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 all falsework. The guidance also applies to the design of class A falsework[1] defined in BS EN 12812, the design of which is specifically excluded from BS EN 12812.

Section 1 gives recommendations in relation to training and education.

Section 2 gives recommendations for procedures to ensure that temporary works are conceived, designed, specified, constructed, used and dismantled all in a safe and controlled manner suitable for all construction projects. These procedures include clauses relating to all roles involved in temporary works: clients, permanent works designers, temporary works designers, contractors (including construction management organizations), suppliers and manufacturers.

Construction sites and methods adopted for controlling the temporary works vary. This British Standard recognizes that the extent of control measures required are greater on the larger or more complex projects, as can be encountered on major infrastructure projects, power stations, airports etc. Generally procedures are to be in accordance with this standard but additional client specific procedures might be required on major infrastructure projects.

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. Although Section 3 was written for permissible stress design, the design concepts and the service loads stated are applicable to limit state design. The loads, including wind loads, are the unfactored service loads and conform to both BS EN 1991-1-4 and BS EN 12812.

The structural design element in this British 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 documents are referred to in the text in such a way that some or all of their content constitutes provisions 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.[2]

BS 449-2:1969 (withdrawn), *Specification for the use of structural steel in building — Part 2: Metric units*

BS 648 (withdrawn), *Schedule of weights of building materials*

1 BS EN 12812 states that design class A is only to be adopted where: a) slabs have a cross-sectional area not exceeding 0.3 m^2 per metre width of slab; b) beams have a cross-sectional area not exceeding 0.5 m^2; 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.

2 As Section 3 has not been updated as part of this revision, it refers to some standards which have now been withdrawn. These have been marked as such.

BS 1139-1:1982 (withdrawn), *Metal scaffolding — Part 1: Tubes — Specification for tubes for use in scaffolding*

BS 1881-115 (withdrawn), *Testing concrete — Part 115: Specification for compression testing machines for concrete*

BS 1881-116 (withdrawn), *Testing concrete — Part 116: Method for determination of compressive strength of concrete cubes*

BS 1881-117 (withdrawn), *Testing concrete — Part 117: Method for determination of tensile splitting strength*

BS 1881-118 (withdrawn), *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 (withdrawn), *Testing concrete — Part 120: Method for determination of the compressive strength of concrete cones*

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

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

BS 5268-2:2002 (withdrawn), *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 5628-1:2005 (withdrawn), *Code of practice for the use of masonry — Part 1: Structural use of unreinforced masonry*

BS 5756:2007, *Visual strength grading of temperate hardwood — Specification*

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

BS 6399-1 (withdrawn), *Loading for buildings — Part 1: Code of practice for dead and imposed loads*

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

BS 8110-1 (withdrawn), *Structural use of concrete — Part 1: Code of practice for design and construction*

BS 8110-2 (withdrawn), *Structural use of concrete — Part 2: Code of practice for special circumstances*

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

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

BS EN 74-1, *Couplers, spigot pins and baseplates for use in falsework and scaffolds — Part 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 — Part 1: Softwood sawn timber*

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

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

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

BS EN 1991-1-6, *Eurocode 1 — Actions on structures — Part 1-6: General actions — Actions during execution*

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

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

BS EN 12811-1:2003, *Temporary works equipment — Part 1: Scaffolds — 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*

NA to 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 British 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 one within the other

*NOTE 1 See also **3.39** 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 asset

permanent structure, building, wall, tunnel, rail track, waterway, road, cutting or earthwork which provides support to a structure, rail track, waterway, road or other construction

3.3 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

3.4 base plate

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

3.5 bay length

distance between the centres of two adjacent standards, measured horizontally

3.6 beam bearer

spanning member, usually horizontal, used to transfer load to supports, commonly timber, aluminium or steel

3.7 blinding

layer of lean concrete on soil to prevent local degradation and provide a clean workplace for construction work

3.8 brace

component placed diagonally with respect to the vertical or horizontal members of a structure to afford stability

3.9 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

3.10 characteristic strength

strength at which members tested would fail, normally associated with a confidence limit that 95% would fail above the value stated

3.11 check list

document that lists activities that need inspection and/or testing

NOTE 1 This list could be available as either a generic list, as an aide-memoire on a particular subject, or as a specific list sequencing the activities in correct order.

NOTE 2 This can be enhanced with a signature to verify that the work has been completed satisfactorily as part of the management process.

NOTE 3 An example of a specific check list would be the order of activities to operate a climbing or advancing formwork system, to ensure that the correct sequence was carried out.

3.12 client

organization or person for which/whom a construction project is carried out

3.13 competent person/organization

person/organization with the necessary skills, knowledge and experience (and organizational capability) of the specific tasks to be undertaken and the risks which the work entails, 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

3.14 component

part of the temporary works structure used and identifiable as a distinct unit

3.15 contractor

any person (including a non-domestic client) who, in the course or furtherance of a business, carries out, manages or controls construction work

NOTE 1 Anyone who directly employs or engages construction workers or manages construction is a contractor. Contractors include principal contractors, sub-contractors, any individual, sole trader, self-employed worker, or business that carries out, manages or controls construction work as part of their business. This also includes companies that use their own workforce to do construction work on their own premises. The duties on contractors apply whether the workers under their control are employees, self-employed or agency workers.

NOTE 2 Where contractors are involved in design work, including for temporary works, they also have duties as designers under the CDM Regulations 2015 [1].

3.16 coupler

component used to fix scaffold tubes together

3.17 design certificate

certificate issued by the designer to indicate that the design is satisfactory and conforms to the design brief, and where provided, the design statement

3.18 design statement

document prepared by the designer outlining the means by which the design is to be developed, the assumptions, method of analysis and other controls

NOTE The design statement can include the potential of the temporary works to affect/impact operational infrastructure.

3.19 designated individual (DI)

senior person within an organization with responsibility for establishing, implementing and maintaining a procedure for the control of temporary works for that organization

3.20 domestic client

client for whom a project is being carried out which is not in the course or furtherance of a business of that client

NOTE Local authorities, housing associations, charities, landlords and other businesses might own domestic properties, but they are not considered to be a domestic client for the purposes of the CDM Regulations 2015 [1]. If the work is in connection with a business attached to domestic premises, such as a shop, the client is not a domestic client.

3.21 effective length

theoretical length of a compression member as determined by the restraint at its ends

3.22 factor of safety

ratio of failure load to the maximum working load

3.23 falsework

temporary structure used to support a permanent structure while it is not self-supporting

3.24 floor centre

beam of adjustable length, usually a metal lattice or sheet metal box beam, used to support decking for a floor slab

3.25 forkhead

U-shaped housing used to support bearers, beams, joists or similar

3.26 formwork

structure, usually temporary, but in some cases wholly or partly permanent, used to contain poured concrete to mould it to the required dimensions 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.

3.27 frame

principal panel unit of a prefabricated falsework structure formed from aluminium or steel sections

NOTE A frame can include connecting components.

3.28 grade stress

stress that can be safely sustained by timber of a particular strength class, or species and grade

3.29 hold point

stage in the temporary works process where no further progress is to be made until the necessary permit or action has been completed

3.30 inspection and test plan (ITP)

document that prescribes the design output to be used to produce an item of work, and the inspections and tests required to verify that the item of work conforms to the design output

NOTE An ITP can refer to quality control check lists to detail and evidence the inspection or test.

3.31 joint pin

expanding fitting placed in the bore of a tube to connect one tube to another coaxially

3.32 joist

small horizontal or sloping member, e.g. the horizontal members that carry decking for a suspended concrete slab

3.33 kentledge

material placed on a structure to provide stability by the action of its dead weight

3.34 lacing

generally horizontal members that connect together and reduce the unsupported length of compression members

3.35 node

theoretical point where two or more members are connected together

3.36 permissible stress

stress that can be sustained safely by a structural material for the particular condition of service or loading

3.37 permit

certificate issued to release a hold point

NOTE Examples include permit to load, permit to take out of use.

3.38 primary

principal bearing member transferring load to the falsework

3.39 prop

compression member used as a temporary support

3.40 quality control check list

document that lists the elements of an inspection or test, that is endorsed to show that the item of work has satisfied that inspection or test, or that the operation has been witnessed

3.41 re-propping

system used during construction in which the temporary supports to a recently cast slab are removed and replaced in a planned sequence

3.42 scaffold

temporary structure that provides access, or on or from which persons work, or that is used to support material, plant or equipment

NOTE *See also **3.23** falsework.*

3.43 soffit

underside surface of a concrete member or slab

3.44 sole plate

timber, concrete or metal spreader used to distribute the load from a standard or baseplate to the ground

3.45 standard

vertical tube or member

3.46 strength class

classification of timber based on particular values of grade stress

3.47 strut

member in compression

NOTE *See also **3.39** prop.*

3.48 sub-consultant

individual or organization appointed by a consultant or designer to provide technical advice, including advice on methodology, and/or design in a specialist area of temporary or permanent works

3.49 sub-contractor

contractor employed by another contractor to carry out or manage construction work

NOTE *See also **3.15** contractor.*

3.50 sway

horizontal displacement at the top of the falsework in relation to the bottom, under application of the load

3.51 temporary works co-ordinator (TWC)

competent person with responsibility for the co-ordination of all activities related to the temporary works

3.52 temporary works supervisor (TWS)

competent person who is responsible to and assists the temporary works co-ordinator

3.53 third party

party, independent of the project, whose procedures are to be followed, and approvals obtained, for temporary works proposals affecting their assets, users or their land ownership

NOTE An example of a third party would be a highway authority, affected by a new rail structure over their asset, required as part of the client's project.

3.54 top restraint

method by which stability of falsework is provided by surrounding permanent works or specifically designed temporary works

3.55 tower

tall composite structure, used principally to carry vertical loading

3.56 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 British Standard.

ACoP	approved code of practice
AIP	approval in principle
BIM	building information modelling
CDM	Construction (Design and Management) Regulations 2015
CEM	cement
CIRIA	Construction Industry Research and Information Association
CPD	continuing professional development
CS	Concrete Society
DI	designated individual
EIR	employer's information requirements
FoS	factor of safety
GS	general structural (timber category)
HAZOP	Hazard and operability study
HSE	Health and Safety Executive

MC	moderately conservative
M&E	mechanical and electrical
NASC	National Access and Scaffolding Confederation
NGRDL	National Grading Rules for Dimension Lumber
NLGA	National Lumber Grades Authority
PC	principal contractor
PC's TWC	principal contractor's temporary works co-ordinator
PD	principal designer
PW	permanent works
PWD	permanent works designer
RAMS	risk assessment and method statement
RSJ	rolled steel joist
SS	special structural (timber category)
TW	temporary works
TWC	temporary works co-ordinator
TWD	temporary works designer
TWDC	temporary works design checker
TWS	temporary works supervisor

The following symbols are used in this British Standard.

Symbol	Meaning	Unit
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
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

Symbol	Meaning	Unit
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_a	Active pressure coefficient	non-dimensional
K_n	Timber modification factor	non-dimensional
K_p	Passive soil resistance coefficient	non-dimensional
L/l	Length	mm
λ	Slenderness ratio	non-dimensional
L	Wave length	m
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	kN/m
N	Characteristic compressive strength of a tubular strut	N/mm^2
n	Number of node points	non-dimensional

Symbol	Meaning	Unit
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
ϕ	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/mm^2
p_c	Permissible axial stress for struts	N/mm^2
p_{cw}	Permissible compressive stress in the web	N/mm^2
p-Δ	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
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

Symbol	Meaning	Unit
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 Overview of temporary works procedures and training

5.1 Overview of procedures

5.1.1 General

5.1.1.1 Temporary works can be described as providing an "engineered solution" that is 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. It is used to control stability, strength, deflection, fatigue, geotechnical effects and hydraulic effects within defined limits.

This description of temporary works includes, but is not limited to:

a) supporting or protecting either an existing structure or the permanent works during construction, modification or demolition;

b) provision of stability to the permanent structure during construction, pre-weakening or demolition (e.g. propping, shoring, facade retention etc.);

c) securing a site, or providing access to a site or workplace on site or segregation of pedestrians and vehicles (e.g. hoarding, haul roads, fencing, stairs);

d) supporting or restraining plant, materials or equipment, including stability of water-borne craft;

e) provision of earthworks or slopes to an excavation or supports to the side or roof of an excavation or supports or diversions to watercourse during construction operations;

f) providing a safe platform for work activity on land or water (e.g. jetty, scaffolding, edge protection or towers);

g) providing measures to control noise, dust, debris, fume, air quality, groundwater or any site discharges during construction or demolition (e.g. screens, bunds, de-watering, demolition debris);

h) providing protection or support to services; and

i) facilitating testing (e.g. pressure testing pipes, pile testing, pre-demolition floor load capacity testing).

5.1.1.2 The temporary works could be removed or left in place (hence becoming sacrificial, e.g. profiled metal decking) after the completion of the permanent works, but in the latter case would not necessarily contribute to the strength of the permanent works.

5.1.1.3 When a project has, or might be anticipated to have, the requirement for any temporary works, all organizations involved in the management of the temporary works, whether implemented by themselves or others, should have and implement a procedure which outlines how they are to discharge their duties in relation to the temporary works.

NOTE The purpose of the procedures is to manage and control the organization's involvement both within their own organization and when they are employing others or working with other organizations to carry out temporary works roles.

5.1.1.4 This overview explains the core principles and organizational interfaces which are recommended, before expanding on the procedural control details in Section 2.

5.1.1.5 All types of organizations, from the use of temporary works by small contractors to the very large organizations and/or utilities should use the procedures outlined in detail below. This includes civil engineering companies and building companies. The approach adopted in Section 2 is "organization focused" so the procedures for each organization are separated – it is accepted that this includes some duplication of text.

NOTE The term "organization" includes clients, designers, permanent works designers, temporary works designers, principal designers, contractors, principal contractors, sub-contractors, specialist contractors, third-party contractors and supplier/manufacturers.

5.1.1.6 To cater for the wide range of knowledge, skills, experience and qualifications which are encountered, this British Standard is drafted in the broadest terms. This should allow the duties, of the TWC and TWS for example, to be carried out by individuals who do not have engineering qualifications.

5.1.1.7 One of the main aims of the procedure and the method of work adopted, should be to minimize the chance of errors being made, and to maximize the chance of errors being discovered if they are made. There should be effective communication of information and requirements between all levels of the construction organizations involved, whether they are concerned primarily with the permanent works or the temporary works. An effective system of checking, both for the design and its implementation, should also be implemented.

5.1.1.8 Procedures should be put in place to manage potential problems in temporary works which can arise at interfaces. The interfaces might be:

a) between areas allocated to be managed by different people, controlled by appointing a lead person; between the perimeter of one area and another part of the PC's site, controlled by exchange of design briefs; or

b) between the design of the main temporary works and the design of additional items of temporary works by another designer, controlled by a lead designer.

5.1.1.9 Work on site should be directed, supervised and checked to ensure that the temporary works are constructed safely in accordance with the agreed design and sequence using materials of agreed quality, and that only when all checks have proved satisfactory are the temporary works used/loaded, and then taken out of use/unloaded in accordance with an agreed procedure (see **6.1.4**).

5.1.1.10 It should be recognized that there are three fundamental principles for controlling temporary works.

1) All organizations have a duty to manage and control their work.

2) The contractor is responsible for building the permanent works, and that includes any associated temporary works in order to construct the project.

3) One person should take overall responsibility for managing the temporary works. For very large or technically complex sites, this should be managed in accordance with **5.1.4.6**.

5.1.1.11 The first principle (see **5.1.1.10**) should be managed by the appointment of a "senior person", defined by the term designated individual (DI), who should be appointed to prepare and manage the organization's procedures.

5.1.1.12 The third principle (see **5.1.1.10**) that one person is to be appointed with overall responsibility for managing the temporary works on a site was first established in the Bragg Report [2]. A temporary works co-ordinator (TWC) should be appointed with overall responsibility for managing the temporary works on a site. This person should be appointed by the principal contractor and should be referred to as the "PC's TWC".

NOTE The TWC can, if necessary, delegate certain day to day activities, such as site inspection, to a temporary works supervisor (TWS).

5.1.1.13 A TWC may be appointed by another contractor to manage their temporary works but this individual should be responsible both to their DI and the PC's TWC.

*NOTE The term "contractor" is taken to mean sub-contractor employed by the PC or a contractor employed directly by the client or a third party (see **3.15**).*

5.1.1.14 Many of the duties of the DI, the PC's TWC, TWC and TWS detailed in this British Standard are activities already being carried out "as routine" by competent persons in the construction team. The activities of these individuals should be formalized in company procedures in accordance with the various clauses below to ensure the temporary works are implemented in a controlled manner. Only in larger organizations and/or on larger sites, with significant temporary works, is it justified to employ specific staff exclusively in the role of DI or TWC.

5.1.2 Summary of control measures

Control measures should be used to ensure safety for all temporary works; a summary of these are given below.

a) Every organization that has an involvement with temporary works should appoint a senior person to prepare, maintain and implement the organization's procedure for the control of temporary works. This person, usually reporting to the board of directors, is referred to as the designated individual (DI). See **6.1.2.1**.

b) Where there is only a single contractor on a site, the contractor should appoint a temporary works co-ordinator (TWC) responsible for all temporary works on that site. See 9.2.3d).

c) Where several contractors are on a project/site, the principal contractor (PC) should have a TWC (PC's TWC) responsible for all temporary works on the project. On particularly large or complex sites more than one PC's TWC may be appointed. See 9.3.2.5, 9.4.1, 9.5.1.6, 11.2.2.1 and 11.3.2.6.

d) The PC's TWC's should be appointed by the PC's DI. See 9.3.2.1.

e) The PC's TWC should be employed by the PC either as an employee, or be an employee of an organization contracted to provide the services of a TWC on behalf of the PC for all the temporary works on the site/project area. See 9.3.2.1.

f) Each PC's TWC should be responsible for a distinct, well-defined area of work. See 9.3.2.5.

g) Where necessary, the PC's TWC may be responsible for several projects if the level of temporary works on each project does not warrant a full-time TWC. See 5.1.4.4.

h) If there are multiple PC's TWC's on a site there should always be one who takes the role of lead PC's TWC. See 9.3.2.5.

i) A sub-contractor to the PC or another contractor (such as a client's contractor) who is contracted to manage their own temporary works and are working within a PC's TWC's area of responsibility should appoint a TWC. See 9.3.3.

j) The TWC should report to the relevant PC's TWC for the area in which they operate. See 9.5.1.4, 11.2.4.1, 11.3.2.1 and 11.3.2.6.

k) The TWC should be appointed by the contracted organization's DI. See 9.3.3.1 and 9.5.1.3.

l) Where there is more than one PC's TWC and/or TWC, the limits of responsibility, interfaces and boundaries should be recorded in writing. See 9.1.2, 9.1.4 and 9.3.2.5.

m) The PC's TWC and TWC should have the same level of management training. Their technical and practical knowledge should be commensurate with the complexity of the work. See 5.2, 9.3.2.2 and 9.3.3.2.

n) Where required, the PC and contractor may appoint temporary works supervisors (TWSs) who report to their TWC. See 9.3.4.1.

o) The organization's DI may delegate the appointment of a TWS to an individual who has the necessary skill, knowledge and experience, for example a contract or project manager or their TWC for the project. The appointment of the TWS should be approved by the DI of the organization for whom the TWS works. See 9.3.4.3 and 9.3.4.4.

p) Except for very low risk temporary works, a design brief should be prepared for the temporary works by the site team and issued by the TWC to the TWD. See 11.2.3, 11.3.3 and 13.2.

q) Where the category of design check has not been specified, the TWD, in consultation with the relevant TWC, should confirm the category and prepare the necessary design output. See 8.1.4a), 8.4.1.3 and 13.7.

r) The TWDC should carry out the design check of the temporary works, and, in certain categories without reference to the TWD's calculations, before issuing a certificate confirming the design is satisfactory. See 13.7.3.

s) The site team should construct the temporary works in accordance with the certified design. See 11.2.3, 11.3.3 and 14.1.

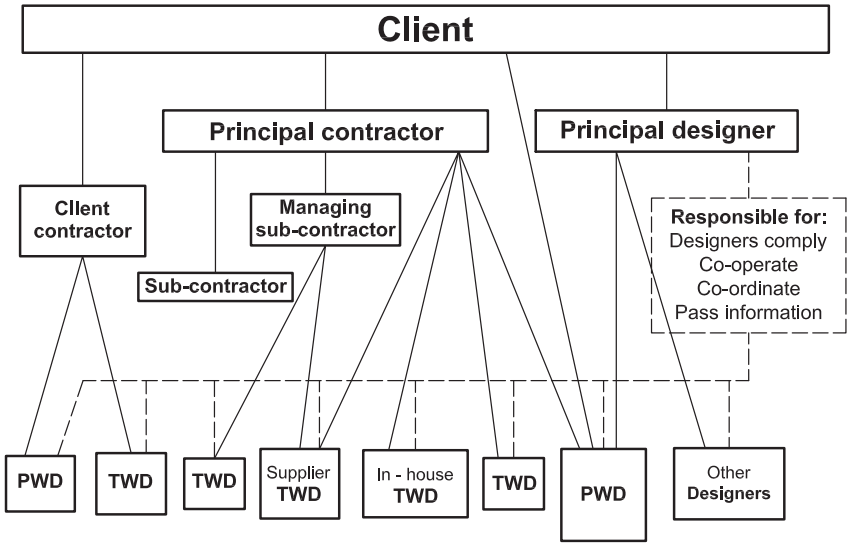
t) The TWC or TWS, as appropriate, should issue a permit to proceed confirming the temporary works have been erected in accordance with the certified design and any agreed revisions. See **11.2.3**, **11.3.3** and **12.3**.

5.1.3 Organizations involved in temporary works

5.1.3.1 There are many combinations of organizations that can be involved in temporary works. They can include clients, management contractors, contractors, sub-contractors, utility authorities, service suppliers (M&E), equipment suppliers, consultants and specialist contractors. Each have different contractual arrangements from project to project but the over-arching principle is that the PC's TWC has overall responsibility on site.

5.1.3.2 The framework of contractual relationships should be taken into account when planning the management of temporary works; an overview of likely contractual relationships between clients, contractors and designers, including both permanent work designers (PWDs) and temporary works designers (TWDs) is shown in Figure 1. Figure 1 also demonstrates the typical links showing how the designers should co-operate, even when not in a contractual relationship (shown as dashed).

Figure 1 — *Typical contractual interfaces between parties on a project*



NOTE 1 Attention is drawn to the CDM Regulations 2015 [1], which require the principal designer to take responsibility for all designers on that project and to co-operate, co-ordinate and transfer relevant information – this is shown by a dashed line.

NOTE 2 There is rarely a contract between the principal contractor and a client's contractor.

5.1.4 Responsibilities where a contractor co-ordinates the temporary works

5.1.4.1 General

The various ways in which the control measures (see **5.1.2**) are likely to be implemented on different projects of varying complexity are shown as lines of responsibility in Figure 2. In all the cases the sole contractor or principal contractor should manage and co-ordinate the temporary works on the project themselves.

5.1.4.2 Small contracts

Small contracts, including domestic client projects, often have only one contractor. This is shown in Figure 2a) and applies to the majority of small organizations, including builders and scaffolding providers.

The contractor should have a company director responsible for the technical work of the company. This person is effectively the DI and their duties include control of any temporary works. In very small companies the same person might also take on the TWC role.

The temporary works is managed either by a TWC, or, more likely, the site would have a trade-based supervisor handling the day-to-day site temporary works, i.e. performing the TWS role.

5.1.4.3 Projects with more than one contractor

If there is more than one contractor, one should be appointed as the principal contractor (PC); and it is the PC who takes the responsibility for the site and all the construction on it, whoever carries it out (see **5.1.1.12**). The temporary works should be managed by the PC's appointed TWC, known as the PC's TWC.

Depending on the size or accessibility of the site, the temporary works may be controlled either directly by the PC's TWC or by responsible TWSs [see Figure 2b)]. If the site is large, or there is another site in the local area, then other TWSs could be incorporated into the TW control process. The arrangement at Figure 2b) is common to many construction sites operating with their own staff.

5.1.4.4 PC with several sites

Small contractors, such as local house builders and many utility companies, operate with multiple small sites, often with only a few operatives to each site; they should operate in accordance with their organization's procedures, including the control of temporary works, even where they are undertaking routine work.

The PC's TWC should be appointed by the organization to cover the group of sites, and may be based in a regional office. The day-to-day control should be left to the responsible TWS on each site.

This procedure, shown at Figure 2c) is common practice with utility organizations and small building companies.

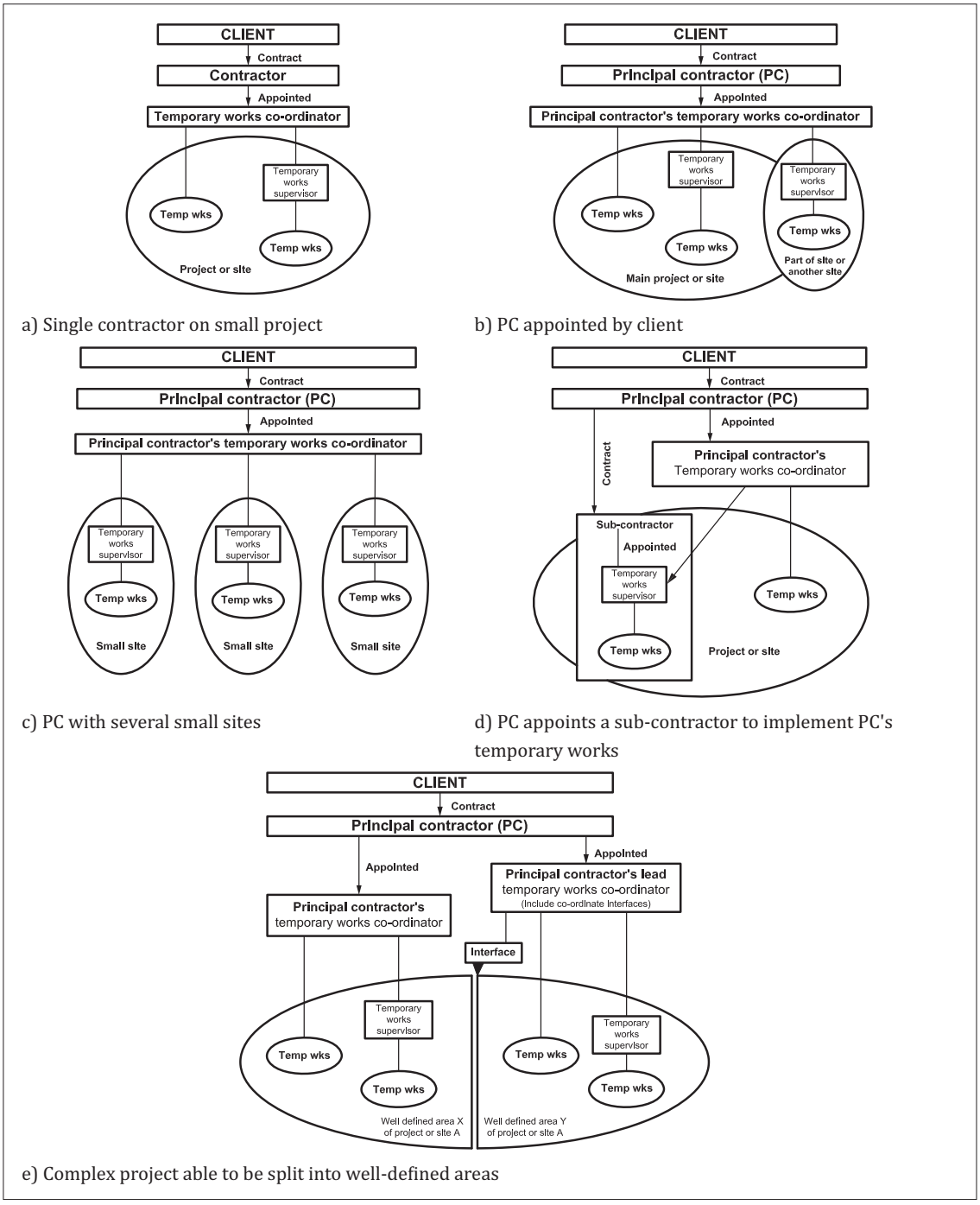
5.1.4.5 PC appoints a sub-contractor

Where the PC appoints a sub-contractor to provide the labour, and possibly also the equipment to be used for the temporary works, but retains the management role for the temporary works, the contractual relationship changes. This is shown in Figure 2d).

The sub-contractor should manage their own work (see the first principle in **5.1.1.10**) and should appoint TWS(s) to assume day-to-day responsibility. The sub-contractor's TWSs should report to the PC's TWC on all temporary works matters.

The management, design and control of the temporary works, along with any other temporary works on the site, should remain with the PC's TWC.

Figure 2 — *Lines of responsibilities where a single contractor or a principal contractor (PC) is co-ordinating the temporary works*



5.1.4.6 Splitting large/complex projects

Whereas the third principle (see **5.1.1.10**) limits one person for ultimate control, this British Standard accepts flexibility for particularly technically or logistically complex projects. It would be unrealistic to give individual responsibility for knowing all that was going on to one person for a major project.

A project or site can be split into more than one well-defined area and a PC's TWC be appointed for each area, e.g. a length of motorway or railway [see Figure 2e)]. Each individual PC's TWC should

be responsible for all the temporary works in the area allocated, irrespective of which organization carries out the temporary works in the area (see **9.3.2.5**).

The principle remains (see third principle in **5.1.1.10**) that only one PC's TWC should be responsible for a specific area at any one time. The interfaces should be clearly established and a lead PC's TWC should be appointed to manage the interfaces between the areas.

NOTE *It is extremely rare that a building project would justify more than one PC's TWC.*

5.1.5 Responsibilities where a contractor co-ordinates their own temporary works

5.1.5.1 General

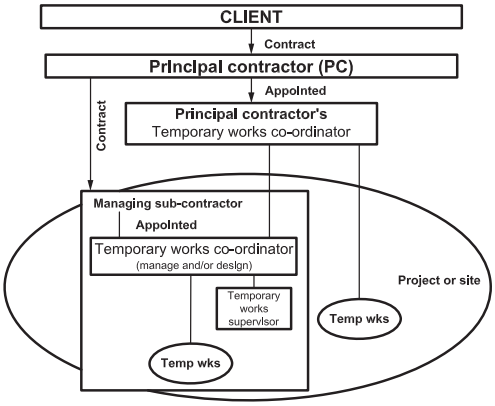
Certain specialist sub-contractors, such as reinforced concrete (RC) frame contractors, ground workers or demolition contractors, have the experience and competence to organize their temporary works and have management capability, often including specialist temporary works design facilities; they can, therefore, be deemed competent to co-ordinate their temporary works.

Where a client appoints a contractor directly, for example an M&E contract, and that contract involves temporary works, then the temporary works should be controlled and managed.

Both the managing sub-contractor appointed by the PC and the client's contractor should manage their own works responsibly. The lines of responsibility are shown in Figure 3. The contractor should appoint a TWC with a responsibility to the PC's TWC. They should also co-ordinate their temporary works with or through the PC's TWC to ensure no temporary works is affected adversely by any other temporary works or plant or other adjacent activities. Where necessary the contractors should also appoint their own temporary works supervisor(s) to manage the day-to-day site activities.

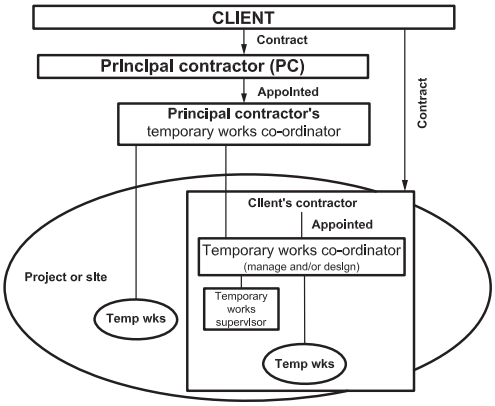
The relationships between the PC and contractor (i.e. a PC appointed sub-contractor or a client appointed contractor), including the roles of PC's TWC and TWC are summarized in Figure 4, but the full details of the relationships, actions and responsibilities are as outlined in Clauses **7**, **9** and **11**.

Figure 3 — *Lines of responsibility where either a principal contractor's (PC) appointed sub-contractor or a client's contractor co-ordinate their own temporary works*



a) PC appoints a sub-contractor to co-ordinate their own temporary works

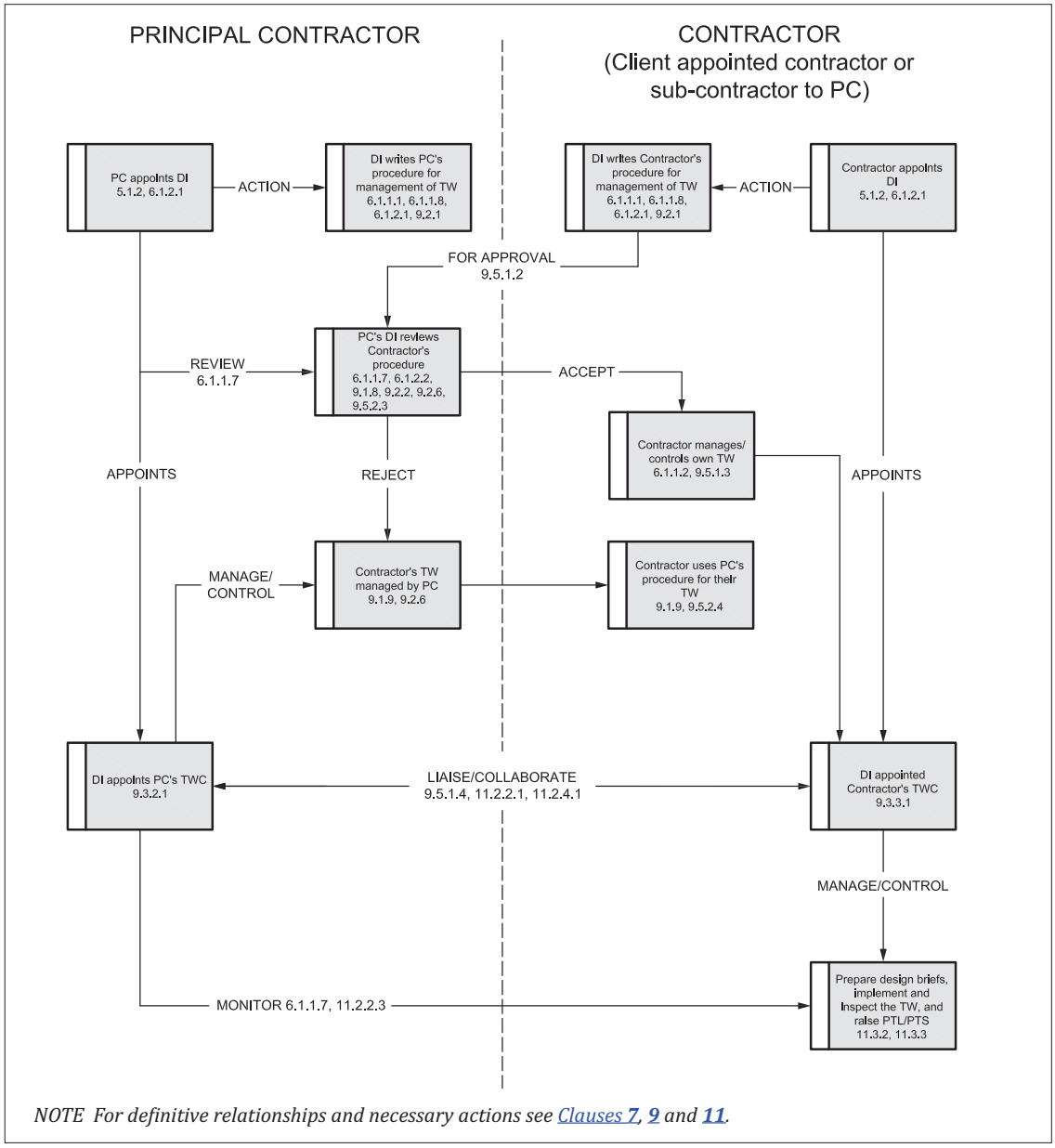
NOTE The PC's designated individual (DI) has to approve the managing sub-contractor's temporary works procedures before appointment of the TWC.



b) Client-appointed contractor to co-ordinate their own temporary works

NOTE The PC's designated individual (DI) has to approve the client contractor's temporary works procedures before appointment of the TWC.

Figure 4 — *Schematic representation of relationships between principal contractor and contractor (client appointed or sub-contractor) including PC's TWC and contractor's TWC*



NOTE For definitive relationships and necessary actions see Clauses 7, 9 and 11.

5.1.5.2 PC appoints a managing sub-contractor

The PC should check that the contracting organization has the ability and processes in place to manage temporary works; only then should the organization be contracted to manage the temporary works under their specific control [see Figure 3a)]. In particular, the PC's DI should confirm that the sub-contractor's procedure for the control of temporary works is satisfactory.

The contractor/sub-contractor should appoint a TWC to control their own temporary works. In effect, the PC has delegated certain duties to the TWC with ultimate control for temporary works remaining with the PC's TWC.

The PC's TWC should control the other temporary works on the site, and liaise with other contractors, to control the various interfaces.

NOTE For example, a RC frame contractor would not necessarily be aware that a ground work sub-contractor was digging a trench across the site close to the RC frame construction.

5.1.5.3 Client-appointed contractor

Where a client appoints a contractor directly and where the work has a temporary works element, such as installing M&E equipment, the implications for the site and the PC can be significant and the effect on procedures should be considered to ensure the PC's TWC can discharge their responsibility in relation to temporary works (see **7.1.3**).

The PC's DI should confirm that the contractor's procedure for the control of temporary works is satisfactory and the client's contractor should appoint a TWC to control their temporary works [see Figure 3b)].

The TWC should report to the PC's TWC and provide a method of communication to liaise between the site and the other contractors for temporary works.

As there is no contract between the parties involved in the temporary works (see Figure 1), the client should take into account that any such appointed contractor should be made aware of the implications and the continuing role of the PC's TWC on the project. This should be made clear to any contractor appointed by the client at an early stage in the procurement/management process.

5.2 Training

*COMMENTARY ON **5.2***

Competence assumes a sufficient up-to-date knowledge of temporary works relevant to the complexity of the project. Although it is desirable that temporary works is included in college and university courses, detailed practical knowledge of the subject is gained through practice. This knowledge is gained by observation, by CPD, or by experience, supplemented by regular training.

It is desirable that universities and colleges include temporary works within the syllabus for building, construction and civil engineering courses.

Although detailed technical knowledge on temporary works has historically been considered necessary for contracting staff, the experience and understanding of the effect of temporary works on design and construction leads to a broader based understanding and a more informed student. This promotes better design of permanent works and better informed engineers joining the construction industry.

A syllabus would be expected to include an introduction to the types of temporary works, both above and below ground; an understanding of likely management processes to be adopted to control the temporary works, with, where possible, indications of the cost implications of temporary works. Temporary works involves assessment of risk, and it is expected that risk management would already be included in the syllabus.

In addition to a general awareness of temporary works, the more commonly occurring temporary works of trenches, scaffolding, backpropping, crane pad foundations, hoardings etc. might justify more detailed coverage on most courses. It is desirable that the principles of stability of temporary works structures are included in this syllabus.

It is also desirable that non-technical courses at colleges and universities for subjects such as quantity surveying, building management etc. include awareness in temporary works. This significantly improves the recognition of temporary works as an important element in construction, contributing to safer, more economical construction.

College and university lecturers are advised to use CPD to keep up-to-date with the latest temporary works subjects, to ensure they have relevant knowledge and technical experience in temporary works.

5.2.1 All those managing temporary works should have, as a minimum, an understanding of:

a) the procedures outlined in Section 2 of this British Standard;

b) the specific procedures for the organization for whom the person works;

c) the risk management aspect associated with the management of temporary works;

d) technical knowledge relevant to both the role and the complexity of the work; and

e) practical knowledge relevant to the complexity of the work.

5.2.2 Technical and practical knowledge training to satisfy **5.2.1**d) and **5.2.1**e) should be related to the role and depend on the scale and specialization of the works. The depth of knowledge varies from general awareness training through to courses for detailed temporary works design and identification and rectification of defects in temporary works. Certain projects might require job-specific technical training (e.g. railway work, demolition, airports, tunnelling, oil and gas): where required, this should be established at an early stage of the project.

NOTE 1 Typical courses for general awareness and practical and technical knowledge are often only one day, increasing to two days for more technical design and awareness courses. Detailed temporary works design courses and practical courses that include the inspection and rectification of known defects in temporary works can be up to three or four days duration and are often in-house.

NOTE 2 Temporary works is essentially very practical, with attention to details often being critical, so on-line training or self-taught with mentoring might also require practical assessment.

5.2.3 Those procuring training should assess the actual trainer for competency, not the training provider; to ensure that the trainer has the relevant and up-to-date technical or practical experience in temporary works.

*NOTE 1 Whereas risk management and procedural aspects of temporary works training can be carried out by safety professionals and/or competent skills centre tutors, they are unlikely to have the necessary understanding in technical and/or practical aspects of temporary works to satisfy the minimum training requirements identified in **5.2.1**d) and **5.2.1**e).*

NOTE 2 The TWf (Temporary Works Forum), although not maintaining a specific list of competent temporary works trainers, does provide a useful source of knowledgeable members on the subject.

