

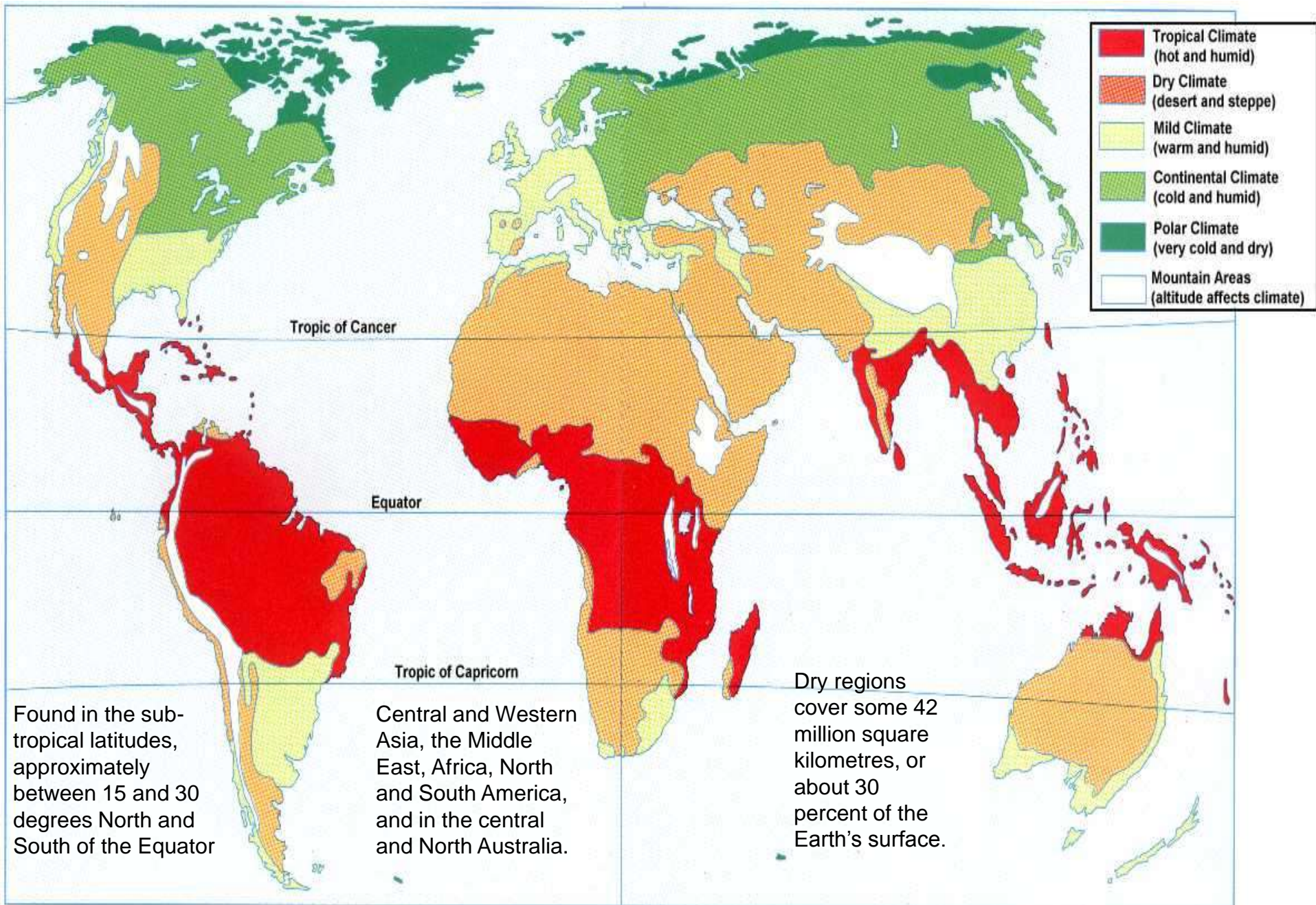
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**ECO-TOWN PLANNING DESIGN
GUIDELINES FOR HOT AND DRY
CLIMATE REGIONS FROM
ARCHITECTURAL PERSPECTIVE**

**Review and Planning Workshop
on Eco Town - 2012**

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Introduction



- Characterized by their aridity
- High summer day time temperatures (32-36° C)
- In hotter regions above 40 and up to 50° C.
- large diurnal temperature range (15-20° C)
- High solar radiations (800-900 w/m²)
- Frequent dust storms, and
- little or no rain.
- Clear sky most of the year, promoting solar heating during the days and long wave radiant loss during the nights.

- Some regions which are hot in summer may experience comfortable winters, while others may have winter temperature well below freezing.
- These variations in the summer and winter conditions create several types of hot-dry regions.
- In each one of them different urban and building design principles and details would be appropriate.

Hot and desert
region



Hot & Steppe
region



DESIGN GUIDELINES

- **SHELTER DESIGN**

House types, General arrangement, Form & Shape, Orientation, Interior and Colour

- **BUILDING ELEMENTS**

Openings and Windows, Walls, and Roofs

- **SPECIAL DETAILS**

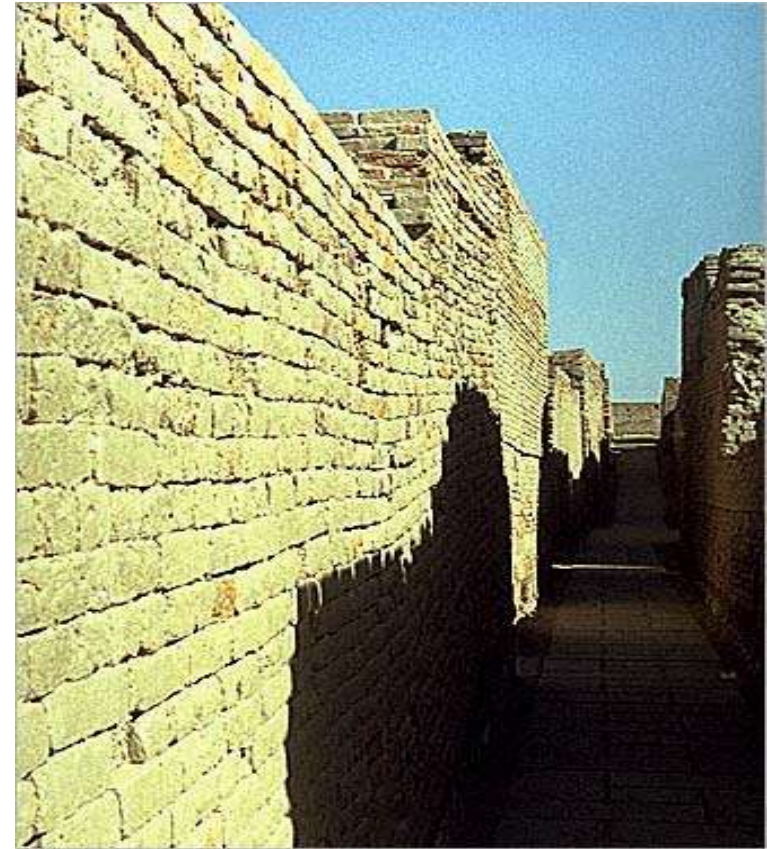
Vegetation near or around the building,
Shading Devices and Materials

(The objective should be to lower indoor temperature and maximize comfort mainly during the summer period)

House types



House types



Computer graphics reconstruction of the "Lower Town"
of Moen-Jo-Daro by Fujitsu Co.

Street View of Moen-Jo-Daro



Drain chute



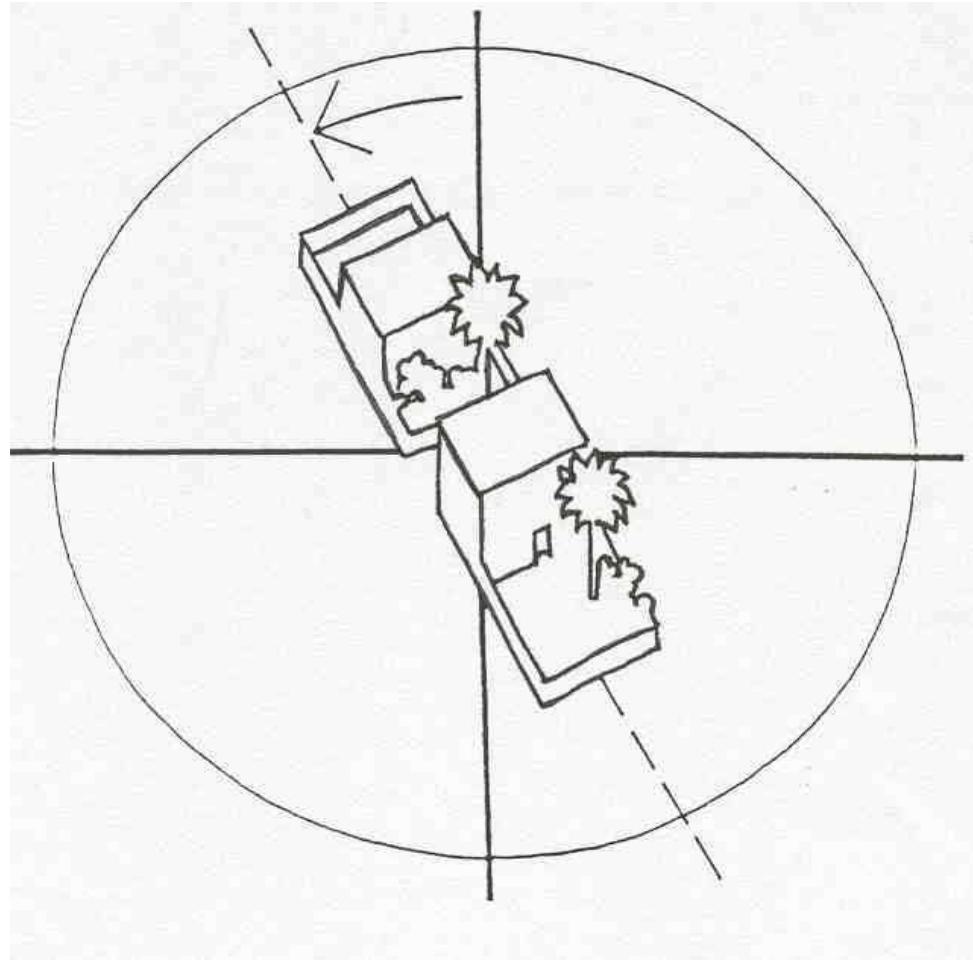
Lane



Dust bin on the side of a lane

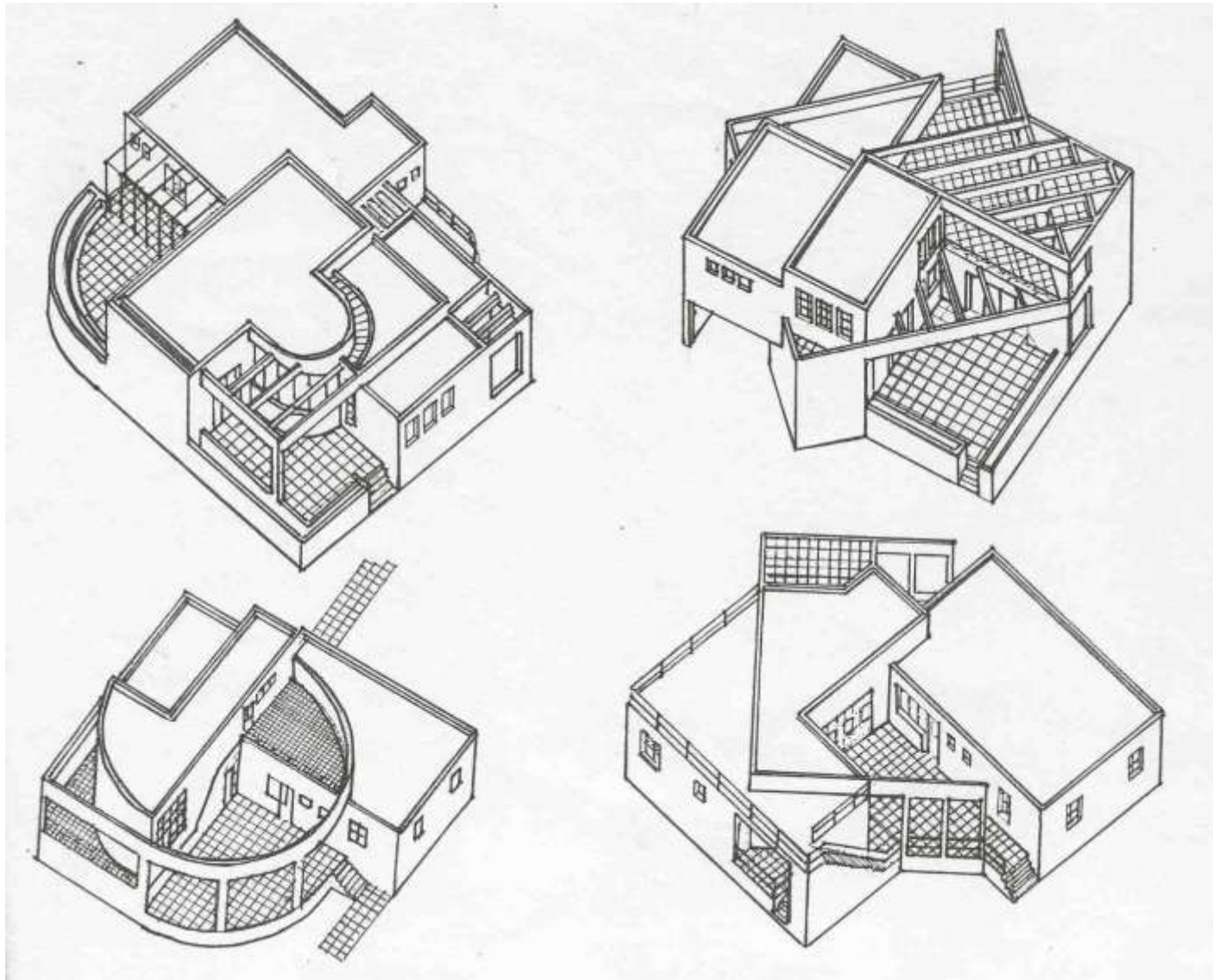


ORIENTATION



Building orientation in hot-dry regions

General arrangement



Houses arranged around courtyards in hot dry regions

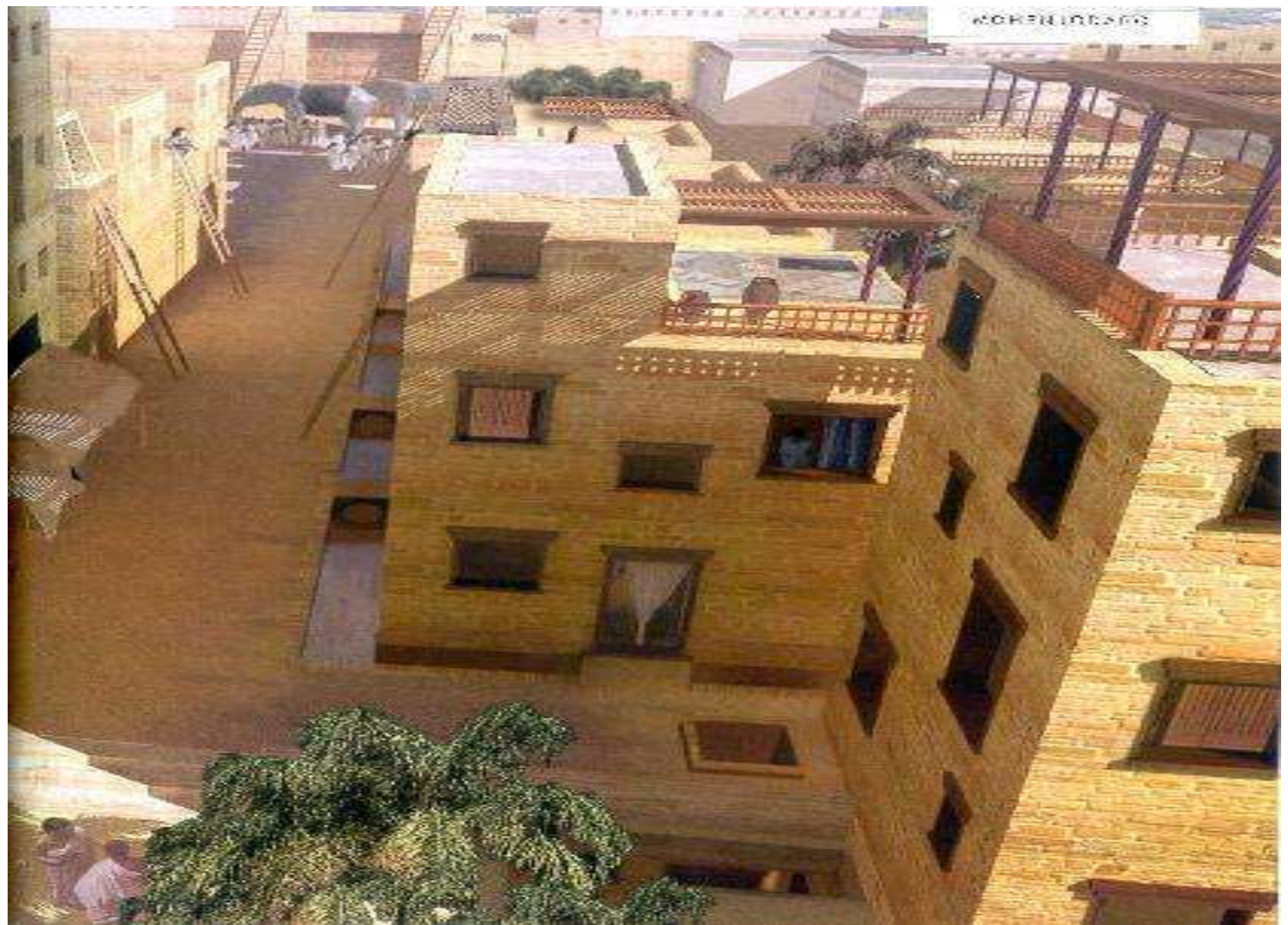
FORM, SHAPE



Square form of the modern desert building



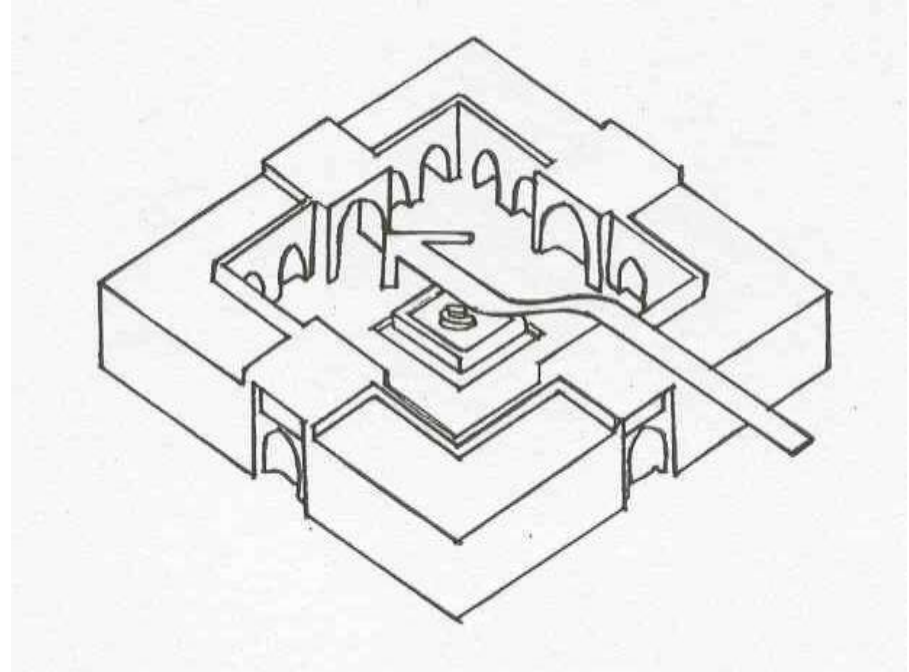
Traditional desert huts in Central Africa



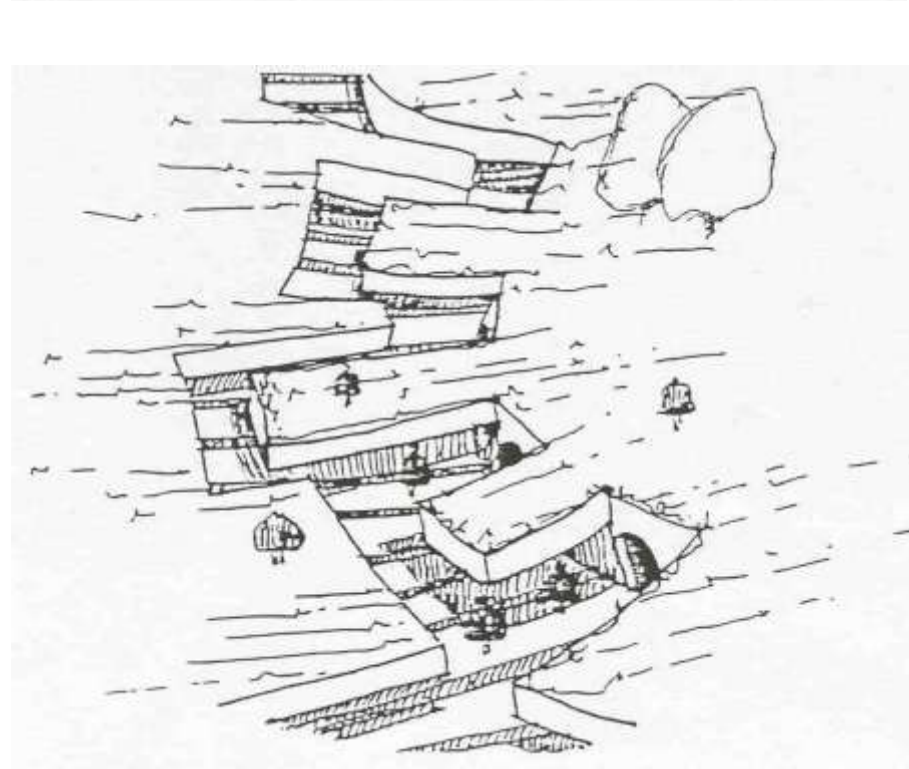
Interiors

- Deep room arrangements can be used as a cooling contrast to intense outdoor heat.
- Use of low emissive “cool” colours reduce heat reflection on interior surfaces.
- Connections with patio areas, verandas and courtyards covered with pergolas have cooling effect on adjacent spaces.

Main building connected with patio areas usually getting advantage of cooling elements



Window below ground alley covered by balconies on a steep slope in hot-dry climate





Colours

- light external colours will minimize internal daytime temperatures, and is better than increasing thermal resistance or capacity
- It has added advantages that comfort at night is also improved
- White paint has high reflection ratio on sun exposed surfaces. Dark absorptive colours are adaptable where reflections towards interior are expected (such as under eaves).

Vegetation near or around the building

- The roof, walls, windows and play and rest areas can be shaded with trees and plants.
- Vegetation in turn reduces the temperature and filter's the dust in and around the house and elevates the humidity level in too dry climates.
- It may reduce as well as increase the wind speed where it is desired.

**Vertical Pergolas
shade the facades**



**Adobe building
surrounded with
vegetation**







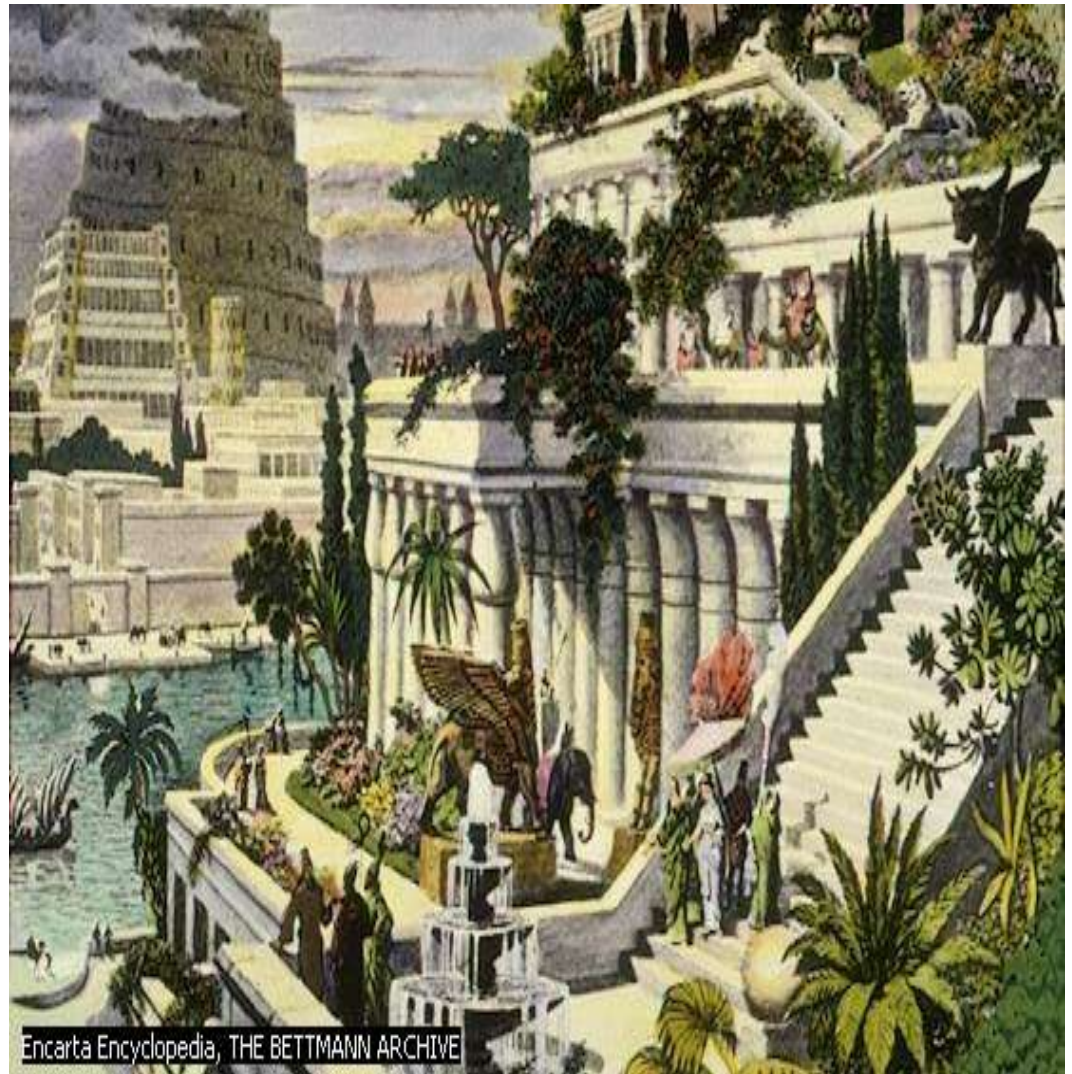


Live oak (*Quercus virginiana*)



Ginkgo (*Ginkgo biloba*), slow growing trees, have very deep roots that make them particularly drought tolerant.

This hand-colored engraving by 16th century Dutch artist Maarten van Heemskerck depicts the Hanging Gardens of Babylon, one of the Seven Wonders of the World. Technically, the gardens did not hang, but grew on the roofs and terraces of the royal palace in Babylon.



Hanging Gardens of Babylon

BUILDING ELEMENTS:

- **Openings and windows**
- Relatively small openings reduce intense radiation. Openings should be tight closing as protection against high diurnal heat.
- Openings should be located on South, North, to a lesser degree, on East sides.
- Low solar angles may bring radiation deep into the house from windows placed on either the eastern or western sides.

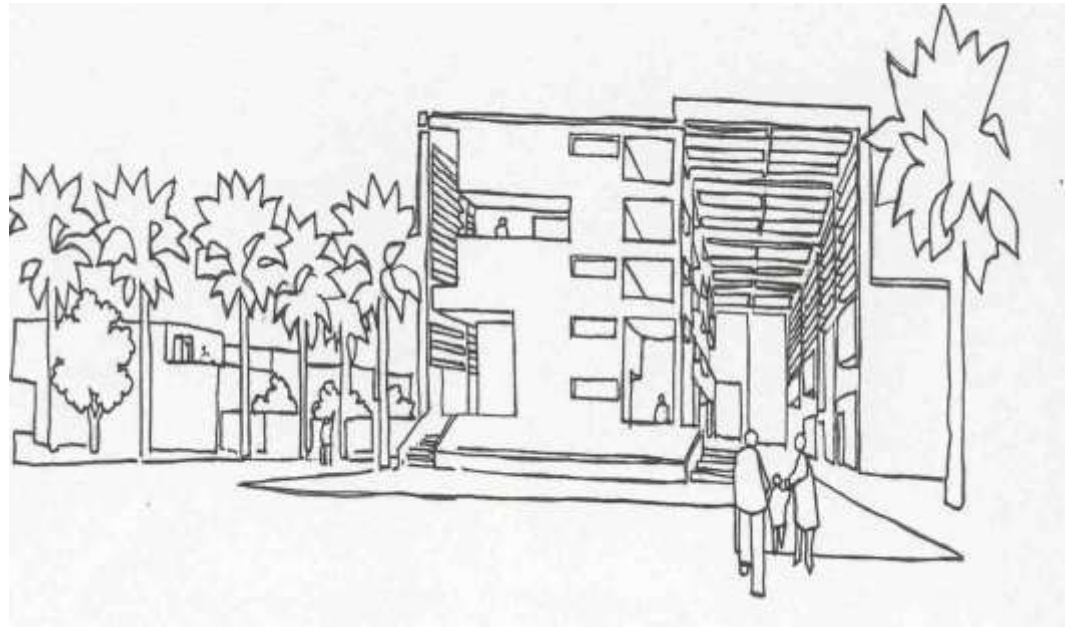




Shading devices

- Effective shading of windows and other glazed areas is one of the major requirements for indoor comfort in these regions during hot summer.
- Such shading can be provided either by fixed shading devices; which are integral elements of the building's structure, or by operable shades.
- Operable shading devices, such as shutters, Awnings, Venetian blinds, etc., can be either internal; or external to the glazing.
- Internal devices are much less effective than external shading in preventing solar heating of the interior space, although they can be very effective in controlling indoor natural lighting.

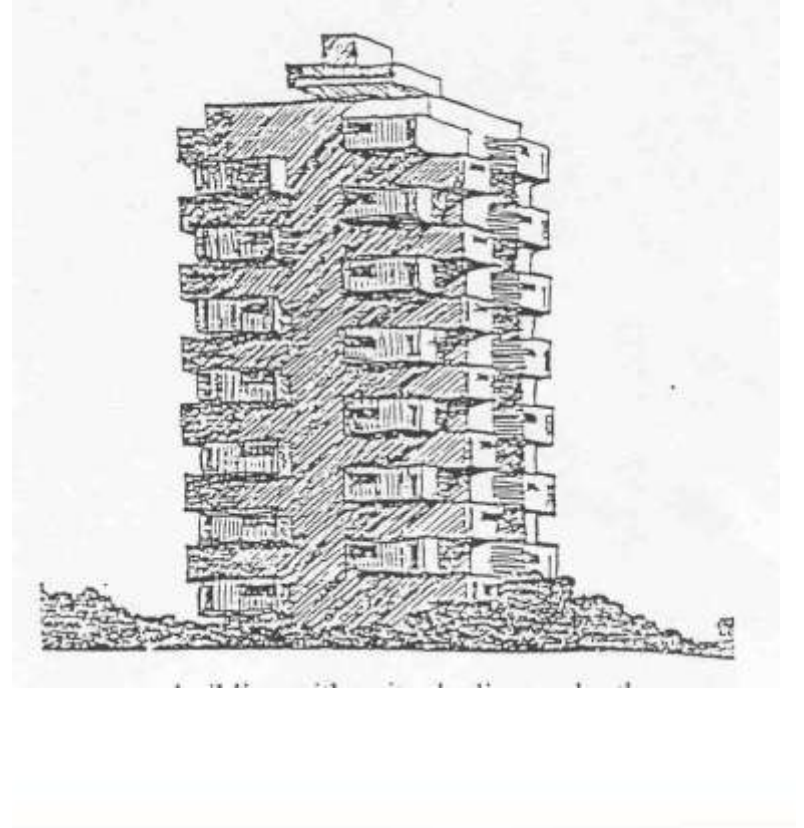
Building fenestration and sun protection



This south-facing view shows how the narrowness of the pathways and the use of vines trellised overhead both provide shade for pedestrians on summer days.



**Multi-storey apartment Building
with units shading each other**



**Visors are designed so that
sunrays never hit the facades.
The bioclimatic design is
enhanced by climbing plants**



Walls

- The walls of daytime living areas should be made of heat-storing materials, while walls of night rooms of materials with light heat capacity
- East and west walls should preferably be shaded.
- Heavy masonry walls are desirable on the west and should be shaded by trees if possible.
- Double wall construction with proper air ventilation should be constructed on westward side.
- High reflective qualities are desirable for both thermal and solar radiation.

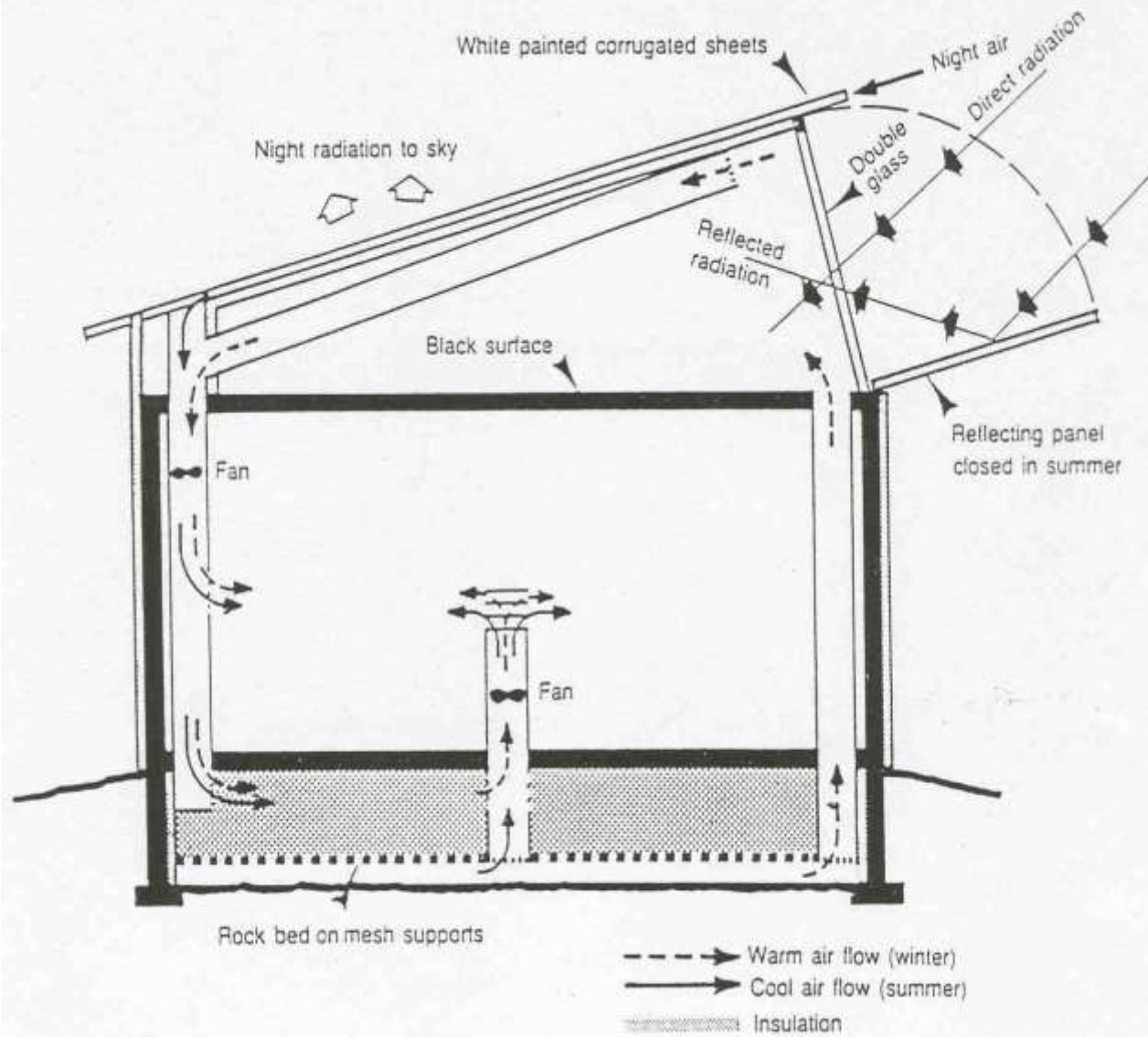
Roofs

- Generally, heat storage insulation is the best, which uses the flywheel effect of out-going radiation for daily heat balance.
- This can be accomplished by thick insulating materials, evaporative cooling on the exterior or radiation screen with ventilation between it and the roof.
- A double roof or a damp-proof or white single roof will reduce the accumulation of heat. Water spray or pool on roof is effective.
- High solar reflectivity is a basic requirement; emissivity is essential for long-wave radiation.

Cont:

- The internal or semi-internal courtyards with access to the rooms of the house through openings cool the interior from several sides rapidly during the evening in hot dry regions.
- Therefore, the roof should slope down towards the courtyard, and be surrounded by a parapet at the upper edges.
- Although the temperature of the whitewashed roof will be close to that of the outdoor air during the day, long-wave radiation to the sky reduces this to 6-10°C below the outdoor level at night.
- Thus air in contact with the roof will be cooled at night and channelled by the slope into the courtyard and then into the rooms





Materials

- Climatic conditions
 - Hand and machine processing
 - Importation possibilities
 - Susceptibility to plant and animal attack, and
 - The economics of production and maintenance.
 - Adaptability
- (Traditional building materials and methods are still widely used in tropical lands).

- However nowadays many manufacturers are selling their materials with the assurance of their applications in different climatic regions.
- Therefore, before choosing materials for the purpose of construction their applications must be known in question.

CONCLUSION

- The aim of the design in hot-dry regions should be to lower both day-time and night-time temperatures in and around the buildings as much as possible to the comfort conditions.
- This can be achieved by keeping building envelopes or surface areas of buildings minimally exposed to the sun environment.

Thank you very much

**Wassalamualaikum
and Good afternoon**