TABLE NG 16/1 - Tests and Compliance values for Support Fluid prepared from Bentonite.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Property to be measured** | **Test method and apparatus** | **API RP13 Section** | **Compliance values measured at 20°C** | |
| **As supplied to pile** | **Sample from pile prior to placing concrete** |
| Density | Mud balance | 1 | Less than 1.10 g/ml | Less than 1.15 g/ml |
| Fluid loss (30 minute test) | Low temperature test fluid loss | 3 | Less than 40 ml | Less than 60 ml |
| Viscosity | Marsh cone | 2 | 30 to 70 seconds | Less than 90 seconds |
| Shear strength (10 min. gel strength) | Fann viscometer | 2 | 4 to 40 N/m² | 4 to 40 N/m² |
| Sand content | Sand screen set | 4 | Less than 2% | Less than 2% |
| pH | Electrical pH meter to BS 3145; range pH 7 to 14 | - | 9.5 to 10.8 | 9.5 to 11.7 |

# NG Sample Appendices

NG Sample Appendix 16/1: General Requirements for Piling and Embedded Retaining Walls

*[Note to compiler: Include here:]*

### **1** General requirements for piling and embedded retaining walls, cross-referring to drawings in the Works Requirements or Works Proposals and other Appendices of Series 1600, and including the following as appropriate.

#### (a) permitted options for piles and embedded retaining walls, and any additional requirements *[1601.23]*

#### (b) damage criteria for adjacent structures or services *[1601.28]* including conditions, restrictions and monitoring requirements.

NG Sample Appendix 16/2: Precast Reinforced and Prestressed Concrete Piles and Precast Reinforced Concrete Segmental Piles

*[Note to compiler: Include here:]*

### **1** Requirements for precast concrete piles, including the following as appropriate

#### (a) specified working loads

#### (b) performance criteria for piles under test as Table NG 16/2 below

#### (c) type of cement

#### (d) types and sizes of aggregate

#### (e) strength classes of concrete

#### (f) designed or prescribed concrete and maximum free water to cement ratio

#### (g) method of testing concrete consistence

#### (h) grades and types of and cover to reinforcement

#### (i) types of prestressing tendons

#### (j) grout

#### (k) marking of piles

#### (l) penetration or depth or toe level *[1602.29]*

#### (m) dynamic evaluation*[1602.28]*

#### (n) trial drives

#### (o) preliminary piles

#### (p) uplift / lateral displacement trials

#### (q) pile shoes (where required)

#### (r) preboring or jetting or other means of easing pile drivability *[1602.33]*

#### (s) additional detailed requirements for driving records) *[1602.30]*

#### (t) requirements to provide details of measures to be adopted to enable piles to comply with Specification where out of tolerance or damaged *[1602.32]*

Table NG 16/2 - Performance Criteria for Piles

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Pile Reference Nos** | **Permitted type(s) ­Specification Clause No.** | **Specified Working Load (SWL)** | **Allocated Allowable Pile Capacity** | **Design Verification Load DVL** | **Load Factor** | **Permitted Settlement at DVL + 50% SWL (mm)** | **Minimum Pile Length from cut-off to toe (m)** | **Minimum Diameter or Dimensions of Cross Section (mm)** |
| **Maximum Settlement** |
|  |  | (kN) | (kN) | (kN) |  |  |  |  |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |

**Notes**

### (1) Each and every pile should be allocated a unique reference number or code.

### (2) Permitted types of pile are restricted to those specified in the corresponding Clause of the Specification, e.g. insertion of “Clause 1603” will restrict permitted type(s) of pile to bored cast in place piles only. Further specification, e.g. “underreams not permitted” may be necessary in particular circumstances.

### (3) Working Loads specified on drawings should be grouped and each group allocated to one Allowable Pile Capacity, e.g. all piles with Specified Working Loads between 858 kN and 930 kN are to be constructed for an Allowable Load of 930 kN. “Grouping” of Working Loads in this way reduces the number of different pile sizes on site and helps eliminate the confusion that can arise when each pile is individually sized.

### (4) The Allowable Pile Capacity is the same as or greater than the highest Working Load in each “Group” (see (3) above).

### (5) The DVL may be much larger than the Allowable Pile Capacity.

### (6) The Load Factor should be specified.

### (7) A realistic estimate of the likely lower bound load settlement curve for a pile tested in isolation should be made, and the Permitted Settlement at DVL + 50% SWL taken from that curve. If a stiffer pile than is indicated by the Permitted Settlement is required, then the pile type or dimensions will have to be changed (e.g. pile lengthened, larger diameter, or underream added).

### (8) The stratigraphy of the ground may make it imperative that piles have a minimum length, to ensure penetration into a particular stratum; alternatively, the minimum penetration into a particular stratum can be specified (the column heading will then require to be changed to “Minimum penetration into XYZ”).

### (9) The minimum pile diameter will normally be determined by the permitted stresses in the pile materials, taking account of axial loads, moments and transverse loads.

NG Sample Appendix 16/3: Bored Cast-In-Place Piles

*[Note to compiler: Include here:]*

### **1** Requirements for cast-in-place piles, including the following as appropriate

#### (a) specified working loads

#### (b) performance criteria for piles under test *[See NG Sample Appendix 16/2]*

#### (c) types of cement

#### (d) cement replacement materials

#### (e) types and sizes of aggregate

#### (f) strength classes of concrete

#### (g) designed or prescribed concrete and maximum free water to cement ratio

#### (h) method of testing concrete consistence

#### (i) grades and types of and cover to reinforcement

#### (j) permanent casing *[1603.4]*

#### (k) support fluid

#### (l) pile dimensions

#### (m) pressure grouting *[1603.23]*

#### (n) preliminary piles

#### (o) trial bores

### **2** Requirements for level of support fluid if different from that stated in sub-Clause 1603.5.

### **3** Requirements for manned inspection of the pile base *[1603.9]*.

NG Sample Appendix 16/4: Bored Piles Constructed Using Continuous Flight Augers and Concrete or Grout Injection Through Hollow Auger Stems

*[Note to compiler: Include here:]*

### **1** Requirements for continuous flight auger piles, including the following as appropriate

#### (a) specified working loads

#### (b) performance criteria for piles under test [see NG Sample Appendix 16/2]

#### (c) sampling and testing of pile materials

#### (d) types of cement

#### (e) cement replacement materials

#### (f) concrete or grout admixtures

#### (g) types and sizes of aggregate

#### (h) strength classes of concrete or grout

#### (i) method of testing concrete or grout consistence [1604.7]

#### (j) designed concrete or grout and maximum free water to cement ratio

#### (k) grades and types of and cover to reinforcement

#### (l) pile dimensions [1604.6]

#### (m) trial bores

#### (n) preliminary piles

### **2** Requirements to submit proposals on how to complete a pile in the event of a failure of the rig instrumentation system *[1604.15]*.

NG Sample Appendix 16/5: Driven Cast-In-Place Piles

*[Note to compiler: Include here:]*

### **1** Requirements for driven cast-in-place piles, including the following as appropriate

#### (a) specified working loads

#### (b) performance criteria for piles under test [See NG Sample Appendix 16/2]

#### (c) sampling and testing of pile materials

#### (d) type of cement

#### (e) cement replacement materials

#### (f) types and sizes of aggregate

#### (g) strength classes of concrete

#### (h) method of testing concrete consistence

#### (i) designed or prescribed concrete and maximum free water to cement ratio

#### (j) grades and types of and cover to reinforcement

#### (k) types and quality of permanent casing [1605.1]

#### (l) types and quality of pile shoes

#### (m) penetration or depth or founding level [1605.8]

#### (n) driving resistance or dynamic evaluation or set [1605.7]

#### (o) trial drives

#### (p) preliminary piles

#### (q) uplift/lateral displacement trials

#### (r) preboring and jetting [1605.12]

#### (s) detailed requirements for driving records (including redrives) [1602.30]

#### (t) requirement to form a pile with an enlarged base [1605.5]

NG Sample Appendix 16/6: Steel Bearing Piles

*[Note to compiler: Include here:]*

### **1** Requirements for steel bearing piles, including the following as appropriate

#### (a) specified working loads

#### (b) performance criteria for piles under test [See NG Sample Appendix 16/2]

#### (c) grades of steel

#### (d) sections of proprietary types of pile

#### (e) thickness of circumferential weld reinforcement

#### (f) lengths of pile to be supplied and additional lengths [1606.32]

#### (g) types of head and toe preparation

#### (h) types of pile shoe

#### (i) surface preparation

#### (j) types of coating [1606.18, 27], and adhesion checks [1606.27]

#### (k) thickness of primer and coats

#### (l) welding procedure and tests [1606.9, 15]

#### (m) non-destructive testing of welds [1606.12]

#### (n) concreting of piles

#### (o) penetration or depth or founding level

#### (p) driving resistance or dynamic evaluation or set [1602.28, 31]

#### (q) trial drives

#### (r) preliminary piles

#### (s) uplift/lateral displacement trials

#### (t) preboring and jetting [1606.36]

#### (u) detailed requirements for driving records (including requirements for measurement of temporary compressions and redrives) [1602.30]

NG Sample Appendix 16/7: Reduction of Friction on Piles

*[Note to compiler: Include here:]*

### **1** Particular requirements for reducing friction on piles *[1607.1]* including the following as appropriate

#### (a) the type and particular description of method to be used

#### (b) the numbers or other identification of piles to be treated to reduce friction

#### (c) the length of pile to be treated

#### (d) preparatory preboring or other work necessary for proper application of the method

#### (e) depth, diameter and means of ensuring temporary stability of any preboring where required

#### (f) designated manufacturer’s name and details where a proprietary product is required

#### (g) testing piles or trial piles to demonstrate the effectiveness of the method.

### **2** Requirements for inspection, exposure or extraction of piles *[1607.8]*.

NG Sample Appendix 16/8: Non-Destructive Methods for Testing Piles

*[Note to compiler: Include here:]*

**Integrity testing of piles**

### **1** Particular requirements for integrity testing *[1608.1 and 1608.2]*, including the following, as appropriate

#### (a) the method of test to be carried out

#### (b) the number, type and location of piles to be tested

#### (c) the stages in the programme of works when a phase of integrity testing is to be carried out

#### (d) the number and location of piles in which ducts are to be placed and number and length of ducts to be provided in each pile for the sonic logging method

#### (e) preparation of pile head for testing using the vibration method

#### (f) where sonic coring is called for, the depth of pile over which the testing is required, the depth intervals to be not greater than 0.25 m.

#### (g) the number of days to elapse between pile casting and integrity testing [1608.3].

**Dynamic testing of piles**

### **2** Particular requirements for dynamic pile-testing *[1608.9]*, including the following, as appropriate

#### (a) the number, type and location of piles to be tested

#### (b) the stages in the programme of works when a phase of dynamic testing is to be carried out

#### (c) the minimum dynamic test load

#### (d) the time period following installation at which testing is required

#### (e) measurement of set and temporary compression

#### (f) details of work to be carried out on a pile head following a test

#### (g) requirement for analysis of selected blows [1608.16]

NG Sample Appendix 16/9: Static Load Testing of Piles

*[Note to compiler: Include here:]*

### **1** Particular requirements for static load testing of piles *[1609.1]*, including the following as appropriate

#### (a) type of pile

#### (b) type of test

#### (c) loads to be applied and procedure to be adopted in testing preliminary piles [1609.7 and 34]

#### (d) loads to be applied in proof-testing of working piles and particular requirements for procedure [1609.6 and 33]

#### (e) special materials to be used in construction of preliminary test piles where appropriate

#### (f) special construction detail requirements for test piles

#### (g) special requirements for pile-testing equipment and arrangement [1609.21]

#### (h) pile installation criteria

#### (i) time interval between pile installation and testing

#### (j) removal of temporary Works

#### (k) special requirements for the application of a lateral load to a pile detailed in accordance with the expected conditions of loading

#### (l) details of work to be carried out to the test pile cap or head at the completion of a test.

NG Sample Appendix 16/10: Diaphragm Walls

*[Note to compiler: Include here:]*

### **1** Requirements for diaphragm walls, including the following as appropriate

#### (a) specified working loads

#### (b) performance criteria for movement under lateral loads

#### (c) types of cement

#### (d) cement replacement materials

#### (e) types and sizes of aggregate

#### (f) strength classes of concrete

#### (g) designed or prescribed concrete and maximum free water to cement ratio

#### (h) method of testing concrete consistence [1610.11]

#### (i) grades, types and bond length of and cover to reinforcement [1610.9]

#### (j) support fluid

#### (k) panel dimensions (minimum thickness and maximum or minimum panel length) [1610.5]

#### (l) water stop requirements, if any

#### (m) water retention [1610.21]

#### (n) instrumentation [1610.22]

#### (o) temporary backfill material [1610.20]

#### (p) integrity testing

### **2** Any restriction on the additional tolerance on panel centre line position given in sub-Clause 1610.15, and the additional overbreak tolerance to be allowed where very soft clay, peat or obstructions are anticipated, *[1610.15]*.

### **3** Line and level requirements for preparation of wall surfaces *[1610.23]*.

NG Sample Appendix 16/11: Hard/Hard Secant Pile Walls

*[Note to compiler: Include here:]*

### **1** Requirements for hard/hard secant pile walls, including the following as appropriate

#### (a) specified working loads (if any)

#### (b) performance criteria for movement under lateral loads

#### (c) types of cement

#### (d) cement replacement materials

#### (e) types and sizes of aggregate

#### (f) strength classes of concrete

#### (g) designed or prescribed concrete and maximum free water to cement ratio

#### (h) method of testing concrete consistence [1611.11]

#### (i) grades and types of and cover to reinforcement, and projecting bond lengths [1611.3, 1611.9]

#### (j) support fluid

#### (k) pile diameters

#### (l) pile spacings and overlap at commencing level

#### (m) water retention [1611.22]

#### (n) instrumentation [1611.23]

#### (o) temporary backfill material [1611.21]

#### (p) integrity testing

### **2** Requirements, if any, for guide walls *[1611.1]*.

### **3** Time period between excavation and placing concrete, if different from that specified in sub-Clause 1611.15.

### **4** Any restriction on the additional tolerance on pile centre line position given in sub-Clause 1611.17, and the additional overbreak tolerance to be allowed where very soft clay, peat or obstructions are anticipated *[1611.17]*.

### **5** Line and level requirements for preparation of wall surfaces *[1610.23]*.

NG Sample Appendix 16/12: Hard/Soft Secant Pile Walls

*[Note to compiler: Include here:]*

### **1** Requirements for hard/soft secant pile walls including the following as appropriate

#### (a) specified working loads (if any)

#### (b) performance criteria for movement under lateral loads

#### (c) types of cement

#### (d) cement replacement materials

#### (e) types and sizes of aggregate

#### (f) strength classes of concrete or alternative pile concrete mixes

#### (g) designed or prescribed concrete and maximum free water to cement ratio

#### (h) method of testing concrete consistence [1612.3, 1611.11]

#### (i) grades and types of and cover to reinforcement, and projecting bond lengths [1611.9]

#### (j) support fluid

#### (k) requirements for self-hardening slurry mix [1612.3]

#### (l) pile diameters

#### (m) pile spacings and overlap at commencing level

#### (n) water retention [1611.22]

#### (o) instrumentation [1611.23]

#### (p) temporary backfill material [1611.21]

#### (q) integrity testing

### **2** Requirements for guide walls *[1612.1]*.

### **3** Time periods between excavation and placing concrete, or self-hardening mix, if different from those specified in sub-Clauses 1611.15 or 1612.11 *[1612.11]*.

### **4** Any restriction on the additional tolerance on pile centre line position given in sub-Clause 1612.13, and the additional overbreak tolerance to be allowed where very soft clay, peat or obstructions are anticipated *[1612.13]*.

### **5** Line and level requirements for preparation of wall surfaces *[1610.23]*.

NG SAMPLE APPENDIX 16/13: Contiguous Bored Pile Walls

*[Note to compiler: Include here:]*

### **1** Requirements for contiguous bored pile walls including the following as appropriate

#### (a) specified working loads (if any)

#### (b) performance criteria for movement under lateral loads

#### (c) types of cement

#### (d) cement replacement materials

#### (e) types and sizes of aggregate

#### (f) strength classes of concrete

#### (g) designed or prescribed concrete and maximum free water to cement ratio

#### (h) method of testing concrete consistence [1611.11]

#### (i) grades and types of and cover to reinforcement, and projecting bond lengths [1611.9]

#### (j) support fluids and temporary casings

#### (k) pile diameters

#### (l) pile spacing

#### (m) additional measures for water retention

#### (n) instrumentation [1611.23]

#### (o) temporary backfill material [1611.21]

#### (p) integrity testing

### **2** Requirements for guide walls *[1613.1]*.

### **3** Time period between excavation and placing concrete if different from that specified in sub-Clause 1611.15.

### **4** Any restriction on the additional tolerance on pile centre line position given in sub-Clause 1613.8, and the additional overbreak tolerance to be allowed where very soft clay, peat or obstructions are anticipated *[1613.8]*.

### **5** Line and level requirements for preparation of wall surfaces *[1610.23]*.

NG Sample Appendix 16/14: King Post Walls

*[Note to compiler: Include here:]*

### **1** Requirements for king post walls including the following as appropriate

#### (a) specified working loads (if any)

#### (b) performance criteria for movement under lateral loads

#### (c) requirements of king post members

#### (d) types of cement

#### (e) cement replacement materials

#### (f) types and sizes of aggregate [1614.1]

#### (g) strength classes of concrete

#### (h) method of testing concrete consistence [1611.11]

#### (i) designed or prescribed concrete and maximum free water to cement ratio

#### (j) grades and types of and cover to reinforcement, and projecting bond lengths [1611.9]

#### (k) support fluid

#### (l) pile diameters

#### (m) pile spacing

#### (n) instrumentation [1614.11]

#### (o) temporary backfill material [1614.10]

### **2** Required tolerances *[1614.8].*

### **3** Time period between excavation and placing concrete if different from that specified in sub-Clause 1611.15.

NG Sample Appendix 16/15: Steel Sheet Piles

*[Note to compiler: Include here:]*

### **1** Requirements for steel sheet piles including the following as appropriate

#### (a) performance criteria for movement under lateral loads

#### (b) grades of steel

#### (c) minimum section modulus, web thickness of sheet pile

#### (d) surface preparation

#### (e) types of coating

#### (f) thickness of primer and coats

#### (g) types of head and toe preparation

#### (h) minimum length of sheet pile to be supplied

#### (i) water retention

#### (j) restriction on working hours during which driving can take place

#### (k) types of pile shoe

#### (l) penetration or depth or founding level [1615.7]

#### (m) driving resistance or dynamic evaluation or set

#### (n) preboring and jetting or other means of easing pile driveability

#### (o) detailed requirements for driving records

### **2** Any requirements for clutch sealant *[1615.5]*.

### **3** Any requirements for the use of a vibrationless jacking system *[1615.7]*.

NG Sample Appendix 16/16: Integrity Testing of Wall Elements

*[Note to compiler: Include here:]*

### **1** Requirements for integrity testing including the following as appropriate

#### (a) the method of test to be carried out

#### (b) the number and location of wall elements to be tested

#### (c) the stages in the programme of works when a phase of integrity testing is to be carried out

#### (d) the number and location of wall elements in which ducts are to be placed and number and length of ducts to be provided in each wall element for the sonic logging method

#### (e) the time after testing at which the test results and findings should be made available, if different from the requirements of sub-Clause 6.

#### (f) the depth of wall element over which the testing is required, the depth intervals to be not greater than 0.25 m.

#### (g) the number of days to elapse between wall element casting and integrity testing, [1616.2].

NG Sample Appendix 16/17: Instrumentation for Piles and Embedded Walls

*[Note to compiler: Include here:]*

### **1** Requirements for instrumentation of piles or embedded walls *[1617.1, 1617.12]*, including locations where the instrumentation is to be installed, expected load, pressure, displacement or strain range for which results are required, and aims and objectives of the instrumentation.

### **2** The type of instrumentation required *[1617.2]*.

### **3** For extensometers, the required movement range *[1617.3]*.

### **4** For load cells, whether the load to be measured is compressive or tensile *[1617.5]*.

### **5** Required times or time intervals for readings *[1617.10]*.

### **6** Calibration range required *[1617.11]*.

### **7** Whether the instrumentation monitoring equipment will become the property of the Employer *[1617.15]*, and any particular requirements for monitoring equipment or output required.

### **8** Whether direct or remote monitoring is required *[1617.15]*.

### **9** Terminal survey requirements including datum and coordinate grid to be used *[1617.17]*, and frequency of surveying.

NG Sample Appendix 16/18: Support Fluid

*[Note to compiler: Include here:]*

### **1** Requirements for support fluid, including any minimum material testing requirements or environmental restrictions on use. *[1618.1]*

### **2** Requirements for and frequency of testing water not available from a public supply, if required *[1618.3]*.