Design Risk Assessment Procedure

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1. Introduction

Design risk assessments have a key role in reducing accidents and reportable incidents on the construction site. The present document contains the procedure followed during the design stage for the identification of hazards, the evaluation of risks, the design of mitigation measures, and the management of risk. It also outlines the training requirements for Engineers carrying out such risk assessments.

The present procedure was developed to fulfil the designer's responsibilities set out in the Construction (Design and Maintenance) Regulations 2015.

2. Objectives

The objectives of this procedure are the following:

1. To fulfil the designer's responsibilities set out in the Construction (Design and Maintenance) Regulations 2015.
2. To ensure a systematic approach for conducting design risk assessments.
3. To foster a culture of risk awareness within the consultancy.
4. To set out the training requirements for engineers carrying out design risk assessments.
5. To elevate the image of the consultancy.

3. Scope

The principles included in the present procedure are applicable to the risk assessment for all designs undertaken by the consultancy. Adherence to the procedure is deemed to fulfil the responsibilities of the designer set out in the Construction (Design and Maintenance) Regulations 2015.

4. Definitions

The following definitions are used throughout the present procedure:

Hazard	The potential to cause injury, harm, illness, loss, or damage.
Consequence	The outcome of a hazard being realised.
Likelihood	The probability of the hazard being realised.
Risk	The combination of the severity and likelihood of the hazard being realised.

5. Duties and Responsibilities

5.1. Director

The Director of the consultancy has the overall duty for the risk management. He is responsible for the development and revision of the design risk assessment procedure, and its correct execution.

5.2. Design Engineer

Design Engineers are responsible for developing design risk assessments for every design they undertake. They are also responsible for communicating the risks to the other dutyholders through the principal designer.

5.3. Checking Engineer

Checking Engineers are responsible for reviewing the design risk assessments for each design check they undertake. Designs should be approved only if all hazards have been adequately identified, evaluated, mitigated, and communicated.

6. Procedures

6.1. Identify the hazards

The first step in the risk assessment procedure is to adequately identify the hazards. The four most important categories of hazards relevant to construction projects are the following:

1. Health and Safety
2. Structural
3. Programme
4. Environmental

To adequately understand the nature of the hazard engineers should understand the construction activity that creates it, its causes, the way in which it occurs, and its consequences. Fundamental towards this goal is the acquisition of all relevant pre-construction information there is available.

6.2. Determine who/what may be harmed

Who or what is affected from the hazard should be determined, and the consequences on them. The correct appreciation of the consequences is a key factor in determining the mitigation measures.

6.3. Evaluate the risk and design mitigation measures

Having identified the hazards, the next step is to evaluate the risk. To evaluate the risk the Design Engineer should evaluate the likelihood of occurrence, and the impact of the consequences. This task is quite subjective, as it depends on the judgement of each engineer. The likelihood of occurrence is given a score between 1-5, as shown in Table 1. The impact of the consequences is given a score between 1-5, shown in Table 2, that reflects the severity of the hazard being realised, for each of the hazard categories. The risk score is calculated using the following equation:

$$Risk\ Score = Likelihood\ Score \cdot Impact\ Score$$

Score	1	2	3	4	5
Characterization	Remote	Unlikely	Possible	Likely	Almost Certain
Description	May occur in exceptional situations	Not expected to occur under normal conditions, but could occur	May occur at some time, particularly if other conditions are present	Expected to occur at some time, but not a persistent issue	Considered almost certain to occur and is a persistent issue

Table 1. Likelihood score.

Score	1	2	3	4	5
Health and Safety	Minor injury not requiring first aid	Minor injury requiring first aid	Major injury requiring medical treatment	Major injury resulting in long term incapacity/ Fatality	Multiple fatalities
Programme	No noticeable delay	Minor delay (hours)	Substantial delay (days)	Major delay (weeks/ months)	Project objectives cannot be met
Structure	No noticeable damage	Minor structural damage	Major structural damage	Partial structural failure	Complete structural failure
Environmental	No noticeable pollution	Minor pollution	Major pollution	Wide scale temporary pollution	Wide scale long-term pollution

Table 2. Impact score.

Having calculated the risk score, the Design Engineer determines the appropriate action for the risk management. The decision for the risk management requires critical judgement and experience. As a guideline, Table 3 shows the recommended actions. Also, Table 4 depicts the risk score matrix, showing the likelihood, impact, and risk scores, and the corresponding action colour.

Risk Score	Risk Level	Measure	Recommended Action
1-4	Low	Tolerate	Risk can be tolerated. No further action needed.
5-9	Moderate	Reduce	Risk can be reduced usually through site measures, such as using personal protective equipment.
10-14	High	Control	Risk can be controlled usually through design measures, such as edge protection.
15-25	Extreme	Eliminate	Risk should be eliminated by avoiding or terminating the related activities altogether.

Table 3. Risk level and recommended action.

		Likelihood				
		1	**2**	**3**	**4**	**5**
Impact	**5**	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5

Table 4. Risk score matrix.

The inherent risk of each hazard (before any mitigation measures) is called “Initial Risk”. If the initial risk score is 5 or higher, the Design Engineer should try to reduce it. For scores between 5-9 the risk can usually be reduced through site measures, e.g. using personal protective equipment. For risk scores between 10-14 the risk can usually be reduced through design measures, e.g. edge protection. Having designed the mitigation measures, the residual risk score is evaluated again; the risk at this stage is called “Residual Risk”. This is essentially an iterative procedure until the risk score is reduced to the minimum possible value.

If the design measures are not sufficient to reduce the risk score to below 10, the situation is escalated to the Director. The Director is responsible for taking appropriate action. Examples of such actions are (1) to terminate the hazardous activity altogether, (2) to request a re-design of the structure from the client with significant revisions that reduce the particular risk, or (3) to transfer the risk to another dutyholder. Only in rare cases the Director should allow the continuation of activities with risk score is between 10-14, so long that the risk has been communicated to the other dutyholders through the principal designer. If the risk score is 15 or higher in categories Health and Safety, Structural, Environmental, the Director is obliged to terminate the hazardous activity.

6.4. Communicate residual risks

Having evaluated the risks and designed the control measures, the residual risks should be communicated to the other dutyholders through the principal designer. Residual risks with score less than 5 can be ignored. Risks are communicated in the following two ways:

1. Notes on the construction drawing under the heading “Safety, Health and Environmental Risks” that should state the hazard and the required action.
2. A Design Risk Assessment Register, using the template included in Appendix A.

7. Training Requirements

Engineers undertaking design risk assessments should have adequate training and professional experience. Training is substantiated through a course on the Construction (Design and Management) Regulations 2015, and on risk assessment. Training requirements can be waived if Engineers demonstrate acceptable performance in developing design risk assessments for a period of at least one year. Professional experience is substantiated through the Chartered Engineer title, and membership at Member level to the Institution of Civil Engineers, or the Institution of Structural Engineers.

8. Monitoring Compliance with Procedure

The present procedure will be monitored by the Director in various ways. This includes periodic auditing of the delivered design risk assessments. Such audits could be random or project-specific.

Appendix A. Design Risk Assessment Register

J&A Theophilou Consulting Engineers (UK) Ltd

Project Name		**Doc. Ref.**	
Brief Ref.		**Designer**	
Description		**Date**	

Design Risk Assessment

HEALTH AND SAFETY										
ID	**Hazard**	**Consequence**	**Initial Risk**			**Control Measures**	**Residual Risk**			**Action**
			L	**I**	**Risk**		**L**	**I**	**Risk**	
1										
2										