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granulomitric analysis and dreux gorisse methode

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1 Determination of the Fineness Modulus and Fine Content of Sand

1.1 Introduction

The grain size analysis of soil is the study of the dimensions of the grain diameters, their distribution, and the differentiation between different types of soils such as rock, gravel, clay, etc. The determination of particle size distribution or the granulometric composition of soil is called the grain size analysis of a material. Soils are classified based on their sizes, which are determined by sieving through sieves or strainers. Grain size analysis allows for the detection and presentation of the size and respective weight percentages of the different grain families constituting the sample.

1.2 Objective of the Test

The aim of the test is manifested through several points. We have, among other things:

- The sizing of particles can vary by several thousand times.
- The characterization of grains of different dimensions can lead to a classification of the studied soils.
- Establishing the granulometric curve provides very precise information about the studied soil.

1.3 Materials Used

1. **Series of sieves for sand**: D = 5 mm, 2.5 mm, 1.25 mm, 0.63 mm, 0.315 mm, 0.16 mm, 0.08 mm (bottom mm).
2. **Series of sieves for gravel**: D = 20 mm, 16 mm, 12.5 mm, 10 mm, 8 mm (bottom mm).
3. 3 kg of soil (sand and gravel).
4. Sieving machine (vibrating device).
5. Balance with 0.1 g precision.
6. A container to collect sand or gravel.

(A) 1

(B) 2

(C) 3

(D) 4

(E) 5

(F) 6

FIGURE 1.1: Materials Used

1.4 Operating Procedure :

a) Sand:

1. Start by setting up the column of sieves. The openings of the sieves must be increasing from bottom to top. The sieves to be considered are in mm: 5, 2.5, 1.25, 0.63, 0.315, 0.16, 0.08, bottom (mm).
2. Take 2 kg of sand.
3. Pour the sand onto the top sieve.
4. Proceed with mechanical agitation for about 5 minutes.
5. Weigh the cumulative residues of the sieves starting from the top sieve.

Proceed with the cumulative weighing of the sieve rejections starting from the top sieve.

b) Gravel: Two types will be used

1. Assemble the sieve column in descending order of mesh opening, adding the lid and bottom: for G1(8,6.3 ,5,3.15,2.5,bottom) and for G2(16,12.5,10, 8, bottom) (mm).
2. Pour the dry material into the sieve column (type 1 gravel is 3-7 and type 2 is 7-15).
3. Mechanically agitate this column (15 minutes).
4. Retrieve the sieves one by one starting with the one with the largest opening, adjusting the bottom and lid.
5. Determine the mass of refusals for each sieve.
6. Continue the operation until the mass of the refusals contained in the bottom of the sieve column is determined.
7. Verify the validity of the granulometric analysis (the difference between the sum of the masses of refusals and sieves and the initial mass. . .).

1.5 Sieve Analysis Results

a) Sand:

Sieve Diameter (mm)	Empty Sieve Weight (g)	Filled Sieve Weight (g)	Partial Refusal (g)	Cumulative Refusal (g)	Cumulative Refusal (%)	Cumulative Passing (%)
5	635.09 g	0 g	0 g	0 g	0 %	100 %
2.5	586.57 g	745.28 g	158.71 g	158.71 g	7.94 %	92.06 %
1.25	500 g	669.21 g	169.21 g	327.92 g	16.41 %	83.59 %
0.63	494.85 g	978.83 g	483.98 g	811.9 g	40.64 %	59.36 %
0.315	462.24 g	1322.74 g	860.5 g	1672.4 g	83.72 %	16.28 %
0.16	346.22 g	578.65 g	232.43 g	1904.83 g	95.35 %	4.65 %
0.08	268.66 g	348.6 g	79.94 g	1984.77 g	99.35 %	0.65 %
Fond	452.18 g	465.11 g	12.93 g	1997.7 g	100 %	0 %

TABLE 1.1: Granulometric Analysis For The Sand

Fineness Module

$$f = \frac{1}{100} \sum \text{Cumulative Refusals (\%) in sieves: } 5; 2.5; 1.25; 0.63; 0.315; 0.16$$

$$f = \frac{1}{100} \sum 0 + 7.94 + 16.41 + 40.64 + 83.72 + 95.35 = 2.4406$$

Sand is a bit too fine: M_f varies from 1.80 to 2.20 (search for ease of use).

Preferred sand: M_f varies from 2.20 to 2.80 (satisfactory workability and good strength with limited segregation risks).

Sand is a bit too coarse: M_f varies from 2.80 to 3.20 (search for high strength, but generally, there will be low workability and segregation risks).

Thus, we have M_f = 2.4406, indicating that the sand is a Preferred sand.

B) Gravel:

1. For G1 :

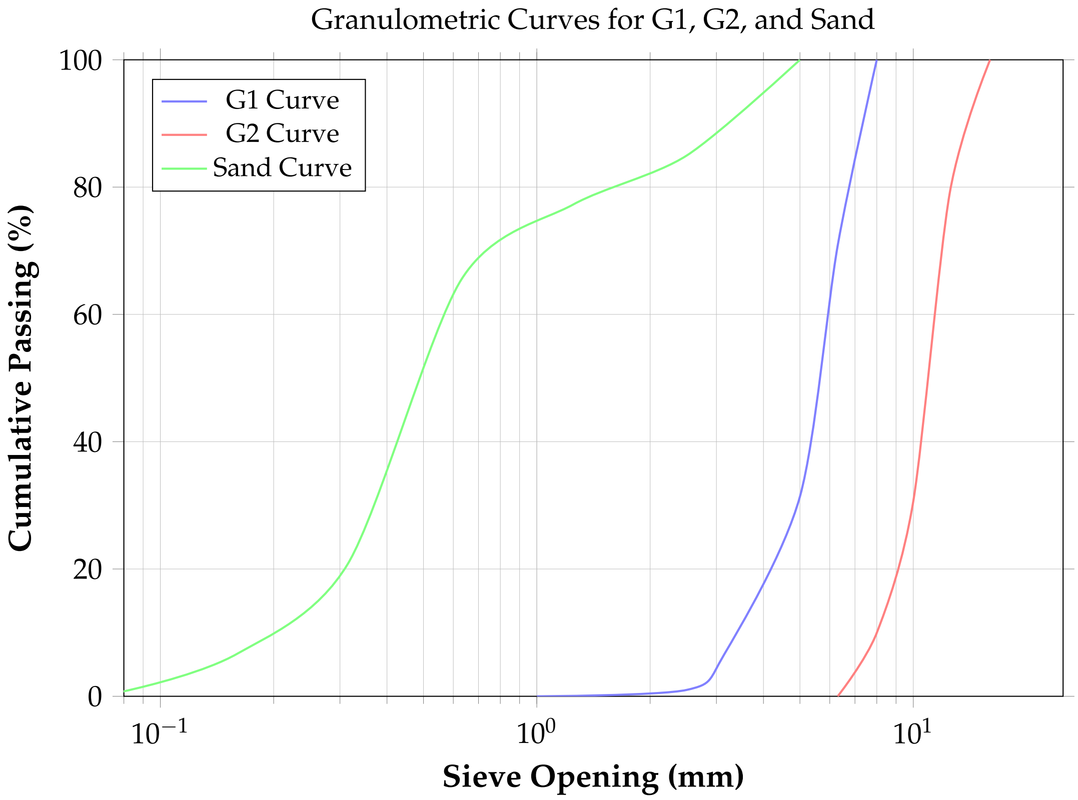
Sieve Diameter (mm)	Empty Sieve Weight (g)	Filled Sieve Weight (g)	Partial Refusal (g)	Cumulative Refusal (g)	Cumulative Refusal (%)	Cumulative Passing (%)
8	575 g	575 g	0 g	0 g	0 %	100 %
6.3	585 g	1770 g	1185 g	1185	29.63 %	70.83 %
5	590 g	2150 g	1560 g	2745 g	68.63 %	31.38 %
3.15	645 g	1635 g	990 g	3735 g	93.38 %	6.63 %
2.5	625 g	850 g	225 g	3960 g	99 %	1 %
Fond	450	490	40 g	4000 g	100 %	0 %

TABLE 1.2: Granulometric Analysis for Gravier Type 1 (G1)

2. For G2 :

Sieve Diameter (mm)	Empty Sieve Weight (g)	Filled Sieve Weight (g)	Partial Refusal (g)	Cumulative Refusal (g)	Cumulative Refusal (%)	Cumulative Passing (%)
16	730 g	730 g	0 g	0 g	0 %	100 %
12.5	760 g	1935 g	1175 g	1175	20.93 %	79.07 %
10	580 g	3300 g	2720 g	3895 g	69.37 %	30.63 %
8	590 g	1750 g	1160 g	5055 g	90.03 %	9.97 %
Fond	460	1020	560 g	5615 g	100 %	0 %

TABLE 1.3: Granulometric Analysis for Gravier Type 2 (G2)



1.6 Conclusion

The percentages of cumulative refusals or cumulative sieve percentages can be represented as a granulometric curve by plotting the sieve openings on a logarithmic scale for the x-axis and the percentages on an arithmetic scale for the y-axis. The curve is drawn continuously and may not pass through all the points.

2 Utilization of the Dreux-Gorisse Method for Determining Concrete Composition

2.1 Introduction

Concrete is a material used to construct various types of structures in the fields of construction, public works, and hydraulics. In this practical, we apply the Dreux-Gorisse formulation, which involves several successive calculation steps required to obtain the theoretical composition of concrete.

2.2 Objective of the Test

Determination of the optimal quantities of materials required to produce one cubic meter of concrete.

- Concrete Constituents :

- **Sand** : It is a sedimentary rock that must be clean and free of dust.
- **Mixing Water** : It influences the setting of the concrete.
- **Aggregate** : Inert materials that come from the erosion or crushing of rocks.
- **Cement** : A hydraulic binder represented as very fine powder.

2.3 Operating Procedure

Several Calculation Steps to Obtain the Theoretical Formulation of Concrete

1. Determination of the C/E ratio, of C and E.
2. Determination of the masses of aggregates; weigh these dry masses and put them in the mixer (Gravel, Sand, and Cement).
3. Add water and mix for 40 seconds.

2.4 Expression of results

Data

- $f_{c28} = 30\,\text{MPa}$
- Slump $Aff = 7\,\text{cm} \rightarrow$ Plastic consistency

- $D = 20\,\text{cm}$
- Cement: CEM-II 42.5 (CPJ)
- $V_c = 113\,\text{L/m}^3$

From the Tables:

Table 2.1 is used to obtain the water dosage and consistency of a concrete (D=20 mm).

TABLE 2.1: Water Dosage and Concrete Consistency (D = 20 mm)

Consistency	Slump at Cone (cm)	Water (E) (L/m³)	Air (a) (L/m³)	Voids (E + a) (L/m³)
Firm (F)	0-4	160	25	185
Plastic (P)	5-9	190	20	210
Very Plastic (VP)	10-15	210	15	225

We take $\mathbf{E} + \mathbf{a} = \mathbf{210}\,\text{L/m}^3$ (for cement type **42.5** used).

Table 2.2 is used to obtain the mechanical performance of cements.

TABLE 2.2: Mechanical Performances of Cement X

Characteristic Class (MPa)	fm - True Class (28 days)	CPA, CPJ (2 days)	CPA, CPJ (7 days)
32.5	45	-	29
32.5 R	45	22	-
42.5	55	-	29
42.5 R	55	20	28
52.5	65	-	35
52.5 R	65	28	-

We take $\mathbf{f_m} = \mathbf{55}$ (for cement type **42.5** used).

Table 2.3 is used to obtain The value of the granular coefficient $\mathbf{k_b}$ for the **Bolomey formula**

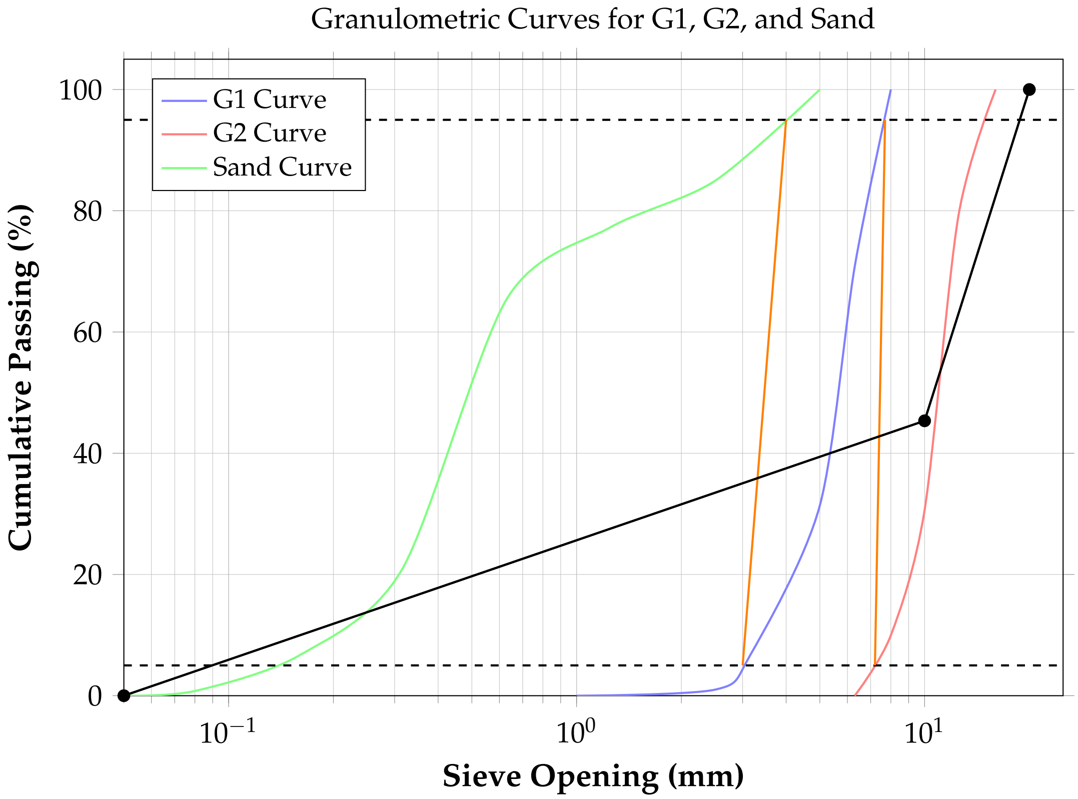
TABLE 2.3: Granular Coefficients K_b for Bologne Formula

Petrographic Nature of Aggregates	10 to 16 mm	20 to 25 mm	30 to 40 mm
Slightly Altered Siliceous	0.45	0.50	0.55
Rounded Siliceous	0.50	0.55	0.60
Hard Limestone	0.55	0.60	0.65

Maximum D used between **20 and 25**, so we take $\mathbf{k_b} = \mathbf{0.55}$.

- $f_m = 55$
- $K_b = 0.55$
- $E + a = 210\,\text{L} = 0.210\,\text{m}^3$

From the Curve:



- $S_1 = 38\%$
- $G_1 = 15\%$
- $G_2 = 47\%$

Calculations:

Cement content formula:

$$f_{c28} = f_m \times K_b \times \left(\frac{C}{E+a} - 0.5 \right) \quad \Rightarrow \quad C = (E+a) \times \left(\frac{f_{c28}}{f_m \times K_b} + 0.5 \right)$$

$$C = 210 \times \left(\frac{30}{55 \times 0.55} + 0.5 \right) = 350\,\mathrm{kg/m^3}$$

Volume balance for sand and gravel:

$$V_c + V_s + V_e + V_g + V_a = 1\,\mathrm{m}^3 \quad \Rightarrow \quad V_s + V_g = 1000 - (V_c + V_e + a) = 1000 - (113 + 210) = 677\,\mathrm{L/m^3}$$

Sand mass:

$$V_s = 0.38 \times 677 = 257.26\,\mathrm{L/m^3}$$
$$S = 2.6 \times 257.26 = 668.87\,\mathrm{Kg/m^3}$$

Gravel mass G_1 and G_2:

$$V_{g1} = 0.15 \times 677 = 101.55\,\mathrm{L/m^3}$$

$$G_1 = 2.5 \times 101.55 = 253.87\,\mathrm{Kg/m^3}$$

$$V_{g2} = 0.47 \times 677 = 318.19\,\mathrm{L/m^3}$$

$$G_2 = 2.5 \times 318 = 795.47\,\mathrm{Kg/m^3}$$

Superplasticizer (S) and air entrainer (G):

$$S = 2\% \quad \Rightarrow \quad S = 668.87 \times 0.02 = 13.38\,\mathrm{L}$$

$$G = 0.5\% \quad \Rightarrow \quad G = (795.47 + 253.87) \times 0.005 = 5.25\,\mathrm{L}$$

Water content E:

$$E + a = 210\,\mathrm{L} \quad \Rightarrow \quad E + a = 13.38 + 5.25 + 210 = 227.83\,\mathrm{L}$$

Volume of Cubes and Cylinders:

- $V_{\text{cube}} = (10 \times 10 \times 10) \times 3 = 0.003\,\mathrm{m^3}$
- $V_{\text{cylinder}} = \pi \times R^2 \times 32 = 0.00643398\,\mathrm{m^3}$
- $V_{\text{Augmentation}} = 15\% = 0.15 \times (0.003 + 0.00643398) = 0.0014148\,\mathrm{m^3}$

Total volume:

$$V_{\text{total}} = 0.0014148 + 0.00643398 + 0.003 = 0.01084908\,\mathrm{m^3}$$

Given:

- $1\,\mathrm{m^3} \to 350\,\mathrm{kg}$
- $0.0108\,\mathrm{m^3} \to X$

Calculated Material Quantities:

- Cement (C) = 3.8 kg
- Water (E) = 2.8 L
- Sand (S) = 7.26 kg
- Gravel 1 (G_1) = 2.75 kg
- Gravel 2 (G_2) = 8.63 kg

2.5 Conclusion:

Finally,This method helps us understand how different materials work together, allowing us to adjust the mix for different conditions. Overall, these results show how important it is to have the right mix for better quality concrete, which is crucial for building safe and lasting structures.