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Soil mechanics

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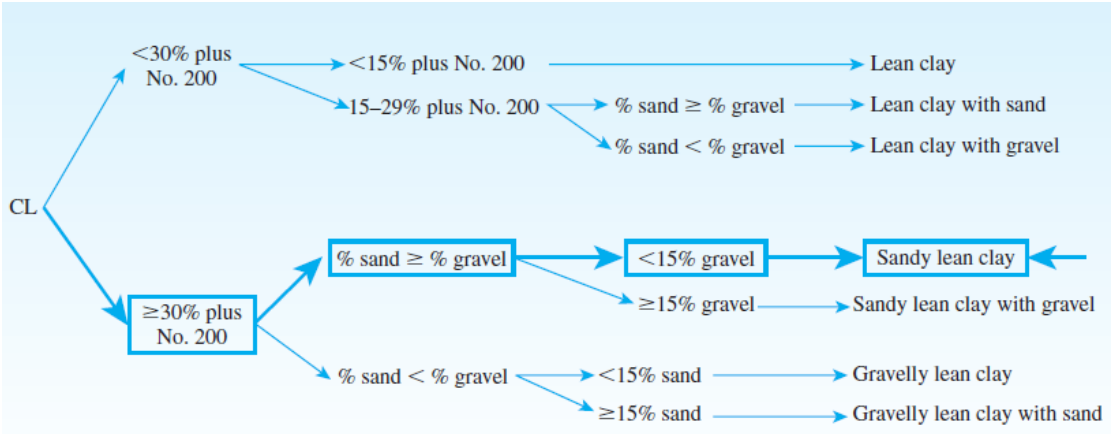
Example 1

The results of the particle-size analysis of a soil are as follows:
Percent passing through the No. 10 sieve= 100
Percent passing through the No. 40 sieve = 80
Percent passing through the No. 200 sieve = 58
The liquid limit and plasticity index of the minus No. 40 fraction of the soil are 30 and 10, respectively. Classify the soil by the Unified classification system.

Solution

Since 58% of the soil passes through the No. 200 sieve, it is a fine-grained soil. Referring to the plasticity chart, for *LL* = 30 and *PI* = 10, it can be classified (group symbol) as CL.

1- The percent passing No. 200 sieve is more than 30%.
2- Percent of gravel= 100 – passing sieve No. 4=0
4. Percent of sand= passing sieve No. 4– passing sieve No. 200
=100-58=42
5. Hence, percent sand > percent gravel.
6. Also, percent gravel is less than 15%. Hence the group name is **sandy lean clay**.



Example 2

For a given soil, the following are known:

- Percentage passing through No. 4 sieve = 70
- Percentage passing through No. 200 sieve = 30
- Liquid limit = 33, Plastic limit = 12

Classify the soil using the Unified Soil Classification System. Give the group symbol and the group name.

Solution

1- The percentage passing No. 200 sieve is 30%, which is less than 50%. So it is a coarse-grained soil.

2- Percent of gravel= percent retained on No. 4 sieve
=100 – passing sieve No. 4
=100 – 70 = 30%

3- Coarse fraction = 100 – passing sieve No. 200
=100 – 30 = 70%

4- Hence, more than 50% of the coarse fraction is passing No. 4 sieve. Thus, it is a sandy soil.

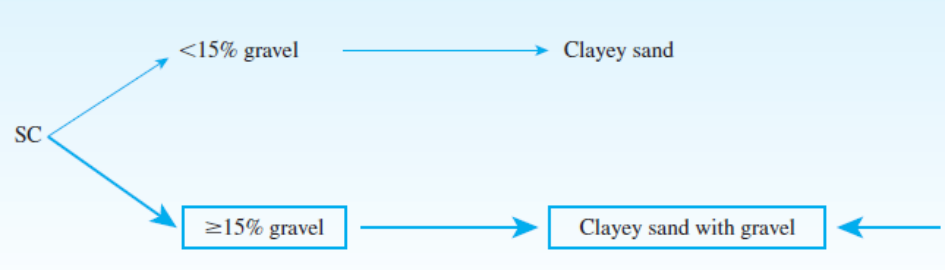
Percent of gravel < 50 % Coarse fraction ——— sand

5- Since more than 12% is passing No. 200 sieve, it is SM or SC.

6- For this soil, *PI* = 33 - 12 = 21 (which is greater than 7).

With *LL* = 33 and *PI* = 21, it plots above the *A*-line. Thus the group symbol is **SC**.

7- For the group name, Since the percentage of gravel is more than 15%, it is **clayey sand with gravel**.



Example 3

The grain-size analysis for a soil is given next:

Sieve no.	% passing
4	94
10	63
20	21
40	10
60	7
100	5
200	3

Given that the soil is nonplastic, classify the soil by using the Unified Soil Classification System.

Solution

1- The percentage passing No. 200 sieve is 3%, which is less than 50%. So it is a coarse-grained soil.

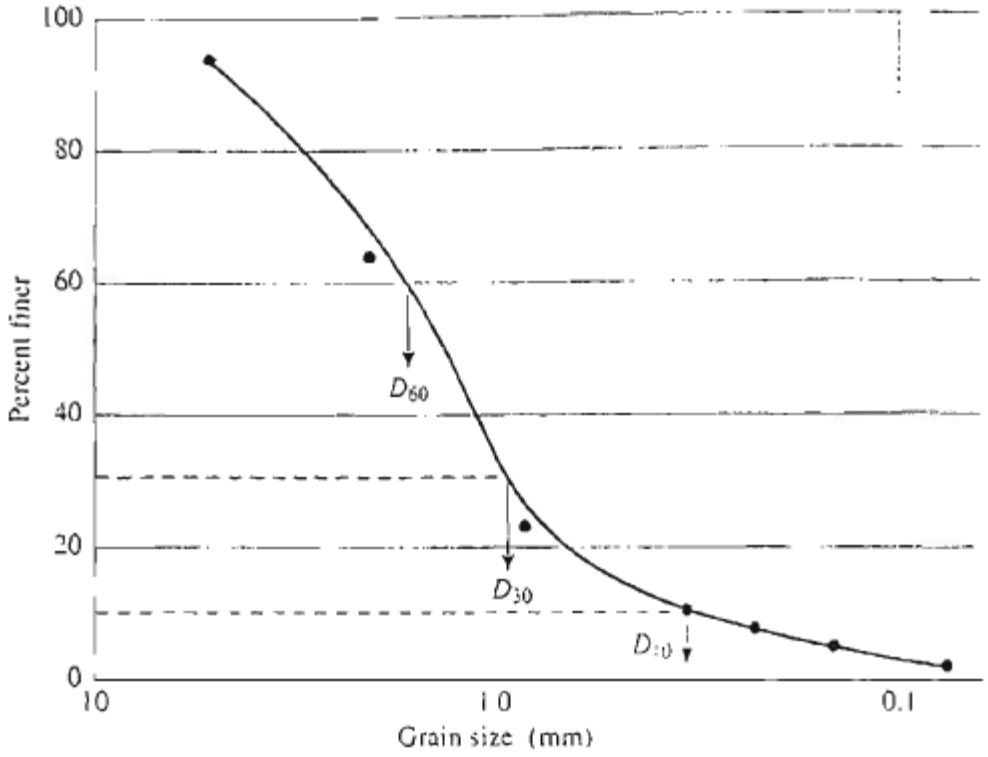
2- Percent of gravel= percent retained on No. 4 sieve
=100 – passing sieve No. 4
=100 – 94 = 6%

3- Coarse fraction = 100 – passing sieve No. 200
=100 – 3 = 97%

4- Hence, more than 50% of the coarse fraction is passing No. 4 sieve. Thus, it is a sandy soil.

Percent of gravel < 50 % Coarse fraction ——— sand

5- Since less than 5% is passing No. 200 sieve, it is SW or SP.



$D_{60} = 1.41$ mm $D_{30} = 0.96$ mm $D_{10} = 0.41$ mm

$$C_u = \frac{D_{60}}{D_{10}} = \frac{1.41}{0.41} = 3.44$$

$$C_z = \frac{D_{30}^2}{D_{60} \times D_{10}} = \frac{0.96^2}{1.41 \times 0.41} = 1.59$$

The soil is poorly graded, SP

8- For the group name, Since the percentage of gravel is less than 15%, it is **poorly graded sand**