Geotechnics
Contract preparation

CP 602 Instructions for specifiers for CC 602 Piling and Embedded Retaining Walls

(formerly)

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Latest release notes

Document Code	Version number	Date of publication of relevant change	Changes made to	Type of change
CP 602	LIVE_2025-01-30	Not available	Core document	Change to policy, major revision, new document development
This document replaces MCHW Series 1600 / Notes for Guidance 1600: Piling and embedded retaining walls. This document directly references the 3rd Edition of the Institution of Civil Engineers (ICE) Specification for Piling and Embedded Retaining Walls (ICE SPERW) which is the UK industry good practice document, including amendments / enhancements, as necessary.				

Previous versions

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Foreword

This document provides specifier instructions for the production of the works specific requirements for CC 602 Piling and Embedded Retaining Walls.

This document does not form part of the works specification.

The works specification is made up of both the Specification for Highway Works and the works specific requirements completed by the Specifier.

This document is applicable for contracts throughout the UK, complemented by the additional specification requirements and contractual changes of each Overseeing Organisation.

Users are responsible for applying all appropriate documents applicable to their contract.

Users are responsible for archiving contract documentation in accordance with the user's quality management system.

1. Specification requirements for piling and embedded retaining walls

1.1 Piling and embedded retaining walls shall be constructed in accordance with the Institution of Civil Engineers (ICE) Specification for Piling and Embedded Retaining Walls (Third Edition) ICE SPERW [Ref 17.N]as amended by this document.

1.2 Specification requirements for piling and embedded retaining walls shall be in accordance with ICE SPERW [Ref 17.N]section B1.

Verification requirements for materials and installation for piling and embedded retaining walls

1.3 Verification shall be undertaken for materials and installation for piling and embedded retaining walls in accordance with ICE SPERW [Ref 17.N]section B1 and table B1.1c.

1.4 The frequency of verification for materials and installation for piling and embedded retaining walls shall be in accordance with ICE SPERW [Ref 17.N]section B1 and table B1.1c.

1.5 The requirements for "Verification" in Section 14 of GC 101 [Ref 13.N] shall apply to the verification undertaken for materials and installation for piling and embedded retaining walls.

Documentation requirements for materials and installation for piling and embedded retaining walls

1.6 The following Documentation shall be submitted for piling and embedded retaining walls prior to the commencement of the piling and embedded retaining wall works: Reports detailing the piling and embedded retaining walls materials and installation to be used, in accordance with ICE SPERW [Ref 17.N] section B1 and table B1.1b.

1.7 The requirements for "Documentation" in Section 2 of GC 101 [Ref 13.N] shall apply to Reports detailing the piling and embedded retaining walls materials and installation to be used.

1.8 The following Documentation for Piling and embedded retaining walls materials and installation shall be submitted as continuous records: Piling and embedded retaining walls materials and installation records in accordance with ICE SPERW [Ref 17.N] section B1 and table B1.1c.

1.9 The requirements of "Records" in Section 3 of GC 101 [Ref 13.N] shall apply to the Piling and embedded retaining walls materials and installation records.

Works specific requirements for piling and embedded retaining walls

1.10 The disposal of excavated material and trimmed excess pile and wall material shall be in accordance with CC 601 [Ref 5.N], unless otherwise stated in CC 602/WSR/001.

1.11 ICE SPERW section B1.2 project specification requirements for piling and embedded retaining walls shall be as specified in CC 602/WSR/001.

ICE SPERW section B1.2 project specification requirements for piling and embedded retaining walls						
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Summary of the piling and/or embedded retaining wall works**	**Construction tolerances for piles and embedded retaining walls**	**Working piling platform and commencing surface level**	**Representative actions (or specified working loads if applicable)**
(a)	(b)	(c)	(d)	(e)	(f)	(g)

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter text, to summarise the piling and/or embedded retaining wall works [ICE SPERW B1.2 (c)].

e) Enter text, to identify the construction tolerances for piles and embedded retaining walls [ICE SPERW B1.2 (g)].

f) Enter text, to identify the requirements for a working piling platform and commencing surface level [ICE SPERW B1.2 (l)].

g) Enter text, to identify the representative actions (or specified working loads if applicable) on the piles and/or embedded retaining walls [ICE SPERW B1.2 (m)].

ICE SPERW section B1.2 project specification requirements for piling and embedded retaining walls (continued)					
Structure	**Pile or wall element dimensions**	**Preliminary piles and trial bores/drives/panels**	**Sampling and testing of materials (other than concrete)**	**Permissible damage criteria for existing critical structures or services**	**Disposal of excavated material and trimmed excess pile and wall material**
(a)	(h)	(i)	(j)	(k)	(l)

h) Enter text, to identify the pile or wall element dimensions [ICE SPERW B1.2 (n)].

i) Enter text, to identify requirements for preliminary piles and trial bores/drives/panels [ICE SPERW B1.2 (o)].

j) Enter text, to identify requirements for sampling and testing of materials (other than concrete) for piles and/or embedded retaining walls [ICE SPERW B1.2 (r)].

k) Enter text, to identify permissible damage criteria for existing critical structures or services [ICE SPERW B1.2 (s)].

l) Enter text, to identify requirements for disposal of excavated material and trimmed excess pile and wall material [ICE SPERW B1.2 (y)] if different from the requirements of CC 601 [Ref 5.N].

ICE SPERW section B1.2 project specification requirements for piling and embedded retaining walls (continued)					
Structure	**Other particular technical requirements**	**Special requirements for embedded retaining walls**	**Loads on walls and excavation depths**	**Surrounding structures, their foundations and associated loadings**	**Water retention function and degree of retention for embedded retaining wall in both temporary and permanent conditions**
(a)	(m)	(n)	(o)	(p)	(q)

ICE SPERW section B1.2 project specification requirements for piling and embedded retaining walls (continued)					
Structure	**Other particular technical requirements**	**Special requirements for embedded retaining walls**	**Loads on walls and excavation depths**	**Surrounding structures, their foundations and associated loadings**	**Water retention function and degree of retention for embedded retaining wall in both temporary and permanent conditions**

m) Enter text, to identify other particular technical requirements [ICE SPERW B1.2 (z)].

n) Enter text, to identify special requirements for embedded retaining walls [ICE SPERW B1.2 (aa)].

o) Enter text, to identify loads on walls and excavation depths [ICE SPERW B1.2 (bb)].

p) Enter text, to identify details of surrounding structures, their foundations and associated loadings [ICE SPERW B1.2 (cc)].

q) Enter text, to identify the water retention function and degree of retention for embedded retaining wall in both temporary and permanent conditions [ICE SPERW B1.2 (dd)].

ICE SPERW section B1.2 project specification requirements for piling and embedded retaining walls (continued)				
Structure	**Design external groundwater level of the water retention system water-tightness**	**Design water retention grade for permanent overall system and the role of the embedded retaining wall as a system component**	**Water-tightness inspections of the embedded retaining wall**	**Permissible limits on ground movements during wall installation**
(a)	(r)	(s)	(t)	(u)

r) Enter a number in units of m, to identify the design external groundwater level of the water retention system water-tightness [ICE SPERW B1.2 (ee)].

s) Enter text, to identify the design water retention grade for permanent overall system and the role of the embedded retaining wall as a system component [ICE SPERW B1.2 (ff)].

t) Enter text, to identify the programme for water-tightness inspections of the embedded retaining wall [ICE SPERW B1.2 (gg)].

u) Enter text, to identify permissible limits on ground movements during wall installation [ICE SPERW B1.2 (hh)].

1.12 Documentation in addition to the ICE SPERW table B1.1 required prior to installation of piling and embedded retaining walls shall be Records in addition to the as specified in CC 602/WSR/001.

Documentation in addition to the ICE SPERW table B1.1 required prior to installation of piling and embedded retaining walls		
ICE SPERW section	**Timing of submission**	**Information to be submitted**
(a)	(b)	(c)

a) Enter a unique reference.
b) Enter text, to identify the timing of submission of documentation.

c) Enter text, to identify the item of information to be submitted.

1.13 The following Documentation shall be submitted for piling and embedded retaining walls prior to the commencement of installation: Documentation in addition to the ICE SPERW [Ref 17.N] table B1.1 as stated in CC 602/WSR/001.

1.14 The requirements for "Documentation" in Section 2 of GC 101 [Ref 13.N] shall apply to Documentation in addition to the ICE SPERW [Ref 17.N] table B1.1 required prior to installation of piling and embedded retaining walls, unless otherwise stated in CC 602/WSR/001.

1.15 Documentation to be submitted during installation of piling and embedded retaining walls in addition to the ICE SPERW table B1.1 shall be Records in addition to the ICE SPERW [Ref 17.N] table B1.1 as specified in CC 602/WSR/001.

Documentation to be submitted during installation of piling and embedded retaining walls in addition to the ICE SPERW table B1.1		
ICE SPERW section	**Timing of submission**	**Information item to be submitted**
(a)	(b)	(c)

a) Enter a unique reference.
b) Enter text, to identify the timing of submission of documentation.

c) Enter text, to identify the item of information to be submitted.

1.16 The Documentation for piling and embedded retaining walls in addition to ICE SPERW [Ref 17.N] table B1.1c required during the installation shall be materials and installation records as stated in CC 602/WSR/001.

1.17 The requirements of "Records" in Section 3 of GC 101 [Ref 13.N] shall apply to the Documentation in addition to ICE SPERW [Ref 17.N] table B1.1c required during the installation of piling and embedded retaining walls, unless otherwise stated in CC 602/WSR/001.

1.18 Performance criteria for piles under test [ICE SPERW B1.2 (q)] shall be as specified in CC 602/WSR/001.

Performance criteria for piles under test [ICE SPERW B1.2 (q)]								
Structure	**Drawing/ model number**	**Pile reference**	**Permitted type(s) – performance specification section number**	**Specified representative action (Frep)**	**Pile designation**	**Minimum model factor**	**Minimum partial resistance factor (base)**	**M p r f (s c o**
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter text, to identify the permitted pile type(s) and associated specification section.

e) Enter a number in units of kN, to identify the representative action for the pile under test.

f) Enter text, to identify the pile designation.

g) Enter a number, to identify the minimum model factor.

h) Enter a number, to identify the minimum partial factor for the pile base resistance.

i) Enter a number, to identify the minimum partial factor for the pile shaft resistance in compression.

Performance criteria for piles under test [ICE SPERW B1.2 (q)] (continued)								
Structure	**Minimum partial resistance factor (total - compression)**	**Minimum partial resistance factor (shaft - tension)**	**Design verification load (DVL)**	**Permitted settlement at DVL**	**Permitted settlement at DVL+50% Frep**	**Minimum pile length from cut-off level to toe**	**Minimum pile diameter or dimensions of cross-section**	**Maxim m pile diame or dimen ns of cross sectio**
(a)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)

j) Enter a number, to identify the minimum partial factor for the total pile resistance in compression.

k) Enter a number, to identify the minimum partial factor for the pile shaft resistance in tension.

l) Enter a number in units of kN, to identify the design verification load.

m) Enter a number in units of mm, to identify the permitted pile settlement at design verification load.

n) Enter a number in units of mm, to identify the permitted pile settlement at DVL+50% representative action.

o) Enter a number in units of m, to identify the minimum pile length from cut-off level to toe.

p) Enter a number in units of mm, to identify the minimum pile diameter or dimensions of cross-section required.

q) Enter a number in units of mm, to identify the maximum pile diameter or dimensions of the cross section required.

1.19 Performance criteria for wall elements during service [ICE SPERW B1.2 (q)] shall be as specified in CC 602/WSR/001.

Performance criteria for wall elements during service [ICE SPERW B1.2 (q)]						
Structure	**Drawing/ model number**	**Wall reference**	**Permitted type(s) – performance specification section number**	**Maximum excavation level**	**Temporary propping details**	**Permanent propping details**
(a)	(b)	(c)	(d)	(e)	(f)	(g)

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter text, to identify the permitted wall type(s) and associated specification section.

e) Enter text, to identify the maximum excavation level.

f) Enter text, to identify the details of temporary wall propping.

g) Enter text, to identify the details of permanent wall propping.

Performance criteria for wall elements during service [ICE SPERW B1.2 (q)] (continued)						
Structure	**Construction sequence**	**Constraints to the wall**	**Permitted lateral wall deflection**	**Water-tightness criteria/minimum depth below excavation**	**Minimum wall element diameter or cross-section dimension**	**Maximum wall element diameter or cross-section dimension**
(a)	(h)	(i)	(j)	(k)	(l)	(m)

Performance criteria for wall elements during service [ICE SPERW B1.2 (q)] (continued)						
Structure	**Construction sequence**	**Constraints to the wall**	**Permitted lateral wall deflection**	**Water-tightness criteria/minimum depth below excavation**	**Minimum wall element diameter or cross-section dimension**	**Maximum wall element diameter or cross-section dimension**

h) Enter text, to identify the wall construction sequence.

i) Enter text, to identify the constraints to the wall.

j) Enter a number in units of mm, to identify the permitted lateral wall deflection.

k) Enter a number in units of m, to identify the water-tightness criteria/minimum depth below excavation.

l) Enter a number in units of mm, to identify the minimum wall element diameter or dimension of cross-section.

m) Enter a number in units of mm, to identify the maximum wall element diameter or dimension of cross-section.

Contractor design of piling and embedded retaining walls

1.20 Piling and embedded retaining walls to be Contractor design items shall be as specified in CC 602/WSR/001.

Piling and embedded retaining walls to be Contractor design items					
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Piling/ embedded retaining wall item to be designed by the Contractor**	**Site specific constraints to the design of the piling/embedded retaining wall item**	**Criteria for the piles/embedded retaining walls including design life**
(a)	(b)	(c)	(d)	(e)	(f)

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter text, to identify the piling/embedded retaining wall item to be designed by the Contractor.

e) Enter text, to identify site specific constraints to the design of the piling/embedded retaining wall item.

f) Enter text, to identify the criteria for the piles/embedded retaining walls including design life.

1.21 The design of piles and embedded retaining walls shall be in accordance with BS EN 1990 [Ref 10.N], NA to BS EN 1990 [Ref 20.N], BS EN 1991-1 [Ref 6.N], NA to BS EN 1991 [Ref 21.N], BS EN 1992 [Ref 7.N], NA to BS EN 1992 [Ref 22.N], BS EN 1993 [Ref 11.N], NA to BS EN 1993 [Ref 23.N], BS EN 1997 [Ref 9.N]and NA to BS EN 1997 [Ref 24.N].

1.22 The design of piles and embedded retaining walls shall be in accordance with CC 602/WSR/001.

1.23 The requirements for "Technical approval of highway structures" in Section 18 of GC 101 [Ref 13.N] shall apply to the design of piles and embedded retaining walls.

1.24 The requirements for "Contractor design" in Section 17 of GC 101 [Ref 13.N] shall apply to the design of piles and embedded retaining walls.

1.25 The following Documentation shall be submitted for approval prior to the commencement of the piling and embedded retaining wall works: CD 622 [Ref 14.N]Geotechnical Design Report.

1.26 The requirements for "Documentation" in Section 2 of GC 101 [Ref 13.N] shall apply to the design records for piles and embedded retaining walls.

ICE SPERW specification requirements amendments

General requirements [ICE SPERW A]

1.27 Section A of ICE SPERW [Ref 17.N] shall not be used.

Standards [ICE SPERW B1.1]

1.28 The first paragraph of section B1.1 of ICE SPERW [Ref 17.N]'All materials and workmanship shall be in accordance with the appropriate British Standards, European Standards, codes of practice and other

specified standards current at the date of tender' shall be replaced with as follows: All materials and workmanship shall be in accordance with the relevant British Standards, European Standards, codes of practice and specified standards.

Project specification [ICE SPERW B1.2]

1.29 The third sentence of the first footnote of table B1.2 of ICE SPERW [Ref 17.N]'Also refer to section C for guidance.' shall not be used.

Submission of information [ICE SPERW B1.3]

1.30 Table B1.1a of ICE SPERW [Ref 17.N] shall not be used.

Design [ICE SPERW B1.4]

1.31 Section B1.4 of ICE SPERW [Ref 17.N] shall not be used.

Safety [ICE SPERW B1.6]

1.32 Section B1.6.1 of ICE SPERW [Ref 17.N] shall not be used.

1.33 Section B1.6.2 of ICE SPERW [Ref 17.N] shall be replaced with as follows: The Contractor, unless otherwise stated in the project specification, shall design, construct, maintain and repair, for the duration of piling and testing operations, a working platform capable of supporting all plant proposed for use on the site.

Installation tolerances - setting out [ICE SPERW B1.8.1]

1.34 The last paragraph of section B1.8.1 of ICE SPERW [Ref 17.N]'Any checks by the employer, contract administrator or designer shall not relieve the contractor of their responsibility.' shall be replaced with as follows: Any checks by the employer, or overseeing organisation shall not relieve the contractor of their responsibility.

Waterproofing of embedded walls - repair [ICE SPERW B1.9.2]

1.35 The last sentence of the first paragraph of section B1.9.2 of ICE SPERW [Ref 17.N]'The contractor shall include in the programme adequate time for repair works.' shall not be used.

Construction method [ICE SPERW B1.10]

1.36 The first sentence of the first paragraph of section B1.10 of ICE SPERW [Ref 17.N]'The contractor shall submit with the tender all relevant details of the method of piling or wall construction, and all relevant details of the plant and monitoring equipment to be used.' shall be replaced with as follows: At least four working weeks prior to commencement of the

piling works, the contractor shall submit details of the method of piling or wall construction, and details of the plant and monitoring equipment to be used.

1.37 Section B1.10.1 of ICE SPERW [Ref 17.N] shall be replaced with as follows: At least four working weeks prior to commencement of the piling works, the contractor shall submit details of the method(s) proposed for dealing with man-made and natural obstructions and voids, when these have been identified in the project specification.

Construction programme [ICE SPERW B1.11]

1.38 Section B1.11 of ICE SPERW [Ref 17.N] shall not be used.

Trimming and cutting off piles and wall elements [ICE SPERW B1.17]

1.39 The first sentence of the first paragraph of section B1.17 of ICE SPERW [Ref 17.N]'The contractor shall provide in their tender full details of the method proposed to prepare the heads of piles or wall elements.' shall be replaced with as follows: At least four working weeks prior to commencement of the piling works, the contractor shall provide full details of the method proposed to prepare the heads of piles or wall elements.

Definitions [ICE SPERW B1.18]

1.40 Where ICE SPERW [Ref 17.N]uses the term 'Contract Administrator' this shall be defined as the Overseeing Organisation.

1.41 Where ICE SPERW [Ref 17.N]uses the term 'Contractor' this shall be defined as the Contractor.

1.42 The text 'Designer: refer to clause A2.1' in section B1.18 of ICE SPERW [Ref 17.N] shall not be used.

ICE SPERW specification requirements additions

Installation tolerances [ICE SPERW B1.8]

1.43 Tolerances not covered by table B1.4 of ICE SPERW [Ref 17.N] shall be in accordance with Geometrical Tolerances for Structural Concrete in CC 482 [Ref 19.N].

1.44 The requirements relating to installation tolerances within ICE SPERW [Ref 17.N] shall take precedence over CC 482 [Ref 19.N].

Supervision and control of the works [ICE SPERW B1.15]

1.45 The quality plan for the piling and embedded retaining walls works shall be in accordance with "Quality Plans" in Section 6 of GC 101 [Ref 13.N].

2. Driven precast concrete piles

2.1 Driven precast concrete piles shall be in accordance with ICE SPERW [Ref 17.N]section B2.

Verification requirements for materials and installation for driven precast concrete piles

2.2 Verification shall be undertaken for materials and installation for driven precast concrete piles in accordance with ICE SPERW [Ref 17.N]section B2 and table B1.1c.

2.3 The frequency of verification shall be in accordance with ICE SPERW [Ref 17.N]section B2 and table B1.1c.

2.4 The requirements for "Verification" in Section 14 of GC 101 [Ref 13.N] shall apply to the verification undertaken for materials and installation for driven precast concrete piles.

Documentation requirements for materials and installation for driven precast concrete piles

2.5 The following Documentation for Driven precast concrete pile materials and installation shall be submitted as continuous records: Driven precast concrete piles material and installation records in accordance with ICE SPERW [Ref 17.N]section B2 and table B1.1c.

2.6 The requirements of "Records" in Section 3 of GC 101 [Ref 13.N] shall apply to Driven precast concrete piles material and installation records.

Works specific requirements for driven precast concrete piles

2.7 ICE SPERW section B2.2 project specification requirements for driven concrete piles shall be as specified in CC 602/WSR/002.

ICE SPERW section B2.2 project specification requirements for driven concrete piles						
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Penetration or depth or toe level**	**Driving resistance or dynamic valuation or set**	**Uplift/ lateral displacement trials**	**Pre-boring or jetting or other means of easing pile driveability**
(a)	(b)	(c)	(d)	(e)	(f)	(g)

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter text, to identify the requirements for penetration or depth or toe level of the pile or wall [ICE SPERW B2.2 (a)].

e) Enter text, to identify the requirements for driving resistance or dynamic valuation or set of the pile or wall [ICE SPERW B2.2 (b)].

f) Enter text, to identify the requirements for uplift/lateral displacement trials [ICE SPERW B2.2 (c)].

g) Enter text, to identify the requirements for pre-boring or jetting or other means of easing pile driveability [ICE SPERW B2.2 (d)].

ICE SPERW section B2.2 project specification requirements for driven concrete piles (continued)					
Structure	**Detailed requirements for driving records**	**Permitted types and quality of pile shoes**	**Permitted types of pre-stressing tendon**	**Marking of piles**	**Other particular technical requirements**
(a)	(h)	(i)	(j)	(k)	(l)

h) Enter text, to identify detailed requirements for driving records [ICE SPERW B2.2 (e)].

i) Enter text, to identify the permitted types and quality of pile shoes [ICE SPERW B2.2 (f)].

j) Enter text, to identify the permitted types of pre-stressing tendon [ICE SPERW B2.2 (g)].

k) Enter text, to identify the requirements for marking of piles [ICE SPERW B2.2 (h)].

l) Enter text, to identify other particular technical requirements [ICE SPERW B2.2 (i)].

ICE SPERW amendments for driven precast concrete piles

Materials - pile quality [ICE SPERW B2.3.5]

2.8 Section B2.3.5 of ICE SPERW [Ref 17.N] shall not be used.

Construction processes - lengthening of precast reinforced and pre-stressed concrete piles [ICE SPERW B2.4.8.2]

2.9 Section B2.4.8.2 of ICE SPERW [Ref 17.N] shall be replaced with as follows: Provision for lengthening piles shall be incorporated at the time of manufacture and shall resist all stresses to which it may be subjected.

3. Bored cast-in-place piles

3.1 Bored cast-in-place piles shall be in accordance with ICE SPERW [Ref 17.N]section B3.

Verification requirements for materials and installation for bored cast-in-place piles

3.2 Verification shall be undertaken for materials and installation for bored cast-in-place piles in accordance with ICE SPERW [Ref 17.N]section B3 and table B1.1c.

3.3 The frequency of verification shall be in accordance with ICE SPERW [Ref 17.N]section B3 and table B1.1c.

3.4 The requirements for "Verification" in Section 14 of GC 101 [Ref 13.N] shall apply to the verification undertaken for materials and installation for bored cast-in-place piles.

Documentation requirements for materials and installation for bored cast-in-place piles

3.5 The following Documentation for materials and installation for bored-cast-in-place piles shall be submitted as continuous records: Bore-cast-in-place piles materials and installation records in accordance with ICE SPERW [Ref 17.N]section B3 and table B1.1c.

3.6 The requirements of "Records" in Section 3 of GC 101 [Ref 13.N] shall apply to Bored-cast-in-place piles material and installation records.

Works specific requirements for bored cast-in-place piles

3.7 ICE SPERW section B3.2 project specification requirements for bored cast-in-place piles shall be as specified in CC 602/WSR/003.

ICE SPERW section B3.2 project specification requirements for bored cast-in-place piles						
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Support fluid**	**Base or shaft grouting**	**Pile shaft and base inspection by closed-circuit television (CCTV) and or sampling/probing**	**Details of permanent casings**
(a)	(b)	(c)	(d)	(e)	(f)	(g)

ICE SPERW section B3.2 project specification requirements for bored cast-in-place piles						
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Support fluid**	**Base or shaft grouting**	**Pile shaft and base inspection by closed-circuit television (CCTV) and or sampling/probing**	**Details of permanent casings**

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter text, to identify requirements for support fluid [ICE SPERW B3.2 (a)].

e) Enter text, to identify requirements for base or shaft grouting [ICE SPERW B3.2 (b)].

f) Enter text, to identify requirements for pile shaft and base inspection by closed-circuit television (CCTV) and or sampling/probing [ICE SPERW B3.2 (c)].

g) Enter text, to identify details of permanent casings [ICE SPERW B3.2 (d)].

ICE SPERW section B3.2 project specification requirements for bored cast-in-place piles (continued)			
Structure	**Inspection of underreams**	**Ribbed piles**	**Other particular technical requirements**
(a)	(h)	(i)	(j)

h) Enter text, to identify requirements for the inspection of underreams [ICE SPERW B3.2 (e)].

i) Enter text, to identify requirements for ribbed piles [ICE SPERW B3.2 (f)].

j) Enter text, to identify other particular technical requirements [ICE SPERW B3.2 (h)].

3.8 ICE SPERW sections B3.2 (g) and B3.5.12 additional project specification requirements for plunge columns shall be as specified in CC 602/WSR/003.

ICE SPERW sections B3.2 (g) and B3.5.12 additional project specification requirements for plunge columns						
Structure	**Drawing/ model number**	**Pile/wall reference**	**Plunge column dimensions**	**Installation tolerances**	**Material grade of plunge column**	**Head plate details**
(a)	(b)	(c)	(d)	(e)	(f)	(g)

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter text, to identify the dimensions of the plunge column.

e) Enter text, to identify the installation tolerances of the plunge column.

f) Enter text, to identify the material grade of the plunge column.

g) Enter text, to identify detailed requirements for head plates.

ICE SPERW sections B3.2 (g) and B3.5.12 additional project specification requirements for plunge columns (continued)			
Structure	**Minimum embedment length**	**Minimum concrete strength of the pile**	**Minimum strength of concrete in the pile bore before the guide frame is struck**
(a)	(h)	(i)	(j)

h) Enter text, to identify requirements on the minimum embedment length of the plunge column.

i) Enter a number in units of N/mm^2, to identify requirements on the minimum concrete strength of the pile.

j) Enter a number in units of N/mm^2, to identify requirements on the minimum strength of concrete in the pile bore before the guide frame is struck.

ICE SPERW amendments for bored cast-in-place piles

Materials - casings [ICE SPERW B3.3.2]

3.9 The fourth sentence of the fourth paragraph of section B3.3.2 of ICE SPERW [Ref 17.N]'If a temporary casing is to be used then the contractor shall submit details of any cutting head to be used on the leading edge of the casing which protrudes outside of the edge of the casing at the time of tender.' shall be replaced with as follows: Where temporary casing is to be used then the contractor shall submit details of any cutting head to be used on the leading edge of the casing which protrudes outside of the edge of the casing at least four working weeks prior to commencement of the piling works.

Construction tolerances - plunge columns [ICE SPERW B3.4.2]

3.10 The second sentence of section B3.4.2 of ICE SPERW [Ref 17.N]'Guidance on appropriate tolerances is given in section C3.' shall not be used.

Construction processes - method of grouting [ICE SPERW B3.5.11.2]

3.11 Item (e) of section B3.5.11.2 of ICE SPERW [Ref 17.N]'method of measuring grout take, which should be automatic with real-time data capture and include a physical method of checking grout take at the end of injection of each circuit' shall be replaced with as follows: method of measuring grout take, which shall be automatic with real-time data capture and include a physical method of checking grout take at the end of injection of each circuit.

3.12 Item (f) of section B3.5.11.2 of ICE SPERW [Ref 17.N]'method of measuring grout pressures which should include a continuous record, and calibration certificates for pressure gauges' shall be replaced with as follows: method of measuring grout pressures which shall include a continuous record, and calibration certificates for pressure gauges.

Construction processes - pile uplift [ICE SPERW B3.5.11.4]

3.13 The third paragraph of section B3.5.11.4 of ICE SPERW [Ref 17.N]'Details of the measurement system shall be submitted by the contractor with the tender and shall be subject to acceptance by the contract administrator.' shall be replaced with as follows: Details of the measurement system shall be submitted by the contractor at least four working weeks prior to commencement of the piling works.

4. Piles constructed using continuous flight augers or displacement augers

4.1 Piles concreted through a hollow auger stem shall be in accordance with ICE SPERW [Ref 17.N]section B4.

Verification requirements for materials and installation for piles constructed using continuous flight augers or displacement augers

4.2 Verification shall be undertaken for materials and installation for piles concreted through a hollow auger stem in accordance with ICE SPERW [Ref 17.N]section B4 and table B1.1c.

4.3 The frequency of verification shall be in accordance with ICE SPERW [Ref 17.N]section B4 and table B1.1c.

4.4 The requirements for "Verification" in Section 14 of GC 101 [Ref 13.N] shall apply to the verification undertaken for materials and installation for piles concreted through a hollow auger stem.

Documentation requirements for materials and installation for piles constructed using continuous flight augers or displacement augers

4.5 The following Documentation for materials and installation for piles concreted through a hollow auger stem shall be submitted as continuous records: Continuous flight auger or displacement auger piles material and installation records in accordance with ICE SPERW [Ref 17.N]section B4 and table B1.1c.

4.6 The requirements of "Records" in Section 3 of GC 101 [Ref 13.N] shall apply to Continuous flight auger or displacement auger pile materials and installation records.

Works specific requirements for piles constructed using continuous flight augers or displacement augers

4.7 ICE SPERW section B4.2 project specification requirements for piles constructed using continuous flight augers or displacement augers shall be as specified in CC 602/WSR/004.

ICE SPERW section B4.2 project specification requirements for piles constructed using continuous flight augers or displacement augers							
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Permitted pile types**	**Single splitting of augers**	**Supply of concrete**	**Detailed requirements for monitoring records**	**Use of compressed air to assist with boring**
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter one or more values, from options CFA, CCFA, SFA, DA, to identify the permitted pile types [ICE SPERW B4.2 (a)].

e) Enter a value, from options permitted, prohibited, to identify whether single splitting of augers is permitted [ICE SPERW B4.2 (b)].

f) Enter a value, from options controlled by pressure, controlled by volume, to identify requirements for the supply of concrete [ICE SPERW B4.2 (c)].

g) Enter text, to identify detailed requirements for monitoring records [ICE SPERW B4.2 (d)].

h) Enter a value, from options permitted, prohibited, to identify whether the use of compressed air to assist with boring is permitted [ICE SPERW B4.2 (e)].

ICE SPERW section B4.2 project specification requirements for piles constructed using continuous flight augers or displacement augers (continued)	
Structure	**Other particular technical requirements**
(a)	(i)

i) Enter text, to identify other particular technical requirements [ICE SPERW B4.2 (f)].

ICE SPERW amendments for piles constructed using continuous flight augers or displacement augers

Construction processes - boring [ICE SPERW B4.4.1]

4.8 The last paragraph of section B4.4.1 of ICE SPERW [Ref 17.N]'For the full duration that the auger is bored into the ground, persons should be protected from coming into contact with the rotating auger.' shall not be used.

Construction processes - removal of augers from the ground [ICE SPERW B4.4.3]

4.9 The last sentence of the last paragraph of section B4.4.3 of ICE SPERW [Ref 17.N]'For the full duration that the auger is withdrawn from the ground, persons should be protected from coming into contact with the rotating auger.' shall not be used.

Construction processes - commencement of concrete supply to each pile [ICE SPERW B4.4.6.2]

4.10 The third paragraph of section B4.4.6.2 of ICE SPERW [Ref 17.N]'For DA piles, the contractor shall submit at the time of tender details of the procedure to be followed to initiate the delivery of concrete.' shall be replaced with as follows: For DA piles, the contractor shall submit details of the procedure to be followed to initiate the delivery of concrete at least four working weeks prior to commencement of the piling works.

Construction processes - rate of supply of concrete [ICE SPERW B4.4.6.3]

4.11 The last sentence of the fourth paragraph of section B4.4.6.3 of ICE SPERW [Ref 17.N]'Positive pressure should be measured at the commencement of concreting.' shall be replaced with as follows: Positive pressure shall be measured at the commencement of concreting.

Construction processes - automated monitoring system [ICE SPERW B4.4.10.1]

4.12 The last sentence of the eighth paragraph of section B4.4.10.1 of ICE SPERW [Ref 17.N]'The contractor shall provide in the method statement full details of any additional monitoring that will need to be carried out to ensure a pile of the specified pile section is formed.' shall be replaced with as follows: The contractor shall provide in the method statement full details of any additional monitoring that shall be carried out to ensure a pile is formed to the specified section.

5. Cast-in-situ displacement piles

5.1 Cast-in-situ displacement piles shall be in accordance with ICE SPERW [Ref 17.N]section B5.

Verification requirements for materials and installation for cast-in-situ displacement piles

5.2 Verification shall be undertaken for materials and installation for cast-in-situ displacement piles in accordance with ICE SPERW [Ref 17.N]section B5 and table B1.1c.

5.3 The frequency of verification shall be in accordance with ICE SPERW [Ref 17.N]section B5 and table B1.1c.

5.4 The requirements for "Verification" in Section 14 of GC 101 [Ref 13.N] shall apply to the verification undertaken for materials and installation for cast-in-situ displacement piles.

Documentation requirements for materials and installation for cast-in-situ displacement piles

5.5 The following Documentation for materials and installation for cast-in-situ displacement piles shall be submitted as continuous records: Cast-in-situ displacement piles materials and installation records in accordance with ICE SPERW [Ref 17.N] section B5 and table B1.1c.

5.6 The requirements of "Records" in Section 3 of GC 101 [Ref 13.N] shall apply to Cast-in-situ displacement piles material and installation records.

Works specific requirements for cast-in-situ displacement piles

5.7 ICE SPERW section B5.2 project specification requirements for cast-in-situ displacement piles shall be as specified in CC 602/WSR/005.

ICE SPERW section B5.2 project specification requirements for cast-in-situ displacement piles						
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Penetration or depth or toe level**	**Driving resistance or dynamic valuation or set**	**Uplift/ lateral displacement trials**	**Pre-boring or jetting or other means of easing pile driveability**
(a)	(b)	(c)	(d)	(e)	(f)	(g)

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter text, to identify requirements for penetration or depth or toe level of the pile or wall [ICE SPERW B5.2 (a)].

e) Enter text, to identify requirements for driving resistance or dynamic valuation or set of the pile or wall [ICE SPERW B5.2 (b)].

f) Enter text, to identify requirements for uplift/lateral displacement trials [ICE SPERW B5.2 (c)].

g) Enter text, to identify requirements for pre-boring or jetting or other means of easing pile driveability [ICE SPERW B5.2 (d)].

ICE SPERW section B5.2 project specification requirements for cast-in-situ displacement piles (continued)					
Structure	**Detailed requirements for driving records**	**Permitted types and quality of pile shoes**	**Sampling and testing of pile materials**	**Enlarged pile bases**	**Integrally cast pile heads/enlarged pile heads**
(a)	(h)	(i)	(j)	(k)	(l)

h) Enter text, to identify detailed requirements for driving records [ICE SPERW B5.2 (e)].

i) Enter text, to identify the permitted types and quality of pile shoes [ICE SPERW B5.2 (f)].

j) Enter text, to identify requirements for sampling and testing of pile materials [ICE SPERW B5.2 (g)].

k) Enter text, to identify requirements for enlarged pile bases [ICE SPERW B5.2 (h)].

l) Enter text, to identify requirements for integrally cast pile heads/enlarged pile heads [ICE SPERW B5.2 (i)].

ICE SPERW section B5.2 project specification requirements for cast-in-situ displacement piles (continued)	
Structure	**Other particular technical requirements**
(a)	(m)

m) Enter text, to identify other particular technical requirements [ICE SPERW B5.2 (j)].

ICE SPERW amendments for cast-in-situ displacement piles

Construction processes - placing concrete [ICE SPERW B5.4.8]

5.8 The final sentence of section B5.4.8 of ICE SPERW [Ref 17.N]'Measures shall be taken to ensure that the structural strength of the placed concrete is not impaired through segregation or bleeding.' shall be replaced with as follows: The structural strength of the placed concrete shall not be impaired through grout loss, segregation or bleeding.

ICE SPERW additions for cast-in-situ displacement piles

Construction processes [ICE SPERW B5.4]

5.9 The extension of permanent steel pile casings during construction shall be carried out in accordance with "Steel bearing piles" in Section 8 of this document.

6. Micropiles

6.1 Micropiles shall be in accordance with ICE SPERW [Ref 17.N]section B6.

Verification requirements for materials and installation for micropiles

6.2 Verification shall be undertaken for materials and installation for micropiles in accordance with ICE SPERW [Ref 17.N]section B6 and table B1.1c.

6.3 The frequency of verification shall be in accordance with ICE SPERW [Ref 17.N]section B6 and table B1.1c.

6.4 The requirements for "Verification" in Section 14 of GC 101 [Ref 13.N] shall apply to the verification undertaken for materials and installation for micropiles.

Documentation requirements for materials and installation for micropiles

6.5 The following Documentation for materials and installation for micropiles shall be submitted as continuous records: Micropiles materials and installation records in accordance with ICE SPERW [Ref 17.N]section B6 and table B1.1c.

6.6 The requirements of "Records" in Section 3 of GC 101 [Ref 13.N] shall apply to Micropiles materials and installation records.

Works specific requirements for micropiles

6.7 ICE SPERW section B6.2 project specification requirements for micropiles shall be as specified in CC 602/WSR/006.

ICE SPERW section B6.2 project specification requirements for micropiles						
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Permitted pile types**	**Monitoring records**	**Permanent casings**	**Environmental constraints on drilling**
(a)	(b)	(c)	(d)	(e)	(f)	(g)

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter one or more values, from options self-drilling hollow bar, bored cast in-situ, sectional flight auger, to identify the pile types permitted [ICE SPERW B6.2 (a)].

e) Enter text, to identify requirements for monitoring records [ICE SPERW B6.2 (b)].

f) Enter text, to identify detailed requirements of permanent casings [ICE SPERW B6.2 (c)].

g) Enter text, to identify environmental constraints on drilling (restrictions on fluids, air or noise) [ICE SPERW B6.2 (d)].

ICE SPERW section B6.2 project specification requirements for micropiles (continued)	
Structure	**Other particular requirements**
(a)	(h)

h) Enter text, to identify other particular requirements [ICE SPERW B6.2 (e)].

ICE SPERW amendments for micropiles

Construction processes - installation of self-drilling hollow bar [ICE SPERW B6.5.2]

6.8 The third sentence of the second paragraph of section B6.5.2 of ICE SPERW [Ref 17.N]'The contractor shall confirm details of the proposed drilling and flushing medium at tender stage.' shall be replaced with as follows: The contractor shall confirm details of the proposed drilling and flushing medium at least four working weeks prior to commencement of the piling works.

7. Helical steel piles

7.1 Helical steel piles shall be in accordance with ICE SPERW [Ref 17.N]section B7.

Verification requirements for materials and installation for helical steel piles

7.2 Verification shall be undertaken for materials and installation for helical steel piles in accordance with ICE SPERW [Ref 17.N]section B7 and table B1.1c.

7.3 The frequency of verification shall be in accordance with ICE SPERW [Ref 17.N]section B7 and table B1.1c.

7.4 The requirements for "Verification" in Section 14 of GC 101 [Ref 13.N] shall apply to the verification undertaken for materials and installation for helical steel piles.

Documentation requirements for materials and installation for helical steel piles

7.5 The following Documentation for materials and installation for helical steel piles shall be submitted as continuous records: Helical steel piles materials and installation records in accordance with ICE SPERW [Ref 17.N]section B7 and table B1.1c.

7.6 The requirements of "Records" in Section 3 of GC 101 [Ref 13.N] shall apply to Helical steel piles materials and installation records.

Works specific requirements for helical steel piles

7.7 ICE SPERW section B7.2 project specification requirements for helical steel piles shall be as specified in CC 602/WSR/007.

ICE SPERW section B7.2 project specification requirements for helical steel piles						
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Penetration or depth or toe level**	**Requirements for pre-drilling or other means of easing pile installation and any limitations**	**Detailed requirements for installation records**	**Permitted grades of steel**
(a)	(b)	(c)	(d)	(e)	(f)	(g)

ICE SPERW section B7.2 project specification requirements for helical steel piles						
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Penetration or depth or toe level**	**Requirements for pre-drilling or other means of easing pile installation and any limitations**	**Detailed requirements for installation records**	**Permitted grades of steel**

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter text, to identify requirements for penetration or depth or toe level of the pile or wall [ICE SPERW B7.2 (a)].

e) Enter text, to identify requirements for pre-drilling or other means of easing pile installation and any limitations [ICE SPERW B7.2 (b)].

f) Enter text, to identify detailed requirements for installation records [ICE SPERW B7.2 (c)].

g) Enter text, to identify permitted grades of steel [ICE SPERW B7.2 (d)].

ICE SPERW section B7.2 project specification requirements for helical steel piles (continued)					
Structure	**Permitted types of corrosion protection**	**Nominal thickness of primer and coats**	**Adhesion test requirements**	**Additional requirements on welding procedure**	**Additional requirements on non-destructive testing of welds**
(a)	(h)	(i)	(j)	(k)	(l)

h) Enter text, to identify permitted types of corrosion protection [ICE SPERW B7.2 (e)].

i) Enter a number in units of um, to identify the required nominal thickness of primer and coats [ICE SPERW B7.2 (f)].

j) Enter text, to identify requirements for adhesion testing [ICE SPERW B7.2 (g)].

k) Enter text, to identify additional requirements on welding procedure [ICE SPERW B7.2 (h)].

l) Enter text, to identify additional requirements on non-destructive testing of welds [ICE SPERW B7.2 (i)].

ICE SPERW section B7.2 project specification requirements for helical steel piles (continued)			
Structure	**Additional requirements on marking of piles**	**Constraints on pile testing procedures**	**Other particular technical requirements**
(a)	(m)	(n)	(o)

m) Enter text, to identify additional requirements on marking of piles [ICE SPERW B7.2 (j)].

n) Enter text, to identify constraints on pile testing procedures [ICE SPERW B7.2 (k)].

o) Enter text, to identify other particular technical requirements [ICE SPERW B7.2 (l)].

ICE SPERW amendments for helical steel piles

Construction processes - penetration Rate [ICE SPERW B7.4.4.4]

7.8 The first paragraph of section B7.4.4.4 of ICE SPERW [Ref 17.N]'If the penetration rate (depth of penetration per revolution of pile) falls outside the prescribed limits stated in BS 8004 annex A, the designer and contract administrator shall be informed immediately.' shall be replaced with as follows: Where the penetration rate (depth of penetration per revolution of pile) falls outside the prescribed limits stated in BS 8004 annex A, the Overseeing Organisation shall be informed immediately.

Protection against corrosion - coating helical piles for protection against corrosion [ICE SPERW B7.5.2]

7.9 The last paragraph of section B7.5.2 of ICE SPERW [Ref 17.N]'The renewal of the surfaces with damaged paint or coating should conform to the project specification.' shall be replaced with as follows: The renewal of

the surfaces with damaged paint or coating shall conform to the project specification.

Static load testing of helical piles - general [ICE SPERW B7.7.1]

7.10 The second paragraph of section B7.7.1 of ICE SPERW [Ref 17.N]'Any contractor proposed changes to the test loading duration or procedure to meet project constraints shall be agreed with the contract administrator at tender. The contractor shall consider the implications of shortened duration or amended test procedures for pile capacity.' shall not be used.

Static load testing of helical piles - lateral load testing [ICE SPERW B7.7.2]

7.11 The last paragraph of section B7.7.2 of ICE SPERW [Ref 17.N]'If required by the project specification, a tiltmeter or a similar sensitive device should be used to measure changes from the vertical level during testing.' shall be replaced with as follows: Where required by the project specification, a tiltmeter or a similar sensitive device shall be used to measure changes from the vertical level during testing.

Records [ICE SPERW B7.8]

7.12 The second sentence of section B7.8 of ICE SPERW [Ref 17.N]'Records should include, where appropriate:' shall be replaced with as follows: Records shall include:.

8. Steel bearing piles

8.1 Steel bearing piles shall be in accordance with ICE SPERW [Ref 17.N]section B8.

Verification requirements for materials and installation for steel bearing piles

8.2 Verification shall be undertaken for materials and installation for steel bearing piles in accordance with ICE SPERW [Ref 17.N]section B8 and table B1.1c.

8.3 The frequency of verification shall be in accordance with ICE SPERW [Ref 17.N]section B8 and table B1.1c.

8.4 The requirements for "Verification" in Section 14 of GC 101 [Ref 13.N] shall apply to the verification undertaken for materials and installation for steel bearing piles.

Documentation requirements for materials and installation for steel bearing piles

8.5 The following Documentation for materials and installation for steel bearing piles shall be submitted as continuous records: Steel bearing piles materials and installation records in accordance with ICE SPERW [Ref 17.N]section B8 and table B1.1c.

8.6 The requirements of "Records" in Section 3 of GC 101 [Ref 13.N] shall apply to Steel bearing piles materials and installation records.

Works specific requirements for steel bearing piles

8.7 ICE SPERW section B8.2 project specification requirements for steel bearing piles shall be as specified in CC 602/WSR/008.

ICE SPERW section B8.2 project specification requirements for steel bearing piles						
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Penetration or depth or toe level**	**Driving resistance or dynamic valuation or set**	**Uplift/ preliminary displacement trials**	**Pre-boring or jetting or other means of easing pile driveability**
(a)	(b)	(c)	(d)	(e)	(f)	(g)

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter text, to identify requirements for the penetration or depth or toe level of the pile or wall [ICE SPERW B8.2 (a)].

e) Enter text, to identify requirements for driving resistance or dynamic valuation or set of the pile or wall [ICE SPERW B8.2 (b)].

f) Enter text, to identify requirements for uplift/preliminary displacement trials [ICE SPERW B8.2 (c)].

g) Enter text, to identify requirements for pre-boring or jetting or other means of easing pile driveability [ICE SPERW B8.2 (d)].

ICE SPERW section B8.2 project specification requirements for steel bearing piles (continued)					
Structure	**Detailed requirements for driving records**	**Permitted grades of steel**	**Acceptance criteria for matching sections of proprietary types of pile**	**Minimum length of pile to be supplied**	**Head and toe strengthening**
(a)	(h)	(i)	(j)	(k)	(l)

h) Enter text, to identify detailed requirements for driving records [ICE SPERW B8.2 (e)].

i) Enter text, to identify permitted grades of steel [ICE SPERW B8.2 (f)].

j) Enter text, to identify acceptance criteria for matching sections of proprietary types of pile [ICE SPERW B8.2 (g)].

k) Enter a number in units of m, to identify requirements for the minimum length of pile to be supplied [ICE SPERW B8.2 (h)].

l) Enter text, to identify requirements for head and toe strengthening of the pile or wall [ICE SPERW B8.2 (i)].

ICE SPERW section B8.2 project specification requirements for steel bearing piles (continued)					
Structure	**Permitted types and quality of pile shoes**	**Practical refusal for pile extraction if different from ICE SPERW**	**Surface preparation**	**Types of coating (including number of coats and coating colour)**	**Nominal thickness of primer and coats**
(a)	(m)	(n)	(o)	(p)	(q)

m) Enter text, to identify the permitted types and quality of pile shoes [ICE SPERW B8.2 (j)].

n) Enter text, to identify requirements for practical refusal for pile extraction if different from ICE SPERW [ICE SPERW B8.2 (k)].

o) Enter text, to identify requirements for surface preparation of the pile or wall [ICE SPERW B8.2 (l)].

p) Enter text, to identify requirements for types of coating (including number of coats and coating colour) [ICE SPERW B8.2 (m)].

q) Enter a number in units of um, to identify requirements for the nominal thickness of primer and coats [ICE SPERW B8.2 (n)].

ICE SPERW section B8.2 project specification requirements for steel bearing piles (continued)					
Structure	**Adhesion test requirements**	**Additional requirements for welding procedures**	**Non-destructive testing of welds**	**Concreting of piles [ICE SPERW B8.2 (r)]**	**Additional requirements on marking of piles**
(a)	(r)	(s)	(t)	(u)	(v)

r) Enter text, to identify requirements for adhesion testing [ICE SPERW B8.2 (o)].

s) Enter text, to identify additional requirements for welding procedures [ICE SPERW B8.2 (p)].

t) Enter text, to identify additional requirements for non-destructive testing of welds [ICE SPERW B8.2 (q)].

u) Enter text, to identify requirements for concreting of piles [ICE SPERW B8.2 (r)].

v) Enter text, to identify additional requirements on marking of piles [ICE SPERW B8.2 (s)].

ICE SPERW section B8.2 project specification requirements for steel bearing piles (continued)	
Structure	**Other particular technical requirements**
(a)	(w)

w) Enter text, to identify other particular technical requirements [ICE SPERW B8.2 (t)].

9. Timber piles

9.1 Timber piles shall not be used.

10. Diaphragm walls and barrettes

10.1 Diaphragm walls and barrettes shall be in accordance with ICE SPERW [Ref 17.N]section B10.

Verification requirements for materials and installation for diaphragm walls and barrettes

10.2 Verification shall be undertaken for materials and installation for diaphragm walls and barrettes in accordance with ICE SPERW [Ref 17.N]section B10 and table B1.1c.

10.3 The frequency of verification shall be in accordance with ICE SPERW [Ref 17.N]section B10 and table B1.1c.

10.4 The requirements for "Verification" in Section 14 of GC 101 [Ref 13.N] shall apply to the verification undertaken for materials and installation for diaphragm walls and barrettes.

Documentation requirements for materials and installation for diaphragm walls and barrettes

10.5 The following Documentation for materials and installation for diaphragm walls and barettes shall be submitted as continuous records: diaphragm walls and barettes materials and installation records in accordance with ICE SPERW [Ref 17.N] section B10 and table B1.1c.

10.6 The requirements of "Records" in Section 3 of GC 101 [Ref 13.N] shall apply to diaphgragm walls and barettes materials and installation records.

Works specific requirements for diaphragm walls and barrettes

10.7 ICE SPERW section B10.2 project specification requirements for diaphragm walls and barrettes shall be as specified in CC 602/WSR/010.

ICE SPERW section B10.2 project specification requirements for diaphragm walls and barrettes						
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Performance criteria for movement under vertical loads**	**Support fluid**	**Panel dimensions (minimum or maximum thickness and/or panel length)**	**Additional overbreak tolerance**
(a)	(b)	(c)	(d)	(e)	(f)	(g)

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter text, to identify performance criteria for movement under vertical loads [ICE SPERW B10.2 (a)].

e) Enter text, to identify requirements for support fluid [ICE SPERW B10.2 (b)].

f) Enter text, to identify requirements for the panel dimensions (minimum or maximum thickness and/or panel length) [ICE SPERW B10.2 (c)].

g) Enter text, to identify requirements for additional overbreak tolerance [ICE SPERW B10.2 (d)].

ICE SPERW section B10.2 project specification requirements for diaphragm walls and barrettes (continued)					
Structure	**Preliminary test barrettes**	**Water stops for diaphragm walls**	**Instrumentation**	**Base or shaft grouting for barrettes**	**Temporary backfill material**
(a)	(h)	(i)	(j)	(k)	(l)

h) Enter text, to identify requirements for preliminary test barrettes [ICE SPERW B10.2 (e)].

i) Enter text, to identify requirements for water stops for diaphragm walls [ICE SPERW B10.2 (f)].

j) Enter text, to identify requirements for instrumentation [ICE SPERW B10.2 (g)].

k) Enter text, to identify requirements for base or shaft grouting for barrettes [ICE SPERW B10.2 (h)].

l) Enter text, to identify requirements for temporary backfill material [ICE SPERW B10.2 (i)].

ICE SPERW section B10.2 project specification requirements for diaphragm walls and barrettes (continued)				
Structure	**Integrity testing**	**Permissible materials for permanent stop-ends**	**Trial panels**	**Other particular technical requirements**
(a)	(m)	(n)	(o)	(p)

m) Enter text, to identify requirements for integrity testing [ICE SPERW B10.2 (j)].

n) Enter text, to identify permissible materials for permanent stop-ends [ICE SPERW B10.2 (k)].

o) Enter text, to identify requirements for trial panels [ICE SPERW B10.2 (m)].

p) Enter text, to identify other particular technical requirements [ICE SPERW B10.2 (n)].

ICE SPERW amendments for diaphragm walls and barrettes

Materials - alternatives to steel reinforcement [ICE SPERW B10.3.4]

10.8 Section B10.3.4 of ICE SPERW [Ref 17.N] shall not be used.

Construction tolerances - dimensions of panels [ICE SPERW B10.4.6]

10.9 The second sentence of the second paragraph of section B10.4.6 of ICE SPERW [Ref 17.N]'The contractor shall be responsible for selecting panel dimensions which ensure stability.' shall not be used.

Construction processes - drawings [ICE SPERW B10.5.1]

10.10 The second sentence of section B10.5.1 of ICE SPERW [Ref 17.N]'These drawings shall be submitted to the contract administrator in accordance with the approval period stated in the project specification.' shall be replaced with as follows: These drawings shall be provided by the contractor at least four working weeks prior to commencement of the piling works.

Construction processes - condition of support fluid prior to concreting [ICE SPERW B10.5.5]

10.11 The last sentence of section B10.5.5 of ICE SPERW [Ref 17.N]'Refer to Tables C20.1 and C20.2.' shall not be used.

Construction processes - stop-ends in diaphragm wall panels [ICE SPERW B10.5.6]

10.12 The first paragraph of section B10.5.6 of ICE SPERW [Ref 17.N]'The contractor shall state in their tender the type of stop-end proposed and whether they will be removed or permanently cast into the panel.' shall be replaced with as follows: At least four working weeks prior to commencement of the piling works, the contractor shall provide details of the type of stop-end proposed and whether they can be removed or permanently cast into the panel.

Construction processes - placing concrete [ICE SPERW B10.5.7]

10.13 The third sentence of the ninth paragraph of section B10.5.7 of ICE SPERW [Ref 17.N]'Thereafter it may be raised by no more than 200 mm in order to minimise the risk of concrete blockages.' shall be replaced with as follows: Thereafter it shall be raised by no more than 200 mm in order to minimise the risk of concrete blockages.

11. Secant pile walls

11.1 Secant pile walls including hard/soft, hard/firm and hard/hard pile arrangements shall be in accordance with ICE SPERW [Ref 17.N]section B11.

Verification requirements for materials and installation for secant pile walls

11.2 Verification shall be undertaken for materials and installation for secant pile walls in accordance with ICE SPERW [Ref 17.N]section B11 and table B1.1c.

11.3 The frequency of verification shall be in accordance with ICE SPERW [Ref 17.N]section B11 and table B1.1c.

11.4 The requirements for "Verification" in Section 14 of GC 101 [Ref 13.N] shall apply to the verification undertaken for materials and installation for secant pile walls.

Documentation requirements for materials and installation for secant pile walls

11.5 The following Documentation for materials and installation for secant pile walls shall be submitted as continuous records: Secant pile walls materials and installation records in accordance with ICE SPERW [Ref 17.N] section B11 and table B1.1c..

11.6 The requirements of "Records" in Section 3 of GC 101 [Ref 13.N] shall apply to Secant pile walls materials and installation records.

Works specific requirements for secant pile walls

11.7 ICE SPERW section B11.2 project specification requirements for secant pile walls shall be as specified in CC 602/WSR/011.

ICE SPERW section B11.2 project specification requirements for secant pile walls						
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Performance criteria for movement under vertical loads**	**Support fluid**	**Additional overbreak tolerance**	**Self-hardening slurry mixes**
(a)	(b)	(c)	(d)	(e)	(f)	(g)

ICE SPERW section B11.2 project specification requirements for secant pile walls						
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Performance criteria for movement under vertical loads**	**Support fluid**	**Additional overbreak tolerance**	**Self-hardening slurry mixes**

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter text, to identify the performance criteria for movement under vertical loads [ICE SPERW B11.2 (a)].

e) Enter text, to identify requirements for support fluid [ICE SPERW B11.2 (b)].

f) Enter text, to identify requirements for additional overbreak tolerance [ICE SPERW B11.2 (c)].

g) Enter text, to identify requirements for self-hardening slurry mixes such as strength, permeability, shrinkage and durability including requirements for sampling and testing of these mixes [ICE SPERW B11.2 (d)].

ICE SPERW section B11.2 project specification requirements for secant pile walls (continued)							
Structure	**Nominal diameter of piles**	**Nominal centre-to-centre spacing of piles at commencing level**	**Nominal overlap of piles at commencing level**	**Depth to which pile interlock shall be maintained**	**Instrumentation**	**Temporary backfill material**	**Integrity testing**
(a)	(h)	(i)	(j)	(k)	(l)	(m)	(n)

h) Enter a number in units of mm, to identify the required nominal diameter of piles [ICE SPERW B11.2 (e)].

i) Enter a number in units of mm, to identify the required nominal centre-to-centre spacing of piles at commencing level [ICE SPERW B11.2 (f)].

j) Enter a number in units of mm, to identify the required nominal overlap of piles at commencing level [ICE SPERW B11.2 (f)].

k) Enter a number in units of mm, to identify the depth to which pile interlock shall be maintained [ICE SPERW B11.2 (g)].

l) Enter text, to identify requirements for instrumentation [ICE SPERW B11.2 (h)].

m) Enter text, to identify requirements for temporary backfill material [ICE SPERW B11.2 (i)].

n) Enter text, to identify requirements for integrity testing [ICE SPERW B11.2 (j)].

ICE SPERW section B11.2 project specification requirements for secant pile walls (continued)	
Structure	**Other particular technical requirements**
(a)	(o)

o) Enter text, to identify other particular technical requirements [ICE SPERW B11.2 (k)].

ICE SPERW amendments for secant pile walls

Materials - self-hardening slurry mixes and low-strength concrete mixes [ICE SPERW B11.3.1]

11.8 The last paragraph of section B11.3.1 of ICE SPERW [Ref 17.N]'Sampling and testing of concrete should be in accordance with section B21.8 and the requirements of the project specification.' shall be replaced with as follows: Sampling and testing of concrete shall be in accordance with section B21.8 and the requirements of the project specification.

Materials - alternatives to steel reinforcement [ICE SPERW B11.3.3]

11.9 Section B11.3.3 of ICE SPERW [Ref 17.N] shall not be used.

Construction processes - bored cast-in-place piles [ICE SPERW B11.5.2]

11.10 The second sentence of section B11.5.2 of ICE SPERW [Ref 17.N]'For the construction of secant pile walls, excavations of secondary piles should be supported by temporary casings.' shall be replaced with as follows: For the construction of secant pile walls, excavations of secondary piles shall be supported by temporary casings.

12. Contiguous pile walls

12.1 Contiguous pile walls shall be in accordance with ICE SPERW [Ref 17.N]section B12.

Verification requirements for materials and installation for contiguous pile walls

12.2 Verification shall be undertaken for materials and installation for contiguous pile walls in accordance with ICE SPERW [Ref 17.N]section B12 and table B1.1c.

12.3 The frequency of verification shall be in accordance with ICE SPERW [Ref 17.N]section B12 and table B1.1c.

12.4 The requirements for "Verification" in Section 14 of GC 101 [Ref 13.N] shall apply to the verification undertaken for materials and installation for contiguous pile walls.

Documentation requirements for materials and installation for contiguous pile walls

12.5 The following Documentation for contiguous pile walls shall be submitted as continuous records: Contiguous pile walls materials and installation records in accordance with ICE SPERW [Ref 17.N] section B12 and table B1.1c.

12.6 The requirements of "Records" in Section 3 of GC 101 [Ref 13.N] shall apply to Contiguous pile walls materials and installation records.

Works specific requirements for contiguous pile walls

12.7 ICE SPERW section B12.2 project specification requirements for contiguous pile walls shall be as specified in CC 602/WSR/012.

ICE SPERW section B12.2 project specification requirements for contiguous pile walls							
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Performance criteria for movement under vertical loads**	**Support fluid**	**Additional overbreak tolerance**	**Nominal diameters of piles**	**Nominal centre-to-centre spacing of piles at commencing level**
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)

ICE SPERW section B12.2 project specification requirements for contiguous pile walls							
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Performance criteria for movement under vertical loads**	**Support fluid**	**Additional overbreak tolerance**	**Nominal diameters of piles**	**Nominal centre-to-centre spacing of piles at commencing level**

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter text, to identify the performance criteria for movement under vertical loads [ICE SPERW B12.2 (a)].

e) Enter text, to identify requirements for support fluid [ICE SPERW B12.2 (b)].

f) Enter text, to identify requirements for additional overbreak tolerance [ICE SPERW B12.2 (c)].

g) Enter a number in units of mm, to identify the required nominal diameters of piles [ICE SPERW B12.2 (d)].

h) Enter a number in units of mm, to identify the required nominal centre-to-centre spacing of piles at commencing level [ICE SPERW B12.2 (e)].

ICE SPERW section B12.2 project specification requirements for contiguous pile walls (continued)				
Structure	**Instrumentation**	**Temporary backfill material**	**Integrity testing**	**Other particular technical requirements**
(a)	(i)	(j)	(k)	(l)

i) Enter text, to identify the requirements for instrumentation [ICE SPERW B12.2 (f)].

j) Enter text, to identify the requirements for temporary backfill material [ICE SPERW B12.2 (g)].

k) Enter text, to identify the requirements for integrity testing [ICE SPERW B12.2 (h)].

l) Enter text, to identify other particular technical requirements [ICE SPERW B12.2 (i)].

ICE SPERW amendments for contiguous pile walls

Materials - alternatives to steel reinforcement [ICE SPERW B12.3.2]

12.8 Section B12.3.2 of ICE SPERW [Ref 17.N] shall not be used.

13. King post walls

13.1 King post walls shall be in accordance with ICE SPERW [Ref 17.N]section B13.

Verification requirements for materials and installation for king post walls

13.2 Verification shall be undertaken for materials and installation for king post walls in accordance with ICE SPERW [Ref 17.N]section B13 and table B1.1c.

13.3 The frequency of verification shall be in accordance with ICE SPERW [Ref 17.N]section B13 and table B1.1c.

13.4 The requirements for "Verification" in Section 14 of GC 101 [Ref 13.N] shall apply to the verification undertaken for materials and installation for king post walls.

Documentation requirements for materials and installation for king post walls

13.5 The following Documentation for materials and installation for king post walls shall be submitted as continuous records: King post walls materials and installation records in accordance with ICE SPERW [Ref 17.N]section B13 and table B1.1c..

13.6 The requirements of "Records" in Section 3 of GC 101 [Ref 13.N] shall apply to King post walls materials and installation records.

Works specific requirements for king post walls

13.7 ICE SPERW section B13.2 project specification requirements for king post walls shall be as specified in CC 602/WSR/013.

ICE SPERW section B13.2 project specification requirements for king post walls						
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Performance criteria for movement under vertical loads**	**Support fluid**	**Pile steel grade and sectional properties**	**Pile coating details**
(a)	(b)	(c)	(d)	(e)	(f)	(g)

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter text, to identify the performance criteria for movement under vertical loads [ICE SPERW B13.2 (a)].

e) Enter text, to identify requirements for support fluid [ICE SPERW B13.2 (b)].

f) Enter text, to identify the requirements for steel grade and sectional properties of the pile [ICE SPERW B13.2 (c)].

g) Enter text, to identify requirements for the pile coating [ICE SPERW B13.2 (d)].

ICE SPERW section B13.2 project specification requirements for king post walls (continued)					
Structure	**Nominal diameter of the pile bores**	**Nominal centre-to-centre spacing of the pile bores**	**Instrumentation**	**Temporary backfill material**	**Other particular technical requirements**
(a)	(h)	(i)	(j)	(k)	(l)

h) Enter a number in units of mm, to identify the required nominal diameter of the pile bores [ICE SPERW B13.2 (e)].

i) Enter a number in units of mm, to identify the required nominal centre-to-centre spacing of the pile bores [ICE SPERW B13.2 (f)].

j) Enter text, to identify requirements for instrumentation [ICE SPERW B13.2 (g)].

k) Enter text, to identify requirements for temporary backfill material [ICE SPERW B13.2 (h)].

l) Enter text, to identify other particular technical requirements [ICE SPERW B13.2 (i)].

ICE SPERW amendments for king post walls

Materials - king post [ICE SPERW B13.3.1]

13.8 Section B13.3.1 of ICE SPERW [Ref 17.N] shall not be used.

14. Steel sheet piles

14.1 Steel sheet piles shall be in accordance with ICE SPERW [Ref 17.N]section B14.

Verification requirements for materials and installation for steel sheet piles

14.2 Verification shall be undertaken for materials and installation for steel sheet piles in accordance with ICE SPERW [Ref 17.N]section B14 and table B1.1c.

14.3 The frequency of verification shall be in accordance with ICE SPERW [Ref 17.N]section B14 and table B1.1c.

14.4 The requirements for "Verification" in Section 14 of GC 101 [Ref 13.N] shall apply to the verification undertaken for materials and installation for steel sheet piles.

Documentation requirements for materials and installation for steel sheet piles

14.5 The following Documentation for materials and installation of steel sheet piles shall be submitted as continuous records: Steel sheet piles materials and installation records in accordance with ICE SPERW [Ref 17.N]section B14 and B1.1c.

14.6 The requirements of "Records" in Section 3 of GC 101 [Ref 13.N] shall apply to steel sheet piles materials and installation records.

Works specific requirements for steel sheet piles

14.7 ICE SPERW section B14.2 project specification requirements for steel sheet piles shall be as specified in CC 602/WSR/014.

ICE SPERW section B14.2 project specification requirements for steel sheet piles						
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Penetration or depth or toe level**	**Permitted methods of installation or extraction**	**Detailed requirements for piling records**	**Permitted grades of steel**
(a)	(b)	(c)	(d)	(e)	(f)	(g)

ICE SPERW section B14.2 project specification requirements for steel sheet piles						
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Penetration or depth or toe level**	**Permitted methods of installation or extraction**	**Detailed requirements for piling records**	**Permitted grades of steel**

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter text, to identify requirements for the penetration or depth or toe level of the pile or wall [ICE SPERW B14.2 (a)].

e) Enter text, to identify the permitted methods of installation or extraction of the pile or wall [ICE SPERW B14.2 (b)].

f) Enter text, to identify detailed requirements for piling records [ICE SPERW B14.2 (c)].

g) Enter text, to identify the permitted grades of steel for the pile or wall [ICE SPERW B14.2 (d)].

ICE SPERW section B14.2 project specification requirements for steel sheet piles (continued)					
Structure	**Pile section type, minimum section modulus, second moment of inertia and web thickness**	**Surface preparation**	**Permitted types of coating**	**Nominal thickness of primer and coats**	**Cathodic protection**
(a)	(h)	(i)	(j)	(k)	(l)

h) Enter text, to identify the required pile section type, minimum section modulus, second moment of inertia and web thickness [ICE SPERW B14.2 (e)].

i) Enter text, to identify requirements for surface preparation of the pile or wall [ICE SPERW B14.2 (f)].

j) Enter text, to identify the permitted types of coating for the pile or wall [ICE SPERW B14.2 (g)].

k) Enter a number in units of um, to identify the required nominal thickness of primer and coats [ICE SPERW B14.2 (h)].

l) Enter text, to identify requirements for cathodic protection [ICE SPERW B14.2 (i)].

ICE SPERW section B14.2 project specification requirements for steel sheet piles (continued)					
Structure	**Permitted types of head and toe preparation**	**Minimum length of pile to be supplied**	**Practical refusal for pile installation or extraction if different from ICE SPERW**	**Water-tightness performance**	**Interlock sealant or seal welds**
(a)	(m)	(n)	(o)	(p)	(q)

m) Enter text, to identify permitted types of head and toe preparation for the pile or wall [ICE SPERW B14.2 (j)].

n) Enter a number in units of m, to identify the required minimum length of pile to be supplied [ICE SPERW B14.2 (k)].

o) Enter text, to identify requirements for practical refusal for pile installation or extraction if different from ICE SPERW [ICE SPERW B14.2 (l)].

p) Enter text, to identify requirements on water-tightness performance of the pile or wall [ICE SPERW B14.2 (m)].

q) Enter text, to identify requirements for interlock sealant or seal welds [ICE SPERW B14.2 (n)].

ICE SPERW section B14.2 project specification requirements for steel sheet piles (continued)		
Structure	**Special piles**	**Other particular technical requirements**
(a)	(r)	(s)

r) Enter text, to identify requirements for special piles [ICE SPERW B14.2 (o)].

s) Enter text, to identify other particular technical requirements [ICE SPERW B14.2 (p)].

ICE SPERW amendments for steel sheet piles

Materials and fabrication - clutch sealant and seal welding [ICE SPERW B14.3.5]

14.8 The first sentence of the second paragraph of section B14.3.5 of ICE SPERW [Ref 17.N]'Details of the brand and properties of interlock sealant shall be supplied by the contractor at tender.' shall be replaced with as follows: Details of the brand and properties of interlock sealant shall be supplied by the contractor at least four working weeks prior to commencement of the piling works.

Construction processes - pile installation [ICE SPERW B14.4.4]

14.9 The third sentence of the second paragraph of section B14.4.4 of ICE SPERW [Ref 17.N]'Tighter tolerances consistent with other types of wall are possible and may be agreed with potential contractors, but if specified it should be appreciated there could be additional costs or practicality implications.' shall not be used.

14.10 The first sentence of the third paragraph of section B14.4.4 of ICE SPERW [Ref 17.N]'The methods for access, handling, pitching and installing the piles, together with details of proposals to guide the piles to ensure verticality, shall be provided by the contractor at tender stage.' shall be replaced with as follows: The methods for access, handling, pitching and installing the piles, together with details of proposals to guide the piles to ensure verticality, shall be provided by the contractor at least four working weeks prior to commencement of the piling works.

14.11 The third sentence of the ninth paragraph of section B14.4.4 of ICE SPERW [Ref 17.N]'The contractor shall inform the contract administrator of any declutching, damage or separation of the sheet pile wall, and submit proposals to the designer in accordance with clause B1.16.' shall be replaced with as follows: The contractor shall inform the overseeing organisation of any declutching, damage or separation of the sheet pile wall, and submit proposals in accordance with clause B1.16.

14.12 The tenth paragraph of section B14.4.4 of ICE SPERW [Ref 17.N]'The selection of plant shall be commensurate with the ground conditions and local environment; within built up areas this probably means that piles should be installed by pressing. The use of a particular technique for installation may also influence the pile section to be used.' shall be replaced with as follows: The selection of plant shall be commensurate with the ground conditions and local environment.

Construction processes - corrosion rates [ICE SPERW B14.4.5]

14.13 The first paragraph of section B14.4.5 of ICE SPERW [Ref 17.N]'Methods and proposals for pile extraction shall be submitted to the contract administrator for approval where required by the project specification.' shall not be used.

15. Integrity testing of piles and embedded retaining walls

15.1 Integrity testing of concrete for cast-in-situ piles, barrettes and wall elements shall be in accordance with ICE SPERW [Ref 17.N]section B15.

Documentation requirements for integrity testing of piles and embedded retaining walls

15.2 The following Documentation for integrity testing of piles and embedded retaining walls shall be submitted as continuous records: Piles and embedded retaining walls integrity testing records in accordance with ICE SPERW [Ref 17.N]section B15 and table B1.1c.

15.3 The requirements of "Records" in Section 3 of GC 101 [Ref 13.N] shall apply to Piles and embedded retaining walls integrity testing records.

Works specific requirements for integrity testing of piles and embedded retaining walls

15.4 ICE SPERW section B15.2 project specification requirements for integrity testing of piles and embedded retaining walls shall be as specified in CC 602/WSR/015.

ICE SPERW section B15.2 project specification requirements for integrity testing of piles and embedded retaining walls						
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Impulse response method for piles and barrettes**	**Sonic echo, frequency response or transient dynamic steady-state vibration method for piles and barrettes**	**Cross-hole sonic logging method**	**Distributed fibre optic sensing methods**
(a)	(b)	(c)	(d)	(e)	(f)	(g)

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter text, to identify the requirements for integrity testing using the impulse response method for piles and barrettes only [ICE SPERW B15.2 (a)].

e) Enter text, to identify the requirements for integrity testing using the sonic echo, frequency response or transient dynamic steady-state vibration method for piles and barrettes only [ICE SPERW B15.2 (b)].

f) Enter text, to identify the requirements for integrity testing using the cross-hole sonic logging method [ICE SPERW B15.2 (c)].

g) Enter text, to identify the requirements for integrity testing using the distributed fibre optic sensing methods [ICE SPERW B15.2 (d)].

ICE SPERW section B15.2 project specification requirements for integrity testing of piles and embedded retaining walls (continued)	
Structure	**Thermistor-based integrity testing**
(a)	(h)

h) Enter text, to identify the requirements for thermistor-based integrity testing [ICE SPERW B15.2 (e)].

ICE SPERW amendments for integrity testing

Measuring instruments [ICE SPERW B15.4]

15.5 The second sentence of point (a) of section B15.4 of ICE SPERW [Ref 17.N]'These may be steel wire armoured cables, with a diameter no larger than 10 mm, capable of protecting the optical fibre during installation.' shall be replaced with as follows: These shall be steel wire armoured cables, with a diameter no larger than 10 mm, capable of protecting the optical fibre during installation.

Interpretation of tests [ICE SPERW B15.8]

15.6 The second sentence of the first paragraph of section B15.8 of ICE SPERW [Ref 17.N]'Should unusual occurrences or delays be apparent during the installation or post installation period that are pertinent to the assessment and evaluation, then these details must be forwarded to the testing organisation.' shall be replaced with as follows: Should unusual occurrences or delays be apparent during the installation or post installation period that are pertinent to the assessment and evaluation, then these details shall be forwarded to the testing organisation.

16. Dynamic and rapid load testing of piles

16.1 Dynamic and rapid load testing of piles shall be in accordance with ICE SPERW [Ref 17.N]section B16.

Documentation requirements for dynamic and rapid load testing of piles

16.2 The following Documentation for dynamic and rapid load testing of piles shall be submitted as continuous records: Dynamic and rapid load pile testing records in accordance with ICE SPERW [Ref 17.N]section B16 and table B1.1c..

16.3 The requirements of "Records" in Section 3 of GC 101 [Ref 13.N] shall apply to Dynamic and rapid load pile testing records.

Works specific requirements for dynamic and rapid load testing of piles

16.4 ICE SPERW section B16.2 project specification requirements for dynamic and rapid testing of piles shall be as specified in CC 602/WSR/016.

ICE SPERW section B16.2 project specification requirements for dynamic and rapid testing of piles						
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Type of pile to be tested**	**Type of dynamic or rapid load test and method statement of test procedure and the standards to be followed**	**Minimum number of dynamic or rapid load tests to be applied to each pile and procedure to be adopted in testing working piles**	**Special construction requirements for test piles**
(a)	(b)	(c)	(d)	(e)	(f)	(g)

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter text, to identify the type of pile to be tested [ICE SPERW B16.2 (a)].

e) Enter text, to identify the type of dynamic or rapid load test and method statement of test procedure and the standards to be followed [ICE SPERW B16.2 (b)].

f) Enter text, to identify the minimum number of dynamic or rapid load tests to be applied to each pile and procedure to be adopted in testing working piles [ICE SPERW B16.2 (c)].

g) Enter text, to identify special construction requirements for test piles [ICE SPERW B16.2 (d)].

ICE SPERW section B16.2 project specification requirements for dynamic and rapid testing of piles (continued)					
Structure	**Special requirements for pile testing equipment and arrangement**	**Pile installation criteria**	**Time interval between pile installation and testing of piles**	**Details of work to be carried out to the test pile cap or head prior to and at the completion of a test**	**Permanent set per blow and temporary compression of the pile and soil system to be measured independently of the instruments being used to record the dynamic test data from a fixed reference point unaffected by the piling operations**
(a)	(h)	(i)	(j)	(k)	(l)

h) Enter text, to identify special requirements for pile testing equipment and arrangement [ICE SPERW B16.2 (e)].

i) Enter text, to identify pile installation criteria [ICE SPERW B16.2 (f)].

j) Enter a number in units of h, to identify the required time interval between pile installation and testing of piles [ICE SPERW B16.2 (g)].

k) Enter text, to identify details of work to be carried out to the test pile cap or head prior to and at the completion of a test [ICE SPERW B16.2 (h)].

l) Enter text, to identify requirements for the permanent set per blow and temporary compression of the pile and soil system to be measured independently of the instruments being used to record the dynamic test data from a fixed reference point unaffected by the piling operations.

ICE SPERW section B16.2 project specification requirements for dynamic and rapid testing of piles (continued)	
Structure	**Other particular technical requirements**
(a)	(m)

m) Enter text, to identify other particular technical requirements [ICE SPERW B16.2 (i)].

ICE SPERW amendments for dynamic and rapid load testing of piles

Construction of a preliminary pile to be tested - method of construction [ICE SPERW B16.3.2]

16.5 The first sentence of section B16.3.2 of ICE SPERW [Ref 17.N]'Each preliminary test pile shall be constructed in a manner similar to that to be used for the construction of the working piles, and by the use of similar equipment and materials.' shall be replaced with as follows: Each preliminary test pile shall be constructed in the same manner as that to be used for the construction of the working piles, and by the use of the same equipment and materials.

17. Static load testing of piles

17.1 Static load testing of piles shall be in accordance with ICE SPERW [Ref 17.N]section B17.

Documentation requirements for static load testing of piles

17.2 The following Documentation for static load testing of piles shall be submitted as continuous records: Static load pile testing records in accordance with ICE SPERW [Ref 17.N]section B17 and table B1.1c..

17.3 The requirements of "Records" in Section 3 of GC 101 [Ref 13.N] shall apply to Static load pile testing records.

Works specific requirements for static load testing of piles

17.4 ICE SPERW section B17.2 project specification requirements for static load testing of piles shall be as specified in CC 602/WSR/017.

ICE SPERW section B17.2 project specification requirements for static load testing of piles						
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Type of pile to be tested**	**Type of test to be undertaken**	**Loads to be applied and procedure to be adopted in testing preliminary piles, including maximum reaction capacity**	**Loads to be applied and procedure to be adopted in proof-testing of working piles, including maximum reaction capacity**
(a)	(b)	(c)	(d)	(e)	(f)	(g)

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter text, to identify the type of pile to be tested [ICE SPERW B17.2 (a)].

e) Enter text, to identify the type of test to be undertaken [ICE SPERW B17.2 (b)].

f) Enter text, to identify the loads to be applied and procedure to be adopted in testing preliminary piles, including maximum reaction capacity [ICE SPERW B17.2 (c)].

g) Enter text, to identify the loads to be applied and procedure to be adopted in proof-testing of working piles, including maximum reaction capacity [ICE SPERW B17.2 (d)].

ICE SPERW section B17.2 project specification requirements for static load testing of piles (continued)						
Structure	**Type of loading**	**Number of loading cycles**	**Special materials to be used in construction of preliminary test piles**	**Special construction requirements for test piles**	**Special requirements for pile testing equipment and arrangement**	**Pile installation criteria**
(a)	(h)	(i)	(j)	(k)	(l)	(m)

h) Enter a value, from options tensile, compressive, to identify the type of loading required [ICE SPERW B17.2 (e)].

i) Enter a number, to identify the number of loading cycles required [ICE SPERW B17.2 (e)].

j) Enter text, to identify requirements for special materials to be used in construction of preliminary test piles [ICE SPERW B17.2 (f)].

k) Enter text, to identify special construction requirements for test piles, including requirements for additional reinforcement, increased concrete strength, sampling or in situ testing [ICE SPERW B17.2 (g)].

l) Enter text, to identify special requirements for pile testing equipment and arrangement, including requirements for any pile instrumentation [ICE SPERW B17.2 (h)].

m) Enter text, to identify pile installation criteria [ICE SPERW B17.2 (i)].

ICE SPERW section B17.2 project specification requirements for static load testing of piles (continued)						
Structure	**Time interval between installation and testing of piles**	**Interpretation of test results**	**Additional records or information**	**Displacement transducer stem travel**	**Test cut-off level**	**Work to be carried out to the test pile cap or head for the test and at completion**
(a)	(n)	(o)	(p)	(q)	(r)	(s)

o) Enter a number in units of h, to identify the time interval required between installation and testing of piles [ICE SPERW B17.2 (j)].

p) Enter text, to identify requirements for the interpretation of test results including the extent of interpretation [ICE SPERW B17.2 (k)].

q) Enter text, to identify requirements for additional records or information from the load test [ICE SPERW B17.2 (l)].

r) Enter a number in units of mm, to identify requirements for the travel of the displacement transducer stem [ICE SPERW B17.2 (m)].

s) Enter text, to identify the cut-off level of the test [ICE SPERW B17.2 (n)].

t) Enter text, to identify requirements for work to be carried out to the test pile cap or head for the test and at completion [ICE SPERW B17.2 (o)].

ICE SPERW section B17.2 project specification requirements for static load testing of piles (continued)		
Structure	**Special requirements for the application of a lateral load to a pile**	**Other particular technical requirements**
(a)	(t)	(u)

t) Enter text, to identify special requirements for the application of a lateral load to a pile detailed in accordance with the expected conditions of loading [ICE SPERW B17.2 (p)].

u) Enter text, to identify other particular technical requirements [ICE SPERW B17.2 (q)].

ICE SPERW amendments for static load testing of piles

Construction of a preliminary pile to be tested - method of construction [ICE SPERW B17.3.2]

17.5 The first sentence of the first paragraph of section B17.3.2 of ICE SPERW [Ref 17.N]'Unless agreed otherwise with the designer, each preliminary pile shall be constructed in the same manner to that to be used for the construction of the working piles using similar equipment and materials.' shall be replaced with as follows: Each preliminary pile shall be constructed in the same manner as that to be used for the construction of the working piles using the same equipment and materials.

Cut-off level [ICE SPERW B17.6]

17.6 The second paragraph of section B17.6 of ICE SPERW [Ref 17.N]'Where the cut-off level of a test pile is below the ground level at the time of pile installation and where it is required to carry out a proof test from that installation level, either allowance shall be made in the determination of the design verification load for friction which may be developed between the cut-off level and the existing ground level, or the pile may be sleeved appropriately to substantially reduce or eliminate friction that develops over the extended length.' shall be replaced with as follows: Where the cut-off level of a test pile is below the ground level at the time of pile installation and where it is required to carry out a proof test from that installation level, either allowance shall be made in the determination of the design verification load for friction which may be developed between the cut-off level and the existing ground level, or the pile shall be sleeved appropriately to substantially reduce or eliminate friction that develops over the extended length.

Safety precautions - testing equipment [ICE SPERW B17.8.4]

17.7 The first sentence of the second paragraph of section B17.8.4 of ICE SPERW [Ref 17.N]'Any automated system should have the ability, and be able to detect, that in the course of carrying out a test, should any unforeseen occurrence take place, further loading shall not be applied (and have the ability to automatically download) until a suitable engineering assessment of the condition has been made.' shall be replaced with as follows: Any automated system shall have the ability, and be able to detect, that in the course of carrying out a test, where any unforeseen occurrence take place, further loading shall not be applied (and have the ability to automatically download) until a suitable engineering assessment of the condition has been made.

Application of load - remote monitoring [ICE SPERW B17.10.4]

17.8 The third paragraph of section B17.10.4 of ICE SPERW [Ref 17.N]'Some of the issues that should be considered for remote testing are' shall be replaced with as follows: Some of the issues that shall be considered for remote testing are:.

Measuring pile head movement - reference beams and electronic displacement transducers [ICE SPERW B17.11.1]

17.9 The second paragraph of section B17.11.1 of ICE SPERW [Ref 17.N]'Check observations of any movements of the reference beam or beams shall be made and a check shall be made of the movement of the pile head relative to a remote reference datum at the start and end of the load test.' shall be replaced with as follows: Observations of any movements of the reference beam or beams and a check of the movement of the pile head relative to a remote reference datum shall be made at the start and end of the load test as well as at maximum load for each loading cycle.

17.10 The second sentence of the third paragraph of section B17.11.1 of ICE SPERW [Ref 17.N]'Alternatively, the transducers or gauges may be fixed to the pile and bear on prepared surfaces on the reference beam or beams.' shall be replaced with as follows: Alternatively, the transducers or gauges shall be fixed to the pile and bear on prepared surfaces on the reference beam or beams.

Test procedure for maintained load compression test - general [ICE SPERW B17.13.1]

17.11 The last paragraph of section B17.13.1 of ICE SPERW [Ref 17.N]'For automated tests, load, hydraulic pressure and displacement measurements should be made at a minimum of every one minute throughout the testing procedure.' shall be replaced with as follows: For automated tests, load, hydraulic pressure and displacement measurements shall be made at intervals no longer than one minute throughout the testing procedure.

Presentation of factual results - schedule of recorded data [ICE SPERW B17.14.2]

17.12 The third bullet point of section B17.14.2 (a) of ICE SPERW [Ref 17.N]'principal contractor, subcontractor, testing contractor, designer, employer' shall be replaced with as follows: All relevant parties (e.g. principal contractor, subcontractor, testing contractor, designer, employer).

ICE SPERW additions for static load testing of piles

Reaction systems - spacing [ICE SPERW B17.9.5]

17.13 Where vertical reaction piles penetrate deeper than the test pile and the base capacity of the test pile is more than 20% of the total ultimate capacity, the centre-to-centre spacing of the reaction piles from the test pile shall be more than five times the diameter of the test pile or the reaction piles whichever is the greatest.

18. Piles with permanent casing and/or coatings

18.1 Permanent casings and/or coatings, for reducing friction or for providing a protective barrier for piles, shall be in accordance with ICE SPERW [Ref 17.N]section B18.

Verification requirements for materials and installation for piles with permanent casing and/or coatings

18.2 Verification shall be undertaken for materials and installation for piles with permanent casing and/or coatings in accordance with ICE SPERW [Ref 17.N]section B18 and table B1.1c.

18.3 The frequency of verification shall be in accordance with ICE SPERW [Ref 17.N]section B18 and table B1.1c.

18.4 The requirements for "Verification" in Section 14 of GC 101 [Ref 13.N] shall apply to the verification undertaken for materials and installation for piles with permanent casing and/or coatings.

Documentation requirements for materials and installation for piles with permanent casing and/or coatings

18.5 The following Documentation for materials and installation for piles with permanent casing and/or coatings shall be submitted as continuous records: Permanent pile casing and/or coatings materials and installation records in accordance with ICE SPERW [Ref 17.N]section B18 and B1.1c..

18.6 The requirements of "Records" in Section 3 of GC 101 [Ref 13.N] shall apply to Permanent pile casing and/or coatings materials and installation records.

Works specific requirements for piles with permanent casing and/or coatings

18.7 ICE SPERW section B18.2 project specification requirements for piles with permanent casing and/or coatings shall be as specified in CC 602/WSR/018.

ICE SPERW section B18.2 project specification requirements for piles with permanent casing and/or coatings						
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Type and description of the permanent casing method and/or coating to be used**	**Purpose of the permanent casing or coating**	**Length of pile to be sleeved or coated**	**Preparatory pre-boring or other work necessary for application of the method**
(a)	(b)	(c)	(d)	(e)	(f)	(g)

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter text, to identify the type and description of the permanent casing method and/or coating to be used [ICE SPERW B18.2 (a)].

e) Enter text, to identify the purpose of the permanent casing or coating [ICE SPERW B18.2 (b)].

f) Enter text, to identify the length of pile to be sleeved or coated [ICE SPERW B18.2 (d)].

g) Enter text, to identify requirements for preparatory pre-boring or other work necessary for application of the method [ICE SPERW B18.2 (e)].

ICE SPERW section B18.2 project specification requirements for piles with permanent casing and/or coatings (continued)					
Structure	**Depth, diameter and means of ensuring temporary stability of pre-boring**	**Designated manufacturer's name and details where a proprietary product is used**	**Filling of annulus surrounding the permanent casing**	**Details of pile testing or trial piles**	**Inspection, exposure or extraction of piles**
(a)	(h)	(i)	(j)	(k)	(l)

h) Enter text, to identify requirements for the depth, diameter and means of ensuring temporary stability of pre-boring [ICE SPERW B18.2 (f)].

i) Enter text, to identify the designated manufacturer’s name and details where a proprietary product is used [ICE SPERW B18.2 (g)].

j) Enter text, to identify requirements on whether any annulus surrounding the permanent casing is to be filled with grout or other suitable self-hardening fluid [ICE SPERW B18.2 (h)].

k) Enter text, to identify details of any pile testing or trial piles required to demonstrate the effectiveness of the method [ICE SPERW B18.2 (i)].

l) Enter text, to identify requirements for inspection, exposure or extraction of piles.

ICE SPERW section B18.2 project specification requirements for piles with permanent casing and/or coatings (continued)	
Structure	**Other particular technical requirements**
(a)	(m)

m) Enter text, to identify other particular technical requirements [ICE SPERW B18.2 (j)].

ICE SPERW additions for piles with permanent casing and/or coatings

Bituminous or other coating materials [ICE SPERW B18.3]

18.8 The following Documentation shall be submitted for bituminous or other coating materials to be used on the piles prior to the commencement of installation of the piles and bituminous or other coatings: Method of installation for bituminous or other coating materials.

18.9 The requirements for "Documentation" in Section 2 of GC 101 [Ref 13.N] shall apply to Method of installation for bituminous or other coatings.

18.10 Where damage to the coating is found to have occurred during partial exposure or extraction of the piles, a method statement shall be submitted for the repair or replacement of the coating prior to carrying out the work.

19. Instrumentation for piles and embedded retaining walls

19.1 Instrumentation to monitor the behaviour of piles and embedded retaining walls shall be in accordance with ICE SPERW [Ref 17.N]section B19.

Verification requirements for instrumentation installation and monitoring for piles and embedded retaining walls

19.2 Verification shall be undertaken for installation and monitoring for instrumentation for piles and embedded retaining walls in accordance with ICE SPERW [Ref 17.N]section B19 and table B1.1c.

19.3 The frequency of verification shall be in accordance with ICE SPERW [Ref 17.N]section B19 and table B1.1c.

19.4 The requirements for "Verification" in Section 14 of GC 101 [Ref 13.N] shall apply to the verification undertaken for installation and monitoring for instrumentation for piles and embedded retaining walls.

Documentation requirements for instrumentation installation and monitoring for piles and embedded retaining walls

19.5 The following Documentation for installation and monitoring for instrumentation for piles and embedded retaining walls shall be submitted as continuous records: Piles and embedded retaining walls instrumentation installation, monitoring and reporting records in accordance with ICE SPERW [Ref 17.N]section B19 and tableB1.1c.

19.6 The requirements of "Records" in Section 3 of GC 101 [Ref 13.N] shall apply to Piles and embedded retaining walls instrumentation installation, monitoring and reporting records.

Works specific requirements for instrumentation for piles and embedded retaining walls

19.7 The Contractor shall be responsible for the instrumentation including installation, calibration, monitoring and interpretation of results, unless otherwise stated in CC 602/WSR/019.

19.8 ICE SPERW section B19.2 project specification requirements for instrumentation for piles and embedded retaining walls shall be as specified in CC 602/WSR/019.

ICE SPERW section B19.2 project specification requirements for instrumentation for piles and embedded retaining walls						
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Aims and objectives of the instrumentation**	**Trigger values of measured parameters that require immediate special attention**	**Reporting of trigger values that require immediate special attention**	**Type of instrumentation**
(a)	(b)	(c)	(d)	(e)	(f)	(g)

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter text, to identify the aims and objectives of the instrumentation [ICE SPERW B19.2 (a)].

e) Enter text, to identify the trigger values of measured parameters that require immediate special attention [ICE SPERW B19.2 (b)].

f) Enter text, to identify to whom the trigger values that require immediate special attention shall be reported to [ICE SPERW B19.2 (b)].

g) Enter text, to identify the type of instrumentation required [ICE SPERW B19.2 (c)].

ICE SPERW section B19.2 project specification requirements for instrumentation for piles and embedded retaining walls (continued)						
Structure	**Depth or location within the pile or wall where the instrumentation is to be installed**	**Time at which the base readings shall be taken**	**Time schedule for readings over the duration of the project**	**Maximum time between taking the readings and reporting**	**Load, pressure, displacement or strain range for which results are required, including resolution**	**Type of loading**
(a)	(h)	(i)	(j)	(k)	(l)	(m)

h) Enter text, to identify requirements for the depth or location within the pile or wall where the instrumentation is to be installed [ICE SPERW B19.2 (e)].

i) Enter text, to identify the time at which the base readings shall be taken [ICE SPERW B19.2 (f)].

j) Enter text, to identify the time schedule for readings over the duration of the project [ICE SPERW B19.2 (g)].

k) Enter a number in units of d, to identify requirements for the maximum time between taking the readings and reporting [ICE SPERW B19.2 (h)].

l) Enter text, to identify requirements for load, pressure, displacement or strain range for which results are required, including resolution [ICE SPERW B19.2 (i)].

m) Enter a value, from options tensile, compressive, to identify the type of loading required [ICE SPERW B19.2 (j)].

ICE SPERW section B19.2 project specification requirements for instrumentation for piles and embedded retaining walls (continued)						
Structure	**Type of output**	**Type of monitoring equipment**	**Reading of results**	**Instrumentation monitoring equipment becomes property of employer**	**Surveying of the pile or element head terminal**	**Responsibility for instrumentation**
(a)	(n)	(o)	(p)	(q)	(r)	(s)

ICE SPERW section B19.2 project specification requirements for instrumentation for piles and embedded retaining walls (continued)						
Structure	**Type of output**	**Type of monitoring equipment**	**Reading of results**	**Instrumentation monitoring equipment becomes property of employer**	**Surveying of the pile or element head terminal**	**Responsibility for instrumentation**

n) Enter text, to identify the type of output required [ICE SPERW B19.2 (k)].

o) Enter a value, from options manual, automatic, to identify the type of monitoring equipment required [ICE SPERW B19.2 (l)].

p) Enter a value, from options remote, direct, to identify the type of reading of the results required [ICE SPERW B19.2 (m)].

q) Enter a value, from options yes, no, to identify whether the instrumentation monitoring equipment will become the property of the employer [ICE SPERW B19.2 (n)].

r) Enter text, to identify requirements for surveying of the pile or element head terminal, to what grid and datum, and frequency of surveying [ICE SPERW B19.2 (o)].

s) Enter text, to identify who is responsible for instrumentation including installation, calibration, monitoring and interpretation of results if different from the Contractor [ICE SPERW B19.2 (p)].

ICE SPERW section B19.2 project specification requirements for instrumentation for piles and embedded retaining walls (continued)	
Structure	**Other particular technical requirements**
(a)	(t)

t) Enter text, to identify other particular technical requirements [ICE SPERW B19.2 (q)].

19.9 ICE SPERW section B19.3.5.8 additional project specification requirements for fibre optic strain sensors shall be as specified in CC 602/WSR/019.

ICE SPERW section B19.3.5.8 additional project specification requirements for fibre optic strain sensors						
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Number and position of instrumented sections of the test element(s)**	**Rate of change of strain to be monitored**	**Required measurement spatial resolution**	**Required measurement sampling resolution**
(a)	(b)	(c)	(d)	(e)	(f)	(g)

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter text, to identify requirements for the number and position of instrumented sections of the test element(s).

e) Enter text, to identify requirements for the rate of change of strain to be monitored.

f) Enter text, to identify the required measurement spatial resolution.

g) Enter text, to identify the required measurement sampling resolution.

ICE SPERW amendments for instrumentation of piles and embedded retaining walls

Type of instrumentation - general [ICE SPERW B19.3.1.1]

19.10 The last sentence of the second paragraph of section B19.3.1.1 of ICE SPERW [Ref 17.N]'Checks should be carried out to verify the operational condition of the instruments after placing and concreting.' shall be replaced with as follows: Checks shall be carried out to verify the operational condition of the instruments after placing and concreting.

Type of instrumentation - magnetic extensometers [ICE SPERW B19.3.1.3]

19.11 The first sentence of the second bullet point of the second paragraph of section B19.3.1.3 of ICE SPERW [Ref 17.N]'reed switch mounted on a hand-held tape similar to that used for ground instrumentation.' shall be replaced with as follows: reed switch mounted on a cable and attached to a micrometer device at the head of the pile such that readings shall be established to an accuracy of better than 0.1 mm.

Type of instrumentation - general [ICE SPERW B19.3.2.1]

19.12 The last sentence of the second paragraph of section B19.3.2.1 of ICE SPERW [Ref 17.N]'The inclinometer access tube can then be installed afterwards using a cementitious grout containing a non-shrink additive, with a strength compatible with its surroundings.' shall be replaced with as follows: The inclinometer access tube shall then be installed afterwards using a cementitious grout containing a non-shrink additive, with a strength compatible with its surroundings.

Type of instrumentation - torpedo type [B19.3.2.2]

19.13 The last sentence of the first paragraph of section B19.3.2.2 of ICE SPERW [Ref 17.N]'The cable should be of an appropriate length with markings at 0.5 m intervals.' shall be replaced with as follows: The cable shall have markings at 0.5 m intervals.

19.14 The seventh paragraph of section B19.3.2.2 of ICE SPERW [Ref 17.N]'Items (c) and (e) should also be presented graphically to show the deviation or displacement plotted against depth and time.' shall be replaced with as follows: Items (c) and (e) shall also be presented graphically to show the deviation or displacement plotted against depth and time.

Type of instrumentation - load cells [ICE SPERW B19.3.3]

19.15 The first sentence of the third paragraph of section B19.3.3 of ICE SPERW [Ref 17.N]'As the cell will give a direct reading of load, it should be positioned so that all the load passes through it without any eccentricity or the possibility of arching that would reduce the recorded load on the cell.' shall be replaced with as follows: As the cell will give a direct reading of load, it shall be positioned so that all the load passes through it without any eccentricity or the possibility of arching that would reduce the recorded load on the cell.

Type of instrumentation - surface attached fibre optic strain sensors [ICE SPERW B19.3.5.7]

19.16 The third sentence of the second paragraph of section B19.3.5.7 of ICE SPERW [Ref 17.N]'The bonding method (e.g. glue) must be suitable for the element’s surface material and must ensure that the bond is

maintained throughout the monitoring period, such that the strain is fully transferred from the element surface to the fibre optic cable.' shall be replaced with as follows: The bonding method shall be suitable for the element’s surface material and ensure that the bond is maintained throughout the monitoring period, such that the strain is fully transferred from the element surface to the fibre optic cable.

19.17 The fourth sentence of the third paragraph of section B19.3.5.7 of ICE SPERW [Ref 17.N]'When compressive strain is to be measured with fibre optic sensors attached at intervals, the strain sensing cable must be pre-tensioned before attachment.' shall be replaced with as follows: When compressive strain is to be measured with fibre optic sensors attached at intervals, the strain sensing cable shall be pre-tensioned before attachment.

Type of instrumentation - specification requirements for fibre optic strain sensors [ICE SPERW B19.3.5.8]

19.18 The first paragraph of section B19.3.5.8 of ICE SPERW [Ref 17.N]'In addition to the items listed in section B19.2, where fibre optic sensors are needed the project specifications should include the following requirement, as applicable:' shall be replaced with as follows: In addition to the items listed in section B19.2, where fibre optic sensors are needed the project specifications shall include the following requirement, as applicable:.

Type of instrumentation - geodetic surveying [ICE SPERW B19.3.6.2]

19.19 The second sentence of the first paragraph of section B19.3.6.2 of ICE SPERW [Ref 17.N]'The spatial movement of the datums and the precision of the survey must be established and agreed before the project begins.' shall be replaced with as follows: The spatial movement of the datums and the precision of the survey shall be established and agreed before the project begins.

Monitoring - readings [ICE SPERW B19.5.2]

19.20 The second sentence of the first paragraph of section B19.5.2 of ICE SPERW [Ref 17.N]'The readings can be taken by a manual or automatic system but must be relayed to the contract administrator in the form required within the time required by the project specification.' shall be replaced with as follows: The readings can be taken by a manual or automatic system but shall be relayed to the overseeing organisation in the form required within the time required by the project specification.

Report [ICE SPERW B19.6]

19.21 The second sentence of point (i) of section B19.6 of ICE SPERW [Ref 17.N]'Key dates should be marked with a brief explanation of their significance.' shall be replaced with as follows: Key dates shall be marked with a brief explanation of their significance.

19.22 The second sentence of the last paragraph of section B19.6 of ICE SPERW [Ref 17.N]'Numbers should not be reported to a greater accuracy than is appropriate.' shall not be used.

19.23 The third sentence of the last paragraph of section B19.6 of ICE SPERW [Ref 17.N]'Graph axes should be linear and clearly labelled together with units.' shall be replaced with as follows: Graph axes shall be linear and clearly labelled together with units.

20. Support fluid for piles and embedded retaining walls

20.1 Support fluid for maintaining the stability of an excavation, including piles, barrettes or diaphragm wall panels, shall be in accordance with ICE SPERW [Ref 17.N]section B20.

Verification requirements for materials and installation for support fluid for piles and embedded retaining walls

20.2 Verification shall be undertaken for materials and installation for support fluid for piles and embedded retaining walls in accordance with ICE SPERW [Ref 17.N]section B20 and table B1.1c.

20.3 The frequency of verification shall be in accordance with ICE SPERW [Ref 17.N]section B20 and table B1.1c.

20.4 The requirements for "Verification" in Section 14 of GC 101 [Ref 13.N] shall apply to the verification undertaken for materials and installation for support fluid for piles and embedded retaining walls.

Documentation requirements for materials and installation for support fluid for piles and embedded retaining walls

20.5 The following Documentation for materials and installation for support fluids for piles and embedded retaining walls shall be submitted as continuous records: Piles and embedded retaining walls support fluid materials and installation records in accordance with ICE SPERW [Ref 17.N] section B20 and table B1.1c..

20.6 The requirements of "Records" in Section 3 of GC 101 [Ref 13.N] shall apply to Piles and embedded retaining walls support fluids materials and installation records.

Works specific requirements for support fluid for piles and embedded retaining walls

20.7 ICE SPERW section B20.2 project specification requirements for support fluid for piles and embedded retaining walls shall be as specified in CC 602/WSR/020.

ICE SPERW section B20.2 project specification requirements for support fluid for piles and embedded retaining walls						
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Minimum material testing requirements and schedule of testing of support fluid**	**Environmental restrictions on the use of support fluid**	**Minimum material testing requirements and schedule of testing of support fluid mix water**	**Submission of testing records**
(a)	(b)	(c)	(d)	(e)	(f)	(g)

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter text, to identify the minimum material testing requirements and schedule of testing of support fluid [ICE SPERW B20.2 (a)].

e) Enter text, to identify environmental restrictions on the use of support fluid [ICE SPERW B20.2 (b)].

f) Enter text, to identify the minimum material testing requirements and schedule of testing of support fluid mix water [ICE SPERW B20.2 (c)].

g) Enter text, to identify requirements for the submission of testing records [ICE SPERW B20.2 (d)].

ICE SPERW section B20.2 project specification requirements for support fluid for piles and embedded retaining walls (continued)	
Structure	**Other particular technical requirements**
(a)	(h)

h) Enter text, to identify other particular technical requirements [ICE SPERW B20.2 (e)].

ICE SPERW amendments for support fluid for piles and embedded retaining walls

General [ICE SPERW B20.1]

20.8 The first sentence of the second bullet point of section B20.1 of ICE SPERW [Ref 17.N]'during excavation and prior to concreting a thick filter cake layer (see section C20) shall not be allowed to form which could affect shaft friction and/or concrete cover.' shall be replaced with as follows: 'during excavation and prior to concreting a filter cake layer shall not be allowed to form which could affect shaft friction and/or concrete cover'.

20.9 The third paragraph of section B20.1 of ICE SPERW [Ref 17.N]'Details of the type of support fluid, manufacturer’s instructions and certificates for the constituents and mix proportions, including all additives, shall be submitted by the contractor at the time of tender.' shall be replaced with as follows: Details of the type of support fluid, manufacturer’s instructions and certificates for the constituents and mix proportions,including all additives, shall be submitted by the contractor at least four working weeks prior to commencement of the piling works.

Evidence of suitability of support fluid [ICE SPERW B20.3]

20.10 Item (c) of section B20.3 of ICE SPERW [Ref 17.N]'details of the tests to be used for monitoring the support fluid during the works and the compliance values for these tests, presented in the form of Table C20.1 or C20.2, or similar.' shall be replaced with as follows: details of the tests to be used for monitoring the support fluid during the works and the compliance values for these tests, presented in tabular form.

Materials - water [ICE SPERW B20.4.1]

20.11 The final sentence of the first paragraph of section B20.4.1 of ICE SPERW [Ref 17.N]'Some guidance on acceptable mix waters for bentonite hydration is given in the Specification for the construction of slurry trench cut-off walls as barriers to pollution migration (Thomas Telford).' shall not be used.

Compliance testing of support fluid [ICE SPERW B20.6]

20.12 The third sentence of the sixth footnote of table B20.1 of ICE SPERW [Ref 17.N]'Measurement accuracy must be to 0.005 g/ml.' shall be replaced with as follows: Measurement accuracy shall be to 0.005 g/ml.

20.13 The last footnote of table B20.1 of ICE SPERW [Ref 17.N]'See section C for recommended control values.' shall not be used.

21. General requirements for concrete, mortar, structural grout and steel reinforcement for piles and embedded retaining walls

21.1 General requirements for concrete, mortar, structural grout and steel reinforcement for piles and embedded retaining walls shall be in accordance with ICE SPERW [Ref 17.N]section B21.

21.2 Requirements for structural concrete for piles and embedded retaining walls for aspects not covered in the ICE SPERW [Ref 17.N]as amended and complemented by this document shall be in accordance with the following parts of CC 482 [Ref 19.N].

1. Execution management of structural concrete;
2. Falsework and formwork for structural concrete;
3. Steel reinforcement for structural concrete;
4. Prestressing of structural concrete;
5. Aggregates for structural concrete;
6. Admixtures for structural concrete;
7. Production and conformity requirements for structural concrete;
8. Additional product requirements for self-compacting concrete for structural concrete;
9. Placing of fresh concrete for structural concrete
10. Additional requirements for placing of self-compacting concrete for structural concrete
11. Precast structural concrete

Verification requirements for materials and installation for concrete, mortar, structural grout and steel reinforcement for piles and embedded retaining walls

21.3 Verification shall be undertaken for materials and installation for concrete, mortar, structural grout and steel reinforcement for piles and embedded retaining walls in accordance with ICE SPERW [Ref 17.N]section B21 and table B1.1c.

21.4 The frequency of verification shall be in accordance with ICE SPERW [Ref 17.N]section B21 and table B1.1c.

21.5 The requirements for "Verification" in Section 14 of GC 101 [Ref 13.N] shall apply to the verification undertaken for materials and installation for concrete, mortar, structural grout and steel reinforcement for piles and embedded retaining walls.

Documentation requirements for materials and installation for concrete, mortar, structural grout and steel reinforcement for piles and embedded retaining walls

21.6 The following Documentation for materials and installation for concrete, mortar, structural grout and steel reinforcement for piles and embedded retaining walls shall be submitted as continuous records: materials and installation records for concrete, mortar, structural grout and steel reinforcement for piles and embedded retaining walls in accordance with ICE SPERW [Ref 17.N] section B21 and table B1.1c.

21.7 The requirements of "Records" in Section 3 of GC 101 [Ref 13.N] shall apply to concrete, mortar, structural grout and steel reinforcement for piles and embedded retaining wall materials and installation records.

Works specific requirements for concrete, mortar, structural grout and steel reinforcement for piles and embedded retaining walls

21.8 ICE SPERW section B21 project specification requirements for concrete, mortar, structural grout and steel reinforcement for piles and embedded retaining walls shall be as specified in CC 602/WSR/021.

ICE SPERW section B21 project specification requirements for concrete, mortar, structural grout and steel reinforcement for piles and embedded retaining walls						
Structure	**Drawing/ model number**	**Pile/ wall reference**	**Concrete designation**	**Strength class**	**Nominal cover to reinforcement**	**Exposure class**
(a)	(b)	(c)	(d)	(e)	(f)	(g)

a) Enter a unique reference.
b) Enter a unique reference.

c) Enter a unique reference.

d) Enter text, to identify the designation of the concrete mix.

e) Enter text, to identify the strength class of the concrete mix.

f) Enter a number in units of mm, to identify the nominal concrete cover to reinforcement.

g) Enter text, to identify the exposure class of the concrete mix.

ICE SPERW section B21 project specification requirements for concrete, mortar, structural grout and steel reinforcement for piles and embedded retaining walls (continued)						
Structure	**DC-class**	**Admixtures**	**Maximum water/cement ratio**	**Minimum cement content**	**Permitted cement and combination types**	**Nominal maximum size of aggregate**
(a)	(h)	(i)	(j)	(k)	(l)	(m)

h) Enter text, to identify the design chemical class of the concrete mix.

i) Enter text, to identify the admixtures required in the concrete mix.

j) Enter a number, to identify the maximum water/cement ratio of the concrete mix.

k) Enter a number in units of kg/m^3, to identify the minimum cement content of the concrete mix.

l) Enter text, to identify the permitted cement and combination types of the concrete mix.

m) Enter a number in units of mm, to identify the nominal maximum size of aggregate of the concrete mix.

ICE SPERW section B21 project specification requirements for concrete, mortar, structural grout and steel reinforcement for piles and embedded retaining walls (continued)					
Structure	**Chloride Class**	**Special requirements for cement or combination**	**Special requirements for aggregates**	**Special requirements for temperature of fresh concrete**	**Special requirements for strength development**
(a)	(n)	(o)	(p)	(q)	(r)

ICE SPERW section B21 project specification requirements for concrete, mortar, structural grout and steel reinforcement for piles and embedded retaining walls (continued)					
Structure	**Chloride Class**	**Special requirements for cement or combination**	**Special requirements for aggregates**	**Special requirements for temperature of fresh concrete**	**Special requirements for strength development**

n) Enter text, to identify the Chloride Class of the concrete mix according to BS 8500-1 [Ref 3.N] Table A.8.

o) Enter text, to identify special requirements for cement or combination.

p) Enter text, to identify special requirements for aggregates.

q) Enter text, to identify special requirements for the temperature of fresh concrete.

r) Enter text, to identify special requirements for strength development.

ICE SPERW section B21 project specification requirements for concrete, mortar, structural grout and steel reinforcement for piles and embedded retaining walls (continued)					
Structure	**Special requirements for heat development during hydration**	**Other special technical requirements**	**Additional requirements**	**Rate of sampling for strength testing**	**Target consistence and test method**
(a)	(s)	(t)	(u)	(v)	(w)

s) Enter text, to identify special requirements for heat development during hydration.

t) Enter text, to identify other special technical requirements.

u) Enter text, to identify additional requirements.

v) Enter text, to identify the rate of sampling for strength testing.

w) Enter text, to identify the target consistence and test method of the concrete mix.

ICE SPERW section B21 project specification requirements for concrete, mortar, structural grout and steel reinforcement for piles and embedded retaining walls (continued)					
Structure	**Tolerance on target consistence**	**Special requirements for consistence retention**	**Acceptance criteria for segregation resistance (test method and limit)**	**Acceptance limit for filtration resistance**	**Acceptance limit for bleeding and/or bleeding rate**
(a)	(x)	(y)	(z)	(aa)	(ab)

x) Enter text, to identify the tolerance on target consistence of the concrete mix.

y) Enter text, to identify special requirements for consistence retention.

z) Enter text, to identify acceptance criteria for segregation resistance of the concrete mix including the test method and limit.

aa) Enter text, to identify the acceptance limit for filtration resistance of the concrete mix.

bb) Enter text, to identify the acceptance limit for bleeding and/or bleeding rate of the concrete mix.

ICE SPERW section B21 project specification requirements for concrete, mortar, structural grout and steel reinforcement for piles and embedded retaining walls (continued)		
Structure	**Acceptance limit for L-box end time (T_{end}) and passing ability ratio**	**Method of placing concrete**
(a)	(ac)	(ad)

cc) Enter text, to identify the acceptance limit for L-box end time and passing ability ratio of the concrete mix.

dd) Enter text, to identify the method of concrete placing.

ICE SPERW amendments for concrete, mortar, structural grout and steel reinforcement of piles and embedded retaining walls

General [ICE SPERW B21.1]

21.9 The second paragraph of section B21.1 of ICE SPERW [Ref 17.N]'Steel reinforcement shall be in accordance with BS 4449 [Ref 18.N]. It shall be manufactured and supplied to a recognised third party product certification scheme meeting the requirements of clause 8.2 of BS 4449 [Ref 18.N], or shall be subject to acceptance testing on each batch in accordance with annex B of BS 4449 [Ref 18.N].' shall be replaced with as follows: Steel reinforcement shall be in accordance with BS 4449 [Ref 18.N]. It shall be manufactured and supplied to a recognised third party product certification scheme meeting the requirements of clause 8.2 of BS 4449 [Ref 18.N].

Testing concrete - sampling for compressive strength testing [ICE SPERW B21.8.3]

21.10 The first sentence of section B21.8.3 of ICE SPERW [Ref 17.N]'For each strength class or different composition of designed concrete, a minimum of four cubes shall be made from each sample.' shall be replaced with as follows: For each strength class or different composition of designed concrete, a minimum of five cubes shall be made from each sample.

Testing concrete - compressive strength testing [ICE SPERW B21.8.4]

21.11 The third sentence of section B21.8.4 of ICE SPERW [Ref 17.N]'One cube shall be tested at an age of seven days, two at 28 days, and one cube shall be held in reserve for further testing as required.' shall be replaced with as follows: One cube shall be tested at an age of seven days, two at 28 days, and two cubes shall be held in reserve for further testing as required.

Steel reinforcement - fabrication of reinforcement [ICE SPERW B21.9.3]

21.12 The first sentence of the second paragraph of section B21.9.3 of ICE SPERW [Ref 17.N]'Reinforcement in the form of a cage shall be assembled with additional support, such as spreader forks and lacings, necessary to form a cage which can be lifted and placed without permanent distortion.' shall be replaced with as follows: Reinforcement in the form of a cage shall be assembled with additional support, such as spreader forks and lacings, necessary to form a cage which shall be lifted and placed without permanent distortion.

Structural grout and mortar - transporting [ICE SPERW B21.10.4]

21.13 Section B21.10.4 of ICE SPERW [Ref 17.N] shall be replaced with as follows: Mortar or grout, including grout for use in post-tensioned structures, shall be transported from the mixer to the position of the pile in such a manner that segregation does not occur.

ICE SPERW additions for concrete, mortar, structural grout and steel reinforcement of piles and embedded retaining walls

Concrete [ICE SPERW B21.2 to B21.8]

21.14 Specification, performance, production and conformity of structural concrete for piles and embedded retaining walls shall be in accordance with BS EN 206 [Ref 2.N], BS 8500-1 [Ref 3.N]and BS 8500-2 [Ref 4.N], as amended and complemented by this document.

21.15 Structural concrete in piles and embedded retaining walls shall be executed in accordance with BS EN 13670 [Ref 12.N]to execution class 3.

21.16 The maximum cement content of structural concrete for piles and embedded retaining walls shall not exceed 550 kg/m^3, unless otherwise stated in CC 602/WSR/021.

21.17 The mix proportions and grading of the constituent materials for structural concrete for piles and embedded retaining walls during production control shall be maintained constant for each concrete mix, with changes in quantities of constituent materials no more than allowed by Table A.1 of BS 8500-2 [Ref 4.N], when batching less than 1m^3 of concrete, or by Table 27 of BS EN 206 [Ref 2.N], when batching 1m^3 of concrete or more.

21.18 Preparation of a construction joint in structural concrete shall ensure that the outer skin of the concrete is removed and the larger aggregate is exposed, without damage to the hardened concrete substrate.

21.19 Preparation of a construction joint in structural concrete for piles and embedded retaining walls shall provide a rough surface in accordance with Section 6.2.5 of BS EN 1992-1-1 [Ref 8.N].

21.20 Stresses induced by handling of precast concrete elements in piles and embedded retaining walls, including those from support, restraint, lifting and transport, shall not cause damage to the precast elements.

Steel reinforcement [ICE SPERW B21.9]

21.21 When a reinforcing bar in a structural part of a pile or embedded retaining wall is welded, welding shall comply with clause 3.2.5 of BS EN 1992-1-1 [Ref 8.N].

21.22 Welding of reinforcing bars shall be undertaken in accordance with BS EN ISO 17660-1 [Ref 25.N].

21.23 Where welding of reinforcing bars is undertaken, the adequacy of the welded geometry under fatigue loading shall be demonstrated by calculation in accordance with clause 6.8.4 of BS EN 1992-1-1 [Ref 8.N].

21.24 In fatigue calculations for welded reinforcing bars, the effect of the weld on the fatigue resistance of the reinforcing bars shall be considered.

Post-tensioned piles

21.25 Contrary to the requirements of CC 482 [Ref 19.N], corrugated plastic ducts used for internal bonded tendons in piles and embedded retaining walls shall not be required to be compliant with fib bulletin 75 (FIB Bulletin 75 [Ref 1.N]) and EAD 160004-00-0301 [Ref 16.N].

21.26 Contrary to the requirements of CC 482 [Ref 19.N], the maximum vent spacing along ducts in post-tensioned prestressed piles and prestressed embedded retaining walls shall not be required to be 15 m.

21.27 Contrary to the requirements of CC 482 [Ref 19.N], the minimum height of vents above the highest point of the duct profile in post-tensioned prestressed piles and prestressed embedded retaining walls shall not be required to be 500 mm.

21.28 Contrary to the requirements of CC 482 [Ref 19.N], verification for leak tightness of the assembled duct system by pressure testing shall not be required in prestressed piles and prestressed embedded retaining walls, unless otherwise stated in CC 602/WSR/021.

SI.21.28 Where required, verification for leak tightness of the assembled duct system for prestressed piles and prestressed embedded retaining walls shall be [enter free text].

22. Normative references

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

Ref.	Document
Ref 1.N	The International Federation for Structural Concrete (FIB). FIB Bulletin 75, 'Bulletin 75: Polymer-duct systems for internal bonded post-tensioning'
Ref 2.N	BSI. BS EN 206, 'Concrete - specification, performance, production and conformity'
Ref 3.N	BSI. BS 8500-1, 'Concrete. Complementary British Standard to BS EN 206. Method of specifying and guidance for the specifier.'
Ref 4.N	BSI. BS 8500-2, 'Concrete. Complementary British Standard to BS EN 206. Specification for constituent materials and concrete.'
Ref 5.N	National Highways. CC 601, 'Earthworks'
Ref 6.N	BSI. BS EN 1991-1, 'Eurocode 1- Actions on Structures'
Ref 7.N	BSI. BS EN 1992, 'Eurocode 2. Design of concrete structures'
Ref 8.N	BSI. BS EN 1992-1-1, 'Eurocode 2: Design of concrete structures. General rules and rules for buildings'
Ref 9.N	BSI. BS EN 1997, 'Eurocode 7. Geotechnical Design.'
Ref 10.N	BSI. BS EN 1990, 'Eurocode: Basis of structural design'
Ref 11.N	BSI. BS EN 1993 , 'Eurocode 3: Design of steel structures'
Ref 12.N	BSI. BS EN 13670, 'Execution of concrete structures'
Ref 13.N	National Highways. GC 101, 'General requirements for the Specification for Highway Works'
Ref 14.N	National Highways. CD 622, 'Managing geotechnical risk'
Ref 15.N	TAGG. Highways England. GC XXX [Do Not Use], 'MCHW Series 100 replacement document (TBC)'
Ref 16.N	EOTA. EAD 160004-00-0301, 'Post-tensioning kits for prestressing of structures [EAD & UKAD]'
Ref 17.N	Institution of Civil Engineers. ICE SPERW, 'Specification for Piling and Embedded Retaining Walls (Third Edition)'

Ref 18.N	BSI. BS 4449, 'Steel for the reinforcement of concrete. Weldable reinforcing steel. Bar, coil and decoiled product. Specification'
Ref 19.N	National Highways. CC 482, 'Structural concrete'
Ref 20.N	BSI. NA to BS EN 1990, 'UK National Annex for Eurocode: Basis of structural design'
Ref 21.N	BSI. NA to BS EN 1991, 'UK National Annex for Eurocode 1: Actions on structures'
Ref 22.N	BSI. NA to BS EN 1992 , 'UK National Annex for Eurocode 2: Design of concrete structures'
Ref 23.N	BSI. NA to BS EN 1993 , 'UK National Annex for Eurocode 3: Design of steel structures'
Ref 24.N	BSI. NA to BS EN 1997 , 'UK National Annex for Eurocode 7: Geotechnical design'
Ref 25.N	BSI. BS EN ISO 17660-1, 'Welding. Welding of reinforcing steel. Load-bearing welded joints'