

Appendix H

Summaries for Geoguide 7: Guide to Soil Nail Design and Construction

Geoguide 7: Guide to Soil Nail Design and Construction

Table H1 - 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 1377-3:1990 Methods of test for soils for civil engineering purposes - Chemical and electro-chemical tests						
Confirmed, Current	N/A	GEO7:1377-1	31	Table 4.2 specifies the methods to be used for various electro-chemical tests to assess the aggressive nature of the ground in relation to corrosion of steel soil nail tendons. The test for resistivity is cited to BS1377-3:1990 .	1990; Normative; GEO7:1377-1; Many test methods described in BS1377:1990 have been replaced in Hong Kong practice by methods published in Geospec 3 (GEO, 2001). This is the case with most tests in Table 4.2. The resistivity test, however, is not included in Geospec 3 so the current citation and reference	1
BS EN ISO 1461:1999 Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods						
Revised, Withdrawn	BS EN ISO 1461:2009	GEO7:1461-1	38	Common corrosion protection measures used in Hong Kong can be divided into three classes: (a) Class 1 - Hot-dip galvanising with a minimum zinc coating of 610 g/m ² to BS EN ISO 1461: 1999 (BSI, 1999) plus corrugated plastic sheathing in accordance with the General Specification for Civil Engineering Works (CEDD, 2006a), (b) Class 2 - Hot-dip galvanising with a minimum zinc coating of 610 g/m ² to BS EN ISO 1461: 1999 (BSI, 1999) plus a 2 mm sacrificial thickness on the radius of the steel reinforcement, and (c) Class 3 - Hot-dip galvanising with a minimum zinc coating of 610 g/m ² to BS EN ISO 1461: 1999 (BSI, 1999) .	1999; Normative; GEO7:1461-1; Geoguide 7 stipulates that a minimum of 610g/m ² of zinc galvanizing is required for corrosion protection of steel soil nail tendons. BS EN ISO 1461 provides the method of testing to ensure compliance with coating requirements. A mass of 610g/m ² is defined as the minimum requirement to be applied to steel that has a minimum thickness of 6mm. This requirement is contained in Table 3 of the current edition of BS EN ISO 1461 and appears to have not changed from the previous edition.	3a
BS 8110-1:1997 Structural use of concrete - Code of practice for design and construction						
Revised, Withdrawn	BS EN 1992-1-1:2004	GEO7:8110-1	44	The allowable pullout resistance provided by the grout-reinforcement bond length in the passive zone, T _{GR} , is given by: $T_{GR} = \frac{\beta \sqrt{f_{cu}} P_r L}{F_{GR}} \dots \dots \dots (5.3)$ where β = coefficient of friction at the grout-reinforcement interface, which depends on the bar type characteristic in accordance with BS 8110 (BSI, 1997) , e.g., 0.5 for high yield deformed steel bars f _{cu} = characteristic strength of cement grout P _r = effective perimeter of the soil-nail reinforcement L = bond length of the soil-nail reinforcement in the passive zone F _{GR} = factor of safety against pullout failure at grout-reinforcement interface	1997; Normative; GEO7:8110-1; The reference document has been replaced by BS EN 1992-1-1:2004 and it's UK NA. This has changed the basis for design and therefore the current equation 5.3 cannot be supported by the new standard. The application of Eurocodes for structural design of slope works is currently subject to a study . Equation 5.3 is to be amended in line with the outcome of the study. The formula relates this length to a design bond strength between steel and grout and the steel/grout contact area. The design bond strength in turn is a function of the characteristic strength of the grout. The formula refers to a factor β obtained from Table 3.26 of BS 8110 which is one of two factors by which the characteristic strength is adjusted. In the vast majority of cases the grout / soil bond will govern the soil nail design, rather than this calculated steel / grout bond. β√f _{cu} denotes design ultimate anchorage bond stress (f _{bu}) (Ch. 3.12.8.4 of BS8110:1997). In BS EN 1992-1:2004, the design value of the ultimate bond stress (f _{bd}) for ribbed bars is calculated using equation 8.2 of Ch. 8.4.2.. As such, equation 8.2 of BS EN 1992-1:2004 should replace β√f _{cu} in equation 5.3 of Geoguide 7.	5
Reference Section of Report						
Confirmed, Current	BS1377-3:1990	GEO7:1377-2	83	BSI (1990). <i>Methods of Test for Soils for Civil Engineering Purposes (BS 1377: Parts 1 to 9: 1990)</i> . British Standards Institution, London, UK, 406 p.	1990; Reference; GEO7:1377-2; The test method accompanying the citation is not included in Geospec 3. Consequently the current reference should remain.	1

Table H1 - 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 1992-1-1:2004	GEO7:8110-2	83	BSI (1997). <i>Structural Use of Concrete. Part 1 - Code of Practice for Design and Construction (BS 8110: Part 1: 1997)</i> . British Standards Institution, London, UK, 163 p.	1997; Reference; GEO7:8110-2; BS EN 1992-1-1:2004 supersedes BS 8110:1997, and following a separate study on it's the impact on structural slope design it is recommended that the reference be updated to BS EN 1992-1-1:2004 and it's UK NA which provides supporting information.	5
Revised, Withdrawn	BS EN ISO 1461:2009	GEO7:1461-2	83	BSI (1999). <i>Hot Dip Galvanised Coatings on Fabricated Iron and Steel Articles - Specifications and Test Methods (BS EN ISO 1461: 1999)</i> . British Standards Institution, London, UK, 22 p.	1999; Reference; GEO7:1461-2; There is no material difference between the withdrawn document and its replacement. It is recommended that the reference be updated.	3a

Table H2 - 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 1377-3:1990 Methods of test for soils for civil engineering purposes - Chemical and electro-chemical tests					
N/A	GEO7:1377-1	31	1	BS1377-3:1990, cl 10 Determination of resistivity	N/A - Current standard not superseded.
BS EN ISO 1461:1999 Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods					
BS EN ISO 1461:2009	GEO7:1461-1	38	3a	Table 3 of BS EN ISO 1461;1999	Table 3 of BS EN ISO 1461:2009
BS 8110-1:1997 Structural use of concrete - Code of practice for design and construction					
BS EN 1992-1-1:2004	GEO7:8110-1	44	5	BS8110-1:1997 whole document.	BS EN 1992-1-1:2004 whole document and UK NA.

Table H3 - 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 1377-3:1990 Methods of test for soils for civil engineering purposes - Chemical and electro-chemical tests						
GEO7:1377-1	31	1	Method of test to determine resistivity.	N/A	No change	No amendment required as the reference remains current.
BS EN ISO 1461:1999 Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods						
GEO7:1461-1	38	3a	Minimum thickness requirements for galvanizing.	Minimum thickness requirements for galvanizing.	No change	Existing reference has been withdrawn. Reference should be updated to current.
BS 8110-1:1997 Structural use of concrete - Code of practice for design and construction						
GEO7:8110-1	44	5	Design factors for calculation of tendon/grout interface stresses.	Design factors for calculation of tendon/grout interface stresses.	The new standard approaches the calculation in a fundamentally different way. This calculation is a structural calculation which has been the subject of review by another GEO study.	The current reference should be updated in line with recommendations of the GEO study.
Reference Section of Report						
GEO7:1377-2	83	1	This reference document is: Confirmed, Current.	The current document(s) is (are): BS1377-3:1990	No change	No amendment required as the reference remains current.
GEO7:8110-2	83	5	This reference document is: Revised, Withdrawn.	The current document(s) is (are): BS EN 1992-1-1:2004	Change of design approach.	BS EN reference to be adopted as per the recommendations of the GEO study.
GEO7:1461-2	83	3a	This reference document is: Revised, Withdrawn.	The current document(s) is (are): BS EN ISO 1461:2009	No change	Existing reference has been withdrawn. Reference should be updated to current.

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Table H4 - 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
				Property	Measured Value	Mark	Test Method	
31	BS1377-3:1990	1	GEO7:1377-1	Resistivity (ohm-cm)	≥10,000 <10,000 but ≥3,000 <3,000 but ≥1,000 <1,000 but ≥100 <100	0 -1 -2 -3 -4	BS1377: Part 3: 1990, Test 10.4 (BSI, 1990)	No Change.
38	BS EN ISO 1461:1999	3a	GEO7:1461-1	Common corrosion protection measures used in Hong Kong can be divided into three classes: (a) Class 1 - Hot-dip galvanising with a minimum zinc coating of 610 g/m ² to BS EN ISO 1461: 1999 (BSI, 1999) plus corrugated plastic sheathing in accordance with the General Specification for Civil Engineering Works (CEDD, 2006a), (b) Class 2 - Hot-dip galvanising with a minimum zinc coating of 610 g/m ² to BS EN ISO 1461: 1999 (BSI, 1999) plus a 2 mm sacrificial thickness on the radius of the steel reinforcement, and (c) Class 3 - Hot-dip galvanising with a minimum zinc coating of 610 g/m ² to BS EN ISO 1461: 1999 (BSI, 1999) .				Common corrosion protection measures used in Hong Kong can be divided into three classes: (a) Class 1 - Hot-dip galvanising with a minimum zinc coating of 610 g/m ² to BS EN ISO 1461: 2009 (BSI, 2009) plus corrugated plastic sheathing in accordance with the General Specification for Civil Engineering Works (CEDD, 2006a), (b) Class 2 - Hot-dip galvanising with a minimum zinc coating of 610 g/m ² to BS EN ISO 1461: 2009 (BSI, 2009) plus a 2 mm sacrificial thickness on the radius of the steel reinforcement, and (c) Class 3 - Hot-dip galvanising with a minimum zinc coating of 610 g/m ² to BS EN ISO 1461: 2009 (BSI, 2009) .
44	BS8110-1:1997	5	GEO7:8110-1	The allowable pullout resistance provided by the grout-reinforcement bond length in the passive zone, TGR, is given by: $T_{GR} = \frac{\beta \sqrt{f_{cu}} P_r L}{F_{GR}} \quad (5.3)$ where β = coefficient of friction at the grout-reinforcement interface, which depends on the bar type characteristic in accordance with BS 8110 (BSI, 1997), e.g., 0.5 for high yield deformed steel bars f_{cu} = characteristic strength of cement grout P_r = effective perimeter of the soil-nail reinforcement L = bond length of the soil-nail reinforcement in the passive zone F_{GR} = factor of safety against pullout failure at grout-reinforcement interface				The allowable pullout resistance provided by the grout-reinforcement bond length in the passive zone, TGR, is given by: $T_{GR} = \frac{2.25 \eta_1 \eta_2 f_{ctd} P_r L}{F_{GR}} \quad \dots\dots\dots (5.3)$ where η_1 = the coefficient related to the quality of the bond condition and the position of the bar during concreting in accordance with Clause 8.4.2 of BS EN 1992-1-1:2004 (BSI, 2004) η_2 = the coefficient related to the bar diameter in accordance with Clause 8.4.2 of BS EN 1992-1-1:2004 (BSI, 2004) f_{ctd} = the design value of concrete tensile strength in accordance with BS EN 1992-1-1:2004 (BSI, 2004) and NA to BS EN 1992-1:2004 (BSI, 2005) P_r = effective perimeter of the soil-nail reinforcement L = bond length of the soil-nail reinforcement in the passive zone F_{GR} = factor of safety against pullout failure at grout-reinforcement interface
83	BS5493:1977	1	GEO7:1377-2	BSI (1990). Methods of Test for Soils for Civil Engineering Purposes (BS 1377: Parts 1 to 9: 1990). British Standards Institution, London, UK, 406 p.				No Change.
83	BS5930:1981	5	GEO7:8110-2	BSI (1997). Structural Use of Concrete. Part 1 - Code of Practice for Design and Construction (BS 8110: Part 1: 1997). British Standards Institution, London, UK, 163 p.				BSI (2004). 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, 230 p
83	BS6031:1981	3a	GEO7:1461-2	BSI (1999). Hot Dip Galvanised Coatings on Fabricated Iron and Steel Articles - Specifications and Test Methods (BS EN ISO 1461: 1999). British Standards Institution, London, UK, 22 p.				BSI (2009). Hot Dip Galvanised Coatings on Fabricated Iron and Steel Articles - Specifications and Test Methods (BS EN ISO 1461: 2009). British Standards Institution, London, UK, 16 p.
	Additional reference required.							BSI (2005). UK National Annex to Eurocode 2: Design of Concrete Structures - Part 1-1: General Rules and Rules for Buildings (NA to BS EN 1992-1-1:2004). British Standards Institution, London, 20 p