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CHAPTER

Soil Mechanics

Classification of Soils and Soil Structure

Q.1 Consider the following statements:
1. Coarse-grained soil having fines (<75 μm in size) between 5% and 12% have a dual symbol according to IS code for soil classification.
2. At liquid limit, all soils have the same shearing strength.
3. Lower the shrinkage limit, greater is the volume change in a soil with change in water content.

Which of these statement are correct?
(a) 1 and 2 (b) 1 and 3
(c) 2 and 3 (d) 1, 2 and 3

Q.2 In a particular soil sample, laboratory analysis has yielded the following result:
1. Sand 20%
2. Silt 30%
3. Clay 50%

Without using textural classification chart, the correct textural classification of the soil used is
(a) loam (b) sandy clay
(c) silt loam (d) clay

Q.3 Match Column-I (different types of soil) with Column-II (symbol for IS classification) and select the correct answer using the code given below:

Column-I
A. Well-graded gravel sand mixture with little or no fines.
B. Poorly graded sands gravelly sand with little or no fines.
C. Inorganic silts and very fine sands or clayey silts with low plasticity.
D. Inorganic clays of high plasticity.

Column-II
1. ML
2. CH
3. GW
4. SP

	A	B	C	D
(a)	2	1	4	3
(b)	3	4	1	2
(c)	2	4	1	3
(d)	3	1	4	2

Q.4 The type of soil structure having arrangement of soil particles with a 'face-to-face' or parallel orientation is generally recognized as
(a) Honey comb structure
(b) Single-grained structure
(c) Flocculent structure
(d) Dispersed structure

Q.5 The liquid and plastic limits of a fine-grained soil are found to be 44 and 21 respectively. How is the soil classified?
(a) ML (b) CL
(c) CI (d) MI

Q.6 Consider the following statements:
I. Grain size is the primary criterion for classification of coarse, as well as fine grained soils.
II. A semi-log plot is used to represent the grain size distribution of a soil sample.
III. Poorly graded or uniformly graded sands compact to low dry unit weights.
IV. For a well graded sand, the coefficient of curvature should lie between 1 and 3.

Which of the above statements are CORRECT?
(a) I, II, III and IV (b) I, II and III
(c) II, III and IV (d) I, II and IV

Q.7 The description of 'sandy silty clay' signifies that
(a) the soil contains unequal proportions of the three constituents, in the order sand > silt > clay
(b) the soil contains equal proportions of sand, silt and clay
(c) the soil contains unequal proportions of sand, silt and clay
(d) the soil contains unequal proportions of three constituents such that clay > silt > sand

Q.8 Match List-I (Soil classification symbol) with List-II (Soil property) and select the correct answer using the codes given below the lists:

List-I
A. GW
B. SW
C. ML
D. CL

List-II
1. Soil having uniformity coefficient > 6
2. Soil having uniformly coefficient > 4
3. Soil having low plasticity
4. Soil having low compressibility

Codes:

	A	B	C	D
(a)	1	2	4	3
(b)	2	1	3	4
(c)	2	1	4	3
(d)	1	2	3	4

Q.9 In a soil specimen, 70% of particles are passing through 4.75 mm IS sieve and 4% of particles are passing through 75 μ IS sieve. Its uniformity coefficient is 8 and coefficient of curvature is 2. As per IS classification, this soil is classified as
(a) SP (b) GP
(c) SW (d) GW

Q.10 Sieve analysis on a dry soil sample of mass 1000 g showed that 980 g and 270 g of soil passes through 4.75 mm and 0.075 mm sieve, respectively. The liquid limit and plastic limit of the soil fraction passing through sieves are 40% and 18%, respectively. The soil may be classified as
(a) SC (b) MI
(c) CI (d) SM

Q.11 The correct sequence of plasticity of minerals in soil in an increasing order is
(a) silica, kaolinite, illite, montmorillonite
(b) kaolinite, silica, illite, montmorillonite
(c) silica, kaolinite, montmorillonite, illite
(d) kaolinite, silica, montmorillonite, illite

Q.12 As per IS classification, a fine grained soil is highly compressible if its liquid limit is greater than
(a) 20% (b) 25%
(c) 50% (d) 35%

Q.13 Match List-I (type of soil) with List-II (permeability) and select the correct answer using the codes given below the lists:

List-I	List-II
A. Gravel	1. 10^{-9} m/sec
B. Sand	2. 10^{-8} m/sec
C. Silt	3. 10^{-3} m/sec
D. Clay	4. 10^{-1} m/sec

Codes:

	A	B	C	D
(a)	1	2	3	4
(b)	4	3	2	1
(c)	3	4	1	2
(d)	2	4	3	1

Q.14 The honey combed structure is found in
1. Fine silts and clays
2. Gravels
3. Coarse sand

Which of these statement/s is/are correct?
(a) only 1 (b) both 1 and 3
(c) only 2 (d) both 2 and 3

Q.15 Which of the following statement/s is correct?
(a) Illite bond is weaker than kaolinite bond.
(b) Illite bond is stronger than montmorillonite bond.
(c) Illites are composed of two silica tetrahedral sheets with a central octahedral sheet.
(d) All of the above

Q.16 As per Indian Standard soil classification system, an expression for U-line is
(a) $0.73(w_L - 20)$ (b) $0.9(w_L - 20)$
(c) $0.73(w_L - 8)$ (d) $0.9(w_L - 8)$

Answers Classification of Soils and Soil Structure

1. (d) 2. (d) 3. (b) 4. (d) 5. (c) 6. (c) 7. (d) 8. (b) 9. (c) 10. (a)
11. (a) 12. (c) 13. (b) 14. (a) 15. (d) 16. (d)

Explanations Classification of Soils and Soil Structure

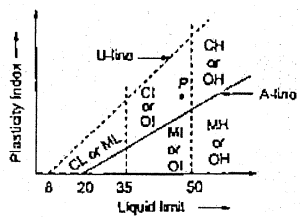
5. (c)

$$IP = LL - PL = 44 - 21 = 23$$

Equation of A-line is

$$IP = 0.73(LL - 20) = 0.73(44 - 20)$$
$$= 17.52$$

⇒ Soil lies above A-line



Also, liquid limit lies between 35 and 50. Therefore soil is clay of intermediate plasticity (CI).

8. (b)

GW is well graded gravel for which coefficient of uniformity (C_u) > 4.

SW is well graded sand for which coefficient of uniformity (C_u) > 6

ML is silt with low plasticity (< 35%)

CL is clay with low plasticity (< 35%). It also possess low compressibility.

9. (c)

Since more than 50% of particles are passing through 4.75 mm sieve while less than 50% are passing through 75μ sieve, the soil is sand.

$$C_u = 8 > 6$$
$$1 < C_c = 2 < 3$$

Therefore its well graded sand (SW)

11. (a)

Silica has least plasticity while montmorillonite has highest plasticity.

15. (d)

Illite: 2:1 clay mineral with K^+ ion occupying position between adjacent layers

Kaolinite: It is also called 1:1 mineral. Layers are held together by hydrogen bond, soil has considerable strength and stability and less tendency to swell.

16. (d)

U-line defines the upper limit of the correlation between PI and LL.

If the results of the soil tests fall above the U-line, repeat Atterberg tests.

Equation for U-line : $0.9\ (W_L - 8) = I_P$

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