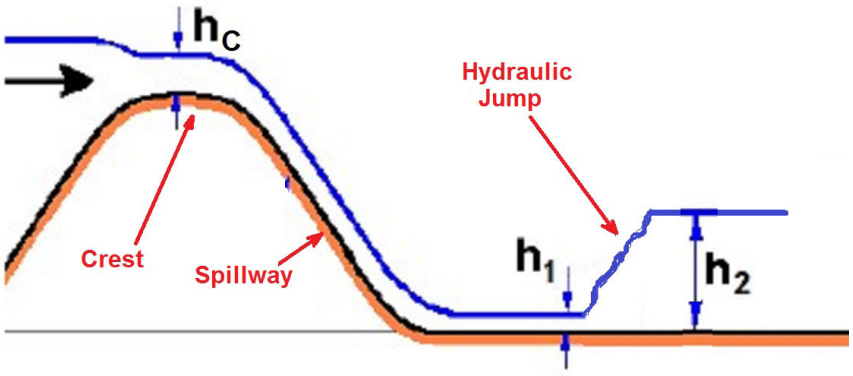
Solution to Problem 450A:

A two-dimensional open channel flow proceeds over the crest of a spillway (where the depth $h_c = 0.2m$), down the spillway and onto a section where the bed is horizontal. Shortly downstream a hydraulic jump occurs



Since the flow over the crest is choked, it follows that the velocity, u_c, of the flow at the crest is given by $(gh_c)^{1/2}$ and therefore the volume flow rate per unit breadth, Q, is

$$Q \;=\; u_c h_c \;=\; (gh_c^3)^{1/2} \tag{1}$$

Now

$$Q \;=\; u_1 h_1 \;=\; u_2 h_2 \tag{2}$$

and the relation between the quantities on each side of the hydraulic jump is given by

$$h_2^2 + h_1 h_2 \;=\; \frac{2Q^2}{gh_1} \tag{3}$$

which, as shown in the text, is derived from the continuity and momentum equations applied to the jump. Then, since $Q^2 = gh_c^3$ we can solve the quadratic equation to obtain

$$h_2 \;=\; \left[\frac{h_1^2}{4} + \frac{2h_c^3}{h_1}\right]^{1/2} - \frac{h_1}{2} \tag{4}$$

and substituting $h_c = 0.2m$ and $h_1 = 0.1m$ this yields $h_2 = 0.353m$.