THE BRITISH MUSEUM

World Conservation and Exhibition Centre

Specification for Piling and Embedded Retaining Walls

(BIW Document Reference: RUK-20-SP-4877-SPERW)

September 2010

project no. 4877

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Revision History

Rev	Date	Purpose/Status	Document Ref.	Comments
P01	Aug 2010	Draft	RUK-20-SP-4877 SPERW P01	Issued for design team comment and co-ordination
P02	Sep 2010	Draft	RUK-20-SP-4877 SPERW P02	Issued for design team comment and co-ordination
T01	Sep 2010	Tender	RUK-20-SP-4877 SPERW T01	Issued for tender

Prepared by:	Reviewed by:	Approved by:
Vicky Potts/Tim Butler	**Tim Hartlib**	**Dr Mohsen Vaziri**
Geotechnical Engineer	Associate	Director

SECTION A – GENERAL REQUIREMENTS

Specification

The Specification shall be the 'ICE Specification for piling and embedded retaining walls' Second edition published by Thomas Telford Services Ltd in 2007 (SPERW) with information, amendments and particular requirements set out in this document. In the event of a conflict of requirements, this document shall take precedence.

Specification Amendments

Page 33, Table B1.4, Column 4, Row 3 – delete "75mm + 13.3mm for every 1m below cut-off level" insert "25mm + 13.3mm for every 1m below cut-off level"

Page 41, Clause B1.14.1, Para 2, Line 2 – delete "blows/25mm" insert "blows/250mm"

Page 42, Clause B1.14.3, Para 7, Line 3 – delete "250 mm" insert "25 mm"

A6 Tender Evaluation

Prior to the submission of his tender the contractor shall visit the site to examine the conditions present including the apparent ground conditions, relationship of existing buildings on and adjacent to the site, the site boundaries, means of access and accommodation required. On submission of his tender the Contractor shall be deemed to have visited the site and considered the above conditions in relation to risks, contingencies and all other circumstances influencing or affecting his tender.

A6.1 Appointment of a Geotechnical Advisor

The Geotechnical Advisor for this project is Mohsen Vaziri CEng MICE of Ramboll UK.

The Geotechnical Advisor shall be consulted during tender evaluation.

The Contractor shall appoint an individual as Geotechnical Specialist for this project. The Contractor's Geotechnical Specialist shall represent the Contractor in technical discussions with the Engineer.

The Contractor's Geotechnical Specialist shall have the same expertise as a Geotechnical Advisor as defined by the ICE Site Investigation Steering Group.

The Contractor's Geotechnical Specialist shall be named and curricula vitae submitted with the tender.

SECTION B – PARTICULAR SPECIFICATION REQUIREMENTS

B1 Specification Requirements for Piling and Embedded Retaining Walls

B1.2 Project Specification

This specification is to be read in conjunction with the Institution of Civil Engineers' "ICE Specification for Piling and Embedded Retaining Walls" Second Edition (SPERW).

The contractor shall ensure that a copy of SPERW is available at all times during the course of the works.

B1.2a Role of the Engineer

As stated in the contract documents. The client shall ensure full compliance with this specification.

B1.2b Location and description of the site

The site is located in London, National Grid Reference TQ 299 817.

The existing buildings on site are currently used as stores, workshops and offices. The site and immediate surroundings on the estate comprise the following key buildings:

- Montague Place to the north
- King Edward Building to the north-east.
- Wellcome Gallery to the east.
- Smirke building to the south-east.
- Duveen Gallery to the south.
- A garden wall to the west which separates the British Museum estate from the adjacent residential properties on Bedford Square to the west.
- Stonemasons, Locksmiths, Stores, and Bindery on site (to be demolished).
- 4 storey terraced property on Montague Place (to be demolished).
- EDF Energy substation (to be demolished).

B1.2c Nature of the Works

The proposed scheme involves the demolition of existing buildings, followed by the construction of four steel frame pavilions containing four floors with a common three storey

basement, with a localised deepening to four storeys to form a truck lift in the western corner. The new development will be supported by piles and secant pile walls. The majority of bearing piles will be inside the three storey basement excavation, with a small number of piles to the south-west where the cut-off level will be at existing ground level.

The presence of a large exhibition space on Level 02 with no internal columns results in significant building loads being transferred to the secant pile walls. The structure and substructure below Level 02 are transferred to foundation level via columns.

The design life of the new structure and substructure is 75 years.

All adjacent buildings, most of which are the British Museum galleries, have an allowable damage category of zero (with respect to the classification system proposed by Boscardin & Cording, 1989) and have strict vibration restrictions. Refer to Bickerdike Allen Partners information for piling vibration limits.

The geology of the site comprises Made Ground, River Terrace Deposits, London Clay, Lambeth Group, Thanet Sands and Chalk.

Existing masonry walls and foundations, potentially under heritage protection, are present on site. Probing will be required as part of the piling works to identify and clear obstructions at pile locations.

All piling is to be undertaken from high level prior to excavation of the basement, however it is envisaged that the secant wall will be constructed first.

Contractor designs that meet the required performance criteria given in this specification may be considered.

B1.2d Working area

Refer to contract drawings.

B1.2e Sequence of the Works and other works proceeding at the same time

The anticipated sequence of works for piling inside the excavation zone is:

1 – Demolition of existing structures

2 – Probing at pile locations and clearance of obstructions

3 – Construction of piling mat

4 – Piling from ground level, granular filled bores between ground and formation level.

5 – Excavation to formation level, including any breaking down of piles above formation level

6 – Construction of basement structure including pile caps and suspended slabs.

The anticipated sequence of works for piling outside the excavation zone is:

1 – Demolition of existing structures

2 – Probing at pile locations and clearance of obstructions

3 – Construction of piling mat

4 – Piling from ground level

5 – Construction of pile caps and ground slab.

The anticipated sequence of works for the secant pile walls are:

1 – Demolition of existing structures

2 – Probing at pile locations and clearance of obstructions

3 - Underpinning/support of adjacent structures

4 – Construction of piling mat

5 – Piling from ground level

6 – Construction of capping beam

7 – Excavation to temporary prop level

8 – Installation of temporary props

9 – Excavation to foundation level, repeating 6 and 7 as necessary

10 – Construction of basement structure bottom-up

11 – Removal of temporary props once permanent slabs have been installed.

It is anticipated that pile probing is to be carried out by others before the Works commence.

Other activities may be being carried out on site concurrently with these works, refer to Main Contractor.

B1.2f Contract Drawings

The Piling General Arrangement is drawing RUK-20-DR-4877/S/101, and can be found in the drawings section of this Project Specification.

B1.2g Office and other facilities for the Engineer

As stated in the contract documents.

B1.2h Submission of information (in addition to Table B1.1)

The information which shall be submitted at the stated stages of the Works Contract is listed in Table B1.1 of the Piling Specification.

In addition, the Tenderer shall submit the following details with his tender:

- Proposed design methodology. Where standards allow different options for design the Tenderer shall provide details of which options will be followed
- Experience report or project sheets detailing other relevant projects that the Tenderer has carried out on other jobs with similar geology and site constraints
- CV of Geotechnical Specialist
- Initial proposals for reducing noise and vibration from different works operations and the effect of distance on attenuation
- Initial proposals for monitoring noise, vibration and ground movements
- Method of penetrating obstructions presented by former foundations or other man-made detritus left in the ground
- Methods for locating and avoiding critical services
- Methods of controlling piling operations to ensure compliance with design including setting out
- Details of how specified tolerances will be achieved including any special plant / monitoring equipment / methodology that will be used
- Details of the method of transporting and placing concrete in piles
- Details of size and weight of plant to be used
- Information for pile mat design
- Details of how the casting level tolerance will be achieved
- Method of stabilising excavations in event of delay in concreting
- Proposals for protection of adjacent facades

- Proposals for working close to existing facades
- Confirmation that the installation of piles will not damage adjacent structures/services
- Typical pile installation record sheets for each pile
- Details of equipment including vibration records
- Programme showing sequence and resources
- Confirmation that load settlement behaviour of piles will be as or better that required in tables B1.2 and B1.3
- Proposed design parameters suitable for method of installation
- Assessment of any need for pile testing to comply with the design
- Methodology for breaking down piles
- Conformation that the proposed working area is suitable
- Any other additional information

B1.2i Responsibility for design, including any division of this responsibility

The Contractor is to design and construct the piles in accordance with SPERW, clause B1.4 Option 2 based on information provided by the Engineer. The Contractor is to confirm acceptance of the site investigation as adequate or propose further investigation as considered necessary.

Design Responsibility	Engineer	Contractor
Scheme design of foundation	**X**	
Choice of piling method	**X**	
Design of piles to carry specified loadings		**X**

The Contractor is to design and construct the wall elements in accordance with SPERW, clause B1.4 Option 3 based on information provided by the Engineer. The Contractor is to confirm acceptance of the site investigation as adequate or propose further investigation as considered necessary.

Given the sensitivity of the adjacent structures, the Contractor's design must be approved by the Engineer. Responsibility for the wall's performance however remains with the Contractor, as detailed in the responsibility matrix overleaf.

Design Responsibility	Engineer	Contractor
Scheme design of retaining wall	**X**	
Choice of walling method	**X**	
Calculation of load on wall	**X** (1)	**X**
Design of wall elements to carry Specified loadings		**X**
Interaction between wall and other foundations		**X**

(1) The Engineer will provide vertical building load adjacent to wall only

The wall manual shall be provided with the tender. The Wall Manual shall follow the format detailed in Appendix C.

In addition to SPERW Clause B1.4.1 the Wall Manual shall include:

- Full design information and predicted deflections
- A statement that no damage is to be caused to neighbouring structures or services. If the Contractor is of the opinion that by any means arising from the Works neighbouring property may be damaged this shall be stated in his tender and the extent and nature of the necessary protective or other temporary works described therein.

B1.2l Working platform and commencing surface level

Working platform expected to be approximately +21.7mOD. Localised build up may be required. Working platform and commencing surface is to be confirmed by Contractor.

B1.2m A schedule of Specified working loads or Representative actions

Refer to the pile load schedule RUK-20-DR-4877/G/200.

B1.2n Pile or wall element dimensions

Refer to drawing Pile General Arrangement 4877/S/101. Hard/firm secant pile walls consist of 900mm male piles and 600mm female piles, with the male piles at 1200mm centre to centre spacing.

Bearing piles are generally 600mm in diameter but may be 900mm piles in some cases.

B1.2o Preliminary piles and trial bores/drives/panels

To be determined by Contractor.

B1.2p Performance criteria for the structure to be supported on the piles or by the wall

Maximum differential settlement between adjacent columns should not exceed a gradient of 1 in 1000.

1.2q Performance criteria for piles under test or wall elements during service

Performance specification criteria for piles under test:

- Pile ref.: TBA.
- Permitted types(s) – Bored cast-in-place
- Specified working load SWL (kN): Refer to load schedule
- Pile designation: TBA.
- Minimum factor of safety: 2.0 for permanent loads, subject to preliminary pile testing being undertaken (refer to Section B15).
- Design Verification Load DVL (kN): TBA.
- Permitted settlement at DVL (mm): 1% of diameter.
- Permitted Settlement at DVL + 1/2 SWL (mm): 2% of diameter.
- Minimum pile length from cut-off level to toe (m): TBA.
- Minimum or maximum pile diameter or dimensions of cross-section (mm): min 600mm, max 900mm.

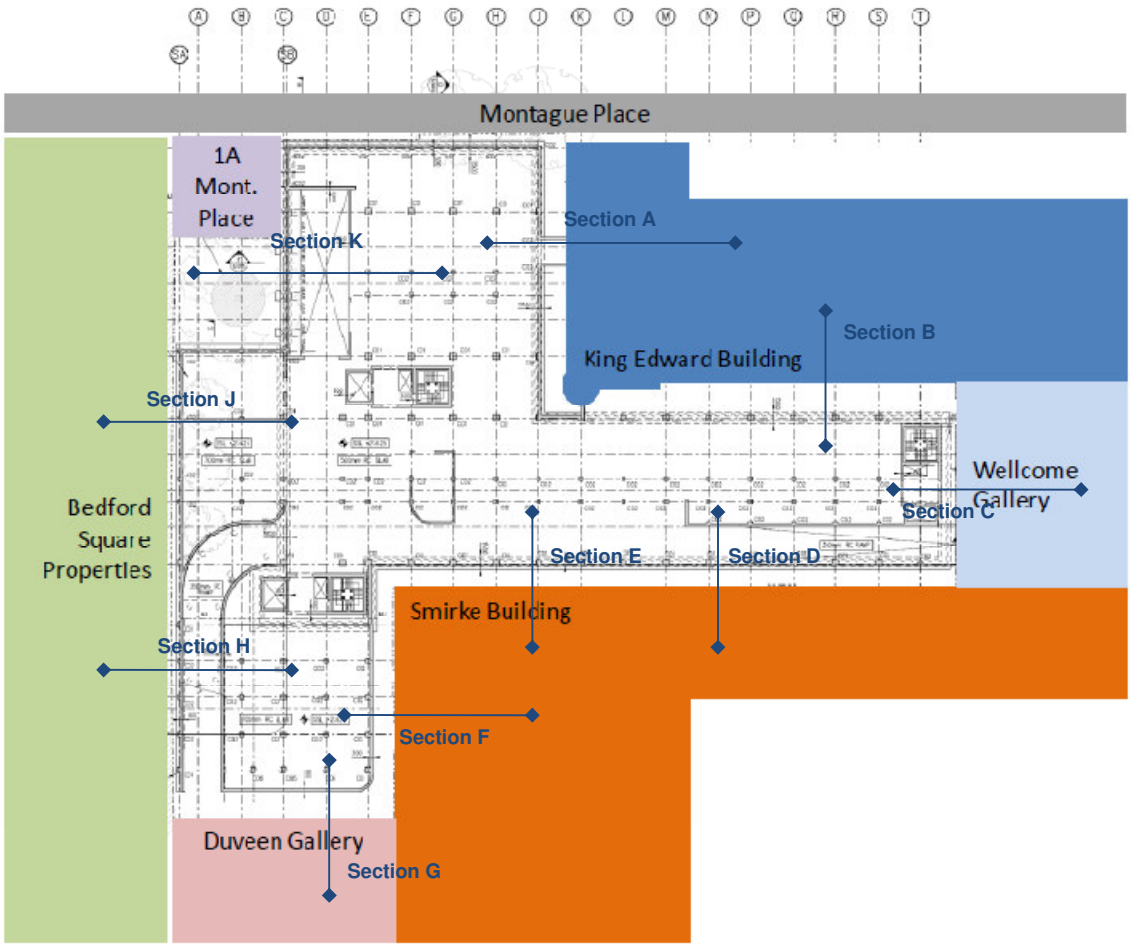
<u>Performance specification criteria for wall elements during service:</u>

- Wall ref.: TBA.
- Permitted types(s) - Secant pile wall.
- Maximum excavation level: Varies – refer to drawings??
- Loads on wall: Refer to load schedule
- Temporary propping details: To be determined by Contractor.
- Permanent propping details: TBA.
- Construction sequence: Refer to Clause B1.2e.
- Constraints to the wall: To be confirmed by Contractor.

- Permitted maximum lateral wall deflection (mm):

Ref	Section	Prop Level	Maximum permitted wall deflection (mm)
A	KEB E-W	Ground Floor	8
		B1	13
		B2	20
B	KEB N-S	Ground Floor	12
		B1	19
		B2	24
C	Wellcome Gallery	Ground Floor	22
		B1	25
		B2	29
D	Smirke N-S Coal Store	Ground Floor	10
		B1	16
		B2	21
E	Smirke N-S	Ground Floor	26
		B1	30
		B2	32
F	Smirke E-W	Ground Floor	30
		B1	28
		B2	27
G	Duveen Gallery	Ground Floor	18
		B1	25
		B2	29
H	Bedford Square Properties S	Ground Floor	3
		B1	14
		B2	17
J	Bedford Square Properties N	Ground Floor	21
		B1	24
		B2	26
K	1A Montague Place	Ground Floor	14
		B1	20
		B2	26
		B3	24

Note: To be read in conjunction with sections plan overleaf



Locations of adjacent buildings and sections for deflection limits

- Permitted lateral deflection of capping beam following construction (mm): 10mm.
- Watertightness criteria/minimum depth below excavation: Continuous male/female interlock 1m below excavation.
- Minimum or maximum pile diameter or dimensions of cross-section (mm): 900mm male piles 600mm female piles.

B1.2r Sampling and testing of materials (other than concrete)

Reference section B19 of the Piling Specification.

B1.2s Permissible damage criteria for existing critical structures or services

No damage is to be caused to neighbouring structures or services. If the Contractor is of the opinion that by any means arising from the Works neighbouring property may be damaged the Engineer shall be informed and the extent and nature of the necessary protective or other temporary works described therein.

The Contractor shall be responsible for rectifying any damage to existing structures or services.

Adjacent structures are sensitive to vibration and so measures to mitigate vibration should be adopted.

B1.2t Additional temporary works plant and duration of loading for which the working platform should be designed

The working platform shall be designed for loadings from piling plant as supplied by the Contractor for the duration of the Works.

The working platform is also to be designed for all handling cranes, mobile cranes and other ancillary plant for loadings supplied by the Contractor.

B1.2u Site datum and site grid

As stated in the contract document

B1.2v Restrictions on permissible working hours

As stated in the contract document

B1.2w Restrictions on noise and vibration levels

As stated in the contract document

B1.2x Site Investigation including geotechnical and geo-environmental information, and the need for further Site Investigation

A site investigation was carried out in May and June 2008 in relation to the proposed development works at British Museum by Soil Mechanics. Their report 'British Museum, North-West Development, London, WC1: Factual Report on Ground Investgation' is included in Appendix A.

Ramboll UK have produced a Geotechnical Interpretative Report that describes the ground conditions revealed and details suggested parameters for design. The Contractor shall satisfy themselves of suitability of parameters adopted for design. This report is attached in Appendix B.

No additional site investigation works are planned. The Contractor shall verify their acceptance of the available site investigation or shall submit their proposals for any additional site investigation. The cost of any additional investigation shall be the responsibility of the Contractor.

If ground conditions are encountered during the works which the Contractor considers more adverse than could have reasonably been foreseen at the tender stage, and these require a change of method of working or design, the Engineer shall be notified immediately and supplied with proposals for overcoming the adverse ground conditions.

B1.2y Disposal of excavated material and trimmed excess pile and wall material

Disposal of excavated material is the responsibility of the Contractor

Spoil generated from the site will require disposal in accordance with the Environmental Protection Act 1990, the Landfill (England and Wales) Regulations 2002, the Waste Management Licensing Regulations 1994 and any other relevant statutory guidance.

B1.2z Other particular technical requirements

Quality Management

The Contractor is required to work to a Quality Management system established in accordance with BS EN 9001:2000. Details shall be provided prior to commencement of the works on site.

The contractor shall comply with the EA guidelines on piling in contaminated land.

Piling in Clay

Where piling in clay, the Contactor shall design the piles for any potential heave and shall submit the design and programme assumptions to the Engineer for approval.

B1.2aa Special Requirements for Retaining Walls

The Contractor shall ensure that pile interlock is maintained to a level of at least 1m below basement formation level. Remedial works must be completed by Contractor if excavation reveals gaps between piles.

B1.2bb Loads on Walls and Excavation Depths

Loads on wall and excavation depths as defined in Clause B1.2q.

B1.2cc Water Retention Function and Degree of Retention for Retaining Wall in Both Temporary and Permanent Conditions

The role of the retaining wall is to prevent weeping of water through the wall in both the temporary and permanent case.

B1.2dd Design External Groundwater Level for the Water Retention System and for Water Tightness Inspections

Design external groundwater level at +20.3mOD.

B1.2ee Design Water Retention Grade for Permanent Overall System and the Role of the Retaining Wall as a System Component

Design water retention grade is 3.

Water retention system includes a secant pile wall, cement seal, cavity drain, damp proof course, unventilated cavity with weep holes at every female pile and 140mm blockwork wall.

The role of the retaining wall is to prevent weeping of water through the wall. Beading is not permitted. Damp patches, as defined by SPERW, on the front face are permitted providing the total area of dampness does not exceed 10% of the total area and no individual patch of dampness has an area in excess of 1m x 1m.

B1.2ff Programme For Watertightness Inspections

To be prepared by the Contractor and agreed by the Engineer and to cover both temporary and permanent cases. It is expected that the inspections are carried out at least following installation and removal of temporary props.

B1.2gg Permissible limits on Ground Movement during Wall Installation

The Piling Contractor shall ensure that there is no damage to existing nearby structures.

All services shall be maintained in a serviceable condition and measures shall be taken to ensure that piling operations and excavation works do not cause damage or disrupt their continued operation. Refer to clause B1.2s.

B1.8 Installation Tolerances

For bearing piles:

- Plan position at commencing level: 75mm.
- Maximum permitted deviation of the finished pile/wall element from the vertical at any time: 1 in 150.

For wall elements:

- Plan position at commencing level: 25mm.
- Maximum permitted deviation of the finished pile/wall element from the vertical at any time: 1 in 150.
- Maximum cumulative deviation: 100mm

B1.9 Waterproofing of Retaining Walls

Damp patches larger than 1m x 1m must be sealed.

B1.10 Obstructions

Pile probing is not envisaged as being necessary due to the reduced level dig.

B1.12 Records

The contractor shall submit a 'Completion Report' as specified in Clause B1.12.2.

B1.14.5 Pre-Boring or jetting or other means of easing pile driveability

Pre-boring is not allowed.

B1.17 Trimming and Cutting Off Piles and Wall Elements

Refer to contract drawings for pile cut-off levels.

Cutting down and disposal of cut-off pile heads is the responsibility of the Client

Piles shall be broken down using the Elliott method or equivalent.

Adequate reinforcement overlap shall be provided for structure to be connected to piles with full tension lap connection to BS8110 Table 3.27.

B2 Driven Pre-Cast Concrete Piles

Not Required

B3 Bored Cast-In-Place Piles

B3.2 Project Specification

B3.2a Support Fluid

The use of support fluid is permitted. Support fluid shall conform to section B18.

B3.2b Base or Shaft Grouting

Not permitted.

B3.2c Pile Shaft and Base Inspection by CCTV and or Sampling/Probing

The base and shaft of each pile shall be inspected in accordance with SPERW Clause B3.5.8.1.

If a support fluid is used pile bases shall be confirmed through base impact testing.

B3.2d Details of Permanent Casings

Permanent steel casing is not required.

B3.2e Inspection of Underreams

Not required.

B3.2f Other Particular Technical Requirements

Lightning protection and earthing connections to pile reinforcement will need to be made to several bored piles. Refer to Arup Services drawings, specifications and information for details.

B3.5.2.3 Placing Concrete in Dry Borings

Requirement additional to SPERW clause B3.5.2.3:

- Height of lower end of delivery tube above top of reinforcement cage (maximum): 10m

Free fall of concrete (maximum): 10m

B4 Piles Constructed Using Continuous Flight Augers (CFA) or Displacement Augers (DA)

Not required

B5 Driven Cast-in-place Piles

Not required

B6 Steel Bearing Piles

Not required.

B7 Timber Piles

Not required.

B8 Diaphragm Walls and Barrettes

Not required.

B9 Secant Pile Walls

B9.2 Project Specification

B9.2a Construction Tolerances

Reference Clause B1.8.

B9.2b Performance Criteria for Movement Under Vertical Loads

Reference Clause B1.2q.

B9.2c Support Fluid

Not permitted.

B9.2d Additional Overbreak Tolerances

None

B9.2e Requirements for Self-hardening slurry mixes

Requirement:

- Uniaxial compressive strength at 28 days: 10 N.mm-2
- Compatible with procedures for forming the secant wall

Proposed slurry mix constituents and strength range: Contractor to submit details for approval.

B9.2f Pile Diameters

Male piles to be 900mm in diameter, female piles 600mm diameter.

B9.2g Pile Spacing and Overlap at Commencing Level

Reference Drawing No. 4877/S/101 Pile General Arrangement.

Pile Spacing 1200mm.

Female piles are to extend a minimum of 1m below excavation formation level.

B9.2h Depth to which Pile Interlock Must be Maintained

Pile interlock shall be at a minimum of 1m below excavation formation level.

B9.2i Instrumentation

Install blind access ducts for inclinometers at locations shown on Drawing No RUK-20-DR-4877/G/103.

Details of the proposed ducts to be submitted to the Engineer.

B9.2j Temporary Backfill Material

Not required.

B9.2k Integrity Testing

To be determined by Contractor

B9.2l Other Particular Technical Requirements

Lightning protection and earthing connections to pile reinforcement will need to be made to the secant pile walls. Refer to Arup Services drawings, specifications and information for details.

Allowance should be made for reinforcement couplers at basement slab level to tie the slab reinforcement to the secant pile wall. Cordek Pilecor (or similar approved) shall be used to form a box out around the connection. Refer to the structural drawings for further details.

B10 Contiguous Pile Walls

Not required.

B11 King Post Walls

Not required.

B12 Steel Sheet Piles

Not required.

B13 Integrity Testing

B13.3 Project Specification

B13.3a The method of test to be carried out

Method: Impulse.

B13.3b The number, type and location of elements to be tested

All bearing piles to be tested.

B13.3c The stages in the programme of works when a phase of integrity testing is to be carried out

Integrity testing to be undertaken after trimming of pile heads.

B13.3d Cross-hole sonic logging

Not required.

B13.3e Availability of results

The preliminary test results to be submitted within 24 hours.

Test results and findings to be reported within five days of the completion of each phase of testing.

B13.3f Number of days between casting and testing

Testing of each pile shall take place within 28 days of casting of that pile and all testing shall be completed within 14 days of casting of the last pile. Integrity testing of cast piles must not be carried out before seven days after casting.

B13.3g Preparation of concrete surface of test element for testing using the vibration method

Prepare pile heads to suit the method of testing.

Note any problems with the pile heads which could inhibit the execution or interpretation of the test and report to Engineer.

B13.3h Other particular requirements

None

B14 Dynamic and Rapid Load Testing of Piles

Contractor to submit satisfactory evidence in support of proposals if dynamic and rapid load testing of piles is required to prove design assumptions.

B15 Static Load Testing of Piles

B15.2 Project Specification

B15.2a Type of pile

Preliminary piles:

- Number: 2% of contract piles
- Type: Bored
- Locations: TBC
- Diameter: TBC

Working piles:

- Number: 5% of contract piles
- Type: Bored
- Locations: TBC
- Diameter: TBC

B15.2b Type of test

Preliminary pile and Working Pile tests to be maintained load tests.

B15.2c Loads to be applied and procedure to be adopted in testing preliminary piles, including maximum reaction capacity

Preliminary pile tests must either be sleeved to basement formation level or undertaken using bi-directional load cells.

Maximum test loads: TBC

B15.2d Loads to be applied and procedure to be adopted in proof-testing of working piles, including maximum reaction capacity

Working Pile tests to be undertaken using either bi-directional load cells, anchor piles or kentledge.

Maximum test loads: TBC

B15.2e Whether test is to be compression or tension and number of loading cycles

Pile testing to be compression.

Number of loading cycles:

For working pile tests:

- 2 cycles, to 100%DVL and 150%DVL

For preliminary pile tests:

- 3 cycles, to 100%DVL, 150%DVL, and geotechnical failure.

B15.2f Special materials to be used in construction of preliminary test piles where appropriate

Prepare pile heads to suit the method of testing.

B15.2g Special construction detail requirements for testing piles, including requirements for additional reinforcement, increased concrete strength, sampling or in-situ testing

Sleeving of test pile shaft above formation level will be required if anchor piles or kentledge are used.

Strain gauges are to be used above basement formation level to quantify the effects of this soil being present at the time of testing where bi-directional load cells are used.

B15.2h Special requirements for pile-testing equipment and arrangement, including requirements for any pile instrumentation

The equipment shall be designed and supervised by a Contractor with proven experience working with similar instrumentation systems. The CV of the Supervising Contractor shall be provided to the Engineer at least one week prior to the commencement of site works.

The Contractor shall demonstrate to the Engineer that the equipment can satisfactorily and accurately measure the applied load.

For bi-directional testing method the instrumentation and measuring shall be specified by the Contractor and provided to the Engineer for approval two weeks prior to the commencement of site works.

B15.2i Pile installation criteria

TBC

B15.2j Time interval between pile installation and testing

The time interval between pile installation and commencement of load testing shall be a minimum of 14 days.

B15.2k Removal of temporary works

All temporary works to be removed from site within 7 days following testing.

B15.2l Whether interpretation is required and extent of interpretation

The contractor shall submit an interpretation of the test results to the Engineer within two weeks of completing the test. The report shall:

- comment on the load settlement results
- interpret the strain gauge data
- provide the ultimate load capacities for both the shaft and base of the barrette
- determine the skin friction along the shaft and resistance at base acting at each loading stage and relate to the actual mobilisation of design parameters
- comment on the influence and contribution of different strata on the results
- recommend design parameters.

B15.2m Additional records or information required from the load test

Not required.

B15.2n Displacement transducer stem travel

Dial gauges, digital gauges or LVDTs used to measure end bearing and side shear movement should have a minimum travel of 100mm and be capable of being read to the nearest 0.01mm. End bearing may alternatively be monitored using LVDTs capable of measuring 150mm.

Dial gauges, digital gauges or LVDTs used to measure shaft compression shall have a minimum travel of 25mm and be capable of being read to the nearest 0.001mm.

B15.2o Cut-off level for test

Cut-off level for test: +21.7 mOD

B15.2p Details of work to be carried out to the pile cap or head at the completion of a test

Any damage to the head of working test piles caused by the test should be made good. Working test piles are to be integrity tested within 48 hours of the working pile test being completed to determine their suitability for use in the permanent scheme.

Preliminary piles or anchor piles (if used) should be cut down to 1m below formation level.

B15.2q Special requirements for the application of a lateral load to a pile detailed in accordance with the expected conditions of loading (the principles of loading and other relevant details may be adapted from the Specification clauses which follow)

Not required.

B15.2r Other particular technical requirements

Not required.

B16 Piles with Sleeves and/or Coatings

Not required.

B17 Instrumentation for Piles and Embedded Retaining Walls

Not required.

B18 Support Fluid

B18.2 Project Specification

B18.2a Minimum material testing requirements and schedule of testing

Testing of the sand content of the support fluid shall be undertaken by the Piling Contractor prior to the concreting of each pile. The concreting of the pile shall not commence until the sand content has been determined as being 2% or lower.

B18.2b Environmental restrictions on use

The support fluid shall be suitable to prevent cross-contamination where the piles are deeper than the base of the London Clay.

Control of support fluid is essential due to groundwater within the River Terrace Deposits.

B18.2c Testing of water and schedule of testing

Not required.

B18.2d Submission of testing records to the Engineer

Records to be submitted weekly.

B18.2e Other particular technical requirements

Not required.

B19 General Requirements for Concrete and Steel Reinforcement

B19.1 General

Standards to BS8055-2 and BS EN 206-1.

A design life of 75 years is required.

Concrete or grout for the piles shall be of the following designation:

1	Concrete designation	1
2	Strength class	C28/35
3	DC – class	DS-2, AC-2
4	Maximum water/ cement ratio	TBC by pile design and submitted to Engineer for approval
5	Minimum cement content ($kg.m^{-3}$)	TBC by pile design and submitted to Engineer for approval
6	Permitted cement and combination types	TBC by pile design and submitted to Engineer for approval
7	Nominal maximum size of aggregate (mm)	TBC by pile design and submitted to Engineer for approval
8	Chloride class	TBC by pile design and submitted to Engineer for approval
9	Special requirements for cement or combination	TBC by pile design and submitted to Engineer for approval
10	Special requirements for aggregates	TBC by pile design and submitted to Engineer for approval
11	Special requirements for temperature of fresh concrete	TBC by pile design and submitted to Engineer for approval
12	Special requirements for strength development	None
13	Special requirements for heat development during hydration	None
14	Other special technical requirements	None
15	Additional requirements	None
16	Rate of sampling for strength testing	TBC by pile design and submitted to Engineer for approval
17	Use of recycled aggregate permitted	Yes
18	Target consistence or consistence class	TBC by pile design and submitted to Engineer for approval
19	Tolerance on target consistence if different from BS EN 206-1	TBC by pile design and submitted to Engineer for approval
20	Method of placing concrete	TBC by pile design and submitted to Engineer for approval

B19.9 Steel Reinforcement

Plain bar reinforcement: To BS 4449, Grade 250.

Cutting and bonding: To BS 8666.