

Above Ground Drainage Design Sample Calculation - Flow Rate

Details		Appliance Discharge Units													Calculate Flow Rate			Pipe Selection			
Decription	Vent Pipe Reference	Appliance Discharge Units													Total	Frequency Factor	Flow Rate	Stack & Stack Vent	Hydraulic Capacity Q _{max} (l/s)		Logic
		WC (6l Cistern)	WC (7.5l Cistern)	WC (9l Cistern)	Bath	WHB	Shower without Plug	Cleaner's Sink	Kitchen Sink	Dishwasher	Washing Machine (6kg)	Washing Machine (12kg)	Slab Urinal	Floor Gully DN 100	ΣDU	K	Q _{ww} (l/s)	DN	Square Entries	Swept Entries	
		1.7	1.8	2	1.3	0.3	0.4	0.6	1.3	0.2	0.6	1.2	0.2								
		System 3																			
CPCR (Grd Flr)		1				1	1								2.4	0.7	1.08	100	5.6	7.3	PASS
Total	SVP01	1	0	0	0	1	1	0	0	0	0	0	0	0	2.4	0.7	1.08	100	5.6	7.3	PASS
Acc. WC & Shower (1st Flr)	SVP06	1				1	1								2.4	0.7	1.08	100	5.6	7.3	PASS
Cleaners Store (1st Flr)	SVP07					1		1							0.9	0.7	0.66	100	5.6	7.3	PASS
Female/ Male Changing (1st Flr)		4													6.8	0.7	1.83	100	5.6	7.3	PASS
Female/ Male Changing (1st Flr)	SVP14					4									1.2	0.7	0.77	100	5.6	7.3	PASS
Staff Welfare (2nd Flr)	WVP04								1	1					1.5	0.7	0.86	100	5.6	7.3	PASS
Prayer Room (2nd Flr)	WVP05					1									0.3	0.7	0.38	100	5.6	7.3	PASS
Total	SVP05	5	0	0	0	7	1	1	1	1	0	0	0	0	13.1	0.7	2.53	100	5.6	7.3	PASS
Female WC (2nd Flr)	SVP09	4													6.8	0.7	1.83	100	5.6	7.3	PASS
	WVP06					4									1.2	0.7	0.77	100	5.6	7.3	PASS
A WC (2nd Flr)	SVP11	1				1									2.0	0.7	0.99	100	5.6	7.3	PASS
Male WC (2nd Flr)	SVP10	2											2		3.8	0.7	1.36	100	5.6	7.3	PASS
	WVP07					3									0.9	0.7	0.66	100	5.6	7.3	PASS
Total	SVP08	7	0	0	0	8	0	0	0	0	0	0	2	0	14.7	0.7	2.68	100	5.6	7.3	PASS
AWC (2nd Flr)		1				1									2.0	0.7	0.99	100	5.6	7.3	PASS
AWC (1st Flr)	SVP13	1				1									2.0	0.7	0.99	100	5.6	7.3	PASS
Acc. WC & Shower (1st Flr)		1				1	1								2.4	0.7	1.08	100	5.6	7.3	PASS
Male Showers (1st Flr)							4								1.6	0.7	0.89	100	5.6	7.3	PASS
Female Showers (1st Flr)							4								1.6	0.7	0.89	100	5.6	7.3	PASS
Café Servey BOH (Grd Flr)									1	1					1.5	0.7	0.86	100	5.6	7.3	PASS
Total	SVP12	3	0	0	0	3	9	0	1	1	0	0	0	0	11.1	0.7	2.33	100	5.6	7.3	PASS
Wet Changing Male WC (Grd Flr)	WVP01					3									0.9	0.7	0.66	50	0.5	0.7	PASS
Wet Changing Female WC (Grd Flr)	WVP02					3									0.9	0.7	0.66	50	0.5	0.7	PASS
Wet Changing AWC & Accessible Shower (Grd Flr)	SVP02	1				1	1								2.4	0.7	1.08	100	5.6	7.3	PASS
Wet Changing Male WC (Grd Flr)	SVP03	4													6.8	0.7	1.83	100	5.6	7.3	PASS
Wet Changing Female WC (Grd Flr)	SVP04	4													6.8	0.7	1.83	100	5.6	7.3	PASS
Cleaners Store (2nd Flr)	WVP03					1		1							0.9	0.7	0.66	50	0.5	0.7	PASS
Reception WC (Grd Flr)	SS01	1				1									2.0	0.7	0.99	100	5.6	7.3	PASS
Reception WC (Grd Flr)	SS02	1				1									2.0	0.7	0.99	100	5.6	7.3	PASS
Reception WC & AWC (Grd Flr)	SS03	2				2									4.0	0.7	1.40	100	5.6	7.3	PASS
Wet Changing Cleaners Store (Grd Flr)	SS04					1		1							0.9	0.7	0.66	50	0.5	0.7	PASS
Reception WC (Grd Flr)	SS05	1				1									2.0	0.7	0.99	100	5.6	7.3	PASS
Clip & Climb AWC (Grd Flr)	SS06	1				1									2.0	0.7	0.99	100	5.6	7.3	PASS
Reception Cleaners Store (Grd Flr)	SS08					1		1							0.9	0.7	0.66	50	0.5	0.7	PASS
Kitchenette (Grd Flr)	SS09								1						1.3	0.7	0.80	100	5.6	7.3	PASS
First Aid (Grd Flr)	SS10					1									0.3	0.7	0.38	50	0.5	0.7	PASS
First Aid (Grd Flr)	SS11							1							0.6	0.7	0.54	50	0.5	0.7	PASS
Wet Changing Shower 1 (Grd Flr)							8								3.2	0.7	1.25	100	5.6	7.3	PASS
Wet Changing Shower 2 (Grd Flr)							8								3.2	0.7	1.25	100	5.6	7.3	PASS

Design Notes

Based on the stage 4 drainage layouts
Calculations in line with BS EN 12056-2 Gravity Drainage Systems 2000 - System 3
Hydraulic capacities based on primary ventilated discharge system

Reference Information

BS EN 12056_2 Extracts

3.5 Calculation

- 3.5.1 discharge unit (DU)
the average discharge rate of a sanitary appliance expressed in litres per second (l/s)
- 3.5.2 frequency factor (K)
variable to take into account the frequency of use of sanitary appliances (dimensionless)
- 3.5.3 waste water flow rate (Q_{ww})
total design flow rate from sanitary appliances in a drainage system or in a part of a drainage system in litres per second (l/s)
- 3.5.4 continuous flow rate (Q_a)
flow rate of all continuous flows, e.g. cooling water, etc., in litres per second (l/s)
- 3.5.5 pumped water flow rate (Q_p)

6.2.2 Discharge units

Discharge units of a variety of sanitary appliances are given in Table 2. The values are given only for the purpose of calculation and are not related to discharge rates of sanitary appliances quoted in product standards.

Table 2 — Discharge units (DU)

Appliance	System I	System II	System III	System IV
	DU l/s	DU l/s	DU l/s	DU l/s
Wash basin, bidet	0,5	0,3	0,3	0,3
Shower without plug	0,6	0,4	0,4	0,4
Shower with plug	0,8	0,5	1,3	0,5
Single urinal with cistern	0,8	0,5	0,4	0,5
Urinal with flushing valve	0,5	0,3	-	0,3

6.3.2 Frequency factor (K)

Typical frequency factors associated with different usage of appliances are given in Table 3.

Table 3 — Typical frequency factors (K)

Usage of appliances	K
Intermittent use, e.g. in dwelling, guesthouse, office	0,5
Frequent use, e.g. in hospital, school, restaurant, hotel	0,7
Congested use, e.g. in toilets and/or showers open to public	1,0
Special use, e.g. laboratory	1,2

Table 11 — Hydraulic capacity (Q_{max}) and nominal diameter (DN)

Stack	System I, II, III, IV
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- discharge rate of waste water pumps in litres per second (l/s)

3.5.6

total flow rate (Q_{tot})

the total flow rate is the sum of the waste water flow rate (Q_{ww}) and continuous flow rate (Q_c) and pumped water flow rate (Q_p), in litres per second (l/s)

3.5.7

hydraulic capacity (Q_{max})

maximum flow rate of water permitted in a branch, stack or drain in litres per second (l/s)

3.5.8

air flow rate (Q_a)

minimum flow rate of air through a ventilating pipe or air admittance valve, measured at 250 Pascal (Pa) pressure drop, in litres per second (l/s)

annex A (informative)].

System I

Single discharge stack system with partly filled branch discharge pipes
Sanitary appliances are connected to partly filled branch discharge pipes. The partly filled branch discharge pipes are designed with a filling degree of 0.5 (50 %) and are connected to a single discharge stack.

System II

Single discharge stack system with small bore discharge branch pipes
Sanitary appliances are connected to small bore branch discharge pipes. The small bore branch discharge pipes are designed with a filling degree of 0.7 (70 %) and are connected to a single discharge stack.

System III

Single discharge stack system with full bore branch discharge pipes
Sanitary appliances are connected to full bore branch discharge pipes. The full bore branch discharge pipes are designed with a filling degree of 1.0 (100 %) and each branch discharge pipe is separately connected to a single discharge stack.

System IV

Separate discharge stack system
Drainage systems type I, II and III may also be divided into a black water stack serving WC's and urinals and a grey water stack serving all other appliances.

End

Slab urinal	0,2*	0,2*	0,2*	0,2*
Bath	0,8	0,8	1,3	0,5
Kitchen sink	0,8	0,8	1,3	0,5
Dishwasher (household)	0,8	0,8	0,2	0,5
Washing machine up to 6 kg	0,8	0,6	0,6	0,5
Washing machine up to 12 kg	1,5	1,2	1,2	1,0
WC with 4,0 l cistern	**	1,8	**	**
WC with 6,0 l cistern	2,0	1,8	1,2 to 1,7***	2,0
WC with 7,5 l cistern	2,0	1,8	1,4 to 1,8***	2,0
WC with 9,0 l cistern	2,5	2,0	1,6 to 2,0***	2,5
Floor gully DN 50	0,8	0,9	-	0,6
Floor gully DN 70	1,5	0,9	-	1,0
Floor gully DN 100	2,0	1,2	-	1,3

- 6.3
- Calculation of flowrate
- 6.3.1
- Waste water flowrate (Q_{ww})
- Q_{ww} is the expected flowrate of waste water in a part or in the whole drainage system where only domestic sanitary appliances (see Table 2) are connected to the system.

$$Q_{ww} = K \sqrt{\Sigma DU}$$

where:

Q_{ww} = Waste water flowrate (l/s)
 K = Frequency factor
 ΣDU = Sum of discharge units

and stack vent DN	Q_{max} (l/s)	
	Square entries	Swept entries
60	0,5	0,7
70	1,5	2,0
80*	2,0	2,6
90	2,7	3,5
100**	4,0	5,2
125	5,8	7,6
150	9,5	12,4
200	16,0	21,0
* Minimum size where WC's are connected in system II.		
** Minimum size where WC's are		

Secondary ventilated discharge stacks
Sizes and limitations of secondary ventilated discharge stacks are given in Table 12.

Table 12 — Hydraulic capacity (Q_{max}) and nominal diameter (DN)

Stack and stack vent DN	Secondary vent DN	System I, II, III, IV Q_{max} (l/s)	
		Square entries	Swept entries
60	50	0,7	0,9
70	50	2,0	2,6
80*	50	2,6	3,4
90	50	3,5	4,6
100**	50	5,6	7,3
125	70	7,6	10,0
150	80	12,4	18,3
200	100	21,0	27,3
* Minimum size where WC's are connected in system II.			
** Minimum size where WC's are connected in system I, III, IV.			