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SIDE EVENT

"In pursuit of sustainable development: Mainstreaming environment in the construction sector"

Background note

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Organized by

The Energy and Resources Institute, New Delhi

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Introduction

In current milieu of increasing urbanization more than half of world's population is living in cities and towns. Nearly twenty eight per cent of India's population (285 million) live in urban areas as per 2001 census. The percentage decadal growth of population in rural and urban areas during the decade is 17.9 and 31.2 percent respectively. It is important to note that the contribution of urban sector to GDP is currently expected to be in the range of 50-60 percent. Increased urbanization seen today is a result of this overall growth. Construction activity is one of the largest activities driving the economy that has a significant impact on the environment. As per the Confederation of Indian Industries, the construction sector contributes to 10% of India's GDP and is growing at the rate of 9.2% as against the world average of 5.5%.

Construction activities in India have been pursued without giving much attention on environmental issues. This has resulted in pressure on its finite natural resources, besides creating impacts on human health and well-being. Unplanned and unsustainable urban development has lead to severe environmental pressures. The green cover and ground water resources have been severely depleted to give way to urban centres. Modern buildings in our cities have high levels of energy consumption because of requirements of air-conditioning and lighting. At national level, domestic and commercial buildings account for more than 30% of annual electricity consumption. TERI studies show that air-conditioning and lighting are two most energy consuming end-uses in the building sector. About 50–60% of energy consumed in a fully air-conditioned building is by air-conditioning followed by 20% by lighting. TERI's experience show that over 20% of energy savings is possible in existing buildings by retrofitting with efficient lighting, air-conditioning and electrical systems. On the other hand, new building can save up to 50% energy by appropriate design interventions in building envelope, lighting and air-conditioning system. Generally buildings also consume copious quantities of water for building use and landscaping and generate substantial waste during construction and operation. Domestic water consumption is 30 billion m^3 with a projected increase to 111 billion m^3 by 2050.

Regulatory environment for mainstreaming sustainable buildings

There have been several recent initiatives by central and state governments to steer the construction industry to design, develop and operate sustainable buildings. The Ministry of Environment and forests has mandated environmental clearance for all large construction projects above a certain size and cost. This requires projects under purview of this clearance to adopt environment friendly measures and techniques. The Environmental Impact Assessment Notification, 1994 was amended on 7th July 2004 making it mandatory for new

projects relating to construction of new townships, industrial townships, settlement colonies, commercial complexes, hotel complexes, hospitals, industrial estates, and office complexes above a certain size to obtain prior environmental clearance from the Central Government before starting any construction on the new project. The EIA process helps in addressing various environmental aspects such as the management of municipal solid wastes and industrial & hazardous wastes, air pollution arising from vehicles and traffic congestion, dependence on fossil fuels for energy demand, inadequate ground water recharge and conservation of water, insufficient public space and green cover, inadequate provision of pedestrian paths and bicycle tracks, sewage treatment facilities and safe disposal etc. which the urban planning regulations are not able to address comprehensively. The EIA process ensures integration of environmental concerns into the new construction projects with legitimate public participation and optimal resource consumption practices.

Simultaneously, the Energy Conservation Act has been passed in 2001, that would eventually facilitate mandatory use of energy efficient building products and appliances, energy labeling for appliances and equipment, adoption of energy conservation building codes, and testing and certification for energy consumption of equipment and appliances. In addition it would also enable raising awareness and capacity building of stakeholders. Some state governments have taken timely step to mandate efficient use of energy in their respective states. The government of Haryana has issued order on mandatory use of energy efficiency measures and renewable energy measures (use of solar water heating system, efficient lighting, design of energy efficient buildings) in government / government aided sector. The Pune Municipal Corporation (PMC) has set up an eco-housing cell to facilitate eco housing in Pune. A set of technical criteria with grading system has also been developed to incentivise eco housing and stimulate fair competition among the builders and developers in Pune.

Benefits of eco friendly design: Case study of Pune

TERI has partnered with the International Institute of Energy Conservation under a USAID/USAEP funded initiative to institutionalize eco-housing practices in Pune city of India. The Pune municipal corporation (PMC) is one of the key partners in the initiative.
Eco housing concepts comprise of efficient site planning (control soil erosion, locating site near to public amenities, prevent ground water contamination, restrict run-off, energy efficient outdoor lighting), environmental architecture, use of eco-friendly, locally available building materials, adoption of safe construction practices and waste water and solid waste management.
Eco housing technical criteria have been evolved and environmental benefits of eco housing has been studied. For example a High income Group housing of 50 households can save 1.6 lacs units of electricity /annum by adopting energy efficient lighting in the households with payback period of less than two years. Additional savings could be accrued by adopting energy efficient/ solar-based lighting systems in common areas, pathways, roads and gardens. The same society can also save on 20 m3 of water per day by adopting water efficient faucets and water closets. Further water savings can be achieved through reuse of harvested rainwater or recycling and re-using wastewater. Use of efficient landscaping techniques restricting the lawn area and incorporating native species with low water requirement can save water to an extent of 550 litres/100m^2 of the vegetated area.

Maintaining appropriate waste segregation and treatment system can generate useful resources such as energy and manure. The energy generation from organic wastes from a colony of 50 households will be equivalent to about 1500 kg of LPG per annum with manure production of 10 kg per day.

Barriers

However there needs to be a concerted action oriented approach to mainstream sustainability considerations in building construction. Sustainability demands restraint over use of natural resources. Its realisation requires an integrated design approach involving all key stakeholders in the process of designing, planning and constructing buildings. The architect, landscape engineer, owner, user, electrical, mechanical, plumbing engineers, environmental engineers and energy professionals need to work hand in hand to evolve a sustainable design that is designed to leave minimum environmental footprint and yet not forego any of the modern day comfort requirements of human beings.

The prime issues that have to be dealt with in totality to ensure sustainable habitats and constructions are 1) land degradation 2) biodiversity 3) air pollution 4) energy 5) management of fresh water 6) materials and 7) solid waste management. Conscious efforts need to be made to integrate the environmental parameters into building and settlement planning to achieve the sustainable development.

Following are usually the cause of negligence towards sustainable development:

- Lack of knowledge and awareness: The implementing bodies involved in large constructions are often not aware of measures, techniques and technologies that should be adopted to ensure that constructions are environmentally benign.
- Financial barriers: The high initial capital cost of resource efficiency measures and lack of data on life cycle costs of the application often deter usage of resource efficiency measures.
- Planning barriers: Currently the building regulations and byelaws do not integrate efficiency within its framework. Building regulations and codes need to incorporate sustainable design features for clearance of construction activities.

Barrier removal holds the key to mainstream sustainable development in construction sector. This development approach has to be internalised and institutionalised to be successful. Proper policy framework, review, and chartering of development through stakeholder participation are a must. There should be considerable focus on appropriate communication and awareness generation at all levels.

In order to strive towards the above goal, organisation of the event is a timely initiative in dissemination of appropriate concepts, techniques, and technologies on environment friendly constructions. The event has been organised to bring together experts and stakeholder groups in the same platform to share best practices and case studies.

Interventions

The following are the areas of design that are to be and shall be addressed in order to achieve sustainably built environments.

1. *Site planning, which essentially looks into the design aspects and optimum utilization of resources available at the site.*

- Development of site for construction purposes disrupts and disturbs the existing natural system.

Unsustainable site development process leads to depletion of existing tree covers and depletion of nutrient rich top soil that is conducive to plant growth. The aquifer gets polluted with uncontrolled sedimentation and erosion from the disturbed site. Hard paved surfaces on developed sites give rise to heat island effect and manicured landscape demand copious quantities of water for maintenance. Large sites also have extensive lighting and pumping requirements, which is energy intensive. Construction activities cause air pollution that needs to be controlled. Health and safety of construction workers are of utmost importance that needs attention. All these issues have to be addressed holistically during site development processes. The most sustainable and environment-sensitive development is the one that requires very minimal site disturbance. Thus, resource conservation and protection in a given site is of prime importance (adequate measures should be taken to conserve and protect existing landscape and site features; control erosion and sedimentation; reduce water usage in landscaping; minimise heat island effects; reduce air pollution during construction; optimise energy use in lighting, transportation and pumping; and ensure health and safety of construction workers)

2. *Ensure energy efficiency through appropriate design interventions and material/ technology selection*

One of the primary requirements of an environment friendly construction is that it should have optimum energy performance and yet would provide the desirable thermal and visual comfort. The three fundamental strategies adopted to optimise energy performance in a building can be broadly classified as:

- Incorporate solar passive techniques in a building design and enhanced building material specifications to minimise load on conventional systems (heating, cooling, ventilation and lighting)

Passive systems provide thermal and visual comfort by using natural energy sources and sinks e.g. solar radiation, outside air, sky, wet surfaces, vegetation, internal gains etc India has varied climatic zones ranging from extreme cold conditions in cold desert of Ladakh to extreme hot and dry conditions in Rajasthan. A building in a cold climatic zone has to adopt measures to maximize solar heat gains by adoption of measures like maximum exposure to south, windows to capture heat, dark colored surfaces, high thermal mass and insulation to retain the captured warmth of the sun, or use of design elements such as trombe wall, sun spaces etc. On the other hand, a building designed for a hot climate would have measures to reduce solar gain like, smaller window sizes, shaded walls, minimum exposure to west and east, or use of design elements like solar chimneys, wind towers, etc to maximize ventilation.

Use of building materials like insulation, energy efficient glass (e.g. insulated double glass units with solar control coatings) can reduce heating/cooling demand by 8-10%.

- Design energy-efficient lighting and HVAC systems (heating, ventilation and air-conditioning)

Once the passive solar architectural concepts are applied to a design, the load on conventional systems (HVAC and lighting) is reduced. Further, energy conservation is possible by efficient design of the artificial lighting and HVAC system using energy efficient equipments, controls and operational strategies. The energy conservation building code that is being drafted by the Bureau of Energy Efficiency prescribes minimum efficiency levels for building envelope and systems

- Use renewable energy systems (solar photovoltaic systems/ solar water heating systems) to meet a part of building load .The pressure on the earth's nonrenewable resources can be alleviated by effective use of earth's renewable resources e.g. solar, wind, geothermal, biomass energy.
- Use low energy materials and methods of construction and reduce transportation energy. An architect also should aim at efficient structural design, reduction of use of high-energy building material (glass, steel etc.) and transportation energy and use of low energy buildings materials. Use of environmentally sensitive construction materials and techniques reduce embodied energy content of buildings. Some common products are use of fly ash in building materials e.g. use of blended cement for structural systems, use of flyash based bricks and blocks etc

3. Ensure proper water management through various water management and water conservation techniques, including rainwater harvesting

Although 75% of earth's surface is covered by water, 97% of it is salt water and only 3% is available as fresh water. Of this fresh water, two thirds is in the form of ice caps and the remaining one-third is accessible for usage. After rainfall only 9% of precipitation is captured for beneficial use and 91% is lost (either as evaporation, transpiration and run off to stream flow). Water shortage does exist in spite of many sources like rivers & lakes. This leads to a high cost of pure water. In India, average domestic water use is 8251 MGD which is 4.1% of total water use and a major amount is for irrigation purpose. . This leads to the importance of water conservation by way of increasing user efficiency, decreasing the demand on these sources and recycling and reusing wastewater including rainwater. Water conservation measures include use of water efficient fixtures and faucets in buildings; minimize losses, use of water efficient landscape (use of species that need less water), and enhancing efficiency of irrigation equipments. Waste water generated can be suitably treated and reused for flushing and irrigation purposes. Rainwater harvesting or recharge can be practiced (as applicable). Harvested and stored rain water can be reused back into the building or used for landscaping.

4. Solid waste management

Solid waste management, which includes storage and management of construction waste, segregation at the individual house level, techniques for solid waste utilization, etc. should be judiciously practiced in all constructions. Solid wastes generated from buildings generally reaches the dumping sites with minimal resource recovery. The waste generated constitutes various materials such as plastics, paper, glass that can be recycled and reused. In addition Indian MSW has a high organic content that makes biological processing a viable option to recover energy and manure.

Creating enabling policy framework

Following are some suggestions, which could be implemented to initiate and charter construction industry on a sustainable path:

- Comprehensive guidelines for new constructions should be developed for buildings under Central Public Works Departments (under purview of the Ministry of Urban Development and Poverty Alleviation), Defence, Railways, Department of Telecommunications, Doordarshan and Civil Aviation. Building specifications/ schedule of rates should be reviewed and wall/ roof/ windows/ lighting/ HVAC specifications should be modified to include energy efficient specifications. Water efficient fixtures and faucets should be included in the specifications.
- Building regulations and byelaws should be reviewed at state level to integrate sustainable construction parameters.
- The Ministry of Environment and Forests should develop/evolve comprehensive environmental clearance norms/guidelines for all constructions under its purview.
- Suitable Awards and building rating systems should be in place to induce competitiveness e.g. the Prime Minister's Award for Excellence in Urban Planning and Design could include sustainable building design in its evaluation criteria. It may be mentioned that TERI has developed a rating system for green buildings, namely TERI-GRIHA that addresses environmental concerns of Indian buildings and has been developed for Indian buildings using Indian codes, standards, and best practices.
- The Infrastructure Development Programme in Mega Cities under the Ministry of Urban Development and Poverty Alleviation should include sustainability parameters e.g. energy efficient street lighting and rain water harvesting from common areas (parks, open areas)
- Extensive awareness/ training programmes should be organized for Architects/ Engineers of state government, housing boards, developments authorities, principal architects
- Hand holding by experienced professionals on mega projects. Some of the important and highly visible projects are the Common Wealth Games Village, Parliament House, Videsh Bhavan, and international airports. It may be mentioned that the Beijing Olympic Games Village is being designed based on sustainable design principles and the Sydney Olympic Games Village had several of these technologies showcased in its premises.
- Sustainability concerns should be built into financial tools and mechanisms for project appraisal.