Exam #1 S 16  CEE 4300  Name **ANDERSON**

1. A sample of clay soil was trimmed into a consolidometer and measurements produced the following results:

   Wet Mass = 152.11 grams  
   Dry Mass = 115.34 grams  
   G = 2.72  
   Volume = 80.44 cm³

Find:

   a) Water content  
   b) Total unit weight in kN/m³  
   c) Dry unit weight in kN/m³  
   d) Void Ratio  
   e) Porosity  
   f) Degree of saturation

\[
\begin{align*}
   \text{a) } \omega &= \frac{W - W_s}{W_s} \\
   \omega &= \frac{152.11 - 115.34}{115.34} = 0.319 \\
   W &= 31.5\%  \\
   \text{b) } \gamma &= \frac{W}{V} = \frac{152.11}{80.44} (9.81) \\
   \gamma &= 18.55 \text{ kN/m}³  \\
   \text{c) } \gamma_d &= \frac{W_s}{V} = \frac{115.34}{80.44} (9.81) \\
   \gamma_d &= 14.07 \text{ kN/m}³  \\
   \text{d) } \gamma_d &= \frac{G}{1 + e} \gamma \omega \\
   \gamma &= 2.72 \left( \frac{9.81}{14.07} \right) - 1 \\
   \gamma &= 0.896 \leq \gamma
\end{align*}
\]

\[
\begin{align*}
   \text{e) } n &= \frac{e}{1 + e} \\
   n &= \frac{0.896}{1 + 0.896} \\
   n &= 0.473  \\
   \text{f) } G_w &= 5 \gamma \varepsilon \\
   \gamma_r &= \frac{G_w}{\varepsilon} \\
   \gamma_r &= 2.72 (0.319) \\
   \gamma_r &= 0.968 \\
   \gamma_r &= 96.8\%  \\
   \varepsilon &= \text{5 points each} = 30
\end{align*}
\]
2. Atterberg Limits and particle size analysis were performed on a soil and the following results were obtained:

Liquid Limit = 55%
Plastic Limit = 25%

Particle size analysis:

<table>
<thead>
<tr>
<th>U.S. Sieve</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 4</td>
<td>100.0</td>
</tr>
<tr>
<td>No. 10</td>
<td>98.1</td>
</tr>
<tr>
<td>No. 40</td>
<td>89.2</td>
</tr>
<tr>
<td>No. 200</td>
<td>74.0</td>
</tr>
</tbody>
</table>

Classify the soil using:

a) The Unified soil classification system
b) The AASHTO classification systems (be sure to calculate the Group Index)

Group index = \((F-35)[0.2 + 0.005(LL-40)] + 0.01(F-15)(PL-10)\)

A-7-6 (8pts)  GI = 23 (2 points)

a) 74% passing #200 sieve > 50%
   \(\therefore\) Fine-Grained soil
   \(LL = 55\%\)
   \(PI = LL - PL = 55 - 25\)
   \(PI = 30\)
   From the plasticity chart
   \(CH\) \(\rightarrow\) unified classification

b) 74% passing #200 sieve > 35%
   \(\therefore\) Silt-clay materials
   \(LL = 55\%\)
   \(PI = 30\)
   \(PI > (LL - 30) \Rightarrow A-7-6\)
   Group Index = \((74 - 35)[0.2 + 0.005(55 - 40)] + 0.01(74 - 15)(30 - 10)\)

b) cont
   Group Index is reported as a whole #
   Round up
3. Given the flow net shown below:
   a) Determine the flow rate under the dam
   b) Determine the pore pressure at point A

\[ q = k \frac{hL}{N} \]
\[ q = 30 \times 10^{-6} (6.5) \left( \frac{\overline{4}}{13} \right) \]
\[ q = 60 \times 10^{-6} \text{ m}^3/\text{s/m} \]

\[ b) \quad h_{PA} = h_{TA} - h_{EA} \]
\[ h_{TA} = 6.5 - \frac{\overline{8}}{13} (6.5) = 2.5 \text{ m} \]
\[ h_{PA} = 2.5 - (-1) = 3.5 \text{ m} \]
\[ U_A = h_{PA} \sigma_{w} = 3.5 (9.81) \]
\[ U_A = 34.3 \text{ kPa} \]
4. The flow field shown below is to be solved using the finite difference method
a) For this "boundary value" problem identify all boundary conditions of the flow field
   by showing the boundary conditions on the figure below. Also show the location of
   your datum.
   b) If the permeability in the horizontal (x) direction were 4 times the permeability in the
      vertical (y) direction:
         i. What would be the length of the base of the dam for the transformed section?
            (Note that the base of the dam on the real section is 20 meters)
         ii. What would be the length of the vertical sheet pile for the transformed
             section? (Note that the length of the sheet pile on the real section is 5 meters)

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