Eliminate hazards at the design stage. What does that mean?

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Introduction

To "eliminate hazards at the design stage" is one of the priorities set out by the National Occupational Health and Safety Commission (2002). The National Occupational Health and Safety Strategy states that the 'responsibility to eliminate hazards or control risk rests at its source. This principle applies to all sources of hazards. Responsibility falls on a wide range of parties, including those outside of the workplace such as designers, manufacturers, constructors or suppliers (p. 9). The parties that make design decisions that affect workplaces are very diverse. They include members of the design community such as engineers and architects and a much larger group of all others who influence decision-making.

Our workplace laws pivot on the notion of hazard elimination at the source. An example is the *Occupational Health and Safety Regulation 2001* (NSW). When determining controls for hazards the following approach is required (clause 5): 1. elimination; 2. substitution; 3. isolation; 4. engineering; 5. administration; and lastly 6. personal protective equipment.

In the workplace this problem-solving model often creates a conundrum. Most employers put hazards in place to achieve a particular function. Often they are integrated within activities. Their "elimination" is easily seen as counter-productive and disruptive. On the other hand, when equipment, structures, processes and so on are being devised, there are greater opportunities for conceptual changes. "Safe design" is sometimes used as shorthand for this work. Safe design is often the best way, and sometimes the only way, to achieve the intent of the workplace safety legislation.

In product and public safety these are not new considerations. They rest on well-known principles. Those making a product or public space need to protect the public from harm. Those they either harm or protect by their decisions are downstream. Sometimes the affected people will be close by, but sometimes far away. Sometimes they will be known to the decision maker but often not. Sometimes the parties will have a contractual relationship. Other times several steps will remove them. What is sought in occupational safety is nothing particularly different. Safe design is about decisions that impact positively on safety downstream. The decision-maker might have no direct relationship with the people affected downstream.

It was made plain even 30 years ago by the Robens committee that this kind of work was vital in order to prevent workplace accidents. The Robens Committee wrote: "… [existing] legislation places many obligations upon employers in respect of their use of plant, machinery and equipment; but very few on those who design and manufacture the equipment. This may be thought surprising in view of the generally accepted proposition that the first step in the promotion of safety and health at work is to ensure, so far as may be practicable, that plant, machinery, equipment and materials are do designed and constructed as to be intrinsically safe in use.' (Committee on Health and Safety at Work 1972, p. iii).

Safe design in construction

I am reluctant to given an impression that safe design is only about construction. It is not. It is about everything that we do. Nevertheless, the conversation about safe design is strongest in the construction sector at present. In discussions of safe design in construction, it has become a well-quoted statistic that 2/3 of construction fatalities can be attributed to bad design or bad planning. The Commission of the European Communities in 1993 reported that about 2/3 of construction fatalities (63%) and most of structural damage and defects (80%)

can be attributed to design decisions. They say these mistakes cost the equivalent of 50% of the entire construction labour cost. These are compelling figures. If they are anywhere near accurate, the benefits that follow better design and planning are staggering. By what other means could we reduce construction deaths by 2/3 and at the same time reduce construction rework by 80% and eliminate the present waste of labour used to fix these problems?

The Commission of the European Communities wrote, "The [construction] site is where the dysfunctions created 'upstream' converge. The accident at work is often the final indicator of dysfunctions revealing weak points in the management and general organisation of the project." (p. 12). Statistics aside, as a principle I think this is irrefutable and a salient point for anyone thinking about how to make construction safer and more economical.

In Europe, safe design in construction has been regulated. The 1992 *European Union Directive Temporary or Mobile Construction Sites* made safe design a priority. Several European Union member states have since implemented laws in response. In 1994 the United Kingdom gave effect to the directive with the *Construction (Design and Management) Regulations 1994*. These regulations require clients, designers and others to turn their minds to the topic of construction safety. Researchers in the United Kingdom examined seven case studies about safe design in construction (Wright, and others 2003). Some of these are listed below to show a little of what safe design means. The case studies show that safe design can deliver safety improvements alongside efficiency, quality and cost savings.

In Australia the *Construction Hazard Assessment Implication Review* developed by NSW WorkCover in partnership with major construction companies aims to develop upstream thinking about construction safety (2001). Individual construction companies like Bovis Lend Lease through their *Risk and Opportunities in Design* follow safe design principles (Campion 2000; Holt 2001). These processes recognize the injury prevention benefits of the safe design approach.

The recent Royal Commission into the Building and Construction Industry concluded that safe design was a vital part of the future of construction safety. The Royal Commissioner, the Honourable Terence Cole wrote:

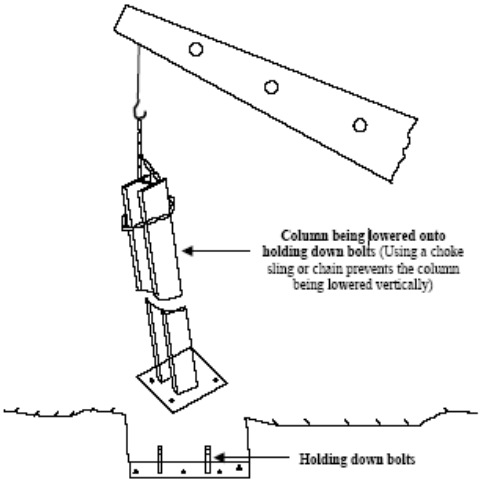
"In my view, occupational health and safety in the building and construction industry ought to begin at the design phase and not the commencement of construction." (Cole 2003 at para. 153).

Commissioner Cole cited support for the advancement of safe design from both employer and employee groups. Organisations such as the following found common ground on this issue:

- Construction Forestry Mining and Energy Union: *"Architects, engineers and their clients obviously have a responsibility to consider the prevention of injuries through intervention at the design and construction planning stages"* (at para. 156);
- Civil Contractors Federation: "*The Federation supports the initiatives being undertaken by various state regulatory authorities, clients and contractors in moving toward safe design. The Federation would agree that design is an issue in fatalities, major injuries and workplace incidents occurring in the construction industry"* (at para. 156);

Safe design examples and ideas

Safe design applies to every activity and every industry. Some examples are provided about fall hazards. Some examples affect workers during construction. Other examples show hazards for maintenance workers. Some further examples show fall hazards to eventual users of structures, especially children. All show issues that could be better addressed with upstream thinking.

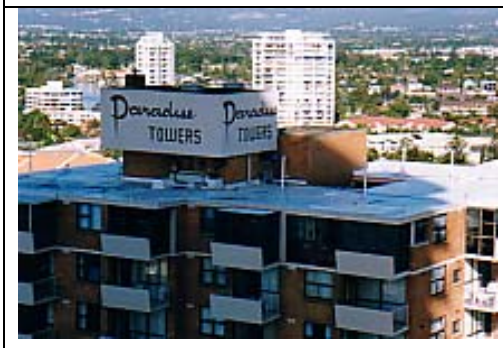
Fall hazards. Design problems and design solutions.	
 	Problem: Precast panels were installed without windows. Window frames must then be installed. The work can be done from scaffolding or other methods but all involve work at height and thus a risk of falling. Safe design solution: Install the windows on the ground. The possibility of a fall injury is eliminated. There are also less deliveries to the construction site and therefore less congestion. On one hospital site the contractor estimated that the saving in scaffolding alone was £50,000.
 	Problem: Steel column sections were lifted into place using a crane. A choke sling was used as the attachment method. Manual handling of the steelwork was required to attach the sling. Once suspended, the column did not hang vertically. Manual handling was therefore required to correctly position the column on the holding down bolts. Once in place a worker needed to use a ladder or 'cherry picker' to remove the sling. Safe design solution: Holes were prefabricated into the top of the column. A piling shackle is used as the attachment method. The column then hangs vertically for installation. Once the column is in place, the shackle can be released by using the cord hanging from the shackle. The system thus results in easier positioning of the columns and substantially reduces manual handling and fall risks. The choke chain would also lead to paint damage to the column. That damage is avoided. The only cost is an extra hole.

Problem: This is the Bolte Bridge in Melbourne. The two outer columns are ornamental – they are not connected to the bridge. But they need access for maintenance of the aircraft warning light at the top of the tower.

One access point is at the roadway level. But there is no walkway. In the absence of Spiderman access can only be achieved blocking off a lane of the bridge and using a "cherry picker". This is a very expensive and time-consuming way to get into a door.

The other access point is in the river. The access choices here include using a boat at high tide or carrying a 6m ladder through the water.

Safe design solution:
Ultimately, the safe design solution would be not to build ornamental towers that need aircraft warning lights. However, the towers look good. The solution might therefore be to make a platform at the lower door where a boat can moor near the tower. The road level access will routinely be very complicated due to passing traffic. Alternative access though is a great idea. As such a walkway between the two structures would make sense.

	
	Problem: There are no railings around this roof – not even a small ledge. The roof of this building is accessible for maintenance. Solution: Put a fence around the edge – high technology!
 	Problem: This is the Westgate Bridge. Inspection and maintenance of any structure creates a requirement for access. Safe design solution: Running beneath the Westgate Bridge is a gantry for maintenance and inspection.

	Problem: The gantry beneath the Westgate is a great feature. However access to gantry is not ideal. Access to the ladder involves climbing over the guardrail, standing outside the rail, reaching for the ladder and then pulling it back to the rail (presumably to discourage everyday access). The potential fall is not all the way into the Yarra river! Nevertheless a fall of several metres onto the gantry could be very serious. Safe design solution: The gantry moves, however it should be possible to make an access system that does not involve standing outside the guard rail.
  	Problem: This is an emergency stairway in a hotel. This stairway fence has big holes. In an emergency, children could easily fall through these gaps. But it's worse than that. This stairway is used as a permanent access to a swimming pool on the top floor. The stairway is used many times per day. Adults and small children alike walk down these stairs with wet feet. Often they will be carrying towels, bags and other paraphernalia. A child could easily stumble and fall through the rails. After I pointed this out, the plywood barrier was installed on the same day. It covers the worst part of the problem. What is there today? I don't know. Safe design solution: Use a barrier that children can neither climb nor fit through. We know how to do that with swimming pools.
	Problem: This railing is at a university campus. Obviously this railing would be very good for children to climb. The consequences could be disastrous. Safe design solution: Safe design would mean using a non-climbable barrier – like the shown on the left of the photograph.

The Victorian regulator, WorkSafe Victoria conducts an annual safety awards program. There is no category for "safe design" but the safe design principles featured prominently. Most of the awards involved safe design aspects. Two great examples were:

1. *Rapid Precast Panels, Ballarat award for the Best Solution for Sprain and Strain Injuries.* "Rapid Precast Panels has pioneered a process to cast concrete panels in the vertical plane that has removed virtually all of the hazardous manual handling. It has also resulted in dramatically reduced noise and dust levels and removed the risk to

people of collapse when panels are being lifted into the vertical position. This process has considerable potential to improve the health and safety of an entire industry sector." (WorkSafe 2003)

2. *Dair Industries, Lyndhurst for Best Strategies for Health and Safety Management* "DAIR Industries comprehensively incorporated OHS best practice into their green fields site at Lyndhurst. As part of this process, numerous hazards were designed out at the planning stage and many engineering controls established. This was done with the assistance of the company's OHS Committee." (WorkSafe 2003)

A Director of Dair Industries summed up the value of safe design in the acceptance speech. He explained that at one time safety and production were competing forces. He explained that a new factory was the only way forward for their business. In the developing the new factory, good design for safety was the priority. Far from being a detriment to production, he explained that good ideas for production tended to be common with those that were good for safety.

Conclusion

The opportunities to improve workplace safety through safe design are abundant. It is plain that using safe design can solve many hazards simply, effectively and cheaply. It is evident that thinking about safe design can be a driver of innovation. The results of new thinking about a problem might yield safety benefits as well as production benefits, quality improvements, new products, cost savings, and so on. What will ultimately drive a change remains to be seen. Will it be this vision of innovation? Perhaps it will be the pressure of regulation and the threat of prosecution, perhaps the fear of common law liability, or perhaps indeed a realisation that it is good for business. What we do know is that safe design is about thinking about downstream or life-cycle effects. The kind of thinking that will be needed *between* workplaces is just that which has proved successful *within* workplaces – consultation. "Designers" and anyone else who makes a decision needs to be aware of how that decision affects people later on. They might be the people who put up a building, the people who drive trucks for a living, or the people who stack cartons of dog food in a supermarket. In any case, turning our mind to the needs of those downstream and seeking their input will need to become a way of life.

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