
6. Principles of effective plumbing systems

This chapter summarizes the aims and objectives of a good local plumbing system – that is, the drinking-water supply that serves a building and the system for liquid waste removal that connects the building to the sewer mains. The system should be operating within a context of standards and codes, determined and overseen by qualified public authorities, that specify the requirements for its design, composition and management, and the training and practices of the plumbers and operators who build and maintain it. In places where these principles are not currently attainable, they should be regarded as high-priority goals to be achieved when circumstances permit, and positive steps should be taken to achieve those goals. They are based upon the need to preserve the health, safety and well-being of the people served by a plumbing system. Efforts should be made to promote public awareness of the benefits of quality plumbing and the dangers of an improperly installed plumbing system.

The three chief aims of a good plumbing system are to supply safe drinking-water in adequate quantities, to remove liquid wastes efficiently, and to minimize risk of failure through vigilance and quality assurance. Each of these chief aims includes a number of subsidiary objectives, which are described in this chapter.

6.1 Water supply goals

The goal for every community or group of homes should be for a piped central source of good-quality water for all domestic uses. In addition, with a piped drinking-water supply, proper sanitary transport and waste treatment and disposal facilities are important to ensure a safe domestic and community environment. There are costs both in the initial construction and maintenance of these facilities, and sustainability requires provisions for finance, operation and maintenance.

6.1.1 The local drinking-water supply should be adequate in terms of quantity, safety, continuity and reliability

The quality of the water provided through public mains is the responsibility of the drinking-water supply authority. It should be continuous and pressured at all times, and it should meet national standards or WHO drinking-water guidelines at the consumers' taps. The distribution system should not be affected by excessive leakage and it should be constructed of appropriate materials.

6.1.2 Water supplied for human consumption should be safe at all times

Plumbing systems in domestic or commercial premises should not be permitted to degrade the mains water in any way. The drinking-water supply must be protected from cross-connections with unsafe sources or with wastewater plumbing systems. It must be able to cope with the hazards of backpressure or backsiphonage, and the water should not be in contact with plumbing materials that might impart contamination. Those materials should meet quality and performance specifications determined by the authorities, or by an accepted certification organization.

6.1.3 Every building should have an internal drinking-water piped system

An adequate piped supply provides safe access to water for domestic needs. It obviates the need for the dedication of time and effort to transport of water, and reduces the risk of contamination during collection, transport and storage. Ready access to sufficient safe water within the home improves personal hygiene and facilitates safe management and disposal of sanitary waste. The quality and quantity of the drinking-water supply within the home not only has a profound effect on the health of the householders, but also contributes to the comfort and enjoyment of their lives and those of the community. Interim measures, based on public standpipes and communal facilities, are effective but they should be regarded as an intermediate stage towards the realization of these principles.

6.1.4 Water should be conserved by minimizing leakage and wastage

Piping systems and plumbing fixtures should be so designed, maintained and used as to minimize leakage and wastage. Leakage can also be avoided by sound installation practices and protection of pipes and fixtures against corrosion and accidental damage, including that caused by freezing. Quickly repairing leaking faucets is an important practice. Wastage can also be minimized by proper education on the need for rational use of drinking-water.

6.1.5 Water should be supplied from a suitable number of accessible and hygienic fixtures

Ideally, every self-contained family dwelling should have, as a minimum, one water closet, one washbasin, one kitchen sink and one bathtub or shower, and provision for laundry facilities. Other buildings, whether used for habitation or other purposes, should be provided with an adequate number of fixtures in accordance with their respective needs. All plumbing fixtures should be made of durable, smooth, non-absorbent and corrosion-resistant material, so designed as to be fit for the purpose and easily cleaned, free from concealed surfaces that could become fouled, and incapable of contaminating the mains drinking-water supply by backsiphonage. They should be located and spaced so that they are accessible for the intended use and for cleaning. Walls and other surfaces that may become accidentally fouled

during the use of the fixture should be impervious to water and accessible for cleaning.

6.1.6 Building contents should be protected from the effects of malfunctioning of the plumbing system

Precautions should be taken against damage to the property, or danger to the health of its occupants, in the event of malfunctioning of the system. Fixtures should be provided with adequate overflow capacity. Roof tanks and other hidden elements of the system should be similarly provided with overflows that discharge in such a way as to act as a warning before causing damage. Every pressure vessel that is part of the system should be equipped with a temperature and pressure relief valve. Food preparation and storage rooms within the building should be located so that any leakage or backflow in the drainage system cannot contaminate their area or contents. In the case of industrial or commercial premises where food is processed or prepared, or where sterile goods or similarly susceptible materials are stored or handled, additional precautions should be taken by indirect connections of the internal fixtures to the plumbing system.

6.1.7 Adequate lighting and ventilation should be provided for toilet and washing fixtures

Rooms where water closets, toilets, urinals or other similar fixtures are located should be properly lighted and ventilated. No such fixture should be allowed in a room used for living, working, food preparation or other such purposes. Industrial or commercial premises or public buildings containing rooms where food and drinks or other material for human consumption are served, handled, stored or prepared should not have a water closet or urinal open directly from such a room, but should be separated by an adequately ventilated lobby or passage. Other fixtures, such as sinks, washbasins and baths, should be located so that lighting and ventilation are adequate to ensure their safe and hygienic use.

6.1.8 Hot water systems should be carefully designed to avoid health hazards

Equipment for heating and storing heated water should be designed and installed in ventilated areas to guard against dangers from explosion or overheating. Pipes used for the conveyance of hot water should be made of materials suitable to withstand the temperature of their contents, and water temperatures should be maintained at the specified level.

6.2 Liquid waste disposal goals

6.2.1 Liquid wastes should be disposed of promptly and hygienically

Every fixture, including a wall-mounted tap, should have drainage facilities to prevent the accumulation of wastewater and spillage, even though this may be

uncontaminated. Wastes should be removed rapidly from each fixture by a system of drainpipes that will prevent any further human contact. When a public sewer exists within reasonable distance of the premises the building waste system should drain to that sewer. Where no such sewer exists, disposal should be through an approved method of treatment, such as to a septic tank, where soils and population densities permit, that is located so as to cause no nuisance to the occupants of the building or to those of neighbouring properties. Where chemical closets are used, adequate arrangements must be made for sanitary disposal of wastewater (such as the wastewater from other fixtures, sinks or baths), as well as the residue from the chemical closet.

6.2.2 Drainage systems should be of adequate size and easily cleaned

Drains should be of adequate capacity and should be designed, constructed and maintained to convey wastewater rapidly from the building without fouling, depositing solids or clogging. They should be furnished with adequate, easily accessible clean-outs or access chambers (manholes) arranged so that the pipes can be readily cleaned.

6.2.3 Drainage systems should be equipped with liquid seal traps

Each fixture, or group of fixtures, connected to the drainage system should be equipped with a liquid seal trap. The depth of liquid in each seal must be adequate to prevent the emission of odours and gases, and must prevent access by insects or rodents from the sewer to the premises. Self-sealing waste valves are a possible alternative to liquid seal traps in some situations.

6.2.4 All drains should be adequately ventilated

Every drainage system should be designed and constructed so that adequate quantities of air can circulate through every pipe, thus enabling the system to function properly and protecting the liquid seal of the traps. The uppermost part of the drainage system should be connected to a ventilating pipe of adequate size, discharging above roof level and positioned so that the return of foul air to the building is prevented. Air admittance valves are a possible alternative when positive pressure is not required. The valves open automatically on sensing negative pressure within the system, allowing air ingress only.

6.2.5 Deleterious substances should be excluded from sewers

Precautions should be taken to exclude from the drainage system any substance that may clog or increase the likelihood of clogging of pipes, produce explosive mixtures, corrode or otherwise damage pipes or their joints, or interfere with the functioning of sewage treatment plants or not be removable by them, thus contaminating receiving waters. Substances that can endanger those who work on

the public sewerage system must also be excluded. Pretreatment requirements and other controls should be imposed on industrial and non-domestic dischargers so that they use suitable disposal methods for those wastes.

6.2.6 Backflow of sewage should be prevented

Drainage systems should be designed and constructed so that sewage cannot enter buildings connected to the sewerage system in the event of backflow from the public sewers due to flood, blockage or any other cause.

6.3 Plumbing goals

6.3.1 Plumbing materials and workmanship should conform to accepted quality standards

Pipes, joints, fixtures and other elements of a plumbing system should conform to accepted quality and performance standards, and should be sufficiently durable to give satisfactory service over a long period. Indications of conformance with standards is often marked on the product. These standards should be specified or adopted from existing standards by appropriate authorities. Only those persons who have been properly trained and have given evidence of their competence should be responsible for the selection and installation of plumbing systems.

6.3.2 Plumbing installations should be tested and disinfected before being put into service

Tests suitable for various types and designs of plumbing systems should be specified by the water, sewerage and other authorities concerned, and no system should be put into service until such tests have been satisfactorily completed (see section 7.4).

6.3.3 Adequate training should be provided for plumbing professionals and the public should be made aware of the dangers of poor plumbing

It is imperative that individuals installing and monitoring plumbing systems have access to adequate continuing education and training. An accreditation system should be developed to ensure that all such individuals have achieved and demonstrated appropriate levels of competency.

6.3.4 Plumbing systems should be properly maintained

Risk avoidance and minimization depend on the effectiveness of maintenance of equipment and facilities. For large or complex systems, or where public use or the handling of food for sale is involved, the public health (or other) authority may require periodic inspection and retesting as a condition for approval. The owner of any plumbing system, irrespective of its size or purpose, should be obligated to identify and to promptly have repaired any fault that may develop, whatever its cause.