Handout

EWCE 341: Soil Mechanics Sessional

Expt. No. 1: Field Identification Test of Soil
(Visual Manual Procedure)

References:

- **ASTM D2488 -17**, Standard Practice for Description and Identification of Soils

Objectives:

- **Classify soils in the field.**
- **Identify and describe subsoil condition in the Field.**

By visual and physical means, and without any specialized laboratory instruments.

For fine grained (organic and inorganic) soils.

Significances:

- **First step** in any geotechnical engineering project is to **identify and describe the subsoil condition.**

For example, as soon as a ground is **identified as gravel**, engineer can immediately form some ideas on the nature of problems that might be encountered in a tunneling project.

In contrast, a **soft clay ground** is expected to lead to other types of design and construction considerations.

- Done without the use of **major equipment**. For **general assessment** of sites during field reconnaissance.
- **Sufficient** for ordinary work.

Therefore, it is **useful to have a systematic procedure** for identification of soils even in the **planning stages of a project.**

Principal Terms Used by Civil Engineers:

- **Gravel (G)**, **Sand (S)**, **Silt (M)** and **Clay ©**.

How Soils are given Name:

Mixture is **given name** of the **constituents that appears to have most influence.**

- **Silty Clay** – predominant property of clay but contains a significant amount of silt.
- **Organic Silt** – Composed primarily of silt-sized particles but contains a significant amount of organic material.

Test Procedure

1. **Preliminary Classification**:

Classification of Soils as Coarse-grained or Fine-grained:

- Soil sample spread on a flat surface
- Particles >75mm (3") are removed and their proportions (fractions) of the whole are estimated and recorded.

Coarse-grained Soils: Soil contains > 50% of coarse fraction.

Fine-grained Soils: Soil contains>50% of fine fraction.

2. **Identification of Peat (Highly Organic Soil)**

- Soil sample composed of **vegetable tissues** in various stages of decomposition.
- Has fibrous or amorphous **texture**.
- Usually dark brown to black **color**.
- Organic **odor**.

Not subject to Field Identification Procedures.

3. **Identification of Inorganic Fine Grained Soils (Silts and clays)**

Field Tests for Field Identification of Inorganic Silts and Clays:

- Color and odor Test
- Dry Strength Test
- Dilatancy Test
- Plasticity and Toughness Test
- Dispersion Test.

a. Color and Odor Test:

- A **representative sample** of the material has to be selected for examination.
- Particles **larger than the #40 sieve** has to be removed until a specimen equivalent to about a handful of material is available.
- Observed and note the **color and odor** of the soil.
- Color although not an important physical property in itself, is an **indication of more important properties**. For example:



Color	Inference
Yellow and Red	Severe Weathering (Iron Oxides)
Dark Greenish Brown	Colloidal Organic Matter
Black	Black Cotton Soils
Black/Brown/Dark Green	Organic Soils
Grey/Light Brown	**Inorganic Origin**

- If the soil (fresh sample) **contains distinctive odor** of decaying materials, **then soils of organic** origin can be suspected.

Results-Color and Odor Test (Sample):

Sample No.	Test Observation		Result
	Color	Odor	
1	Gray	Nil	Not Organic
2	Reddish Brown	Nil	Not Organic

b. Dry Strength Test:

A representative sample to be selected for examination.

- Mold into a ball of 1 inch (25mm) diameter.
- Mold **till consistency** is putty.
- 3 Specimens are made.
- Dry in air/sun/artificially (temperature $<60^{o}$ C)
- **Natural dry lump** of the same size may also be used with lump of 0.5 inch (12.5mm) diameter.
- Soil fragment has to **be pressed between** thumb and forefinger.
- **Effort required to break** the fragment provides a basis for describing the strength as **very low/none**, **low**, **medium**, **high, or very high.**



Criteria for describing Dry Strength of Soil Sample:

Description	Criteria
None	Dry Specimen **Crumbles into powder** by mere **pressure of handling**
Low	Dry Specimen **Crumbles into powder** with **some finger pressure.**
Medium	Dry Specimen **breaks into pieces or crumbles** with **considerable finger pressure**.
High	Dry Specimen **cannot be broken** with finger pressure. Specimen will **break into pieces between thumb and a hard surface.**
Very High	Dry Specimen **cannot be broken between thumb and a hard surface.**

Results – Dry Strength Test (Sample):

Sample	Test Observation	Result
1	Dry specimen breaks into pieces with considerable finger pressure	Medium
2	Dry specimen cannot be broken between the thumb and hard surface.	Very High

Note:

- Natural lump contains coarse sand should not be used.

Presence of high strength water soluble cementing materials, shows exceptionally high dry strength.

Can be detected by reaction with dilute HCl

c. Dilatancy Test:

- Mold the soil specimen into a **ball of 0.5 inch** (12.5mm) diameter.
- Specimen to be molded with adding water if necessary, until it is soft but not sticky consistency.
- **Smooth the ball** in the palm of one hand with spatula.
- **Shake the palm vigorously** with other hand several times.
- **Reaction of water** is to be noted appearing on the surface.
- Sample has to be **squeezed by closing the palm**, and **noted the reaction** (Dilatancy) as none, slow or rapid.
- **Reaction** is the speed with which water appears while shaking, and disappear while squeezing.



Criteria for Describing Dilatancy

Description	Criteria
None	**No visible change** in specimen
Slow	Water **appears slowly** on the surface of the specimen during shaking and **does not disappears** or **disappears slowly** upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly.

Results – Dilatancy Test (Sample):

Sample	Test Observation	Result
1	Water **appears slowly** on the surface of the specimen during shaking and **disappears slowly** upon squeezing.	Slow
2	**No visible change** in the specimen.	None

d. **Toughness or Plasticity Test:**

- Specimen is shaped into **elongated pat** and **rolled by hand** on a smooth surface or between palms into a thread about 1/8" (3mm) diameter.
- If the sample is **too wet to roll easily**, it should spread into thin layer & allowed to lose some water by evaporation.
- Sample should be folded thread and **rerolled repeatedly** until the thread crumbles at a diameter about 1/8 inch.
- Thread **crumble at a diameter of 1/8", when the soil is near the plastic limit**.
- **After the thread crumbles**, sample pieces should be lumped together and kneaded until lump crumbles.



- Toughness of the materials has to be noted during kneading.
- **Toughness of the thread** and **lump** should be described as low, medium or high & **plasticity as** non-plastic, low, medium and high according to the criteria.

i. **Criteria for Describing Toughness:**

Description	**Criteria**
Low	**Only slight pressure** is required to roll the thread near the plastic limit. Thread and the lump are **weak and soft**.
Medium	**Medium pressure** is required to roll the thread near the plastic limit. Thread and the lump have **medium stiffness.**
High	**Considerable pressure** is required to roll the thread near the plastic limit. Thread and the lump have very **high stiffness.**

Results – Toughness Test (Sample):

Sample	**Test Observation**	**Result**
1	**Medium pressure** is required to roll the thread to near plastic limit. The thread and lump has **medium stiffness.**	Medium
2	**Considerable pressure** is required to roll the thread to near the plastic limit. Thread and lump have **high stiffness**	High

ii. **Criteria for Describing Plasticity:**

Description	**Criteria**
Non-plastic	An 1/8-inch **cannot be rolled** at any water content.
Low	Thread can **barely be rolled** and **lump cannot be formed** when drier than plastic limit.
Medium	**Thread** easy to roll and **not much time** is required to reach plastic limit. **Thread** cannot be rolled after reaching plastic limit. **Lump crumbles** when drier than the plastic limit.
High	It takes **considerable time** rolling and kneading to reach plastic limit. Thread can be **rerolled several time** after reaching plastic limit. **Lump can be formed** without crumbling when drier than plastic limit.

Results – Plasticity Test (Sample):

Sample	**Test Observation**	**Result**
1	Thread is **easy to roll** and **not much time** is required to reach plastic limit. Thread **cannot be rolled** after reaching plastic limit. **Lump crumbles** when drier than plastic limit.	Medium
2	Take **considerable time** for rolling and kneading to reach plastic limit. Thread **can be re-rolled** several times after reaching plastic limit. **Lump can be formed** without crumbling when drier than the plastic limit.	High

e. Dispersion Test:

- For **rough estimate of relative amounts of sand, silt and clay** in a soil sample.
- **Soil is dispersed with water** in a glass cylinder/beaker then allowed to settle.
- Usually coarser particles fall out in first and the finest particles remain in suspension the longest period.
- Usually **sand settles within 30-60 seconds**, **silt settles within 15-60 min** and **clay remains** in suspension for **several hours**.





Results – Dispersion Test (Sample):

Sample	Dispersion Time	Test Observation	Description
1	1 Hour 50 minutes	Water gives a **clear look**	Silt
2	6 hour 30 minutes	Even after this time, **water remained unclear**. It is obvious that it will take more time to settle**.**	Clay

Deciding Inorganic or Organic Soil

1. **Identification of Inorganic Fine Grained Soils:**

Dry Strength	Dilatancy	Toughness	Soil Type & Symbol
None to Low	Slow to Rapid	Low or Thread cannot be formed	Silts (ML)
Medium to High	None to Slow	Medium	Lean Clay (CL)
Low to Medium	None to Slow	Low to Medium	Elastic Silts (MH)
High to very High	None	High	Fat Clay (CH)

2. **Identification of Organic Fine Grained Soils:**

- Organic soils may be identified as **Organic silt** (OL) and **Organic clay** (OH).

Organic soils may be:

- Dark brown to black color
- May be organic odor
- Change color, black to brown, when exposed to air.
- Lighten color significantly when air dried.
- Normally will not have high toughness or plasticity.
- Tet for toughness test will be spongy.

Field Identification – Type of Fine-grained Soils (using following Table):

Typical Name	**Dry Strength**	**Dilatancy**	**Toughness**	**Dispersion**
Sandy Silt	None to very Low	Rapid	Low	30 Sec 60 Sec
Silt	Very Low to Low	Rapid	Low	15 to 60 min
Clayey Silt	Low to **Medium**	Rapid to **Slow**	**Medium**	**15 min to several hours**
Sandy Clay	Low to high	**Slow** to None	**Medium**	30 sec to several hours
Silty Clay	**Medium** to High	**Slow** to None	**Medium**	**15 min to several hours**.
Clay	High to very High	None	High	Several hours to days
Organic Silt	Low to **Medium**	Slow	Low	15 min to several hours
Organic Clay	**Medium** to very high	None	High	Several hours to days.

Final Result: Field Identification of Fine-grained Soils (Sample):

Serial No.	**Observation/Test**	**Sample 1**	**Sample 2**
1.	Organic/Inorganic	Inorganic	Inorganic
2.	Dry Strength	Medium	Very High
3.	Dilatancy	Slow	None
4.	Toughness	Medium	High
5.	Plasticity	Medium	High
6.	Dispersion	1 hr. 50 min	6 hr. 35 min

Typical Name: Sample 1: Clayey Silt (MH)