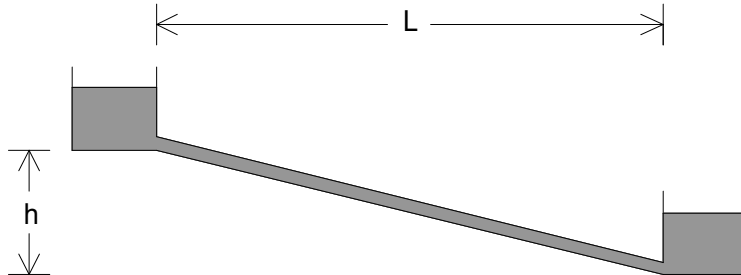


Project 325 Deansgate, Manchester				Job no. 22244	
Calcs for Surface Water Run 2 - 300 mm				Start page no./Revision 1	
Calcs by AC	Calcs date 11/10/2023	Checked by AO	Checked date	Approved by	Approved date

DESIGN OF A SURFACE WATER DRAIN

TEDDS calculation version 1.0.04



Drain design details

Design flow rate $Q_{\text{design}} = 82.9 \times 10^{-3} \text{ m}^3/\text{s}$
Length of the drain $L = 16.0 \text{ m}$
Fall along length of drain $h = 0.160 \text{ m}$
Gradient of drain $i = h / L = 0.010 \text{ (1 in 100)}$

(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 $D = ((Q_{\text{design}}^2 \times 16) / (\pi^2 \times m \times c^2 \times i \times 1 \text{ m/s}^2))^{0.2} = 269 \text{ mm}$
Nearest pipe diameter $D_{\text{chezy}} = 300 \text{ mm}$
Flow velocity using Chezy $V_{\text{chezy}} = c \times \sqrt{(m \times D_{\text{chezy}} \times i \times 1 \text{ m/s}^2)} = 1.534 \text{ m/s}$

Using the Eschritt equation

Diameter of pipe required $D = (Q_{\text{design}} \times 1000 \times \sqrt{(1 / i) / 0.00035 \text{ m}^3/\text{s}})^{0.382} \times 1 \text{ mm} = 272 \text{ mm}$
Nearest pipe diameter $D_{\text{eschritt}} = 300 \text{ mm}$
Flow velocity using Eschritt $V_{\text{eschritt}} = 26.738 \times (D_{\text{eschritt}} / 1 \text{ mm})^{0.62} \times 1 \text{ m/s} / (\sqrt{(1 / i) \times 60}) = 1.530 \text{ m/s}$

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

Design pipe diameter $D_{\text{design}} = \max(D_{\text{chezy}}, D_{\text{eschritt}}, D_{\text{min}}) = 300 \text{ mm}$
Constant $Z = \sqrt{(2 \times (g_{\text{acc}} / 1 \text{ m/s}^2) \times (D_{\text{design}} / 1000 \text{ mm}) \times i)} = 0.243$
Flow velocity $V_{\text{full}} = -2 \times Z \times \log((k_s / (3.7 \times D_{\text{design}})) + ((2.51 \times \nu) / (D_{\text{design}} \times Z \times 1 \text{ m/s}))) \times 1 \text{ m/s}$
 $V_{\text{full}} = 1.568 \text{ m/s}$

Flow rate running full $Q_{\text{full}} = V_{\text{full}} \times \pi \times D_{\text{design}}^2 / 4 = 111. \times 10^{-3} \text{ m}^3/\text{s}$

PASS - Maximum flow rate is greater than design flow rate

From Hydraulics Research Tables 35 and 36

Depth as proportion of D $x = 0.646$

Flow velocity at design flow rate $V_{\text{design}} = 1.717 \text{ m/s}$