

Green infrastructure for housing schemes: Lessons from Canada

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Original article was published in two parts in *The Island* (www.island.lk) on 9 and 16 October 2006

In urban and suburban areas, housing schemes of multi-storey buildings are a common solution for shelter in order to save the expensive urban land. However, their high population density usually causes significant pressure on the local community as well as on the city's infrastructure.

In Colombo and its suburbs, for example, a large number of families live in multi-storey housing schemes. The majority of them are low- and middle-income families. Long neglected since their inception, most of the buildings require renovation for improved functioning and efficiency. Moreover, in the long run, these families will find it difficult to face the imminent increases in the energy prices due to the country's worsening energy crisis. Meanwhile, the pipe borne water tariff system was recently revised to promote water savings. Now, by reducing the water consumption, people can save more money than in the past. It is therefore highly desirable for these families to lower their dependence on the conventional energy supply and the city's pipe borne water system.

A Canadian project with a green approach for energy and water

At the Global Holcim Awards ceremony in Bangkok, Thailand in April 2006, the project "Greening the Infrastructure at Benny Farm" won the Bronze Award and 150,000 US dollars as prize money. Its main author is Professor Daniel S Pearl of Montreal University. The competition is organized by the Holcim Foundation for Sustainable Construction (www.holcimfoundation.org) in order to promote sustainable construction efforts around the world. The Global Holcim Awards jury views this low-cost sustainable housing project as a well-integrated blend of urban, architectural and landscape design that displays the enormous advantages of a collective approach to designing urban renewal projects.

The project proposes the sustainable construction and renovation of 187 housing units on four properties and to link them with a shared green infrastructure – energy and water. Energy will be generated onsite, using two environment-friendly renewable sources,

namely geothermal energy and solar power. So the houses will depend less on conventional energy. Infrastructure will also be provided for onsite management of rainwater and grey water, in an environment-friendly manner. Rainwater will be used for recharging the water table while the treated grey water will be reused for flushing toilets.

The three housing organizations involved have formed a non-profit company called "Green Energy Benny Farm" (GEBF). This community run utility company will oversee the ownership, management and continual re-investment in sustainable construction for this common energy and water infrastructure. Moreover, the owners, the tenants and the local community were all involved in the project.

This innovative project will deliver a host of benefits. Onsite generation using renewable sources will supply 75% of the total energy requirement. So the partners can enjoy a significant level of protection from future increases in energy costs due to oil crisis and depletion of fossil fuel reserves. Onsite water management can reduce water use by more than half, so the partners will not be significantly affected by the increases in water prices. The project has also taken measures for improved indoor air quality.

The project will relieve the burden on the city's energy and water infrastructure by way of onsite energy generation and water management. It will also minimize the burden on the environment by various means including the use of renewable sources for energy generation, onsite water table recharge by rainwater and green building approaches such as reuse of materials and use of materials with a recycled content.

Designed to be copied, the Benny Farm project is a demonstration model for collectively driven sustainable construction. It clearly displays the advantages of a collective approach to designing urban renewal projects, showing environmental and social sensitivity. It also aims to build public awareness of the benefits of energy saving and environment-friendly measures. The project began construction in June 2005.

The following are the key exemplary features of this project:

- It is a collective effort with a local focus
- It generates onsite environment-friendly energy
- It manages onsite rainwater and grey water
- It improves indoor air quality
- It uses natural resources efficiently
- It is sustainable and provides “room” for future expansion

A collective effort with a local focus

The 18-acre development at Benny Farm in the west end of Montreal in Quebec, Canada was built in 1947 for World War II veterans. With time, the veterans aged, moved on or passed away and the site gradually fell into decline. As the authorities planned complete demolition to sell the land for private development, the buildings gradually became vacant and maintenance was neglected. By 1990 Benny Farm had fallen into disrepair and demolition seemed the only reasonable option.

However, Benny Farm’s symbolic reality as a community driven, community focused and essentially optimistic place attracted public attention. Having recognized the site’s potential, the local community fought for over a decade to preserve it. During this period seven different versions for its redevelopment were proposed. Finally, in 2003, the master plan produced by Saia Barbarese Topouzanov Architects got the green light. This redevelopment plan called for 35-40% renovation.

The project “Greening the Infrastructure at Benny Farm” adopted an innovative approach. The three housing organizations that make up the pilot project formed a partnership called Green Energy Benny Farm (GEBF). This non-profit utility company was to develop, own and manage a common energy and water management infrastructure for this housing project with clear potential for additional phases.

With the owners, tenants and the local community in the driving seat, the project sports a strong local focus together with an extensive stakeholder involvement. Both the municipal and provincial authorities were closely involved in the project.

The project emphasized as a goal the use of locally appropriate technologies over technical sophistication. The technology related

decisions were based on know-how in the local construction industry and onsite conditions and possibilities. Where necessary, steps were taken to develop relevant skills of the local construction industry personnel.

This project is Canada’s first large scale partnership in the affordable housing sector where long term sustainability issues front and center.

Onsite generation of environment-friendly energy

In the region Quebec, where Benny Farm is located, the main sources of energy for buildings are electricity and natural gas. Hydropower, the region’s principal source of electricity generation, is now unable to meet the rising demand for electricity. While new suitable dam sites are costly to develop, they are likely to cause significant alterations to the surrounding natural ecosystems. So Quebec is likely to have an increased reliance on oil and coal for electricity generation. Heavy dependence on such non-renewable sources will pave the way for electricity prices hikes in the future.

However, controlling energy costs is extremely important for the three housing organizations, as the majority of their members are low-income families. Therefore, the project decided to lower the tenants’ dependence on the conventional energy option and resorted to onsite energy generation using two renewable energy sources, namely geothermal energy and solar energy. Geothermal energy is obtained using the heat generated by natural processes deep within the earth. Chief energy resources include hot dry rock and molten rock called “magma”. The underground reservoirs of steam or hot water are tapped by wells and the steam rotates turbines that generate electricity. Onsite generated energy using these renewable sources can supply 75% of project’s energy requirement so that the tenants would depend on the externally supplied energy only for the remaining 25% of the total requirement.

Since renewable sources will have little effect from the inevitable price increases in non-renewable sources such as oil, they are more affordable in the long run. Moreover, renewable sources are more environment-friendly. Onsite renewable energy sources drastically reduce the environmental impact of transporting energy or burning of fuel.

Onsite rainwater and grey water management

Montreal, the city where Benny Farm is located, has a long neglected water infrastructure and over a third of the city's water supply is lost due to leaky pipes, some of which over a century old. So the system faces a massive scale renovation that may last for several decades. Users who heavily depend on this system are likely to encounter increased costs and inconveniences during renovation. Moreover, the city has a combined sanitary and storm sewers, greatly hampering the efficiency of sewage treatment plants.

Therefore, the project adopted a viable alternative to the use of overburdened city infrastructure, lowering the tenants' dependence on it by way of onsite rainwater and grey water management. A key element in the onsite rainwater management is the reduction of the rainwater discharge. Extensive green roofs will be installed on new buildings and most of the existing buildings are upgraded to include green roofs. Green roof evaporation will reduce the volume of rainwater collected. Landscaping measures are designed to keep all rainwater on site. In landscaping permeable surfaces were preferred to impermeable ones so that the rainwater discharge could recharge the water table. Moreover, rainwater discharge from roofs is channeled to underground percolation beds, again to recharge the water table. Such water table recharging will help the functioning of the natural water cycle.

Onsite infrastructure is provided for treatment of grey water from showers, sinks and laundry. Experimental mechanical and biological (filter mash) grey water filtration streams run in parallel to compare the long-term viability. If required, additional treatment measures can be added to this system. The treated grey water will be used for flushing toilets, reducing the amount of water the tenants will obtain from the city's water supply. While lowering their dependence on the city's aging water supply network, this approach will reduce the loads on the city's combined sewage systems. In order to determine the suitability of the treated water for onsite percolation back to the natural water table, water quality data will be gathered over the first few years of operation of these systems.

Improved indoor air quality

Certain modern building materials such as adhesives and coatings greatly contribute to

indoor air pollution. Volatile organic compounds (VOCs) are a class of such pollutants that causes respiratory problems and are harmful to human health. A wide array of building materials commonly used today emits VOCs. Usually, the presence of VOCs indoors is up to ten times higher in concentration than outdoors. In order to improve the indoor air quality, low VOC building materials were selected for this project.

Ventilating indoors is important to flush out the polluted indoor air. The project therefore upgraded the inefficient mechanical ventilation systems for improved functioning and provided windows on both sides of the new buildings in order to preserve and enhance natural cross ventilation.

Efficient use of natural resources

A major cause of natural resources depletion is building construction. Moreover, production of building materials consumes energy while the non-renewable energy sources are "drying up". So building materials and the energy embodied in them should be used to the maximum possible level. In order to reduce the project's burden on natural resources, the project took various measures for their efficient use, such as reuse of building materials, use of materials with recycled components, ensuring durability, lightweight structural design and sharing of the infrastructure.

The project creatively reuses bricks, wood flooring, heating radiators and piping salvaged from existing buildings. All these materials and equipment have consumed energy during their production. Merely throwing them away after demolition or removal will be wasting the materials and the energy embodied in them. The bricks removed during demolition are sorted, tested and cleaned before reuse. Moreover, new materials were selected based on their recycled content.

To improve the long-term durability of all building envelopes, high performance detailing strategies were incorporated. This can lower the need for repair or replacement. For installing green roof systems on renovated buildings, ultra light extensive systems were selected so that there was no need for expensive additional reinforcement for the existing load-bearing structures. Through sharing infrastructure, more value was obtained out of the capital expenses when compared to discrete systems for separate projects. Moreover, the back-up systems were

also shared across the site and between buildings so that they are cheaper and more efficient.

Modern building industry is focused on cost efficiency, with little concern for the extensive waste it produces. On the other hand, this project's construction process is sensitive and responsive to its immediate and remote environmental impact. It efficiently uses natural resources and reduces waste generation and pollution associated with production of building materials.

Sustainability and future expansion

While preserving the Benny Farm's symbolic identity as a strong community, the project has a solid plan for its sustenance and future expansion.

Recycled materials and salvaged equipment relate the renovated and new buildings with the glorious past of Benny Farm. For example, reused materials and equipment such as bricks and radiators will blur the boundaries between the old and the new generation, creating a link stronger than mere repetition of visual patterns.

The proposed systems will significantly reduce the tenants' consumption of the energy and water supplied by the city's infrastructure. Thanks to the onsite energy generation and water management, the Benny Farm tenants will not be significantly affected by the future renovation of the city's aging water and sewage infrastructure.

The non-profit company Green Energy Benny Farm (GEBF) is developing a 30-year business plan to manage the shared infrastructure, to take care of the operations and maintenance and to put money aside for further investment in the project and the community. The project calls for 95% local reinvestment of funds it generates when it comes to management, maintenance and sourcing equipment.

Using energy savings between the years 16 to 30, the GEBF will set up a Green Infrastructure Replacement Fund, which will fund the long-term improvement of the project's water and energy systems. Moreover, the shared infrastructure proposed to link the member buildings can be extended to cover other local buildings in the neighborhood.

A living model of sustainability

Innovative sustainable technologies are usually ignored because they seem to be complex. Standard construction materials and methods are generally preferred even when the resulting product will be of lower quality. This is commonplace especially in large projects, mainly due to the time constraints and quality control concerns. This is a chronic problem in the construction industry around the world.

This demonstration project is a bold step in the direction of sustainability. It aims to prove that this model of green infrastructure works and is applicable to a variety of situations. Its core innovation is the unique integration of buildings, sustainable systems and community process in the affordable housing sector. And it applies sustainable design knowledge and technology at all scales, from the urban to fine grain details.

Careful economic consideration played a key role in both the project's design and long-term feasibility.

Savings from renewable energy generated onsite provide for continual reinvestment in the system and this is the primary economic innovation that made this project possible.

The promise of sustainability is real!

In this project, innovative engineering of sustainable systems will provide a better quality of life for the Benny Farm tenants at an affordable cost.

As non-renewable energy costs inevitably continue to rise, benefits to the residents will increase because there will be little impact on them. The financial model promises the residents a saving of 50% over the cost of externally supplied energy. The remainder of the savings will fund continued operation, maintenance, management and reinvestment. Onsite grey water management will reduce the tenants' consumption of the city's supplied water. Less dependence on the city's water supply network will provide some protection against future water price increases or taxes due to extensive renovation of the aging water supply network. With low VOC materials and proper ventilation, the tenants can enjoy an improved indoor air quality.

The project's self sufficiency means increased land use efficiency without requiring the expansion of the external infrastructure. The

project will build 187 housing where only 76 units existed previously, providing much needed affordable housing in the center of a vibrant urban community. However, because of onsite water management, there will be no burden on the city's water infrastructure. The reduction of the water consumption will be 6.7 million liters a year while the reduction of the wastewater volume requiring treatment will be 11 million liters a year. Such reductions will save the energy that would otherwise be spent for pumping water throughout the city and recovering sewage to the centralized treatment plant. The project's local systems will reduce the burden on the city's water and sewage infrastructure.

The project depends on renewable energy, contributing to reduce greenhouse gas emissions that lead to climate change. And recharging the water table through onsite rainwater management helps the natural water cycle function effectively. Moreover, reuse of materials and equipment will preserve the precious natural resources, which would otherwise be consumed for producing building materials and equipment. Such reuse will also lower the waste stream from the building construction sector.

This project is therefore living proof that a better quality life is affordable without causing an unnecessary burden on the local community or the planet Earth. The project's immediate impact will be modest, but it will be a beacon to other housing redevelopment projects around the world.

The Benny Farm project offers several key lessons for upgrading our existing housing schemes in urban and suburban areas. It shows ways to improve the quality of life of the tenants of such schemes in an affordable manner while relieving part of the burden on the water and sewage infrastructure in these areas.

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