Module 25: Plumbing: Pipes & drains

Module Objectives

By the end of this session, participants will understand:

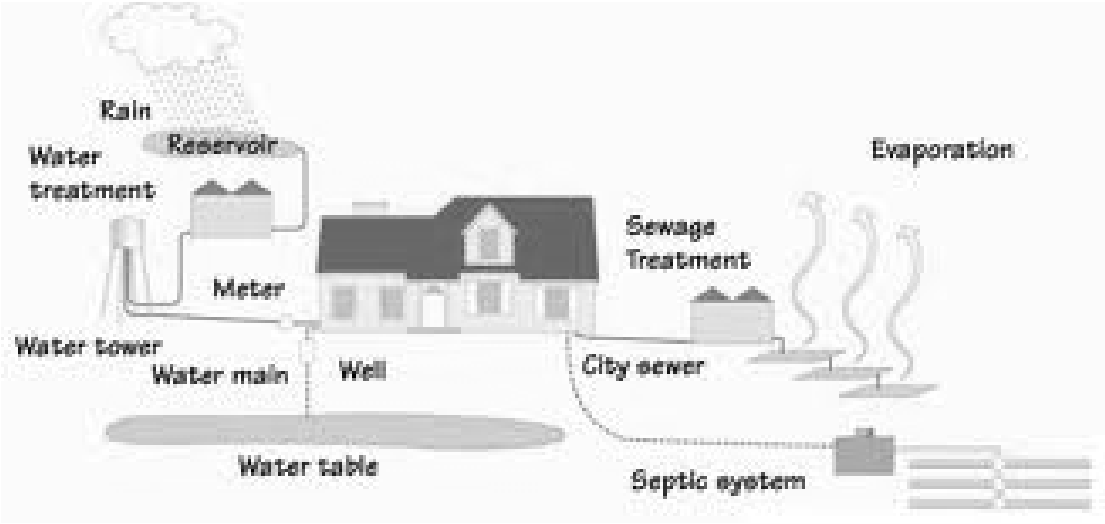
1. How clean water is supplied to a house and how waste water is removed.
2. Water supply pipes – features and problems
3. The mechanics of a drain – air pressure, water seals and gradient.
4. Inspection guidelines for plumbing and drains

Module at a glance:

Topic	You will learn
Elements of the water supply to a house	- About the mains stop cock - Supply pipes
The drains	- How a drain works
Inspecting plumbing and drains	- What an inspector should look out for when inspecting plumbing and drains

Plumbing – pipes & drains

The home inspector is not a licensed plumber but he/she is an "all-rounder" who is expected to inspect and report on all defects to the plumbing system of pipes and drains which the inspector observes. For this reason, the home inspector is expected to have a basic general knowledge as to how a water supply and waste removal system works in the average South African house.



The above schematic shows how clean water is piped to a house and how sewerage and other waste is removed from the house and treated

Water pipes

Water is piped to South African houses via underground pipes. If the water is from a municipal supply, the water comes from the municipal main supply and passes through a water meter, normally located on the boundary of the property.

Water main and shut off valve

Most houses (but not all) are equipped with a stop cock (shut off valve) between the water meter and the house. It is important for the inspector to try and locate this valve so that the home owner knows where to go, so that the water supply to the house can be easily shut off when plumbing work needs to be done in the house.

A connection to the municipal water supply with meter and stop cocks

Types of water pipe

There are four main types of water pipe:

1. Galvanised metal pipes – no longer widely used, but often still found in many underground water supplies to houses and sometime also in internal house plumbing. These galvanised pipes are prone to eventually narrowing as a result of the build-up inside the pipes, of scale and mineral deposits. Rust and resultant leaks are also common problems with this piping as it ages.

2. Plastic pipe – normally either high density polyethylene (often referred to as "PE" pipe) or reddish "polycop" piping. Polycop piping is widely used for interior and below ground plumbing, but is not suitable for a hot water supply. Polycop uses the same "Conex" type compression connectors with "O" rings. Polycop pipe is cheap and easy to use.

3. Copper pipe – the most widely used water pipe for interior plumbing. Plumbers use Conex connectors or soldered joints to connect copper piping. Copper pipe is durable and stable but is relatively costly, prone to pipe theft by copper thieves and sometimes develops pinhole leaks.

4. Composite pipe – this is a modern, multi-layer pipe which is made from two layers of high density polyurethane, with a middle layer of welded aluminum. Cheaper than copper and not susceptible to pinhole leaks and theft, multi-layer piping, which can be used for hot and cold water supply, is probably the water piping which will become most widely used in the future. However, because composite pipe requires different plumbing tools, and because plumbers are a conservative lot, copper and polycop piping will probably continue to be the piping of choice for most new plumbing installations for some time to come.

Water leaks

It is estimated that between 30-40% of water pumped from the Vaal River never gets to the users' taps. This water gets "lost" on the way. This is due to the poor state of the water reticulation/distribution systems in Gauteng and elsewhere in South Africa.

The City of Cape Town has addressed this problem by passing a new bylaw (effective from 18 February 2011) in terms of which a Cape Town property can no longer be transferred without a certificate from a licensed plumber certifying that:

- There are no leaks in the plumbing system
- No rain water is going into the municipal sewers
- The plumbing installation complies with city bylaws and the National Building Regulations.

In the light of the growing water shortages in South Africa it can be expected that other South African municipalities will follow the Cape Town example.

Rusted galvanised pipes, buried underground, or located inside house walls, are the main source of leaks. Galvanised pipes eventually rust (sometimes only after 50-100 years).

Water pipes also sometimes rust from the inside, but the prime source of leaks is most often external rust and damage.

Important...
Pipe leaks can prove to be extremely expensive for the homeowner. The municipalities are very rigid as regards leaks on private property. If it is the homeowner's pipe that is leaking (after the meter) then the home owner is responsible for the account.

Some leaks are very difficult to detect. In one case a townhouse complex was charged a large amount above their normal water bill. It was eventually discovered that the water leak ran directly into the sewer so there was no evidence of the leak on the surface.

How to detect a leak

First, stop all the consumption of water in the house. Even switch off the toilet cistern taps if necessary. Make sure the dishwasher and washing machine are off. Go outside and watch your water meter for five minutes. The meter should stay dead still during this time. If it moves there is a leak.

While you are looking at the meter make a note of the reading. Compare this reading with the last water and lights account reading. Does it make sense? You can then work out your daily consumption. Does this tie in with previous month's daily consumption?

If the meter moves when everything is switched off, then there is a leak. It is a significant leak if you can see the meter moving. If you can barely see it move over three minutes, then there is a slight leak which will get worse over time.

The next step is to try and establish where the leak has occurred. Follow the probable line of the pipe to the house and look for obvious signs of damp, mud, moss on walls etc. If you don't see any of these signs then there may be a bigger problem – the leak may be under the house or some other structure. This could be a very big problem, because leaks under structures threaten the integrity of the structure itself.

There are a variety of methods plumbers use to detect leaks. The most popular methods are sound or gas:

- Sound (Acoustic) detection can be very simple or pretty sophisticated. The plumber uses one, or many, ground microphone/s to locate the leak.

- Gas (a mixture of Hydrogen and Nitrogen) is pumped into the pipe and the plumber uses a very sensitive detector to pick up the highest concentration of hydrogen.

- Infra-red detection using an infra-red camera

Water pressure

Most suburban homes in South Africa are connected to a main feeder pipe supplied by their municipality. The most common connection from the municipal main is a 22mm pipe that links in to the main supply.

The pressure in the main feeder pipe is at a certain pressure. This pressure is variable - but fairly constant for houses close to each other on the same feeder pipe. This pressure depends on where the house is located on the municipal supply line, and also on the water pressure available to the authority supplying the water. Water pressure also depends on how many others are using the pipe, and to a large degree, the time of day.

Some areas experience good average water pressure while others have very poor pressure - especially early in the mornings as everyone has a shower. In the "dead" period at night (12am to 4am) the pressure is at its highest. This is when leaks start or leak the most.

“Good pressure” for household use could be defined at anything over three Bars of static pressure. Two to three Bars of static pressure is reasonable and below two Bars is poor. Under one Bar is a problem.

What does this mean to the home owner?
The pressure at the main supply may be fine, but pressure may be really poor in the house.

The first thing to check is the diameter of the feed pipe to the house. Some plumbers previously used 15mm pipes for a supply feed to a house. This is a problem which can only be solved by replacing the feed with a 22mm pipe.

Boosting Pressure...
There are essentially only three things which can be done to boost pressure:

- Increase the diameter of the feeder pipe (or add another);
- Replace any old galvanised piping which has become scaled and damaged, and also partially kinked copper pipe;
- Or install a pressure booster pump. Pressure boosters of adequate flow rates do a great job. They "suck" the water out of the main feeder and do a good job at maintaining really good pressure (4 Bar and more) in the house. But pressure booster pumps use a lot of electricity. Typically these are 750-1000 Watt units and they may switch on every time a tap is opened.

Remember...
That there must be a good cold water pressure, to enable a good hot water pressure. If the cold water pressure is fine but the hot water trickles, then there are a number of possible reasons:

- The pressure control valve on the geyser is faulty, or the filter in this valve is blocked.
- The geyser inlet and/or outlet piping is partially blocked.
- A pipe is damaged in some way. Copper piping can easily be accidentally flattened.
- The hot water tap/s or mixers are faulty.
- The wrong diameter pipes have been used.

- The valve controlling the cold water supply into the geyser may not be fully open.

- There may be an old geyser with a header tank or low pressure (1 Bar) Lacto type system. Old geysers eventually lose efficiency through the build-up of scale.

Converting to a high pressure hot water supply

Converting the hot water systems from a low pressure (1 Bar) to high pressure 4 or 6 Bar geysers is problematic, unless the pipes supplying hot water to the bathrooms, toilets, kitchen and laundry are replaced at the same time that a high pressure geyser is installed.

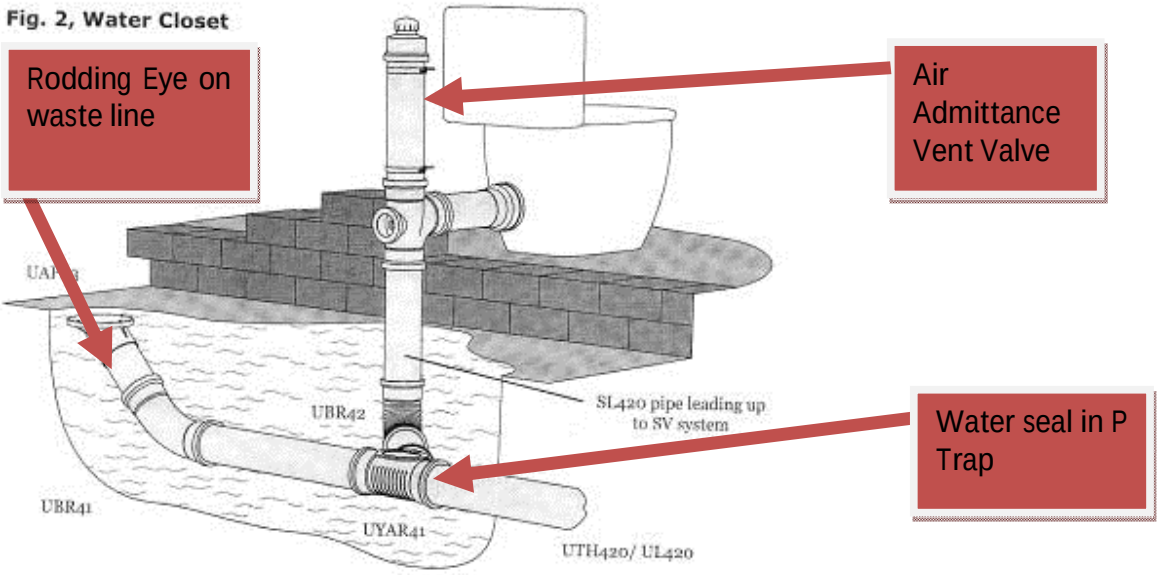
If the old piping is not to be ripped out, then the system must be pressure tested so that problems with the existing hot water pipes can be exposed. The old pipe system, which has previously carried one bar of pressure, may be too weak to carry high pressure of say six bar. The pressure testing should at least go up to the working pressure of the new system.

Drains & traps

All household plumbing fixtures – toilets, bidets, baths, showers, basins and sinks – discharge into the household drain, which is a 110mm waste pipe which carries sewerage and grey water to discharge into the municipal sewer line, or into either a conservancy tank (sewerage storage system) or into an on-site septic tank.

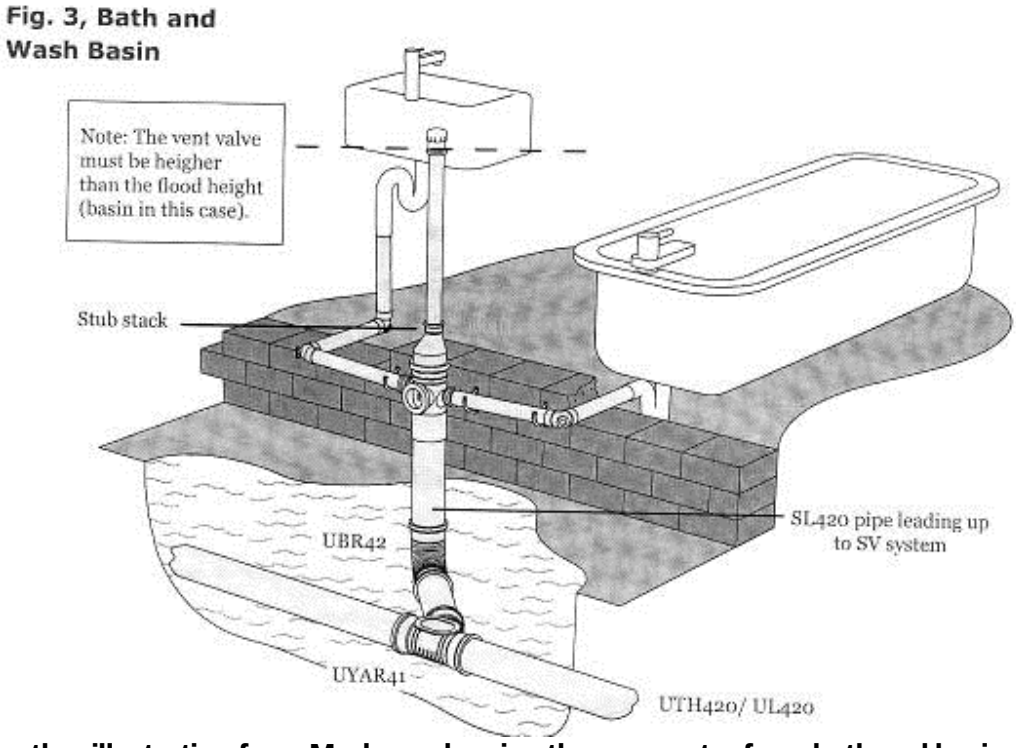
Prevention is better than cure...
To prevent sewer gasses from entering the house, every plumbing fixture connected to the drainage system is protected with a water trap seal.

Some typical water trap seals found in South African houses



This illustration, provided by Marley, shows how waste from a toilet enters the drain

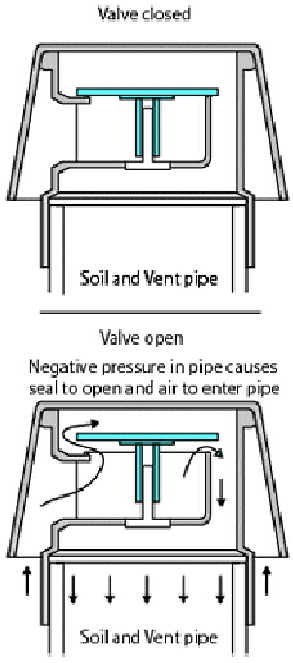
The purpose of the water seal is to prevent bad smells from the drains from entering the house. The water seal also prevents vermin (rats, cockroaches) from entering the home through the drains. These water seals are located in traps of different shapes - an "S-bend", a "P-trap" or a bottle trap on the line between the plumbing fixture and the drain.



Another illustration from Marley – showing the grey water from bath and basin entering the drain via water seal traps

These plumbing fixture water trap seals need to be protected against air pressure differentials within the drainage system, which would otherwise cause the water from the trap seal to be siphoned away – thereby allowing sewer gasses to enter the building.

The older method of protecting the trap seal, was by the installation of a vent system that provided an open pipe connection to the outside air – thereby equalising air pressure in the drain and atmospheric pressure. This open pipe vent system protected the trap seal from both low pressure and high pressure conditions. These vent pipes had to be long enough to discharge gas from the sewers above roof level, and such pipes can be seen in older houses projecting up through the roof.



The more modern air admittance valve (left), also known as a "Durgo" valve. incorporates a sealing diaphragm which is normally held closed under its own weight or slight spring pressure, thus sealing the foul air within the pipework - see diagram on left.

When a plumbing fixture discharges into the drain, a slight negative air pressure is produced in the drain pipework, which lifts the sealing diaphragm and allows air from the atmosphere to be drawn in. This intake of air equalises the air pressure and the sealing diaphragm falls back, sealing the valve. The inrush of air through the open valve prevents the foul air in the drain from escaping into the room/roof space, and prevents the water seals in traps along the pipework from being broken.

Air admittance valves, which are now found on more modern houses are shorter vent stub and have replaced the older vent pipes which protruded above the roof line. Air admittance stubs can be short because they form part of a "closed pipe system" – as distinct from the earlier "open pipe system" with had long vent pipes opening to the atmosphere high enough above the ground to avoid unpleasant smells at ground level.

Information...
Vents also admit oxygen to the waste system to allow aerobic sewage digestion if the drain discharges to a septic tank on the property. This is important for the proper functioning of the septic tank.

All drain waste vent systems (both open and closed pipe); maintain neutral air pressure in the drains, thereby allowing the flow of water and sewage down drains and through waste pipes by gravity. As such, it is critical that a downward slope be maintained throughout. By comparison, potable water supply systems operate under pressure to distribute water up through buildings.

Note...

An air admittance valve must be installed so that it is positioned above the highest flood level of the appliances fitted to the pipe - that is to say, where a washbasin is connected to the pipe work, the air admittance valve must be higher than the overflow of that basin. This is to ensure the correct operation of the air admittance valve; otherwise there is a risk that the water seal in the basin's trap may be broken.

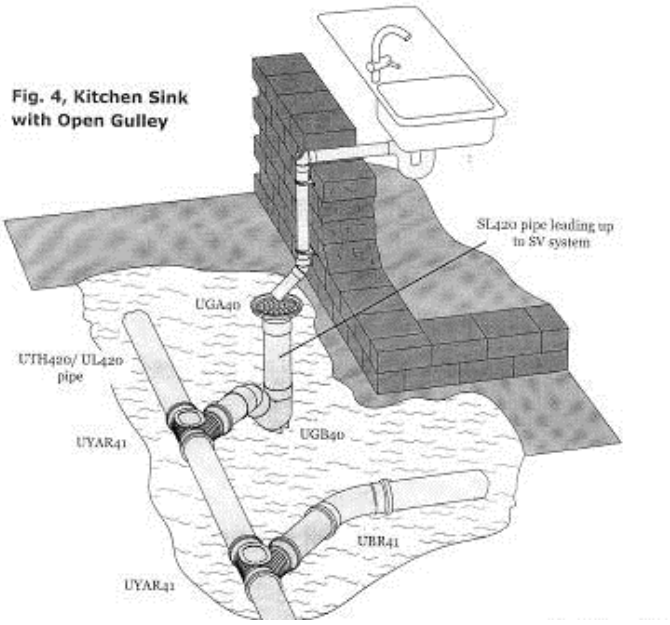
The use of air admittance valves are governed by the National Building Regulations (Part H) and they cannot be used in all situations. Generally speaking, within a normal, two story house with an existing vent pipe, there will be no problem; fitting air admittance valves within a taller building or a block of flats may be problematic.

Air admittance valves are easy to fit, some incorporate seal rings which seal against the inside of the pipework, other valves just slip onto the top of the vertical pipe. However, expertise and experience is required in designing the system. Problems can also arise where air admittance valves are fitted to vent pipes which are not separately vented, and which include water traps - this can lead to back pressure in the pipework when an appliance is discharged, which will affect the appliance discharge - this will be especially noticeable when a toilet is flushed.

Air admittance valves do not need any maintenance. If they become faulty and sewer gas is allowed to into the building, then the valve should simply be replaced.

Gullies

Gullies are used as a method of collecting water to discharge to a drain. Gullies can be either un-trapped or trapped. A trapped gully holds water, to prevent foul air from escaping from the drain. They are used when discharging grey water into a sewer drain. An un-trapped gully hopper is often used for taking water from a rainwater pipe or area of paving for example, into an underground drain.



Sink discharging to a gulley

Drains and gradient

Drainage/sewerage systems are generally "self-cleansing". Drainage systems are generally designed to run at a maximum of three quarters full bore. Pipe gradients should be sufficient so that the velocity of the waste ensures adequate self-cleansing.

A 110mm drain taking the discharge from a single stack, should be laid at a 1:40 (25mm per meter) fall. A drain taking the discharge from more than one stack, can be laid at 1:80 (12.5mm per meter).

Drains must be provided with a rodding point – either a rodding eye or an inspection manhole – at every bend and also near the boundary of the property, or the sewerage servitude where the house drain enters the municipal sewer.

Blocked drains

The most common reasons for drains blocking are**:**

- Roots have found a way into the pipe through a break or loose fitting joint.
- Someone has flushed something unusual down the toilet like a nappy, clothes or toy. This type of blockage often occurs when there are already roots in the system.
- The system has been incorrectly installed/modified (often during extensions) and this is the point that is prone to blockage.
- The pipe system is starting to collapse for some reason. This is common with old ceramic pipes, or plastic pipes, which have been deflected by roots.
- Fats, detergent powders and other substances which have accumulated and blocked the drain.
- Concrete, grout or filler has been put into the drain.

The most reliable and efficient method of clearing blocked drains is by manual or mechanical rodding. When drains collapse or start to become chronically blocked, the drain line normally should be dug up and replaced. If this is difficult or too costly because of structures built on top of the line, then the line needs to either be re-routed or sleeved. Modern camera techniques enable specialised plumbers to “look” inside the drain, analyse the problem and determine whether sleeving is an option.

Clearing block sink, basin, bath and shower waste pipes

A proprietary drain cleaner with hot water usually works. A rubber plunger is also effective – especially after the use of caustic water to loosen the blockage. Again, be careful when plunging if there is caustic soda in the drain. Wear gloves and eye protection. Cleaning the drain every couple of months will ensure that it never blocks.

Inspecting the pipes and drains

The home inspector needs to observe and report on the following, as regards the plumbing and drains:

- The location of the mains stop cock (if it can be found). If the inspector is unable to locate the stop cock, he/she should mention this in the report.
- Any obvious leaks to supply and waste pipes and to taps/mixers. In this regard the inspector should check the waste lines under basins, sinks and behind toilets.
- Any blocked gullies and any bad smells connected with the drains.
- If practical and especially if trees are nearby, the inspector should try and lift the cast iron inspection hatches on the drain line and check for visible root infestation.

Before you take the online test, please.....
Make sure that you are thoroughly familiar with the material in this module before completing the online test. The more familiar you make yourself with the information presented in this Module the better you will be as a professional home inspector. Review thoroughly all areas of this module before and during the open book online test.