

Green and Safe – Why Not Both?

**Michael Behm, PhD, CSP
East Carolina University
Greenville, NC**

**Neil Silins. LEED, AP, O&M
EMS Environmental, Inc.
Chicago, IL**

Introduction

The last several years have seen a transformation of the “green movement” from a tree-hugger fringe to the catch phrase of the new economy. While it is difficult to avoid news about hybrids, fuel cells and alternative sources of energy, many in the safety profession have not fully grasped the breadth of impact of the green/sustainable movement. Far beyond “environmental professionals in safety” or “safety professionals with environmental responsibilities”, the national emphasis on green innovation offers the safety profession an unprecedented opportunity and unique challenges. In fact, if current trends continue, nearly all jobs in the future will be impacted to a greater or lesser extent by the requirements of a green or sustainable economy.

The purpose of this paper is to summarize rationales for including worker safety consideration within the green building movement. We want to be very clear that we are **not** advocating that best safe practices should be developed for green construction and not included in conventional construction. Many readers and audiences in the past have viewed the inclusion of safety into green as ignoring the wider construction industry, and we want to be clear that is not what we are advocating. As you will read from our paper, we believe our work in safe and green is generalize-able to the entire construction sector and to other sectors “going green”.

The basic premise of the presentation is summed up by Gilding et al. (2002) who claim that no entity that presides over projects that experience avoidable workplace deaths, serious injuries, or illnesses can ever claim to be sustainable. For green buildings to be considered sustainable, therefore, construction safety and health concepts must be included in the design phase and integrated into upstream considerations.

Previous Work

Silins (2009) examined several green building rating systems, including the United States’ Green Building Council’s (USGBC) Leadership in Energy and Environmental Design (LEED) rating systems, to identify areas where and how occupational safety and health are addressed (and where

they are lacking). There are LEED rating systems specific to new construction and design, including owner-occupied as well as tenanted commercial buildings, for retrofitting and maintaining existing buildings, and rating systems for schools, data centers and communities (neighborhoods).

The LEED systems consider worker comfort, productivity and exposure to potentially hazardous air pollutants in several of the prerequisites and credits. Note that these concerns are focused on the eventual occupants (post-occupancy). However, none of the rating systems currently include a credit or prerequisite for including a safety plan or program, either during initial construction or renovation, or for the post-occupancy engineering and maintenance workers.

Silins determined that a “safety prerequisite” need not place an undo burden on architects and engineers. The design process espoused by the LEED rating systems is a “charrette,” one or more discussions where all of the building stakeholders meet to determine the most effective and economical avenues to garner the number of credits needed to achieve one of the four LEED levels. Currently the stakeholders include owners, architects, tenants, mechanical engineers, managers, design professionals, product manufacturers and financial advisors. Adding a safety professional to this list does not seem beyond the realm of the possible.

At the International Council for Research and Innovation in Building and Construction’s (CIB) Working Group 099, for safety and health on construction sites, conference in Melbourne, Australia, Behm et al (2009) provided a perspective and rationale on why green building construction should include worker safety considerations. A central theme in that paper was that the terms ‘green’ and “sustainable” are not synonymous. They are similar, but not the same. In a review of sustainable construction textbooks and articles, these authors found that the terms ‘green’ and “sustainable” are being used interchangeably in the construction industry (see for example Kibert, 2008; Kopec, 2009). This is confusing to readers and, in our case, confusing to construction professionals, such designers, construction managers, and owners who are procuring, designing, and managing green construction. The definition of sustainable includes environmental aspects, addresses the continuity of economic considerations, resource conservation, and the social aspects of human society. For example, a newspaper reporter in San Francisco highlights the difference stating that that sustainability raises the "green" discussion from materials and processes to include marketing, distribution, disposal and human labor (Evans, 2006). The United States Green Building Council (USGBC) in their 2009 Strategic Plan recognizes that “the meaning of ‘green’ is evolving, to more fully include human and social relationships to the built environment” (USGBC, 2009). We reviewed the 2009 USGBC strategic plan and the USGBC website, but found that construction worker safety and health, or construction workers at all for that matter, is not mentioned.

One example of a green building where construction safety failures occurred is at the Las Vegas, NV Mirage City Center which was striving for USGBC LEED certification at the Silver level. During this construction project, scheduled to be completed near the end of 2009, six construction workers died on the job in an 18 month period (CPWRa, 2008). Regarding the safety and green link on this project, Ivanovich (2008a) posed the question “how many construction site deaths should there be to make a building ‘not green’ regardless of the environmental benefits?” Ivanovich (2008b) went on to suggest awarding one credit if a project is completed without a serious injury or death. He also proposed that green certifications should be revocable where

accidental injuries or deaths occurred during construction and were proved to be complicit with negligence after the certification was awarded.

At the 2010 American Industrial Hygiene Conference, Behm (2010), gave a presentation “If a Construction Worker Dies during Green Building Construction Does Anyone Hear It?” as part of the roundtable, Green Construction Practices: Integrating Occupational Health and Safety. In the presentation, the focus was on the rationale to include construction worker safety best practices in green building design and management.

Green Rating Systems

Current green design and construction practices are primarily aimed at minimizing environmental and resource impacts and improving the safety, health, and productivity of a building’s final occupants and the public. Several organizations have developed green building rating systems, including the US EPA, the Department of Energy, and various municipalities. Additionally, several green rating systems exist.

The National Association of Home Builders has the National Green Building Standard, a residential green building rating system. This standard sets green baselines for all new residential construction, development, and remodeling projects. ASHRAE, the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, publishes the Advanced Energy Design Guide, with the goal of achieving a 30% energy reduction and, eventually, net-zero energy buildings. More recently, ASHRAE published Standard 189.1 Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings, which also serves as a jurisdictional compliance option to the Public Version 2.0 of the International Green Construction Code™ (IgCC) published by the International Code Council. The IgCC regulates construction of new and remodeled commercial buildings. Having a green building code, consistent and coordinated with the existing family of Codes and Standards, should prevent green buildings from having to adhere to two standards at least -- the conventional building code, and the green building standard. This conflict has caused some issues, including a fiasco involving waterless urinals, in which the waterless urinals which were specified for sustainability were prohibited under conventional code provisions. Also, the A10 Construction Industry Safety Standards committee, under ASSE auspices, has stated that they don’t want separate standards for green building construction.

BREEAM (Building Research Establishment Environmental Assessment Method-BRE Environmental & Sustainability Standard) is the property of BRE Global Ltd. and is more common in Europe. Energystar is a program of the US EPA. It is a voluntary government and industry partnership. It began in 1991 as the Green Lights program, followed shortly by the introduction of the ENERGY STAR label. In 1996, the EPA partnered with the U.S. Department of Energy to increase the range of ENERGY STAR product offerings. The label now covers a short list of building types, residential heating and cooling equipment, major appliances, office equipment, lighting, and consumer electronics.

Green Globes is a product of the Green Building Council (www.thegbi.org/), similar to NAHB, and is now owned by Jones Lang LaSalle. Please notice that the listed programs a) focus primarily on HVAC, energy and water usage, and b) apply to only one or a few types of

buildings, or a combination. However, worker safety is largely ignored or is an afterthought in the green schemes.

The USGBC has developed consensus protocols for green building design, construction and day-to-day operations. These protocols are a third-party certification program and have become nationally accepted benchmarks for the design, construction and operation of high performance green buildings. LEED is being continually evaluated and improved by USGBC and the various LEED committees. Incentives available from federal tax credits to local financing initiatives make green building more appealing financially. More importantly, many municipalities are requiring some green efficiency rating, and more specifically LEED, in permit requirements.

These rating systems, such as the U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) put little, if any, focus on the safety and health of the initial occupants, the construction workers, or those that maintain these buildings. Yet such rating systems and their proponents represent a largely untapped opportunity for safety and health practitioners to enlist in efforts to promote designing for safer workplaces during the building's construction and maintenance.

NIOSH Safe Green Jobs

The potential impact of sustainable construction has also been the subject of many focus groups at the national level. As part of the Prevention through Design (PtD) initiative, NIOSH and its partners are developing a framework to create awareness, provide guidance, and address occupational safety and health issues associated with green jobs and sustainability efforts (NIOSH, 2011). A Safe Green Jobs workshop was held in December 2009. Specifically, within the NORA construction sector activity, a Green Jobs Committee has been recently formed. The committee's goal is to evaluate mechanisms to integrate safety and health into the LEED and other systems. The authors will report on the noteworthy advances at the presentation in June.

OSHA

OSHA now recognizes the green movement and has created a Green Jobs Hazards area on their webpage, <http://www.osha.gov/dep/greenjobs/index.html>. The site lists hazards, controls, and a summary of fatalities within the categories, of green roofs, solar, wind energy, recycling, hydrogen fuel cells, geothermal energy, weather insulating / sealing, and bio fuels. OSHA recognizes the importance of Prevention through Design strategies in these new industries and jobs.

Prevention through Design

Despite OSHA's recognition of PtD and the green movement as opportunities to enhance worker safety, the likelihood of governmental regulations that would broadly specify PtD efforts in upstream construction activities is remote. In the United States, unlike the United Kingdom, the European Union, and Australia, PtD will likely only be utilized by leading-edge firms, at least in

the short term. Because PtD has seen international support in enhancing construction worker safety and health, innovative and creative ways to diffuse the concept in the United States must be developed. National Occupational Research Agenda (NORA) Construction Sector goals, whose formulation was facilitated by NIOSH in collaboration with external stakeholders, are described as they relate to green building elements and ideologies.

Sustainable Construction Safety and Health (SCSH) rating system

A SCSH rating system has been developed in an attempt to close the aforementioned gap. The system provides a way to rate “green” projects based on the importance given to worker safety and health. The rating system was developed by Rajendran and Gambatese and was the focus in *Professional Safety* interview in the February 2011 issue. The SCSH rating system consists of 50 safety and health elements grouped into 13 categories implemented throughout the life cycle of the project beginning with conceptual design (*Professional Safety*, 2011).

ASSE Sustainability Taskforce

Recognizing ASSE’s role as a global leader and champion for safety professionals, the Council on Professional Affairs and the Environmental Practice Specialty determined that sustainability was a critical strategic issue for the safety profession and formed a Sustainability Taskforce. While not limited in scope to construction safety, the Sustainability Taskforce has developed an enterprise wide Safety and Health Sustainability Index, including performance indicators and quality measurements.

The Taskforce has also been instrumental in creating the Center for Safety and Health Sustainability. When operational, the Center is positioned to provide the safety and health community with a mechanism to ensure that safety professionals will have a strong voice and leadership in the development of sustainability policies and approaches which include occupational safety and health.

Unique Green Hazards – Vegetated Roofs and Solar Panels

Vegetated roofs are becoming increasingly popular in the United States for their environmental benefits and their ability to earn credits in the green building certification process. Additionally, municipalities are providing tax incentives to encourage vegetated roof installation and passing regulations that require government buildings to provide vegetated roofs. Vegetated roofs have been proven to provide environmental benefits.

Vegetated roofs are not “maintenance free” (Lockett, 2009). There is an increased frequency of roof access required to maintain vegetated roofs compared to a conventional roof; this was confirmed through site visits by one of the authors. The installation and maintenance of vegetated roof materials presents unique hazards and an increased risk to roofers and landscapers. We visited nineteen vegetated roofs in the US in 2010, and noted numerous safety and health

hazards associated with falls due to lack of parapet or other protection, poor access for workers and materials, vegetation next to fragile skylights. In some cases no irrigation water sources have been provided at roof level. The picture on the next page shows a vegetated roof on a 47 story building. The parapets are about 8" high, there are no engineered fall protection systems or anchorage points for workers to tie-off to, and the vegetation goes to the edge of the building's roof. The picture also shows the effect of the wind blowing the dirt and sedum off the roof.

The second picture is of a vegetated roof that is no longer maintained because there is no easy or safe way to access the roof. Doing so is very costly for the owner of the building. The net effect of a vegetated roof to building ownership should be operating cost efficiency plus the marketing value of a vegetated roof, less the cost of installation, maintenance and replacement. In these cases the value of operating cost efficiencies is much reduced due to marginal if any increases in insulation and stormwater management.

Solar panels also present hazards that increase risk if not appropriately planned and managed. According to recent solar installation fatality investigations from the California Department of Public Health's Occupational Health Branch (OHB), some interesting parallels can be drawn to worker safety on vegetated roofs. The hazards and risks are similar. According to OHB, "as the use of solar energy continues to grow, an increasing number of workers are exposed to unique hazards that they should be protected from. Over the past 24 months, CA's Fatality Assessment and Control Evaluation program investigated the deaths of three solar panel installers. One of the workers died when he was electrocuted by an overhead power line, another fell through a skylight, and the third worker fell off a roof. Although the research carried out by one of the authors did not discover any instances of worker deaths on vegetated roofs, similar hazards and risks exist.





Solar panels and vegetated roofs are certainly not thinly “green” features that present increased safety risk. A graduate student from the University of Colorado recently examined six LEED projects as case studies and evaluated the risk increase and/or decrease of the green elements. This manuscript has been recently submitted to the *Journal of Construction Engineering and Management* for consider of publication. Please contact the authors of this proceeding for additional information.

USGBC Innovation in Design Credits

The intent of the Innovation in Design (ID) Credit is to provide design teams and projects the opportunity to be awarded points for *exceptional* performance above the requirements set by the LEED Green Building Rating System and/or *innovative* performance in green building categories not specifically addressed by LEED (USGBC, 2008). LEED ID Credits are evaluated for each project and the award of an ID Credit for one project at a specific point in time does not constitute automatic approval for a similar strategy in a future project (USGBC, 2004). Worker safety and health has been awarded ID credits for ergonomic improvements. Two ID credits titled “Ergonomic conveyor system” and “Operations floor ergonomic assessment” are found in the ID catalog. Both of these credits were awarded for LEED New Construction rating system under the

Environmental Quality category. The requirements of these two credits are summarized in Table 1 (USGBC, 2008).

Table 1. Summary of USGBC Innovation in Design ergonomic related credits

Credit title	Requirements	Submittals
Ergonomic conveyor system	Implement a new ergonomic conveyer system and quantify the associated health, safety, morale and cost efficiency savings	<ul style="list-style-type: none"> • Copy of a study listing health and safety issues associated with old system and how these issues are addressed by the new system • Documentation of improved productivity and occupant satisfaction
Operations floor ergonomic assessment	Demonstrate a comprehensive approach to ergonomics in the workspace by performing ergonomic assessment and design and creating mockups to determine the best workstation configuration for different workers sharing the same space.	<ul style="list-style-type: none"> • Narrative describing approach used in ergonomic assessment and design for the operations floor • Description of strategies implemented including adjustable computer displays, height adjustable tables and adjustable chairs

While the guidance is explicit that the award of an ID Credit for one project at a specific point in time does not constitute automatic approval for a similar strategy in a future project (USGBC, 2004), we believe this is an area for further analysis by safety professionals, ASSE, and other organizations interested with integrating safety with green construction. Perhaps other areas such as the prevention of falls during construction and maintenance, the utilization of Prevention through Design strategies, etc. could be implemented for ID credits.

Summary

Yudelson (2008) predicts that green and sustainable construction is predicted to evolve and grow over the next few decades. Therefore, perhaps what is labeled green construction today will be conventional construction for our children and grandchildren. The environmental movement has generated staggering innovative and creative changes in the methods that buildings are built and maintained. Unfortunately, the improvements in overall national construction worker safety and health have not seen the same improvement and lag behind environmental enhancement. One main reason is the lack of the safe design thinking and integration that is utilized in the UK and Australia, where the fatality rates are about half those in the U.S. (CPWR, 2008b). In the U.S., we continue to focus on downstream interventions to improve worker safety, ignoring the hierarchy of controls and upstream decisions. Because there is no statistical evidence to the contrary, green and sustainable buildings will continue to be built by a process that employs 8% of the nation's workforce yet experiences over 20% of its deaths. Green and sustainable construction should incorporate recognized construction safety best practices,

including PtD, in order to truly have a positive impact on the dismal safety record and ensure a sustainable building life cycle.

References

CPWR, The Center for Construction Research and Training (2008a). Worksite Assessment Team Site Visit Report for City Center and Cosmopolitan Construction Projects, Las Vegas Nevada. November 2008. <http://www.cpwr.com/research-sitereport.html>

CPWR, The Center for Construction Research and Training (2008b). The Construction Chart Book. Silver Spring, MD. <http://www.cpwr.com/rp-chartbook.html>

Gilding, P., Humphries, R., and Hogarth, M. (2002). Safe Companies: A Practical Path for 'Operationalizing' Sustainability. An Ecos Corporation Discussion Paper. March 2002.

Kibert, C. (2008). Sustainable Construction: Green Building Design and Delivery, 2nd edition. John Wiley & Sons, Inc., Hoboken, NJ.

Kopec, D. (2009). Health, Sustainability, and the Built Environment. Farichild Books, New York.

Ivanovich, M. (2008a). Bloody Buildings. CSE Live. http://www.csemag.com/blog/Give_and_Take/11206-Bloody_Buildings.php

Ivanovich, M. (2008b). LEEDing construction safety: A Natural Step. CSE Live. http://www.csemag.com/article/177222-LEEDing_construction_safety_a_Natural_Step.php

Luckett, K. (2009). Green Roof Construction and Maintenance. McGraw Hill. New York.

National Institute for Occupational Safety and Health (2011). Prevention through Design: Green, Safe and Healthy Jobs. <http://www.cdc.gov/niosh/topics/PtD/greenjobs.html>, accessed January 20, 2011.

Professional Safety Standards Insider (2011). Sustainable Design and Construction: Incorporating Worker Safety. *Professional Safety*, 56 (2), 41-42.

Silins, N. (2009). "LEED & the Safety Profession: Green Has Come of Age." *Professional Safety*. 54(3), 46-49.

United States Green Building Council (USGBC) (2008). Guidance on Innovation and Design Credits. March, 2008. Washington, DC.

United States Green Building Council (USGBC) (2004). Innovation in Design Credit Catalog.. April 8, 2004. Washington, DC.

Yudelson, J. (2008). The Green Building Revolution. Island Press, Washington, DC.