

**BS EN 1997 –
WHERE ARE WE WITH
EUROCODE 7?**

**David Norbury
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The Eurocode
scream!

Or is this an
opportunity?



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- New approaches?
- Formalisation of current practice?
- Progress?

BRITISH STANDARD

BS EN 1997-1:2004

**Eurocode 7:
Geotechnical design —**

Part 1: General rules

BRITISH STANDARD

BS EN 1997-2:2007

**Eurocode 7 —
Geotechnical design —**

Part 2: Ground investigation and testing

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Eurocode 7 (EN 1997)

- Part 1 published 2004
 - National Annex published
- Part 2 published 2007
 - NA public comment closed. Publication soon
- National Standards can coexist with EN 1997 until March 2010
- After that – withdrawal or supersession

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EC7 Part 1 - GENERAL RULES

<ol style="list-style-type: none"> 1 General 2 Basis of geotechnical design 3 Geotechnical data 4 Supervision of construction, monitoring and maintenance 5 Fill, dewatering, ground improvement and reinforcement 6 Spread foundations 7 Pile foundations 8 Anchorages 9 Retaining structures 10 Hydraulic failure 11 Overall stability 12 Embankments 	<p>PLUS:</p> <p>Annexes A to J</p> <p>NATIONAL ANNEX</p>
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EC 7 Part 2

<ol style="list-style-type: none"> 1 General 2 Planning of GI 3 Soil and rock sampling and groundwater measurements 4 Field tests in soil and rock 5 Laboratory tests on soil and rock 6 Ground Investigation report 	<p>Annexes</p> <p>– A – B Planning</p> <p>– C – K Field Testing</p> <p>– L – W Laboratory testing</p>	<p>+ NATIONAL ANNEX</p>
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EC 7 Part 2

1. General
2. Planning of GI
3. Soil and rock sampling and groundwater measurements
4. Field tests in soil and rock
5. Laboratory tests on soil and rock
6. Ground Investigation report

PLUS:
ANNEXES A to X
National Annex

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AIM OF INVESTIGATIONS

- Geotechnical investigations shall provide sufficient data concerning the ground and the ground-water conditions at and around the construction site for a proper description of the essential ground properties and a *reliable assessment of the characteristic values of the ground parameters* to be used in design calculations

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INVESTIGATION POINTS SPACING

Structure/example	Spacing	Arrangement
High-rise and industrial	15m - 40m	Grid
Large-area	60m	Grid
Linear roads, railways, channels, pipelines, dikes, tunnels, retaining walls	20 - 200m	-
Special bridges, stacks, machinery foundations	2 - 6	Per foundation
Dams and weirs	25 - 75m	Along vertical sections

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INVESTIGATION DEPTHS SHALLOW FOUNDATIONS

- For high-rise and civil engineering projects $z \geq 6m, z \geq 3.0 b$
- For raft foundations $z \geq 1.5 b$
- On competent strata with known geology z may be reduced to 2m
- With uncertain geology, at least one borehole should go to $z \geq 5m$
- where
 - z is depth of investigation below base of foundation
 - b is width of foundation

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INVESTIGATION DEPTHS PILE FOUNDATIONS

- Depth of investigation points $z \geq 5m, z \geq b, z \geq 3 D_b$
- On competent strata with known geology z may be reduced to 2m
- With uncertain geology, at least one borehole should go to $z_a \geq 5m$
- where
 - z is depth of investigation below lowest point of foundation
 - b is width of group (smaller side)
 - D_b is base diameter

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NUMBERS OF TESTS – per stratum

Test	Range	No experience	Medium experience	Extensive experience
PSD		4 - 6		2 - 4
Water content		All samples of Quality Class 1 to 3		
Strength Index		All samples of Quality Class 1		
Consistency Limits		3 - 5		1 - 3
Density	>0.02 Mg/m ³	4	3	2
	<0.02 Mg/m ³	3	2	1
c_u	Max > 2 min	6	4	3
	Max < 1.25 min	3	2	1
Φ	$r < 0.95$	4	3	2
	$r > 0.98$	2	1	1

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REPORTING

- **Geotechnical Design Report GDR**
- **Part 1, 2.8**
 - The Geotechnical Design Report (GDR) shall record the assumptions, data, methods of calculation and results of the verification of safety and serviceability
- **Geotechnical Investigation Report GIR**
- **Part 2, 6**
 - The GIR will comprise part of the GDR

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GROUND INVESTIGATION REPORT

- The results of a geotechnical investigation shall be compiled in the Ground Investigation Report
- The GIR shall consist of:
 - a presentation of all available geotechnical information including geological features and relevant data;
 - a geotechnical evaluation of the information, stating the assumptions made in the interpretation of the test results.
- The GIR may include derived values.
- The GIR shall state known limitations of the results.
- The GIR should propose necessary further field and laboratory investigations, with comments justifying the need for this further work.

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PRESENTATION

- The presentation of geotechnical information shall include documentation of the methods, procedures and results including all relevant reports of:
 - desk studies
 - field reconnaissance
 - field investigations, such as sampling and measurement
 - field tests
 - laboratory tests
- The results of the field and laboratory investigations shall be presented and reported according to the requirements defined in the EN and/or ISO standards applied in the investigations

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THE EUROCODE 7 SUITE

- THE ATTACHMENTS
- A series of Standards on:
 - Execution of geotechnical works**
 - Qualifications**
 - Drilling and sampling**
 - Field tests**
 - Laboratory tests**
 - Soil and rock description and classification**

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EXECUTION STANDARDS

EN 1536: 1999	Bored piles
EN 1537: 1999	Ground anchors
EN 1538: 2000	Diaphragm walls
EN 12063: 1999	Sheet-pile walls
EN 12699: 2000	Displacement piles
EN 12715: 2000	Grouting
EN 12716: 2001	Jet grouting
EN 14199: 2005	Micropiles
EN 14475: 2006	Reinforced fill
EN 14679: 2005 & 6	Deep mixing
EN14731: 2005	Ground treatment by deep vibration
EN15237: 2007	Vertical drainage

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STANDARDS

<ul style="list-style-type: none"> • 22475 - SAMPLING METHODS AND GROUNDWATER MEASUREMENT • 22476 - FIELD TESTING • 22477 - GEOTECHNICAL STRUCTURE TESTS • 22282 - GEO-HYDRAULIC TESTS • 17892 - LABORATORY TESTING • 14688 & 14689 - SOIL AND ROCK DESCRIPTION 	<ul style="list-style-type: none"> /1 Technical principles for execution /2 Qualification criteria for enterprises and personnel – TS /3 Conformity assessments of enterprises and personnel by third parties – TS <p style="text-align: center; font-weight: bold;">PUBLISHED</p>
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INFORMATION BEFORE SAMPLING AND MEASUREMENT

At least the following information **shall** be available before starting

- a) **objective** of the sampling and measurements
- b) **location** of the planned boreholes or excavations or groundwater measurements
- c) **orientation**, inclination and acceptable deviations in boreholes
- d) surveying requirements, and expected geological and hydrogeological conditions
- e) required **accuracy** and uncertainty of measurements
- f) **frequency** of measurements
- g) environmental and safety risks
- h) **possible risks**, e.g. services, traffic, ordnance, contamination

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INFORMATION BEFORE SAMPLING AND MEASUREMENT

- i) planned **depths** of boreholes and/or excavations
- j) sampling method and sampling category intended
- k) requirements on sample and hole numbering
- l) sample handling, storage and transport intended
- m) **in situ tests intended**
- n) hole completion method and reinstatement
- o) environmental **care**
- p) emergency arrangements
- q) name of contact person
- r) the planned flow of information

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SAMPLE QUALITY CLASSES

- All samples are “disturbed” at least to some extent
- Category A sampling methods
 - “no” disturbance of structure, void ratio, water content or chemistry
 - eg thin wall pushed, rotary core or block samples
- Category B sampling methods
 - Constituents in original proportions and water content
 - General arrangement of constituents and layers intact
 - eg thick walled driven, Mostap
- Category C sampling methods
 - Structure, layers and water content changed
 - eg SPTs, window samples, bulk bags, grab samples

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USE OF SAMPLES

Sample category	A	A, B	A, B, C
Type of soil	Y	Y	Y
Sequence of layers	Y	Y	Y
Strata boundaries	Y	Y	
Water content	Y	Y	
Index, PSD	Y	Y	
Density, strength, permeability	Y	U100 = Class B	
Compressibility, shear strength	Y		

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COMPETENCE – 22475/2 AUDIT – 22475/3

- Defines the required competencies of the
 - Responsible Expert
 - Qualified Driller
 - Enterprise (or company)
- Frequency of third party assessment

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STANDARDS

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22476/2 and /3 - DYNAMIC PROBING and SPT

- IMPLEMENTED 2007
- BS1377 Part 9 Clause 3.2 (DP) and
- BS1377 Part 9 Clause 3.3 (SPT)

WERE WITHDRAWN

Do not refer to these

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HAMMER CALIBRATION

- Energy ratio = % ratio of actual to theoretical energy of the hammer
- Energy losses occur. Therefore the energy ratio of the equipment has to be known if the N values are going to be used for the quantitative evaluation of foundations or comparison of results.
- A certificate of the calibration of the energy ratio immediately below the driving head or anvil **shall** be available
- Q – what use are designers going to make of Er?

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STANDARDS

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STANDARDS

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STANDARDS

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STANDARDS

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SOIL DESCRIPTION

- Improvements by defining all terms
- No word order prescribed
- No % terms for secondary constituents
- Plasticity terms included – low and high
- ‘silty CLAY’ and ‘clayey SILT’ replace ‘CLAY/SILT’
- More organic soils terms
- Six angularity terms
- Consistency terms by hand test only = CHANGE
- Some other differences but no conflict

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ROCK DESCRIPTION

- Improvements by defining all terms
- Terms generally ISRM, not BS
 - Strength terms
 - Roughness terms
 - Aperture terms
- Weathering classifications are those discarded in 1999

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ROCK STRENGTH q_{ur} MPa

TERM	2007	1999
• Extremely weak	• 0.6 – 1.0 in UK	• -
• Very weak	• 1 – 5	• <1.25
• Weak	• 5 – 25	• 1.25 – 5
		• 5 – 12.5
• Medium strong	• 25 – 50	• 12.5 - 50
• Strong	• 50 – 100	• 50 - 100
• Very strong	• 100 – 250	• 100 – 200
• Extremely strong	• > 250	• > 200

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CURRENT SITUATION

Over the next few years, there are a large number of mostly normative new Standards coming out which have to be implemented and followed

Progress being tracked on www.drnorbury.co.uk

Practitioners will now need many Standards to hand to ensure their practice is compliant.

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IMPLEMENTATION

- New Standards - be aware of existence
 - read and understand
- Update specification clauses
- Inform and Train staff
- Notify clients
- Deploy procedures into practice
- Update recording and reporting templates
- Adjust interpretation routines as necessary
- Implementation achieved – months?

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HOW MANY STANDARDS?

		TOTAL
Eurocodes	EC 0 - 9	1 2 3 4 5 6 7 8 9 10
Eurocode 7	Parts 1 - 2	2
National Annexes		4
Execution Standards		16
Test Standards		
	22475	1 2 3
	22476	1 2 3 4 5 6 7 8 9 10 11 12 13
	22477	1 2 3 4 5 6 7 8
	22282	1 2 3 4 5 6
	17892	1 2 3 4 5 6 7 8 9 10 11 12
	14688	1 2 3
		61
		YES THAT IS 61

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- 61 Standards on the shelf = THE SCREAM
- So what is the progress element?

Impact of Eurocode 7 Part 2

“...the greater general emphasis on the assessment of deformation is likely to lead to a greater need for SI providers to consider ground deformation parameters”

- Opportunity to raise standards in scope and precise targeting of investigation and its aims
- Go out and communicate with clients
- Improve market for technical work quality