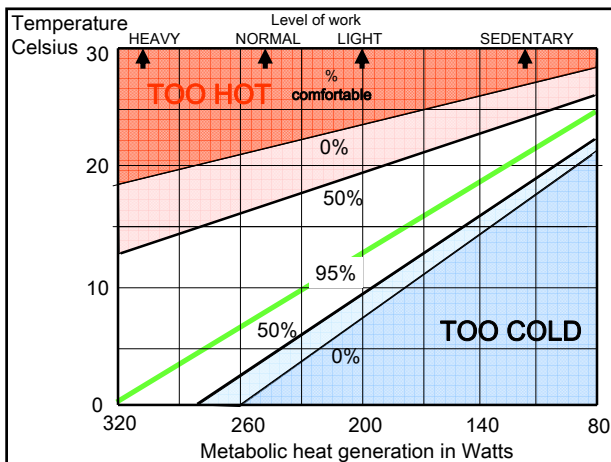


Delivering Comfort

Thermal comfort

A balance between
heat generated by metabolism and heat lost or gained by the body

$$\text{Metabolic heat} = \text{heat lost from body}$$



Mechanisms of heat transfer

Conduction
Evaporation
Convection
Radiation

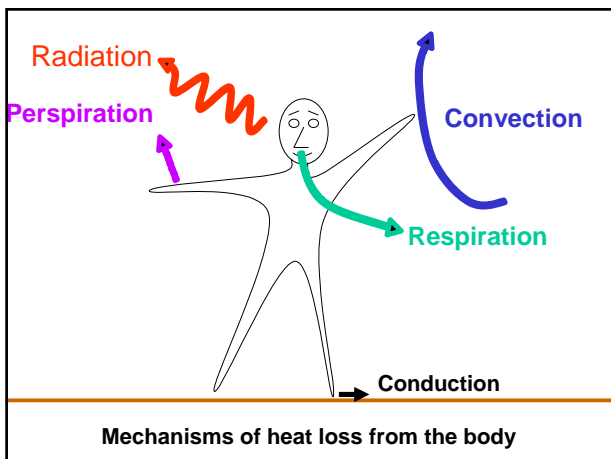
Behavioural factors

Activity
Clothes

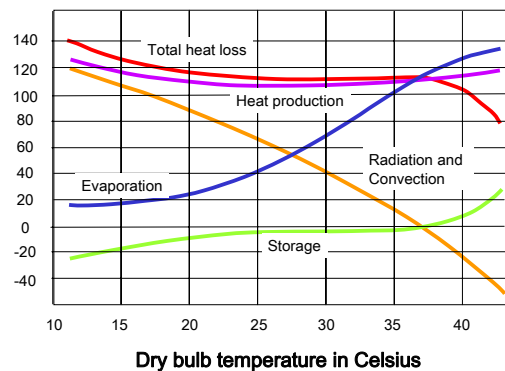
Environmental factors

Air temperature
Relative humidity
Air movement
Mean radiant temperature

Factors in Thermal Comfort



Metabolic heat in Watts



Comfort temperature

$$T_C = 0.5 T_{AIR} + 0.5 T_{RADIANT}$$

T_C - Dry Resultant temperature

Creating Comfortable conditions

- 1 Radiant Temperatures of room surfaces
- 2 Dry Bulb temperature of air
- 3 Wet Bulb temperature of air
- 4 Air movement, speed and direction
- 5 Freshness of air

Ventilation - Planned introduction of fresh air

Infiltration - Unplanned ventilation

Need for Fresh air

- 1 Oxygen to breathe
- 2 Clean air free of pathogenic bacteria
- 3 Sweet smelling air free from body odours
- 4 Freshness of perceived air movement

*Fresh air requirement l/per person per second .
Limit to level of CO₂ in air (measure of contamination)*

| Type of Space | Smoking | Recommended l/s | Minimum l/s |
|---------------------------------------|---------|-----------------|--|
| Factories, Offices, Shops | some | 8 | 5 |
| Hotel bedrooms, Laboratories, Offices | some | 12 | 8 |
| Cocktail bars, conference rooms | some | 18 | 12 |
| Board rooms, conference rooms | heavy | 25 | 18 |
| Corridors Kitchens Toilets | | | 1.3 l/m ² 20 l/m ² 10 l/m ² |

Heat = mass . specific heat . temperature difference Joules

m - Mass in kg
c - Specific heat in J/kg
T - Temperature difference K or °C

mass = volume . density
L = volume in l
v = volume in m³
ρ = density in kg/m³

For air c = 1000 J/kg, and ρ = 1.2 kg/m³

$$\text{Heat} = v \cdot \rho \cdot c \cdot \Delta T = \frac{L}{1000} \cdot 1.2 \cdot 1000 \cdot \Delta T = L \cdot 1.2 \cdot \Delta T \text{ J}$$

$$\text{Heat flow} = \text{Heat per second} = L/s \cdot 1.2 \cdot \Delta T \text{ W}$$

Temperature differences

Limit the temperature differentials experienced

Higher temperature differentials where input is mixed

Lower differentials where air is in direct contact with occupants

Mixing air up = mixing systems

Allowing stratification of air = displacement ventilation

