Homi Bhabha Centenary
DAE-BRNS National Symposium
on
Landscaping for Sustainable Environment

November 20-21, 2008

PROCEEDINGS

Editors
T.S. Verma and C.K. Salunkhe

Organised by
Landscape and Cosmetic Maintenance Section
Bhabha Atomic Research Centre
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In association with
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New Delhi

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Mumbai

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DAE-BRNS NATIONAL SYMPOSIUM 2008

ON

LANDSCAPING FOR SUSTAINABLE ENVIRONMENT

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Proceedings of Symposium

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Bhabha Centenary
DAE-BRNS National Symposium
on
Landscaping for Sustainable Environment
November 20-21, 2008
at BARC Training School Hostel, Anushaktinagar, Mumbai - 400 094

PROGRAMME

Thursday, November 20, 2008

Inaugural Function		
Welcome	Shri N.D. Sharma, Chairman Organizing Committee & Controller BARC	
Presidential Address	Dr. V.K. Verma, DDG (Hort.), CPWD	
Inaugural Address & Release of Proceedings	Dr. Rakesh Tuli, Director, NBRI, Lucknow	
Vote of Thanks	Shri T.S. Verma, Convener, Organizing Committee	
Session I		
IL-01	Dr. S.S. Sindhu	Ornamental Horticulture
IL-02	Dr. R.K. Roy	Landscape designing-principles and practice
IL-03	Shri Kishore Pradhan	Landscape design and its sustainability
S.S.	Shri T.S. Verma	Slide show of the BARC Campus landscape planning
Session II		
IL-04	Prof. Roshni Udyavar	Landscape Design for sustainable environment
OP-01	Dr. B.K. Dhaduk	Architectural effect of plant material in Urban Landscape
OP-02	Shri B.V.A. Krishnamurthy	Coastal landscaping
IL-05	Prof. Pallavi Latkar	Ecological Landscapes for restoration of water bodies in urban areas
IL-06	Dr. Ajit Gokhale	Landscaping relevant to water management
Session III		
IL-07	Dr. S.B. Chaphekar	Phytoremediation
OP-03	Dr. S.P. Sharma	Landscaping –An effective tool for mitigation of environmental pollution
OP-04	Dr. Rajesh Bhalla	Landscaping as an aid to combat pollution

IL-08	Dr.Manish Kumar Sharma	Modern irrigation solution is master key of sustainable landscape development
OP-05	Dr. Y.C. Gupta	Use of native ornamental plants for sustainable landscaping in mid Himalaya region

DIRECT INTERACTIVE SESSION (POSTER PRESENTATION)

Friday, November 21, 2008

Session IV		
IL-09	Dr. B.K. Banerji	Improvement of Bougainvillea for landscaping
OP-06	Dr. J. Biswas	Bougainvillea – Landscaper's friend
IL-10	Dr. G. Sudhakar	Landscaping of tailing ponds
IL-11	Dr. Prafulla Soni	Landscape restoration in mined areas - An ecological approach
OP-07	Dr. Alka Singh	Trees for environmental moderation in urban landscaping
IL-12	Dr. A.H. Khan	Remediation of uranium mill Tailings : Role of vegetation and plants
Session V		
IL-13	Dr. Manjiri Bhalerao	The role of housekeeping in providing a creative R&D environment
OP-08	Dr. Jacob Joemon	Role of palms in ornamental horticulture
OP-09	Dr. S.K. Chavan	Aesthetic placement of flowering climbers in landscape architecture
OP-10	Dr.P. Naveen Kumar	Ground covers for landscaping

Visit to BARC

Briefing by Shri R.K. Sharma

CONCLUDING SESSION
at
CC Auditorium, BARC

LANDSCAPE DESIGN FOR A SUSTAINABLE ENVIRONMENT

Udyavar Roshni
Head, Rachana Sansad's Institute of Environmental Studies, Prabhadevi, Mumbai

ABSTRACT

There is a worldwide movement towards sustainability in all fields. Architecture and its allied field, Landscape Design, have been reviewed with respect to their impact on natural ecosystems and an effort is made to develop Architecture and landscape which is sensitive and benign.

From the LEED (Leadership in Energy & Environment Development), BREEAM (British Research Establishment Environment Assessment Method) rating systems to Eco-housing and TERI *Griha*, the emphasis is on sustainable site & landscape design so as to reduce the impact of built forms on the ecology and environment.

The effects of unsustainable site planning and landscaping can lead to:

- Contamination of soil and ground water.
- Destruction of top soil.
- Wastage of water.
- Loss of local flora, fauna and biodiversity.
- Urban heat island effect.
- Excess load on storm water and sewage.

Sustainable practices in site planning and landscape design take into consideration the above impacts and reduce it using techniques such as:

- Not constructing on lands which are eco-sensitive – demarcated or otherwise
- Remove and store topsoil prior to construction activity and re-use on site for landscaping
- To protect existing vegetation on site or replanting after construction
- To compensate for the removed vegetation by afforestation
- To minimize soil erosion - design check dams and contour trenches on sloppy sites; design with minimum disruption of site; design drainage system along existing slopes/contours so as to minimize costs and avoid flooding.
- To use recycled organic waste generated on site as fertilizer
- To plant indigenous trees and vegetation to protect and promote habitats of local fauna
- To prevent contamination of ground water during construction, take adequate measures for spill prevention and control of hazardous wastes during construction. Hazardous wastes are pesticides, paints, cleaners, and petroleum products.
- Site should be properly planned to mitigate the 'heat island effect' (thermal gradient difference between developed and undeveloped areas) by providing shade on at least 40% of non-roof impervious surfaces on the site, including parking lots, walkways,

plazas etc., use of light colored (Solar Reflectance index > 0.5) for pavements, walkways etc.

- Restrict net surface run-off of site to 0.4 – 0.7* to facilitate ground water recharge and restrict run off to mitigate local flood problems.
  * Eco-Housing Version II, International Institute of Energy Conservation, Mumbai

Keywords: Site planning, green roofs, solid waste management, water shed management, indigenous plant species, soil and water conservation, urban heat island effect, mitigating effects of built forms, preservation of bio-diversity.

Introduction

Landscape design has always formed a complimentary aspect of built form – a sort of balance between the built form and the wilderness. In different ages, gardens such as the Allahambara in Granada, Spain, and the Charbagh in Kashmir, India, have been designed for recreation, for microclimate control, for aesthetics and for the intangible benefits of a green outdoor space. In fact, garden design is perhaps one of the oldest traditions of humanity that has evolved, adapted and recreated to suit the needs of the times. For example, Alhambra, which was designed and developed in the early 14th century with its central water body and fountain, and manicured shrubs on either sides, is symmetrically proportioned with Islamic details and represents a distillation of the Eastern Mediterranean tradition of garden-making. Landscape design may continue its intangible effect on humans through an exploration of design ideas. However, the need of this era is a sustainable design which minimizes resource use and conserves to create a sustainable environment. Although most garden designs historically, are sustainable models, the introduction of modern technology, such as water pumping and chemical fertilizers for faster and disease-free growth, has led to a landscape which is devoid of life and the rich habitation of forests. Gardens are devoid of bio-diversity, are often water and soil intensive and require intensive maintenance.

Five strategies for ecological landscape design and sustainable environment:

1. **Water management:**
   Water, the primary ingredient in any landscape design can be managed by:

   a. **Water conservation** measures such as drip irrigation, sprayers and sprinklers which are appropriately laid out to meet the specific requirements of each plant and can be individually controlled.

   b. **Computer control** techniques can be applied once adequate research about the water requirements of different plants is known.

   c. **Rain water harvesting** for use in gardening either by storage in a tank that lasts throughout the year or during non-monsoon seasons or by recharging a well or bore-well. Appropriate measure for rainwater harvesting on site ensures percolation in the 'vadose' zone by use of pervious paving material and also reducing the load on storm water in case of a city.

   d. **Water-shed management** techniques such as Continuous Contour Trenches (CCTs), Check Dams & plantation of ground cover wherever soil is exposed. This will not only allow for groundwater recharge but will be adequate to control soil erosion.

2. Reducing building footprint and urban heat island effect:

Any built structure alters the natural landscape by impacting in various ways on the ecosystem of the place. The micro-flora and fauna of the place is first affected leading to the loss of habitat for several species of plants, insects and animals. Further, it imposes a footprint – usually concrete – on the land, which absorbs and reflects heat. In urban areas, the combined effect of concrete buildings, road surfaces, pavements and emissions from vehicles and industries, leads to a considerable rise in temperature of the city's ambient air as compared to the surrounding hinterland. This effect known as the urban heat island effect, is capable of raising the temperature of the city by 3-4 degrees Celsius.

Ecological Landscape design can mitigate the effects of building footprint and Urban Heat Island Effect by:

a. **Building intensive and extensive green roofs**: An extensive green roof comprises of a geo-fabric or membrane with filter material and pores which allows the growth of small succulents such as sedums which cover the roof area thus changing the albedo of the roof while at the same time allowing the harvest of rainwater. These can be developed on existing buildings. Extensive green roofs require planning and are usually applicable for new buildings. It contains of a soil and gravel layer of about 1 feet or more on which plants are directly planted. It is important to consider structural loading of the roof slab prior to undertaking this project.

b. **Provision of percolation tiles**: These tiles with less concrete are designed to allow for the growth of plants from within them thereby reducing the footprint of pavements, pathways and parking areas.

3. Native vegetation and biodiversity:

Landscape design has often embodied a cosmetic aesthetics which depends on exotic and exogenous species of plants which may, no doubt, create an element of interest, but nevertheless demand more in terms of maintenance and resources. The layout may appear quite neat but unless it is maintained with adequate climate control measures, will probably not survive more than a day.

Native species of trees and plants require much less maintenance and resources such as water and fertilizers because they have evolved in the land over millennia being able to flourish with minimum water, soil and nutrients.

Additionally, indigenous species provide habitat to numerous birds, insects even micro-organisms. Therefore, it is most likely that we may find their leaves eaten up by worms, which, in fact, form the biodiversity of the region.

Some of the native Indian trees include Ficus religiousa, Ficus bengalensis, Azadiracta Indica, etc. Flowering plants include orchids, rhododendrons, musk rose (Rosa moschata), begonia, balsam (Immpatiens balsamina), globe amaranth (Gomphrena Globosa), gloriosa lily (Gloriosa superba), foxtail lily (Eremerus himalicus), primula (Primuladenticulata P.rosea), blue poppy (Meconopsis), lotus (Nelumbo nucifera), water lily Nymphae spp.), clematis (Clematis Montana- a climber) and the wild tulip of the Himalayas

(Tulipa stellata and T.aitchisonii). Some of these as the Lotus find mention in ancient Sanskrit scripture of the Vedic times such.

4. Natural nutrition and pest control:

Rachel Carson's Silent Spring published in 1962, for the first time, awoke the world to the disasters of chemical fertilizers and pesticides particularly a group of chlorinated compounds termed as Organochlorines and heterocyclic anti aromatic compounds known as Dioxins. The popular pesticide DDT which belongs to the former category was banned in the United States sometime in the 1970s after the publication of the book. However, DDT and several polychlorinated compounds continue to be used in Africa and Asia. Carson proved in her book the effects of these compounds on the entire food chain as the chemicals pass from prey to predator. The use of chemical pesticides and fertilizers, the chemical composition and effects of which are little known, pose a serious threat to the natural environment – human beings, birds and insects. They can be avoided by:

a. **Use of natural and herbal pesticides** made from natural anti-bacterial derivates such as Neem oil, garlic, molasses, etc. A whole range of such pesticides are now available in the market.

b. **Use of compost or organic manure**: Natural manure can be obtained from various sources: decomposed organic waste, cow dung, night soil and pot-ash are some of the commonly used natural fertilizers. Vermicomposting is used to obtain high grade organic nutrients. The process is easy and fertilizers can be generated on site from organic waste from the garden and its surroundings itself.

c. **Use of predator-prey natural pest control**: A method commonly employed in organic farming practices, natural pest control involves minimal intervention in the landscape design. It also involves plantation such that the flower of one plant may provide pest protection for a neighboring plant.

d. **Fertigation** is the application of fertilizers through an irrigation system. The advantage of Fertigation is that it increases absorption rate by plants by up to 90% as against 30 – 40% in dry format application. With appropriate research as has been successfully done in Israel and other countries, Fertigation reduces over-feeding, waste and run-off.

5. Soil conservation:

Soil erosion occurs wherever top soil is exposed to the elements and is aggravated by microclimatic conditions such as wind speed and direction, topography and drainage. Soil and water conservation measures are inter-related. It is important to understand the nature of soil erosion in the first place. There are many different ways in which soil erosion occurs – splash, gully, rill and sheet erosion. The following measures can be taken after erosion analysis:

a. **Designing cut-off drains** along natural drainage paths to divert storm water and percolate them in the ground where possible.

b. **Designing retention and infiltration ditches** which catch and retain incoming runoff and hold it until it seeps into the ground.

c. **Use of grass for prevention of soil erosion**: Grasses such as Vetiver can be planted along slopes especially when ditches are created to control storm water run off. Varieties of fodder grass are also effective in controlling soil erosion particularly along contoured embankments.

d. **Mulching** is the process of covering the top soil with a protective layer of organic material usually grass, dried leaves, straw, bark chips, saw dust and similar materials. This not only protects the soil from erosion, but also reduces compaction from the impact of heavy rains, conserves moisture, reducing the need for frequent watering and maintains an even soil temperature.

Organic mulches also improve the condition of the soil. As these mulches slowly decompose, they provide organic matter which helps keep the soil loose. This improves root growth, increases the infiltration of water, and also improves the water-holding capacity of the soil. Organic matter is a source of plant nutrients and provides an ideal environment for earthworms and other beneficial soil organisms.

Conclusion

Apart from the aesthetic values of landscape design, the most significant consideration must be its sustainability and the sustainability of the environment of which it is a part. Traditional and vernacular methods of landscape management present us with positive examples of natural and low-cost sustainable practices. These must be integrated with modern techniques such as drip irrigation and fertigation. Further, research in the field of water resistant varieties of plants, water requirements of different plants and fertigation techniques will coalesce the field of landscape design into environmental sustainability.

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