HELEN LINGARD, PAOLO TOMBESI, NICK BLISMAS, BLAIR GARDINER Guilty in theory or responsible in practice? Architects and the decisions affecting occupational health and safety in construction design

Introduction

The endorsement of occupational health and safety (OHS) measures is a sign of a mature society, one that requires its members to be productive while making sure that the environment in which they work minimises the risk of injury or ill-health arising as a result of wealth generating activities. Yet every year thousands of people in advanced economies are killed or seriously injured in workplace-related accidents. Further, evidence suggests that the incidence of work-related ill-health far exceeds that of injuries. In many industrialised countries, including Australia, the construction industry is one of the worst offenders, leading policy makers and legislators to treat the construction industry as a priority industry for the development of OHS improvement strategies. In the past ten years, one significant policy response to the construction OHS problem has been an increasing focus on bringing the activities of the industry's professionals, most notably designers, within the scope of OHS regulation.

The enactment of new OHS legislation, which includes specific statutory responsibilities for construction design professionals—that is, architects and engineers, creates a new environment in which designers provide their professional services and is a significant development that will shape professional practice in construction design in the future. Within this context, the need to ensure that OHS risks that can be eliminated or, if not, reduced at the design stage will need to be balanced against the architectural profession's legitimate concerns relating to the possibility of facing criminal sanction for issues which are not always within designers' control.[1] In Australia, the issue of compliance with design OHS legislation is particularly daunting due to the

fact that the legislation presently in place is, as yet, largely untested, that there is a lack of national uniformity in the scope of construction designers' OHS responsibilities, and that practicing construction design professionals are not equipped with extensive training in OHS.

We describe the background to the introduction of design OHS legislation in Australia, identify the current situation at the time of writing and identify some problems for the practical implementation, in the construction industry, of the design OHS legislation as it is presently framed. We conclude by recommending methodologies for the analysis of design decision-making on which a realistic allocation of OHS responsibility could be based.

The poor OHS performance of the construction industry

In Australia, between 1994 and 2000, 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;[2] the rate of serious injury is 50 per cent higher than the all industries average.[3] Construction workers are exposed to a wide range of chemical and physical hazards that cause debilitating and life-threatening illnesses. Although reliable statistics concerning the incidence of occupational illness are not available, it is estimated that the incidence of occupational illness far outweighs that of acute injuries. The effects of the construction industry are significantly multiplied when account is taken of the injuries, ill-health and fatalities arising in the use and operation of the constructed product—that is, buildings, roads and other structures.

Policy and legislative initiatives in the construction sector

The *National OHS Strategy 2002–2012* defines the elimination of physical hazards at the design stage as an area of national priority. The strategy aims 'to build awareness and observance of this approach and to give people the practical skills to recognise design issues and to ensure safe outcomes'.[4] In response to this policy, specific obligations for OHS designers of buildings and structures have been established in preventive OHS legislation in four Australian jurisdictions, Western Australia, South Australia, Queensland and Victoria. These are summarised in Figure 1.

FIGURE 1: DESIGN OHS REQUIREMENTS IN AUSTRALIAN LEGISLATION

State	Requirement
Western Australia	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	The *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.
South Australia	The *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	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.[5]

Implications for designers

One important implication of the inclusion of specific responsibilities for construction designers in the preventive OHS legislation is that designers' liability no longer requires that someone must first be injured to initiate legal proceedings. Previously, a common law action against a designer could 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.

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 case for design OHS

Statistics are often cited to support the case for holding construction design professionals responsible for OHS. For example, in his review of Victorian OHS legislation, Chris Maxwell cited statistics provided by the National Occupational Health and Safety Commission, (NOHSC), now the Australian Safety and Compensation Council. According to NOHSC, in a two year period ending 30 June 2002:

- A minimum of one in four workplace fatalities occurred as a result of poor design;
- A minimum of 42 per cent of compensated serious workplace injuries were caused, in part, by poor design;
- Design-related issues were definitely or probably involved in at least half of the incidents in the agriculture, construction, mining, transport and manufacturing industries; and
- Nearly all the fatalities involving machinery and fixed plant were at least partly caused by design-related issues.[6]

The extent to which a case for design responsibility in the construction industry can be made has been questioned, based on the fact that these statistics are not industry-specific and many reflect design problems in plant and/or equipment rather than building design.

However, the case for design OHS in construction based upon international research remains compelling. Recent analysis identifies design as a causal factor in fatalities and serious injuries in the construction industry.[7] In 2004, Gibb et al published a detailed review of 100 construction accidents and reported that, in 47 per cent of cases, a design change would have, at least, reduced the risk of injury.[8] Although most of the empirical evidence for the impact of design decisions on OHS performance during the construction stage of the life cycle of a building or structure has been collected in Europe or the United States of America, there is no reason to assume that the OHS implications of design decisions in the Australian construction industry would be significantly different.

Designing for OHS is also consistent with the 'hierarchy of controls' adopted in OHS risk management. This hierarchy is based on the principle that control measures that target hazards at source and act on the work environment are more effective than controls that aim to change the behaviour of exposed workers.[9] Undoubtedly, in many instances, design decisions can be regarded as the 'source' of OHS risks in the construction industry. This is illustrated by well-publicised case studies of hazard elimination or risk reduction achieved through careful consideration and selection of design options.[10]

Problems with the current approach

Despite the recognition that many OHS problems apparent in the construction and post-construction stages of a building's lifecycle can be traced back to aspects of the design, the regulation of design OHS in the construction sector has, thus far, failed to deliver significantly improved outcomes.

Overseas experience shows that creating statutory OHS duties for construction designers does not automatically deliver reductions in OHS risk through the life cycle of a building/structure. For example, in the UK, statutory responsibilities for occupational health and safety in the construction stage of a building were imposed upon construction designers under the *Construction (Design and Management) Regulations 1994*. Recent reviews of the impact of the CDM Regulations indicate that significant improvements in construction

OHS have not occurred since the regulations were passed. This is often attributed to construction designers' lack of OHS knowledge and inability to apply risk management concepts in the design process.[11] However, a more fundamental explanation for the limited impact of the CDM Regulations is their failure to reflect adequately the structure of the construction industry or the complexity of the design process.[12] Specifically, these failures concern: 1) the structure of work (collaborating parties); 2) the structure of information (knowledge transactions); and 3) the structure of governance (contractual arrangements) actually in place.

1) The structure of work

In spite of the simple description provided by OHS legislation, the construction design process is characterised by complex inter-organisational relationships, sub-clustering, information dependencies and considerable division of labour. In a submission to the National Occupational Health and Safety Commission, the Royal Australian Institute of Architects criticized a national draft *Safe Design Guideline* for failing to distinguish adequately between the different design functions that apply at various stages in delivering a building, and for failing to reflect the fact that, in many instances, control and influence over design outcomes resides with parties other than the principal designer or architect.[13]

Several authors have suggested that modern building design, especially in non-residential markets, is characterized by a high level of interpretation, innovation and discretionary decision-making by those charged with the manufacture of components and erection of buildings.[14] Indeed, as Groak and Pietroforte have explained, product complexity, market uncertainty, technological innovation and work liability have increased architects' reliance on other parties to develop technical aspects of building design.[15] For example, specialised contractors, who previously acted as suppliers or erectors of building components, now often act as 'engineers of record' for the detailed design of the building elements they develop and install.[16]

2) The structure of information

In line with this more articulate mapping, construction design has been conceptualised as a network of tasks, requiring contributions from many specialists.[17] The design process relies on the exchange of information and

frequent and detailed interaction between these specialists in order to ensure that the components of a building/structure, which must fit together, are compatible. Activities and interfaces between specialists form a complex network of design activity.[18] One analysis of four typical building designs revealed that the building design process comprised between seven and ten iterative loops each comprising between five and 30 interrelated loops.[19] The number of design tasks was around 350 to 400 and the number of information dependencies was over 2,400.

3) The structure of governance

The structure of governance of a construction project is also an element subject to change, based on the preferred allocation of risk and resources and, subsequently, decision-making between the parties involved in a construction project—that is, client/promoter, designer, contractor and specialist contractors/consultants.[20] Broadly speaking, the project delivery strategy determines the role played by each of the actors. For example, the 'design and build' approach provides a natural opportunity to address OHS in design, while the 'construction management' approach allows the client/promoter to play a more aggressive role in project decision-making.[21] Between these broad categories, there exists a great number of 'hybrid' approaches to project procurement, each of which has implications for the allocation of risk and liability. The allocation of risk in a construction project is normally stipulated in contracts, which have become highly diversified to respond to the variety of procurement options and situations arising in the construction industry.[22] For example, in a *Guide to Standard Forms of Construction Contract*, Rethinking Construction has developed a series of charts illustrating the extent to which a variety of project risks are differentially borne by clients (owners), consultants (designers) and contractors (builders) under various standard forms of construction contract used in the UK construction industry.[23]

The three arguments outlined above clarify that OHS responsibilities for construction designers in the legislation may be difficult to implement in the practice of modern construction projects because these obligations do not elegantly reflect the division of intellectual labour, the mechanics of decision making, and the structure of information on the ground. For OHS legislation to be effective, the obligations spelled out in the policy documents must reflect the complexity and variety of the social and technical arrangements

for delivering construction projects. Policy makers must create a framework of reference and eventual application, in which responsibilities and liability are appropriately placed with the roles effectively played by the actors in the specific construction project, rather than with abstract social categories such as 'the designer'.

Methodologies for analysing OHS responsibility

If one of the fundamental requirements for the practical application of the regulation of design OHS in construction is the ability to make some sensible allocation of responsibility for design decisions impacting upon OHS in the construction and post-construction stages, no simple solutions to this problem exist. Owing to the complexity of the design process as described above, and significant variation between projects in structures of work, information and governance, responsibility may need to be defined and allocated on a case-by-case basis.

This variation should be explored by design professionals, academics and regulators in an attempt to comprehend the complexity and recommend realistic and workable mechanisms for allocating OHS responsibility in construction design. This exploration could be achieved by the post-hoc identification of 'latent hazards' in completed buildings or other structures. Following this identification, in collaboration with the project team members, a 'walk back' through design decisions, capturing the participants, the chronology of events and the motivation and influences in the decisions made would be carried out.

Through the analysis of documentation and project correspondence relating to the building/structure and in-depth interviewing project participants a retrospective analysis of the key events, the actors, and the determinants of decisions made during the design process could be carefully mapped. Such in-depth case analyses would provide an indication of the complexity inherent in the construction design process and could provide the basis for the development of terms of reference for the allocation of responsibility for OHS in construction design that would reflect the reality of industry practice. These terms of reference could not prescribe a general allocation of design OHS responsibility suitable to all projects, but would benefit the design profession and OHS regulators through highlighting critical socio-technical configurations where attention to the consequences of design decisional pathways is

particularly in order. They could also articulate, clearly, the need to consider the structures of work, information and governance in the allocation of design OHS responsibility and provide critical baseline information to deploy in the regulatory review process and the development of policy and industry guidelines for design OHS.

Implications for professional practice

The analysis of design decision making relevant to OHS hazards and risks is also of great importance to design professionals in order to ensure that they have met their OHS obligations in their professional practice. The best way for construction design professionals to demonstrate compliance with the OHS legislation is to implement and document a systematic process for managing OHS risk in-house. This involves undertaking rigorous analysis of the implications of their design decisions for the OHS risks, evaluating the extent of the OHS risk, and exercising some professional judgment about the requirement for and, if required, appropriate methods of reducing OHS risk in the construction and/or post-construction stages of the building's life cycle.[24]

There is no doubt that these requirements will be particularly onerous to carry out initially; firstly because they imply a degree of cultural shift in the decision-making process of some design professions; secondly because—within an environment that provides little institutional training for OHS design—they require the outlay of additional time and resources in the procurement of design services. Yet, building design professionals and chiefly architects do not seem to have much choice in the present context. The ability to foresee and correct the negative repercussions of design decisions, either one's own or other parties', will be one of the defining elements of a sustainable practice.

1 J.A. Gambatese, M. Behm and J.W. Hinze, 'Viability of designing for construction worker safety', *Journal of Construction Engineering and Management*, 131, 2005, pp. 1029-1036.

2 G. McWilliams, G. Rechnitzer, N. Deveson, B. Fox, A. Clayton, T. Larsson and L. Cruickshank, *Reducing serious injury risk in the construction industry*, Policy Research Report No. 9, Monash University Accident Research Centre, Melbourne, 2001.

3 T.R.H. Cole, *Final Report of the Royal Commission into the Building and Construction Industry*, Canberra, ACT: Commonwealth of Australia, 2003.

4 National Occupational Health and Safety Commission, *National OHS Strategy 2002-2012*, ACT: Commonwealth of Australia, 2002.

[5] The recommended wording for this section specifically mentioned designers' responsibility for OHS during the construction of the building or structure, but this was omitted from the wording of the new Act.

[6] Chris Maxwell, *Occupational Health and Safety Act Review*, Melbourne: State Government of Victoria, 2004, p. 180.

[7] See, for instance, A. Suraji, A.R. Duff and S.J. Peckitt, 'Development of a causal model of construction accident causation', *Journal of Construction Engineering and Management*, 127 (2001): pp. 337-345; or M. Behm, 'Linking construction fatalities to the design for construction safety concept', Safety Science, 43 (2005): pp. 589-611.

[8] A. Gibb, R. Haslam, S. Hide and D. Gyi, 'The role of design in accident causality', in S. Hecker, J. Gambatese and M. Weinstein (eds), *Designing for safety and health in construction: Proceedings, Research and Practice Symposium*, Eugene, Oregon: UO Press, 2004.

[9] N. Martens, 'The Construction (Design and Management) Regulations 1994: Considering the competence of the planning supervisor', *Journal of the Institution of Occupational Safety and Health*, 1 (1997): pp. 41-49.

[10] See, for example, the documented case studies or the safe design guides published by the not-for-profit UK organisations Design Best Practice (http://www.dbp.org.uk/pages/welcome.htm) and Safety in Design (http://www.safetyindesign.org/).

[11] See, for instance, S. Summerhayes, CDM Regulations Procedures Manual, London, 2002; N. Rigby, *Designer Initiative 17th March 2003*: Final Report, Scotland and Northern England Unit, Construction Division, Health and Safety Executive; Entec, *Construction health and safety for the new millennium*, Health and Safety Executive Contract Research Report 313/2000, HMSO, Norwich.

[12] L. Bluff, *Regulating Safe Design and Planning Construction Works*, Working Paper 19, National Centre for Occupational Health and Safety Regulation, Australian National University, Canberra, 2003.

[13] Royal Australian Institute of Architects, (2005) *Safe Design Guideline*, Submission to National Occupational Health and Safety Commission, 28 February 2005.

[14] The literature includes: C. Gray and R. Flanagan, *The changing role of specialist and trade contractors*, The Chartered Institute of Building, Ascot, 1989; J. Bennett and D. Ferry, 'Specialist contractors: a review of issues raised by their new roles in building', *Construction Management and Economics*, 8 (1990): pp. 259-283; S. Slaughter, 'Buildings as sources of construction innovation', *Journal of Construction Engineering and Management*, 119, 3 (1993): pp. 532-549; P. Tombesi, 'The carriage in the needle: building design and flexible specialization systems', *Journal of Architectural Education*, 52 (1999): pp. 134-142; P. Tombesi, 'Modelling the dynamics of design error induced rework in construction: Comment', *Construction Management and Economics*, 18 (2000): pp. 727-732.

[15] Steven Groak, 'The decline of robust technologies in the building industry', *Building Research and Practice*, 3 (1990): pp. 162-168. Roberto Pietroforte, 'Communication and governance in the building process', Construction Management and Economics, 15 (1997): pp. 71-82.

[16] David Haviland, (1996), 'Some shifts in building design and their implications for design practices and management', *Journal of Architectural and Planning Research,* 13, 1 (Spring 1996): pp. 50-62; Paolo Tombesi, 'Involving the industry: The use of 'Request for Proposal' packages at Frank O. Gehry and Associates', *Architectural Research Quarterly*, 6, 1 (2002): pp. 77-87.

[17] P. Tombesi, 'Cost vs. Investment: architecture, technical knowledge, and the socialisation of value' in M. Benedikt (ed), Center 11 – Value 2, pp. 130-141, Austin: The University of Texas Press, 1999, pp. 130-141; S. Pryke, 'Analysing construction project coalitions: exploring the applications of social network analysis', *Construction Management and Economics* 22, 8(2004): pp. 787-797.

[18] C. Gray, W. Hughes, W. and J. Bennett, *The Successful Management of Design*, Reading: Centre for Strategic Studies in Construction, 1994.

[19] S. Austin, A. Baldwin, B. Li and P. Waskett, 'Analytic design planning technique (ADePT): a dependency structure matrix tool to schedule the building design process', *Construction Management and Economics*, 18 (1999): pp. 173-182.

[20] A. Foster, 'Construction management and design-build/fast-track construction', Law and *Contemporary Problems*, 46/1, 1983. C.H. Nam and C.B. Tatum, 'Leaders and champions for construction innovation', *Construction Management and Economics*, 15 (1997): pp. 259-270. P. Tilley, 'Causes, effects and indicators of design and documentation deficiency', *Building the Future Together.* Proceedings of the First International Conference on Construction industry Development, Singapore, 9-11 December 1997, Vol. 2: pp. 388-395.

[21] Gambatese *et al*, 'Viability of designing for construction worker safety', pp. 1029-1036.

[22] S. Rowlinson, 'A definition of procurement systems', in S. Rowlinson and P. McDermott (eds), *Procurement systems*: a guide to best practice in construction, London: E & F. N. Spon, 1999, pp. 27-53.

[23] See www.rethinkingconstruction.org/rc/publications.

[24] Depending upon the jurisdiction in which an Australian architect practices, they may have specific OHS responsibilities for the construction stage, the post-construction stage or both (See Figure 1).

Note: This article builds on a Discovery Grant research application on OHS policy-making in Australia by Lingard, Tombesi, Blismas and Gardiner, which was submitted to the Australian Research Council in 2006.