TOOLS & TECHNIQUES FOR ERGONOMICS

HOW CAN ERGONOMICS CONTRIBUTE TO TECHNOLOGY DEVELOPMENT IN INDUSTRIALLY DEVELOPING COUNTRIES

- By adaptation of new technology
- By improving working conditions through ergonomics interventions
- By developing traditional methods
- In acquiring modern technology
- In modifying techniques

Need Training and Education in Ergonomics

ERGONOMIC CONTRIBUTIONS TO DEVELOPMENT IN INDUSTRIALLY DEVELOPING COUNTRIES

- Research on basic data needs
- Promote special abilities
- Refine simple methods
- More appropriate “experts”
- Action learning (Learning by doing, not imitating)
- Better supported education and research
- Re-conceptualize standard setting

PRESENT TREND OF OCCUPATIONAL DISEASES AND COMPLAINTS

Factors	% of diseases and complaints
Ergonomics	52.9
Chemicals	22.1
Noise	12.1
Biological	3.2
Other causes	9.5

WHY?

- ➔ More sedentary work
- ➔ Fewer distinct work types
- ➔ Less muscle usage
- ➔ More static than dynamic work

- Physical ergonomics is mainly related with posture, limb movement during human machine interaction, health, workplace layout etc. For instance, if we consider a repetitive work that a laborer is doing, it has to be recorded, assessed for the muscle fatigue happening over the

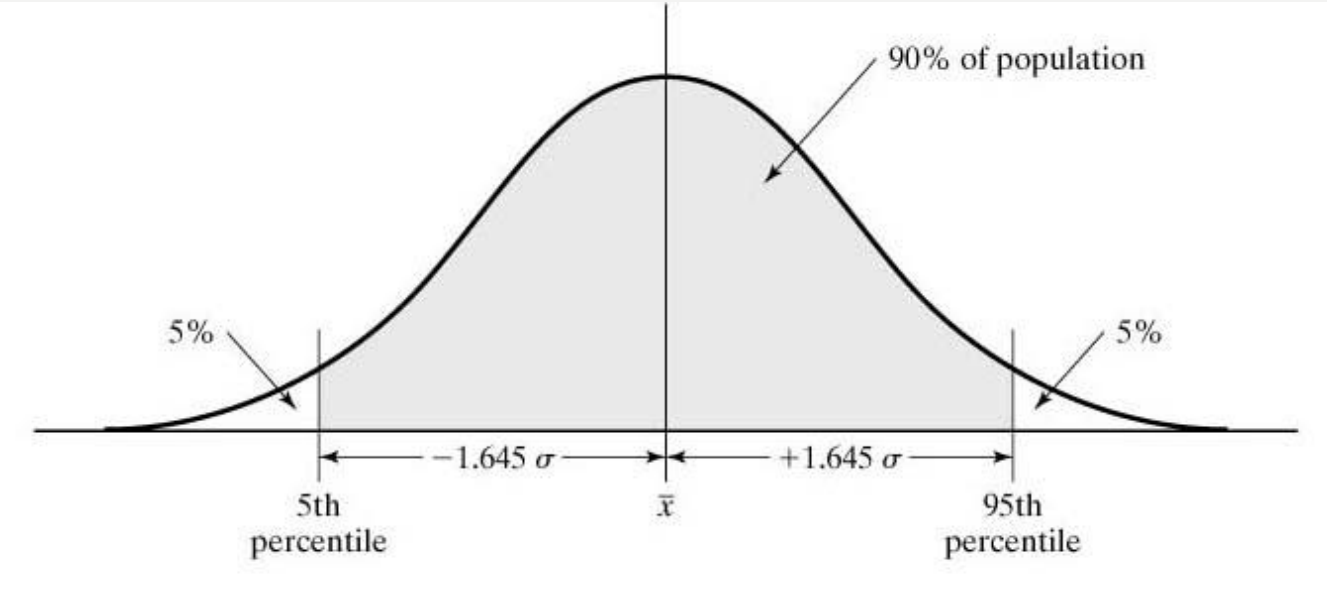
ANTHROPOMETRIC DATA

ANTHROPOMETRIC DATA

- Anthropometric data for a homogeneous population usually obeys normal distribution
- Published data indicate not only mean values but also some measure of dispersion
  - Percentile limits on the variable
    - 5^{th} and 95^{th} percentile points common
  - Standard deviation
    - Applies to specific anthropometric variable (e.g., heights of females from Northern Europe)

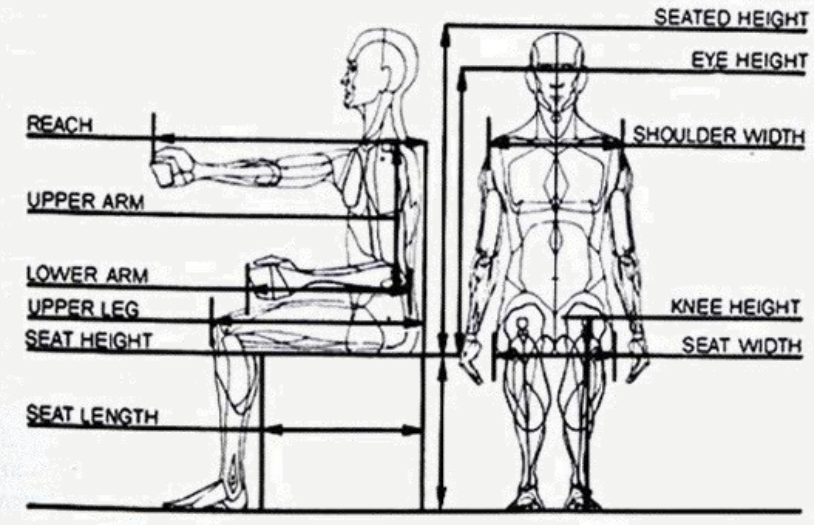
Normal Distribution in Anthropometry

Normal distribution for a given anthropometric variable of interest



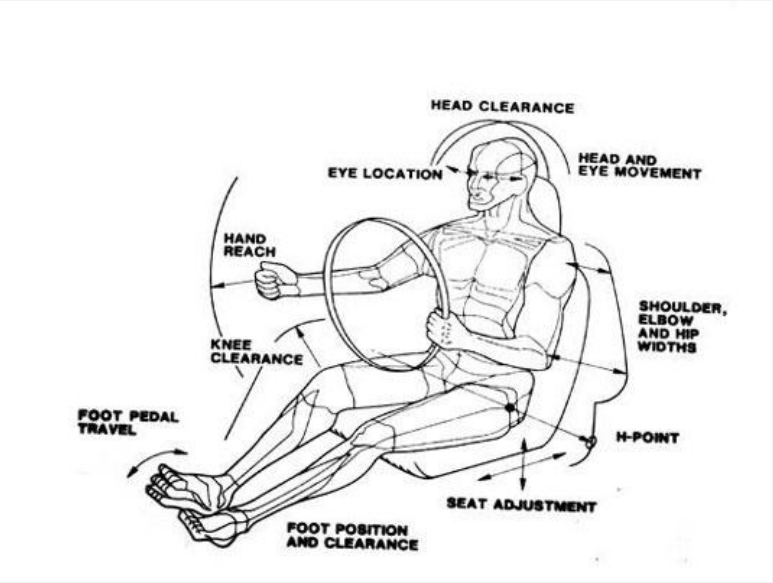
MEASUREMENTS

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.



MEASUREMENTS

- The measurements are taken with the human body dimensional co-ordinates x, y, z with respect to body land marks as reference points. at work or motion in the workspace. Typically they are represented in three dimensional co-ordinates x, y, z with respect to body land marks as reference points:
- In automobile design, at first the position of the occupant/driver with comfortable driving posture on the seat is defined. Then all other components are arranged around the driver to provide easy reach, vision and control operations.



HOW TO USE 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.

ANTHROPOMETRIC RESOURCES

- The following software Programs provide additional information about anthropometry.

So• ANTHROPOS and RAMSIS, human-solutions.com

- DELMIA Safework, delmia.com
- ErgoForms, ergoforms.com
- Jack Human Modeling, ugs.com
- LifeMOD Biomechanics Modeler, lifemodeler.com
- ManneQuinPRO, nexgenergo.com

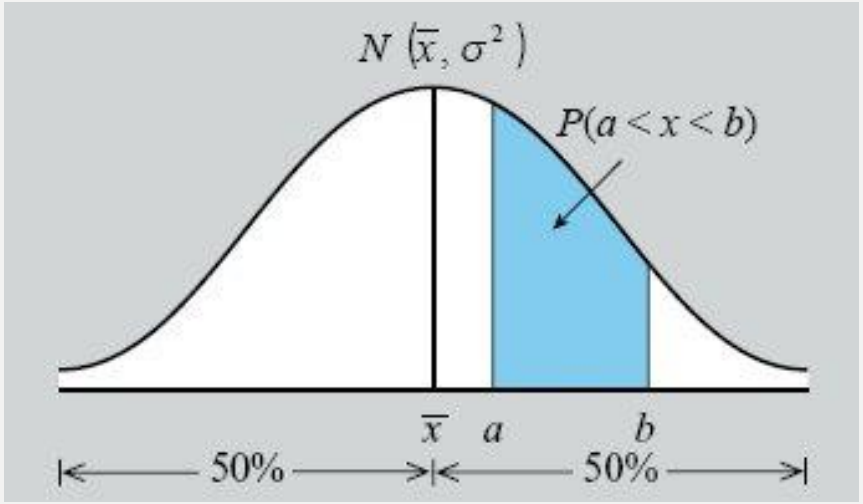
STATISTICS ESSENTIALS

- Anthropometric variables usually follow a normal distribution curve.
- Thus curve has a mean and standard deviation. (refer the mathematical formula to calculate mean and standard deviation from normal distribution curve)
- The more individuals that can be measured in an anthropometric survey, the more accurate the estimates will be. A statistic known as the standard error of the mean (se) is calculated to enable accuracy to be estimated.
- Se = sd/$\sqrt{n}$, where sd is standard deviation of the mean and n is the number of people measured in the survey.

QUESTIONS TO SOLVE

- Ninety fifth percentile value of a normal distribution variable is found by adding 1.64 standard deviations to mean. If the mean body mass of males is 82.1 kg and the standard deviation is 17.1 kg, what is the 95^{th} percentile body mass?

- The 5^{th} percentile of a normally distributed variable is found by subtracting 1.64 standard deviation from the mean. If the sitting height of females is 861 mm and standard deviation is 36 mm, what is the 5^{th} percentile sitting height ?



Properties of a Normal Distribution Curve

•The normal distribution is symmetric about the mean $\bar{x}$, ; 50% of the values lie above the mean (to the right), and 50% of the values lie below the mean (to the left). Because the mean divides the distribution in half, the mean is also the median. Because the maximum point on the graph occurs at the mean, the mean is also the mode of the distribution.

•100% of the distribution lies below the curve, the total area below the curve is 100% or 1.

•Approximately 68.3% of the distribution lies within one standard deviation of the mean; that is, the area below the curve between $\bar{x}-\sigma$ and $\bar{x}+\sigma$ is about 0.683.

•Approximately 95.4% of the distribution lies within two standard deviations of the mean; that is, the area below the curve between $\bar{x}-2\sigma$ and $\bar{x}+2\sigma$ is about 0.954.

•The area below the curve between x = a and x = b is P(a < x < b), the probability that a given x-value will lie between a and b.

$\bar{x}-\sigma$

CALCULATING PERCENTILE VALUE OF THE BODY DIMENSION

- Any percentile may be calculated if mean and sd are known.
- The pth percentile of a variable X is given by,
- $X_p = m+z\ SD$
- Where z is the constant for the percentile concerned which we look up in the statistical table.
- For a convention purpose, Whenever a number is followed by another is square bracket, it refers to mean and standard deviation.

TOOLS USED FOR ERGONOMIC ASSESSMENT

- Digital photogrammetry
- Alcimage
- All Body Scan 3D
- Aplob
- APPID
- Biotonix
- Corporis pro
- Fisimetrix
- Fisiometer posturogram
- Physical Fisio
- Physio Easy
- Posture Print
- SAPO

MEASURING TOOLS

- Digital Force Gauge
- Biometrics Goniometers and Biometrics DataLog
- Electromyography
- 7-piece Hand Evaluation Set
- A Wartenberg wheel
- Digital force gauge
- Anthropometers (Large anthropometer, Chest depth measuring instrument)
- Sound level Meter and light meters
- Heart rate watches

CAD SOFTWARE TOOLS

3D Model Toolbox for Solidworks:

- Data Sets for Anthropometric Data:
- Custom Models:

Body Labs

- MoSH: Motion & Shape Capture from Sparse Markers
- Monocular RGB-D Sequences
- Dyna
- SMPL: Skinned Multi-Person Linear Model

CAD SOFTWARE TOOLS

Make Human

- Make Human is another software tool for CAD which allows a user to design, visualize, analyse the human anthropometry and related things. It uses 3D morphing technology. There is a base of average human body available in the GUI of the software which can be modified by the dimensions to fit the required shape and then analyse to design a further usable product accordingly or other purpose.
- More than 1000 morphings i.e., base shapes are available in the software package which can be modified. The basic parameters for morphings are age, gender, height, weight, shape of face, details of hands and feet, features of face etc.

Michigan 3DSSP Software Package

- This tool is developed at Michigan university's Centre of Ergonomics. This software can be used to calculate the muscular efforts and endurance of muscles for a task or work element. Taking the force, posture and anthropometry dimensions as input it calculates percentile of workers who have appropriate strength to perform the given task. The performance index is compared by the guidelines given by NISOH. The software also contains the 3D animation to showcase the posture generation while doing the task to visualize the effect prior to job.

APPLICATIONS OF CAD SOFTWARE TOOLS

Designing a product or Service

- This tools can be used to design a product and service which is more suitable to the human who is expected to use it.

Research

- Research requires data and the data collected and analysed using these tools helps in widening the scope of the development and research methodologies.

Medical

- The ease in visualization may also help in medical fields to perform appropriate cure or preventions.

APPLICATIONS OF CAD SOFTWARE TOOLS

Sports & Fitness

- Sports and fitness is very much dependent on the study of human body and its dimensions. It is also related to the effects and injuries while playing. The techniques which are ergonomically suggested can help improve the performance of the sportsman.

Movies and Games

- The tools can be and are used in animation and VFX to add new natural and more dramatic effects which are not possible to generate without digitalization. The effects produced by computer also reduce the risk of stunt-men and the cost of film making in few cases.
- The gaming now a days is bringing the revolution. The control are shifted from the figure tips to the entire body. A child used to play a video game in old days with clicking on the buttons by his fingers but now the control is on entire body and the good example is PlayStation or X-box which uses stereo camera or similar technology to read the instructions and commands for the game.

APPLICATIONS OF CAD SOFTWARE TOOLS

Fashion & Clothing

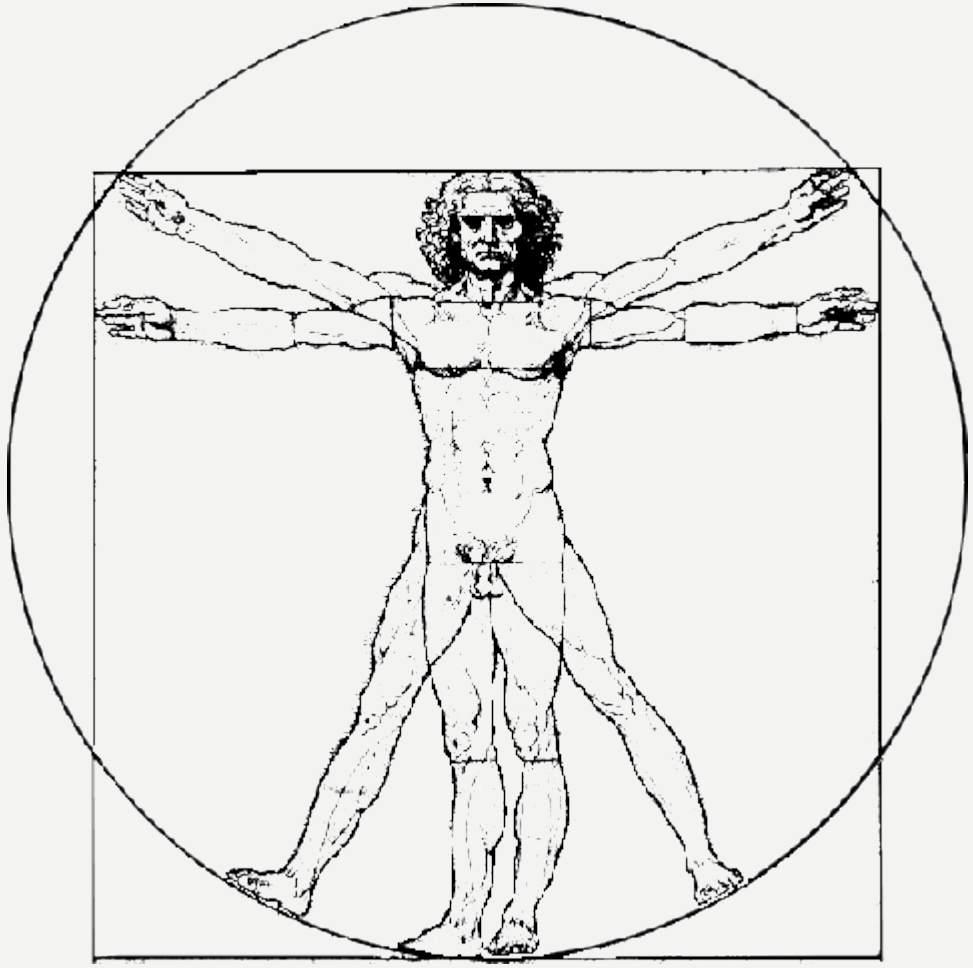
- Fashion is the most important thing is today's world. Everybody wants to look good and the textile industries are making billions. The accurate and more precise anthropometric data enables the industry or fashion designer to make a good fit which looks amazing and gets attention of viewers.

LECTURE CLOSING

DID YOU KNOW……????

Your body measurements equal each other

- You're probably familiar with Leonardo da Vinci's famous sketch, The Vetruvian Man. It's one of the earliest and best explorations of anthropometry, or the scientific study of the measurements and proportions of the human body.
- As we mentioned, your foot will fit neatly into your forearm, from elbow to wrist. But did you know:
- Your height basically equals to the span of your arms when you stretch them out to the sides.
- You height is also roughly 10 times the length from your wrist to the tip of your middle finger, and about seven times the length of your foot.
- This kind of anthropometric correlation isn't just fun to know. An anthropologist might use it to determine how tall the owner of a particular bone was, and a forensic scientist might use a footprint or handprint to estimate the height of a criminal.



IF YOU WERE……????

- If you were a civil engineer how high would you allow the roof to be to fit all the types of people……???

A BRIEF HISTORY ANTHROPOMETRY

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

" If a piece of equipment was designed to fit 90 % of the male population in US, 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.

GRAFFITI


"THAT LAST SUIT WAS A BIT STIFF."
JARIOS
CARTOONSTOCK .com
Search ID: gja0403

THANK YOU …..

PLEASE READ ANTHROPOMETRY FROM RECOMMENDED REFERENCE BOOKS FOR A BETTER UNDERSTANDING OF NEXT LECTURE