

ESSENTIAL CONSIDERATION OF 'SOFT HAZARDS' ON CIVIL AND BUILDING ENGINEERING PROJECTS¹

**A check-list for all those engaged in structural or fire
engineering design.**

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October 2022**

¹ This document may be copied and distributed for the purpose of improving standards of risk management. It would be appreciated if the authorship was recognised.

CONTENTS

SYNOPSIS

- Definition of soft hazards
- Why this consideration is written

A INTRODUCTION

B CROSS

- Reminder of CROSS- key use and contributing aspects having regard to known hurdles
- References

C 3Ps: People, Process and Product

- Explanation of 3Ps and their relevance to understanding failure; leading to ‘soft hazards’
- References

D SOFT HAZARDS

- Explanation, and relevance to failure
- Selected soft hazards: action points

Hazard entries

*Competency of team,
Resource*

Essential actions relating to the Brief

Incomplete design/design by others

Design assumptions

Information for others

Interfaces

Change control

Value engineering

Construction sequence and Temporary Works

Standard of submission data for Part A Building Regulations approval

Checking

Disproportionate collapse data

Gateways

Tendering and construction time

Competency of constructors

Site supervision

Information for H&S File: having regard to Safety Cases

Maintenance and planned repair assumptions

De-commissioning

Other (to make point that above list is not necessarily exhaustive)

E ETHICAL RESPONSIBILITIES

- Institution Codes of Conduct
- Action in cases of concern
- References

F FURTHER LEARNING

Relevant references, not included above, regarding risk management

ESSENTIAL CONSIDERATION OF SOFT HAZARDS ON CIVIL AND BUILDING ENGINEERING PROJECTS

SYNOPSIS

This short, but direct aide memoire, is written to highlight to those who act as designers², or manage the design function, the criticality of giving adequate attention to 'soft hazards'.

In this document we define 'soft hazards' as a hazard which :

Originates from the design, but whilst leading to a risk to others, does not lead to a work task on site [1]. They are, in essence 'design-related management issues'.

These hazards are not new. They are amongst the causes of most of the disasters and other failures that have occurred over many decades. Many of these failures have involved death or injury, and all have incurred significant cost. However, despite being known hazards, they often recur on projects of all sizes and types and are also often ignored or given insufficient attention. The fire at Grenfell Tower in London on 14th June 2017 is an appalling reminder of what can occur when risk is not managed adequately.

Although structural engineering designers (including associated consideration for fire) are to the fore (due to the resultant safety risk), and the key audience of this document, other designers may find this document helpful as a means of mitigating the financial, reputational, and other costs, associated with failures due to the same shortcomings on projects of all types.

This document, and the highlighted hazards, is applicable to civil engineering structures as well as building structures.

The term 'designer' should be taken as applicable to both permanent works designer and also, as relevant in the circumstances, to the temporary works designer.

The document is written as, to the author's knowledge, there is no other published explicit advice relating to these specific hazards, applicable across the industry. It is not a guide, nor a comprehensive paper on risk: it is, in essence, a 'check list for action'.

References

1 Designing a safer built environment ICE publishing s7.3 and Table 7.1 p114

² As this document springs from the Grenfell Tower fire, 'designers' in this document means those involved in structural engineering or fire design. This aligns with the Building Safety Act, and also with the likely discipline involvement of most civil/structural engineers who act in a design capacity. However, the messages and advice of this document apply to all project designers. Additionally, it does not matter if the 'designer' is the 'Client', or other body (in accordance with the definition given in the CDM Regulations).

TERMINOLOGY

At the time of writing this document³, new, or amended terms are coming into force, related to the Building Safety Act and associated Regulations. These include:

Duty-holder term	Comment
Designer	As defined at present under CDM but competency requirements now also set for buildings under the Building Safety Act, and subsidiary legislation. A higher threshold of competence is demanded if working on Higher Risk Buildings (HRBs)
CDM Principal Designer (CDM PD)	As defined in CDM. Higher threshold required for HRBs
Principal Designer (PD)	Modelled around the CDM structure but applicable to Building Regulations compliance. Higher threshold of competence if working on HRBs.
Accountable Person (AP)	The person responsible for the safety of the HRB during residential occupation. The AP produces the Safety Case. May also be a 'Principal Accountable Person'

A INTRODUCTION

Exceptional events demand exceptional responses. The Grenfell Tower fire, on 14th June 2017, is one such occurrence and this document is presented as a result of that. However-

The mistake should not be made that, whilst the event was tragic, the lessons from Grenfell only apply if one is a designer of tall residential buildings. On the contrary: the root causes, as distinct from the consequential reasons, apply to all projects, of any size, and have the potential for proportionately serious consequences: not only in life and limb (primarily on projects involving structures), but also in cost and reputation. These root causes are well-known and have been present in our industry for many years.

Little has been done by industry Institutions to drill down to the level of direct preventative action required. This document is designed to do that, targeting very specific, and well-known shortfalls.

The new legislation, stemming from Grenfell, will form the basis of a new regime for building design, for all buildings. However, as Dame Judith Hackitt has emphasised (paraphrasing) '*do not wait for the legislation. Take action now*'. This is what we are doing.

It is reasonable to suggest that designers should adopt the following advice, unless good reason not to, and this is recorded.

³ Late 2022

B COLLABORATIVE REPORTING FOR SAFER STRUCTURES (CROSS)

Learning from others is a key means of avoiding error oneself. CROSS provides a database of anonymised reports, Alerts, Newsletters and other information. All Designers should sign up for this facility if engaged in any structural engineering design work, or design work which might relate to fire, and use it as a design risk management tool. It can be found [here](#).

Designers should also use it to report matters of concern; perhaps a near-miss, or a structural or fire related event that would be a learning event for others, but which might not be formally published.

Reports by CROSS are anonymised, based on long-standing tested procedures.

However, where there is a reluctance by individuals to participate alone, in the reporting of an event, they are encouraged to discuss the matter within their own organisation, and for the latter to make the submission, which will be anonymised.

C THE '3Ps' (People, Process and Product)

The '3Ps' is an established means of readily identifying the root causes of structural failure, and hence an understanding of how it can be avoided. It is a simplistic, but nonetheless an accurate and meaningful method, easily understood and applicable to all scenarios. (1) It is:

Element:	Examples:
People	capability, resource
Process	Clarity of brief, Validation of software, checking, review of concept, communication, site monitoring,
Product	Failure to perform as specified, Unexpected behavioural characteristic.

Most failures occur due to a combination of failings under 'People' and 'Process' (1) (2). In the UK, it is rare, but not unknown, for 'Product' failures.

The Grenfell Tower fire vividly illustrated the applicability of the '3Ps' in quickly identifying shortcomings in the management of risk, all of which (leaving aside deceit and possible criminal acts) substantially match those of previous failures.

Section D, below, is constructed around this thesis. It does not dwell on 'Product' as the whole subject area has been extensively scrutinised following Grenfell and will be subject to new regulatory control. Here, we concentrate on People and Process.

References

1 Designing a safer built environment ICE publishing s2.7, p25.

2 16th Biennial Report from SCOSS at [SCOSS review 2005-07 \(cross-safety.org\)](https://www.scoss.org.uk/reports/16th-biennial-report)

D SOFT HAZARDS

It is expected that Designers follow through on the examples below, unless an item is clearly inapplicable (eg 'Building Regulations Submission' on a civil engineering project); there is some other project-specific reason why it does not apply; or the individual Designer legitimately is unable to follow through on an action, due, for example, by being in a junior post and genuinely lacking the authority or competence. It is always possible to raise the issue, even if action is limited by virtue of the team structure. 'Passing the buck' is not acceptable.

The following items are included as they are known recurring hazards which are often not well considered. On a specific project there may well be others and this possibility should always be considered (see D21).

Where 'reasonable steps' are mentioned, these are likely to be influenced by an Institution Code of Conduct, if the Designer is a member; by a general duty of care; and by law, if the matter relates to safety.

D1 Competency of the team

The need for a competent team, albeit that on smaller projects that might just be one individual, is well known, long-established and a legal requisite. Notwithstanding, as a Designer, you should take reasonable steps to ensure that, for your organisation, the:

- i. Assessment of competency, individually and for your team, realistically matches the brief
- ii. Assessment of competency relates to both occupational safety and health, and building regulations.
- iii. Makes allowance for absenteeism when it occurs (for instance, due to leave, sickness, secondments to other projects)
- iv. Is realistically re-assessed if the brief changes, or becomes more demanding.
- v. Is emphasised if specific competencies will be required on further design by others.

References

1 CDM Regulation 8; Building Safety Act Clause 35

D2 Resource

As for competency, the need for adequate resource is well known, long-established and a legal requisite.

Notwithstanding, as a Designer, you should take reasonable steps to ensure that the assessment, for your organisation:

- i. Is determined with planned actions for known future absences
- ii. Is realistically re-assessed for unplanned occasions when individuals leave or are temporarily unavailable for the assumed period.
- iii. Takes account of 'project pressures' (which may manifest as time, fees, the demands of 'parallel' projects, or other pressure points) through strong management oversight.
- iv. Allows for adequate de-briefing when a member is replaced

D3. Essential actions relating to the Brief

A key document, not only for you, as a specific discipline designer, but also for others so that they know what you are engaged to do. You, in turn, should be aware of their brief, where relevant.

As a Designer, you should take reasonable steps to ensure that the brief:

- i. Succinctly describes your organisation's role, identifying any specific omissions or additions from what might normally be expected, and how it relates to/or departs from any relevant standard industry appointment form,
- ii. Is in written format, as soon as practicable (you may need to initiate that action, developed from an oral brief, even if it is modified at a later stage),
- iii. Highlights where the design in your discipline will need to be finished by others (typically 'contractor-design').
- iv. Identifies where further investigation of data will need to be collected/made available, and by whom, and the actions which follow from that,
- v. Is made available to all who may have an interest.
- vi. Matches the available competence and resources of your team, and your organisation.
- vii. Has been carefully reviewed by a competent person, unless recorded as unnecessary.

D4 Incomplete design/design by others

It is commonplace for the design relating to a particular discipline to be completed by more than one design organisation. Unfortunately, this is not always 'good risk management' but is instead more 'custom and practice', often driven by commercial pressures.

As a Designer, you should take reasonable steps to avoid unnecessary interfaces and splits in design responsibility. Nonetheless, you should also, where they do occur, ensure that:

- i. The extent of design 'yet to be done' is clear to key personnel eg CDM Principal Designer , Principal Designer; and clear to those who follow and those who will undertake that process,
- ii. The design codes used, design data and other essential information is passed on.
- iii. The key assumptions made in the partially completed design, including specific design criteria, are made known, where they relate to safety.
- iv. Critical interfaces are made known
- v. The assumed construction sequence, including any assumed specific temporary works, is made clear, unless trivial
- vi. Formal consideration is made to the passing on of the digital design model when this is going to be an important aspect of further design.

D5: Assumptions

Where assumptions, on which the design is based, may affect the safety of the structure, or compliance with building regulations, these should be spelt out and documented.

As a Designer, you should take reasonable steps to ensure that your team assumptions:

- i. Are documented so as to be readily accessible to anyone who has a need to view the design eg Building Control, other project-related designers, future contractor-appointed designers (1), the CDM Principal Designer, the Principal Designer (PD), the Accountable Person, as appropriate.
- ii. Relate to the construction, operational and de-commissioning phases, as appropriate.

- iii. Document any necessary monitoring/supervision regimes
- iv. Document any required or assumed construction sequences (unless obvious to a competent contractor), including temporary works.
- v. Document any relevant structural movement limits during construction, such as might apply to basement walls or adjacent existing buildings.
- vi. Document where the design relies on other structures for stability.

References

1 See ICE Advice Note as examples: Steelwork Temporary Conditions at [Design Risk Management: Steelwork Temporary Conditions | Institution of Civil Engineers \(ICE\)](#)

D6 Interfaces

Risk thrives at interfaces.

Interfaces may be of two types: physical or procedural (1), and it is at these positions, or in these instances, that clarity is required.

As a Designer, you should take reasonable steps to ensure that interfaces relating to your brief:

- i. Are eliminated whenever reasonably practicable; if not:
- ii. Are reviewed with the aim of mitigating risk, and

for physical interfaces:

- iii. They are considered from a constructability viewpoint and that construction sequence, temporary stability and temporary works are all carefully considered and communicated as necessary to others.
- iv. That the possibility of 'interface' loadings/forces, larger than in the final completed state, are considered and if present are designed for and communicated to those who need to know, and

for procedural interfaces:

- v. Any gaps or overlaps in responsibilities are identified and eliminated
- vi. Any further design is clearly set out
- vii. That responsibilities are clear for all involved parties (these might include consideration of competencies, checking, further design, data provision)

References

1 Designing a safer built environment ICE publishing s2.6, p23.

D7 Change Control

The inadvertent introduction, or raised level of risk, as a consequence of poorly controlled design change is a known problem; there have been some notable related failures (1) (2).

As a Designer, you should take reasonable active steps to ensure that no design change, related to your brief, or affected by other changes, occurs without:

- i. The involvement of yourself or a competent designer (and preferably the former) together with adequate time for careful consideration.

- ii. That any change follows an agreed approval and recording procedure
- iii. That the above need is drawn to the attention of relevant persons, and is also written into construction contracts.
- iv. That the agreed procedures are fit for the construction phase when you may not be available, and queries may arise from sub-contractors.

References

1 See Wikipedia at [Hyatt Regency walkway collapse - Wikipedia](#) and the formal studies referenced for more technical detail.

2 Stonehaven derailment at [Report 02/2022 - Derailment of a passenger train at Carmont - GOV.UK \(www.gov.uk\)](#)

D8 Value engineering

In the right hands, value engineering is a powerful tool to enable the design to be professionally reviewed, usually so as to reduce cost and/or time, or improve constructability, whilst maintaining functionality, safety and quality. However, it can often be little more than a cost cutting exercise when in the wrong hands, or when undertaken under inappropriate pressures.

As a Designer, you should take reasonable steps to ensure that any such exercise, involving design over which you have responsibility, or where a change to the design of others could affect your design, is properly conducted. Such measures should include:

- i. Adoption of general procedural policies for value engineering so that any change, and its impact, is properly conducted, having regard to safety, and is recorded.
- ii. Suggesting the use of a competent moderator
- iii. Discussing the negatives as well as the positives from any actions

If you are overridden, or excluded, without such consideration, you should:

- i. raise this with your seniors (internally) and with the CDM PD, or PD (as appropriate)
- ii. Consider the advice in Section E.

D9 Construction sequence and Temporary Works

It is essential that an acceptable construction sequence is identified by the relevant designer, and, if not obvious to a competent contractor, made known in graphic or other format, together with any constraints, interim instabilities, or other safety issues. Although this process is a natural output from the CDM regulations many designers have remained reluctant to comply. A similar reluctance often exists with regard to the associated temporary works.

As a Designer, you should take reasonable steps to ensure that:

- i. The assumed construction sequence, relating to your design, or other elements affecting it, is illustrated unless obvious to a competent contractor
- ii. The assumed temporary works is similarly indicated, and
- iii. That both i) and ii) are safe, economic and practical
- iv. Details of any intermediate instability or where the loadings are likely to exceed those allowed for in the completed structure are identified (but preferably eliminated).

References

1 See ICE Advice Note as examples: Steelwork Temporary Conditions at [Design Risk Management: Steelwork Temporary Conditions | Institution of Civil Engineers \(ICE\)](#)

D10 Standard of submission data for Part A Building Regulations approval

In England, most buildings require a submission to be made under Part A of the Building Regulations to demonstrate compliance. Although this is a devolved matter, similar or equivalent arrangements are required elsewhere in the UK and hence the principles of this section apply generally.

It is essential that the submission data is clear, comprehensive and easily understood. It is known from various sources that this is not always the case.

As a Designer, you should take reasonable steps to ensure that any submission, relating to a design by your organisation, satisfies the Institution of Civil Engineers' [Guidance Note](#) (which also picks up on some of the points made elsewhere in this document).

D11 Checking

Considered checking of the design is an essential risk mitigation measure which should always feature as part of the duty of care and also in discharge of statutory duty where harm to persons may result from failure.

As a Designer, you should take reasonable steps to ensure that the design undertaken by your organisation is subject to an appropriate check, the nature of which might vary between a selective numerical check through to a comprehensive independent peer review, with various options in between (1).

References

1 Designing a safer built environment ICE publishing s7.9 p125

D12 Disproportionate collapse data

Where disproportionate collapse has been considered the background data should feature as part of the submission to Building Control for approval under Part A of the Building Regulations (see D10) and be made available to others with a need to see it.

Where consideration of disproportionate collapse is necessary for other 'non-building' structures the background data should feature in a similarly prominent manner, available to all those who need to see it.

This aspect of design will become more prominent on HRBs, owing to the demands of the Safety Case. However, from a risk management perspective this same emphasis should be evident on other structures also.

References

1 Robustness and Disproportionate Collapse of Buildings
Institution of Structural Engineers 2010

2 Advice Notes from HSE relating to the Building Safety Act (in hand)

D13 Gateways

For HRBs and some public sector work these are mandatory. They also feature in most Institution Plans of Work.

As a Designer, you should take reasonable steps to ensure that appropriate Gateways are adopted on your own design work, as the norm, so as to:

- i. Tie in with those highlighted in standard Plans of Work (1,2), but
- ii. Capture other project-specific desirable 'hold-points' (3)

References

- 1 The Structural Plan of Work 2020 at [Guidance-to-structural-plan-of-work-20200701.pdf \(istructe.org\)](#)
- 2 RIBA Plan of Work at [RIBA Plan of Work \(architecture.com\)](#)
- 3 Designing a safer built environment ICE publishing s7.8 p123

D14 Time for tendering, mobilising and constructing

It is essential that all parties to the construction phase have adequate time to tender, then, if successful, to mobilise, and finally to construct.

There will always be commercial and programming pressures in these regards and the Designer may not always have a direct voice in the decided timings.

However, as a Designer, and when safety, arising from your design, is an aspect to be considered in these decisions, you should take reasonable steps to ensure that:

- i. the periods chosen, and which affect your design are realistic for the specific project (and thus adequately mitigate any time-related safety risks), and
- ii. that, if these are not achieved, for reasons outside your control, any concerns are documented and communicated to those who should need to know.

Section E may assist here.

D15 Design competency of sub-contractors

When the design of an element is to be completed by others (eg detailed steelwork design, or structural fixings) this is often passed to a sub-contractor with a design element to the sub-contract.

As a Designer, you should take reasonable steps such that the construction contract:

- i. Ensures the specific contract package is let on a 'design/construct' basis (ie the design element is made explicit)
- ii. Has the facility for checking the design competency of any such sub-contractor
- iii. Highlights the critical design safety issues and includes the key design data
- iv. Highlights any necessary monitoring/supervision requirements.

D16 Site supervision

Over the years, and indeed decades, the provision of site monitoring or supervision, by the designer, has changed from a 'given' to a decision frequently taken by the Client. The presence of the designer on site, to provide oversight, is a risk management matter and should be assessed by the designer as part of the design process, and then recommended to the designer's client.

The Eurocodes make assumptions as regards site monitoring, which are related to the Execution Class. 'Mistake' on site is a hazard which should be flagged by the designer and appropriate risk mitigation instigated as a result. When the risk is safety related it is part of the statutory process.

As a Designer, you should take reasonable steps to ensure (via the Construction Contracts), that your design is subject to appropriate site monitoring/supervision, in order to manage safety risk, by considering:

- i. The expected level derived from BS EN 1990, and whether this needs amplifying/clarifying in the construction contract
- ii. Whether additional measures are required for sub-contracted work
- iii. Whether additional measures are required for specific elements of work
- iv. Whether you, as designer, need to be involved on site in any way

This consideration, and communication, should occur whether or not your contract, or responsibilities, as a designer, extends into the construction phase.

D17 Information for H&S File: having regard to Safety Cases

The structural design of all new HRBs needs to be undertaken having regard to the fact that a safety case will need to be drawn up by the Accountable Person (AP). The AP will rely on the structural engineer having derived and presented the design, and associated relevant information (the golden thread), in such a way that it is straightforward to 'slot in' to the safety case. This is likely to be a highly regulated process, working to the BSA and HSE guidance.

As a Designer, you should take reasonable steps to ensure that the design and its output satisfies the above.

In addition however, although a safety case is not required by law for other buildings, as a responsible Designer, you should take reasonable steps, as a risk management measure, to ensure that your design, and the outputs, are subject to similar proportionate rigour and availability as part of the H&S File.

D18 Maintenance and planned repair assumptions

It is important that anticipated maintenance and repair, arising from the design, is made known to the Client and others who will need to know. Where these activities involve significant residual risk, this is also a statutory obligation.

As a Designer, you should take reasonable steps to ensure that the information, relating to your design, includes:

- i. Assumed access assumptions set out in the maintenance access strategy (1)
- ii. Any significant residual risks

References

1 Safe Access for Maintenance and Repair CIRIA 2nd Ed. 2009. s1.7.2

D19 De-commissioning

The process of de-commissioning of many structures will not involve significant residual risk. It will be a known process to a competent contractor. Although many structures will only be de-

commissioned after a long life (say 60 years) when methods of de-commissioning may have changed significantly from contemporary practice, there will be others that are de-commissioned well before that time in order to free up the site for alternative development.

Hence, as a Designer, you should take reasonable steps to ensure that, if there are issues relating to your design likely to be unexpected or difficult to control, then these are clearly highlighted together with the assumed method of dealing with them. Specifically these would include:

- i. Pre and post tensioned structures
- ii. Interim stability issues
- iii. Situations where there is reliance on adjacent structures
- iv. Structures which need to be de-commissioned in the reverse order in which they were constructed.

D21 Other

The list above includes common hazards, but it is not exhaustive. Any project has the capability to contain a specific issue requiring the attention of the designer and which is not included above.

Hence, as a Designer, you should take reasonable steps to ensure your actions reflect the actual hazards arising, and do not just follow a prescribed list.

E ETHICAL RESPONSIBILITIES

The need for responsible Designers to follow the recommended actions given in this document often flow from statutory requirements, but all flow from the duty of care demanded under Institution Codes of Conduct. For example, ref.1. This Code states, in part:

1 All members shall discharge their professional duties with integrity and shall behave with integrity in relation to all conduct bearing upon the standing, reputation and dignity of the Institution and of the profession of civil engineering.

2. All members shall only undertake work that they are competent to do.

3. All members shall have full regard for the public interest, particularly in relation to matters of health and safety, and in relation to the well-being of future generations.

In addition, the accompanying advice to the Code of Conduct states:

A member must notify the Institution if he or she, in good faith, believes there has been a significant breach of the Rules of Professional Conduct by another member.

Failure to follow the advice in this document, could be deemed to be a breach of the Code of Conduct and may require another member to report it to the Institution, as noted above.

Other Institutions will have similar requirements. Even someone, acting in a Design role, but not a member of a recognised industry institution, will have to demonstrate competency in accordance with the law.

A Designer who is aware of unsafe practice should:

- Use their own internal organisation reporting procedure
- Refer to their own Institution for advice
- Refer to Engineering Council advice (2)

References

1 see [Code of Conduct | Institution of Civil Engineers \(ICE\)](#)

2 see [Engineering Council \(engc.org.uk\)](#)

F FURTHER LEARNING

Relevant references, not included above, regarding risk management

1. Structural Safety. Study into critical factors in the design and construction process. K C Terwel.
2. Risk in Structural Engineering 2013. Institution of Structural Engineers
3. Release of safety-critical data following an incident in the UK Construction Industry. ICE Forensic Engineering Journal October 2015
4. See several sources quoted in 'Designing a Safer Built Environment' ICE Publishing
5. The 'Get it right initiative' (GIRI), an industry-wide campaign to reduce error of all types ([About | Get It Right Initiative](#)). There is significant synergy between this document and

GIRI. However this document concentrates on actions directly related to safety and all of which can be influenced by individual designers.

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ICE Gold Medallist 2021

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