Evolving a Sustainable Campus

Vinod Gupta

Campus planning is about the development of an institution for learning, a place for students and staff to live in, work and learn. Learning is a continuous process not limited to the classroom and master planning is about creating the conditions under which learning can take place. Campus design revolves around the site and its geographical and climatic context, access to site, development potential of site (zoning and bylaws), organisation of components on campus, conceptual design framework, phasing of development, sustainable mobility and parking. The client's own requirements can include other functional and aesthetic requirements. With climate change in mind, many owners now ask for resource conservation and green certification. Some even ask for a Net Zero Energy Campus. While the norms for green buildings are well established, there is no agreement yet on what constitutes a sustainable campus. This article is a quick look at how sustainable campus planning has evolved in India.

SPORADIC DEVELOPMENT OF LPU

India has a great tradition of building green and sustainable human settlements and in some ways these ideas influenced foreign architects who came and built in India. Architects like Lutyens, Le Corbusier and JA Stein also built keeping sustainability in mind. With the advent of the international style of architecture and air-conditioning during the last 50 years, the green ideas were abandoned in certain kinds of buildings. What we call green buildings now started in the Western countries and arrived in India in 2001 with first LEED certification. The criteria adopted for LEED by IGBC and later by GRIHA for commercial buildings, reflect the concerns of the Western countries and focus mainly on energy conservation. Though energy supply is a problem in India as well, there are other more pressing problems that affect our survival in times of difficulty. Ensuring food and water for an expanding population are challenging areas. We have an abundance of solar energy but a huge shortage of water and of land for agriculture. Food and water (other than the water used directly for operation of buildings) do not find a place in green building norms. A more comprehensive approach to sustainable development in India would have to concern itself with all aspects of food and water and the time has come to look beyond the norms for green buildings.

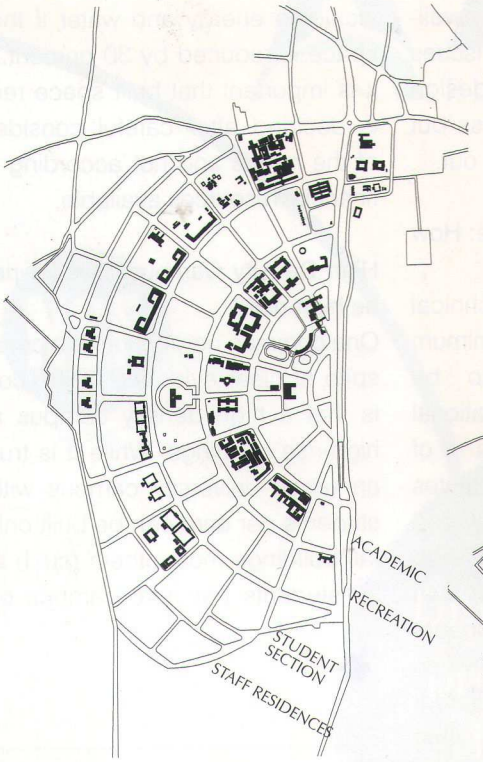
While sustainable development strategies are necessary for new townships and cities, large residential

Food and Water

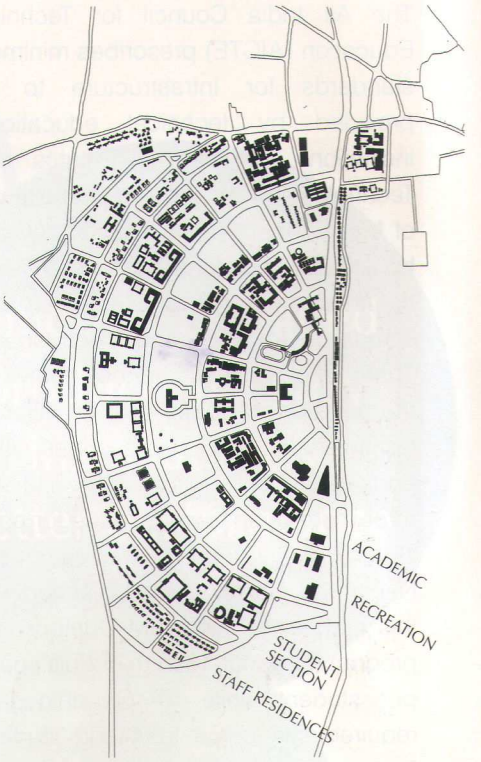
Agriculture is the major consumer of land and water in the world. As much as 70 percent of available fresh water is used for agriculture. This water constitutes what is best called water embedded in food and used indirectly by human beings. The author has calculated that the water used by people in buildings, say 180 litres per person per day is less than 10 percent of the water consumed as embedded water in food and other artifacts used by human beings. Agricultural scientists note that food brings embedded nutrients to the city and after consumption by citizens; these nutrients become pollutants (solid and liquid waste) in the city. If these are put to use for growing food in the city, two things will happen. First the water requirements for agriculture will be reduced because technologies used for urban agriculture use water more efficiently. Second, the nutrients that pollute our water bodies and water ways will be used for growing food and the need for artificial fertilisers will be eliminated. Perhaps the most important change will be a more sustainable and resilient infrastructure for food and water. Unfortunately, green design has been focused only on the built components of the environment – buildings, roads and services.

Embedded Water in Buildings

The concept of embedded energy has been used for a long time in choosing materials and technologies for construction. However, the idea of embedded water in buildings has not been used for making green decisions. According to Indian and International research publications, every square metre of built area with commonly used RC frame construction has 20-25 cubic meters of embedded water used to produce the building materials and to assemble them on site. This means the volume of water used exceeds the volume of built space by six or seven times. Most of this water goes into production of steel used in the building. Steel then becomes not just an energy intensive material but also the most water intensive building material.



BANARAS HINDU UNIVERSITY
50 Years of development



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educational campuses present an opportunity for new sustainable design ideas. Two kinds of campuses are being built in India today. The government sponsored universities like IIM and IIT start with allotment of a large piece of land (often agricultural or forest land) and an open ended development programme, built over many decades. Private universities start with a smaller site area that would support a well-defined building programme. While successful private universities like Jaypee and Amity exhaust the building potential of their site fairly quickly, a government funded university like Banaras Hindu University, is still being built almost 100 years after it was established. This article is about campuses that grow slowly and have the potential to deal with more environmental, economic and social issues than other types of development can. These include change of land use, efficient and productive use of land, efficient use of built space, water self-sufficiency, energy self-sufficiency, minimum waste export, sustainable mobility, preservation of bio-diversity and social equity.

Large campus developments in India require Environmental Impact Assessment Clearance process that deals with some of the above issues. Green campus certification (GRIHA LD or LEED ND) is more related to buildings and construction management and

less with planning. There are other well-known functional and aesthetic issues of urban design and landscape design that campus layout plans address but often the following issues get left out.

Best Use of Land and Built Space: How much is enough?

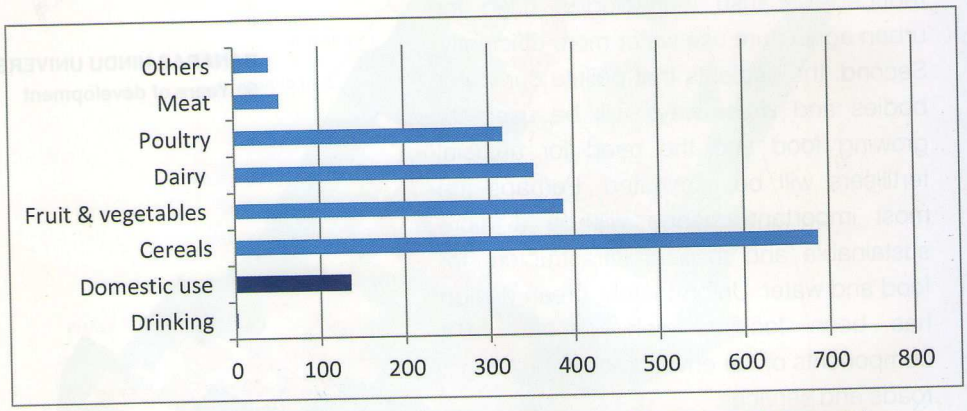
The All India Council for Technical Education (AICTE) prescribes minimum standards for infrastructure to be provided by technical educational institutions. Indian Institutes of Technology (IITs) and Indian Institutes of Management (IIMs) are not covered by AICTE regulations and each IIT and IIM is therefore free to establish its own standards for built and open space. There are vast differences between the per student space built by different institutions. AICTE prescribes that engineering colleges should build 9sq m or more of academic space for each student and NIIT University's campus at Neemrana, Rajasthan was planned with this number in mind. IIM Udaipur was programmed with 16sq m of built space per student while IIT Gandhinagar's requirements came to 44sqm/student. The land required to build the campus depends upon the permissible FAR and once again there is wide variation in this. NIIT University, Neemrana (100 acres, 9000 students); IIT Gandhinagar (400 acres, 6000 students); and IIM Udaipur (250 acres, 1200 students) are all residential campuses and the density of students on site varies from 90/acre at NIIT to 15/acre at IIT Gandhinagar to 5/acre at IIM Udaipur. The nature of terrain, connection of site with nearby urban areas, and the accepted lifestyle influence the carrying capacity of an institutional site and there are international urban campuses with 250 students/acre and large campuses like Stanford University with only two students per acre. The extent of resource used in a project depends directly upon how much space is built for the project. While it is difficult to save 30 percent energy or water in a building, it is easy to save 30 percent of all resources including energy and water if the built space is reduced by 30 percent. Thus, it is important that built space required is decided after careful consideration of the needs and not according to the financial resources available.

High Density Campus: Does it need to be high-rise?

One common perception that persists in spite of clear evidence to the contrary is that a high density campus needs high-rise buildings. While it is true that an urban university campus with 250 students per acre can be built only with tall buildings most others (such as the 90 students per acre campus of NIIT University) can be built with three or four storey walk up buildings. Low-rise buildings have a better chance of being less resource intensive, allowing for use of sustainable technologies such as solar power and less energy and water intensive building materials.

Preservation of Bio-diversity: Many green field sites have flora or fauna that need to be preserved. Sometimes these may not be obvious. There are also site features such as water courses and water bodies that need to be respected and preserved. The best value of land is not derived simply from the built area but also in leaving space for direct and indirect functions that require open space not buildings.

Sustainable Mobility: A residential campus requires transportation for connecting it to the surrounding areas and for connecting residential areas to the institutional areas within the campus. As the size of a campus grows, so does the need for internal transportation. If the actively used areas of the campus can be kept small enough for walking, the use of automobiles can be limited to connections with the surrounding areas. By appropriate planning measures such as safe, shaded and rain protected walkways it is possible to encourage walking and discourage automobile use. If car use is limited on campus, an alternative system of transportation is required to take care of the needs of young children, old people and the handicapped.



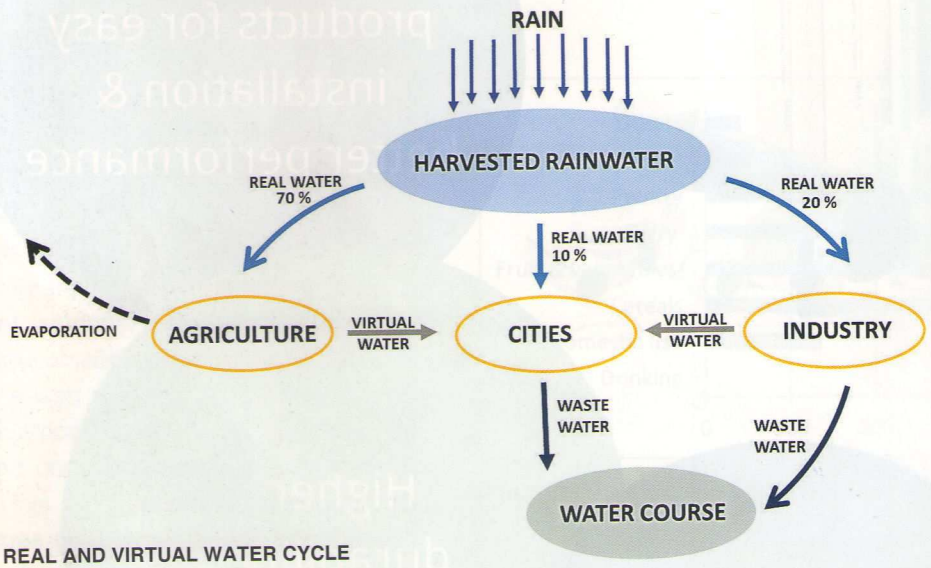
DAILY REAL AND VIRTUAL WATER USE BY AN URBAN INDIAN MALE (LITRES PER DAY)

Social Equity: It is generally the privileged of Indian society that live and work in institutional campuses of higher learning. While there are relatively small differences in the income levels of those employed directly by the institution, there are larger inequities that become obvious when one looks at people employed indirectly by the institution. A campus is built over many years and a large construction work force is engaged for carrying out the works. Institutions also outsource maintenance

work and facilities like dining halls. It is necessary that the needs of construction workers, outsourced staff and sub-contracted workers be taken care of at the campus. Large institutions impact the population of the surrounding areas even before they are established. In many cases land owned by villagers is acquired and handed over to the institution by the government. While many villagers will welcome the infusion of capital into their economy, it can result in disruption of access routes, means of communication, grazing lands and even water supply. It is important that the institution concern itself with welfare of the impacted population as well.

in place of ornamentals trees. The major advantage of growing food on campus is that the water and nutrients that are essential for agriculture, are available free of cost as solid and liquid waste from residential areas.

Harvesting Energy on Site: Keeping climate change in mind, it is necessary to harvest renewable energy on a campus. While it is common for campuses to meet their commitment of using renewable energy by installing photovoltaic panels on buildings, other sources of energy such as wind or bio mass may also be available. On large campuses, 'net zero energy' is also possible if the energy needs of the project are managed well.



REAL AND VIRTUAL WATER CYCLE

Food Growing: Residential complexes produce solid and liquid waste that need to be disposed off. With proper treatment, many of these wastes can be converted to solid or liquid fertilizer that can be used for cultivation of plants. Fresh vegetables grown on such manure are welcome on any dining table. Every campus has extra land available during the initial phases, land that can be used for growing food. Planning can ensure that when the campus is fully built up, space is still available for growing food. Space saving techniques such as hydroponics, aquaponics and aeroponics may also be used. Fruit bearing trees can and ought to be used

Zero Water Import: The carrying capacity of a site can be defined in different ways and in a water-scarce area an important factor is the sustainable quantity of water available. All towns in desert areas of Rajasthan depend upon rainwater even though the annual rainfall is only a few hundred millimetres. As these towns demonstrate, sustainable water source may be from the site itself or from distant areas. A project requires water first for construction of buildings and later for the use by the residents. Even if rainfall at the site is insufficient for complete needs of the built project, with proper and timely action it is almost always sufficient for construction of buildings (excluding embedded water). Zero import of water is ideal which can be achieved if the needs of the residents are managed and matched with the availability of water.

Zero Waste Export: Waste generation at the site starts with the construction of the buildings and infrastructure and continues all through the life of the project. While it is possible to manage construction wastes and compost organic wastes within the site, zero waste export is actually not possible due to the e-waste that campuses generate.

A major change has taken place in the way campus owners approach planning. The new government funded campuses are required to obtain minimum 3-star Griha Certification for their buildings. Carefully designed buildings can easily attain this certification and with money spent on the right things Griha LD rating can also be achieved. IIT Jodhpur and IIT Gandhinagar spent a great deal of time to build sustainable design features in the master plans for their campuses. In both cases, the buildings are being designed and the infrastructure being detailed by architects and engineers other than the ones who planned the campus and there is a possibility that some of the sustainable design ideas may be diluted. The competition brief for IIM Udaipur also asked for sustainable design features but a major advance took place with the design competition for Nalanda University where the competition brief asked for a 'net zero energy' campus. Since the master plan and the buildings are being designed by the same team for IIM Udaipur and Nalanda University, these campuses have the best potential for demonstrating how a sustainable campus can be built. They should also point the way for sustainable features that future 'Smart Cities' ought to have.

Vinod Gupta is an architect practising sustainable design at various levels in Delhi. He has been involved in university planning, architecture and furniture design.