Soils for Civil Engineering - Terminology

SOIL PROPERTY TESTING LTD
HUNTINGDON, CAMBS
Tel 01480 455579
MOISTURE CONTENT

- The mass of water which can be removed from the soil, usually by heating at 105°C
- This is expressed as a percentage of the dry mass
- The term water content is also widely used.

(w)
LIQUID LIMIT

• The moisture content at which a soil passes from the liquid to the plastic state.
• Definitive method is by the Cone Penetrometer
• \( W_L \)
PLASTIC LIMIT

• The moisture content at which a soil becomes too dry to be in a plastic condition (ie changing to solid state)
• Determined by rolling threads of soil that shear longitudinally and transversely at approximately 3mm diameter
PLASTICITY INDEX

- The numerical difference between the liquid limit and the plastic limit of a soil.
- Ie The range over which a soil is in its plastic condition

LIQUID – PLASTIC – SEMI SOLID–SOLID

\( (Ip) \)
LIQUIDITY INDEX

• The ratio of the difference between moisture content and plastic limit of a soil, to the plasticity index:

\[ I_L = w - w_p \]

\[ I_p \]
CLAY CONTENT

• The fraction of soil composed of particles smaller in size than 0.002mm.

• Flat platelets of minerals held together by the water surrounding them
COLLOIDAL ACTIVITY

- Measure of activity based on particle size of “clay material” and its mineral composition.

- \text{ACTIVITY} = \frac{\text{PI}}{\text{CLAY CONTENT}}

- (Montmorillonites are very active, kaolinites less active.)
SILT FRACTION

• The fraction of a soil composed of particles between the sizes of 0.06mm and 0.002mm
• Divided into 3 divisions
  • Coarse Silt 0.06 to 0.02mm
  • Medium Silt 0.02 to 0.006mm
  • Fine Silt 0.006 to 0.002mm
• Particles are spherical like sand /unlike clay
SAND FRACTION

- The fraction of a soil composed of particles between the sizes of 2.0mm and 0.06mm
- Divided into 3 divisions
  - Coarse sand: 2.0mm to 0.6mm
  - Medium sand: 0.6mm to 0.2mm
  - Fine sand: 0.2mm to 0.06mm
SAMPLE PREPARATION

• Whenever possible the liquid & plastic limits should be carried out on soil in its natural state.

• Permissible to remove coarse particles by hand and weigh and report.

• Where sand and gravel present, wet sieve procedure has to be used, and soil is not allowed to become dry before testing.
PREPARATION FROM NATURAL

- Clays without significant material retained on 0.425mm are prepared from natural, ie a cheese grater is ideal to shred the soil down before adding water.
PICKING OUT COARSE MATERIAL

- Where occasional material greater than 0.425mm this can be picked out by hand. Tweezers are ideal for this procedure.
WET SIEVE PROCEDURE

• Sample is mixed with De-ionised water to form a slurry. This is left overnight before passing through a 0.425mm sieve. Material retained on 0.425mm is oven dried and its weight recorded. Slurry passing is air dried back to its liquid and plastic limits. Original mass of sample calculated using moisture content to ascertain original dry weight.
CURING BEFORE LIQUID LIMIT TEST

- The sample must cure for a minimum of 24 hours in a sealed container, after being mixed up from dry, or obtained from the wet sieve procedure. This allows water to permeate through and gives a uniform paste. (Very silty or sandy clays may be tested immediately after mixing)
Assessing Heave on tree removal

• BRE DIGEST 412 gives a methodology for calculating the potential heave.
• This is carried out from moisture contents taken at regular intervals from the boreholes. One borehole should be close to the effected structure, the other in a green field location, ie away from trees where the moisture content should be at its equilibrium.
MOISTURE CONTENT PLOTS

Moisture Content (%) vs Depth (m)

- SH3 (Control)
- SH2 (Affected)
Spreadsheet showing moisture content deficiency and estimated heave potential

London N11,

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Measured (gravimetric) water contents (%)</th>
<th>Layer thickness (mm)</th>
<th>Average layer water content (%)</th>
<th>Layer water deficiency (mm)</th>
<th>Cumulative water deficiency (mm)</th>
<th>Heave Potential (mm)</th>
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<td>ΔH</td>
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