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CONTENT

LIMITING THE DESTRUCTIONS OF THE PLANET: Towards Green Approach in Architecture

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Abstract. It is tempting to borrow the ancient view, and imagine the built environment as poised between the four ancient elements, such as: earth, water, air, fire, and interact with each other. At present such interaction is largely destructive rather than sympathetic. However, if the interaction were to become focus, either the building or the built environment, then it might be possible to reinstate these relationships around a sustainable and appropriate level of technology. The objective of this paper is to describe the destruction of the system in the planet, downgraded of the quality of natural resources and how far architecture can contribute on them. The conclusion will discuss on green approach in architecture design.

Keywords: *air, water, fire, earth, green architecture, green approach.*

1. INTRODUCTION

During the industrial revolution in the mid-1800s, the design of buildings came to depend less on ambient energy and more on the abundant supply of fossil fuels for their thermal comfort. Current trends in architecture and urbanism often continue to ignore the potential of passive measures to achieve the thermal comfort. The resulting impacts can be measured in several aspects, especially in environmental terms. There is an increasing acceptance among planners, urban designers and government officials that the current modes of human existence are unsustainable in the environmental terms. Some of the factors supporting this view are indications of global climate change, resource depletion, droughts, floods, local pollution and damage to the ecosystems (Brophy et, al. 2000).

To the ancients' belief, all matter was composed of four elements of earth, water, fire and air, in varying proportions. Today the composition of matter is known to be far more complex, but the four elements is still useful way of looking at how buildings interact with the environment. Most buildings are constructed of materials taken from the earth, they are serviced with water and 'fire', and they interact with the air, water, 'fire' and earth of which their occupants depend upon for survival (Vale & Vale, 1991).

2. THE DESTRUCTIONS

2.1. Air

Human activities are altering the composition of the atmosphere in such a way that it traps more heat from the sun. This is the so-called 'green house effect'. The temperature inside the greenhouse rises when the sun shines on it because the glass is relatively transparent to the short-wave solar radiation and allows it to enter easily. When the radiation strikes the earth and plants in the greenhouse they are heated and give off long-wave heat radiation. This is less able to pass through the glass, which is relatively opaque to radiation at these longer wavelengths. Certain gases in the atmosphere act like the glass in a greenhouse. They allow radiation to enter and warm the surface of the Earth, but they prevent the longer-wave heat radiation from escaping back into space. The Earth maintains a thermal equilibrium because the energy coming in from the sun is balanced by the heat that flows out. If less heat flows out because it is trapped in the atmosphere, the Earth's temperature will rise.

The principle 'greenhouse gases' is carbon dioxide (CO_2), which contributes about half of total global warming effect. About 80 % of the carbon dioxide comes from burning of fossil fuels (coal, oil and gas), the remaining 20% from the burning of forests and firewood and from agricultural sources. The atmosphere at present contains more than 700 billion tones of carbon and fossil fuels are adding about 6 billion tones per year. A further 18 % of global warming comes from the gas methane (CH_4). This is produced by bacteria that break down organic matter in the absence of oxygen in places such as swamps and bogs. A major source of methane is the stomachs of ruminants such as cows and sheeps. The next most important components of these atmospheric gases are the CFCs; each atom of chlorine from a CFC molecule can help destroy 100,000 ozone molecules in the stratosphere (Vale & Vale, 1991).

The greenhouse effect is the most threatening effects of pollution, but what is relevance to architecture, and those who use the buildings? The relevance arises from the fact that roughly 50 % of the CFCs produced throughout the world are used in buildings, as a part of the air conditioning or refrigeration systems, in fire extinguisher system and in certain insulation materials. Similarly, 50 % of world fossil fuel consumption is related to the servicing of building, therefore 50 % of the carbon dioxide output is under the control of designers or inhabitants of buildings (Vale & Vale, 1991). Architects who condone such building types through designing them must bear some responsibility for the pollutants produced, just as architect who neglect to build energy-conserving buildings bear a responsibility for pollutants from the unnecessary burning of fossil fuels.

2.2. Water

Buildings use a prodigious quantity of water, both during their construction and during their occupation. The average domestic consumption is 160 liters per head of population per day in the UK, 220 liters per head per day in the US. In order to survive, the human body needs only about 1 liter per day and the average consumption of water in food and drink is about 2 liters per head per day (WCED, 1987)

Building materials need large amount of water for their manufacturing process. Cement uses 3.6 tones of water for every tone of dry cement powder, but to make cement into concrete requires more water. The manufacture of a tone of steel uses 300 tones of water. Bricklaying and plastering are also large consumption of water at the building site. Once a building is completed, its water consumption will depend on its function. In domestic and office accommodation the largest single consumption of water is WC, in which flushing alone can contribute to about one third of the total water used by domestic sector. This is usually fresh water, purified and safe to drink, which is flushed straight back to the sewers.

The water supply to these demands comes almost entirely from the river. Only 3 % of the water on Earth is fresh and can be used for drinking, while two-thirds of this is locked up in the polar ice caps and the glaciers. In fact 0.0001 % of the Earth's water is in the river that is part of which the people depend for their mean of supply. The total volume of the water in the world's rivers at the mean time is about 130 cubic kilometers, enough to supply a world population of 5 billion people with 26.000 liters of water each (Vale & Vale, 1991). The main reason is that human activities contribute to the pollution of water that is required. The rivers that serve to supply drinking water also receive effluents from sewage work, toxic wastes from industry and run-offs of pesticides and fertilizers from farmland. Much of these fertilizers are wasted because it is not taken up 100% by vegetations and it leaches into groundwater supplies and may render drinking water unsafe.

Most people know of the hydrological cycle in which water is evaporated from the sea by the action of sunlight, condenses and falls as rain to the ground, where it fills the rivers and flows back to the sea. This solar-powered cycle is the source of all fresh water supplies; but here again the human activities are interfering with a natural system. The water vapor that evaporates from the sea leaves behind the minerals that had been carried down the rivers. However in its passage through the atmosphere the water picks up the pollutants those human activities have pumped to the air.

2.3. Fire: Problem of Fuels

The fuels used can be divided into two categories: finite and renewable. The finite fuels are those that are not renewable, such as: coal, oil, natural gas and uranium while renewable fuels are those that are derived from natural resources such as solar energy, wind power and water-power.

The problem of finite fuel is that they can deplete at any time. Estimation of the amounts of the fossil fuels is decreasing. The following are based on studies by the Watt Committee on Energy in London (1980):

coal	11.000.000	Mtce
oil	510.000	Mtce
Natural gas	320.000	Mtce

mtce: million tones of coal equivalent

The immediate problem with these fuels is that they release carbon dioxide into atmosphere as they burn. Clearly if all the fossil fuels reserves were to be burned, almost all additional carbon would enter the atmosphere, and precipitate disaster.

Current world energy consumption stands at 10 terawatt (TW) years per year, that is equivalent to 10.000 mtce (Vale & Vale, 1991). If the per capita energy use were remained at the same levels as today, a world population of 8.2 billion (a mid range estimate of the possible increase) would need about 14 TW years per year. If the per capita consumption generally rose to the global consumption of 55 TW years per year (WCED, 1987) and, incidentally, the fossil fuels would all be gone in about two hundred years.

Energy is a key problem to be tackled if humanity is to continue living on the Earth. The discussion above shows that there is no longer possible to follow based on a continous development on increased fossil fuels use. A massive reduction in the energy used in buildings, achieved through a green approach to architecture, could move to a position where energy was no longer generated through burning fossil fuels. All could abandon the need for fossil fuels through a reassessment of current attitudes to buildings.

2.4. Earth: Materials and Resources

Building exist through the extracting materials for their construction from the earth, be it stone quarried direct from a stratum of rock or bricks made from baked clay. However, whether it be iron and glass, or the more modern aluminum and plastic, all materials are still won, or more precisely, wrenched, from the earth. The iron ore for producing steel, the bauxite ore for aluminum, the sand from which glass is made, are all extracted from the ground.

Although, it is a common practice that building materials can be extracted out of the earth that is by digging them up and using them, but the processes of extraction, refining, fabrication and delivery are all energy-consuming. The energy used added to its share of pollution in the form of acid deposition and carbon dioxide.

The problem of deciding which building material causes the least global damage is complex. Firstly, it is the need to consider the direct impact on the environment – is it preferable, to quarry the landscape for stone for building? In addition, the energy content of any material needs to be considered, for it offers a crude guide to the amount of pollution involved in its manufacturing. However, the choice of the materials becomes more complex in the manner in which it is used within the building as considered.

It is also evident that energy used to construct building may be as much as that required for ten or twenty years of operation. This points need to be considered very carefully for the life of the building (planning and durability of materials) and the possibility of recycling the materials, when the building reaches the end of its usefulness. Some architects are attempting to consider the impact of their choice of materials as widely as possible. For example, at the Findhorn Community in Scotland a group of self-build houses has designed for a minimum ecological impact (Vale & Vale, 1991). All the materials chosen are low energy and non-toxic. The houses are largely constructed of timber from sustainable sources, untreated or finished with organic paints or wax. The roofs are clay pan-tiles. The insulation material is cellulose material manufactured from recycled newspapers, impregnated with non-toxic boron (boric acid) to render with fire resistant. Everything used in the construction is bio-degradable. Should a house reach the end of its useful life, all its materials can be re-used, or be allowed to rot naturally, without environmental impact.

The built environment, then, relates to earth and water, fire and air, and its interaction with each of these elements is such that it involved the transfer of energy. In a world under threat, each transfer of energy needs to determine its implications, and whether it is really necessary.

3. GREEN APPROACH TO ARCHITECTURE

The 'green' approach to architecture design is not a new approach. It has existed since human first set foot on earth and selected a south-facing cave rather than one facing north to achieve comfort in temperate climate. What is new is the realization of green approach to the built environment which involves a holistic approach to the design of buildings; where all the resources that go into building, either the materials, fuels or the contribution of the users is needed to be reconsidered if a sustainable architecture is to be produced.

Vale & Vale (1991) proposed six 'green' principles in architectural design. However, the green principles proposed are not intended as an asset recipe that must be followed, but it is put forward as a reminder of the issues that many designers has ignored. They are as follows:

a. Conserving energy: a building should be constructed so as to minimize the usage of fossil fuels to run it.
b. Working with climate: buildings should be designed to work with climate and natural energy sources.
c. Minimizing new resources: a building should be designed so as to minimize the use of new resources and, at the end of its useful life, to form the resources for other architecture.
d. Respect for users: a green architecture recognizes the importance of all people involved with it.
e. Respect for the sites: a building will 'touch-this-earth-lightly'
f. Holism: all the green principles need to be embodied in a holistic approach to the built environment.

4. DISSCUSIONS

Past societies accepted the necessity of conserving energy and working with climatic principles without question. It is only with the recent proliferation of materials and technologies that the basis for ordinary building has been lost. Whether by the use of materials of the disposition of building elements, building modified climate to suit the needs of the users. The idea of community comes from the sheltering of people together, whether to provide maximum areas of shade and cooler air between buildings or to reduce the external surface area of the community as it faced the hostile weather. Recent buildings that have attempted to reduce dependency on fossil fuels have tended to stand alone as separate experiments rather than cluster in patterns that respond to local climate.

In the West for example, before the widespread exploitation of fossil fuels the main energy was wood. As wood became scarce, it seemed natural to many citizen to make use of heat from the sun to reduce the need for wood to provide heat. The ancient Greeks were well aware of the benefits of solar design, and commonly arranged their houses to collect the rays of the winter sun. Greeks cities such as Priene, following its relocation to avoid flooding were laid out on a grid plan with street running east-west to allow a southerly orientation of the buildings. The Romans continued the solar design principles that they learned from their contacts with the Greeks, for examples, they were able to make use of window glazing, developed in the first century, to increase the heat gained during winter into the building.

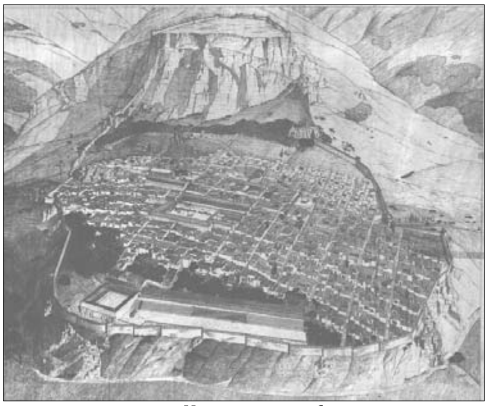
Fig. 1. Illustration of Priene City

The tradition of designing with climate to achieve comfort in buildings is not confined to the provision of warmth aspects. In many climates the problem that faces the architect is to cool the spaces in order to achieve a comfortable condition. The conventional modern solution is the provision of air conditioning systems which is no longer a crude process of opposing climate with energy, which was foolish when energy is cheap and pollution not considered, but is now verging on the insane.

The minimizing of new resources principle is directed towards new buildings, it acknowledges that immense resources are already part of the existing building environment, and that the rehabilitation and upgrading of the existing building stock for minimal environmental impact is as important, if not more so, than the creation of a new green architecture. There are insufficient resources in the world for the built environment to be constructed for each generation; hence the issue of re-use and recycle are appearing.

Re-use can take the form of recycling materials or recycling space. The recycling of both buildings and building components is part of history in architecture. St. Albans Abbey, for example, which was built between 1077 and 1115 on the site of Benedictine Abbey, used Romans bricks taken from the ruins of Verulanium at the bottom of the hill to reinforce the walls of flint, the only building built of stone available in Hertfordshire. Often those whose has accessed to resources is least to have demonstrated the way in which structures is designed for one purpose that can be adapted to suit the different need. However, the alterations are necessary that can often more or less obliterate the original form of the structure or building. This produce a dilemma for those concerned with the conservation of buildings. Should a building be preserved "unchanged" because it was once important, or should it be made useful, be conserved in a changed state? A green approach to the problem might suggest that the question be decided on resources alone. If the resources required to alter a building are less than for demolishing then the former course is adopted.

The respect for user principle may appear to have a little relevance to the issues of pollution, global warming and destruction of ozone layer. But a green approach to architecture that includes respect for all the resources that contribute to construction of a building will not exclude human beings. All buildings are made by hand, but in some cases in architecture, this fact is acknowledged and appreciated, whereas others have attempted to deny the human dimension in a building process. The greater respect for human needs and labour can be evidenced in two separate ways. To the professional builder, it is essential that the materials and processes that form the buildings are as little pollution and dangerous to the individual worker or user as they are to the planet. Architect have begun to realize the extent of global or human poisons that may be found on the building sites, and it is no longer feasible to use materials that contain CFCs, or to use methods of timber treatment that are carcinogenic.

A building that guzzles energy creates pollution and does not alienate its users. The most direct interpretation of the phrase that is to ‘touch this earth lightly’ would be the idea that the building “leaves it in the condition it was before the building was placed there”. An interesting example is the sculpture pavilion designed by Dutch architect Benthem Crouwel for the Sonsbeek ’86 festival (Fig 2). This building was designed to protect a fragile works of a sculpture placed outside, and so the structure was intended to be almost invisible. It used only four basic materials: i.e. a precast concrete for the footings, laminated glass for the walls and roof, steel for trusses and connections are from silicone mastic to stick the panes of glass together. Fins of glass are glued to the glass walls which gave additional rigidity, and provided a place of attachment for the light steel trusses that carried the flat glass roof. The floor was dirt, merely covered with wood shavings to prevent it becoming muddy. At the end of the event the building was dismantled and removed, the foundations were lifted and soil replaced, the shavings were raked up, and the site was completely unaltered by the events that had taken place. The building could be taken away to be use elsewhere for another exhibition, or recycled into another structure.

Fig.2. Sonsbeek Pavilion

However, it is not easy to embody all the green principles in a holistic approach to the built environment. Hence, it is not easy too to find buildings that embody all principles of green architecture, for a green architecture is yet to be realized.

5. CLOSING

The question of what a green architecture might look like has been touched. At the present time, so few examples of a green approach in the built environment exist that it may be appropriate to glance back to the vernacular architectures that espoused the green approach for some clues. But it must be recognized that the green architecture does not mean that we return to such tradition.

In the world of more than six billion people this is not possible. It is the attitude to materials and resources expressed in the vernacular approach that needs to be accommodated in the future architecture.

To survive on a planet with more than six billion people requires a shared system of values which arrived at both now and for the future. An architecture that would look at buildings with similar judgments, and determine beauty through performance might not be so bad. Maybe a green approach to the built environment will succeed if not, at least it can provide again an architecture for all.

6. REFERENCES

ARNOLD, H.E. (1980), *Trees in Urban Design*, New York: Van Nostrand Reinhold, Co.

BROPHY, et, al. (2000), *Sustainable Urban Design*, Ireland: Energy Research Group – University College Dublin.

HAUGHTON, G., C. Hunter (1994), *Sustainable Cities*, London: JKP.

KOSTOF, Spiro, (1992), *The City Assembled, The Elements of Urban Form Through History* London: Thames and Hudson Ltd.

KOSTOF, Spiro, (1992), *The City Shaped: Urban Patterns and Meaning Through History* London: Thames and Hudson Ltd.

MACHARG, I.L. (1971), *Design with Nature*, New York: Doubleday, Garden City.

ROSELAND, Mark. (1998), *Toward Sustainable Communities – Resources for Citizens and their Governments*, Canada: New Society Publisher.

SAUNDERS, P.J.W, and WOOD, C.M, (1977), Plants and Air Pollution, in: Clouston, Brian (1977). *Landscape Design with Plants*, London: The Landscape Institute.

VALE, Brenda, and VALE, Robert (1991), G*reen Architecture: Design for a Sustainable Future,* London: Thames and Hudson Ltd.

WATT Committee on Energy (1980), *An Assessment of Energy Resources*, London: Report No. 9.

WCED (World Commission on Environment and Development),(1987), *Our Common Future (Brundtland Report)*, Oxford.