NATURE

Toward Zero Energy Development (TZED) at Bangalore, India

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TZED Bangalore: Sustainable Living in a City

Introduction

A city is sustainable depending on the successful integration of nature within its boundaries. There are a number of factors in a city which contribute to sustainability including adequate green cover, buildings, transport, water and energy habits, quality of life and most importantly, awareness of the environment and our impact on it. Cities have begun exploring different models to incorporate sustainability as a way a life.

The city of Bangalore, in south India, has built one such model which assimilates green architecture, efficient water and electricity consumption patterns, rainwater harvesting and waste management to name a few. The project, Towards Zero Energy Development (TZED), by Biodiversity Conservation India Limited (BCIL) was LEED-Platinum certified and became the world's first residential complex which fulfilled the criteria (Ecobcil, 2009). The Platinum rating is awarded a minimum of 80 points on a base of 100. The five categories include Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources and Indoor Environmental Quality. It proves that modern and comfortable housing is possible by using sustainable methods (USGBC, 2009).

Features of TZED

In 2007, a sprawling campus of 5.5 acres in Whitefield, a suburb of Bangalore, opened its doors to residents. The aesthetic campus of 75 apartments and 16 independent homes was ready for occupation. It has the amenities of a regular complex which includes a park, gymnasium, library and a convenience store. In addition, there is a restaurant by the swimming pool with an amphitheatre surrounding it.

The major difference between TZED and regular apartment complexes is that TZED is almost entirely self sustainable. Its dependence on the water and electricity connection from the municipal corporation is minimal. The sewage and the biodegradable waste are treated on campus. Each feature of the campus as well as the facilities in the apartments is unique. The

project was completed in 3 years giving careful consideration to the life cycle of the apartment buildings, the sewage system, air conditioning techniques, refrigeration, landscaping and water treatment capability.

BCIL is headed by Chandrashekhar Hariharan, whose vision is to create energy efficient and environment friendly homes which are affordable. TZED is just one among BCIL's initiatives towards achieving that goal. The apartments are priced between $160,000 to $400,000 which is comparable to other residential properties in Whitefield and affordable to the upper middle class (Interview, 2009). While TZED was under construction, future residents had the opportunity to design their apartments to suit their style. The project has been well appreciated for its efficiency and design and was awarded the Ryutaro Hashimoto APFED Award from Japan for good practices towards sustainable development (Ecobcil, 2009).

Buildings at TZED

The TZED concept was initiated in 2002 on a brownfield and consists of apartments and independent homes which provide accommodation for 91 residences. The foundation and framework for the structures have utilized insulated concrete forms which have resulted in a savings of 26% in the consumption of steel and concrete during the construction phase (Ecobcil, 2009). The structures are made of laterite sun-dried soil stabilized blocks and re-used construction debris, which are used for the exterior walls and roof planes. These blocks are energy efficient and environmental friendly. The partitions within the housing structures used low-energy fly ash bricks. These bricks provided the interior finish and thermal insulation and were locally made from residual ash to reduce the carbon footprint during procurement. The outside sheathing provides a secure, economical and energy efficient system. To replace the customary vitrified tiles used for flooring, stones completed the flooring and were procured locally. The roof slabs are a combination of laterite bricks with pine wood cladding and reinforced concrete. The doors in the apartments are frameless, flush doors covered with rubber wood. The wardrobes are optional and are made from rice husk and particle or bamboo

boards. The buildings were designed to reduce their carbon footprint by 70% in terms of materials used (Ecobcil, 2009).

Water-Consumption and Recycling

The project aims to be self-sufficient in terms of drawing water from the municipal board. Since the project is in the initial 3 year period, it draws 30% of the daily water requirements from the local supply till it establishes its independence. TZED has developed various sustainable methods to capture run-off water efficiently. The campus has a network of 44 shallow, rainwater percolation wells which is connected to an underground water tank of a capacity of 100,000 gallons. Water collected from rain water harvesting techniques on the roof of buildings and from the green expanses around buildings flows into the wells and adds water to the tank. The water from this tank is pumped to the apartments using a high pressure pneumatic pump which runs on photovoltaic cells.

The grey water is supplied to water efficient toilets, gardens and for car washes. The water required for cooking, washing and bathing is treated with ozone for quality. The kitchens are equipped with dishwashers which produce ultrasonic waves, require minimum water and have low detergent requirements. The use of the central laundry is encouraged at the complex which supplies biodegradable detergents. This ensures that the water discharged is not contaminated and can be treated on campus. These initiatives reduce the water consumption of the residents by 50% as compared to typical residential developments (Ecobcil, 2009).

Power Supply and Efficient Appliances

TZED had introduced a number of design initiatives which significantly reduces its dependence on the local grid to supply power. It draws 30% of the energy required from renewable sources such as solar energy and bio-diesel. Each apartment is provided with a customized refrigerator that does not require electricity and works on ammonia which is more ozone friendly compared to CFC and HCFC. Centralized air conditioning powered by renewable energy resources are more energy efficient and provide better quality of air when compared to split air conditioners.

Water heaters run on solar energy during the summer and on low voltage heating elements in the winter. The apartments are well-lit with solar passive architecture to maximize natural lighting. The apartments are fitted with CFL and LED lights and the use of personal lighting is discouraged. Intelligent electric switch controls which can be powered by a cell phone and motion sensors are present in each apartment.

Waste treatment

The waste generated on TZED's campus is treated in house. They are segregated according to their type with non-biodegradable waste being returned to the municipal authorities and biodegradable waste which is fed to a biogas digester. The digester is an enclosed, air-tight tank which is filled with waste and produces biogas which is used as a fuel. The digester has a capacity of 330 lbs though the daily waste generated by the community is 132 lbs. To ensure optimum utilization of the digester, a Green Council was constituted to collect waste from neighboring residential complexes. The biogas produced is another source of energy as 220 lbs of wet waste produces 9.9 lbs of biogas which is sufficient to power a kitchen. The solid waste is a nutrient-rich natural fertilizer and a soil conditioner which is used for gardening.

Waste water generated at the campus from kitchens, showers and sinks is recycled and utilized for gardening through drip irrigation and for car washes. The technique employed on campus is called Decentralized Wastewater Treatment (DEWATS) and has been successful in cities across India and the world. In the process, the sullage enters a tank and flows through multiple chambers which are separated by baffles. The water is purified up to 90% as sedimentation and floatation occurs and the water passes through filters. This water is treated in a reed bed under sand through an aerobic process which produces clarified water with no residual odor. This water is treated with ozone and also used for toilets and sky gardens (Ecobcil, 2009 and Interview, 2009).

Landscaping

The landscape at TZED is aesthetic and attention has been given to design and detail. The land was carved according to the contours in a manner to ensure judicious use of its own water resources. The general landscape has vegetation which is theme based and there are personal gardens for the residents on campus. The campus is pedestrian and disabled friendly with drop kerbs and speed restrictors with a road layout where cars are move at walking pace. The roads are 'soft' and built over a consolidated natural earth surface using hollow or perforated terracotta blocks that allows the roads to be permeable for run-off water to seep through. Grass and vegetation are planted in spaces in between to give a visual continuation of the natural landscape and vegetation.

Achievements

TZED has achieved considerable success for a residential project. It has capital savings of approximately 20,000 tons of Carbon Emissions and revenue savings of approximately 1,500 tons of carbon emissions. BCIL had invested in advanced technology for power generation, water treatment and waste management, used materials for construction of buildings, roads and landscaping which had a negligible carbon footprint. Each resident gains $260 annually which they attribute to their carbon credits savings at TZED. TZED which houses 91 homes consumes 60% of the energy demand of typical 100 homes which it owes to energy efficient design of buildings, energy from renewable sources and superior technology. The residents pay 30% less on electricity bills and 20% less on maintenance (Archidev, 2009). BCIL continues to work on sustainability issues and encourages its residents to follow a green lifestyle. They sponsor a campaign 'Million Seed Balls' where corporations, schools or residents are provided with kits to made Seed Balls which BCIL plants at different locations. The use of electric cars is encouraged and there are several charging points available on campus.

Issues

TZED is a successful incorporation of various innovative technologies and advanced design techniques. At present, there are a few areas of concern which are being addressed. The building materials, soil stabilized bricks, are prone to weathering and require regular maintenance. Though the initial cost of procuring the bricks and the carbon footprint was low, every 2 years, the buildings have to be coated for water-proofing to prevent deterioration. Green roofs or sky gardens are discouraged as cracks have occurred on the roofs which can lead to leakages. The building is unable to take the additional weight and excess moisture though the roofs had an insulated cover. Instead, detached plants are encouraged in courtyards which overlook parking spaces. Another promising feature was the zero electricity, ammonia based refrigeration which could not live up to the expectation. The common chiller plant and cooling of the brine based solution for refrigeration were inadequate as the technology used was outdated and hampered its functioning at a community level. Though this resulted in a modest increase in electricity consumption, TZED plans to continue with the model and are working towards an upgrade to include recent technology (Interview, 2009).

Conclusion

The project has been deemed successful and can be emulated by cities across the globe. BCIL had taken a risk by combining technology and innovations under a single project TZED which paid off. It addresses issues of sustainability and green design which used appreciated designs by not following real estate trends. The occupancy rate of the complex is placed at 98% and residents are more than satisfied with the quality of life TZED has to offer. They have appreciated the savings from reduced consumption of electricity and water and the treatment of waste. It serves as a model for energy conscious development in urban locations.

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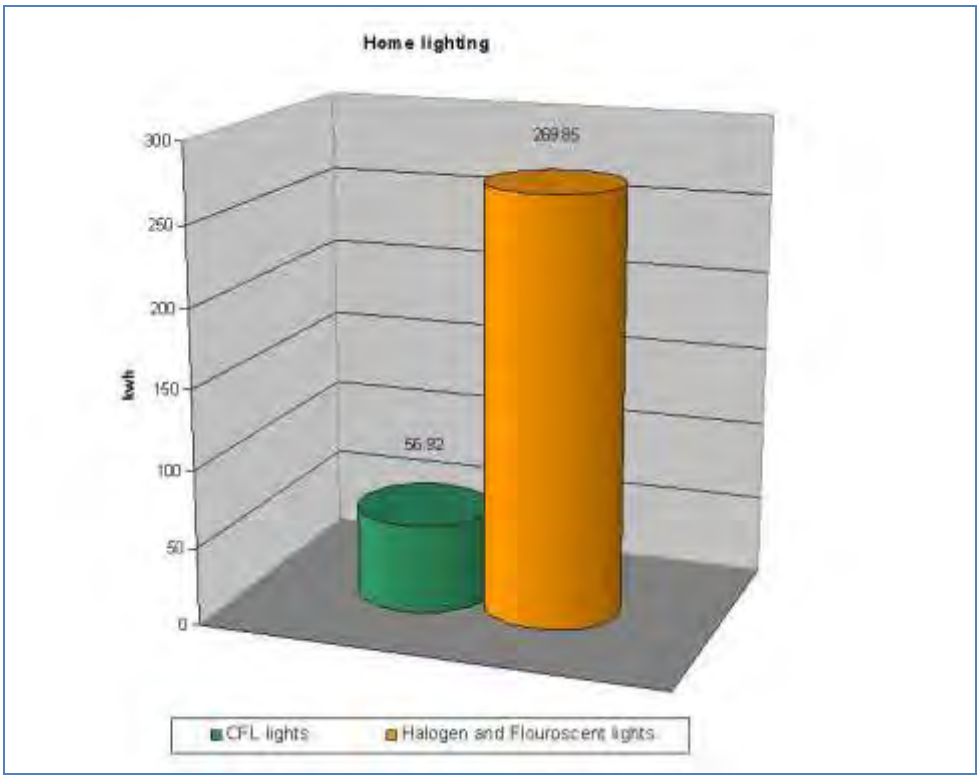
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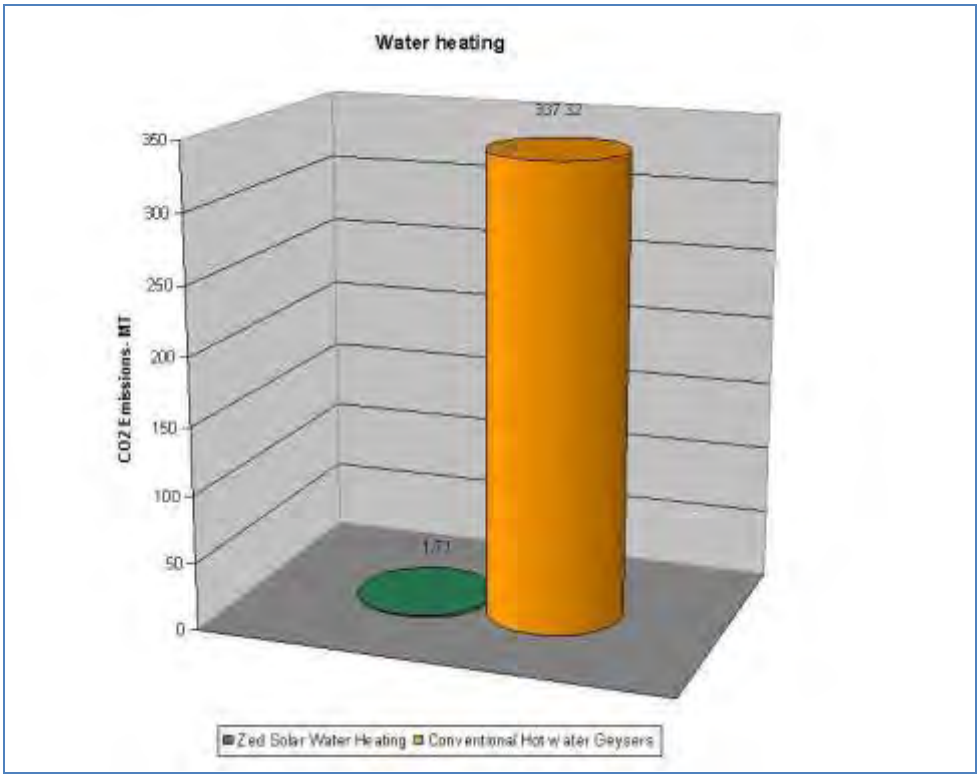
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150
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1.71
Zed Solar Water Heating
Conventional Hot water Geysers

Fig 1 Aesthetic wooden ceiling

Fig 2 Apartment exterior

Fig 3 Eco-store on the campus

Fig 4 Soil Stabilized Bricks

Fig 5 Balcony of an apartment

Fig 7 Steel staircase connecting apartments

Fig 8 Landscape

Fig 9 Restaurant by the poolside