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Safe Design

THERE IS NOW AN EMPHASIS ON DESIGNING FOR SAFE BUILDINGS WHICH, THROUGH A PLETHORA OF LEGISLATION, PLACES ADDED RESPONSIBILITY ON OUR DESIGNERS. THIS REVIEW LOOKS AT THE EMERGING ISSUES AND BEST PRACTICE FOR SAFE DESIGN.

DAVIS LANGDON



Safe Design

Designers have always provided designs that are safe from an engineering, structural and mechanical performance point of view.

However past safe design practices and BCA requirements do not always assure that Occupational Health & Safety (OHS) outcomes for the workplace are resolved in the design.

Safe workplaces

The Building Code of Australia (BCA) establishes requirements under the Building Act relating to some aspects of safety for occupants. These include access and egress, lighting and ventilation requirements and fire protection. Compliance with the BCA is independently verified by a building surveyor before the building can be occupied. This is a long standing design activity to achieve safe buildings for all occupants.

But there is a new emphasis on workplace safety that is not always captured by conventional safe design practices and the requirements of the BCA.

New OHS Legislation

This additional requirement on designers has been formalised by the inclusion of OHS obligations for design professionals in new OHS legislation in Australia and overseas. But under the weight of the legislation and large volumes of related codes of practice, books and reports associated with OHS and design OHS, designers are learning to understand these broader OHS implications in their continued pursuit to provide professional services.

Buildings as workplaces

Every building is a workplace at some time in its life cycle. Typically they are workplaces for owners and tenants. But, buildings are also workplaces during construction maintenance, renovation works and during demolition. This includes workplaces for those who undertake routine cleaning and maintenance work on them.

This response adds another step into existing design processes to assure that safe workplaces are achieved as well as the safe design of buildings.



Under all these circumstances as workplaces the designer must now consider the best way to protect the health and safety of people who:

- are engaged in the construction of the building or structure, including initial construction, modification and demolition;
- occupy and/or use the building or structure; and
- maintain, clean and repair the building or structure.

Design OHS, then, needs to consider and identify those OHS hazards affecting the workplace during the building life cycle and resolve these to make sure the design poses minimal risk to the health and safety of employees in their workplace. These hazards extend to the building in use such as 'sick building syndrome', slipperiness of floors and external window cleaning. None of these issues are assured through conventional safe engineering design or covered by the BCA.

In today's world of the 'preferred workplace environment', OHS management models and legislative frameworks, new emphasis is placed on the designers' responsibilities for more assurance (and therefore evidence) of their consideration of design OHS in the designer's design control process.

New emphasis on design OHS for workplaces

The construction industry is one of the most dangerous industries in which to work in Australia. Between 1994 and 2000, around 50 construction workers were killed each year as a result of their work.

The construction industry fatality rate, at 10.4 per 100,000 persons, is similar to the national road toll fatality rate and the rate of serious injury is 50% higher than the average of all industries. These statistics led Commissioner Terence Cole, who headed a recent Royal Commission into the Australian Building and Construction Industries, to describe OHS as an 'issue of fundamental importance' to the industry. Commissioner Cole also stressed the need for cultural and behavioural change to improve the sector's appalling performance in this area.

Sources of decisions leading to fatal incidents in construction (Commission of European Communities, 1993)

Design	Organisation	Site
35%	28%	37%

In Australia, the National Occupational Health and Safety Commission (NOHSC) commissioned research to understand the contribution of design to the incidence of occupational injuries and fatalities in Australia.

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Design as a source of OHS hazards

Research indicates that decisions made early in a construction project's life, particularly during the design stages, can impact upon the health and safety of workers who work in, on or around the constructed facility through its entire life cycle.

In 1993, the Commission of the European Communities reported that 60% of all fatal construction accidents could be attributed to design and planning decisions made before construction work commenced on site (see chart next column).

NOHSC reports note that:

- a minimum of one in four workplace fatalities (26%) occurred as a result of design-related issues in a two year period ending 30 June 2002;
- a minimum of 42% of compensated serious workplace injuries included in the analysis were caused, in part, by poor design;
- design-related issues were definitely or probably involved in at least half of the incidents in several industries, including construction; and

- nearly all fatalities involving machinery and fixed plant were at least partly caused by design-related issues.

Australia's National OHS Strategy 2002–2012, endorsed by the Australian Workplace Relations Ministers' Council in May 2002, establishes the elimination of OHS hazards through improved design as being an area of national priority.

Optimising Design OHS

The principle underpinning the 'design for OHS' concept is that greater opportunity exists for making improvements in OHS in key 'upstream' phases of a construction project's life cycle

(See Figure 1). Thus, the OHS performance of a construction project can be optimised if the people who make key decisions in the design stages consider OHS during their decision-making.

How does design OHS affect designers?

Designers' responsibilities are now clearly specified in the OHS legislation of several Australian states and territories (see Appendix 3). However, there are no simple answers to questions concerning the boundaries of designers' responsibilities for OHS in the organisationally and contractually complex environment of a construction project.

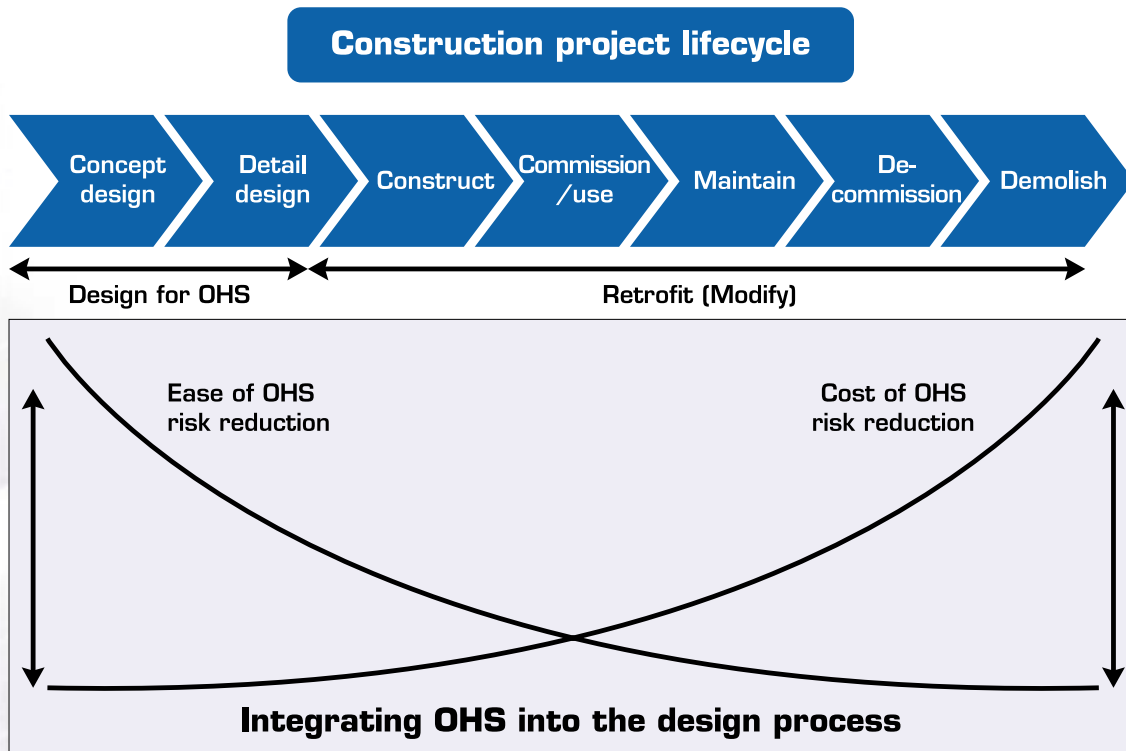
In the light of this uncertainty, designers must exercise care to:

- ensure that OHS risks (through the life cycle of a building or structure) are adequately considered in their designs;
- demonstrate that design OHS responsibilities and OHS hazards have been managed;
- include OHS considerations in their design documentation.

Improving OHS through design

Designers have considerable opportunity to eliminate or reduce OHS risk throughout the life cycle of a building or structure. For example, designers make choices about the design, methods of construction and materials used.

Figure 1: Integrating OHS into construction design (NOHSC2003)





Example design decisions to minimise OHS risk

Risk 1: Falls/falling objects from working at height.

Design control: Pre-fabricate building components off-site or at ground level and erect them as complete assemblies.

Risk 2: Traffic access and risk of collision between plant and machinery and/or with pedestrians or overhead power lines.

Design control: Determine the location of the structure on the site so as to allow sufficient space for plant to access the site and be kept away from power lines, trenches and other hazards.

Risk 3: Manual handling risks.

Design control: Specify a maximum size of blocks to be used e.g., all blocks must be under 20 kg.

Risk 4: Risk of being struck by a moving vehicle during roadwork.

Design control: Design roads with a wide shoulder to allow room for work crews and equipment.

Risk 5: Insufficient means of anchorage for safety cables or lanyards.

Design control: Design columns with a hole above floor level to support guard-rail cable or provide an anchor point for lanyards.

Risk 6: Risk of falling as a result of routine cleaning/maintenance requirements.

Design control: Select windows that can be cleaned from inside.

Clearly, there is considerable potential to reduce OHS risks through design. However, in order to achieve this, there needs to be a systematic process to ensure that OHS hazards are identified when a facility is being designed and that appropriate risk mitigation strategies are selected and recorded in design documentation.

Designers' common law liabilities in Australia

In Australia, legal action against a construction designer for an OHS issue could arise in a number of ways. Under the common law, an OHS issue could arise for an alleged breach of contract, for example, in the event of a failure to address OHS issues in design or in the event of a contravention of a contract term. However, it should be noted that OHS responsibility cannot be transferred by contract terms and a designer would only be liable for issues that were the proper responsibility of the designer.

Common law action against a designer could also arise for the tort of negligence where an injury or loss has occurred as a result of failure of the designer to exercise a duty of care owed to a plaintiff (in this case the injured party). This relies on the argument:

- that the designer owed the injured party a duty of care;
- that the designer ought to have foreseen the risk of injury arising as a result of the design; and
- that the design decision caused the injury.

The operation of the law of negligence means that it would be prudent for designers to identify foreseeable OHS risks inherent in their designs and determine how these risks can be minimised so far as is practicable.

Designers' responsibilities in Australian OHS legislation

OHS preventive legislation in Australia is complicated because each state and territory has its own principal OHS Act and subsidiary regulations. Typically these Acts specify a general set of OHS duties for key parties, including employers,

employees, suppliers of materials, plant and others. For many years, the emphasis was upon employers' responsibilities for the OHS of employees, including contractors and sub-contractors.

However, in some Australian jurisdictions (Western Australia, South Australia, Queensland and Victoria), specific OHS obligations for designers of buildings and structures have recently been established in the principal OHS Acts.

Because these obligations vary from state to state, design OHS can be confusing for designers. Designers must therefore be aware of the provisions specific to the state/territory in which they practice. (A summary of design OHS requirements is provided in Appendix 3.)

Implications for designers

One important implication of the inclusion of specific responsibilities for designers in the preventive OHS legislation is that designer's liability no longer requires that someone must first be injured to initiate legal proceedings.

Whereas actions for the tort of negligence required that an injury (or other form of loss) must have occurred, OHS preventive legislation places a positive duty upon design professionals to consider the OHS issues in their designs. The only way that they can demonstrate that they have met this duty is for designers to implement and document a systematic process for managing design OHS. Hence, designers must become much more proactive to demonstrate compliance.

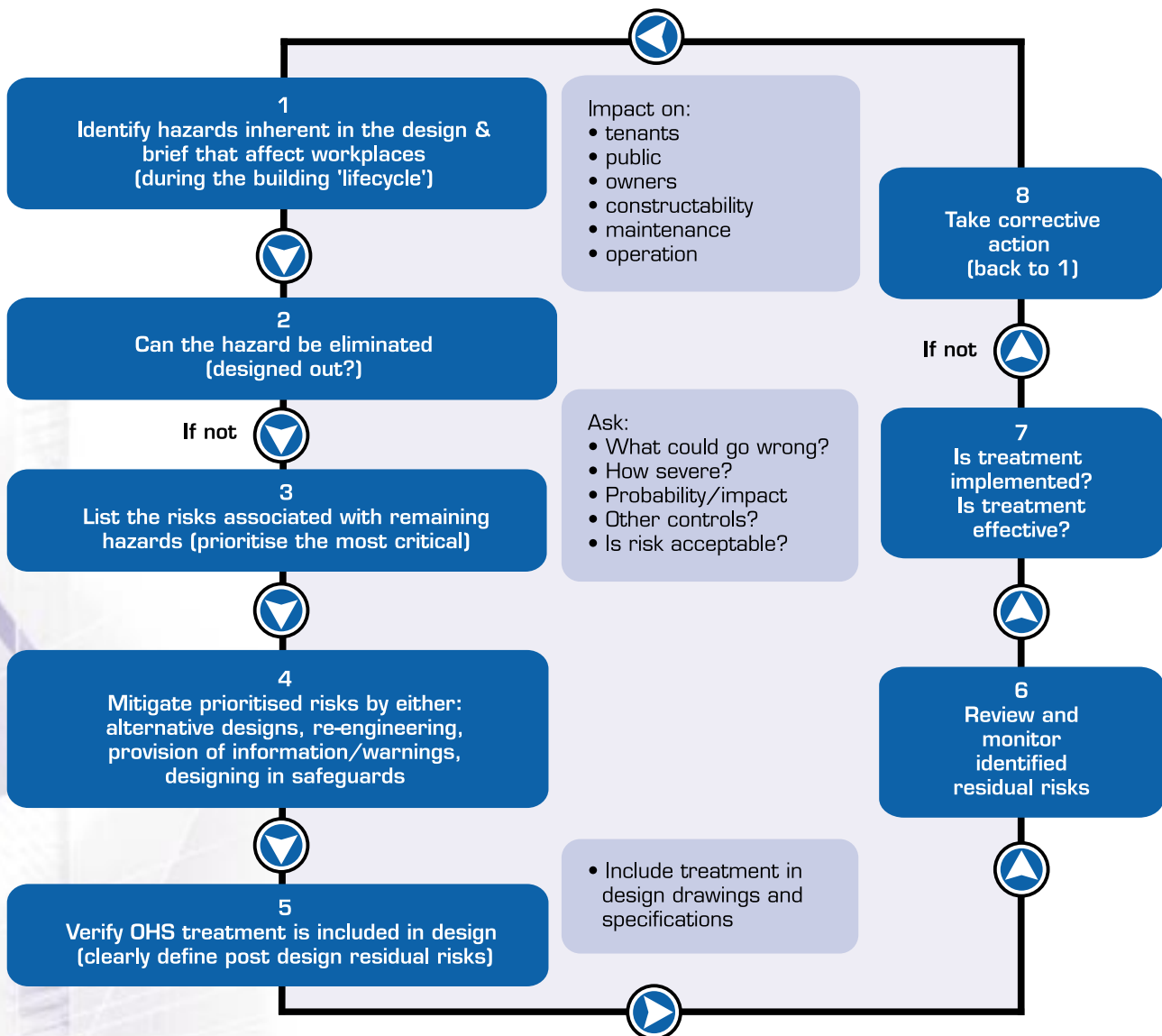
In many cases, penalties for noncompliance under the OHS legislation have also been substantially increased and Directors and Senior Officers within organisations can be individually prosecuted. As a result, in certain circumstances, it is possible for designers to be prosecuted where building-related OHS issues can be traced back to the design process, the designer, Directors and/or Senior Officers of the design practice.

How can OHS design be integrated into design processes?

Design OHS workplace requirements can be achieved by including an OHS design risk management step into the designers usual design control practices.

It is evident that designers may not recognise that they can formalise this additional OHS design obligation simply by including OHS design for the workplace into their current safe design practices for engineering and compliance. Design OHS issues are readily able to be incorporated into the usual safe design control practices that have been the hallmark of design over the years.

Figure 2: Design OHS risk management process



RISK COMMUNICATION - STAKEHOLDER CONSULTATION & DESIGN REVIEW (throughout steps 1 - 8)



OHS design risk management

The risk management framework described in Australian Standard AS4360:2004 – Risk Management provides a good starting point for the integration of OHS into conventional design decision-making.

AS 4360 is a suitable process for OHS hazard identification, risk assessment and treatment. The application of this process is depicted in Figure 2.

The key for designers is to comprehensively assess risks and address treatments in their design documentation. This enables important information to be transferred to other parties who need to know about OHS during the life cycle of the building/structure, for example contractors who have to construct the building and owners who have responsibilities to operate and maintain the property.

'Technological' control measures – such as the elimination of hazards, the substitution of hazardous materials or processes, or engineering controls – are preferable to 'individual' controls, such as the introduction of safe work practices or the use of personal protective equipment. This is because controls that rely on human behaviour are less reliable, since human beings are fallible and prone to error. Thus, wherever possible, designers should focus on the identification and implementation of 'technological' risk controls. The application of this hierarchy is depicted in Figure 2 on previous page.

Risk reduction at source

It is also important to note that risk management enables risk reduction at source.

Risk management principles state that it is better to eliminate OHS hazards at source than to try to control risks once they are present (See Figure 1). Within the construction industry, this 'source' is the design team.

Designers of construction projects, whether architects or engineers, have the opportunity to consider OHS risks in the project's design stage. For example, designers make choices about the design, methods of construction and materials used, which could all impact upon the health and safety of those who build, occupy, maintain, clean, renovate, refurbish or demolish the building or structure.

For any of these, risk management involves answering difficult questions including:

- Which risks, if any, are tolerable?
- Can intolerable risks be eliminated?
- If intolerable risks cannot be eliminated, what is the best way to reduce them?
- How should risk reduction methods be selected?
- After risk reduction methods have been implemented, is the residual risk still too high?

Where do designers start?

In 1995, the Construction (Design and Management) Management Regulations were enacted in the UK. Since their introduction designers have remained unsure as to what is required of them.

One of the most important lessons to be learned from the UK experience under the CDM Regulations is the need for education, training and

support for construction design professionals to help them to understand their responsibilities for OHS and address OHS in their professional practice.

At Davis Langdon we suggest that, in the future, there must be a place in the curriculum of every design course for the inclusion of OHS as a subject equal to design theory, aesthetics and project management.

In the meantime, practical guidance and management tools are urgently needed. Some tools have begun to be developed, for example the CHAIR design risk assessment tool developed by the New South Wales WorkCover Authority. This tool uses a Hazard and Operability Study approach to identify OHS risks arising out of design and improve project 'buildability' through collaborative workshops. However, these tools are presently used to a limited extent only by very large organisations in high-profile projects.

We believe that designers should be provided with assistance to ensure design OHS becomes a normal part of design activities, similar to BCA compliance. Davis Langdon can provide the training, tools and competencies enabling designers to create buildings and structures that are visually impressive and functional, as well as being safe and healthy workplaces - throughout their entire life cycles.

Web-based design OHS risk management tool

To help designers, Davis Langdon is developing a web-based design risk assessment tool which provides designers with an AS 4360 - compliant OHS risk assessment methodology.

This tool will support the delivery of OHS risk management and control in the design process by providing an effective method for risk identification and assessment for OHS risks through the life cycle of all types of building projects. Furthermore, the design risk assessment tool will be efficient and will be accessed directly from designers' 'desktops.' The tool will also permit the recording of design decisions, helping designers to demonstrate compliance with their legal OHS requirements.

The Davis Langdon web-based design risk assessment tool, one of the first of its kind, will also provide the foundation for the collection and retention of long term historical records for property OHS issues, from design through property transfer and ultimately to demolition.

A systematic approach to design OHS

Davis Langdon also recommends a systematic OHS management approach to planning, documenting and controlling design OHS in the designer's design process.

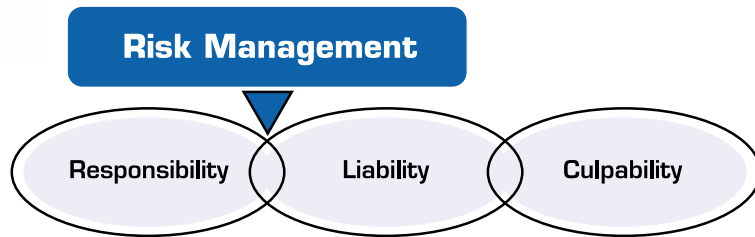
A useful starting point for an OHS management system is AS/NZS 4801:2001 : Occupational health and safety management systems guidelines.

The adoption of an OHS management systems approach to design OHS will help to ensure a focus on safe design and a transfer of OHS risk 'knowledge', throughout the building life cycle –

this systematic approach will set the design OHS objectives for the design and provide the assurance that they are delivered in the final design drawings and specification.

every party whose actions impact upon OHS, including owners, developers, contractors, consultants and designers.

Figure 3:



Third party certification

These design OHS management systems can be independently certified by an appropriate JASANZ-accredited third party certification body, such as Davis Langdon DLIQ Certification Services.

Third party certification provides designers (and their clients) with the additional assurance that their design OHS practices are commensurate with world's best standards and that clients' OHS design expectations and design OHS legislative requirements have been met.

These parties must all work together to reduce OHS risks so far as is practicable. This will require working cooperatively to find appropriate risk mitigation solutions and sharing information and ideas. The fostering of a 'no-blame' culture is essential to the success of this approach.

At Davis Langdon, our experience leads us to conclude that design for OHS can best be assured by including OHS as part of the normal design management processes. We have observed that design OHS should not increase design costs for designers, investors or owners where

Davis Langdon also recommends a systematic OHS management approach to planning, documenting and controlling design OHS in the designer's design process.

No-blame culture

However, it must also be said that the design OHS debate is not about shifting the blame for occupational injuries and ill-health onto the designer and away from other parties in the construction process. The focus must be on collaboration and the active involvement of

it is properly integrated into existing design control practices.

We do, however, recommend that design reviews should involve consultation with stakeholders and user groups, as well as those providing the design input. A consultative approach enables creative and practical solutions to



OHS issues to be found, as well as allowing important risk information to be collected, documented and communicated to the people who need to know.

Client involvement

In the future we also envisage that discerning purchasers of property will require current owners to inform them about the OHS history of the property as well as environmental issues which may affect the purchase value at sale.

If done properly, the designer's initial OHS risk management documentation could become the foundation of this OHS knowledge, which is managed and transferred between parties as required.

Positive OHS (and ESD) initiatives

In recent years the construction design professions have embraced the concept of environmentally sustainable design (ESD). Designers whose building designs excel in the area of ESD are rewarded with professional recognition and considerable accolades.

The extension of design performance criteria to include design OHS takes the concept of socially responsible design a step further. Buildings that pose a significant threat to the health and safety of those who work in, on or about them are socially unsustainable, just as buildings that waste large amounts of energy are ecologically unsustainable.

There could be a cultural change in the design profession if design OHS is regarded as being of equal importance to ESD. The design professionals themselves, perhaps through their professional institutes and peak bodies, could play an important role in sponsoring design for safety awards and recognising designs (and designers) that achieve high levels of OHS performance.

Swiss cheese model

Design omissions/oversights represent "accidents waiting to happen" or latent failures - similar to the holes in Reason's "Swiss cheese" model. An accident or incident occurs where risk "holes" in these layers align. Risk management is an important "intervention" technique to prevent the alignment of holes over time and may have a practical application in OHS safe design.

Summary

It is evident that designers have always considered safety in their design. Safe design has centred on the idea of material, strength, BCA requirements, ergonomics, usability, practical intent and human involvement. However, other aspects of a building's OHS workplace performance, such as slips, trips and falls, sick building syndrome and other operational safety issues are not covered by conventional safe design methods or BCA compliance requirements.

Increasingly the net of legal responsibility for OHS is being broadened to include 'upstream' activities, notably supply and design.

OHS risks from design activities may arise throughout the life cycle of a building or structure, from construction, through to operation, maintenance and eventual demolition. Unless properly managed, OHS risks may also arise at the interface between these phases.

At Davis Langdon, it is our opinion that by focusing on more OHS-inclusive design input criteria and applying a robust risk management methodology, designers will be able to demonstrate that all foreseeable OHS hazards and risks arising as a result of design decisions have been identified and treated effectively.

This requires effective leadership, management tools and documented evidence to show that design professionals' legal and social responsibilities are being met and that design OHS outcomes achieve safe workplaces.

The application of a focused systematic approach to design OHS, incorporating OHS risk management, is the best way to ensure that OHS performance is optimised through the life cycle of a building or project. Where this is integrated into existing design practices, third party OHS management systems certification may be desirable.

In all cases OHS risks must be recognised and dealt with at the appropriate level. The aim should be to eliminate design OHS hazards at source by designing them out of buildings or structures during the design control process of a designer's OHS management system.

Where design OHS is appropriately managed, OHS knowledge will be captured and transferred through the phases of the building life cycle to ensure continuity of OHS risk management effectiveness. At Davis Langdon we believe that designers will readily respond to their newly legislated obligations to provide a safe workplace as they have done so well in the past.



APPENDIX 1

Design OHS services provided by Davis Langdon

Davis Langdon already plays a central role in providing practical OHS solutions for the construction industry and is well-positioned to provide OHS services to construction design professionals to assist them in meeting their OHS responsibilities.

Services provided include:

- provision of advice to designers on OHS through the project life cycle;
- advice concerning hazard identification for designs;
- life cycle OHS risk assessments;
- advice concerning design risk control strategies;
- performance of property OHS audits (trust, director and owners' compliance reports);
- performance of Dangerous Goods and ergonomic reviews;
- risk knowledge management and transfer; and
- facilitation of design OHS review workshops.

APPENDIX 2

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APPENDIX 3

Legislated OHS Design requirements by State

Western Australia

In Western Australia, under the Occupational Safety and Health Act 1984, Section 23(3a) requires that a person who designs or constructs any building or structure for use at a workplace shall, so far as is practicable, ensure that the design and construction of the building or structure is such that: (a) persons who properly construct, maintain, repair or service the building or structure; and (b) persons who properly use the building or structure, are not, in doing so, exposed to hazards.

Queensland

Under Queensland's Workplace Health and Safety Act, Section 34B requires a person who designs a building or other structure (or part thereof), which is intended to be used as a workplace to ensure that when the building 'is being used as a workplace and for the purpose for which it was designed' relevant persons will not be exposed to risk to their health or safety arising out of the design. The Queensland Act makes specific reference to workers occupying the building and people cleaning, servicing and maintaining it. However, unlike the WA Act, the Queensland Act does not extend to OHS issues affecting workers during the construction stage of a building.

South Australia

Under South Australia's Occupational Health, Safety and Welfare Act 1986, Section 23A states that a person who designs a building that is reasonably expected to comprise or include a workplace must ensure, so far as is reasonably practicable, that the building is designed so that people who might work in, on or about the workplace are, in doing so, safe from injury and risk to health. While this seems to relate to considerations about the end use of the building, it could also be construed that people who work in, on or about the workplace also includes those who work on it during construction. This ambiguity is yet to be resolved in case law. Section 24(2a) also states that a person who designs a structure that is to be erected during the course of any work must ensure, so far as is reasonably practicable, that the structure is designed so that persons who erect it are safe from injury and risks to health.

Victoria

The most recent inclusion of design responsibilities in OHS legislation occurred in Victoria when the OHS Act 1985 was revised following a comprehensive review by Chris Maxwell (the Maxwell Review). Section 28 of the Occupational Health and Safety Act 2004 requires that persons who design a building or structure (or part thereof) who knows, or ought reasonably to know, that the building or structure (or part thereof) is to be used as a workplace, must ensure, so far as is reasonably practicable, that it is designed to be safe and without risks to the health of persons using it as a workplace for the purpose for which it was designed. While the Occupational Health and Safety Act 2004 came into operation on 1 July 2005, the provisions relating to construction designers (section 28) do not apply until 1 July 2006, providing designers with some time to understand their new obligations and implement appropriate OHS management approaches.

Interestingly, Maxwell's recommended wording for section 28 specifically mentioned designers' responsibilities for OHS during the construction of the building or structure, but the explicit reference to the construction stage was omitted from the wording of the revised Victorian OHS Act.

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