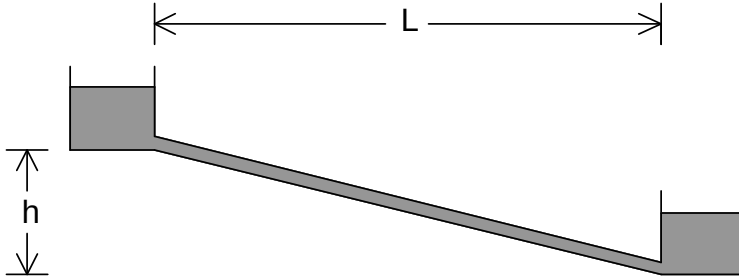


DESIGN OF A SURFACE WATER DRAIN

TEDDS calculation version 1.0.04



Drain design details

Design flow rate

$$Q_{\text{design}} = 53.0 \times 10^{-3} \text{ m}^3/\text{s}$$

Length of the drain

$$L = 19.0 \text{ m}$$

Fall along length of drain

$$h = 0.220 \text{ m}$$

Gradient of drain

$$i = h / L = 0.012 \text{ (1 in 86)}$$

(Library item Drain design details)

Minimum pipe diameter

$$D_{\text{min}} = 225 \text{ mm}$$

Surface roughness

$$k_s = 0.6 \text{ mm}$$

Mean hydraulic depth factor

$$m = 0.25$$

Kinematic viscosity of fluid

$$\nu = 1.31 \times 10^{-6} \text{ m}^2/\text{s}$$

Using the Chezy equation

Constant

$$c = 56$$

Diameter of pipe required

$$D = ((Q_{\text{design}}^2 \times 16) / (\pi^2 \times m \times c^2 \times i \times 1 \text{ m/s}^2))^{0.2} = 219 \text{ mm}$$

Nearest pipe diameter

$$D_{\text{chezy}} = 225 \text{ mm}$$

Flow velocity using Chezy

$$V_{\text{chezy}} = c \times \sqrt{(m \times D_{\text{chezy}} \times i \times 1 \text{ m/s}^2)} = 1.429 \text{ m/s}$$

Using the Eschritt equation

Diameter of pipe required

$$D = (Q_{\text{design}} \times 1000 \times \sqrt{(1 / i) / 0.00035 \text{ m}^3/\text{s}})^{0.382} \times 1 \text{ mm} = 223 \text{ mm}$$

Nearest pipe diameter

$$D_{\text{eschritt}} = 225 \text{ mm}$$

Flow velocity using Eschritt

$$V_{\text{eschritt}} = 26.738 \times (D_{\text{eschritt}} / 1 \text{ mm})^{0.62} \times 1 \text{ m/s} / (\sqrt{(1 / i) \times 60}) = 1.378 \text{ m/s}$$

Using the Colebrook-White Equation for pipe running full and partially full

Design pipe diameter

$$D_{\text{design}} = \max(D_{\text{chezy}}, D_{\text{eschritt}}, D_{\text{min}}) = 225 \text{ mm}$$

Constant

$$Z = \sqrt{(2 \times (g_{\text{acc}} / 1 \text{ m/s}^2) \times (D_{\text{design}} / 1000 \text{ mm}) \times i)} = 0.226$$

Flow velocity

$$V_{\text{full}} = -2 \times Z \times \log((k_s / (3.7 \times D_{\text{design}})) + ((2.51 \times \nu) / (D_{\text{design}} \times Z \times 1 \text{ m/s}))) \times 1 \text{ m/s}$$

$$V_{\text{full}} = 1.404 \text{ m/s}$$

Flow rate running full

$$Q_{\text{full}} = V_{\text{full}} \times \pi \times D_{\text{design}}^2 / 4 = 55.8 \times 10^{-3} \text{ m}^3/\text{s}$$

PASS - Maximum flow rate is greater than design flow rate

From Hydraulics Research Tables 35 and 36

Depth as proportion of D

$$x = 0.781$$

Flow velocity at design flow rate

$$V_{\text{design}} = 1.591 \text{ m/s}$$