



Water Management | Precast | Retaining Walls

Marshalls CPM Ovoid Pipes
Tables of capacities and velocities for ovoid pipes

Slope	Ks	0.3	Ks	0.6	Ks	1.5	
	Qm ³ /s	V m/s	Qm ³ /s	V m/s	Qm ³ /s	V m/s	
400 x 600	Area 0.18m²						
	Size of circular pipe with nearest area is 450mm/525mm diameter						
	0.0001	0.038	0.206	0.036	0.196	0.033	0.179
	0.0002	0.055	0.299	0.052	0.283	0.047	0.255
	0.0005	0.089	0.484	0.083	0.451	0.074	0.402
	0.0010	0.126	0.685	0.118	0.641	0.106	0.576
	0.0020	0.182	0.989	0.169	0.918	0.151	0.821
	0.0050	0.290	1.580	0.269	1.462	0.240	1.304
	0.0100	0.412	2.239	0.382	2.076	0.339	1.842
	0.0200	0.586	3.185	0.544	2.956	0.480	2.609
	0.0500	0.930	5.054	0.857	4.658	0.760	4.130
0.1000	1.317	7.158	1.214	6.598	1.074	5.837	
600 x 900	Area 0.4134m²						
	Size of circular pipe with nearest area is 750mm						
	0.0001	0.111	0.268	0.106	0.256	0.096	0.232
	0.0002	0.160	0.387	0.151	0.365	0.137	0.331
	0.0005	0.258	0.624	0.242	0.585	0.218	0.527
	0.0010	0.368	0.890	0.345	0.834	0.310	0.750
	0.0020	0.525	1.270	0.490	1.185	0.439	1.062
	0.0050	0.837	2.024	0.778	1.882	0.696	1.683
	0.0100	1.189	2.876	1.103	2.668	0.985	2.382
	0.0200	1.686	4.078	1.563	3.780	1.395	3.374
	0.0500	2.674	6.467	2.474	5.984	2.207	5.338
0.1000	3.786	9.157	3.502	8.470	3.122	7.551	
800 x 1200	Area 0.73504m²						
	Size of circular pipe with nearest area is 975mm						
	0.0001	0.237	0.322	0.226	0.307	0.206	0.280
	0.0002	0.341	0.464	0.323	0.439	0.293	0.399
	0.0005	0.549	0.747	0.516	0.702	0.466	0.634
0.0010	0.784	1.067	0.734	0.999	0.662	0.901	

0.0020	1.116	1.518	1.042	1.418	0.937	1.275
0.0050	1.777	2.418	1.654	2.250	1.485	2.020
0.0100	2.522	3.431	2.344	3.189	2.102	2.860
0.0200	3.576	4.865	3.320	4.517	2.974	4.046
0.0500	5.667	7.710	5.256	7.151	4.706	6.402
0.1000	8.024	10.916	7.439	10.121	6.657	9.057

Source of data: Capacities calculated by Wallrus Simulation Part 1. Velocities calculated from areas derived from Crimp and Bruges tables. The equivalent circular sizes shown have approximately the same flows and velocities for given roughness and gradients as the ovoid pipes. The capacities of ovoid pipes are 1.6 times the capacities of circular pipes of the same width, whereas the velocities are similar.

Hydraulic calculations

Design of sewers using ovoid pipes

Marshalls CPM ovoid pipes are a form 1 ovoid section for which approximate full and part full velocities and discharges can be readily determined using the following procedure.

An equivalent circular pipe diameter is calculated by using $Da = 0.773y$ where y is depth of ovoid.

This is a circle with the same hydraulic radius as a form 1 ovoid.

The actual equivalent diameter then has to be corrected to the nearest nominal metric pipe size to utilise hydraulic flow charts. All values are for pipes flowing full.

$$\frac{Qa}{Qn} = \left(\frac{Da}{Dn}\right)^x \text{ and } \frac{Va}{Vn} = \left(\frac{Da}{Dn}\right)^{(x-2)}$$

Where:

Qa = Equivalent circular diameter discharge (m³/s)

Qn = Nominal diameter discharge from charts (m³/s)

Va = Equivalent circular diameter velocity (m/s)

Vn = Nominal diameter velocity from charts (m/s)

Da = Equivalent circular pipe diameter (m)

Dn = Nominal circular pipe diameter (m)

X = The value is dependant on the Reynolds Number, however an average of 2.675 can be assumed.

Q_{ovoid} = Ovoid full pipe discharge (m³/s)

The following can be established.

Pipe - full velocities

Read directly from charts for nominal circular pipe diameter (V_n) and apply Interpolation expressions to calculate V_a .

Pipe - full discharges

Read directly from charts for nominal circular pipe diameter (Q_n) and apply Interpolation expressions to give actual pipe discharge (Q_a). Multiply Q_a by a shape factor of 1.089 for a form 1 ovoid. Hence discharge in ovoid pipe is then given by

$$Q_{\text{void}} = Q_a \times 1.089$$

Part - full velocities and discharges

Determine pipe full values and apply proportional flow information given for part-full ovoid pipes. For more detailed information reference should be made to Hydraulics Research document "Charts for the design of channels and pipes" or calculation by Wallrus Simulation Part 1.

Example:

Given a foul sewer is to be laid using WN 800 x HN 1200 ovoid pipes at a gradient of 0.005 (1 in 200) with an assumed $K_s = 1.5\text{mm}$.

1. Calculate the full bore discharge.

Equivalent circular pipe diameter $D_a = 0.773y$

$$D_a = 0.773 \times 1.2 = 0.928\text{m}$$

Nearest nominal pipe size is DN 900

From hydraulic chart Q_n at 0.005 gradient is $1.26\text{m}^3/\text{s}$

$$\text{Interpolating } Q_a = (1.26 \times (0.928)^{2.675}) / 0.900 = 1.37\text{m}^3/\text{s}$$

Final shape correction gives

$$Q_{\text{void}} = 1.37 \times 1.089 = 1.49\text{m}^3/\text{s}$$

2. Calculate discharge when depth of flow is 0.3m.

$$\text{Proportional depth} = 0.3 / 1.2 = 0.25$$

$$\text{From (1) } Q_{\text{void}} = 1.49\text{m}^3/\text{s}$$

From proportional flow table, proportional discharge is 0.113.

$$\text{Hence discharge at a flow depth of 0.3m is } 0.113 \times 1.49 = 0.17\text{m}^3/\text{s}$$

3. Calculate velocity when minimum flow is $0.1\text{m}^3/\text{s}$.

From (1) $Q_{\text{Ovoid}} = 1.49\text{m}^3/\text{s}$

Proportional discharge = $0.1 / 1.49 = 0.067$

By interpolating proportional flow table, proportional area is 0.108

ence from $Q = VA$

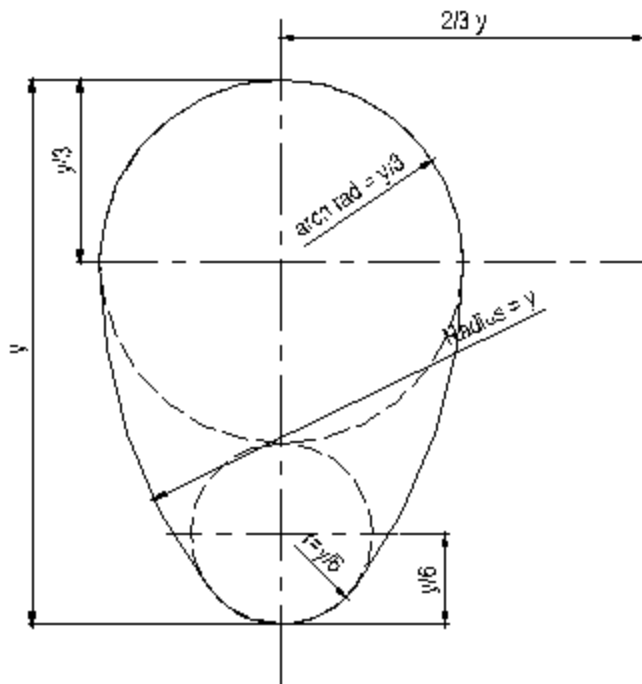
Where:

$Q = \text{Discharge } \text{m}^3/\text{s}$

$A = \text{Area of Ovoid } (0.73504\text{m}^2 \text{ for WN } 800 \times \text{HN } 1200)$

$V = \text{Velocity } \text{m/s}$

$V = 0.1 / (0.108 \times 0.735) = 1.26\text{m/s}$



WN400 x HN600 - Ovoid $y = 600$ - Area = 0.18m^2

WN600 x HN900 - Ovoid $y = 900$ - Area = 0.41346m^2

WN800 x HN1200 - Ovoid $y = 1200$ - Area = 0.73504m^2

For further information please call our technical team on 01902 356220 or email technical-CPM@Marshalls.co.uk