Appendix L

Summaries for GEO Publication No. 1/2006:
Foundation Design and Construction

GEO Publication No. 1/2006 - Foundation Design and Construction

Table L1 - Summary of Current British Standard References and Replacement Eurocodes

BS Status	Relevant Updated Code for Citation	ID No.	Page no.	Existing Content of Technical Guidance Document	General Comments to define Scope of Updating / Specific Clauses in EN (s) / UK NA(s)	Scope of Updating
Technical Clauses in Report						
BS 8004:1986 Code of Practice for Foundations						
Superseded, Withdrawn	BS8004:1986 (NCCI)	P1-2006:8004-2	23	BS 8004 (BSI, 1986) adopts an arbitrary embedment depth of 3 m as a way to define shallow foundations. In the context of this document, a shallow foundation is taken as one in which the depth to the bottom of the foundation is less than or equal to its least dimension (Terzaghi et al, 1996).	1986; Informative; P1-2006:8004-2; The citation is to a passing reference giving a definition of 'shallow foundations'. As this definition of a shallow foundation given in BS8004:1986 is explicitly excluded from use in the context of the whole document, the sentence containing the citation can be removed without any impact on the sense of the publication. It will also remove any risk of conflict with BS EN 1997-1:2004.	2
Superseded, Withdrawn	BS8004:1986 (NCCI)	P1-2006:8004-3	55	In the installation of piles, either displacement or replacement of the ground will predominate. A classification system based on the degree of ground displacement during pile installation, such as that recommended in BS 8004 (BSI, 1986) encompasses all types of piles and reflects the fundamental effect of pile construction on the ground which in turn will have a pronounced influence on pile performance. Such a classification system is therefore considered to be the most appropriate.	1986; Informative; P1-2006:8004-3; 1986; Informative; P1-2006:8004-3; There is no classification system defined in BS EN 1997-1:2004, nor does a classification system contradict the requirements of BS EN 1997-1:2004. Consequently, this citation is to the part of BS8004:1986 deemed as NCCI.	1
Superseded, Withdrawn	BS8004:1986 (NCCI)	P1-2006:8004-4	153	In determining the relevant rock mass deformation parameters, consideration should be given to influence of non-homogeneity, anisotropy and scale effects. Deformation of a rock mass is often governed by the characteristics of discontinuities. There are a number of methods that can be used to assess the deformation properties including : (a) correlations of the modulus of the rock mass to the modulus of the intact rock (the latter can be correlated to the uniaxial compressive strength, σc) by means of a mass factor denoted as 'j' factor (BSI, 1986), (b) semi-empirical correlations with the Rock Mass Rating, RMR (Figure 6.7), and (c) semi-empirical relationships with properties of the rock joints (Barton, 1986), which can be used in complex computer codes based on distinct element models of the rock mass (Cundall, 1980).	1986; Informative; P1-2006:8004-4; The 'j' factor is an arbitrary nomenclature in BS8004:1986. In BS8004:1986 it is applied to the Young's Modulus of intact rock to obtain the Young's Modulus of a rock mass. The value of 'j' is not stated as it is dependent on the condition of the rock mass. BS EN 1997-1:2004 is silent on specifics of rock mass assessment. The information in BS8004:1986 is still valid and classed as NCCI.	1

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Superseded, Withdrawn	BS8004:1986 (NCCI)	P1-2006:8004-5	196	See Figure 7.13: The overall foundation stiffness, K_f, is given by the following expression : $K_f = \frac{K_g + K_c (1 - 2\alpha_{cp})}{1 - \alpha_{cp}^2 \frac{K_c}{K_g}}$ The proportion of load carried by the pile cap (P_c) and the pile group (P_g) is given by : $\frac{P_c}{P_c + P_g} = \frac{K_c(1 - \alpha_{cp})}{K_g + K_c (1-2\alpha_{cp})}$ Legend : K_g = stiffness of pile group = $R_g\, n_p\, K_v$ K_c = stiffness of pile cap = $\frac{2G\sqrt{A_{cap}}}{I\,(1-v_s)}$ r_m = radius of influence of pile ≈ length of pile R_g = stiffness efficiency factor for pile group (Section 7.5.1.6) K_v = stiffness of individual pile under vertical load v_s = Poisson's ratio of soil n_p = number of piles I = influence factor, see Poulos & Davis (1974) or BSI (1986) G = shear modulus of soil α_{cp} = average interaction factor = $\frac{\ln (r_m/r_c)}{\ln (r_m/r_o)}$ r_o = radius of pile D = pile diameter L = length of pile A_{cap} = area of pile cap r_c = equivalent radius of the pile cap associated with each pile = $\sqrt{\frac{A_{cap}}{\pi n_p}}$ **Figure 7.13 – Analysis of a Piled Raft Using the Elastic Continuum Method (Fleming et al, 1992)**	1986; Informative; P1-2006:8004-5; The citation refers to a factor within a formula to define pile cap stiffness. BS8004:1986 is a withdrawn standard, but is still cited in UK Building Regulations. BS8004 is also included on the list of NCCI standards in BS EN 1997-1:2004 and, therefore, is considered to be NCCI and the existing reference can be retained in Publication 1/2006.	1
Superseded, Withdrawn	BS8004:1986 (NCCI)	P1-2006:8004-6	205, 206	The weight of the hammer should be sufficient to ensure a final penetration of not more than 5 mm per blow unless rock has been reached. It is always preferable to employ the heaviest hammer practicable and to limit the stroke, so as not to damage the pile. When choosing the size of the hammer, attention should be given to whether the pile is to be driven to a given resistance or to a given depth. The stroke of a single-acting or drop hammer should be limited to 1.2 m, preferably 1 m. A shorter stroke and particular care should be used when there is a danger of damaging the pile. (BSI, 1986).	1986; Informative; P1-2006:8004-6; The paragraph is taken virtually verbatim from BS8004:1986. There is no contrary advice given in BS EN 1997-1:2004. The information is NCCI.	1
Superseded, Withdrawn	BS EN 1997-1:2004	P1-2006:8004-7	280, 281	A commonly-used definition of failure load is taken to be that at which settlement continues to increase without further increase in load; alternatively, it is customarily taken as the load causing a settlement of 10% of pile diameter (BSI, 1986).	1986; Normative; P1-2006:8004-7; Cl 7.6.1.1(3) of BS EN 1997-1:2004 states 'For piles in compression it is often difficult to define an ultimate limit state from a load settlement plot showing a continuous curvature. In these cases, settlement of the pile top equal to 10% of the pile base diameter should be adopted as the "failure" criterion'. This citation can therefore be replaced by citing BS EN 1997-1:2004.	4b
CP4:1954 Code of Practice for Foundations						
Superseded	N/A	P1-2006:CP4-2	23	Traditional foundation design practice in Hong Kong relies, in part, on the British Code of Practice for Foundations (BSI, 1954), together with empirical rules formulated some 40 years ago from local experience with foundations in weathered rocks.	1954; Historical; P1-2006:CP4-2; This is the sole citation for the reference. It is historic information, therefore the text and reference require no change.	1
BS6349-1:2000 Maritime Structures, Part 1 – Code of Practice for General Criteria						
Current, Superseded	BS6349-1-3:2012	P1-2006:6349-2	25	General guidance on the range of site investigation methods is given in Geoguide 2 : Guide to Site Investigation (GCO, 1987), which is not repeated here. Specific guidance pertinent to marine investigations is given in BS 6349-1:2000 (BSI, 2000a). This Chapter highlights the more important aspects of site investigation with respect to foundations.	2000a; Informative; P1-2006:6349-2; BS6349-1:2000 has been replaced by four sub-parts. Geotechnical investigation and design is contained in BS6349-1-3:2012. Only the citation and reference require updating.	3a

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BS Status	Relevant Updated Code for Citation	ID No.	Page no.	Existing Content of Technical Guidance Document	General Comments to define Scope of Updating / Specific Clauses in EN (s) / UK NA(s)	Scope of Updating
BS EN 1997-1:2004 Eurocode 7: Geotechnical Design – Part 1: General Rules						
Current	BS EN 1997-2:2007	P1-2006:1997-2	52	Guidelines and procedures for conducting plate loading tests are given in BS EN 1997-1:2004 (BSI, 2004) and DD ENV 1997-3:2000 (BSI, 2000b).	2004; Informative; P1-2006:1997-2; The wrong reference is cited. Plate loading tests are described in BS EN 1997-2:2007, cl 4.11 and Annex K. (See also P1-2006:1977X-2.)	3a
Current	BS EN 1997-1:2004	P1-2006:1997-3	53	Raft foundations are relatively large in size. Hence, the bearing capacity is generally not the controlling factor in design. Differential and total settlements usually govern the design. A common approach for estimating the settlement of a raft foundation is to model the ground support as springs using the subgrade reaction method. This method suffers from a number of drawbacks. Firstly, the modulus of subgrade reaction is not an intrinsic soil property. It depends upon not only the stiffness of the soil, but also the dimensions of the foundation. Secondly, there is no interaction between the springs. They are assumed to be independent of each other and can only respond in the direction of the loads. BSI (2004) cautions that the subgrade reaction model is generally not appropriate for estimating the total and differential settlement of a raft foundation. Finite element analysis or elastic continuum method is preferred for the design of raft foundations (French, 1999; Poulos, 2000).	2004; Informative; P1-2006:1997-3; The cited standard is current. There is no requirement for a change.	1
Current	BS EN 1997-1:2004	P1-2006:1997-4	83	Both ultimate and serviceability limit states should be considered when undertaking a limit state design for foundations. The ultimate limit state governs the safety of a structure against collapse or excessive deformation of a foundation leading to the collapse of the structure it supports. It should have a very low probability of occurrence. Different failure mechanisms are considered in a limit state design as given below (BSI, 2004) : (a) loss of equilibrium of the structure or the ground, in which the strengths of structural materials and the ground are insignificant in providing resistance, (b) excessive deformation of foundations, in which the strength of soils are significant in providing resistance, (c) excessive deformation of the structure or structural elements, in which the structural strength is significant in providing resistance, (d) loss of equilibrium of the structure due to uplift pressure of water or other vertical forces, in which the strength of materials or the ground is not significant in providing resistance, and (e) hydraulic failure, internal erosion or piping caused by hydraulic gradients.	2004; Informative; P1-2006:1997-4; The cited standard is current. There is no requirement for a change.	1
Current	BS EN 1997-1:2004	P1-2006:1997-5	84	The load and material factor design method applies partial factors to reduce material strengths. Resistance is calculated based on these factored material strengths. This is sometimes known as the European approach, as it is adopted in the Eurocodes, e.g. BS EN 1997-1:2004 (BSI, 2004). Simpson (2000) considered that this approach is better, as it applies factors to the sources of uncertainties.	2004; Informative; P1-2006:1997-5; The cited standard is current. There is no requirement for a change.	1

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DD ENV 1997-3:2000 Eurocode 7: Geotechnical Design – Part 3: Design Assisted by Field Testing						
Revised, Withdrawn	BS EN ISO 22476-13	P1-2006:1997X-2	52	Guidelines and procedures for conducting plate loading tests are given in BS EN 1997-1:2004 (BSI, 2004) and DD ENV 1997-3:2000 (BSI, 2000b).	2000b; Informative; P1-2006:1997X-2; The normative method for carrying out a plate loading test is contained in BS EN ISO 22476-13, which has yet to be published. In the mean time, guidance on plate loading tests is given in BS EN 1997-2:2007; which should be referenced. This citation can be deleted. (See also P1-2006:1997-2.)	2
Revised, Withdrawn	BS EN 1997-2:2007	P1-2006:1997X-3	52	The elastic soil modulus can be determined using the following equation (BSI, 2000b) : $E_s = q_{net}\, b \dfrac{(1-\nu_s^2)}{\delta_p} I_s$ [3.4] where q_{net} = net ground bearing pressure δ_p = settlement of the test plate I_s = shape factor b = width of the test plate ν_s = Poisson's ratio of the soil E_s = Young's modulus of soil	2000b; Informative; P1-2006:1997X-3; The reference DD ENV 1997-3:2000 is superceded and is not NCCI and the refence should be deleted. Equation [3.4] is to be retained for use in Hong Kong practice.	2
Revised, Withdrawn	BS EN 1536:2010	P1-2006:1997X-4	240	Mechanical under-reaming tools should be used in forming bell-outs (BSI, 2000b). The dimensions of the bell-outs can be calibrated at the ground surface by stretching the cutting arm fully and recording the vertical displacement of drill string. The use of offset chiselling to form the bell-outs is not encouraged because of difficulty in controlling the chisel. It is not easy to form the enlargement in a full diameter.	2000b; Normative; P1-2006:1997X-4; The current execution standard for bored piles, BS EN 1536:2010, is silent on the method of forming widened bases and shafts (under-reams and bell-outs). Consequently the current reference has no replacement. The removal of the citation alone will not alter the preceding sentence.	2
BS8110-1:1997 Structural Use of Concrete. Part 1 - Code of Practice for Design and Construction						
Superseded, Withdrawn	N/A	P1-2006:8110-2	84	In the past three decades, design codes for concrete structures are largely based on limit state design, e.g. BS 8110 (BSI, 1997) and Code of Practice for the Structural Use of Concrete (BD, 2004d). A partial factor is defined for each type of material and loading to reflect the relative uncertainties. There are merits in adopting limit state design for foundations such that a common design methodology is adopted both for the superstructure and substructure.	1997; Historical; P1-2006:8110-2; The citation in the context of the paragraph is entirely historic and non-contentious.	1
Superseded, Withdrawn	BS EN 1992-1-1:2004	P1-2006:8110-3	163	Where protected from direct exposure to the marine atmosphere, reinforced concrete should comply with the recommendations given in BS 8110 (BSI, 1997) for 'moderate' conditions.	1997; Normative; P1-2006:8110-3; It should be noted that exposure recommendations for durability were removed from BS8110-1:1997 in November 2005 and replaced by reference to BS8500. At this point the recommendation in GEO Publication 1/2006 became invalid as the reference to BS8110-1:1997 does not specify which amendments apply. The term ' moderate' is no longer applicable if the changes to standards after 2005 are accepted. The current UK standard setting out exposure classes is BS EN 206-1:2000 (incorporating corrigenda Nos. 1 and 2 and amendments Nos. 1, 2 and 3 – i.e. last updated in 2006). The exposure classes are reproduced in BS EN 1992-1-1:2004 (incorporating corrigenda Nos. 1 and 2 – i.e. last updated in 2011). It is probably not practical to restrict the citation to a withdrawn reference published in a narrow time period. It is recommended that the text be amended to remove reference to a class no longer supported by the cited reference and cite a current reference for the user of the Geoguide to consult.	5

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Superseded, Withdrawn	BS EN 1992-1-1:2004	P1-2006:8110-4	207	The criterion for acceptable crack width prior to driving should be considered in relation to the degree of aggressiveness of the ground and groundwater and the need for making allowance for possible enlargement of cracks as a result of pile driving. In general, cracks up to 0.3 mm are normally considered acceptable (BSI, 1997), although for bridge design, the local practice has been to adopt a limiting crack width of 0.2 mm for buried structures.	1997; Normative; P1-2006:8110-4; No guidance on cracks in pre-cast concrete piles prior to driving has been found in the last revision of BS8110-1:1997. In the context of the whole paragraph, it may be that this sentence is not covered by the citation. There are no recommendations on crack widths in the last revision of BS8110-1:1997, however cl 3.2.4.2 of BS8110-2:1985 states: "For members in aggressive environments, the calculated maximum crack widths should not exceed 0.3 mm". BS EN 1992-1-1:2004 has replaced BS8110-1:1997 and BS8110-2:1985 in UK usage. Table 7.1N in BS EN 1992-1-1:2004 gives some guidance on maximum crack widths related to exposure classes, however the narrowest crack	4a
BS 14199:2005 Execution of Special Geotechnical Works – Micropiles						
Current	BS EN 14199:2005	P1-2006:14199-2	162	It is recommended that steel piles above seabed, whether fully immersed, within the tidal or splash zone, or generally above the splash zone, should be fully protected against corrosion for the design life (CEO, 2002). This precaution should also extend to precast piles where the sections are welded together with the use of steel end plates. Below the sea-bed level, an allowance for corrosion loss of 0.05 mm per year on the outer face of steel pile is considered reasonable. BS EN 14199:2005 (BSI, 2005) put forward some guidance on the rate of corrosion in different types of soils.	2005; Informative; P1-2006:14199-2; The cited standard is current. There is no requirement for a change.	1
Current	BS EN 14199:2005	P1-2006:14199-3	163	With grouted piles such as mini-piles, the minimum cover to steel elements depends on factors such as the aggressiveness of the environment, magnitude of tension or compression load, steel type used (BSI, 2005). This may need to be increased in contaminated ground or alternatively a permanent casing may be required.	2005; Informative; P1-2006:14199-3; The cited standard is current. There is no requirement for a change.	1
BS8500-1:2002 Concrete – Complimentary British Standard to BS EN 206-1: Part 1 – Method of Specifying and Guidance for Specifier						
Revised, Withdrawn	BS 8500-1:2006+A1:2012	P1-2006:8500-2	162	In the case of concrete piles, the best defence against the various possible forms of attack as summarised by Somerville (1986) is dense, low permeability concrete with sufficient cover to all steel reinforcement. Bartholomew (1980) classified the aggressiveness of the soil conditions and provided guidance on possible protective measures for concrete piles. Further recommendations are given in BS 8500-1:2002 (BSI, 2002) for specifying concrete grade and cover to reinforcement to improve corrosion resistance for different soil environments. However, high strength concrete may not necessarily be dense and homogeneous. Specifying high strength concrete is no guarantee for durability.	2002; Informative; P1-2006:8500-2; The existing reference has been updated to BS8500-1:2006+A1:2012. The reference should be updated to reflect the new standard and the citation amended accordingly.	3a
BS EN 12699:2001 Execution of Special Geotechnical Work – Displacement Piles						
Current, Work in hand	BS EN 12699:2001	P1-2006:12699-2	208	The driving stresses must not exceed the limiting values that will cause damage to the pile. The following limits on driving stresses suggested by BS EN 12699:2001 (BSI, 2001) are given in Table 8.6.	2001; Informative; P1-2006:12699-2; The reference is current. No change required, however the terminology used in Table 8.6 is at variance with that used in BS EN 12699:2001. See P1-2006:12699-4.	1
Current, Work in hand	BS EN 12699:2001	P1-2006:12699-3	208	The General Specification for Civil Engineering Works (HKG, 1992) stipulates that the driving stresses in precast reinforced concrete piles and prestressed concrete piles should not exceed one half of the specified grade strength of the concrete, which is much more restrictive than the limits proposed by BS EN	2001; Informative; P1-2006:12699-3; The reference is current. No change required.	1

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<table>
<tr><th>BS Status</th><th>Relevant Updated Code for Citation</th><th>ID No.</th><th>Page no.</th><th>Existing Content of Technical Guidance Document</th><th>General Comments to define Scope of Updating / Specific Clauses in EN (s) / UK NA(s)</th><th>Scope of Updating</th></tr>
<tr><td>Current, Work in hand</td><td>BS EN 12699:2001</td><td>P1-2006:12699-4</td><td>211</td><td>See Table 8.6:

Table 8.6 – Limits on Driving Stress (BSI, 2001)<table><tr><th>Pile Type</th><th>Maximum Compressive Stress</th><th>Maximum Tensile Force</th></tr><tr><td>Steel piles</td><td>$\leq 0.9f_y$</td><td>-</td></tr><tr><td>Prefabricated concrete piles (including prestressed piles)</td><td>$\leq 0.8\ f_{cu}$</td><td>$\leq 0.9\ f_y\ A_s$ – Prestressing force</td></tr></table>Notes : (1) f_y is the yield stress of steel, A_s is the area of steel reinforcement and f_{cu} is the specified grade strength of concrete.
(2) If driving stress is actually monitored during driving, the limits can be increased by 10% and 20% for prefabricated concrete piles and steel piles respectively.</td><td>2001; Informative; P1-2006:12699-4; The reference is current. No change required to the BS EN reference.</td><td>1</td></tr>
<tr><td colspan="7">BS5228-4:1992 Noise Control on Construction and Open Sites – Code of Practice for Noise and Vibration Control Applicable to Piling Operations</td></tr>
<tr><td>Revised, Withdrawn</td><td>BS5228-2:2009</td><td>P1-2006:5228-2</td><td>223</td><td>BS 5228:4-1992 (BSI, 1992) gives some guidance on the control of vibration due to piling operations. The method for estimating peak particle velocity takes similar form as Equation [8.3], with the exception that it is based on radial distance between the source and the receiver.</td><td>1992; Informative; P1-2006:5228-2; The reference document was revised in 1999 and has subsequently been replaced by BS5228-2:2009. This latest version also gives some guidance on the control of vibration from piling (cl 8.5). The equation for estimating PPV is unchanged in form. Therefore the reference and citation can be updated to BS5228-2:2009.</td><td>3a</td></tr>
<tr><td>Revised, Withdrawn</td><td>BS5228-2:2009</td><td>P1-2006:5228-3</td><td>223</td><td>The coefficient k can be taken as 0.75 for hammer-driven piles, but this should be confirmed with field measurements (BSI, 1992).</td><td>1992; Normative; P1-2006:5228-3; The stated value of k is not found in BS5228-2:2009, where a range of 1-5 is given dependent on ground conditions and pile resistance. The existing reference is to be retained and advice on the value of k must be changed before the cited reference can be updated to the current 2009 version.</td><td>5</td></tr>
<tr><td colspan="7">BS7385-1:1990 Evaluation and Measurement for Vibration in Buildings – Part 1: Guide for Measurement of Vibrations and Evaluation of Their Effects on Buildings</td></tr>
<tr><td>Superseded, Withdrawn</td><td>BS ISO 4866:2010</td><td>P1-2006:7385-2</td><td>225</td><td>Detailed assessment of the effects of ground-borne vibrations on adjacent buildings and structures can be carried out in accordance with BS 7385 Part 1:1990 (BSI, 1990).</td><td>1990; Informative; P1-2006:7385-2; The referenced standard has been superseded. The new standard is BS ISO 4866:2010.</td><td>4a</td></tr>
<tr><td colspan="7">BS EN 1536:2000 Execution of Special Geotechnical Work – Bored Piles</td></tr>
<tr><td>Revised, Withdrawn</td><td>BS EN 1536:2010</td><td>P1-2006:1536-2</td><td>229</td><td>Specifications on properties of bentonite slurry are given in the General Specification for Civil Engineering Works (HKG, 1992) and BS EN 1536:2000 (BSI, 2000c). These specifications are summarised in Table 8.7. Some local contractors have adopted more stringent control on properties of bentonite.</td><td>2000c; Informative; P1-2006:1536-2; The reference is no longer current but there has been no alteration to the information cited. Update the reference.</td><td>3a</td></tr>
</table>

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Revised, Withdrawn	BS EN 1536:2010	P1-2006:1536-3	230	See Table 8.7:	2000c; Informative; P1-2006:1536-3; The reference is no longer current but there has been no alteration to the information cited. Additional requirements have been made in the new standard with respect to filter cake. If this is to be included in the revision of GEO Publication 1/2006, a row needs to be added to Table 8.7.	5

Table 8.7 – Limits on Properties of Bentonite Slurry

Bentonite Property at 20°C	Method of Testing	General Specification for Civil Engineering Works (HKG, 1992)	BS EN1536:2000 (BSI, 2000c)	Common Specifications by Local Contractors
Density as supplied to excavation	Mud density balance	$\leq$ 1.10 g/ml $\leq$ 1.25 g/ml(1)	$\leq$ 1.10 g/ml $\leq$ 1.15 g/ml(1)	$\leq$ 1.015 to 1.03 g/ml $\leq$ 1.15 to 1.2 g/ml(1)
Viscosity	Marsh cone method (946ml flow through cone)	30 to 50 sec	32 to 50 sec	$\leq$ 32 sec $\leq$ 40 sec to 45 sec
	Fann viscometer	$\leq$ 0.02 Pa. s (i.e. $\leq$ 20 cP)	NA	NA
Fluid loss	Baroid filter press (in 30 minute test)	NA	< 30 NA(1)	$\leq$ 25 $\leq$ 35 to 40(1)
Shear strength (10 min gel strength)	Shearometer	1.4 to 10 N/m^2	NA	1.4 to 10 N/m^2
	Fann viscometer	4 to 40 N/m^2	NA	NA
pH value	pH indicator paper strips or electrical pH meter	8 to 12	7 to 11 NA(1)	8 to 11
Sand content		-	< 4%(1)	< 3%(1)

Notes : (1) Denotes condition before concreting. Other values refer to bentonite in fresh or recycled condition.
(2) NA denotes no requirement imposed.

Reference Section of Report						
Superseded, Withdrawn	N/A	P1-2006:CP4-1	299	BSI (1954) British Standard Code of Practice for Foundations (CP4:1954). British Standards Institution, London, 173 p.	1954; Reference; P1-2006:CP4-1; This reference has one historical citation in the publication.	1
Superseded, Withdrawn	BS EN 1997-1:2004 (although BS8004:1986 is retained for NCCI)	P1-2006:8004-1	299	BSI (1986) British Standard Code of Practice for Foundations (BS 8004:1986). British Standards Institution, London, 149 p.	1986; Reference; P1-2006:8004-1; This reference has 6 citations; 1 normative and 5 informative. 1 citation (normative) requires updating to a BS EN 1997-1:2004, 3 citations (informative) require no change and 2 citations (informative) should be deleted. The reference should therefore be retained.	1
Superseded, Withdrawn	BS ISO 4866:2010	P1-2006:7385-1	299, 300	BSI (1990) Evaluation and Measurement for Vibration in Buildings – Part 1: Guide for Measurement of Vibrations and Evaluation of Their Effects on Buildings (BS 7385-1 :1990). British Standards Institution, London, 18 p.	1990; Reference; P1-2006:7385-1; This reference has one informative citation. It has been superseded by BS ISO 4866:2010. The reference should be revised.	4b
Revised, Withdrawn	BS5228-2:2009	P1-2006:5228-1	300	BSI (1992) Noise Control on Construction and Open Sites – Code of Practice for Noise and Vibration Control Applicable to Piling Operations (BS5288-4:1992). British Standards Institution, London, 70 p.	1992; Reference; P1-2006:5228-1; This reference has 2 citations; one informative and one normative. Both citations can be attributed to the updated version of BS5228-2:2009, however one will require some revision of the text. (NB Original referencing is incorrect. The standard is BS 5228, NOT BS 5288.)	3b
Superseded, Withdrawn	BS EN 1992-1-1:2004	P1-2006:8110-1	300	BSI (1997) Structural Use of Concrete. Part 1 - Code of Practice for Design and Construction (BS8110-1:1997). British Standards Institution, London, 163 p.	1997; Reference; P1-2006:8110-1; This reference has 3 citations; 1 historical and 2 normative. The historical citation requires retention of the reference. Both normative citations are not consistent with current European practice set out in BS EN 1992-1-1:2004. It is recommended that these citations be removed through amendment of the text and citation of current standards.	1
Current, Superseded	BS6349-1-3:2012	P1-2006:6349-1	300	BSI (2000a) Maritime Structures, Part 1 – Code of Practice for General Criteria (BS 6349-1:2000). British Standards Institution, London, 239 p.	2000a; Reference; P1-2006:6349-1; This reference has one informative citation in the publication. The reference requires updating to the current standard; BS6349-1-3:2012.	3b
Revised, Withdrawn	BS EN 1997-2:2007	P1-2006:1997X-1	300	BSI (2000b) Eurocode 7: Geotechnical Design – Part 3: Design Assisted by Field Testing (DD ENV 1997-3:2000). British Standards Institution, London, 146 p.	2000b; Reference; P1-2006:1997X-1; This reference has 3 citations; 1 normative and 2 informative . The normative citation should be deleted as it is not supported by any current design or execution standard. The informative citations should be reallocated to current standard; BS EN 1997-2:2007.	2

Table L1 - Summary of Current British Standard References and Replacement Eurocodes

BS Status	Relevant Updated Code for Citation	ID No.	Page no.	Existing Content of Technical Guidance Document	General Comments to define Scope of Updating / Specific Clauses in EN (s) / UK NA(s)	Scope of Updating
Revised, Withdrawn	BS EN 1536:2010	P1-2006:1536-1	300	BSI (2000c) Execution of Special Geotechnical Work – Bored Piles (BS EN 1536:2000) British Standards Institution, London, 87 p.	2000c; Reference; P1-2006:1536-1; This reference has 2 citations, both informative. The reference is out of date and the current standard should be referenced. This will not alter the validity of the citations, although additional text may be required in the text of the publication.	3b
Current, Work in hand	BS EN 12699:2001	P1-2006:12699-1	300	BSI (2001) Execution of Special Geotechnical Work – Displacement Piles (BS EN 12699:2001). British Standards Institution, London, 46 p.	2001; Reference; P1-2006:12699-1; This reference has 3 citations; all informative. The reference standard is current.	1
Revised, Withdrawn	BS 8500-1:2006+A1:2012	P1-2006:8500-1	300	BSI (2002) Concrete – Complimentary British Standard to BS EN 206-1: Part 1 – Method of Specifying and Guidance for Specifier (BS 8500-1:2002). British Standards Institution, London, 44 p.	2002; Reference; P1-2006:8500-1; This reference has one informative citation in the publication. The reference has been updated and needs to be amended to BS8500-1:2006+A1:2012.	3b
Current	BS EN 1997-1:2004	P1-2006:1977-1	300	BSI (2004) Eurocode 7: Geotechnical Design – Part 1: General Rules (BS EN 1997-1:2004). British Standards Institution, London, 167 p.	2004; Reference; P1-2006:1977-1; This reference has 4 citations; all informative. The reference standard is current. One citation, however, is incorrect: P1-2006:2004-2 should refer to BS EN 1997-2:2007.	1
Current	BS EN 14199:2005	P1-2006:14199-1	300	BSI (2005) Execution of Special Geotechnical Works – Micropiles (BS 14199:2005). British Standards Institution, London, 48 p.	2005; Reference; P1-2006:14199-1; This reference has 2 citations, both informative. Although the information cited is correct and has not changed, it is recommended that the reference be changed to BS EN 1993-5:2007 as this is the primary source of the quoted information and it is a design standard, not an execution standard.	1

Table L2 - Extracts of Relevant Sections or Clauses of the British Standards and Eurocodes / National Annexes

Relevant Updated Code for Citation	ID No.	Page no.	Scope of Updating	Extracts of Relevant Sections or Clauses of the superseded British Standard(s)	Extracts of Relevant Sections or Clauses of the replacement British/European Standards
Technical Clauses in Report					
BS 8004:1986 Code of Practice for Foundations					
BS8004:1986 (NCCI)	P1-2006:8004-2	23	2	Shallow foundations are taken to be those where the depth below finished ground level is less than 3 m and include strip, pad and raft foundations. The choice of 3 m is arbitrary; shallow foundations where the depth/breadth ratio is high may need to be designed as deep foundations (see 2.3.3). Similarly, some of the considerations in this section apply to deeper foundations where the depth/breadth ratio is low. The various forms of shallow foundations are illustrated in Powell (1979).	No change
BS8004:1986 (NCCI)	P1-2006:8004-3	55	1	Piles may be divided into three main types, depending on their effect on the soil as shown in Figure 14. These are as follows. a) Large displacement piles. These include all types of solid pile, including timber and precast concrete and steel or concrete tubes closed at the lower end by a shoe or plug, which may either be left in place or extruded to form an enlarged foot. b) Small displacement piles. These include rolled steel sections, such as H piles, open-ended tubes and hollow sections if the ground enters freely during driving. However, it should be recognized that open-ended tubes and hollow sections frequently plug and become displacement piles particularly in cohesive soils. H-piles may behave similarly. c) Replacement piles. These are formed by boring or other methods of excavation; the borehole may be lined with a casing or tube that is either left in place or extracted as the hole is filled.	No change
BS8004:1986 (NCCI)	P1-2006:8004-4	153	1	See Appendix A Derivation of charts for the determination of allowable bearing pressures on weak and broken rocks	No change
BS8004:1986 (NCCI)	P1-2006:8004-5	196	1	No material found in BS8004:1986 that could be related to the citation. Citation appears to be an error.	No change
BS8004:1986 (NCCI)	P1-2006:8004-6	205, 206	1	7.4.2.5.2 Hammer. Piles may be driven with any type of hammer, provided they penetrate to the prescribed depth or attain the specific resistance without being damaged. The hammer, helmet, dolly and pile should be coaxial and should sit squarely one upon the other. The weight or power of the hammer should be sufficient to ensure a final penetration of not more than 5 mm per blow, unless rock has been reached. It is always preferable to employ the heaviest hammer practicable and to limit the stroke, so as not to damage the pile. When choosing the size of the hammer, regard should be given to whether the pile is to be driven to a given resistance or to a given depth. The stroke of a single-acting or drop hammer should be limited to 1.2 m, preferably 1 m. A shorter stroke and particular care should be used when there is a danger of damaging the pile. The following are examples of such conditions: a) where, in the early stages of driving a long pile, a hard layer near the ground surface has to be penetrated; b) where there is very soft ground to a considerable depth, so that a large penetration is achieved at each hammer blow; c) where the pile is expected suddenly to reach refusal on rock or other virtually impenetrable soil.	No change

Table L2 - Extracts of Relevant Sections or Clauses of the British Standards and Eurocodes / National Annexes

Relevant Updated Code for Citation	ID No.	Page no.	Scope of Updating	Extracts of Relevant Sections or Clauses of the superseded British Standard(s)	Extracts of Relevant Sections or Clauses of the replacement British/European Standards
BS EN 1997-1:2004	P1-2006:8004-7	280, 281	4b	In cl 7.5.1, BS8004:1986 states 'For practical purposes, the ultimate bearing capacity may be taken to be that load, applied to the head of the pile, which causes the head of the pile to settle 10% of the pile diameter, unless the value of the ultimate bearing capacity is otherwise defined by some clearly recognizable feature of the	Cl 7.6.1.1(3) of BS EN 1997-1:2004 states 'For piles in compression it is often difficult to define an ultimate limit state from a load settlement plot showing a continuous curvature. In these cases, settlement of the pile top equal to 10% of the pile base diameter should be adopted as the "failure" criterion'.
CP4:1954 Code of Practice for Foundations					
N/A	P1-2006:CP4-2	23	1	Original CP4:1954 not found	Not required.
BS6349-1:2000 Maritime Structures, Part 1 – Code of Practice for General Criteria					
BS6349-1-3:2012	P1-2006:6349-2	25	3a	BS6349-1:2000, Section 6 - Geotechnical considerations, whole text.	BS6349-1-3:2012, whole document.
BS EN 1997-1:2004 Eurocode 7: Geotechnical Design – Part 1: General Rules					
BS EN 1997-2:2007	P1-2006:1997-2	52	3a	Incorrect reference	Revise reference to BS EN 1997-2:2007 cl 4.11 and Annex K. (see P1-2006:1997X-2)
BS EN 1997-1:2004	P1-2006:1997-3	53	1	BS EN 1997-1:2004 in cl 6.8(6) states: 'Total and differential settlements of the structure as a whole should be calculated in accordance with 6.6.2. For this purpose, subgrade reaction models are often not appropriate. More precise methods, such as finite element computations, should be used when ground-structure interaction has a	No change
BS EN 1997-1:2004	P1-2006:1997-4	83	1	BS EN 1997-1:2004 in cl 2.4.7.1(1) states: — loss of equilibrium of the structure or the ground, considered as a rigid body, in which the strengths of structural materials and the ground are insignificant in providing resistance (EQU); — internal failure or excessive deformation of the structure or structural elements, including e.g. footings, piles or basement walls, in which the strength of structural materials is significant in providing resistance (STR); — failure or excessive deformation of the ground, in which the strength of soil or rock is significant in providing resistance (GEO); — loss of equilibrium of the structure or the ground due to uplift by water pressure (buoyancy) or other vertical actions (UPL); — hydraulic heave, internal erosion and piping in the ground caused by hydraulic gradients (HYD)	No change
BS EN 1997-1:2004	P1-2006:1997-5	84	1	All of BS EN 1997-1:2004.	No change
DD ENV 1997-3:2000 Eurocode 7: Geotechnical Design – Part 3: Design Assisted by Field Testing					
BS EN ISO 22476-13	P1-2006:1997X-2	52	2	DD ENV 1997-3:2000 Section 11.	Revise reference to BS EN 1997-2:2007 cl 4.11 and Annex K. (see P1-2006:1997-2)
BS EN 1997-2:2007	P1-2006:1997X-3	52	2	The stated equation does not appear in DD ENV 1997-3:2000, which is a superceded standard.	No equivalent equation in the updated standard.
BS EN 1536:2010	P1-2006:1997X-4	240	2	No reference to mechanical under-reaming tools or forming bell-outs has been found in DD ENV 1997-3:2000.	Not required.
BS8110-1:1997 Structural Use of Concrete. Part 1 - Code of Practice for Design and Construction					
N/A	P1-2006:8110-2	84	1	Historic reference to whole document.	No change
BS EN 1992-1-1:2004	P1-2006:8110-3	163	5	The reference does not support the text in the publication due to changes in the reference document.	No equivalent text in current standard to support the text in GEO Publication 1/2006.
BS EN 1992-1-1:2004	P1-2006:8110-4	207	4a	The reference does not support the text in the publication due to changes in the reference document.	BS EN 1992-1-1:2004, Table 7.1N.

Table L2 - Extracts of Relevant Sections or Clauses of the British Standards and Eurocodes / National Annexes

Relevant Updated Code for Citation	ID No.	Page no.	Scope of Updating	Extracts of Relevant Sections or Clauses of the superseded British Standard(s)	Extracts of Relevant Sections or Clauses of the replacement British/European Standards
BS 14199:2005 Execution of Special Geotechnical Works – Micropiles					
BS EN 14199:2005	P1-2006:14199-2	162	1	Annex D Guidance on corrosion rates	No change
BS EN 14199:2005	P1-2006:14199-3	163	1	7.6.1 The protection against corrosion of steel elements placed in a micropile shall take into account: the aggressiveness of the environment (groundwater, soil, stray electric currents, etc.); the micropile type; the type of load (tension or compression); the type of steel; and	No change
BS8500-1:2002 Concrete – Complimentary British Standard to BS EN 206-1: Part 1 – Method of Specifying and Guidance for Specifier					
BS 8500-1:2006+A1:2012	P1-2006:8500-2	162	3a	Whole of BS8500:2002.	Whole of BS8500-1:2006.
BS EN 12699:2001 Execution of Special Geotechnical Work – Displacement Piles					
BS EN 12699:2001	P1-2006:12699-2	208	1	Cl 7.7.2 and cl 7.7.3 of BS EN 12699:2001.	No change
BS EN 12699:2001	P1-2006:12699-3	208	1	Cl 7.7.2 of BS EN 12699:2001.	No change
BS EN 12699:2001	P1-2006:12699-4	211	1	Cl 7.7.2 and cl 7.7.3 of BS EN 12699:2001.	No change
BS5228-4:1992 Noise Control on Construction and Open Sites – Code of Practice for Noise and Vibration Control Applicable to Piling Operations					
BS5228-2:2009	P1-2006:5228-2	223	3a	BS5228-4:1992 not found	BS5228-2:2009 cl 8.5
BS5228-2:2009	P1-2006:5228-3	223	5	BS5228-4:1992 not found	BS5228-2:2009 Annex E
BS7385-1:1990 Evaluation and Measurement for Vibration in Buildings – Part 1: Guide for Measurement of Vibrations and Evaluation of Their Effects on Buildings					
BS ISO 4866:2010	P1-2006:7385-2	225	4a	All of BS7385-1:1990.	All of BS ISO 4866:2010.
BS EN 1536:2000 Execution of Special Geotechnical Work – Bored Piles					
BS EN 1536:2010	P1-2006:1536-2	229	3a	See Table 8.7 of GEO Publication 1/2006.	See Tables 1 and 2 of BS EN 1536:2010.
BS EN 1536:2010	P1-2006:1536-3	230	5	See Table 8.7 of GEO Publication 1/2006.	See Tables 1 and 2 of BS EN 1536:2010.

GEO Publication No. 1/2006 - Foundation Design and Construction

Table L3 - Description of Standards, Differences and Recommended Amendments

ID No.	Page no.	Scope of Updating	Description of Design, Specification and/or Testing Required		Effects of differences in Adopting Up-to-date Standard(s)	Recommended Amendments
			Quoted Standard(s)	Up-to-date Standard(s)		
Technical Clauses in Report						
BS 8004:1986 Code of Practice for Foundations						
P1-2006:8004-2	23	2	NCCI.	NCCI.	N/A	Delete citation and amend text accordingly.
P1-2006:8004-3	55	1	NCCI.	NCCI.	No change.	No amendment required. Citation is to NCCI.
P1-2006:8004-4	153	1	NCCI.	NCCI.	No change.	No amendment required. Citation is to NCCI.
P1-2006:8004-5	196	1	NCCI.	NCCI.	No change.	No amendment required. Citation is to NCCI.
P1-2006:8004-6	205, 206	1	NCCI.	NCCI.	No change.	No amendment required. Citation is to NCCI.
P1-2006:8004-7	280, 281	4b	Definition of ultimate limit state derived from a pile test.	Definition of ultimate limit state derived from a pile test.	No change.	Citation to be updated to current standard.
CP4:1954 Code of Practice for Foundations						
P1-2006:CP4-2	23	1	General historical reference to whole document.	N/A	N/A	No amendment required. Citation is historical.
BS6349-1:2000 Maritime Structures, Part 1 – Code of Practice for General Criteria						
P1-2006:6349-2	25	3a	General guidance on maritime ground investigation.	General guidance on maritime ground investigation.	No change.	Citation to be updated to current standard.
BS EN 1997-1:2004 Eurocode 7: Geotechnical Design – Part 1: General Rules						
P1-2006:1997-2	52	3a	Incorrect reference.	N/A	N/A	Cite correct reference. Amend text.
P1-2006:1997-3	53	1	General advice on settlement calculations.	N/A	N/A	No amendment required. Standard is current.
P1-2006:1997-4	83	1	Classification of failure mechanisms.	N/A	N/A	No amendment required. Standard is current.
P1-2006:1997-5	84	1	Definition of basis of design on partial factor methods.	N/A	N/A	No amendment required. Standard is current.
DD ENV 1997-3:2000 Eurocode 7: Geotechnical Design – Part 3: Design Assisted by Field Testing						
P1-2006:1997X-2	52	2	Description and procedure for plate loading test.	Description and procedure for plate loading test.	No change.	Remove citation. The replacement reference for P1-2006:1997-2 covers this citation.
P1-2006:1997X-3	52	2	Equation for deriving plate modulus.	No equivalent, following withdrawal of referred standard.	No reference available.	Delete reference and retain existing equation.
P1-2006:1997X-4	240	2	Cited information not found in standard.	No equivalent to cited information found in current standards.	No appropriate alternative reference found.	Remove citation.
BS8110-1:1997 Structural Use of Concrete. Part 1 - Code of Practice for Design and Construction						
P1-2006:8110-2	84	1	General historical reference to whole document.	N/A	N/A	No amendment required. Citation is historical.
P1-2006:8110-3	163	5	Advice on crack width in reinforced concrete.	Advice on crack width in reinforced concrete.	Classification of environment has changed so current citation is no longer supported.	Text to be amended and citation updated to new standard.
P1-2006:8110-4	207	4a	Implied advice on crack width in pre-cast concrete piles not found in reference.	No advice on crack width in pre-cast concrete piles identified in current reference.	N/A	Citation to be updated to current standard.
BS 14199:2005 Execution of Special Geotechnical Works – Micropiles						
P1-2006:14199-2	162	1	Informative guidance on corrosion rates	Informative guidance on corrosion rates	N/A	No amendment required. Standard is current.
P1-2006:14199-3	163	1	Informative guidance on corrosion rates	Informative guidance on corrosion rates	N/A	No amendment required. Standard is current.
BS8500-1:2002 Concrete – Complimentary British Standard to BS EN 206-1: Part 1 – Method of Specifying and Guidance for Specifier						
P1-2006:8500-2	162	3a	Recommendations for specifying concrete grade and cover to reinforcement to improve corrosion resistance for different soil environments.	Recommendations for specifying concrete grade and cover to reinforcement to improve corrosion resistance for different soil environments.	No change.	Citation to be updated to current standard.
BS EN 12699:2001 Execution of Special Geotechnical Work – Displacement Piles						
P1-2006:12699-2	208	1	Advice on limits for driving stresses in pre-cast concrete piles.	N/A	N/A	No amendment required. Standard is current.
P1-2006:12699-3	208	1	Advice on limits for driving stresses in pre-cast concrete piles.	N/A	N/A	No amendment required. Standard is current.

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Table L3 - Description of Standards, Differences and Recommended Amendments

ID No.	Page no.	Scope of Updating	Description of Design, Specification and/or Testing Required		Effects of differences in Adopting Up-to-date Standard(s)	Recommended Amendments
			Quoted Standard(s)	Up-to-date Standard(s)		
P1-2006:12699-4	211	1	Advice on limits for driving stresses in pre-cast concrete piles.	N/A	N/A	No amendment required. Standard is current. However, minor transcription errors should be corrected.
BS5228-4:1992 Noise Control on Construction and Open Sites – Code of Practice for Noise and Vibration Control Applicable to Piling Operations						
P1-2006:5228-2	223	3a	Not found, but stated purpose of reference is to give general guidance on control of vibration from piling operations.	General guidance on control of vibration from piling operations.	No change.	Citation to be updated to current standard.
P1-2006:5228-3	223	5	Not found, but quoted value of k is 0.75.	The value of k in current guidance ranges from 1 to 5 dependent on ground conditions and driving resistance.	Updated guidance gives more information on selection of the correct value for a key factor in assessing vibration.	Citation to be updated to current standard and text to be revised to address values of k.
BS7385-1:1990 Evaluation and Measurement for Vibration in Buildings – Part 1: Guide for Measurement of Vibrations and Evaluation of Their Effects on Buildings						
P1-2006:7385-2	225	4a	General guidance on evaluation and measurement for vibration in buildings.	General guidance on evaluation and measurement for vibration in buildings.	No change.	Citation to be updated to current standard.
BS EN 1536:2000 Execution of Special Geotechnical Work – Bored Piles						
P1-2006:1536-2	229	3a	Advice on bentonite slurry.	Advice on bentonite slurry.	No change.	Citation to be updated to current standard.
P1-2006:1536-3	230	5	Specification of limits for bentonite slurry composition.	Specification of limits for bentonite slurry composition.	Requirement for limits on filter cake to be added to properties of bentonite slurry.	Citation to be updated to current standard. Additional information required in Table 8.7.
Reference Section of Report						
P1-2006:CP4-1	299	1	This reference document is: Superseded, Withdrawn.	The current document(s) is (are): N/A	No change.	No amendment required. Citation is historical.
P1-2006:8004-1	299	1	This reference document is: Superseded, Withdrawn.	The current document(s) is (are): BS EN 1997-1:2004 (although BS8004:1986 is retained for	No change.	No amendment required. Citations are to current parts of the standard (NCCI).
P1-2006:7385-1	299, 300	4b	This reference document is: Superseded, Withdrawn.	The current document(s) is (are): BS ISO 4866:2010	The identified documents are directly equivalent to the existing citations in GEO Publication	Reference to be replaced by current standard.
P1-2006:5228-1	300	3b	This reference document is: Revised, Withdrawn.	The current document(s) is (are): BS5228-2:2009	The identified documents are directly equivalent to the existing citations in GEO Publication	Reference to be replaced by current standard.
P1-2006:8110-1	300	1	This reference document is: Superseded, Withdrawn.	The current document(s) is (are): BS EN 1992-1-1:2004	No change.	No amendment required. Citation is historical.
P1-2006:6349-1	300	3b	This reference document is: Current, Superseded.	The current document(s) is (are): BS6349-1-3:2012	The identified documents are directly equivalent to the existing citations in GEO Publication	Reference to be replaced by current standard.
P1-2006:1997X-1	300	2	This reference document is: Revised, Withdrawn.	The current document(s) is (are): BS EN 1997-2:2007	All citations of this reference can be either reallocated to current references or deleted.	Reference to be deleted. All citations reallocated to current standards.
P1-2006:1536-1	300	3b	This reference document is: Revised, Withdrawn.	The current document(s) is (are): BS EN 1536:2010	The identified documents are directly equivalent to the existing citations in GEO Publication	Reference to be replaced by current standard.
P1-2006:12699-1	300	1	This reference document is: Current, Work in	The current document(s) is (are): BS EN	No change.	No amendment required. Standard is current.
P1-2006:8500-1	300	3b	This reference document is: Revised, Withdrawn.	The current document(s) is (are): BS 8500-1:2006+A1:2012	The identified documents are directly equivalent to the existing citations in GEO Publication	Reference to be replaced by current standard.
P1-2006:1977-1	300	1	This reference document is: Current.	The current document(s) is (are): BS EN 1997-	No change.	No amendment required. Standard is current.
P1-2006:14199-1	300	1	This reference document is: Current.	The current document(s) is (are): BS EN	No change.	No amendment required. Standard is current.

Table L4 - Recommended Revisions to Existing Clauses referring to British Standards

Page no.	BS Referenced in Technical Guidance Document	Scope of Updating (1)	ID No.	Existing Content of Technical Guidance Document	Recommended Content for Updated Technical Guidance Document
23	BS 8004:1986	2	P1-2006:8004-2	Foundations can be classified as shallow and deep foundations, depending on the depth of load-transfer from the structure to the ground. The definition of shallow foundations varies in different publications. BS 8004 (BSI, 1986) adopts an arbitrary embedment depth of 3 m as a way to define shallow foundations. In the context of this document, a shallow foundation is taken as one in which the depth to the bottom of the foundation is less than or equal to its least dimension (Terzaghi et al, 1996).	Foundations can be classified as shallow and deep foundations, depending on the depth of load-transfer from the structure to the ground. The definition of shallow foundations varies in different publications. In the context of this document, a shallow foundation is taken as one in which the depth to the bottom of the foundation is less than or equal to its least dimension (Terzaghi et al, 1996).
23	CP 4:1954	1	P1-2006:CP4-2	Traditional foundation design practice in Hong Kong relies, in part, on the British Code of Practice for Foundations (BSI, 1954), together with empirical rules formulated some 40 years ago from local experience with foundations in weathered rocks. Foundation design and construction for projects that require the approval of the Building Authority shall comply with the Buildings Ordinance and related regulations. The Code of Practice for Foundations (BD, 2004a) consolidates the practice commonly used in Hong Kong. Designs in accordance with the code are 'deemed-to-satisfy' the Buildings Ordinance and related regulations. Rational design approaches based on accepted engineering principles are recognised practice and are also allowed in the Code of Practice for Foundations. This publication is intended as a technical reference document that presents modern methods in the design of foundation.	No change.
25	BS 6349-1:2000	3a	P1-2006:6349-2	General guidance on the range of site investigation methods is given in Geoguide 2 : Guide to Site Investigation (GCO, 1987), which is not repeated here. Specific guidance pertinent to marine investigations is given in BS 6349-1:2000 (BSI, 2000a). This Chapter highlights the more important aspects of site investigation with respect to foundations.	General guidance on the range of site investigation methods is given in Geoguide 2 : Guide to Site Investigation (GCO, 1987), which is not repeated here. Specific guidance pertinent to marine investigations is given in BS 6349-1-3:2012 (BSI, 2012a). This Chapter highlights the more important aspects of site investigation with respect to foundations.

Table L4 - Recommended Revisions to Existing Clauses referring to British Standards

Page no.	BS Referenced in Technical Guidance Document	Scope of Updating (1)	ID No.	Existing Content of Technical Guidance Document	Recommended Content for Updated Technical Guidance Document
52	BS EN 1997-1:2004 DD ENV 1997-3:2000 DD ENV 1997-3:2000	3a 2 2	P1-2006:1997-2 P1-2006:1997X-2 P1-2006:1997X-3	Guidelines and procedures for conducting plate loading tests are given in BS EN 1997-1:2004 (BSI, 2004) and DD ENV 1997-3:2000 (BSI, 2000b). The test should mainly be used to derive geotechnical parameters for predicting the settlement of a shallow foundation, such as the deformation modulus of soil. It may be necessary to carry out a series of tests at different levels. The plate loading test may also be used to determine the bearing capacity of the foundation in fine-grained soils, which is independent of the footing size. The elastic soil modulus can be determined using the following equation (BSI, 2000b): $$E_s = q_{net} \cdot b \cdot \left(\frac{(1-\upsilon_s{}^2)}{\delta_p}\right) I_s \quad [3.4]$$ where q_{net} = net ground bearing pressure δ_p = settlement of the test plate I_s = shape factor b = width of the test plate ν_s = Poisson's ratio of the soil E_s = Young's modulus of soil	Guidelines and procedures for conducting plate loading tests are given in BS EN 1997-2:2007 (BSI, 2007). The test should mainly be used to derive geotechnical parameters for predicting the settlement of a shallow foundation, such as the deformation modulus of soil. It may be necessary to carry out a series of tests at different levels. The plate loading test may also be used to determine the bearing capacity of the foundation in fine-grained soils, which is independent of the footing size. The elastic soil modulus can be determined using the following equation: $$E_s = q_{net} \cdot b \cdot \left(\frac{(1-\upsilon_s{}^2)}{\delta_p}\right) I_s \quad [3.4]$$ where q_{net} = net ground bearing pressure δ_p = settlement of the test plate I_s = shape factor b = width of the test plate ν_s = Poisson's ratio of the soil E_s = Young's modulus of soil For tests carried at the base of a borehole, the plate settlement modulus should be determined in accordance with BS EN 1997-2:2007 (BSI, 2007).
53	BS EN 1997-1:2004	1	P1-2006:1997-3	Raft foundations are relatively large in size. Hence, the bearing capacity is generally not the controlling factor in design. Differential and total settlements usually govern the design. A common approach for estimating the settlement of a raft foundation is to model the ground support as springs using the subgrade reaction method. This method suffers from a number of drawbacks. Firstly, the modulus of subgrade reaction is not an intrinsic soil property. It depends upon not only the stiffness of the soil, but also the dimensions of the foundation. Secondly, there is no interaction between the springs. They are assumed to be independent of each other and can only respond in the direction of the loads. BSI (2004) cautions that the subgrade reaction model is generally not appropriate for estimating the total and differential settlement of a raft foundation. Finite element analysis or elastic continuum method is preferred for the design of raft foundations (French, 1999; Poulos, 2000).	No change.

Table L4 - Recommended Revisions to Existing Clauses referring to British Standards

Page no.	BS Referenced in Technical Guidance Document	Scope of Updating (1)	ID No.	Existing Content of Technical Guidance Document	Recommended Content for Updated Technical Guidance Document
55	BS 8004:1986	1	P1-2006:8004-3	In the installation of piles, either displacement or replacement of the ground will predominate. A classification system based on the degree of ground displacement during pile installation, such as that recommended in BS 8004 (BSI, 1986) encompasses all types of piles and reflects the fundamental effect of pile construction on the ground which in turn will have a pronounced influence on pile performance. Such a classification system is therefore considered to be the most appropriate.	No change.
83	BS EN 1997-1:2004	1	P1-2006:1997-4	Both ultimate and serviceability limit states should be considered when undertaking a limit state design for foundations. The ultimate limit state governs the safety of a structure against collapse or excessive deformation of a foundation leading to the collapse of the structure it supports. It should have a very low probability of occurrence. Different failure mechanisms are considered in a limit state design as given below (BSI, 2004) : (a) loss of equilibrium of the structure or the ground, in which the strengths of structural materials and the ground are insignificant in providing resistance, (b) excessive deformation of foundations, in which the strength of soils are significant in providing resistance, (c) excessive deformation of the structure or structural elements, in which the structural strength is significant in providing resistance, (d) loss of equilibrium of the structure due to uplift pressure of water or other vertical forces, in which the strength of materials or the ground is not significant in providing resistance, and (e) hydraulic failure, internal erosion or piping caused by hydraulic gradients.	No change.
84	BS 8110-1:1997	1	P1-2006:8110-2	In the past three decades, design codes for concrete structures are largely based on limit state design, e.g. BS 8110 (BSI, 1997) and Code of Practice for the Structural Use of Concrete (BD, 2004d). A partial factor is defined for each type of material and loading to reflect the relative uncertainties. There are merits in adopting limit state design for foundations such that a common design methodology is adopted both for the superstructure and substructure.	No change.
84	BS EN 1997-1:2004	1	P1-2006:1997-5	The load and material factor design method applies partial factors to reduce material strengths. Resistance is calculated based on these factored material strengths. This is sometimes known as the European approach, as it is adopted in the Eurocodes, e.g. BS EN 1997-1:2004 (BSI, 2004). Simpson (2000) considered that this approach is better, as it applies factors to the sources of uncertainties.	No change.

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Page no.	BS Referenced in Technical Guidance Document	Scope of Updating (1)	ID No.	Existing Content of Technical Guidance Document	Recommended Content for Updated Technical Guidance Document
153	BS 8004:1986	1	P1-2006:8004-4	In determining the relevant rock mass deformation parameters, consideration should be given to influence of non-homogeneity, anisotropy and scale effects. Deformation of a rock mass is often governed by the characteristics of discontinuities. There are a number of methods that can be used to assess the deformation properties including : (a) correlations of the modulus of the rock mass to the modulus of the intact rock (the latter can be correlated to the uniaxial compressive strength, σ_c) by means of a mass factor denoted as 'j' factor (BSI, 1986), (b) semi-empirical correlations with the Rock Mass Rating, RMR (Figure 6.7), and (c) semi-empirical relationships with properties of the rock joints (Barton, 1986), which can be used in complex computer codes based on distinct element models of the rock mass (Cundall, 1980).	No change.
162	BS 14199:2005	1	P1-2006:14199-2	It is recommended that steel piles above seabed, whether fully immersed, within the tidal or splash zone, or generally above the splash zone, should be fully protected against corrosion for the design life (CEO, 2002). This precaution should also extend to precast piles where the sections are welded together with the use of steel end plates. Below the sea-bed level, an allowance for corrosion loss of 0.05 mm per year on the outer face of steel pile is considered reasonable. BS EN 14199:2005 (BSI, 2005) put forward some guidance on the rate of corrosion in different types of soils.	No change.
162	BS 8500-1:2002	3a	P1-2006:8500-2	In the case of concrete piles, the best defence against the various possible forms of attack as summarised by Somerville (1986) is dense, low permeability concrete with sufficient cover to all steel reinforcement. Bartholomew (1980) classified the aggressiveness of the soil conditions and provided guidance on possible protective measures for concrete piles. Further recommendations are given in BS 8500-1:2002 (BSI, 2002) for specifying concrete grade and cover to reinforcement to improve corrosion resistance for different soil environments. However, high strength concrete may not necessarily be dense and homogeneous. Specifying high strength concrete is no guarantee for durability.	In the case of concrete piles, the best defence against the various possible forms of attack as summarised by Somerville (1986) is dense, low permeability concrete with sufficient cover to all steel reinforcement. Bartholomew (1980) classified the aggressiveness of the soil conditions and provided guidance on possible protective measures for concrete piles. Further recommendations are given in BS 8500-1:2006+A1:2012 (BSI, 2012b) for specifying concrete grade and cover to reinforcement to improve corrosion resistance for different soil environments. However, high strength concrete may not necessarily be dense and homogeneous. Specifying high strength concrete is no guarantee for durability.
163	BS 14199:2005	1	P1-2006:14199-3	With grouted piles such as mini-piles, the minimum cover to steel elements depends on factors such as the aggressiveness of the environment, magnitude of tension or compression load, steel type used (BSI, 2005). This may need to be increased in contaminated ground or alternatively a permanent casing may be required.	No change.
163	BS 8110-1:1997	5	P1-2006:8110-3	Where protected from direct exposure to the marine atmosphere, reinforced concrete should comply with the recommendations given in BS 8110 (BSI, 1997) for 'moderate' conditions.	Where protected from direct exposure to the marine atmosphere, reinforced concrete should comply with the recommendations given in BS EN 1992-1-1:2004 (BSI, 2004a).

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Page no.	BS Referenced in Technical Guidance Document	Scope of Updating (1)	ID No.	Existing Content of Technical Guidance Document	Recommended Content for Updated Technical Guidance Document
196	BS 8004:1986	1	P1-2006:8004-5	*[In Figure 7.13]*: I = influence factor, see Poulos & Davis (1974) or BSI (1986)	No change.
205	BS 8004:1986	1	P1-2006:8004-6	The weight of the hammer should be sufficient to ensure a final penetration of not more than 5 mm per blow unless rock has been reached. It is always preferable to employ the heaviest hammer practicable and to limit the stroke, so as not to damage the pile. When choosing the size of the hammer, attention should be given to whether the pile is to be driven to a given resistance or to a given depth. The stroke of a single-acting or drop hammer should be limited to 1.2m, preferably 1m. A shorter stroke and particular care should be used when there is a danger of damaging the pile. (BSI, 1986).	No change.
207	BS 8110-1:1997	4a	P1-2006:8110-4	The criterion for acceptable crack width prior to driving should be considered in relation to the degree of aggressiveness of the ground and groundwater and the need for making allowance for possible enlargement of cracks as a result of pile driving. In general, cracks up to 0.3 mm are normally considered acceptable (BSI, 1997), although for bridge design, the local practice has been to adopt a limiting crack width of 0.2 mm for buried structures.	The criterion for acceptable crack width prior to driving should be considered in relation to the degree of aggressiveness of the ground and groundwater and the need for making allowance for possible enlargement of cracks as a result of pile driving. In general, cracks up to 0.3 mm are normally considered acceptable (BSI, 2004a), although for bridge design, the local practice has been to adopt a limiting crack width of 0.2 mm for buried structures.
208	BS EN 12699:2001	1	P1-2006:12699-2	The driving stresses must not exceed the limiting values that will cause damage to the pile. The following limits on driving stresses suggested by BS EN 12699:2001 (BSI, 2001) are given in Table 8.6.	No change.
208	BS EN 12699:2001	1	P1-2006:12699-3	The General Specification for Civil Engineering Works (HKG, 1992) stipulates that the driving stresses in precast reinforced concrete piles and pre-stressed concrete piles should not exceed one half of the specified grade strength of the concrete, which is much more restrictive than the limits proposed by BS EN 12699:2001.	No change.
211	BS EN 12699:2001	1	P1-2006:12699-4	*[In Table 8.6]*: Notes : (1) f_y is the yield stress of steel, A_s is the area of steel reinforcement and f_{cu} is the specified grade strength of concrete.	No change.
223	BS 5228-4:1992 BS 5228-4:1992	3a 5	P1-2006:5228-2 P1-2006:5228-3	BS 5228:4-1992 (BSI, 1992) gives some guidance on the control of vibration due to piling operations. The method for estimating peak particle velocity takes similar form as Equation [8.3], with the exception that it is based on radial distance between the source and the receiver. The coefficient k can be taken as 0.75 for hammer-driven piles, but this should be confirmed with field measurements (BSI, 1992).	BS 5228:2-2009 (BSI, 2009) gives some guidance on the control of vibration due to percussive piling. The method for estimating peak particle velocity takes similar form as Equation [8.3], with the exception that it is based on radial distance between the pile toe and the receiver. A range of values of coefficient k are given for different ground conditions for percussive piling (BSI, 2009), but this should be confirmed with field measurements.
225	BS 7385-1:1990	4a	P1-2006:7385-2	Detailed assessment of the effects of ground-borne vibrations on adjacent buildings and structures can be carried out in accordance with BS 7385 Part 1:1990 (BSI, 1990).	Detailed assessment of the effects of ground-borne vibrations on adjacent buildings and structures can be carried out in accordance with BS ISO 4866:2010 (BSI, 2010b).

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Page no.	BS Referenced in Technical Guidance Document	Scope of Updating (1)	ID No.	Existing Content of Technical Guidance Document	Recommended Content for Updated Technical Guidance Document
229	BS EN 1536:2000	3a	P1-2006:1536-2	Specifications on properties of bentonite slurry are given in the General Specification for Civil Engineering Works (HKG, 1992) and BS EN 1536:2000 (BSI, 2000c). These specifications are summarised in Table 8.7. Some local contractors have adopted more stringent control on properties of bentonite.	Specifications on properties of bentonite slurry are given in the General Specification for Civil Engineering Works (HKG, 1992) and BS EN 1536:2010 (BSI, 2010a). These specifications are summarised in Table 8.7. Some local contractors have adopted more stringent control on properties of bentonite.
230	BS EN 1536:2000	5	P1-2006:1536-3	*[In Table 8.7]*: BS EN 1536:2000 (BSI, 2000c)	*[In Table 8.7]*: BS EN 1536:2010 (BSI, 2010a) *[Add row to Table 8.7 with the following content:-* *Bentonite Property at 20°C* Filter Cake in mm *BS EN 1536:2010 (BSI, 2010a)* Fresh Bentonite suspension <3 Re-used Bentonite suspension <6 N/A(1)*]*
240	DD ENV 1997-3:2000	2	P1-2006:1997X-4	Mechanical under-reaming tools should be used in forming bell-outs (BSI, 2000b). The dimensions of the bell-outs can be calibrated at the ground surface by stretching the cutting arm fully and recording the vertical displacement of drill string. The use of offset chiselling to form the bell-outs is not encouraged because of difficulty in controlling the chisel. It is not easy to form the enlargement in a full diameter.	Mechanical under-reaming tools should be used in forming bell-outs. The dimensions of the bell-outs can be calibrated at the ground surface by stretching the cutting arm fully and recording the vertical displacement of drill string. The use of offset chiselling to form the bell-outs is not encouraged because of difficulty in controlling the chisel. It is not easy to form the enlargement in a full diameter.
280	BS 8004:1986	4b	P1-2006:8004-7	A commonly-used definition of failure load is taken to be that at which settlement continues to increase without further increase in load; alternatively, it is customarily taken as the load causing a settlement of 10% of pile diameter (BSI, 1986).	A commonly-used definition of failure load is taken to be that at which settlement continues to increase without further increase in load; alternatively, it is customarily taken as the load causing a settlement of 10% of pile base diameter (BSI, 2004b).
299	N/A	1	P1-2006:CP4-1	BSI (1954) British Standard Code of Practice for Foundations (CP4:1954). British Standards Institution, London, 173 p.	No change.
299	BS EN 1997-1:2004 (although BS8004:1986 is retained for NCCI)	1	P1-2006:8004-1	BSI (1986) British Standard Code of Practice for Foundations (BS 8004:1986). British Standards Institution, London, 149 p.	No change.
299	BS ISO 4866:2010	4b	P1-2006:7385-1	BSI (1990) Evaluation and Measurement for Vibration in Buildings – Part 1: Guide for Measurement of Vibrations and Evaluation of Their Effects on Buildings (BS 7385-1 :1990). British Standards Institution, London, 18 p.	BSI (2010b) Mechanical vibration and shock. Vibration of fixed structures. Guidelines for the measurement of vibrations and evaluation of their effects on structures (BS ISO 4866:2010). British Standards Institution, London, 40 p.

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300	BS5228-2:2009	3b	P1-2006:5228-1	BSI (1992) Noise Control on Construction and Open Sites – Code of Practice for Noise and Vibration Control Applicable to Piling Operations (BS5288-4:1992). British Standards Institution, London, 70 p.	BSI (2009) Code of practice for noise and vibration control on construction and open sites - Part 2: Vibration (BS 5228-2:2009). British Standards Institution, London, 89 p.
300	BS EN 1992-1-1:2004	1	P1-2006:8110-1	BSI (1997) Structural Use of Concrete. Part 1 - Code of Practice for Design and Construction (BS8110-1:1997). British Standards Institution, London, 163 p.	No change.
300	BS6349-1-3:2012	3b	P1-2006:6349-1	BSI (2000a) Maritime Structures. Part 1 – Code of Practice for General Criteria (BS 6349-1:2000). British Standards Institution, London, 239 p.	BSI (2012a) Maritime works - Part 1-3: General - Code of practice for geotechnical design (BS 6349-1-3:2012). British Standards Institution, London, 64 p.
300	BS EN 1997-2:2007	2	P1-2006:1997X-1	BSI (2000b) Eurocode 7: Geotechnical Design – Part 3: Design Assisted by Field Testing (DD ENV 1997-3:2000). British Standards Institution, London, 146 p.	*[Reference deleted]*
300	BS EN 1536:2010	3b	P1-2006:1536-1	BSI (2000c) Execution of Special Geotechnical Work – Bored Piles (BS EN 1536:2000) British Standards Institution, London, 87 p.	BSI (2010a) Execution of special geotechnical works - Bored piles (BS EN 1536:2010). British Standards Institution, London, 82 p.
300	BS EN 12699:2001	1	P1-2006:12699-1	BSI (2001) Execution of Special Geotechnical Work – Displacement Piles (BS EN 12699:2001). British Standards Institution, London, 46 p.	No change.
300	BS 8500-1:2006+A1:2012	3b	P1-2006:8500-1	BSI (2002) Concrete – Complimentary British Standard to BS EN 206-1: Part 1 – Method of Specifying and Guidance for Specifier (BS 8500-1:2002). British Standards Institution, London, 44 p.	BSI (2012b) Concrete. Complementary British Standard to BS EN 206-1. Method of specifying and guidance for the specifier (BS 8500-1:2006+A1:2012). British Standards Institution, London, 59 p.
	Additional reference required.				BSI (2004a) Eurocode 2: Design of concrete structures - Part 1-1: General rules and rules for buildings (BS EN 1992-1-1:2004). British Standards Institution, London, 225 p.
300	BS EN 1997-1:2004	1	P1-2006:1977-1	BSI (2004) Eurocode 7: Geotechnical Design – Part 1: General Rules (BS EN 1997-1:2004). British Standards Institution, London, 167 p.	No change.
300	BS EN 14199:2005	1	P1-2006:14199-1	BSI (2005) Execution of Special Geotechnical Works – Micropiles (BS 14199:2005). British Standards Institution, London, 48 p.	No change.
	Additional reference required.				BSI (2007) Eurocode 7: Geotechnical design - Part 2: Ground investigation and testing (BS EN 1997-2:2007). British Standards Institution, London, 196 p.