

PLUMBING SYSTEMS

CONSIDERATIONS

A plumbing system is used to safely transfer liquids and gases to and from a building and its site. Water supply, plumbing fixtures, and waste piping may be the most common type of plumbing system within a building, but other types of plumbing systems may be required, including plumbing for gas service, and, depending on the facility type, services such as medical gases in a hospital.

Determining the fixture count, space requirements, and location of toilet rooms within the building should be an early planning consideration of the design team. Other issues that should be considered in the design of the facility plumbing system include the control of noise, vibration, and piping condensation.

- *Noise* is a factor of high-velocity liquid flow in pipes or of fixture noise (such as flush valves).
- *Vibration* is the result of mechanically coupling pipes to moving equipment (such as pumps), as well as the manner in which piping is physically isolated from the building structure. Structure-borne noise can propagate very efficiently.
- *Condensation* occurs when exposed or insufficiently insulated pipes cooled by their contents pass through warm, moist air and the exterior temperature of the pipe reaches the dew point.

The potential flow of unhealthy and dangerous sewer gases back into the building requires the use of water-filled traps at each fixture, as well as a system of venting to open air. There are code requirements for the location of exterior vent openings.

Plumbing fixtures provide the most visible design elements in this system; they are the parts of the building that occupants actually

touch and feel. Most other plumbing components are concealed within the building construction.

The basic components of a plumbing installation (water distribution and sanitary waste drainage system) are as follows:

1. Service tap
2. Meter
3. Shutoff valve
4. Service entry
5. Fixture supply tree
6. Fixture
7. Trap
8. Drain
9. Venting
10. Waste piping
11. Cleanouts
12. Building trap
13. Sewer connection

WATER SUPPLY SUSTAINABILITY

The quality and quantity of clean water available for building use is a major environmental issue. Decreases in water supplies have already affected residents of the southwestern United States. Clean water is unavailable to many of the world's people, and is predicted to become even scarcer in the near future. Less than 2% of the earth's water is fresh and available for use in groundwater, lakes, and rivers. Six times the amount of water is used today than a century ago, and population demands are expected to continue to grow.

Climate change affects water quantity as patterns and intensity of precipitation change, and floods and droughts increase. Rising sea

levels increase saltwater intrusion into freshwater supplies, and increased precipitation leads to runoff of toxins and pollutants. Drought and temperature increases raise the demand for water for irrigation and livestock use.

Water and energy use are related. Water treatment and wastewater plants use energy to process and transport water used in buildings. In addition, water is used to extract, refine, and process fuels and run energy-producing equipment. Manufacturing requires water to produce building products and interior finishes and furnishings.

Although we do not need to, we use expensive and energy-intensive drinking-quality (*potable*) water to flush wastes out of buildings.

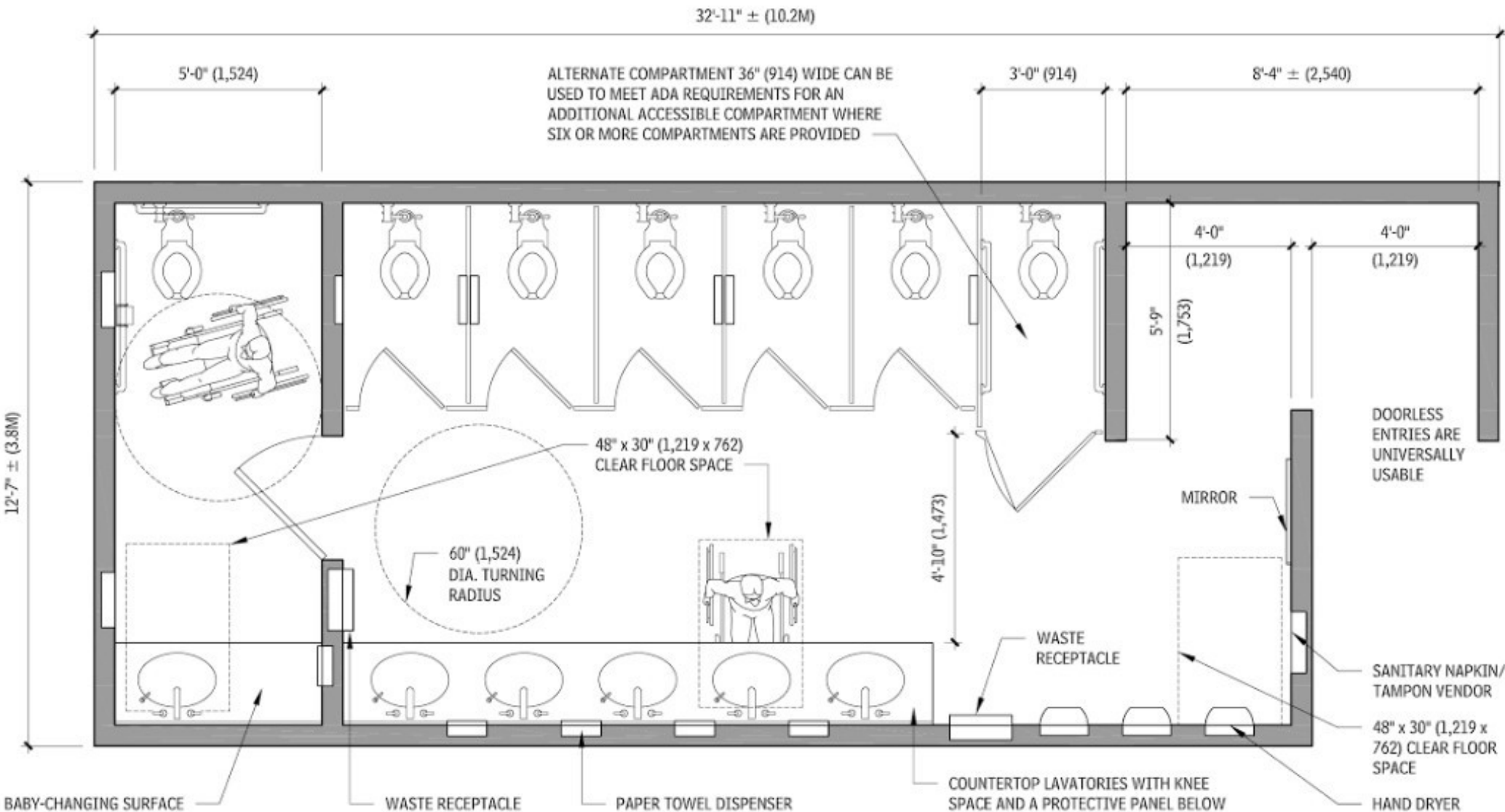
Buildings also affect our water supply when they endanger wetlands. Runoff from pavement and buildings interferes with the natural cycle that returns precipitation to the ground for purification and reuse.

Concerned citizens are beginning to develop watershed protection programs that follow natural waterways across political boundaries. Manufacturers are increasingly conserving, protecting, and reusing their water supplies. Buildings are being designed in innovative ways to conserve and absorb rainwater on-site. Appliances and equipment are being designed to use less water and less energy to heat and process water.

Designers and architects should consider the following:

- Specify ultralow-flow faucets with aerators and automatic shutoff sensors.
- Specify toilets that meet or exceed Energy Policy Act of 1992 (EPAct) specifications.
- Specify waterless urinals.

WOMEN'S TOILET ROOM WITH OPEN VESTIBULE
5.53



CODES AND STANDARDS

Plumbing codes establish minimum acceptable standards for the design and installation of plumbing systems and the selection of the components they comprise. Requirements for plumbing system design should be based on the adopted code of the jurisdiction of the project. Tables and charts provided in this chapter are for preliminary planning purposes and should not be used for actual design.

The word "approved" is often used in conjunction with components and devices that come in contact with potable water and products used for human consumption or use. Nonetheless, a responsible code official or agency must examine and test these items to determine whether they are suitable for a particular intended use. Only materials and devices approved by the local jurisdiction can be used in plumbing systems. Plumbing design drawings and utility services also must be examined and found to be in compliance with local codes, rules, and regulations.

TOILET ROOMS

The spacing and location of plumbing fixtures and toilet rooms should respond to occupant needs and code requirements. The design professional should be aware of how water is piped to plumbing fixtures and how waste is plumbed from fixtures, along with general venting requirements. Even during preliminary design, the design team should begin to address the requirements for accumulation and flow of water through horizontal and vertical piping. Additional design issues needing to be considered include coordination of plumbing fixture location with toilet compartments and urinal screens, toilet and bath accessories, and tub and shower doors.

ACCESSIBILITY

Dimensional criteria for this section on accessible toilet rooms are based on the ADA/ABA Accessibility Guidelines 2004, and on adult anthropometrics.

In new construction, all public and common-use toilet rooms are generally required to be accessible.

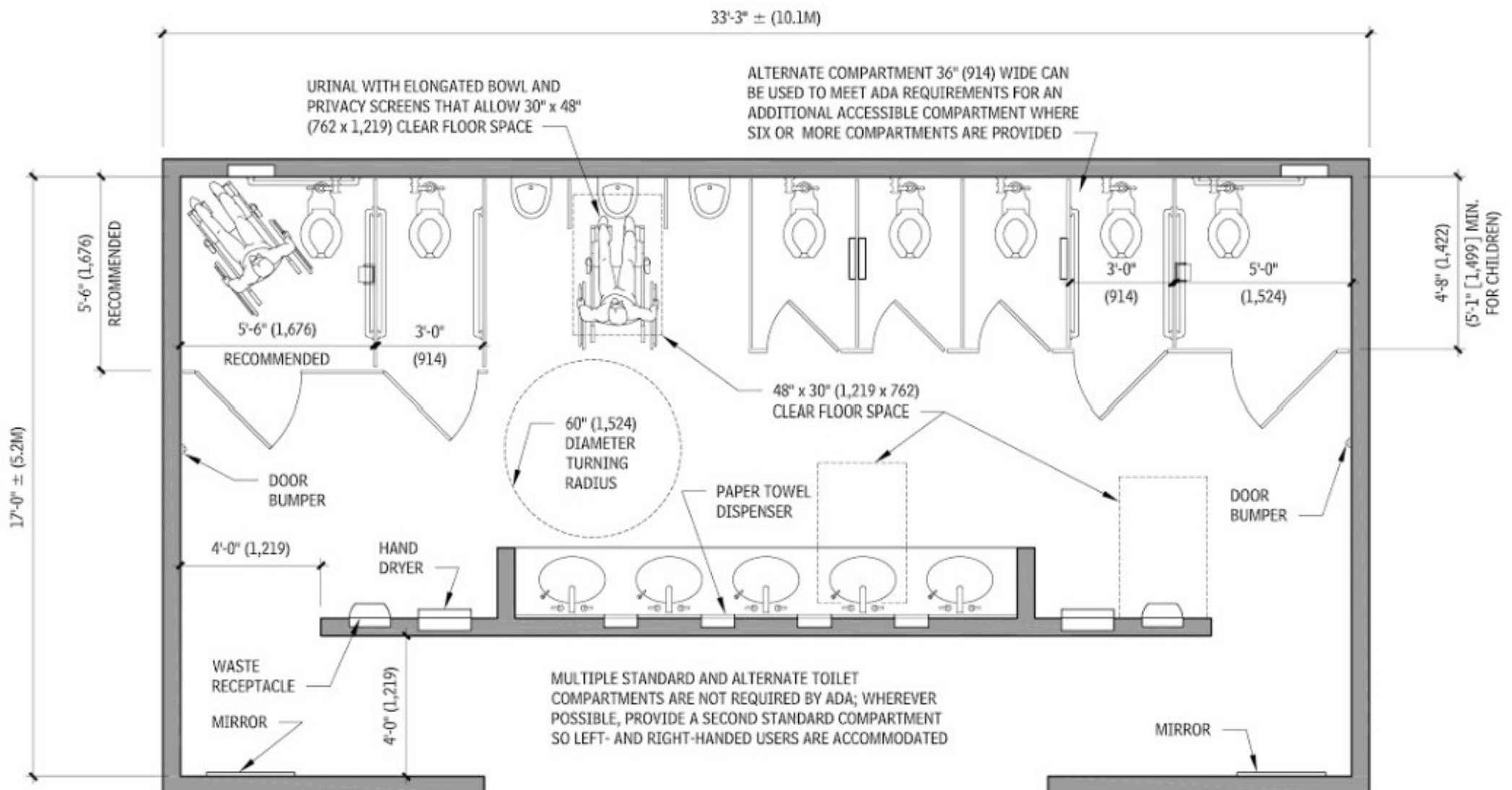
Where multiple single-user toilet rooms or bathing rooms are clustered in a single location, and each serves the same population, only 5%, but not less than one, of the rooms must be accessible. The accessible room(s) must be identified by appropriate accessible signage.

Single-user toilet and bathing rooms provided within a private office are permitted to be adaptable, rather than fully accessible. Replacement of the water closet and lavatory, changing the swing of the door, and installing grab bars in previously reinforced walls are steps permitted to make the room accessible.

Doors in accessible toilet compartments are not permitted to swing into the required clear floor space at any fixture, except in single-user rooms, where a clear floor space is provided beyond the swing of the door.

Where toilet compartments are provided, at least one must be wheelchair accessible. Where six or more toilet compartments are provided in a toilet room, in addition to the wheelchair-accessible compartment, a 36 in. (914 mm) wide ambulatory-accessible compartment is required for persons who can walk short distances or with assistance. Toe clearance 9 in. (229 mm) high and 6 in. (152 mm) deep is required at the front and at least one side of accessible toilet compartments. Toe clearance is not required when the compartment size exceeds the minimum dimension by 6 in. (152 mm) or more. Left- or right-handed configurations are permitted.

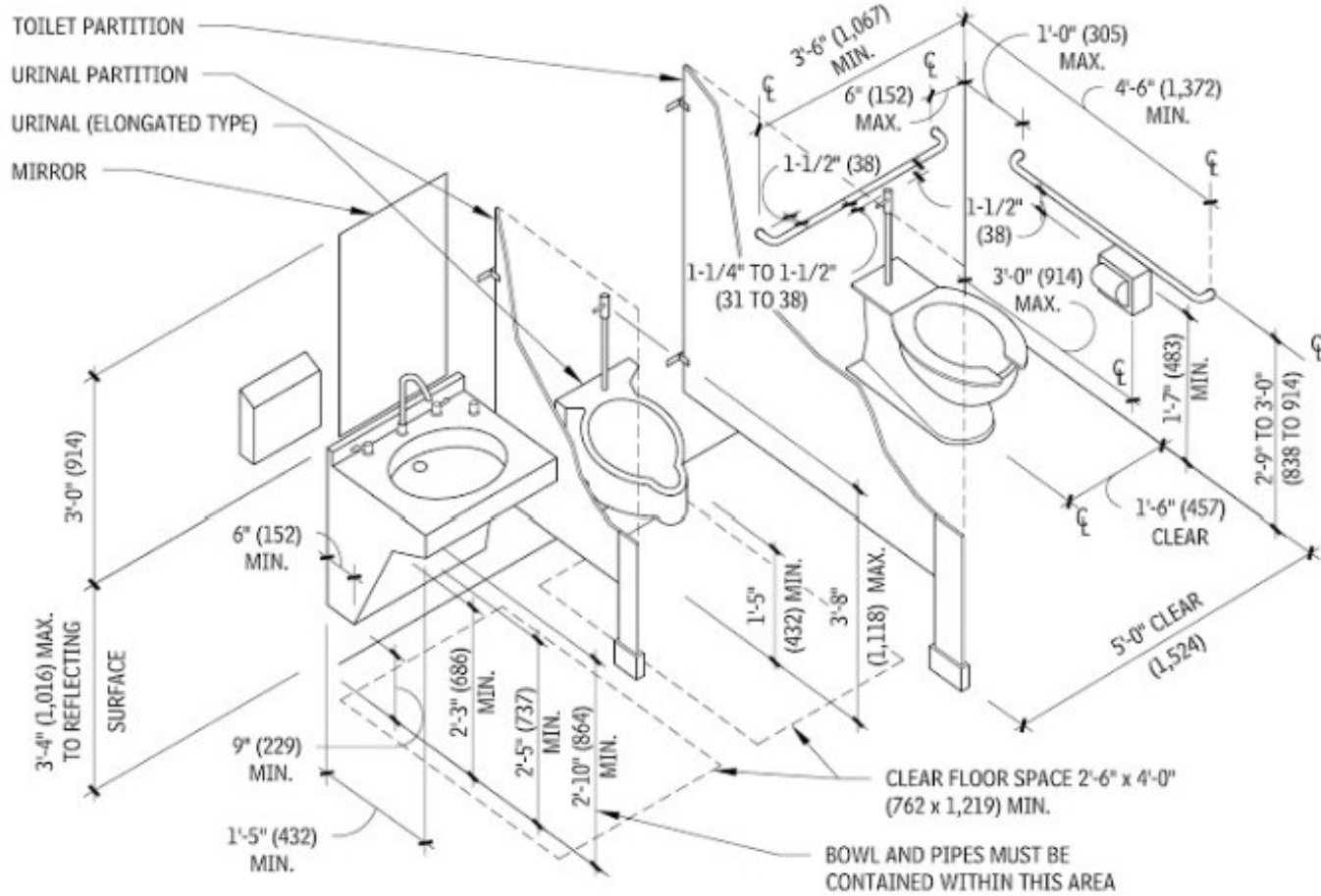
MEN'S TOILET ROOM WITH DOUBLE OPEN VESTIBULE
5.54



Source: Bobrick Washroom Equipment, Inc., North Hollywood, California.

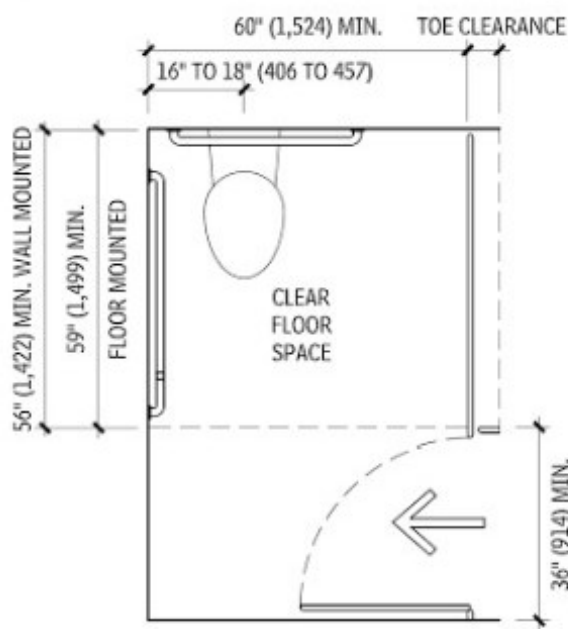
LOCATION OF ACCESSIBLE FIXTURES AND ACCESSORIES

5.55



TOILET COMPARTMENTS

5.56



**END OF ROW
WHEELCHAIR ACCESSIBLE**

UNISEX TOILETS

The ADA/ABA Accessibility Guidelines allow the use of unisex (or single-user) toilet rooms in alterations when technical infeasibility can be demonstrated. Unisex rooms must be located in the same area and on the same floor as the existing inaccessible facilities.

Unisex toilet rooms are very helpful to a person with a personal care assistant of the opposite sex, and the ADA/ABA Accessibility Guidelines encourage their use in addition to accessible single-sex toilet rooms in new facilities. Unisex toilet rooms may be required by some codes in certain assembly and mercantile occupancies; this requirement applies when a total of six or more water closets (or water closets and urinals) is provided in the building.

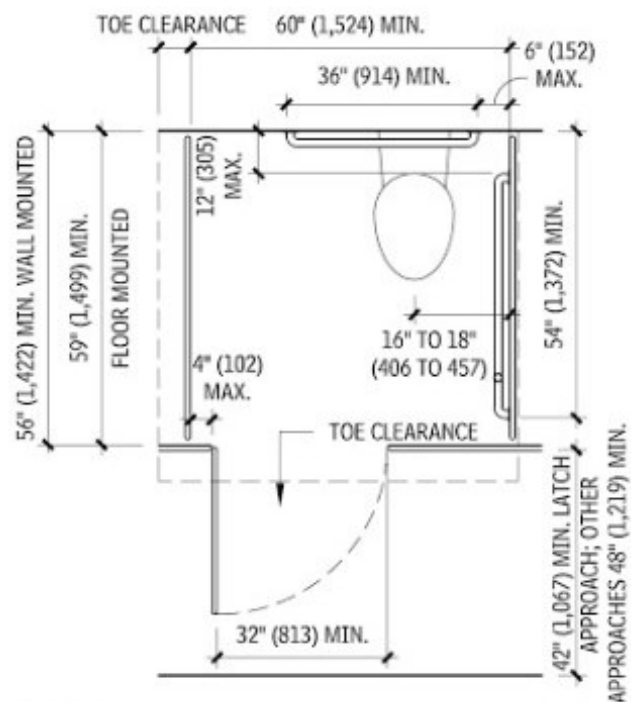
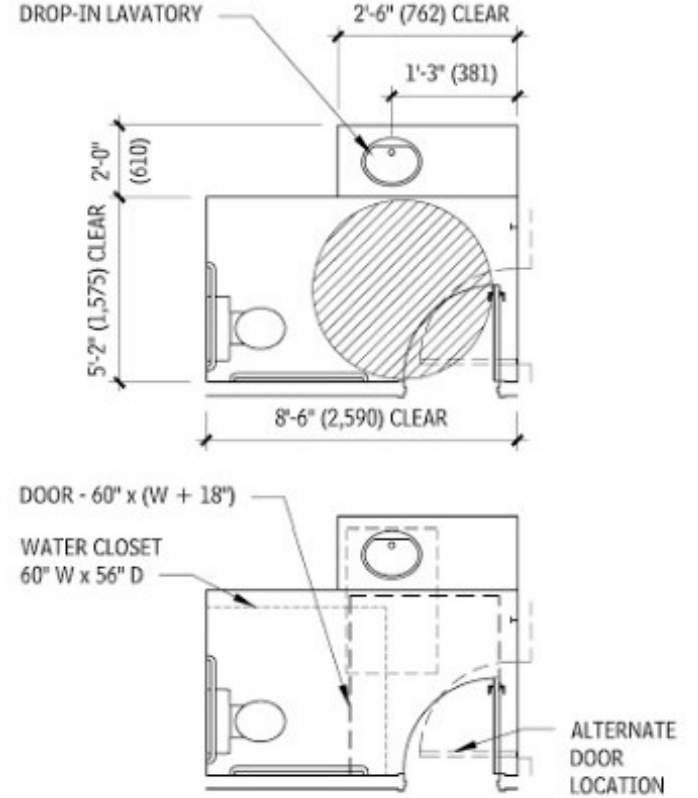
Unisex facilities must be located within 500 ft (152 m), and within one floor, of separate-sex facilities. Doors to unisex toilet and bathing rooms must be securable from within the room.

NOTE

5.55 The particular configuration of clear floor space affects the maximum and minimum heights of the controls. If the partition is greater than or equal to 2 ft (610 mm) deep, the urinal clear floor space must be 3 ft (914 mm) wide. If the partition is less than 1 ft 5 in. (430 mm) deep, it may be 29 in. (737 mm) wide.

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LAVATORY ON SIDE WALL
5.57

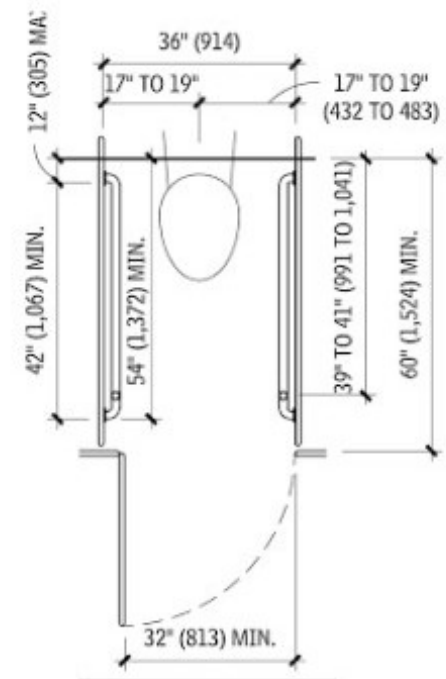


MIDROW

ACCESSIBLE TOILET ROOM LAYOUTS

Some of the toilet room layouts shown in Figures 5.57, 5.58, 5.59, and 5.60 are similar; variations are in the direction of the door swing and based on whether the width or depth is the more constraining dimension. Dimensions show comfortable minimums and preferred dimensions. Overall room dimensions include a 2 in. (51 mm) construction tolerance. Each layout shows the required clear floor space for the fixtures and the doors.

For door maneuvering clearances, see the ADA/ABA Accessibility Guidelines for various requirements and conditions. Variables include direction of swing, direction of approach, size of door, and door hardware. Doors to bathrooms are assumed to be 36 in. (914 mm) wide, with a closer and latch for privacy.



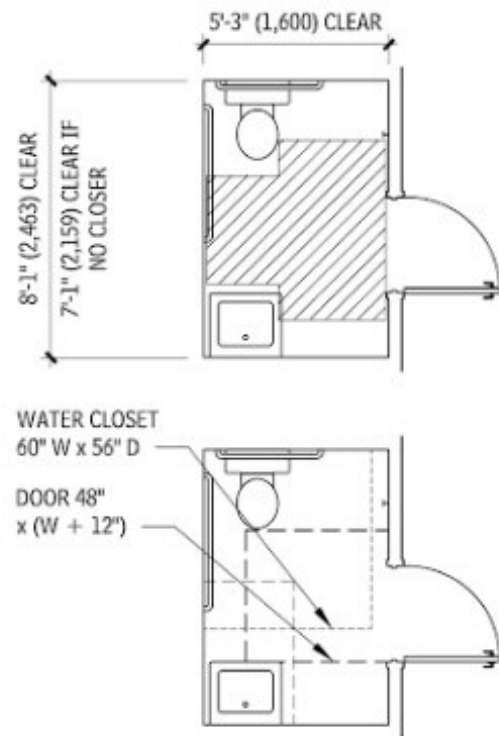
AMBULATORY ACCESSIBLE

Maneuvering clearances at the base of water closets and below lavatories may vary due to fixture design. Confirm actual water closet and lavatory dimensions for other makes and models.

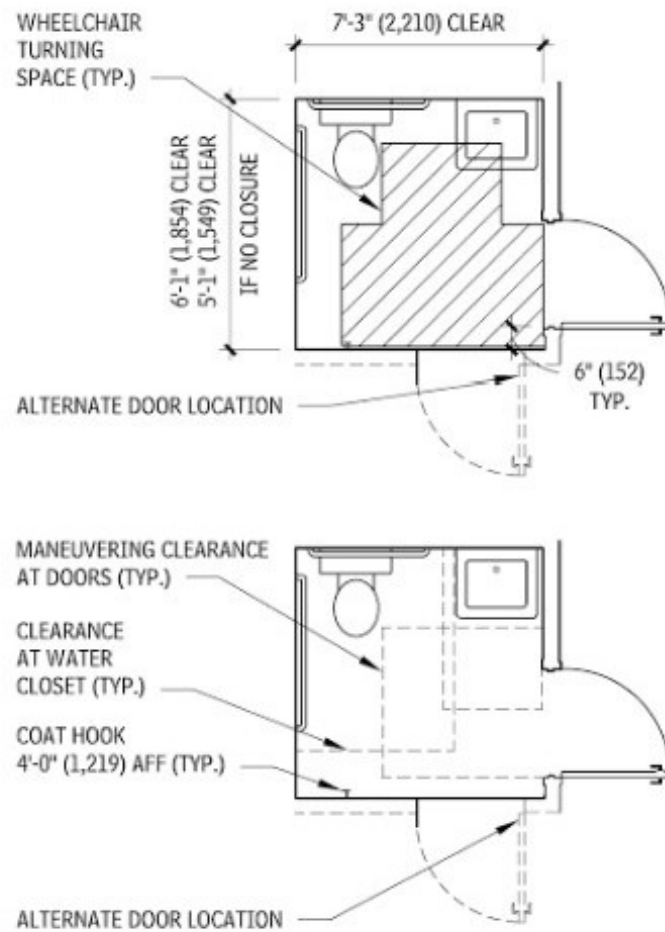
ICC/ANSI 117.1, published by the American National Standards Institute, requires the water closet clearance to be unobstructed by lavatory or other fixtures. Other regulations allow configurations with a lavatory within the water closet clearance.

Accessibility requirements for toilet rooms vary; check the state and local code requirements.

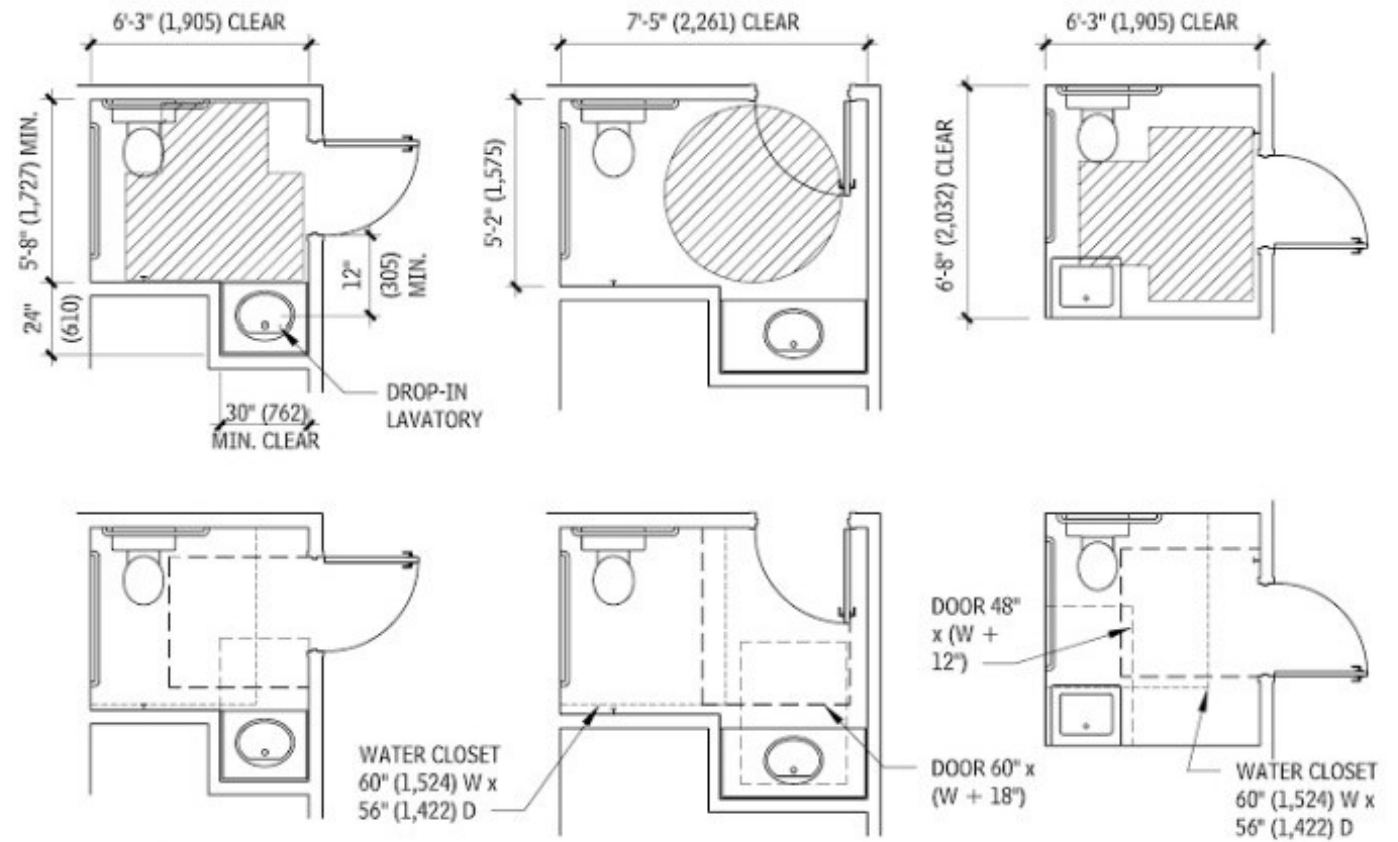
SMALL TOILET ROOM—LAVATORY OPPOSITE TOILET
5.58



SMALL TOILET ROOM—LAVATORY ADJACENT TO TOILET
5.59

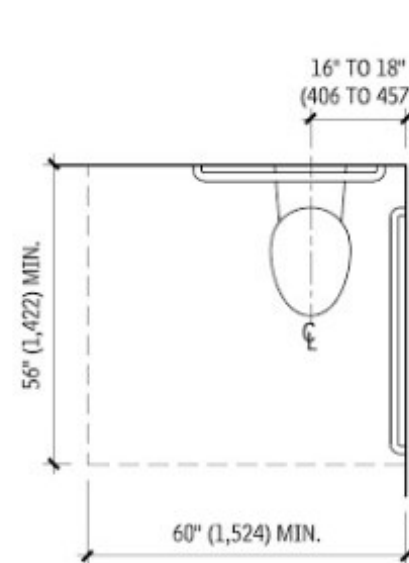


LAVATORY ON OPPOSITE WALL
5.60



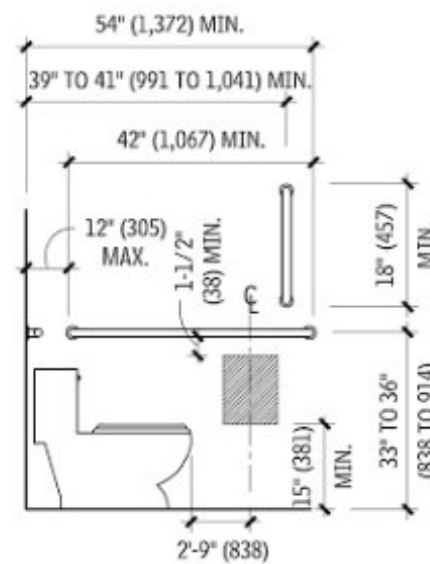
OUTWARD-SWINGING DOOR WITH RECESSED SINK

WATER CLOSETS
5.61



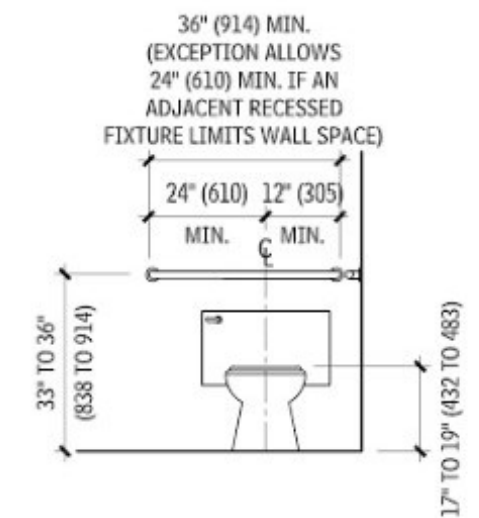
PLAN CLEARANCE

INWARD-SWINGING DOOR



SIDE WALL ELEVATION

LAVATORY ON OPPOSITE WALL



REAR WALL ELEVATION

RESIDENTIAL ACCESSIBILITY STANDARDS

Residential bathrooms and single-use toilet rooms can be divided into two general categories: *private facilities* such as those located in single- or multifamily dwellings, and *public or institutional facilities* such as those located in nursing homes, hospitals, dormitories, or hotels.

Wheelchair bathroom standards for private dwellings are included in the ICC/ANSI A117.1. The Uniform Federal Accessibility Standards (UFAS) have published nearly identical bathroom standards for dwellings included in federal projects.

In most multifamily projects, whether privately or publicly funded, between 1 and 5% of the total dwellings must meet the ICC/ANSI or UFAS standards for full wheelchair accessibility. The Fair Housing Amendments Act (FHAA) is a federal civil rights law that addresses private multifamily housing design. The FHAA guidelines include two alternative residential bathroom design standards. In covered dwellings with two or more full bathrooms, the more strict standards can be used for one bath; more minimal standards can be applied to the second bathroom.

The ADA/ABA Accessibility Guidelines 2004 are not typically applied to private residential facilities because the previously issued FHAA standards already apply. However, bathrooms located in "transient lodging" facilities, such as hotels, or public institutional facilities, such as hospitals, may be required to meet both the ADA/ABA Accessibility Guidelines and the FHAA standards.

With all these standards in effect, it is imperative to verify current local, state, and national requirements for residential accessible bathroom and toilet room design.

ADAPTABLE BATHROOMS

ICC/ANSI A117.1 defines adaptability as the capability of certain elements to be altered or added so as to accommodate the needs of persons with or without disabilities, or to accommodate the needs of persons with different types or degrees of disabilities. Some codes and civil rights laws require provisions in certain residential bathrooms for adaptable features.

For single-family custom homes or remodeling projects, bathroom designs should be specially tailored to the individual homeowners. If a master bathroom is planned for a wheelchair user, for example, the design should reflect that person's individual capabilities and preferences.

MANEUVERING SPACE

Bathrooms that comply with the FHAA standards must be "usable" rather than "accessible" and therefore have lower maneuvering space standards. According to the FHAA standards, if the entry door swings into the bathroom, there must be enough clear space to position a wheelchair clear of the door swing.

All of the standards permit required floor space for fixtures to overlap with required maneuvering space. ADA/ABA Accessibility Guidelines 2004, however, do not permit the bathroom door (even in single-user facilities) to swing into any fixture clearance, with some relatively complex exceptions.

BATHROOM ENTRY DOORS

The FHAA standards permit a 34-in. (864-mm) door to provide a nominal 32 in. (813 mm) clear opening. ICC/ANSI, UFAS, and the ADA/ABA Accessibility Guidelines require installation of at least a 36-in. (914-mm) door to provide the full 32 in. (813 mm) clear opening.

CONVENTIONAL BATHROOM LAYOUTS—NOT ACCESSIBLE
5.62

