# Safety trends affecting the wood construction industry

By Daniel Hindman, Ph.D.

As part of my research at Virginia Tech, I been studying the lateral buckling of wood composite I-joists. Lateral buckling is important as a safety issue to workers during construction, when workers may walk on unbraced joists. These joists may become unstable and lead to worker's falling on jobsites.

I recently received funding from the National Institute of Occupational Safety and Health (NIOSH) to study the loads that workers place on unbraced I-joists and the chance that lateral buckling may contribute to falls. As part of the writing process of this project, I studied many of the sources of accidents on jobsites and some of the prevention measures being used.

Also, I am a member of the Center for Innovation in Construction Safety and Health (CICSH), a NIOSH-funded center at Virginia Tech. I want to share some of my observations about safety and safety practices that could be applied to post-frame businesses to help improve their own safety practices.

## Injuries, errors and why safety is everyone's concern

The first part of this article will describe some of the types of injuries that workers can be exposed to in the area of wood construction. Fatalities in building construction are relatively low. However, there are still areas of concern where we can improve our practices to continually eliminate injuries.

The second part of the article will discuss some of the more recent trends in safety research, providing a reevaluation of the term "human error" and a short discussion on what role designers can play in safety on worksites.

Safety is something that should concern everyone involved in construction. The purpose of this article is not to suggest that post-frame in particular is an unsafe industry. However, accidents in construction happen at a rate three times higher than the average incident rate for all occupations in the United States.

For the purposes of the fall protection statistics, all wood construction is listed under the agriculture category (even though only a small percentage of all wood construction is directly related to agriculture) which has the second highest rate of safety incidents, with mining having the highest rate of incidents.

## Meta-trends of worker safety in wood construction

Worker safety is one of the most effective ways to ensure constant production on the jobsite. Safety incidents are costly to workers and owners, including lost time from work, medical costs and can lead to increases in workers' compensation and insurance premiums.

Costs associated with safety incidents can far outweigh the expenses of safety training and equipment. Accidents can also have deeper consequences, such as eroding trust and confidence between managers and workers.

Most safety discussions place a large emphasis on safety training and equipment, including personal protective equipment (PPE). Understanding the causes and highlighting the majority of causes of safety incidents can provide insight into particular jobs or activities, which can lead to accidents. For a better understanding of safety, we should examine the root causes of safety incidents rather than prescribe more PPEs.

A source of fatality and injury reports for many industry segments is the Bureau of Labor Statistics (BLS), available at www.bls.gov. These statistics have been categorized by types of incident, industry sector, job position and other factors. The statistics can be used to describe meta-trends or overall ideals used by the Occupational Safety and Health Administration (OSHA) and the National Institute of Occupational Safety and Health (NIOSH) in establishing research and training priorities.

The wood products industry is categorized under Agriculture, Forest and Fishing. The agriculture, forestry, fishing and hunting category has the highest rate of fatalities (32.5 fatalities per 10,000 workers) of all major industries. The farming, fishing and forestry category had the highest rate of occupational injuries (31.4 injuries per 10,000 workers) of all major occupation groups. The fatality rate of logging workers is 92.9 fatalities per 10,000 workers, the second highest fatality rate after fishing.

The rates of fatalities for areas such as logging and fishing dominate the list of occupations in the surrounding group. These occupations could skew the numbers associated with other occupations in the same class. Examining the fatality numbers for the wood products industry gives little information about safety incidents since there are few recorded fatalities. Therefore, it may be more telling to look at the injuries associated with these areas.

Figure 1 (see page 33) shows the injury rates as cases per 100 workers for selected segments of the wood products industry for 2006. The industry segments with the highest rates of injuries include prefabricated wood building manufacturing, truss manufacturing, manufactured home production and all other wood manufacturing. The industry segments with the lowest injury rates include softwood veneer and plywood manufacturing, reconstituted wood product manufacturing and sawmills.

## Injuries mean lost days

Figure 2 (see page 34) shows the number of injury cases that resulted in days away from work per 100 workers during 2006. These statistics indicate the more severe injuries where workers were required to take time off due to hospitalization or recovery. Industry segments with the highest number of days away from work correspond to the same industry segments from Figure 1 (prefabricated wood building manufacturing, truss manufacturing, manufactured home production and all other wood manufacturing).

Industry segments with the lowest days away from work were the softwood veneer and plywood manufacturing and the reconstituted wood product manufacturing.

The prefabricated wood building manufacture and miscellaneous wood products manufacturing categories had the highest number of days away from work, indicating that injuries in this area were typically more severe when they occurred.

Looking at the injury rates for different areas in the wood products industry, injury rates are higher in areas of prefabricated wood building manufacturing, truss manufacturing, manufactured home (mobile homes), and other area of wood products manufacturing. Many of the injuries sustained in these areas were severe enough to warrant days away from work, as were injuries sustained in sawmills.

The most common injury types for all wood products industry sectors were overexertion and being struck by objects. These two safety concerns should receive further study and training.

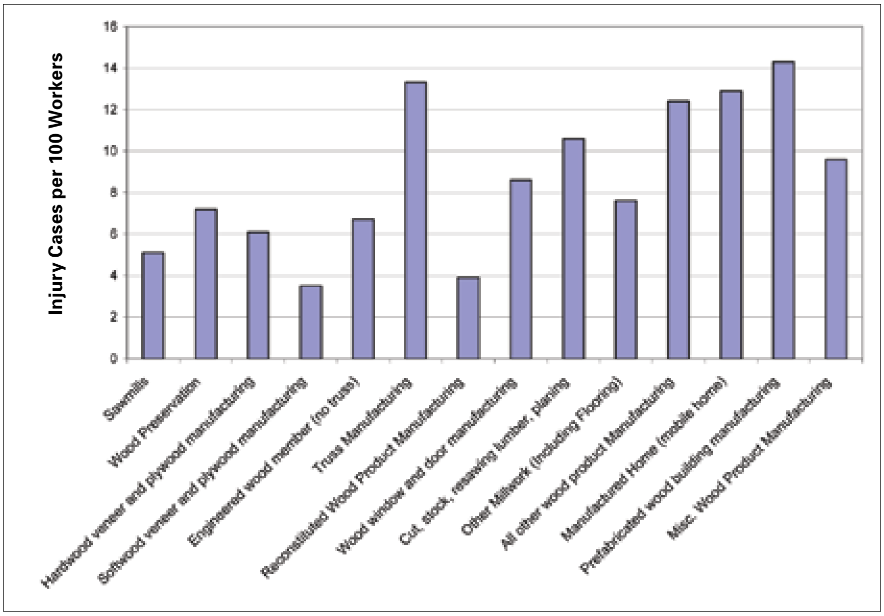


Figure 1: 2006 Injury cases per 100 workers from selected areas of the wood products industry (BLS 2008)

## What is 'human error'?

As I read these statistics and the accident case reports, the term "human error" appears frequently. Apparently, this is a catch-all term that can include any intentional misuse, abuse or unintentional action that results in a safety incident. Human error is something that is often thought of as the element that cannot be accounted for in safety, kind of the acceptable margin that occurs.

A recent paper by Sidney Dekker, a professor in Sweden, discusses the current and proposed differences in the term human error. The term "systems" can refer to the construction process, communication within a company, safety practices, and procedures, among others.

Dekker (2002) summarizes the current view of human error:

"Human error is the cause of most accidents. The engineered systems in which people work are made to be basically safe; their success is intrinsic. The chief threat to safety comes from the inherent unreliability of people. Progress in safety can be made by protecting these systems from unreliable humans through

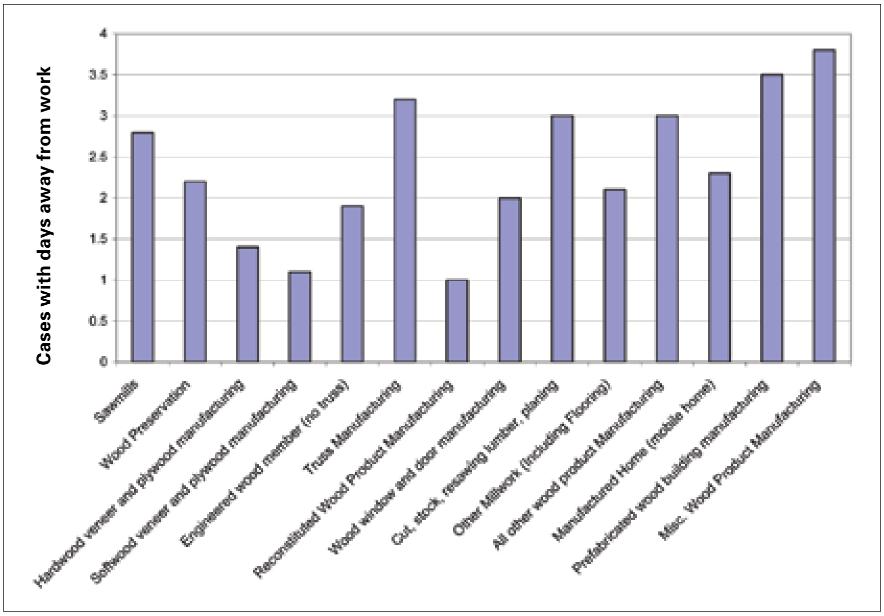

Figure 2: 2006 Injury cases with days away from work for selected areas of the wood products industry (BLS 2008)

selection, proceduralization, automation, training and discipline."

As I read this statement from Dekker (2002), I am reminded of the 'Cowboy After OSHA' cartoon (Figure 3) where the cowboy and horse are covered with protective equipment to such a degree that there is no way the cowboy can work. Human error is a cause of accidents, while the surrounding systems (which were designed by humans) are seen as safe. The statement seems to indicate that people are the root cause of many safety incidents.

Dekker (2002) then presents a new view of human error:

"Human error is a symptom of trouble deeper inside the system. Safety is not inherent in systems. The systems themselves are contradictions between multiple goals that people must pursue simultaneously. People have to create safety. Human error is systematically connected to features of people(s') tools, tasks and operating environment. Progress on safety comes from understanding and influencing these connections."

This statement of human error seems less accusatory and more helpful. Dekker's main argument is that human error is a symptom of a deeper problem that somehow conflicts with human intuition or ability.

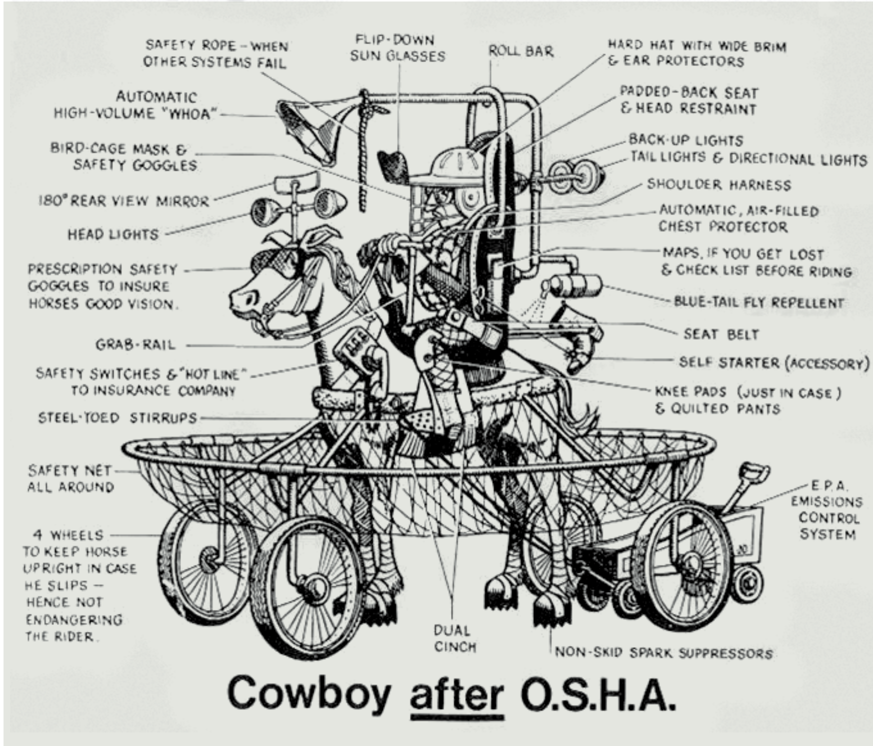


Figure 3: Cowboy After OSHA










For instance, a safety system may be correct in terms of the structural mechanics, including required loads. However, if the posture required to use the device is uncomfortable or proper directions are not provided or easily intuitive, accidents may still happen.

The change in definition of human error may seem like a matter of semantics, but the change in definition also can change the focus of future safety research and initiatives. A change to more surveys of workers on the jobsites about how particular jobs are performed or safety equipment is used will help guide new developments. Rather than considering the physical mechanics of a system, the interaction of that system with humans needs to be studied as well. As anyone who has worked in a laboratory attempting to recreate the actions or thoughts of humans will tell you, we are very unique and unpredictable. The best data sources are humans themselves.

## The designer's role in creating a safe construction site

Many safety engineering documents discuss a hierarchy of controls, shown in Figure 4, which was adapted from the National Safety Council information. The different controls represented in Figure 4 are all in use at the same time on a jobsite.

The red and green arrows on the figure indicate that specific tasks that place more emphasis on the upper levels of control contain less risk of safety incidents and less associated costs. For specific tasks that place more emphasis on the lower controls, there is an increased level of costs.

Obviously, it is mandatory that all workers wear appropriate PPE, and the author is not suggesting that these incidents can be eliminated entirely. However, elimination of hazards, warnings and training used in conjunction with PPE can help eliminate safety incidents.

At the top of the diagram is the elimination of hazards, which is considered to be the best way to prevent accidents (i.e., if workers are able to do the same tasks on the ground rather than on a roof, or using a crane instead of tilt-up methods). If the hazards cannot be eliminated, then warnings should be provided. After warnings, training and administrative controls are effective ways of preventing accidents. This area includes training of workers for specific tasks, as well as limiting workers from performing tasks without proper training or from entering hazardous situations.

Finally, if no other controls can be taken, workers should be equipped with appropriate PPE to help arrest safety incidents (i.e., hard hats, safety glasses, fall arrest systems).

The easiest and most sure method for accident prevention is the elimination of the hazard from the jobsite. One place where the elimination of hazards can occur is in the selection of materials and subsystems that will be used in the building.

John Gambatese, a professor at Oregon State University,

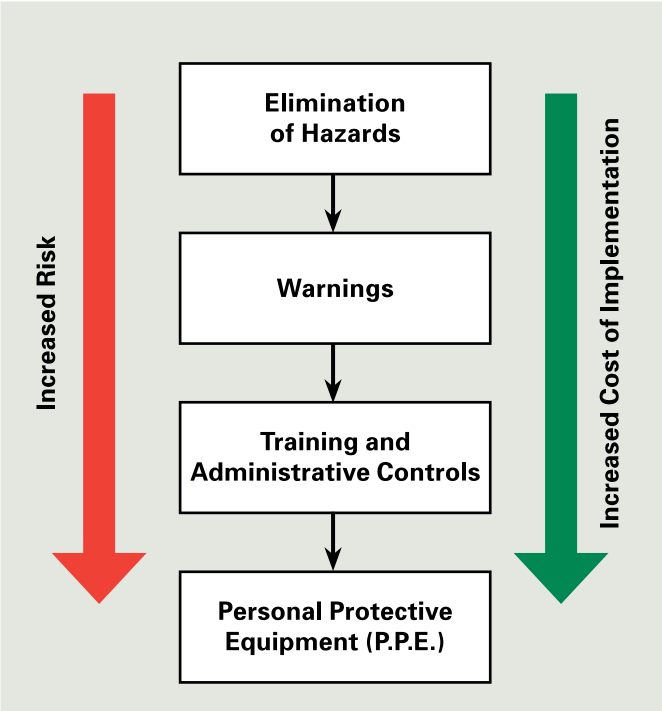


Figure 4: Hierarchy of Controls, adapted from the National Safety Council

has advocated for a new concept in structural design called "Prevention through Design." It is explained in a recent article:

"An issue of particular concern is the attitude that construction work is inherently unsafe and a project's design has no effect on safety. This attitude must be dispelled. It must be recognized that the physical work conditions do not have to harbor numerous safety hazards. In addition, some of the hazards exist as no fault of the contractor. That is, in some cases the contractor is bound by a design that places specific hazards on the construction site. Designers who are cognizant of a response to their effect on construction safety would aid in making jobsites safer for construction workers" (Gambatese et al. 1997)

The object of Prevention through Design is not to cast blame on any group of individuals, but to try to remove the potential for safety incidents by emphasizing the "elimination of hazards" section shown in Figure 4.

For example, Gambatese et al. (1997) note that according to the International Building Code (IBC), a parapet wall must be 30 inches high. However, OSHA mandates that a temporary guardrail must be 42 inches high. If the IBC recommendation (which is an established design minimum value) is used, a temporary guardrail must be used during construction and also in the future at times when maintenance work near the edge is needed. If the parapet height were increased to 42 inches, the parapet would satisfy both the IBC and OSHA requirements to act as a guardrail for future use.

Gambatese et al. (1997) have developed a “Design for Construction Safety Toolbox” which is an on-line resource for Prevention through Design issues. The original database was created from worker surveys and safety expert input. The toolbox is available through the Construction Industry Institute (CII) for a fee. The interface for the database allows users to search for Prevention through Design practices by construction activity, site hazards and project systems. The goal of this project is to tweak the engineering design of a structure to help prevent safety incidents.

## Conclusion / implications for post-frame construction

One of the reasons I feel compelled to look at safety in post-frame as well as other wood structures is the general disconnect between researchers and practitioners of engineering and safety. Many safety experts I have worked with have little knowledge of wood design in general, let alone post-frame design.

The primary purpose of engineering is to create structures that fulfill a specified purpose. One of the inherent purposes that we do not mention is that the structure should be SAFE — for its inhabitants as well as during construction. The connection between engineering and safety is essential to fulfill this purpose.

To keep workers safe, safety managers must understand the trends in safety and what kind of accidents can be anticipated. In particular for the wood products industry (including post-frame), injuries due to overexertion and workers struck by objects are most common. This information can help sharpen the focus of safety managers.

The new definition of human error is a little more intellectual than practical, but if every worker is having trouble with a safety practice, maybe the safety practice is the problem rather than the worker. Connected to the new definition of human error, the idea of Prevention through Design can help eliminate safety issues before they reach the jobsite.

The hope of Prevention through Design is that by eliminating hazards through engineering processes, the safety of every person involved with the structure can be improved. ■

## References

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