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David Norbury
Engineering Geologist

AN OVERVIEW OF EUROPEAN GI METHODS

David Norbury
David Norbury Limited
Sussex University

QUESTIONS ASKED

D David Norbury Engineering Geologist N

	In soft to firm soil	In stiff to very stiff soil	In extremely weak to weak rock	In medium strong or stronger rock
Typical method(s) of drilling/ forming the borehole				
Typical method(s) used to obtain good quality samples for strength/ deformability testing				
Typical field test(s) used as index test				
Typical field test(s) used to determine strength/ deformability				

- **Brief questionnaire informally circulated**
- **Responses summarised**
- **North European bias**

UK METHODS

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	In soft to firm soil	In stiff to very stiff soil	In extremely weak to weak rock	In medium strong or stronger rock
Typical method(s) of drilling/ forming the borehole	Cable percussion Dynamic Probing CPTU	Cable percussion Dynamic probing Rotary core drilling (CPTU)	Cable percussion Rotary core drilling	Rotary core drilling
Typical method(s) used to obtain good quality samples for strength/ deformability testing	Piston samples	Rotary core Piston samples (UT100)	Rotary core	Rotary core
Typical field test(s) used as index test	SPT	SPT	(SPT)	n/a
Typical field test(s) used to determine strength/ deformability	SPT CPTU Vane test Pressuremeter	SPT CPTU Pressuremeter	(SPT) Pressuremeter ?	n/a

SOFT TO FIRM SOIL

Typical method(s) of drilling/ forming the borehole	DE – Hammer driving DK – Cable percussion, dry rotary drilling, vibrocoring FI – Drilling with sampler - piston, auger NO – CPT then piston sampling SE – NO-X, Odex 88-120 mm
Typical method(s) used to obtain good quality samples for strength/ deformability testing	DE – Clay cutter with inside cutter, thin walled sampler DK –Shelby tube, vibrocore FI – Block and piston samplers 52 mm, Auger sampler NO – 54-76 mm piston sampler, 160-250 mm block sampler SE – 50 mm piston sampler
Typical field test(s) used as index test	DE – Dynamic probing DK – see next slide FI – only by laboratory testing NO – CPTU, vane SE – Visual description and manual testing
Typical field test(s) used to determine strength/ deformability	DE – Pressuremeter, phicometer DK – Vane, CPT, SPT FI – Vane, weight sounding NO – CPTU, vane, plate loading SE – n/a

DK – TYPICAL FIELD TESTS

- In connection with the geological soil description classification tests including
  - natural water content,
  - bulk density/void ratio and
  - carbonate content are performed – normally by the drilling company.
- These standard tests often are supplemented by further testing by the drilling company:
  - particle size distribution,
  - plasticity index,
  - loss of ignition (organic content),
  - particle density,
  - carbonate content.

- Similar answers of reliance on description and various levels of index and more sophisticated testing came from several countries, particularly in rock testing

STIFF TO VERY STIFF SOIL

Typical method(s) of drilling/ forming the borehole	DE – Hammer driving DK – Cable percussion, dry rotary drilling, core drilling FI – auger sampler NO – CPT then piston sampler, moraine (foil) sampler SE – NO-X, Odex 88-120 mm
Typical method(s) used to obtain good quality samples for strength/ deformability testing	DE – Clay cutter with inside cutter, thin walled sampler DK – Shelby tube, rotary core FI – Rotary core NO – 54-76 mm piston sampler SE – 50 mm piston, Geobor S
Typical field test(s) used as index test	DE – Dynamic probing DK – only by laboratory testing FI – only by laboratory testing NO – CPTU, vane test SE – none in particular
Typical field test(s) used to determine strength/ deformability	DE – Pressuremeter, phicometer DK – Vane test, CPT, SPT FI – Weight sounding, DPSH NO – CPTU, vane test, plate loading SE – n/a

EXTREMELY WEAK TO WEAK ROCK (INCLUDES TILLS)

Typical method(s) of drilling/ forming the borehole	DE – Rotary core drilling DK – Cable percussion, dry rotary drilling, core drilling and DTH drilling FI – Rotary core drilling and percussive drilling, MWD NO – Rotary core drilling SE – NO-X, Odex 60-120 mm, Geobore S
Typical method(s) used to obtain good quality samples for strength/ deformability testing	DE – Rotary and wireline core DK –Shelby tube, rotary core FI – Rotary core NO – Rotary core SE – Geobor S core
Typical field test(s) used as index test	DE – Dynamic probing for rockhead DK – only by laboratory testing FI – only by laboratory testing NO – none in particular SE – none in particular
Typical field test(s) used to determine strength/ deformability	DE – Pressuremeter DK – SPT, (CPT), Geophysics FI – DPSH NO – none in particular, laboratory testing SE – none in particular

MEDIUM STRONG OR STRONGER ROCK

Typical method(s) of drilling/ forming the borehole	DE – Rotary core drilling DK – Rotary core drilling, DTH drilling FI – Rotary coring and percussive drilling, MWD NO – Rotary core drilling SE – Rotary core drilling without casing
Typical method(s) used to obtain good quality samples for strength/ deformability testing	DE – Rotary core, wireline core DK – Rotary core FI – Rotary core (single or double barrel) NO – Rotary core SE – Rotary core
Typical field test(s) used as index test	DE – none DK – see next slide FI – only by laboratory testing NO – none in particular SE – none in particular
Typical field test(s) used to determine strength/ deformability	DE – (Pressuremeter) DK – Geophysics FI – Rotary or percussive drilling with MWD NO – none in particular, laboratory testing SE – n/a

OTHER COUNTRIES

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	In soft to firm soil	In stiff to very stiff soil	In extremely weak to weak rock	In medium strong or stronger rock
Typical method(s) of drilling/ forming the borehole	NL – CPTU	NL – CPTU	NL – CPTU	
Typical method(s) used to obtain good quality samples for strength/ deformability testing				
Typical field test(s) used as index test	FR – Menard pressuremeter NL – CPTU	FR – Menard pressuremeter NL – CPTU	FR – Menard pressuremeter FR - MWD NL – CPTU	FR – MWD
Typical field test(s) used to determine strength/ deformability	FR – Menard pressuremeter NL – CPTU	FR – Menard pressuremeter NL – CPTU	FR – Menard pressuremeter NL – CPTU	

KEY POINTS ARISING

- Methods used bear some reflection on the ground conditions nationally
- Cable percussion used in DE, DK as well as UK
- Sampling horizon located by CPT in NO
- Various piston and Shelby tube configurations widely used
- Index testing in laboratory but includes SPT, CPT, vane, and Dynamic probing
- CPTU and Vane test most widely used in soils, together with WST and DPSH
- Rotary core drilling widely used, down to firm soils, and in most rocks
- Various drilling configurations used including single, double and triple barrels, wireline, DTH
- MWD used in FI with drilling and to measure parameters
- Apparently only DK uses Geophysics to measure parameters
- Pressuremeters only mentioned by DE

SUMMARY

David Norbury
Engineering Geologist

- Incomplete informal summary
- Some common methods in use surprisingly widely
- Some strange selection of methods and tests in use
- A re-run of the survey would probably achieve more consistent responses