Designing a Safer Built Environment

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A complete guide to the management of design risk

John Carpenter

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Dedication

To Dave Short, fellow engineer and friend

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Foreword

I am honoured to provide a foreword to this book. The author, John Carpenter, has been a friend and colleague for years and we share a strong commitment to aiding our profession in its pursuit of construction safety. None of us involved in construction can be content when tragedies occur, lives and careers are blighted, workers' health suffers and vast resources are squandered. Readers only have to keep abreast with current news and events in their own business sector to reveal examples. John's theme is that the cause of such events is normally inadequate management of inherent risk since for sure all construction is a risky business. John's focus is that a proper appreciation and management of risk at the time of design will yield significant benefits. Yet despite this being a legal and moral duty, the feedback of actual practice is disappointing.

As John writes, the underlying causes of tragedy are rarely ones of unforeseen technical ignorance. Rather, they are usually exacerbated by human failings which ought to be controllable. I've had a long design career and in reading this book I see many echoes of events that I have witnessed, or of mistakes I myself have made.

That last comment on personal mistakes is one made not so much as a confession but a recognition that ours is a vast and complex industry with so much to learn that I wonder how any of us can hope to acquire the requisite skill set within one career's lifespan. After our initial engineering education, we all start out with a mindset that if only we apply mathematics, all will be well. Alas, the task of engineers is to deal with uncertainty on a huge scale. We start out assuming our more senior colleagues know what they are doing. But as we progress, we learn that just isn't always true and, as John emphasises, 'People', their quirks and fallibilities, are a root cause of many problems.

If ever we needed a reminder not to be complacent, we should have regard to the (2017) Grenfell Tower fire, which this book rightly highlights. We may ask ourselves: how can we have ended up with such a tragedy? What went so wrong? More aptly, what went wrong with the whole design and project management process that terminated in this awful incident? John mentions many other cases, though he doesn't refer to the Boeing 737 Max affair. Readers may recall there were two plane crashes (in 2018 and 2019) which revealed serious faults in the plane's design, not just technically but in the whole process of handling and

regulating the design's evolution. The net result was a collapse in confidence, worldwide groundings, a dramatic drop in Boeing's market value and huge order cancellations. Those who wish to learn would do well to read the 2020 report commissioned by the US House Committee on Transportation and Infrastructure. It is a damning indictment of the engineering and the whole design process. Many parallels will be found with comments in this book which centre on another of John's key messages: watch the 'Processes'.

Readers may feel that the world of Grenfell and Boeing is somewhat remote from their daily workings. Do not fall into that trap. There are significant dangers on 'High Street projects'. Not long ago, a multimillion-pound Chelsea house collapsed during extension works. Lessons of what goes wrong in all these projects can be traced back to a lack of design risk management across the spectrum of design and construction and generic lessons are the same for a small domestic project just as for the mighty task of bringing a major plane upgrade to market.

John's text does not make for a comfortable read. As designers, we have contractual and moral obligations to actively consider and manage risks but for a myriad of reasons this task is not being performed to the standard required: we must do better and John's aim is to help us all. His text offers some practical explanation and guidance on how we can do better and all of this is gleaned from his vast experience. It is not easy, not least for those starting out. The only solution is to be patient but commit to observe and learn continually. We learn from each other and we learn by studying what has gone wrong elsewhere and why, and we learn from others who have given the problem much thought: this text has some strong pointers. Finally, John offers firm advice: do not look upon a proper risk assessment as a legal chore. Powerful benefits to self-preservation and good business accrue when carrying out proper designer risk assessments. If you want to stay motivated, stay successful and make a profit, by far the best thing you can do is avoid a catastrophe.

Allan Mann BSc, PhD, CEng, FIMStructE, FREng

About the author

John Carpenter CEng, FICE

The author is a past Fellow of the Institution of Structural Engineers and of the Institution of Occupational Safety and Health. He has majored on risk management, in one way or another, for most of his career. John is a past Secretary to the Standing Committee on Structural Safety (SCOSS), during which time the Confidential Reporting on Structural Safety (CROSS) scheme was launched; was the founding Secretary of the Temporary Works Forum (TWf); and is the technical author of PAS 8811:2017. He has undertaken several research commissions for HSE and was the author of the CDM 2007 designer guidance and the competency frameworks supporting the regulations. He has published and spoken widely on risk issues, in the UK and internationally.

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- Allan Mann
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- MPW R&R Ltd (Consultants): Mike Webster
- Structural-Safety (incorporating SCOSS and CROSS): Alastair Soane
- Specialist Engineering Contractors group (SEC): Rudi Klein
- Temporary Works Forum (TWf): David Thomas.

I have had useful conversations with these people, received outputs from surveys relating to designer performance, permissions to use published articles and general support, for which I am grateful. I hope that the result is of use to them.

Glossary

ACoP	Approved Code of Practice
APS	Association for Project Safety
BCSA	British Constructional Steelwork Association
Category 1 Hazard	See Hazard
Category 2 Hazard	See Hazard
CDM	Construction (Design and Management) Regulations
CIC	Construction Industry Council
CIRIA	Construction Industry Research and Information Association
Constructability	Measure of the availability of a safe (and economic) construction sequence including temporary works aspects
CROSS	Confidential Reporting of Structural Safety, now combined with SCOSS as 'Structural-Safety'
ECI	Early Contractor Involvement
EIR	Employer Information Requirements
ERIC	Eliminate, Reduce, Inform, Control
FRC	Financial Reporting Council
Hazard	Something with the potential for harm
	Category 1 (soft hazards)
	Originates from the design, but while leading to a risk to others, does not lead to a work task on site (or later on the completed structure), e.g. calculation or design concept error, analysis error or lack of adequate specified/achieved supervision on site
	Category 2 (hard hazards)
	Originates from the design itself and leads to a work task on site (or later on the completed structure) and hence a hazard and risk to others
HASWA	Health and Safety at Work etc Act 1974
'High Street project'	A way of representing the typical project for many, perhaps the majority, of design engineers: requiring considerable skill but not of the size, or given the publicity, of the larger prestige projects

HRRBs	High Rise Residential Buildings
HSE	Health and Safety Executive (For GB and, separately, for Northern Ireland)
ICE	Institution of Civil Engineers
IOSH	Institution of Occupational Safety and Health
IStructE/ISE	Institution of Structural Engineers
JIGSR	Joint Institution Group on Safety Risk
MEWPs	Mobile Elevated Work Platforms
MHSWR	Management of Health and Safety at Work Regulations
MHCLG	Ministry of Housing, Communities and Local Government
‘Mrs Miggins’	A fictitious lay-character who represents individuals, and also some organisations, which, by becoming ‘commercial clients’ on construction projects, find themselves with statutory responsibilities, despite knowing nothing of construction, and having employed a team of experts
Non-standard work task	A task that is not a ‘standard work task’
PWD	Permanent Works Designer
Regulation 9 risk	Regulation 9 from CDM 2015 requires designers to eliminate or mitigate risk, <i>so far as is reasonably practicable</i> (SFARP)
RIBA	Royal Institute of British Architects
Risk	combination of the probability of occurrence of harm and the severity of that harm
RRFSO	Regulatory Reform (Fire Safety) Order 2005
SCI	Steel Construction Institute
SCOSS	Standing Committee on Structural Safety, now combined with CROSS as ‘Structural-Safety’
SFARP	<i>So far as is reasonably practicable</i>
Significant residual risk	<i>Not necessarily those that involve the greatest risks, but those (including health risks) that are not likely to be obvious, are unusual or likely to be difficult to manage effectively</i> (taken from the HSE guidance to CDM 2015)
	Note that in PAS 1192-6 the term ‘Elevated risk’ is used. This is defined as: <i>risk whose information is shared because of its exceptional nature or raised level given the agreed mitigation and context of the project</i>

NOTE 1 This includes risks judged to:

(a) have potential consequence of single or multiple fatality, life changing or serious injuries, long lasting detriment to physical health, mental health and well-being

(b) be not obvious to a competent and experienced participant or outside of normal expectations

(c) remain a concern because of its potential occurrence within the asset lifecycle

NOTE 2 Information about other risks, typically those below 'moderate', may also be shared

SME	Small- and Medium-sized Enterprises
Soft hazard	See Hazard
'Standard work task'	Defined as those, arising from or connected to the design, which are an inherent part of the common design/construction/maintenance/cleaning/operational process, having accepted contemporary industry solutions so as to eliminate or reduce risk
Structure	Used as defined in the CDM Regulations, Regulation 2(1)
Structural-Safety	The umbrella body for SCOSS and CROSS
Traditional employment model	As illustrated in Table 3.1
'Three-person practice from Bury St Edmunds'	A fictitious practice of engineers, chosen to represent the size of many design organisations, based in areas other than the large urban centres; hard working and broadly knowledgeable, but just want to know 'what to do'; the 'silent majority'
TWC	Temporary Works Coordinator
TWD	Temporary Works Designer
TWf	Temporary Works Forum
WHSWR	Workplace (Health, Safety and Welfare) Regulations