Flow Calculation by Measuring Horizontal Pipe Discharge

When brink depths are greater than 0.5D, the more general purpose Purdue pipe method developed by Greve (1928) should be used, rather than the California pipe method. The Purdue method applies equally well to both partially and completely filled pipes. The Purdue method consists of measuring coordinates of the upper surface of the jet as shown above. If the water in the pipe is flowing at a depth of less than 0.8D at the outlet, the vertical distance, Y, can be measured at the end of the pipe where X = 0. For higher rates of flow, Y, may be measured at horizontal distances, X, from the pipe exit of 6, 12, or 18 inches. The most accurate results will be obtained when the pipe is truly horizontal. If it slopes upward, the indicated discharge will be too high. If it slopes downward, the indicated discharge will be too low.
Vertical Pipe Discharge

The following formula is an approximation of the output of a vertical pipe.

\[ \text{GPM} = \sqrt{H \times K \times D^2 \times 5.68} \]

- \( \text{GPM} \) = gallons per minute
- \( H \) = height in inches
- \( D \) = diameter of pipe in inches
- \( K \) = constant from 0.87 to 0.97 for diameters of
  2 to 6 inches and height (\( H \)) up to 24 inches

Example: \( K = 0.97 \), 6 inch diameter with 10 inch height \( \approx 626 \text{ GPM} \)

Lawrence and Braunworth (1906) noted that two kinds of flow occur from the end of vertical pipes. With a small rise of water (up to 0.37\( d \)) above the end of the pipe, the flow acts like a circular weir. When the water rises more than 1.4\( d \), jet flow occurs. When the rise is between these values, the mode of flow is in transition. When the height of the jet exceeded 1.4\( d \), as determined by sighting over the jet to obtain the maximum rise, the discharge is given by:

\[ Q = 5.01d^{1.99}h^{0.53} \]

where:

- \( Q \) = rate of flow, gallons per minute
- \( d \) = inside diameter of the pipe, inches
- \( h \) = height of jet, inches

When the rise of water above the end of the pipe is less that 0.37\( d \), discharge is given by:

\[ Q = 6.17d^{1.25}h^{1.35} \]