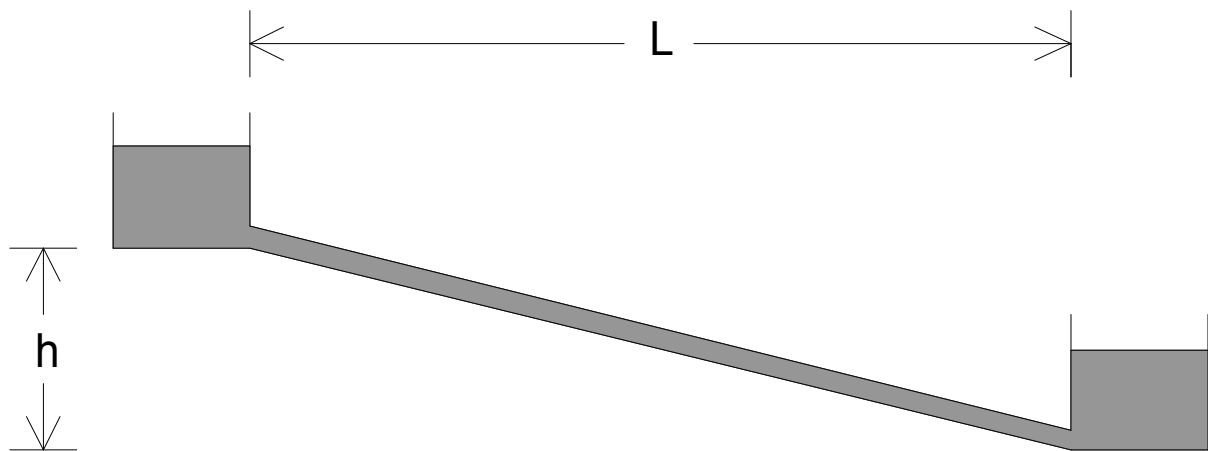
 <p>GEODOMISI Ltd. - Dr. Costas Sachpazis Civil & Geotechnical Engineering Consulting Company for Structural Engineering, Soil Mechanics, Rock Mechanics, Foundation Engineering & Retaining Structures.</p>	Project: Design of a Surface Water Drain			Job Ref.	
	Section Civil & Geotechnical Engineering			Sheet no./rev. 1	
	Calc. by Dr.C.Sachpazis	Date 10/11/2013	Chk'd by -	Date	App'd by

DESIGN OF A SURFACE WATER DRAIN



Drain design details

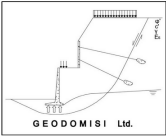
Design flow rate;
Length of the drain;
Fall along length of drain;
Gradient of drain;
Minimum flow velocity;
Minimum pipe diameter;
Surface roughness;
Mean hydraulic depth factor;
Kinematic viscosity of fluid;

$Q_{\text{design}} = 5.00 \text{ m}^3/\text{s}$
 $L = 250.0 \text{ m}$
 $h = 25.0 \text{ m}$
 $i = h / L = 0.100; (1 \text{ in } 10)$
 $V_{\text{min}} = 0.750 \text{ m/s}$
 $D_{\text{min}} = 200 \text{ mm}$
 $k_s = 0.6 \text{ mm}$
 $m = 0.25$
 $\nu = 1.31 \times 10^{-6} \text{ m}^2/\text{s}$

Using the Chezy equation

Constant;
Diameter of pipe required;
Nearest pipe diameter;
Flow velocity using Chezy;

$c = 56$
 $D = ((Q_{\text{design}}^2 \times 16) / (\pi^2 \times m \times c^2 \times i \times 1\text{m/s}^2))^{0.2} = 876 \text{ mm}$
 $D_{\text{chezy}} = 900 \text{ mm}$
 $V_{\text{chezy}} = c \times \sqrt{(m \times D_{\text{chezy}} \times i \times 1\text{m/s}^2)} = 8.400 \text{ m/s}$

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Using the Eschritt equation

Diameter of pipe required;

840 mm

Nearest pipe diameter;

Flow velocity using Eschritt;

= 9.563 m/s

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

$$D_{\text{eschritt}} = \mathbf{900 \text{ mm}}$$

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

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

Design pipe diameter;

Constant;

Flow velocity;

$2 \times Z \times \log((k_s / (3.7 \times D_{\text{design}})) + ((2.51 \times v) / (D_{\text{design}} \times Z \times 1\text{m/s}))) \times 1\text{m/s}$

Flow rate running full;

$$D_{\text{design}} = \max(D_{\text{chezy}}, D_{\text{eschritt}}, D_{\text{min}}) = \mathbf{900 \text{ mm}}$$

$$Z = \sqrt{(2 \times (g_{\text{acc}} / 1\text{m/s}^2) \times (D_{\text{design}} / 1000\text{mm}) \times i)} = \mathbf{1.329}$$

$$V_{\text{full}} = -$$

$$V_{\text{full}} = \mathbf{9.932 \text{ m/s}}$$

$$Q_{\text{full}} = V_{\text{full}} \times \pi \times D_{\text{design}}^2 / 4 = \mathbf{6.32 \text{ m}^3/\text{s}}$$

PASS - Maximum flow rate is greater than design flow rate

From Hydraulics Research Tables 35 and 36

Depth as proportion of D;

Flow velocity at design flow rate;

$$x = \mathbf{0.673}$$

$$V_{\text{design}} = \mathbf{10.986 \text{ m/s}}$$

PASS - Design velocity is greater than 0.750 m/s