Laboratory Testing Information

Classification Tests

The Test	Used For	How Much Material	Things to Specify
Water Content (used to be called Moisture content)	Basic soil property. Find out where the soil is in relation to its liquid and plastic limits.	Silt & clay: 30 g Sand: 100 g Up to 10 mm: 500 g Up to 31.5 mm: 3 kg Up to 63 mm: 21 kg	None
Saturation Moisture Content (SMC) [not saturated moisture content]	Used in conjunction with chalk crushing value to classify freshly placed fill.	Intact lump of **chalk** 300 – 500 ml (around 1 kg)	None
Liquid & Plastic Limits (also known as Atterberg Limits or Plasticity Index)	Classify silts and clays by their plasticity. Can be used to indicate how much a soil might consolidate under load.	200 g of soil finer than 0.425 mm (so if gravelly or sandy, allow extra)	Whether 1 point test or 4 point test is required. (note: 4 point tests are usually specified unless material on site has been previously classified using 4 point tests)
Particle Size Distribution (PSD) -includes sieve analysis and mechanical analysis (by pipette or hydrometer method)	Quantifying the grain sizes that make up the soil.	Clay/silt/sand: 100 g Up to 6.3 mm: 300 g Up to 10 mm: 500 g Up to 20 mm: 2 kg Up to 37.5 mm: 14 kg Up to 63 mm: 40 kg	If mechanical analysis is required to differentiate the clay and silt content; typically conditional on how much fines there are, such as “MA if >15% fines”. If pipette (preferred) or hydrometer method is to be used.
Particle Density (used to be called Specific Gravity)	To help identify the mineralogy of the soil. To accurately determine the voids ratio in other tests.	Clay/silt/sand: 50 g Gravel: 800 g	None
Bulk and Dry Density		At least 50 ml volume of **intact material** (120 g usually sufficient)	None
Compaction Test (soil/moisture relationship)	Find at what water content the soil can reach its highest dry density	If affected by crushing <5 % of >20 mm: 15 kg >5 % of >20 mm: 40 kg Unaffected by crushing <5 % of >20 mm: 6 kg >5 % of >20 mm: 15 kg	Type of compaction required: 2.5 kg effort 4.5 kg effort Vibro-compaction
California Bearing Ratio (CBR)	Determining suitability of ground for intended road/pavement design/specifications.	6 kg if remoulded, **Completely full** CBR mould if intact.	Remoulding conditions if remoulded. Surcharge to be applied. If soaking is required.
Moisture condition Value (MCV)	Permitting assessment of water content based on how it compacts.	Single point: 4 kg Five point MCV calibration: 15 kg if crushable 4 kg if not crushable	If single point test or 5 point calibration is required.
Maximum Density	Finding the densest state of a soil	Sand: 2 kg Gravel: 16 kg	None

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Classification Tests

The Test	Used For	How Much Material	Things to Specify
Minimum Density	Finding the loosest state of a soil	Sand: 2 kg Gravel: 10 kg	None

Strength Tests

The Test	Used For	How Much Material	Things to Specify
Quick Undrained Triaxial (QUT or QUTxl)	Immediate bearing capacity. Pile design.	Undisturbed: Sufficient to prepare specimen having a 2:1 length:diameter ratio of typically 38 mm or 100 mm diameter (other diameters are possible) Remoulded: 200 g of <6 mm for 38 mm diameter 4 kg of < 20 mm for 100 mm diameter	Whether single stage, multi-stage, or sets of 3 specimens. Confining pressure(s). Specify if stress-strain plot is required.
Unconfined Compressive Strength (UCS)	Immediate bearing capacity. Pile design.	Undisturbed Sufficient to prepare specimen having a 2:1 length:diameter ratio of typically 38 mm or 100 mm diameter (other diameters are possible) Remoulded: 200 g of <6 mm for 38 mm diameter 4 kg of < 20 mm for 100 mm diameter	Specify if stress-strain plot is required.
Direct Shear (also known as Shear Box)	Slope stability (gives peak strength and optionally residual strength)	Note: 3 specimens required to determine friction angle Small Shear Box: Sufficient to prepare 60 mm square x 20 mm tall specimen, or 200 g of <2 mm to remould Large Shear Box: Sufficient to prepare 300 mm square x 150 mm tall specimen, or 30 kg of <20 mm to remould	How many specimens. Whether peak only or peak and residual is required. Vertical stress(es). Remoulding conditions if remoulded.
Ring Shear	Slope stability (gives reliable residual strength parameters)	Note: a single specimen can be tested at 3 vertical stresses. 200 g of <2 mm	Vertical stress(es). Water content to remould to.
Consolidated Undrained Triaxial Compression	Foundation design using parameters based on pore pressures not having sufficient time to dissipate.	Undisturbed: Sufficient to prepare specimen having a 2:1 length:diameter ratio of typically 38 mm or 100 mm diameter (other diameters are possible) Remoulded: 200 g of <6 mm for	Whether single stage, multi-stage, or sets of 3 specimens. Effective consolidation pressure(s).

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Strength Tests

The Test	Used For	How Much Material	Things to Specify
		38 mm diameter 4 kg of < 20 mm for 100 mm diameter	
Consolidated Drained Triaxial Compression	Foundation design using parameters based on drained conditions where pore pressures have sufficient time to dissipate.	Undisturbed: Sufficient to prepare specimen having a 2:1 length:diameter ratio of typically 38 mm or 100 mm diameter (other diameters are possible) Remoulded: 200 g of <6 mm for 38 mm diameter 4 kg of < 20 mm for 100 mm diameter	Whether single stage, multi-stage, or sets of 3 specimens. Effective consolidation pressure(s).

Consolidation Tests

The Test	Used For	How Much Material	Things to Specify
Incremental Oedometer Consolidation (also known as one dimensional consolidation)	Rate and amount of settlement.	Sufficient to prepare a specimen typically 76 mm diameter x 20 mm tall. Smaller diameters are available.	Sequence of pressures to be applied. Whether secondary consolidation is to be determined. If material is like to swell, what to do in this case. Whether swelling pressure is to be determined.
Hydraulic Cell Consolidation (also known as Rowe Cell consolidation)	Rate and amount of settlement for varying drainage conditions, such as radial drainage for horizontally laminated materials.	Undisturbed: Sufficient to prepare a specimen 76 mm diameter x 25 mm tall. Remoulded: 250 g of <2 mm material	Drainage: whether vertical one-way, vertical two-way, radial inwards or radial outwards. Strain: whether equal or free. Effective consolidation pressure(s). Whether secondary consolidation is to be determined. Whether permeability stages are required at any of the consolidation stages.
Constant Rate of Strain (CRS) Oedometer	Rate and amount of settlement with continuous determination of parameters throughout the test, not at fixed increments.	Sufficient to prepare a specimen typically 60 mm diameter x 20 mm tall.	Sequence of target stresses to be reached. Whether unload/reload loops are required – if so, at what stresses. Whether holds are required when target stresses are reached – if so, for how long.

Laboratory Testing Information

Permeability Tests

The Test	Used For	How Much Material	Things to Specify
Triaxial Permeability	Ensuring low permeability of materials used for applications such as landfill liners and slurry lagoons.	Undisturbed: Sufficient to prepare specimen having a 1:1 length:diameter ratio of typically 100 mm diameter (other diameters are possible) Remoulded: 2.5 kg of <8 mm material	Effective consolidation pressure(s). Differential pressure. Remoulding conditions if remoulded.
Permeability in a Permeameter	Ensuring high permeability of materials used for applications such as drainage layers.	2 kg of <6 mm material 7 kg of <10 mm material	Remoulding conditions (note: high levels of compaction may not be possible since the material is remoulded into an acrylic permeameter)
Hydraulic Cell Permeability (also known as Rowe Cell permeability)	Measuring the permeability for varying drainage conditions, such as radial drainage for horizontally laminated materials.	Undisturbed: Sufficient to prepare a specimen 76 mm diameter x 25 mm tall. Remoulded: 250 g of <2 mm material	Drainage: whether vertical one-way, vertical two-way, radial inwards or radial outwards. Effective consolidation pressure(s).

Rock Tests

The Test	Used For	How Much Material	Things to Specify
Point Load Test (PLT)	Assessing strength (often correlated with some UCS tests)	Irregular lump: Smallest dimension of lump at least 15 mm. Diametral: Intact core at least as long as the diameter Axial: Intact core with a length of at least 0.3 of the diameter.	Whether diameter, axial or both orientations required. How many determinations required per sample.
Uniaxial Compressive Strength (UCS)	Assessing strength	Core sample 38 to 150 mm diameter from which a specimen with a height:diameter ratio of 2.5-3.0 can be prepared. We can recore from intact lumps if the material is suitable.	Whether Young's Modulus and Poisson's Ratio are required. Whether the specimen is to be saturated before testing.
Triaxial Compressive Strength (also known as Hoek Triaxial)	Assessing strength	Core sample 38 mm, 54 mm or 76 mm diameter of sufficient length to prepare 2:1 height:diameter specimen (or oversize core or block sample suitable to recore to one of specified sizes)	Confining pressure(s)

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Rock Tests

The Test	Used For	How Much Material	Things to Specify
Indirect Tensile Strength (also known as Brazilian Disc)	Assessing strength	Core sample 38 mm to 100 mm diameter (or intact block suitable to recore). The test specimen shall be a circular disk with a thickness to diameter ratio (t/D) between 0.2 and 0.75.	None
Sound Wave Velocity (also known as P and S waves)	Assessing stiffness moduli	Core sample 38 mm to 150 mm diameter (or intact block suitable to recore). It is recommended that the ratio of the pulse-travel distance to the minimum lateral dimension not exceed 5.	Whether compression wave (P) and/or shear wave (S) velocities are required.
Direct Shear Strength (also known as Rock shear Box)	Friction angles for slope stability	Core sample 38 mm to 150 mm diameter (or intact block suitable to recore)	Whether single stage or multi-stage tests are required. Normal (vertical) stress(es). Whether residual strengths are required. Whether an existing discontinuity or a cut shear plane is to be tested.
Porosity and Density	Basic material properties	Regular and perfect core sample (cylinder) for caliper method, with a maximum of 120 mm in length. Irregular lumps for buoyancy method	None
Particle Density (used to be called Specific Gravity)	To help identify the mineralogy of the rock. To accurately determine the voids ratio in other tests.	Clay/silt/sand: 50 g Gravel: 800 g	None
Cerchar Abrasivity	To assess how aggressive the rock will be on tunnelling equipment.	The sample should be sufficient to permit 5 test scratches (10 mm) at least 5 mm from the edge of the rock surface and each test should be 5 mm apart. If it is a core, the diameter should be less than 76 mm and length less than 150 mm. Ideally size is like a tennis ball. The test scratch ideally should be done on a natural rough surface and perpendicular to any lamination or bedding.	None