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A. Climate Conditions Impact on the Architectural Design in Palestine.

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Abstract: The relation between architecture and climate is a key factor influencing the origin and development of architecture. Climate and environment challenges the designers from many years, owners and the masons can always come over the building materials by local affordable materials, and can solve structural problems depending on the previous experiences and in some cases by inventions, the main problematic and challengeable exercise is to save energy and to safeguard the environment. This paper summarizes adaptive practice in vernacular Architecture with emphasis on constructing in the hot-summer and cold-winter zone. Secondly, the paper explores the exhibition of the wind condition in different city configurations and different types of architecture. The final part contains recommendation and suggesting for the future planning and designing.

Keywords: Climate, geography, Traditional materials, Urban Fabric, Environment and Climate.

1. Introduction

The relation between architecture and climate is a key factor influencing the origin and development of architecture. Nowadays, the energy and environmental crises are obstacles to the development of mankind. The progress of technology has enabled people to consume more than ever, thus intensifying the crisis of non-renewable energy and other resources. Now is the time to abandon the traditional way of thinking, and to restore the natural connection between architecture and climate. Climate and environment challenges the designers from many years, owners and the masons can always come over the building materials by local affordable materials, and can solve structural problems depending on the previous experiences and in some cases by inventions, the main problematic and challengeable exercise is to save energy and to safeguard the environment. Its means to reach the comfort zone in the building, by using different materials that meet the energy saving requirements the development of the paper follows four steps: firstly, the foreword introduces the general relationship between architecture and climate, discussing the influence upon climate of the development of cities, summarizing the related theories and practices. In order to examine how wind circumstance affects the creation of architecture, this dissertation draws a correlation between climatic differences and diversity of architecture, analysing distinctiveness by climatic elements. This paper summarizes adaptive practice in vernacular Architecture with emphasis on constructing in the hot-summer and cold-winter zone. Secondly, the paper explores the exhibition of the wind condition in different city configurations and different types of architecture.
The final part contains recommendation and suggesting for the future planning and designing.

1.1 Objective of the research

This paper will define architectural buildings design problems in cities, villages and refugees in Palestine , and try to find scenarios and visions for solution, through three steps; 1) collecting available data and information from Department of Meteorology West bank and Gaza , and other published reports. 2) Analysing and evaluation for these data. 3) Establishing recommendation for the architectural Climatic Design in Palestine in order to create a minimum standard of healthy buildings models for all people in the future. This can alleviate and enhance their living conditions.

1.2 Justification of methods & Strategies

The study uses a qualitative approach in order to provide a deeper understanding of architectural Climatic Design and buildings conditions in Palestine. The vulnerable and miserable architectural situation in Palestine has badly affected the innocent cities, villages and refugees. In case there is an international

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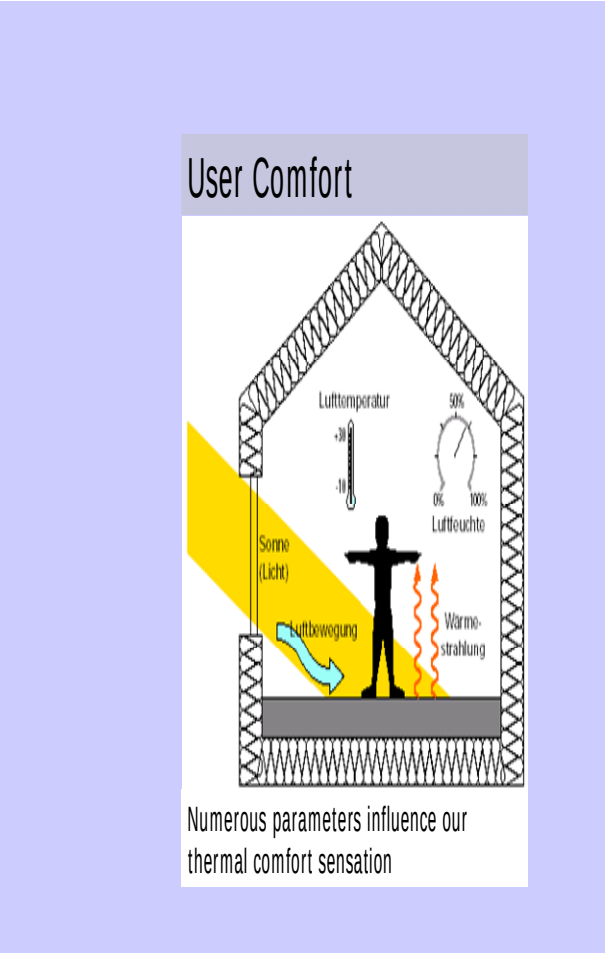
support for upgrading through proper donation, the main living and buildings condition in cities, villages and refugees can be improved considering of the result of this research.

Figure 1.



2. Climate Definition

Climate (from Greek Klima) is defined as certain conditions of temperature, dryness, wind, light, etc. of a region. Different regions of the world have diverse characteristic climates. A place or region's climate is determined by both natural and manmade factors. The natural elements include the atmosphere, geo-sphere, hydrosphere and biosphere; while the human factors can include land use and consumption of other natural resources. Changes in any of these factors can cause local, regional, or even global changes in the climate. The relationship between People, Climate and buildings is non- linear and complexly interdependent. Climate also affects the use of land, the type of crop that can be grown or the animal husbandry that can be practiced. These variations in the use of land can cause regional climatic changes- such as the spread of desert conditions due to deforestation. Microclimate variations can be caused by presence of trees, grass and water. Built up areas and cities would tend to have their own microclimate which would differ significantly from the climate of the region. Ground reflecting surfaces and artificial topographical features can affect wind flow, solar radiation and hence temperature patterns. It is now established that the consumption of energy in cities for buildings and transport etc. can make very significant changes to temperature.

2.1 How does climate differ from weather?

A. Weather is the current atmospheric conditions, including temperature, rainfall, wind, humidity and sky conditions at a given place. Weather is that which is happening right now or is likely to happen tomorrow or in the very near future. Climate on the other hand, is the general weather conditions over a long period of time. Climate is sometimes referred to as "average" weather for a given area. In totality, climate is the sum of all the statistical weather information that helps describe a place or region.

2 .2 Climate of Gaza Strip

The following climatic parameters should be considered in this new climatic zoning analysis:

1. -Mean annual average of solar radiation,

2. -Mean annual average of temperature, and

- Mean annual average of relative humidity

The analysis resulted in the recognition of three correlation factors that describe most of the variance observed of the analyzed climate variables (i.e. incident solar radiation, temperature, and relative humidity). See please figure 1.

2.3 The Gaza Strip: geography

Gaza is famous for its moderate weather in the summer and winter, which encourages the people, to go to the beaches, parks and gardens. People

also spend their leisure time on farms, orchards, and at tourist facilities. The most beautiful sights in Gaza are the sea, the beaches, the coast, the sky, the golden bright sand, the sun and warmth, and the soft breeze situated at the climate division line and the latitude 31.3 degree north to the Equator. Gaza has occupied a dividing position between the desert in the south and the Mediterranean climate in the north. This location, as such, had made the city acquire the role of a prosperous trading market for world products, both tropical, and cold. Gaza has occupied a dividing position between the desert in the south and the Mediterranean climate in the north. This location, as such, had made the city acquire the role of a prosperous trading market for world products, both tropical, and cold. This importance was reinforced by its distinguished position on a hill, 45m above sea level and within a range of 3 Km. away from the sea. [1] The climate of the Palestinian Territories is influenced by the Mediterranean climate where long, hot, dry summer and short, cool, rainy winter climate conditions prevail. Climatic variations occur in the different topographical regions. Though relatively small in area, the West Bank enjoys diverse topography, soil structure and climate conditions [2]. The West Bank is relatively arid, with about 50% of the land having a rainfall less than 500 mm/year, including hyper-arid area with a rainfall less than 100 mm/year. However, the remaining land has a rainfall range of 500-800 mm/year and 100-400 mm/year in Gaza. Most Palestinians live near the wetter more moderate western slopes in major cities In this study, the classification of Palestinian climatic regions or zones is based on the averages of annual rainfall, annual temperature, humidity and the Cloudiness of the West Bank and Gaza.

2.4Climatic Zones of Gaza:

Along the Mediterranean coast the winters are short, mild and rainy and the summers long, hot and dry. Gaza (365 km2) is a coastal area along the eastern Mediterranean Sea, 40 km long and between 6 to 12 km wide The area forms a transitional zone between the sub-humid coastal zone of Israel in the north, the semiarid loess plains of the northern Negev Desert in the east and the Gaza has a Mediterranean dry arid Sinai Desert of Egypt in the south. According to the Koppen system for climatic zoning, summer subtropical climate with mild winters. This climate is classified as Csa indicating that the warmest month has a mean temperature above 22 0C [3].

The average daily mean temperature ranges from 25 0C in summer to 13 0C in winter. Daily relative humidity fluctuates between 65 % in the daytime and 85 % at night in the summer, and between 60 % and 80 % respectively in winter. The prevailing winds during the summer come from the northwest with a pronounced daily fluctuation of the wind speed indicating daily average maximum wind velocity of 3.9 m/s in the afternoon. At night, the wind speed declines to reach the half of this figure. In contrast, during winter the most frequent direction is southwest and the average wind velocity is about 4.2 m/s with no distinct daily fluctuation. Nevertheless, storms have been observed in winter with a maximal hourly wind speed of up to 18 m/s mainly from the southwest [4].

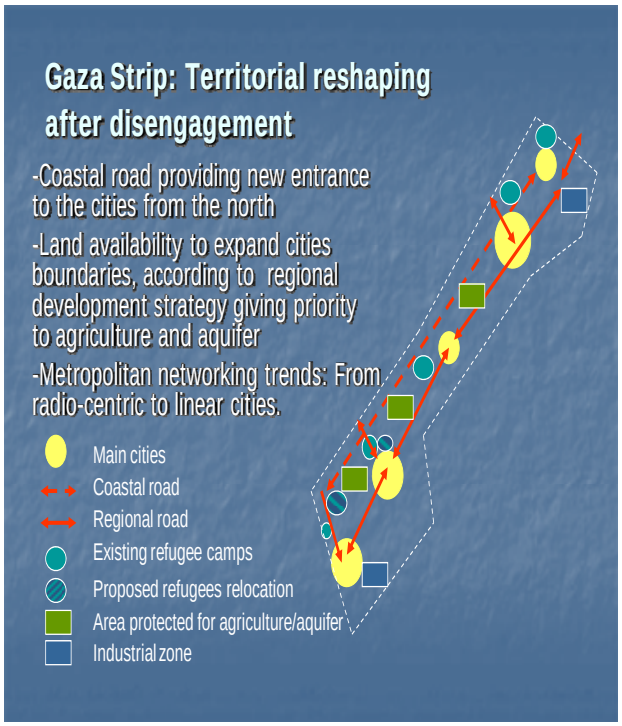


Figure 2 Gaza strip plan after the disengagement (UNRWA, 2006)

3.0 Average Temperature & Average Humidity Climate and Sun

Building technology in Palestine pays a little attention to climate and most people build their house without referring to any engineering consultancy, in addition to that most designers do not consider climate as one of the main design criteria in their buildings. Many buildings do not provide the occupants with the comfortable environment they wish. This comfortable environment can be achieved by using energy. But

when as the case in Palestine, energy is valuable, and out of reach of many people, this becomes unreasonable. The alternative is a careful design of buildings respect to the climatic condition in the area [5].Climate conditions in Palestine vary widely. The coastal climate in Gaza Strip is humid and hot during summer and mild during winter. These areas have low heating loads, while cooling is required during summer. Daily relative humidity fluctuates between 65% in the daytime and 85% at night in the summer, and between 60% and 80% respectively, in winter [6]. The daily average temperature and relative humidity vary in the ranges: 13.3 -25.4 C° and 67 - 75% respectively. In the hilly areas of the West Bank, cold winter conditions and mild summer weather are prevalent. Daily average temperature and relative humidity vary in the ranges: 8 - 23 C° and51 - 83% respectively. In some areas the temperature decline below OC° [7].

Gaza Strip has a relatively high solar radiation. It has approximately 2861, annual sunshine -hour sunshine throughout the year. The daily average solar radiation on a horizontal surface is about 222 W/m2 (7014 MJ/m2/yr) [8]. This varies during the day and through out the year. For many design purposes, the position of the Sun on a given date at a given time has to be known. This enables the building designer to predict which faces of the building would be sunlit, and hence receive direct radiation; to calculate the shadow cast around the building, the patches on sunlight on floors walls, etc. The knowledge of altitude and the azimuth of the Sun enable the designer to predict the intensity of solar radiation for a specified space and time coordinates. This influences building size, volumetric proportions, orientation, fenestration details, shading devices, ventilation, building materials, etc. [8] &[9].

3.1. Traditional materials

Before the second half of the 20th century, stone was the main material in traditional buildings, except in Jordan Valley. All buildings built in West Bank had lime-based (gypsum-based) mortars, Cement and reinforced concrete, a new techniques invented in the 19th century in France, were not available here before World War II. Therefore all traditional building in the West Bank and Gaza Strip were built without cement. Lime, mud and gypsum were the traditional binders used by masons for centuries, in the West Bank and Gaza Strip.

-Palestinian Stones:

In the West Bank and Gaza Strip areas, three main kinds of stone were used for building a stone house:

- Limestone (used in the central mountains areas)
- Sandstone (used in the coastal Plain)
- Mudstone (used in Jordan Valley and the Coastal plain)

-Lime Stone

The characteristics of the stone in the central mountains vary with localities. The traditional classification of limestone in the area is based on used rather than the origin.

-Sandstone

The sand stone is found in outcrops along the coast. The coastal cities were built on these outcrops using the sandstone, as building materials. Kurkar is porous, in homogeneous, relatively young sandstone. It is easy to quarry and dress, but behave badly to weathers; this is the reason why they used to plaster the exterior walls. Sand stone built all of those buildings made from stones in Gaza Strip In addition to these kinds of stones, Basalt (black stone) a third kind is available in the Galilee area.

-Mudstone

Mudstone (sun dried bricks) was used in the Gaza area and in Jordan valley specially Jericho. It is a molding stone that was form in wooden molds after grading; it was used in ancient cultures and found in many areas in Palestine like Gaza and Jericho. Mudstone was prepared from the local mud (red soil), mixed with sand and existing chemicals in the soil, it was mixed with water and dried by sun. It was prepared in molds usually 20*20*40 to form a stone that was used in the building courses (row of stone) the inner partition were in smaller thickness [9].

-Mortars

Mortars are composed of two distinct elements: the binder (lime, hydraulic lime) and the aggregates (sand, gravel, brick dust, ashes, straw or other organic elements). Lime Quicklime (Calcium Oxide-Cao) made by burning limestone (Calcium Carbonate-CaCO3), was slaked by adding water to create hydrated lime (Calcium Hydrate- Ca (OH) 2. Lumps of fresh quicklime were added to water, the mixture was stirred until the chemical reaction was complete;

it was strained through a mesh and finally stored for at least two weeks under water in sealed containers [10].

-Sand

Sand gives mortar most of its characteristic color and texture. In traditional buildings sand was not screened and graded as today and had therefore different size of grains. Natural sand is much better than manufactured one for binding with lime. Other aggregates like brick-dust usually make up a small proportion of the total. Other materials like animal hair, clay particles and partially burnt lime are commonly found in old mortars.

-Wood

Wood had been used in traditional building in doors, windows and niches, local a wood was expensive building material used. In addition to the openings, wood was used as a structural element for roofs in the mudstone houses in Jordan valley and the coastal plain.

-Concrete hollow blocks with external plaster

This type is mainly found in Gaza Strip, Jordan valley, refugee camp and villages, hollow blocks are cheaper than stone, this type of walls can reduce the total cost up to50% [11]. Such type of walls can be found with one layer of hollow blocks with external and internal plaster and paintings, or can be found with two layers, with insulation. The efficiency of this wall is less than the stone-walls, humidity and salt layers can be found on walls in Gaza strip area, and the plaster needs maintenance every now and then, depends on the orientation of the elevations and the exposure to the salty wind coming from the sea.

4- Available Construction Materials after the last Israel ware in Gaza.

Currently there are two routes where housing sector construction materials are entering Gaza. First is via the crossing points from Israel, and the second are via the tunnels from Egypt. This could be divided as followed:

From tunnels

- Cement
- Lime
- Steel reinforcement bar
- Wood
- Aluminum
- Floor and wall tiles
- Paint
- Nails & screws
- Toilets & sinks
- Shower trays
- Electrical fittings
- Tools, equipment and machinery

4.1 Urban Fabric

Urban design should be concerned with those climatic challenges that stress the population when they engage in outdoor activities, while architectural design or building design must address indoor comfort. The urban fabric is the physical form of towns and cities. This theoretical explanation is valid in West Bank and Gaza Strip, with exceptions in some parts here and there. The urban fabric may have different characteristics from a small village than a city or a refugee camps, but all cities, villages, and refugee camps have a common elements and components forming an urban fabric. Downtowns and neighborhoods are the two main types of development for urban areas; others may include educational institutions, industrial areas or individual buildings. Downtowns are the hub not only of a town or city but of the region, they are the primary location of retail, business, entertainment, government, and education. But they also include residential uses. Neighborhoods are primary residential areas, but also include commercial uses such as grocery stores, restaurants, and small offices. Educational (elementary schools) are located in some neighborhoods in Palestinian cities, and in residential areas in villages and refugee camps, they small enough that most students can walk to school downtowns are more densely developed than neighborhoods; commercial and public buildings are attached to each other that form a continuous raw of buildings, with no set back line in most cases, while residential uses in downtowns mostly take the form of apartments or huge buildings. Neighborhoods have many types of buildings: detached houses, villas, and apartments; all buildings must have a set back line (few meters) from the sidewalk [12]. A Greening and natural landscape is part of neighborhoods, especially in villages and some areas in cities. Urban fabric in most Palestinian villages is formed from traditional architecture with some modern additions,

traditional architecture is the hub (the center) of the village, and all recent development were made around this hub. Contemporary architecture in villages surrounds the center and expands horizontally in any direction depending on availability of land and its use [13].

Figure 3.

Is urban design only making nice drawings?

-Urban fabric basic elements.

In order to understand Palestinian urban fabric, and to be familiar with classification of buildings and different zoning, urban fabric elements must be studied as followed:

-Pathways:

Buildings must be designed to create street level interest and pedestrian comfort. Doorways, covered walkways, windows, and other street level ornamentation should be incorporated to create pedestrian scale and inviting spaces. These are the major and minor routes of circulation, which people use to move about. A city, villages and refugee camps has a network of major routes and pathways. Scale of Pathways varies from a place to another; neighborhood network has minor routes than in downtown, and a refugee camp has smaller pathway than in a village. A building has a several main routes, which people use to get in and out of it.

Figure 4

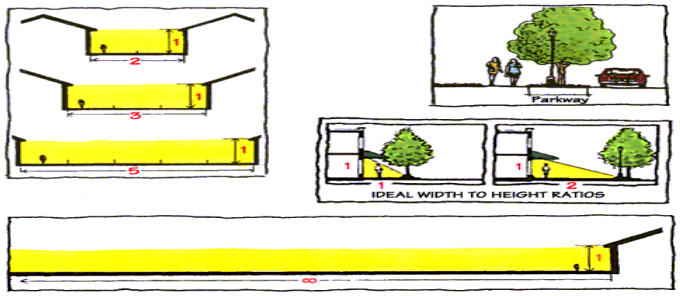


Figure 5

Figure 6

Figure 7

-Districts:

Cities and some villages are composed of component neighborhood, industrial areas, downtowns or districts. Sometimes they are distinct in form and extent especially in cities, like the Al Remal neighborhood in Gaza city, it has special characteristics and could be distinguish as new developed area, identifying districts is the most important element to study architecture and functions of buildings.

-Edges:

The termination of a district is its edge. Some districts have no distinct edges at all, but gradually taper off and blend into another district. When two districts are joined at an edge they form a one unit; Ramallah and Al Bireh is a good example. In some

cases residential building is built at the edge of an industrial area, it is hard to distinguish the function of this building the same applies on edges of commercial areas.

-Land markers:

The prominent visual of the city are its landmarks. Some landmarks are very large and are seen at great distance, like the radio poles in cities or major squares. And some landmarks are very small and can only be seen close up, like a street clock, a fountain, or a small statue.

Landmarks are an important element of urban form because they help People to orient themselves and buildings in the city and help to identify an area.

-Nodes:

A node is a center of activity. Actually it is a type of landmark but it is distinguished from a landmark but virtue of its active function. Where a Landmark is a distinct visual object; a node is a distinct hub of activity. Vegetable markets in Palestinian cities are good examples for nodes. These five elements of urban fabric alone are sufficient to make a visual survey of the fabric of a city. Their importance lays in the fact that people think of the cities spontaneously from these basic elements. Beside these urban elements orientation and views are very important; the view to the west is one of the determent elements in orientation of buildings especially in Gaza Strip area and some cities and villages in West Bank, where in mountain area the orientation is mostly to the open view, (the best view), those who have clear vision to the Mediterranean coast.

5.0 Environment and Climate

A. Orientation of Buildings

Buildings should take in consideration the shaded indoor and outdoor living areas in design and orientation, and consider in hot and sunny days the indoor and outdoor areas, and the wind protection and breakers when the weather is cold. It is not always possible to site the building to save energy, the Palestinian land is so limited for building purposes and shape and orientation of land is a predetermined element in design process well-designed buildings should be got enough natural light and ventilation. In this way the eastern and western sides are exposed to the low-angle summer sun in the morning and afternoon. The high angle of the sun in the sky in summer makes it easy to shade windows using only a generous roof overhang or horizontal shade. The longer north/south sides of the building benefits from the low angle sun in winter. The roof overhang or shading on the equator side should allow the Sun to shine into the building when its warmth is required in winter, and provide adequate protection from high-angle Sun in summer. Oriented, and the spaces arranged in such a way, that the majority of rooms If the majority of windows are designed into the equator-facing wall, sun penetration into the building will be maximized. Living areas should be sited to gain maximum benefit from cooling breezes in hot weather and shelter from undesirable winds in winter. This does not mean that the orientation of the building should be varied from north towards prevailing breezes as it does not have to face directly into the breeze to achieve good cross-ventilation. Within the internal planning, rooms such as dining and recreation area that require more heat during the winter months should be placed on the equator side. Rooms that are used for short periods of time during the day can be placed towards the rear, or more effectively, as buffer zones on the west side to protect living areas from the hot afternoon Sun (for example bathrooms, laundry, entry corridors, stairs, bedrooms, bars).

Some buildings have the long axis running east-west. Smaller surface areas facing east and west receive less sunlight in the early morning and late afternoon of summer months, while a larger surface facing south receives more sunlight at noon over the winter months [13].

Figure 8

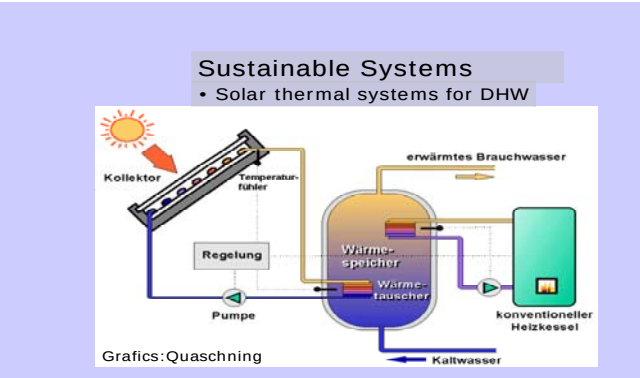


Figure 9

B. Landscaping

Architecture became “a precise tool of urban planning”. In deploying thousands of trees, the status of trees and plants as individuals, tended with specific care, as gardeners would, diminished. However to grow plants, gardeners were still required. Consequently garden design and landscape architecture became professions in their own right that were separated from gardening. Landscape is an important element to reduce cooling and heating cost if designed and planted well. Traditionally most of separate houses and buildings have spaces for domestic Landscape, in which it is used as climatic element and as fruitful trees. Trees and other greening element were used as green screen for privacy and windbreakers in winter days beside shaded areas in sunny days.

5.1 Analysis and Conclusions:

In the last fifty years, and as a result of development in communities' technology, the impact of western civilization has been very powerful on the third world countries. It influenced all aspects of life including architecture. Consequently new building climatic conditions, it's noticed that new houses have no courtyards and unshaded external walls, with large, western style windows and thin concrete or metal roofs. That says, "Without full air-conditioning, these houses are far less comfortable". Following this survey, reading and analyzing data and information tradition, but not meat to be done for energy saving. These helping elements were not selected after thermal calculations, such as Balconies, colors, shading elements, opening, etc. Building materials and techniques were not used as an important element in thermal isolation, and building is still treated as a structure and not as a living object that needs special techniques to breath, and to keep air temperature in comfortable level in summer and winter times. Insulation materials were mainly used as typical detail and not according to thermal calculations; different areas and spaces with different opening and orientation were treated and isolated with the same technique, building materials, and the same wall section and sicknesses. On the other hand, traditional architecture provides the architect with the experience learned through generations of trial and error and, obviously, has gone a long away in satisfying the climate among other requirements. Thus many architects have looked to vernacular construction and traditional buildings as an inspiration. However, this has led to some mistakes and it worth to mentioning here that, although traditional buildings and traditional building methods have always paid some respect to the climate and include some ingenious solutions, it is strongly believed that these buildings and solutions should be studied, evaluated and developed but not copied. It is known that some of the traditional examples could not be repeated now days because it needs larger piece of land (for courtyard houses) or for the differences in the contemporary functions we need.

6.0 RECOMMENDATIONS

Following this research the relation between architecture and climate in Palestine, these findings and recommendations resulted from analysis of data and observations:

1. Maximizing/minimizing solar load can be achieved by spacing and orientation of buildings, whether providing shade or allowing sunlight.

2. Importance of orientation, finding the best orientation for the building can reduce heat loss in winter time and heat gain in summer time. And by well orientation architects can achieve better natural lighting and ventilation and air circulation in summer time.

3. Architectural elements should be taken in consideration, we should be aware to the opening and its treatments; opening sizes in different elevations are important valuable element, especially in southwest and east elevations. Glazing is not less effecting factor single, double, and triple glazing as well as reflected glass can give totally different thermal loss in summer and winter.

4. Building materials must be studied more, in order to use new building materials and techniques for isolation. This can be achieved by organizing building materials’ exhibitions and public lectures in different places in West Bank and Gaza Strip. Experience, proven and appropriate Computer software's for local climate may help architect and engineers to calculate thermal loss.

5. Architects and engineers should be more aware to the value of traditional architectural elements, studying traditional architecture and its effect on saving energy. Beside these elements massing and shading on elevations should be considered as well as landscape elements.

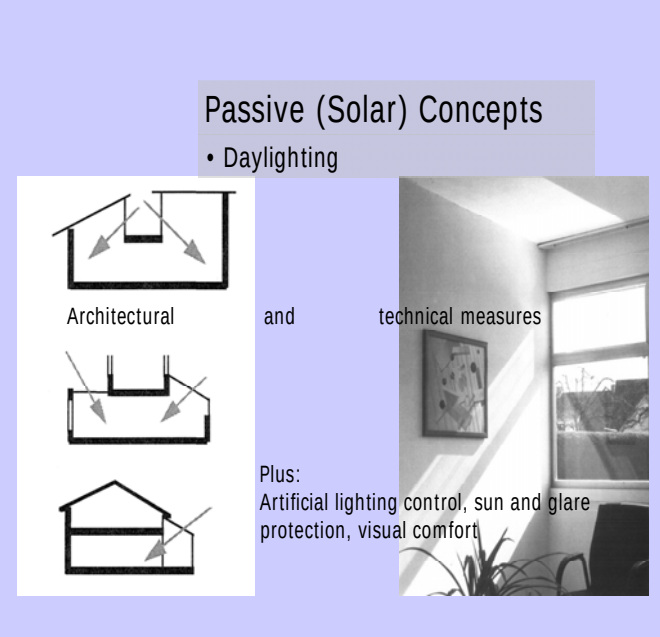


Figure 10

Literature review

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