Shading effects upon cooling house strategy in Iraq

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ABSTRACT

Macroclimatic forces have been important factors ever since man first constructed shelter. Throughout architectural history, local buildings have used great in providing the most comfortable internal conditions possible within the exigencies and constraints of local climate. The habitual living way in Iraq is accurately reflected in the households’ organization, in their volumetric configuration, in the forms of useful locations they engender. Houses are compact with interior courtyard; the streets are sinuous and pass through houses volumes. The shady interior courtyard has the effect that the rooms do not communicate directly with the overheated air outside, but through intermediate buffer spaces. In the mean time between courtyard and street at least a wall or a building is always interposed. This isolation from the street indicates concerns for defense. The architectural elements are strongly decorated, reproducing special typologies and traditional houses. The socials relations are strong, a situation which leads to personal-social spaces. The shadow is wanted to create both by means of architectural details and volumes, which have become a landmark of the local architecture specific character, and by means of natural elements (vegetation, water, etc.). The northern orientation is perfect for the summer functional rooms.

1. CLIMATE IN IRAQ

The average temperatures in Iraq ranges from higher than 48 degree C in July and August to below freezing in January. A majority of the rainfall occurs from December through April and is more abundant in the mountainous region and may reach 100 centimeters a year in some places. The summer months are marked by two kinds of wind phenomena. The southern and southeasterly *shari*, a dry, dusty wind with occasional gusts of eighty kilometers an hour, occurs from April to early June and again from late September through November. It may last for a day at the beginning and end of the season but for several days at other times. This wind is often accompanied by violent duststorms that may rise to heights of several thousand meters and close airports for brief periods. From mid-June to mid-September the prevailing wind, called the *shamal*, is from the north and northwest. It is a steady wind, absent only occasionally during this period. The very dry air brought by this *shamal* permits intensive sun heating of the land surface, but the breeze has some cooling effect. Roughly 90 percent of the annual rainfall occurs between November and April, most of it in the winter months from December through March. The remaining six months, particularly the hottest ones of June, July, and August, are dry. Except in the north and northeast, mean annual rainfall ranges between ten and seventeen centimeters. Data available from stations in the foothills and steppes south and southwest of the mountains suggest mean annual rainfall between thirty-two and fifty-seven centimeters for that area. Rainfall in the mountains is more abundant and may reach 100 centimeters a year in some places, but the terrain precludes extensive cultivation. Cultivation on nonirrigated land is limited essentially to the mountain valleys, foothills, and steppes, which have thirty or more centimeters of rainfall annually.

![Figure 1: Maximum temperature map in Iraq](http://unosat.web.cern.ch/unosat/freeproducts/iraq/mean_maximum_temperature.jpg)

Even in this zone, however, only one crop a year can be grown, and shortages of rain have often led to crop failures.
2. COOLING BY SHADING IN IRAQIS TRADITIONAL CONCEPTS

The volumes were concept to create shadow which helps to move the air by natural movement to the deep superior side, that can be achieve through special holes. Specific house volume in Iraq reflects the necessity to achieve thermal comfort. Flat roofs, courtyard position, and a compact form of residential unit, explain the new concept of bioclimatic house. The relation between living space and outside can be read through;

Necessity to achieve strong shade
Necessity to achieve natural ventilation

Figure 2: Iraqi vernacular house conception.
http://www.h-net.org/~bahai/docs/vol8/BaghdadHouse3.gif

A traditional house in Iraq was influenced of the first house create by Sumerians civilization in Ur city south part of Iraq which was displays with heavy facades; limited openings on the external elevations but those that do exist are well shaded. These simple ideas used with modern and traditional materials can produce an energy effective house, which is traditionally Iraq. In vernacular houses in Iraq, man creates closed spaces that are embraced by walls to conserves the cool interior. The opposition of light and shade is dramatically expressed in these architectures of walls. The spatial relation between the interior and exterior is limited to a few apertures in the thick walls, through which the light penetrates, revealing the thickness of walls. In such cases, the border between the interior and the exterior has depth. Just in architecture from warm dry climates is of walls, where in the temperate climates it is roofs. Open spaces, covered by large roofs, are interesting due to the mix of diffuse light and shade that are an essential aesthetic factor in these buildings. In them inhabit the depth, the reflections, the veils, the chiaroscuro, and the attenuated clarifies that are specificity of the shade. The transition from the intense and crude light of the exterior and the shade of the interior via the eaves, pergolas, and other elements produce an intermediation of chiaroscuro and create an interior shade that is perceived as a shade surrounded by half shades.

3. COOLING BY SHADING CONCEPT

3.1 Overview
Shading is a first step towards natural cooling house systems. Starting point of cooling house systems is to prevent sun to enter the house in warm periods. A shade is like putting a hat on a house. Shading must be the first line of defense against excessive heat gain. Shading in Iraq’s climate is vital. While there’s no dispute about the general benefit of shading, nailing down actual savings can be difficult. Place the highest priority on the surfaces that receive the most summer heat. That’s usually the east and west. The best shading occurs before the sun’s heat reaches the house. Shading is a very important manner to stop heat gain and unwanted direct sunlight is to divert sun’s rays before entering the house. This can be accomplished through the use of fixed and adjustable shading. Shading of the house and outer spaces can;

- reduces summer temperatures
- improves thermal comfort
- saving house energy.

Direct sun can generate the same heat as a single bar radiator over each square meter of the surface. Shading can up to 90 percent of this heat. The big problem of sun is a direct sunlight heat and the radiant heat from the sun passes through glass and is absorbed by house elements and furnishings, which then re-radiate it. Reradiate heat has a different wavelength and cannot pass back out through the glass as easily. In most climates, trapping radiant heat is desirable for winter heating but must be avoided in summer. Shading of wall and roof surfaces is important to reduce summer heat gain, particularly if they are dark colored and/or heavyweight. For treating this factor of cooling we must suggestion that;

- The most important consideration is the orientation of the aperture which is being shaded. South-facing windows are easy to shade, because in summer months, when shading is necessary, the angle of the sun is high. However, east and west facing windows are much more difficult to shade because the sun is much lower in the sky.
- Use plants to shade the house, particularly windows, to reduce unwanted glare and heat gain. Shading of roof and wall surfaces is important to reduce summer heat gain. Lighter colored shading devices reflect more heat. Internal shading will not prevent heat gain unless it is reflective.
- Shading on the house structure or outer spaces is not enough for creation cool in the house. Shading can re-
duce the temperature between 5-10ºC. The solution is in combining cooling systems like, evaporative cooling by water or trees and/or earth inertia cooling, ventilative cooling, etc, which can help us to create an efficient cooling system.

3.2 Shading specific categories
3.2.1. Shading by volumes
These types of shading is essential for Iraq hot climate where the architectural creation concept start from a shadow as protective form against high temperature and cooling source that cover all architectural spaces, therefore the first step in architectural study is who can I make different volumes which can help me in a create shading and in the same time to save the interior energy.

The courtyard can work well with existing shading, water and vegetation. It’s important to make the courtyard with two floors for create enough shading on courtyard walls. Shading or otherwise avoiding heat gain is the first rule of thermal comfort in hot climate courtyard houses. While the courtyard is by definition open to the sky, there are reasons in addition to the hot sun for at least temporarily filtering this space, including dusty wind, and bats or other intruders form. The shading of the courtyard reduces significantly the effective temperature in it by neutralizing the element of radiation and also by maintaining the external wall surfaces surrounding the courtyard at a relatively low heat. The result is a courtyard, very useful during most of the year, where a large portion of the inhabitant’s activities can take place. Shading in courtyard can be create by own house structure, but it is also preferable to be create by trees.

3.2.1.2. Shading by space in space concept
This concept takes in evidence the vital role of shading in architecture from Iraq. The concept consists of two volumes such as house in house concept. These volumes have two different functions. The covering volume is a protective area expose directly to the sunlight, considering the first line of defends against excessive heating. Covering space can include auxiliary functions like (service rooms, stores, flat green area for recreation, simply flat plate, etc). The other volume includes the essential function of house like living room, bedrooms that must be protect from the exterior heat excess. This concept can be success applicable in many form and cases, but the common form is two or a complex of volumes to create shading to help in ameliorate a local microclimate, therefore can be used in;
- Private spaces covered public space.
- Public space covered private spaces.
- Public space covered public space.
- Private space covered private space.

3.2.1.3. Shading by elements
3.2.1.3.1. Shading by natural elements
Plants are very effective at blocking unwanted direct beam solar radiation; converting much of its heat into stored biochemical energy in their leaves, while still providing an attractive view to the outdoor. The best things for shading east and west facing windows are trees, shrubs, or other vegetation spaced a few meters from the buildings.
- Trees with high canopies are useful for shading roofs and large portions of house structure. Trees offer excellent natural cooling. They throw shade over the walls and roof. They also will shade driveways, sidewalks and patios that can bounce heat to the house.
Then plant new trees immediately after construction. Trees provide a cooling bonus. To keep themselves cool, trees pump water from the ground into their leaves. As this water evaporates from the surface of the leaves, it cools the tree. This “evaporative cooling” cools the surrounding area, too. Deciduous trees are best for south yards, because their canopies are broad and dense. When the leaves fall in the winter, many deciduous trees allow solar heat to reach the house. Evergreens can work well for north and northwest yards. Passive cooling is also achieved by planting trees and bushes around house to create thermal break.

- Shrubs offer less shading, but they have several other advantages. They usually cost less, reach mature size more quickly and require less space. Shrubs can shade walls and windows without blocking roof-mounted solar panels.

### 3.3. Shading device

The drawing of shading device is a rather complicated mission with many parameters implicated, from solar geometry to aesthetics or maintenance. Shading device can be internal or external.

#### 3.3.1. Internal shading device

All interior shading device are less effective than exterior shading device, in addition, user must adjust interior shading device to reduce solar heat infiltration. Interior shading device should be designed to be durable. Interior shading device should be light colored to minimize glare especially if they are the only shading device. Interior shades, such as roller shades, blinds and drapes, can reduce heat gain. However, interior shades don’t block sunlight as well as exterior shades. Interior shades work in three ways. They reflect sunlight back out the window before it can turn into heat. They block the movement of hot air from the area around the window into the room. They insulate the room from the hot surfaces of the window glass and frame. (For more information see the window thermal function)

#### 3.3.2. External shading device

Well planned external shading is the most effective method of reducing solar heat gain. In addition, it offers possibilities for incorporating day lighting and passive heating. External shading is much easier to integrate into the design of a new house that it is to retrofit. Fixed shading devices have some inherent disadvantages, the first of which is due to their inability to allow for lack of synchronization between the heating season and the altitude of the sun.

If a fixed shading device is designed to prevent overheating in September, the result is that solar energy will be rejected to the same extent in March. March, unlike September, has a relatively high demand for solar heating and such control would be unwelcome. Fixed shading devices will also usually cast a shadow on a portion, albeit a small portion, of the collection window for most of the heating season. This is expensive in terms of cost of glass and higher energy losses than gain over this area of shaded window. External shading device can be;

- **Overhangs for shading**

Overhangs may be solid, louvered, support vegetation, or combine all of these aspects. Some shutters, eaves, trellises, light shelves, and awnings serve the same purpose as an overhang. Most houses have a built-in shading device. Overhangs block the high-angle, summer sun, but allow the lower winter sun to strike the house. Fixed overhangs will always be a compromise, since the sun’s angle is the same in spring and autumn. We might want solar gain in March, but not in September. We can use overhangs function also in combiners with bioclimatic solution for intelligent sustainable house in Iraq.

- **Awnings**

Awnings work like the visors on baseball caps by blocking high-angle sunlight. On houses awnings can cover...
individual windows or sections of outside walls. They are most effective on the south side of the house. Some awnings stay in a fixed position. Others can be rolled up in the winter to allow low-angle sun to reach the living space on house. In some intelligent bioclimatic solution we can combined the awning function with, water or/and vegetation to enhances the physical comfort in living spaces, so awnings function become for shading and ameliorate living spaces environments. Awnings and overhangs are the most effective means of solar control since they prevent sunlight from striking the windows. Movable systems are adjustable according to season, but are more prone to failure or mistreatment. Fixed overhangs are more dependable, but their design must account for daily and seasonal variation of the sun’s path.

- **Trellises**

Trellises are permanent structures that partly shade the outside of a house. Clinging vines growing over the trellis add more shade and evaporative cooling. Fast growing vines create shade quickly, while trees can take years to provide useful shade. Trellises and climbing plants are a design solution that's attractive and flexible. Trellises can take place on the flat roof in Iraq for shading a sleeping place, or for shading the roof surface on hot times of summer.

- **Shade screens**

Outside shade screens prevent sun from entering a window. Put these only on windows exposed to direct sunlight. These devices are often called “sun screens” “shade cloths” or “solar shields”. The screens are made from aluminium or plastics in which are lightweight, durable and easy to install. New forms of sol ceils can be used such as shade screens in the south orientation beside the vital function of electrical energy producing.

4. CONCLUSION

The traditional living way in Iraq is accurately reflected in the households’ organization, in their volumetric configuration, in the forms of useful locations they engender. The shadow is wanted to create both by means of architectural details and volumes, which have become a landmark of the local architecture specific character, and by means of natural elements (vegetation, water, etc.). The northern orientation is perfect for the summer functional rooms. Open spaces, covered by large roofs, are interesting due to the mix of diffuse light and shade that are an essential aesthetic factor in these buildings. In them inhabit the depth, the reflections, the veils, the chiaroscuro, and the attenuated clarifies that are specificity of the shade. The transition from the intense and crude light of the exterior and the shade of the interior via the eaves, pergolas, and other elements produce an intermediation of chiaroscuro and create an interior shade that is perceived as a shade surrounded by half shades. These half shades are limit that has depth and width, and of considerable dimensions with its universe of lights, shades, and experiences, becoming an important theme of design to resolve the transition between inside and outside. The way people use houses in Iraq has an important bearing on their effectiveness. The over-night supplied coolness of rooms in protected by systems of galleries or loggia, of wooden jigsaws walls etc. On the other hand, ingenious systems of natural ventilation have been achieved inside the houses which cross, vertically or horizontally, the entire house’s rooms. Creating higher rooms, which might take over a greater quantity of cool air, also enables the thermal comfort.

REFERENCES

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