# *Eco-Design and Planning*

KEN YEANG

I am going to talk about the work that I have been doing for the last twenty years: trying to design ecological buildings and masterplans. I call this designing artificial ecosystems, because this is basically what I am trying to do.

This is a brick; I am showing an image of a brick because it is important to realise that most of the buildings that we design are inorganic. In fact if you look at the building we are in, the Tehran Museum of Contemporary Art, everything in it is inorganic, except you and me and the bugs. So the biggest question that occurred to me is: "Where is the organic component?" When people talk about green buildings, where is the greenery? For me, if we are to look at green buildings or ecological buildings at this most fundamental level of understanding it is necessary to bring more greenery into them, and to balance the abiotic constituents with the biotic as with ecosystems in nature.

In 1986, we realised a building for IBM with planting running continuously up the façade. The greenery starts from a patch at ground level and then goes upwards, around the corner, and makes its way to the top of the building.

Being based in Malaysia we are of course more used to the conditions that arise close to the equator, but we also work in London, which is fifty-two degrees above the equator. There, the sun falls mostly on the south façade, and so the greenery is planted essentially on the south, south-east and south-west facing surfaces. There are a number of features that we have learned about putting vegetation in buildings. For instance, it is important to choose hardy species that are specific to the locality, especially non-flowering ones that survive well in winter and summer. The resistant kinds of species that grow spontaneously near railroads and as hedges along roadsides are the kinds that we try to select for tall buildings.

In ecology, an ecosystem consists of organic and inorganic components, acting as a whole. Nature consists of physical components, both inorganic and organic. If you think about it for a minute, what we as human beings are doing is making the environment of the world more and more inorganic, and more artificial. We build roads, we build bridges, we build buildings, we build marinas making the biospheres more and more concrete, artificial and inorganic. We are also destroying our forests, so the biosphere is being simplified; its complexity and biodiversity are being drastically reduced. If I were to leave a single thought with you when you leave this room today it would be to bring more greenery and organic mass into your buildings.

I started to look at different ways of putting greenery into the built environment. We can either put it all in one place, or put the biomass in a series of locations in a pattern of patches that may or may not be integrated with each other. Ecologically it is better to have an integrated continuous pattern so that different species can interact or migrate, creating a much more diversified and stable ecosystem.

You can have series of green courts or squares, you can have a spine, or you can have a series of corridors with fingers, or even a network. These last two are the preferred patterns that serve as guidelines for me, when I do my master planning and architectural design work.

When I look at a site for the first time I usually ask myself what sort of site it is. Is it an ecologically mature site, like a pine or rain-forest, or is it ecologically immature, which is to say a site that is partially devastated by man? It could be a mixed artificial site, where there is a combination of man-made and natural elements, like a park. It could be a monoculture site like an agricultural field, a corn field. Or is it a city-centre site, where there are no natural components at all, neither flora nor fauna?

From the monoculture to the ecologically mature site it is necessary to do a thorough ecological analysis before you start putting buildings on it. Obviously the complexity of the ecological analysis depends on the site. Any ecosystem is very complex; it can be compared to the human body. A real ecological analysis cannot be done in a day, a week or a month; a full year is required. That is the time it takes to see the energy and material flows, and the species diversity, and so on.

We, as architects, and designers, and engineers, usually do not have the luxury of time. So in the 1960s landscape architects developed what they called a layer-cake method for looking at an ecosystem. Any site is regarded as being made up of a series of layers and you can map each of the layers to study the ecosystem. It is very easy to look at this statistically, but for each of these layers the interactions tend to be very complex. So it is more than just mapping – you have to understand the inter-layer relationships as well. After you map the layers, you overlay them and assign points and then produce a composite map to help you in the location and shaping of your building.

I started to look at the way species move across cities. In a city, even though it is very well developed, you may have patches of green here and there. Some species are able to migrate across urban areas. Such movement may only be gradual – it does not happen in one or two years but may require sixty or eighty years in a city.



I started to talk to my ecological designer friends and I asked them what ecological design is. For many, ecological design is construction with minimal impact on the environment. I said to myself, isn't that a dreadful way of looking at designing, because even if you try to design with as little detrimental impact as possible, you will always have an impact on the environment. It is a receding battle you will never win. So I thought about how we could design to have a positive, rather than negative, impact on the environment, as a much more positive and cheerful proposition My response was to design in order to help increase biodiversity.

Let us say we have two sites, A and B, divided by a road or a highway that inhibits species migration and interaction. Now consider what happens if we bridge the road and make the bridge wide enough and have it vegetated so as to provide opportunities for species to interact and migrate. In this way we contribute to improving the biodiversity of the site and improve its connectivity, rather than trying to avoid reducing the biodiversity.

For a master plan we did in Quanzhou, in China, this was exactly our planning strategy. We designed the whole scheme with interconnecting vegetation, from one end of the site to the other, and we created a series of landscape bridges to cross some of the main roads across the site.

I get increasingly distressed every time I pick up a magazine and some architect talks about the fact that he has designed an ideal ecological building. The reason why I feel distressed is because we are a long way from being able to design a truly ecological building. Most magazines have the idea that if you assemble enough eco-gadgets such as solar collectors, photovoltaics, and recycling systems in one single building, then you have ecological architecture. The result may be a low-energy building, but is it really an ecological building?

Architects and scientists today can calculate the embodied energy in a building. For instance a typical office building would require between eleven and sixteen giga-joules per square metre.

Any building also has an operational cost. It uses energy to operate. Then we need to consider the end costs which must include demolition, reuse and recycling because you have to take into account what happens with that building at the end of its useful life. It uses huge amounts of energy and materials, and has people using the building, which has transport consequences. It also gives up a huge amount of energy. All these factors are interconnected.

I would like to talk about the operational systems in a building, because, to me, buildings are basically enclosures for some human or human-related activity. It may be for office use, for entertainment, a residence, or even a warehouse, but it is basically an enclosure produced by human beings for some sort of activity. The enclosure is built to protect us from the elements. In modern times we have mechanical electrical systems that use energy and materials. Essentially there are four modes to create comfort conditions in buildings. The first one is passive, the second is mixed, the third is full, and the fourth is the productive mode.

The passive mode is basically a building which has no mechanical electrical systems, such as in traditional buildings in any country in the world. Passive mode design takes into account the climate of a place without any electro-mechanical effort to improve conditions. The mixed mode uses some mechanical-electrical systems, such as ceiling fans, or double-skin walls, and so on. The third mode is in fact any conventional building you see; it will have full electro-mechanical systems. In the productive mode, a structure generates some of its own energy through photovoltaics, for example.

When you are designing a building it is necessary to first optimise all passive mode strategies, before you go to mixed or to full mode. This is also a sensible way of looking at design, because if your building is designed to optimise the passive mode, it remains comfortable even without external energy. If you have not optimised your passive mode strategy, then if, for instance, there is no electricity and no external energy source, the building becomes intolerable to use.

We designed another building for the IBM franchise building in 1992 (which received an Aga Khan Award) with some passive strategies (pl. 95). We mapped the sun path of the locality, so the first strategy was in shaping the configuration so that the hot sides of the building are buffered by the elevator cores. We made diagrams optimising all the passive mode strategies heading towards a low energy situation.

A full mode building would probably use anything between 100 and 400 Kw/h per square metre per annum. In the United Kingdom as a temperate climate, it is held that a good benchmark is to try to achieve 100 Kw/h per square metre per annum for commercial buildings. If we use mixed mode, like for instance in Tehran where you have a cold winter and a hot summer, because of the humidity level you can use evacuative cooling as a mixed mode system.

If you insist on having consistent temperature throughout the year, then you have a full mode situation. If you are prepared to be a little colder in winter and a little hotter in summer, then you are heading towards a low energy situation.

We have recently designed a building in Malaysia which is naturally ventilated, meaning that it uses wind to create conditions of comfort. This is an example of how a developing nation can cope with the very real problems posed by excessive energy consumption.



There are architects who first consider the ecosystem, such as myself, and others who approach these problems from the engineering end. There are fundamental differences between the two ways of working, because where I start with nature and ecology, the opposite approach begins with technology. There are many engineering-driven architects who tend to start with pre-established specifications. We look for systemic integration, where engineers look for system efficiency. One is artificial, the other is natural. The big problem is how to design our buildings in a more natural manner.

My opinion is that we should concentrate our design efforts towards looking at the interface between natural systems and our man-made systems. An architect is really the one who should try to design artificial systems that can form a mechanically and organically integrated whole. In many ways it is just like designing a prosthetic device. All of us are designing buildings that are artificial, prosthetic devices, which we somehow have to integrate with the host organic system – which is nature, the biosphere – and with the ecosystems.

The environmental integration that we seek between our man-made systems and the natural systems in nature is not just mechanical but organic; for example, in the case of an artificial heart. If you take the most advanced artificial heart that we can produce, it still uses external energy sources. It uses batteries. We are still unable to develop an artificial heart that uses the energy of the body. Furthermore, the survival rate is seventy percent. So if we cannot even design an artificial prosthetic device to interface in a truly organic and self-sustaining way, then can you imagine how far we are from being able to design an ecological architecture that can truly integrate with all the systems in nature?

I started here by looking at the properties of ecosystems and how we could re-interpret them in our man-made world. I do believe in principle that today we are able to achieve all of this technologically but have not yet begun to do so in effective and efficient ways.

What should an ecological building look like? What is the ecological aesthetic? My early work was very mechanical, and my later work is much more organic. At the end of the day, I think that a design's benign systemic integration with the natural environment is the most important aspect of eco-design.

*For projects by Ken Yeang, the reader is referred to pls. 95, 96 and 140-147.*

140.

141.

142.

143.

144.

140. Ken Yeang, Amsterdam Centre of Science and Technology, entrance, Watergraafsmeer, Amsterdam, Netherlands, 1998.

141. Ken Yeang, Amsterdam Centre of Science and Technology, aerial view, Watergraafsmeer, Amsterdam, Netherlands, 1998.

142. Ken Yeang, Mewah Oils Headquarters, Pulau Indah Industrial Park, Port Klang (Westport), Selangor, Malaysia, 2001-2003.

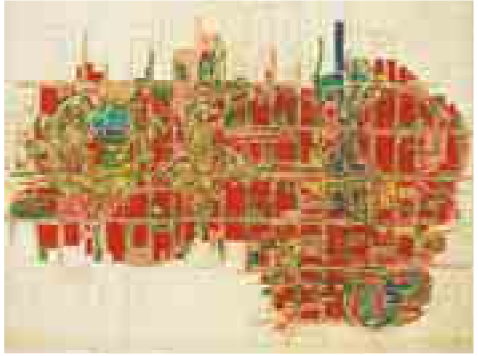
143, 144. Ken Yeang, Menara Umno, Jalan Macalister, Penang, Malaysia, 1998.

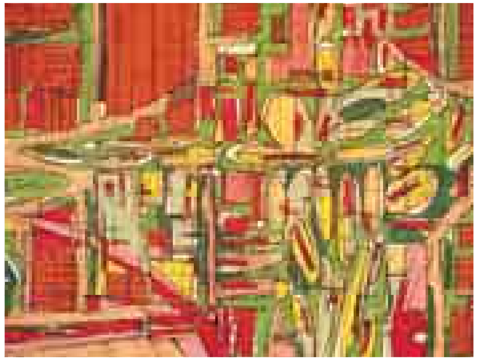

145.


146.


147.

145-147. Ken Yeang, Parramata Road, Sydney, Australia, 2000.


148.


149.


150.


151.

148, 149. Michael Sorkin, East New York Community Masterplan, Brooklyn, New York, NY, United States, 1995.

150, 151. Michael Sorkin, House of the Future, imaginary site somewhere in the United States, 1999.