It is vitally important to have an efficient means of disposing foul and surface water from a building to not only safeguard public health but also to prevent long term damage to the building construction. Installer looks at the key considerations for drainage systems.

In the event of a drain leaking, there is a possibility that the mains water supply may become contaminated or the air becomes unpleasant to breathe. In extreme cases, irreparable damage to the buildings structure could happen if the escaping discharge is allowed to wash away the soil underneath the foundations. It is equally important to size the drains correctly to prevent overloading and possible flooding of contaminated water. The priorities for a good drainage system should be, then, that the design is simple and economic, drains must be laid at suitable gradients, the flow of wastewater (effluent) should be self-cleansing, the effluent should be conveyed without leakage and all relevant regulations and standards must be complied with.

Statutory requirements
- BS EN 752: 2008 Drain and sewer systems outside buildings provides a framework for the design, construction, rehabilitation, maintenance and operation of drain and sewer systems outside buildings. This document will give such guidance on removal of wastewater from premises for public health and hygiene reasons, prevention of flooding in urbanised areas and protection of the environment.
- BS EN 1610: 1998 Construction and testing of drains and Sewers provides guidance on the method of testing and which medium should be used.
- Approved Documents are normally intended to provide guidance to meet common building situations. The designer or installer is under no obligation to follow them as long as the requirements can be met some other way. However, following the Approved Documents will ensure that compliance is being met.

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Systems of drainage
Historically, there have been three types of below ground drainage, but the design and layout of drainage and sewerage systems should always comply with The Building Regulations and Water Authority Specification. A reference should also be made to the Sewers for Adoption manual that contains guidance for the design and construction of sewers that will be adopted by Sewerage Undertakers in England and Wales in accordance with Section 104 of the Water Industry Act 1991.

Separate system
In this system, wastewater discharges from sanitary appliances are conveyed in foul drains and sewers whereas the surface water is conveyed in separate surface water drains and sewers. As the name implies, both wastewater and surface water are kept completely separate throughout. An advantage of this type of system is that only the wastewater is conveyed to the sewage treatment plant, which will essentially save costs; the surface water is conveyed into watercourses, such as streams, rivers or soakaway etc via a surface water sewer. During construction of this type, it is vitally important that...
there is no ‘cross connection’ between the sanitary system and the surface at sanitary appliances and inside the building. It is, therefore, very important that trapped gulles are installed at every rainwater pipe connected to the drain or sewer. This is the main reason why, for the majority of water discharge, it is essential to have a separate system.

**Combined system**

In some drainage systems, predominantly older systems, both wastewater and surface water are discharged to a common drain or sewer. This system is known as a combined system, as all building drainage is combined into one drain or sewer.

The problem with this type of system is that surface water, which is relatively ‘clean’, is mixed with wastewater and must undergo the same treatment process as waste water. Treating surface water to this extent is uneconomical when pumping is required.

**Advantages**

The combined system is uneconomical when pumping is required.

Rain water is kept separate from sewage.

Load on treatment units becomes less.

The natural water is not unnecessarily polluted.

The sewers are small in size.

The storm water can be discharged into natural streams without any treatment.

The system proves to be economical when pumping is required for the lifting of sewage.

**Disadvantages**

The combined system is uneconomical when pumping is required.

The cleaning of sewer is difficult, as they are small.

The maintenance cost is high.

The self-cleaning velocity is not easily achieved.

The system requires two sets of sewers and can be costly to install.

There is no cross connection between the two systems.

There is a risk of cross connection between the two systems.

**Foul water drain design consideration**

Foul water drainage systems are generally designed to run for a maximum of three quarters of a mile. The reason is that if the diameter of the drain in question is too large, it will be difficult to maintain atmospheric pressure to prevent the build-up of toxic or explosive gases and to ensure adequate fume escape or to provide access for maintenance equipment by using shallower depths.

Pipe gradients should be established such that the velocity does not fall below 0.70m/s to ensure adequate self-cleaning and prevent the setting of soil matter. The proportionate velocity relating to pipes running part full must be taken into consideration when determining compliance with this requirement. When calculating flow rates for foul water drains, it is recommended that reference is made to BS 12056-2: 2000, gravity drainage systems inside buildings. Sanitary pipework, layout and calculation and BS EN 762: 2008 to determine peak discharge rates. The procedure detailed in these standards takes into consideration the type of pipe and frequency of use to derive required pipe sizes and gradients which are directly related to the flow rates. The design will also determine the size of chamber and the depth of the chambers. The design will also determine the size of chamber and the depth of the chambers.

The combined system is uneconomical when pumping is required.

**Drainage materials**

There are many types of material used for drainpipes. Whichever type is selected must be strong enough to withstand the imposed on it, be robust enough to withstand site handling and be capable enough to remain watertight for the life of the system. The system and the pipes should also be watertight to prevent ingress of groundwater and be compatible to the material of the pipe being jointed. To overcome the effects of settlement, it is recommended that pipes should have flexible joints. Suitable materials include:

- Cast iron
- Concrete
- Vitrified clay
- Angle iron
- Unplasticised polyvinyl chloride (uPVC)
- Polyethylene
- Structural walled plastic pipe (SWP)

**Flexible pipes**

- PVC-U
- UPVC
- PE-U
- PVC-U
- Flexible pipes

**Advantages**

- The drainage system is flexible and can be easily adapted to suit the site requirements.
- The system is easy to install and requires minimal maintenance.
- The system is cost-effective and can be installed quickly.
- The system is durable and can withstand harsh conditions.
- The system is environmentally friendly and reduces the risk of pollution.

**Disadvantages**

- The system requires a continuous supply of water to remain effective.
- The system can be prone to leaks and require frequent repairs.
- The system can be affected by freezing and burst pipes in cold climates.
- The system can be affected by corrosion and require frequent repainting.

**Access fittings**

- Rodding eyes
- Inspection chambers
- Vent stacks
- Access points
- Trap seals

**Advantages**

- The system is easy to access and provides easy maintenance.
- The system is durable and can withstand harsh conditions.
- The system is environmentally friendly and reduces the risk of pollution.

**Disadvantages**

- The system requires a continuous supply of water to remain effective.
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**To sum up**

- **Effective drainage is there to safeguard public health.**
- **Separate and Combined are the two main drainage systems used.**
- **Velocity rates must be considered to prevent settling and blockages.**
- **Testing of drains should follow Approved Document Building Regulations Part H and BS EN 1610.**

**Other maintenance equipment**

They are not intended to provide access for maintenance equipment and are generally not more than 600 mm deep.

**Inspection chambers**

Larger than access chambers and typically have a minimum 450 mm diameter. They are used to check the integrity of the system and provide access for maintenance equipment but tend to have more branches/pipes feeding into them and are often up to 1000 mm deep.

**Manholes**

The largest chambers providing access to a sewer or drain for maintenance equipment and, in some cases, for operatives to enter the system itself. The minimum internal dimensions of a manhole are 600 x 900 mm and they can be of any depth although most modern manholes tend to be at least one metre deep with inspection chambers used for shallower depths. These access points should be sited on or near the top of the drain, at a bend or change of gradient, when there is a change of pipe size, and at a junction. Unless the drain can be cleaned from an access point.

**Ventilation**

All drainage and sewerage systems require adequate ventilation to the open air in order to reduce the build-up of toxic or explosive gases and to maintain atmospheric pressure when effluent flows through the drainage system. Ventilation should be provided at the head of a drain normally through a soil and vent pipe or separate vent stack, but not through a manhole. The vent should terminate at least 900 mm above any window and not within 1 m of an existing opening back into the building or window.

**Testing of drainage systems**

- The Building Regulations Approved Document H requires the drains to be tested after any work has been carried out, including laying the drain and any necessary charming, or surrounding the drain with concrete and backfilling the trench. There are two acceptable test methods: air and water.
- Testing of any system should be carried out as required by the particular approved Local Authority, making reference to Building Regulations Part H. Clause 2.25 and BS EN 12051:1997 Sections 12 and 13. It is generally recommended that the air test method is used.
- The method is used for pipes up to 300 mm in diameter and is as follows:
  - **The drain length should be effectively plugged.**
  - **Pressurise the pipe up to a pressure of 1000 mm water gauge.**
  - **Hold this pressure for approximately 5 minutes.**
  - **The pipe should then hold an initial pressure of 100 mm.**
  - **Maximum head loss would be 25mm in a period of 7 minutes.**
  - The water test can be used and reference for the test procedure should be followed as described in the various documents.