FORM FOLLOWS CLIMATE - CHARLES CORREA

Editor's Note: This essay was written by Charles Correa in the late 1970s in response to the energy crisis that affected much of the Western world. Foreseeing similar or grave mishaps for the 'Third World' he started to advocate for sustainable design and planning practices as means to ward off a bleak future. Originally published in the Architectural Record, July 1980.

To live in the Third World is to respond to climate. We simply cannot afford to squander the kind of energy required to air condition a glass tower under a tropical sun. And this, of course, is an advantage. For it means that the building itself must, through its very form, create the "controls" the user needs.

This degree of climate control involves much more than just sun angles and louvers; it concerns the section, the plan, the shape and the heart of the building. The Emperor Akbar's magnificent capital complex at Fatehpur-Sikri is not just an attempt to create an architectural *tour de force* in the classic sense (scale, proportion, silhouette, materials); it also sets out to be at least 10 degrees cooler than the surrounding landscape. Hence the pattern of open pavilions, placed formally in the context of courtyards, inlaid with fountains and running water. Sensational as this architecture appears against the evening sky, it is only when you are within that you comprehend the fundamental impulse (the architectural deep-structure) that generates the form. It is the necessity to control luminosity, air movement and temperature; in short, to establish a micro-climate (and hence (as we shall see, a life-style) for its users.

Seen from this viewpoint, the energy crisis could mean much more than just fiddling around with the thermostat. It might well be an Allah-sent opportunity for architects in the U.S. (and I mean *especially* those concerned with the visual and sculptural aspects of their work) to turn again to that seminal progenitor of form: climate.

As designers, we all want to see (and build) interesting and exotic — form. But the "beautiful object" needn't be something which is developed in oppositions to the forces of nature around it. On the contrary. The extensive overhangs of Frank Lloyd Wright's Usonian houses, the baroque double-heights and giant *brise soleil* of Corbusier: all these great sculptural decisions were triggered off by a desire to modify the prevailing climate. Similar instances abound in the old architecture of most Third World countries, constituting, in effect, what could well be an invaluable technological transfer, in reverse!

For instance, at Trivandrum in the southern tip of India, there lies the thousand-year-old Padmanabapuram palace. It is a hot and humid area, and these palace buildings are indeed extraordinarily inventive in their response to the prevailing breezes and light; response to the prevailing breezes and light; as witness this

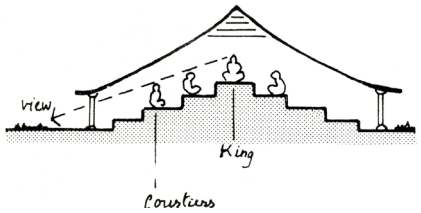


Diagram 1

Royal pavilion, in which the slope of the tiled roof echoes the pyramidal form of the plinth *(Diagram 1)*.

The King sits on the top of the pyramid, with his courtiers on descending levels around him. The basic configuration of the building has two enormous advantages. First, it doesn't need any enclosing walls to keep out the hot sun and rain. Second, when you are within the pavilion, your line of vision is deflected downwards to the grass around: a cool fresh green which in itself is therapy on a hot day!

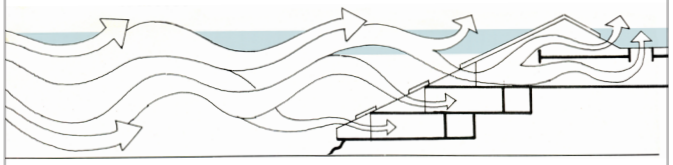
We have used this principle in many of our projects as for instance, in the development of Kovalam, one of India's most beautiful beaches, just a few miles away from Padmanabapuram. This complex of resort facilities uses the local vernacular of tiled roofs and white plastered brick-bearing walls, with a natural hill slope providing the necessary plinth profile.

Cross-ventilation is essential in most of the hot-humid coastal region of India. In Bombay, for instance, the temperature is warm throughout the year, varying from about 70 degrees F to 100 degrees F. The humidity is often above 90 per cent. In this climate, and without air conditioning, the new Salvacao Church has to accommodate large congregations, of over 2,000 people at a time.

Now, the conventional church form, evolved in the relatively cold climate of Europe, is basically a closed box. Islam — the only religion involving congregational prayer which grew up in the East — uses a totally different configuration. Mosques in Pakistan and

India (as for instance, the great Jumma Masjid in Delhi) are virtually just open-to-sky courtyards, defined by a colonnade all around. In other words just enough structure to make you feel you are in a "built environment"; in actual fact, of course, you are under the open sky.

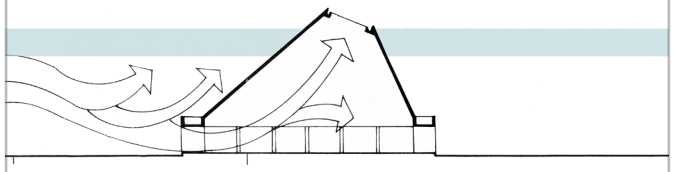
Kovalam Beach Development, Kerala

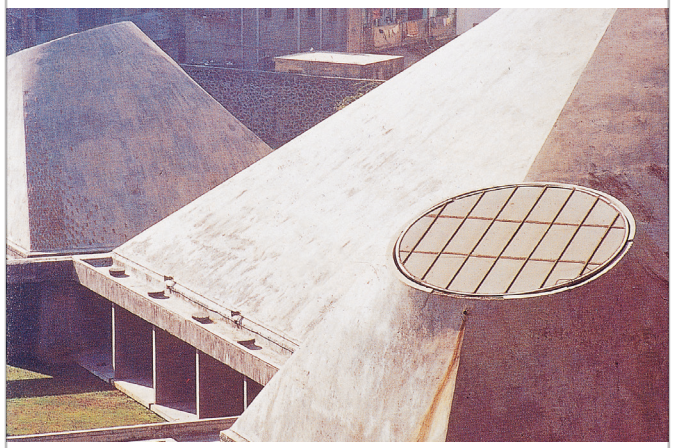


Kovalam, one of India's most spectacularly beautiful beaches, is near Trivandrum along the Arabian Sea. The first phase of this project consists of hotels, cottages, and specialized centers for yoga, ayurvedic massage and water sports. In order to preserve the natural beauty of the site, the facilities are built into the hill slopes—every room getting its own private terrace for sunbathing and relaxing. The construction is in the traditional Kerala vernacular: white plastered brick walls, red tiled roofs. The slopes of these roofs run generally parallel to the natural hillslopes to catch the prevailing breeze currents and also to deflect the eye away from the hot sky and down towards the palm fringed beach.

Unfortunately, a church cannot, for liturgical reasons, be uncovered. (Though if Christianity, which started in the Near East, had remained there and not switched to Rome, perhaps it would have had open-to-sky churches.) So, for the Salvacao Church in Bombay we created a series of interlocking courtyards and

Salvacao Church, Bombay





This church, completed in 1977, consists of a series of interlinked spaces, some covered, and others open to sky. The shell roofs are ventilated at the top, thus setting up continuous convection currents of air. This church is based on the following concept:
I. That there are three basic periods in the life of Christ: A. the Baptism, B. the public life and C. the Crucifixion.
II. That theologically these three periods correspond to: A. Preparation, B. Instruction, i.e. enlightenment; & C. the final sacrifice.
III. Furthermore, liturgically these find expression in: A. the baptismal font & confessionals, B. the pulpit and altar and the tabernacle.

covered spaces, a pattern which allows any particular activity either to take place in the open or under cover — depending on the weather. These spaces are functionally differentiated in an analogue of Christ's life, and the covered ones, protected by concrete shells, act as giant flues: the hot air rising and exiting through a vent at the top, thus drawing in fresh air from the courtyards around. All the various areas, both indoor and outdoor, interconnect horizontally, so that the space — and the breeze — flows across the site.

Here, at the other extreme, is a high-rise example: the Kanchanjunga apartments in Bombay. The prevailing breezes come in from the Arabian Sea on the west — so the units had to face this way. But this is also the direction of some less desirable elements: like the hot afternoon sun, the monsoons, and so forth. In order to deal with this dichotomy, it was decided to create an intermediate zone between the dwelling unit and the outside — a large double-height terrace garden which would also (at appropriate times of the day) constitute a major living space *(Diagram 2)*.

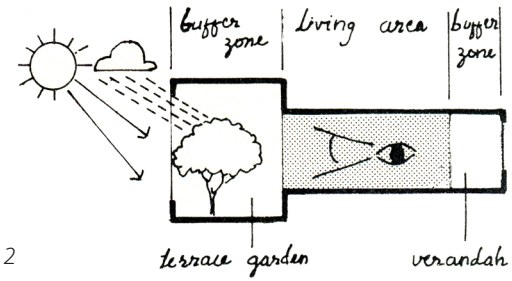


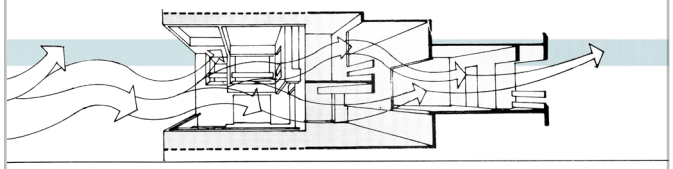
Diagram 2

In section, the apartments interlock so that each unit traverses the building, from east to west. This not only ensures cross-ventilation but also serves to "connect" the two principal views available in our city: the westward view out across the Arabian Sea, and the eastward view across the harbor to the main-land. The double-height terrace gardens form the focal point of each apartment — providing a dramatic platform

from which one can overlook the city; each one a shaded, breeze-filled space.

In Bombay, where the high humidity precipitates an overnight dew, it is essential to provide a cover — at some level — to the terraces. But in the dry climate of northern and central India, sleeping out at night on roof terraces has been a tradition for many centuries. These open terraces are also used during the sunny winter days, for sitting out, drying food grains, etc.

Kanchanjunga Apartments, Bombay



This tower, 21 meters by 21 meters and 85 meters high, has interlocking apartments—each of which opens out on to a two-story terrace garden. These gardens are placed on the east and west where they can get the sun and rain they require: at the same time they form a buffer zone, protecting the main living spaces from these very elements. A typical apartment has three bedrooms; additional half-levels can be added so as to form up to six bedrooms. The sheer rein-forced concrete walls on the sides of the tower are structurally necessary to support the cantilevered terraces; they also express the spatial organization of the various sized apartments within the building.

From this premise grew the design for the Tara Group Housing project, a low-rise high-density complex in Delhi. The narrow housing units have an open double-height terrace in front. They are arranged so as to create a central semi-covered community space, in which trees and fountains act as humidifying elements, essential in the dry heat.

The idea of creating a central zone with its own special micro-climate is also the departure point for an office building in Hyderabad — a city in the hot/dry region of the Deccan plateau. It is the administrative center for ECIL, a large electronics corporation in a fast-growing industry. Thus right from the beginning, the client insisted that the form be flexible so that the building could "grow" with time. Second, they wanted a building which would create its own climatic conditions, without recourse to mechanical ventilation and cooling systems.

With these two objectives in mind, the architectural form of the building evolved as a series of modules arranged around a central focus: the whole protected at roof level by slats and by a 100 milimeter layer of water (to reflect the heat and sunlight) *(Diagram 3)*.

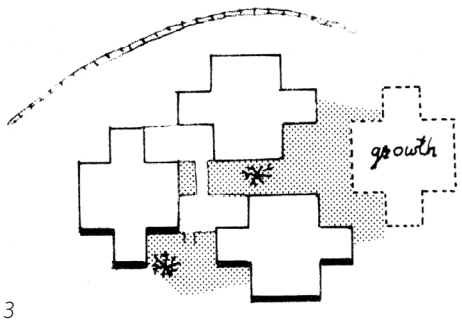
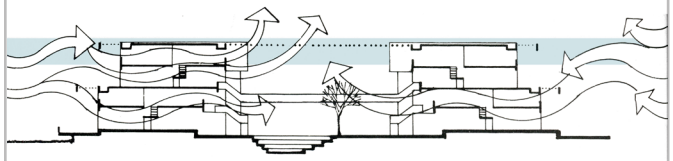


Diagram 3

Tara Group Housing, Delhı



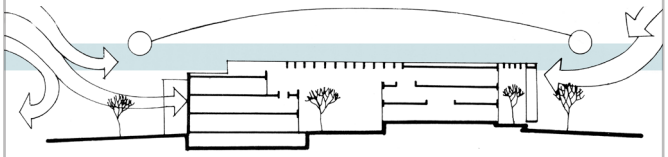
This project, completed in 1979, is a low-rise high-density (525 persons per hectare) configuration of 2- and 3-bedroom units. Two tiers of narrow maisonettes, each 3 meters wide, 15 meters long, and two stories high, are arranged so that the roofs of the lower level of units form open-to-sky terraces for the upper level. This step-back arrangement also serves to form a central terraced garden, partially covered by a pergola, which acts as a focus, replete with trees and fountains, for the whole community.

Because of the panoramic view of the factory and township to the west, it was decided to erect a large screen, away from the building, to provide sun protection: the whole contraption acting as a sieve, humidifying the breezes that pass through.

We now come to a project which, though small in scale, has been of crucial significance in the architecture we have developed over the last many years. This was a tube house, which in 1961 won the first prize in an all-India competition for low-income housing. The competition brief called for walk-up units, but we

found that we could achieve the same density with these units, each 3.6 meters wide. The warm air rises along the sloping ceiling and escapes through a vent at the top: this in turn draws fresh air through the window to replace it, thus setting up a

Administrative Complex, E.C.I.L., Hyderabad



The program stipulated that the building should be expandable; the architecture should create a special micro-climate which would obviate the necessity for air conditioning. Hence the configuration of the units—which can be added on to as growth occurs. The roof consists partly of slats and partly of a thin membrane of water, which reflects the sunlight back up to the sky. The central area has humidifying elements, creating a special micro-climate. Through it passes the main circulation ramp and the overhead bridges, connecting the different modules. The east faces of the building are blank to keep out the sun: continuous strip glazing runs along the other three facades, (protected on the west by a screen which, held away from the building, frames the landscape).

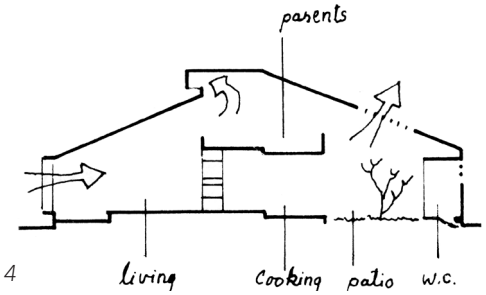


Diagram 4

natural convection current. By adjusting the position of louvers in the window, the rate of exchange of air within the house can be controlled *(Diagram 4)*.

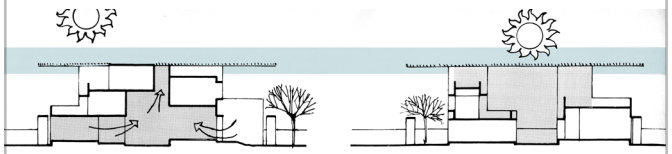
A year later, we used the same principle in the design of the Ramkrishna house, a large private residence belonging to one of the mill owners of Ahmedabad. The idea was then further developed for an industrial township near Kota, Rajasthan, where there is an abundance of local sandstone, in lengths up to 3.5 meters long (for floor spans).

In designing these long narrow row-houses, we developed two basic sections. The first I call a "summer section." It creates a pyramidal interior space, closing off the sky: it is to be used in the hot afternoons. The other is the "winter section": a reverse pyramid, opening up to the sky. It is to be used in the cold season, and in the summer evenings.

The Parekh house, built in Ahmedabad around the same time, has the summer section down the middle of the house, sandwiched between the winter section on one side and a service bay on the other. Thus at different times of the day (or year) different areas of the house are used.

Which brings us to that fundamental principle, namely, the concept of fracturing a building program into a number of discrete, but mutually complementary, spaces *(Diagram 5)*.

Parekh House, Ahmedabad



The plan of this house, built in 1968 in Ahmedabad, consists of brick-bearing walls which define three parallel bays: down the center runs the "summer section," a pyramidal interior space which closes off the sky, for protection during the hot afternoons; on the west side is the service bay which contains the circulation, toilets, kitchen, etc.; on the east is the "winter section," a reverse pyramid which opens to the sky, creating a series of terraces usable in the cold season, and during the summer evenings. As in the case of the Kanchanjunga apartments, the elevations of this house diagrammatically express the climatic concepts which underlie it.

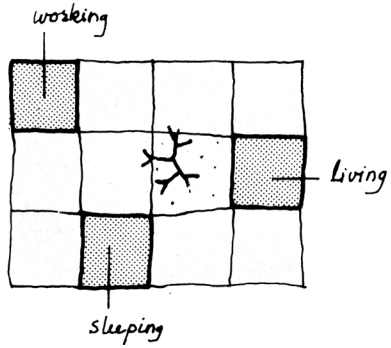
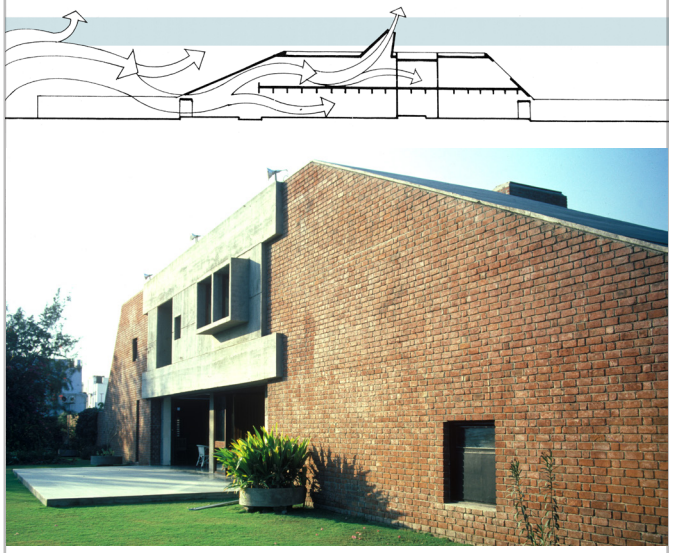


Diagram 5

We have used this concept several times, notably in the Patwardhan houses in Poona, and in the Gandhi Memorial Museum at the Sabarmati Ashram in Ahmedabad. Warm climates abound in examples of this kind of poly-centric planning, from the circle of mud huts in an African chieftain's house to the marble pavilions of the Mughals. They seek to control climate by creating a *nomadic* life-style for the occupants, particular spaces being used at particular times of day. And it is a pattern which can change with the seasons of the year. For instance, in the Agra fort, during the summer months a velvet curtain was stretched across the courtyards in the early morning, trapping the cold night air in the lower level of rooms *(Diagram 6)*.

Ramkrishna House, Ahmedabad



A large private residence, built in 1964-65, for one of the millowners of Ahmedabad. The plan is formed by a series of parallel bearing walls, creating a number of internal courtyards and climaxing in the main opening to the garden on the south. The section has a sloping profile which allows the hot air to rise and escape from vents at the top, drawing in fresh air to replace it, and thus setting up a convection current of natural ventilation. It is an expanded version of the "tube" house, a prize-winning low-income project, designed for the Gujarat Housing Board.

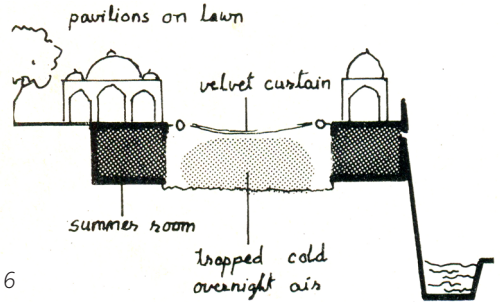
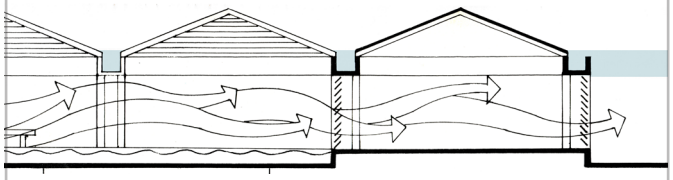


Diagram 6

In the evening, the purdah was removed and the Emperor came out on the cool pavilions and gardens of the terrace levels. In the cold (but sunny) winter, the pattern was reversed: the terrace garden being used during the day, and courts and lower levels at night. Thus to be inventive about *climate* one has really to be inventive about *life-style*. To live in Fatehpur-Sikri, the Mughals created a pattern quite different — though equally royal — to that of Versailles. And in America, the owners of the plantation houses near New Orleans evolved configurations of spaces — and patterns of living — quite different from those they left behind in Europe.

All truly *new* architecture and planning, in the final analysis, concerns the conception of an alternate life-style. This is the real issue — and opportunity! — of the present energy crisis. To reduce a challenge as magnificent as architecture to a mere juggling of surfaces and textures is bathos indeed. It is a symptom of the crippling myopia that has affected the modern architect for the last decade or two; that is to say, ever since he handed over so much of his legitimate responsibilities to his mechanical engineers. It calls to mind Louis Sullivan's caveat, that a building is like a sentence: it cannot consist exclusively of adjectives and exclamation signs. It must have syntax. Climate — that perennial springboard of architectural invention — could well supply the deep-structure we need.

Gandhi Smarak Sangrahalaya, Ahmedabad



In the Sabarmati Ashram, built in the years 1959-62, the historic home of Gandhiji, is this memorial to the Mahatma — which also functions as a museum and as a center of Gandhian scholarship. The basic element of the design is a unit, 6 meters by 6 meters, grouped in a casual meandering pattern around courtyards and water pools. Some units are enclosed by walls; the various exhibition spaces so created are differentiated according to function and are counterpointed by areas of visual rest where the visitor can meditate. No glass is used anywhere in the building: light and ventilation being provided by operable wooden louvers. The Sangrahalaya is a "living structure" which can grow. Recently some more units were added, extending the pattern. This process will continue, as more photographs, letters and other documents are collected —e ach generation making its contribution, and paying its homage, to the Mahatma.