

Key Issue Roundtable #16: Integrating Safety & Health into Green Construction

**Matt Gillen, MS, CIH
National Institute for Occupational Safety and Health (NIOSH)
Office of Construction Safety and Health
Washington, DC**

Introduction

Improving sustainability and the environmental performance of buildings is an important mission. Commercial and residential buildings account for about 40% of primary energy consumption nationwide.¹ Conventional construction consumes a large amount of raw materials and creates a large waste stream. Once completed, buildings also have a considerable impact on human health and the environment. The growth of “Green” building practices is a direct response to these findings. The US EPA defines Green Building as:

The practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building’s life cycle, from siting to design, construction, operation, maintenance, renovation, and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Green building is also known as sustainable or high performance building.²

Green building rating systems were developed to define and evaluate these practices. The first and most widely used rating system in the US is *Leadership in Energy and Environmental Design (LEED*³), developed by the US Green Building Council (USGBC). Two other existing systems are *Green Globes*, developed by the Green Building Initiative, and the *Living Building Challenge*, developed by the International Living Building Institute. There are similar green rating systems in use in more than 25 countries. The rating systems are organized using point totals addressing several categories of environmental, health, and energy conservation practices.

Green buildings are considered to provide a number of benefits. These include environmental benefits, reduced energy costs, lower long-term operations and maintenance costs, and improved occupant worker productivity and well being.⁴ A broad cross-section of

¹ Rogers, D. *Commercial Building Initiative: DOE’s Commercial Buildings Program: A Market-Based Approach to Zero-Energy Performance*. Presentation to U.S. Department of Energy Capitol Hill Forum on Sustainability. September, 11, 2008. Accessed at http://sites.nationalacademies.org/DEPS/FFC/DEPS_047402

² See <http://www.epa.gov/greenbuilding/pubs/about.htm>

³ LEED is a registered trademark of the US Green Building Council

⁴ See 2013 World Building Council Study press release: <http://new.usgbc.org/articles/world-green-building-council-showcases-cost-effective-green-building-benefits-throughout-wo>

construction clients, ranging from the governments at the federal, state, and local level to hospitals, commercial buildings, universities, hotels, schools, and industrial owners have embraced green building practices for new construction and retrofit work. As of 2012 there were over 162,000 accredited LEED professionals and over 31,000 buildings participating in the LEED process.⁵

Green... and Safe?

The Las Vegas “CityCenter” construction project raised questions about a potential disconnect between green construction and good safety and health practice for many in the construction safety and health community. This large high visibility project was awarded six Gold LEED certifications in November of 2009.⁶ The project had a high profile because it was the largest commercial construction project in the US at the time, and it was the subject of a Pulitzer Prize-winning series of safety articles in the Las Vegas Sun focusing on multiple fatalities during its construction. The construction of this large multiple building project involved the same number (six) of construction worker fatalities⁷ as the number of LEED certifications. While there was no indication that the green practices had any direct link to the safety record on the project, this juxtaposition did raise questions about an apparent disconnect between good environmental practice and good construction and safety and health practice.

NIOSH and NORA (National Occupational Research Agenda) activities

NIOSH has encouraged dialogue on green job safety. NIOSH hosted a national “*Making Green Jobs Safe*” workshop to discuss the connection between emerging green jobs and occupational safety and health, and to frame the issues for ensuring that sustainable design includes elements to eliminate hazards and minimize the risk to workers. The meeting was co-hosted by EPA, OSHA, the National Institute for Environmental Health Sciences (NIEHS), and the National Toxicology Program (NTP), and was attended by 170 stakeholders.⁸

The potential to improve construction safety through linkage with green and sustainable efforts was one of the major areas of agreement among participants. “Sustainability” was viewed as flawed or incomplete without incorporation of occupational safety and health concepts. Participants voiced the view that worker safety and health should be placed at the same level of importance as energy and environment in sustainability considerations. The meeting included breakout sessions to identify compelling activities for follow-up. Participants voted on the list of activities to suggest priorities, and among the top 10 were:

- Include occupational safety and health into green and sustainable standards as they are being updated

⁵ Wang, N. Fowler, K Sullivan, R. *Green Building Certification System Review*. U.S. Department of Energy. March 2012 at http://www.gsa.gov/graphics/ogp/Cert_Sys_Review.pdf

⁶ *City of Gold: Vegas’ CityCenter earns six LEED® Gold Certifications for Hotels, Residences, and Retail District Opening this December*. Press Release dated November 20, 2009. Accessed at: http://www2.citycenter.com/press_room/press_room_items.aspx?ID=778

⁷ CPWR- Center for Construction Research and Training, *Worksite Assessment Team Site Visit Report for City Center and Cosmopolitan Construction Projects*, Las Vegas Nevada. November 2008. Accessed at <http://www.cpwr.com/research-sitereport.html>

⁸ See <http://www.team-psa.com/safeandgreenworkshop/home.asp> for information about the workshop

- Integrate safety and health into green elements of contractor specifications
- Include occupational safety and health into federal sustainability efforts and procurement
- Develop, validate, and disseminate a LEED-like safety and health rating system

NIOSH also published a 2010 blog piece titled “*Going Green: Safe and Healthy Jobs*”, which described six considerations for making green and sustainable jobs safe and healthy for workers. It stated:

As green and sustainable practices become more common in the U.S, there is an opportunity to promote worker safety and health as a fundamental dimension of true sustainability. A sustainable product, process, or technology should not only protect the environment and consumer but also the worker. Green jobs must be safe jobs...

Sustainable practices and green technologies, products and processes need to be evaluated for worker safety and health just like any other new job, product or practice. Such evaluation can identify work-related hazards that can then be prevented or controlled. It can also help identify those green practices, products and technologies that improve worker safety and health so that they can be widely promoted.⁹

NIOSH supports NORA, which is intended to bring together multiple stakeholders to identify top problems and to develop goals to address them in key industry sectors. The Construction agenda includes this goal:

Within 4-6 years, develop methods to utilize the U.S. Green Building Council’s (USGBC) Leadership in Energy and Environmental Design (LEED) rating system and the sustainability movement to implement CHPtD (Construction Hazard Prevention through Design).¹⁰

The NORA Construction Sector Council identified “Integrating Safety and Health into Green Construction” as one of two topics for special emphasis and it organized a green coordinating group to initiate activities. This has generated a number of activities by NIOSH and the coordinating group such as:

- Outreach to the USGBC to discuss integrating safety and health into LEED.
- Outreach to safety and health professionals to raise awareness.
- A “Credit-by-Credit” review of the 2009 LEED credits to identify credits with positive or negative potential to impact construction and maintenance worker safety and health.
- Identification of pilot credit concepts and guidance materials to incorporate safety concepts.
- Development of strategies for raising awareness among architects and building owners.

⁹ Gillen, M. Check, P. Branche, C. *Going Green: Safe and Health Jobs*. NIOSH Blog, January 4, 2010. See <http://blogs.cdc.gov/niosh-science-blog/2010/01/green-2/>

¹⁰ See Goal 13.3.2 on page 113 of <http://www.cdc.gov/niosh/NORA/comment/agendas/construction/pdfs/ConstOct2008.pdf>

Does LEED address worker safety and health?

Improving health and well being of **building occupants** is an explicit objective of LEED and other rating systems. There are credits intended to enhance occupant comfort and well being, and several explicitly mention the intent to reduce exposures to potentially hazardous or harmful contaminants. The 2009 version of LEED does include some credits with intended co-benefits for construction workers. For example the indoor air quality management credits include the intent to “promote the comfort and well-being of construction workers”. LEED does not explicitly address safety (i.e., injury prevention), and none of the LEED credits directly mention construction, operation, or maintenance worker safety. Some LEED credits involve activities such as installation of skylights, use of vegetative roofs) that may increase exposure to hazards such as falls for construction, maintenance and operations workers.

The credit-by-credit review performed by the NORA green coordinating committee identified seven (13%) credits with potential to reduce risks to construction and maintenance workers and eleven (20%) with potential to increase risks. The remaining two thirds of the credits were viewed as relatively neutral. The coordinating group selected six credits and developed language that could be inserted in both the credits and the accompanying LEED reference guide materials to integrate safety and health into these green practices.

Note that LEED is regularly updated. The version currently being finalized is LEEDv4 and is expected to be finalized in late 2013.

What does research find?

Several investigators have evaluated the links between green construction and safety and health. A selection of studies is described below.

Rajendran, Gambatese and Behm compared OSHA recordable incident and lost time case rates for seven firms involved with 86 projects constructed in the Northwest from 2000 to 2006. The study included 38 LEED and 48 non-LEED projects. All of the construction firms involved had experience modification rates below 1.0. The researchers found no statistical difference in rates between the two types of projects, suggesting that green construction was no safer.¹¹

Fortunato and colleagues interviewed members of project design and construction teams (including superintendent, foremen, workers) to compare hazards for green design elements compared to conventional construction. The study looked at potential safety impacts on six Colorado LEED building projects. Results indicated thirteen credits that could potentially increase risks, five that could potentially decrease risks, and thirty nine that would be likely to have no or negligible change.¹² Note that these results align closely with the findings of the NORA green coordinating committee.

Dewlaney and colleagues interviewed designers and contractors about their perceptions of increased or decreased risks related to twelve LEED credits identified from the previous study.

¹¹ Rajendran, S. Gambatese, J. Behm, M. *Impact of Green Building Design and Construction on Worker Safety and Health*. October, 2009. JCEM 135:10 1058-1066.

¹² Fortunato, B. Hallowell, M. Behm, M. Dewlaney K. *Identification of Safety Risks for High-Performance Sustainable Construction Projects*. April, 2012. JCEM 138:4 499-508

The interview group included eleven architects, thirteen general contractors, and two subcontractors. Group members had an average of eighteen years of experience in construction and an average experience of four LEED and over a hundred conventional construction projects. The group did perceive that several of the LEED work activities would be likely to increase risks. For example they reported a perceived 36% increase in lacerations, strains and sprains would result from recycling materials and a 24% perceived increase in likelihood of falls from installation of solar panels.¹³

Behm evaluated worker safety conditions for 19 vegetated green roofs in the US. He found poor access for six of the roofs and he observed potential fall-protection hazards on eleven of the roofs.¹⁴

“Life Cycle Safety” as a way to frame the issues

The EPA definition of green construction describes how this concept includes taking a broad look at the entire building “Life Cycle”. NIOSH and the NORA green construction coordinating workgroup is promoting use of the term “**Life Cycle Safety**” to describe the need to comprehensively address building-related occupational safety and health risks for all affected worker groups across all life cycle stages. For construction, this means the workers who construct the new building, the workers who come into the building to service and maintain the equipment or repair or renovate various components such as the roof, or the workers who eventually dismantle or deconstruct the building at the end of its useful life.

Life Cycle Safety means the proactive use of “Job Hazard Analysis” thinking to evaluate potential hazards and exposures. For example, vegetated roofs are a green building feature. These roofs require workers to access the roof for periodic plant care and maintenance. How will they get to the roof? How will they get supplies to the roof? How will they be protected from falls while on the roof? These are all Life Cycle Safety considerations best addressed during building design and planning stages.

NIOSH and the NORA green construction coordinating group are considering developing a “Safe Roof Design Guide” to describe roof-related Life Cycle safety issues and design and planning options. Such a product would be relevant for several LEED credits that present fall hazards such as: Daylighting (skylights); Heat Island reduction (vegetative and reflective “cool” roofs); and energy production (rooftop solar and wind installations).

Key issues for Roundtable discussion

Green construction is becoming the norm. Seventy six percent of architects, sixty six percent of contractors, and fifty one percent of subcontractors reported believing that green construction will be the norm for their trade or profession by 2016.¹⁵ The question for safety and health practitioners is whether or not construction and maintenance will be any safer when it becomes the new norm.

¹³ Dewlaney, K. Hallowell, M. Fortunato, B. *Safety Risk Quantification for High Performance Sustainable Building Construction*. August, 2012. JCEM 138:8 964-971

¹⁴ Behm, M. *Safe Design Suggestions for Vegetated Roofs*. JCEM August, 2012. JCEM 138:8 999-1003.

¹⁵ McGraw Hill, 2012. *Expectation of Green as a Norm for Firm/Industry by 2016*.

Finally, the researcher Helen Chen describes the importance of construction to the overall dialogue about integrating safety and health into green jobs. She states:

Green construction represents both our greatest opportunity in terms of mitigating climate change but also, because of the dangers inherent to high-hazard construction work, our greatest threat in terms of risks to workers. What we do at the nexus of green construction and occupational safety and health will set the standard for all green jobs.¹⁶

Here are several “thought starter” questions to help launch the roundtable discussions.

- Do participants have any specific examples to share of green construction practices that were either increase or decrease safety and health risks for construction and maintenance workers?
- What views do participants have on how green practices can lead to increased risk? Is it related to their green attributes? Or because they are new? Or something else?
- Are there specific green practices that could benefit from developing specific safety and health guidance to ensure safe construction and maintenance?
- Do participants have examples to share where green construction resulted in use of “Prevention through Design” approaches by architects and engineers that improved safety and health conditions for construction and maintenance workers?
- What are the best ways for ASSE members to collaborate with NIOSH and others to improve safety and health for construction and maintenance workers?

The findings and conclusions in this presentation have not been formally disseminated by the National Institute for Occupational Safety and Health and should not be construed to represent an agency determination or policy

¹⁶ Chen, H. *Green and Healthy Jobs*. Labor Occupational Health Program, University of California at Berkeley. CPWR – Center for Construction Research and Training. 2010.