<u>Example: -</u> A concrete trapezoidal channel has a bottom width of 4 m and 45-degree side slopes. If the channel is on a 1-percent slope and is flowing at a depth of 1 m throughout its length, how much flow is being carried (use Manning's equation)? How much flow would the same channel carry if it were a rectangular channel 4 m wide assume a Manning's n of 0.013 for concrete.

<u>Solution</u>

Because the channel is flowing at the same depth throughout, we can assume that normal depth has been achieved (that is, the friction slope is equal to the channel slope). We will

From the trapezoidal geometry, we can easily calculate the area and wetted perimeter, and then the hydraulic radius, as follows:

$A = (4\text{ m} \times 1\text{ m}) + 2 \times (0.5 \times 1\text{ m} \times 1\text{ m}) = 5.00\text{ m}^2$

$P_w = 4\text{ m} + 2 \times (1\text{ m} \times 2^{0.5}) = 6.83\text{ m}$

$R = A / P_w = 5.00\text{ m}^2 / 6.83\text{ m} = 0.73\text{ m}$

Manning's equation for velocity can then be solved. The discharge can be computed as

$V = (1.00/0.013) \times 0.73^{2/3} \times 0.01^{1/2} = 6.25\text{ m/s}$

$Q = V \times A = 6.25\text{ m/s} \times 5.00\text{ m}^2 = 31.2\text{ m}^3\text{/s}$

To answer the second part of the question, we simply repeat the steps for a rectangular section shape.

$A = (4\text{ m} \times 1\text{m}) = 4\text{ m}^2$

$P_w = 4\text{ m} + 2 \times (1\text{m}) = 6\text{ m}$

$R = 4\text{ m}^2 / 6\text{ m} = 0.67\text{ m}$

$V = (1.00/0.013) \times 0.67^{2/3} \times 0.01^{1/2} = 5.87\text{ m/s}$

<u>$Q = 5.87\text{ m/s} \times 4\text{ m}^2 = 23.5\text{ m}^3\text{/s}$</u>