Design & Requirements

The layout of the underground drainage system should be kept as simple as possible, with the minimum number of changes in direction and gradient. Access points should be provided only if blockages could not be cleared without them.

Connections of drains to other drains should be made obliquely, in the direction of flow.

Sewers, i.e. a drain serving more than one property, should be kept as far as is practicable away from the point on a building where a future extension is likely, i.e. the rear or side of a dwelling where there is room for an extension.

The system should be ventilated by a flow of air, normally provided by a ventilating pipe situated at or near the head of each main drain.

Drains should belaid to even gradients and any change of gradient should be combined with an access point.

Recommended minimum gradients for foul and surface water drains are shown in the table below:

Peak flow (litres/sec)	Pipe Size	Minimum Gradient	Maximum Capacity (litres/sec)
<1	82mm	1:40	4.10
<1	110mm	1:40	9.20
>1	82mm	1:80	2.80
>1	110mm	1:80	6.30
>1	160mm	1:150	15.00

Note: Building regulations and Codes of Practice do not recommend maximum gradients for drainage systems. The assumption that water would run away leaving solid matter behind, in a drain laid with a steep fall, is unfounded.

Calculation of Flow Rates

Foul Drains

Individual sanitary applicances, e.g., a WC or washbasin have a Discharge Unit value to enable flow rates to be established. BS EN 12056:part 2 details the Discharge Unit values, which may vary slightly, depending on the soil system configuration to which they are connected. However, the following figures are suitable for general calculation purposes.

Appliance	Discharge Unit Value
Washbasin	0.5
Bidet	0.5
Shower	0.6
Single urinal with cistern	0.8
Bath	0.8
Sink	0.8
Dishwasher	0.8
Washing Machine	0.8
WC with 7.5 litre cistern	2.0

Formula for calculation of flow rate:

$Q = k\sqrt{\Sigma DU}$

where Q= Flow rate in litres/sec
k= Frequency factor
∑DU= Sum of discharge units

k= 0.5 for dwellings, guest houses, offices etc.
0.7 for hospitals, schools, restaurants, hotels etc.
1.0 for toilets/showers open to the public

Surface Water Drains

It is generally accepted that a suitable rainfall design intensity for sizing surface water drains is 0.014 litres/second/m^2 (50mm/hour).

For high risk areas, where ponding would lead to flooding of buildings, the drainage scheme should be designed in accordance with BS EN 752:part 4, where a higher rainfall intensity would be appropiate.

Minimum Velocities

Flow velocities in drainage systems should be minimum of 0.76 metres/sec to avoid the possibility of grit and other solid waste being deposited along the invert of the drain.

Maximum Spacings of Access Points

From ⇩ To ⇨	Junction	Inspection Chamber	Manhole
Start of external drain (stack or ground floor appliance)	-	22m	45m
Rodding Eye	22m	45m	45m
Shallow Inspection Chamber (up to 1.20m deep)	22m	45m	45m
Deep Inspection Chamber and Manhole (deeper than 1.20m)	-	45m	90m

Capacities of Drains

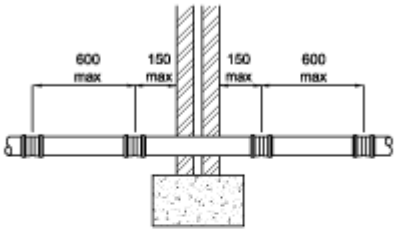
Gradient 1 in...	110mm k = .06	110mm k = .60	110mm k = 1.5	160mm k = .06	160mm k = .06	160mm
②			**Capacity in Litres/Second**			
5	33.3	25.1	21.6	96.2	73.4	63.5
10	23.3	17.7	15.3	67.4	51.8	44.9
15	18.9	14.5	12.4	54.7	42.2	36.6
20	16.3	12.5	10.8	47.2	36.5	31.6
25	14.5	11.2	9.7	42.0	32.6	28.4
30	13.0	10.2	8.8	38.2	29.8	25.9
35	12.2	9.5	8.2	35.3	27.5	23.9
40	11.3	8.8	7.6	33.0	25.9	22.0
45	10.5	8.3	7.2	31.0	24.1	21.0
50	10.0	7.8	6.7	29.2	23.0	20.0
55	9.5	7.5	6.5	28.0	22.0	19.0
	9.2	7.2	6.2	26.7	21.0	18.0
65	8.6	6.8	5.8	25.4	20.1	17.5
	8.5	6.6	5.6	24.6	19.4	16.8
75	8.0	6.4	5.5	23.8	18.8	16.3
	7.8	6.2	5.3	23.0	18.0	15.7
85	7.5	6.0	5.2	22.2	17.5	15.1
	7.3	5.8	5.0	21.7	17.0	14.5
95	7.1	5.7	4.9	21.0	16.6	14.2
	6.9	5.5	4.8	20.5	16.2	14.0

The capacity of a drainage system will be determined by the diameter and gradient of the pipework. The table above shows capacities of 100mm and 160mm diameter drains for each of the roughness coefficient factors usually applied to pipework for calculation purposes as follows:

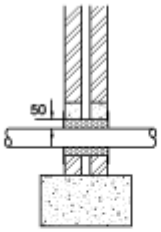
k = 0.06 for new surface water drains
k = 0.60 for new foul water drain
k = 1.50 for mature foul drains

The figures are also based on the recommended proportional depth of flow of 0.75. Foul drains are normally designed to carry peak discharges at less than full depth to allow for a safety factor and to aid ventilation of the system.

Pipes Through Walls



A. Short length of pipe bedded in wall with joints formed within 150mm of each wall face. Adjacent rocker pipes of 600mm max. length with flexible joints.



B. Arch or lintelled opening to give min 50mm space all round the pipe. Mask opeing on both sides of the wall with rigid sheet material to prevent entry of fill or vermin.
Important Fill void with compressible material to prevent entry of gas.