110: Towards a zero energy house strategy fitting for south Iraq climate

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Abstract
Improving energy efficiency through technological advances has been the focus of Iraqi energy policy for the next generation of buildings. However, there is evidence that technology alone will be neither sufficient nor timely enough to solve looming crises associated with fossil fuel dependence and resulting greenhouse gas accumulation. The energy efficiency should not be the only parameter to consider in high-performance building design. Other parameters related to the three dimensions of the Sustainable Development (environment, economy and society) should also be considered, in order to obtain higher performance and more sustainable buildings. Houses consume approximately 20 to 30% of primary energy in the south of Iraq. Energy consumption for cooling represents approximately 20 % of the total consumption for residential buildings. The percentage of fully air-conditioned home floor area is increasing in Iraq. Cooling thus accounts for a significant proportion of the total energy consumption in buildings, and its impact on greenhouse gas emissions is enhanced by the fact that these cooling systems are usually electrically driven. In order to overcome the increasing energy demand in buildings and related environmental problems, new efficient energy technologies and new integrated building concepts, like passive houses concept. The zero energy homes are a revolutionary technology that aims to create homes that produce as much energy as they consume. The main idea is to cut energy consumption in the home by at least 50 to 70%. This can be measured in different ways (relating to cost, energy, or carbon emissions) and, irrespective of the definition used; different views are taken on the relative importance of energy generation and energy conservation to achieve energy balance. The concept focuses on annual consumption and annual on-site generation, not second-by-second consumption and generation. This definition does not affect any electricity or natural gas used for domestic water heating or space heating. To the majority of zero energy designers, the goal of a zero energy building is not only to design a building that uses zero energy, and produces zero emissions, but one that also minimizes all energy use and damage to the environment, irrespective of the fact that the energy may come from renewable resources.

Keywords: Zero energy house, strategy, human comfort

1. Introduction
Optimal study takes the passive form of architecture to create the comfortable living spaces. For build a zero energy house fitting for south Iraq climate we have to create a strategy of zero energy projects. Therefore we have to start with four different politics that start with, the definition of the existent problem, conversion the negative effect of climate to an positive effect, by using the natural heat phenomenon, and development the concept of heat isolated constrictive elements, at last selection of the competent cooling system.

2. Existent facts

2.1 South Iraqi macroclimate

The average temperatures in the south of Iraq range from higher than 48 degree ºC in July and August to below freezing in January. In most regions the wind speed and direction is considerably modified by the land and gulf, particularly at the times when prevailing winds are light. The wide diurnal temperature variations and the consequent differences between air, ground and water temperatures give rise to a large variety of local wind effects. Most nights are clear in the summer, and about one third of the nights are cloudy in the winter 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, at approximately 32 ºC, are dry. The influence of the Arabic Gulf on the climate of south Iraq is limited. But near the gulf the relative humidity is higher than in other parts of the country.

Fig 1. South Iraqi map climate

2.2 Chronological Passive house concept

House adaptation in the south Iraq consists in protecting occupied spaced from the solar radiation but favoring airflows through them. Air flows in houses are due to wind and thermal buoyancy that create a pressure variation over the building envelope. 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.). In vernacular houses, human creates closed spaces that are embraced by walls to conserves the cool interior. 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.

3. Zero energy house strategy

3.1. Enhancement of local microclimate

The first step to create zero energy houses is by generating a healthy local microclimate supported by managing of the existing negative power of the climate variety. A well designing of surrounds landscape can be a good long term investment for reducing heating and cooling costs by protecting against winter wind and summer sunlight.
In summer, shading can reduce surrounding air temperatures as much as 5 grad and air temperatures directly under trees by up to 14ºC. The use of trees and landforms as shelter belts is one of the most influential aids available for influencing the microclimate. Thermodynamics is the study of the properties of the system that have a temperature and involve the flow of energy from one place to another. This phenomenon can be successful used to enhance the thermal functions of house construction, and create of many intelligent sustainable systems which can assist in create a thermal comfort in living spaces.

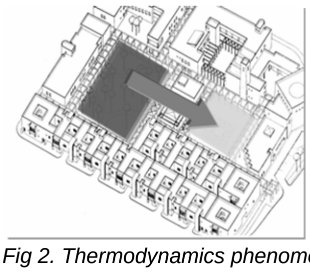

Fig 2. Thermodynamics phenomenon application (Air moving from shaded space to sunny space)

3.1.1. Volume in volume concept

This conjecture takes in evidence the vital role of shading in architecture from the south of Iraq buildings. The idea consists of two volumes collaborates such a climatic system. The top volume is a protective area expose directly to the sunlight, with auxiliary architectural functions, considering the first line of defends against excessive climate action (heat or cold).

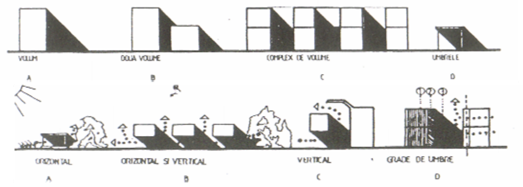

Fig 3. Shading category and types

The other volume includes the fundamental function of the house like living room, bedrooms, where they must be protect from the exterior. This concept can be success applicable in many form and cases, but the common form is two or complexes of volumes to create shading to help in ameliorate a local microclimate.

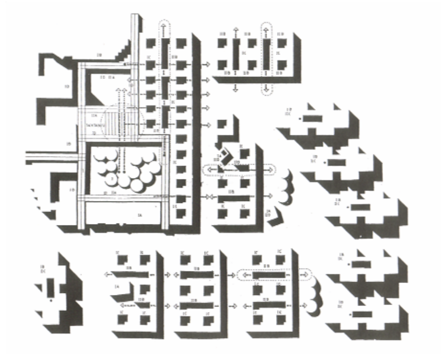

Fig 4. Shading study necessary for ZEH.

3.1.2. Energy allocate such cascade

Energy in the house must be allocate throughout regarding of thermal zones in the house by utilized the energy in diverse house functional spaces such as cascade. That is important to concerning the thermal level for different house spaces. The thermal hierarchy energy can be reflected in the house plan. It is better to assemblage the interior spaces that have the same temperature and intern contribution, such as living rooms or bedrooms towards the center of house plan, and the spaces which have more high temperature such as kitchen in the periphery of house plane. Architect must avoid emplacing of spaces with a large different of temperature collectively. Architect must employ in maximum form the natural convection in a house interior, for achievement transfer of energy to exterior, this difference of temperature is necessary for creation the natural ventilation by airflow. Thermal zoning is a vital consideration in recently designed environmental houses. A thermal zone represents an enclosed space in which the air is free to flow around and whose thermal conditions are relatively consistent. In most cases, any room can be closed off with a door would be a separate zone.

3.2. Development of architectonics house theory

3.2.1. Thermal spaces concept

Houses plans in arid zones in general and south Iraq in special had an endomorphic form that means development of residential units from (0) (entrance) to a concentrate of living spaces in the depth of house plan such as open tree. Thermal zoning tries to ensure the best match possible between the distribution of room and the distribution of the available energy.
The ZEH must have three thermal spaces concepts;

3.2.1.1. Closed functional spaces

Closed functional spaces are related to the outside both directly and by means of intermediary spaces. The habitable rooms having high level height, warm air raises during summer, and then it is evacuated by the currents of air deriving from the difference of temperature between the outside space and the cold air storage place. The rooms are isolated, the shadows deep and the two spaces can overlap generating the vertical seasonal removal.
For an effective and operational zero energy house, the closed functional space in plan concept must be divided into three thermal zones;

3.2.1.1.1. Imperative zone

This zone includes living space. The most favourable comfort temperature for these zones is between18-21ºC. The best placement for this zone is in the center of the house (at the side of the courtyard), warning such as such possible the external walls, with orientation towards the east, north and north-east.
However, this zone needs a good light and an easterly window or skylight is preferred. The main living rooms need regular warmth and light and are best placed on the east, north - east or north.

3.2.1.1.2. Auxiliary zone

This zone includes kitchens and bathrooms. The optimal comfort temperature for this zone is between 20-23ºC. That means a 23ºC for bathrooms and 20ºC for kitchen. This zone is modest warm and can locate in the periphery of the house plane for;
- Create of natural ventilation.
- To be beside the imperative zone for create of radiant heat corresponding house functional schema.

3.2.1.2. Semi-open space (intermediate space)

This space is a very important for passive and zero energy houses. Going on the study of ZEH from South Iraq, become visible and incredibly vital thing to give attention on these kinds of spaces, because all conception and creation of house spaces seeking for existing these types of spaces.

Intermediate space can take place between open spaces and closed. Energetic role of intermediary space is between hot exterior spaces and interior functional spaces and contrary, therefore the essential role of intermediary spaces are such as thermal buffering. Intermediary space such as conservatories, garages, balconies, loggias, terraces, service rooms, etc. which share building elements with heated or cooled rooms can act as thermal. The incorporation of conservatories into the plan and form of a house requires particular care as this will affect both the heat loss and solar gain of the house and determine those of the conservatory. Transitional spaces or unheated spaces; is other name of intermediary space, is a traditional spaces used for stairs, utility spaces, circulation, and any other areas where movement take place.

3.2.1.3. Open spaces

The patio is the fundamental habitual open space for architecture from south Iraq and others arid countries. This space plays a significant role on local microclimate and helping in ameliorates of the surrounding environment. The terrace take a important part of lowering the temperature and creating a pleasant atmosphere in the ZEH conception, it can be covered by the shadow of the trees and the climbing plants which are cooling it or it can be covered by a light fabric canvas.

3.2.2. Thermal elements concept

3.2.2.1. Wind catcher

The simplest design for a wind tower is a vertical construct that projects above its surroundings and has an open top. Catcher cans good work at the daytime in corresponding of the pressure differential which is created by a house in the bath of an air stream. A positive pressure will be exerted on the windward face of the house, and a negative pressure will form over the roof and leeward face. The greater the restriction of air flow due to the house form, the greater the positive pressure at the windward face. This will also produce a more powerful negative pressure over the roof and the wind tower. Additionally, the wind catcher itself will act as an obstacle to the air flow, creating an area of positive pressure in front of the device, and a negative over the opening of the chimney. At night the function of catcher in South Iraq can cover the dominant cold wind by orientation the wind catcher against northwest. The house can be aerodynamically shaped to encourage an increased velocity air stream over the house.

3.2.2.2. Façade elements

The thermal role of those elements is also a reflection of the sunlight and changing the current of air direction.

3.3 enhancement of thermal conventional Insulation

The concept of enhancement of thermal conventional Insulation consists much in effective thermal insulation which is vital for the accomplishment of the house development. The materials can be adapted to any size, shape or surface, and forms. A variety of finishes are used to protect the insulation from mechanical and environmental damage, and to enhance appearance. Heat management of the external building components is the most effective assess for energy efficiency in houses. Zero energy houses have need of a compact layer of insulation, which guarantees for both low heat losses and a high level of thermal comfort.
The regular door has a U-value of 1.0 W/m2C°. This can be improved by adding an extra internal door swinging into the room. Otherwise doors with U-value of 0.8 W/m2C° must be sourced. As with all components making up a zero energy house, the total performance of the house must be considered. The U-value of this optimized wall is 0.12 W/m2C°. For an efficient roof we need to develop ways to do this but it is essential the finishing teams are willing to work to the exact specifications and with the tools required. The vapor barrier is installed in a special way to make it connect to the vapor barrier in the walls on the ground floor. U-value 0.082 W/m2C°
A complete thermal bridge free construction is needed. The linear thermal transmittance to exterior must be below 0.01W/mK°. A very well insulated house possibly will have infiltration losses of around 35% of the seasonal heat losses. As a result, by substantially reducing the infiltration rate, 90% solar heating is without problems achievable. The problem is that infiltration is reduced to this level with great difficulty. The 1.4 air change per hour for typical house must reduce to about 0, 5 air change per hour by income of good quality weather stripping around openings and by caulking house cracks. The entire building envelope must be totally airtight.
The total energy performance of a zero energy house is, to a large degree, dependent on how airtight the house is. We can observe that the changes of energy are various in south Iraq climates (winter and summer).
Optimized south facing glazing with none or minimal window openings to the north is a requisite. Most windows should be fixed as these have a higher performance than the opening type.

3.4. Enhancement of energy saving concept

3.4.1. Biophilic architecture

Biophilic architecture is a part of a new concept in architecture, that work intensive with human health, ecology and sustainability precepts, such a integrate part of architectural formation which must be in optimal proportion with other buildings material. The hypothesis is that this affiliation leads to positive responses in terms of human performance and health even emotional states. This path will discover a far deeper integration of nature with the built environment and the potential synergies in exchanging energy and nutrients across the human-nature interface. The position of green covering and its area depend basically on the category of functions that occur under this area.

3.4.1.1. Climatic skin roof

The climatic skin roofs covering indirectly affects the inhabitants feeling of comfort, and has a significant aesthetic function within the building's vicinity. The zero energy houses coating significantly contribute to the formation of balance between human and environment.
Every new development ideally should have an explicit energy strategy, setting out how these benefits are to be achieved. The energy query has become the key query of contemporary developed countries and developing countries. Environmental disasters are becoming more and more common. 75% of all environmental problems are energy problems. The biggest and essential role of climatic skin roof is that to conserve, insulate and hold back a change of energy flux, between outdoor and indoor. Lower exchange of energy transfer throughout summer and winter can help in decreased demand for electricity. Thermal insulating climatic skin roof build up with official property values are permitted to be supplementary to the conventional thermal insulation.
Climatic skin roofs insulate houses by preventing heat from moving through the roof. Their insulation properties can be maximized by using an increasing medium with a low soil density and high moisture comfortable and by selecting plants with a high leaf area directory. Ideally it is composed of three layers:
- Top layer: plants, even dead leaf, shade the surface of the substrate without blocking the air stream.
- Mid layer: 5-50 cm of substrate. The effect depends on the kind of substrate: material with high porosity and light colors are to be preferred.
- Bottom layer: the drainage layer can be composed of substrate or of material with big pores to drain the water, which cannot be retained by the cavity of the substrate.

On a summer day, the temperature of a gravel roof can increase by as much as 20ºC to between 30-40ºC. Covered with grass, the temperature of the roof would not rise above 20 C, thus resulting in energy cost savings. 20 cm of substrate with a 20-40 cm layer of thick grass has the combined insulation value of 15 cm of mineral wool. Spaces under a climatic skin roof are at least 3-4C cooler than the air outside, when outdoor temperatures range between 25-30ºC.

3.4.1.2. Climatic skin façade

Architects working in group effort with engineers are now taking an energy responsible move toward to the design of house facades where the façade contributes to both the embodied energy as well as in service energy of house. Climatic skin facades are not proposed to supporter in maintaining the structural integrity of a building. Deceased loads and live loads are thus not proposed to be transferred via the curtain wall to the foundations. Green façades offer many opportunities to enhance the greenery on inner city structures. The huge potential of available growing areas is more than double the ground area. The cooling effect depends on the density of foliage of the climber. Only a very few architects are able to play with these structures to integrate them into Terrace houses, balconies or as types of hanging garden structures.

3.4.2. Double skin façade

Double – skin facades offers a protected layer from the extreme environmental conditions; these shading devices are less expensive than system mounted on the exterior. The principal benefit of double-skin façades over traditional architecture is that they permit the application of blinds even for the buildings with substantial wind. The main layer of skins is usually insulating. The air space between the skins layer is as insulation against temperature extremes, winds, and the sound. If there are two skins of glass, or other thermal opaque materials so for shading interior space that the sun-shading devices are often located between the skins. Skin facade must give buildings inhabitant shield against hot, cold, wind, external noise, and enhance security.

4. Cooling policies and systems

4.1. Cooling by ventilative comfort system

Ventilation is an important factor in all cooling processes because all cooling system needs ventilation as driver dynamic factor, therefore the concept of ventilation or air stream (naturally or mechanically) is vital when architect start to create or build own cooling system in his project.

4.1.1 Cross ventilation

Openings in the house are usually windows and doors Air movement can be provided by the wind, by the stack effect, or by a fan. Much work has been done analyzing the effects of different window placement and house design for maximizing air movement under the pressure of the wind. Some conclusions are;

- Cross ventilation is improved by an irregularly- shaped, spread- out house.
- Facing the house at the oblique angle to the prevailing wind is better than facing it directly perpendicular to the wind direction.
- Wing wall which stick out can act as scoops to enhance wind capture, and can also generate different pressures on the same side of a house, greatly increasing the air flow through the adjacent space compared to a house with a flat façade. Casement windows when open act as wing walls.
- Sizing the inlet area equal to the outlet area is best.
- Horizontally shaped windows (width greater than height) work better than vertical windows.
- Highest velocities are attained when windows and doors are unscreened, so one tactic is to do insect protection with a screened porch but leave the windows between the porch and house unscreened.

4.1.2. Nocturnal ventilative cooling

In a South Iraq climate, native residential cooling methods also include pre-cooling house thermal mass by nighttime ventilation to mitigate anticipated uncomfortably warm conditions during the coming day. this form of cooling use for cooler the structural mass of the building interior by air movement from the cooler outside during the night and closed the building to the warm outside air during the daytime. When an insulated high-mass building is ventilated at night its structural mass is cooled by convention from the inside, bypassing the thermal resistance of the envelope, while during the daytime, the cooled mass acts as a heat sink.

4.2. Cooling by radiant system

This system of cooling to reduce the external air temperature is characteristically accomplished in swine conveniences through the use of evaporative cooling pads. As air is drawn through wet cooling pads, water is evaporated into the air causing the temperature to be reduced at the same time as increasing the moisture level. Indirect evaporative cooling techniques include roof spray and roof bond systems, earth cooling tubes. Airs in this situation don't need adding moisture. This systems are very expensive and consumption more energy than direct system.

4.2.1. Roof spray system

The exterior surface of roof or façade is kept wet using sprayers. The sensible heat of the roof surface is converted into latent heat of vaporization as water evaporates. Night spray on roof surface cools water by evaporation and radiation to 5 to 8ºC below minimum night air temperature. This cools the roof surface and a temperature gradient is created between the inside and outside surfaces causing cooling of the house.

4.2.2. Roof bond system

The roof bond consists of a shaded water pond over a non-insulated concrete roof. Evaporation of water to the dry atmosphere occurs during day and nighttime. The temperature within the space falls as the ceiling acts as a radiant cooling panel for the space, without increasing indoor humidity levels. The limitation of this technique is that it is confined only to single storey structure with flat, concrete roof and also the capital cost is quite high.

4.3. Cooling by underground earth inertia

Cooling by using a free Underground space means an open space that can be used also such a functional space (social space for family meeting, living, or with an auxiliary function).
It is necessary to appreciate that using of this space must be limited which means just in occasionally cases, because this space must be healthy so it must be isolate from all negative exterior agent such dust, pollute air, humidity, etc. At the same time this space must be tightly to the house interior or/and exterior, and the connection must be just through the terminals, which have air filters against, dust, bacteria, humidity, and ionizer effects. This space is partial contact with earth ground, just in the floors.

4.3.1. Underground rock bed storage system

This includes a layer of thermal mass such as rock bed, where is the earth temperature transferred from/ to the rock bed, in this time thermal mass become as source of cooling in summer season. The cooling of Living spaces can occurs by radiation effect or by using of air such as cool transporter element, in which can be coordinate in corresponding of living space area and thermal mass cool capacity. For optimal working of system, we must take in evidence;
velocity of airflow must correspond the thermal internal comfort airflow circulation must be tightly to the exterior existing of air filter such healthy element in both terminals input/output easily to reparation and maintenance of the system
This system can be used in correspondences with other types of cooling, all such as an intelligent complex system.

4.3.2. By tub system

A cooling tube system uses either an open- or closed-loop design.
- In an open loop system, the outdoor air is drawn into the tubes and transported directly to the inside of the house. This system provides ventilation while optimistically cooling the house's interior.
- In a closed-loop system interior air circulates through the earth cooling tubes. A closed loop system is more efficient than an open loop design. It does not exchange air with the outside.

5. Conclusion

The contemptible Iraqis ZEH provide with the opportunity to reach extremely low levels of energy consumption by employing high quality, cost-efficient measures to general house components - such measures are in turn off advantage to the ecology and economy sector. We have responsibility to come together all factors that determine houses quality to be relative cheap. We shall start to take in consideration factors that can help us to reduce remarkable ZEH cost by helping of mathematical models in operation research science and marketing researches, etc.

6. Acknowledgements

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