

BUILDING HONG KONG

ENVIRONMENTAL CONSIDERATIONS

Edited by

WONG Wah Sang *and* Edwin Hon-wan CHAN



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Introduction: Living With The Environment In An Urban Context

Wong Wah Sang

■ INTRODUCTION

Charles Darwin's Theory of Evolution assumed nature's development through a process of natural selection, whereby stronger animals eat weaker animals and only the fittest could survive. A modern society like Hong Kong would agree to this principle as we witness people supplanting each other. There is keen competition all around. And the reward is materialistic wealth for a few successful people.

However, a society does not belong to a few people but to all who live in it and contribute to it. The Theory of Evolution ignored the aspect of mutual cooperation among living things to maintain a liveable Earth in equilibrium and harmony. For instance, the composition of air in the atmosphere has remained constant throughout hundreds of years despite the Earth being an open system. At every moment, energy enters and leaves the Earth. To insulate

Earth's mass is not an easy job for the atmosphere. Living things all work together to create a balance in the environment. The stable salt content in the composition of sea water is yet another example. A stable condition imparts comfort and health for living things. Any deviation will lead to instability and eventually the extinction of certain species.

Now, the importance of biodiversity is recognized as performing a vital role in the functioning of ecosystems. To allow for biodiversity, the strategy of shielding all genes, species and ecosystems from human influence is not practical. Instead, an approach is required to look at the planning of the entire ecosystem for controlled, environmentally dynamic policies so as to afford positive adaptation with minimum adverse impacts on biodiversity. This method of maintaining harmony between human beings and the environment can also be applied in the urban context.

■ PROBLEMS OF THE URBAN ENVIRONMENT

More than half of the world's population now live in urban areas, and by 2020, the projected level is 60%. This implies that the urban environment is becoming increasingly important in a global context. To generate economic activities, cities consume a lot of natural resources while creating and leaving behind a lot of waste and pollution. Cities have become a major cause of degradation of the environment. Urban dwellers are living in generally healthier spaces with higher incomes, but at the expense of the rural environment. Human pursuits and efforts in certain economic and social developments have upset the balance of the natural ecology.

Cities consume natural resources and produce waste inside and outside the city boundaries. The environmental problems generated by cities range from those on a household level, a building level, a city level to those on a global level. The impact of these problems produces effects on human health, economies and ecosystems.

Specific urban problems vary and depend on a city's size, population, growth, topography, climate and government. Threats to human health include those from drinking water and sanitation, waste water disposal, indoor and urban air pollution, as well as solid and hazardous wastes. For large cities, environmental management is often complicated. Income level is also a factor in the creation of environmental problems. Combined with the natural features of a city and its surroundings, the type of environmental problems can be

predicted. For example, air pollution increases with an increase in income level due to higher levels of car use, industrial production and fuel consumption associated with wealthier cities.

High energy consumption is a common phenomenon associated with cities. Studies have revealed that global energy use will rise considerably in coming years. Increases are in the range of 34% to 44% by 2010, and 54% to 98% by 2020. Most of these energy sources still depend on traditional coal, oil and natural gases. Renewable energy sources such as solar, wind and farm-grown energy crops are predicted to supply only 2% to 4% of the global energy for the coming decade.

Environmental problems bear both direct and indirect economic costs. Direct costs include medical costs for treatment of pollution-related diseases. Indirect costs could be reduction of productivity through lost workdays, loss of educational opportunities and shorter working lives. After cities have exhausted the natural resources in their surroundings, resources from further afield have to be brought in at greater costs. However, human health and life affected by environmental problems cannot be compensated purely by monetary means.



Creating one's own environment in the high-density urban fabric of Hong Kong.

■ URBAN IMPACTS ON NATURAL RESOURCES IN HONG KONG

With 11 600 persons per km² in its most dense area, Hong Kong is the most densely populated urban centre in the world. To gain flat land from the original hilly topography, reclamation is necessary and has built up over 25% of the total urban land area. Extensive reclamation is still ongoing. And combined with densely populated shoreline habitats and heavy fishing pressures, the shoreline ecology is being continuously threatened and altered.

Raw sewage flows into the Victoria Harbour together with toxic industrial wastes. Animal wastes and agricultural chemicals add to the pollution. The heavy shipping traffic causes hydrocarbon pollution. To improve the situation, an integrated coastal zone management is required. Laws have been passed to restrict effluent discharges from industry and ships. An urban sewer with treatment facility is under construction.

Other environmental problems in Hong Kong are associated with air, noise and energy. The source of air pollution comes mainly from vehicular traffic, especially diesel engines, construction sites and open quarries. Noise pollution is a result of the high-density urban way of life, which is a complex situation of activities, materials and traffic. As a compact city, Hong Kong has fewer energy problems. The main consideration for energy lies in the ventilation and lighting of buildings by artificial means and the use of the building enclosure to separate the natural external climate from the controlled interior.

The high density also induces an overlapping of environmental problems, as the populace is normally subjected to more than one form of pollution. Noise, air and energy problems occur together in many cases. So these environmental problems cannot be dealt with in isolation. An example is infrastructure failure causing traffic congestion. Not only is the efficiency of work decreased by unproductive waiting, but inefficient fuel use and worsened air pollution also result. Besides, workers' stress and aggravation are increased. So an overall view should be held to confront the urban environmental challenge.

■ TO LIVE WITH THE ENVIRONMENT

In ancient times, people respected the climate and their surroundings when designing their first shelters. For instance, in 5000 BC, around the Yellow River in China (黄土地穴居), people dug a hole in the ground and the ground was burnt to harden the earth, forming a better enclosure against water and the cold. The timber for the roof cover was covered with clay to achieve fire



Reclamation as an intrusion into one of the best natural resources in Hong Kong — the Harbour.

protection. Such was the adaptation to respect and live with the natural elements.

Modern environmental challenges are vast in scale, affecting human health, resources of nature and economic productivity. On a global scale, people now are concerned for the poor, especially the urban poor who are suffering from a degrading urban environment. The poor should be allowed to recognize their environmental risks and to determine their priorities and needs through community initiatives. Job opportunities may also be created from environmental challenges, such as in waste recycling.

Another challenge for cities is to develop strategies for economic activities with concern for environmental protection. Rapidly industrializing cities in developing countries are creating most of the worst environmental degradation. Demand on natural resources has to be worked out in ecologically sound methods without long-term harmful effects. Strategies should aim for sustainability.

Environmental management for cities is often complicated by governmental issues. National and local governments have to work together to achieve multi-goal successes. However, an informed citizenry is as important as a determined top-level management or government. Indeed, many innovative approaches

to improving the environment are emerging from the bottom up — from individuals to neighbourhoods to communities — to create more human, liveable and ecologically sound cities.

In Hong Kong, the Environmental Protection Unit was established in 1977 to formulate environmental protection policy and to coordinate environmentally related activities of other government departments. This Unit was replaced in 1981 by the Environmental Protection Agency, which had developed comprehensive programmes of environmental protection measures, geared to local conditions. In 1986, the Environmental Protection Department was established in its present form with a more powerful and more resourceful set-up. The government's efforts in environmental protection are summarized in Table 1.



The balance of issues with opposing values in the city — the poor versus the rich, the disorder versus the discipline, the identity versus the non-identity...

■ PLANNING CITIES WITH URBAN ECOLOGY

Town planning deals with the layout of districts on a large scale. Land use and resource management are planned to aim for sustainable utilization for the economic and social well-being of the present as well as future generations.

To allow environmental planning, strategies and policies are set and implemented to provide a satisfactory and balanced environment with minimal adverse impacts on nature.

The basis of environmental planning for cities is urban ecology – the recognition of the dependence of one life process on another, the interconnected development of living and physical processes, and the recycling of living and non-living materials as a self-perpetuating biosphere. The environment is best served when town planning is perceived to cope with natural processes rather than utopian ideals. Environmental costs are also considered rather than considering just 'functional' design or good aesthetics. Cities are recognized as centres with highly concentrated nutrient energy. Biological solutions rather than just engineering solutions can be used for solving cities' infrastructure problems. Humanity and nature are considered as integrated issues.

Confucius (孔子) interpreted the *Book of Changes* (易經) as a sequence of changes with nature at work. Natural processes are dynamic. No one stage can persist for ever. Cities have the same analogy. Urban form is a result of an evolutionary process driven by physical, social, economic and political changes. Modern buildings replace old ones. Urban decay and renewal are constantly witnessed in cities.

When human beings are considered as part of the natural process, changes can be fine-tuned to afford constructive opportunities. Even destructive changes can produce benefits to the environment. Land is constantly being changed by artificial or natural processes. Planning can thus be considered as initiating purposeful and positive changes. Humankind and urban ecology are the basis for planning.

Besides the concept of change or processes, the principle of 'the least effort for the maximum gain' can be applied to urban ecology. Spending the least amount of resources and energy to achieve the best results is the principle of economics applying to cities. A city can be both the supplier and the consumer of products, like a recycling procedure. An example of a constantly recycled city is Rome, where many of its buildings are constructed out of materials and components from previous, old buildings.

Another principle for designing cities is diversity. From an ecological point of view, diversity implies health. In an urban context, diversity gives social order. Through diversity, choice is offered to meet the requirements of a diverse urban society and its lifestyles. In a larger context, diversity is related to culture and identity.

On the other hand, the different urban elements and systems are interconnected and interdependent. Any piece of land is affected by its

hinterland and bio-region. So a local area has to be related to its larger context for a balanced ecological planning. Recognizing the interdependence of people and nature will create new landscapes and urbanscapes that are a mixture of the natural and the artificial, possessing ecological, economic and social values that are more adaptable to changes which occur in life.

In Hong Kong, high density is a unique factor in planning considerations. Handled positively, the urbanscape would be compact and efficient; but if mishandled, overcrowding can result, with damage to the environment. In the land use planning process, environmental impact assessment (EIA) is used as an analytical tool to allow a more dynamic approach to planning by taking account of changes in and interrelationships among different systems.



The coexistence of different functions — residential, shopping and leisure — may not strike a balance of harmony in the urban environment.

■ DESIGNING THE BUILDING ENCLOSURE WITH ENVIRONMENTAL CONSIDERATIONS

Buildings form the major part of the urbanscape, and the enclosures of buildings act as the interphase between natural and artificial environments. In this respect, the fundamental functions of a building enclosure include ventilation, daylighting, noise control, heat transfer as well as visual contact. The internal

environment is controlled by artificial means to achieve a constant condition regardless of the external environments. Architectural design can respond to various needs, but proper building management is as important as the initial provisions.

Energy enters and discharges from a building through the enclosure in various forms, some of which are interchangeable. Solar heat, light, sound and wind are environmental factors to be tackled. Design strategies range from massing with favoured orientation, choice of materials, detailing, to the provision of special features to self-regulating 'intelligent' façades.

The impact of solar radiation is affected by the sunpath and also the location of the building. In Hong Kong, the problem is with solar heat gain in summer, especially with tall buildings. Arranging buildings with the wider façades facing north or south can reduce solar energy absorption. Service cores, including lift lobbies, stairways and toilets, are a good device to face other orientations that have more heat gain. Shading devices such as fins, overhangs, balconies or projecting eaves are effective in cutting off sunlight. Various types of glass can be used for solar control. More sophisticated methods include a double building skin and mechanically ventilated cavity façades. Vegetation can also help to cool down buildings. Alternatively, a photovoltaic envelope can be installed on the façade or roof to convert solar radiation into electricity to supply part of the energy used by the building.



Planning with environmental considerations can impart more varied urban forms.

Wind can be harnessed in different ways to benefit a building. The simplest way is to allow natural ventilation. Cross-ventilation or stack effect are possible means that can be introduced to the architectural design. Another possibility is to absorb the energy from the wind through turbines and convert this into other usable forms of energy.

Noise in Hong Kong is a problem associated with its high density, and especially with traffic. To deal with the noise problem, different design strategies involving an energy aspect can be used but will produce different outcomes.

Environmental problems can be interrelated, so an overall view has to be held during the architectural design stage. Integration with building services can also introduce a good solution to the building enclosure to make the internal and external environments harmonious.

■ ENVIRONMENTAL EFFECTS OF BUILDING MATERIALS

Cities are built up of urbanscapes that are composed of mainly buildings which are constructed from components and building materials. The extraction of materials, for building and construction, can create damage to the natural landscape, which is often difficult to recover from ecologically. Besides extraction, energy is also required for the transport of raw materials, with it also come pollution problems. Production can involve a lot of energy and may generate by-products or unusable waste. Some building materials allow recycling or adaptation to other use.

Materials are used with the aim to integrate their life cycles as much as possible with the building to achieve sustainability. This means a minimum of waste and an efficient use of materials, lengthening the life span of building components. Materials and products are encouraged to be recycled after the demolition of a building, so that natural resources can be conserved. In this respect, buildings designed for future dismantling have obvious advantages.

During the life cycle of building materials, environmental impacts in various forms and magnitudes are produced. Issues in considering the choice of materials include extraction of the raw materials, consumed energy, by-products, waste, renewability, maintenance, and lifespan.

Concrete as a common building material has low energy content, but it can be increased by the addition of steel reinforcement. And much energy is used during transport and construction. Demolition will create rubble that occupies space but can be reused as filler. Stonework and brickwork have similar environmental impacts.

Glass needs a large amount of energy for processing the raw materials required. Some pollution arises during the manufacturing process. Glass can be recycled through remelting, so the problem is that of contamination.

Ceramic is made from clay. A high energy content is involved in firing the clay and glazing. The energy content for the layer of adhesive or cement has to be taken into account too. Ceramic waste is mostly used as a filler material.

Metals are extracted and transformed into building products by using a lot of energy. Harmful by-products may be produced during manufacture. Reusability of metals is an environmental benefit and is often economically feasible.

Synthetics like polyethylene, PVC, bitumen, rubber, polyurethane and polystyrene have petroleum as the basic raw material. During extraction, harmful emissions and waste could be introduced to the environment. During the life cycle, contamination often leads to problems in recycling.

Wood is a very important renewable raw material. Little energy is involved during its production. Sustainable forestry management allows a sustainable supply of wood. Preservatives are often required. The transport of wood also requires energy. Plywood, fibreboard and chipboard, etc., are also produced mainly from renewable raw materials and offer a good choice and variety for use.



Correct choices of materials and detailing for a building are positive attributes for environmental improvement.

There are numerous paints with various compositions. Many paints release organic hydrocarbons during application and may harm the health of painters and occupants. Additives are usually also harmful. During the dumping of painted materials, harmful elements may be released.

■ CONCLUSION: AN ECOLOGICAL APPROACH

From the broad perspectives of building products and of town planning and urban landscapes to the selection of building products and materials, we learn that modern technology developed to shelter human beings can be unfriendly and polluting – a hard and forceful gesture in the process of civilization. Due to human activities, the recent increased carbon dioxide content in the atmosphere has increased the insulation value and hence the temperature of the atmosphere. A glazier that is formed of hard ice crushes into the others and cuts into the surrounding land, but only moves slowly at one metre per day. However, a river is smooth and meandering, flowing down cliffs and nourishing a vast landscape. And most importantly, it contains life. A considerate, lively response is much more rewarding than a forceful, unfriendly act. Environmental strategies vary by responding to different contexts, and approaches can be through legislation, the economy or technology. Environmentally responsive use of artificial creations can produce lively buildings and create cities of the best architectural and urban quality.

To conclude this introduction, I believe a broader approach is essential to cultivate environmental consciousness. When we choose to be friendly to the environment, the environment will be friendly to us. We can be part of the natural environment and vice versa. Through education, architecture and everyday life with the appreciation of changes imparted by the environment, we can learn to live harmoniously with the environment.



The correct positioning of development with environmental awareness can lead Hong Kong into a truly sustainable future.

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