FLOW CHART
UNIFIED SOIL CLASSIFICATION SYSTEM
FIELD IDENTIFICATION OF COARSE and FINE GRAINED SOILS

Start Here - To use this chart start on the left and work to the right, using the chart to guide you to the appropriate USCS Symbol, Group Name, and Modifier.

				Symbol	Group Name	Modifier
COARSE-GRAINED SOILS More than half of material (by weight) is of individual grains visible to the naked eye or >50% settles through the water column in 20-30 seconds.	**GRAVEL and GRAVELLY SOILS** More than half of Coarse Fraction (by DRY weight) is larger than 1/4 inch size. **(size of "Lemon" to "Pea")**	**CLEAN GRAVELS** Will not leave a dirt stain on a wet palm	Wide range in grain sizes and substantial amounts of all intermediate particle sizes.	**GW**	**Well Graded Gravel**	**Add "w/sand" if >=15% sand (1/4 of an inch to 3 inch)**
			Predominantly one size or a range of sizes with some intermediate sizes missing.	**GP**	**Poorly Graded Gravel**	
		DIRTY GRAVELS Will leave a dirt stain on a wet palm	Nonplastic fines or low-plasticity fines (for identification of fines see characteristics of ML below).	**GM**	**Silty Gravel**	
			Plastic fines (for identification of fines see characteristics of CL or CH below).	**GC**	**Clayey Gravel**	
	SAND and SANDY SOILS More than half of Coarse Fraction (by DRY weight) is smaller than 1/4 inch size. **(size of "Pea" to "Salt")**	**CLEAN SANDS** Will not leave a dirt stain on a wet palm	Wide range in grain sizes and substantial amounts of all intermediate particle sizes.	**SW**	**Well Graded Sand**	**Add "w/gravel" if >=15% gravel (1/200 to 1/4 of an inch)**
			Predominantly one size or a range of sizes with some intermediate sizes missing.	**SP**	**Poorly Graded Sand**	
		DIRTY SANDS Will leave a dirt stain on a wet palm	Nonplastic fines or low-plasticity fines (for identification of fines see characteristics of ML below).	**SM**	**Silty Sand**	
			Plastic fines (for identification of fines see characteristics of CL or CH below).	**SC**	**Clayey Sand**	

	Liquid Limit (L vs. H)	Dilatancy (L vs H)	Plasticity (M vs. C)	Toughness (M vs. C)	Ribbon (M vs. C)	Shine (M vs. C)	Dry Strength (M vs. C)	Symbol	Group Name
FINE-GRAINED SOILS More than half of material (by weight) is of individual grains not visible to the naked eye or <50% settles through the water column in 20-30 seconds.	1. Add water to dry sample: quick penetration = low LL slow penetration = high LL 2. **Cube test--flood surface and crack open: if water penetrates, sample has low LL; if not, high LL** 3. Wet sample to putty-like consistency: the more water it takes, the higher the LL.	Take the soft, putty-like soil pat and mold into a mass in palm of hand. **Strike** the side of your palm several times with the other hand. In samples with **rapid dilatancy, water appears quickly on the surface, and disappears quickly upon squeezing.**	Dry the soil pat from previous test by adding dry soil until it reaches plastic limit, or PL (rolled thread begins to crack). The **longer it takes to get to the PL**, and the **more times a thread can be re-rolled or a lump formed** without crumbling, the **higher the plasticity index (C).**	While performing the plasticity test, the **more finger pressure** it takes to roll a thread or form a lump, the **higher the plasticity index (C).** **Low** toughness = **soft** **Medium** toughness = **firm** **High** toughness = **stiff**	With pat of soil near the PL, form a ribbon of soil with thumb and index finger, about 1/2 inch wide and as long as possible. Hold one end and gently shake until it breaks under its own weight. **Rate the ribbon strength. High plasticity (C) soils have high ribbon strength.**	With pat of soil near the PL, cut the pat with a knife blade or stroke it with a knife or fingernail. Observe the degree of shine under direct light. Soils with **high plasticity (C) are shiny**, those with **low plasticity (M) are dull.**	Mold moist soil into a 1/2 inch ball or cube and allow to dry completely. Evaluate by breaking dried cube with finger/thumb pressure, or against hard surface if necessary. Soils with **high plasticity (C) have high dry strength**; soils with **low plasticity (M) have low dry strength.**		
	SILTS & CLAYS (water penetrates = low LL)	Rapid **(2-4 strikes)**	Low to Non Plastic-**NP** **(can't roll thread)**	Low to None	None **(cannot form ribbon)**	Dull	Low **(crumbles with some finger pressure)**	**ML**	**Silt (PI = 0-15)**
		Medium to Slow **(4-10 strikes)**	Low to Med. **(can't be rerolled & lump crumbles)**	Medium	Weak **(<3" and may support its own weight)**	Slight to Shiny	Medium to High **(high pressure or hard surface)**	**CL**	**Lean Clay (PI = 10-30)**
		Slow to None **(>7 strikes)**	Low **(thread barely rolled & lump crumbles).**	Low (Spongy)	None **(cannot form ribbon)**	Dull to Slight	Medium to High **(high pressure or hard surface)**	**OL**	**Organic Silt or Organic Clay**
	SILTS & CLAYS (Little or no water penetrates = high LL)	Very Slow to None **(> 10 strikes)**	Low to High **(thread and lump may be rerolled)**	Medium to High	Weak to Strong **(<3" and can support itself)**	Slight	Medium **(high pressure to crumble w/fingers)**	**MH**	**Elastic Silt (PI = 5-40)**
		None	Med. to High **(thread & lump can be rerolled)**	High	Strong **(>3" ribbon that supports itself)**	Shiny	Very High **(not broken with thumb & hard surface)**	**CH**	**Fat Clay (PI = 30-50)**
		None	Low **(thread barely rolled & lump crumbles).**	Low to Medium (Spongy)	Weak **(<3" and may support its own weight)**	Dull to Slight	High **(can be broken with thumb and hard surface)**	**OH**	**Organic Silt or Organic Clay**

Modifiers for fine grained soils:
71-85% passes the #200 then add "**w/gravel**" (%G>%S) or "**w/sand**" (%S>%G)
50-70% passes the #200 & **%S>%G**, then add "**Sandy _ w/gravel**" (if %G>=15%) or "**Sandy _**" (if %G<15%)
50-70% passes the #200 & **%S<%G**, then add "**Gravelly _ w/sand**" (if %S>=15%) or "**Gravelly _**" (if %S<15%)

HIGHLY ORGANIC SOILS	Readily identified by color, odor, spongy feel, and frequently by fibrous texture.	**PT**	**Peat**

***For all soil types - Add with "w/Cobbles" if >= 15% Cobbles (3 - 12 inches)**

****For all soil types - Add with "w/Boulders" if >= 15% Boulders (>12 inches)**

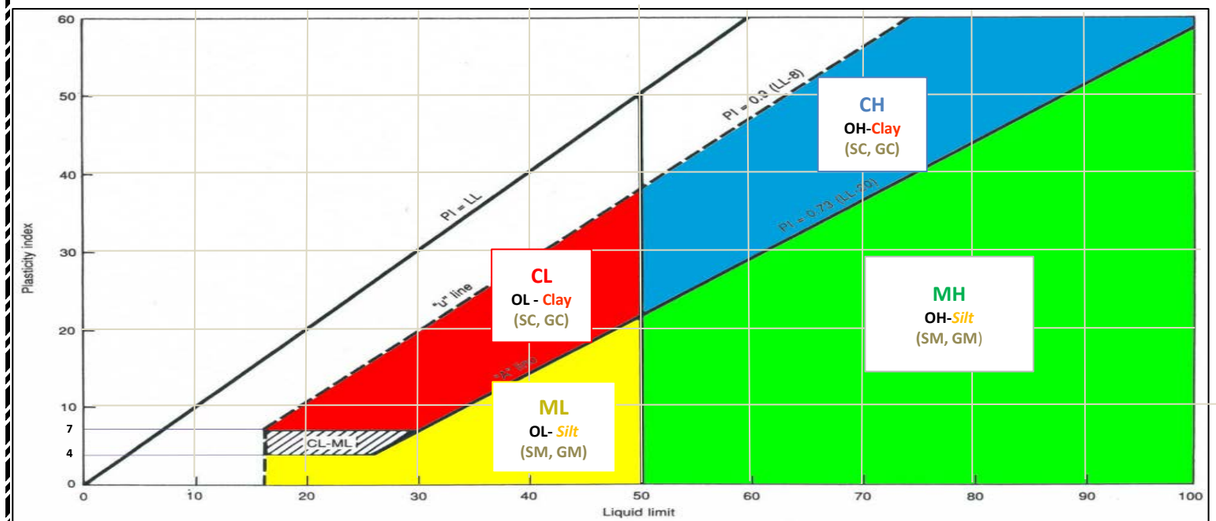
Determining the Unified Soil Classification System (USCS) Symbol and Group Name with Modifier using lab data (ASTM D2487)

Step 1: Use the gradation of the entire sample to determine if a majority of the sample is Fine Grained or Coarse Grained.

FINE-GRAINED (>50% by dry weight passes the #200 sieve)

Step 2: Use Atterberg limits results and plot on plasticity chart.

Step 3: Classify the soil based on the plasticity chart.



Inorganic fines

CL- Lean Clay-LL<50 & PI > 7 and plots on or above "A" line.

ML- Silt-LL<50 & plots on or below the "A" line.

CL-ML- Clayey Silt-LL<50 & PI >4< 7 and plots on or above "A" line.

CH- Fat Clay- LL>50 & plots above the "A" line.

MH- Elastic Silt- LL>50 & plots below the "A" line.

Organic Fines - If LL oven dry / LL air dry is < 0.75

Organic Clay plots above the "A line" and can be an **OL** (LL<50) or an **OH** (LL>50)

Organic Silt plots below the "A line" and can be an **OL** (LL<50) or an **OH** (LL>50)

Pt - Peat is mostly Organic Matter (OM) with little or no inorganic material.

Can be either **Sapric** (<33% OM fibers), **Hemic** (33-67% OM fibers), or **Fibric** (> 67 % OM fibers).

Step 4: Add coarse grained modifiers.

70.1-85% passes the #200 then add "**w/gravel**"(%G>%S) or "**w/sand**"(%S>%G)

50-70% passes the #200 & %S>%G, then add "**Sandy _ w/gravel**" (if %G>=15%) or "**Sandy _**" (if %G<15%)

50-70% passes the #200 & %S<%G, then add "**Gravelly _ w/sand**" (if %S>=15%) or "**Gravelly _**" (if %S<15%)

COARSE-GRAINED (<50% by dry weight passes the #200 sieve)

Step 2: Determine if a majority of the **coarse fraction** is sand or gravel.

SAND-the majority passes the #4 sieve	**GRAVEL- the majority doesn't pass the #4 sieve**

Step 3: determine if it is **Clean** (<5%, <#200), **Dirty** (>12%, <#200), or **Dual class** (5%-12%, <#200).
*See PDF in SM1 Part B.ppt for Dual Class *

"Dirty" Sand with > 12% fines	"Clean" Sand with < 5% fines	"Dirty" Gravel with > 12% fines	"Clean" Gravel with < 5% fines
Step 4a: Use Atterberg limits results on the fines (<#200) and classify based on whether the fines are plastic or not using the plasticity chart to the left.	**Step 4b**: Use the grain size distribution to obtain the D10, D30, and D60. Calculate the CC and CU. $CC = \frac{D_{30}^2}{D_{10} \times D_{60}}$ $CU = \frac{D_{60}}{D_{10}}$	**Step 4a**: Use Atterberg limits results on the fines (<#200) and classify based on whether the fines are plastic or not using the plasticity chart to the left.	**Step 4b**: Use the grain size distribution to obtain the D10, D30, and D60. Calculate the CC and CU. $CC = \frac{D_{30}^2}{D_{10} \times D_{60}}$ $CU = \frac{D_{60}}{D_{10}}$

Sand with **>12% fines** that plot **below PI of 4** and **below the A-line**.	**Sand** with **>12% fines** that plot **above PI of 7** and above **the A-line**.	**Sand** with **<5% fines** and a **Cu<6** and / or (**Cc<1 or Cc >3**)	**Sand** with **<5% fines** and a **Cu>=6** and (**Cc >= 1 and Cc <=3**) ***Meets Both***	**Gravel** with **> 12% fines** that plot **below PI of 4** and **below the A-line**.	**Gravel** with **> 12% fines** that plot **above PI of 7** and above **the A-line**.	**Gravel** with **<5% fines** and a **Cu<4** and / or (**Cc<1 or Cc >3**)	**Gravel** with **<5% fines** and a **Cu>=4** and (**Cc >= 1 and Cc <=3**) ***Meets Both***
SM	**SC**	**SP**	**SW**	**GM**	**GC**	**GP**	**GW**
Silty Sand	**Clayey Sand**	**Poorly Graded Sand**	**Well Graded Sand**	**Silty Gravel**	**Clayey Gravel**	**Poorly Graded Gravel**	**Well Graded Gravel**

Step 5: Add Coarse Grained modifier if > 15% of other component.

Add "**w/gravel**" if **>= 15% gravel** | Add "**w/sand**" if **>= 15% sand**

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