Review of Basic Principles in Open Channel Flow

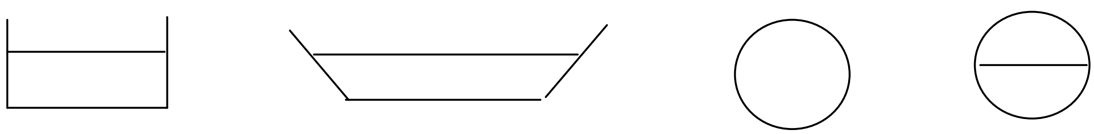
1. Uniform flow (or normal flow). (page 440), and Manning equation

Manning equation (SI unit, Q in cubic meter per second): $Q = \frac{1}{n} A R_h^{2/3} S^{1/2}$

Manning equation (English unit, Q in cfs) $Q = \frac{1.49}{n} A R_h^{2/3} S^{1/2}$

Hydraulic radius: R_h=A/P, where A is the cross-section area, P is wetted perimeter.

Types of problems:
1.1 Determine wetted parameter **(P)** and hydraulic radius **(R_h)** for the following cross sections.

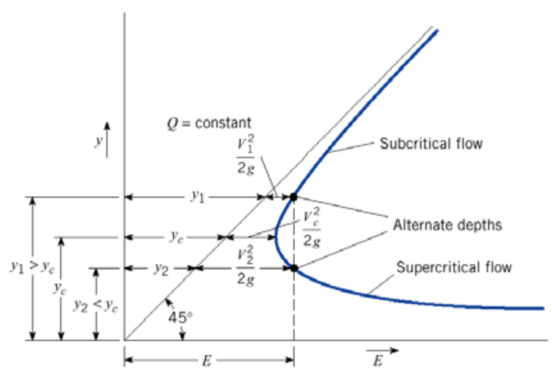


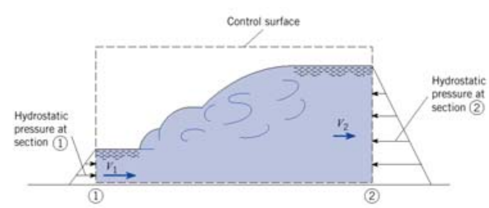
1.2: Determine velocity and flowrate when other data are given.

1.3. Determine normal depth (the depth in Manning equation) when all other data are given.
(When you are asked to determine the super critical flow/subcritical flow, you need to find normal depth from Manning equation to compare with the critical depth)

2. **Specific Energy** (page 677): $E_s = y + \frac{v^2}{2g}$.

3. **Critical depth, subpercritical flow, subcritical flow**. Critical depth occurs at minimum specific energy





How to find critical depth:

3.1: General equation for critical depth (pg 679, eq 15.8): $\frac{Q^2 T_c}{g A_c^3} = 1$

3.2. For rectangular cross-section, critical depth can be determined from Eq 15.13:

$$y_c = (\frac{q^2}{g})^{1/3}, \quad \text{where } q=Q/B$$

3.3. If yn > yc, flow is subcritical.
If yn=yc, flow is critical.
If yn<yc, flow is supercritical flow.

4. **Hydraulic Jump**:

Hydraulic jump occurs only when flow changes from *supercritical* to *subcritica*l flow.

What you need to know:

4.1: Water depth before and after the hydraulic jump (pg 692, eq 15.27 or 15.28)

$$y_2 = \frac{y_1}{2}(\sqrt{1+8Fr_1^2} - 1)$$

$$y_1 = \frac{y_2}{2}(\sqrt{1+8Fr_2^2} - 1)$$

4.2. Head loss in hydraulic Jump: $h_L = \dfrac{(y2 - y1)^3}{4y_1y_2}$