CLIMATE AND INDIGENOUS BUILDING IN DEVELOPING COUNTRIES

By: the Development Workshop
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Introduction:

The potentials of indigenous systems have been neglected in most Third World countries. Instead they have been replaced by Western methods often inappropriate to local conditions and needs - physical, economic, social, cultural and aesthetic. The visible material success of the Western industrialised world has made it the obvious model for Third World countries.

Today there is a growing awareness that such literal transference of methods rarely works. Nor is it adequate to start with basically Western objectives and methods and then modify them to local conditions. The Third World has very different social, cultural and economic bases (and in most cases, different physical environments as well).

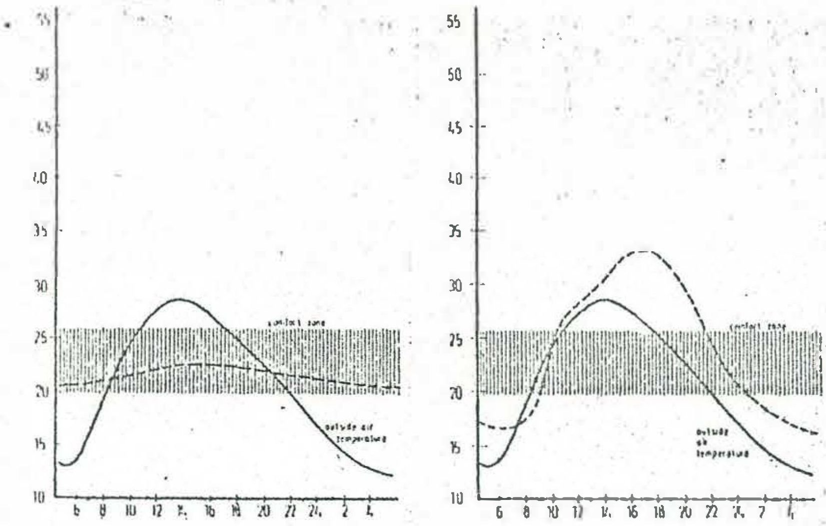
Especially with the growing global concern for energy and resource depletion, indigenous systems have much to teach us. Many of them remain relevant to local needs, being based on low and local use of energy and resources, and working in harmony with the natural environment.

When planning or designing in a country where one finds a severe climate one must consider the effect of that environment on the ways of living and ways of building of the inhabitants. For hundreds of years the inhabitants of any particular area have been building up a collective knowledge and way of dealing with their local conditions. This knowledge and experience is there for anyone to share and learn from, standing in the local architecture and living patterns of each particular region. The problem presented is how to extract the principals of design inherent in the vernacular building and apply them to modern design and the projects of rural and urban development.

The spacing between buildings within the settlement affects wind flow within the settlement and the shading of streets, just as does the organisation of the spaces within the house. Open spaces can be organised in such a way as to induce air movement when there is no wind. Materials used in the construction of buildings affect their internal thermal environment. Particular features within buildings such as wind catchers (badgir) and cleverly designed openings, as well as orientation on a site, all affect the micro-climates within and around buildings.

When comparing imported building materials with those used locally one is likely to find that in terms of heat transfer and thermal comfort the local materials are superior (see fig.), and when one compares the material costs, the local materials will likely prove the most economic. In any contemporary design if the structural performance of a local material meets the standards required in the design and is superior climatically there is no question but that it should be employed.

Note: The Development Workshop is a group of architects from a number of countries working collectively on research and development of indigenous building and planning methods in Third World Countries.



Mud brick room.
Interior air temperature – – –

Prefab concrete room.
Interior air temperature – – –

Fig. 1
Based on experiments carried out by the authors, at the Building Research Centre in Cairo. May 1973

Mud brick maintains favourable interior temperatures all day, while temperatures within concrete rooms are either too hot or cold.

By a thorough analysis of the behavior of certain traditionally used building materials and ways of building, we hope to find ways of improving on their use and of course develop ways of improving services and standards in new buildings using these materials, thus evolving a modern architecture truly in harmony with the climate, the local environment, the changing ways of life embodied in improved standards of living.

Wind Catchers:
The wind catcher or wind tower as an element in the traditional house form can be found in settlements ranging from the Sind region in Pakistan, through Iran and Arabia to Egypt and North Africa. Its design form varies from region to region according to climatic conditions. In general, their use proves advantageous in hot regions where air movement can provide some degree of cooling, just as air passing over the skin's surface helps the body to lose heat through evaporation.

As shown graphically, the wind catcher, in having its intake as high above ground as possible, obtains air which is cooler and cleaner. This is even more important in dense urban areas where breezes are inhibited at ground level and the air is hot and dusty. The wind tower must be high enough above the roofs to catch an unobstructed high level air stream. It is usually oriented so as to catch favourable breezes. For example, the Egyptian wind catcher (Malkaf) has a scoop-like form and those studied in the old quarter of Cairo usually faced north to intercept the breeze off the Nile from the Mediterranean. The catch is one-directional, since winds blowing from other directions are from the desert and are hot and dusty.

It became apparent in Cairo after making tests on the wind tower throughout a daily cycle, that its function is not dependent purely on the wind's ability to force its way into the house. In fact, during the heat of the day, a breeze will tend not to enter the house, even if the catcher is open, because the air inside the house is already cooler than outside, the temperature inside being kept down by the massive loadbearing walls which retain much of the previous night's coolness. The cooler interior air is dense and has a higher pressure than the hot, lighter, exterior air. The walls keep the inside temperature constant at about the daily average; so that in the afternoon or evening, when the outside air does fall below that average, the exterior air's temperature and pressure relative to that of the interior has reversed and air flows freely into the house. Thus the wind catcher only functions when it is needed, and only encourages cooler air into the house. The whole house functions to control the micro-climate within, and responds to the climate in different ways at various times throughout the day.

The design of the wind catcher itself is not the only consideration. The air outlet is just as important. While wind blowing from a single direction exerts a positive pressure on the front face of the building, it also creates a suction on roof and leeward wall. If exhaust openings are located in these areas, air will be sucked or drawn through the building. The section of the Cairo house illustrates how a raised section of the roof is employed as an air exhaust. Its roof is of light construction and heats up rapidly, thus heating the air underneath it. This warm air rises and escapes, leaving a low pressure area behind, which induces more air movement upward and outward.

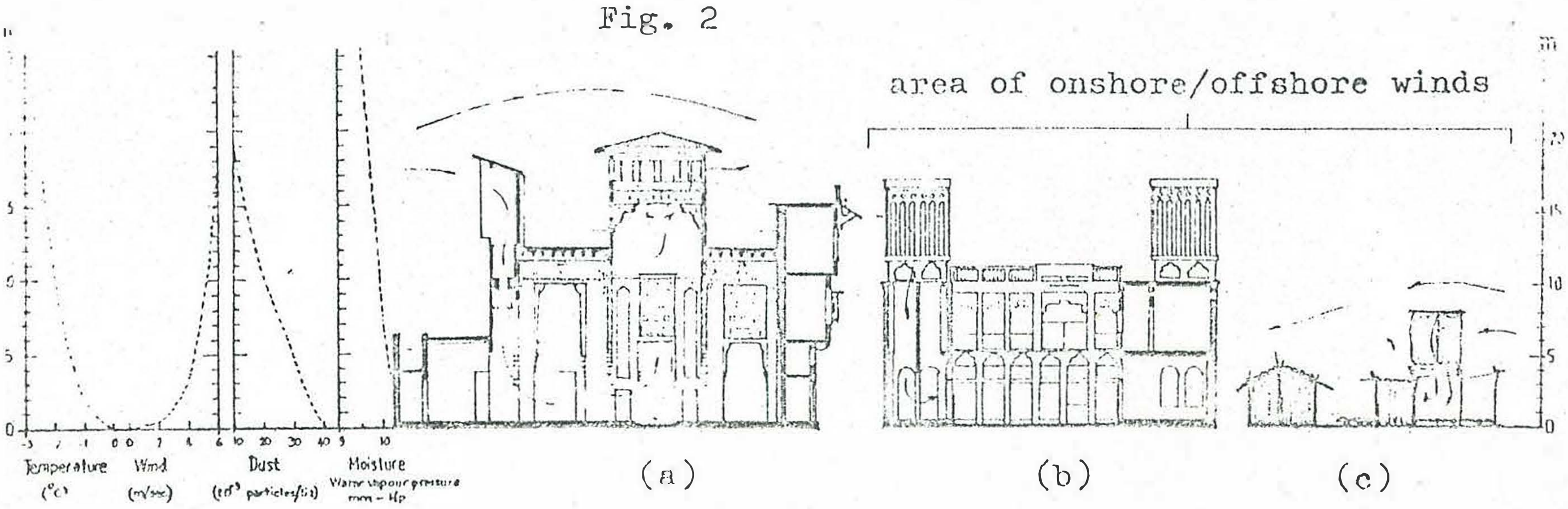
Thus one example in Old Cairo teaches us that the wind catcher design depended upon not only a consideration for the prevailing wind, but also upon the micro-climate within the building, influenced by the heat capacity of the building materials, as well as a concern for the effective escape of the exhaust air.

In Iraq, an ingenious solution to the problem of variable wind direction is the incorporation of a sail or fin-like projection into a pivot-mounted scoop, to keep it facing the wind at all times.

A simpler and more common solution to shifting winds is the multi-directional wind catcher (badgir) found in the Arab Gulf region and Iran. In urban areas, these towers are elaborately sculpted and decorated. A horizontal section through one of them would show an X configuration. Winds from any direction are thus admitted into the house. This kind of tower is found usually on the coast where land-sea breezes are in effect. During the day the wind catcher admits cool air off the sea, while at night breezes blow off the land. In cooler seasons, when air movement is not needed, traps are shut and the wind catchers' openings covered.

In rural areas, on the Batina Coast of Oman, cloth sails like wind catchers are used which have a similar X configuration to those of the Arab Gulf. These in some ways are more directly responsive to the climate as they are demountable and can be taken down and stored in the winter.

Fig. 2



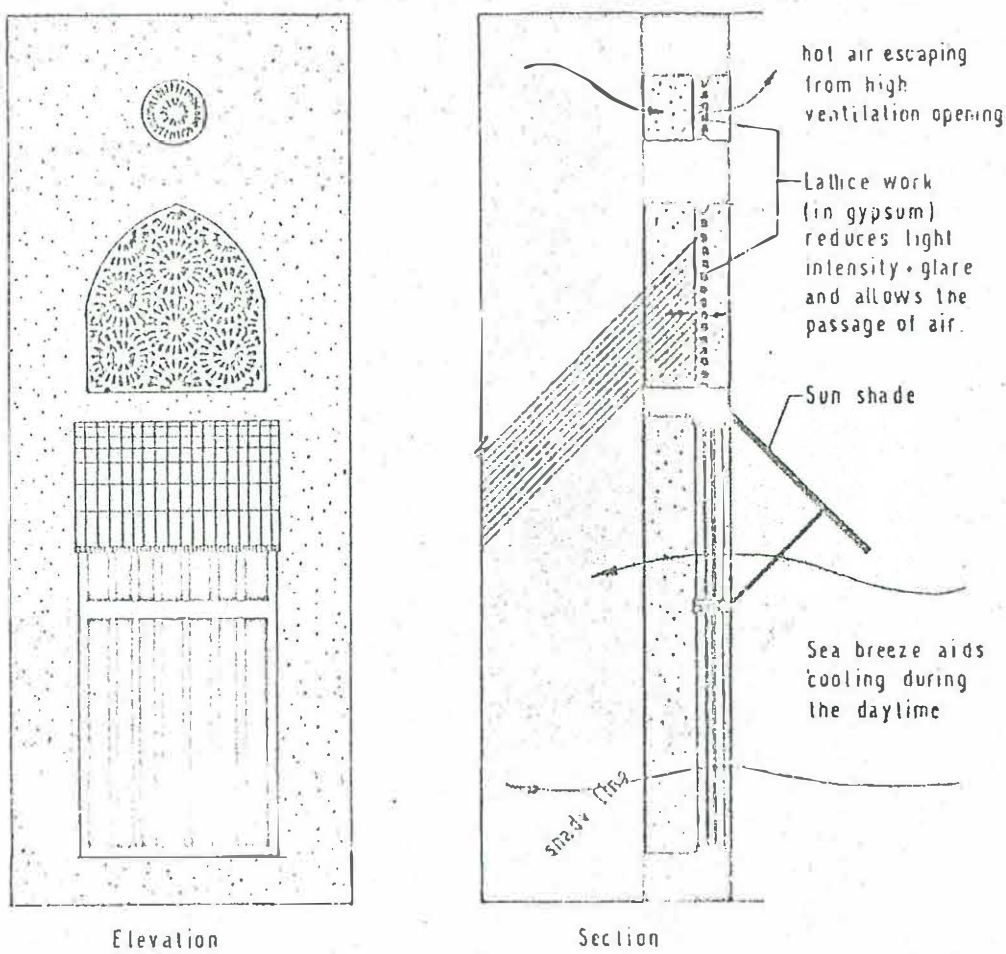
(a) Uni-directional wind catcher. Ka Mohib al Din, Old Cairo.
(b) Multi-directional wind catcher. Courtyard town house, Dubai.
(c) Cloth multi-directional wind catcher. Batina Coast, Oman.

Some wind catchers are able to cool the air before it enters the building. Air is often drawn through a cool basement chamber, or across a bed of planting, before entering the living quarters. Evaporative cooling can be incorporated into the wind catcher in the form of porous water-filled jars, or mats of wet grasses. Hassan Fathy, in the design of a wind catcher for a school in his Gourna Village, used beds of wet charcoal for the air to pass over before entering rooms, and claims to have measured a drop of 10°C in air temperature.

With the costs of mechanical air conditioning remaining prohibitively high, the use of the wind catcher could prove advantageous today in many regions.

Openings:
In general the functions of a window are firstly to permit light to penetrate the interior of a building in such quantity and distribution that a satisfactory interior illumination results, and secondly to provide a view of the exterior. However, in the case of hot countries in general, ventilation and the control of glare that results from the brightness of the exterior light, together with the provision of privacy, are all equally important considerations in designing the window opening. The European framed glass window does not satisfy all these functions even after shading devices and setbacks are added.

Fig. 3
A development of the window as a ventilating screen (whilst still letting in light) is the multi-level openings, in this case as found in Muscat, Oman.



Summary:
Indigenous methods of building offer us appropriate, low cost and low energy solutions to environmental problems. Mud-brick, one of the most common building materials used in Developing Countries, has positive inherent thermal properties. Wind catchers can in many cases eliminate the need for costly mechanical air conditioning. Screens and multi-level wall openings found in indigenous building are environmentally and socially superior to the European glass window. The development of indigenous methods could form the basis of a building industry truly responsive to local social and economic as well as environmental needs.