1. Stream Channel Geometry

LEARNING OUTCOMES

By the end of this assignment you should be able to:

• Calculate the geometric characteristics of stream channels;
• Calculate stream flow velocity and discharge for a given channel geometry; and,
• Describe potential relationships between stream channel geometry, flow velocity and discharge.

SYMBOLS

\(d\) = average channel depth (ft) \(w\) = channel width (ft) \(A\) = cross-sectional area (ft\(^2\)) \(Q\) = discharge (ft\(^3\)/s)

\(P_w\) = wetted perimeter (ft) \(r\) = hydraulic radius (ft) \(\bar{v}\) = average cross-sectional flow velocity (ft/s)

EQUATIONS

\[A = w \times d\]
\[P_w = w + 2d\]
\[r = \frac{A}{P_w}\]
\[Q = w \times d \times \bar{v} = A \times \bar{v}\]

QUESTIONS

1. Calculate the following geometric values for channels A through H, diagrammed below. [6]

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<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
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<td>4</td>
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A

[Diagram of channels A through H]
2. a. Calculate the discharge \((Q)\) for the following channels assuming average flow velocity, \(\bar{v}\), is 2 ft/s.

Channel A  
Channel C  
Channel B  
Channel E 

b. At a constant velocity, what impact does a change in cross-sectional area have on discharge? Why? 

3. a. Calculate the average flow velocity, \(\bar{v}\), for the following channels assuming discharge, \(Q\), is 30 ft\(^3\)/s.

Channel A  
Channel F  
Channel D  
Channel H 

b. At a constant discharge, what impact does a change in channel cross-sectional area have on flow velocity? Why? 

4. If the depth of a channel decreases but discharge stays the same, what must change? Why?
5. a. Channels A, C, E, and G all have the same depth but different widths, while channels A, D, F, and H have the same width but different depths. Based on your calculations for Question 1, what causes the wetted perimeter to increase faster? 
   
   a. Increases in channel width.
   
   b. Increases in channel depth.

   b. Should wide shallow channels or narrow deep channels provide more resistance to flow based on wetted perimeter? Why?

6. a. Again, channels A, C, E, and G all have the same depth but different widths, while channels A, D, F, and H have the same width but different depths. What causes the hydraulic radius to increase faster? 

   a. Increases in channel width.
   
   b. Increases in channel depth.

   b. Should wide shallow channels or narrow deep channels provide more resistance to flow based on hydraulic radius? Why?

7. In general, for a given cross-sectional area, should flow velocity be faster in wide shallow channels or narrow deep channels? Why?