

BS 5975:2008+A1:2011



BSI Standards Publication

Code of practice for temporary works procedures and the permissible stress design of falsework

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Foreword

Publishing information

This British Standard is published by BSI and came into effect on 31 December 2008. It was prepared by Subcommittee B/514/26, *Falsework* on behalf of Technical Committee B/514, *Access and support equipment*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes BS 5975:2008, which is withdrawn.

Information about this document

The start and finish of text introduced or altered by Amendment No. 1 is indicated in the text by tags **A1** **A1**.

A report on falsework by the Joint Committee of the Institution of Structural Engineers and the Concrete Society [1] was published in 1971, following a number of significant collapses and an apparent lack of authoritative guidance.

A further significant collapse of falsework (over the river Loddon, near Reading) occurred in October 1972, resulting directly in the publication of the Bragg Report [2] in 1973/74.

This code of practice was first published in 1982. It reflected the recommendations of the Bragg Report [2] and used, as the main reference document during the drafting stages, the report on falsework by the Joint Committee of the Institution of Structural Engineers and the Concrete Society [1].

It is believed that when first published, no previous standard or code referring to falsework was known to exist anywhere in the world.

The standard drew together all those aspects that need to be considered when preparing a falsework design using permissible stress methods, and in so doing included recommendations for materials, design and work on site. Because the success of falsework is closely tied up with its management, this code described procedures as well as technical aspects. The standard provided guidance on the accuracy of construction required in order to be able to adopt the recommended design approaches.

Recommendations were given on the actions that ought to be taken and possible ways of allocating the duties to individuals. The Bragg Report [2] recommended that the duty of ensuring that all the relevant procedures and checks are carried out be given to one individual in the construction organisation, such an individual being known as the “temporary works co-ordinator”. BS 5975:1982 endorsed such action, but adopted the narrower term “falsework co-ordinator”, because the procedures section of the code did not consider the other activities covered by the general term temporary works, such as scaffolding and excavations. This edition, incorporating procedures for all temporary works, has reverted to the term “temporary works co-ordinator”. A full description of the duties of the temporary works co-ordinator is included. **A1** This standard re-emphasizes the Bragg Report [2] recommendations that the temporary works co-ordinator be an individual employed by the construction organization now known as the principal contractor, or

on projects which are not notifiable under CDM 2007 [8], the main contractor. This principle is similarly preferred for the appointment of any temporary works supervisor. ^{A1}

A second edition of the standard was published in 1996.

The European standard on falsework, BS EN 12812:2004 was published in 2004 and exists in parallel with this standard. It specifies performance requirements for the design of falsework in accordance with one of three classes: A, B1 and B2. Limit state design methods are specified for design classes B1 and B2. It does not provide guidance for the structural design of Class A.

BS EN 12812:2004 does not provide guidance on procedures necessary for the successful management of work on site. The recommendations of the Advisory Committee on Falsework (the Bragg Report [2]) in respect of the falsework co-ordinator have not been included in it.

The foreword of this standard was amended in 2004, immediately following the publication BS EN 12812:2004.

^{A1} Subsequent to the publication of BS EN 12812:2008, the drafting committee has taken the opportunity to update the majority of this standard, retaining the principles of permissible stress design. The principal changes introduced by this amendment are as follows.

- The term temporary works co-ordinator (TWC) has been adopted to reflect the need for procedural controls of all temporary works and to recognize that the majority of contractors already control temporary works in this manner.
- Compliance with the Construction (Design and Management) Regulations 2007 (COM) [3], [8] has been incorporated, particularly in respect to the interface between the design of permanent works and the design of temporary works.
- This amendment to BS 5975 introduces wind loading to BS EN 1991-1-4:2005+A1 and the UK National Annex (NA). The background information in PD 6688-1-4:2009 has also informed this revision.
- Information on the wind load on formwork attached to falsework, together with the effects of shielding of falsework members in unclad structures, has been retained from the previous edition of this code.
- The section for the design of falsework has been substantially rewritten to bring it up-to-date with current practice and materials. It now defines the conditions for top restrained and free standing falsework and the dependency of the former on the stability of the permanent works and plate action of the formwork.

Although the wind code BS EN 1991-1-4:2005+A1 is widely applicable, its application in accordance with NA to BS EN 1991-1-4:2005+A1 restricts its use to the UK. For other locations covered by BS EN 1991-1-4:2005+A1, refer to the relevant National Annex. For locations outside of those covered by BS EN 1991-1-4:2005+A1 local design codes are to be used to calculate the peak velocity pressure.

Users of this standard are reminded that it might be necessary for them to appraise third parties with whom they are in contractual relations of certain provisions in the code. ^{A1}

Use of this document

As a code of practice, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

Any user claiming compliance with this British Standard is expected to be able to justify any course of action that deviates from its recommendations.

Presentational conventions

The provisions in this standard are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is "should".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

Section 1: General

1 Scope

This British Standard gives recommendations and guidance on the procedural controls to be applied to all aspects of temporary works in the construction industry. It also includes guidance on design, specification, construction, use and dismantling of falsework. This standard gives guidance on permissible stress design of falsework. This guidance is also applicable to the design of what is termed class A falsework¹⁾ in BS EN 12812:2004, the design of which is specifically excluded from BS EN 12812:2004.

Section 2 gives recommendations for the procedures required to ensure that temporary works are conceived, designed, specified, constructed, used and dismantled all in a safe and controlled manner.

Section 3 covers the design of temporary works and in particular the design of falsework and relevant formwork. In addition Section 3 covers: materials including material factors; loads and load factors; design of falsework, including both proprietary equipment and traditional scaffolding solutions; wind loading (reference to temporary and permanent stability) and reference to other British Standards for the design of structural steelwork, reinforced concrete and excavation support.

The structural design element in this standard is additional information necessary for the structural design of falsework. It can be used in conjunction with existing structural standards.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 449-2:1969, *Specification for the use of structural steel in building – Part 2: Metric units*

BS 648, *Schedule of weights of building materials*

BS 1139-1, *Metal scaffolding – Part 1: Tubes – Specification for tubes used in scaffolding (superseded)*

BS 1881-115, *Testing concrete – Part 115: Specification for compression testing machines for concrete*

BS 1881-116, *Testing concrete – Part 116: Method for determination of compressive strength of concrete cubes*

BS 1881-117, *Testing concrete – Part 117: Method for determination of tensile splitting strength*

¹⁾ According to BS EN 12812, design class A is only to be adopted where:

- a) slabs have a cross-sectional area not exceeding 0.3 m² per metre width of slab;
- b) beams have a cross-sectional area not exceeding 0.5 m²;
- c) the clear span of beams and slabs does not exceed 6.0 m;
- d) the height to the underside of the permanent structure does not exceed 3.5 m.

BS 1881-118, *Testing concrete – Part 118: Method for determination of flexural strength*

BS 1881-119, *Testing concrete – Part 119: Method for determination of compressive strength using portions of beams broken in flexure (equivalent cube method)*

BS 1881-120, *Testing concrete – Part 120: Method for determination of the compressive strength of concrete cones*

BS 4074:1982, *Specification for metal props and struts (withdrawn)*

BS 4978:1996, *Specification for visual strength grading of softwood*

BS 5268 -2:2002, *Structural use of timber – Part 2: Code of Practice for permissible stress design, materials and workmanship*

BS 5507-1, *Methods of test for falsework equipment – Part 1: Floor centres*

BS 5507-3, *Methods of test for falsework equipment – Part 3: Props*

BS 5628-1, *Code of practice for the use of masonry – Part 1: Structural use of unreinforced masonry*

BS 5756:2007, *Specification for visual strength grading of hardwood*

BS 5930:1999, *Code of practice for site investigations*

BS 5975:1996+A2:2004, *Code of practice for falsework*

BS 5975:2008, Code of practice for temporary works procedures and the permissible stress design of falsework

BS 6399-1, *Loading for buildings – Part 1: Code of practice for dead and imposed loads*

BS 6399-2:1997, *Loading for buildings – Part 2: Code of practice for wind loads*

BS 8002, *Code of practice for earth retaining structures*

BS 8004:1986, *Code of practice for foundations*

BS 8110-1, *Structural use of concrete – Part 1: Code of practice for design and construction*

BS 8110-2, *Structural use of concrete – Part 2: Code of practice for special circumstances*

BS 8110-3, *Structural use of concrete – Part 3: Design charts for singly reinforced beams, doubly reinforced beams and rectangular columns*

BS 8118-1, *Structural use of aluminium – Part 1: Code of practice for design*

BS 8118-2, *Structural use of aluminium – Part 2: Specification for materials, workmanship and protection*

BS EN 39:2001, *Loose steel tubes for tube and coupler scaffolds – Technical delivery conditions*

BS EN 74-1, *Couplers for steel tube – Requirements and test procedures*

BS EN 1011-1, *Welding – Recommendations for welding of metallic materials – Part 1: General guidance for arc welding*

BS EN 1011-2, *Welding – Recommendations for welding of metallic materials – Part 2: Arc welding of ferritic steels*

BS EN 1065:1999, *Adjustable telescopic steel props – Product specifications, design and assessment by calculation and test*

BS EN 1313-1:1997, *Round and sawn timber – Permitted deviations and preferred sizes – Softwood sawn timber*

BS EN 1313-2:1999, *Round and sawn timber – Permitted deviations and preferred sizes – Hardwood sawn timber*

BS EN 1991-1-1, *Eurocode 1 – Actions on structures – General actions – Densities, self-weight, imposed loads for buildings*

BS EN 1992-1-1, *Eurocode 2 – Design of concrete structures – General rules and rules for buildings*

BS EN 1991-1-4:2005+A1:2010, *Eurocode 1: Actions on structures – Part 1-4: General actions – Wind actions* 

BS EN 10025-2:2004, *Hot rolled products of non-alloy structural steels – Technical delivery conditions*

BS EN 12811-1:2003, *Temporary works equipment – Part 1: Scaffolds – Performance requirements and general design*

BS EN 12812:2004, *Falsework – Performance requirements and general design*

BS EN 12812:2008, *Falsework – Performance requirements and general design* 

BS EN 12813, *Temporary works equipment – Load bearing towers of prefabricated components – Particular methods of structural design*

BS EN 1991-1-4:2005+A1:2010, *UK National Annex to Eurocode 1 – Actions on structures – Part 1-4: General actions – Wind actions*

PD 6688-1-4:2009, *Background information to the National Annex to BS EN 1991-1-4 and additional guidance* 

3 Terms and definitions

For the purposes of this standard, the following terms and definitions, together with those given in Annex E apply.

3.1 adjustable telescopic steel prop

prop comprised of two tubes which are telescopically displaceable within each other

NOTE 1 See also *prop*.

NOTE 2 A prop has coarse adjustment with a pin inserted into holes in the inner tube and a means of fine adjustment using a threaded collar.

3.2 backpropping

propping installed at levels below the slab that supports the falsework in order to distribute the load on the uppermost slab to suitable supports, such as lower slabs or the foundations

3.3 base plate

rigid plate used for spreading the load in a standard, raker or other load-bearing member over a greater area

3.4 bay length

distance between the centres of two adjacent standards, measured horizontally

- 3.5 beam bearer**
spanning member, usually horizontal, used to transfer load to supports, commonly timber, aluminium or steel
- 3.6 blinding**
layer of lean concrete on soil to prevent local degradation and provide a clean workplace for construction work
- 3.7 brace bracing**
component placed diagonally with respect to the vertical or horizontal members of a structure to afford stability
- 3.8 camber**
internal curvature of a beam or formwork, either formed initially to compensate for subsequent deflection under load, or produced as a permanent effect for aesthetic reasons
- 3.9 characteristic strength**
strength at which members tested would fail, normally associated with a confidence limit that 95% would fail above the value stated
- 3.10 Checks**
- 3.10.1 check**
inspection on site to determine whether the temporary works have been constructed in accordance with the design
- 3.10.2 design check**
evaluation of the design to determine whether it conforms with the design brief and can be expected to provide a safe engineered solution
- 3.11 competent person**
person with sufficient knowledge of the specific tasks to be undertaken and the risks which the work will entail, and with sufficient experience and ability to enable them to carry out their duties in relation to the project, to recognize their limitations, and to take appropriate action in order to prevent harm to those carrying out construction work, or those affected by the work
- NOTE Modified from HSE CDM2007 [3].*
- 3.12 component**
part of the temporary works structure used and identifiable as a distinct unit
- 3.13 coupler**
component used to fix scaffold tubes together
- 3.14 effective length**
theoretical length of a compression member as determined by the restraint at its ends
- 3.15 factor of safety**
ratio of failure load to the maximum working load
- 3.16 falsework**
temporary structure used to support a permanent structure while it is not self-supporting

- 3.17 floor centre**
beam of adjustable length, usually a metal lattice or sheet metal box beam, used to support decking for a floor slab
- 3.18 forkhead**
U-shaped housing used to support bearers, beams, joists or similar
- 3.19 formwork forms**
structure, usually temporary, but in some cases wholly or partly permanent, used to contain poured concrete to mould it to the required dimensions and support it until it is able to support itself
NOTE Formwork consists primarily of face-contact material and the bearers that directly support the face-contact material.
- 3.20 frame**
principal panel unit of a prefabricated falsework structure formed from aluminium or steel sections
NOTE A frame can include connecting components.
- 3.21 grade stress**
stress that can be safely sustained by timber of a particular strength class, or species and grade
- 3.22 joint pin**
expanding fitting placed in the bore of a tube to connect one tube to another coaxially
- 3.23 joist**
small horizontal or sloping member, e.g. the horizontal members that carry decking for a suspended concrete slab
- 3.24 kentledge**
material placed on a structure to provide stability by the action of its dead weight
- 3.25 lacing**
generally horizontal members that connect together and reduce the unsupported length of compression members
- 3.26 node**
theoretical point where two or more members are connected together
- 3.27 permissible stress**
stress that can be sustained safely by a structural material under stress for the particular condition of service or loading
- 3.28 permit to load**
certificate issued to indicate that the temporary works may safely be put to its designed use
- 3.29 permit to strike
permit to dismantle**
certificate issued to indicate that the permanent works have gained sufficient strength to be self-supporting and that the temporary works may safely be removed or dismantled to an agreed procedure
- 3.30 primary**
principal bearing member transferring load to the falsework
- 3.31 prop**
compression member used as a temporary support

- 3.32 re-propping**
system used during construction in which the temporary supports to a recently cast slab are removed and replaced in a planned sequence
- 3.33 scaffold**
temporary structure that provides access, or on or from which persons work, or that is used to support material, plant or equipment
NOTE Compare with the definition of falsework.
- 3.34 soffit**
underside surface of a concrete member, slab, etc.
- 3.35 sole plate**
sill
timber, concrete or metal spreader used to distribute the load from a standard or baseplate to the ground
- 3.36 standard**
vertical tube or member
- 3.37 strength class**
classification of timber based on particular values of grade stress
- 3.38 strut**
member in compression
NOTE See also prop.
- 3.39 sway**
horizontal displacement at the top of the falsework in relation to the bottom, under application of the load
- 3.40 temporary works**
parts of the works that allow or enable construction of, protect, support or provide access to, the permanent works and which might or might not remain in place at the completion of the works
NOTE Examples of temporary works are structures, supports, back-propping, earthworks and accesses.
- 3.41 temporary works co-ordinator**
TWC
competent person with responsibility for the co-ordination of all activities related to the temporary works
- 3.42 temporary works supervisor**
TWS
competent person who is responsible to and assists the temporary works co-ordinator
- 3.43 top restraint**
method by which stability of falsework is provided by surrounding permanent works or specifically designed temporary works
- 3.44 tower**
tall composite structure, used principally to carry vertical loading
- 3.45 wedge**
piece of material, timber or metal that tapers in its length and is used to adjust elevation or line or angle
NOTE Folding wedges comprise a pair of wedges laid one above the other so that their outer faces are parallel.

4 Abbreviations and symbols

The following abbreviations are used in this standard.

ACoP	approved code of practice
BCA	British Cement Association
CDM	Construction (Design and Management) Regulations
CEM	cement
CIRIA	Construction Industry Research and Information Association
CS	The Concrete Society
FoS	factor of safety
GS	general structure (timber category)
HSE	Health and Safety Executive
ICE	The Institution of Civil Engineers
LOLER	Lifting Operations and Lifting Equipment Regulations 1998 [4]
MC	moderately conservative
MHSW	Management of Health and Safety at Work Regulations
NASC	National Access and Scaffolding Confederation
NGRDL	National Grading Rules for Dimension Lumber
NLGA	National Lumber Grades Authority
PPE	Personal Protective Equipment at Work Regulations
PUWER	Provision and Use of Work Equipment Regulations
PWD	permanent works designer
RSJ	rolled steel joist
SI	Statutory Instrument
SS	standard structural (timber category)
TWC	temporary works co-ordinator
TWS	temporary works supervisor
WAHR	Work at Height Regulations

The following symbols are used in this standard.

Symbol	Meaning	Units
τ_1	Average shear stress	N/mm ²
τ_2	Maximum shear stress	N/mm ²
A	Altitude of the site	m
A	Cross-sectional area of standard	mm ²
A_d	Area of obstruction presented by trapped debris and falsework	m ²
A_e	Effective area of the component	m ²
A_w	Effective area normal to the flow	m ²
A_x	Cross-sectional area of pipeline	mm ²
b	Width of beam	mm
b	Width of falsework	m
b	Stiff length of the bearing	mm

Symbol	Meaning	Units
c	Undrained shear strength	N/m^2 , kN/m^2
c_f	Force coefficient for the component	non-dimensional
C_{pe}	Net pressure coefficient	non-dimensional
c_s	Site coefficient	non-dimensional
C_w	Coefficient for water appropriate for falsework members	non-dimensional
d	Height of the leeward parapet	m
Δ	Delta	mm, m
D	Overall depth of beam or section	mm
d	Still water depth	m
d_1	Depth from top of soffit to underside level of primary bearer	mm
d_2	Depth from top of soffit to underside level of secondary bearer	mm
d_f	Clear distance between flanges	mm
E	Young's modulus of elasticity	N/mm^2
e_o	Eccentricity of a beam	mm
f	Max. force exerted by the wind on a component of a falsework structure	N
F_{bc}	Max. applied compressive bending stress	N/mm^2
F_C	Horizontal concrete force	N
F_c	Max. applied compressive axial stress	N/mm^2
F_d	Force on trapped debris	N
F_f	Limiting value of the frictional force	N
F_H	Horizontal disturbing force	N
F_{Rc}	Maximum applied compressive stress in the web	N/mm^2
F_s	Partial soil factor	non-dimensional
F_v	Shear force	N
F_w	Force due to water flowing around falsework members	N
F_x	Force due to concrete pipeline	N
f_y	Yield stress	N/mm^2
h	Depth of beam	mm
H	Reference height	m
h	Depth/height	m
H	Wave height	m
H_c	Compression flange restraint force	N
H_e	Effective height of the falsework	m
h_f	Total height of the formwork	m
h_F	Total height of the falsework	m
I	Moment of inertia	cm^4
J	Moment of inertia of stiffener	mm^4
K_n	Timber modification factor	non-dimensional
K_a	Active pressure coefficient	non-dimensional
K_p	Passive soil resistance coefficient	non-dimensional
L/l	Length	mm
λ	Slenderness ratio	non-dimensional
L	Wave length	m

Symbol	Meaning	Units
L_b	Clear length of a beam	mm
L_d	Horizontal distance of the slope downwind	m
L_e	Effective length of a strut	mm
L_E	Effective length	mm
L_s	Clear length of a column or strut	mm
L_u	Horizontal distance of the slope upwind	m
L_w	Width between vertical forms	mm
m	Factor for cantilever projection	non-dimensional
M_c	Safe working moment	kNm
N	Characteristic compressive strength of a tubular strut	N/mm ²
n	Number of node points	non-dimensional
n_1	Length obtained by dispersion at 45°, from extreme of stiff bearing	mm
n_2	Length obtained by dispersion at 30°, from extreme of stiff bearing through the flange plates	mm
N_H	Notional internal force	N
$\emptyset$	Mathematical function	non-dimensional
p	Maximum pressure in pipeline	N/mm ²
P	Force	N
p_1	Clapotis pressure	kN/m ²
p_a	Active soil pressure	N/m ²
P_B	Concrete force	N
p_b	Allowable bearing stress	N/mm ²
p_{bc}	Permissible bending stress in compression members	N/mm ²
p_{bc}	Permissible compressive stress due to bending	N/mm ²
p_{bt}	Permissible bending stress in tension members	N/mm ²
p_c	Permissible axial compressive stress	N/mm ²
P_c	Safe load in compression for a column	N/mm ²
p_c	Max. water pressure at level C	kN/m ²
p_c	Permissible axial stress for struts	N/mm ²
p_{cw}	Permissible compressive stress in the web	N/mm ²
$P-\Delta$	P-delta, 2nd order effect	
P_h	Concrete force	N
P_L	Concrete force	N
p_p	Passive soil resistance (or pressure)	N/m ²
P_R	Concrete force	N
p_t	Permissible axial tensile stress	N/mm ²
P_v	Concrete force	N
q	Max. dynamic wind pressure	N/m ²
Q_5	Total force on the falsework	N
$Q_{5,limit}$	Upper limit of force	N
q_b	Allowable bearing pressure	kN/m ²
q_s	Dynamic pressure	N/m ²
q_w	Dynamic pressure of flowing water	N/m ²

Symbol	Meaning	Units
R	Reaction	N
r	Radius of gyration	mm
R_C	Reaction to horizontal concrete force F_C	N
$R_{Cx, Cy}$	Orthogonal components R_C	N
r_g	Radius of gyration	mm
R_H	Reaction to horizontal disturbing force F_H	N
S	Wind factor	non-dimensional
S	Plastic modulus	cm ³
S_a	Altitude factor	non-dimensional
S_b	Terrain and building factor	non-dimensional
S_d	Direction factor	non-dimensional
S_p	Probability factor	non-dimensional
S_s	Seasonal factor	non-dimensional
T	Mean thickness of flange	mm
T	Topographical factor	non-dimensional
T_{max}	Max. thickness of compression flange	mm
t_s	Web stiffener thickness	mm
t_w	Web thickness	mm
U	Concrete cube strength	N/mm ²
V_b	Basic wind speed for the site	m/s
v_b	Basic wind speed	m/s
v_e	Effective wind speed	m/s
V_H	Hourly mean wind speed at reference height H	m/s
V_s	Design wind speed	m/s
v_s	Site wind speed	m/s
V_w	Speed of water flow	m/s
W	Applied vertical load	N
w	Force applied per unit volume of water	kN/m ³
W_w	Max. wind force during working operations	m/s
X	Depth of bracing panel	mm
γ	Soil density	kg/m ³
γ_f	Partial safety factor for loads	non-dimensional
γ_m	Partial safety factor for resistances	non-dimensional
Δb	Out-of-straightness of a beam	mm
Δv	Inclination from vertical	mm
Δs	Out-of-straightness of a column or strut	mm
η	Shielding factor	non-dimensional
θ	Angle from horizontal	degrees
μ	Coefficient of static friction	non-dim
τ	Shear stress	N/mm ²
φ	Angle of internal friction	degrees
χ	Mathematical function	non-dimensional

5 Legislation

5.1 General

Attention is drawn to the following acts and regulations, and HSE approved codes of practice (ACoP) and guidance in relation to construction works and operations.

Health and Safety at Work etc. Act 1974 [5].

Management of Health and Safety at Work Regulations 1999 (MHSW Regulations) [6] and *Management of health and safety at work* (HSE L21) [7].

Construction (Design and Management) Regulations 2007 (CDM) SI 2007/320 [8], *Managing Health and Safety in Construction*. (HSE L144) [3] and *Health and safety in construction* (HSG150) [9].

Work at Height Regulations 2005 (WAHR), including the Work at Height (Amendment) Regulations 2007 [10] and *Work at Height Regulations 2005 (as amended) – A brief guide* [(INDG401(rev1))] [11].

Lifting Operations and Lifting Equipment Regulations 1998 (LOLER) [4] and *Safe use of lifting equipment. Lifting Operations and Lifting Equipment Regulations 1998. Approved code of practice and guidance*. (HSE L113) [12].

Personal Protective Equipment at Work Regulations 1992 (PPE) [13] and amendments, and *Personal protective equipment at work (Second edition)* (HSE L25) [14].

Provision and Use of Work Equipment Regulations 1998 (PUWER) [15] and *Safe use of work equipment* (HSE L22) [16].

It is strongly recommended that temporary works designers and co-ordinators are provided with copies of the above legislation and Approved Codes of Practice and guidance publications.

Employers and the self-employed should ensure that they take appropriate steps keep employees, including temporary works designers and co-ordinators, updated of any changes to relevant legislation and revised guidance material.

NOTE This section does not consider any legislation relating to the protection environment as enforced by the Environment Agency or the Scottish Environmental Protection Agency.

Neither is consideration given to the Building Act 1984 or the Building (Scotland) Act 2003.

5.2 The Health and Safety at Work, etc. Act 1974

The basis of British health and safety law is the Health and Safety at Work, etc. Act 1974 [5]. The Act sets out the general duties which employers and self-employed persons have towards employees and to persons other than their employees (including the public). Duties relate to the “conduct of the undertaking” of the employer or self-employed person. The duties are qualified in the Act by the principle “so far as is reasonably practicable”.

Regulations, for example the Management of Health and Safety at Work Regulations 1999 [6], may be made under Section 15 of the Health and Safety at Work, etc. Act 1974.

Regulations made under the Act may require stricter standards than “reasonably practicable”. For example with regard to Regulation 28 (1), *Stability of Structures* of the Construction (Design and Management) Regulations 2007 [8] the standard is that of “all practicable steps”.

In respect of Regulation 28 (2), *Stability of structures* of the Construction (Design and Management) Regulations 2007, for example, an absolute standard, albeit qualified, is set, i.e.:

“Any buttress, temporary support or temporary structure must be of such design and so installed and maintained as to withstand any foreseeable loads which may be imposed on it, and must only be used for the purposes for which it is so designed, installed and maintained.”

5.3 The Management of Health and Safety at Work Regulations 1999

The Management of Health and Safety at Work Regulations 1999 [6], [7] make more explicit what employers and the self-employed are required to do to manage health and safety under the Health and Safety at Work, etc. Act 1974. They apply to every work activity including the provision of temporary works.

The fundamental feature of the Regulations is the requirement at Regulation 3 for employers and the self-employed to carry out a risk assessment. Employers with five or more employees need to record the significant findings of the risk assessment. The Approved Code of Practice, *Management of Health and Safety at Work* (HSE L21) [7] and the HSE leaflet *Five steps to risk assessment* [17] provide more information.

Amongst other matters the regulations also require employers, and, as may be required, the self-employed, to:

- make arrangements for implementing the health and safety measures identified as necessary by the risk assessment;
- appoint competent people to help them to implement the arrangements;
- set up emergency procedures;
- provide clear information and training to employees; and
- to co-operate, and work together, with other employers sharing the same workplace.

5.4 The Personal Protective Equipment at Work Regulations 1992

The main requirement of the Personal Protective Equipment at Work Regulations 1992 [13], [14], is that personal protective equipment is to be supplied and used at work wherever there are risks to health and safety that cannot be adequately controlled in other ways.

The Regulations also require that PPE:

- is properly assessed before use to ensure it is suitable;
- is maintained and stored properly;
- is provided with instructions on how to use it safely; and
- is used correctly by employees.

5.5 Work at Height Regulations 2005 as amended by the Work at Height (Amendment) Regulations 2007

The Work at Height Regulations 2005 as amended by the Work at Height (Amendment) Regulations 2007 Reg. [10] and [11], require that duty holders do all that is reasonably practicable to prevent anyone falling.

The Regulations require that employers ensure that work is not carried out at height where it is reasonably practicable to carry out the work safely otherwise [see Reg. 6(2)].

Where work is carried out at height, every employer is required to take suitable and sufficient measures to prevent, so far as is reasonably practicable, any person falling a distance liable to cause personal injury [Reg. 6(3), 6(4) and 6(5)].

The Regulations also set out a simple hierarchy for managing and selecting equipment for work at height (Reg. 7). There is a specific requirement [Reg. 7(a)] to give collective protection measures (eg. safe working platforms and guard-rails, toe-boards etc.) priority over personal protection measures (eg. fall protection and fall arrest systems).

Amongst other matters the Regulations deal with include:

- planning and organization of work at height (see Reg. 4);
- the requirement that all work at height takes account of weather conditions that could endanger health and safety [see Reg. 4(3)];
- the competence and training of those who engage in any activity (including organisation, planning and supervision) relating to work at height (see Reg. 5);
- in the case of specific categories of particular work equipment (i.e. protective measures/work equipment/working platforms/personal fall protection systems) that the employer ensures compliance with the appropriate Schedules to the Regulations (see Reg. 8 and Schedules 2, 3, 4, 5, and 6);
- the inspection of work equipment for work at height (see Reg. 12); and
- the inspection of places of work at height (see Reg. 13).

Schedule 3 of the Regulations provides specific requirements for working platforms and supporting scaffolding, including stability, strength and rigidity. This includes:

- the provision of strength and stability calculations for scaffolding (see Schedule 3, paragraph 7); and
- the supervision (together with the training of workers) of the assembly, alteration and dismantling of scaffolds (see Schedule 3, paragraph 12).

The Regulations and Schedules deal with the suitability, strength and stability of any anchorages required for fall arrest, fall protection or work restraint systems. See for example:

- Reg. 8 (c) and Schedule 4, paragraph 4; and
- Reg. 8 (d) and Schedule 5, Part 1, paragraph 3.

The use of ladders is dealt with under Reg. 8(e) and Schedule 6. Paragraph 1 of Schedule 6 requires that every employer shall ensure that a ladder is used for work at height only if a risk assessment [made under Reg. 3 of the Management of Health and Safety at Work Regulations 1999 (see 5.3.1)] has demonstrated that the use of more suitable work equipment (e.g. proprietary stair access towers) is not justified.

5.6 The Lifting Operations and Lifting Equipment Regulations 1998

Generally the Lifting Operations and Lifting Equipment Regulations 1998 (LOLER) [4] require that lifting equipment provided for use at work is:

- strong and stable enough for the particular use and marked to indicate safe working loads (see Reg. 4 and Reg. 7);
- positioned and installed to minimise any risks (see Reg. 6);
- used safely ,i.e. the work is planned, organized, supervised and performed by competent people (see Reg. 8); and
- subject to ongoing thorough examination, and where appropriate, inspection by competent people (see Reg. 9).

Lifting equipment includes any equipment used at work for lifting or lowering loads, including attachments used for anchoring, fixing or supporting it. The Regulations cover a wide range of equipment including: cranes, scaffold hoists, runway beams, forklift trucks, telescopic handlers, lifts, hoists, mobile elevating work platforms and vehicle inspection platform hoists. The definition also includes lifting accessories such as chains, lings, eyebolts, etc. LOLER does not apply to escalators, these are covered by other legislation, i.e. the Workplace (Health Safety and Welfare) Regulations 1992 [18].

If employees are allowed to provide their own lifting equipment, then this too is covered by the Regulations.

Specific "approved code of practice" status paragraphs and guidance in the HSE publication, *Safe use of lifting equipment, Lifting Operations and Lifting Equipment Regulations 1998. Approved code of practice and guidance* (HSE L113) [12], provide basic guidance on the stability of lifting equipment and factors such as the proximity of adjacent excavations, strength of the supporting ground and the need to provided suitable spreader plates, etc. (see ACoP and commentary to LOLER Reg. 4 and Reg. 8).

In using, any lifting equipment, the requirements of LOLER have to be met. For example, to the employer has to ensure that all lifting equipment is:

- sufficiently strong, stable and suitable for the proposed use. Similarly, the load (eg. falsework components, formwork panels, etc.) and anything attached or supporting it (eg. lifting points, timber pallets, stillages, etc.) has to be suitable (see Reg. 4);
- positioned or installed to prevent the risk of injury, e.g. from the equipment or the load falling or striking people (see Reg. 6);
- visibly marked with the appropriate information to be taken into account for its safe use, e.g. safe working loads. Accessories, e.g. slings, clamps etc, should be similarly marked (see Reg. 7).

Additionally, the employer has to ensure that:

- lifting operations are planned, supervised and carried out in a safe manner by people who are competent (see Reg 8);
- where equipment is used for lifting people it is marked accordingly, and it should be safe for such a purpose, e.g. all necessary precautions should have been taken to eliminate or reduce any risk (see Reg 5);
- where appropriate, before lifting equipment (including accessories) is used it has a current thorough examination certificate or if new and supplied complete, that it has been supplied with a Declaration of Conformity to the Machinery Directive. Lifting equipment that has to be assembled or built up on site will need a thorough examination carried out prior to first use to ensure it has been correctly erected/installed and a certificate issued.. Lifting equipment needs to be examined in use at periods specified in the Regulations (i.e. at least six-monthly for accessories and equipment used for lifting people and, at a minimum, annually for all other equipment) or at intervals laid down in a written examination scheme drawn up by a competent person. All examination work has to be carried out by a competent person who is sufficiently independent from the management of the site so not to be unduly influenced by pressures to finish the work; and
- following a thorough examination or inspection of any lifting equipment, a report is submitted by the competent person to the employer to take the appropriate action.

5.7 The Provision and Use of Work Equipment Regulations 1998 (as amended)

In general terms, the Provision and Use of Work Equipment Regulations 1998 (PUWER) [15] require that equipment provided for use at work be:

- suitable for the intended use;
- safe for use, maintained in a safe condition and, in certain circumstances, inspected to ensure this remains the case;
- used only by people who have received adequate information, instruction and training; and
- accompanied by suitable safety measures, e.g. protective devices, markings, warnings.

The duty on people who have control of work equipment reflects the way that work equipment is used in industry where there may not necessarily be a direct “employment” relationship between the user and the person who controls the work equipment. For example, where falsework equipment is supplied to a site by a plant hire company.

There is a need to ensure that the work equipment provided meets the requirements of PUWER. In doing so it is necessary to ensure that it is:

- suitable for use, and for the purpose and conditions in which it is used;
- maintained in a safe condition for use so that peoples health and safety is not at risk; and

- inspected in certain circumstances to ensure that it is, and continues to be, safe for use. Any inspection has to be carried out by a competent person (this could be an employee if they have the necessary competence to perform the task) and a record kept of the next inspection.

There is a need to ensure that risks, created by the use of equipment, are eliminated where possible, or controlled by:

- taking appropriate “hardware” measures, e.g. providing suitable guards, protection devices, markings and warning devices, system control devices (such as emergency stop buttons) and personal protective equipment; and,
- taking appropriate “software” measures, such as following safe systems of work (e.g. ensuring maintenance is only performed when equipment is shut down etc.), and providing adequate information, instruction and training.

A combination of the above measures might be necessary depending upon the requirements of the work, the assessment of the risks involved, and the practicability of such measures.

There is a need to ensure that people using work equipment have received adequate training, instruction and information for the particular equipment.

NOTE Various amendments have been made to the Provision and Use of Work Equipment Regulations 1998. This includes amendments to Reg. 6 Inspection in respect of work equipment that is required to be inspected under Regs. 31(4) Excavations or 32(2) Cofferdams and caissons of the Construction (Design and Management) Regulations 2007, and that to which Reg. 12 Inspection of work equipment of the Work at Height Regulations 2005, which includes scaffolding and working platforms. The amended regulations are provided in the HSE publication, Safe use of work equipment – Provision and Use of Work Equipment Regulations 1998. Approved Code of Practice and guidance, third edition, 2008 (HSE L113) [16].

5.8 Construction (Design and Management) Regulations 2007

The Construction (Design and Management) Regulations 2007 [3], [8] are aimed at improving the overall management and co-ordination of health, safety and welfare throughout all stages of a construction project. They place duties on all those who can contribute to the health and safety of a construction project: clients, designers, construction, design and management (CDM) co-ordinators, principal contractors and contractors.

Designers [the term includes temporary works engineers (including those designing auxiliary structures, earthworks supports, sheet piling, piling/crane platforms, spreader plates and grillages for cranes and other lifting equipment, formwork, falsework, backpropping, façade retention schemes, needling schemes and scaffolding etc.)] have a key role within a construction project in ensuring that the health and safety of those who are to construct, use, maintain, repair or dismantle a structure are considered during the design process. Failure to do this could delay the project, make it much more difficult for contractors to devise safe systems of work and cause the client to make costly changes so that the structure can be maintained safely. It could also relate in injury or death.

The term “design” within the Regulations includes amongst other terms the word “specification”. On this basis anyone who specifies a method of working/construction is a designer and has to be aware of their responsibilities under the Regulations.

The most important contribution a designer can make to improve health and safety will often be during the concept and feasibility stage when the main considerations will be about the different design options that are open so that hazards can be avoided. A designer is required first to consider measures that protect everyone (ie. collective measures), rather than individual protective measures.

The Regulations include, amongst other requirements, the following:

- a) that no person, for whom the Regulations place a duty, shall appoint or engage a CDM co-ordinator, designer, principal contractor or contractor unless he has taken reasonable steps to ensure the person to be appointed or engaged is competent [see Regulation 4(1)(a)]. Neither should a person accept such an appointment or engagement unless he is competent [see Regulation 4(1)(b)];
- b) that no person, for whom the Regulations place a duty, shall arrange for or instruct a worker to carry out or manage design or construction work unless the worker is:
 - 1) competent; or
 - 2) under the supervision of a competent person.
(see Regulation 4(1)(c));
- c) that every person concerned in a project shall seek the co-operation of any other person concerned in any project involving construction work, at the same or an adjoining site, so far as is necessary to enable himself to perform any duty or function under the Regulations (see Reg. 5);
- d) that all persons concerned shall co-ordinate their activities with one another in a manner which ensures the health and safety of persons carrying out, or affected by, the construction work (see Reg. 6);
- e) that the client shall ensure that relevant information, in the clients possession, is provided, (including any such further information which is reasonably obtainable) (see Regs. 10 and 15);
- f) that designers (including both those designing the permanent works and those designing temporary works) need to comply with their duties under Regs. 11 and 18. These include:
 - 1) that designers do not commence work on a project unless the client is aware of his duties under the Regulations [see Reg. 11 (1)];
 - 2) that where a project is notifiable no designer shall commence work (other than initial design work) in relation to the project unless a CDM co-ordinator has been appointed [see Reg 18 (1)];
 - 3) that designers shall in preparing or modifying a design that may be used in construction work, so far as is reasonably practicable, taking due account of any other relevant design considerations, avoid foreseeable risks to the health and safety of any person carrying out construction work or liable to be affected by such construction work [see Regs. 11 (2) and 11 (3) (a) and (b)];

- 4) that in discharging duties under Regs. 11 (2) and 11 (3) designers shall eliminate hazards which give rise to risks; and reduce risks from any remaining hazards, and in doing so shall give collective measures priority over individual measures [see Reg. 11 (4) (a) and (b)];
- 5) that designers shall provide sufficient information about aspects of their design of the structure or its construction or maintenance that will adequately assist- clients, other designers and contractors to comply with their duties under the Regulations [see Reg 11(6)]; and
- 6) that designers provide adequate information about aspects of the design of the structure or its construction or maintenance as will adequately assist the CDM co-ordinator in complying with his duties under the Regulations, including his duties in relation to the health and safety file [see Reg. 18 (2)];
- g) that contractors shall amongst other matters:
 - 1) plan, manage and monitor construction work carried out (either directly or under their control) in a way which ensures that, so far as is reasonably practicable, that it is carried out without risks to health and safety [see Reg. 13(2)];
 - 2) provide workers and employees with appropriate information and training [see Regs. 13 (4), 13 (5) and 22 (2)];
 - 3) provide the principal contractor with relevant information (including any relevant part of any risk assessment in his possession or control) [see Regs. 19 (2) (a) and 22 (1) (g)];
 - 4) comply with any directions of the principal contractor or any site rules [see Regs. 19 (2) (c) and 22 (1) (d) and (e)].
- h) that, where the project is notifiable, the client shall ensure that the construction phase does not start unless the principal contractor has prepared a suitable construction phase health and safety plan (see Reg. 16);
- i) that amongst other matters CDM co-ordinators shall:
 - 1) take all reasonable steps to ensure that designers comply with their duties under Regs. 11 and 18(2) [see Reg. 20 (2) (c)];
 - 2) take all reasonable steps to ensure co-operation between designers and the principal contractor during the construction phase in relation to any design or change to a design [see Reg. 20 (2) (d)].
- j) that amongst other matters the principal contractor shall:
 - 1) before the start of the construction phase prepare a construction phase plan and as often as appropriate throughout the project update, review, revise and refine the plan [see Reg. 23 (1)];
 - 2) take all reasonable steps to ensure that the construction phase plan identifies the risks to health and safety arising from the construction work and includes suitable and sufficient measure to address such risks, including any site rules [see Reg. 23 (2)];

NOTE For a list of topics to be considered for the construction phase plan refer to Appendix 3 of Managing health and safety in construction. (HSE L144) [3].

- 3) plan, manage and monitor construction work carried out (either directly or under their control) in a way which ensures that, so far as is reasonably practicable, that it is carried out without risks to health and safety [see Reg. 22 (1) (a) and Reg. 23];
- 4) liaise with the CDM co-ordinator in performing his duties in regulation 20 (2)(d) during the construction phase in relation to any design or change to a design [see Reg. 22 (1) (b)];
- 5) where necessary for health and safety reasons draw up site rules [see Reg. 22 (1) (d) and Reg. 23 (2)];
- 6) give reasonable directions to any contractor [see Reg. 22 (1) (e)];
- 7) where necessary to consult a contractor before finalising relevant parts of the construction phase plan [see Reg. 22 (1) (g)];
- 8) ensure the provision of relevant information to the contractor [see Regs. 22 (1) (h) and (i)];
- 9) take all reasonable steps to ensure that workers are provided with any information and training required for particular work to be carried out without undue risk to health and safety [see Reg. 22 (2)];
- k) that there is a safe place of work (ie. with suitable and safe access to and egress from the place of work, and with that access and egress properly maintained) (see Reg. 26; also see 5.5);
- l) that there is stability of any structure, i.e. all practicable steps taken to ensure that any new or existing structure does not collapse, with any buttress, temporary support or temporary structure designed, and installed and maintained, to withstand any foreseeable loads which may be imposed on it (and only used for the purposes for which it is designed, installed and maintained) (see Reg. 28);
- m) that the demolition or dismantling of a structure, or part of a structure, shall be planned and carried out in such a manner as to prevent danger or, where it is not practicable to prevent it, to reduce danger to as low a level as is reasonably practicable (any arrangements for carrying out such demolition or dismantling shall be recorded in writing before the demolition or dismantling work begins) (see Reg. 29);
- n) that with regard to excavations (which also includes earthworks, tunnels, shafts, trenches, etc. (see Reg. 2, *Interpretation*)) that:
 - 1) all practicable steps shall be taken, where necessary to prevent of the provision of supports or battering, etc. [see Reg 31 (1)];
 - 2) they are not overloaded (or the adjacent ground) by work equipment or material [see Reg 31 (3)];
 - 3) they are inspected by a competent person [see Reg 31 (4) and 31 (5)];
- o) that cofferdams and caissons shall be of suitable design and construction, and, are appropriately equipped and properly maintained [see Reg. 32 (1)]. Also that cofferdams and caisson and associated work equipment and materials shall only be used if inspected by a competent person [see Regs. 32 (2) and 32 (3)].

Other relevant regulations include: Reg. 33, *Reports of inspections* (and also Schedule 3); Reg. 34, *Energy distribution systems*, which deals with both electric power cables and other underground services (e.g. gas, water, etc.), including the risks to services arising from construction work; Reg 35, *Prevention of drowning*; Reg 36, *Traffic routes*; Reg 37, *Vehicles*, of which Reg 37 (6) deals with the prevention of vehicles falling into excavations, pits, water, etc.; Reg. 38, *Prevention of risk from fire etc.*, which also deals with flooding and risks of asphyxiation; Reg 39, *Emergency procedures*; Reg. 40, *Emergency routes and exits* and Reg.42, *Fresh air*.

Remember: specific regulations relating to work at height, including the provision of access scaffolds and working platforms, are provided with under the Work at Height Regulations 2005 and the Work at Height (Amendment) Regulations 2007 [10] (see 5.5).

Section 2: Procedural control of temporary works

6 Procedures

6.1 General

6.1.1 Temporary works is an “engineered solution” used to support or protect either an existing structure or the permanent works during construction, or to support an item of plant or equipment, or the vertical sides or side-slopes of an excavation during construction operations on site or to provide access.

6.1.2 The temporary works may be removed or left in place after the completion of the permanent works but in the latter case would not necessarily contribute to the strength of the permanent works.

6.1.3 Where the method of construction of the permanent works differs from that which has been indicated by the permanent works designer, the temporary works solution should include an assessment of the permanent works for the various stages of construction, modification or demolition to determine adequacy of strength and/or stability.

6.1.4 A temporary works study may involve an assessment of excavation stability or necessary supports particularly where the excavation slopes are steep, or are surcharged by other loads.

6.1.5 Work on site should be the subject of careful direction, supervision and checks to ensure that the temporary works structure is constructed safely in accordance with the agreed design with materials of agreed quality, and that only when all checks have proved satisfactory is the structure first loaded, and then dismantled in accordance with an agreed procedure (see 6.2).

6.1.6 Communication tends to be one of the major problem areas of temporary works because of the multiplicity of actions normally required when temporary works is being constructed and put into service. Such activities may be widely separated in time and place and it is therefore essential that lines of communication and responsibility are explicit (see 6.4). To facilitate progress, a methodical approach should be adopted and it is recommended that comprehensive records are maintained (see 6.3.1.2).

6.2 Control of procedures

6.2.1 The use of proper procedures is essential to control risk and also gives economy in operation.

6.2.2 Collection and application of technical data of the type set out in Clause 8 represents only part of the action necessary to ensure the preparation and implementation of a safe and economical temporary works scheme. It is also essential to have effective work procedures, adequate control of these procedures and effective communication between all parties during both the design and execution of a scheme.

6.2.3 With respect to the provision of temporary works the CDM Regulations [8], the HSE Approved Code of Practice (ACoP), *Managing Health and Safety in Construction* [3] (see 5.8) and the Management of Health and Safety at Work Regulations [6], [7] (see 5.3) effectively require:

- a) clients to provide pre-construction information;
- b) principal contractors to prepare a construction phase plan (which should include appropriate rules and reference to relevant risk assessments and any method statements);
- c) designers to provide adequate information about any significant risks associated with the permanent works, e.g. drawings, specifications and site investigations used in the design of the permanent works, data sheets, suggested construction sequences and other information showing particular constraints to the construction process;
- d) CDM co-ordinators to take reasonable steps to ensure co-operation between permanent works and temporary works designers;
- e) the co-ordination of design work, e.g. design reviews;
- f) appointment of a competent adequately resourced principal contractor;
- g) appointment of competent and adequately resourced contractors;
- h) the production of job-specific risk assessments, as required, for specific structures;
- i) the erection, use, maintenance and dismantling of the temporary works in a co-ordinated sequence and controlled manner.

6.2.4 One of the main aims in any method of work should be to minimize the chance of errors being made and to maximize the chance of errors being discovered if they are made. To this end there needs to be effective communication of information and requirements between all levels of the construction organizations involved in the scheme, whether they are concerned primarily with the permanent works or the temporary works. An effective system of checking, both design and implementation is also needed.

6.3 Roles and responsibilities of organizations

6.3.1 Organizational aspects

6.3.1.1 Every organization involved in temporary works should have a designated individual responsible for:

- a) establishing, implementing and maintaining a procedure for the control of temporary works for that organization; and
- b) ensuring that any sub-contractors have adequate temporary works procedures if they are carrying out and managing temporary works.

The procedure should cover the management of the design process, and include measures for ensuring that the design function and the roles of the temporary works co-ordinator and temporary works supervisor are carried out by competent individuals.

NOTE 1 Organizations which typically could have an involvement in temporary works include: clients, management contractors, contractors, sub-contractors, suppliers, and consultants.

NOTE 2 These organizations have duties under the Construction (Design and Management) Regulations [8] and are expected to provide and receive relevant information. See 5.8.

NOTE 3 It is expected that the designated individual would generally be the senior person in the organization with responsibility for the management of temporary works, such as the Chief Engineer or Engineering/Operations Director. A1

6.3.1.2 The procedure should A1 text deleted A1 include measures to ensure that responsibilities are properly allocated and for controlling the communication of requirements and actions. The key items are:

- a) responsibility for each of the actions set down in this code should be specifically allocated, in particular those listed in 6.3.1.3;
- b) these responsibilities should be clearly defined;
- c) all instructions should be clear and complete
- d) documented records of responsibilities allocated, instructions given and actions taken should be maintained.

6.3.1.3 The main items for which responsibility should be established are as follows:

- a) the appointment of a temporary works co-ordinator (TWC);
- A1 b) the appointment of a temporary works supervisor, where required (TWS);
- c) the limits of authority of the TWS, where appointed, including any authorization to issue permits to load (bring into use) or unload (take out of use) the temporary works; A1
- d) the preparation of an adequate design brief, including where appropriate the establishing of the scheme concept;
- e) the design, including calculations, sketches, drawings, specification, preparation of a A1 text deleted A1 risk assessment and where necessary a designer's method statement for the temporary works scheme;
A1 text deleted A1
- f) the independent checking of the design; this should include the definition of the degree of check to be carried out on any design (see 9.2.2);
- g) the issue of a design/design-check certificate, where appropriate;
- h) the procurement of materials in accordance with the designer's specification;
- i) the control of erection, safe use and maintenance and finally dismantling on site;
- j) the checking of the erected temporary works, and control of their use, maintenance and dismantling, in stages where necessary, to ensure compliance with the design and any hold points;
- k) where necessary, the issue of a formal "permit to load" and a "permit to dismantle A1 (unload) A1" the temporary works.

6.3.1.4 Whoever these responsibilities are allocated to, it is essential that they are given authority to take and enforce decisions.

6.3.2 Site related aspects

6.3.2.1 For every site, it is important to establish responsibility for, and the scope of, the work of all organizations and individuals involved in any aspect of temporary works.

6.3.2.2 For a given site, **A1** the principal contractor, or on projects which are not notifiable under CDM 2007 [8], the main contractor, should appoint a temporary works co-ordinator (TWC) **A1** who is responsible for the implementation of their organization's temporary works procedures and those of all other contractors who are directly or indirectly in their employ.

A1 6.3.2.3 One or more temporary works supervisors (TWS) may be appointed to assist the temporary works co-ordinator. See 7.3.1. **A1**

6.4 Organizational interfaces

6.4.1 The design and construction of permanent works and the attendant temporary works often involves several organizations, so introducing a number of organizational interfaces. Common arrangements include the following and combinations thereof:

- a) equipment may be hired, with the supplier carrying out the design, or supplying the basic design data;
- b) equipment may be erected using operatives who are not direct employees of the main construction organization e.g. the supplier of the equipment may also erect it;
- c) use of a design produced by another organization.

6.4.2 When work is being carried out by different organizations, the organizational interfaces may be manifested on site as physical interfaces between different phases of the scheme, e.g. it is common for one organization to prepare and provide the foundations upon which another subsequently erects the main temporary works structure. The physical interface in this example is particularly critical, but in all cases it is important that the physical constraints and interface conditions are clearly defined and that the work procedures adopted are able to take effective account of such matters.

6.4.3 The temporary works co-ordinator should manage these interfaces and retain an overview of the whole scheme to ensure each step of the procedure is completed and does not adversely affect the scheme.

6.4.4 Details of the **A1** interfaces should be included in the construction phase plan (see 6.2.3).

6.4.5 When work is being carried out at a number of small sites, a TWS with an appropriate level of authority may be appointed for each individual site, under the overall responsibility of a single TWC. **A1**

7 Appointment of the temporary works co-ordinator and the temporary works supervisor

7.1 Appointment of the temporary works co-ordinator

7.1.1 The appointment of a temporary works co-ordinator (TWC) should be the first operation in a chain of events culminating in

the construction of a temporary works scheme. The TWC should be appointed by the designated individual of ^{A1} the principal contractor, or on projects which are not notifiable under CDM 2007 [8], the main contractor ^{A1} (see 6.3.2.2).

7.1.2 It is essential for the TWC to be competent and to have relevant up-to-date training and both the qualifications and the experience appropriate to the complexity of the project. The appointment of the TWC should be made known to all concerned.

^{A1} **7.1.3** The TWC may be proposed by a contracts director/manager or senior manager, but the designated individual should be satisfied that the proposed TWC has the abilities outlined in 7.1.2 before confirming acceptance of the proposal. ^{A1}

7.2 Responsibilities of the temporary works co-ordinator

7.2.1 The TWC should be the first point of contact between the designer and the site team ^{A1} for all temporary works matters.

7.2.2 The TWC should be responsible for ensuring that the organization's procedure for the control of temporary works is implemented on site.

7.2.3 The TWC should be responsible to the designated individual (see 6.3.1.1) for ensuring the temporary works design is implemented in accordance with the relevant drawings and the specification. It is preferable that the TWC is not responsible for the day-to-day progress of the temporary works or other project matters. However, this might not be possible on projects that have few or no engineering staff. If the TWC has responsibility for both checking the temporary works and progress, it is essential that decisions are not compromised by commercial or other pressures. If the TWC considers that he is under undue pressure from site management to achieve production, then he should be able to seek assistance from the designated individual (see 6.3.1.1). ^{A1}

7.2.4 It is important that the appointment gives the TWC adequate authority to carry out his tasks including authority to stop the work if it is not being carried out satisfactorily. The TWC should be responsible for the provision of formal permission to load, which when signed would certify that all appropriate steps had been taken. The TWC should not permit erection to continue beyond any critical stage until it is to the standard specified. The TWC should ensure that once the temporary works has been checked and passed, it is not altered until the loading stage has been completed, and the design allows for it to be dismantled or altered. In the case of complex construction it might be advisable for those checking critical individual items to sign when each of those particular parts of the work is to their satisfaction. To ensure the independence of checks, if any of the tasks requiring checking have been carried out by the TWC, the TWC should delegate the checking to another individual.

^{A1} The TWC should define and record the actual responsibilities of each TWS, where appointed. (See 7.3.3). ^{A1}

7.2.5 The principal activities of the temporary works co-ordinator should be to:

- a) co-ordinate all temporary works activities;
- ^{A1} b) ensure a temporary works register is established and maintained; ^{A1}

- c) ensure that the various responsibilities have been allocated and accepted;
- d) ensure that a design brief is prepared (see Clause 8) with full consultation, is adequate, and is in accordance with the actual situation on site;
- e) ensure that any residual risks, identified at the design stage, assumed methods of construction or loading constraints identified by the designer of the permanent works are included in the design brief;
- f) ensure that a satisfactory temporary works design is carried out;
- g) ensure that a design check is carried out **[A1]** by someone who was not involved in the original design (see 9.2) **[A1]**; this should include checking for:
 - 1) concept;
 - 2) structural adequacy;
 - 3) compliance with the brief;
- h) where appropriate, ensure that the design is made available to other interested parties, e.g. the CDM co-ordinator or the designer of the permanent works;
- i) register or record the drawings, calculations and other relevant documents relating to the final design;
- j) ensure that those responsible for on-site supervision receive full details of the design, including any limitations and guidance notes associated with it and prepare a specific method statement;
- k) ensure that checks are made at appropriate stages (see 6.1.3 and 7.4);
- l) ensure that any proposed changes in materials or construction are checked against the original design and appropriate action taken;
- m) ensure that any agreed changes, or corrections of faults, are correctly carried out on site;
- n) ensure that during use of the temporary works all appropriate maintenance is carried out;
- o) after a final check, **[A1]** which is satisfactory, ensure a permit to load (bring into use) is issued by either the TWC or TWS (see 7.3.3); **[A1]**
- p) when it has been confirmed that the permanent structure has attained adequate strength **[A1]** and/or stability, ensure a permit to unload (take out of use) the temporary works is issued by either the TWC or TWS, (see 7.3.3);
- q) ensure that a documented safe system of work is in place and implemented for the dismantling of any temporary works;
- r) ensure that any relevant information for the health and safety file is transmitted to the CDM co-ordinator;
- s) in all cases, ensure that the TWSs are operating in accordance with the approved procedures. **[A1]**

7.3 Appointment of the temporary works supervisor(s)

7.3.1 On larger sites or where the site manager or project manager considers it necessary, **[A1]** or where there are one or more subcontractors

carrying out temporary works operations, or where the TWC requests assistance, one or more temporary works supervisors (TWSs) may be appointed. The TWS should be appointed by the designated individual of the organization for whose work the TWS is responsible. ^{A1}

7.3.2 It is essential for the TWSs to be competent and to have relevant up-to-date training and both the qualifications and the experience appropriate to the ^{A1} complexity of the project.

7.3.3 The TWS may be proposed by a contracts director/manager, TWC or senior manager, but the designated individual of the organization for whose work the TWS is responsible should be satisfied that the proposed TWS has the abilities outlined in 7.3.2 before confirming acceptance of the proposal.

7.3.4 A TWS would only be permitted to issue a permit to load (bring into use) or unload (take out of use) if the designated individual of the principal contractor, or on projects which are not notifiable under CDM 2007 [8], the main contractor, is satisfied that either:

- an individual TWS is competent and has issued the appropriate authority in respect of that individual; or
- a subcontractor's procedures for the control of temporary works are satisfactory and that the designated individual of that sub-contractor has appointed a competent TWS to be responsible for that sub-contractors temporary works; in which case the appropriate authority comprises the approval of the subcontractors procedures by the designated individual and the appointment of the named TWS. ^{A1}

7.4 Responsibilities of the temporary works supervisor(s)

The TWS should be responsible to the TWC. The TWS should assist the TWC in the supervision and checking of the temporary works. This should include the supervision of the erection, use, maintenance and dismantling of the temporary works, as applicable. This should also include carrying out the checks of the scheme(s) during construction on site and liaising with the TWC to ensure any modifications to the scheme or differences from the envisaged conditions (use or environmental) are drawn to the attention of the designer. ^{A1} (See also 7.3.3.) ^{A1}

8 Design brief

8.1 A design brief should be prepared (see 6.3.1.3) to serve as the starting point for subsequent decisions, design work, calculations and drawings. All concerned with the construction should contribute towards the preparation of the brief.

8.2 The brief should include all data relevant to the design of the temporary works. It is important that it is prepared early to allow sufficient time for all subsequent activities i.e. design, design check, procurement of equipment and construction/erection of the scheme.

8.3 The preparation of the brief might involve relatively little work for the smaller scheme, but for major work such as the construction of a large bridge or deep excavation it is likely that a large amount of information will need to be collated before design work can commence or a programme for the construction of the temporary works can be drawn up.

8.4 The information required might need to be obtained from various sources, and might include data from earlier site operations or details of existing structures. Certain information might be of direct relevance to both the permanent works designer and the temporary works designer, such as site investigation information or where the temporary works affect or take support from the permanent works. The following indicates the type of information that might be required for the preparation of the brief:

- a) details of the organizations involved in the design of the scheme and their respective responsibilities;
- b) appropriate drawings of the permanent works;
- c) appropriate clauses from the specification for the permanent works;
- d) statement of any requirement to design the temporary works in accordance with a particular standard or guidance document, for example in the case of falsework whether the design method is to be in accordance with Clause 19 of this standard or BS EN 12812:2004;
- e) information on any significant risk associated with the design of the permanent works;
- f) programme for the construction of the permanent works;
- g) programme for the various phases of the design, design check, any external approvals, and procurement and erection of the temporary works;
- h) the timing for the removal of the temporary works in relation to the ability of the permanent works to be self-supporting;
- i) any requirements for access onto, under, or around the permanent works;
- j) requirements for access for erection, maintenance, use and dismantling of the temporary works and for other site activities;
- k) any requirements for public access, for example a requirement to keep a public footpath open;
- l) equipment and materials available for use in the temporary works;
- m) proposals for any moving and re-use of temporary works;
- n) environmental information such as the location, altitude and topography of the site, the distance from the nearest sea, rainfall, water levels and current velocities;
- o) site investigation data and reports relating to the areas under and adjacent to the foundations of the temporary works; this should include information on all underground and over-head services;
- p) any limitations on the staged construction of the works due to positioning of construction joints, sequence of separate pours, rate of successive pours, timing of post-tensioning and removal of supports;
- q) any requirements for pre-cambering or residual camber;
- r) loads that may be induced in the temporary works by permanent works that have been completed, such as the application of staged post-tensioning, load re-distribution and any movements of significance including any settlements or deflections that can be anticipated from the permanent works as load is progressively increased;

- s) any limitations stated by the designer of the permanent works on the position and extent of loads imposed by the temporary works onto elements of the permanent works which have been constructed such as loads imposed by successive floors of multi-storey construction onto lower floors or loading of permanent foundations required to support the temporary works;
- t) any limitations on the positioning of loads from temporary works over underground services or adjacent to excavations or retaining walls forming part of the permanent works;
- u) proposals for the protection of the temporary works, including its foundations, against disturbance or impact;
- v) limitations imposed by various authorities in relation to working within or adjacent to railways, highways, water-courses, etc.;
- w) any environmental constraints placed on the site by the local authority or other body, for example a requirement by the local authority to limit noise to certain hours of the day;
- x) details of obstructions that might preclude or influence the position of the temporary works.

8.5 The design brief should be provided to the designer, who may be from the same organisation as the TWC but it is equally important to provide the design brief when another organisation, such as a supplier, is to carry out the design of the temporary works.

8.6 When the design has been completed the design brief should be provided to the organization/individual who is to carry out the design check.

Examples of information that should be collated for particular types of scheme are given in Annex G.

NOTE 1 A designer includes anyone who specifies or alters a design, or who specifies a particular method of work, or material; thereby assuming the responsibilities of a designer under the CDM Regulations (Regulations 11 and 18).

NOTE 2 Some of the required information might only be available from other designers. Every designer has a responsibility under the CDM regulations to co-operate with the CDM co-ordinator and with any other designer to enable each of them to comply with these regulations.

NOTE 3 Further information on statutory requirements is given in Clause 5.

9 Design

9.1 General

9.1.1 Those responsible for the design of a temporary works scheme should base their design on the previously agreed design brief (see Clause 8). It should be noted, however, that it may become necessary to accommodate alterations or modifications to the design when, for example, the final details of the permanent works are known, or experience is gained during the construction of the temporary works. The designer may not be able to fully accommodate the requirements of the design brief and any proposed modifications should be drawn to the attention of the TWC as soon as the changes are identified.

9.1.2 The preparation of design calculations, drawings and specifications should be undertaken in a manner similar to the procedures (including checking) applied to the design of permanent works. They should define such points as: requirements for foundations; positions of components; the nature of connections to other components and limitations for loading and sequence of operations. The CDM Regulations require that any designer provides adequate information about any significant risk associated with the design, e.g. a list of residual hazards. There is also a requirement to co-ordinate the work with that of others in order to improve the way in which risks are managed and controlled. This may include the use of suggested construction sequences. For complex schemes it is recommended that the temporary works designer brief the site team on the key elements and hazards identified during the design process.

9.1.3 The temporary works designer should identify, from the design brief and associated information, the various loads that will act on the structure together with the combinations in which they will be considered. In addition, the relevant British Standards or other documents used in the design process should be identified. This information should be summarized separately from the design calculations in order that it can be available to the checker. For complex schemes the information may be presented in the form of a “design statement” which may also include: an idealised structure, method(s) of analysis, and the version of computer software, if any, used.

9.1.4 Temporary works should be designed in accordance with recognized engineering principles. The design should take into account the variability of materials, workmanship, site conditions and construction tolerances.

9.1.5 Temporary works systems should be designed with regard to ease and safety of erection and dismantling. Temporary works designers and suppliers should provide guidance on the implementation of their design.

9.1.6 The permanent works designer can be expected to have considered the buildability of the structure. The overall design should have taken account of the methods of construction and the space required for the temporary works. The permanent works designer should provide the relevant information – particularly the significant risks involved in its construction. The temporary works designer should take this information into account in the preparation of the design.

9.2 Design check

9.2.1 Prior to the commencement of the construction work, the proposed temporary works design should be checked for concept, adequacy, correctness and compliance with the requirements of the design brief. This check should be carried out by a competent person or persons independent from those responsible for the design. The ability of the checker and his remoteness or independence from the temporary works designer should be greater where new ideas are incorporated or the temporary works are complex.

9.2.2 Design checks should be undertaken in accordance with one of the categories given in Table 1.

9.2.3 For categories 2 and 3, the checker should carry out the check without reference to the designer’s calculations using only the design

brief, design statement, drawings and specification and associated information not produced by the designer.

9.2.4 In certain situations it may be necessary to apply different categories of check to different parts of a design. For example if a proprietary supplier is carrying out a falsework design assumed to be fixed at the head, the check on the falsework would be category 1 but the check that the structure is able to resist the applied horizontal load may be category 2.

9.2.5 On completion of the design and design check, a certificate should be issued for all categories, confirming that the design complies with the requirements of the design brief, the standards/technical literature used and the constraints or loading conditions imposed. The certificate should identify the drawings/sketches, specification and any methodology that are part of the design and it should be signed by the designer and design checker. The package of information issued to the TWC should include this certificate.

Table 1 Categories of design check

Category	Scope	Comment	Independence of checker
0	Restricted to standard solutions only, to ensure the site conditions do not conflict with the scope or limitations of the chosen standard solution.	This applies to the use of standard solutions and not the original design, which will require both structural calculation and checking to category 1, 2 or 3, as appropriate.	Because this is a site issue, the check may be carried out by another member of the site or design team.
1	For simple designs. These may include: formwork; falsework (where top restraint is not assumed); needling and propping to brickwork openings in single storey construction.	Such designs would be undertaken using simple methods of analysis and be in accordance with the relevant standards, supplier's technical literature or other reference publications.	The check may be carried out by another member of the design team.
2	On more complex or involved designs. Designs for excavations, for foundations, for structural steelwork connections, for reinforced concrete.	Category 2 checks would include designs where a considerable degree of interpretation of loading or soils' information is required before the design of the foundation or excavation support or slope.	The check should be carried out by an individual not involved in the design and not consulted by the designer.
3	For complex or innovative designs, which result in complex sequences of moving and/or construction of either the temporary works or permanent works.	These designs include unusual designs or where significant departures from standards, novel methods of analysis or considerable exercise of engineering judgement are involved.	The check should be carried out by another organization.

9.3 Avoidance of progressive collapse

Temporary works usually comprises a structure with many components, junctions and connections. Careful attention should be paid to the way in which such connections and junctions are detailed,

to reduce the dependence on workmanship and extensive checking on site. Detailing of the temporary works structure should be such that any local failure of the structure does not lead to the progressive collapse of the whole.

9.4 Choice of temporary works solution

9.4.1 A number of different arrangements/solutions are likely to satisfy the design brief and merit consideration prior to selection of the preferred option. It should be decided whether it is appropriate to have a bespoke design or, alternatively, to proceed on the basis of a "standard solution". A "standard solution" comprises a suitable arrangement for which the basic design work has already been carried out and presented in a tabular or other easily assimilated form, and for which no further structural calculations are necessary. When selecting a "standard solution", those responsible for making the final choice should ensure that they understand and take full account of the limitations of these designs so that they will only be used in appropriate circumstances. The choice of a "standard solution" may be influenced by such matters as availability of material and the particular experience of the supervisory and construction work force.

9.4.2 The design offices of contractors or suppliers or the like may produce "standard solutions" to suit their materials or operations. Such designs should be produced in accordance with the recommendations of relevant codes and should also be accompanied by information covering layout, loading, limitations, tolerances, etc.

9.4.3 Those who select a particular standard solution should be aware that they have responsibilities and duties of a "designer" (see 5.8).

9.5 Selection of materials and components

9.5.1 It is necessary to identify the properties of the materials and the components that it is proposed to use. When designing for the use of proprietary equipment the design should normally utilize the equipment in accordance with the current recommendations of the supplier of the equipment being used. Particular care is required to ensure that the terms used to define capacity are understood; they may be either in safe working loads or in characteristic strength. Where it is proposed to use the equipment in situations not specifically intended by the supplier, it is recommended that in the first instance the supplier is consulted for specific advice about the proposed method of use.

NOTE 1 The term "characteristic strength" means that value of the strength of the component below which only 5% of all test results would be expected to fail. Where a characteristic strength is stated, an appropriate material factor has to be used together with an appropriate load factor to determine the component's safe working load. The characteristic strength is used in limit state design (see BS EN 12812).

NOTE 2 Under the Health and Safety at Work, etc. Act 1974 [5], suppliers and importers of equipment have a duty to supply relevant and correct performance data. Performance data issued by a supplier of equipment can reasonably be relied on without further justification.

9.5.2 Where performance information is not readily available, or as an alternative means of obtaining the required data, the user should assess the capability of the material(s) to resist the loading conditions

using fundamental engineering principles and, where appropriate, arrange for testing.

9.5.3 When compliance testing is required, for example weld testing or confirmation of ground bearing capacity, this should be clearly indicated with the design information.

10 Co-ordination and supervision of work on site

10.1 Work on site should be the subject of careful direction, supervision and inspection to ensure that the temporary works is constructed safely in accordance with the design and specified materials, and that only when all checks have proved satisfactory is the works loaded, used, maintained and then dismantled in accordance with the design documentation and method statement.

10.2 The design documentation and method statement should be followed but those responsible for work on site should bear in mind the need to compare conditions experienced on site during construction with those assumed in the proposed design in order that appropriate action can be taken to modify the design if it becomes apparent that this might be advisable.

10.3 Any alterations to the temporary works, proposed by the site team, should be referred to the designer for confirmation that they are acceptable.

10.4 The TWC should ensure that the guidance on the implementation of the design provided by the designer or supplier (see **9.1.2** and **9.1.4**) is incorporated into a specific method statement by those responsible for site supervision.

10.5 It may be necessary to carry out inspections of the temporary works, during construction, to check the adequacy of the critical elements. Prior to loading the temporary works a final inspection should also be carried out to verify that it has been constructed in accordance with the requirements of the design and any subsequent modifications. The results of these inspections, together with any requirements for improvement, should be recorded by the TWC/TWS.

[A1] The TWC should ensure that a permit to load (bring into use) is issued to the site team prior to its use, as stated in **7.2.5o**). A TWS may issue the permit when specifically authorized for a defined scope and range of work. (See **7.3.4**.) Some temporary works may involve staged construction and will require a number of permits. In certain conditions the permit may be time limited, for example a permit to load for a falsework is normally valid for 24 hours. The area over which loading may take place, and to what extent, should also be set down in the permit, e.g. it may be "reinforcement only". The TWC should identify which permits will be signed by the TWC and which will be signed by the TWS where this is authorized. **[A1]**

10.6 Where the temporary works is used to provide support to the permanent works until it is self-supporting, **[A1]** the TWC should determine that the permanent works have attained adequate strength and/or stability, prior to ensuring that a permit to unload (take out of use) is issued, as stated at **7.2.5p**). A TWS may issue the permit when specifically authorized for a defined scope and range of work. (See **7.3.4**.) The TWC or the TWS might need to verify concrete strength or that all structural steelwork elements and connections are completed

or that any post-tensioning has been carried out prior to issuing the permit. The TWC should identify which permits will be signed by the TWC and which will be signed by the TWS where this is authorized. ^(A1)

^(A1) text deleted ^(A1)

11 Checking on site

11.1 General

At all stages during construction/erection, use and dismantling of the temporary works, it is necessary to check that the information being used is correct, and that the work carried out is in accordance with the design details (drawings/sketches) and is as specified to ensure that the completed structure will function as intended. This is necessary, not only to ensure that the temporary works are safe to use, but also to facilitate remedial work should this prove necessary; it is frequently difficult to do this later. Details of checking procedures for falsework are given in Clause 20.

11.2 When to check

From the information supplied by the designer the TWC should establish a plan to carry out checks on the temporary works as the structure is under construction. The TWC should develop this plan using the drawings, specification and methodology supplied, by the designer, and should then define points at which the structure will be checked for compliance with the design by either the TWC or the TWS. The results of these inspections will be recorded and any variations from the design will be rectified or the designer informed in order that he can review and accept the changes or advise on further remedial works.

12 Alterations

Changes in the requirements of the design brief should be recorded in writing, with reference to the original design brief, and confirmed to the designer. The designer should check the proposals against the original design and incorporate the requirement for these alterations into the design and drawings (see also 20.2). If there is no significant change to the design, the designer should confirm the acceptability of the alterations.

The designer should advise the design checker of the alterations and any revisions to the drawings/specification and these should be checked in the same manner as the original design. A revised design/check certificate should be issued when considered appropriate by the designer and checker.

13 Loading (bringing) the temporary works (into service)

As a means of exercising control over bringing the temporary works into service a formal procedure for giving permission to load, or progress to the next stage in the implementation sequence should be established. In simple cases a single "permit to load" when the

temporary works has been checked, may be appropriate. In complex, or larger cases, permits may be required at different stages, both as regards loading or for different areas or for excavation. It will normally be desirable to limit the period of validity of the permit, as subsequent modifications may take place. The area over which loading may take place, and to what extent, should also be set down in the permit, e.g. it may be "reinforcement only".

14 Dismantling

When the structure being supported by the temporary works has become self-supporting, or the excavation has been backfilled or other condition, the temporary works may be dismantled (removed) subject to a previously agreed procedure and/or restrictions imposed by the permanent works. As at the loading stage, a permit to dismantle or unload the temporary works may be appropriate, particularly where this takes place in stages. It may be appropriate to issue it in conjunction with, or after consultation with, the designer of the permanent structure.

Section 3: Falsework

15 General

The definition of falsework given in 3.16 is broad, but this code does not give information on the support of excavations (see BS 6031) nor does it describe flying shores or façade retention systems (see CIRIA C579 [19]). For guidance on the design and use of access scaffolding and special scaffold structures other than falsework, reference should be made to BS EN 12811-1 and the NASC guide TG20 [20].

A considerable amount of falsework is of comparatively low technology, and very repetitive. Information is provided in 9.4.1 and 19.1.4 on how standard solutions can be used.

Where reference is made in this section to design in accordance with limit state design codes, for example BS 5268 and BS 8110, appropriate load and material factors should be used.

NOTE For certain materials, guidance on appropriate load and material factors is provided in this standard.

16 Materials

16.1 General considerations

16.1.1 Suitability of materials

All materials, when new, should conform to the requirements of the appropriate British Standard(s), where one exists.

16.1.2 Identification and properties

Materials and components should be clearly and readily identifiable by shape or size. Where this is not possible they should be marked.

No material should be used unless its properties are known or established, and its application should be within these limits.

16.1.3 Handling of materials and components

Materials and equipment used in falsework will, in most cases, be used many times. In choosing these, account should be taken of the rough conditions under which they will be handled.

Robust material will obviously suffer less damage but will usually be heavier. Mechanical aids that allow their use should be considered.

16.2 Testing and inspection

16.2.1 Testing

Where doubt exists as to the quality, by composition or condition, of the material or component it may be submitted to a test of the load/deflection type, wherever possible in accordance with an appropriate British Standard.

Testing on site is not normally recommended, as even the most simple tests require disciplined test procedures.

If the performance of an item of equipment is not known, or is in doubt and calculations are impracticable, tests should be carried out to determine necessary values. It should be realized that a single test might give misleading results.

16.2.2 Inspection

Materials and components used for falsework should be examined for damage or excessive deterioration before use and if found unsuitable they should be repaired or rejected. Accepted engineering principles should be applied in determining whether the element requires rejection or remedial work. The integrity of welds should be visually examined, and for a proper examination, paint coatings may have to be removed.

Careful inspection is essential in preventing unfit second-hand material from being used. Welds should be checked and material that is bent, distorted or badly corroded should be rejected or sent for repair. Items made from steel should be kept in a well-painted or otherwise protected condition. Timber should be inspected between uses not only for evidence of physical damage but for signs of attack by decay, rot or insect attack or the development of shakes or splits. Where the surface of the timber is so obscured by dirt, concrete or other coatings as to prevent inspection for defects and deterioration, it should not be used structurally.

Detailed recommendations for the reuse of used materials are given in **16.3** to **16.9**.

16.3 Steelwork (other than scaffold tube)

*NOTE Specific recommendations for tubular steel scaffolding and manufactured components are given in **16.8** and **16.9** respectively.*

16.3.1 Quality of steel

Except in cases where particular properties are desirable, weldable structural steel of a higher grade than grade S 275JR of BS EN 10025-2:2004 should not be specified. If the material properties are not known, steel should be assumed to be mild steel grade S235 JR of BS EN 10025-2:2004 for design purposes (but see **16.3.6** for welding). For design purposes, old steel of grade 43A may be assumed to be equivalent to grade S275 of BS EN 10025-2:2004 if it was manufactured in accordance with the 1986 or 1990 editions of BS 4360. Old steel of grade 43A, manufactured to previous editions of BS 4360, should be assumed to have a strength midway between grades S235 and S275.

16.3.2 Identification of steel

It is of the utmost importance that the correct quality, size and mass of section should be used. Each element should be clearly marked to assist erection and inspection. The permanent marks, formed when a section is rolled, may not give any indication of quality, mass or

true size. Attention is drawn to the differences between rolled steel joists (RSJ) and universal beam (UB) sections, the latter often having thinner webs and dimensions that are nominal only and vary with the particular mass per unit length.

Where steelwork other than mild steel is used for particular properties, it should be so marked as to be readily distinguishable and any connections should be designed to obviate substitution errors.

16.3.3 Permissible stresses

The permissible stresses should be based on the allowable stresses given in BS 449-2:1969 according to the steel being used, as follows.

- a) The BS 449-2:1969 allowable stresses for grade 43 should be used for grade S275 steel to BS EN 10025 and for old grade 43 steel to BS 4360:1990 or 1986.
- b) For old grade 43 steel to editions of BS 4360 prior to 1986 the BS 449-2:1969 allowable stresses for grade 43 steel should be divided by 1.1. See Table A.1 and Table A.2.
- c) For grade S235 steel to BS EN 10025 and for unidentified mild steel, the BS 449-2:1969 values for grade 43 steel should be divided by 1.2. See Table A.1 and Table A.2.

16.3.4 Section properties

Where the cross-sectional area of a steel section has been reduced, the actual dimensions should be measured and section properties calculated on the basis of the least cross-sectional area. If such measurements are not possible owing to heavy corrosion or any other reason, load testing should be carried out.

16.3.5 Fatigue

There is normally no need to consider fatigue when designing falsework.

16.3.6 Welding and rectification of steelwork

Different steels require different welding techniques. In general, welding of unidentified steels should not be undertaken for structural work. Steelwork that has been repaired by welding may be used provided that the remedial work has been carried out in accordance with BS EN 1011-1 and BS EN 1011-2. The quality of steel being repaired should first be identified.

Bent sections should be carefully straightened and the work should be carried out preferably by means of straightening rolls, hydraulic press or other controlled method.

Where, for any member to be used as a strut, the lack of straightness is clearly visible to the eye, or exceeds the appropriate tolerances recommended in 20.3.2, the member should be straightened or rejected.

16.4 Timber

16.4.1 Timber quality

16.4.1.1 General

Timber for falsework should be stress graded in accordance with BS 4978:1996 for softwood, or BS 5756:2007 for hardwood, or other appropriate standards of other countries. A full range of stresses for both softwood and hardwood is given in BS 5268-2:2002. That standard also gives a simplified approach to the stress grading by using nine rationalised strength classes for softwood and six for hardwood, enabling a variety of species to be used efficiently. The softwood classification is termed Cxx and the hardwood timber as Dxx. Data on strength classes C16, C24, C27, D30, D40 and D50 are given in Table 2.

Details of equivalent timber grades satisfying these various strength classes are given in Table 3, Table 4, Table 5 and BS EN 1912:2004. Alternatively, timber may be graded directly to a particular strength class.

Table 2 Basic stresses and moduli of elasticity for the wet condition

Strength class	Bending stress parallel to grain N/mm ²	Tensile stress parallel to grain N/mm ²	Compressive stress perpendicular to grain N/mm ²	Shear stress parallel to grain N/mm ²	Modulus of elasticity	
					Mean N/mm ²	Minimum N/mm ²
Softwoods:						
C16	4.24	2.56	1.32 (1.02)	0.60	7 040	4 640
C24	6.00	3.60	1.44 (1.14)	0.64	8 640	5 760
C27	7.60	4.80	1.50 (1.20)	0.99	9 200	6 560
Hardwoods:						
D30	7.20	4.32	1.68	1.26	7 600	4 800
D40	10.0	6.00	2.34	1.80	8 640	6 000
D50	12.8	7.68	2.70	1.98	12 000	10 080
Modification Factor used	K ₂	K ₂	K ₂	K ₂	K ₂	K ₂

NOTE 1 This table is based on Table 8 of BS 5268-2:2002. The values take account of the modification factor K₂ for the wet condition (Service class 3) in that code.

NOTE 2 Timber in the wet condition has a moisture content greater than 20%.

NOTE 3 Values for compressive stress allowing for wane are shown in brackets.

Table 3 Softwood species which satisfy strength classes in accordance with BS 4978

Standard name	Strength class		
	C16	C24	C27
Imported:			
Paraná pine	GS	SS	
Caribbean pitch pine			SS
redwood	GS	SS	
whitewood	GS	SS	
Douglas fir-larch (Canada and USA)	GS	SS	
hem fir (Canada and USA)	GS	SS	
spruce-pine-fir (Canada and USA)	GS	SS	
southern pine (USA)		SS	
British grown:			
Larch	GS	SS	
Key			
GS	general structural		
SS	special structural		

Table 4 North American softwood species and grade combinations which satisfy strength classes in accordance with national lumber grades authority (NLGA) and national grading rules for dimension lumber (NGRDL) joist and plank rules

Standard name	Strength class		
	C16	C24	C27
Douglas fir-larch (Canada and USA)	No. 1, No. 2	Sel	
hem fir (Canada and USA)	No. 1, No. 2	Sel	
spruce-pine-fir (Canada and USA)	No. 1, No. 2	Sel	
southern pine (USA)	No. 3		Sel

Table 5 Hardwoods which satisfy the strength classes graded to BS 5756:2007

Standard name	Strength class		
	D30	D40	D50
Tropical hardwoods:			
iroko, jarrah, teak		D40	
merbau, opepe, karri, keruing			D50
Temperate Hardwoods:			
oak Grade TH1 and THB	D30		
oak Grade THA		D40	
<i>NOTE Consideration should be given to sustainability when specifying certain hardwood species.</i>			