# survival, sustainability and

Vinod Gupta

Sustainability is accepted as a way of using natural resources that allows us to meet our needs without compromising the ability of our children to meet their needs. It requires us to use resources efficiently. Since natural resources belong to the world and not to any country, in international negotiations, Southern countries demanded a measure of equity in the use of global resources and the Kyoto protocol requires the North to reduce its green house gas emissions, while allowing the South to increase its standard of living, resource consumption and green house gas emissions. The concept of equity and reasonable levels of consumption has to be applied to our own context within India as much as we wish to apply it to the global context. Sustainability will be achieved only if there is reasonable equity– else even reduced consumption levels will not be sustainable.

In cities and towns, sustainability needs to be based upon the following principles (after Alborg Charter 1997): the standard of living must be based on the carrying capacity of the natural environment; consumption must be based on social justice; water and energy resources must not be consumed faster than natural systems can replenish them; non-renewable resources must not be consumed at a rate greater than the rate of development of renewable resources; the rate of emission of pollutants must not exceed the capacity of the air, water and soil to absorb and process them; and biodiversity must be maintained.

These rules need to be applied to existing as well as new towns. While it is difficult to deal with the wide range of issues that are common in towns and cities, a whole lot of work has been done on dealing with sustainability for individual buildings and projects.

## Are 'green buildings' sustainable?

The term 'Green' is often confused with sustainable. 'Green' comes from the European Green Movement, from a culture that

has reached a measure of equity. The minimum standard of living and levels of consumption are already established and going green means doing more with progressively less resources. If this green trend is taken to its logical conclusion, efficiency of resource use can be increased, possibly leading to a sustainable level of consumption.

In India, there is a vast difference in levels of consumption and there is no accepted common level from which one needs to move on the road to sustainability. The standards of water consumption defined by BIS are never achieved in practice and national standards for energy consumption do not even exist. In the absence of a common level, 'Green' has come to mean the creation of projects and buildings that accept the levels of consumption from European or American culture and that claim to optimise resource use by reducing those unreasonably high levels of consumption. Such green standards can be applied only to a few. If applied to all buildings in India, they will cause an unsustainable increase in consumption.

## Sustainable urban development

It is generally accepted that compact urban developments are more energy efficient than low-density suburban sprawl. The density of a city (persons per hectare or gross FAR) is limited by the system of transport. When the car is the main means of transport, the resulting density is low. If an urban dweller needs 25sq m space at home, 10sq m in workplace and another 5sq m for all other needs, he also needs a total of 80 to 90sq m for parking his car at different places. Thus car parking requirements are nearly twice as much as other needs and that does not include the space for roads. Since parking in structures or garages is expensive, it is provided in the open and it occupies a great deal of space on the ground. If cars are the major means of transport, car parking limits the density of development. And it is well-known that low-density developments are automobile dependent!

A survey of energy consumption in North American, Australian, European and Asian cities (Newman and Kenworthy) established clearly that dense cites have a lower per capita consumption. The lowest per capita consumption in American cities happens to be in New York. European and Asian cities have the lowest energy consumption while Australian cities are mid way between USA and Asia. Hong Kong has about the same energy consumption level as Singapore even though its density is more than three-and-a-half times as high as Singapore. Detractors of this theory of dense and efficient cities point out that life in low spread out cities is much cheaper even though it may not be energy efficient. In any case, the efficiency improvement due to more density is limited as vastly different cities like Paris, London, Berlin, Vienna, Tokyo and Hong Kong have similar levels of energy consumption.

Dense cities with tall buildings like Hong Kong or New York use two systems of transport– one for horizontal and another for vertical transport. The horizontal system includes subway, bus, taxi and walking while the vertical system includes mainly elevators. It is the elevator that makes tall, high-density cities possible. While users pay for horizontal transport, vertical transport is free. Unfortunately town plans are made only with horizontal transport and the two systems have never been integrated to produce an economically viable and efficient system. It is conceivable that somebody will come up with a resource efficient urban form that includes vertical transport and that will one day be sustainable.

Elevators take up floor space in tall buildings and as building height increases, the efficiency of the building gets limited by the space taken up by elevators. The proportion of space taken up by elevators in a building is much more than the space needed for roads in a city.

The current theory of building science by which tall buildings are designed is a theory of insulation and exclusion. The building envelope is sealed tight and it insulates the buildings from the environment. This is what produces the typical form of a city with towers. Traditional settlement design has always worked with a different theory– that of an interaction. If an urban area is to have an interactive relationship with the environment, its form and density will be dependent upon the interactive forces. There are many traditional interactive urban forms but only a few examples of modern complexes with interactive envelope.

Urban density may be limited by another factor– the energy needed to make the city work and the waste heat that this energy use produces. Urban development assumes power availability and

# urban development

**Facing page: The dense city of New York has the lowest per capita energy consumption among American cities**
**Above: Life in low spread out cities like Paris, is cheaper, even though it may not be energy efficient**

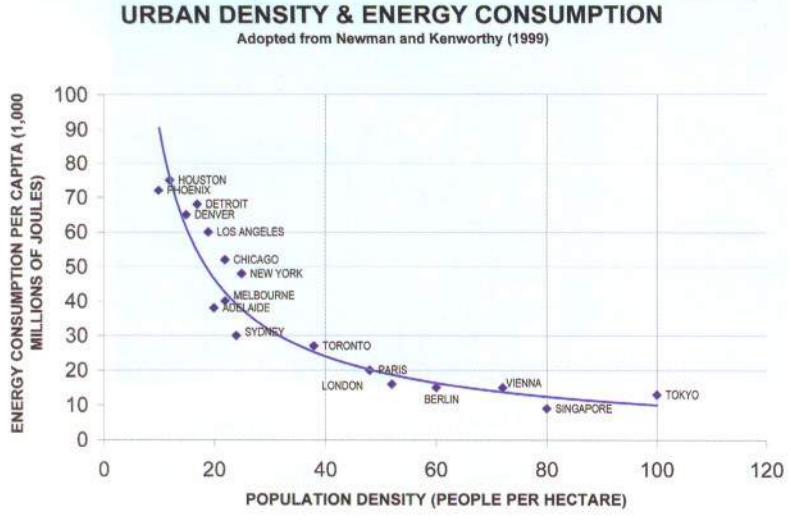
also the possibility of disposing off wastes. For a sustainable city, density ought to be derived from the energy available from the sun. A truly sustainable city would be dependent upon rainwater and solar energy for growing its food and meeting all energy needs. But a simple calculation will show such a thing is not possible with present day technology. Humankind has already developed systems to overcome the limitation of site-specific resources. Systems to transport water, energy, food and materials are in place. These may not always be efficient but they exist. Nature also carries essentials over long distances. Rainwater from the hills flows to the plains and then to the ocean.

If we assume the availability of such essentials from far away, what then becomes the limiting factor for density of urban developments? Perhaps the most important factor is the ability of the environment to absorb and process our wastes – liquid, solid, gas and heat. Dispersal has been our main means of treatment of wastes.

The capability of the environment to absorb wastes is limited and because wastes are in a state of high entropy, it is difficult to carry them over a long distance. While systems have been developed to carry primary resources over a long distance, the economically viable technology to carry wastes over long distances has not been developed. Gaseous automobile emissions are simply discharged into the atmosphere. Conceivably, these gases could be converted into solids that would be small enough in volume to be carried away for disposal.

## Does sustainability require 'autonomous' developments?

Buildings are one component in a larger system and it is meaningless to consider them sustainable or otherwise on their own. Even so called 'autonomous' buildings require connection with their physical surroundings. People come and go; and services like water supply, power, communication and waste disposal are needed. Energy and resources consumed within the building are only part of the complete picture, which includes resources consumed at the neighbourhood and city level. Making a resource efficient building in a remote location can be more resource consuming than an inefficient building in a central location served by public transport and city services. Transport is a major consumer of resources and private automobiles are the least efficient of all transport modes available to us. A suburban development like Gurgaon near Delhi is an example of how resources may be squandered. Gurgaon depends upon private automobiles for transport. Those who can afford, have one car for each member of the family and one to spare. Those who cannot afford are forced to have one car for each working member of the family. Gurgaon has no public transport and the town is divided into two parts by a highway that pedestrians and slow moving traffic cannot cross. The automobile is the only way from one side to the other. It is meaningless to talk of energy efficient and sustainable buildings in such a place.




The idea of autonomous sites has been carried to a ridiculous level in some new building regulations in India, for instance the one that requires a home owner on a site bigger than 100sq m, to build an independent rainwater harvesting system. That home owner must already collect municipal water in his own underground tank, pump it to an overhead tank and have his own backup power supply since power supply is discontinuous. Towards the idea of 'autonomous buildings', even green building norms require a building owner to generate power on site, preferably from renewable resources. Small systems like these are unstable and prone to break downs for want of maintenance. For each system there is a size that is economical to install and maintain and generally speaking, the bigger the system, the more stable it is. So the idea that each building or site ought to be working in an 'autonomous' way is not sustainable.

With all the high technology that is employed in it, is a space station self-sufficient and sustainable? What does it import or export? A space station is self sufficient only in terms of energy. It depends upon imports for everything else. It does have a recycling system for water but not for human wastes. The latter is packed and sent back to earth. Present day space station technology depends upon chemical treatment as against bacterial treatment that we use on earth. The bacterial systems have been with us for millions of years but they are not used in spacecraft because they are extremely unstable at a small scale.

Contrary to what one might believe, even Earth is not autonomous. It depends upon energy imports from the sun and discharges waste heat into deep space. We have a global warming problem because earth is approaching its capacity to radiate waste heat into space.

If the Earth is not 'autonomous', why should buildings and sites be made 'autonomous'?

## Sustainability/robustness

Most ideas on sustainability dwell upon limiting consumption of natural resources to a level that can be maintained indefinitely. However, there are many who believe that so far as climate change is concerned, the world has crossed the tipping point and that major climate changes are imminent. This trend cannot be reversed now by reducing or limiting consumption. If this is true (and the scale and frequency of recent natural disasters does make us believe it is true) then there is no such thing as a sustainable level of consumption. Regions that are rich in rainfall may suffer drought

and others that are drought-prone may end up with excessive rain. Some scientists predict that areas with rain will get more of it while rain deficient areas will have even less rain. Temperature will rise and there will be extreme weather events. Given this situation, we need to look at the robustness of systems rather than their consumption level. A robust system is one that will survive and recover from extreme weather variations. Whatever may have been the level of resource consumption in a project in coastal Sri Lanka, it would have been wiped out by the tsunami unless it was structurally robust. Similarly, hurricane Katrina would have rendered useless even highly efficient buildings in New Orleans. Ultimately only robust systems will survive and they would be the only ones that we could call sustainable.

We have been so concerned with sustainability that little thought has been given to creation of robust systems. It has not always been so. Most of the old world systems that we find sustainable were actually conceived as robust systems initially. The Internet was created by the US military primarily as a robust communication system, one that would survive a nuclear war. Robust design is now a much talked about philosophy of engineering design and manufacture– different from six sigma that concerned itself mainly with consistent quality of performance. Robust Systems are supposed to deliver consistent quality under widely varying, anticipated and unanticipated conditions. Robust Systems are supposed to be not just strong but flexible, idiot proof, simple and efficient.

Ideas about robustness can lead to completely different conclusions. According to Richard Meier, the environmental planner – many of whose predictions about Asian cities have come true – future Asian rural populations will need to move to urban areas and this move may be a good thing as urban areas with their complexity have a higher chance of surviving extreme weather phenomenon than their suburban or rural counter parts. Tall residential buildings in dense developments could make better use of recycled human wastes for growing food in tiny vertical gardens. These buildings would be more amenable to using new recycling technology that in years of drought will enable survival with very little water. Rural populations, with no access to such technology, would probably perish in a drought. Such a conclusion is obviously far from what is commonly believed.

The pre-occupation with sustainability of future towns and cities is good but not enough by itself to ensure survival.

*Architect* **Vinod Gupta**, *based in Delhi, works with resource conserving/sustainable buildings.*

*E-mail: vinod@space-design.com*