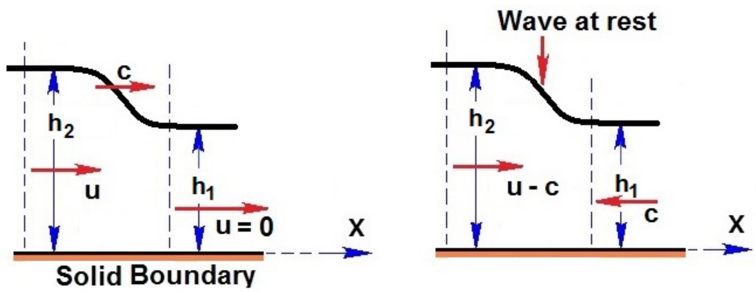
Solution to Problem 454A:

A tidal bore forms in an estuary in which the depth of the water prior to the passage of the bore is $h_1 = 2m$. If the depth of the water behind the bore is $h_2 = 3m$ we seek the speed of the bore neglecting the velocity at which the water ahead of the bore is flowing.



First we make a Galilean transformation from the frame of the question (the left-hand diagram) to a frame of reference in which the bore is fixed (the right-hand diagram). Then the analysis is identical with that of a stationary hydraulic jump and we can utilize the basic relation between the conditions on the two sides of the jump namely

$$h_2^2 + h_1 h_2 - \frac{2Q^2}{gh_1} \;=\; 0 \tag{1}$$

where Q is the volume flow rate relative to the jump (per unit breadth of the bore). It follows from this that $Q = 12.1m^2/s$. Then back in the frame of reference of the bore and neglecting the water velocity ahead of the bore, it follows that the velocity of the bore, c, is Q/h_1 or $c = 6.06m/s$.