Grain Size Distribution

Particle size analysis

- **Course Grained**
  - •Boulder > 12 in
  - •Cobble 3 – 12 in
  - •Gravel 4.75 mm (#4) – 3 in
    - •Course 0.75 – 3 in
    - •Fine #4 – 0.75 in
  - •Sand 0.075 mm (#200) – #4
    - •Course 2 mm (#10) - #4
    - •Medium 0.425 mm (#40) - #10
    - •Fine #40 - #200
- **Fine Grained**
  - •Silt 0.002 mm - #200 Non-plastic
  - •Clay <0.002 mm Plastic

Sieve Analysis

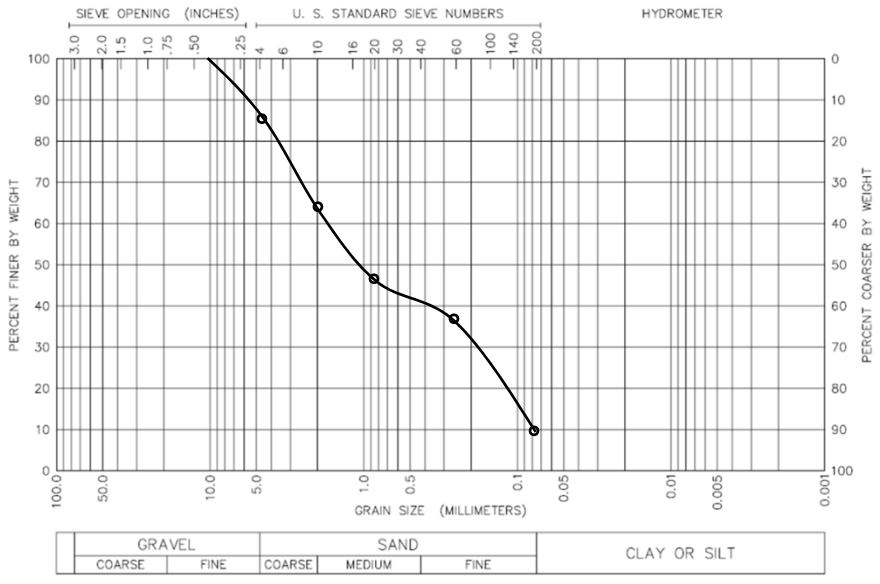
Sieve no.	Opening (mm)	Sieve no.	Opening (mm)
4	4.75	35	0.500
5	4.00	40	0.425
6	3.35	50	0.355
7	2.80	60	0.250
8	2.36	70	0.212
10	2.00	80	0.180
12	1.70	100	0.150
14	1.40	120	0.125
16	1.18	140	0.106
18	1.00	170	0.090
20	0.850	200	0.075
25	0.710	270	0.053
30	0.600		

$$\text{Percent Retained} = \left(\frac{\text{Weight retained on a sieve}}{\text{Weight of sample used for sieve analysis}}\right) \times 100$$

% passing = 100 - % retained

Sieve no.	4	10	20	60	200	Pan
Sieve size (mm)	4.75	2.0	0.84	0.25	0.074	—
Weight retained (g)	31	58	38	26	68	21

Sieve #	Sieve Size (mm)	Mass retained g	Mass retained %	Cumulative % retained	Cumulative % passed
4	4.75	31	12.81	12.81	87.19
10	2.0	58	23.97	36.78	63.22
20	0.84	38	15.70	52.48	47.52
60	0.25	26	10.74	63.22	36.78
200	0.075	68	28.10	91.32	8.68
pan		21	8.68	100.00	0.00
Σ		242	100.00		100.00



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Hydrometer Analysis

$$v = \frac{\rho_s - \rho_w}{18.\eta}.D^2$$

v = Velocity of the particle
ρ_s = Density of soil particle
ρ_w = Density of water
η = Viscosity of water
D = Diameter of soil particle

Specific gravity of soil solid $(G_s) = \frac{Unit\ weight\ of\ a\ material}{unit\ weight\ of\ water}$

$$D = \sqrt{\frac{18.\eta.v}{\rho_s - \rho_w}}$$

$$v = \frac{L}{t}$$

$$D = \sqrt{\frac{18.\eta.\frac{L}{t}}{G_s.\rho_w - \rho_w}}$$

$$D = \sqrt{\frac{18.\eta}{\rho_w(G_s - 1)}}.\sqrt{\frac{L}{t}}$$

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$$\frac{D(mm)}{10} = \sqrt{\frac{18.\eta(\frac{g.\sec}{cm^2})}{\rho_w(\frac{g}{cm^3})(G_s - 1)}}.\sqrt{\frac{L(cm)}{t(\min).60}}$$

$$D = \sqrt{\frac{30.\eta}{\rho_w(G_s - 1)}}.\sqrt{\frac{L}{t}}$$

$$K = \sqrt{\frac{30.\eta}{\rho_w(G_s - 1)}}$$

$$D = K.\sqrt{\frac{L}{t}}$$

Values of K

Temperature (°C)	G_s 2.45	2.50	2.55	2.60	2.65	2.70	2.75	2.80
16	0.01510	0.01505	0.01481	0.01457	0.01435	0.01414	0.01394	0.01374
17	0.01511	0.01486	0.01462	0.01439	0.01417	0.01396	0.01376	0.01356
18	0.01492	0.01467	0.01443	0.01421	0.01399	0.01378	0.01359	0.01339
19	0.01474	0.01449	0.01425	0.01403	0.01382	0.01361	0.01342	0.01323
20	0.01456	0.01431	0.01408	0.01386	0.01365	0.01344	0.01325	0.01307
21	0.01438	0.01414	0.01391	0.01369	0.01348	0.01328	0.01309	0.01291
22	0.01421	0.01397	0.01374	0.01353	0.01332	0.01312	0.01294	0.01276
23	0.01404	0.01381	0.01358	0.01337	0.01317	0.01297	0.01279	0.01261
24	0.01388	0.01365	0.01342	0.01321	0.01301	0.01282	0.01264	0.01246
25	0.01372	0.01349	0.01327	0.01306	0.01286	0.01267	0.01249	0.01232
26	0.01357	0.01334	0.01312	0.01291	0.01272	0.01253	0.01235	0.01218
27	0.01342	0.01319	0.01297	0.01277	0.01258	0.01239	0.01221	0.01204
28	0.01327	0.01304	0.01283	0.01264	0.01244	0.01225	0.01208	0.01191
29	0.01312	0.01290	0.01269	0.01249	0.01230	0.01212	0.01195	0.01178
30	0.01298	0.01276	0.01256	0.01236	0.01217	0.01199	0.01182	0.01169

[a] After ASTM (2004)

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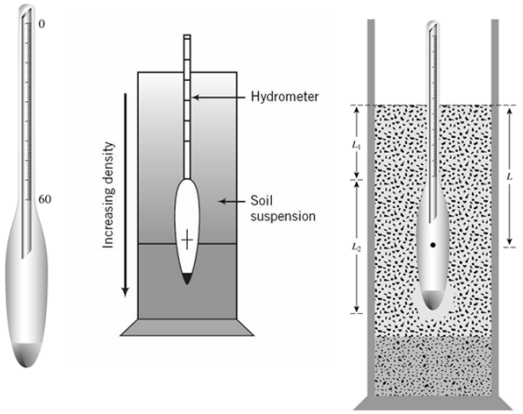


L_1
10.5 cm for R=0
2.3 cm for R=50

$$L = L_1 + \frac{1}{2}(L_2 - \frac{V_B}{A}) \qquad L_1 = 10.5 - \frac{(10.5 - 2.3)}{50}.R$$

$$L = 10.5 - 0.164R + \frac{1}{2}(14 - \frac{67}{27.8})$$

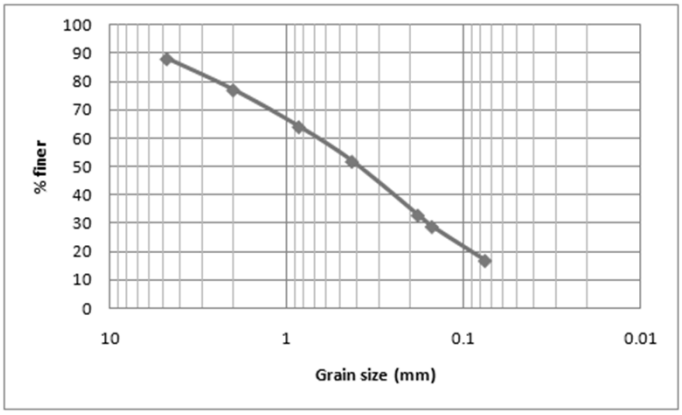
L = 16.29 – 0.164 x R

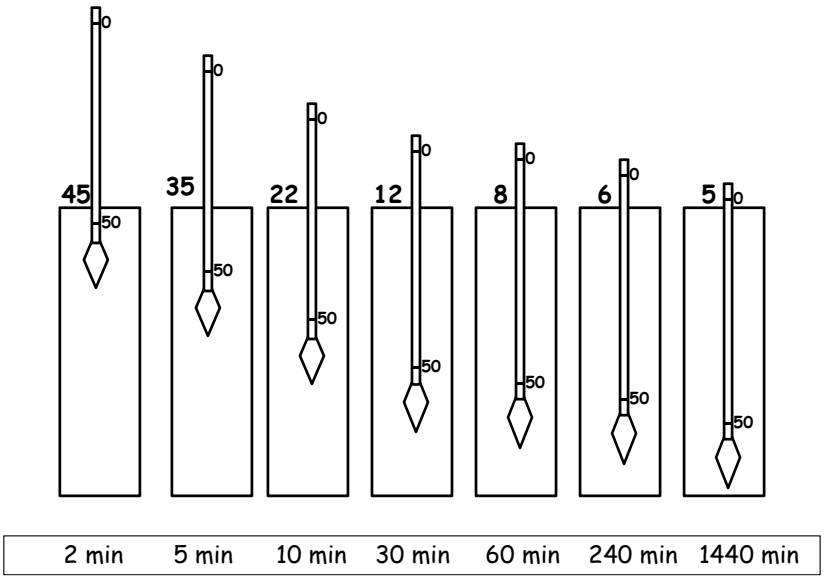
$$P' = \frac{(R-b)a}{M_d} \times 100\% \qquad P = P' \times P_{-\#40}$$

Gs	a
2.5	1.03
2.55	1.02
2.6	1.01
2.65	1.00
2.7	0.99
2.75	0.98
2.8	0.97
2.85	0.96

Temperature (°C)	b
17	5.9
18	5.6
19	5.3
20	5.0
21	4.7
22	4.4
23	4.1
24	3.8

Sieve #	Size (mm)	Mass retained (g)	% retained	cum% retained	% passed
4	**4.75**	**60**	**12**	**12**	**88**
10	**2**	**55**	**11**	**23**	**77**
20	**0.85**	**65**	**13**	**36**	**64**
40	**0.425**	**61**	**12.2**	**48.2**	**51.8**
80	**0.18**	**95**	**19**	**67.2**	**32.8**
100	**0.15**	**20**	**4**	**71.2**	**28.8**
200	**0.075**	**60**	**12**	**83.2**	**16.8**
pan		**84**	**16.8**	**100**	**0**
Sum		***500***	***100***		

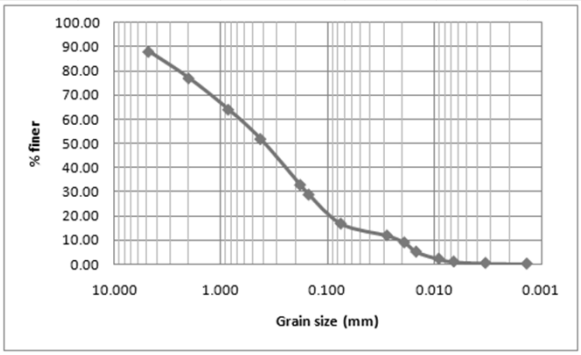


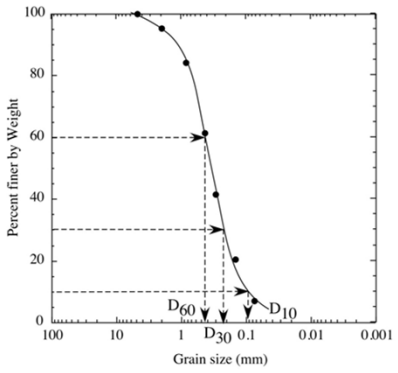


t(min)	R	L (cm)	D (mm)	P'	P
2	45	8.91	0.028	22.968	11.897
5	35	10.55	0.019	17.311	8.967
10	22	12.682	0.015	9.957	5.158
30	12	14.322	0.009	4.299	2.227
60	8	14.978	0.007	2.037	1.055
240	6	15.306	0.003	0.905	0.469
1440	5	15.47	0.001	0.339	0.176

Opening	% passing
4.750	88.00
2.000	77.00
0.850	64.00
0.425	51.80
0.180	32.80
0.150	28.80
0.075	16.80
0.028	11.90
0.019	8.97
0.015	5.16
0.009	2.23
0.007	1.05
0.003	0.47
0.001	0.18

Mass (g)	Temp (deg)	a	Gs	b	K
175	22	0.99	2.7	4.4	0.01312

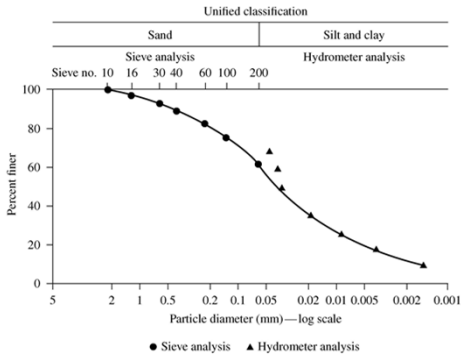




$$C_u = \frac{D_{60}}{D_{10}}$$

$$C_c = \frac{D_{30}^{\ 2}}{D_{10}\ D_{60}}$$

D_{10}
D_{30}
D_{50}
D_{60}



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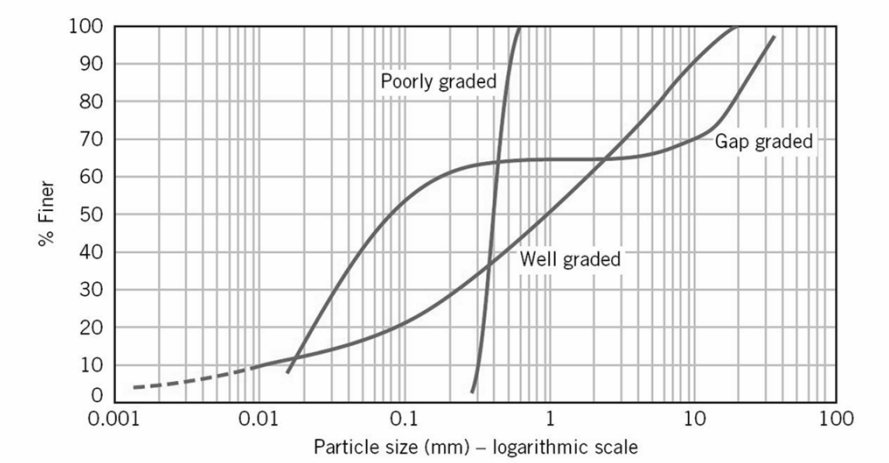


A hydrometer test was conducted for
60 g of the specimen, and
Gs = 2.68
Temperature of water = 23^{0}C
At time = 180 minutes
after the start of the sedimentation
Hydrometer reading (R) = 38

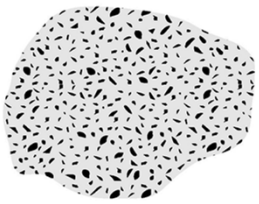
The diameter of the smallest sized particles that have settled beyond the zone of measurement at that time?

% of the particles finer than that diameter?

Angular

Subangular

Subrounded



Rounded