

Introduce yourself –

আমি ----. বর্তমানে অধ্যয়নরত ৩য় বর্ষ জোড় সেমিস্টার, রাজশাহী প্রকৌশল ও প্রযুক্তি বিশ্ববিদ্যালয়

## Ex- 1 Determination of relative density

### 1. Formula

$$\frac{e_{max} - e}{\frac{e_{max} - e_{min}}{\gamma_d - \gamma_{d\ min}} \times \frac{\gamma_{d\ max}}{\gamma_{d\ max} - \gamma_{d\ min}} - \gamma_d} = \frac{wt\ of\ sand}{volume\ of\ mold}$$

**Definitions**

- Relative Compaction R should not be confused with relative density  $D_r$ , because they are not the same

Relative Compaction R	Relative Density $D_r$
$R = \frac{\gamma_{fd}}{(\gamma_{do})_{max}} \times 100$	$D_r = \frac{e_{max} - e}{e_{max} - e_{min}} = \frac{\gamma_d - (\gamma_d)_{min}}{(\gamma_d)_{max} - (\gamma_d)_{min}} \times \frac{(\gamma_d)_{max}}{\gamma_d}$
<ul style="list-style-type: none"> <li><math>\gamma_{fd}</math> = Field Unit Weight</li> <li><math>\gamma_{do}</math> = Optimum Unit Weight</li> </ul>	

### 2. Relative density –

The ratio of the difference between

- void ratio of soil in its loosest state  $e_{max}$  and its natural state void ratio to
- The difference between the void ratios in the loosest and densest state

is the ratio of the density (mass of a unit volume) of a substance to the density of a given reference material.

### 3. Relative Compaction

It is the looseness or denseness of both cohesionless or cohesive soil.

For the determination of the maximum wet density of soils and aggregates

### 4. Soil type used in this exp?

Cohesionless, free draining soil, sandy soil

### 5. Why relative density and percent compactness is used?

Determine the state of compactness of a given soil mass. Shear strength, Compressibility and permeability of a given soil depends on the level of compaction

### 6. Type of soil according to relative density

Relative Density (%)	Classification
< 15	Very Loose
15 - 35	Loose
35 - 65	Medium dense
65 - 85	Dense
> 85	Very Dense

7. What are the tests for shear strength parameters?  
Direct shear test, Triaxial Compression test, Unconfined compression test
8. Allowable settlement amount?  
1 inch or 25 mm
9. Why we use relative density for sand?  
We can't separate clay, not free drain occurs
10. What is degree of compaction?  
The degree of compaction is a value defined by the ratio of the soil density. measured in situ to its maximum dry density
11. Procedure
  - Loose condition - Mold, pour sand, take  $\gamma_{d(loose)}$
  - Dense Condition - Mold, pour sand (3 layer and 25 blows), take  $\gamma_{d(dense)}$

## Ex – 2 Unconfined Compression test

1. What are the shear strength parameter of diff. type of soil?  
Sand –  $C=0, \phi = \phi$   
**Saturated Clay –  $C=C, \phi = 0$**   
Mix type soil =  $C-\phi$  Soil
2. What do you mean by the term unconfined?  
Zero lateral pressure, when strain hardening occurs, then the stress corresponding to 20% strain of sample length is equal to  $q_u$ .
3. Importance of this test?
  - Earth pressure calculation
  - Bearing capacity of soil
  - Slope stability problem (road, embankment slope)
4. What is the mold dimension relation?  
L is equal or more than 2D, less than 2D will cause compression block
5. What is the maximum strain in soil sample?  
20% strain of initial length
6. Why this test is not possible for sand?  
Need confined pressure to stay on its position
7. What type of test is this?  
Unconsolidated Undrained shear strength test
8. How undisturbed soil is taken?  
By shelby Tube
9. Amount of mold layer and blows  
3, 25
10. What is the interval in deformation dial reading?

25 divisions

11. what is meant by sensitivity of clay sample?

The sensitivity of clays is defined as the ratio of their undisturbed and remoulded strengths, and varies from about 1.0 for heavily over-consolidated clays to values of over 100 for the so-called extra sensitive or “quick” clays. As a result of experimental work it is shown that thixotropy can account for low or medium sensitivity but not for high sensitivity. Both laboratory and field evidence, however, show that a reduction in the salt concentration in the pore water, caused by leaching clays of marine or estuarine origin, can result in high sensitivities.

12. Procedure

- Took 20 % strain-stress value from Axial stress vs strain graph
- Took for all 3 and then unified cohesion,

## Ex – 3 Direct Shear Test

1. For which soil?

Cohesionless, sand,  $c=0$  so not  $c$ - $\phi$  soil

2. Where shear strength is needed?

- Earth pressure calculation
- Bearing capacity of soil
- Slope stability problem (road, embankment slope)

3. What are the two curves in this test and how they found?

4. What does a direct shear test tell you?

The purpose of a direct shear test is to determine the shear strength of a soil; this is done by forcing the soil to shear along an induced horizontal plane of weakness at a constant rate.

5. Direct shear test 2 dimensional

## Ex- 4 Consolidation test

1. What settlement phenomena actually does?

Remove air from void

2. Settlement measure according to code

1 inch or 25 mm, for mat foundation 2 inch

3. What is the next procedure if lab test settlement found more than 1 inch

Field consolidation – need to compact the site soil by necessary instrument.

4. Define  $C_c$ ,  $C_s$ ,  $C_v$  and problems related to these terms

$C_c$  – compression index =  $.009(LL-10)$

$C_s$  – swelling index

$C_v$  – coefficient of compressibility – the decrease in void ratio per unit increase in pressure

5. What are the two-consolidation method?

Square time root method and logarithmic method

6. What is the dimension type of our test?

One dimensional consolidation test

7. Which soil we used? Keno be?

Clay. Karon in saturated stratum of sandy soil when stress increases, then pore water pressure is increased and drainage of some water occurs from voids of soil due to high permeability. Here volume change occurs immediately. But we don't consider it under consolidation.

- So we may say consolidation occurs in clay soil.
8. Difference between compaction and consolidation  
By removing air from void and by removing water from pore
  9. What we get from this test?  
compression index, the recompression index and the pre-consolidation pressure
  10. Equipment
    - Why we use porous stone?  
Porous Stones provide solid support at both ends of soil specimens while allowing free passage of water
    - Dial gauge (0.0001 inch = 1.0 div. on dial)
  11. Which type soil and sampler we use?  
Undisturbed and Shelby tube
  12. Split spoon sampler for disturbed soil.
  13. How we determine the disturbance of sampler?  
Area ratio method – slim thicker Shelby has less disturbance for less thickness

## Exp – 5 Subsoil Exploration

1. What is bearing capacity value if  $C_u=10$   
5
2. If SPT VALUE =1, then bearing capacity =  $.15 \times 1 = .15$  tsf
3. Final target of this test?  
Select appropriate type of foundation
4. What are the tests carried out in this exploration?
  - Physical identification test
  - Moisture content test
  - Wet and dry density test
  - SG test
  - Grain size dist. Test
  - UC test
5. We did these tests to know the shearing resistance, UC strength and bearing capacity of soil
6. Penetration test executed for 90ft
7. Executed boring by wash boring method
8. Used split spoon sampler, outer dia-Inner dia about 2in-1.8in
9. Undisturbed sample possible for only shallow depth , for greater depth we use tubes
10. Undisturbed soil – Shear strength, consolidation, permeability  
Disturbed soil – Compaction, GSD, S.G. TEST, Atterberg limit
11. Shallow depth considered as 6 ' or 20m

## Exp – 5 Tri axial compression test

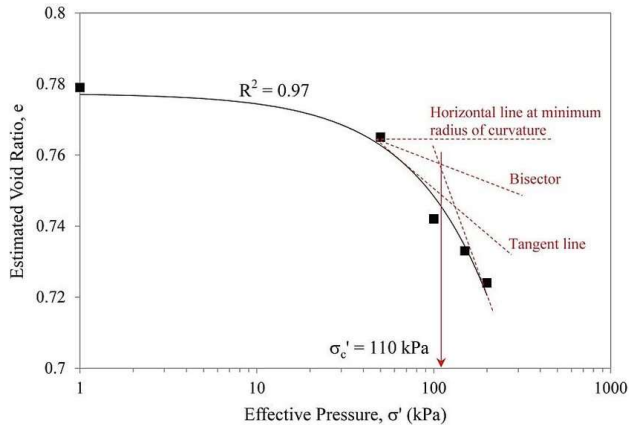
1. It is a 3dimensional test
2. Z direction – load transmit to soil and  
X and y direction – surrounding soil pressure (pressure caused by water)
3. 3 Types – CU, CD, UU
4. Type of our test

UU

5. Ours one is CD and respective steps are
  - Saturation – to fill water in voids by removing air
  - Consolidation – stressed to remove the pore water
  - shearing – sheared to find the failure point
6. Deviator stress - Deviator stress is the difference between the major and minor principal stresses in a triaxial test, which is equal to the axial load applied to the specimen divided by the cross-sectional area of the specimen
7. Deviator stress =  $\sigma_3 - \sigma_1$
8. Mohr coulomb formula -  $\sigma_1 = \sigma_3 \tan^2 \theta + 2c \tan \theta$ ,  $\theta = (45 + \frac{\phi}{2})$
9. Clay – triaxial, unconfined CT, vane shear test  
Sand – direct shear test
10. What are the pressures applied at the time of test?  
Cell, back, pore pressure



- 11.
12. Determine pre-consolidation pressure from e-logp



13. What are the two slopes

$C_c$  = Compression index and  $C_s$  = Swelling index

14. Procedure –

Graph1 – Deviator stress vs strain and determined max 3 values for 3 samples

Graph2 – Axial stress vs normal stress and determined  $C, \phi$  value