BA SANGAM COLLEGE

YEAR 13

APPLIED TECHNOLOGY

WORKSHEET 1

Learning Outcomes

By the end of this topic, students will: know the components of sanitary plumbing.

Sanitary plumbing

The work of fixing or unfixing any sanitary fixture or sanitary appliance, or any associated fittings or accessories:

a. the work of fixing or unfixing any trap, waste or soil pipe, ventilation pipe, or overflow pipe connected with or intended to be connected with or accessory to any sanitary fixture or sanitary appliance or any drain (whether or not the sanitary fixture, sanitary appliance, or drain is there when the work is done):
b. the work of fixing or unfixing any pipe that

d. supplies or is intended to be a means of supplying water to any sanitary fixture or sanitary appliance (whether or not that sanitary fixture or sanitary appliance is there when the work is done); and
e. is within the legal boundary of the premises on which that sanitary fixture or sanitary appliance is or will be installed (whether or not that sanitary fixture or sanitary appliance is there when the work is done):

2. generally all plumbing work associated with any sanitary fixture or sanitary appliance

Therefore the legal definition of *sanitary plumbing* encompasses **all water pipes within the boundary of a property, including any fixtures and fittings within that system**. This includes hot water systems, valves and devices used to control pressure and temperature and to prevent backflow.

Foul water collection and disposal systems are also included in this definition. This includes pipes, vents and devices to control pressure fluctuations and foul air movement.

Why is this?

There are three main ways in which faulty plumbing can cause serious health and safety issues, two of them fairly obvious, the third less so.

1. **Risk of disease**
    - Water contaminated with human waste and other noxious substances are a breeding ground for a multitude of diseases, from cholera to SARS. We refer to such contaminated material as ***foul water***. It is self-evident that the safe collection and disposal of these products is fundamental to preventing any outbreak and spread of these many illnesses.
2. **Necessity for a fresh and clean water supply**
    - Fresh and clean water, known technically as *potable* water, is a fundamental necessity for healthy life. It is particularly important when people are crowded together in communities. The contamination of communal drinking water by disease or chemical pollution can very quickly create serious problems if transferred through a public, or shared, water supply. Because our water systems are mostly interconnected and come from common sources, any contamination can be rapidly carried from its source through to the rest of the community supply. Accidental cross-connection, or the forced mixing of contaminants by pressure differential, is preventable by the correct layout and separation of pipe systems, and the incorporation of back flow

      prevention devices. Plumbers have the training and experience to identify potential risks and determine the appropriate solutions.
3. **Hazards associated with producing hot water**
    - Hot water systems, especially storage systems, are intrinsically dangerous if installed incorrectly. A mixture of pressure and temperature can create a variety of hazards from scalding (by either hot water or steam), or in extreme cases, explosion (illustration below). Although systems are usually controlled by a thermostat, these commonly fail. A range of other devices must be installed to monitor and protect the system, both from *over-pressure* and *over-temperature*.

Despite subsection (1), *sanitary plumbing* does not include

a. the work of fixing or unfixing any sanitary fixture or sanitary appliance that is installed in any ship, boat, aircraft, or vehicle, or any plumbing work associated with any of those sanitary fixtures or sanitary appliances; or
b. the work of fixing or unfixing a bedpan washer, a bedpan sterilizer, a dishwasher, or a washing machine in any case where the fixing or unfixing of waste pipes or of pipes supplying or intended to supply water is not involved; or
c. the work of fixing or unfixing a pipe for reticulating water in any central heating or cooling system downstream of a testable backflow prevention device that is used exclusively for that central heating or cooling system; or
d. the work of repairing or replacing taps, ball valves, tap washers, or plugs; or
e. the work of fixing or unfixing any shower that is installed over a bath and that is supplied with water through the bath taps

This means that work an unlicensed person (including a home owner) can undertake, includes:

Maintenance of taps and tap washers. If the work does not involve fixing and unfixing of water supply pipes, any person may replace tap washers and repair taps and valves.

Installing/replacing spouting and downpipes. Any work above ground may be done by unqualified persons, but note that most below-ground work must only be done by a Registered Drainlayer.

Roof work. Most roof work does not require registration currently, but this may change as certain sections of the Building Act relating to licensing of builders come into force.

Review question

1. **Define sanitary plumbing**
2. **List down 4 components of sanitary plumbing**
3. **Difference between septic and sewage system**

LESSON PLAN

Subject: Applied Technology		**Year/Level:** 13
Week: 1	**Lesson 2**	**Date:**
Topic: **sanitary plumbing**		

Previous Knowledge

Students have some prior knowledge on topic which was done last year in Year/Level 12/ 2019.

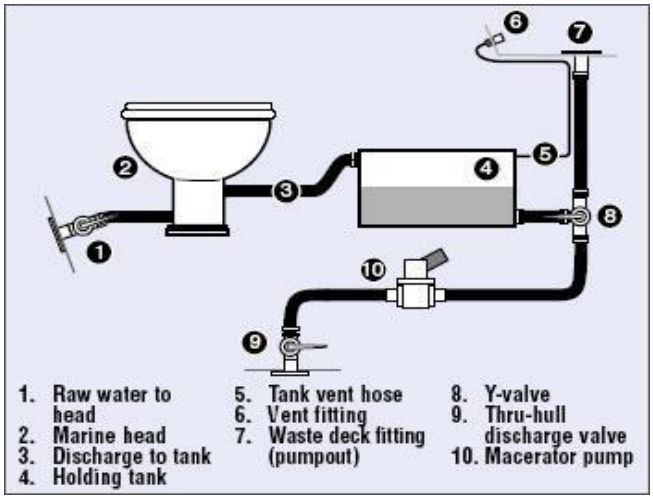
Learning Outcomes

By the end of this topic, students will: know the components of sanitary plumbing.

Components of Sanitary Plumbing.

The major categories of plumbing systems or subsystems are:

1. Potable cold and hot tap water supply.
2. Plumbing drainage venting.
3. Sewage systems and septic systems with or without hot water heat recycling and gray water recovery and treatment systems.
4. Rainwater, surface, and subsurface water drainage



Water services and systems

Water is required for many purposes such as washing and cleaning, personal hygiene, sanitary flushing, fire protection and commercial uses. Water services and systems transport cold, hot and warm water from a water source to points of discharge in a building and the surrounding property.

Types of water systems

Depending on the type of plumbing work you are involved with you may be contracted to design a variety of water systems that suit different developments. You need to be aware of the systems and their application.

Water systems include those for:

domestic houses
multiple living units
large developments that may require multiple mains connections (hospitals and schools)
multi-storey constructions
non-drinking water services
flushing systems for sanitary fixtures
supply of water to a heated water system
fire services.

LESSON PLAN

Subject: Applied Technology		**Year/Level:** 13
Week: 1	**Lesson 3**	**Date:**
Topic: **sanitary plumbing**		

Previous Knowledge

Students have some prior knowledge on topic which was done last year in Year/Level 12/ 2019

Hot water systems

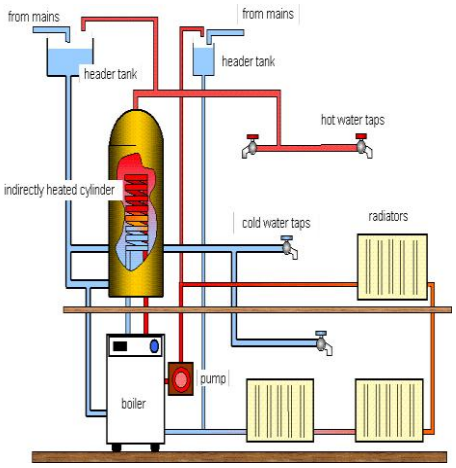
Hot water is required in most domestic, commercial and industrial situations to meet the requirements of the building occupants. Appliances that store and/or heat water must be available and a pipework system designed that transports the heated water to the required discharge points. This is called the hot water system.

Energy sources for heating water

Hot water systems require an energy source to heat the water. The most common energy sources are:

- electricity
- gas (including natural, Liquefied Petroleum Gas (LPG), town gas, tempered LPG, simulated natural gas, processed natural gas)
- solar power.

In the current era of improving environmental sustainability and reducing society's dependence on natural resources the use of solar power is growing. You will need to develop a good understanding of the principles of solar power and how this affects hot water systems.



Solar heating

Solar power may be captured by solar collectors and the heat used directly, or it may be collected by photovoltaic cells that convert the heat to electricity which can be stored for future use.

Most solar water heaters operate in one of two ways:

- a unit that consists of solar collectors that transfer radiant heat directly to water in a storage tank. A gas or electric booster system is required. The hot water moves through the hot water system by means of natural convection or a circulator.

a solar heat pump unit that draws heat from require collectors.

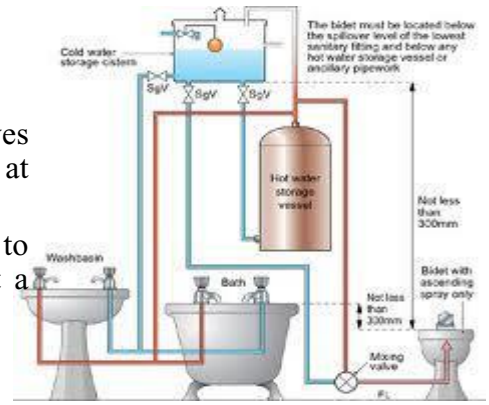
Hot water pressure

Water heaters may deliver hot water:

at mains pressure –hot and cold water are at the same pressure

at reduced (medium) pressure –pressure reducing valves connected to the cold water connection reduce the pressure at which hot water is delivered

at gravity (low) pressure –gravity is used to deliver hot water to the discharge points. The storage tank must be located at a sufficient height above the discharge points.



Hot water Supply –Vented Systems

There are two main types of vented hot water system. The older type is the direct hot water system and the more modern is the indirect hot water system.

Hot Water Cylinder

With both, there is a hot water cylinder which supplies hot water to the taps in the house. The hot water cylinder is fed directly by its own supply from the cold water storage cistern (usually in the attic) and this feed incorporates a stop valve allowing for maintenance and repairs. This is the valve used to switch off the hot water supply when you need to carry out work on the system –for example when changing a tap. Some people find it a little confusing that the way to turn off the hot water supply is to close the valve on the cold supply feeding the cylinder. The reason is that the pressure which forces the hot water to flow at a hot tap is caused by the head of water from the cold water storage cistern. The weight of water acting down via the cold feed forces the water out of the top of the hot water cylinder.

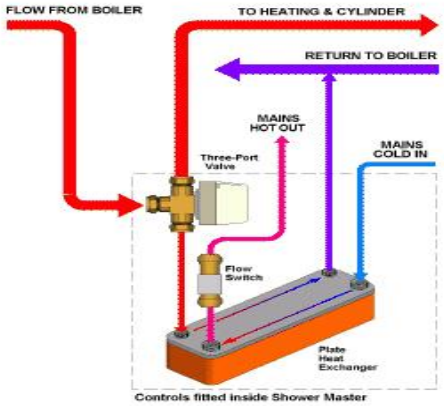
The hot water distribution pipe is connected at the top of the cylinder and will run horizontally for at least 450mm before it connects with the vent pipe. This vent pipe runs back up and over the cold water storage cistern. It keeps the system at normal air pressure and also allows for overheated water to escape. The horizontal section of pipe is there to ensure correct circulation. The distribution pipe then continues on to each of the hot water outlets in the house.

As the water heats up it expands and pushes back up the cold feed so the water level in the cold water storage cistern will rise and fall to accommodate this.

Combined Hot Water Storage Cylinder

On some systems, the cold water storage cistern is mounted immediately above the hot water storage cylinder in a combined unit. From an installation point of view this has some advantages such as the reduction in pipe work required. However, there are some significant disadvantages as well which should be taken into account. Because the cold water storage is not in the attic it will likely be significantly lower and this reduces the head of water. The head of water, or the weight of water acting down, determines the pressure at the hot water taps. For this reason, the combined unit needs to be positioned so that it is as high as it can be above the uppermost hot tap in the house. If it were positioned at the same level, there would be no water pressure at the taps.

The feed from the cold water storage part is similar to that for a regular system and a float valve also controls water coming into it. The open vent is still required to maintain atmospheric pressure in the system and this runs from the cylinder up into the cold water storage part so that it terminates above the water level.



REVIEW QUESTION

1. Name three of cold water and explain the difference between them

2. Explain 3 types of energy sources of heating water

LESSON PLAN

Subject: Applied Technology		**Year/Level:** 13
Week: 1	**Lesson 4**	**Date:**
Topic: **sanitary plumbing**		

Previous Knowledge

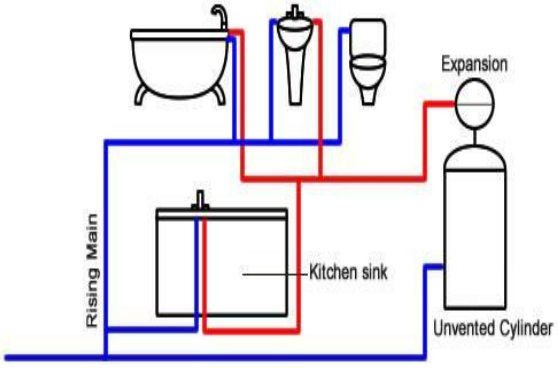
Students have some prior knowledge on topic which was done last year in Year/Level 12/ 2019

Direct Hot water Supply

Seen in older properties where the hot water supply system has not been modernized, this works on the gravity system. Hot water is less dense than cold and this creates a flow within a circuit. Water may be heated by a boiler in which case the primary flow goes from the boiler to the hot water cylinder, heating the water within, and returns from the bottom of the cylinder to the boiler again. The hot water cylinder may not be connected to a boiler at all, and simply have an immersion heater element inside to heat the water.

Indirect Water Supply

With an indirect hot water system, a primary circuit from the boiler feeds a heat exchange element in the hot water cylinder. The hot water in the cylinder itself is totally separate from the water in the primary circuit. The two do not mix at any point. The water in the cylinder is heated by the coiled hot water pipe –the heat exchanger - from the primary circuit.



Indirect Hot Water Feed and Expansion Cistern

This type of indirect hot water circuit is the most common with vented systems. It should be noted that the primary circuit from the boiler has a completely separate feed and vent system from the one used for the hot water itself. As was explained earlier, the hot water cylinder is fed by the cold water storage cistern. But with the indirect system, a separate cistern is also feed and expansion cistern. The purpose is similar but it ensures that water from the two separate circuits cannot mix. If the primary circuit was vented over the cold water storage cistern, it would be possible for the two to mix resulting in contamination of the water supply in the house.

The feed and expansion cistern has two main functions. It is used as a supply of water to fill the primary system, but more importantly, it allows for expansion of the water as it heats up. Water expands by some 4% when it is heated so some way of accommodating this is needed. With the feed and expansion cistern, the additional volume is forced back up the supply pipe and into the cistern. If you look at the water level in this cistern when the system is cold and when it is hot, you will see how different the water levels are. This is the amount by which your water has expanded. It follows that when the system is cold the water level should be set fairly low down in the cistern. A float valve on the incoming water supply to this cistern will automatically top up the water should it fall below the set level. In addition, there will be an overflow from this cistern to the outside so that, should the float valve jam or fail, excess water can be discharged in an obvious place so that you know there is a problem.

The open vent from the primary circuit runs back up past this feed and expansion cistern by at least 450mm before looping back over it. The open vent has two purposes –maintaining normal air pressure in the system, and allowing for pressure surges within the system.

Immersion Heater

If you have an immersion element in the cylinder it is well worth checking that this has a secondary thermostat to guard against overheating. Old style immersion heaters only have one thermostat and there have been cases recently where this has lead to disastrous consequences. If the immersion heater fails to switch off when the water is at the required temperature, the water will continue to heat and overflow into the cold water storage cistern. If this continues, the cistern can fail and the boiling water pour down through the ceiling.

Many hot water cylinders have two elements –one at the bottom and one near the top. The idea behind this is to use the lower one during off peak hours to heat the whole cylinder and the top one at other times when only a small amount of extra hot water is required

Review questions

1. Name three of cold water and explain the difference between them.
2. Sketch an indirect and direct hot water system

LESSON PLAN

Subject: Applied Technology		**Year/Level:** 13
Week: 1	**Lesson 5**	**Date:**
Topic: **sanitary plumbing**		

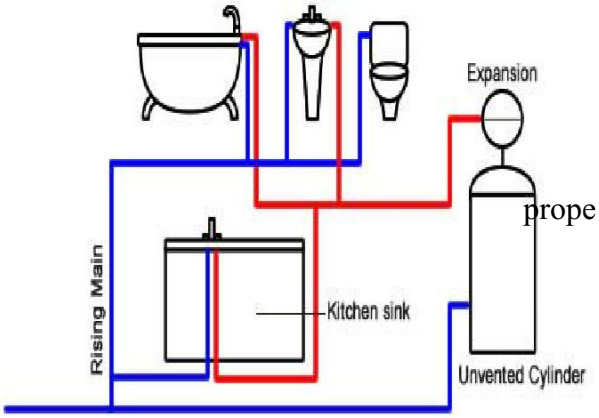
Previous Knowledge

Students have some prior knowledge on topic which was done last year in Year/Level 12/ 2019

Cold water supply

Cold water may be supplied to a building and its surrounds by a variety of methods. You will have to design the cold water service that meets the requirements of the building occupants but also suits the supply system.

Most properties are supplied with water through the direct connection of pipes to a high pressure main. This is called mains pressure supply. The water main is the responsibility of the relevant water authority. The water main runs to an external stop valve which
The stop valve eliminates the risk of backflow into the mains supply.
Mains pressure is a good option if it provides enough constant pressure to supply all the fixtures as requirements.



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Mains pressure (non-potable)

Non-potable water supply might come from reclaimed or recycled water supplies. It is non-drinking water and is used only for toilet flushing, clothes washing or watering gardens.

Pumped supply from rainwater tank (drinking water)

In many areas, both rural and suburban, rainwater is collected from roof catchments and stored in rainwater tanks. This water may be used for drinking, cooking, some washing and cleaning tee

Pumped supply from rainwater tank (non-drinking water)

urban areas are now installing rainwater tanks due to severe water restrictions. The water from these tanks is used to supplement the mains water supply for functions such as toilet flushing, clothes washing or garden watering.

Pumped supply from private bore or dam (non-drinking water)

An alternative water supply to rain water tanks are private on-site bores or dams. This water is used for gardening, washing and toilet flushing.

Mains pressure with storage tank

This system may be used in multi-storey buildings where there is sufficient mains pressure at times during the day to raise water to a storage tank on the top of the building. The stored water is used when the mains pressure is insufficient to meet the building requirements. It is not a common system because the stored water may be used up before the tank refills.

Mains pressure boosted (pressure system)

This system may be used in multi-story buildings where only a small section of the building does not get supplied with water during peak periods. Pressure from a centrifugal pump boosts the water to the required area.

Mains pressure boosted (pneumatic)

An air compressor is used to further compress air within a pump that boosts water to the top levels of a building.

Mains pressure boosted (with a storage tank)

This system has a storage break tank between the main and the booster pump. It may be required by some water authorities to prevent cross contamination particularly in industrial situations.

Review questions

1. Sketch and label a cold water system.
2. List down ways of collecting rain water.