Unit 5

General Guidelines While Designing Water Supply Pipe Lines

Designing pipe lines in a house or building needs careful vision. There is no cross connection between pipes for drinking water and pipes containing impure and waste water. Pipe work is accessible for inspection, replacement and repair. All joints of pipes are completely water tight.

Underground pipe lines are laid at proper depth so that they are not damaged by traffic load etc. Here are given a few guidelines for designing pipelines.

- Pipes and fixture should be fixed into proper line to give sufficient volume, adequate pressure and satisfactory function in all normal conditions.
- There should be no cross connection between pipes for drinking water and pipes containing impure and waste water.
- Pipe work should be planned so that the pipes are accessible for inspection, replacement and repair.
- Service pipe should not be connected to any water closet.
- The service pipe should not be connected directly to any hot water system also.
- The supply of water for water closet should be from storage tank.
- Vertical pipes are fixed in such a way that they should be away from window, ventilator and cabinets etc.
- All joints of pipe work should completely be water tight.
- Provision of direct supply of water should be kept in kitchen for drinking and cooking etc.
- No pipes should be laid or fixed to pass above/below or adjoining any sewer line, scour outlet or drain or any man hole.
- Underground pipe line should be laid at such a depth that it cannot be damaged by traffic load etc.
- To reduce friction losses, change in direction and in diameter of pipes should be gradual and not abrupt.

Precautions while Fixing Accessory

- All pipes which are in open should be painted completely to avoid rusting.
- Ball cock must be provided in water tank.
- All fixtures and fittings should tightly be fixed.
- Care should be taken that the surface of fittings does not spoil while fixing.
- All sanitary fittings should be fitted with care without damaging any surface of sanitary ware or developing any crack.
- It is advisable that fitting should be covered by papers or old cloths before starting painting. In case any the splashes of paint drops on fittings should be cleaned immediately.

System layout and pipework

The water supply system must be designed to achieve appropriate water pressure and flow, and to avoid contamination to potable water.

As well as avoiding contamination and achieving the right pressure and flow, the system must be suitable for the temperature of water carried. A well-designed and installed system will also be durable, minimise noise from water flow and from problems such as water hammer, and support efficient use of water.

All water supply systems use a combination of pipes (of different dimensions and materials), valves and outlets to deliver water to building users. Some water supply systems also use storage tanks and pumps. Designing a water supply system involves getting all of these elements right so that clean water is delivered to the user at the appropriate rate and temperature.

Water pressure

If the aim is to provide for building users' needs while also using water efficiently, the right water pressure is crucial. If water pressure is too low, this will be inconvenient for building users – for example, because showers have poor water flow, and baths take a long time to fill. If pressure is too high, this will lead to wastage of water, as well as high wear and tear on the system.

Typically, new buildings in areas with mains water supply will have mains pressure systems. Existing buildings, and buildings that are not connected to mains water, may have low pressure systems or unequal pressure systems (with different pressures for hot and cold water supply).

As an example of the difference in water usage, a low pressure hot water system shower flow may average about 7 litres per minute, while a mains pressure shower may average around 12–20 litres per minute.

Mains pressure systems require pressure limiting and pressure reducing valves to control water pressure and temperature. Typically, pressure limiting or pressure reducing valves will be used to control pressure in mains-supplied hot water systems or where high pressure may lead to problems such as burst pipes.

Low pressure systems require few valves or controls. In low or unequal pressure systems, pressure can be increased to adequate levels by storing water in a header tank (typically in the ceiling space) so that gravity can be used to create water pressure. If a tank is being used, see the BRANZ publications Water and Plumbing for details of installation requirements.

Pressure can also be raised to adequate levels using a pressurising pump, in which case it may be necessary to use pressure limiting and pressure reducing valves.

Water flow rate

The Building Code requires that sanitary fixtures and appliances have adequate water supply at an adequate flow rate.

As with water pressure, flow rates are crucial. A flow rate that is too high will result in water being wasted, whereas a flow rate that is too low will mean that sanitary fixtures and appliances don't work properly.

Flow rate is affected by:

- Water pressure
- Pipe diameters – The smaller the internal diameter of the pipe, the lower the pressure and flow rate. (Note that pipes are generally referred to by their inside nominal diameter (DN), but it is actually the internal diameter that counts; a pipe rated as DN 15 may have an actual inside diameter ranging between 10–18 mm.)
- Water temperature – higher temperatures will tend to raise pressure and flow rates (note: also see materials below).

A flow regulator can be used to maintain a constant flow, independent of water pressure. As an example, if someone is in the shower and the kitchen tap is turned on full, the temperature and flow are likely to remain more stable if a flow regulator is used.

Limiting the flow for a tap or appliance to a reasonable rate helps balance the available pressure throughout the system. Regulating flow allows a simpler design and minimum pipe sizes as peak flow rates can be specified accurately and can also reduce noise, splashing taps, and water hammer.

Manufacturers' recommendations must be referred to for pressure and flow information when selecting tempering valves and outlets (taps, mixers and shower heads).

Flow rate can also be controlled by specifying low-flow outlets.

Flow rate and pipe size Acceptable Solutions

Building Code Acceptable Solution G12/AS1 sets out flow rates and pipe sizes. Pipes must be sized to achieve flow rates set out in accordance with Table 3 (see table below), or the pipes must be sized in accordance with Table 4.

When calculating pipe size, the speed of the water (velocity) moving through the pipes must not exceed 3.0 m/s.

Acceptable flow rates for fixtures and appliances

Fixture	Flow rate (l/s) and temperature °C
Basin	0.1 at 45 °C
Bath	0.3 at 45°C
Sink	0.2 at 60°C (hot) and 0.2 (cold)
Shower	0.1 at 42°C
Laundry tub	0.2 at 60°C (hot) and 0.2 (cold)
Dishwasher and washing machine	0.20

Adapted from G12/AS1 Table 3

The flow rates in Table 3 must be capable of being delivered simultaneously to the kitchen sink and one other fixture.

System layout

In the design process, the layout of the plumbing system will largely follow room layout. Nonetheless, there are many things to consider which relate to Code compliance, building users' comfort, and sustainability.

When planning a water supply layout, the following must be considered:

- Pipe runs and lengths – Keep pipe runs as short as possible. Pass pipes close to fixtures to minimise the number of branches and unnecessary elbows, tees and joints. Having longer pipe runs and more fixtures will reduce flow rate, increase heat losses, and increase use of materials

- Point of entry into the building – This should be into a utility space such as garage/laundry and include an accessible isolating valve, line strainer and pressure limiting valve (if required)
- Water heating system – Locate centrally to reduce the length of pipe runs to fixtures because longer pipe runs require more water to be drawn off before hot water is discharged. Install a separate point-of-use water heater for fixtures that are more than 10 m from the main water heater
- Noise prevention – Avoid running pipes over or near bedrooms and living areas.

Backflow

Backflow is the unplanned reversal of flow of water (or water and contaminants) into the water supply system. The system must be designed and used to prevent contamination from backflow. See backflow prevention for more.

Mains connection

Where the water source is a mains supply, the network utility operator is responsible for the water supplied to the property boundary. The property owner is then responsible for providing the pipework to bring the water into the building.

An isolating valve must be fitted at the point of connection to allow for maintenance and repair of the building's water supply system if required.

Pipe materials and specifications

The pipes used in a building must not contaminate potable water supply, and must be suitable for the water pressure, flow rate and temperature of water they will be carrying. This will be influenced by the materials used and also by other factors such as the wall thickness.

Other considerations are durability, ease of installation, cost, and sustainability. Common materials for domestic water supply include copper, polybutylene (PB), polyethylene (PE), polypropylene (PP-3 or PP Type 3), and cross-linked polyethylene (PEX).

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House Plumbing

Plumbing, system of pipes and fixtures installed in a building for the distribution and use of potable (drinkable) water and the removal of waterborne wastes. It is usually distinguished from water and sewage systems that serve a group of buildings or a city.

One of the problems of every civilization in which the population has been centralized in cities and towns has been the development of adequate plumbing systems. In certain parts of Europe the complex aqueducts built by the Romans to supply their cities with potable water can still be seen. However, the early systems built for the disposal of human wastes were less elaborate. Human wastes were often transported from the cities in carts or buckets or else discharged into an open, water-filled system of ditches that led from the city to a lake or stream.

Plumbing Systems in Buildings

Plumbing system in buildings consists of underground tank which is supplied water via municipal or water department supply lines, from there with the help of pumps and piping distribution system water is supplied to overhead tank and thereby due to gravity water reaches to home outlets.
The overhead tank can however be eliminated if water is supplied directly from underground tank to kitchen toilet outlets, there comes the need of pumps which can give uninterrupted supply of water with required pressure to outlets so that when one opens the tap he gets continuous supply of water. Such pumps are called hydro-pneumatic system.

Objectives of Plumbing System

Water Supply goals

- To provide enough water to serve each fixture.
- To provide of no opportunity of backflow of used water into the water supply pipes.

Waste Disposal goals

- Wastes should be disposed of promptly and hygienically.
- Drainage systems should be of adequate size and easily cleaned.
- Drainage systems should be equipped with liquid seal traps.

Plumbing Components

Pipes

Cast Iron Pipes

These are made by pouring molten iron into sand molds. These are used for rain water disposal, waste water disposal etc. they are available only in shorter lengths.

Cast Iron Pipes
https://theconstructor.org/building/types-of-plumbing-pipes-building/12514/

PVC Pipes

These are used for both supply system and drainage system. These are very economical and easy to maintain. Soil pipes, kitchen waste pipes are generally PVC pipes.

PVC Pipes
https://theconstructor.org/building/types-of-plumbing-pipes-building/12514/

Galvanized Iron Pipes

When compared to copper pipes, G.I pipes or steel pipes are very economical. But they corrode easily in soft and acid waters. In the other case galvanized iron pipes are much stronger than copper pipes so, we can use this pipes in places where chance of corrosion is less or in hard water areas. Hammering is needed to remove the scales formed by hard water.

Galvanized Iron Pipes
https://theconstructor.org/building/types-of-plumbing-pipes-building/12514/

Concrete Pipes

For heavy drainage water disposal, concrete pipes of large diameters are used. Smaller diameter pipes are used for small flows. These are made of concrete only; no reinforcement is provided. These are pre casted pipes.

Concrete Pipes
https://theconstructor.org/building/types-of-plumbing-pipes-building/12514/

Taps Valves and Stopcock

Tap

Valves

https://www.wickes.co.uk/John-Guest-Speedfit-15STVP-Plastic-Stopcock---15mm/p/160110

Stopcock

https://www.wickes.co.uk/John-Guest-Speedfit-15STVP-Plastic-Stopcock---15mm/p/160110

Fixtures

Kitchen Sink

Lavatory

https://www.thefreedictionary.com/bathroom+fixture

Water Closet

Bathtub

https://www.thefreedictionary.com/bathroom+fixture

Types of Joints

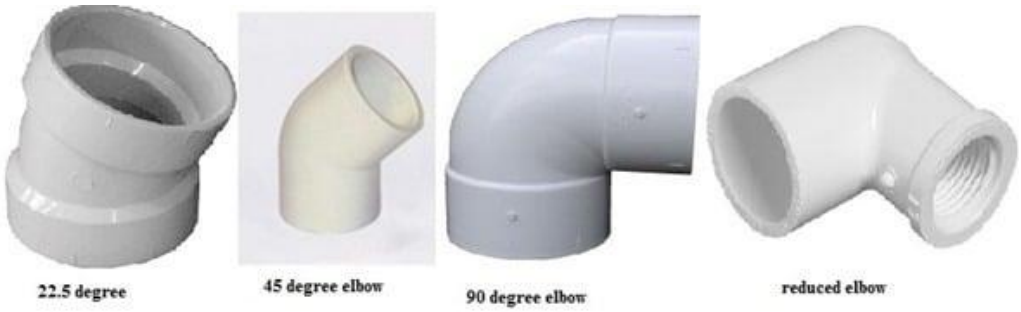
Types of Pipe Fittings in Plumbing System

Different pipe fittings and their functions are explained below.

Elbow
Tee type
Cross type
Coupling
Unions
Adaptors
Olet
Plug
Cap
Valve

Elbow Pipe Fittings

Elbows are used to change the direction of flow between two pipes. Elbows are generally available with an angle of 22.5^{o}, 45^{o} and 90^{o}. If pipes are of same diameter then normal elbows are used otherwise Reducer elbows are used. Elbows are made of different materials. These are generally coming with female threads and we can fix them by butt or socket welding also.



Elbow Pipe Fittings

https://theconstructor.org/building/types-of-pipe-fittings-in-plumbing/12541/

Tee type Pipe Fitting

Tee type fitting is a component of plumbing system which is in T-shape. It is having one inlet and two outlets, outlets are arranged at 90^{o} to the main line connection (inlet). It can also be used to combine the flow from two inlets to one outlet. They are also available in different materials and different sizes. If the 3 sides of T-fitting are similar in size then it is called as Equal tee otherwise it is called as Unequal tee.

Tee type Pipe Fitting

https://theconstructor.org/building/types-of-pipe-fittings-in-plumbing/12541/

Cross type

Cross type fittings contains 4 opening in 4 directions. These are connected when there are 4 pipes are meeting at a point. These fittings generate more amount of stress on pipe as the temperature changes, because they are located at the center of four connection points. Cross fittings are generally used for fire sprinkler systems.

Cross

https://theconstructor.org/building/types-of-pipe-fittings-in-plumbing/12541/

Coupling

A coupling is used to connect the pipes of same diameter. Coupling are also useful if the pipe is broken or leakage occurs. Generally there are two types of couplings are available. Compression coupling and slip coupling. Compression coupling is regular coupling which is connected between two pipes and it prevents leakage by the arrangement of gaskets or rubber seals on both sides, otherwise glue is provided. Slip coupling is easier to install and it contains two pipes which are arranged as one into other, inner pipe can slide up to some length. So, we can fix long length damaged pipe by slip coupling.

Compression coupling

Slip coupling

https://theconstructor.org/building/types-of-pipe-fittings-in-plumbing/12541/

Unions

Union is a type of fitting, which functions as similar to coupling. But coupling cannot be removed after fixing but in this case we can remove the union whenever we needed. Unions consists nut, male and female ended threads. So, this is also useful for maintaining purpose of pipe.

Union

https://theconstructor.org/building/types-of-pipe-fittings-in-plumbing/12541/

Plumbing types

Direct System

• Supply of water is given to various floors in a building directly from the main.

• Enough pressure is provided to feed all the floor and sanitary fitting at the highest part of the building.

Indirect System

Up Feed

• The procedure of storing water into the overhead storage tanks.

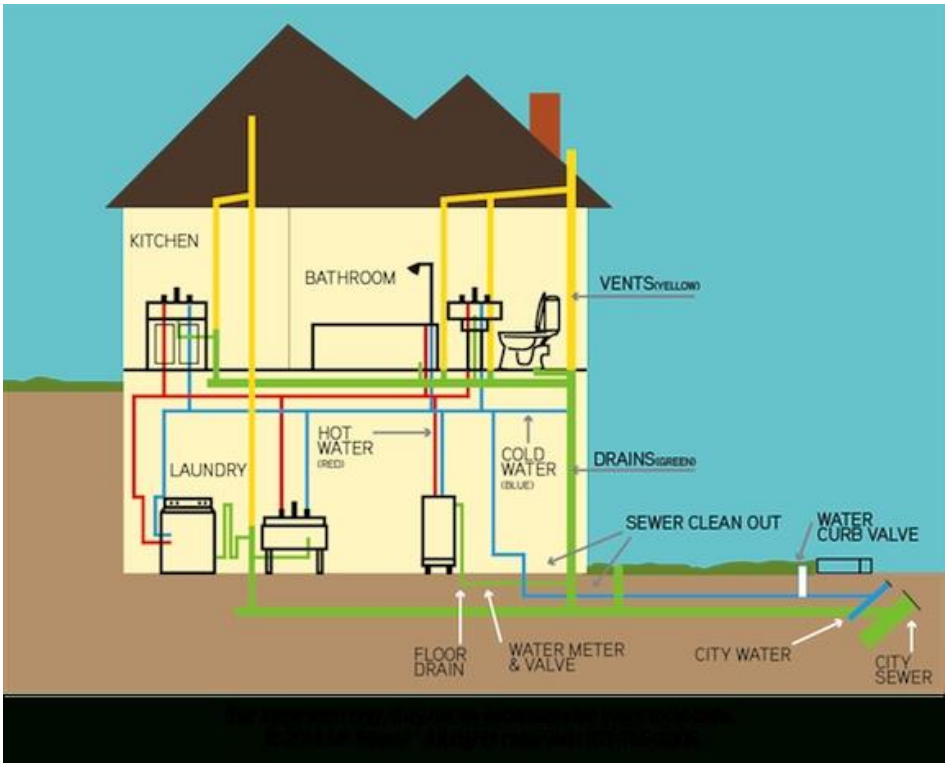
• Water is supplied in enough pressure by machine or by providing mechanical energy.

Down Feed

• • Water is distributed to the floors from the overhead storage tanks.

• • No need of extracting extra pressure because of gravitational energy water is distributed along the floors.

Drainages System



Drainages System

https://www.britannica.com/technology/waste-disposal-system

Drainage Pipe Requirements

• Provision of adequate supports for drainage pipes during construction of building.

• Pipe lay out should be direct and simple. Pipes should be laid in straight lines.

• Any abrupt changes in the direction of flow should be avoided.

• Installation not to be done to impair structural safety of a building.

The drainage pipes should be sufficiently strong and durable. They should also be air-tight and gas tight.

• The pipe-joints should be strong and leak proof.

• The entire network of pipes should have ample means for cleaning and removing obstruction.

• Traps are required for every fixture.

• Any possibility of airlocks, siphon age, undue deposits and obstruction should be thoroughly looked into and avoided.

• Pipes when not embedded should run clear of the wall with a minimum clearance of 5 cm.

• Each stack should be suitably covered on top above roof by copper or galvanized iron wire dome.

Sanitary Drainage System Components

• House sewer

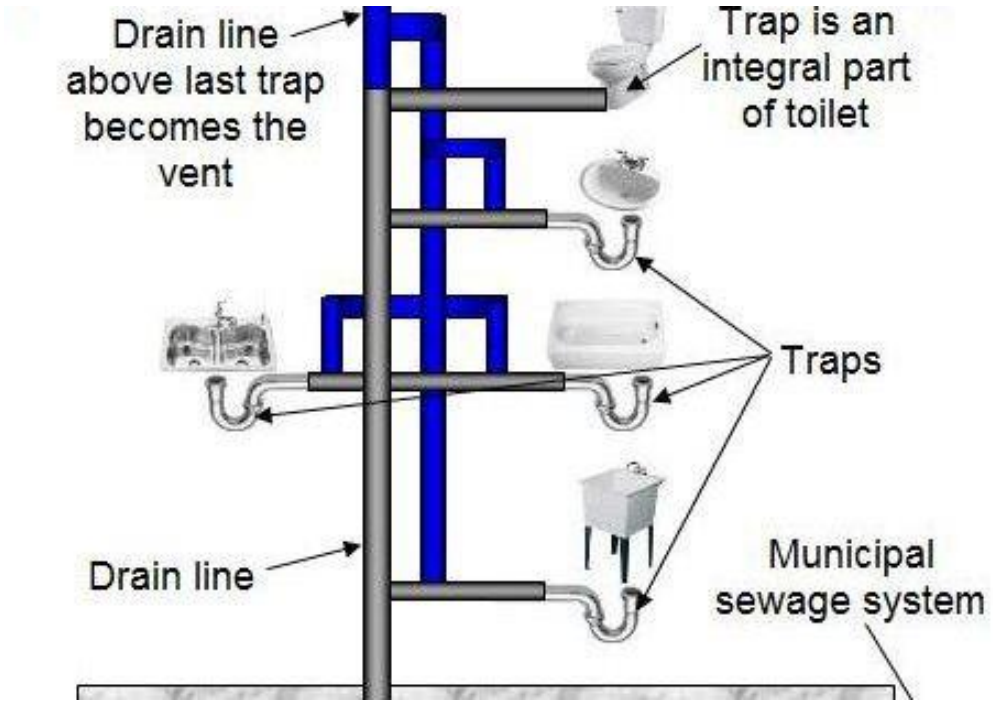
• House drain

• Soil, waste, vent stacks

• Fixture branches & branch vents

• Fixture traps

• Fixtures



Sanitary Drainage System

https://theconstructor.org/building/types-of-pipe-joints-in-plumbing/12559/

Common Plumbing problems

1. Dripping faucets.
2. Slow draining sink.
3. Clogged bath or shower drain.
4. Clogged toilet.
5. Running toilet.
6. Faulty water heater.
7. Low water pressure.
8. Jammed garbage disposal.
9. Leaky pipes.
10. Sewer system backup.

Reference:-

1. https://www.britannica.com/technology/plumbing
2. https://gharpedia.com/blog/residential-plumbing-system/
3. https://www.thisoldhouse.com/ideas/ground-plumbing
4. https://www.diy.com/departments/heating-plumbing-cooling/plumbing/valves-stopcocks/DIY1652508.cat
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8. https://www.hidrasoftware.com/en/sanitary-drainage-design-in-buildings-with-desagues-part-iii-building-house-drains/
9. https://lentheplumber.com/blog/common-plumbing-problems/
10. https://www.watersafe.org.uk/advice/common_plumbing_questions1/

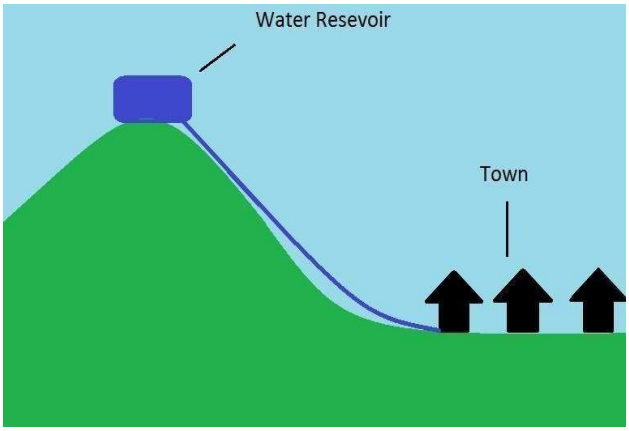
WATER SUPPLY SYSTEM

- The purpose of distribution system is to deliver water to consumer with appropriate quality, quantity and pressure.
- Distribution system is used to describe collectively the facilities used to supply water from its source to the point of usage.

Methods of water distribution

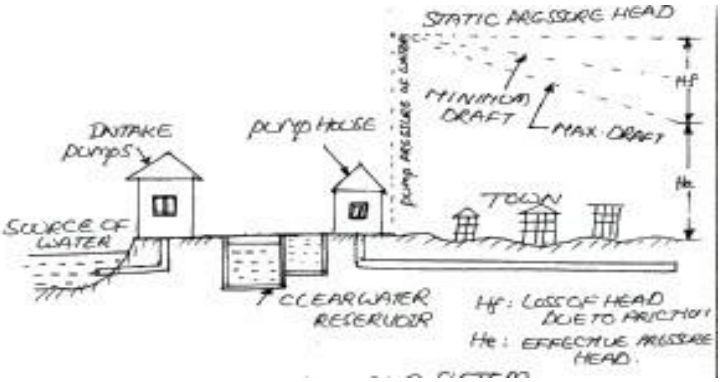
1. **Gravity system**

- Suitable when source of supply is at sufficient height.
- Most reliable and economical distribution system.
- The water head available at the consumer is just minimum required.
- The remaining head is consumed in the frictional and other losses.



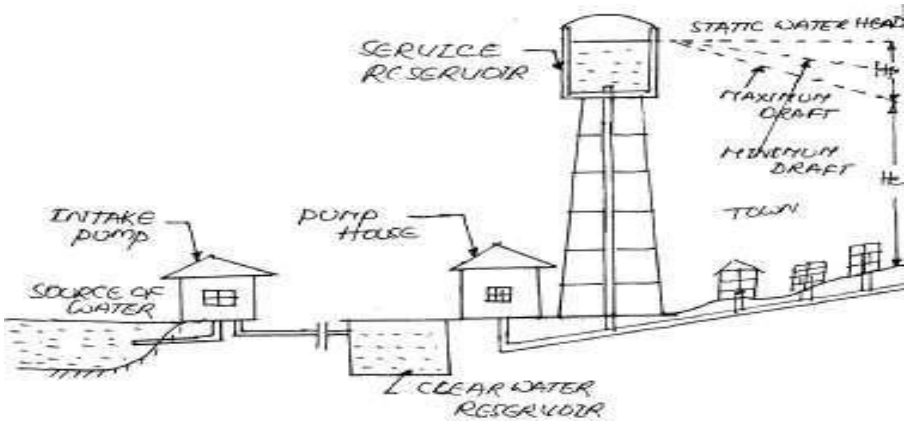
2. **Pumping system**

- Treated water is directly pumped in to the distribution main with out storing.
- Also called pumping without storage system.
- High lifts pumps are required.
- If power supply fails, complete stoppage of water supply.
- This method is not generally used.



3. Combined gravity and pumping system

- Most common system.
- Treated water is pumped and stored in an elevated distribution reservoir.
- Then supplies to consumer by action of gravity.
- The excess water during low demand periods get stored in reservoir and get supplied during high demand period.
- Economical, efficient and reliable system.



Water supply systems:

1. Cold water system
2. Hot water system

Cold water system

Cold water supply is nothing but an external water supply. However, cold water supply system can also use filter, water softener appliances, or any other fixture. The connection for the cold water system is done in such a way that other appliances could receive it through fixtures and taps. Such appliances include sinks, hot water heaters, faucets, bathtubs, showers etc.

Hot water system

There are certain appliances that can be used to provide hot water, such as water heaters. Cold water supply system supplies a volume of water to such appliances, where they heat the water and provide hot water.

TYPES OF WATER SUPPLY SYSTEM ARE:

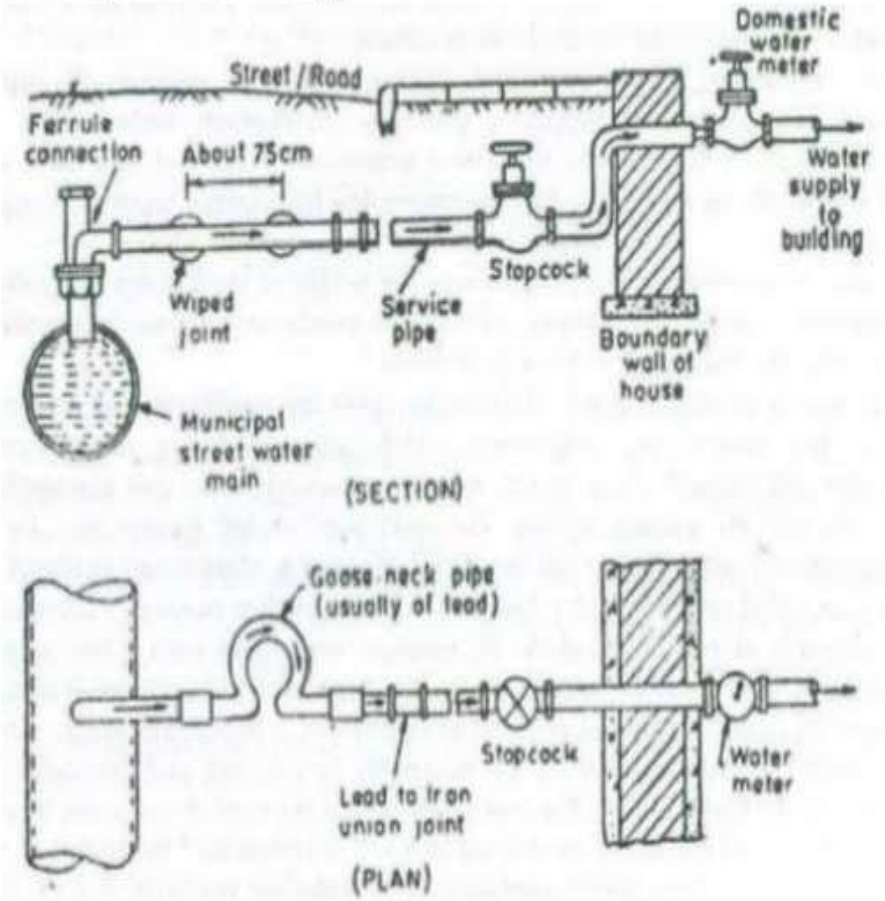
- Direct supply system
- Indirect supply system

Direct systems source water straight from the mains water supply. Indirect water systems require larger storage and more pipe work because they provide water for hot and cold services.

Types of pipes for cool water supply

A water pipe is any pipe or tube designed to transport treated drinking water consumers. The varieties include large diameter main pipes, which supply entire towns, smaller branch lines that supply a street or group of buildings, or small diameter pipes located within individual buildings. Materials commonly used to construct water pipes include cast iron, polyvinyl chloride (PVC), copper, steel or concrete.

Distribution System for a Building:



DISTRIBUTION SYSTEM :

The methods of distribution of water in a multi-storeyed buildings are:

- Direct pumping systems
- Hydro – pneumatic systems
- Overhead tanks distribution

Direct pumping systems :

Water is pumped directly into the distribution system without the aid of any overhead tank, except for flushing purposes**.** The pumps are controlled by a pressure switch installed on the line.

Over-head tank distribution :

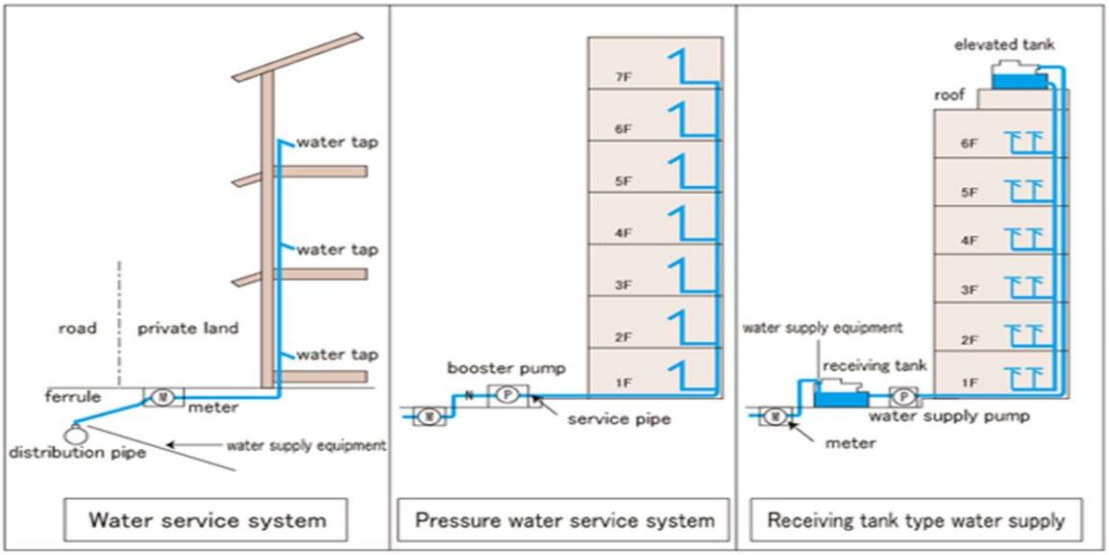
This is the most common of the distribution systems adopted by various type of buildings. The system comprises pumping water to one or more overhead tanks placed at the top most location of the hydraulic zone. Water collected in the overhead tank is distributed to the various parts of the building by a set of pipes located generally on the terrace.

Hydro-pneumatic systems :

Hydro-pneumatic system is a variation of direct pumping system. An air-tight pressure vessel is installed on the line to regulate the operation of the pumps. Hydro-pneumatic system generally eliminates the need for an over head tank and may supply water at a much higher pressure than available from overhead tanks particularly on the upper floors, resulting in even distribution of water at all floors.

Basically the system is configured into 5 types they are :

1. Single booster system
2. Zone- divided system
3. Roof tanks system
4. Series- connected systems with intermediate break tanks
5. Series- connected system



Water supply system design consideration:

The water supply system must be designed to achieve appropriate water pressure and flow, and to avoid contamination to potable water.

- Water pressure
- Water flow rate
- Flow rate and pipe size
- System layout
- Connection to the mains supply
- Backflow
- Mains connection
- Pipe materials and specifications

Water pressure

If water pressure is too low, this will be inconvenient for building users .If pressure is too high, this will lead to wastage of water, as well as high wear and tear on the system.

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- Limiting the flow for a tap or appliance to a reasonable rate helps balance the available pressure throughout the system. Regulating flow allows a simpler design and minimum pipe sizes as peak flow rates can be specified accurately and can also reduce noise, splashing taps, and water hammer.
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- Point of entry into the building – This should be into a utility space such as garage/laundry and include an accessible isolating valve, line strainer and pressure limiting valve (if required)
- Water heating system – Locate centrally to reduce the length of pipe runs to fixtures because longer pipe runs require more water to be drawn off before hot water is discharged. Install a separate point-of-use water heater for fixtures that are more than 10 m from the main water heater
- Noise prevention – Avoid running pipes over or near bedrooms and living areas.

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An isolating valve must be fitted at the point of connection to allow for maintenance and repair of the building's water supply system if required.

Pipe materials and specifications

The pipes used in a building must not contaminate potable water supply, and must be suitable for the water pressure, flow rate and temperature of water they will be carrying. This will be influenced by the materials used and also by other factors such as the wall thickness. Other considerations are durability, ease of installation, cost, and sustainability.

Pipe materials and components must not contaminate potable water. They must also be:

- suitable for the expected temperatures and pressures
- compatible with the water supply, to minimise the potential for electrolytic corrosion
- suitable for the ground conditions (if used underground) to minimise the potential for corrosion of the exterior of the pipe
- suitable for the local climate (if used outdoors) such as freezing conditions or atmospheric salt

So, when selecting of materials for water supply pipes, consider water pressure, water temperature, compatibility with water supply, durability, support, ease of installation, and cost.

Piping design considerations The design of the piping must also take into consideration other factors, including expansion and contraction in the piping and the static and dynamic loads of the piping, as they will be reflected in the structural steel framing system of the building; the need for access to expansion joints and the anchors and guides for the piping, which should be subjected to periodic inspection after the building is constructed; the provision of fire stopping between the pipe and the sleeve located at all penetrations of rated slabs, walls, and partitions; and, if required, seismic restraints on the piping systems and the pumps.

System of plumbing

Following are the four principle systems adopted in plumbing work in building

1) Two pipe system.

2) One pipe system.

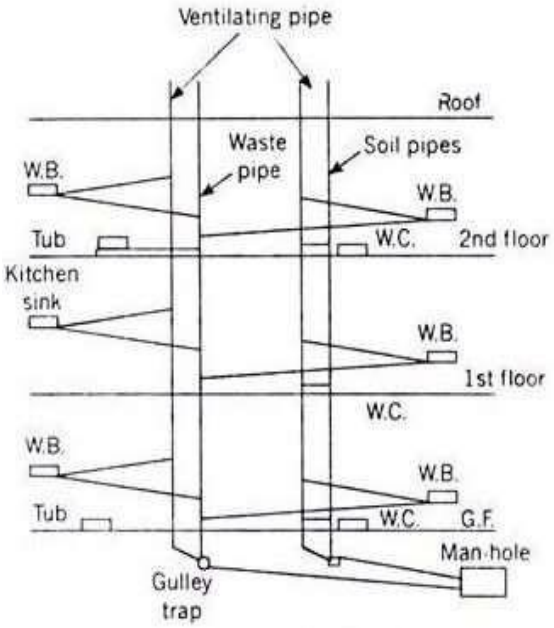
3) Single stack system

4) Partially ventilated single stack system.

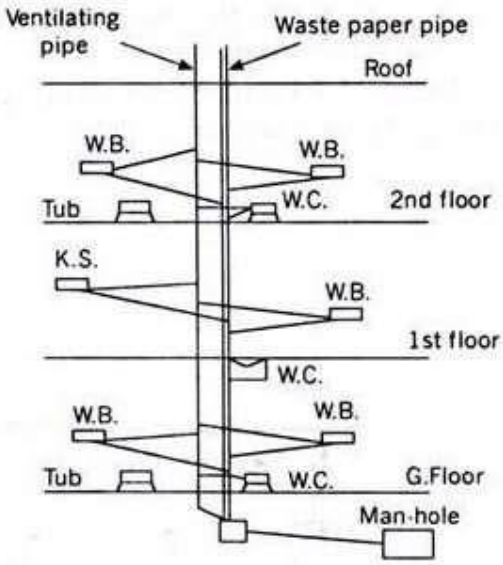
Two pipe system:-

1. This is the best and most improved type of system of plumbing.
2. In this system, two sets of vertical pipes are laid, i.e. one for draining soil and other for draining sullage.
3. The pipe of the first set carrying soil are called soil pipes. and the pipes of the second set carrying sullage from baths etc are called sullage pipe or waste pipe

4. The soil fixtures, such as latrines and urinals are thus all connected through branch pipes to the vertical pipe.
5. Where the sludge fixtures such as baths, sinks, wash-basins, etc are all connected through branch pipes to the vertical waste pipe.
6. The soil pipe as well as the waste pipe are separately ventilated by providing separate vent pipe .



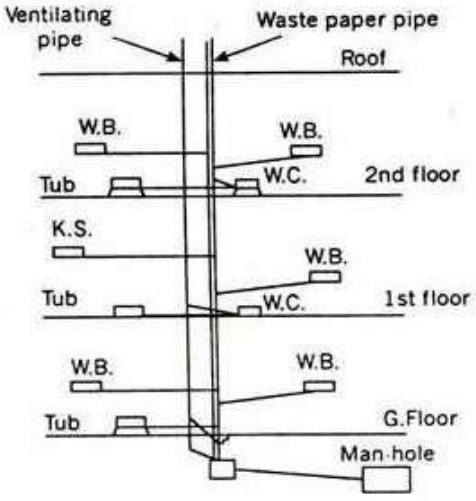
Two-pipe system.



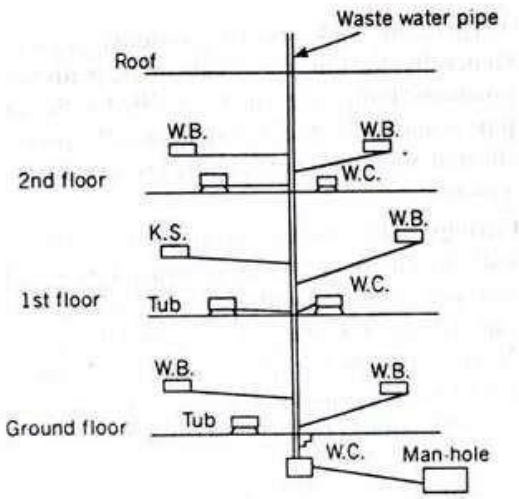
One-pipe system.

One pipe system:-

- In this system, instead of using two separate pipes(for carrying sullage and soil, as it done in the two pipe system), only main vertical pipe is provided which collects the soil as well as the sullage water from their respective fixtures through the branch pipes.
- This main pipe is ventilated in itself by providing cowl at its top and in addition to this, a separate vent pipe is also provided.



One-pipe partially ventilated system



Single stack system.

Single Stack System:-

- This system is a single pipe system without providing any separate ventilation pipe.
- It uses only one pipe which carries the sewage as well as sullage, and is not provided with any separate vent pipe , except that it itself is extended upto about 2m higher than the roof level and provided with a cowl for removal of foul gases as

Partially ventilated single stack:-

- This is an improved form of single stack system in the sense that in this system, the traps of water closets are separately ventilated by a separate vent pipe called relief vent pipe.
- This system uses two pipes as in single pipe system but the cost of branches is considerably reduced compared to single pipe system.

Drainage system considerations

- In the drainage system for a multi-storey building, the drains from the plumbing fixtures are connected to vertical drain stacks that convey the waste and sewage to below the lowest floor of the building.
- The fixture drain traps must be vented to prevent their water trap seal from being siphoned by negative pressure or blown out by positive pressure in the drain piping.
- The fixture vent pipes must extend through the roof to outdoors. They can be run individually or be combined into one or more vents through the roof.
- Where buildings are over 10 storeys high, the drainage stacks require relief vent connections at specified intervals from the top, and connected to a vent stack that terminates above the roof. This relieves and equalizes the pressure in the drainage stack to maintain the water seal in traps serving plumbing fixtures.
- Wherever possible, the sanitary drainage system from a building should discharge to the public sewer by gravity.
- All plumbing fixtures located below ground level should be pumped into the public sewer or the drainage system leading to the sewer. The pump line should be as short as possible and looped up to a point above ground level to prevent back siphonage of sewage.
- The pump discharge rate should be controlled so as not to cause scouring of the internal bore of the pump line or the drainage or sewer system into which it discharges. High-velocity discharge rates may also cause the flooding of adjoining plumbing fixtures or overloading of the sewer itself.

Plumbing inspection

A plumbing inspection is a systematic process of assessing the critical areas of the plumbing system of a property. It is performed by certified plumbers to avoid the risk of pipe corrosion, clogs, leaks, and burst tubes that can cause flooding and property damage.

Importance of Plumbing Inspection

- Conducting regular plumbing inspection keeps the system running smoothly which helps businesses or households prevent costly and unexpected repairs.
- Detect early problems to mitigate the risk of damaged pipelines and plumbing systems;

- Eliminate the hassle of delayed work due to clogs and water leaks;
- Avoid bigger water damage; and
- Prevent a drastic increase in water consumption bill

Defects in Water Supply System

1) Rusting
2) Leakage
3) Dents & Buckles
4) Blockage
5) C

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- Inspection of main pipeline, distribution pipe or branch pipes.
- Inspect for signs of corrosion and leakage in pipe linkage
- Inspect

for the water

tank / storage

Leakage

- Inspection of leakage underground pipe
- Inspection of loose joints or fitting in the pipelines
- I

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- Inspection of pipe shapes and size; is it normal to the standard size or changes inoriginal size
- Inspection of anomalies that

could result to failure of pipesBlockage

- Inspection for possible causes of blockage such as tree roots, rust, accumulation ofsand and stone
- Inspect the water

pressure level in the

pipelineCracks

- Inspect for the weld area is it the causes of crack or not
- Inspect for the sign of crack

Types of Plumbing System in Building Construction

Anonymous • June 26, 2017 3

The plumbing system installed in the building has two main objectives to be served. They are:

1. Supply of water for the human use
2. To get rid of human waste

The plumbing system of a building will include the water distribution pipes, the fixture and the fixture traps, the waste, soil and the vent pipes, the building drain and building sewer, storm drainage system with their connected devices, connections and appurtenances within the building and outside, that is within the property line.

When considered systems of plumbing, there are four categories. They are:

1. Single stack system
2. Partially vented single stack system
3. One-pipe system
4. Two-pipe system

1. Single Stack System

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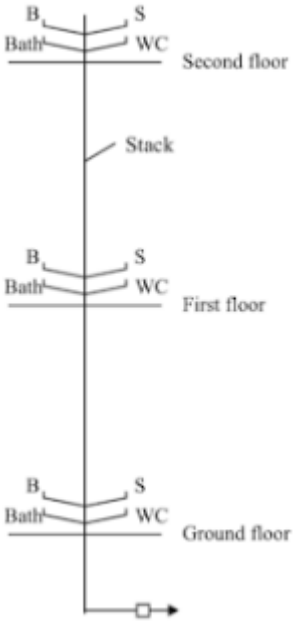

Fig.2: Single Stack System in Plumbing

This is the simplest form of plumbing system among the four categories mentioned. The figure-2 shows the basic arrangement of a single stack system. This system of pipes carries waste water from the wash basin, bathrooms, sinks and the foul matters from the water closets. This is connected to a final single pipe. The pipe will terminate as the vent pipe at its top. A single stack system will need the use of traps that are filled with 75mm water seal.

2. Partially Vented Single Stack System

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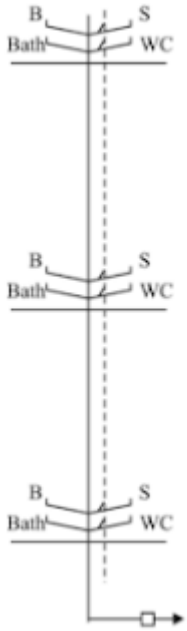

Fig.3.Partially Vented Single Stack System

This is a single stack system where the vent pipe provides ventilation to the traps of the water closet. Here the traps of the wash basin and the sinks are not connected to the vent pipes. The figure-3 shows a partially vented single stack system.

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3. One Pipe System

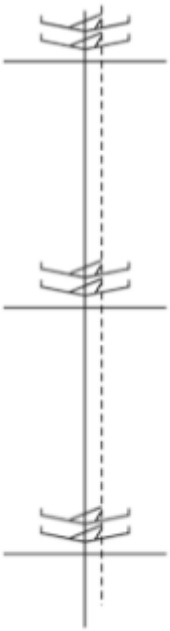

Fig.4: One-Pipe System

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Here the system uses a single stack and the vent pipe will receive the connections from all the traps. This will not be the only trap of closets, but also for the sinks, wash basins etc. The figure –4 shows a one pipe system.

4. Two Pipe System

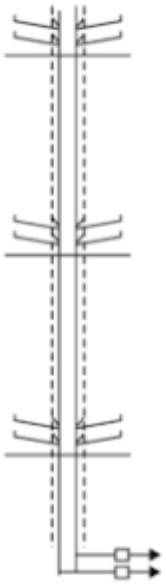

Fig.5: Two–pipe system

This system will make use of separate pipes for connecting the water closets and for the discharges from the basin, baths, sinks etc. Here both pipes are separately ventilated. This system forms a four–pipe connection system. The figure–5 shows the two–pipe system. Most of the multistoried buildings prefer this system.

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Anre A
23 June

Thank You :)

Reply

charles beaverson
23 January

Great information. Thank you.

Reply

Why design criteria for piping is important?

- Simply defined, pipes are pathways through which fluids are contained and flow in a system. The fluids may be water, glycol solution, fuel oil and refrigerant liquid. A network of pipes, fittings, joints, valves and supports is defined as a pipe system
- Choosing the right pipe system and design is essential to ensure excellence in mechanical, plumbing, fire protection and beyond
- An optimum pipe system design is critical to the operation and longevity of the overall infrastructure and requires a multipronged approach. With appropriate maintenance, piping is typically expected to last the age of the building, while other equipment is replaced at the end of its service life. As pipe systems span multiple disciplines with varying requirements, developing an all-encompassing design guideline would be a monumental task.

Factors considered while selecting pipe system

- Water pressure
- Water flow rate
- Flow rate and pipe size Acceptable Solutions
- System layout
- Connection to the mains supply
- Backflow
- Mains connection
- Pipe materials and specifications

1. Water pressure

- To use water efficiently, the right water pressure is crucial. It should be neither low nor high. Low pressure will take time to fill the buckets, whereas high will lead to wastage

- Typically, new buildings in areas with mains water supply will have mains pressure systems. Existing buildings, and buildings that are not connected to mains water, may have low pressure systems or unequal pressure systems (with different pressures for hot and cold-water supply)

- As an example of the difference in water usage, a low-pressure hot water system shower flow may average about 7 litres per minute, while a mains pressure shower may average around 12–20 litres per minute

- Mains pressure systems require pressure limiting and pressure reducing valves to control water pressure and temperature. Typically, pressure limiting or pressure reducing valves will be used to control pressure in mains-supplied hot water systems or where high pressure may lead to problems such as burst pipes

- Low pressure systems require few valves or controls. In low or unequal pressure systems, pressure can be increased to adequate levels by storing water in a header tank so that gravity can be used to create water pressure. Pressure can also be raised to adequate levels using a pressurising pump, in which case it may be necessary to use pressure limiting and pressure reducing valves.

2. Water flow rate

- Flow rates are crucial. A flow rate that is too high will result in water being wasted, whereas a flow rate that is too low will mean that requirements are not met

- Flow rate is affected by:

a) Water pressure
b) Pipe diameters – The smaller the internal diameter of the pipe, the lower the pressure and flow rate. (Note that pipes are generally referred to by their inside nominal diameter (DN), but it is actually the internal diameter that counts; a pipe rated as DN 15 may have an actual inside diameter ranging between 10–18 mm)
c) Water temperature – higher temperatures will tend to raise pressure and flow rates

- A flow regulator can be used to maintain a constant flow, independent of water pressure. As an example, if someone is in the shower and the kitchen tap is turned on full, the temperature and flow are likely to remain more stable if a flow regulator is used.

3. Flow rate and pipe size acceptable solutions

- Pipes must be sized to achieve flow rates set out in accordance with Table shown below
- When calculating pipe size, the speed of the water (velocity) moving through the pipes must not exceed 3.0 m/s.

Acceptable flow rates for fixtures and appliances

Fixture	Flow rate (l/s) and temperature °C
Basin	0.1 at 45 °C
Bath	0.3 at 45°C
Sink	0.2 at 60°C (hot) and 0.2 (cold)
Shower	0.1 at 42°C
Laundry tub	0.2 at 60°C (hot) and 0.2 (cold)
Dishwasher and washing machine	0.20

4. System flow rate

- In the design process, the layout of the plumbing system will largely follow room layout

- When planning a water supply layout, the following must be considered:

a) Pipe runs and lengths – Keep pipe runs as short as possible. Pass pipes close to fixtures to minimize the number of branches and unnecessary elbows, tees and joints. Having longer pipe runs and more fixtures will reduce flow rate, increase heat losses, and increase use of materials

b) Point of entry into the building – This should be into a utility space such as garage/laundry and include an accessible isolating valve, line strainer and pressure limiting valve (if required)

c) Water heating system – Locate centrally to reduce the length of pipe runs to fixtures because longer pipe runs require more water to be drawn off before hot water is discharged. Install a separate point-of-use water heater for fixtures that are more than 10 m from the main water heater

d) Noise prevention – Avoid running pipes over or near bedrooms and living areas.

Backflow and Mains connection

5. Backflow

Backflow is the unplanned reversal of flow of water (or water and contaminants) into the water supply system. The system must be designed and used to prevent contamination from backflow. See backflow prevention for more.

6. Mains connection

- Where the water source is a mains supply, the network utility operator is responsible for the water supplied to the property boundary. The property owner is then responsible for providing the pipework to bring the water into the building.
- An isolating valve must be fitted at the point of connection to allow for maintenance and repair of the building's water supply system if required.

7. Pipe materials and specification

- The pipes used in a building must not contaminate potable water supply, and must be suitable for the water pressure, flow rate and temperature of water they will be carrying. This will be influenced by the materials used and also by other factors such as the wall thickness.
- Other considerations are durability, ease of installation, cost, and sustainability. Common materials for domestic water supply include copper, polybutylene (PB), polyethylene (PE), polypropylene (PP-3 or PP Type 3), and cross-linked polyethylene (PEX).

Pipe materials

Pipe materials

- The pipes used in a building must not contaminate potable water supply, and must be suitable for the water pressure, flow rate and temperature of water they will be carrying.
- They must also be:

a) suitable for the expected temperatures and pressures
b) compatible with the water supply, to minimize the potential for electrolytic corrosion
c) suitable for the ground conditions (if used underground) to minimize the potential for corrosion of the exterior of the pipe
d) Suitable for the local climate (if used outdoors) such as freezing conditions or atmospheric salt or sulphur
e) able to withstand UV effects (if used outdoors).

Pipe materials: (1) Copper

- Copper has long been used for all types of domestic water services and distribution because it:

a) is durable

b) has good corrosion resistance

c) is malleable and easy to bend

d) is self-supporting

e) has good flow characteristics

f) requires few fittings

g) can be recycled.

- Copper may be annealed (i.e. heated, then cooled slowly) which improves its properties, for example making it less brittle and stronger.
- Although copper in general has good corrosion resistance, this depends on the environment. Acidic conditions, either from the soil (if buried) or from the water, can cause corrosion, so local pH levels should be checked before using copper pipes.

Pipe materials: (2) Polybutylene (PB)

- Polybutylene is a plastic material that was introduced in the late 1970s and used extensively for water supply pipes until the mid 1990s. Unfortunately, one brand of polybutylene gained a reputation for failure, resulting in a significant drop in use.
- Polybutylene has excellent properties for use as water supply pipework, including:

a. low cost
b. Flexibility
c. ease of installation
d. ability to be used for both hot and cold water services
e. frost resistance.

- In outdoor situations, it must be protected from UV exposure.

Pipe materials: (3) Polyethylene (PE or HDPE)

- High density polyethylene (often called alkathene or polythene) has been used since the early 1960s. It is suitable for both potable water and wastewater services but it can only be used for cold water supply.
- It is the most commonly used plastic pipe for supplying the mains water to a dwelling. Polyethylene:

a. is durable
b. is corrosion resistant
c. has good flow characteristics
d. is lightweight and flexible
e. is easy to install
f. has a good bending radius
g. is inexpensive
h. requires few fittings.

Pipe materials: (4) Polypropylene (PP)

- There are three types of polypropylene:

A. P-H has good mechanical properties and excellent chemical resistance for use as industrial and sewerage waste pipes systems
B. PP-R has good resistance to high internal pressure so it is suitable for domestic pressure water supply systems and both hot and cold water services
C. PP-B is suitable for buried sewerage and wastewater drainage as it has good impact strength, particularly at low temperatures, and excellent chemical resistance.

- The use of polypropylene has been increasing since the late 90s as it is:

a. chemical and corrosion resistant
b. heat resistant
c. Lightweight
d. easy to install
e. frost resistant.

In outdoor situations, it must be protected from UV exposure.

Pipe materials: (5) Cross-linked polyethylene (PEX)

PEX tubing is made from a cross-linked, high density polyethylene polymer, which results in a stronger material that polyethylene. Properties include:

a. more durability under extremes of temperature and chemical attack
b. greater resistance to cold temperatures, cracking and brittleness on impact
c. it can be used for hot water supply and hydronic heating systems, as well as potable water supplies
d. Flexibility
e. ease of installation
f. it can be used for indoor and buried outdoor situations.

PEX is not recommended for outdoor above ground use – although it can withstand some UV exposure, this should not exceed the manufacturer's instructions.

Pipe materials: (7) Unplasticized polyvinylchloride

The plastic uPVC has been used extensively in New Zealand since the 1960s. Today in domestic construction it is used chiefly for drains, wastes and vents, and is rare for water supply in new individual houses. The primary jointing method for uPVC is solvent welding, where solvents soften the surfaces of the material, which then chemically fuse together. A rubber ring (elastomeric seal) joint system is also available. This piping:

a. is inexpensive
b. is easy to handle
c. has low resistance to flow.

Pipe jointing system

Brazing is the most common method for joining copper pipe in New Zealand. Straight joins are made by soldering using a solder that comprises copper, phosphorus and 15% silver, to create a lapped capillary joint that is permanent and durable.

Manipulative mechanical jointing uses brass fittings to make copper pipe connections. A nut is placed over the end of the pipe and a swaging (crox) tool is inserted to expand the pipe, creating a rolled groove to secure the nut in position. The joined ends are made watertight using plumbers' hemp or thread tape. This joint is most commonly used for connecting pipes to valves and fixtures. It is prone to loosening over time and should therefore not be used in concealed or inaccessible locations.

Pipe jointing system

Non-manipulative jointing also uses brass fittings, but instead of expanding the pipe with a swaging tool, a brass ‘olive’ is placed over the pipe and compressed between the nut and fitting to create a secure joint that can easily be separated later.

Crimp ring uses an external stainless steel or copper ring that is placed over the pipe, then compressed with a hand tool. As long as the ring is correctly placed and aligned, the resulting joint is very robust.

Sliding sleeve uses a sleeve that is placed over the pipe end and then expanded to go over the serrated spigot. A special tool forces the sleeve over the pipe and spigot to create an effective joint. Sleeves can be removed with the application of heat and then reused. The disadvantage of this connection is that the tools to create it can be difficult to use in confined spaces.

Pipe jointing system

Heat fusion welding is where the surface of the pipe and connection are melted together using a heating iron. As the two ends are overlapped and fused without the application of welding fillers, the result is effectively a continuous pipe.

Solvent cement welding also overlaps and fuses the pipes but uses a solvent to ‘glue’ the pipes together.

Jointing system	Copper	PB	PP	uPVC	PE	PEX
Brazing	*					
Manipulative mechanical jointing	*					
Non-manipulative jointing	*					
Crimp ring		*			*	*
Sliding sleeve		*				*
Heat fusion welding			*		*	
Solvent cement welding			*			