CHAPTER

17 Roof Drain Systems and Sewer and Drain Cleaning

OBJECTIVES

After completing this chapter, the student should be able to:

- Identify the segments of a roof drain system.
- Understand the scope of a storm drain system.
- Identify the basic steps of clearing sewer and drain stoppages.

GLOSSARY

Conductor: conveys storm water vertically from upper-horizontal storm drain piping to a building storm drain; located on the inside of a building

Downspout: vertical pipe or square tube that conveys water from a gutter to the ground; often fabricated from sheet metal

Grout: placement of a grout mixture under and over a catch basin grate to seal its connection with the catch basin

Leader: conveys storm water vertically from upper-horizontal storm drain piping to a building storm sewer; located on the outside of a building

Parapet: vertical walls constructed on a roof edge

Peak rainfall period: the amount of rainfall projected in one hour based on certain historical data accumulated over 10, 25, or 100 years; codebooks include this information

Sweating: the process of condensation forming on the exterior of a pipe; also used to describe the soldering of copper pipe

This chapter will discuss the segments of a storm drain system. Many roofs feature drainage systems that convey rainwater to designated locations on a parcel. Others connect to a storm sewer system. Some cities have complex storm sewer systems, whereas others allow the collected water from roofs and streets to discharge to designated location or nearby creeks and rivers.

This chapter also discusses the basic steps taken to locate blockages in drainage and sewer systems. The equipment that is used can vary, and not all drain-clearing equipment can be used for every segment of a drainage system. Many stoppages can be cleared with chemicals, but the chemicals are dangerous and safety issues must be addressed.

SAFETY ALERT When working with chemicals, always wear protective clothing and personal protection equipment (PPE) dictated by the material safety data sheet (MSDS) for the specific chemical. Ensure that the MSDS is readily available in case of emergency.

A vertical pipe that connects a roof drain or a series of horizontal drains is called a **leader** or **conductor**. A leader is located outside a building, and a conductor is located inside. The conductor and leader work similar to the stack in a DWV system; they connect other segments to a main pipe, such as a storm building drain or sewer. Most codes dictate a cleanout at the base of the leader and conductor. In addition, the horizontal portion of a storm drain typically must be insulated. When cold water drains into a horizontal pipe installed in a heated space, condensation forms on the exterior of the pipe. This occurrence is called **sweating** and can cause property damage. The underside of the roof drain body must also be insulated for the same reason.

TIP To reduce sweating, hangers installed on most horizontal storm drain systems must be located on the outside of the pipe insulation. Metal shields are installed to separate the hanger and the insulation so that the hanger does not damage the insulation.

STORM DRAIN SYSTEMS

Similar to a drainage, waste, and vent (DWV) system, a storm drain system also possesses identifying segments. A storm sewer is located on the exterior of a building, and the storm drain is located on the inside. Table 17–1 lists the segments of a storm drain system; Figure 17–1 illustrates the segments listed in Table 17–1. Many codes use the same regulations for pipes and fittings that apply to a DWV system. Other codes allow the fitting selections to differ from a DWV system and do not mandate that long-radius fittings be installed. A roof drain does not have to be installed with a p-trap like those that connect to a DWV system. A p-trap is required only if the system is a combination sewer system connecting the storm drain system to a DWV system.

Roof Designs

Most residential buildings use sloped roofs with a gutter and downspout design to evacuate rainwater or melted snow from the roof. Commercial and industrial buildings use many roof designs that are often based on the building size and codes. A roof drain is similar to an area drain, and numerous designs are available. The specific roof drain selection and quantity installed are specified on a blueprint, but a plumber might have to select a roof drain on smaller projects. Each drain should be selected so that it is compatible with the roof construction and sized to handle the **peak rainfall period** dictated and listed in local codebooks. Table 17–2 lists some areas that might drain into a storm drain or storm sewer system.

Table 17–1 Segments of a Storm Drain System

Storm Sewer	Exterior piping that conveys building storm water to a point of disposal. Begins outside of a building with the connection of a building storm drain.
Building Storm Drain	Interior horizontal drainage system that connects to branch piping and vertical conductors. Conveys storm water to the storm sewer.
Leader	Located outside of a building. Conveys storm water vertically from upper-horizontal storm drain piping to a building storm sewer.
Conductor	Located inside of a building. Conveys storm water vertically from upper-horizontal storm drain piping to a building storm drain.
Horizontal Branch	Horizontal interior piping that connects roof drains or similar inlet points to a conductor or building storm drain.

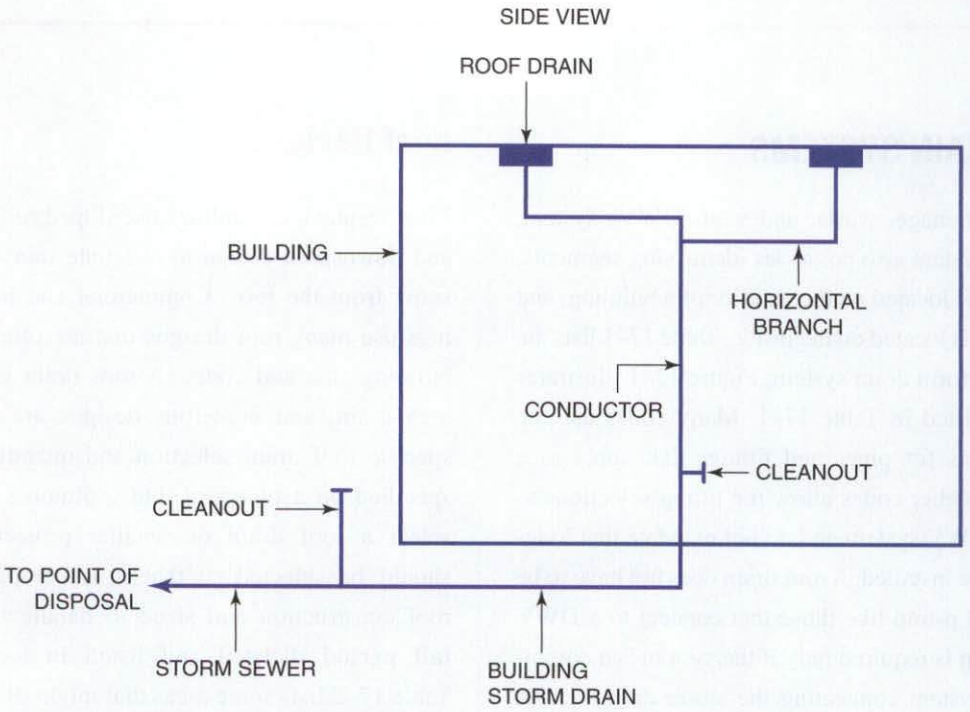

Figure 17–1 Segment identification of a storm drain system

Table 17–2 Storm Water Areas and Methods to Drain a Storm Drain System

Area	Method
Yard or Driveway	Area drain or catch basin
Patio	Patio drain
Sloped Roof	Gutter and **downspout**
Flat Roof	Roof drain
Flat Roof	Scupper drain and downspout
Street	Sloped roadway
Street	Catch basin
Grassy Area/Field	Catch basin

Roof Drain

A commercial building with a flat roof design still has a slight slope that allows water to drain to designated locations. A common flat roof design used for commercial buildings includes a metal deck with foam insulation that is installed before the final roofing components. A rubber membrane is installed over the insulation, and washed stone is placed over the rubber for protection and added weight. A roof drain installed in this application is inserted into a large-diameter hole cut through the metal deck. The drain body is secured to the deck with an under-deck clamp that bolts to the drain body from below. The rubber membrane is installed into the drain body and is held in place with a clamp ring that bolts to the drain body. The clamp ring also serves as a securing ring for a dome strainer. Different types of strainers are available, and one common feature is a gravel stop to help prevent the washed stone from entering the drain. Figure 17–2 illustrates a roof drain installed on a flat metal roof with a rubber membrane.

Scupper Drain

Some codes require an overflow drain to be installed adjacent to a roof drain to ensure that the roof does not collapse if the roof drain becomes plugged. An overflow system has a flow height that is set a few inches above the primary roof drain height. The overflow drain is never used unless the amount of rainfall is more than the primary drains can handle, a single drain is obstructed, or the entire drain pipe is plugged. Another overflow design uses a slot in the perimeter of a building so water will spill over the edge of the roof. This design is called a scupper drain (Figure 17–3) and may also be used on some smaller commercial buildings as the primary roof drain. The scupper drain is constructed in a **parapet** wall, and a plumber might have to install the downspout piping or underground piping. A parapet wall is constructed to a specific height above the roof based on the specific building design. In some designs, a plumber installs drainage piping from the ground level to a catch basin. In other designs, the water spills onto the ground directly below the scupper drain.

Area Drains

Patios, driveways, yards, and streets all require water to be routed to a safe area dictated by local codes. Some codes allow the storm water to flow into nearby creeks, whereas other codes may state that the water must drain into a dedicated catch basin or storm sewer. Many municipalities have ordinances that dictate that storm water must flow to a designated area such as a pond to allow for sediment control. A blueprint for a new project should indicate the design based on local codes, but a contractor must know the codes and be able to recognize a design that does not comply.

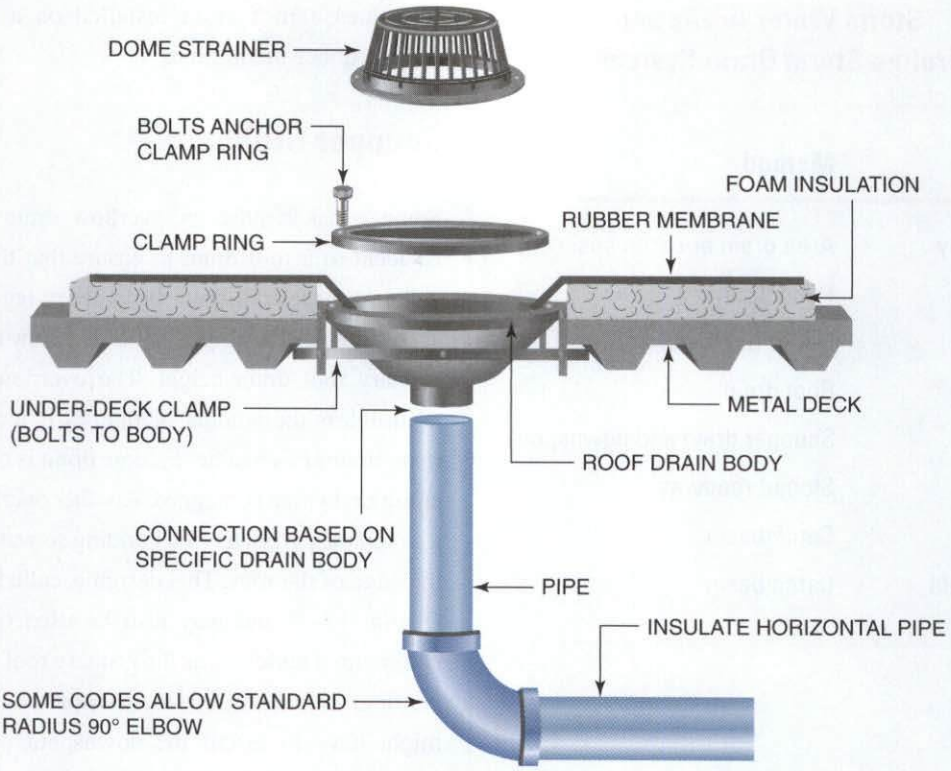

Figure 17–2 A basic roof drain installation on a metal deck with a rubber membrane roof

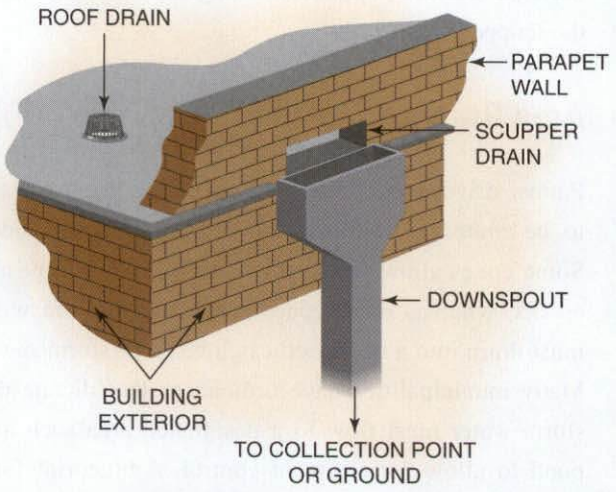

Figure 17–3 A scupper drain serves as the main drain of a roof or can be used as an overflow drain

The landscaped areas surrounding structures must slope away from them to prevent damage from erosion caused by water flow.

Many commercial buildings feature patios on upper floors; these patio drains are often piped to connect to the interior storm drain system. Patios on a ground floor can be piped to the building storm drain or storm sewer. Area drains installed in a driveway that do not allow large amounts of sand to enter a system may be allowed by some codes to connect directly to a storm sewer.

Catch Basins

If sand entering a system is a concern, the driveway or yard area drains can be piped directly into a catch basin.

The use of a catch basin allows for sand and debris to be separated before it enters the building sewer. A catch basin is used on most public streets as an entry point for rainwater. Various designs of catch basins are available, and they are installed based on their intent to collect water and separate sand and debris. They must be cleaned periodically and are located on low points of a road or other drained areas.

A catch basin's piping is similar to that of a manhole. A series of catch basins can be connected, or a single basin can be connected to a manhole or terminate in a creek or river. A concrete catch basin base is installed below ground; if required, spacers are placed on top of the base to extend the frame and grate to a desired elevation. The frame rests on the spacer or the base, is often anchored, and is **grouted** to seal the connection. The grate, which is removable for cleaning, is where the water and debris enter the catch basin. Figure 17–4 illustrates the basic design of a catch basin.

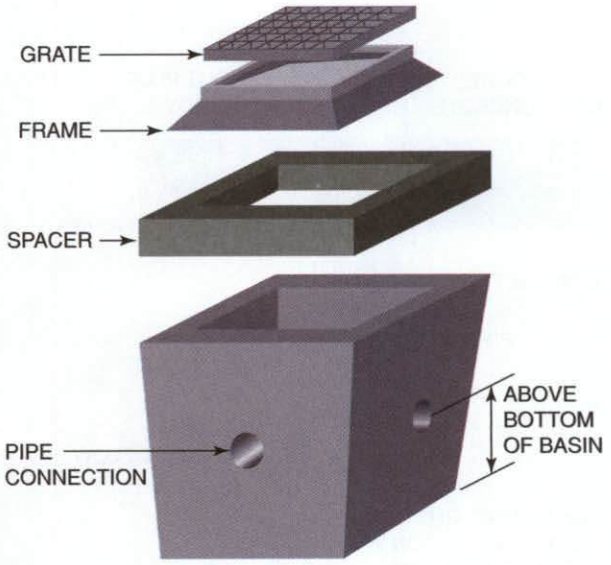

Figure 17–4 A catch basin is manufactured in numerous designs; some feature a base, spacer, frame, and grate design

SEWER AND DRAIN CLEANING

Stoppages in a sewer or drain can cause sewage to spill onto the ground or into a building. Customers often refer to a stoppage as their drain being "plugged." Clearing a stoppage is often called "cleaning," but the process actually entails clearing an obstruction. Many codes allow a company to engage in clearing obstructions from a DWV system without being a licensed plumbing contractor. However, when direct access to a drainage system requires the removal of a trap, such as a toilet, a plumbing license may be required. Most codes dictate that a plumbing license is required to work on any portion of a DWV system that is downstream of a trap. Always check local codes before removing a trap or toilet if you are not a licensed plumber; sewer gas will enter the occupied space from which a trap is removed.

SAFETY ALERT Clearing obstructions from drains can expose you to bloodborne pathogens and dangerous drain-cleaning chemicals. Familiarize yourself with first aid response procedures and know how to protect yourself from bloodborne pathogens; refer to Chapter 2 of this book for appropriate safety lessons.

Grease buildup, roots, too much food entering the drain, and incorrect installations are common causes of blockages. Obstructions in the fixture drain are considered local blockages and only affect the individual fixture. Blockages in a horizontal branch, waste stack, building drain, or building sewer affect more than one fixture and often the entire plumbing system.

The cleanout size and location that serves as an entry point to clean a drain is based on the pipe size, the fixture being served, local codes, and proper installations. The tools, equipment, and accessories used to clear a blockage are determined by the blockage location. A drain-cleaning cable machine is often referred to as

Table 17–3 Drain-Cleaning Equipment

Type of Equipment	Common Uses
Plunger	Used for plugged traps and fixture drains
Closet Auger	Water closet (toilet)
1/4" and 3/8" Diameter Cable Machine	Fixture drains 1 1/4" to 2"
1/2" and 5/8" Diameter Cable Machine	Pipes 3" to 4"
Jetting	Mostly large-diameter sewers

Note: Follow manufacturer recommendations for cable sizes to use with certain drain sizes.

a snake. Table 17–3 lists several pieces of drain-cleaning equipment that are discussed in the chapter. This table presents rule-of-thumb information regarding the drain size served by each diameter of cable; manufacturers' recommendations must be followed at the job site.

Cleanouts

Many types of cleanouts (COs) are available, and all provide access for clearing stoppages. Some blueprints may use the abbreviation FCO for floor cleanout and WCO for wall cleanout. As previously discussed in the DWV lessons of this book, some codes allow a fixture drain to be served by a removable p-trap. If a fixture (such as a toilet) can be removed to access the drain, some codes will consider that acceptable access without adding another cleanout. The size of the cleanout is often dictated by code to equal the size of a drain. Following are some allowable exceptions to that regulation:

- A 4" cleanout can serve 4" and larger pipe sizes.
- A 1 1/4" trap adapter can serve as a cleanout for 1 1/4" and 1 1/2" pipe sizes.
- A 1 1/2" trap adapter can serve as a cleanout for 1 1/2" and 2" pipe sizes.

Always check local codes before assuming they allow exceptions.

Locating a cleanout can be difficult if the installation was not done correctly or if renovations of an existing building covered it. Exterior cleanouts that serve a building sewer should be visible. If they are installed in a grassy area, they typically are raised above the finish grade or are poured in place in a sidewalk, driveway, or specially constructed concrete pad. Figure 17–5 illustrates a cleanout installed in a concrete pad, which enables it to be located in a grassy area. The basic design concept for a cleanout installed in a concrete pad is similar to all cleanouts installed in concrete floors, loading docks, or sidewalks. The weight that may roll over a cleanout must be considered when the appropriate cleanout body to embed in the concrete is selected.

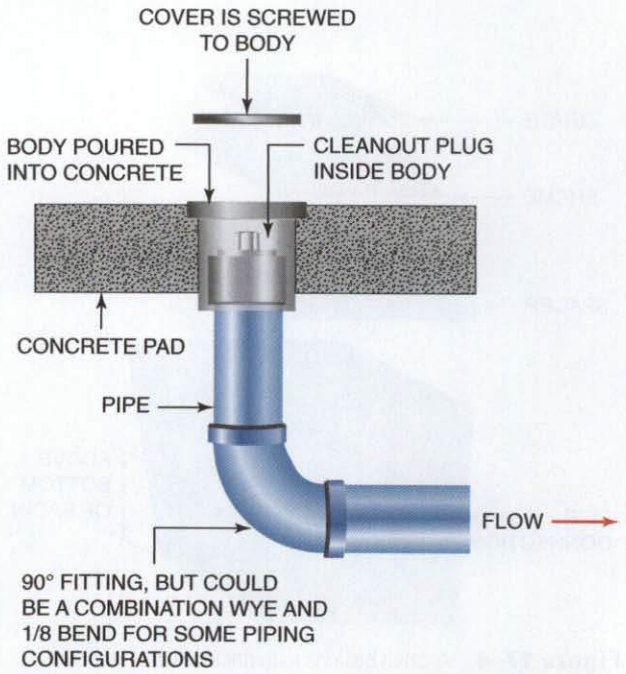

Figure 17–5 Cleanouts are often embedded in concrete, and the cover is removed to access the plug

Stacks are often located in walls or chases, and access plates are typically installed to easily locate the cleanout at the base of a stack. Large retail stores or manufacturing plants feature floor cleanouts that are typically no more than 100'-0" apart. Codes regulate the distance between cleanouts; some codes require a cleanout if a drain offsets more than 45°, whereas other codes mandate a cleanout at every 90° turn. Once a cleanout is located, the cleanout cover must be removed. Floor and exterior cleanouts have metal covers that are removed to expose the cleanout plug.

Some cleanouts plugs have a raised area called a lug. A wrench is used to unscrew the plug from the cleanout body. Other cleanout designs have a countersunk area, which allows the cleanout to be installed in walls without a lug protruding. These cleanouts require a compatible tool that is inserted into the countersunk area for removal. Figure 17–6A illustrates a raised-lug plug, and

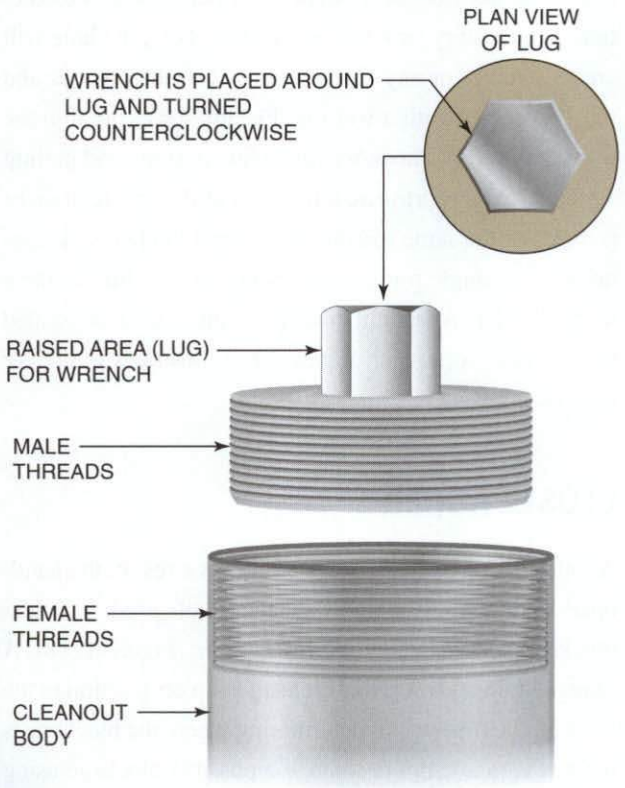

Figure 17–6A Some cleanouts have a raised area often referred to as a lug

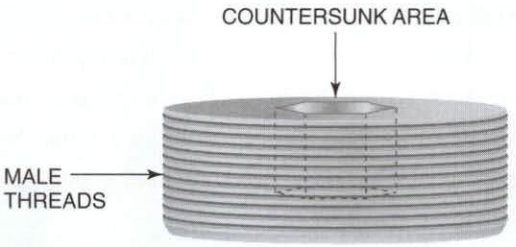

Figure 17–6B A countersunk cleanout plug is used in confined installation spaces

Figure 17–6B shows a countersunk type. Another less common cleanout plug has a slotted top. A flat object, such as a metal bar, is inserted to remove the plug.

On some residential buildings, a roof vent can be used to run a drain-cleaning cable if a cleanout cannot be located. This approach is only pursued when the blockage is beyond the fixture waste arm portion of a fixture drain. If the building sewer location is known and a cleanout cannot be located, the pipe can be excavated and a cleanout installed. This process should be avoided, however, if a plugged sewer has placed the pipe under pressure. Once the cleanout is removed, a visual inspection inside the pipe indicates whether the pipe is holding water. If the pipe is dry, the blockage is most likely upstream from that cleanout, or the water has slowly drained from the pipe past the downstream obstruction. It is important to find as many cleanouts as possible and inspect the piping so a drain-cleaning machine can be placed as close to the obstruction as possible.

Cleaning Fixture Drains

As previously discussed in the DWV section of this book, a fixture drain serves an individual fixture. A p-trap is installed for each fixture except for those that have an integral trap (such as a toilet) that is removed for clearing a stoppage in its fixture drain. If a fixture is not draining and no other fixtures are affected, a local blockage may be assumed. The waste arm of a fixture drain extends from the vent to the trap.

Small-diameter cable machines are used to clear fixture drains up to 2" in size; larger-sized cable machines clear 3" and larger fixture drains. A closet auger is a specialty tool designed to clear an obstruction in a toilet. Several types are available, and some extend farther into the toilet than others.

Plumbers must know the basic piping practices of a DWV system to determine possible pipe routes that can be installed in walls, ceilings, and floors. A plumber must be able to recognize a pipe that is offsetting by feeling the restrictions encountered when operating a drain-cleaning machine. A machine often reacts differently when an obstruction is encountered or when the cable is becoming lodged than it does when the pipe is offsetting.

Safety is a primary concern when clearing stoppages. Drain-cleaning chemicals can cause serious injury, and a plumber should always ask customers if they used chemicals in their attempts to unstop the blockage. In addition, knowing the first aid treatment for drain-cleaning chemicals is important.

SAFETY ALERT Always wear protective clothing, eyeglasses, and leather gloves with proper rubberized gloves underneath when clearing a stoppage. Wearing only rubber gloves may cause a dangerous situation if the gloves get wrapped in the cable. Approach each job as if there are drain-cleaning chemicals in the wastewater unless you have verified otherwise.

Plunger

If a blockage is suspected in the p-trap, a plunger may be the first choice, but it will often just push the blockage farther down the drain. A plunger is only effective when the blockage is in the waste arm or p-trap; thus, it may be useful for a toilet blockage. A blockage in a fixture drain that is downstream from the waste arm cannot be cleared with a plunger, because the pressure created by the plunger would escape through the individual vent.

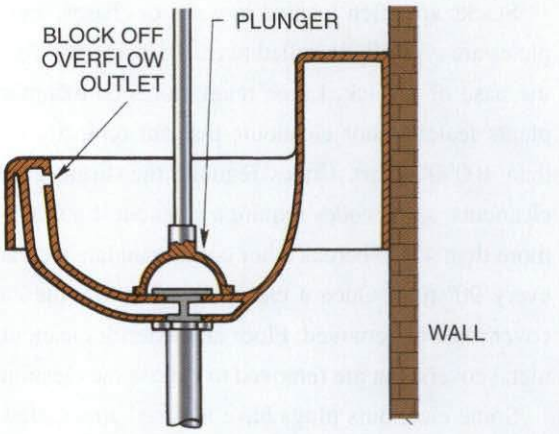

Figure 17–7 A plunger can often be used successfully when a stoppage is located in the p-trap

The first movement of the plunger should be upward to create suction—not downward to further pack the obstruction. If a lavatory sink has an overflow hole, the hole will create a route for any force created with the plunger and must be sealed with a wet rag. Placing a wet rag into the overflow hole of a lavatory sink while pushing and pulling a plunger directs pressure into or out of the fixture drain or p-trap. For the same reason, a two-bowl kitchen sink connected to a single p-trap requires one of the sink strainers to be sealed. A bathtub overflow must also be sealed before using a plunger. Figure 17–7 illustrates a plunger used on a lavatory.

CLOSET AUGER

A toilet is also called a water closet; as a result, the hand-operated drain-cleaning specialty tool used to clear blocked toilets is called a closet auger (Figure 17–8). A plugged toilet is not always related to an obstruction in the fixture. The first step in determining where the blockage is located is to attempt to remove a possible blockage using a closet auger. If a blockage is within the toilet, an auger is designed to remove the item without pushing it into the

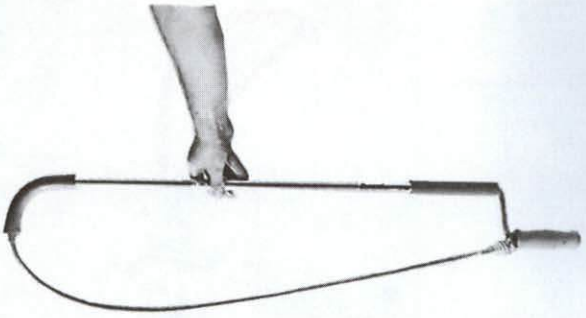

Figure 17–8 A closet auger is used to remove blockages in a toilet

drain. If the object blocking the passageway of the toilet cannot be removed with an auger, then the toilet is removed. The toilet can be turned upside down, and the object that could not be removed with an auger may be manually removed.

CLEANING SMALL-DIAMETER DRAINS

Sinks are typically installed with 1 1/4" to 2" drains, which can be cleaned using small-diameter cable machines. Cable machines (often called snakes) are available from a variety of manufacturers, and they all rotate to turn the cable while a plumber inserts it into a drain. They typically include a foot-control device so both hands are free to operate the machine; these machines are often referred to as a drum type (Figure 17–9). The drums are removable from many machines and can be replaced with a drum that houses a different diameter of cable.

Equipment selection is often based solely on the cable diameter. Typically, 1/4" or 3/8" diameter cable is used, but 1/2" diameter may be used if recommended by a manufacturer or company preference. If the cable diameter is too small, the cable can become twisted or knotted inside the drain. If the cable diameter is too large, it can be difficult, if not impossible, to navigate the tight turns of small-diameter drain pipes.

Different types of cables are used, and each type is specific to the type of machine being used. The length of

Figure 17–9 Small-diameter cable machines usually have a foot-control device to operate the rotation of the machine (Courtesy of Ridge Tool Company [RIDGID])

Figure 17–10 Drill-type electric drain-cleaning machine

cable for the common drum-type machine is typically 50"-0" for 3/8" diameter and 75'-0" for 1/2" diameter.

Some small machines are rotated using a pistol drill (Figure 17–10). These machines are not designed for long distances and often create a working condition that involves keeping one hand on the rotating drill and using the other to push the cable into the drain. If an obstruction is encountered, the cable could become twisted within the drain and the drill may react violently. Jet equipment designed for small drains can be used; this is discussed further in this chapter.

SAFETY ALERT Always use a ground fault circuit interrupter (GFCI) when operating an electric cable machine.

CLEANING LARGER DRAINS AND SEWERS

Pipes 3" and larger can receive discharge from a toilet; the minimum size drain that can be installed to serve a toilet is 3". This means that fecal matter could be present in the obstructed pipe and may be a possible cause of blockage. Once a cleanout is located and a visual inspection confirms that it is the closest one to the downstream blockage, a cable can be inserted into the cleanout.

If a cable is not the desired equipment, a jet machine can be used. A jet applies water pressure to the interior walls of the pipe, scouring the pipes and penetrating grease as it cleans. Though a cable often penetrates grease, the grease can congeal when the cable is retrieved and continue to obstruct water flow in the pipe. A video inspection camera is often placed in a drain before a jet is inserted; jet equipment is expensive, and the camera can serve to verify what the jet will encounter. A camera is often used to inspect the condition of piping systems as a preventative maintenance approach.

Large-Diameter Cable Machines

The most common cable diameter for clearing stoppages in 3" through 6" drains is 5/8", and the machine used is larger than the ones shown in Figures 17–9 and 17–10. These larger machines usually include wheels to move the equipment. Many are drum types; like the smaller version, the drum can be removed and replaced with a drum that houses a different diameterof cable. The common length for a 5/8" cable on the machine shown in Figure 17–11 is 100'-0". With the maximum distance between cleanouts mandated by most codes as 100'-0", there is usually no need to have more than 100'-0" of cable. If a cable is inserted to its entire length and the stoppage is not cleared, the plumber must move to the next downstream cleanout. Accessories, such as a cutting blade installed at the end of a cable, are available for all diameter cables. Some accessories are used to cut roots, others retrieve objects from a pipe, and some deal with blockages such as grease. A plumber learns the use of various accessories during work on a job, and the selection of specific accessories is often left to the plumber to determine.

Figure 17–11 Large-diameter cable machines usually include wheels to relocate the machine (Courtesy of Ridge Tool Company [RIDGID])

Jet Equipment

Similar to cable machines, jet equipment is available to serve various drain sizes. One trade reference for jet equipment is "jetters." Small drains can be cleaned using smaller jet equipment, and larger sewers using truck-mounted equipment. All jet equipment utilizes water pressure, and many portable machines use pressures that range from 1350 to 3000 psi. Small-diameter hoses and accessories are used to clean small-diameter fixture drains, and larger diameters are used to clearing stoppages in sewers.

SAFETY ALERT Never connect a garden hose used for cleaning a drain directly to a hose bibb or any other connection to a potable water system. Backflow can occur and contaminate the potable water system.

Portable jet equipment connects to a garden hose to provide a water source, and a hydrostatic pump increases the water pressure. A high-pressure hose is then inserted into the cleanout, and a specialized nozzle (selected for the type of obstruction) connects to the hose end. A pulsating action applies varying bursts of pressure, and the force of the water assists in propelling the nozzle and hose into the drain. The nozzle is where the water pressure flows into the pipe and clears the obstruction.

Large truck-mounted jet cleaners use a water storage tank instead of a garden hose connection. The length of the hose varies according to the diameter of the hose. Small-diameter hoses, such as 3/8", are often 200'-0" in length. Because sewer manholes are typically located no more than 400'-0" apart, larger truck-mounted hoses must be able to serve longer distances than smaller portable types.

Most jet machines are gas powered, similar to a power washer used to clean surfaces. Many models include an optional accessory to use the machine as a power washer to clean up after a job is complete. Figure 17–12 shows a gas-powered portable jet drain cleaner. A plumber learns to use the various nozzle types on the job. As with cable accessories, selection is based on the plumber's preference.

Figure 17–12 Portable jet drain-cleaning machines are used when grease is obstructing a drain or sewer (Courtesy of Ridge Tool Company [RIDGID])

Video Inspection

A camera is inserted into many drains to inspect the condition of the interior piping or to locate an obstruction. A cable is housed in a drum similar to a drum-type cable machine, and a specialized camera is attached to the hose end. The camera and hose are pushed into the drain, and a monitor displays what the camera encounters. Most models can record the inspection. Figure 17–13 illustrates one type of equipment and camera, and Figure 17–14 shows a monitor with video recording capabilities. A camera can be used along with a locating tool to locate a blockage or to pinpoint where to excavate a pipe. Several different types of transmitters and locators are available. A remote

Figure 17–13 A drain or sewer can be inspected with the use of a specialized camera (Courtesy of Ridge Tool Company [RIDGID])

Figure 17–14 Some camera models utilize a monitor and VCR (Courtesy of Ridge Tool Company [RIDGID])

Figure 17–15A A remote transmitter is installed at the end of a camera cable and inserted into a pipe sending a signal above ground (Courtesy of Ridge Tool Company [RIDGID])

transmitter is installed at the end of the hose, and a handheld locating device receives a signal above ground from the transmitter. Figure 17–15A shows a remote transmitter, and Figure 17–15B shows a handheld locator.

TIP A camera is also used to inspect underground drains and sewers for improper slope or other damage. If inadequate slope is present, the water does not flow and causes an obstruction.

Figure 17–15B Handheld locators are used to receive a signal from a transmitter (Courtesy of Ridge Tool Company [RIDGID])

DRAIN-CLEANING CONSIDERATIONS

Now that you have been introduced to the basic types of equipment used to clear stoppages in drains or sewers, the logical steps for completing a job can be incorporated into the lesson.

Listening carefully to the customer's description of the problem is the first step in solving the stoppage location and cause. Asking good questions is the second. Some helpful questions to ask are:

1. What are the observable symptoms?

   A laundry tray filled with water that recedes slowly or not at all gives us a pretty clear starting point. Water running out of a floor drain is another. A basement floor that is flooded may not be so obvious. Is there a floor drain under the water? Has it rained heavily recently? Does the water have a

sewage smell? Are other homeowners on the street having the same problem? Simple questions asked in the beginning can save exploration time.

2. Is one fixture involved or is more than one involved?

   If only one fixture is involved, the task may be limited to only one drain. Often, however, blockages are only partial and the fixture closest to the stoppage is backing up first. The homeowner may not be aware that flushing the water closet on the floor above will cause the water level to rise in the accused fixture. Gurgling sounds in other fixtures can be a tip-off that the blockage is in a main line. The plumber should run some of the other fixtures just to eliminate this possibility before turning complete attention to only one drain line.

3. Has this particular blockage occurred before, and what was the cause at that time?

   A poorly designed or installed plumbing system may have blockage problems that recur at the same place in the system. The customer will often be able to supply a history of blockages from the past and the places at which they occurred in the system. Recurring blockages at the same place call for some redesigning of the materials or routing of the system. Sink waste lines, for instance, often block up from an accumulation of grease. If the pipe is cast iron or galvanized steel, rust and scale accumulation inside of the pipe may be providing "hooks" for grease to build up on. Replacing the old steel or cast iron pipe with smooth plastic or copper DWV tubing will often solve the problem.

4. Does the homeowner or building manager have any knowledge of what the blockage might be?

   Children sometimes put toys in toilets and then flush the fixture. With some gentle prompting, an apartment dweller will often recall that there is a fork or a washcloth missing. It is not that the plumber will have a difficult time locating the stoppage without the homeowner's help. The question may be: is the blockage just an accumulation of hair and soap or is it a broken drinking glass? If it is the latter, it is best to remove it rather than to push it farther down the pipeline to cause problems later.

5. Has the homeowner attempted to clear the blockage, and, if so, what was used?

   There are on the market a number of stoppage-clearing chemicals that the homeowner can buy. If the fixture trap is full of caustic drain-cleaning chemicals, the plumber could easily be severely burned when the trap is disassembled. *Always take extreme care when cutting into or disassembling drainage piping to clear a stoppage.*

Safety Hazards

As has been mentioned, caustic chemicals in a pipeline or trap may result in severe burns. It should also be kept in mind that the affected pipe is filled with human or decomposed kitchen waste. They have the potential to cause serious illness. Plumbers who do not show reasonable caution may find themselves endangered when they:

1. Cut into a pipeline that is full of backed-up sewage.
   - **a.** Effluent may be sprayed all over, including on the plumber.
   - **b.** An electrically powered tool may "short out" through the plumber's body.
2. Take pipe apart that is filled with sewage.
   - **a.** Effluent or caustic chemical products may get on the skin or, worse, in the eyes.

3. Fail to clean stoppage-clearing tools carefully after use.
   a. Exposure to air and sunlight kills most harmful bacteria. But built-up "crud" on tools harbors the bacteria within these lumps and prevents their exposure to air and sunlight.
4. Fail to remember to shower and change clothing before eating.
5. Fail to wear appropriate protective safety glasses, face shields, rubber gloves, boots, and clothing.
   a. Follow directions on containers of commercial chemical drain cleaners meticulously.
   b. Wear protective outerwear and safety equipment when opening a pipeline below its internal water line.
   c. Pushing a rod into a plugged pipeline will often result in a violent back spray of the pipe's contents.

Often something as simple as draping an old rag over a fitting before it is opened will direct all contents down rather than outward. Of course, if the line is not totally plugged, waiting for the water to drain down is the best and safest course. In larger buildings it is wise to turn off the water supply to affected fixtures so that they will not inadvertently be used while the drain line is being worked on.

Practical Stoppage Clearing

Locating a stoppage in the main drain should be guided by certain conditions on the job (Figure 17–16).

If the stoppage is in the building sewer (A), the fixtures will not drain properly and water will overflow at the washing machine (WM). There could be a check valve on the WM waste to prevent water from backing into the trap. This stoppage may be cleared from the cleanout plug on the sewer. Care must be taken when removing the cleanout

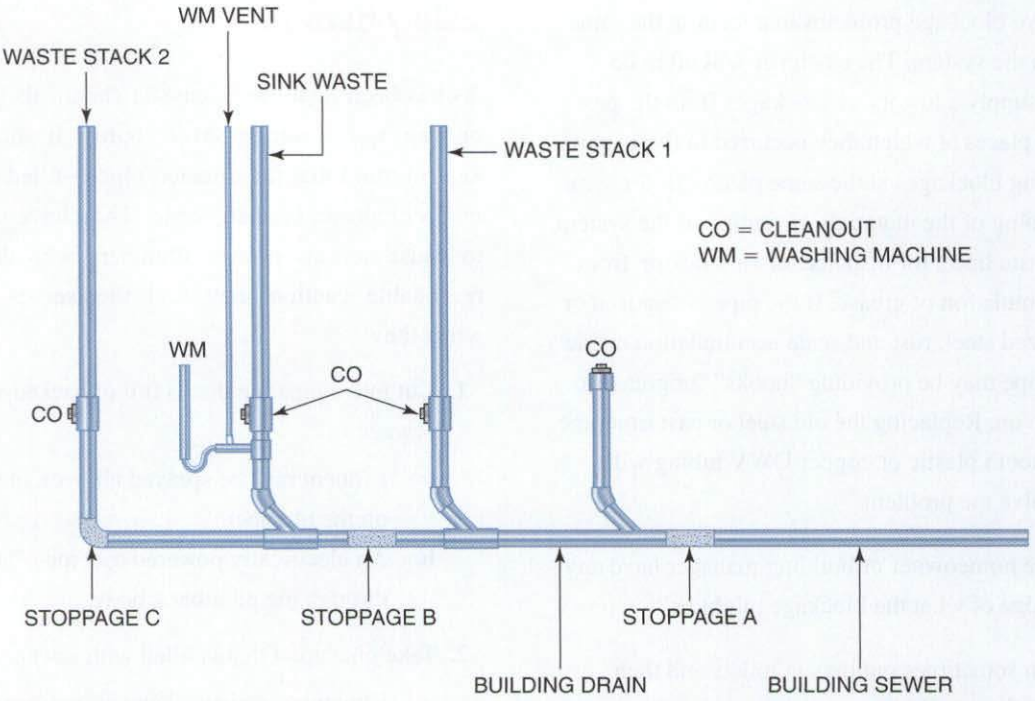

Figure 17–16 Approaches to clearing stoppages are based on the location of the obstruction (Courtesy of Ridge Tool Company [RIDGID])

plug since back pressure from the stoppage may flood the area with raw sewage.

Stoppage at point B is often grease from the sink waste. It may be cleared by using a cable through the cleanout (CO).

With a stoppage at point B, the waste stack 1 would not be affected. This would show that the stoppage was upstream of the stack.

A blockage at point C may be cleared with a cable inserted in waste stack 2 cleanout.

SAFETY ALERT Always wash your hands and tools after working on clogged drains.

SUMMARY

A storm drain system consists of several segments. Storm drain systems are often regulated by the same codes that regulate DWV systems. However, some local codes might allow shorter radius fittings where DWV codes would mandate long radius fittings.

Horizontal, above-ground storm drain piping and the underside of a roof drain body may require insulation in cold climate regions. If insulation is not applied and cold water drains through the pipes in a heated space, condensation may form and drip from the exterior of the pipe.

Roof drains are strategically located to ensure that a roof is entirely drained. They are sized based on the coverage area of each drain. Some roof drainage system designs require an overflow drain to be installed, whereas others use a scupper drain as an overflow. Some flat roofs use scupper drains as their primary roof drain. The flat roof slightly slopes toward the scupper drain, and a plumber might be required to pipe the vertical downspout or the underground horizontal piping from a downspout.

Catch basins are used in large grassy areas, driveways, and streets to collect and route storm water. They are also used to intercept sand and debris and must be periodically cleaned.

Blockages in a drain or sewer are removed or cleared using a variety of methods and equipment. Cable machines and jet equipment are used for specific blockages. Their size and accessory selection is based on the pipe size, the type and location of the obstruction, and the plumber's preference. A camera can be inserted into a drain or sewer for visual inspection. A transmitter can be installed at the end of the camera cable, and a handheld locator will receive the transmitted signal above ground to pinpoint the end of the cable.

TEST YOUR KNOWLEDGE

1. A roof drain installed on a metal deck with a rubber membrane:
   - **a.** uses an under-deck clamp
   - **b.** has a clamp ring to secure the rubber membrane
   - **c.** has the drain body installed through a hole in the deck
   - **d.** all of the above
2. A scupper drain:
   - **a.** is installed in a parapet wall
   - **b.** only serves a sloped residential roof
   - **c.** uses a drain body and a dome strainer
   - **d.** none of the above
3. A catch basin is installed:
   - **a.** to serve only streets
   - **b.** to serve only roof drains
   - **c.** with a frame and grate
   - **d.** none of the above
4. The two most common types of cleanout plugs have either a raised area (lug) or a:
   - **a.** plastic knockout area
   - **b.** countersunk area
   - **c.** series of screws
   - **d.** none of the above

5. The first movement of a plunger should be:
   a. downward to create pressure in a drain
   b. upward to create a suction
   c. through the overflow of a fixture
   d. none of the above

6. A drain-cleaning tool used for a toilet is called a:
   a. closet auger
   b. toilet snake
   c. drum-type cable machine
   d. all of the above

7. A camera used for drain inspections can be equipped to pinpoint the location of the end of the camera cable with:
   a. a cable finder and transformer
   b. a tape measure and monitor
   c. a transmitter
   d. none of the above

8. Drain-cleaning equipment that uses high-pressure water to clear a stoppage is called a:
   a. pressure washer
   b. water cleaner
   c. high-pressure drain injector
   d. jet cleaner (jetter)

9. A storm sewer is:
   a. located outside a building
   b. located inside a building
   c. not allowed to be installed below ground
   d. required to be insulated

10. Horizontal roof drain piping installed in a heated space and in a cold climate is insulated to:
    a. keep water inside pipes from overheating
    b. minimize condensation forming on the outside of the pipe
    c. eliminate routing the pipe through unheated space
    d. none of the above

11. A roof drain conductor is located:
    a. inside
    b. outside
    c. both a and b
    d. none of the above

12. A roof drain leader is located:
    a. inside
    b. outside
    c. both a and b
    d. none of the above

13. Hangers installed on most horizontal storm drain systems must be:
    a. split-ring type
    b. adjustable swivel-ring type
    c. on the outside of the pipe insulation
    d. none of the above

14. Unless it is connected to a combined sewer system, a roof drain does not have to be installed:
    a. with a p-trap
    b. to code
    c. by a licensed plumber
    d. none of the above

15. Each drain should be selected so it is compatible with the roof construction and sized to handle:
    a. 1" of rainfall based on local weather
    b. snowmelt from 6" snowfall
    c. the peak rainfall period based on a codebook
    d. none of the above

16. Roof drains are sized based on:
    a. the coverage area of each drain
    b. the size of the connecting pipe
    c. being half the diameter of the drain
    d. being no less than 1 1/4"

17. A plugged toilet is _____ related to an obstruction in the fixture.

- **a.** always
- **b.** not always
- **c.** never
- **d.** none of the above

18. On a jetting operation, the _____ is where the water pressure flows into the pipe and clears the obstruction.

- **a.** garden hose
- **b.** drum machine
- **c.** nozzle
- **d.** none of the above

19. When using a closet auger and the object blocking the passageway of the toilet cannot be removed:

- **a.** a cable machine is used
- **b.** the toilet is removed
- **c.** jet equipment is used
- **d.** none of the above

20. Before attempting a drain-cleaning project, a plumber should always ask customers:

- **a.** to flush all toilets
- **b.** if they used chemicals
- **c.** how to remove the cleanout plug
- **d.** where to begin