

Technology & Env 1

M4X01974

Lecture 2

BUILDING FUNCTIONS **(Performance Requirements,** **Health and wellbeing)**

Low rise domestic dwellings

Definitions

● What do we mean by Design Technology?

Design, *to draw; to plan and execute artistically, to form a plan of; to contrive; invent; to intend*

Technology, *technical means and skills characteristic of a particular civilization, group or period [Greek techne - art, skill and logy]*

Learning Outcomes

- Aim -To explain the climatic and environmental factors that affect building design
- Learning Outcomes– understand the principles of environmental design with regard to the building fabric and conditions necessary for a healthy environment

Shelter - *environmental envelope*

- Introduction
- Buildings provide the primary physical need 'shelter' protection from the elements
- To enclose space and create a satisfactory internal environment
- Function of the building fabric modifies the natural or external environment to provide a satisfactory internal environment

Shelter - *environmental envelope*

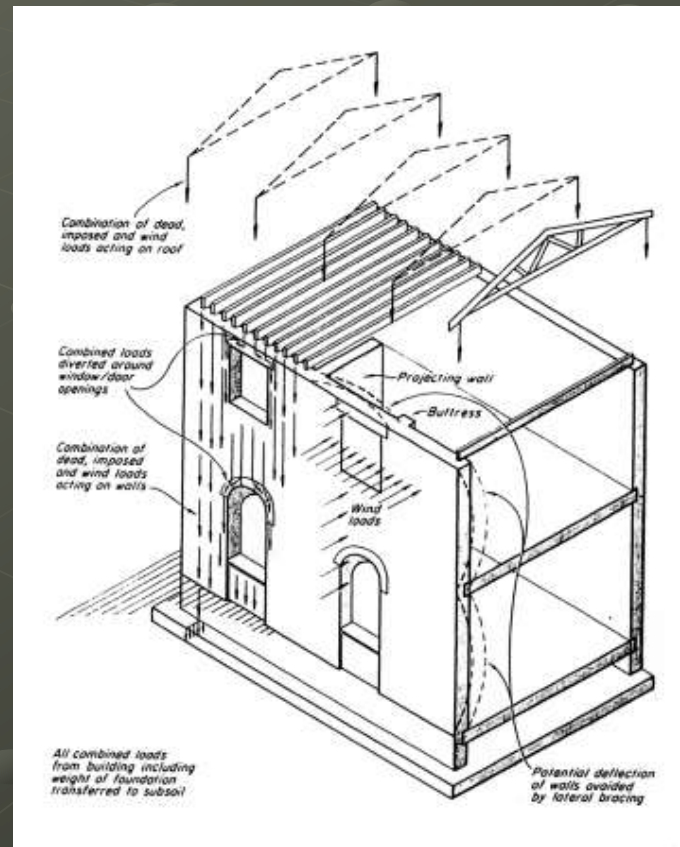


Shelter - *environmental envelope*



Structure

- The building fabric – *environmental envelope* constructed to withstand safely all forces to which the building will be subjected in use.
- In other words be developed as a *structure*



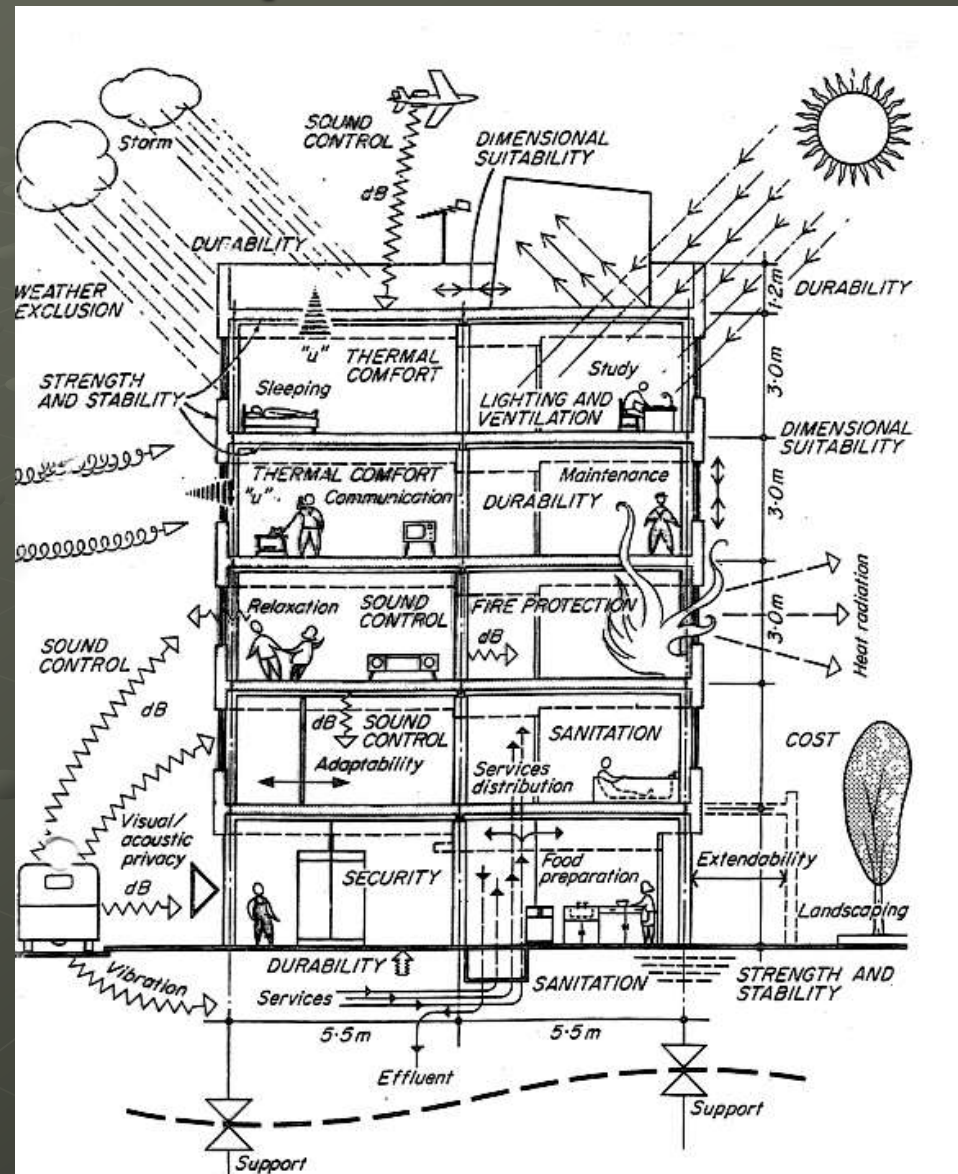
BUILDING REQUIREMENTS

● Provide a healthy environment for human habitation

- Clean air and water
- Absence of agents of disease
- Enhance human well-being (provide interest, delight etc)

Performance Requirements

- What do we mean by performance requirements?



Performance Requirements of a Building

USE OF TECHNOLOGY IN BUILDING DESIGN

**To understand how
to achieve a safe
and comfortable
environment it is
important to
consider;**

- What are the requirements of a building?
- What affects the performance of a building?
- How can buildings be built to perform well and satisfy the requirements?

BUILDING REQUIREMENTS

- **Provide a safe environment by preventing harm to the occupant resulting from**
 - The building itself (e.g. structural stability, environmental impacts)
 - External factors (e.g. criminal activity)

BUILDING REQUIREMENTS

● Provide a comfortable environment

- Temperature, relative humidity
- Light
- Noise
- Privacy

ISSUES AFFECTING BUILDING PERFORMANCE AND DESIGN

- Climate

- Geographical factors

 - Soil

 - Topography (Land forms etc)

 - Site microclimate (Urban, rural, protected, exposed etc)

 - Vegetation

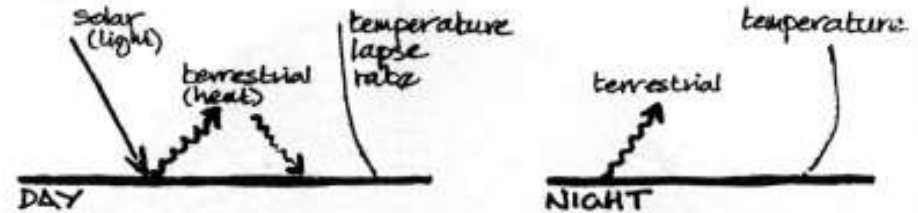
CLIMATE

CLIMATIC ELEMENTS AND THEIR EFFECT ON DESIGN

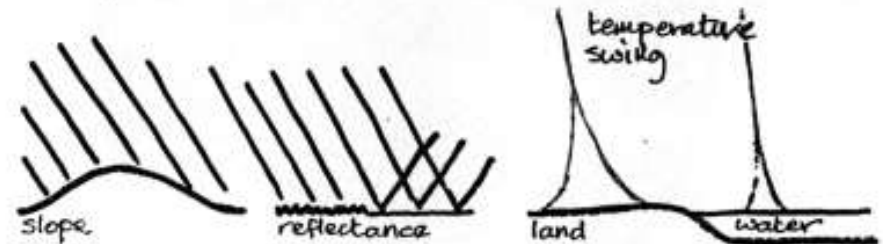
Climatic Factors

CLIMATIC PRINCIPLES

SOLAR RADIATION HEATS THE GROUND



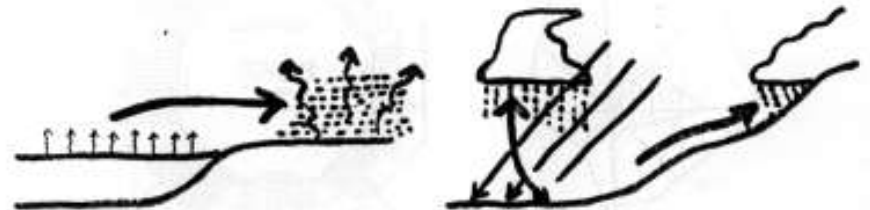
DAILY/SEASONAL TEMPERATURE SWINGS DIFFER.



DIFFERENCES IN TEMPERATURE GENERATE WIND



AIR MOVEMENT CARRIES MOISTURE

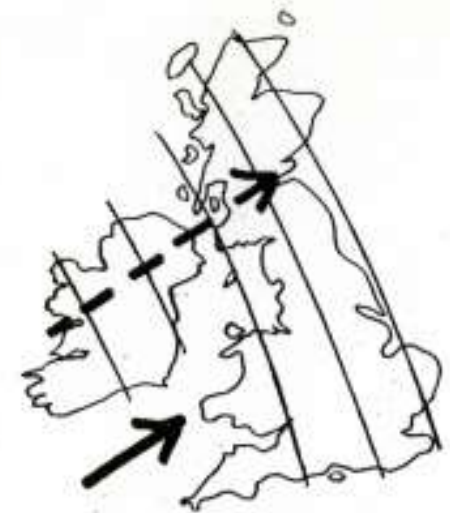


Local Climate

INFLUENCES ON LOCAL CLIMATE



HIGH GROUND
height and topography



GLOBAL CIRCULATION
prevailing wind
dominant air masses
north atlantic drift



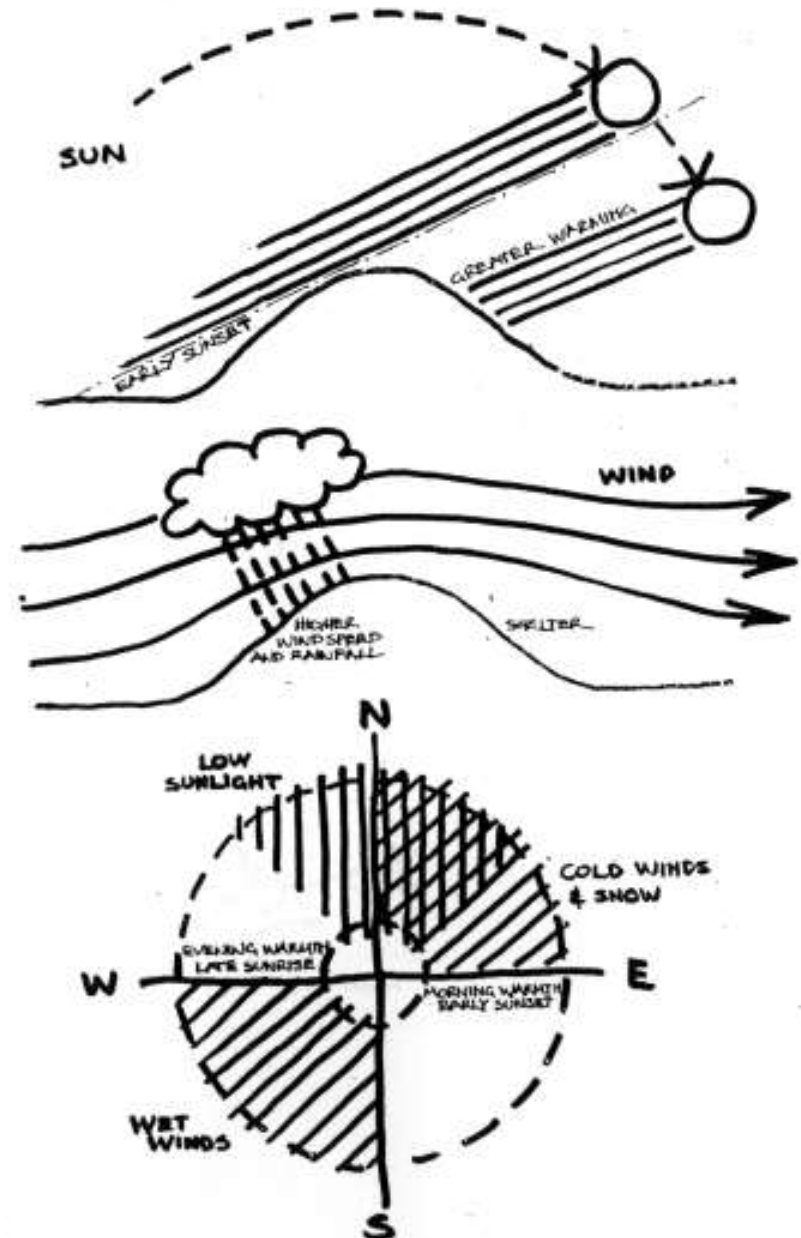
COASTAL BOUNDARY
contrast between land and sea
distance from coast



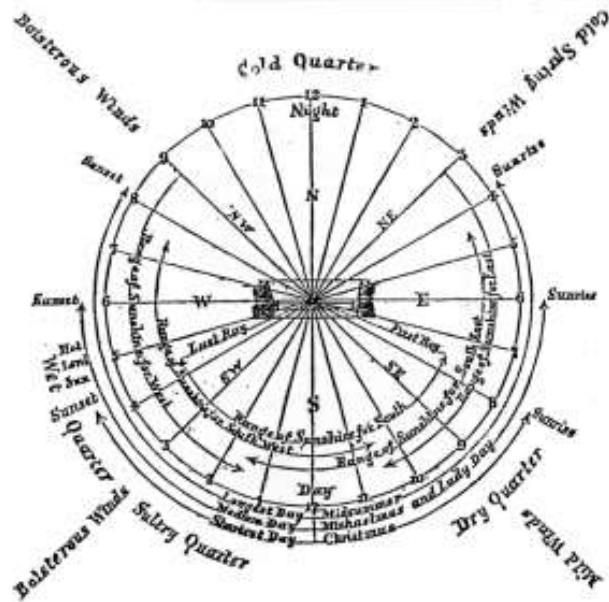
LATITUDE

Local Conditions

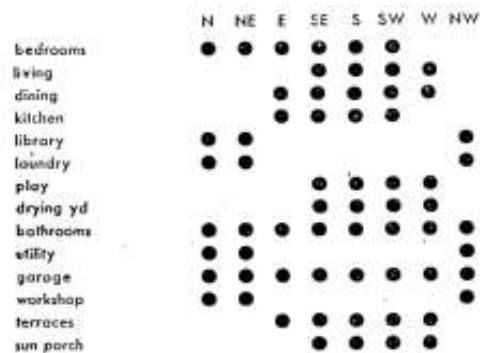
HILL AND VALLEY CLIMATES VARIATION WITH ASPECT



Climatic Influences

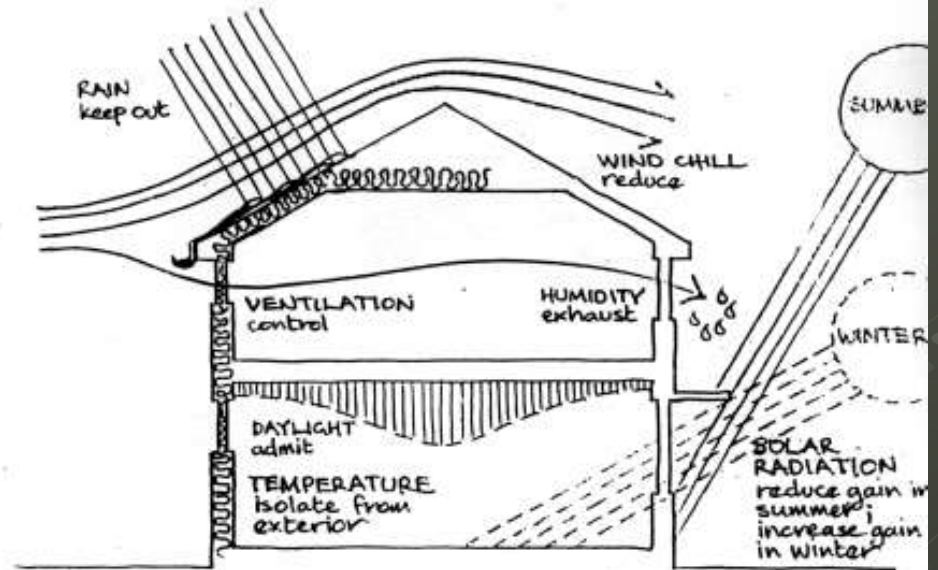


ASPECT-COMPASS.

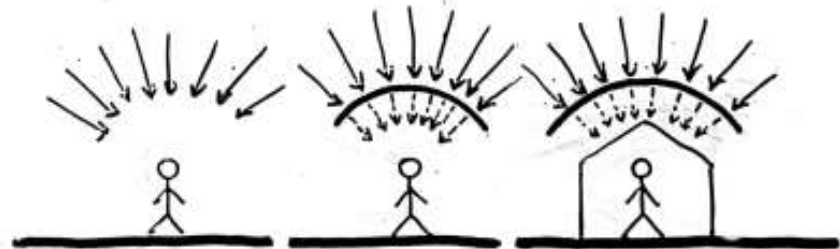


Suggested sun orientation for rooms.

ASPECT OF SPACES IN THE BUILDING



TO MAKE THESE OBJECTIVES EASIER TO ACHIEVE THE CONDITIONS TO AIM FOR IN THE SITE CLIMATE ARE THE SAME ON THE WHOLE AS WOULD FAVOUR PEOPLE IF THE BUILDING WERE NOT THERE FAVOURABLE SITE CONDITIONS MAKE IT EASIER TO MAINTAIN A COMFORTABLE INTERNAL ENVIRONMENT



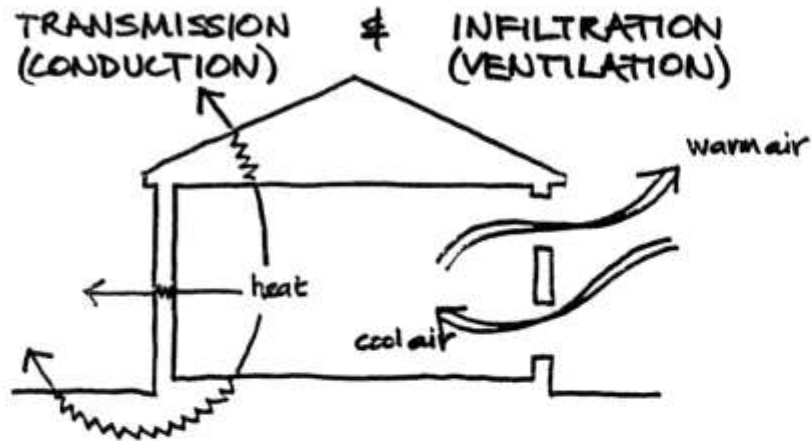
INFLUENCE OF CLIMATE ON THE BUILDING'S ENVIRONMENT

Skin Clothes Building fabric

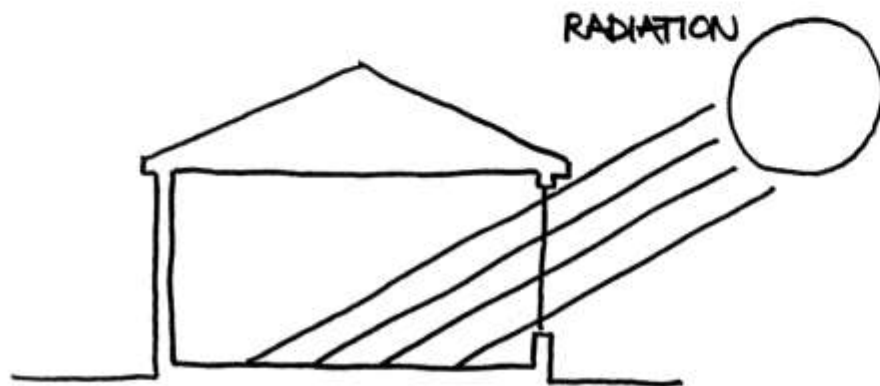


Our skin is vital to our health and comfort. Our body temperature, moisture, and bioelectrical balance are maintained owing to its capacity to “breathe”. Our second skin – our clothes – must also be able to breathe, as must our third skin – our homes – if they are to provide a healthy indoor environment for us all.

IN OUR CLIMATE FABRIC
HEAT LOSS IS MAINLY BY

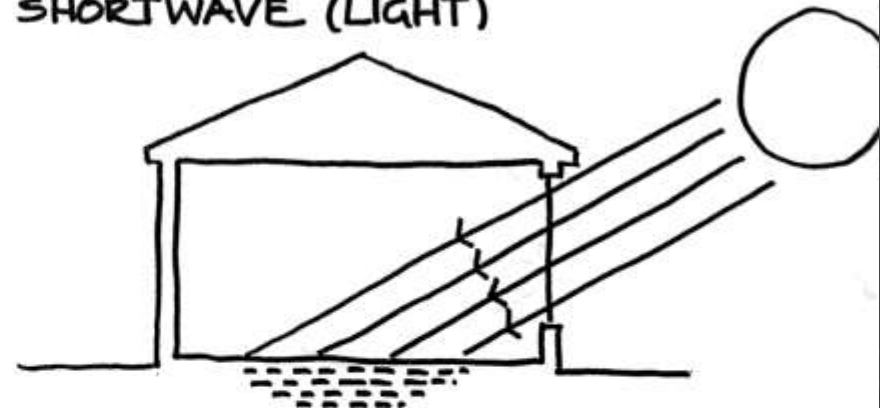


HEAT GAIN IS MAINLY BY



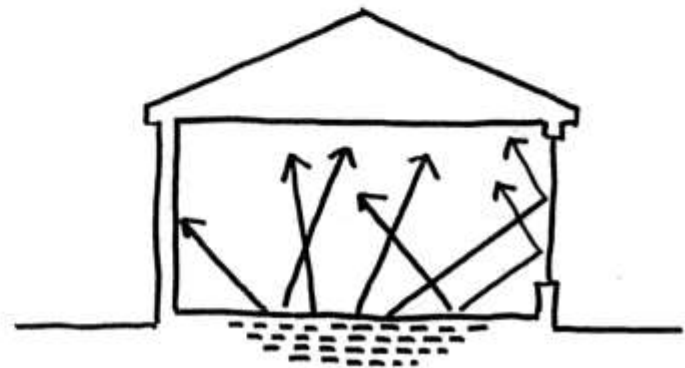
HEATING
GREENHOUSE EFFECT

SHORTWAVE (LIGHT)



glass is transparent

LONGWAVE (HEAT)



glass is opaque

HEALTH AND WELL BEING

- Health is a fundamental right of all humans and the basis for developing a high quality of life.

DESIGN ISSUES for healthy buildings

Physical characteristics

● Sensible characteristics

- Temperature
- Humidity
- Lighting
- Sound
- Ventilation

● Insensible characteristics

- static electricity
- electro magnetism

Physical characteristics

● Spatial characteristics

- accessibility and usability of space
- links to nature and the outdoors, a sense of security, belonging, privacy

● Chemical characteristics affecting the indoor environment resulting from:

- Materials used
- Ventilation of building

● Likelihood to attract biological agents of disease

Thermal comfort

- **Temperature and humidity levels plus air movement**
- For a body to achieve comfort there should be a balance of the:
- the metabolic heat generated by the body (through metabolic rate and physical activities)
- the heat loss from the body

Thermal Comfort

- The body exchanges heat with the environment through
- Convection (transfer of heat through fluid, in most cases air, due to the tendency of heat to rise)
- Evaporation (the changing of a liquid to a vapour)
- Radiation (energy sent out as electromagnetic waves or subatomic particles)
- Conduction (transmittance of heat directly through a material)

Thermal Comfort

- The body adjusts the amount of heat lost
- Sweating (*evaporation*)
- Increased breathing levels (panting) to lose heat
- dilation of the blood vessels in the extremities
- the body may increase the supply of water available for evaporation

Thermal Comfort

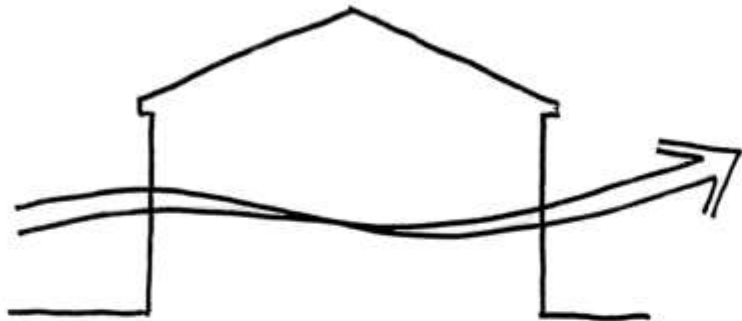
Table 4.3 Typical heat output of human body

<i>Activity</i>	<i>Example</i>	<i>Typical heat emission of adult male</i>
Immobile	Sleeping	70 W
Seated	Watching television	115 W
Light work	Office	140 W
Medium work	Factory, dancing	265 W
Heavy work	Lifting	440 W

Note: Adapted from the CIBSE Guide

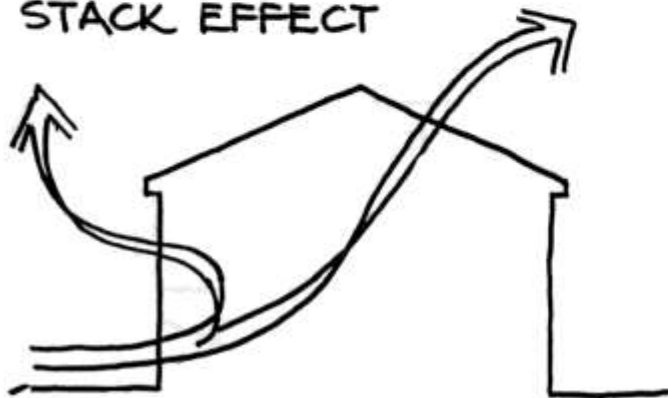
COOLING NATURAL VENTILATION THROUGH

WIND EFFECT



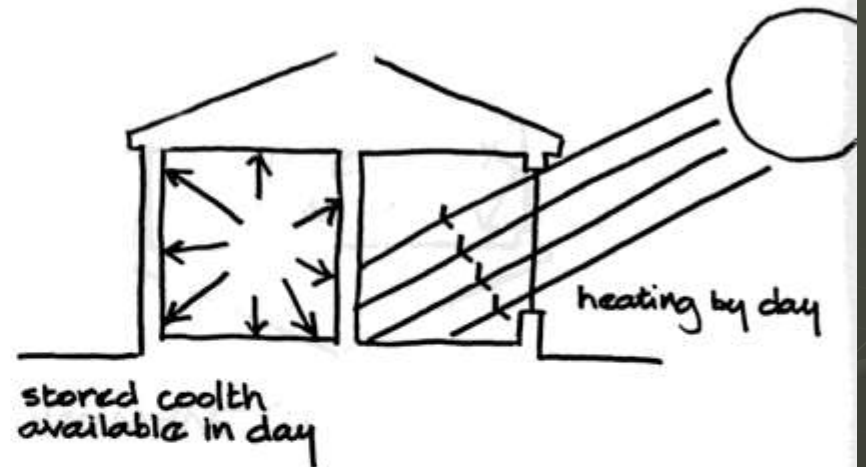
driven by pressure difference
between faces with openings

STACK EFFECT

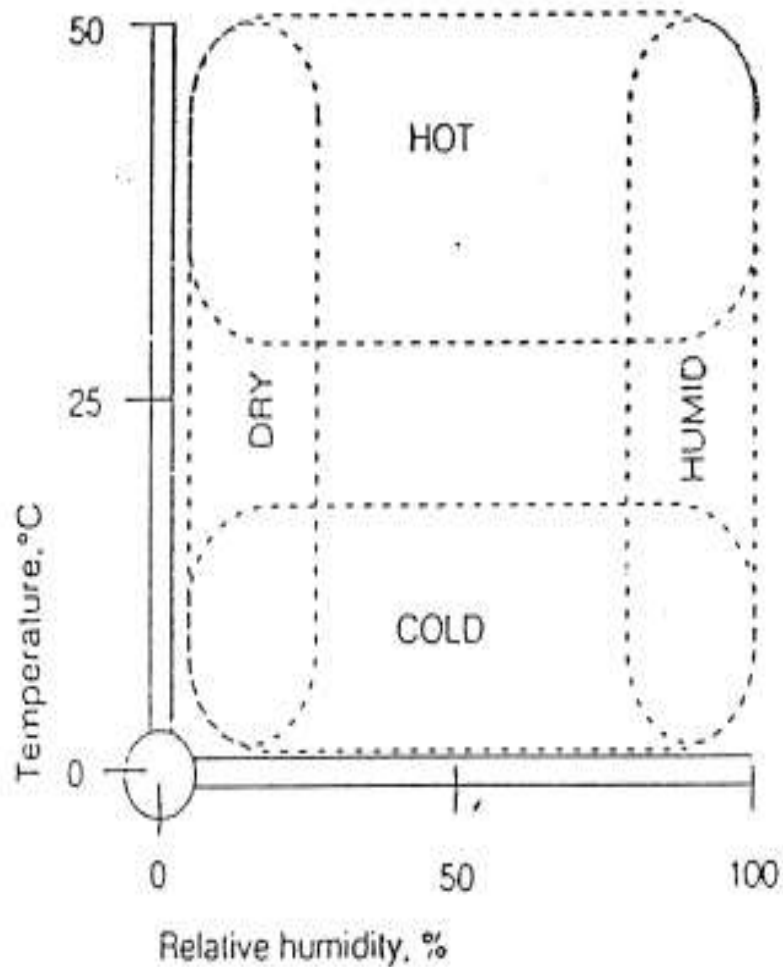


driven by temperature difference
and height between openings

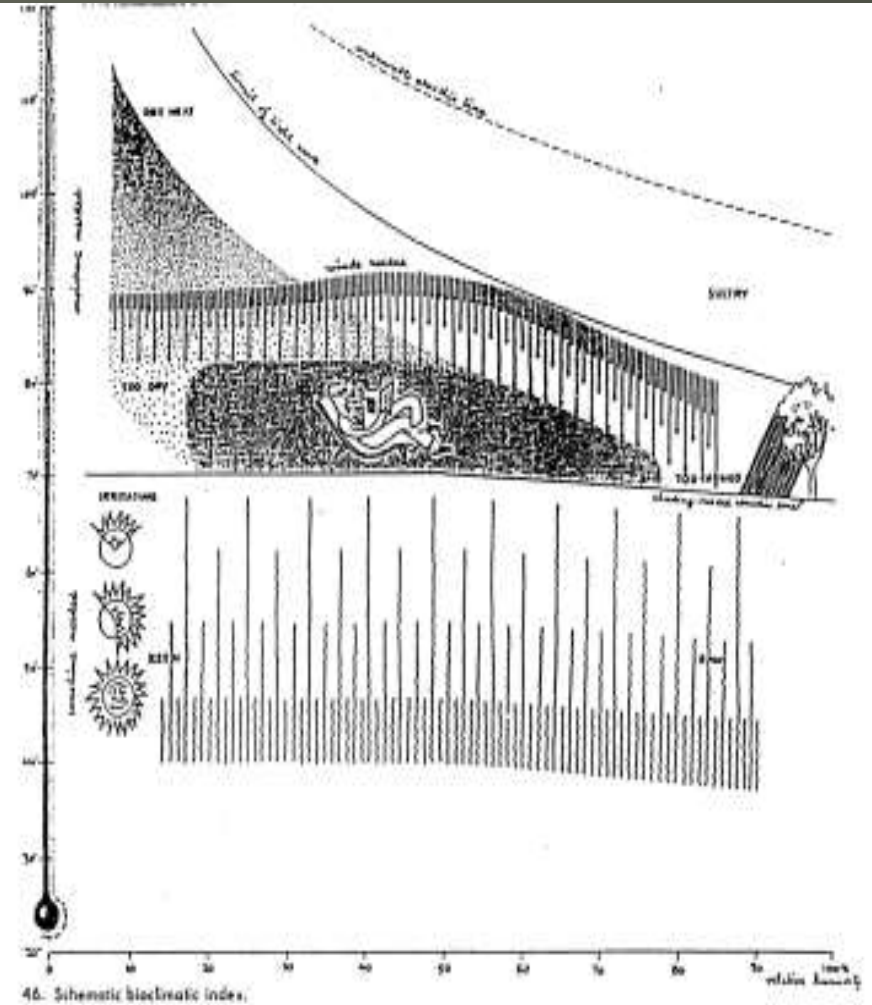
STORAGE OF COOLTH \$ WARMTH



Comfort Zone



COMFORT ZONE



Clothing Comfort

Table 4.4 Clothing values

<i>clo value</i>	<i>Clothing example</i>	<i>Typical comfort temperature when sitting (°C)</i>
0 clo	Naked; swimwear	29
0.5 clo	Light trousers, shirt; light dress, blouse	25
1.0 clo	Business suit; dress, jumper	22
2.0 clo	Heavy suit, overcoat, gloves, hat	14

Note: Appropriate underclothing is assumed in each case.

Clothing Comfort

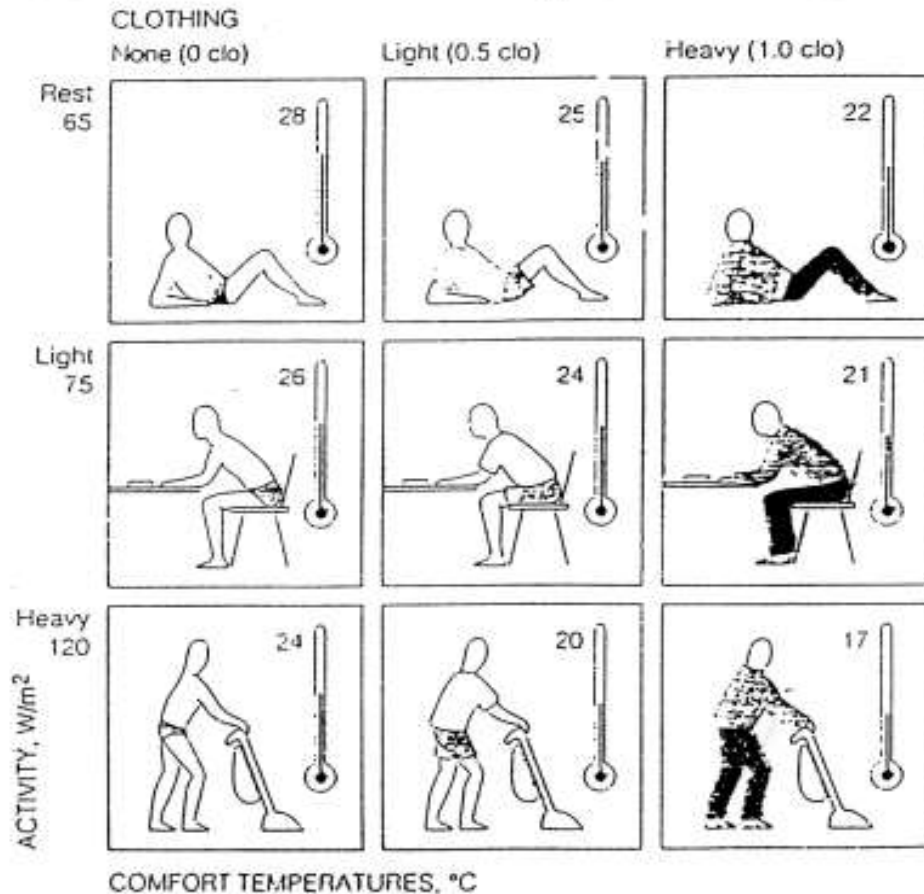


Table 5.3 Requirements for a pleasant environment according to Bedford

- 1 Rooms should be as cool as is compatible with comfort.
- 2 The velocity of air movement should be about 10 m per minute in winter (less than 6 m per minute may cause stuffiness). Higher rates are desirable in summer.
- 3 Air movement should be variable rather than uniform.
- 4 The relative humidity should not exceed 70% and should preferably be substantially below this figure.
- 5 The average temperature of internal surfaces should preferably be above or at least equal to the air temperature.
- 6 The air temperature should not be appreciably higher at head level than near the floor and excessive radiant heat should not fall on the heads of occupants.

Relative Humidity should ideally be between the range of 40-70% for comfortable conditions

Ventilation

- In any occupied space ventilation is necessary to provide oxygen and to remove contaminated air.
- Fresh air contains about 21% oxygen and 0.04% carbon dioxide.
- Expired air (breath out) contains 16% oxygen and 4% carbon dioxide.

Ventilation

- The human body requires a constant supply of oxygen but the air would be unacceptable well before there was danger to life.
- As well as a comfort consideration the rate of ventilation has a great effect on the heat loss from buildings and on condensation in buildings.
- Recommended rates of ventilation depend on the volume of the room, the number of occupants, the type of activity and if smoking is permitted.

Ventilation

Table 4.6 Typical fresh air-supply rates

<i>Type of space</i>	<i>Recommended air-supply</i>
Residences, offices, shops	8 litres/s per person
Restaurants, bars	18 litres/s per person
Kitchens, domestic toilets	10 litres/s per m ² floor

Condensation

- Condensation in buildings occurs when warm moist air meets surfaces that are at or are below the dew-point of that air.
- Warm air can hold more moisture than cold air.
- Condensation in buildings is a form of dampness caused by water vapour in the air.
- The effects are misting of windows, beads of water on non absorbent surfaces, dampness of absorbent materials and mould growth.



Light

● Circadian Rhythm

- Effects of natural light on people include:
- feeling energetic and positive when it is sunny
- feeling sluggish and even depressed when grey and dark.

Symptoms of SAD Seasonal Affective Disorder

<https://www.nhs.uk/Conditions/Seasonal-affective-disorder/Pages/Introduction.aspx>

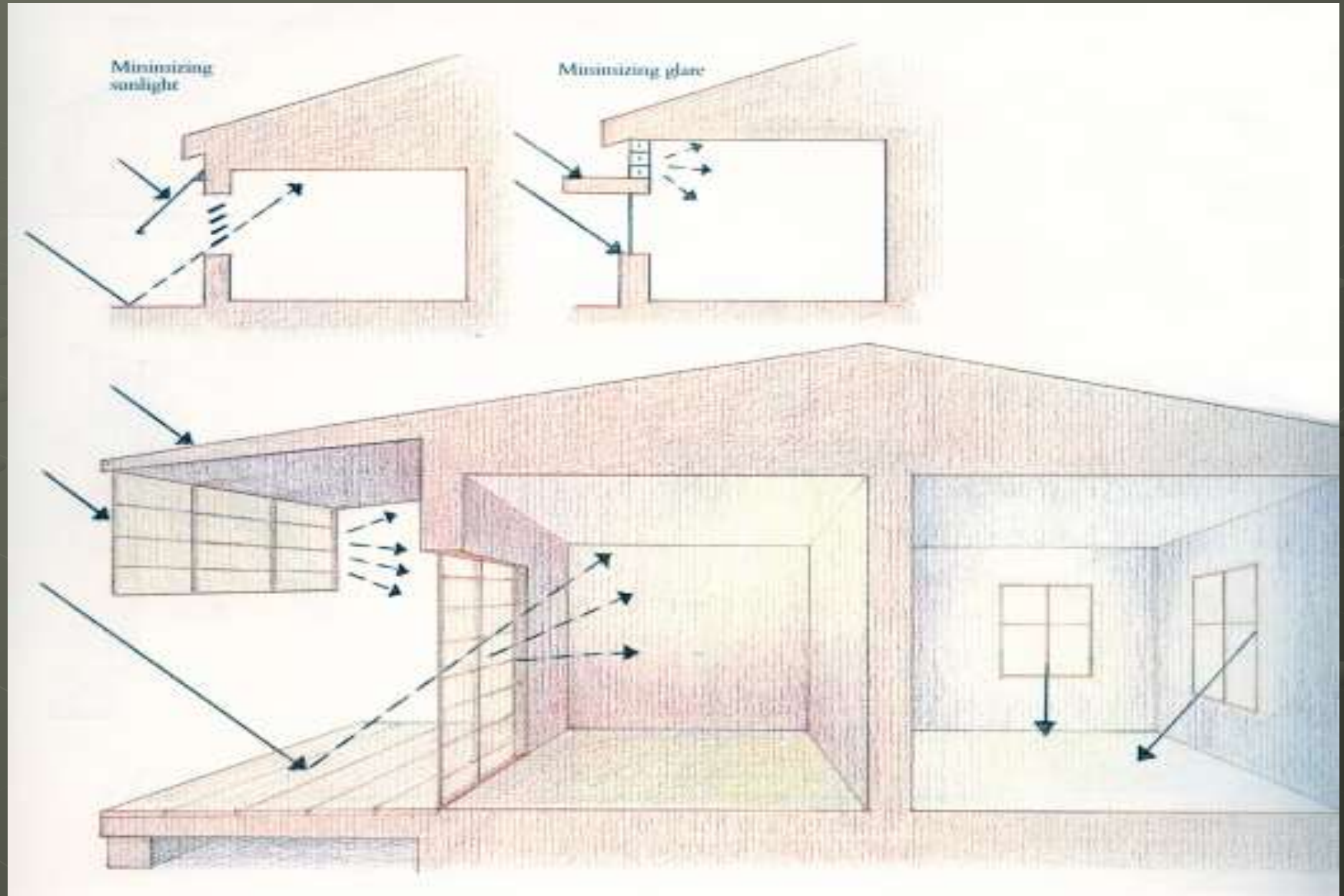
Symptoms of SAD can include:

- a persistent low mood
- a loss of pleasure or interest in normal everyday activities
- irritability
- feelings of despair, guilt and worthlessness
- feeling lethargic (lacking in energy) and sleepy during the day
- sleeping for longer than normal and finding it hard to get up in the morning
- craving carbohydrates and gaining weight
- For some people, these symptoms can be severe and have a significant impact on their day-to-day activities.

Daylighting / Glare



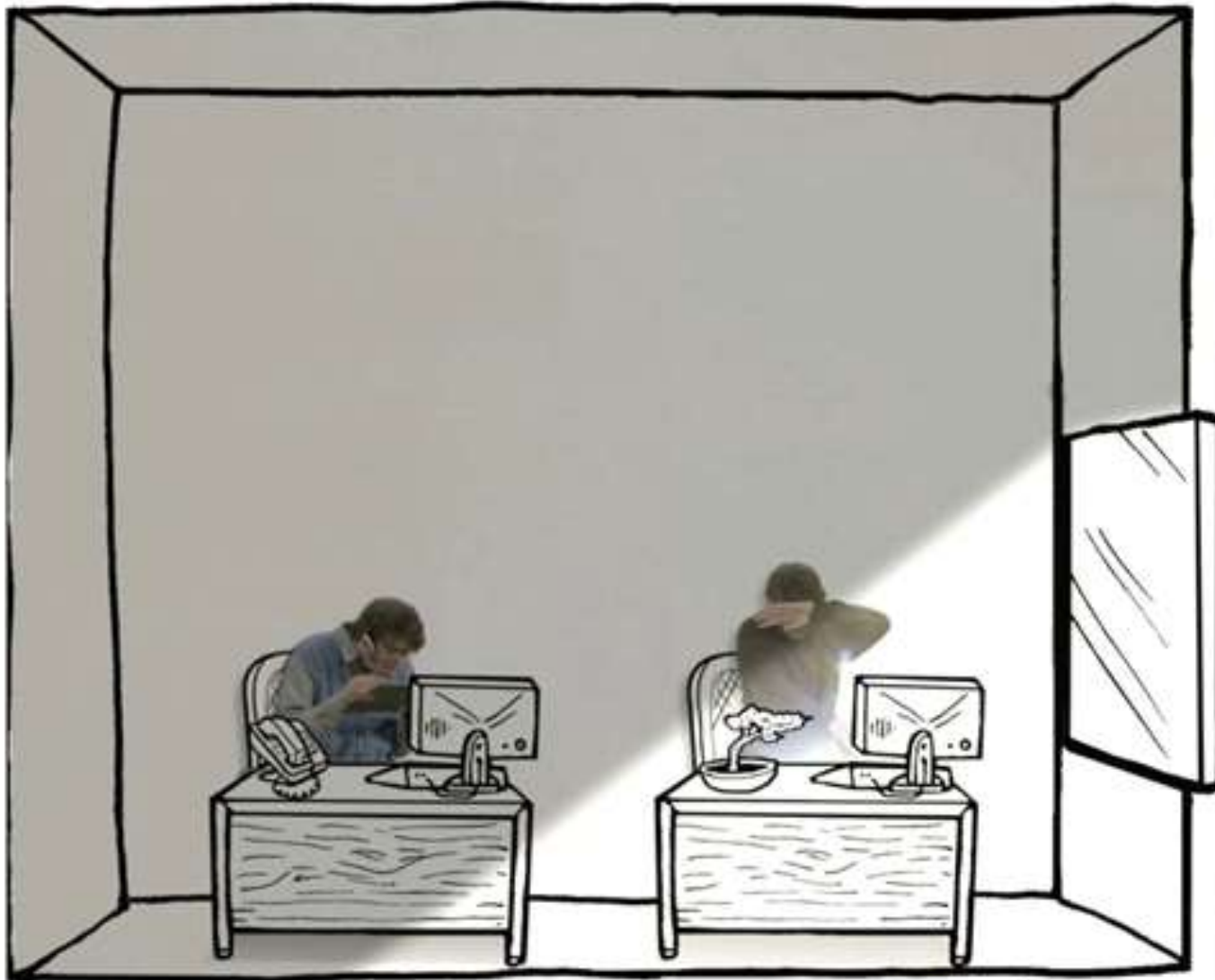
Daylighting / Glare



Glare

- **Glare** can occur when a bright light is directly in the field of vision e.g. the sun shining directly on a work table.
- It can also occur when even a small light creates a high level of contrast e.g. a single light at night.

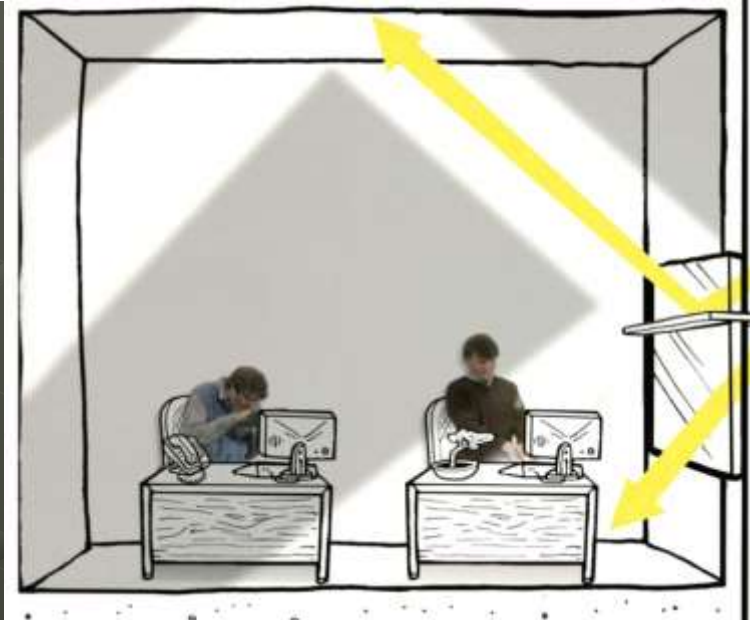
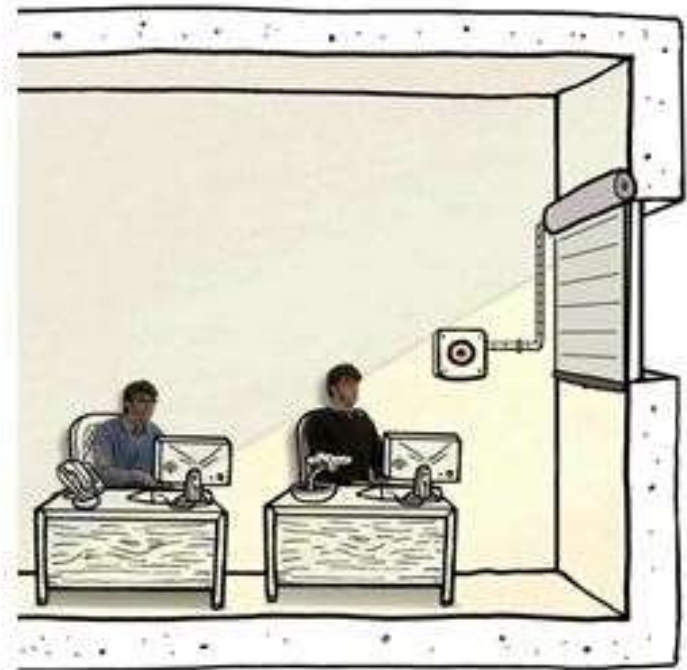
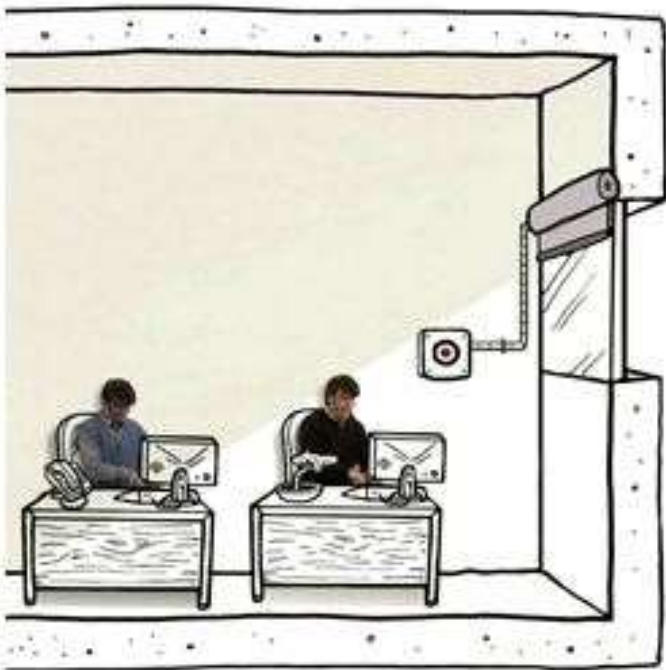
Glare



Glare

A nighttime photograph of a two-lane road. In the distance, a car is driving away, its taillights glowing red. On the left side of the road, the headlights of an oncoming vehicle are very bright, creating a significant glare effect with multiple light rays extending across the frame. The road is flanked by dark trees and foliage. The sky is a deep blue, indicating twilight or early night. The overall scene illustrates the concept of nighttime glare in driving.

Night time glare



Glare control

Solar control



Solar control



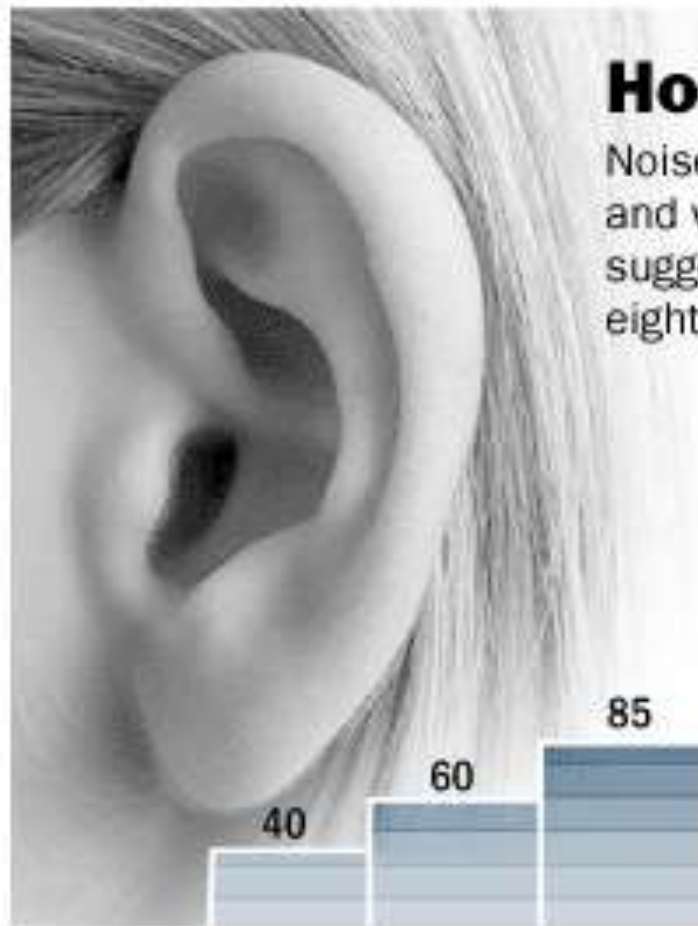
Noise



Noise

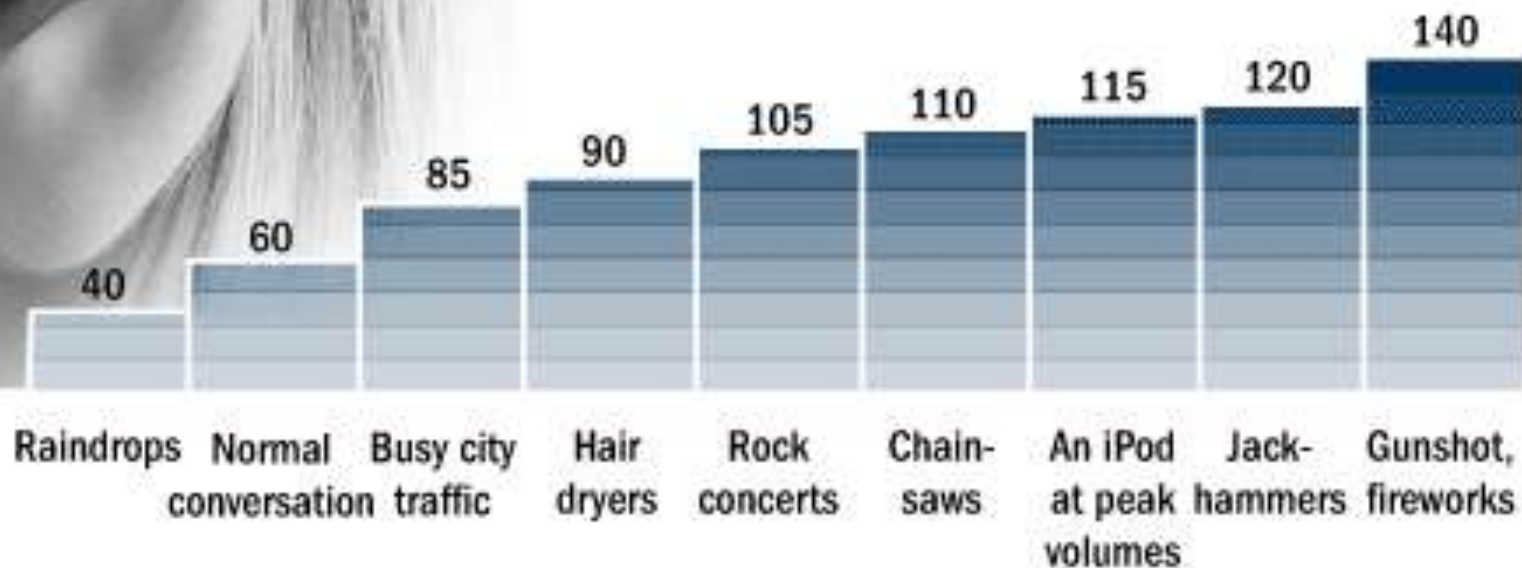
- Noise can be a major cause of discomfort, particularly in cities people are exposed to high levels of noise from:
- roads, aircrafts, trains
- factories etc.
- machinery outside and inside buildings e.g. office equipment . services e.g. ventilation fans
- people walking, moving, talking

Noise

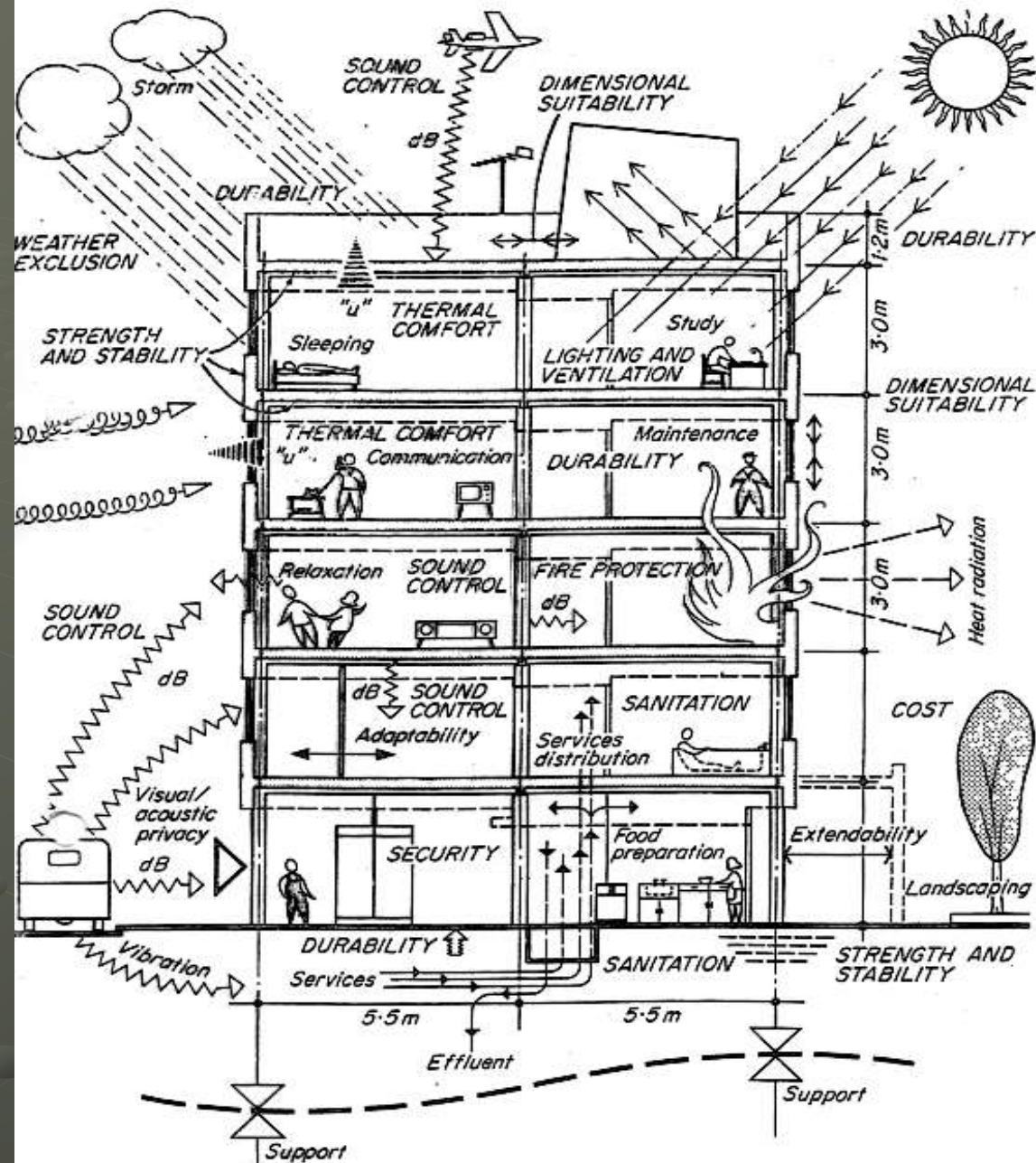


How Loud Is Too Loud?

Noise-induced hearing damage is related to the duration and volume of exposure. Government research suggests the safe exposure limit is 85 decibels for eight hours a day. Some common decibel levels:



Noise



Performance Requirements of a Building

References for further reading

- Daniel D. Chiras, **The natural house**: a complete guide to healthy, energy-efficient, environmental homes, Chelsea Green Pub., 2000
- Steve Curwell [et al.], **Hazardous building materials**: a guide to the selection of environmentally responsible alternatives, London: Spon, 2002
- Steve Curwell, Chris March, Roger Venables editors, **Buildings and health**: the Rosehaugh guide to the design, construction, use and management of buildings, London: RIBA, 1990
- Bilt Holdsworth and Antony Sealey, **Healthy buildings**: a design primer for a living environment, Harlow, Essex: Longman, 1992
- David Pearson, **The new natural house book**: creating a healthy, harmonious, and ecologically sound home, New York: Simon & Schuster, 1998
- G.J. Raw, **Sick building syndrome**: a review of the evidence on causes and solutions, London: HMSO, 1992

ISSUES AFFECTING BUILDING PERFORMANCE AND DESIGN

Man-made conditions

- Vibrations etc
- Pollution (Noise, materials, water and air)
- Social factors (anti-social behaviour, user needs)

ISSUES AFFECTING BUILDING PERFORMANCE AND DESIGN

Legislation

- Building Regulations
- Building and material standards

ISSUES AFFECTING BUILDING PERFORMANCE AND DESIGN

Construction

- Economic considerations

ISSUES AFFECTING BUILDING PERFORMANCE AND DESIGN

Construction

- Economic considerations
- Construction process
- Appropriate structure
- Appropriate materials
- Appropriate services