STORM EVENT ANALYSIS

LAB 8

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CN for calculating runoff amount in **INCHES**

Convert from inches into a volume by multiplying by watershed area

Rational equation used to calculate peak flow
MUSLE

- Modified Universal Soil Loss Equation
- Used to calculate sediment yield from a single storm event
- Instead of using the rainfall erosivity factor “R”, peak flow and runoff are used

\[ Y = 95 \times (Q \times q)^{0.56} \times K \times LS \times C \times P \]

- \( Y \) = single storm sediment yield in tons
- \( Q \) = storm runoff volume in acre-ft
- \( q \) = peak discharge in cfs
Typically used to find flow or velocity, but can be used to calculate flow depth

\[ Q = vA \]

\[ v = \frac{1.5}{n} R^{2/3} S^{1/2} \]
MANNING’S EQUATION

There are two ways to find the depth of flow using Manning’s Equation

1. Use “solve” on your calculator
2. Trial and Error
TRIAL AND ERROR EXAMPLE

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1. $W = 6 \text{ ft}$
2. Trapezoidal channel with $10:1$ horizontal:vertical ratio
3. $q = 50 \text{ ft}^3/\text{s}$
4. $S = 0.005 \text{ ft/ft}$
5. $n = 0.05$
TRIAL AND ERROR EXAMPLE

Trapezoidal cross section

\[ Z = \frac{e}{d} \]

= horizontal
going vertical
### TRIAL AND ERROR EXAMPLE

<table>
<thead>
<tr>
<th>Channel Shape</th>
<th>Cross-Sectional Area $A$</th>
<th>Wetted Perimeter $p$</th>
<th>Hydraulic Radius $R = \frac{A}{p}$</th>
<th>Top Widths $t$ and $T$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rectangular</td>
<td>$bd$</td>
<td>$b + 2d$</td>
<td>$\frac{bd}{b + 2d}$</td>
<td>$t = b$</td>
</tr>
<tr>
<td>Triangular</td>
<td>$Zd^2$</td>
<td>$2d\sqrt{Z^2 + 1}$</td>
<td>$\frac{Zd}{2\sqrt{Z^2 + 1}}$</td>
<td>$T = b$</td>
</tr>
<tr>
<td></td>
<td>or $\frac{d}{2}$ approx.</td>
<td></td>
<td></td>
<td>$T = 2dZ$</td>
</tr>
<tr>
<td>Trapezoidal</td>
<td>$bd + Zd^2$</td>
<td>$b + 2d\sqrt{Z^2 + 1}$</td>
<td>$\frac{bd + Zd^2}{b + 2d\sqrt{Z^2 + 1}}$</td>
<td>$t = b + 2dZ$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$T = b + 2dZ$</td>
</tr>
<tr>
<td>Parabolic</td>
<td>$\frac{2}{3} td$</td>
<td>$t + \frac{8d^2}{3t}$</td>
<td>$\frac{t^2d}{1.5t^2 + 4d^2}$</td>
<td>$t = \frac{A}{0.67d}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>or $\frac{2d}{3}$ approx.</td>
<td>$T = t \left(\frac{D}{d}\right)^{0.5}$</td>
</tr>
</tbody>
</table>

**TABLE 8.1** Relationships Among Channel Dimensions (Fig. 8.1) and Channel Geometric Properties
TRIAL AND ERROR EXAMPLE

AREA = b d + Z d² = 6.0 d + 10 d²

\[ P = b + 2d \sqrt{Z^2} + 1 = 6.0 + 2d \sqrt{10^2} + 1 = 6.0 + 2d \times 10.05 \]

R = AREA / p

\[ v = \left(\frac{1.49}{0.05}\right) R^{2/3} (0.005)^{1/2} \text{ and } q = v \times a \]
## TRIAL AND ERROR EXAMPLE

Calculate \( q \) and compare against the given value = 50

<table>
<thead>
<tr>
<th>( d ) (ft)</th>
<th>( A ) (ft(^2))</th>
<th>( p ) (ft)</th>
<th>( R ) (ft)</th>
<th>( v ) (ft/sec)</th>
<th>( q ) (ft(^3)/sec)</th>
<th>comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>16.0</td>
<td>26.1</td>
<td>0.61</td>
<td>1.52</td>
<td>24.3</td>
<td>Too Shallow</td>
</tr>
<tr>
<td>2.0</td>
<td>52.0</td>
<td>46.2</td>
<td>1.13</td>
<td>2.28</td>
<td>118.6</td>
<td>Too Deep</td>
</tr>
<tr>
<td>1.5</td>
<td>31.5</td>
<td>36.15</td>
<td>0.87</td>
<td>1.92</td>
<td>60.1</td>
<td>Still too deep</td>
</tr>
<tr>
<td>1.4</td>
<td>28.0</td>
<td>34.14</td>
<td>0.82</td>
<td>1.85</td>
<td>51.7</td>
<td>Close Enough</td>
</tr>
</tbody>
</table>