B Manning's Eq.

In 1890 manning Proposed in Place of relation given as:

$$Q = \frac{1}{n} R_h^{2/3} S^{1/2} A$$

and, $$V = \frac{1}{n} R_h^{2/3} S^{1/2} A$$

where n is the manning's discharge coefficient.

ان قيمه معامل مانك متغيره وذلك بسبب اعتماده على العوامل الاتيه :

١- خشونه السطح المتاخم ٢- عمق الماء وانتظام المقطع

٣- امتداد مجرى النهر وتقدر الترسبات

٤- العوارض وحجم وشكل القناة.

٥- التغير في التصريف.

nd, the manning's coefficient is not dimensionless, The dimensions is $T L^{1/3}$ $(sec.\, m^{1/3})$

كما واقترح العالم الايرلندي مانك علاقه بين معامل شيزي C ومعامل مانك وكالاتي :

$$C = \frac{R_h^{1/6}}{n}$$

Ex5 For rectangular channel (3m wide) and (1m deep) with slope (1:2500) determine the flow rate ? using manning Eq.

Sol^n: $A = By = 3 \times 1 = 3m^2$ $P = B + 2y = 3 + 2(1) = 5m$

$$R_h = \frac{A}{P} = \frac{3}{5} = 0.6m$$

manning eq. $\Rightarrow$ $Q = \frac{1}{n} R_h^{2/3} S^{1/2} A$

$$Q = \frac{1}{n} (0.6)^{2/3} \left(\frac{1}{2500}\right)^{1/2} (3)$$

حسب معادله مانك اعلاه تعتمد حساب قيمه Q الان على مقدار معامل الخشونه n وبأن السؤال لم يحدد قيمه n سنأخذ مجموعه من الحالات وكالاتي :

Case No.	Surface type	n	Q m^3/sec
1	Smooth cement lined channel	0.011	3.88
2	Rough brick	0.015	2.85
3	Rubble masonary	0.017	2.51

Ex6 Find the discharge in trapezoidal channel with a bed width of (10m), side slope (1:1) and depth of flow (2m), bed slope $= 10^{-4}$, $n = 0.02$ and Find chezy constant?

Soln

$$A = By + Zy^2 = 10(2) + 1(2)^2 = 24 m^2$$

$$P = B + 2y\sqrt{1+Z^2} = 10 + 2(2)\sqrt{1+1^2} = 15.66 m$$

$$\therefore R_h = \frac{A}{P} = \frac{24}{15.66} = 1.53 m$$

From manning Eq. $\Rightarrow Q = \frac{1}{n} R_h^{2/3} S^{1/2} A$

$$Q = \frac{1}{0.02}(1.53)^{2/3}(10^{-4})^{1/2}(24) = 16 \ m^3/sec$$

and, $$C = \frac{R_h^{1/6}}{n} = \frac{(1.53)^{1/6}}{0.02} = 52.4 \ \frac{m^{1/2}}{sec}$$

Ex7 Water flow at rate of ($5 m^3/sec$) in a rectangular open channel of (3m width). Assuming manning constant $n = \frac{1}{50}$, calculate the slope required to maintain a depth of (2m)?

Soln.

$$A = By = 3 \times 2 = 6 m^2$$

$$P = B + 2y = 3 + 2(2) = 7 m$$

$$R_h = \frac{A}{P} = \frac{6}{7} = 0.86 m$$

$$Q = \frac{1}{n} R_h^{2/3} S^{1/2} A$$

$$S = \frac{1}{\frac{1}{50}} (0.86)^{2/3} (S)^{1/2} (6)$$

$\therefore S = 0.00034$ ANS

TABLE 15.1 Typical Values of Roughness Coefficient, Manning's n

Lined Canals	n
Cement plaster	0.011
Untreated gunite	0.016
Wood, planed	0.012
Wood, unplaned	0.013
Concrete, troweled	0.012
Concrete, wood forms, unfinished	0.015
Rubble in cement	0.020
Asphalt, smooth	0.013
Asphalt, rough	0.016
Corrugated metal	0.024
Unlined Canals	
Earth, straight and uniform	0.023
Earth, winding and weedy banks	0.035
Cut in rock, straight and uniform	0.030
Cut in rock, jagged and irregular	0.045
Natural Channels	
Gravel beds, straight	0.025
Gravel beds plus large boulders	0.040
Earth, straight, with some grass	0.026
Earth, winding, no vegetation	0.030
Earth, winding, weedy banks	0.050
Earth, very weedy and overgrown	0.080

Manning Equation: Traditional System of Units

The form of the Manning equation depends on the system of units because Manning's equation is not dimensionally homogeneous. In Eq. (15.15), notice that the primary dimensions on the left side of the equation are L^3/T and the primary dimensions on the right side are $L^{8/3}$.

To convert the Manning equation from SI to traditional units, one must apply a factor equal to 1.49 if the same value of n is used in the two systems. Thus, in the traditional system the discharge equation using Manning's n is

$$Q = \frac{1.49}{n} A R_h^{2/3} S_0^{1/2} \tag{15.16}$$

In Example 15.4, a value for Manning's n is calculated from known information about a channel and compared to tabulated values for n in Table 15.1.

EXAMPLE 15.4

Apply the Chezy Equation to find Manning's Value of n for Flow in a Channel

Problem Statement

If a channel with boulders has a slope of 0.0030, is 100 ft wide, has an average depth of 4.3 ft, and is known to have a friction factor of 0.130, what is the discharge in the channel, and what is the numerical value of Manning's n for this channel?

Define the Situation

Water flows in an channel with boulders:

$$S_0 = 0.003, B = 100 \text{ ft}, y = 4.3 \text{ ft}, f = 0.13$$

Assumptions: $R_h \approx y = 4.3$ ft (because the channel is wide).

State the Goal

1. Q(cfs) ⬅ discharge in the channel
2. n ⬅ Manning's n