

Construction Hazards and Risks Control

Lecture Title: – Human Factors Safety in construction

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Undergraduate Diploma in
Occupational Health and Safety

What are human factors?

- A bit of history
- https://youtu.be/g_AqH1xLGPO
- Human factors refer to the traits and abilities of individuals that affect their interactions with their work environment, tasks, tools, and coworkers. These factors encompass physical attributes (like body size, strength, vision, and hearing), cognitive abilities (including attention, memory, decision-making, and problem-solving), and emotional elements (such as motivation, stress, fatigue, and mood). Additionally, human factors take into account the social and organizational dimensions of work, including communication, teamwork, leadership, culture, and policies.



Why are human factors important for construction safety?

- Human factors play a crucial role in construction safety because they influence how individuals carry out their tasks, how they react to hazards and emergencies, and how they learn from incidents and feedback.
- For instance, human factors can improve safety by allowing workers to leverage their skills, knowledge, and experience to identify and manage risks, collaborate effectively with others, and adapt to evolving situations.
- Conversely, human factors can jeopardize safety by contributing to human errors, such as slips, lapses, mistakes, and rule violations, which may result in accidents, injuries, and fatalities.

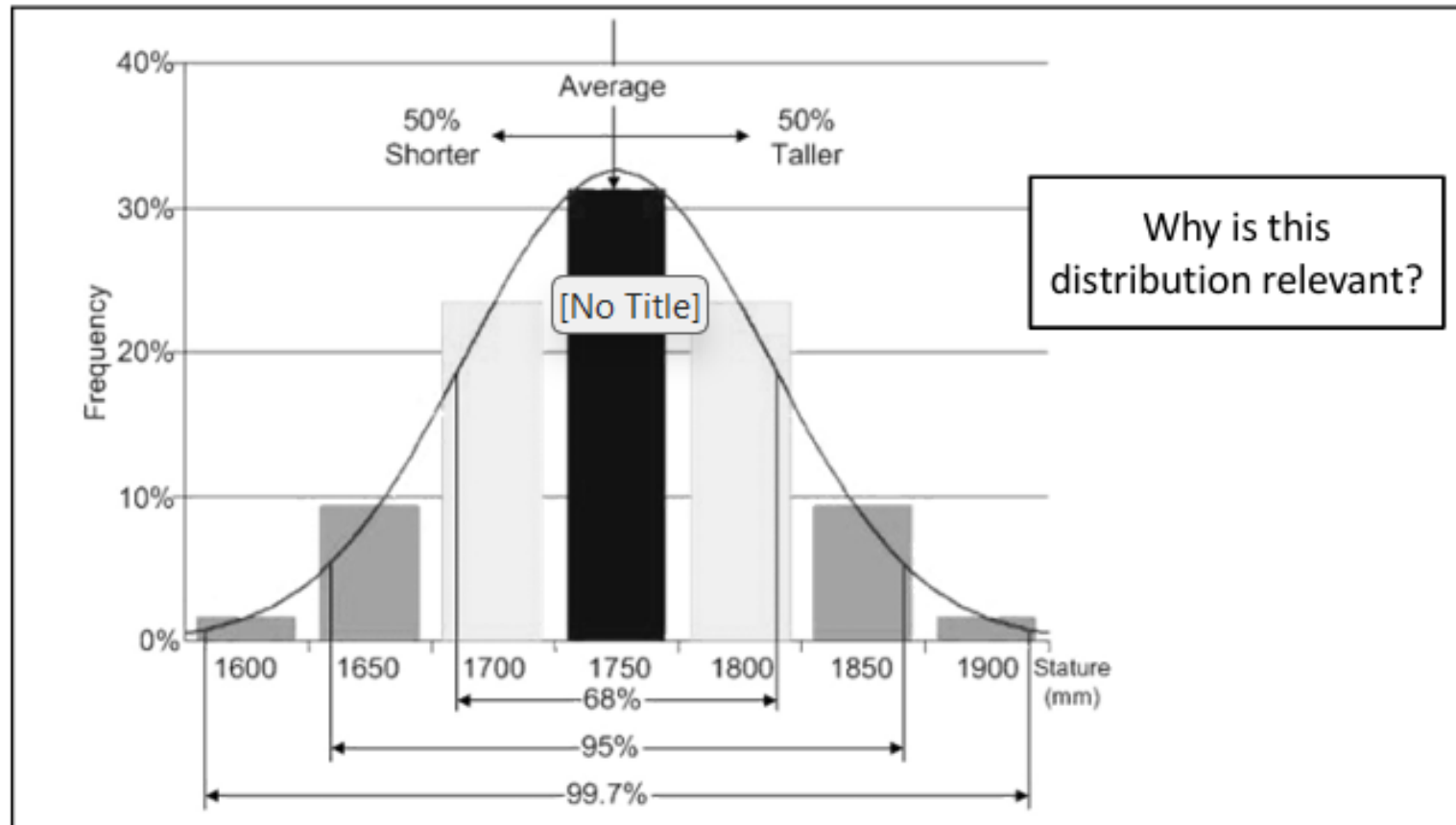


Structural Anthropometry

Deals with body measurements

- Size
- Shape
- Body composition





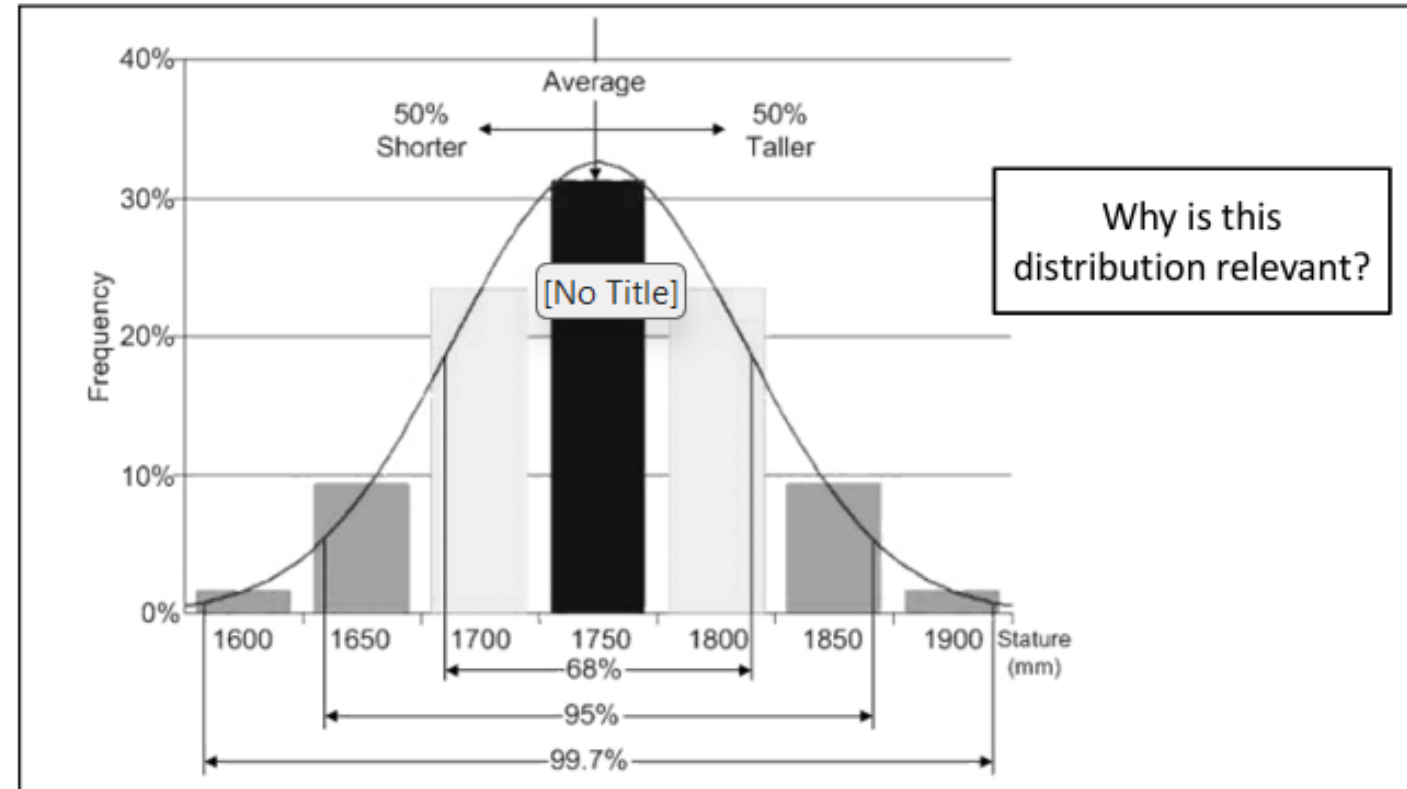
Parameters

- Two most important variables:
 - Mean
 - Standard deviation (SD)
- Mean or average – The central tendency of the data in question. It is determined by adding all the data points in a population and then dividing the total by the number of points.
- The standard deviation is an index of the degree of variability in the population concerned



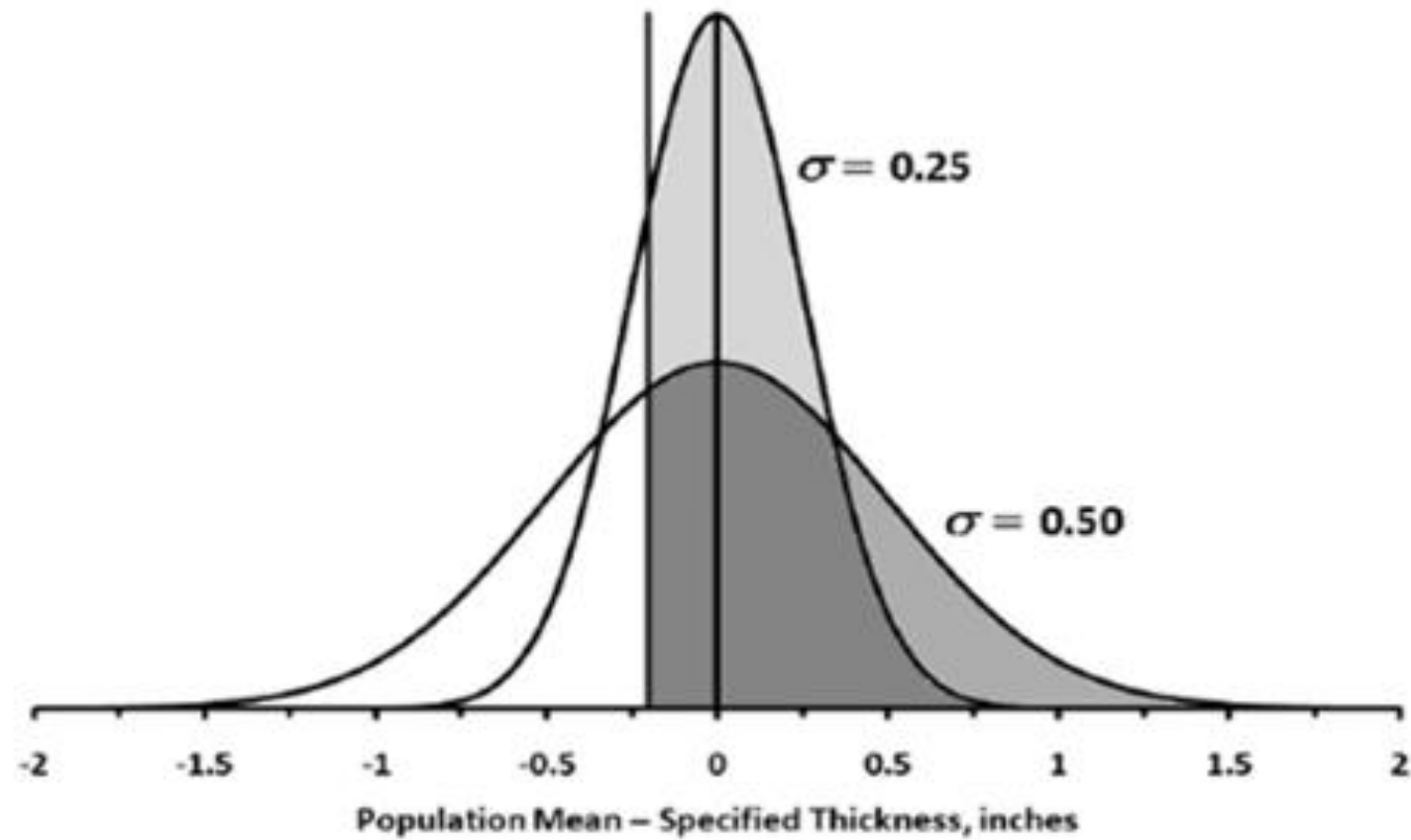
Anthropometrics

- In most cases aiming to accommodate 95% of users is the ideal design limit
- In certain cases, however, we will need to set wider limits



How would the mean (average) height and the standard deviation vary in a population of basketball players vs the general population?





Anthropometrics vary between people, what factors do you think will influence them the most?



A look at anthropometrics

- Gender
- Age
- Ethnicity
- Occupation



In most adult populations a difference of about 7% between the average heights of men and women



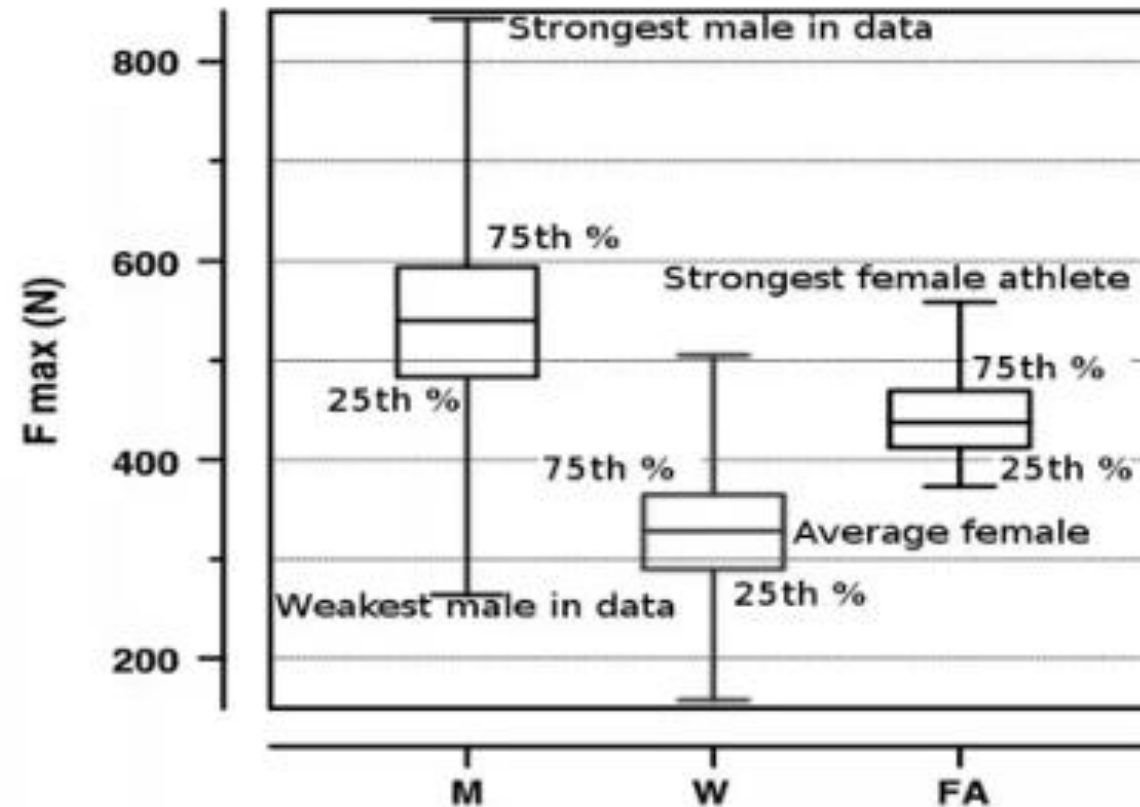


Fig. 6 Maximum hand-grip forces (F_{max}) of young adult men (M , $n = 1,654$), women (W , $n = 533$) and female elite athletes (FA , $n = 60$). Values are median $\pm$ interquartile (25th and 75th percentile) and absolute range

Leyk et al (2007)

Aging and anthropometrics



- Why is it important?
- What changes can we expect?

bones tend to shrink in size and density. This weakens them. Age-related bone changes also might cause you to become a bit shorter. Muscles tend to lose strength, endurance and flexibility

Ethnicity and anthropometrics Vary Across the World



Ethnicity and anthropometrics

If a piece of equipment was designed to fit 90% of Americans it would also fit:

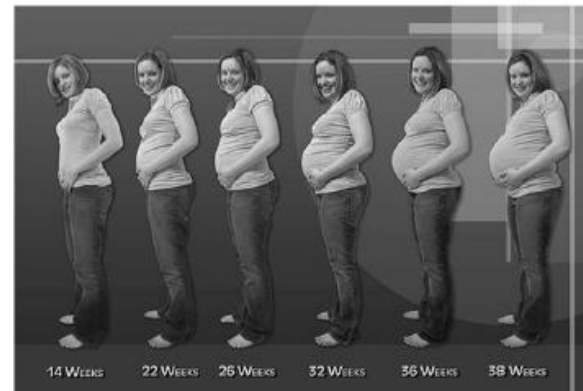
- 90% of Germans
- 80% of French
- 65 % of Italians
- 45% of Japanese
- 25% of Thais
- 10% of Vietnamese



Other considerations

- Pregnant workers
- Disabled workers

A few other considerations



Human Information Processing

- Human Information Processing explains how people receive, store, interpret, and act on information from their environment. In anthropometrics and ergonomics, this concept is critical because workplaces must be designed to match how human senses and cognition actually function.
- Input from Environment (via senses)
- Stores into Temporary sensory Register/Memory
 - Sight & Sound



Input from the environment (via the senses)

- Humans interact with the workplace primarily through their sensory systems, especially:
 - Vision (sight)
 - Hearing (sound)
- These senses detect:
 - Shapes, colors, movement, distance
 - Alarms, warnings, verbal instructions, machine noise
- Anthropometric relevance
- Anthropometrics is not only about body size — it is also about sensory capability and limitation.
 - Examples:
 - Eye height varies between workers
 - Field of vision depends on head position and posture
 - Hearing ability varies with age, exposure, and health
- If information is not presented within human sensory limits, it may not be perceived at all.



Temporary sensory register (sensory memory)

What is the sensory register?

- The sensory register is a very short-term storage system that holds raw sensory information for a fraction of a second:

Sense	Duration
Vision (iconic memory)	~0.2–0.5 seconds
Hearing (echoic memory)	~2–4 seconds

This allows the brain to:

- Decide what is important
- Filter out irrelevant information
- Pass selected information to short-term memory

Sight (Visual sensory register)

- Anthropometric importance of vision
- Visual information depends on:
 - Eye height
 - Viewing angle
 - Distance
 - Lighting
 - Contrast and colour
- These vary between individuals.



Construction Examples Re Sight

- Warning signs positioned above eye height of shorter workers
 - Poor lighting on stairways or scaffold platforms
 - Control displays too small or too far away
 - Obstructions blocking line of sight
-
- If visual input:
 - Is outside the worker's visual field
 - Is poorly illuminated
 - Is visually cluttered



Sound (Auditory sensory register)

- Anthropometric importance of hearing
- Auditory perception varies with:
 - Hearing sensitivity
 - Age
 - Prior noise exposure
 - Use of hearing protection
- Construction examples
 - Audible alarms masked by background noise
 - Verbal instructions lost in high-noise environments
 - Reversing alarms not heard due to PPE or distance



Stress and Fatigue

Stress at work

- The awareness of not being able to cope with the demands of the work environment and when this realisation is of concern to the person so that s/he has a negative emotional response.

Fatigue

- Temporary inability /decrease in ability/strong disinclination to respond to a situation due to previous overactivity (mental, physical or emotional)



Common Sources of Stress

- Tight deadlines and production pressure
- Long working hours
- Heat, noise, dust, vibration
- Poor planning and last-minute changes
- Job insecurity or subcontracting pressures
- Conflicting instructions from different supervisors
- Poor communication or supervision



How Stress Affects Human Performance

- Cognitive effects
 - Reduced attention and concentration
 - Narrowed focus (“tunnel vision”)
 - Poor judgement and decision-making
- Emotional effects
 - Irritability
 - Anxiety
 - Reduced motivation
- Behavioural effects
 - Risk-taking
 - Shortcuts
 - Reduced compliance with procedures



Common Sources of Fatigue

- Long shifts and overtime
- Night or early-morning work
- Repetitive manual tasks
- Heat stress (especially in summer conditions)
- Insufficient rest breaks
- Poor work-life balance



How Fatigue Affects Human Performance

- Fatigue leads to:
 - Slower reaction times
 - Reduced coordination and balance
 - Memory lapses
 - Poor hazard perception
 - Increased error rates
- Fatigue can impair performance to a level comparable with alcohol intoxication.



Safety & Job Burnout (1/2)

- The result of an individual's attempt to cope with excessive & prolonged stress.
- Caused by both individual & work/life factors. Coping strategies must address personal skills & organisational issues

Characteristic Traits of Burnout:

- Emotional Exhaustion - Often also physical & cognitive
- Depersonalization - shown as social withdrawal, flat emotions/irritable response to others
- Inefficacy - efforts are felt as having no value/not making any difference



Safety and Job Burnout (2/2)

- Impact of Burnout

Severe Injury

Errors

Absenteeism, turnover, Low satisfaction



State of Consciousness

- Psychoactive Drugs:
- Chemical that changes our states of consciousness, especially our perception, moods, cognition and behaviour by affecting the central nervous system.
- These substances, which include both prescription medications and recreational drugs, generally fall into 3 main categories (depressants, stimulants and hallucinogens)
- Frequently prescribed e.g. Sleeping pills, anti anxiety medications & tranquilizers
- Negative effect through continued use accompanied by increased doses leading to abuse



Reading

- Pheasant, S. & Haslegrave, C.M. (2006) Bodyspace. Anthropometry, ergonomics, and the design of work. Taylor and Francis
- https://www.faa.gov/files/gslac/courses/content/258/1097/AMT_Handbook_Addendum_Human_Factors.pdf