Chapter 6

Main Water Supplies

Chapter 6 discusses four aspects of water supplies:

1. The main water connection
2. Sources of supply
3. Multiple water connections
4. Ring main systems

The Main Water Connection

The main pipe distributing the water, which is operated by the local authority, is referred to as a 'water main'. It is generally located outside the property alignment on local authority land and will be at a depth between 900 and 1250mm. There are circumstances where this may vary to coordinate with other public services, such as electricity and communication cables.

It is good design practice on every new project to confirm the exact location of the water main and the available sizes of water service connections, which are provided by the local authority. It should not be assumed that local authorities provide all the standard connections. Common sizes are 20, 25, 32, 40, 50 and 100mm. Larger connections such as 150 and 225mm are available by special application to the local authority.

The actual connection on the water main between the building service and the authority's main is referred to as a 'tapping'. The tapping is often carried out on a live water main to minimise disruption to other properties in the area.

The minimum tapping for a residential property is 20mm. It should be appreciated that in some cases a 25 or 32mm service will be required. However, the potential problem arises that many authorities do not permit connections greater than 20mm for residential purposes. In such cases the smaller tapping can cause high friction losses that will considerably reduce the pressure at the outlet.

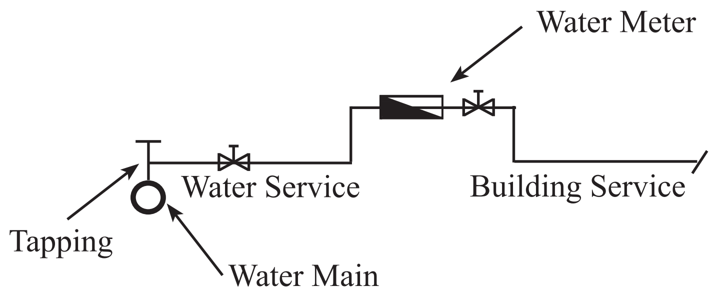

Figure 6-1 Typical Water Service

Exercise 6-1

A large house is to be built on a hill 100 metres from the water main, with a rise of 25 metres between the water main and the upper floor level. The available pressure in the main is 45 m/h. The required flow has been calculated at 1.0 L/s.

Had the home been built closer to the water main and at the same level, a 25mm copper pipe would have been satisfactory, although the velocity of around 2.42 m/s could be considered high. A pressure drop of 25.0 m/h per 100 metres would have been experienced. In this case both results are outside good design parameters, but within acceptable minimum standards.

The following calculation demonstrates a 25mm pipe is inadequate when the 100 metre run of pipe to the residence and the 25 metre rise, are taken into account.

a) Required pressure at the outlet	21 m/h
b) Static head	26.9 m/h (25m rise + 1.9m to shower outlet)
c) Friction loss	25.0 m/h (Over the 100m length of pipe)
d) Total required	**72.90 m/h**
e) Available in the main	45.00 m/h
f) Residual	- 27.90 m/h

A shortfall of 27.90 m/h would be experienced.

Calculations for Exercise 6-1 can be checked using Table 4-1.

There are three alternatives, the first two avoid the use of pumps and the third incorporates a pump.

Alternative 1

Install a 25mm copper water service, keeping the length of pipe from the water main to the water meter as short as possible. On the outlet of the water meter, increase the building service pipe to 32mm copper for the entire length to the residence.

The pressure at the outlet will be 9.10 m/h rather than the desired 21 m/h. While the result is not as good as the occupants may like, it meets the 5 metre minimum head stated in some standards.

The calculation is:

a) Required pressure at the outlet	9.10 m/h
b) Static head	26.9 m/h
c) Friction loss	9.0 m/h
d) Total required	**45.00 m/h**
e) Available in the main	45.00 m/h
f) Residual	0.00 m/h

Alternative 2

Install a 25mm copper water service, keeping the length of pipe from the water main to the water meter as short as possible. Then increase the supply pipe from the outlet of the water meter to 40mm copper for the entire length to the residence. The pressure at the outlet will be 15.40 m/h rather than the desired 21 m/h. In these circumstances, the pressure could be considered satisfactory.

The calculation is:

a) Required pressure at the outlet	15.40 m/h
b) Static head	26.90 m/h
c) Friction loss	2.70 m/h
d) Total required	**45.00 m/h**
e) Available in the main	45.0 m/h
f) Residual	0.00 m/h

Alternative 3

Use the 32mm copper pipe as calculated in Alternative 1 and trickle the water into a storage tank adjacent to the residence. The water will fill the tank over a 12 to 18 hour period. A pressure pump is fitted to boost the water to a constant predetermined pressure (approximately 35 m/h, 343.35 kPa or 3.43 bar).

Sources of Supply

A source of supply is a 'nominated point in the design that identifies the start of a section which is to have its own analysis'. A different velocity, flow or water temperature may be applied to the particular section of the project. A source of supply can be introduced at any time during the design. Examples of situations where a source of supply may be required, include:

a) A header tank in a high-rise building, for a down-feed system.
b) A storage tank inside the property alignment, separating the water main from the building service on the property.
c) At the point of connection, where individual buildings connect to the main building service within the property.
d) Start of the hot water service.
e) Each individual level in a high-rise building.
f) Individual areas within a hotel or tourist resort complex, differentiating between the commercial kitchen or laundry and the accommodation area.
g) Water tanks on a farm.
h) Pumps from rivers or dams.

Note: The Local Authority Water Main is always 'Source of Supply 1' (SS-1)

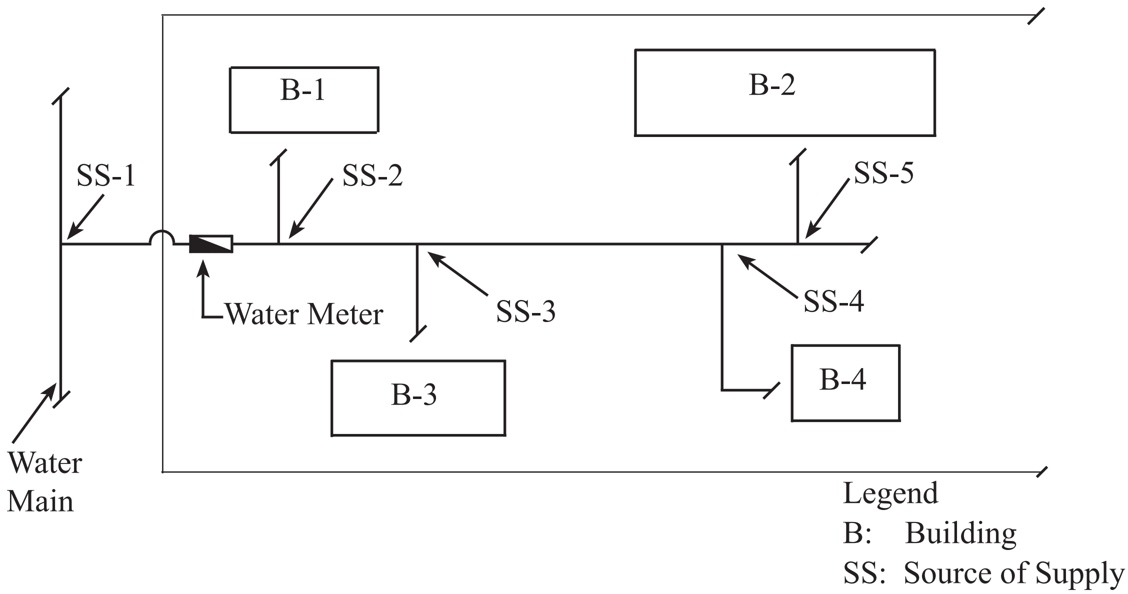

Figure 6-2 Typical Sources of Supply Locations

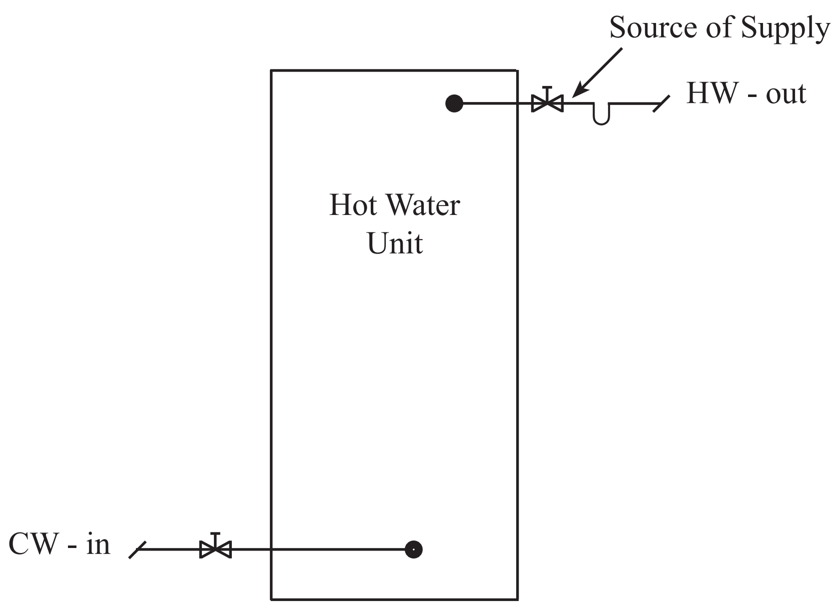

Figure 6-3 Typical Source of Supply for a Hot Water System

The purpose of nominating a separate source of supply to various sections of a project is to enable the designer to analyse a particular section of the project. The specifics of each source of supply are taken into account separately and jointly in the overall calculations to determine the diameter of the main supply pipe. Nominating a source of supply allows a number of designers to work on a project at the same time. Being able to analyse the project in this manner is particularly helpful when designing universities, schools, tourist resorts and high-rise buildings that require a number of designers to coordinate their work.

A source of supply should not be confused with the main water connection, which actually delivers the water from the local authority's water main to the property.

An engineer may apply specific velocities, temperatures or possible flows to a given section of the project, such as a commercial laundry, which is likely to require a higher possible flow demand than the residential area for the same project. The laundry supply external to the building may be designed at 2.2 to 2.5 m/s velocity, rather than 1.2 to 1.8 m/s for the internal pipe work.

Multiple Water Connections

More than one water connection to the local authority mains may be provided for large projects and this presents a number of benefits to the end users, as the additional connections will:

a) Reduce the likelihood of interruptions of flow from the authority's water main.
b) Safeguard against disruptions when the local authority's main is out of service due to damage.
c) Equalise the flow and pressure from each direction.
d) Reduce friction losses and pressure drop.
e) Reduced property insurance premiums as in the case of fire cover.

It is important in the first instance of designing a potable water system and sizing the pipes, not to be influenced by any planned additional water connections. Analysis of the design should be based on one connection only. The pipes are sized from the most disadvantaged outlet back to the water main, as described in Chapter 4.

Once the size of the water connection has been determined, all other connections to the property should be of the same size. The pipe sizes for the building services are adjusted where required to suit the new design, incorporating the extra connections.

Note: These recommendations refer to integrated systems, where all pipes on the property are interconnected.

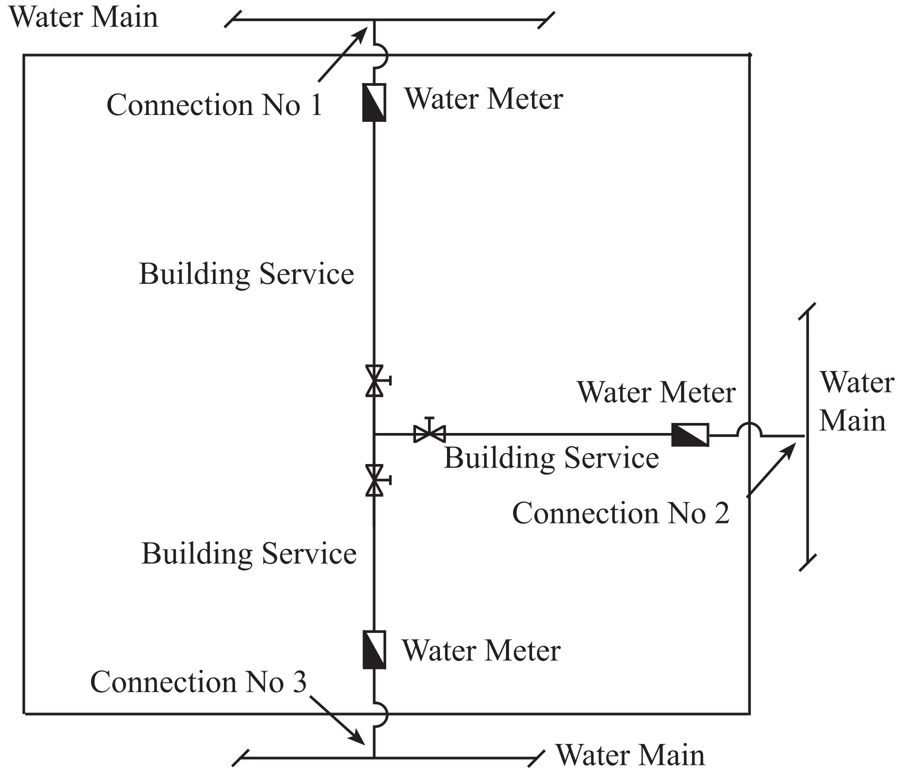

Figure 6-4 Typical Layout for 3 x Water Connections

It is possible for a project to have additional connections of varying sizes that are not interconnected. In such cases they will be supplying separate buildings and not form part of the overall integrated service.

Should the local authority water main be disrupted at any time, causing one of the connections to be shut down, the integrated system ensures that any one of the other connections will be capable of delivering the required flow.

If it is established that the water main connection is to be 100mm, all additional connections should be a minimum of 100mm. It is possible for the designer to be tempted to reduce the second and third connections, however, the designer must be able to satisfy him/herself that if only one connection were operating that it would be of sufficient capacity to meet the demand.

Exercise 6-2

A property has a planned development for 20 townhouses. In the interest of simplicity, there is a 10 metre distance from the water main to the first townhouse and 7 metres between each of the other nineteen branch pipes. The water main has an available pressure of 55 m/h.

Each townhouse has a design flow of 0.50 L/s. The only allowance for friction loss in fittings is the actual 'tee' branches to each townhouse.

An analysis will show a 50mm water service is required to the first townhouse, gradually reducing to 25mm for the most disadvantaged townhouse, as shown in Figure 6-5. What is the residual pressure, using 1 x 50mm water connection?

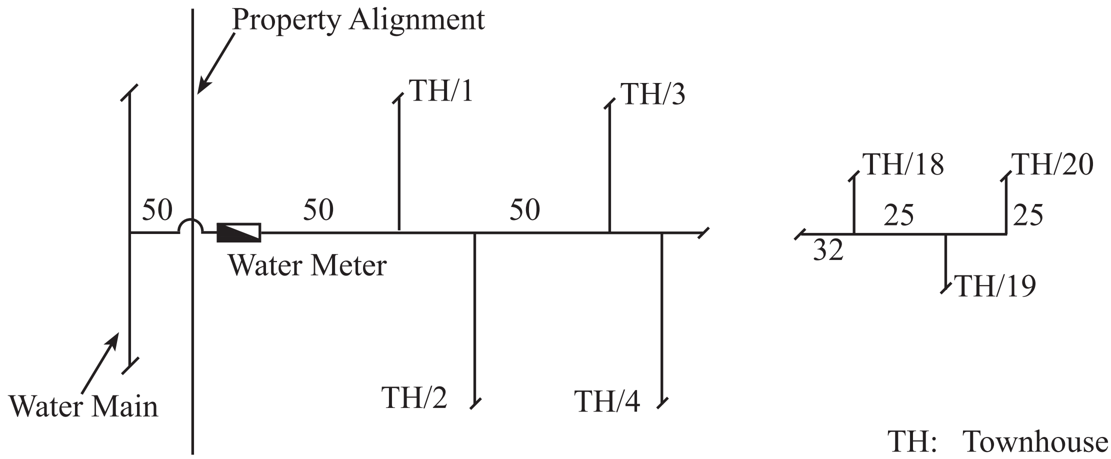

Figure 6-5 Illustrates a 20 Townhouse Development with 1 x 50mm Connection

The following is calculated using 1 x 50mm water service connection.

a) Required pressure at the outlet	21.00 m/h
b) Static head	00.00 m/h (no allowance in this exercise)
c) Friction loss through pipes	11.37 m/h
d) Friction loss through tees	1.23 m/h (branch tees only)
e) Total required	**33.6 m/h**
f) Available in the main	55.00 m/h
g) Residual	21.40 m/h

Exercises 6-2, 6-3 and 6-4 have been calculated using ***'WaterFlow pipe sizing'*** software, rather than Table 4-1.

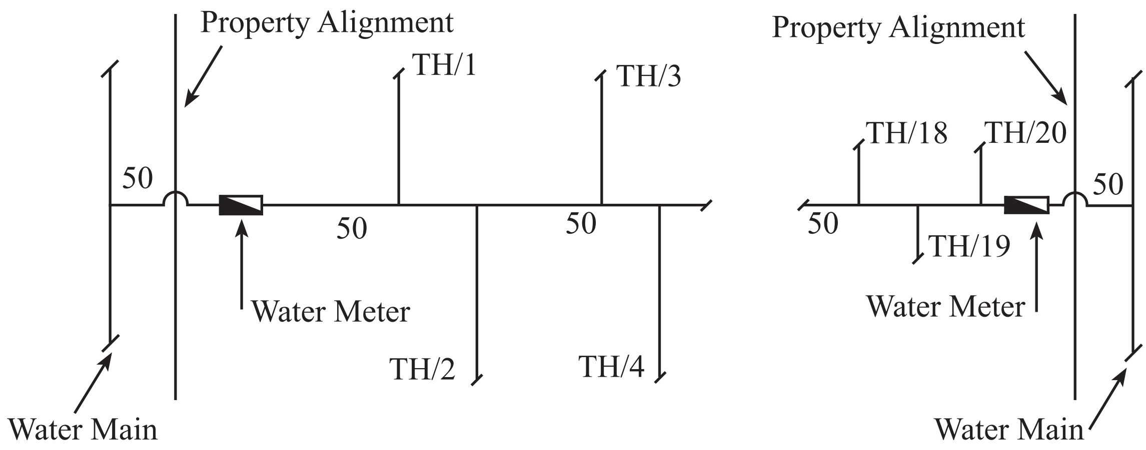

Figure 6-6 Illustrates a 20 Townhouse Development with 2 x 50mm Connections

Exercise 6-3

Using 2 x 50mm water connections and the 50mm pipe for the entire length of the project, as shown in Figure 6-6, what is the residual pressure?

a) Required pressure at the outlet	21.00 m/h
b) Static head	00.00 m/h (no allowance in this example)
c) Friction loss through pipes	9.15 m/h
d) Friction loss through tees	1.02 m/h
e) Total required	**31.17 m/h**
f) Available in the main	55.00 m/h
g) Residual	23.83 m/h

Note: The pressure in the water service increases due to the reduced friction loss through the pipe. This has been made possible by using a 50mm copper pipe extended for the length of the project, instead of the gradual reduction to 25mm.

Exercise 6-4

The following analysis refers to the same 20 townhouses, using 2 x 40mm water service connections and the 40mm pipe extending the entire length of the project.

a) Required pressure at the outlet	21 m/h
b) Static head	00.00 m/h (no allowance in this example)
c) Friction loss through pipes	39.22 m/h
d) Friction loss through tees	3.76 m/h
e) Total required	**63.98 m/h**
f) Available in the main	55.00 m/h
g) Residual	-8.98 m/h

The residual pressure in this case is -8.98 m/h. In fact, the pressure at the outlet will be 12.02 m/h. In this exercise, it is well short of the desired 21 m/h required for good design practice.

Ring Main Systems

Ring mains are used for similar reasons as Multiple Water Connections. It is more likely that a ring main will be used on a large project with buildings spread over the site, than on a high-rise building. Local authorities use the ring main method of distribution throughout their network of water mains due to the benefits and greater efficiency the ring main system offers.

The benefits of a ring main system to a construction project, are:

a) Minimal disruption to buildings which are not in the immediate vicinity of a broken water main.
b) Equalisation of the flow and pressure from each direction in the building service.
c) Reduction in pressure drop through lower friction losses.

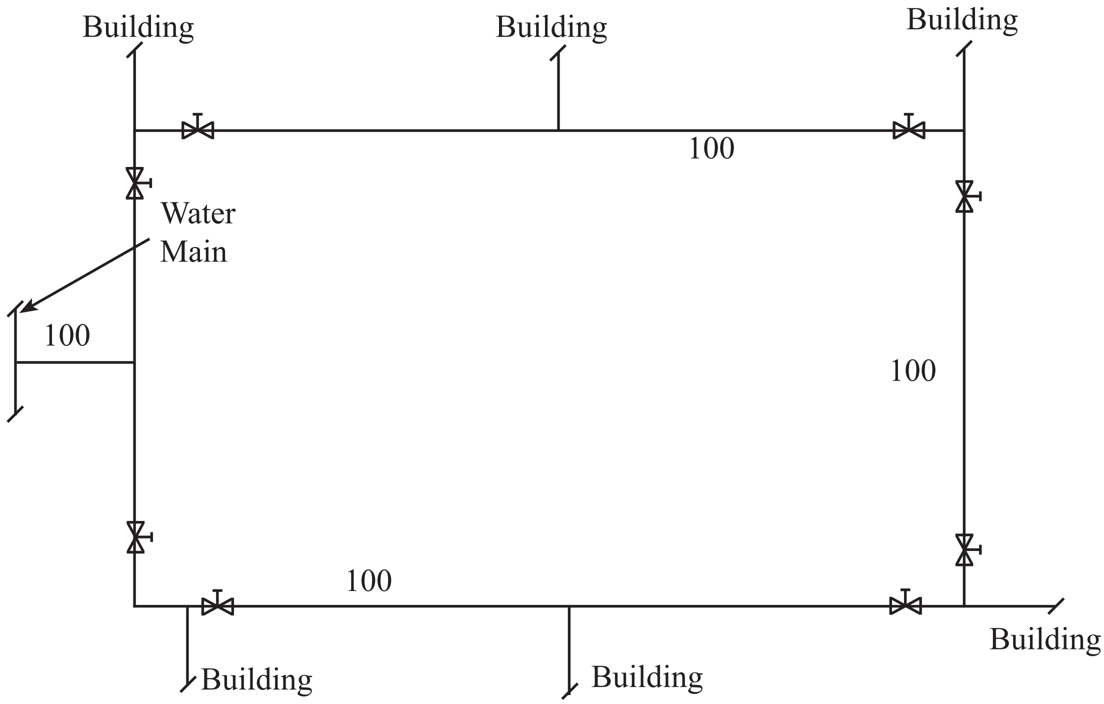

Figure 6-7 Typical Ring Main with 1 x Water Connection

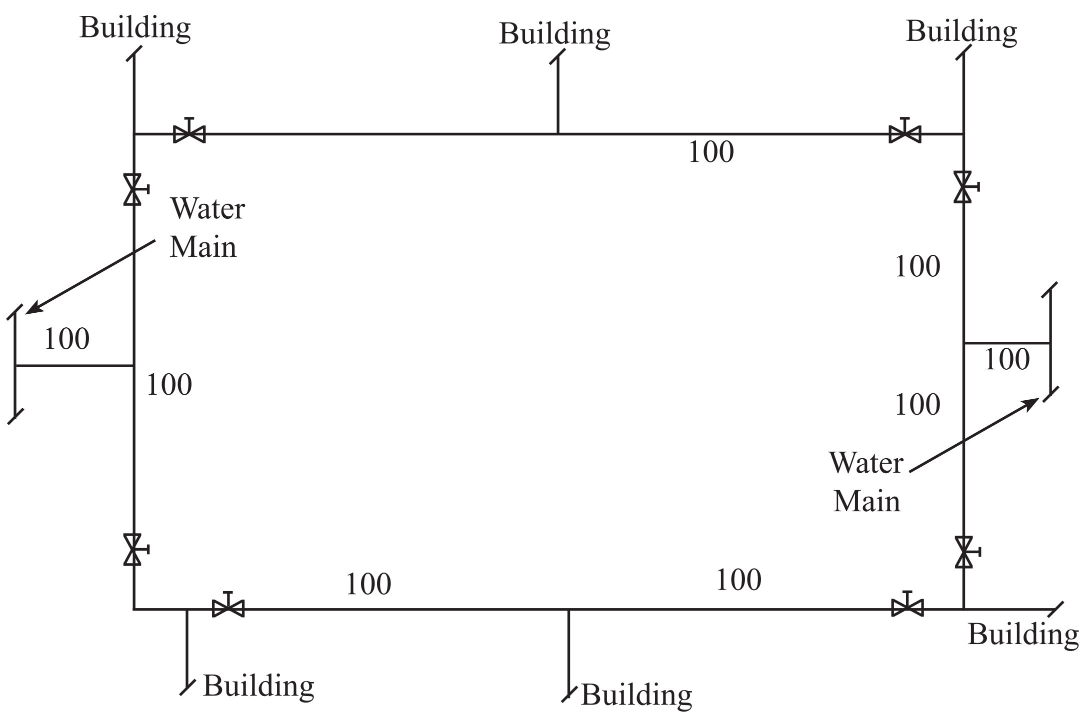

Figure 6-8 Typical Ring Main with 2 x Water Connections

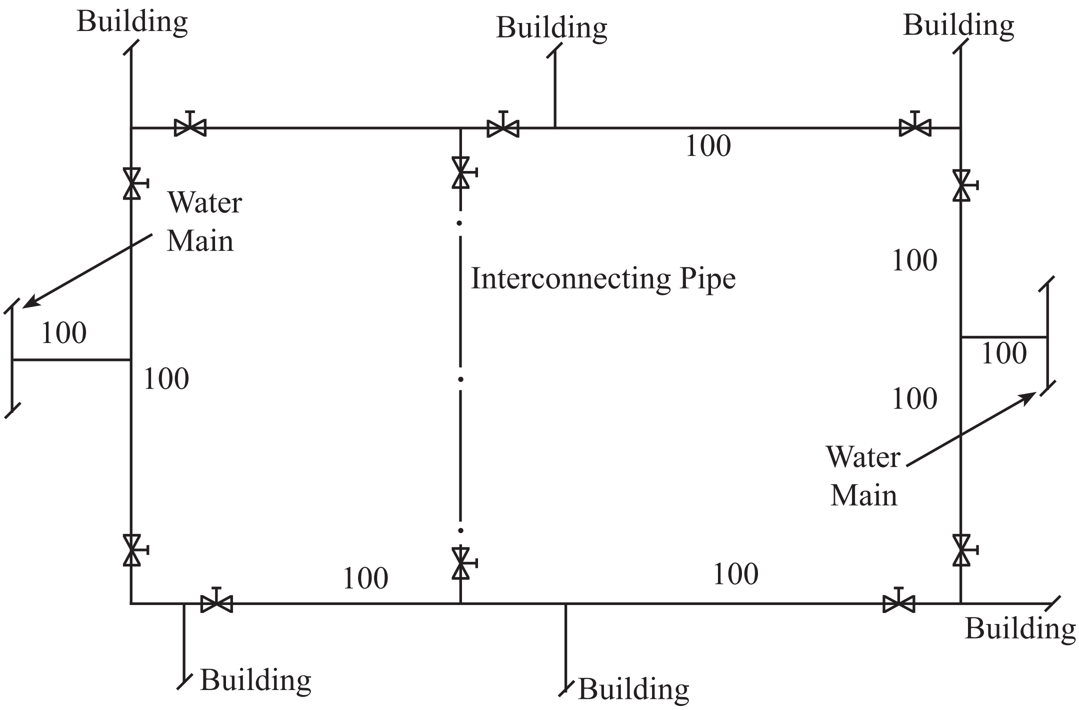

Figure 6-9 Typical Ring Main with an Interconnecting Pipe

Before the size of the ring main is determined, the pipe sizes are calculated using the same method described in Chapters 4 and 5, starting at the most disadvantaged outlet and working back to the main water supply.

Having established the largest diameter pipe required, the ring main is completed and the pipe size will be equal to that calculated. There can be special design reasons for the diameter to be reduced. The most important criterion is that the most disadvantaged outlet must be adequately provided for from both directions, as explained in the section on 'Multiple Water Connections'. If the supply is operating from both directions, the water flow will find the least line of resistance, friction losses will be reduced and the velocity slowed.

The ring main is particularly important in the design of fire services, where limiting the drop in pressure becomes extremely important. Depending on the size of the building, two or more hydrants must be capable of discharging the required flow of water simultaneously at the correct flow pressure. Regardless of which direction the water flows, in an emergency the required flow must be maintained. If the ring main were reduced in size, the required flows and pressures would not be adequate from one direction only.

A major benefit for incorporating a ring main in the design is that a section of pipe can be closed at any time and only a limited area of the site will be affected. Therefore, the position of control valves is crucial for good design. A well thought-out design will result in the building having an efficient water supply at all times.

It has been the author's observation over many years, that major buildings have been inconvenienced and even closed down on occasions due to poor design of water services. In such cases, insufficient thought was given to the standard questions every designer should ask him/herself during the design phase:

a) What would be the outcome if the local authority's water main were to burst and leave a section of the building without water?
b) How can the design be improved to guarantee a supply of water?
c) What would be the effect on a particular building, or a section of that project, if the building's water service were to break inside the property?
d) What if a fire were to break out during the period when the building was without water?

The author has seen hospitals closed for days and operations cancelled due to the water service being shut down. Hotels, office blocks and high-rise buildings have been unable to function in similar circumstances, due to the fact there's no alternative water supply.

Design engineers have a duty of care and responsibility to provide a design that allows for reasonable contingencies by incorporating an alternative water supply, which will be operable in as many situations as possible.