Sustainability and green building rating systems

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Increasing population and economic improvements in countries like India and China have resulted in construction boom in these countries. This has lead to the extensive extraction of construction materials and depletion of the reserves, raising concerns of sustainable construction. In addition, the extraction, production and transportation of construction materials require considerable energy and pollute the environment. In order to streamline the construction activities and to have sustainable construction, several green building rating systems have been developed. These rating systems are briefly reviewed and the LEED v4 Points achievable through the use of concrete are also explained. Tools available for selecting building materials and products, for a high performance green building, are also briefly discussed. The future and the development of green building codes are also outlined.

INTRODUCTION

The definition of sustainability, suggested by then Prime minister of Norway, Gro Bruntland, in 1987, is *meeting the needs of the present without compromising the ability of future generations to meet their needs*. Sustainability is thus is a realization that today's population is merely borrowing resources and environmental conditions from future generations. The greatest threats to the sustainable development on earth are: population growth and urbanization, energy use and global warming, excessive waste generation and the subsequent pollution of soil, air, and water, transportation in cities, and limited supply of resources. Many of them are interrelated and are discussed in the work of Subramanian, 2016.

The materials we use in our construction affect the environment. Their production and transportation deplete natural resources, consume considerable energy, and pollute the environment. Several building materials, and also the energy needed to produce them are becoming scarce. If the present trends continue, some of the common raw materials and energy sources (like oil and natural gas) will be exhausted within about the next century. As per www.msci.org, the grades of mined copper and iron ore are declining and the natural reserves of Lead, Molybdenum, Chromium, Nickel, Copper, Zinc, Tin, and Radium, are depleting. There is an urgent need to use alternate materials-for example, using M-sand in the place of natural sand, to preserve natural resources.

A reclassification of all building materials and products based on sustainability, and also to meet criteria pertaining to personal health and health of environment is necessary. Traditional materials like clay, lime, and stone are still abound and timber (especially softwoods) can be replenished by properly managed forestation. In addition, these materials can be easily reused or recycled; they produce little or no pollution and are reabsorbed into the natural cycles of environment, when they are discarded. Recycling materials like steel and aluminium also preserves the natural resources and saves considerable energy.

Healthy materials

In order to satisfy the criteria of being healthy to human beings, the materials should be (Pearson, 1998)

Clean and should not contain pollutants or toxins, emit no biologically harmful vapours, dust, particles or odours either during manufacture or usage. They should also be resistant to bacteria, viruses, moulds, and other harmful micro-organisms.

They should not be radioactive and not emit any harmful levels of radiation.

They should not be electromagnetic and should not allow the conduction or built-up of static electricity or emit harmful electric fields of any type.

They should have good sound reduction properties, and should not themselves produce any noise.

Ecological Materials

For materials to be environment friendly they should satisfy the following criteria (Pearson, 1998):

They should be renewable and abundant and coming from diverse natural sources, and its production has a low impact on the environment.

They should be non-polluting and should not emit harmful vapours, particles or toxins into the environment, either during manufacture or usage.

They should be energy efficient, and use low energy in production, transport and use and should generally be available locally.

They should be durable and easy to maintain and repair- additionally it is better if they are tried and tested over several generations, as in the case of natural materials.

They should produce less waste during production and capable of being reused and recycled, so that the vast amount of energy spent on processing raw materials could be saved.

Many countries now have a system of labeling environment-friendly products. In USA, from 1989, a non-profit organization called Green Seal identifies products and services that have less impact on our health and environment and awards a "Green Seal" as shown in Figure 1 (www. greenseal.org). Similar 28 international eco-labeling programs exist, including Germany's Blue Angel, the EU's Ecolabel, and the Nordic Swan, and all are members of the Global Eco-labeling Network (GEN).

GREEN BUILDING RATING SYSTEMS

To promote design and construction practices, which reduce the negative environmental impacts of buildings and improve occupant health and well-being, the U.S. Green Building Council (USGBC), a Washington D.C.-based, nonprofit coalition of building industry leaders, developed the LEED® green building rating system in 1993. In the United States and in a number of other countries around the world, LEED® certification is the recognized standard for measuring building sustainability. Similar assessment systems are available in other countries also. Some of these are (1) The British green building rating system developed by Building Research Establishment (BRE) in 1992 called the Building Research Establishment Environmental Assessment Method (BREEAM), (2) The comprehensive Assessment System for Building Environmental Efficiency (CASBEE) of Japan, (3) Green Star of Australia, (4) Griha in India, and (5) Green Globes, which is a web-based, interactive learning tool developed from BREEAM to the needs of U.S. commercial buildings. All these systems are designed to encourage construction of green buildings, which will minimize disruption of local ecosystems; ensure the efficient use of water, energy, and other natural resources; and also ensure healthy indoor environment. However, they differ in terminology, structure, assessment of performance, points assigned to different performance criteria, and documentation required for certification. These systems, while voluntary in nature, continue to gain recognition. It is interesting to note that adoption of these systems also result in economic incentives, as owners and renters are increasingly demanding facilities with high green building ratings.

LEED-NC

From 1994 to 2009, LEED® grew from one standard for new construction to a comprehensive system of six interrelated standards covering all aspects of the development and construction process: LEED-NC for New Construction, LEED-EB, for Existing Buildings, LEED-CI, for Commercial Interiors, LEED-H, for Homes; and LEED-CS-for Core and Shell projects and LEED-ND for neighborhood development (Kibert,2005). LEED –NC, which was originally developed for office buildings, but being used for all types of buildings, except single family homes, is briefly discussed.

It must be noted that LEED is continuously evolving and improving. The LEED rating systems aim to promote a transformation of the construction industry through strategies designed to achieve seven goals:

1. To reverse contribution to global climate change
2. To enhance individual human health and well-being

Figure 1. Green Seal and EU Ecolabel

Table 1 Overview of LEED-V4 categories and credits

Heading	Points
Integrative Process: 1 Possible Point	
Location and Transportation: 16 Possible Points	
Credit 1 Sensitive Land Protection	1
Credit 2 High Priority Site	2
Credit 3 Surrounding Density and Diverse Uses	5
Credit 4 Access to Quality Transit	5
Credit 5 Bicycle Facilities	1
Credit 6 Reduced Parking Footprint	1
Credit 7 Green Vehicles	1
Sustainable Sites: 10 Possible Points	
Prerequisite 1 Construction Activity: Pollution Prevention	Required
Credit 1 Site Assessment	1
Credit 2 Site Development - Protect or Restore Habitat	2
Credit 3 Open Space	1
Credit 4 Rainwater Management	3
Credit 5 Heat Island Reduction	2
Credit 6 Light Pollution Reduction	1
Water Efficiency: 11 Possible Points	
Prerequisite 1 Outdoor Water Use Reduction	Required
Prerequisite 2 Indoor Water Use Reduction	Required
Prerequisite 3 Building-Level Water Metering	Required
Credit 1 Outdoor Water Use Reduction	2
Credit 2 Indoor Water Use Reduction	6
Credit 3 Cooling Tower Water Use	2
Credit 4 Water Metering	1
Energy and Atmosphere: 33 Possible Points	
Prerequisite 1 Fundamental Commissioning and Verification	Required
Prerequisite 2 Minimum Energy Performance	Required
Prerequisite 3 Building-Level Energy Metering	Required
Prerequisite 4 Fundamental Refrigerant Management	Required
Credit 1 Enhanced Commissioning	6
Credit 2 Optimize Energy Performance	18
Credit 3 Advanced Energy Metering	1
Credit 4 Demand Response	2
Credit 5 Renewable Energy Production	3
Credit 6 Enhanced Refrigerant Management	1
Credit 6 Green Power and Carbon Offsets	2
Materials & Resources: 13 Possible Points	
Prerequisite 1 Storage & Collection of Recyclables	Required
Prerequisite 2 Construction & Demolition Waste Management Planning	Required
Credit 1 Building Life-Cycle Impact Reduction	5
Credit 2 Building Product Disclosure & Optimization - Environmental Product Declarations	
Credit 3 Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
Credit 4 Building Product Disclosure & Optimization - Material Ingredients	2
Credit 5 Construction & Demolition Waste Management	2
Indoor Environmental Quality: 16 Possible Points	
Prerequisite 1 Minimum IAQ Performance	Required
Prerequisite 2 Environmental Tobacco Smoke (ETS) Control	Required
Credit 1 Enhanced Indoor Air Quality Strategies	2
Credit 2 Low-Emitting Materials	3
Credit 3 Construction Indoor Air Quality Management Plan	1
Credit 4 Indoor Air Quality Assessment	2
Credit 5 Thermal Comfort	1
Credit 6 Interior Lighting	2
Credit 7 Daylight	3
Credit 8 Quality Views	1
Credit 9 Acoustic Performance	1
Innovation and Design Process: 6 Possible Points	
Credit 1 Innovation in Design	5
Credit 2 LEED® Accredited Professional	1
Regional Priority-4 Possible Points	
Credit 1Regional Priority	1-4
Project Total: 100 base points; 6 possible Innovation in Design and 4 Regional Priority points	
Certified: 40-49 Points; *Silver:* 50-59 Points; *Gold:* 60-79 Points; *Platinum:* > 80 Points	

Source: www.usgbc.org

3. To protect and restore water resources
4. To protect, enhance, and restore biodiversity and ecosystem services
5. To promote sustainable and regenerative material resources cycles
6. To build a greener economy
7. To enhance social equity, environmental justice, community health, and quality of life.

LEED-V4, launched in 2014, is structured with twelve prerequisites and a maximum of 110 points divided into the following categories: Integrative Process (1 point), Location and Transportation (16 points), sustainable sites (10 points), water efficiency (11 points), energy and atmosphere (33 points), materials and resources (13 points), indoor environmental quality (16 points), innovation and design process (6 points), and Regional priority (4 points), as shown in Table 1.

A building must achieve at least 40 points for the basic certification level. Table 2 outlines the certification levels achievable in LEED v4.

Table 2. LEED certification levels and points required for each level

LEED v4 Certification Levels	Points Required
Platinum Level	80+ points
Gold Level	60-79 points
Silver Level	50-59 points
Certified Level	40-49 points

LEED v4 Points Achievable through the use of Concrete

Concrete is a versatile material and can be used in numerous applications in a building project, from foundation to superstructure, and from sidewalks to parking lots. Concrete can also contribute to every credit category of LEED v4. Using concrete can influence 25 of 55 LEED v4 credits and prerequisites and potentially contribute to as many as 68 to 74 points out of the total the available 110 points. Table 3 provides this list of LEED v4 credits influenced by using concrete (Detailed discussion on how concrete can influence these points is provided by Lemay and Peng, 2014, and www.concretethinker.com/technicalbrief/LEED-credits-concrete.aspx). Of course, simply using concrete will not directly achieve credits, but the environmental attributes of concrete can help project designers to achieve LEED certification (Lemay and Peng, 2014 and RMC-Guide, 2010).

Table 3. Summary of possible points to increase LEED Ratings of buildings

LEED Credit Categories	Total Number of possible points	Points potentially influenced by concrete
Integrative Process	1	1
Location and Transportation	16	10-16
Sustainable Sites	10	8
Water Efficiency	11	8
Energy and Atmosphere	33	18
Materials and Resources	13	11
Indoor Environmental Quality	16	2
Innovation and Design Process	6	6
Regional priority	4	4
Total	110	68-74

Source: Adapted from RMC-Guide, 2010

LEED-Neighborhood Development (ND)

The existing LEED® system is geared toward specific buildings, which earn points toward certification by using such green features as recycled building materials, pervious pavements, low-flush toilets and green roofs. The USGBC approved new guidelines for Leadership in Energy and Environmental Design for Neighborhood Development (LEED-ND), was introduced in April 2009 and gives more weight to factors that affect energy efficiency and greenhouse gas emissions. Extra points are also been given to buildings that deal with local environmental conditions such as low water use features in dry regions. LEED-ND adopts a new system where the credits are weighted according to Life Cycle Analysis Indicators. The LEED-ND rating system has 109 points including 9 prerequisites, compared with 69 points for LEED-NC. LEED-ND is divided into four point categories: Smart Location & Linkage; Neighborhood Pattern & Design; Green Construction & technology; and Innovation and Design Process. The amount of points a building will now get will be different for every building depending on its materials, their durability, etc.

Projects must be in a "smart" location near water and wastewater facilities. Developing on farmland or a floodplain is forbidden, compact development is a must, wetlands have to be preserved and "imperiled" species must not be disturbed. They can gain points toward certification for things such as wetland restoration (one point), Brownfield redevelopment (two points), housing and jobs proximity (three points), diversity of uses (four points) and reduced car dependence (eight points). LEED-ND certification levels include "certified" (40 to 49 points), Silver (50 to 59 points), Gold (60 to 79 points) and Platinum (80 to 106 points).

Figure 2. India's first Platinum rated Green Building- CII-Sohrabji Godrej Green Business Centre, Hyderabad

Indian Green Building Council's (IGBC) Green Building rating systems

The 11,000 square feet CII-Sohrabji Godrej Green Business Centre building (also known as CII or CIIGBC) in Hyderabad was the first to receive prestigious Platinum rated green building rating in India in 2003 (See Figure 2). Vegetated roofs cover 55-60% of the building's roofs, and the remaining portion of the roof is covered by solar photo voltaic with a 24 KW capacity. The 100 to 120 units of power generated per day is fed into the grid meeting 20% of the total energy cost of the building. The architect, energy and structural Consultants of this building were Karan Grover & Associates, Tata Energy Research Institute, and Comten Engineers, respectively. The CII or CIIGBC building lead to the formation of Indian Green Building Council's (IGBC) Green Building rating systems, which is a part of the Confederation of Indian Industry (CII)- it is similar to LEED®. Since then, these rating systems have been successfully applied to more than 4025 buildings, with a foot-print of 4.50 Billion square feet. It is given under 16 different categories: (1) IGBC Green New Buildings, (2) IGBC Existing Buildings, (3) IGBC Green Homes, (4) IGBC Green Residential Societies, (5) IGBC Green Healthcare, (6) IGBC Green Schools, (7) IGBC Green Factory Buildings, (8) IGBC Green Data Centers, (9) IGBC Green Campus, (10) IGBC Green Villages, (11) IGBC Green Townships, (12) IGBC Green Cities, (13) IGBC Green SEZ, (14) IGBC Green Landscapes, (15) IGBC Green Mass Rapid Transit System, and (16) IGBC Green Existing Mass Rapid Transit System (https://igbc.in). It is also possible to obtain LEED® certification through IGBC.

Green buildings adopt various strategies for water management: using low flow or ultra low flow plumbing fixtures, electronic controls and fixtures, substitution of alternative water sources (rainwater, reclaimed water, and gray water) for potable water, rainwater harvesting, xeriscaping, and use of other technologies and approaches that result in reduction of potable water consumption (Kibert,2005).

GBI-Green Globes™

Green Globes™ is an outgrowth of the Building Research Establishment Environmental Assessment Method (BREEAM), which was developed in the U.K. It is a Web-based assessment and rating tool for green building performance. It was developed in Canada, and is being introduced to the U.S. market as an alternative to the U.S. Green Building Council's LEED® Rating System. This online tool was first developed by the Green Building Initiative

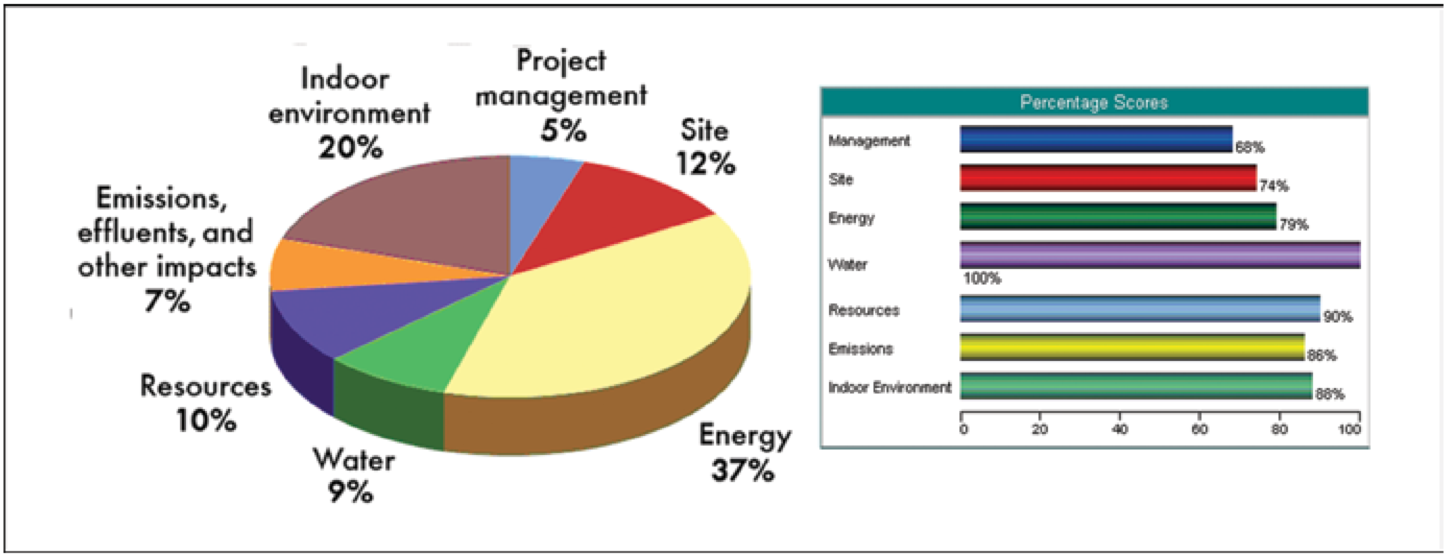

Figure 3. Distribution of points and percentage scores generated by Green Globes web-tool (Source: www.greenglobes.com)

(GBI), Canada, during 2000. It was revised and released in 2002 by a team of experts including representatives from Arizona State University, the Athena Institute, Building Owners and Managers Association of Canada (BOMA), and several federal departments (www.greenglobes.com).

Green Globes™ consists of a series of seven questionnaires on topics such as project management, site, energy, water, resources, emissions, and indoor environment. The questionnaire corresponds to a checklist with a total of 1,000 points listed in the above seven categories (see Figure 3). Once each questionnaire is completed, the online system automatically generates a report, which contains recommendation for improvement and additional supplementary information. The report also contains the overall score of the project as well as percentage scores in each category as shown in Figure 3. Thus, it serves as a virtual consultant and provides instant feedback. The straightforward questionnaire format is easy to complete even if one does not have environmental design background or experience. Note that largest number of points is allocated to energy, followed by indoor environment.

Unlike LEED®, however, the actual number of points available varies for different projects. Thus, Green Globes™ does not penalize projects for strategies that are not applicable. For example, points are available for exterior lighting to avoid glare and skyglow; but if a project has no exterior lighting, the user can select the option "N/A", which removes those points from the total number of available points.

Based on the percentage of points achieved, projects are assigned a rating of one or more Green Globes ( ). In Canada the ratings range from one to five Green Globes. However in the U.S. the lowest rating has been eliminated and the rest adjusted so that the highest rating is four Globes. Independent third party verification by a trained and licensed engineer or architect, with significant training and experience, is required before receiving the final rating. After reviewing the existing supporting documents (such as working drawings, building specifications, waste disposal plans, evidence of energy and life cycle modeling), the verifier may confirm the percentage of points obtained through the online assessment report.

It has to be noted that Green Globes™ is broader in its technical content than LEED®, since it allocates points for issues such as optimized use of space, acoustical comfort, and an integrated design process. Green Globes is unique in providing life-cycle assessment tools that quantify the cradle-to-grave implication of building materials selection in terms of CO_2 emission potential, embodied primary energy, pollution of air and water and weighted resource use on the environment (Sakai and Sordyl 2009). It is difficult to compare the points achieved in the LEED® and Green Globes™, because they are organized differently. Moreover precise requirements of Green Globes™ are not transparent.

Several buildings have obtained Green Globes certification. The Integrated Learning Centre at Queen's University in Kingston, Ontario, designed by B+H Architects of Toronto, received a four-globe rating in 2004. More details about the energy efficient systems, water conservation features, resources used, and source control of indoor pollutants of this building as well other Green Globe certified buildings may be found in www.thegbi.org.

Energy Star

ENERGY STAR® is a joint program of the USEPA and the U.S. Department of Energy, which aims to assist industry to improve competitiveness through increased energy efficiency and reduced environmental impact. ENERGY STAR® provides guidance, energy management tools, and strategies for successful corporate energy management programs. With the help of ENERGY STAR®, Americans saved $16 billion on their utility bills in 2007 alone, thus avoiding greenhouse gas emissions equivalent to those from 27 million cars (www.energystar.gov). The ENERGY STAR® was introduced in 1992 as a voluntary labeling program designed to identify and promote energy-efficient products to reduce greenhouse gas emissions. This label (see Figure 4) may be found now on several equipment and appliances including computers, refrigerators & freezers, washing machines, dish washers, air conditioners, heating and cooling equipment, water heaters, home electronics, office equipment, lighting, etc. Such ENERGY STAR qualified products help save money and protect our environment by using energy more efficiently. USEPA has recently extended the label to cover new homes and commercial and industrial buildings.

Figure 4. Energy Star® label

To earn the ENERGY STAR® label, a home must meet strict guidelines for energy efficiency set by the U.S. Environmental Protection Agency. These homes are at least 15% more energy efficient than homes built to the 2004 International Residential Code (IRC), and include additional energy-saving features that typically make them 20–30% more efficient than standard homes. Any home with three stories or less can earn the ENERGY STAR® label if it has been verified to meet USEPA's guidelines. ENERGY STAR® qualified homes must include a variety of energy-efficient features (such as, effective insulation, high-performance windows, tightly sealed building envelope and ducts, efficient heating and cooling equipment, and efficient products) that contribute to improved home quality and homeowner comfort, and to lower energy demand and reduced air pollution. Independent Home Energy Raters are available who can assist users to choose the most appropriate energy-saving features for their homes. Additionally, these third-party raters may be engaged to conduct onsite testing and inspections to verify the energy efficiency measures, as well as insulation, air tightness, and duct sealing details.

Considering the cement industry, the cost of energy as part of the total production cost is significant, warranting efforts for energy efficiency. Hence, an ENERGY STAR® guide for improving the energy efficiency of cement plants has been developed (Worrell and Galitsky, 2004). PCA member companies partnered with the USEPA and developed a cement plant Energy Performance Indicator (EPI), to improve the industry's energy efficiency. The tool helps cement plant operators to identify opportunities to improve energy efficiency, reduce greenhouse gas emissions, conserve conventional energy supplies, and reduce production costs. This rating tool also allows plants to assess how efficiently the plant uses energy, relative to similar plants nationwide. The rating system provides a scale of 1–100; a rating of 50 indicates average energy performance, while a rating of 75 or more indicates good performance. Plants receiving an EPI score of 75 or higher are eligible to earn ENERGY STAR® recognition. This tool is available in the website of USEPA (www.energystar.gov).

AVAILABLE TOOLS

The task of selecting building materials and products, for a high performance green building, is the most difficult and challenging task for any design team. Several tools are available for this process and one best tool is the *life-cycle assessment* (LCA). LCA provides information about the resources, emissions, and other impacts resulting from the life cycle of material use, from extraction to disposal. Hence one must consider the impact of the material from extraction to disposal. One such LCA program is BEES-**B**uilding for **E**nvironmental and **E**conomic **S**ustainability software (BEES-NIST).

Ideally the material cycle should be closed looped and waste free. Thus, the following rules apply while selecting the materials for green construction.

1. They should consume least energy to manufacture
2. They should not involve long distance transportation (for the raw materials as well as finished product)
3. The natural resources and raw materials used does not affect the environment
4. They must be easy to recycle and safe to dispose in landfills
5. Materials should be harmless in production and use
6. Materials dissipated from recycling must be harmless.
7. They should have long life and durability
8. Buildings must be de-constructible.
9. Building components must be easy to disassemble

It may be difficult to identify a material that obeys all the above rules. Especially the last rule of disassembly has not been considered in traditional building materials, except prefabricated steel structures. Disassembly also discourages the use of composite materials.

GB Tool

GB Tool, now known as Sustainable Building (SB) tool, is another performance assessment system developed by the International Initiative for a sustainable Built Environment (IISBE), an international non-profit organization, operating from Ottawa, Canada. This system, launched in 1996, is a framework operating on Excel that can be configured to suit almost any local condition or building type.

In GBTool scores are assigned in the range of -2 to +5. The scores of - 2 and -1 denote levels of performance below the acceptable level, for the specified occupancy; the score of 0 is the minimum level of acceptable performance for specified occupancy; a score of 3 indicates Best Practice; and 5 is the best technically achievable, without consideration of cost (http://greenbuilding.ca/).

In order to evaluate both technical and social aspects of the resource-flow of concrete, a resource flow simulation system called ecoMA has been developed in Japan. The system uses the concept of Multi Agent System and is designed to focus on the decision-making dynamics between each company and government within the city-scale so that social constraint of resource flow can be simulated properly. The system also uses the concept of graph theory to model the supply-chain and time (Nagai, et al., 2007).

It has to be noted that the existing green rating systems have been developed with little input from the concrete industry. Many of these rating systems confuse the use of concrete to achieve sustainability with the actual production of cement and techniques to reduce concrete's environmental footprint (Sakai and Sordyl, 2009). The beneficial effects such as the thermal comfort provided by concrete due to its high thermal mass and CO_2 uptake during the operational phase of buildings should be given proper importance. LEED was developed with input from the wood and steel industries but not from concrete industry (Sakai and Sordyl, 2009). Moreover, in rating systems such as LEED® main focus is given to buildings only; infrastructure applications such as bridges, dams, pavements and roads are not yet considered.

As mentioned already, rating systems such as LEED, Green Globes, NAHB Green Building Standard and Energy Star have been designed as voluntary standards and have not been written in the typical mandatory language typically associated with building codes and standards. However, many local jurisdictions have adopted these rating systems requiring building to meet a certain rating. As a result, these rating systems have in effect become codes.

It will be interesting to see over time how the courts handle these particular cases. For example, if a building is required to be designed to LEED Gold certification but during the design decisions are made that renders the building to become LEED Silver certified, does the building owner have the right to sue the designer? Is the designer or building owner criminally liable for this shortcoming and what will be the penalty? Will the building be prohibited from opening as a result?

FUTURE

A performance based environmental design method has been developed recently by the Task Group 3.6 of the International Federation for Structural concrete (fib) commission 3 (fib 2008). This document is intended for incorporation into existing codes or specifications. It provides general principles applicable to the design, construction, use, maintenance, dismantling, and disposal of concrete structures. It is applicable both to new and existing concrete structures. Performance requirements cover global issues such as generation of GHG (green house gases) and consumption of resources, regional issues such as use and pollution of water and soil, and other issues such as dust, noise and vibration control. The environmental performance of structures is verified using life cycle assessments (USEPA-2005). America's first green building code was released by the International Code Council in February 2009 and contains chapters on green building, planning and design, energy efficiency, water efficiency and conservation, material conservation and resource efficiency, and environmental quality. It is unclear at this point whether the provisions of the "green" code will be incorporated as mandated material into the building code.

Currently, it is up to the building owner to provide for a sustainable structure. As it stands, the purpose of the building code remains the same, to provide a safe building for the occupants. It has not yet been able to incorporate the many aspects of construction, which degrade our environment and deplete our precious natural resources. However, the current trend is moving in the direction of having building codes that address sustainability in some way or the other.

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