(Art. 115) Table 115 is the same for all systems of measures. The results in Art. 115, for Bazin's semicircular conduits of 1.25 meters' diameter on a slope $s = 0.0015$, are as follows, when all dimensions are in meters:

| For cement lining | | | | For mortar lining | | | |
|---|---|---|---|---|---|---|---|
| $d'$ | $r$ | $v$ | C | $d'$ | $r$ | $v$ | C |
| 0.625 | 0.314 | 1.85 | 85 | 0.625 | 0.312 | 1.69 | 78 |
| 0.491 | 0.264 | 1.61 | 81 | 0.515 | 0.275 | 1.51 | 75 |
| 0.314 | 0.185 | 1.27 | 76 | 0.332 | 0.194 | 1.18 | 69 |
| 0.180 | 0.112 | 0.92 | 71 | 0.186 | 0.116 | 0.88 | 66 |

Here the coefficient C for any depth $d'$ may be roughly expressed by $C_1 - 30(\frac{1}{2}d - d')$, where $C_1$ is the coefficient for the conduit half full.

(Art. 116) Table 127*b* gives metric values of C for wooden and rectangular sections on a slope $s = 0.0049$, as determined by the work of Darcy and Bazin.

TABLE 127*b*. CHEZY COEFFICIENTS C FOR RECTANGULAR CONDUITS

Metric Measures

| Unplaned Plank $b = 1.2$ Meters | | Unplaned Plank $b = 2$ Meters | | Neat Cement $b = 1.8$ Meters | | Brick $b = 1.9$ Meters | |
|---|---|---|---|---|---|---|---|
| $d$ | $c$ | $d$ | $c$ | $d$ | $c$ | $d$ | $c$ |
| 0.08 | 55 | 0.06 | 49 | 0.06 | 64 | 0.06 | 49 |
| .15 | 60 | .09 | 56 | .08 | 69 | .09 | 54 |
| .18 | 61 | .13 | 60 | .13 | 73 | .15 | 57 |
| .27 | 63 | .18 | 62 | .17 | 74 | .17 | 58 |
| .30 | 63 | .20 | 64 | .19 | 75 | .20 | 58 |
| .36 | 64 | .24 | 64 | .21 | 75 | .22 | 59 |
| .39 | 65 | .27 | 65 | .24 | 76 | .26 | 60 |
| .44 | 65 | .29 | 66 | .27 | 76 | .30 | 61 |

(Art. 117) In designing channels in earth the following values may be used for preliminary computations:

| | |
|---|---|
| for unplaned plank, | C = 55 to 66 |
| for smooth masonry, | C = 50 to 61 |
| for clean earth, | C = 33 to 40 |
| for stony earth, | C = 22 to 33 |
| for rough stone, | C = 19 to 28 |
| for earth foul with weeds | C = 17 to 28 |



(Art. 118) When $r$ is in meters and $v$ in meters per second, Kutter's formula takes the form

$$C = \frac{\frac{1}{n} + 23 + \frac{0.00155}{s}}{1 + \frac{n}{\sqrt{r}}\left(23 + \frac{0.00155}{s}\right)} \qquad (127)_1$$

in which the number $n$ depends upon the roughness of the surface, its values being those given in Art. 118. It may be noted that when the hydraulic radius $r$ is one meter, the value of C is $1/n$.

(Art. 119) Metric coefficients for sewers will be found in Table 127*c*. As these are given to the nearest unit only, the error in using them is slightly greater than with the larger coefficients of the English system. In important cases the values of C may be directly computed from Kutter's formula.

TABLE 127*c*. KUTTER'S COEFFICIENTS C FOR SEWERS

Metric Measures

| Hydraulic Radius $r$ in Meters | $s = 0.00005$ | | $s = 0.0001$ | | $s = 0.01$ | |
|---|---|---|---|---|---|---|
| | $n = 0.015$ | $n = 0.017$ | $n = 0.015$ | $n = 0.017$ | $n = 0.015$ | $n = 0.017$ |
| 0.05 | 26 | 22 | 31 | 25 | 37 | 30 |
| 0.1 | 34 | 29 | 37 | 32 | 43 | 36 |
| 0.15 | 39 | 33 | 42 | 36 | 48 | 40 |
| 0.2 | 43 | 38 | 46 | 40 | 51 | 43 |
| 0.3 | 49 | 42 | 51 | 44 | 55 | 48 |
| 0.5 | 56 | 48 | 57 | 50 | 60 | 52 |
| 0.7 | 62 | 54 | 62 | 55 | 63 | 56 |
| 1.0 | 67 | 59 | 67 | 58 | 66 | 59 |

(Art. 120) Table 127*d* in metric measures corresponds to Table 120 in English measures and is used in the same manner.

(Art. 121) The metric coefficients C for steel, cast-iron, and wood pipes may be obtained from those in the text by multiplying by 0.552, while the velocities and diameters may easily be replaced by metric equivalents with the help of Table C at the end of this volume.

(Art. 122) The values of C in Table 127*e* have been taken from the more extended table published in 1897 by Bazin, while those in

Table 122 have been computed by (115). In metric measures Bazin's formula for channels is

$$v = c\sqrt{rs} \qquad c = \frac{87}{1 + m/\sqrt{r}} \qquad (127)_2$$

in which $m$ has the same values as those given in Art. 122.

TABLE 127*d*. KUTTER'S COEFFICIENTS c FOR CHANNELS

Metric Measures

| Hydraulic Radius $r$ in Meters | $s = 0.00005$ | | $s = 0.0001$ | | $s = 0.01$ | |
|---|---|---|---|---|---|---|
| | $n = 0.025$ | $n = 0.030$ | $n = 0.025$ | $n = 0.030$ | $n = 0.025$ | $n = 0.030$ |
| 0.2 | 22 | 18 | 24 | 19 | 27 | 21 |
| 0.3 | 27 | 22 | 29 | 33 | 31 | 25 |
| 0.5 | 32 | 27 | 34 | 27 | 35 | 28 |
| 0.7 | 36 | 30 | 37 | 30 | 38 | 31 |
| 1.0 | 40 | 33 | 40 | 33 | 40 | 33 |
| 1.5 | 45 | 38 | 44 | 38 | 43 | 36 |
| 2. | 48 | 41 | 47 | 40 | 45 | 38 |
| 3. | 53 | 44 | 50 | 44 | 47 | 40 |
| 5. | 59 | 50 | 53 | 47 | 51 | 43 |

TABLE 127*e*. BAZIN'S COEFFICIENTS c FOR CHANNELS

Metric Measures

| Hydraulic Radius $r$ in Meters | $m = 0.06$ | $m = 0.16$ | $m = 0.46$ | $m = 0.85$ | $m = 1.30$ | $m = 1.75$ |
|---|---|---|---|---|---|---|
| 0.2 | 76.7 | 64.1 | 42.9 | | | |
| 0.4 | 79.4 | 69.4 | 50.4 | 37.1 | | |
| 0.6 | 80.7 | 72.1 | 54.6 | 41.4 | 32.5 | |
| 0.8 | 81.5 | 73.8 | 57.4 | 44.6 | 35.5 | 29.4 |
| 1.0 | 82.0 | 75.0 | 59.6 | 47.0 | 37.8 | 31.6 |
| 1.5 | 82.9 | 76.9 | 63.2 | 51.3 | 42.2 | 35.8 |
| 2.0 | 83.4 | 78.1 | 65.6 | 54.3 | 45.3 | 38.9 |
| 2.5 | 83.8 | 79.0 | 67.4 | 56.6 | 47.7 | 41.1 |
| 3. | 84.0 | 79.6 | 68.7 | 58.3 | 49.7 | 43.3 |
| 4. | 84.4 | 80.9 | 71.5 | 61.0 | 52.7 | 46.4 |
| 5. | 84.7 | 81.2 | 72.1 | 63.0 | 55.0 | 48.8 |
| 6. | | 81.6 | 73.2 | 64.6 | 56.8 | 50.7 |
| 8. | | | 74.8 | 66.9 | 59.5 | 53.7 |
| 10. | | | | 68.5 | 61.6 | 56.0 |



(Art. 123) The metric formula for the Sudbury conduit is $v = 80.9r^{0.62}s^{0.5}$, and Foss' formula Art. 124 for circular conduits or large pipes when running full is $s = 0.0118q^{\frac{11}{8}}/d^5$.

Prob. 127*a*. Compute the value of c for a circular conduit 1.4 meters in diameter which delivers 4.86 cubic meters per second when running full, its slope being 0.008.

Prob. 127*b*. Find the hydraulic radius for a circular conduit of 1.6 meters diameter when the water is 1.2 meters deep.

Prob. 127*c*. If the value of c is 30, compute the depth of a trapezoidal section to carry 10 cubic meters per second, the slope $s$ being 0.0015, the bottom width double the depth, and the sides making an angle of 34° with the horizontal.

Prob 127*d*. A conduit lined with neat cement has a cross-section of 3.45 square meters and a wetted perimeter of 5.02 meters and its slope is 0.00025. Compute the discharge in liters per 24 hours, (*a*) by Kutter's formula, and (*b*) by Bazin's formula.