Soils for Civil Engineering – Terminology

WATER 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

(w)

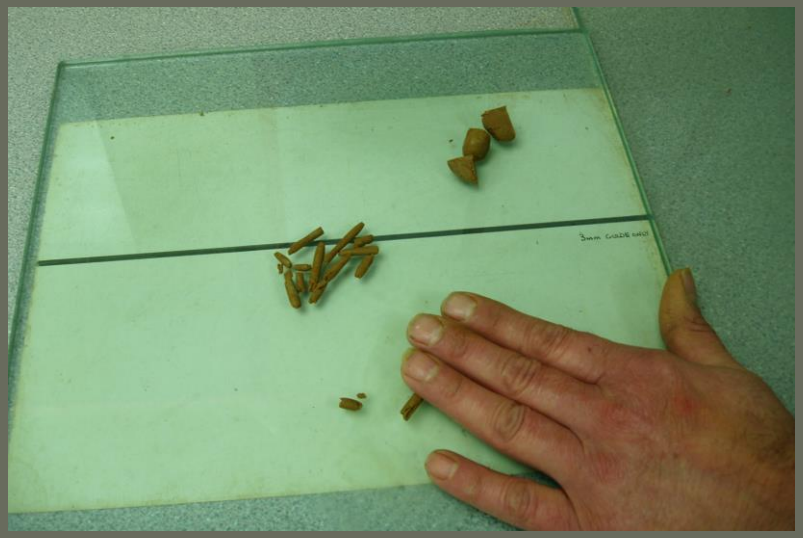
LIQUID LIMIT

- The water 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 water content at which a soil becomes too dry to be in a plastic condition (i.e. changing to solid state)

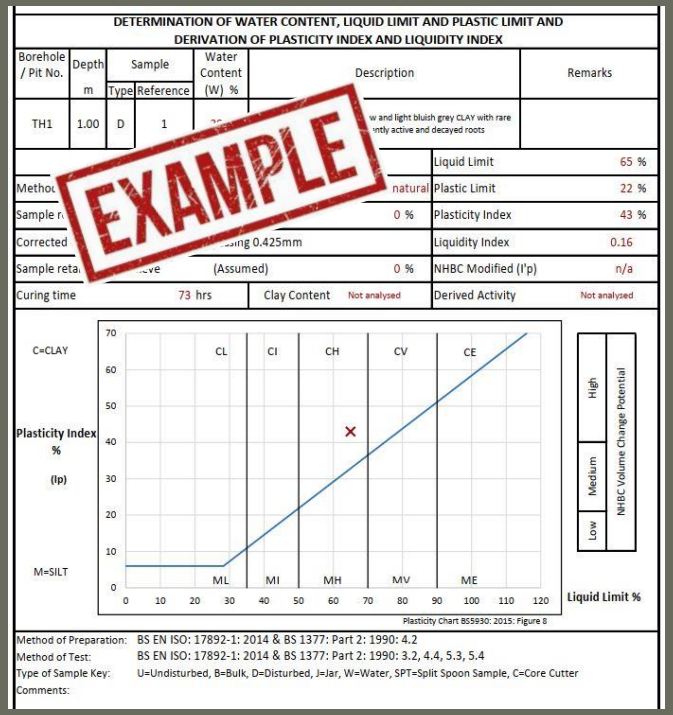
- Determined by rolling threads of soil that shear longitudinally and transversely at approximately 3mm diameter



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

(Ip)



DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole / Pit No.	Depth m	Sample Type	Sample Reference	Water Content (W) %	Description	Remarks
TH1	1.00	D	1		w and light bluish grey CLAY with rare ntly active and decayed roots	

EXAMPLE

Method	natural	Liquid Limit	65 %
Sample r	0 %	Plastic Limit	22 %
Corrected	ing 0.425mm	Plasticity Index	43 %
Sample reta	(Assumed) 0 %	Liquidity Index	0.16
Curing time	73 hrs	NHBC Modified (I'p)	n/a
	Clay Content Not analysed	Derived Activity	Not analysed

Plasticity Chart BS5930: 2015: Figure 8

Method of Preparation: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
Method of Test: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:

LIQUID ⇢ PLASTIC ⇢ SEMI SOLID ⇢ SOLID

LIQUIDITY INDEX

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

$$I_L = \frac{w - w_p}{I_p}$$

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.

- ACTIVITY = PI / 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, 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, i.e., 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 water content to ascertain original dry weight.

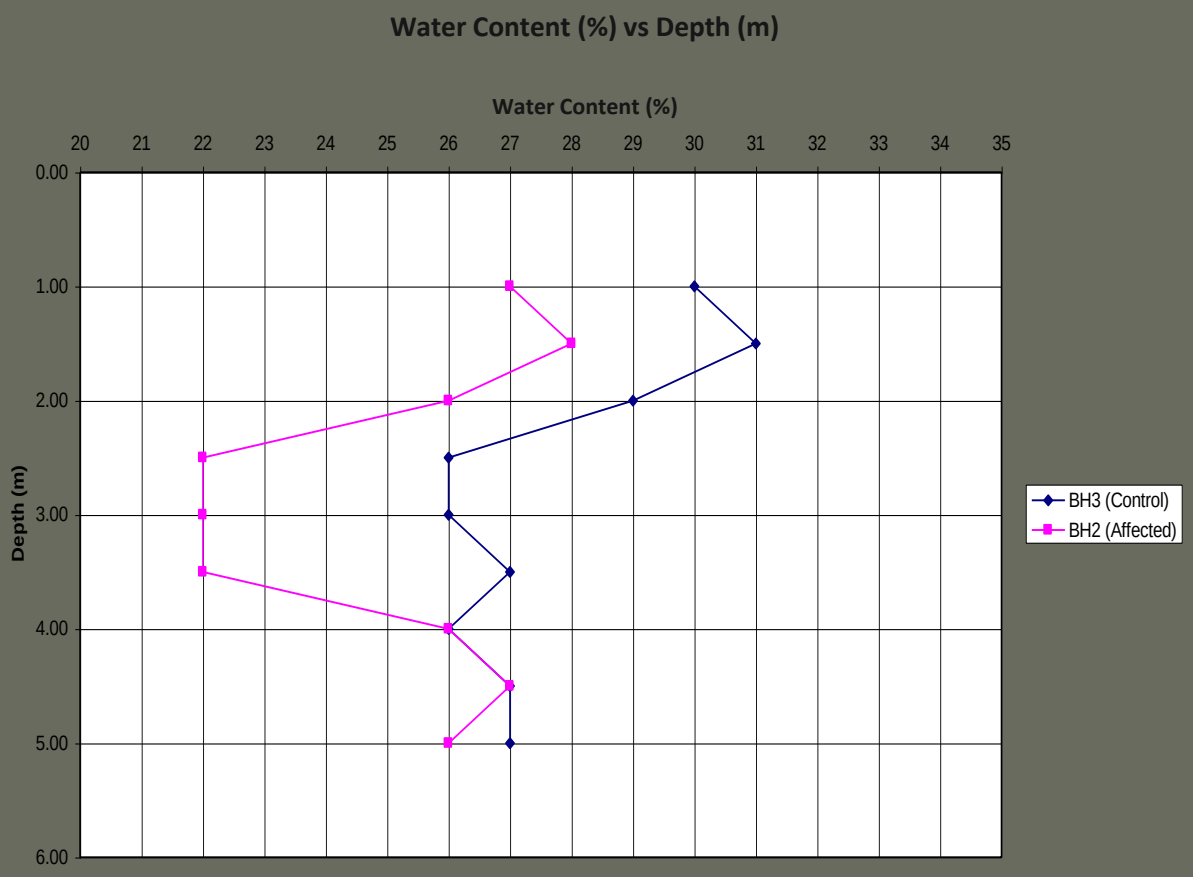
CURING BEFORE LIQUID LIMIT TEST

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

- This is carried out from water contents taken at regular intervals from the boreholes. One borehole should be close to the effected structure, the other in a green field location, i.e. away from trees where the water content should be at its equilibrium.

WATER CONTENT PLOTS



Produced by
Soil Property Testing Ltd.

18 Halcyon Court, St Margarets Way
Huntingdon, Cambridgeshire
PE29 6DG
Tel: 01480 455579
Email: enquiries@soilpropertytesting.com

Spreadsheet showing water content deficiency and estimated heave potential

London N11.

Assumed Gs = 2.75

Depth (m) z	Measured (gravimetric) water contents (%)		Layer thickness (mm) ΔH	Average layer water content (%)		Layer water deficiency (mm)	Cumulative water deficiency (mm)	**Heave Potential (mm)**
	BH3 w_f (control)	BH2 w_i		BH3 w_f (control)	BH2 w_i			
1.00	30	27					173.7	**43.4**
			500	30.5	27.5	23.5		
1.50	31	28					150.2	**37.5**
			500	30	27	23.7		
2.00	29	26					126.5	**31.6**
			500	27.5	24	29.0		
2.50	26	22					97.5	**24.4**
			500	26	22	34.3		
3.00	26	22					63.2	**15.8**
			500	26.5	22	38.6		
3.50	27	22					24.7	**6.2**
			500	26.5	24	20.7		
4.00	26	26					4.0	**1.0**
			500	26.5	26.5	0.0		
4.50	27	27					4.0	**1.0**
			500	27	26.5	4.0		
5.00	27	26					0.0	**0.0**