Today’s topics
- Strom hydrograph from a series of triangular hydrographs

Announcements
- Assignment: HW#11 (due 10/15 after test #1)
- HW#9 due today
- HW#10 due 10/8

Test #1 on 10/13/14
- Closed notes / closed book ➔ 15 – 25 questions
- Multiple choice / true – false / short problems
- Material will cover lectures up to 10-8-14 / HW# 1 - 10 / labs 1 – 4 / text book readings
Example 5.11 in Text

- **Given:**
  - Same as Example 5.10 but this time more detailed rainfall information
  - 1-hr storm = 2.5 in.
    - 0 – 15 min = 0.5 in.
    - 15 – 30 min = 1.0 in.
    - 30 – 45 min = 0.75 in.
    - 45 – 60 min = 0.25 in.
  - 500 ac watershed
  - Land use = commercial – business
  - Watershed soil ➔ HSG = D
  - Average watershed slope = 1%
  - Hydraulic length of watershed = 6,000 ft

- **Required:**
  - Find the storm hydrograph
Example 5.11

- **Solution:**
  - HSG = D / Commercial ➔ T. 5.1 ➔ CN = 95
    - S = 0.53 in.
      - (same as Ex. 5.10, S = (1000 / CN) - 10)
  - Assume AMC = II ➔ Q = 1.96 in. of runoff
    - (same as Ex. 5.10, Q = (P - 0.2S)^2 / (P + 0.8S))
  - Find points to develop the unit hydrograph
    - t_L = 0.75 hr (45 min)
      - (same as Ex. 5.10, t_L = [L^{0.8}(S + 1)^{0.7}] / [1900 x Y^{0.5}]
    - **New** since D = 15 min. ➔ t_p = t_L + D/2 = 0.88 hr (52.5 min)
    - **New** since t_p = 52.5 min ➔ q_p = 484(A)/t_p = 432 cfs / 1 in. of runoff
Example 5.11 in the Text

- 0 – 15 min $\Rightarrow$ P = 0.5 in. (given)
  - $Q_1 = [0.5 - 0.2(0.53)]^2 / [0.5 + 0.8(0.53)]$
  - $Q_1 = 0.17$ in. of runoff
  - $q_{p1} = 432$ cfs / 1" of SRO x 0.17" = $73.44$ cfs
  - $t_{p1} = t_L + D/2 = 45 + 15/2 = 52.5$ min
  - $t_{b1} = 2.67(t_p) = 2.67(52.5) = 140.2$ min
Example 5.11 in the Text

- 0 – 30 min \( P = 0.5 + 1.0 = 1.5 \) in.
  - \( Q_1 + Q_2 = [1.5 - 0.2(0.53)]^2 / [1.5 + 0.8(0.53)] \)
  - \( Q_1 + Q_2 = 1.01 \) in. of runoff
  - \( Q_2 = 1.01 - 0.17 = 0.84 \) in. of runoff
  - \( q_{p2} = 432 \text{ cfs} / 1'' \text{ of SRO} \times 0.84'' = 362.88 \text{ cfs} \)
  - \( t_{p2} = 52.5 + 15 = 67.5 \) min
    - Shift on the x-axis by 15 min
  - \( t_{b2} = 140.2 + 15 = 155.2 \) min
    - Shift on the x-axis by 15 min
Example 5.11 in the Text

- 0 – 45 min \( P = 0.5 + 1.0 + 0.75 = 2.25 \) in.
  - \( Q_1 + Q_2 + Q_3 = [2.25 - 0.2(0.53)]^2 / [2.25 + 0.8(0.53)] \)
  - \( Q_1 + Q_2 + Q_3 = 1.72 \) in. of runoff
  - \( Q_3 = 1.72 - 0.17 - 0.84 = 0.71 \) in. of runoff
  - \( q_{p3} = 432 \) cfs / 1” of SRO x 0.71” = 306.7 cfs
  - \( t_{p3} = 52.5 + 15 + 15 = 82.5 \) min
    - Shift on the x-axis by 30 min
  - \( t_{b3} = 140.2 + 15 + 15 = 170.2 \) min
    - Shift on the x-axis by 30 min
Example 5.11 in the Text

- 0 – 60 min \( \Rightarrow P = 0.5 + 1.0 + 0.75 + 0.25 = 2.50 \) in.
  - \( Q_1 + Q_2 + Q_3 + Q_4 = [2.5 - 0.2(.53)]^2 / [2.5 + 0.8(.53)] \)
  - \( Q_1 + Q_2 + Q_3 + Q_4 = 1.96 \) in. of runoff
  - \( Q_4 = 1.96 - 0.17 - 0.84 - 0.71 = 0.24 \) in. of runoff
  - \( q_{p4} = 432 \text{ cfs} / 1” \text{ of SRO} \times 0.24” = 103.6 \text{ cfs} \)
  - \( t_{p4} = 52.5 + 15 + 15 + 15 = 97.5 \) min
    - Shift on the x-axis by 45 min
  - \( t_{b4} = 140.2 + 15 + 15 + 15 = 185.2 \) min
    - Shift on the x-axis by 45 min
Figure 5.13. Development of a storm hydrograph based on knowledge of the rainfall distribution.
<table>
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<tr>
<th>Time (min)</th>
<th>Incremental Hydrograph 1</th>
<th>Incremental Hydrograph 2</th>
<th>Incremental Hydrograph 3</th>
<th>Incremental Hydrograph 4</th>
<th>Storm Water Hydrograph</th>
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* Sum of columns 1, 2, 3, and 4.
\[ Y = mX + b \implies m = \frac{(73.4 - 0)}{(52.5 - 140.2)} \implies m = -0.837 \]

\[ Y = -0.837X + b \implies b = Y + 0.837X = 73.4 + 0.837(52.5) \implies b = 117.343 \]

\[ Y = -0.837X + 117.343 \]
Class Wrap-up

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