Buildings for sustainability: Materials and construction

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Although we need buildings to lead our lives, they can contribute against sustainability, which the World Business Council for Sustainable Development (WBCSD) defines as "forms of progress that meet the needs of the present without compromising the ability of future generations to meet their needs".

Based on a discussion with Professor Thishan Jayasinghe (Professor of Civil Engineering, University of Moratuwa), an article titled "Buildings for sustainability: An overview" appeared in The Island recently. It presented an overview on how a building's adverse effects on sustainability can be mitigated or even prevented, covering the following areas in brief: Materials and construction, presence of buildings and use of buildings.

Continuing this four-article series with Professor Jayasinghe as resource person, this second article discusses in more detail the aspects of building materials and construction in the context of "Buildings for sustainability". Subsequent articles will cover building presence and use in length.

Building materials

Extraction of natural resources as building materials or as raw materials for production of building materials and building materials production itself consume energy, cause environmental degradation and contribute to global warming.

A two-fold approach is appropriate for this problem: make maximum use out of the natural resources already used for conventional building materials production, and reduce the use of conventional building materials and non-renewable energy resources.

Consider the vast amount of natural resources (both material and energy) consumed by conventional building materials. Make maximum use of these already-used-up resources. Efficient use of these materials by way of efficient structural systems or as high strength materials is an example. Instead of producing building materials from the first step, adopt recycling to utilize the minerals and energy embedded in the materials branded as "waste" (e.g., use of demolition waste for block making). While contributing to conserving the natural resources, these methods will reduce extraction and production related to building materials, lowering the consequent adverse effects on the environment.

Use of more environment-friendly alternatives to conventional building materials and fossil fuels will lower adverse impacts on the environment, especially the contribution to global warming. For example, an appropriate alternative to river sand (e.g., offshore sand) will lower river sand mining, mitigating the associated adverse environmental effects. Cement-stabilized blocks made with laterite soil, now commercially available, is a good alternative to conventional building materials. Moreover, use of cement stabilized compacted soil on the base prior to cement rendering the floor and construction of rammed earth walls are two more examples. A distant goal can be the use of energy generated from environment-friendly renewable sources (e.g., wind, wave energy, solar). Meanwhile, the use of alternative fuels (e.g. industrial waste) for building materials production will reduce the consumption of conventional, non-renewable energy sources such as oil, coal and gas. These alternatives will contribute to conserve the fast depleting non-renewable energy reserves, and will also lower the adverse environmental effects (e.g., emissions) due to the consumption of non-renewable sources.

Building construction

Land clearing and leveling for construction alters the natural drainage paths and hydrological characteristics in the area, causes soil erosion and adversely impacts the local biodiversity. Meanwhile, transport of building materials and construction equipment and then construction activities themselves consume energy and release harmful emissions. Moreover, building construction generates waste.

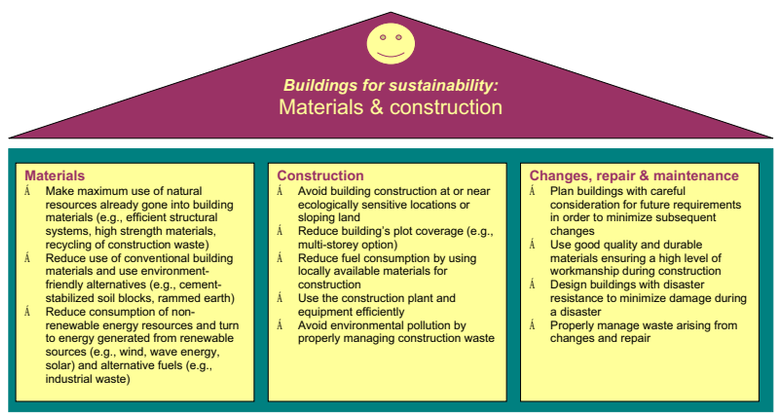
That an artificial body is put in place where originally fauna and flora thrived is fundamental to most of the sustainability issues related to buildings. Therefore, building construction must be avoided at or near ecologically sensitive locations, such as wetlands. It is also desirable to avoid sloping land as removal of vegetation on slopes promotes soil erosion and may also contribute to landslides if the slope is unstable.

The purpose of a building is to provide its occupants with indoor spaces (e.g., rooms). Suppose the occupants of a proposed house need eight spaces (e.g., Living, Dining, Kitchen, Store and four bedrooms). The proposed house can be planned as either single-storey or two-storey. By planning it as two-storey, the ground area covered (i.e., the building's foothold on the planet) can be cut approximately in half. Therefore, as a rule of thumb, the multi-storey option should be preferred even when land area is available. This move will reduce the built area and the consequent adverse effects on the local ecosystem. As you read on, you'll find that the multi-storey option is desirable in several other respects as well.

Transport of building materials and equipment, especially the former, consumes energy and releases emissions, including greenhouse gasses. Use of locally available materials for construction will mitigate these effects.

Construction activities, such as compacting fresh concrete using poker vibrators, are also responsible for energy consumption and emissions. Efficient use of construction plant and equipment can lower the undesirable effects. Moreover, construction generates wastes (e.g., waste timber, leftover concrete, off-cut steel), which should be managed properly, minimizing adverse environmental effects while making use of the embedded materials and energy where possible. Recycling demolished brickwork for use in block making is an example.

Buildings for sustainability: Materials & construction (Article No 2)



Building changes, repair and maintenance

Like in the case of building construction, changes, repair and maintenance of the building use up building materials and generate construction waste – but to a lesser degree.

In order to avoid unplanned changes after construction, plan the building with careful thought about future requirements. To lower the need for maintenance and repair, use good quality, durable materials while ensuring a high level of workmanship during construction. Moreover, design buildings with a satisfactory level of resistance against both natural disasters (e.g., earthquakes, cyclones, flooding) and man-made ones (e.g., explosions). Moreover, manage the waste properly, without any adverse impacts on the environment.

Summary
Materials:

* Make maximum use of the natural resources already used for conventional building materials (e.g., efficient use by way of efficient structural systems or high strength materials, recycling of construction waste)
* Reduce the use of conventional building materials and use environment-friendly alternative materials (e.g., cement-stabilized soil blocks, rammed earth)
* Reduce the consumption of non-renewable energy resources. Turn to energy generated from environment-friendly renewable sources (e.g., wind, wave energy, solar) and use alternative fuels (e.g., industrial waste)

Construction:

* Avoid building construction at or near ecologically sensitive locations or sloping land
* Reduce the building's plot coverage (e.g., multi-storey option)
* Reduce fuel consumption by using locally available materials for construction
* Efficiently use the construction plant and equipment
* Avoid environmental pollution by properly managing construction waste

Changes, repair & maintenance:

* Plan the building with careful consideration for future requirements in order to minimize subsequent changes
* Use good quality and durable materials ensuring a high level of workmanship during construction
* Design buildings with disaster resistance to minimize damage during a disaster
* Properly manage waste arising from changes and repair

NOTE:

Eng (Prof) Thishan Jayasinghe (thishan@civil.mrt.ac.lk), B.Sc. Eng. (Moratuwa), Ph.D. (Cambridge), C.Eng, MIE(SL), graduated in 1987. He completed Ph.D. in 1992 and then worked at the Department of Civil Engineering, University of Moratuwa, for the last 14 years. His research interests are in the areas of tall buildings, masonry structures, long-span bridges, energy efficient buildings and sustainable development.

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Of fixing price for natural gas

by Sunita Narain

On the face, it seems like a fight between brothers. One brother, in this case the elder, Mukesh Ambani, managed to get control over the country's gas reserves. The other, Anil Ambani, inherited the power generation business. When they were in it together, it worked brilliantly, the gas, priced low, would make it to the power plant, which in turn would yield rich dividends.

But now, the brother with the gas has reneged. The Union ministry of petroleum and natural gas is his mediator. Mukesh Ambani wants to price gas "at market rates". The ministry is willing to play ball. It says it wants "transparent and competitive bidding" to determine the price of domestically drilled natural gas. But as there is no competition—natural gas being in the hands of one big private player, Reliance Industries—this means next to nothing. Or it means a lot, if you are Reliance and are free to dictate the price.

But there is much more to this story than a family soap. Natural gas is crucial to the country's energy security. Gas-based power stations are easy to install, with low emissions. When compressed, gas can drive vehicles—as in Delhi. With investment in public transport, gas can reduce air pollution substantially in cities. So the price of this gas must not be a family affair. It is our affair.

Worldwide, the price of natural gas is not determined through demand and supply. Also unlike oil products, there is no cost in manufacturing gas. Beyond the capital costs of drilling, the cost of extracting gas is minimal. There are no refining costs. The only cost involves pumping and piping. Pipeline costs are amortised over years of operation.

Given this situation, countries choose from three strategies to fix prices. They can decide on long-term price agreements. For instance, Europe, which is dependent on Russian gas, fixes rates periodically. The other option is to link the price of gas to the basket of imported crude. If the average of different oil products goes up, the price of natural gas also increases—a floating price index. But this is an artificial construct because there is no market price.

The third option is to fix the price of natural gas at the rate of liquefied natural gas (lng), which is often more widely available, since it can be transported without pipelines. In the case of lng, the extra costs involve the costs of cooling and re-gasification. But as there is no 'market' price of natural gas, this is equally a construct, created on the basis of agreements. For lng to be the basis of the price of natural gas there needs to be substantial agreements on gas imports. Currently, we have one or, at most, two. There is no market to work with.

India has, till date, had an "administered" price regime, which market wallahs are allergic to. In this system, as far as prices go, the government has differentiated between users—priority sectors like power and fertilisers, small users and users of cng in transport, and others like petrochemicals and industry. The price of transporting gas has also been fixed through the state-owned gas company, Gail. In this way, the gas price remains competitive against its replacement, coal, in the case of power stations, petrol and diesel, in the case of transport and naphtha, in the case of industry. It worked well, until the government handed over gas reserves to one private company. Now, without competition and without markets to operate within, the company will have a field day.

I know this because I have been carefully watching the developments to bring cng to cities. In Delhi, because the market was mandated by the Supreme Court, through its order that all public transport vehicles should transit to gas, the price was also controlled on a cost-plus basis. In 2002, the then Union minister of petroleum and natural gas was dead against the introduction of cng in Delhi. He wanted diesel to continue. When all ploys to mislead the court failed, he simply raised the price of gas. The court asked us to examine if the price rise was justified. When we looked at the balance sheet of the company, it became clear that because the market was not developed (and never could be) the price, if not regulated through a formula, could lead to windfall profits. We asked that the price should be set so that costs were recovered and profits were secured, but that profits should not be excessive. As a result, Delhi's gas company, Indraprastha Gas Limited (igl), has been making profits but prices of gas have not increased substantially.

An offshore natural gas drilling platform

As cng was being introduced in other cities, we also wanted a policy directive on its availability and price, which would encourage its use as an environmentally acceptable fuel. This was not done. A pricing policy was made. But by then private players had entered the lucrative market and it was in their interest to keep things unregulated. The policy wasn't finalised. In city after city—Ahmedabad, Gurgaon, Noida, Lucknow—the programme has faltered because the private company, which by now has arm-twisted state governments to secure rights to distribute gas, has dictated the price.

We know air pollution is choking our cities. But they also need electricity. The option is to build coal-based power stations to supply this need. But even with the best of technology (which we don't have) for so-called clean coal, air and solid waste emissions are high. Gas would be an ideal option for these cities. But if the price of gas is determined based on non-existent market rates, then there is no way it can compete with coal—domestic or even imported.

In other words, we have through this market (which doesn't exist) policy of competition (when there is none) compromised, indeed jeopardised, our energy and environment security. But then who said anything about government or the market being free or fair.