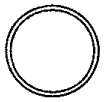
16. Sewerage

Technical Brief No. 10 dealt with WASTE STABILIZATION PONDS. Whether treatment is in ponds or in sewage plants (with percolating filters for activated sludge) sewage has to be carried in sewerage – a system of sewers.

SEWERS are normally circular pipes,



although some sewers have other shapes.

SEWERS are made from the following materials:

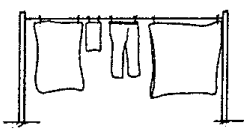
plastics	–	usually small diameters (62-300mm)
	–	care needed with storage
asbestos cement	–	liable to damage during transport
clayware	–	should be glazed/vitrified
	–	can be made locally
bricks	–	local kiln-dried bricks can be used
plain concrete	–	requires smooth inside surface
reinforced concrete	–	for large diameters (300mm or more)
cast iron	–	for pumping mains and sewers under buildings

Foul sewage

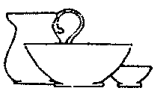
Foul sewage consists of flow from water closets;

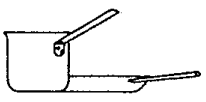
and wastewater from washing or bathing;

from washing clothes;



from preparing, cooking and serving food;



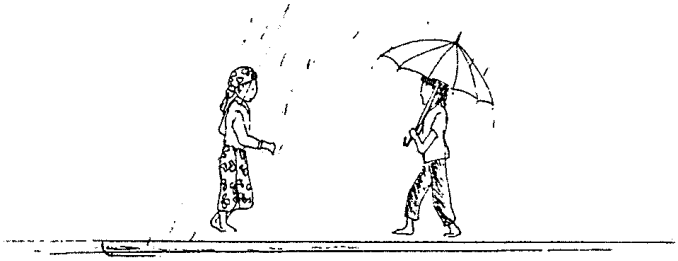


and other domestic, commercial and industrial wastewater.

Sewerage

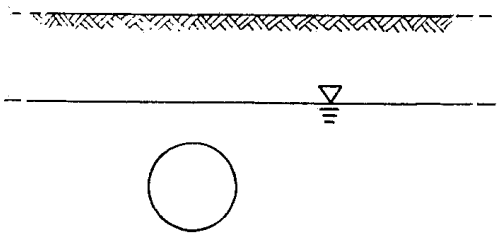
The quantity of foul sewage depends on the amount of water supplied. If 75 – 200 litres per person per day is provided, the sewage flow may be taken as 80% of the water supply.

Greater water use is often due to garden watering, and the water used for this does not go into the sewers.



Most sewers are designed to carry foul sewage only.

Rainfall is removed in a separate system of storm drains or monsoon drains.



Nevertheless, some raIn always gets into foul sewers.

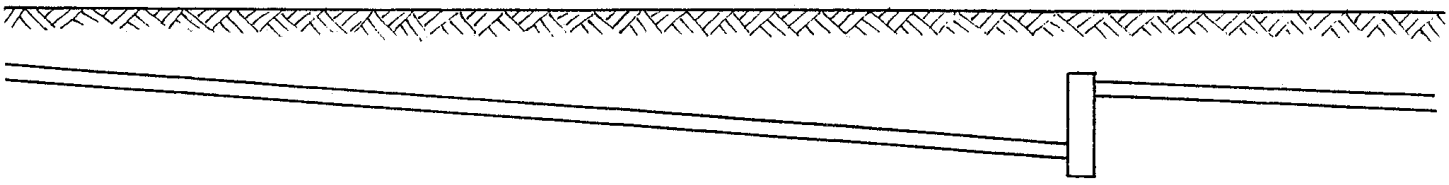
If the groundwater table is above the sewer (either throughout the year or seasonally) some infiltrates into the sewer.

Sufficient capacity has to be provided in foul sewers to carry rainwater and infiltration water. Sometimes it is assumed that the maximum sewage flow will be some multiplier of the dry weather flow (dwf). 6 x dwf is often used for design.

Gravity sewers

Normally sewage flows along sewers because they are laid with a slope (or 'gradient'). Where the ground has a natural slope, the depth of the sewers below ground level is often made constant. The sewers slope downhill towards ponds or treatment works in low-lying areas.

Where land is flat, sewers get deeper to maintain a downward slope. Deep sewers are expensive and difficult to construct so it is necessary to raise the sewage by pumping.



Pumping station

Pumping of sewage

- adds to the capital cost;
- introduces running costs for power;
- is liable to failure because of plant breakdown, shortage of fuel or electricity failure.

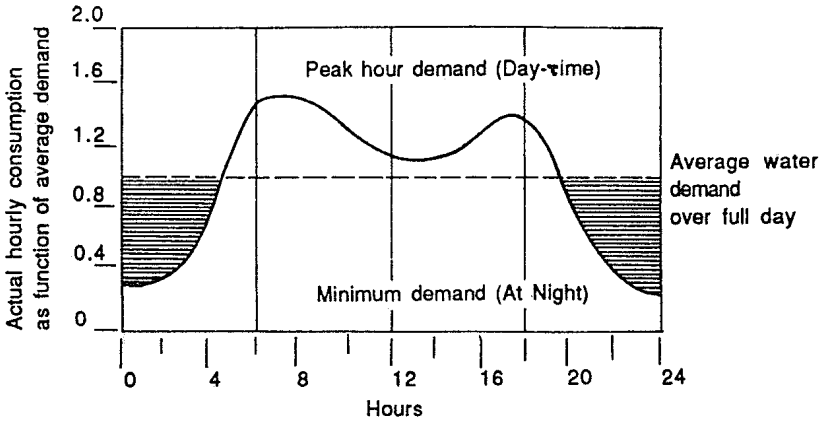
Design

1. The gradient should be sufficient to ensure that the velocity is at least 0.6 metres per second when carrying the maximum daily flow. Solids are then carried along the sewer. Minimum gradients to give this velocity are:

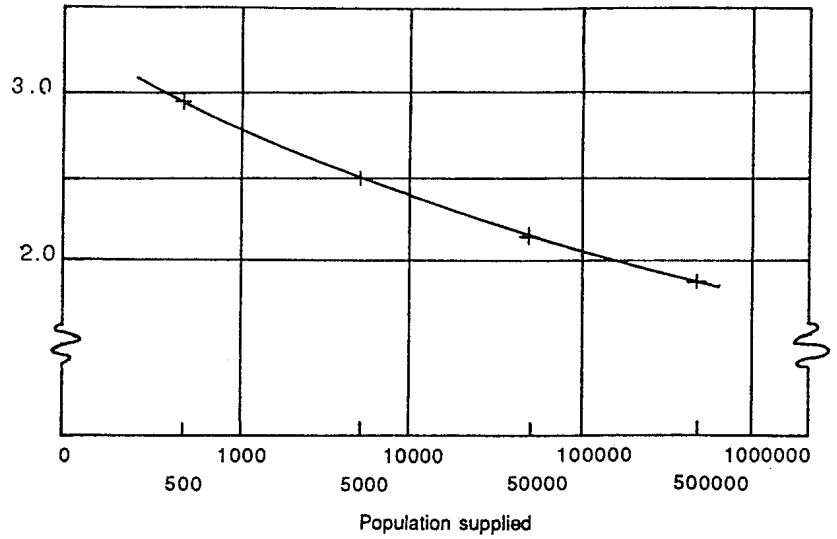
	Sewer Diameter			
Material	100mm	150mm	225mm	300mm
Plastic	1/185	1/305	1/500	1/710
Asbestos cement	1/180	1/295	1/485	1/685
Clayware	1/175	1/285	1/465	1/660
Smooth concrete	1/155	1/255	1/420	1/600
Rough concrete	1/85	1/150	1/250	1/370

2. The sewer capacity must be enough for the maximum expected flow (or 'design flow') of all the sewage entering upstream, allowing for rainfall and infiltration. Published tables or graphs are used to find the size of sewer needed to carry the design flow, taking account of the pipe material and the gradient.

3 . The maximum daily flow of the foul sewage (i.e, excluding rainfall and infiltration) may be based on the maximum water supply.



Ratio of maximum flow to average flow:



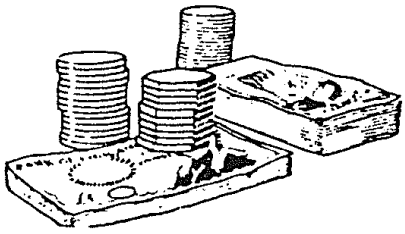
4. For a single house the maximum flow may be based on the simultaneous discharge of water fittings, for example, w.c. flushing while baths and sinks are emptied.

   As more people contribute to a sewer there is less likelihood of them all using the system simultaneously and the ratio of maximum flow to average flow decreases.

Sewerage

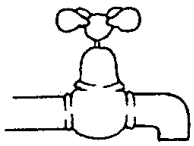
Disadvantages and limitations of Sewerage

HIGH COST



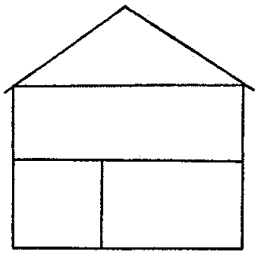
Sewerage is the most expensive of all sanitation systems. Sewers alone may cost up to $1300 per person.

WATER USE



Good piped water distribution is essential. Sewers block if supply is intermittent or if the water supply falls during dry weather. Normally there must be a supply sufficient for 75 litres per person per day.

HOUSE CONNECTIONS



Every house must have piped water with multiple outlets to w.c., bathroom and kitchen. Internal plumbing is expensive.

GOOD DESIGN

Sewerage systems must be designed by qualified technologists.

N.B. Engineers with conventional training based on industrialized country technology are often more capable of designing sewerage systems than low-cost sanitation options.

CONSTRUCTION

To ensure good operation and long life, sewer laying should be supervised by professional engineers or surveyors.

Unconventional Sewerage

Two systems with reduced diameter and reduced gradient have been installed in a few places.

1 . SMALL BORE SEWERS carry effluent from tanks (septic tanks, aqua-privies or interceptor chambers). Solids are retained in the tanks, so there is less risk of sewer blockage, providing solids are regularly removed from the tanks.

2. In high-density housing areas, CONDOMINIAL SEWERAGE uses conventional sewer pipes laid at a shallow depth within plots, normally behind the houses. Householders are responsible for clearing any blockage within their plots.

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