

Design the Hazards Away: Prevention Is the Cure

**Jeremy T. Deason, PE
Managing Director
Safety Through Engineering, Inc.
New Carlisle, OH**

**Michael C. Wright, PE, CSP, CPE
President
Safety Through Engineering, Inc.
New Carlisle, OH**

The Problem

History has shown that just realizing something needs to be done is not the fix; you have to be willing to reject ideas that fail to meet the goal. The traditional methodology for addressing safety for facilities, machines or products is for owners, architects, engineers, consultants, contractors and vendors to complete the design, engineering, construction or fabrication of a project based on past knowledge, experience and training. Safety, though, has typically not been one of the required skills for all project participants.

Furthermore, the norm has not been to consider the safety of the people performing site work, construction, maintenance, fabrication, operation and decommissioning at the conceptual stage. Rather, each party has been left to consider and create an individual safety strategy for their portion of the project activity. The focus of identified safety hazards remains on how the exposed worker can abate or avoid the hazard rather than how the design team can eliminate the creation of that hazard or provide a safe work process during the design stage.

As safety professionals, our mantra should be nothing less than Sustainable Safety; which can be defined as integrating safety methods throughout the lifecycle of a project, process or machine. A key element to Sustainable Safety is the ability to identify and address foreseeable hazards with effective countermeasure integration. So why do the “Commonly Used Statistics” from the United States Department of Labor paint such a bleak picture?

- Yearly 3.3 million people are injured at work.
- Monthly there are 62 construction related deaths.
- Weekly disabling injuries cost employers over \$1 billion.
- Daily 12 people die on the job.

As reported through the 2007 Census of Fatal Occupational Injuries, fatal injuries from falls have increased to a high of 847 workers in a single year. That is a 39 percent increase since 1992. And in the previous five years, the construction industry has reported the largest increase in

fatalities of any industry. In 2008, we saw the number of fatal falls drop to 700 and then to 645 in 2009. Although encouraging on the initial glance, a deep look shows that from 2007–2009 the aggregate weekly hours worked in construction dropped by 22.1 percent.

The 2009 Workplace Safety Index for Liberty Mutual shows that disabling workplace injuries cost the U.S. approximately \$52 billion and “falls to a lower level” have increased 33.5 percent over the last 10 years, now costing \$6.2 billion annually in workers’ compensation.

According to OSHA, fall protection was the most penalized and the second most cited violation in fiscal year 2009. Currently OSHA lists the top ten most cited violations in this order:

1. 1926.451: Scaffolding
2. 1926.501: Fall Protection
3. 1910.1200: Hazard Communication
4. 1910.134: Respiratory Protection
5. 1910.147: Lockout/Tagout
6. 1910.305: Electrical, Wiring Methods
7. 1910.178: Powered Industrial Trucks
8. 1926.1053: Ladders
9. 1910.303: Electrical, General Requirements
10. 1910.212: Machine Guarding

If a work activity is listed in the top ten most cited standards, that means workers, employees, and/or people were put in harm’s way. The work associated with much of this list is directly associated with the requirements passed down by the owner and design professionals of a project. Not addressing hazards up front, that is, during the project concept stage is placing the burden of safety countermeasures on contractors and maintenance personnel—who, as shown above, still face significant hazards. This safety strategy is not Sustainable Safety.

The Solution

In order for the hazards to be eliminated, the entire building construction process and maintenance process must be considered. Design professionals have a duty to design in safety for each worker into every phase of every building project—from construction to maintenance. Owners, employers and safety professionals have the ability to stop paying for hazards by requiring that design professionals “design out hazards” with the same professional attention given to the technical detail as they would to their designing or planning of the building project.

Certain industries, such as window washing, amusement parks and demolition, have taken or are taking the steps through consensus standards and law to force safety to be addressed earlier. Prevention through Design (PTD), Construction Hazards Prevention through Design (CHPtD), and Sustainable Safety have a commonality in that each one is addressing the need for a new approach in designing out the hazards.

The problem with the solution rests in the fact that the design professionals:

- a. Aren’t trained to recognize the hazards;
- b. Feel they would be dictating ways and means which could expose them to greater liability; and
- c. Don’t think they have a legal, regulatory or contractual requirement to assess their designs for created hazards.

In the US right now the only thing policing the industry is litigation—or the fear of litigation. Consensus documents from ANSI and ASSE address this issue, but as you know, these are not “laws.” The American Society of Civil Engineers (ASCE) has an official statement in which they reiterate that design engineers have responsibility for “recognizing that safety and constructability are important considerations when preparing construction plans and specifications; and providing through the specifications that the design or details of critical elements of temporary construction, erection and lifting schemes, complicated form work and scaffolding be prepared by a professional engineer.”

Prevention is clearly the cure, but what is keeping owners from providing a sustainable hazard-free work environment where employees can be confident they will go home in the same condition as they arrived?

Designing Out Construction Hazards

The construction industry, which is in the center of the discussion, is traditionally burdened with the task of assessing and addressing hazards created by the design of others. Since 18.5 percent of all worker fatalities are in construction and the Construction Industry accounts for 7 percent of the U.S. workforce but 21 percent of fatalities, it is understandable that there has been an increased focus on protecting that industry from the failure of design professionals to keep the workers’ safety in mind.

The OSHA Alliance program spawned a Design for Safety Workgroup that created a website titled “Prevention through Design, Design for Construction Safety.” They explain in no uncertain terms why PtD is important in construction. The site states, “The injury and fatality rates in construction are so high that all parties—including owners, design professionals, contractors, subcontractors and material vendors—must proactively attempt to reduce injuries to the extent that is feasible for them.”

They continue, “Although typical contract terms clearly state that designers are not responsible for the safety of construction workers, nearly all designers would feel an ethical obligation to take action to prevent a serious injury to a construction worker if the hazard was imminent and obvious to the designer. Shouldn’t designers feel a similar ethical obligation to take reasonable actions to prevent injuries that are not as imminent or obvious?”

Designers already address a number of Life Safety issues such as earthquakes, fires, wind, snow, terrorism and other code required design criteria. These design criteria have evolved throughout the years in direct response to new and continually updated information. Past failures in any of these life safety issues prompts the design community to reassess how those issues were considered and what future actions should be codified. Those issues are addressed by design so that incidents like the Northridge earthquake collapses, the Chicago fires, or school gym roof collapses from too much snow don’t happen again. Therefore, the design professional’s responsibility for project constructability and how that directly affects safety should be addressed. To do this, we need to increase the level of safety experience of all participants involved in the design phase.

An example of designing out a hazard in the design phase is an architectural spire that was specified to project approximately 30 feet above the roof level of a building. This height triggered a FAA requirement for installation of a light at the top of the spire. The architect hired a structural engineer from STE Inc. with extensive safety experience and discussed several options for safely accessing the light, ranging from vertical lifeline systems to “hidden” ladders and platforms—

along with each option's pros and cons for safety and architectural acceptance. As the discussions progressed, other design team members were brought into the discussion—several with little or no experience in safety—and the available countermeasures crept lower and lower on the hierarchy of fall protection, thus becoming less and less sustainable. At one point in the process, the solution was determined to be: “require the work to be performed by an outside contractor so that owner liability was limited.” It was finally determined that the best solution meeting the requirements of Sustainable Safety was to incorporate a separate rooftop pole in another area of the roof that was just a little taller than the spire. This pole would be hinged at the bottom allowing it to be laid down so the light could be safely accessed at the roof level.

Including this level of involvement from experienced safety design professionals is not typical for most projects. The current pressure for achieving the goal of designing out the hazards remains the threat of litigation or contractual requirements.

Industries Are Designing Out the Hazard

The window washing industry is a prime example of an industry that is designing out the hazards. Their anchorage design requirements and the specific guidance they wrote into ANSI A120.1-70: Safety Code for Powered Platforms for Exterior Building Maintenance was adopted by reference by OSHA.

Specific sections of the U.S. Navy have detailed requirements that outline what every contractor and design professional must take into account for each new project in order to design out the hazards.

Amusement ride manufactures are adjusting their designs to eliminate the hazards maintenance personnel were previously exposed to because the industry is demanding it.

Applying the Solution

The Building Code, industry standards, OSHA regulations, litigation and contract language are a few of the things that drive safety. Each one has a little different use, jurisdiction or influence.

- OSHA, for the most part, is reactive—law written and passed because enough blood was spilled to justify saying “you can't do it in this manner anymore.” It is the minimum standard for protecting employees from hazards.
- The Building Code is what architectural and engineering professionals use to create safe structures and facilities. Similar to OSHA regulations, much of the Building Code is based on trial and error. Failed structures are analyzed to discover why they failed and the Building Code is updated accordingly.
- Industry Consensus Standards provide the agreed manner of operation or best practices within a particular industry. Sometimes OSHA adopts them by reference and sometimes they are referenced in a 5(a)(1) citation.
- Contractual language can be where many owners have the most influence over preventing hazards before they own them. Purchasing power can change an industry.
- Litigation can create incentive for manufactures and design professionals to correct or address potential hazards but remain un-citable by OSHA. Often litigation paves the way for the development of Consensus Standards.

If given the option, why would we continue to purchase new hazards? The power of the purse goes a long way when change is desired. Industry leaders are stepping up and requiring that

manufactures and designers provide products or services that provide detailed instructions or engineered protection from hazards.

If we are going to influence our own industries we must change the current design professional culture to address safety as an inherent piece of the project—not as an afterthought. Challenges to implementing this Sustainable Safety mind-set can be summarized as:

1. Design professionals aren't trained to recognize the hazards.

It is true that the pool of trained design professionals is not large. But there are individuals out there who can perform reviews of drawings in the design phase in order to identify potential hazards. Sometimes incorporating the safety department into the design phase is enough to make sure that known hazards aren't purchased again.

2. Design professionals feel they would be dictating ways and means which could expose them to greater liability.

The contracts should be written in such a manner as to spur on designing out the hazards without making the design professionals feel as though they were taking over the duties of the safety department.

3. Design professionals don't think they have a legal, regulatory or contractual requirement to assess their designs for created hazards.

As we mentioned earlier, both ANSI and ASCE have verbiage that states that design professionals should perform this task and companies should clarify their contracts to require foreseeable hazards to be designed out.

Sustainable Safety provides a safety strategy to the design team, owners and managers for the incorporation of continuous employee safety into designs, products, educational programs and services. Certified building planners, design engineers and design architects become aware of and consider, at the conceptual stage, the personal safety of the project's construction, maintenance and operation personnel and their equipment as they create their projects. Sustainable Safety certified building managers will have clearly defined policies and safety procedures established, implemented and enforced throughout the project lifecycle.

These certified planners, engineers and architects will meet the Sustainable Safety requirements of a safe workplace with all known and foreseeable safety hazards eliminated or controlled for each of the projects functions and required work activities. This will establish a sustainably safe culture for future personnel.

Owners, employers and safety professionals must contractually require design professionals to learn and incorporate Sustainable Safety design principles into every project or facility. Once preplanning to design out the hazards is implemented at the design phase, the direct result will be a drastic reduction in serious injuries.