Engineering Geology Test Bank

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- A wet soil sample of 125cm², has 220g wet mass & 200g dry mass of quartz particles (G) =2.5. calculate the following
  - dry density
  - Wet density
  - Porosity
  - Void Ratio

Wet mass = Ms + Mw, Dry mass = Ms = 200g
Wet mass – Dry mass = Mw = 220 - 200 = 20g

$$Gs = \frac{\rho_s}{\rho_w} \rightarrow \rho_s = 2.5g/cm^3$$

$$\rho_s = \frac{M_s}{V_s} \rightarrow V_s = \frac{200gcm^3}{2.5g} = 80cm^3$$

$$V_a = V_T - (V_s + V_w) =$$

	M	V
S	200g	80cm³
W	20g	20cm³
A	0	25cm³
T	220g	125cm²
V	20g	45cm³

$$\rho_d = \frac{M_s}{V_T} = \frac{200g}{125cm^3} = 1.60g/cm^3$$

$$\rho_{wet} = \frac{M_{wet}}{V_t} = \frac{M_w + M_s}{V_T} = \frac{20g + 200g}{125cm^3} = 1.76g/cm^3$$

$$n = \frac{V_v}{V_t} = \frac{45cm^3}{125cm^3} = 0.36$$

$$e = \frac{n}{1-n}x100\% = \frac{0.36x100\%}{1-0.36} = 26.5\%$$

- A wet soil sample has a volume of 125 cubic centimeters, a wet mass of 220 g, and a dry mass of 200 g. Sp gravity of quartz particles =2.5. wet density=
- A road fill is being placed & compacted. To determine whether contract specifications being met, sand cone test is conducted. The volume of the hole is 100cc & the dry mass of dug soil is 180g, with moisture content 10%. Previous laboratory test gave a maximum dry density 1.86 g/cc, & optimum moisture content 12% Calculate the compaction ratio of the road fill

max ρ_{dry} 1.86 g/cc, & optimum w= 12% ***القيمة القياسية:***
Vt 100cc, Ms = 180g, w% = 10% ***الذي تم حسابه في الميدان:***
compaction ratio ***المطلوب:***
dry ***والتي نحسب من خلالها ال*** moist density ***اولا يجب ان نحسب ال***
(مطلوبة في السؤال الاصلي) ونقسمها على الكثافة القياسية density
ومنه سنحدد اذا ما كان عمل المقاول جيد compaction ratio ***سيعطينا ال***

$$\rho_{moist} = \frac{m}{v} = \frac{180g}{100cc} = 1.80g/cc$$

$$\rho_{dry} = \frac{\rho_{moist}}{1+w\%} = \frac{1.80g/cc}{1+0.1} = 1.64g/cc$$

$$compaction\ ratio = \frac{\rho_{measured}}{\rho_{calculated}} = \frac{1.64}{1.86}x100\% = 88\%$$

النسبة اقل من 95 ما يعني ان عمل المقاول لم يكن جيد

- **The angle of internal friction of clay is higher than that of sand**
  1. True
  2. False

Sol. False
Note. Sand have higher γ (unit weight), φ (internal friction), & δ (metal friction), while clay have higher cohesion

- **Densification upon loading vesicular or porous rocks, produces early plastic deformation**
  1. True
  2. False

Sol. True

- **Soil profile can be constructed based on friction ratio of CPT**
  1. True
  2. False

Sol. True
Note. CPT: Protect Compaction Test

- **Which of the following is durability test**
  1. point load test
  2. UCS test
  1. freeze-thaw test
  2. liquid limit test

Sol. 3

- **Dense soil is a term to describe**
  1. non-cohesive
  2. granular soil
  3. clay soil
  4. cohesive soil
  5. organic soil

Sol. 1

- **Liquid limit of a soil equals 65 & plastic limit equals 35, its plasticity index (PI) equals**

$$PI = LL - PL = 65 - 35 = 30$$

- **Shear strength of discontinuity with angular crushed rock is higher than that filled with clay**
  1. True
  2. False

Sol. True
Note. Angular crushed rock have high cohesion which directly proportional to the shear strength

- **The equation that represents effective strength**
  1. $T = c - (\sigma + u)\tan(\varphi)$
  2. $T = c + (\sigma + u)\tan(\varphi)$
  3. $T = c - (\sigma - u)\tan(\varphi)$
  4. $T = c + (\sigma - u)\tan(\varphi)$

Sol. 4

- **In USC (Unified Soil Classification), sieve no ___ is used to identify fine from coarse grained**
  1. No. 4
  2. No. 400
  3. No. 200
  4. No. 10

Sol. 3 (200)
Note. #4 to very large grains, #10 used to separate sand from gravel, #200 used to separate fine from coarse grained

- **Void filling & cementation generally increase rock strength**
  1. True
  2. False

Sol. True

- **In direct shear test we measure normal & shear stresses & construct a failure envelope that determine two parameters: What are they?**

Sol. Cohesion (C) & Angle of friction (φ)

- **Void ratio is given by the following equation**
  1. e = Vs / VT
  2. e = Vv / VT
  3. e = Vs / Vv
  4. e = Vv / Vs

  Sol. 4
- **Adding water is a major stabilizing agent of landslides**
  1. True
  2. False

  Sol. False

  Note. Landslides increases with increasing water content in soils
- **Stabilizing factors of landslides could be**
  1. unloading, draining & anchoring slope
  2. add buildings on top of the slope
  3. excavate under the slope
  4. rainfall

  Sol. 1
- **What is the parameters of UCS test?**

  Cohesion (C) & Angle of friction (φ)
- **Sensitivity of soil is the strength ratio between**
  1. stress/strain
  2. remolded/undisturbed
  3. strain/stress
  4. cohesive/non-cohesive

  Sol. 2

  Note. Sensitivity is the Ratio of *undrained shear strength of undisturbed soil* to the *undrained shear strength of remoulded soil* at same water content
- **In direct shear test we measure normal & shear stresses & construct an envelope called:**

  Mohr-coulomb failure envelope
- **Napitanes decided to build this structure in the Cambrian sandstone because**

  Sandstone is strong enough to hold a structure & weak enough to excavate
- **Shear strength is a soils' ability to resist sliding along internal surfaces within the soil mass**
  1. True
  2. False

  Sol. True
- **Causes of landslides are the following except**
  1. water flow & earthquakes
  2. unloading
  3. clay under massive rock
  4. increase of driving force

  Sol. 2
- **Decreasing grain size of soil or rock particles increases strength**
  1. True
  2. False

  Sol. True
- **CH soil refers to**
  1. Clay with high plasticity
  2. High Cohesive Clay
  3. High Consolidated clay
  4. High strength Clay

  Sol. 1
- **Stiff soil is a strength discretion of granular soil**
  1. True
  2. False

  Sol. 1
- **Granite show higher range of strength (low & high strengths) than quartzite. Why?**

  Weathering **لكن بعد حدوث** *high strength* **بالاصل هو** *granite* **ال** *low strength* **يصبح لذا هو احيانا** *high* **واحيانا** *low* **اما ال** *quartzite* **مقاوم لل** *weathering* **لذا الاختلاف بال** *strength* **قليلة**
- **Average strength of gneiss is higher than the average strength of schist. Why?**

  Foliation texture in schist reduce rock strength (weak), but Gneiss is an exclusion
- **Joint filling may increase or decrease rock strength. Why?**

  Joint filling (or in general void filling) will increase rock strength, because increases density of rock, cementation, & grading
- **Write down 3 parameters that affect rock mass classification & show the effect of each**
  1. **Particle Size:** main classification(G,S,C,M)
  2. **Plasticity:** affect fine grained materials (C, & M) classified as L (low) & H (high)
  3. **Sorting:** Affect coarse grained materials (S, & G) classified as P (poorly) & W (well)
- **What is the factors that determine the density results from soil compaction (with their affect)**
  1. **The energy used in compaction:** directly proportional to the density result
  2. **The water content of the soil**: as moisture increases the density increase until reach the peak (maximum dry density), then become inversely proportional
  3. **The properties of the soil:** for example grain size (inversely proportional), Plasticity, & Grading (directly proportional)
- **The soil that has a size range in between 75-2000μm is**
  1. Silt & Clays
  2. Sand
  3. Clay
  4. Gravel

  Sol. 2
- The soil size that passes through sieve no 10 & retained on sieve no 200
  1. Cohesive
  2. Non-Plastic
  3. Un-Homogeneous
  4. Non-cohesive

  Sol. 2
- The correct decreasing order of rock strength
  1. Gypsum, Granite, Quartzite
  2. Granite, Gypsum, Quartzite
  3. Granite, Quartzite, Gypsum
  4. Non of the above

  Sol. 3
- Resistance to weathering of minerals _____ with T of formation so aggregates with Qz is _____ resistance to weathering than with calcarenite

  Sol. Decrease, More

- The 3 photos are show rock type used in construction materials

1. What is the type of each rock?
2. Comment on the engineering properties of this 3 types of rocks

Solution

1. **Basalt, Sandstone, & limestone**
2. **Basalt**: are very strong rock (resist stress)

Basalt: More stable than granite because has less cracks due to their lower grain size

Sandston: strong enough to hold a structure & weak enough to excavate

Limestone: لانه الصخر المتوفر في المنطقة وتكلفة نقل الصخور كبيرة

- **Improving sorting will _____ rock strength & low strength minerals led to ____ strength rock**

Sol. Decreases, low

Ep	Affect on properties	Example
Composition	**High-strength mineral grains produce a higher-strength rock**	**granite is strong due to the strong minerals (i.e.Qz)**
Texture	**Strength are directly related to grain backing, cement content, & inversely related to voids, sorting, grain size…**	**aphanitic texture in ign. rock provide higher strength due to low interlocked crystal**
Discontinuity	**Strength inversely related to rock spacing, joint, crack, cave, fault, pores…**	**the source of weakness in schist are foliation texture**
Weathering	**Phy-chemo-Bio-disintegration or decomposition of rocks influences the strength of rocks**	**Granite is very strong rock but weathering transfers it to a very weak**

- **The soil that product of underlying rock in suit is called _____**
  1. Transported soil
  2. **Residual soil**
  3. Weathering soil
  4. Fertile soil
- **A nature aggregates of mineral grains that separate in such mechanical means as agitation**
  1. **Soil**
  2. Rock
  3. Minerals
  4. Compounds
- **Mechanical properties of soils are a function of**
  1. Soil mineralogy & particle size & shape
  2. Organic content
  3. Moisture content & fabric
  4. **All of the above**
- The highest plasticity, water absorption & CEC caly
  1. Illite
  2. **Montmorillonite**
  3. Kaolinite
- **In a given sample, mass of solid is 100gm, Gs is 2.5, volume ratio of solid to water to air 4:1.5:1, calculate Dry; Wet; Saturated densities, Porosity, Void Ratio, Saturation Degree**

	M	V
S	100g	40 cm³
W	12g	15 cm³
A	0	10 cm³
T	112g	65 cm³

$$\rho_d = \frac{M_s}{V_T} = \frac{100g}{65cm^3} = 1.54g/cm^3$$

$$\rho_{wet} = \frac{M_{wet}}{V_t} = \frac{M_w + M_s}{V_T} = \frac{112g}{65cm^3} = 1.72g/cm^3$$

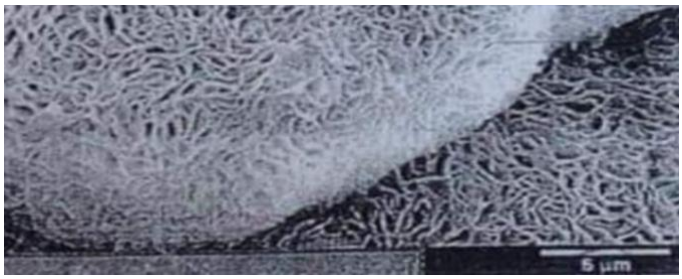
$$n = \frac{V_v}{V_t} = \frac{(15+10)cm^3}{65cm^3} = 0.38$$

$$e = \frac{n}{1-n}x100\% = \frac{0.38x100\%}{1-0.38} = 62.5\%$$

$$S = \frac{V_w}{V_v}x100\% = \left(\frac{15cm^3}{25cm^3}\right)x100\% = 60\%$$

$$\rho_{sat} = \frac{M_{sat}}{V_{sat}} = \frac{M_s + M_w + V_a}{V_t} = \frac{100+12+10}{65} = 1.88$$

Depending on the following SEM photo

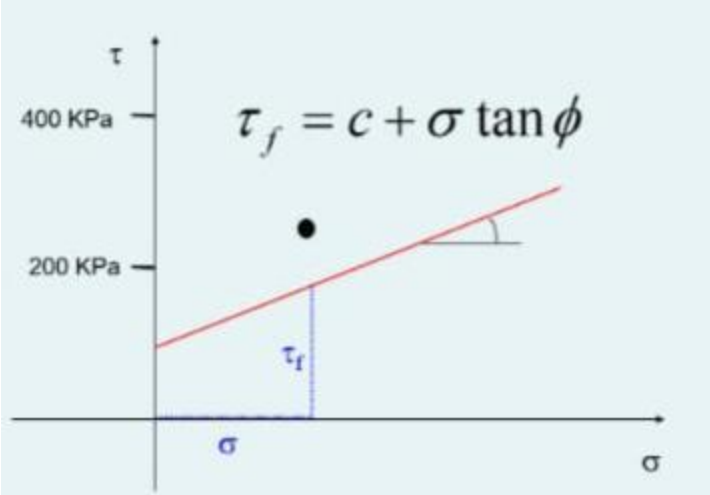


- **The size of the particle range from**
  1. **1-5 µm**
  2. 1-5 mm
  3. 5-10 cm
  4. 1 nm
  - **Show how you get the answer?**
    From scale on the photo
- **This structure indicates**
  1. Low permeability & High porosity
  2. Low permeability & Low porosity
  3. **High permeability & High porosity**
  4. High permeability & Low porosity
- Soil of this type passes through
  1. Sieve no. 4
  2. Sieve no. 10
  3. Sieve no. 200
  4. **All of them**
- Descried the shape & size of particles
  Fabric shape & 1-5 microns in size
- **Rock mass classification system except**
  1. Rock mass rating (RMR)
  2. Q-System
  3. **unified classification system**
  4. Rock structure rating (RSR)
- **The given device is used to measure of samples**

  1. UCS
  2. Velocity in sample
  3. jointing due to loading
  4. **Point load strength**
- **Rock mass classification depends on the following except**
  1. point load test & UCS
  2. UCS
  3. UCS fracture spacing & bedding plane spacing
  4. **USAID**
- **Los Angelos & slake durability test are used for**
  1. Durability of rock mass
  2. Mineral hardness
  3. **Durability of rock substance**
  4. Rock composition
- **The mostly used rock mass classification to determine ground support in underground mining & engineered rock slopes is**
  1. RMR
  2. unified classification
  3. ASHTOO
  4. **RQD**
- **5cm coring carried out to 5m depth, recovered core pieces: 8, 31, 15, 9, 12, 65, 5, 19, & 45, RQD**
  1. 45%
  2. 70%
  3. **37%**
  4. 60%
- **Joint spacing is directly related to the block size**
  1. **True**
  2. False
- **All the following are discontinuities in rock masses except**
  1. Joints
  2. Fractures & Caves
  3. **Fold**
  4. Faults & Bedding Planes
  5. Non-conformity surfaces
- **Rock Mass Rating (RMR) is ____ related to RQD**
  1. not at all
  2. randomly
  3. inversely
  4. **directly**
- **Joints in massive limestone filled with clay soil inherit of shearing resistance**
  1) **Decrease**
  2) huge improvement
  3) increase
  4) neither increase nor decrease
- **Joint intensity is inversely proportional to RQD**
  1. **True**
  2. False
- **The following is the elements of Rock classification system, except**
  1. rock type
  2. joints intensity, orientation & fillings
  3. rock strength
  4. **groundwater**
- **High-strength grains produce high-strength soil**
  1. **True**
  2. False
- **Loading of vesicular basalt will produce elastic phase then plastic**
  1. **True**
  2. False
- **Improved rounding decreases soil strength**
  1. **True**
  2. False
- **The angle of internal friction of rounded particle soil is higher than that of angular particle soil**

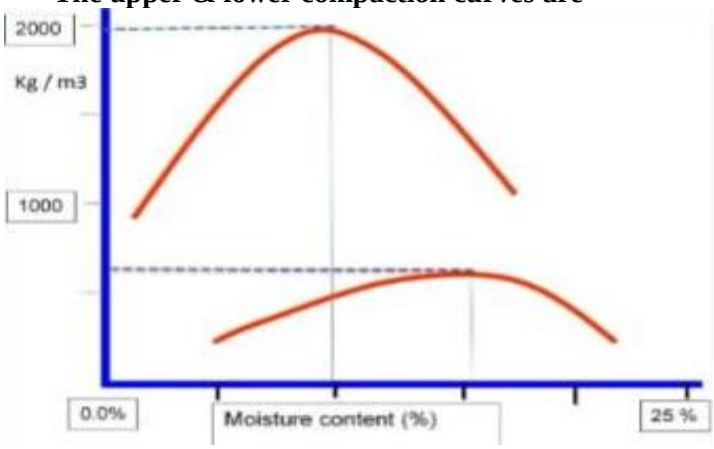
1. True
2. **False**

- **Decreasing grain size increases strength**
  1. **True**
  2. False
- **Void filling & cementation increase strength**
  1. **True**
  2. False
- **Estimate the amount of shear stress at the point above the failure envelope line & if this is the applied stress on soil, then the soil will _____**



1. 350 kPa, the soil is stable
2. 100 kPa, the soil will stay stable
3. **230 kPa, the soil will fail**
4. 300 kPa, the soil will fail

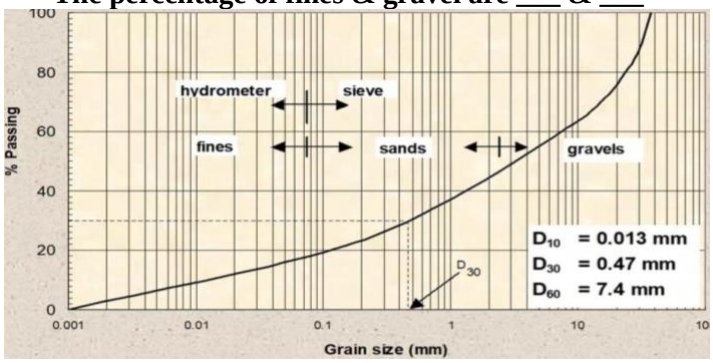
- **The slide surface or plane in landslides could be one of the following except**
  1. **retaining wall**
  2. joint surface
  3. bedding plane
  4. wet clay layer
- **The upper & lower compaction curves are**



1. clay & crushed rock
2. limestone & gypsum
3. **sand & clay**
4. clay & sand

- **Shear strength is the resistance to movement between particles due to the following except**
  1. **Vander valve force between the atoms**
  2. Particle interlocking
  3. Atoms sharing electrons at surface contact
  4. Chemical bonds (cementation) such as crystallized calcium carbonate

- **Which of the following is not valid?**
  1. foliation texture reduces the strength of the rock
  2. **weathering not influence on rock strength**
  3. smaller interlocked crystal provide high strength
  4. Size, Shape, Grading & Packing of rock particles increases the rock strength
- **Engineering properties of rocks are generally controlled by the following factors EXCEPT**
  1. Rock texture
  2. **Rock color, light or dark**
  3. Rock composition & degree of weathering
  4. Discontinuities
- **At low water content of soil during compaction, max dry density cant be achieved due to**
  1. **less lubrication & high friction in dry particle**
  2. not enough water to create lubrication
  3. not enough water to increase friction
  4. more lubrication & low friction
- **The percentage of fines & gravel are ___ & ___**



1. **18% & 52%**
2. 82% & 60%
3. 18% & 48%
4. 52% & 18%

- **The following variables determine the density of compacted soil EXCEPT**
  1. **the person who perform the compaction**
  2. soil properties
  3. water content of the soil
  4. energy used in compaction
- **RQD is proportional to fracture frequency**
  1. **Inversely**
  2. Randomly
  3. not related
  4. directly
- **In direct shear test we measure normal & shear stresses & construct envelope called _____**

Mohr-coulomb failure envelope

#200 (0.75mm) between coarse size & fine size
#10 (2mm) between gravel & sands
#4 (4.75mm) larger