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DESIGNING FOR SAFETY IN CONSTRUCTION

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DESIGNING FOR SAFETY IN CONSTRUCTION:

Taking account of the 'general principles of prevention'

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Introduction:

At the European Construction Safety Summit entitled "Building in Safety" on the 22nd November 2004 the Bilbao Declaration was signed by the representative organisations of the Construction Industry across Europe.

- FIEC - European Construction Industry Federation
- EFBWW - European Federation of Building & Woodworkers
- EBC - European Builders Confederation
- EFCA - European Federation of Engineering Consultancy Associations
- ACE - Architects Council of Europe
- ECCE - European Council of Civil Engineers
- - Ministry for Social Affairs and Employment Dutch Presidency of the European Union

The Bilbao Declaration resulted in the formation of the European Construction Safety Forum. This European Construction Safety Forum was facilitated in its work by the European Agency for Safety & Health at Work. EFCA and ACE publish this Document "Designing for Safety in Construction" as an outcome of its work with the European Construction Safety Forum.

The Council Directive 92/57/EEC on the 24th June 1992 on the implementation of minimum Safety and Health Requirements at temporary or mobile construction sites (hereinafter referred to as "the Directive"), places responsibilities on various individuals involved in the construction process.

This publication concentrates on the responsibilities placed by the Directive on the Designer. Each construction project will have numerous specialists carrying out the role of designer and through the use of practical examples this document is intended to assist them to comply with their requirements.

Although designers may act as project co-ordinators this document is only intended to provide advice in their capacity as designers and not co-ordinators.

Acknowledgements

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We are also grateful to the following organisations for their comments on the drafts of this document.
FIEC – European Construction Industry Federation
EBC – European Builders Confederation
RICS – Royal Institute of Chartered Surveyors

Scope

1. Council Directive 92/57/EEC of 24 June 1992 on the Implementation of minimum Safety & Health Requirements at Temporary or Mobile Construction Sites (hereinafter referred to as "The Directive").

Definition of design

2. This guidance document is addressed primarily to those who are normally regarded as the designers of a building/structure, i.e. the designer - or design team – engaged by the developer/client to design, on behalf of the latter, the structure as it will be when constructed. However, it should be noted that under the various National Regulations implementing The Directive in the Member states of the EU, the definition of design (and, correspondingly, designer) is very wide and includes not only the preparation of drawings and/or specifications for the end product but to many other matters relating to how a project is to be executed. Thus, apart from those who normally think of themselves as the designers of a building/structure, responsibility for design may extend to anyone who, for example, designs proprietary products, or who designs or decides on temporary works for contractors. Some decisions of clients may even be construed as being design decisions.

3. Also note that under the various National Regulations implementing The Directive in the Member States, the definitions of "construction" and of "structure" may vary widely, extending well beyond the normally accepted meanings of those words.

General principles of prevention

4. The *general principles of prevention* are set out in Table 1 of this document. They are a generic hierarchy of risk control measures applicable to all places of employment; they are probably more appropriately applied in manufacturing industries where there is, generally, a constant, stable workplace than they are in construction. In construction, while there may be similarities between projects, every site is unique, every building/structure is unique and the set of persons involved is unique; further, a construction site is constantly changing from day to day.

5. Not all of the principles of prevention are relevant to what a designer can do, but it would seem reasonable that a designer should as far as reasonably practicable:

- Seek, for each design feature/option, in a systematic way to identify the associated key construction hazards and risks, considering generally the methods that might be used by a contractor in the construction/execution of each option,
- Seek, on the same basis, to "design out" those risks that can be avoided,
- Assess, as best as the designer can, those risks that remain and then mitigate them by "combating at source" (rather than relying on protective measures to be taken on site) and,
- in due course, facilitate, as far as reasonably practicable, other protective measures (e.g. installing temporary running lines) being taken on site by contractors.

Consideration of safety should be an integral part of the design process at the various stages. Designers should assess the design as it progresses and if any significant hazard is identified the design should be altered to eliminate the hazard where reasonably practicable, or otherwise to reduce the risk where

reasonably practicable. As the design progresses from concept to detail, consideration of safety issues moves from general aspects to specific aspects. The most important contribution that a designer can make is (probably) at the concept and early design development stages of a project when project-wide and system hazards are being considered.

6. The practical context, the limitations and the manner whereby a designer can seek to do this are discussed hereunder.

Safety of whom?

7. National Regulations within the various Member States of the EU vary on the issue of whose safety is to be considered by the designer. There is the safety of all those involved in constructing the project, and of third parties who could be affected by construction operations such as members of the public and those who will maintain the project upon completion. It appears that, generally, the safety of those who manufacture components off site does not have to be considered by designers and the maintenance work itself will constitute a separate construction project in due course.

Definitions

8. The definitions that have been adopted for the purposes of these guidance notes, are:

> A "*hazard*" is a condition or event with the potential to cause harm.
>
> "*Risk*" (R) is the probability (P) that harm from a particular hazard will occur combined with the likely severity (S) of the harm; or, in simple terms, R = S x P.

Risk assessment - general

9. Risk is an estimate of the probability of loss from a large population of hazardous opportunities; it does not predict what or when disaster will happen. It is easier to identify hazards than to evaluate associated risk and in risk assessment, professional judgement is by far the most important component. Various methods of assessment can be used to provide indications as an aid to professional judgement, but these methods cannot be considered as a substitute for it. Of course, professional judgement can be wrong on occasion.

10. There are serious difficulties with risk assessment in any field, not just construction. Probably the most significant weakness is the difficulty in allowing for human error; the effect of this has been roughly estimated to increase even relatively sophisticated numerical assessment of risk by a factor of ten. Another problem is lack of reliable data due to confidentiality. A further problem is knock-on effects in real situations; risk assessment is most effective with discrete, stand-alone events rather than when they are interrelated or part of a system as is more often the case. Accordingly, risk assessment results must always be viewed with scepticism and used with caution.

11. This is particularly so in construction where useful statistical evidence is extremely scarce and where the place of work is necessarily far more chaotic than in most other industries, each construction site being unique and constantly changing from day to day. The necessary statistical data is not available for any sophisticated risk analysis - except possibly in relation to some elemental, stand-alone issue as opposed to general strategic

issues or systems issues. The notions of time or frequency for example are not allowed for in the concept of the probability of a hazard causing harm. Thus, in construction, safety risk evaluation procedures are relatively unsophisticated and they predominantly try to compare in a simple, common sense, qualitative way alternatives for achieving the same end.

Formal risk assessment

12. There is no explicit duty to carry out formal risk assessment of health and safety issues set out in The Directive. However, it can be said that the degree of detail involved in the risk assessment need only be proportionate to the nature of the project. For many projects a simple intuitive assessment will normally be appropriate. For unusual features an explicit risk assessment procedure – possibly requiring expert advice – may be appropriate.

Assessment matrix method

13. A technique in fairly common use in several EU Member States for evaluating risk R=SxP (see paragraph 8 above) involves grading both S and P into a small number of categories to form an assessment matrix. The Health and Safety Executive (HSE) in the UK, for example, proposes 3 categories for each – high, medium and low. Values of 3, 2 and 1 respectively can be assigned to these. The HSE gives guidance on the likely severity of harm (S) caused by the most common basic hazards (see Table 2); a general feature/hazard (e.g. flat roof option) would have to be broken down into these basic hazards if using this approach. The likelihood, or probability, that harm will occur (P) can be considered under categories: high – certain or near certain to occur; medium – reasonably likely to occur; and low – very seldom or never occurs; again, values of 3, 2 and 1 can be assigned to high, medium and low respectively. Thus, by multiplying the S and P values, each basic hazard will have a risk assessment of between 1 and 9 inclusive.

14. The HSE (UK) gives as an example the hazard *"being struck by mobile plant*" (severity rating S = 3). They say P depends on the amount of plant and the size and layout of the site, so that on a house building site it would probably be "low" to "medium" (thus, risk R = 3 to 6); on a civil engineering site involving earth moving, "medium" to "high" (risk R = 6 to 9); on carriageway repairs, "high" (risk R = 9).

15. In addition to the problems with risk assessment in general, as discussed above, there are obvious practical difficulties with this particular matrix approach. For example, assigning the P value can be so subjective that it questions the validity of the output. Also, when comparing two, or even more, options/hazards (e.g. flat roof construction versus sloping) each of which involves its own set of sub-hazards, there is no practical methodology for combining the sub-hazard evaluations to give an overall assessment.

16. An assessment matrix, or one of its variants, may be of assistance to a designer in forming a judgement in particular circumstances. However, the deceptive attraction of, and common over-reliance on, the method may well be due to its quasi-scientific appearance - and the production of paperwork. It is least applicable to assessment of project-wide and system

hazards which, generally, is where designers can contribute most.

Hazardous materials

17. Applying the principles of prevention to the specification of materials is particularly problematic due to the lack of comprehensive comparative data. There is a huge number of products used in construction many of which can be hazardous if not used in accordance with the manufacturer's recommendations. It is likely that, in time, comparative assessments of particular product types (e.g. paint systems) will become available to assist the designer, which will take into account all relevant aspects of products including health and safety.

Design teams

18. Evaluating a particular hazard may involve more than one member of a design team. This is particularly so at concept stage. However, wherever possible each identified hazard should be formally assigned to one member of the design team and left to that member to handle. Designers are obliged, by the provisions of The Directive, to co-operate with each other and with the Project Coordinators.

Realistic limitations

19. Those who are normally thought of as the designers of a building/structure have expertise in designing the building/structure to be safe and suitable for its intended purpose on completion of construction. While such designers generally have a reasonable understanding of construction methods, they do not require expertise in regard to the particular means, methods and procedures of construction that the builder must possess, and they do not, in general, design the temporary works needed to execute construction. Nor does the designer determine or control the resources to be made available by the builder or the management, planning, supervision etc. of the construction site itself. It is important therefore to acknowledge the limitations of what a designer can bring to bear when seeking to identify and assess risks that can be avoided or mitigated at design stage.

20. On a typical construction site there will be countless hazards and circumstances that could give rise to hazards. A designer cannot hope to identify all possible hazards; he can only try to identify as many key hazards as he can and, insofar as is reasonably practicable, eliminate or mitigate them.

21. In determining what is reasonably practicable in respect of safety, safety features can only be considered in the context of, and with due regard for, all the other design parameters such as functional requirements, aesthetics, financial constraints, environmental impact, Building Regulations, Planning Acts, etc.; in other words a balance must be struck between <u>all</u> the design requirements.

22. In taking account of the principles of prevention during design a designer can be expected to do so only to the extent that it is reasonable to address the risks at the time the design is prepared.

Recording decisions

23. Designers should consider how best to keep their own records of the hazards they have identified and how they have

dealt with the associated risks. These will be discussed during design reviews and progress meetings and the appropriate records could form part of the existing systems for project management. There may be practical reasons to keep records: in case of personnel changes, unexpected delays in the progress of the design, etc. A suggested form for recording health and safety decisions is appended to this document, but designers may prefer to develop their own standard format by which they might (a) list matters that they have identified as having significant safety implications in the course of the construction of the project and its subsequent maintenance and (b) record decisions taken in relation to these matters.

24. This guidance does not prescribe how designers should record their considerations and decisions arising from compliance with the various relevant National Regulations in each of the EU Member States, as each State will have its own approach when establishing recommended procedures and audit trails. However, designers should record all key information and decisions and should avoid unnecessary bureaucracy.

Information for contractor(s)

25. If residual identified risks remain which a designer judges are significant and unusual in the context of the type of project proposed, the designer should alert contractors to those risks that they cannot reasonably be expected to know or deduce from the documents prepared for the project and supplied to them. Information should be provided to the extent appropriate to enable reliable performance by a competent contractor. Information about risks that a competent contractor could be expected to routinely identify and deal with should not be included; to do otherwise could result in significant information being swamped by a recital of a mass of routine everyday information.

26. The detailed, comprehensive identification of hazards and control of risks on site is the responsibility of the contractor(s). The Directive does not require designers to dictate construction methods generally, or to evaluate contractors' proposals. It would not be in the interests of health and safety for the non-expert in construction methods – i.e. the designer – to unnecessarily dictate to or hamper the expert – i.e. the contractor. However, where a specific construction method or sequence was envisaged by the designer which is not readily discernible from the drawings, or is outside the normal scope of a competent contractor in the context of the proposed work, this should be made known to contractor(s).

27. Information as described in paragraphs 25 and 26 can be passed on to contractors in the contract drawings or specifications or by means of any other "Health and Safety Plan" that may be required by National Regulations. Note however that some National Regulations may stipulate that particular risks are identified.

Appendices

28. Appendix 2 of this document provides examples of design options that, depending on the circumstances of a particular project, might be available to designers to eliminate or mitigate risks.

Table 1:
The general principles of prevention

(a)	The avoidance of risk.
(b)	The evaluation of unavoidable risks.
(c)	The combating of risks at source.
(d)	The adaptation of work to the individual, especially as regards the design of places of work, the choice of work equipment and the choice of systems of work, with a view, in particular, to alleviating monotonous work and work at a predetermined work rate and to reducing their effect on health.
(e)	The adaptation of the place of work to technical progress.
(f)	The replacement of dangerous articles, substances or systems of work by non-dangerous or less dangerous articles, substances or systems of work.
(g)	The development of an adequate prevention policy in relation to safety, health and welfare at work, which takes account of technology, organisation of work, working conditions, social factors and the influence of factors related to the working environment.
(h)	The giving to collective protective measures priority over individual protective measures.
(i)	The giving of appropriate training and instructions to employees.

Table 2:
HSE [UK] guide to likely severity of harm caused by the most common hazards

Severity (S) / **Hazard**	High	Medium	Low
Falls from >2m	•		
Falls from <2m		•	
Being struck by mobile plant	•		
Tripping			•
Collapse	•		
Manual handling		•	•
Moving objects	•		
Electricity 220v and above	•		
Electricity 110v			•
Contact with moving machinery	•		
Fire	•		
Harmful substances	Depends on substance		
Noise and vibration	Depends on exposure		

High – Fatality; major injury or illness causing long-term disability.
Medium - Injury or illness causing short-term disability
Low - other injury or illness.

References, sources and further recommended reading:

1. Designing for Safety in Construction: “Association of Consulting Engineers of Ireland, Royal Institute of the Architects of Ireland”, March 2003.

2. Health and Safety Executive: “Designing for health and safety in construction”, HSE Books, 1994

3. The Engineering Council: “Guidelines on Risk Issues”, 1993

4. Architects’ Council of Europe: “Memorandum on Council Directive 92/57/EEC”, January 1994.

5. Hambly & Hambly: “Risk Evaluation and /realism”, Proceedings of the Institution of Civil Engineers, May 1994.

6. Construction Industry Research and Information Association: “CDM Regulations – Case Study Guidance for Designers, An Interim Report”, Report 145, 1995.

7. Construction Industry Research and Information Association: “Control of Risk: A guide to the Systematic Management of Risk from construction”, SP 125, 1996.

8. Tietz, S B: “Risk analysis – Uses and Abuses”, The Structural Engineer, 20th October 1998.

9. RICS “Surveying Safety – Your Guide to Personal Safety at Work”

10. Kavanagh, J A: “Safety, Health And Welfare at Work (Construction) Regulations 2001 - A Designer’s Perspective”, paper to a joint seminar of the Law Society of Ireland and Institution of Engineers of Ireland, March 2002.

APPENDIX 1

***Outline pro forma**: passing designer's information to contractors by way of a Preliminary Health and Safety Plan (see paragraphs 25, 26 and 27). Other available, relevant information (e.g. existing drawings or information on existing site services) should also be included or referred to where judged appropriate.*

<table>
<tr><td colspan="2">Project……
Information for the Project Coordinator – Design Stage
from……[design consultant]
in relation to that section of the Project which, under the terms of our appointment by the Client, we are responsible for designing and/or specifying.</td></tr>
<tr><td>1</td><td>'Particular Risks':
The following information comprises our opinion in regard to such information as is known or reasonably foreseeable concerning particular risks as defined in The Directive that would not be evident and reasonably deducible from drawings or other supporting documentation to a competent Project Coordinator – Construction Stage:

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____</td></tr>
<tr><td>2</td><td>Other Residual Risks
Having taken account of the "Principles of Prevention" as recommended in "Designing for Safety in Construction" published by the European Construction Safety Forum, we set out below all residual hazards (other than 'Particular Risks' as set out above) identified by us which in our opinion are significant and unusual and could not otherwise reasonably be known or deduced by a competent contractor. This information is provided to the extent appropriate, in our opinion, to enable reliable performance by a competent contractor. It should be read in conjunction with the contract documents where appropriate.

_____
_____
_____
_____
_____
_____</td></tr>
<tr><td>3</td><td>Construction Methods
The detailed, comprehensive identification of hazards and control of risks on site is the responsibility of the contractor(s). The Directive does not require designers to dictate construction methods generally, or to evaluate contractors' proposals. However, where specific construction methods or sequences are envisaged by us during design which, in our opinion, are not reasonably discernible from the contract documents or are outside the normal scope of a competent contractor in the context of the proposed work, these are set out below. This information should be read in conjunction with the contract documents where appropriate.

_____
_____</td></tr>
</table>

APPENDIX 2:

The following are examples of options that may be practicable depending on the particular circumstances of a project. They are indicative, not prescriptive.

- Site layout: Design the site layout (i.e. the location of structures) to avoid work, and mobile plant movement, in the vicinity of overhead electric cables – see Appendix 3 also. Locate structures, pipe runs, etc. to avoid contaminated areas of the site.

- Structural frames: minimize connections at height by facilitating off-site and/or ground level assembly; facilitate ground slab construction before frame erection for use by mobile work platforms for bolting up.
- Use quieter methods of construction e.g. bored piling rather than hammer driven.
- Facilitate erection of stairways as the frame is erected which can provide safe access to heights and a means of escape in case of fire.
- Structural designs should facilitate as far as reasonably practicable the incorporation of guardrails or similar edge protection.
- Avoid/minimise as far as reasonably practicable unusual designs that involve temporary instability during erection.
- Design to facilitate larger concrete pours, so reducing the need for noisy scabbling.

- Avoid/minimise the fire loading arising from materials and products stored and used in a structure under construction by specifying non/low flammable or combustible materials and products.
- Avoid/minimise finishes which involve noisy operations such as concrete scabbling.
- Do not specify fragile roofing material through which workers can fall.
- Specify light fittings that can be lowered or manoeuvred to floor or landing level for lamp or tube changing.
- Avoid/minimise low-level pipe runs in plant rooms.
- Plant room entrances should be designed (shape, size, access not via ladders) and plant rooms laid out to allow safe handling of plant and equipment.
- Equip plant rooms with lifting beams where heavy plant might have to be handled.
- Equipment providing mechanical and electrical services to the structure should include means of isolation from the electrical supply that is easily understood, i.e. laid out in the same sequence as the plant and clearly labelled.

- Maintenance: Reduce exposure by designing for reduced frequency of maintenance e.g. using low maintenance materials.
- Locate features such as road bridge piers in a position where workers carrying out repair on them are not brought into close proximity to traffic.
- Avoid/minimise features at height on roofs, e.g. plant rooms, which require frequent access for maintenance.
- Incorporate permanent walkways, platforms, travelling gantries across fragile roofs.
- On flat roofs specify permanent edge protections such as guardrails, parapet walls.
- Specify reversible windows that can be fully cleaned on both sides from within the building.

- Incorporate permanent walkways, platforms, travelling gantries at high/ceiling level, to clean atria, windows and skylights (internal and external).
- Provide anchors for safety lines where no other protection is available for window cleaning.

- Hazardous materials: most materials can be hazardous if not used in accordance with the manufacturer's recommendations. Consider the following insofar as is reasonably practicable:

  - Avoid using a potentially hazardous substance (for example, specify a natural finish rather than paint) or substitute with a safer substance (for example: specify water-based paints, glues, etc. which are generally safer than solvent-based ones; specify replacement of rotten timber rather than remedial treatment with pesticides – subject to Protected Structures legislation.
  - Avoid/minimise use in confined or difficult to ventilate areas.
  - Specify off-site production (where conditions are more easily controlled), e.g. factory finishing and decoration of components.
  - Avoid/minimise dust-producing processes. For example

    1. Avoid 'chasing' walls by designing to provide ducts and conduits, by routing pipes and wires through voids rather than wall thicknesses and using surface fixed conduit.

    2. Construction work in or near health care facilities in which immuno-suppressed patients are housed requires particular measures to minimize disturbance and dispersal of dust and dirt.

  - Specify substances and application methods which minimise atmospheric contamination, for example: paints which can be brushed rather than sprayed; fire protection board or sheet which can be fixed to steelwork, rather than fire spray.

APPENDIX 3:

Designers are advised that they should implement the following recommendations insofar as is reasonably practicable in the circumstances of any particular project:

(a) Fragile Roof lights & Sheeting:

Designers should specify “non-fragile” roofing materials.

(b) Overhead Cables etc.

The client, or the relevant designers on behalf of the Client, should request the local utilities - Electricity, Telecom, etc. - to move overhead cables in advance of the main contractor arriving on site. Where this is not possible, the movement of the overhead cables should be included in an ‘enabling works’ contract if one is proposed. If there is no ‘enabling works’ contract for the project, the lead designer should specify that the contractor arrange that overhead cables be moved at the earliest stage practicable in the construction programme

(c) Underground Services

A similar approach to the one proposed for the overhead cables is suggested. The relevant designer(s) should write to local utilities - Electricity, Gas, Water etc. - to request drawings/information regarding the nature and extent of the underground services in the area. The designer should then establish whether any of these underground services should be relocated. In the event that some of the underground services need to be relocated the designers should follow the same steps as those indicated above for overhead cables. Copies of all information obtained from utility suppliers regarding the location and nature of existing services in the area should be issued to contractors with the tender documentation, or as soon as available thereafter.

(d) On-site protective measures

The tender documentation should indicate that where contractors/sub-contractors may require fixing facilities for collective protective measures, such as hooks welded to steelwork for attaching safety netting or fixings in concrete for guardrails, such requirements should be determined in good time by the main contractor to allow early consent to be sought from the building designers.

(e) Excavations

Where excavations for basements, deep drains, etc. are necessary - particularly if close to the site boundary - designers should, where appropriate, highlight on the contract drawings that temporary supports to all excavations must be provided by the contractor as necessary. This is not intended to subvert or conflict with the normal contractual arrangement whereby it is the contractor’s specified responsibility, inter alia, to ensure that all excavations are properly supported under temporary conditions and to prevent damage during construction to adjoining lands and properties.

(f) Asbestos

Designers should make all reasonable efforts to establish if there is any asbestos present in an existing structure. If asbestos is present then the designer should advise the client to avoid disturbing the asbestos material if possible or, if not possible, determine whether or not the work needs to be carried out by a specialist contractor. Specialist contractors must always be employed where friable asbestos – e.g. asbestos lagging, coating or asbestos insulating board – is involved. The task guidance sheets in *'HSG210 – Asbestos Essentials: Task Manual'*, issued in 2001 by the UK Health and Safety Executive, may be used to develop a safe system of work and the contract documents should refer non-specialist contractors to these. When asbestos is to be removed, the designer should advise the client to arrange for its removal in an 'enabling works' contract in advance of the main contract. If there will be no "enabling works" contract for the project, the lead designer should specify that the contractor arrange that the asbestos be removed – by a specialist sub-contractor if necessary - at the earliest stage practicable in the construction.

(g) Maintenance etc.

Designers should consider the safety and health of persons using and maintaining places of work and must design them, insofar as is reasonably practicable, to be safe and without risk to health. Designers should take account of the general principles of prevention when considering the maintenance requirements of a building. Designers should design for reasonable and safe access to all items of plant and should consider how best to facilitate a safe system of maintaining the plant.

APPENDIX 4:

Examples are presented below that show how a designer might record decisions taken in relation to safety during construction and future maintenance, in regard to elements of the project for which the designer was responsible. The examples are indicative, not prescriptive – see paragraphs 23 and 24.

The first example – a structural engineer's record – is, for purposes of illustration, written up more formally and at greater length than needed to record health and safety issues and decisions. The other examples are what would be more likely to represent a designer's actual recording.

In these examples, safety matters are shown as being considered at particular design stages, but this may not always be necessary, e.g. in the case of small projects, or where the total design-stage time is short, all safety related matters might be recorded without reference to stages. On the other hand, if design modifications take place during the construction stage, a further record sheet may be required.

These records could be retained on the designer's file for the project and would constitute evidence that safety matters, in addition to other considerations, had been taken into account in the design at the design stage – see the main text, paragraphs 23 and 24.

Designer's Assessment of Safety during Construction and Maintenance taking account of the Principles of Prevention			
Company name	Project: Ref:	Designer:	Date:
		Checker:	Sheet no:

Design Stage:

No.	Key hazards identified	Decisions/action

Items to be drawn to the attention of contractor(s):

Example 1 – Structural Engineer

In this example the designer is the structural engineer providing professional services where the designer is part of a design team led by an architect.

The proposed project involves the construction of a large single storey industrial unit with ancillary office areas and a basement plant room. The site adjoins a river that has the potential to flood the lower part of the area on which it is proposed to construct the factory; final ground levels after construction will be above this flood level. Soil investigations indicate approximately 1.5m of fill, possibly contaminated, under the proposed footprint of the building and a water table level just below the level of the fill. There are no known underground services in the areas of construction; overhead lines are being looked after by the services consultant.

As already noted, this example is, for purposes of illustration, written up more formally and at greater length than would normally be considered necessary to record health and safety issues and decisions.

Designer's Assessment of Safety during Construction and Maintenance taking account of the Principles of Prevention			
Company name	Project: Ref:	Designer:	Date:
		Checker:	Sheet no:

Design Stage: *Concept*

No.	Key hazards identified	Decisions/action
1	*Construction in ground with high water table*	*Elimination/mitigation by re-locating building requires action by Project Coordinator (Design Stage)/design team. Referred to Project Coordinator (Design Stage) the possibility of re-locating but this was considered impracticable. Risk mitigated by omitting the basement and re-locating the plant room.*
2	*River flooding during construction*	*Ditto*
3	*Construction in contaminated soil*	*Re-location of building away from area of contaminated soil not practical but Project Coordinator (Design Stage)/design team agreed contaminated soil would be specified to be removed by a specialist sub-contractor from beneath the building before general construction commences.*

Items to be drawn to the attention of contractor(s):

Nos. 1 and 2, being "Particular Risks", will be noted in the Preliminary Health and Safety Plan
No. 3: Removal of contaminated soil to be in the project specification and noted in the Preliminary Health and Safety Plan.

Designer's Assessment of Safety during Construction and Maintenance taking account of the Principles of Prevention			
Company name	Project: Ref:	Designer:	Date:
		Checker:	Sheet no:

Design Stage: *Scheme design (sheet 1 of 2)*

No.	Key hazards identified	Decisions/action
1	*Erection of structural frame to production area*	*Practical design options are steel or precast concrete. Neither has any inherent abnormal risks and it is considered neither will offer any significant overall advantage over the other with regard to safety during construction or maintenance.* *For other reasons steel is selected. The design will allow the sub-contractor to fabricate as large sections as possible off-site. Shop painting, rather than site applied, will be specified. On-site welding will be avoided as much as possible.* *Advise the Project Coordinator (Design Stage)/design team that consideration be given to minimizing features that require loose secondary steel (e.g. rooflights, irregular windows etc.)*
2	*Office area structure*	*The office area is irregular, indicating for the first floor in-situ concrete as the simplest form of construction thus minimising hazards. Detailed design will standardise beam/slab/column sizes as much as reasonably practicable.* *The architect requires the slab to cantilever in a manner which, in the temporary condition, could be unstable; the contractor will be provided with sufficient information to enable him develop a safe construction sequence.*

Items to be drawn to the attention of contractor(s):

Item 1: Note on drawings or in the specification that off-site fabrication should be maximised

Item 2: Information on drawings Regarding cantilever slab stability; noted also in Preliminary Health and Safety Plan.

Designer's Assessment of Safety during Construction and Maintenance taking account of the Principles of Prevention			
Company name	Project: Ref:	Designer:	Date:
		Checker:	Sheet no:

Design Stage: *Scheme design (sheet 2 of 2)*

No.	Key hazards identified	Decisions/action
3	*Substructures*	*It has been decided that contaminated soil will be removed by a specialist sub-contractor. Then, by removing also the remaining layer of soft silt, either granular fill suitable to support a floating ground floor slab, or other fill but with a suspended concrete floor can be used. The former is chosen, in consultation with the Project Coordinator (Design Stage)/design team, on cost, flexibility and safety grounds.* *Foundation types considered were piles, raft or bases/strip footings. Piles are not cost effective with good ground at just 1.5 to 2.0m depth. Bases/strips were chosen. Mass concrete will be used to minimise construction time below ground.*
4	*Roofing*	*Non-fragile roof decking will be used for safety during construction and maintenance. (Note: Other members of the design team are considering matters such as rooflights, roof profiles to minimise internal gutters, access for and protection during external cleaning, etc)*
5	*Atrium*	*A glazed atrium is required for architectural reasons and internally this is to be cleaned from a platform hoist. The floor slab will be designed to cater for the loading imposed by the intended hoist. If hooks for maintenance safety harnesses are also required (as determined by the architect), the steel fabricator will be referred to the architect's requirements for these. The location and extent of holes/hooks in structural members for erectors safety harnesses to be determined by the fabricator/erector and submitted for the structural engineer's consent.*

Items to be drawn to the attention of contractor(s):

Item 3: Tenderers/contractor's attention will be drawn, by way of a note on the drawings and reference in the Preliminary Health and Safety Plan, to the risk from flooding and high water table that must be controlled by pumping and/or other suitable measures. Also, highlight on the drawings the specification requirement that temporary supports to all excavations must be provided by the contractor as necessary.

Item 5: Various relevant notes to go on the drawings

Designer's Assessment of Safety during Construction and Maintenance taking account of the Principles of Prevention			
Company name	Project: Ref:	Designer:	Date:
		Checker:	Sheet no:

Design Stage: *Detailed design*

No.	Key hazards identified	Decisions/action
		Decisions made in the last stage are carried through to final detailing/specification, including: o *Low maintenance painting spec. finalised in consultation with the architect* o *Bolted site connections specified* o *Information provided regarding office cantilever slab sufficient to enable the contractor develop a safe construction sequence* o *Harness hook points as required for atrium cleaning noted on steelwork general arrangement drawings.* *Generally details are simplified and standardised as much as reasonably practicable.* *Minimum of 4 holding down bolts will be specified for all braced- bay columns.* *No particular erection sequence is necessitated by the design and therefore none will be stipulated.*

Items to be drawn to the attention of contractor(s):

As noted at Concept and Scheme Design stages

Example 2 Civil Engineer

In this example the designer is the civil engineer, providing professional services.

The proposed project involves the construction of a sewage pumping station incorporating underground pump sump and valve chambers and a single storey superstructure to contain control equipment, standby generator, etc. The depth of the sump below ground level is 13.0m and the plan area is 240m^2. The water table is affected by the rise and fall of the tide and at high water spring tides is about 0.5m below ground. The ground investigation has revealed made ground and soft alluvial silts and sands to 7.0m depth over very stiff boulder clay and glacial gravels, both with cobbles and boulders. The site is confined; there is a railway line on one side and a warehouse on the other, both about 5.0m from the pump station wall. The site is adjacent to a former gas works and contains some contaminated soil. Responses from enquiries to utilities indicate that there are no underground services in the area of construction. However a 10kV overhead power line crosses the site.

Designer's Assessment of Safety during Construction and Maintenance
taking account of the Principles of Prevention

Company name	Project: Ref:	Designer:	Date:
		Checker:	Sheet no:

Design Stage: *1*

No.	Key hazards identified	Decisions/action
1.	Deep Excavation	*Consider construction method* *Get geotechnical advice*
2.	*Contaminated Land*	*Specify prior removal/ disposal*
3.	*Deep Sumps (maintenance)*	*Ladders / stairs / landings / handrails*
4.	*Sewer Gas (also maintenance)*	*Ventilation* *Zoned areas*
5.	*Overhead power line*	*Discuss diversion with the public utility company*

Items to be drawn to the attention of contractor(s):

1. *Specify that cofferdam be used*
2. *Preliminary Health and Safety Plan*
3. *Preliminary Health and Safety Plan*
4. *Include in contract (nominated subcontract with the public utility company)*

Designer's Assessment of Safety during Construction and Maintenance
taking account of the Principles of Prevention

Company name	Project: Ref:	Designer:	Date:
		Checker:	Sheet no:

Design Stage: *2*

No.	Key hazards identified	Decisions/action
1.	*Deep Excavation*	*See geotechnical report* *Secant piling recommended* *Design structure as recommended*
2.	*Contaminated Land*	*Specify prior removal* *Estimate quantity*
3.	*Deep Sump (maintenance)*	*Stairs where possible* *Landings* *Handrails*
4.	*Sewer gas (also maintenance)*	*Ventilation system, 10 air changes /hr* *Zoned area/ explosion proof motors/lights* *Provide breathing apparatus*
5.	*Overhead power lines*	*Specify prior diversion by the public utility company*

<u>Items to be drawn to the attention of contractor(s):</u>

1. *Preliminary Health and Safety Plan*
2. *Preliminary Health and Safety Plan*
4. *Preliminary Health and Safety Plan*
5. Preliminary Health and Safety Plan

Example 3 Services Engineer

In this example the designer is the building services engineer providing full design, site inspection and cost control service as a member of a design team comprising, Client, Architect, Structural Engineer, Building Services Engineer and Quantity Surveyor.

The project is to provide a factory / warehouse/ office unit in suburban location. There appears to be mixed fill used on the site previously.

There is a high tension electrical network bordering the site and the National gas network is adjacent.

The intended use of the factory is light engineering involving pressings, cuttings, finishings, assembly and packaging.

Designer's Assessment of Safety during Construction and Maintenance
taking account of the Principles of Prevention

Company name	Project: Ref:	Designer: Checker:	Date: Sheet No:

Design Stage: *1 Outline*

No.	Key Hazards Identified	Decisions / Action
1.	*Utility Services*	*a. Divert high tension line, overhead* *b. Divert underground gas* *c. Fire main will cross over drain*
2.	*Overhead Services*	*Divert before contractor takes site.*
3.	*Pylons, Masts or Lightning Conductors*	*a. Safety Plan – Earthing provisions* *b. Test facilities*
4.	*Low Level Terrain*	*Structural Engineer/ Architect on flooding protection.*
5.	*Ground Gases*	*Note for detail design.*
6.	*Fuel Storage*	*Oil remote from unit on development plan, no special provisions for gas.* *Testing safety systems*
7.	*Boiler House*	*Location at ground level on perimeter of building unit – direct National ventilation provided.* *Heavy plant access*

<u>Items to be drawn to the attention of tenders/ contractors:</u>

1. a, b & c Site services drawings
3. Inform Project Coordinator Design Stage and note for testing section of electrical specification.

Designer's Assessment of Safety during Construction and Maintenance taking account of the Principles of Prevention

Company name	Project:	Designer:	Date:
	Ref:	Checker:	Sheet No.

Design Stage: *2 Detail Design (sheet 1)*

No.	Key Hazards Identified	Action
1.	Underground Services	Sub-station provided – power to run in underfloor ducts. Keep vents clear, protected from heavy traffic.
2.	Overhead Services	High tension services have been diverted. Telephone cables to be marked.
3.	Pylons, Masts or Lightning Conductors	Lightning protection to be provided at early stage. Testing points included.
4.	Sump Types	Pumps to be installed and commissioned before completion of contract. Fall arrestor, wash down, emergency light and ventilation provided, emergency alarm included
5.	Ground Gases	Vents to air being provided in all aprons adjoining building. Vents to be kept clear and clean.
6.	Building Envelope for Gas Penetration	Test voids for noxious gases. No history of gases.
7.	Safe Access	Fixed ladders provided to overhead services with walkways and platforms Platforms have attention arrestor rails. Ducts have width for walking and ventilation provided. Protection rails at switchboards.

Items to be drawn to the attention of tenders/ contractors:

Designer's Assessment of Safety during Construction and Maintenance taking account of the Principles of Prevention			
Company name	Project: Ref:	Designer: Checker:	Date: Sheet No.

Design Stage: *2 Detail Design (Sheet 2)*

No.	Key Hazards Identified	Action
8.	*Electrical Plant*	*Protection barrier in warehouse area door fixers on distribution boards, yellow men for restricting passers bye at distribution boards.*
9.	*Mechanical Plant*	*Heavy lifting beams included. All tanks to have full arrestor ladders and hoops.*
10.	*Testing*	*Safety systems listed for routine test.* *Schedules for maintenance provided.*

Items to be drawn to the attention of tenders/ contractors:

1. Add notes to site drawings.
2. See certification.
3. Test records.
4. All drainage to be tested.
7. Check all access provisions.
9. Test certificates.

Example 4 Architect

In this example the architect is the design team leader and is also acting as Project Coordinator for the design stage.

The proposed project involves the construction of a large single story industrial unit with ancillary office areas and a basement plant room. The site adjoins a river that has the potential to flood the lower part of the area on which it is proposed to construct the factory; final ground levels after construction will be above this flood level. Soil investigations indicated approximately 1.5m of fill, possibly contaminated, under the proposed footprint of the building and a water table level just below the level of the fill. There are no known underground services in the areas of construction; overhead lines are being looked after by the services consultant.

Designer's Assessment of Safety during Construction and Maintenance taking account of the Principles of Prevention

Company name	Project: Ref:	Designer:	Date:
		Checker:	Sheet no:

Work Stage: 1 - Inception and General Studies

No.	Key hazards identified	Decisions/action
1	Client indicates site subject to flooding	Initial appraisal indicates that relocation is not an option for Client. Further survey will be required – input from civil engineer.
2	Overhead power lines	Diversion of lines required. Establish if Client will agree to pre-contract removal. Contact made with the public utility company.

Items to be drawn to the attention of contractor(s):

1 Being a "Particular Risk", will be noted in the Preliminary Health and Safety Plan

2 Being a "Particular Risk", will be noted in the Preliminary Health and Safety Plan

Designer's Assessment of Safety during Construction and Maintenance taking account of the Principles of Prevention

Company name	Project: Ref:	Designer:	Date:
		Checker:	Sheet no:

Work Stage: 2 - Outline proposals

No.	Key hazards identified	Decisions/action
1	Survey establishes high water table	Consider eliminating proposed basement and basement plant room
2	Survey establishes contaminated ground	Relocation not an option for client. Contaminated soil to be removed by specialist contractor in enabling works pre-contract as recommended by civil engineer.
3	Production Area	Structural engineer advises no abnormal risks in steel frame proposed and off site fabrication can be facilitated
4	Office	Basement removed – plant on roof. Slab cantilever discussed with structural engineer who will inform contractor to enable him to develop a safe construction sequence.

Items to be drawn to the attention of contractor(s):

1 Being a "Particular Risk", to be noted in Preliminary Health and Safety Plan
2 Ditto
4 Info on drawings in relation to cantilever slab and noted in the Preliminary Health and Safety Plan

Designer's Assessment of Safety during Construction and Maintenance
taking account of the Principles of Prevention

Company name	Project: Ref:	Designer:	Date:
		Checker:	Sheet no:

Work Stage: 3 - Scheme Design

No.	Key hazards identified	Decisions/action
1	Atrium	Client change to programme requires greater reception/display/social space. Exising open court to be glazed as atrium. Internal cleaning by cherry picker as permanent access not possible. Discuss and inform structural engineer with specialist location of fixings for safety harnesses.
2	Roofing	Non-fragile roof, rooflights to be used. Provision made for access to plant, external cleaning etc. Permanent perimeter edge protection can be provided
3	Maintenance	.Maintenance of completed building: • Low maintenance paint spec • Low maintenance external cladding • Windows to be cleaned from inside building

Items to be drawn to the attention of contractor(s):

1 Atrium being a "Particular Risk", to be noted in the Preliminary Health and Safety Plan and as noted in Stages 1 & 2

Designer's Assessment of Safety during Construction and Maintenance taking account of the Principles of Prevention

Company name	Project: Ref:	Designer:	Date:
		Checker:	Sheet no:

Work Stage: 4 and 5 - Detail Design/Building Regulations, Production Information

No.	Key hazards identified	Decisions/action
1	Assessments from structural engineer, civil engineer and services consultants	As noted in each Assessment. Design and specifications changes not required. Decisions made in previous stages to be carried through in final drawings/specifications including: • Atrium cleaning fixings • Structural systems • Non-fragile roofing and rooflights • Cleaning access/maintenance • Perimeter protection • Plant access/maintenance • Structural engineer, civil engineer and services consultants and confirm all spec/drgs items carried through in their drgs/specs.
2	Power Lines	Client does not want pre-contract removal. Inform contractor of need to move lines at earliest stage in the contract.

Items to be drawn to the attention of contractor(s):

As noted in Stages 1, 2, 3, 4 and 5