



Hampshire
County Council

Economy, Transport and Environment Department

Technical Guidance Note TG5 - Geotechnical Investigation, Testing and Design

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1. Policy / Approach

- 1.1. This Technical Guidance Note refers to the relevant standards for geotechnical investigation, testing and design for construction schemes to be built or adopted by Hampshire County Council (HCC).
- 1.2. Geotechnical investigation should be undertaken for all construction projects (i.e. roads, footways, structures (bridges, culverts, retaining walls), earthworks, soil stabilisation/improvement, infiltration drainage etc) in accordance with the relevant British Standards. It is a requirement that the execution of the provisions of the British Standards will be entrusted to appropriately qualified and experienced people. The aforementioned appropriately qualified and experienced people should assess the scope and scale of investigation and testing required in line with the design and scale of the project and provide the relevant reports to HCC with their S278/S38 submission and in advance of construction.
- 1.3. HCC will need to be satisfied that geotechnical investigation, testing and design has been carried out to a suitable standard prior to any adoption and will therefore require the relevant reports for review. Accordingly it would be advisable for developers/designers to agree the scope of proposed investigation and testing with the Council prior to undertaking any such work. Contact geotechnics@hants.gov.uk for further advice.
- 1.4. For guidance regarding archaeology, please refer to <https://www.hants.gov.uk/landplanningandenvironment/environment/historicenvironment>
- 1.5. For advice regarding unexploded ordnance risk assessments refer to:
 - CIRIA C681 - Unexploded ordnance (UXO) A guide for the construction industry, and
 - CIRIA C785 - Unexploded ordnance (UXO) risk management guide for land-based projects

2. Guidance

The principal British Standard to inform geotechnical investigation and testing is:

[BS 5930:2015+A1: 2020](#) Code of Practice for Ground Investigations

This cross-references other standards, to which reference should be made as appropriate.

Other publications (the list below is not exhaustive) which advise on investigation and testing in particular situations or requirements are:

ADEPT. [Managing Reclaimed Asphalt](#). Version 2019 Revision 1

Building Research Establishment. Concrete in Aggressive Ground, BRE [Special Digest 1](#). Watford: BRE, 2005.

Building Research Establishment. Soakaway Design. BRE [Digest 365](#).

Watford: BRE, 2016.

[BS 10175:2011+A2:2017](#), Investigation of Potentially Contaminated Sites – Code of Practice.

[BS EN 1997-1:2004+A1:2013](#) Eurocode 7 – Geotechnical Design
General Rules

[BS EN 1997-2:2007](#) Eurocode 7 – Geotechnical Design Ground
Investigation and Testing

[BS EN 16907 Parts 1-6 2018](#) Earthworks.

[Britpave](#). Soil Improvement and Soil Stabilisation- Definitive Industry
Guidance (2019).

[Britpave](#). Stabilised Soils as a Subbase or Base for Road and Other
Pavements (2004).

Highways England/National Highways Pavement (Highway) Design
Advice Notes;

[CD622](#) Managing Geotechnical Risk (2020)

[CD225](#) Design for New Pavement Foundations (2020)

[CS229](#) Data for Pavement Assessment (2020)

3. Technical Requirements

The following stages should be undertaken for a satisfactory investigation:

3.1. Desk Study

A desk study (or preliminary sources study as National Highways refer to it) with a field walkover/reconnaissance (where required) should be undertaken to identify the site history and salient features which will inform the scope of investigation required. This should be in line with section 2 of BS 5930 and Appendix D of CD622.

3.2. Investigation

The nature and scale of site investigation required should be determined by a competent geotechnical practitioner (holds a relevant qualification with at least 5 years post qualification experience) based on the desk study information and the development proposals. The investigation should utilise techniques sufficient to identify the soil types and properties in locations and to depths dependent upon the development proposals and in line with section 3 of BS5930. Examples of this are as below.

3.2.1. Pavement

Investigations for development sites should include investigations for highway pavement construction (pavement being the vehicular-trafficked carriageway as opposed to the pedestrian footway). This will normally involve shallow trial pits at approximately 50m spacings (the Design Manual for Roads and Bridges suggests a maximum of 60m) with in-situ testing and sampling for laboratory testing. Where ground conditions are variable or pavement lengths shorter, the spacings should be reduced to between 5m and 20m. For smaller sites, such as for a Section 278 junction or bellmouth, a minimum of three in-situ tests and three equilibrium determinations shall be undertaken per site. The exact number and position of tests to be undertaken shall be agreed with the Highway Authority in advance.

CD225 refers to LR1132 for equilibrium CBR determination and this considers high water table and low water table conditions. A high water table is one 300mm beneath formation level and a low water table is 1 metre down. Trial pits will therefore need to be excavated to a minimum of 1m to examine water table levels, preferably in winter or spring when levels are seasonally high.

CD225, CS229 and the Manual of Contract Documents for Highway Works advocate in-situ testing utilising the Dynamic Cone Penetrometer

(DCP), Falling Weight Deflectometer (FWD) or Lightweight Deflectometer (LWD).

Hampshire County Council will discourage the use of the DCP which is not suitable for the low strength soils found across much of Hampshire. HCC will accept the use of the LWD or Clegg Impact Hammer. Results may be presented either in CBR % or MPa.

Testing should be undertaken in accordance with the relevant standards or guidance. On plastic cohesive (clay) soils, samples should be laboratory tested to establish the plasticity index in consideration of determining the equilibrium CBR. In some circumstances soaked CBR testing might be required (i.e. in moisture sensitive/flood prone sites). To assist in the identification of chalk intact dry density (IDD) tests should be undertaken. Refer to [Technical Guidance Note TG6-1 - Pavement Foundation Design](#).

Tar bound Pavements

Where modification to the existing carriageway or tie in is required, PAK marker spray testing should be undertaken on the existing asphalt to confirm if there is any PAH contamination (from coal tar). If a PAK marker spray test gives a positive reading, samples should be sent for speciated PAH (PAH16) analysis (HCC County Highway Laboratory can arrange this testing if required) for waste classification purposes. Sample preparation and testing shall be in accordance with appendix C of the Adept guidance note Managing Reclaimed Asphalt.

3.2.2. Earthworks

The depth of investigation for earthworks will depend on the size of the earthworks. For cuttings, a depth in excess of the proposed cutting depth should be investigated and samples tested for earthworks suitability and to enable stability analysis, design and specification for soil re-use. Groundwater levels should be monitored for as long as possible, ideally over the Winter period. Generally water levels should be highest in March and lowest in October. For embankments, investigation will need to examine the soils beneath the proposed embankment and the bearing capacity and settlement characteristics determined. Stability should be analysed. If bearing capacity is low and settlements found to be excessive or stability an issue, then investigation for improvement techniques to considerable depths may be required. Investigations may therefore require trial pits, windowless sampler boreholes or percussive/rotary boreholes, or a combination of these.

If improvement techniques such as soil stabilisation are to be considered then appropriate laboratory testing of differing mixes should

be undertaken and reported, as per the relevant standards and guidance listed in section 2 above.

3.2.3. Structures

Investigation for proposed structures will be similar in concept to that for embankments – the footprint of retaining walls, culverts, headwalls, abutments, wing walls and approach embankments will need to be investigated to determine bearing capacity and settlement characteristics and deep boreholes may be required for piled foundations. Chemical assessment of the soils will be required for concrete specification. Groundwater levels should be monitored. Refer to [Technical Guidance Note TG7 – Adoption of Structures](#).

3.2.4. Contaminated Ground

Where contaminated ground is anticipated (i.e. from desk study) or encountered then investigation and testing will be required to assess the nature and extent of the contamination and to inform any remedial measures required which should be agreed with the relevant Borough or District Council Environmental Health/Contaminated Land Officer or the Environment Agency (as appropriate).

3.2.5. Made Ground

In a similar approach to that for contaminated land, any made ground (reworked natural soils or man-made materials placed in an uncontrolled manner) anticipated or encountered should be investigated to establish the extent, variability, composition, relative density of the materials and whether they are suitable for founding upon (commonly they are not). Contamination testing (including for the possible presence of asbestos) should be undertaken.

3.2.6. Infiltration testing

Where infiltration drainage is being considered the soils should be tested to establish that they are permeable, what the rate of infiltration is and the depth to groundwater. Groundwater monitoring may be required for this and this should preferably be undertaken over winter. Infiltration should be undertaken in the location of the proposed soakaway and to the depth of the proposed soakaway. Testing should be in accordance with BRE 365 and utilise three fills of the test pit. If the pit does not drain within 6-8 hours, then it's unlikely to be suitable. In chalk, samples should be taken for laboratory intact dry density (IDD) testing. This will determine the spacing from structures/roads to be applied. [Refer to Technical Guidance Note TG 8-1 Drainage - Infiltration](#)

3.3. Laboratory testing

Soil samples from ground investigations should be tested in UKAS accredited laboratories and to the relevant British Standard. The testing should be scheduled by a competent geotechnical practitioner (holds a relevant qualification with at least 5 years post qualification experience) with the intention of determining the mechanical and chemical properties of the soil for design purposes. Typically testing will be comprised of particle size determinations (gradings), Atterberg (liquid & plastic limit) testing, moisture contents, dry density/moisture content relationship testing, intact dry density (IDD) tests, chemical testing (including pH and sulfates), contamination testing, triaxial and shear box testing, consolidation (oedometer) tests, frost susceptibility tests, organic matter content, aggregate suitability tests etc. The nature of the development proposal and ground conditions will influence the number and types of testing required.

3.4. Reporting

Depending on the size of the site and the proposals (and in line with BS 5930, BS EN 1997 parts 1 and 2 and CD622) a separate Ground Investigation Report (GIR) and Geotechnical Design Report (GDR) may be necessary. This will be assessed on a site-by-site basis. On smaller schemes a combined report, also incorporating the earlier desk study information, may be acceptable. The reports should be written and approved by suitably qualified and experienced geotechnical practitioners. The information in these reports may form the basis of an Approval in Principle (AIP) submission for a highway structure or a Special Geotechnical Measures Form (SGMF) for strengthened earthworks approval. The reports should be submitted and approved by Hampshire County Council prior to any development taking place.

4. Further Support

- 4.1. Should you have a specific query or feedback about any of the content of this Technical Guidance Note, please send an email to technical.guidance@hants.gov.uk with the start of the email title as “TG5 – “
- 4.2. Should you have a query about applying this to your particular project, please contact:
- the Design Check Engineer dealing with your S278 or S38 application (if you are a Developer or Developer’s Consultant)
 - the Technical Guidance Note Specialist(s) (if you are a working within Hampshire County Council)