13. Design of plumbing systems for multiple dwellings

A multiple dwelling is a building housing several families or individuals in discrete units. The term includes apartment buildings, tenements, hotels, barracks, nursing homes and boarding schools. The common factors are that their prime purpose is for habitation, at least parts of their plumbing systems are in communal use and they are supplied by the normal pressure in the public mains.

The basic types of fixture will be the same as those dealt with under single dwellings – water closets, baths, showers, sinks and washbasins. However, other fixtures may be introduced, such as drinking fountains, laundry appliances and urinals. Health hazards are similar to those already described, but the risks are intensified by the possibility of cross-contamination of the drinking-water supply of one resident through the carelessness or unsanitary actions of another. Health precautions must therefore be similar to, but more stringent than, those already described for single dwellings.

The design of every plumbing system, and the capacity and dimensions of its component parts, should be adequate to satisfy immediate needs and those that can be reasonably anticipated during its expected life, based on the unit demands listed in Table 11.1. Whenever water flows in a pipe there will be some resistance to its flow as a result of its viscosity and also friction between the flowing water and the walls of the pipe. This resistance is related to the velocity of flow, the roughness of the piping material and the diameter of the pipe. In single dwellings the resistance to flow in water and drainage pipes will be very small, provided pipes of recommended diameters and materials have been installed. The pipework in multiple dwellings is more complex and resistance to flow must be taken into account when designing the system to accommodate the high rates of flow that will occur when several plumbing fixtures are being used simultaneously.

In a single dwelling, when a bath is being filled at the same time as a water closet flush tank only a minor reduction in flow will result. In a multiple dwelling there is a possibility that many different fixtures will be operated simultaneously, and this could have more serious effects: some fixtures may receive no water at all, and the drainage system may become temporarily overloaded. Various strategies can be employed to avoid this situation and are detailed elsewhere in this document. Any authority expecting that a number of multiple dwellings will be erected in its area of jurisdiction may well include one of these
design methods in its plumbing code of practice or simply make reference to the fact that special conditions apply to multiple dwellings.

### 13.1 Domestic storage tanks

The size of the water storage tank needed will depend on such factors as the capacity and pressure of the public mains supplying the building, the probability of an interruption of flow and whether a hot water and central heating system is to be installed. It is generally considered good practice to have sufficient storage for one day’s consumption.

Water authorities usually specify the maximum height to which they can consistently supply mains water, and water storage tanks may not be necessary for buildings below the nominated height. However, where tanks are not installed an approved backflow prevention device should be provided in the incoming water service as near as possible to the stop valve within the building. The backflow prevention device prevents contaminants being introduced into the public mains by backpressure or backsiphonage. If a water tank for fighting fires is installed, it should not be combined with the domestic water tank. This precaution excludes the possibility of contamination of the domestic water storage.

### 13.2 Control valves

In multiple dwellings having units under separate occupation, control valves must be inserted into the drinking-water supply system to enable each separately occupied unit to be isolated from the remainder of the building. This permits repairs or maintenance to be carried out in one dwelling unit without interfering with the supply to other occupants. It also enables the water to be cut off in a temporarily unoccupied apartment. In buildings such as hotels or boarding houses, especially where water closets or bathrooms are used communally by a number of occupants, the need for separate control of each dwelling unit may be less, but there should be sufficient valves to control relatively small groups of fixtures or rooms.

Some authorities require each fixture to be controlled by a separate valve in multiple dwellings. This allows each fixture to be serviced or replaced without shutting off any other fixture and minimizes risk of negative pressure and backsiphonage whenever a substantial part of the system has to be shut down or emptied.

### 13.3 Waste systems

Drainage from a multiple dwelling may be designed on the one-pipe, two-pipe or single-stack principle. In the one-pipe system all wastes from water closets, sinks, baths and other fixtures are collected together and conveyed to the underground drainage pipes by common stacks. All branches are ventilated to
protect the traps from positive or negative air pressure. In the two-pipe system, the wastewater pipes (carrying human sewage) and greywater pipes are kept separate and discharged outside the building into gullies. Wastewater from upper floors is conveyed to the gullies or trenches by vertical pipes from the fixtures and is carried to a back inlet gully. When vent pipes are omitted from the one-pipe system, it is called a single-stack system. In the single-stack system, the stack and the branches must be carefully designed to provide effective ventilation within the stack and branches. The one-pipe system may be necessary in very large and complex buildings or where there is the risk of frost damage.

The contents of wastewater pipes should be collected into vertical stacks, the lower ends of which are connected directly to underground drains. Junctions between drains from different stacks should be made in covered access chambers outside the building. If the numbers of drains is so large as to make junctions of this nature impracticable, two or more drains may be combined into suitably sized common drains. Each stack should usually be carried separately above the roof to form a vent, unless special conditions make it necessary to combine the upper ends of two or more stacks into a common ventilating stack. Careful planning of the building enables the number of stacks to be kept to the minimum by grouping the water closets close together, and one above the other in buildings of several storeys. The length of the outlet pipe between the fixtures and the stack should be kept to a minimum in every case. Many authorities require that the stack pipe is located outside the building for the reasons given in chapter 12. For buildings such as hotels, where a large number of rooms have individual water closets, it would be impracticable to locate all of these pipes on exterior walls, so a number of wells or shafts are often constructed within the building. They must be accessible for cleaning, as this is the only way to keep them clear of rats and cockroaches. Shafts must always be of sufficient size for repair work.

Fixtures other than those carrying human wastes should have their trap outlets carried to the open air through an exterior wall where they drain either directly to a gully or trench, or through a hopper head into a vertical pipe set over a gully or trench, the outlet from which is connected to the underground drain in an access chamber. However, it should be noted that hopper heads are no longer acceptable in the United Kingdom or Europe, due to the unsanitary implication of unhygienic water splashing directly to the atmosphere. Should the number of fixtures be so large as to make individual discharges of this nature impracticable, the outlets may be combined into suitably sized common outlets, discharging either to the open air as described or into stacks conveying waste-water only. When fixture outlets are combined in this way each outlet should be separately ventilated to protect against evaporation of the liquid in the trap seal.

Ventilation gases may be exhausted to the open air by means of ventilation pipes. These are separate short lengths of 25 millimetres (1 inch) diameter pipe – some codes of practice provide for a minimum vent pipe size of 40 millimetres.
(1.5 inches) – terminating in a wire grating or mosquito gauze capping outside the exterior wall. Alternatively, the ventilation pipes from the fixture drains close to the downstream side of each trap may be combined and carried upward to a waste stack at a point above the highest connection carrying liquid waste to the stack.