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, Sri Lanka, www.mrt.ac.lk), this article discusses the aspects of building materials and construction in the context of "Buildings for sustainability".

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.

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.

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

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NOTE

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