The principles way that design of a building can react to climate

- **Introduction**
- Climate plays an integral role in our lives for a whole range of decisions about where we decide to live, what we wear, whether we recreate outside or inside, how we think and act in our workplace and how we feel generally.
- Any significant change in climate is likely to have some effect on the social and lifestyle needs of Human at home, in the workplace and in the community.
- Climate also has the potential to impact on buildings and the urban environment in a number of ways, through damage and impacts from more intense cyclones and hail storms, flash flooding events and subsidence due to heavy rainfall, clay soil shrinkage from drier conditions, increased fire risk, as well as changes in demand for space heating and summer cooling. In other words, there is no doubt that climate have broad and far-reaching effects on our society, lifestyles, economy and governance.

- Vice Versa Many features of the physical structure of the city can affect the

urban climate. Therefore it is possible to modify the urban climate through urban policies and design of neighborhoods and whole new cities. With such modifications it is possible to improve the comfort of the inhabitants outdoors and Indoors and to reduce the energy demand for heating in winter and for cooling in summer. The following urban design elements that affect the urban climate are discussed in this article, with reference to the research literature:

- Size of the city
- Orientation and width of the streets
- Density of the built-up area
- Height of buildings
- Building color
- Effect of parks and other green areas on the urban climate

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❖ The climate conditions that relate directly to thermal design include :

- Solar radiation, sun path and cloud cover See figure (1-1)
- Wind speed and direction
- Air temperature
- Relative humidity
- Rainfall and driving rain

- **Solar radiation and sun path**
- Solar radiation impacts on the building in three forms, Direct radiation, from the position of the sun in the sky
- Diffuse radiation, from the whole of the visible sky; and
- Reflected radiation (albedo) from adjacent surfaces.

All three components will vary according to time of day, time of year and cloud cover, and how much sky is seen by the building depending on natural and man-made obstructions. The solar path can be determined from the altitude and azimuth angles of the sun as in (1-2). Typical values of solar radiation are given in Tables IX and X, and the effect of sun angle and overshadowing in (1-3).

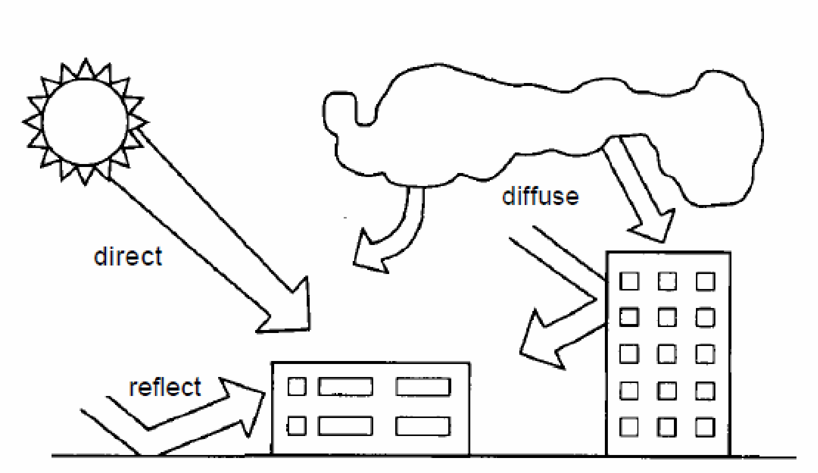


Figure (1-1)Direct, diffuse and reflected solar radiation

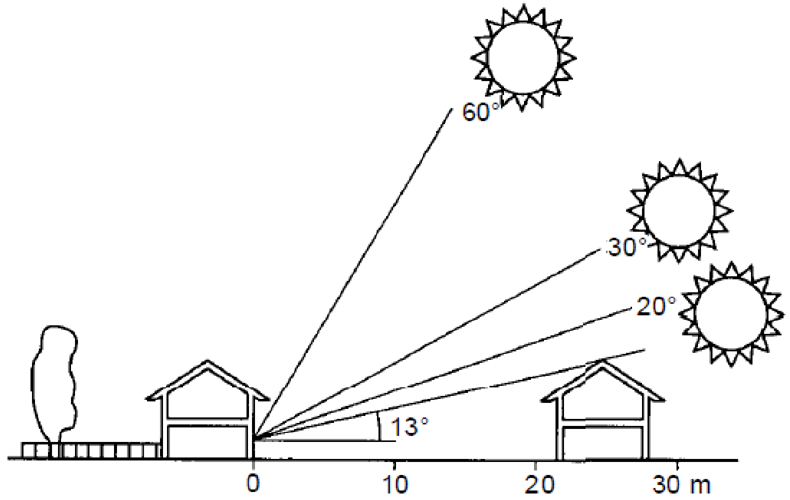


Figure (1-3) Sun angle and overshadowing

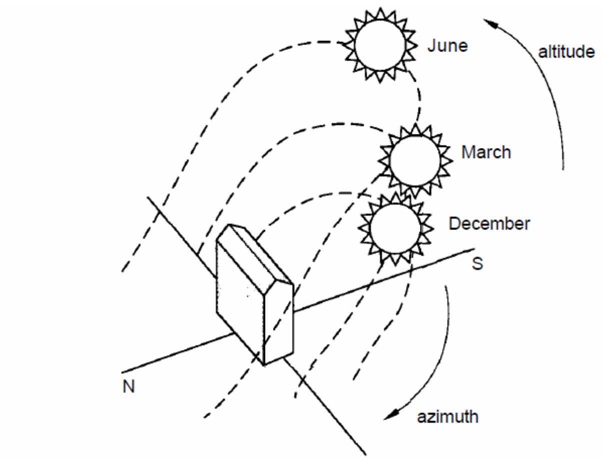


Figure (1-2) Sun angles indicating azimuth and altitude

Wind

The impact of wind on a building has two main consequences for thermal design. It affects the connective heat loss at the external surfaces, as well as the ventilation and infiltration rate and the associated heat loss.

Wind speed and direction

Wind speed is measured in m/s or sometimes in knots where 1 knot equals 0.4 m/s. Wind direction is usually measured at eight points of the compass or, when required in more detail, in degrees clockwise from south. The wind speed and direction can be represented by a wind rose, which indicates the relative frequency and speed of wind from different directions.
Wind speed increases with height due to the frictional drag of the ground. The profile of variation with height is called the boundary layer, and it will vary from town to open country locations, as shown in (2-1), and according to the relationship:

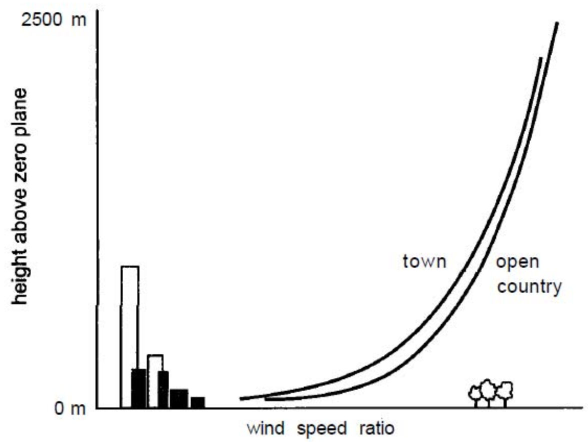


Figure (2-1) Boundary layer wind profile

Dynamic and static wind pressures

The static pressure (Ps) of the air is the pressure in the free-flowing air stream (as shown on the isobars of a weather map). Differences in static pressure arise from global thermal effects and cause wind flow. The dynamic pressure (Pd) is the pressure exerted when the wind comes into contact with an object such as a building, (2-2). The total or stagnation pressure (Pt) is the sum of the static and dynamic pressures. In most cases P s can be ignored in thermal design as it is usual to deal with pressure differences across a building, ie the difference in P d. The dynamic wind pressure is related to the air density (r) and the square of the wind speed (v).

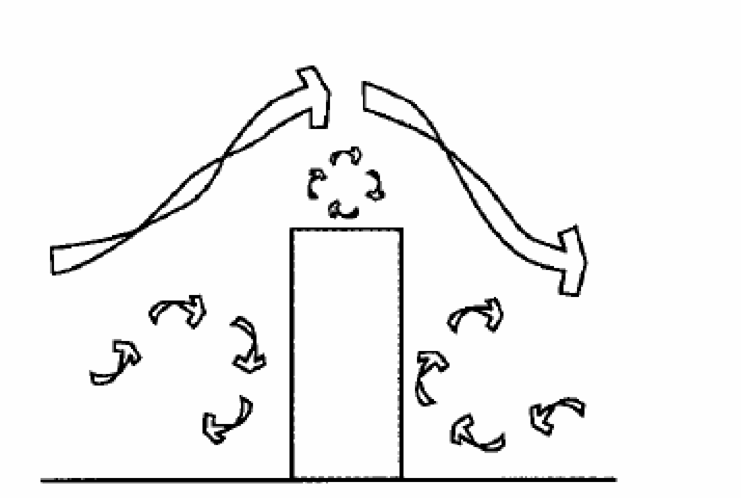


Figure (2-2) Typical wind flow pattern around a high-rise building

- **Pressure coefficients**

The impact of wind on the building form generally creates areas of positive pressure on the windward side of a building and negative pressure on the leeward and sides of the building. The pressure coefficient is the relative pressure at a specific location on the building and it can be used to calculate the actual dynamic pressure for a given wind speed.
The pressure coefficients are dependent on general building form, as shown in the example in (2-3). A scale model of the building can be placed in a wind tunnel to predict C ps. Building form is the main determinant of pressure distribution for a given wind direction. Openings should then be located to produce the required ‘cross-ventilation’ from pattern, (2-4).

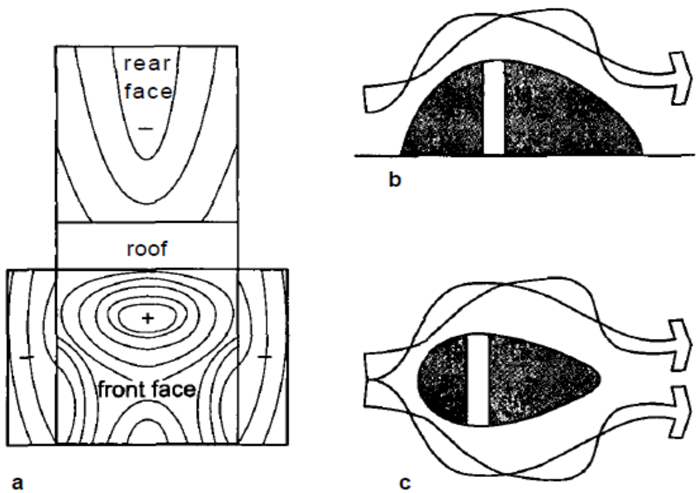


Figure (2-3) Wind pressure over a building envelope: a Pressure distribution; b Section; c Plan

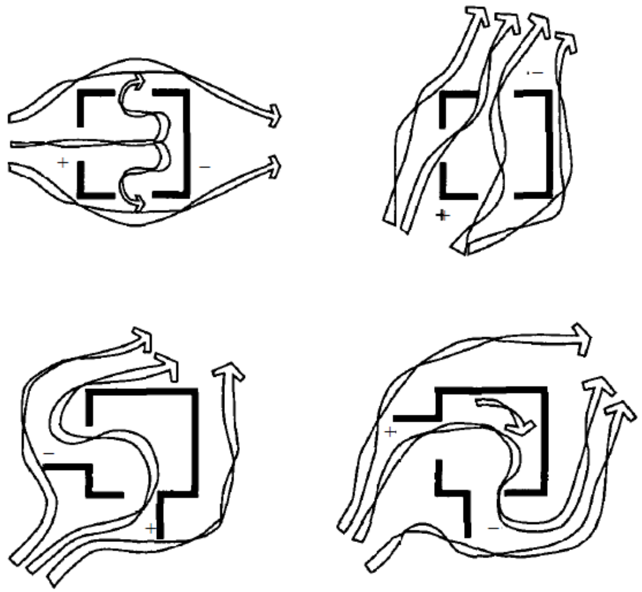


Figure (2-4) Pressure coefficients can be manipulated by the form of the building

- **Pressure External sheltered areas**

The There are ‘rules of thumb’ which can be applied to estimate the impact of wind on buildings, in relation to creating external sheltered areas (for example, courtyards). These are shown in (3-1). The figures show that distances between buildings should be less than about 3.5 times the building height, in order to create shelter from the prevailing wind. Barriers can be used to reduce wind speed and create external sheltered areas. Porous barriers are often more suitable than ‘hard’ barriers as they reduce wind speed and do not induce counter wind flow areas as shown in (3-2). High wind conditions can be created by downdraughts from tall buildings (as in 2-4), wind ‘canyons’ or acceleration around corners (3-3).

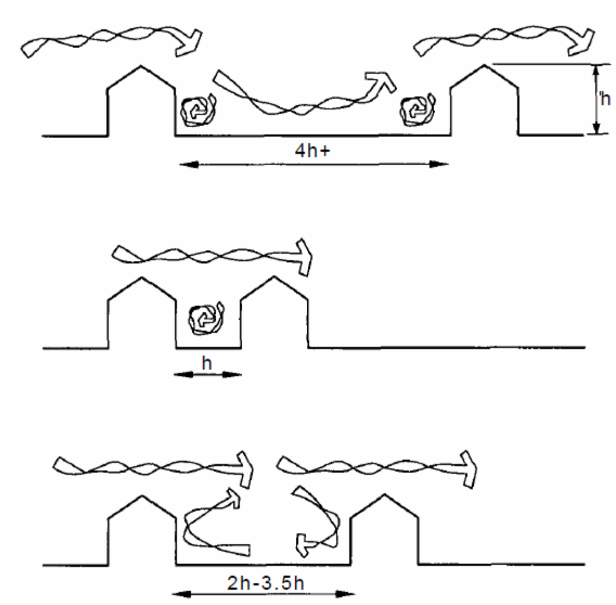


Figure (3-1) Building spacing and provision of sheltered external spaces

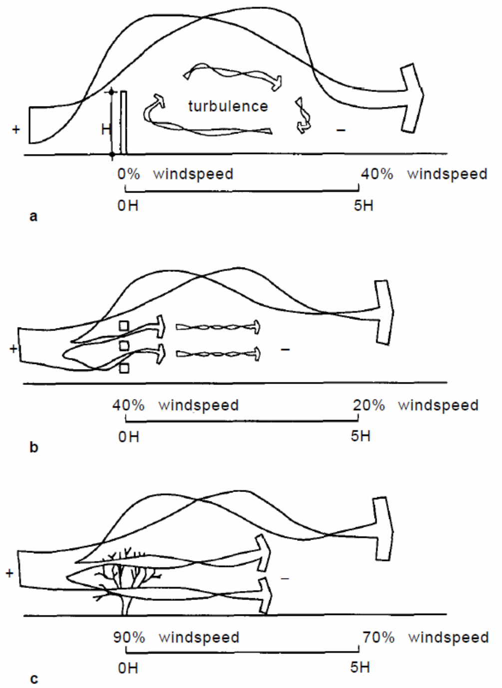


Figure (3-2) Barriers and their effect on wind flow: a Dense barrier; b Medium barrier; c Loose barrier

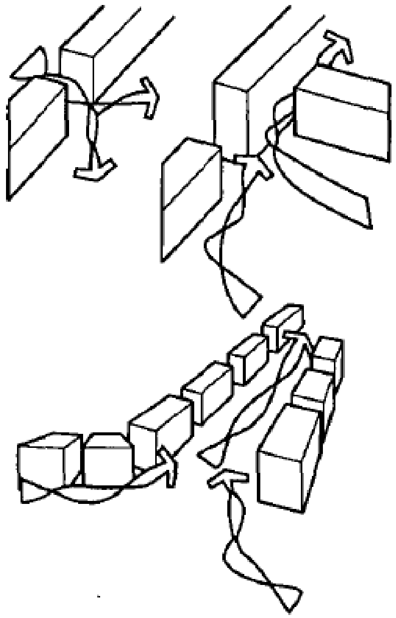


Figure (3-3) Localized high wind speeds can be caused by ‘canyon’ effects and acceleration around corners

- **Site analysis**

An overall site analysis should identify the prevailing wind, the seasonal sun paths, and existing shelter and obstructions, well as other aspects, such as noise sources and views,

- **Air temperature**

The external air temperature will affect the rate of transmission and convective heat loss from a building. It will typically vary over a 24-hour period (the diurnal variation) and over a year (seasonal variation). It will also vary with location.

- **Relative humidity**

The external RH will vary with external air temperature and moisture content of the air. During periods of warmer weather, the RH may be relatively low due to the higher external air temperatures, although at night it will rise as the air temperature falls, During cold weather the external RH can rise typically to over 90%. presents seasonal average RH values.

- **Rainfall and driving rain**

Rainfall can affect thermal performance. If an external surface is wet then it will lose heat by evaporation and this will reduce the external surface temperature, sometimes to below air temperature, increasing heat loss. Wind-driven rain (‘driving rain’) can penetrate some constructions, causing a reduction in thermal resistance. In areas of high incidence of driving rain, care must be taken to select constructions that provide protection against rain penetration.

- **Information needed by the construction industry**

- local microclimate information including temperature, rainfall, solar radiation and wind
- how the predicted availability of resources, such as gas/electricity energy sources, are influenced by climate change
- urban wind and urban flooding predictions, to indicate both the likelihood and potential impact
- clarification on extreme events. Can the probability of extreme weather events be broken down regionally?
- What will extremes of climate be like in 30 years' time? And will more regular extreme weather events such as storms, flooding, heat waves and droughts affect structural and material stability?
- site-specific climate change information for designers
- how climate change will affect the population; how will they react? Will the public tolerate the change or will their actions make predictions worse?
- engineers need help interpreting the practical implications of climate change margins of error.

- **How is a building designed?**

As you can see, when designing a building there are lots of things to think about. There are also a lot of people involved in the process.

The architect will come up with a concept for the building and then the Design Team will help them optimize their ideas within the constraints of the design – that is client expectations, cost, location, use etc. In order to design a building well the whole team needs to work together to produce the best design for everyone. This may involve compromise between the various aspects of the design, for example – a building needs to look good, but it also needs to be within budget, gold taps might look great but if the client can't afford them he won't thank the team for designing them. The budget might be tight, but getting rid of the heating system to save money isn't an option! These are extreme examples, but the end product of the design process needs to fulfill all the requirements of the client and the user.

- We need to design a building to ensure that the people that use the building are comfortable inside it.

- **Conclusion**
- Topography, climate , Culture ,Live Development , and geography are all utilized as natural determinants in vernacular architecture ,Especially plays an integral role in Building design
- The Design concept, Using Materials , direction of the Building , Windows Type and Size , Isolation type, all these data reacted by the Climate
- Urban Historical , Live Development , Culture are reacted by the Climate too
- Architecture and landscape design should grow from local climate, topography, history, and building practice.

- in designing for tropical, temperate and cold climate cities, but the application of the principles (except in extreme climatic conditions) has to compete for attention with aesthetic concerns and the price of land as populations swell. In tropical areas, for instance, buildings should be set apart to allow breezes to waft through them, but economic forces push land values up and denser environments result. In hot arid climates such environments are necessary but cars take up considerable space.

- Climate and Building Design

You'd like to have a comfortable home, save energy and costs, reduce pollution, and protect the environment. But where do you start? Check our quiz to see if your house makes the grade! The design starting point is the outdoor climate - how can the house modify the ambient conditions, so that indoors is always more comfortable than outdoors? Each climate zone needs a different design approach

Human requirements regarding indoor climate

- 1 Human physiology
- 2 Thermal comfort zone
- 3 Requirements for buildings according to their functions
- 4 Limitations

One of the main functions of buildings is to protect the inhabitants from outdoor climatic conditions which are often harsh and hostile. The building must provide an environment that does not harm the health of the inhabitants. Moreover, it should provide living and working conditions which are comfortable. To achieve this, the physiological functions of the human body are to be considered. It is also necessary to know under which thermal conditions human beings feel comfortable.

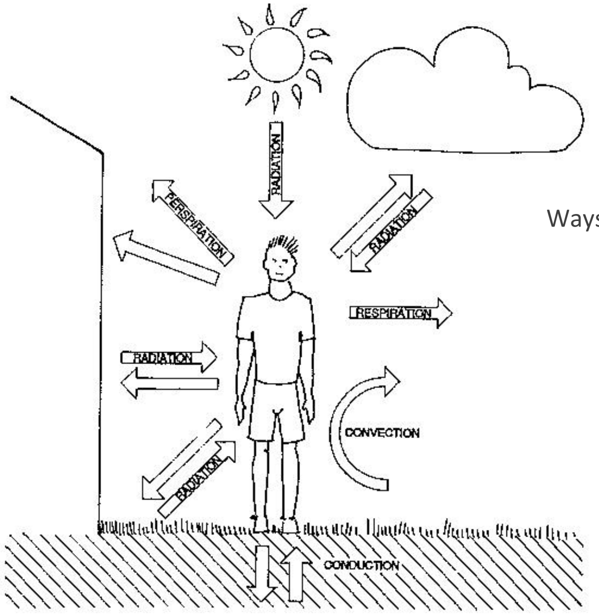
- Human physiology

Physiological factors are of primary importance with regard to comfort. The internal temperature of the human body must always be kept within narrow limits at around 37°C. Any fluctuation from this value is a sign of illness, and a rise of 5°C or a drop of 2°C from this value can lead to death.

The body has the ability to balance its temperature by various means.

This thermal balance is determined, on the one hand, by the "internal heat load" and on the other, by the energy flow (thermal exchange) between the body and the environment.

The thermal exchange between the body and the environment takes place in four different ways: conduction, convection, radiation and evaporation (perspiration and respiration).



Ways of thermal exchange by the human body

If the Design Concept worked with the Climate it will led to the Thermal comfort zone which the Definition of (T.C.Zone)is
The optimum thermal condition can be defined as the situation in which the least extra effort is required to maintain the human body's thermal balance. The greater the effort that is required, the less comfortable the climate is felt to be.

The maximum comfort condition can usually not be achieved. However, it is the aim of the designer to build houses that provide an indoor climate close to an optimum, within a certain range in which thermal comfort is still experienced.
This range is called the comfort zone. It differs somewhat with individuals. It depends also on the clothing worn, the physical activity, age and health condition. Although ethnic differences are not of importance, the geographical location plays a role because of habit and of the acclimatization capacity of individuals.
Four main factors, beside of many other psychological and physiological factors, determine the comfort zone:

· air temperature
· temperature of the surrounding surfaces (radiant heat)
· relative humidity
· air velocity

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