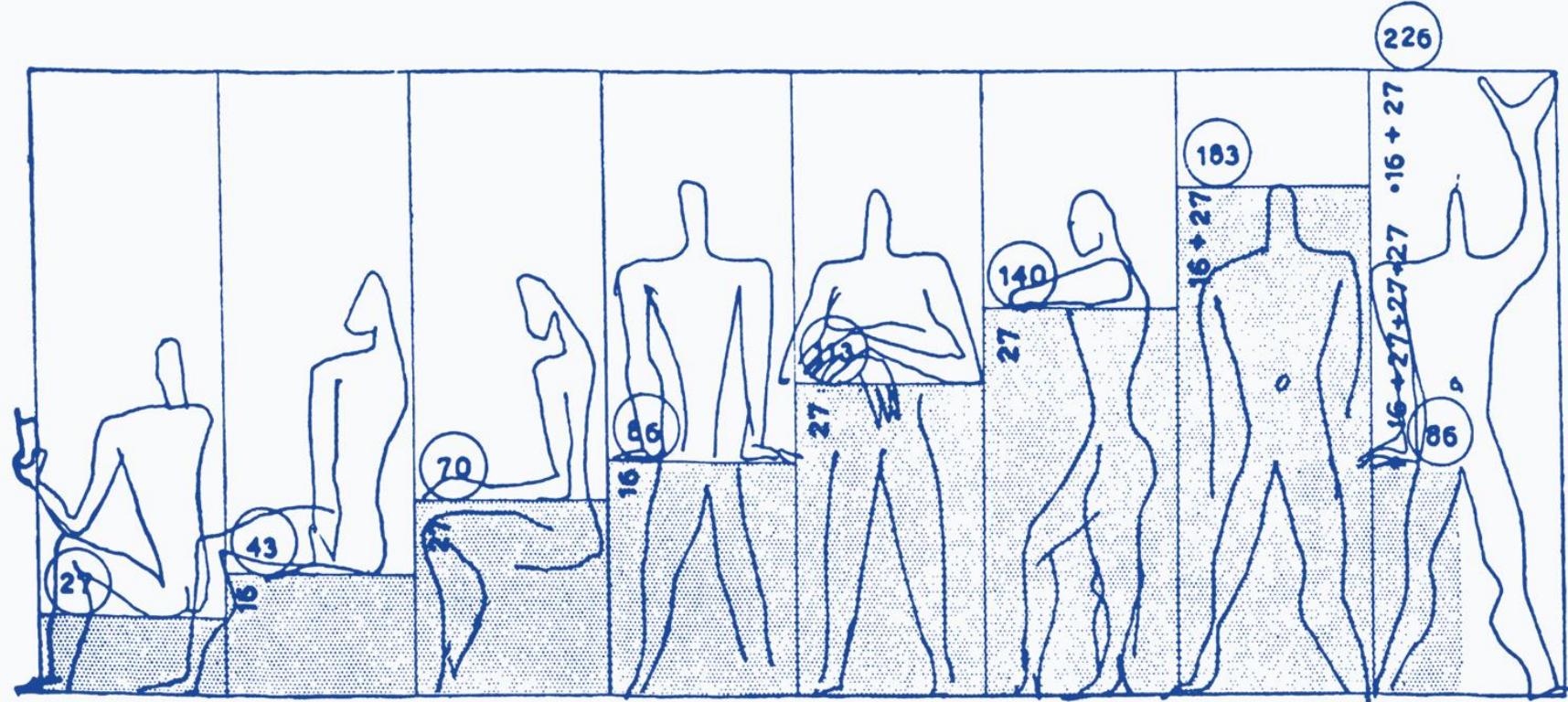
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1. History of Anthropometry Studies

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HUMAN DIMENSION:
ANTHROPOMETRICS

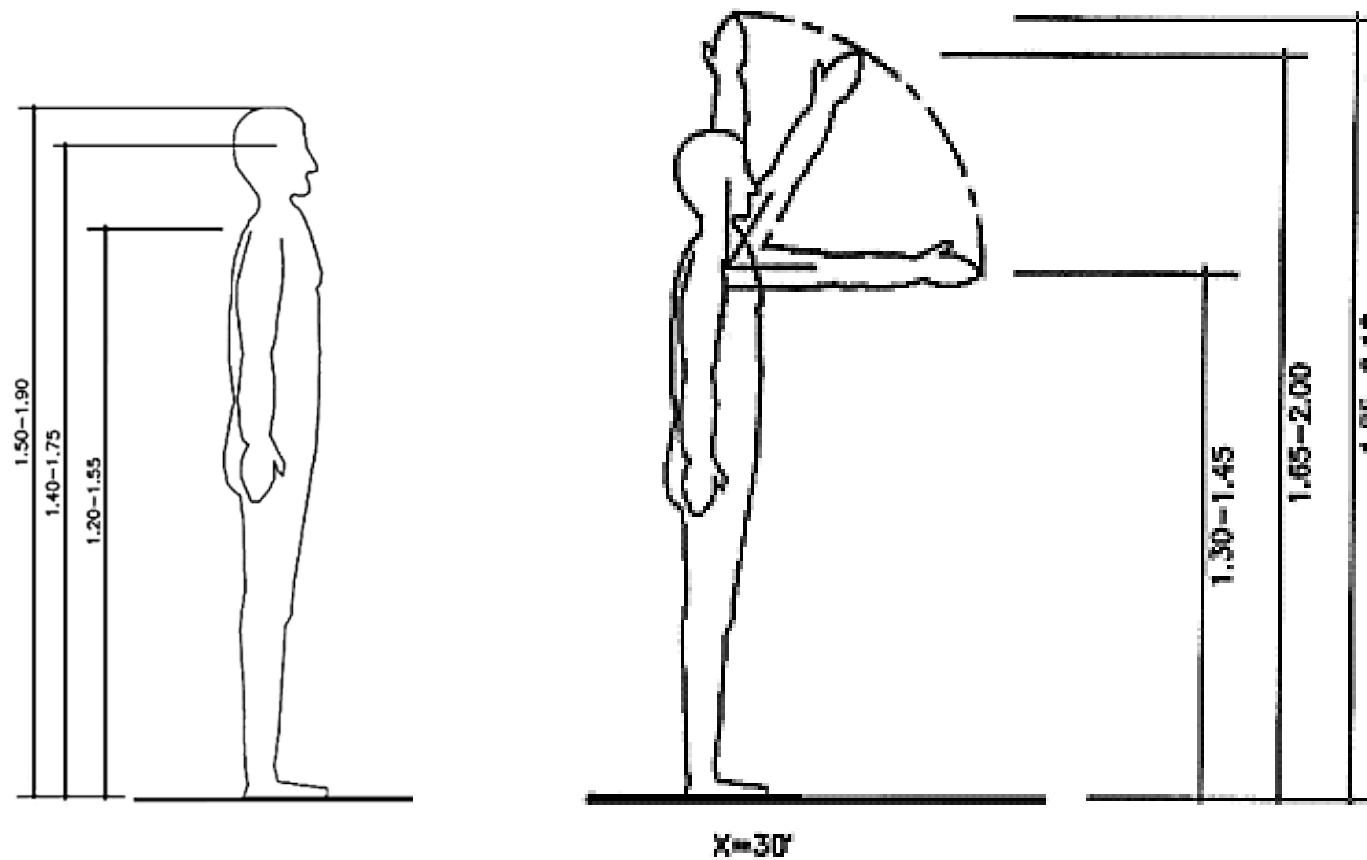


Le Corbusier developed many standards based on his studies on **human proportions**.

1. History of Anthropometry Studies

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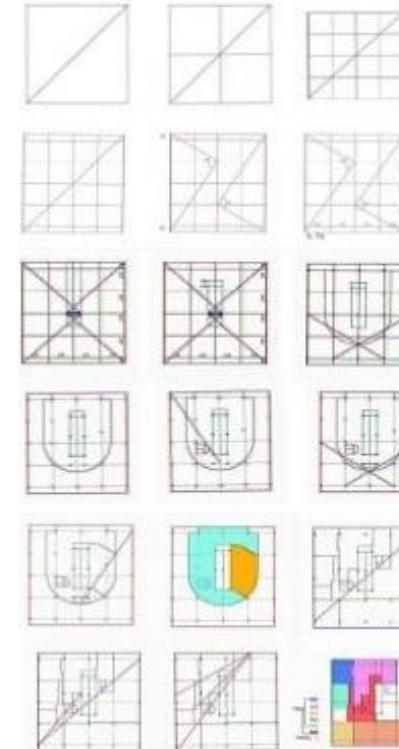
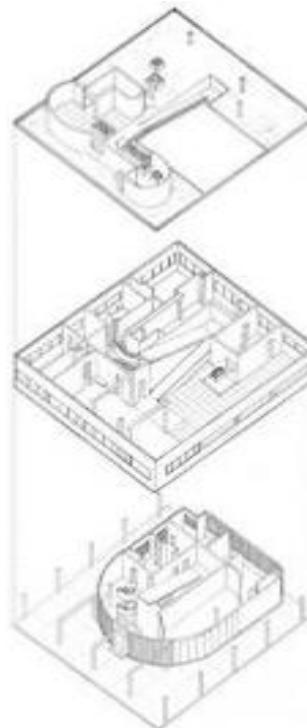
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Height	1.50 m - 1.90 m
Eye	1.40 m - 1.75 m
Shoulder	1.20 m - 1.55 m

Dimensional Data to a Normal Person

Le Corbusier's Villa Savoye



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Le Corbusier put the concept of Golden Section in the facades using baseline of 12 degrees to determine the rule of dividing the main part + the central ramp/ windows/ roadway.

1. History of
Anthropometry
Studies

Use of Golden Section in the facades at
Le Corbusier's Unité d'habitation

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As mentioned earlier anthropometry deals with human physical dimensions, capabilities, and limitations.

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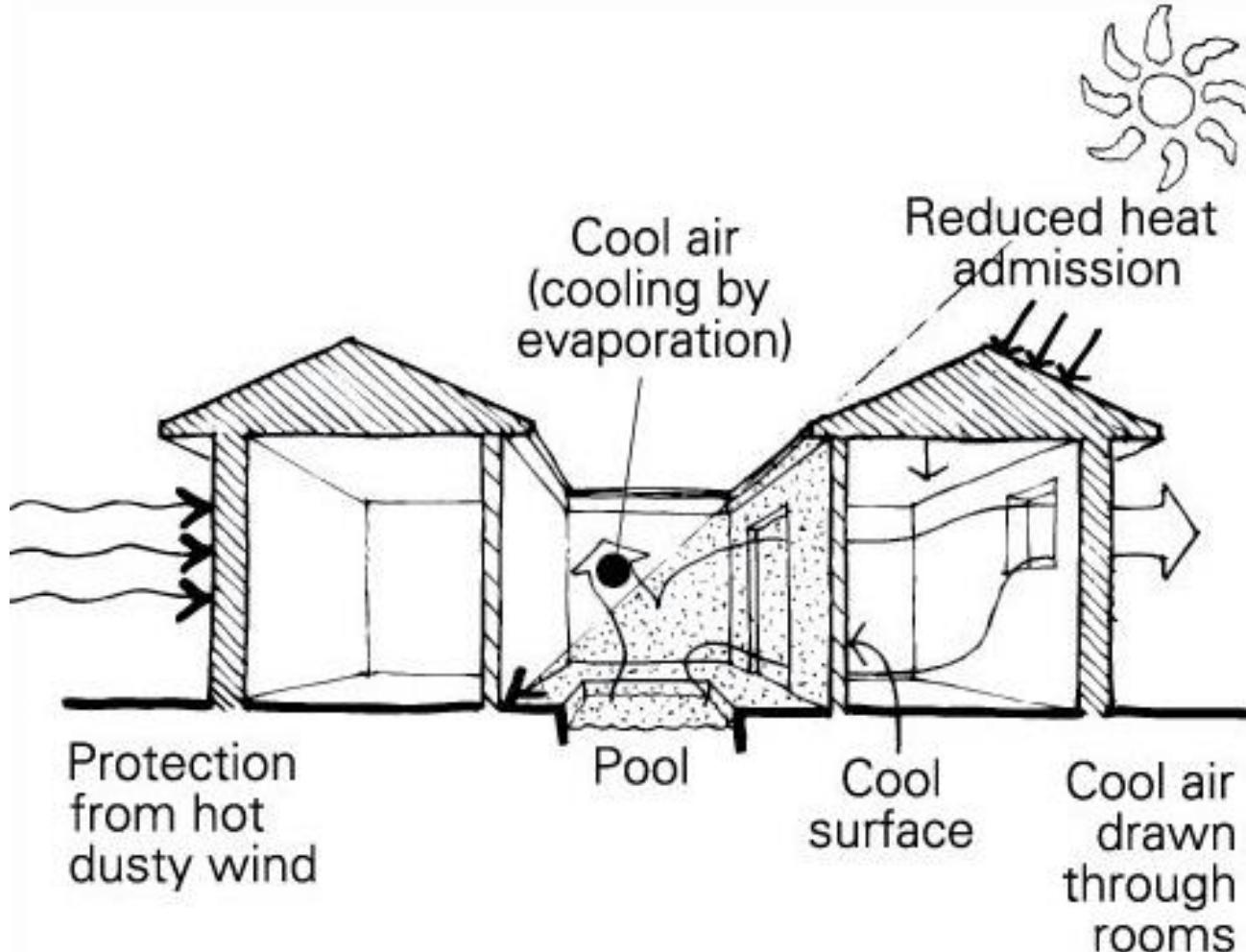
Human metabolism also have **capabilities for bodily heat** exchanges with the environment.

Comfortable temperature for an individual depends on that person's activity and clothing and on the characteristics of the person involved.

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2. Capabilities of Human Body

2.1 Thermal Comfort



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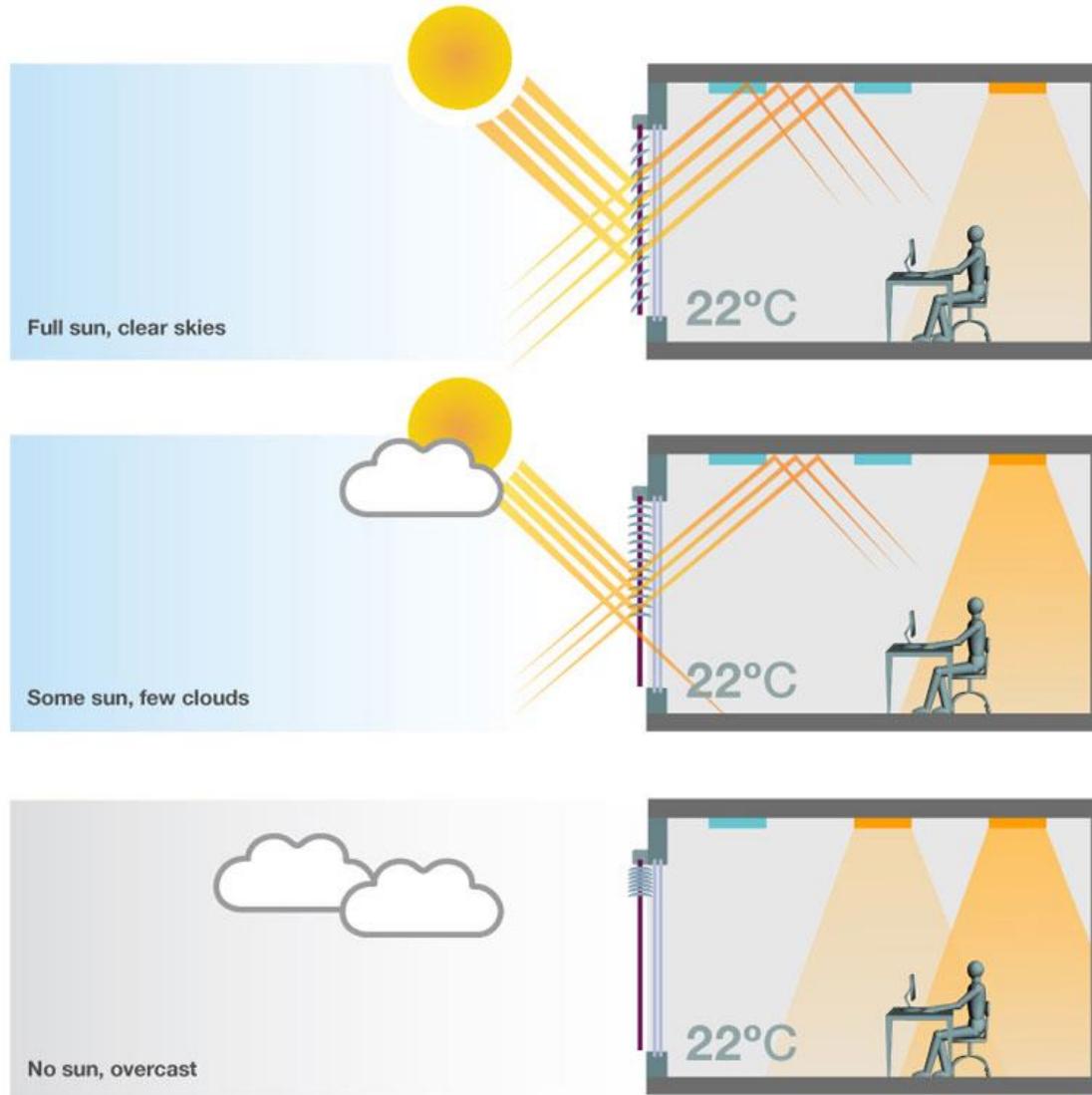
Thermal comfort can be provided in an indoor environment by the orientation of the building, location of the openings as natural ventilation.

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2. Capabilities of Human Body

2.2 Lighting

Optimization of Natural Light with Artificial Lighting



Similar to thermal comfort, **lighting** is also important for the humans.

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Lighting can be provided **natural** and **artificial** in the indoor environment.

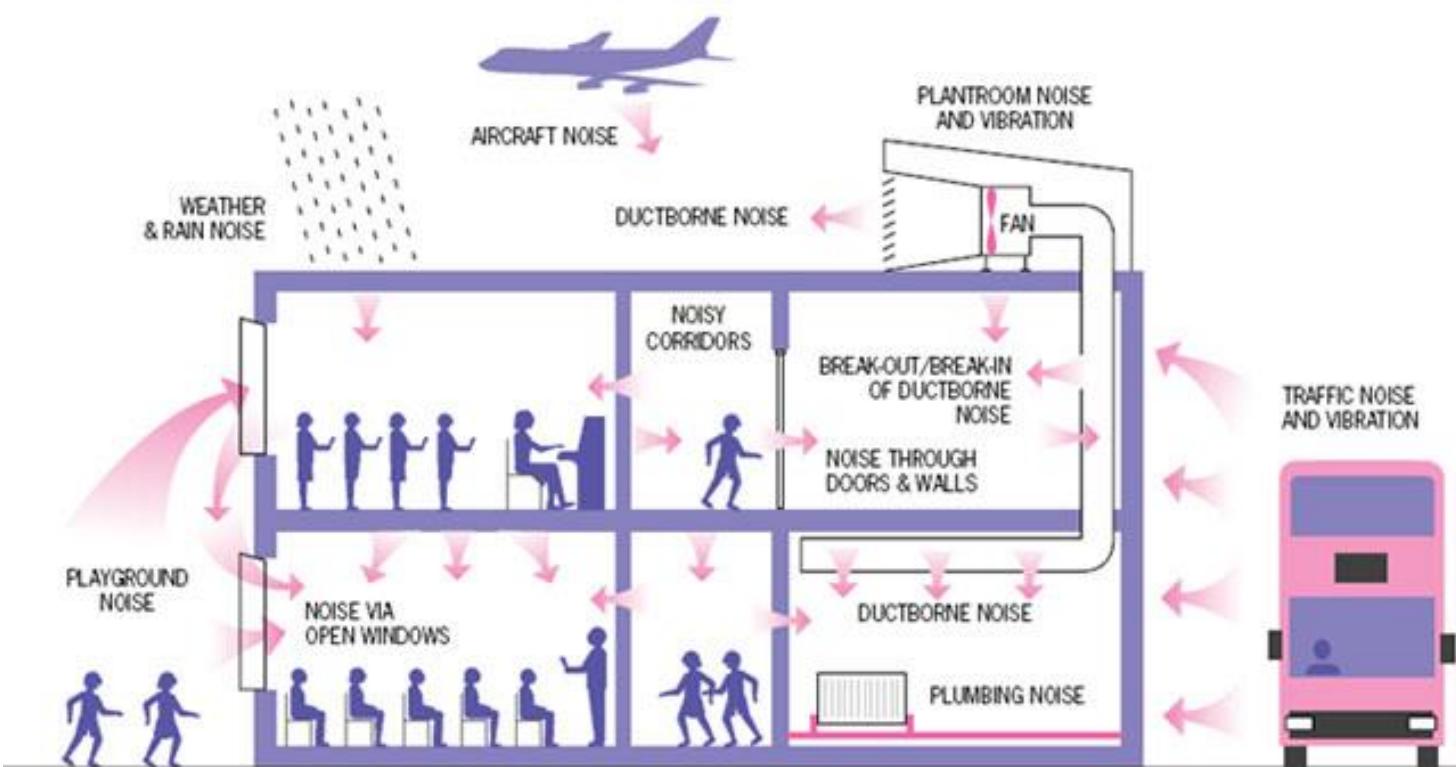
There is need to optimize natural lighting with artificial lighting during the day time.

2. Capabilities of Human Body

2.3 Sound Control

In modern living sound and noise is unavoidable.

Sound control (acoustics comfort) is very important for design since unwanted sounds disturb sleep and create anxiety.



There are many sources of noise in daily life: Aircrafts, automobiles, trains, machines, generators, house hold appliances and entertainment.

For acoustic comfort there is need for a barrier between the source and receiver.

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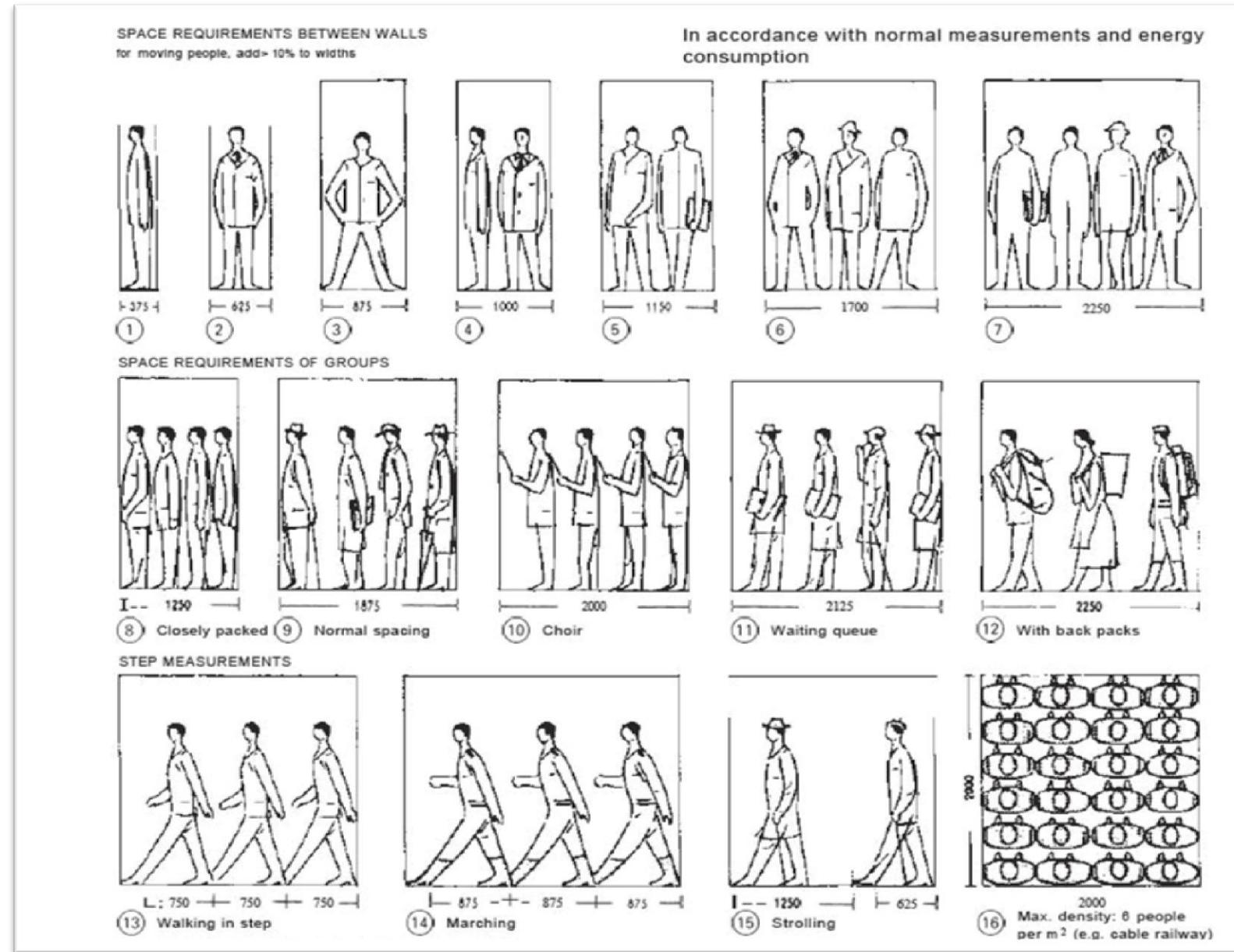
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3. Human Dimensions and Space Requirements

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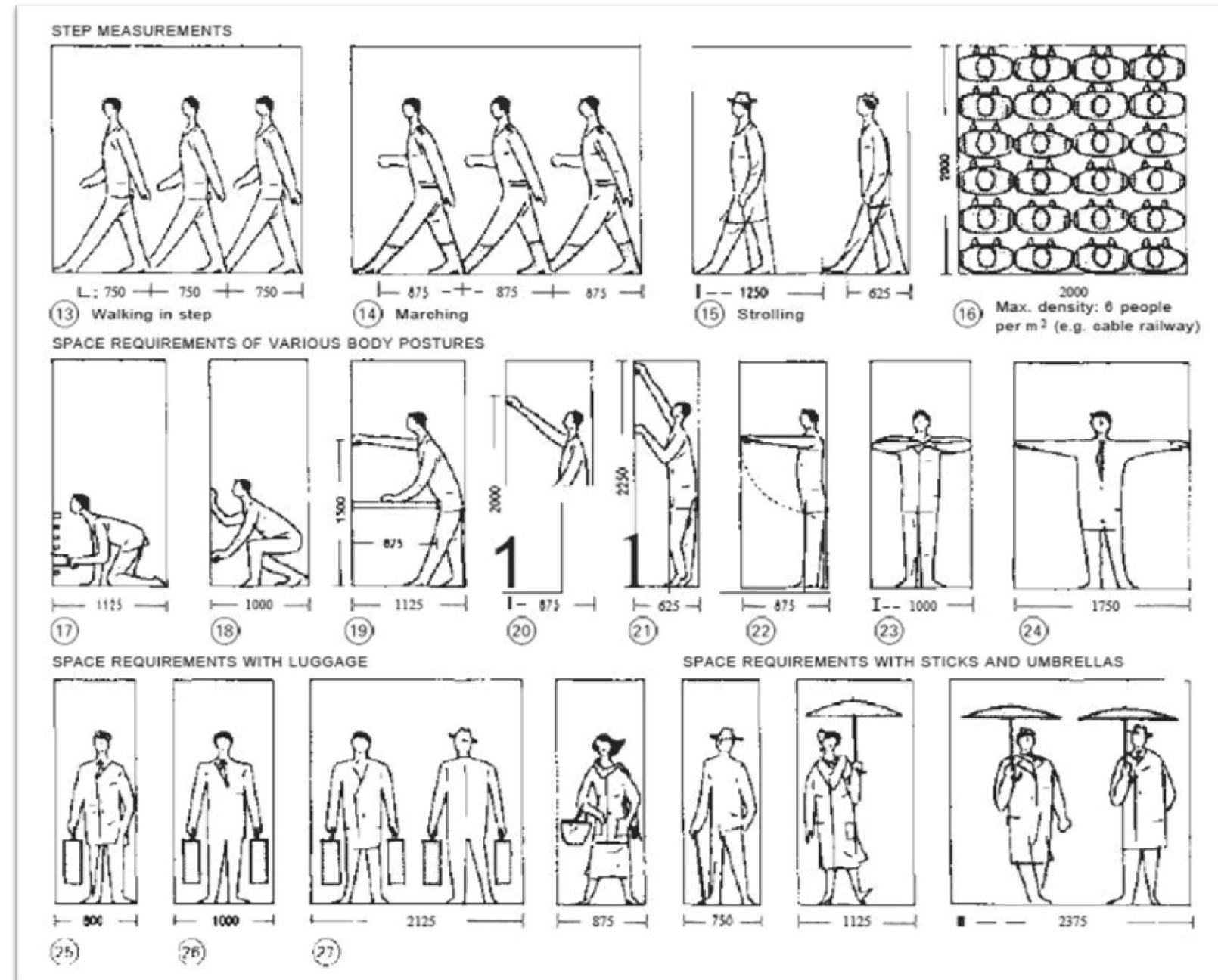
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ANTHROPOMETRICS



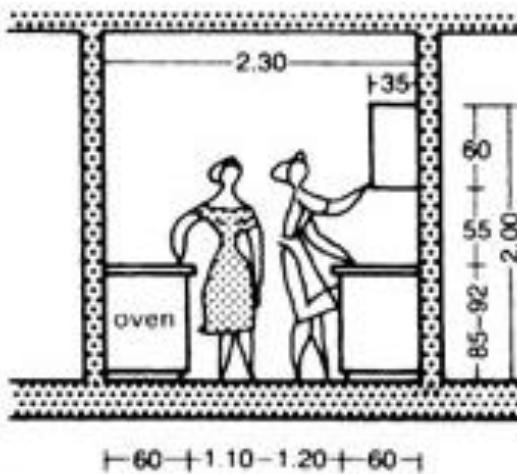
3. Human Dimensions and Space Requirements

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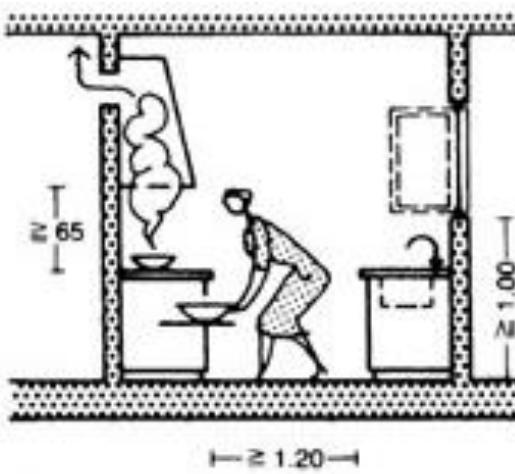
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ANTHROPOMETRICS



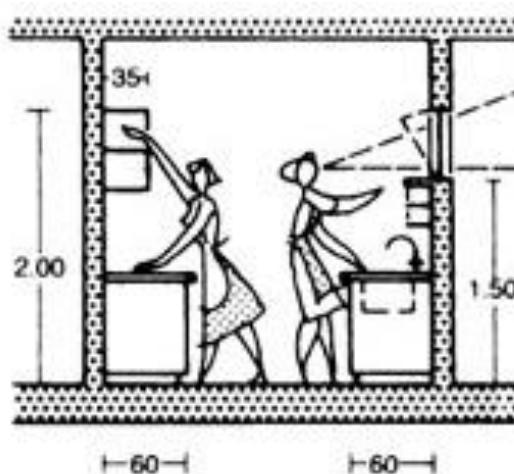
3. Human Dimensions and Space Requirements



② Section through kitchen;
space for two people



③ Low-level oven requires
adequate space in front;
extractor hood above cooker

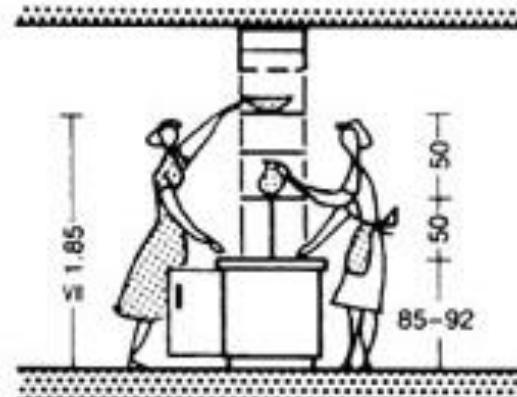


④ Worktops and storage
60 cm deep

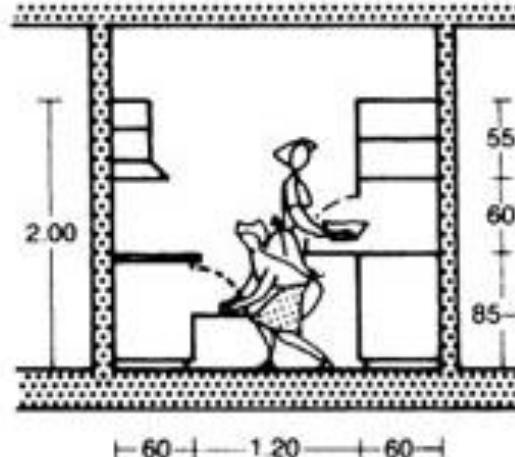
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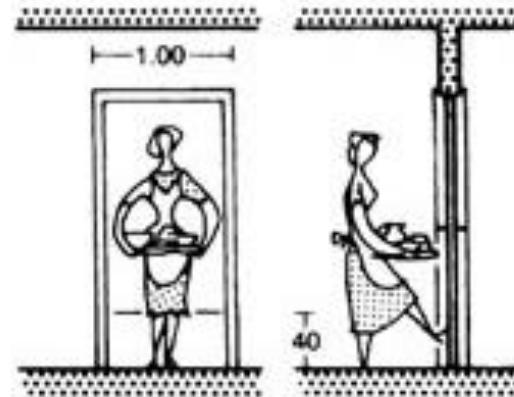
KITCHENS



⑥ Hatch between kitchen and
dining room



⑦ Side-by-side working



⑧ Self-closing doors with
kick-plate between pantry
and dining room

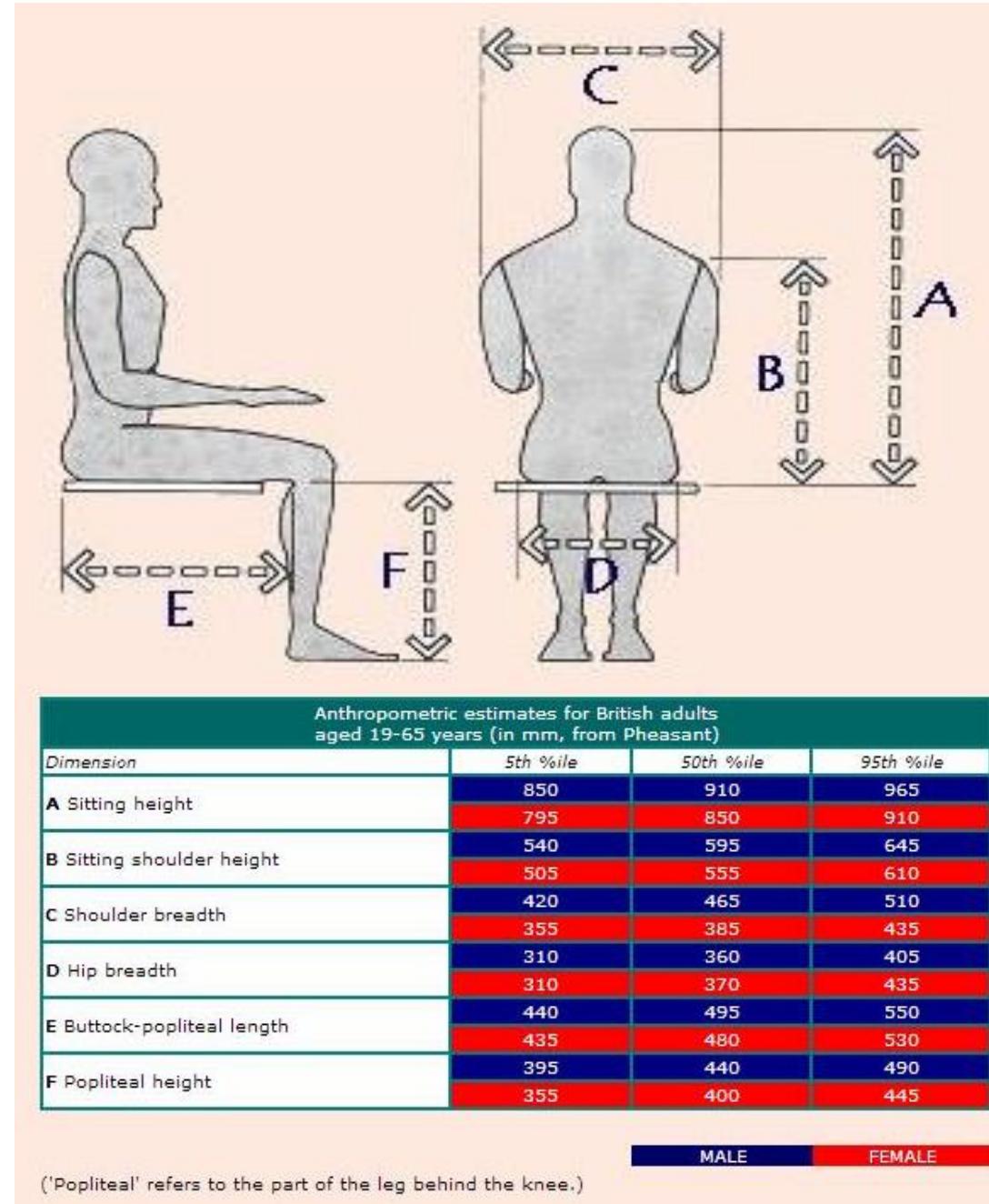
3. Human Dimensions and Space Requirements

The seat height should not be so high so that your legs are left dangling.

This means that there would be pressure on the soft tissues under person. This pressure interferes with the return of blood from the lower limbs, which may cause numbness in the thighs due to pressure on blood vessels and nerves.

The seat back and angle should support the natural curves of your spine.

In addition, a chair should enable you to change posture at intervals



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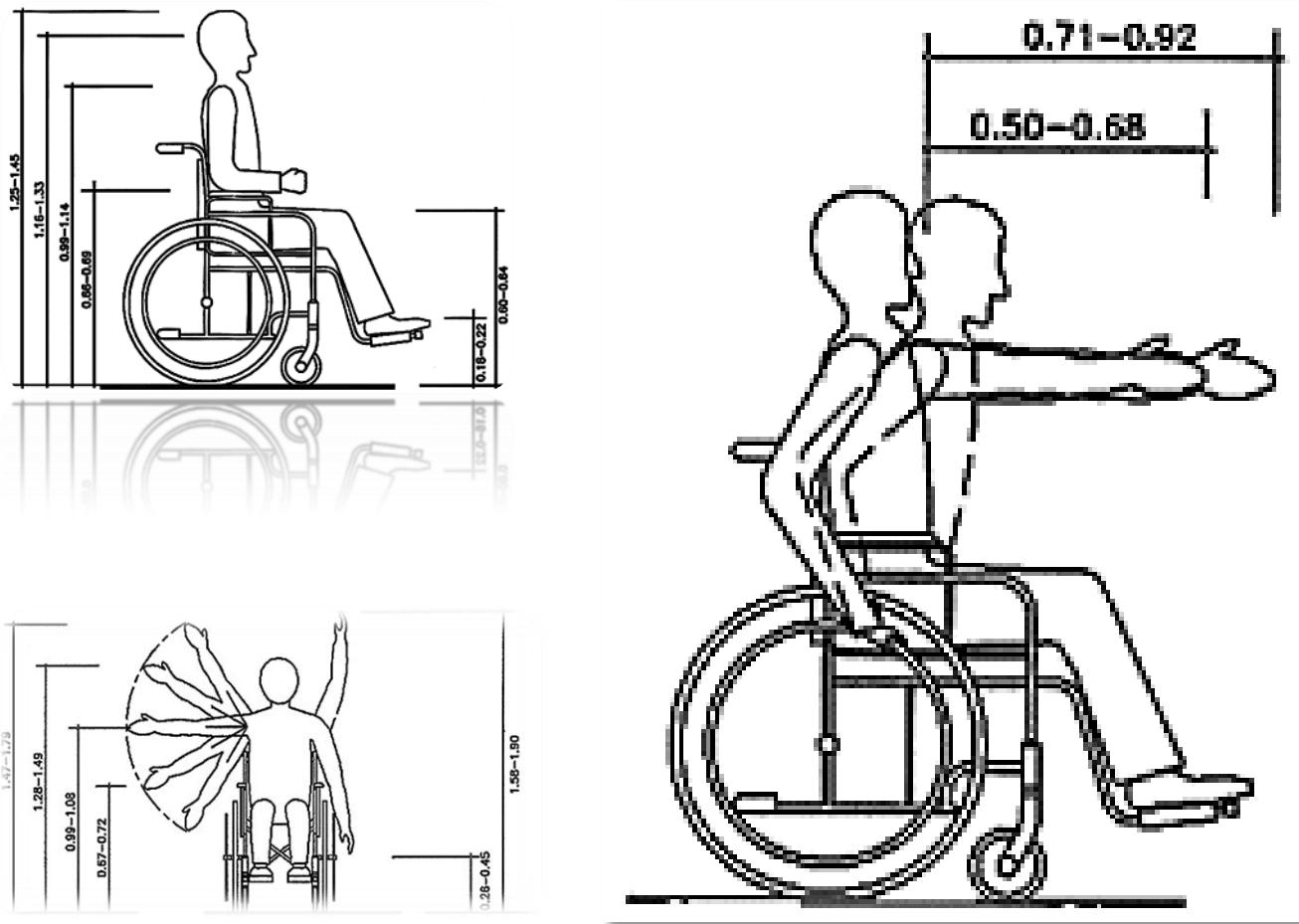
The simple methodology for anthropometrics study related to architecture and interior design:

- **The dimensional study of individuals and groups in motion and without motion.**
- **The dimensional study of individuals and groups during various activities.**
- **The data to explore individual, smaller groups, medium groups and larger groups in terms of intimate and social and public zones.**
- **Special study on dimensional requirements of physically handicapped and elderly people.**

In application of anthropometric data, we should consider:

- **Psychological factors, body buffer zones and distance zone;**
- **Body movements within the limits and functions.**

3. Human Dimensions and Space Requirements



Horizontal forward reach of a wheelchair user

1.16 m - 1.33 m

0.99 m - 1.14 m

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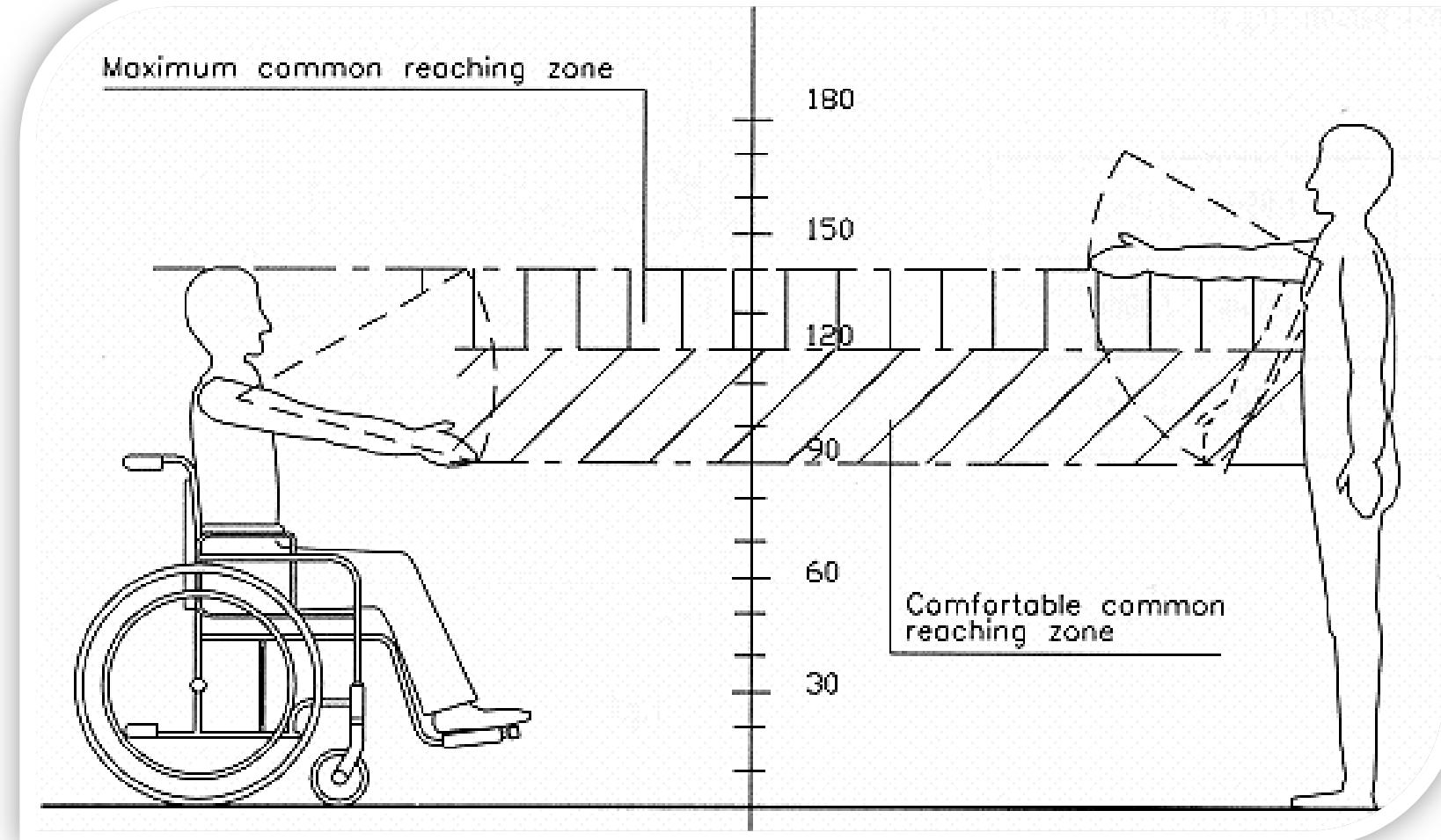
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3. Human Dimensions and Space Requirements

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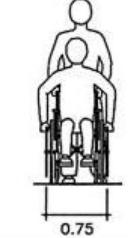
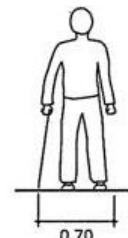
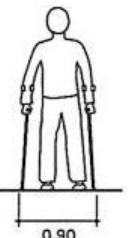
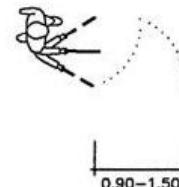
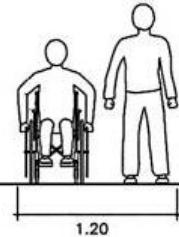
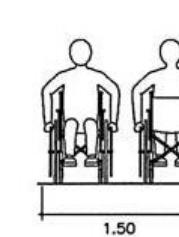
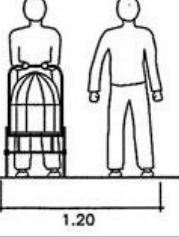
Common Reaching Zone

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3. Human Dimensions and Space Requirements

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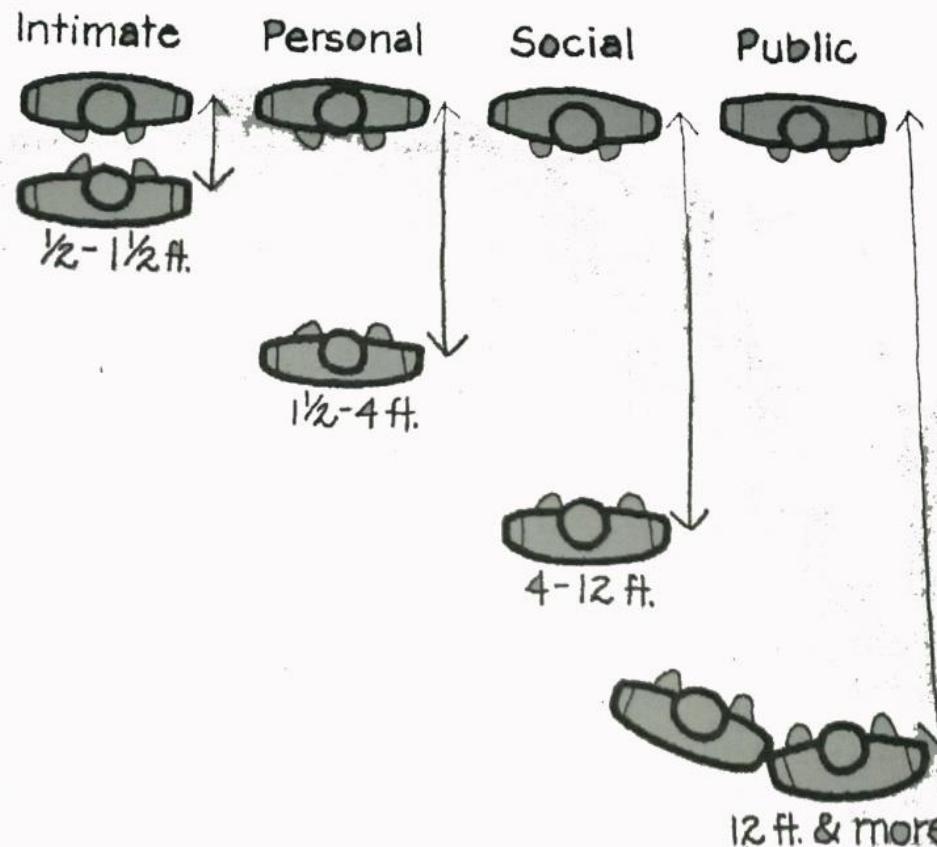
HUMAN DIMENSION:
ANTHROPOMETRICS

	Visually impaired person using a long white cane. 	
Person using a cane 	Persons using crutches 	Detectable path dimension 
		
		

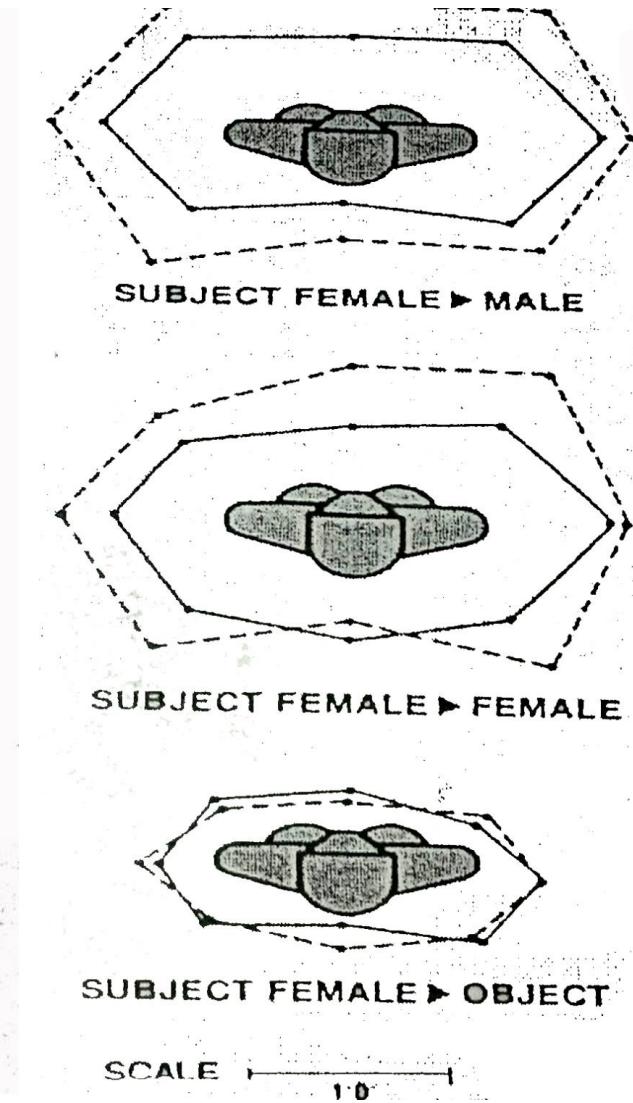
Pathway Dimension

3. Human Dimensions and Space Requirements

Distance Relationships Among People (Hall)



Distance Zones



Body Buffer Zone

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