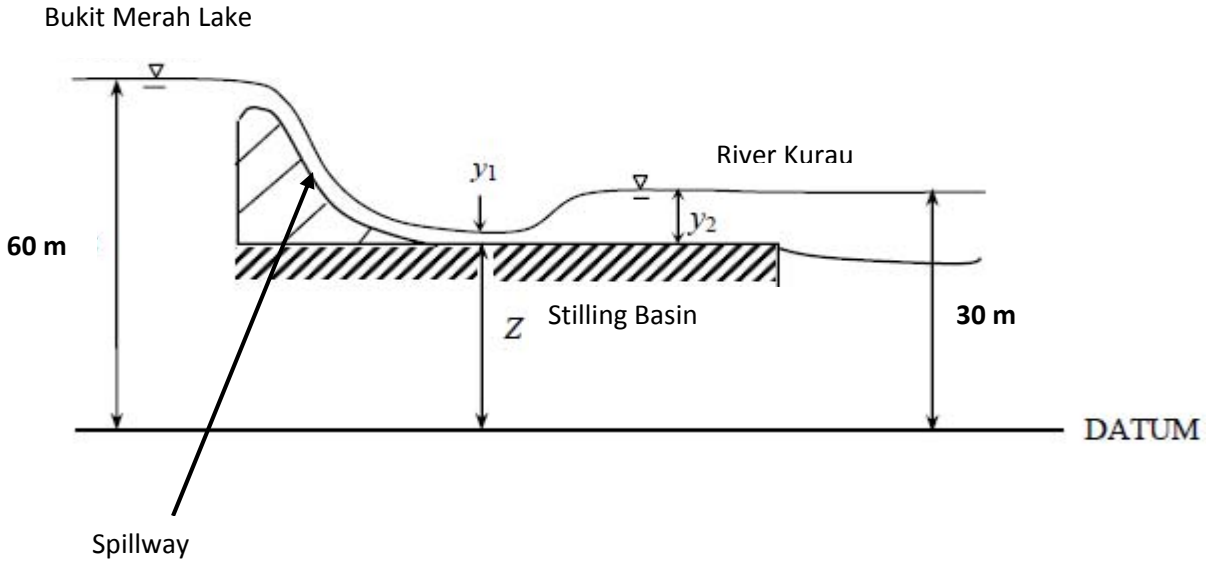
EAH 225 HYDRAULICS - Open Channel Hydraulics

Tutorial : Application of the Energy Equation and Hydraulic Jump

The discharge of water over a spillway 12 m wide is 283 m^3/s into a stilling basin of the same width. The Bukit Merah lake level behind the spillway has an elevation of 60 m, and the Kurau River water surface elevation downstream of the stilling basin is 30 m. Assuming a 10 percent energy loss in the flow down the spillway, find the invert elevation of the floor of the stilling basin so that the hydraulic jumps forms in the basin.



SOLUTION:

Let Z = the unknown elevation of the floor of the stilling basin, and write the energy equation from the upstream reservoir surface to section 1 assuming an energy loss that is 10 percent of the difference between the reservoir water surface elevation and the water surface elevation just upstream of the hydraulic jump:

$$60 = Z + y_1 + \frac{q^2}{2gy_1^2} + h_L$$

$$Z = 60 - y_l = \frac{283/12}{64.4 \times y_1^2} - 0.10 \times (60 - Z - y_1) \qquad (1)$$

Then from section 1 to section 2, apply the momentum equation to the hydraulic jump to yield:

$$\frac{y_2}{y_1} = \frac{1}{2}\left(-1 + \sqrt{1 + 8F_1^2}\right) = \frac{1}{2}\left(-1 + \sqrt{1 + 8\frac{q2}{gy_1^3}}\right) \qquad (2)$$

Finally, the tail water must match the elevation of the sequent depth which is expressed by:

$$Z + y_2 = 30 \qquad (3)$$

Equations 1, 2, and 3 are solved simultaneously. If solved by trial, a value of y_1 can be assumed, and Equation 1 is solved for Z. Then Equation 2 is solved for y_2, and the value of Z from Equation 1 is checked with the value obtained from Equation 3. The results are y_1 = 0.95 m; y_2 = 11.83 m; and Z = 21.5 m.