The following is an extraction of the book:

“This Sustainable Urban Design and Climate With Reference to Palestine”

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It is evident that the geometry of the urban form as an urban design parameter is crucial. The layout of the structure can modify the urban climate through proper design, thus improving the thermal comfort both outside and inside buildings, even reducing energy demands for heating and cooling requirements. The main goal of the research is to examine the relationship between different urban forms and the shadow patterns they generate, and to develop evaluation tools for deriving climatic design criteria suitable for use by designers. The main structure of this thesis is arranged in two parts. The first part identifies the conceptual framework of the sustainable urban design in order to provide the reader with basic information about the subject. Secondly, parametric studies have been performed to bridge the gap in the previous studies. The study compares patterns (radial and rectangular) with different orientations and their relations to solar accessibility, bilateral type of buildings, and urban density. While the analysis was mainly related to the Palestinian climate, the techniques employed may be applicable to other countries.
Climate Effect On Human Shelter

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1.3 Climate effect on human shelter:

Climate effects on human shelter include:

1- The choice of location for new settlements (shapes and spatial patterns of settlements).

2- The orientation of the urban mass.
1.3.1 Shelters for Hot-dry climates:
The climate characterized by:

- Extremely hot summers.
- Moderately cold winters.
- Continuously moderate humidity.
- A little or no cloud cover.

The result:
The solar irradiance and its control by minimizing its thermal and glare effects becomes the most important environmental physical field.
Dry air + low humidity + minimal rainfall = Discourage plant life.
Cloud Effects On Earth's Radiation

- Incoming solar shortwave radiation
- Reflected solar radiation
- Reflected by the surface
- High clouds
- Outgoing longwave radiation
- Outgoing longwave radiation
- Reflected solar radiation
- Low clouds
- Earth's surface
1.3.1.1 Traditional Shelters:

Shelter has to be designed to reduce the impact of heat and provide shade (as a result of excessive heat and sun glaring).

Pueblo of San Juan structures:

These structures were constructed of:

1- Massive adobe roofs and walls (Witch have good insulative value to delay heat impacts for long hours).

2- Buildings where packed together (The amount of exposed surfaces were reduced).

3- Pueblo Structures usually extended on east west axis)
Pike met with the priest at San Juan Pueblo for an extended visit. The view is of the Pueblo’s plaza. San Juan was Juna de Onate’s first capital in 1598.
Design Criteria

- Thermally Massive External Walls
- Court Yards
Design criteria:

1. **Thermal Massive external walls**: (Its benefits include):
   - Delay the passage heat from the peak hot period.
   - Absorbs excess heat.
   - Helps the interior of buildings stay cool.
1. Thermal Massive external walls:

Traditional Houses in Egypt
1. Thermal Massive external walls:
Court Yards

Water
- Fountains, ponds, and pools.

Vegetation
- Plants and trees.
Court Yards
Water + vegetation
Court Yards:

- It’s desirable in areas with very low humidity.

Why?

- To provide Evaporative cooling.
- Water is often in a short supply and so need to be conserved.

Note:

Court yard (water + plants) = acts a cooling well and modifies a microclimate.

- Vegetation can used for (shading building elements) = cooling by transpiration, trapping cooled air and filtering dust.
Cooling by transpiration:
1.3.1.2.1 Site Layout:

In hot dry climates

( shading is more important than ventilation).

Settlements Characterized By:

- A dense layout
- Small openings
- Enclosed compactly Planned (inward looking building)
- Aligning buildings Close to each other (East and west walls are placed close together)
A dense layout

It’s preferable to have compact planning for groups of buildings to provide:

- Minimum exposure
- Mutual shading
1.3.1.2.1 Site Layout:

In hot climate we attend to have:

Close groups of buildings
Narrow roads and streets.
Arcades, colonnades and courtyards.

In order to obtain maximum a mount of shades and coolness.

Note:

In warm climates, many daily activities take place in the out door spaces, So we should treat external spaces as carefully as the building it self.

How?
A adjacent buildings + pavements + dry grounds

= Heat up quickly and causing both a painful glare and reflected heat radiations towards the buildings during the day.
1.3.1.2.2 Urban Form:

Outdoor conditions are so hostile in hot climate, so both buildings and external living spaces need to be protected against intense solar radiation:

What is preferable in this climate?

1- An enclosed, compactly, planned and inward looking building.

2- Surfaces exposed to sun should be reduced as much as possible (The roof is the most surface exposed to sun radiations, followed by the eastern and western walls).

3- The larger dimensions of building preferably face the north and south direction (These elevations receive the lowest heat loads from solar radiations)
Mud Houses in Kano:
What is preferable in this climate?

4- Developing rows of houses, detached or terraced, with long facades facing south-north.

( Can maximize winter solar exposure and provide shading during summer)

* In the summer season the angle of the south sun is quite high at a midday ( overhang or similar device will provide effective protection)

* In winter, the lower angle of the southern sun allows sun to pass through the building.

* Sun angle is lower in the morning and afternoon (so that the effect of sun on the east and west facades is more difficult to control)
The prominent characteristics of this climate are the hot humid conditions and the continual presence of dampness.

Air temperature remains moderately high, with little variation between day and night. Moisture in the air, combined with moderate heat and high rainfall, is favorable to the growth of vegetation.
The hot-humid area presents two major problems: the avoidance of excessive solar radiation and moisture evaporation. To cope with this problem, the tribes built their village to allow free air movement, and the scattered individual units were mixed into the shade of surrounding flora. The Seminoles raised large gable roofs to cast large areas of shadow over the dwellings. The steep angle and extensive overhang of this roof offered also a good protection against rainfall. The floors were elevated to keep them dry and to allow air circulation underneath.
Buildings are usually separated and scattered with free spaces between them to utilise airflow. As air movement is the only available relief from climatic stress, therefore vital to indoor comfort, buildings have to be opened up to breeze and oriented to receive air movement. Failure to fulfil this would produce indoor conditions always warmer than a shaded external space which is open to air movement.
In this climate, where the need for shelter from sun and rain predominates, the roof becomes the dominant structural and formal element: steeply sloping to shed heavy rains, with a maximum of insulation and large overhangs to protect buildings against sun and blowing rain.
In hot and humid climates, emphasis is given to cross ventilation as the high humidity of air creates discomfort for human beings. Cross ventilation of streets and buildings is desirable in order to reduce discomfort from excessive humidity. The structure of the settlements becomes scattered and loose in order to channel winds through the streets and inside buildings.
groups of buildings tend to be spread out, spacing of buildings should optimise access to breezes. The orientation of Buildings should respond to available cooling winds as well as to sun. From the point of view of solar heat gain, the best arrangement would be to orientate buildings with the long axis in an east-west direction.
Open spaces left under buildings elevated on stilts can also be utilized as shaded out-door spaces. Trees and planting can be relied on for shading, as plants carry full foliage all year round. Pergolas and light framing which are covered by climbing plants can cheaply and effectively provide shade to an open space.
In the warm-humid climate, openness and shading are the dominant characteristics of the buildings. Buildings designed for passive cooling would be as open as possible, to ensure the maximum possible cross-ventilation; consequently these would be totally unsuitable for air-conditioning. If the building is to be air-conditioned, a completely different design approach must be adopted. In this case the building would be closed, sealed and well insulated.
By definition, cold climates need an additional heat input; therefore the best strategy is to conserve heat.
1.3.3.1 Traditional Shelters

Ventilation is minimal, consisting of a small opening near the top of the dome. The tunnel exits of igloos are usually oriented away from the prevailing winds to reduce the leak of warmed air from the interior.

1.3.3.2 Design criteria

The severity of this climate suggests that the cold temperature and wind conditions alone dictate the form of buildings, and their organisation, as well as wall and window construction. As a result of the severity of winter conditions, designing buildings for all.
1.3.3.2.1 Site Layout

- In cool zones, multiple dwellings sharing walls, and apartment buildings could be reasonable because they improve the isolation of each dwelling from the external environment.

- In cool zones, the low winter temperature overrules the sun's effort to elongate the structure in the east-west direction and presses it into a nearly square shape.
Urban Form

- Construction should be airtight and compatible with the requirements for minimum ventilation. Reduction of the surface/volume ratios is desirable.

- The best example is the traditional igloo, but contemporary buildings might be compact and cubic in nature.

- A good strategy is to insulate the building envelope to high standards.
-Windows should be small, and double or even triple glazed, sometimes with evacuated or other specialized glazing.

-At entrances, external wind protection is crucial.

-Generally entrances and exits from the dwelling should be by way of air-locks.
1.3.4 The Temperate Area

Temperate climates are those without extremes of temperature and precipitation (rain and snow).

- This climate has mild to warm summers and cool winters. The need for winter home heating is greater than the need for summer cooling.
1.3.4.1 Traditional Shelters

- As a result of the wide range of seasonal temperatures that characterise this temperate region, indigenous building envelopes (like clothing and plants) are quite sophisticated in their ability to open and close, in order to adapt to the changeable conditions.

- The envelopes are changeable in that they make use of a variety of components that can be switched from a closed to an open configuration, rejecting or admitting outside conditions.
1.3.4.2 Design criteria

-Temperate climates is "a naturally favourable climate, that made fewer thermal demands on its inhabitants, and there is a corresponding diversity and freedom in the structure of these people".

-Winter requirements are similar to cold climates, but because the under-heated period is not as severe, insulation standards are not strict.

-The use of deciduous vegetation for automatic shading discrimination between winter and summer is recommended.

-Ventilation can deal successfully with most summer overheating by removing the excess amount of heat.
Structures Design Criteria

- Design loads
- Discrete events/environment
  - Maintainability
    - Repairability
    - Inspectability
  - Producibility
- Static strength
- Stiffness/flutter
- Durability
  - Fatigue
  - Corrosion
- Fail-safety
- Damage tolerance
- Crash-worthiness
1.3.4.2.1 Site Layout

- In temperate regions, the temperature range allows more flexible plans to be developed.
- The thermal stresses, even on buildings extending in a north-south direction, cause fewer unpleasant consequences than in the other zones.
- In a temperate climate, wind direction usually changes with the season. In this case, it may be possible to choose a street layout which will block the winter wind, yet permit cooling summer breezes through the settlement.
- In cooler parts of the temperate zone, or on exposed sites, it is desirable to utilize wind protection (tree shelter belts, closely spaced buildings of constant height, main streets perpendicular to the prevailing wind).
- The parks to be a very pleasant and enjoyable place to stay in winter.

- Therefore, permanent shading, even if needed in summer, compromises when sun in temperate climates is undesirable in summer but it can cause any open space and inter sun.
Urban Form

-In the Temperate Zone there is the least stress from any specific direction. The least penalty is received from this climate, allowing considerable freedom in form.

-However, elongated form is desirable, especially shapes on the east-west axis. As night temperatures are often below what is comfortable, even in summer, thermal mass is preferable.

-Solar heat input in winter is preferable, so it is recommended to face windows to the equator.

-The most effective tool is a combination of roof overhangs, external shutters or shades, and foliage to prevent the summer sun from entering the home.

-Unless these measures are applied, the system will continue to heat the home in summer, thus increasing air conditioning loads and undermining the net energy benefit of the passive system.
1. Conclusions

There is a clear link between zones of the climate map and the area in which certain types of buildings commonly occur.

- For example, flat roofs usually appear in the hot zones, while vaulted roofs are found in dry areas.

- Inclined roofs are found in temperate climates with consistently dry summers, while buildings with higher roofs are used in the wet-temperate and cooler territories.

- It is important to take into account the urban history of the region in order to identify climatic necessity in urban design and the planning of cities.
Contemporary architecture would be greatly enriched, both aesthetically and functionally,
1-by a careful analysis of the climatic responsive designs of early civilizations
2- a more skilful application of these fundamental principles (although not necessarily the actual materials or methods) to contemporary buildings.

-It is interesting to note that, while the environment of the region was one of the main factors that supported the formation and development of the early urban centres, it was often the cause of their downfall.

- It was ecological changes in the subcontinent that brought the decline of many civilizations; flooding of the rivers, climatic changes from humid to dry, hydrological changes in the soil etc.
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The Book on the web:

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