

Block D: Drainage Systems



Plumbing Apprenticeship Program Level 2 Series

Block D: Drainage Systems

BC Plumbing Apprenticeship, Level 2

SKILLED TRADES BC

*BC PIPING ARTICULATION AND CURRICULUM SUBCOMMITTEE; ROD
LIDSTONE; AUDREY CURRAN; AND PAUL SIMPSON*

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Contents

Block D: Drainage Systems Introduction	1
Acknowledgments	5
Accessibility	10
D-2 Planning and Installation of DWV Systems	
D-2 Planning and Installing DWV Systems Introduction	363
D-2.1 Types of DWV Drawings	366
D-2.2 Planning Interior DWV System Layouts	386
D-2.3 Creating Plans and Isometric Drawings of DWV Systems	391
D-2.4 Organizing a Plumbing Project	409
D-2.5 Installing DWV Systems	419
Self-Test D-2.1 Types of DWV Drawings	433
Answer Key: Self-Test D-2.1	439
Self-Test D-2.2 Planning Interior DWV System Layouts	440
Answer Key: Self-Test D-2.2	441
Self-Test D-2.3 Creating Plans and Isometric Drawings of DWV Systems	442
Answer Key: Self-Test D-2.3	445
Self-Test D-2.4 Organizing a Plumbing Project	446
Answer Key: Self-Test D-2.4	448
Self-Test D-2.5 Installing DWV Systems	449
Answer Key: Self-Test D-2.5	452
Plumbing Apprenticeship & Trade Resources in BC	671
Version History	674

In the field, there are many similarities or overlaps with the work of plumbers and gas fitters. Many plumbing and heating contractors employ both plumbers and gas fitters as well as tradespeople with dual certifications.

Upon completion of a Plumbing Apprenticeship, a plumber can receive cross-program credit for a portion of the Gas fitter apprenticeship. As such, training in fuel gas has been incorporated into all levels of the Plumbing Apprenticeship.

Block D of the **Plumbing Apprenticeship Program Level 2 Series** focuses on the fundamentals of sanitary and storm drainage systems, providing apprentices with a comprehensive understanding of installation, maintenance, and repair processes. This section equips apprentices with essential skills to handle the complexities of both sanitary and storm drainage systems, ensuring effective installation and upkeep in various settings.

Plumbing Apprenticeship Program Level 2 Series

The *Plumbing Apprenticeship Program Level 2 Series* offers comprehensive training materials designed to build on foundational skills and knowledge. The series is divided into four main blocks, each focusing on critical areas of plumbing systems and installations.

Block A: Fuel Gas Systems (<https://a-fuelgas-bcplumbingapprl2.pressbooks.tru.ca/>)

A-1: Gas Fired Appliances

A-2: Gas Codes Regulations and Standards

A-3: Gas Appliance and Building Air Requirements

A-4: Technical Instruments and Testers

Block B: Heating and Cooling Systems (<https://b-heating-bcplumbingapprl2.pressbooks.tru.ca/>)

B-1: Types of Heating and Cooling Systems

B-2: Hydronic Heating and Cooling Generating Equipment

B-3: Hydronic Heat Transfer Units

B-4: Hydronic Heating Piping and Components

Block C: Install Fixtures and Appliances (<https://c-plumbfixappliance-bcplumbingapprl2.pressbooks.tru.ca/>)

C-1: Plumbing Fixtures and Trim

C-2: Plumbing Appliances

Block D: Drainage Systems

(<https://d-drainagesystems-bcplumbingapprl2.pressbooks.tru.ca/>)

- D-1: Sanitary Drain, Waste and Vent Systems
- D-2: Planning and Installation of DWV Systems
- D-3: Storm Drainage Systems
- D-4: Test and Drainage Systems
- D-5: Drainage System Maintenance and Repairs

Plumbing Apprenticeship Program Overview and Upcoming Resources

- **Plumbing Apprenticeship Program Level 1 Series** is coming soon to TRU Open Press in 2025–2026!
- **Plumbing Apprenticeship Program Level 3 Series** (<https://collection.bccampus.ca/search/?q=%22pl3%22>) can be found in the BCCampus Open Collection (<https://collection.bccampus.ca/>).
- **Plumbing Apprenticeship Program Level 4 Series** (<https://bccampus.ca/projects/archives/zed-cred-z-degrees/ztc-open-educational-resources-for-trades/>) can be found in the BCCampus Open Collection. (<https://collection.bccampus.ca/>) (Block F: Commission and Service will be available soon.)

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Safety Advisory

The current Standards and Regulation in BC can be obtained at the WorkSafeBC (<http://www.worksafebc.com>) website:
<http://www.worksafebc.com>

Please note that it is always the responsibility of any person using these materials to inform themselves about the Occupational Health and Safety Regulation pertaining to their areas of work.

Symbol Legend



Important Information



Potentially Toxic/ Poisonous Situation



Required or Optional Resources



Potentially Flammable Situation



Complete a Self-Test



Possibly Explosive Situation



Use Protective Equipment



Potential Electric Shock

Acknowledgments

The development of the *Piping Trades Learning Guides* was a collaborative effort driven by a commitment to excellence in trades education. These guides were created to support apprentices and journeypersons in mastering the skills and knowledge essential to the piping trades. This achievement would not have been possible without the dedication and expertise of *Skilled Trades BC* and the *Piping Trades Articulation Committee*, whose leadership and guidance have been instrumental in shaping high-quality training resources. We extend our sincere gratitude for their contributions and ongoing stewardship in advancing the piping trades.



The Open Press

The Open Press combines TRU's open platforms and expertise in learning design and open resource development to support the creation and reuse of open educational resources, while encouraging open scholarship and research.

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Starting December 1, 2022, Industry Training Authority was officially renamed to SkilledTradesBC. Hear more in this video from SkilledTradesBC CEO, Shelley Gray, on what this means for the trades industry and British Columbians. Closed captioning and transcripts are available with this video, Introducing Skilled Trades BC (<https://www.youtube.com/watch?v=OQgwdP0rNog>) (2022) on YouTube.



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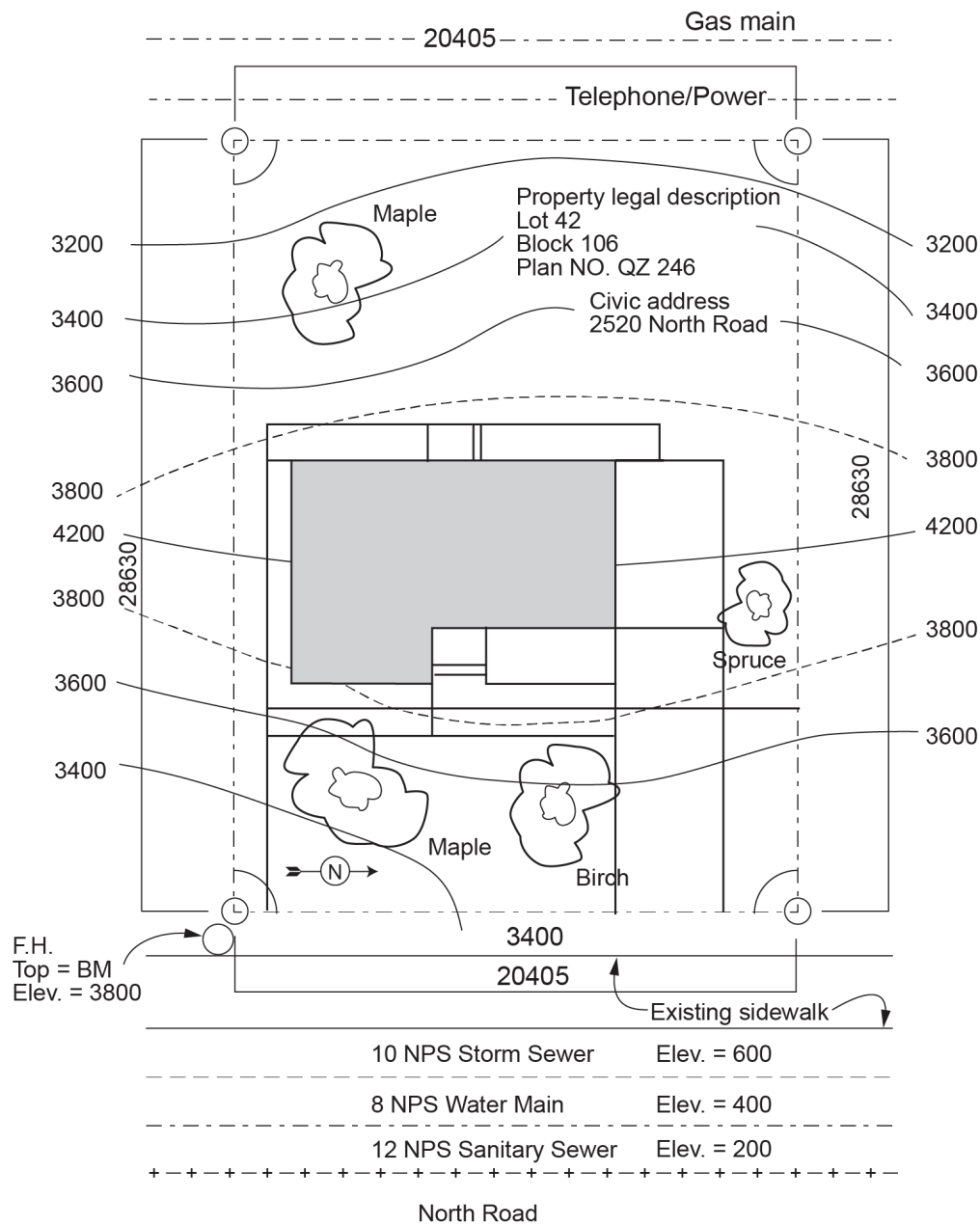
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D-2 PLANNING AND INSTALLATION OF DWV SYSTEMS

Plumber Apprenticeship Program – Level 2



D-2 Planning and Installing DWV Systems

Introduction

Communication between architects, homeowners, tradespeople, and inspectors is important when developing any project. While this could take place through extended conversations, the most efficient way to ensure success is by using drawings and diagrams.

Material organizational skills are essential for increasing job site productivity. Your blueprint reading and drafting skills will allow you to create installation drawings and organize your materials accordingly. Organizing materials in a list format eliminates material procurement errors and minimizes stock overruns. Knowing exact quantities and installation phases creates a systematic work atmosphere. Proper ordering techniques can decrease labour costs by minimizing material handling, thereby allowing more time for installation. By coordinating with other trades and organizing material, a plumber can expedite the installation of piping systems. This module will present proven methods for creating a productive job site.

Learning Objectives

After completing the chapters in this section, you should be able to:

- Describe the organization of a residential project.
- Describe considerations when handling plumbing materials.
- Describe the planning of interior DWV layouts.
- Create plan drawings of piping systems.
- Create isometric drawings of piping systems using the required lettering and line type.
- Describe the information to be contained in an isometric drawing of a piping system.
- Draw piping systems with the detail required.
- Use appropriate dimensioning and pipe sizing.
- Describe take-off procedures.
- Describe take-off materials from piping drawings.
- Describe the installation of DWV piping systems.



Resources

You will be required to reference the most current National Plumbing Code.

The following terms will be used throughout this section. A complete list of terms for this section can be found in the **Glossary**.

- **architectural drawing:** the main plan of a building that shows its design, layout, materials, and finishes. It includes floor plans, elevations, sections, and detailed views to guide construction. These drawings are usually marked with an “A” followed by a page number (e.g., A-4). (Section D-2.1)
- **“As-built”:** The record drawings and documentation defining deviation to the designed information occurring during construction at the end of the project. (Section D-2.1)
- **bulkhead:** A barrier or wall built within a building that may require plumbing installation adjustments for the DWV system. (Section D-2.2)
- **consumables:** (Also known as consumable goods, non-durable goods, or soft goods); goods that can be consumed, dissipated, wasted, or spent. In plumbing construction projects, these may include materials such as solder, flux, sand cloth, fasteners, Teflon tape, and glue. (Section D-2.4)
- **dimensioning:** The process of adding measurements to a drawing. (Section D-2.3)
- **elevation drawings:** Vertical views of a building’s outside, showing details like the roof slope and wall openings. It also displays the distance from the first floor to the basement. To find the basement elevation, subtract the space between floors from the first-floor elevation. (Section D-2.1)
- **fire-stop system:** A method used to seal penetrations in fire-rated walls or ceilings to prevent fire from spreading through the openings. (Section D-2.2)
- **fixture schedule:** A list detailing the location and specifications of plumbing fixtures. (Section D-2.4)
- **flashing:** A material used to create a watertight seal around vent pipes where they penetrate a roof, preventing water intrusion. (Section D-2.5)
- **floor plan:** A horizontal view of one floor of a building, showing room layout, dimensions, materials, and fixture locations, critical for determining piping routes. (Section D-2.1)
- **frost line:** The depth below the ground surface where the soil freezes in cold climates. Pipes must be installed below this line to avoid freezing. (Section D-2.2)
- **groundwork inspection:** Inspection of underground plumbing before covering pipes. (Section D-2.4)
- **hoisting and rigging:** The use of cranes, hoists, and rigging equipment to lift and position heavy materials safely on a construction site. (Section D-2.5)
- **isometric drawings:** 3-dimensional (3D) pictures that show how pipes in a building connect and work together. They help plumbers see where drain, waste, and vent pipes go and what size they should be. These drawings make it easier to plan and install plumbing systems correctly, whether in homes or larger buildings. (Section D-2.3)
- **key plan:** A small map on a drawing (usually near the title block) showing the location of the area depicted, especially if the drawing is of part of a larger structure. (Section D-2.1)
- **material handling:** The process of safely receiving, storing, moving, and disposing of plumbing materials to prevent damage and ensure efficiency. (Section D-2.5)
- **materials take-off:** (MTO) A list of materials required for a plumbing installation. (Section D-2.4)
- **orthographic drawing:** A 2D drawing that shows different views (top, front, side) of an object. (Section

D-2.3)

- **Personal Protective Equipment (PPE):** Safety gear, such as gloves, goggles, and respirators, required to protect plumbers from workplace hazards. (Section D-2.5)
- **pipe supports:** Structures or brackets that hold pipes in place, ensuring they are properly aligned, supported, and maintained at the correct slope for drainage. (Section D-2.2)
- **plumbing plan:** A two-dimensional plan view drawing showing the plumbing system. It is generated from the architectural floor plan showing the types and locations of the plumbing fixtures in the building. The plumbing plan describes the location, sizes, and types of all piping and fittings used in the system rough-in. The horizontal branches and fixture drains are drawn to scale, but due to the two-dimensional properties of the drawing, only the locations of all vertical pipes are shown. (Section D-2.3)
- **project scope:** The defined objectives, requirements, and limitations of a project. (Section D-2.4)
- **project specifications (specs):** Detailed documentation outlining materials, installation procedures, and performance requirements. (Section D-2.4)
- **Safety Data Sheet (SDS):** A document providing information on hazardous materials, including handling, storage, and emergency procedures. (Section D-2.5)
- **sectional view:** Drawing showing a cut-through of a building to provide detailed information about wall construction and other interior elements (exterior and interior wall finish). Check these drawings for potential obstructions or conflicts for all locations where piping must penetrate walls. (Section D-2.1)
- **seismic forces:** The forces exerted on structures during an earthquake, which plumbing systems must be designed to withstand. (Section D-2.2)
- **site plan:** A drawing that shows the layout of the building and how it fits on the land, including things like roads, utilities, and the property boundaries. It is a plot plan with a basic outline of the building superimposed on it, which helps understand the location and surroundings of the building. (Figure 2, Section D-2.1)
- **structure penetrations:** Openings made in a building's walls, floors, or beams to allow pipes, ducts, or wires. These must be carefully planned to avoid weakening the structure and must follow building codes and regulations, especially for load-bearing or fire-rated components. (Section D-2.2)

D-2.1 Types of DWV Drawings

A plumber should be competent in creating and interpreting drawings. Time and materials can be wasted if a project is not planned well. You may not always be provided with a set of piping drawings, so you must be able to extract all required information about the piping systems from general architectural drawings. This is usually the case on smaller jobs.

You must know how to read drawings in order to work efficiently with other trades. By clearly envisioning the location of structural members, wiring, and ductwork, you can spot possible conflicts in the piping system and solve problems before you start to install the piping.

Construction Drawing Types

To identify their purpose, drawings are divided into classifications. On very large projects, such as high-rise office towers, it would be impossible to place all the pertinent information on one drawing. So, several types of drawings are made, each with specific information. The types of drawings include:

- Plot
- Architectural
- Structural
- Mechanical
- Electrical
- Shop
- As-built

Plot Plan

Plot plans are usually shown on the first sheet of a set of drawings. The property line appearing on the plot plan shows the size and shape of the lot. Public utility mains, or at least the points of hookup to them, are usually shown on plot plans. Included among these utilities are potable water, gas, sanitary and storm sewer mains, and electrical and telephone lines.

Each contour line on the plot plan shows points of equal height or elevation on the lot. Every contour line is marked with a particular height, say 3.8 m or 44 ft, meaning that every point on that line is 3.8 m or 44 ft above a chosen point of reference. This point of reference may be sea level, an engineering elevation marker, or simply a convenient assumed elevation, such as 100 m or 100 ft. By comparing the heights between different contour lines, you can determine the slope of the lot at any given point. In addition to contours, plot plans show the heights of specific points on the lot, such as the corners of the lot or the locations of trees.

Figure 1 is a plot plan in metric.

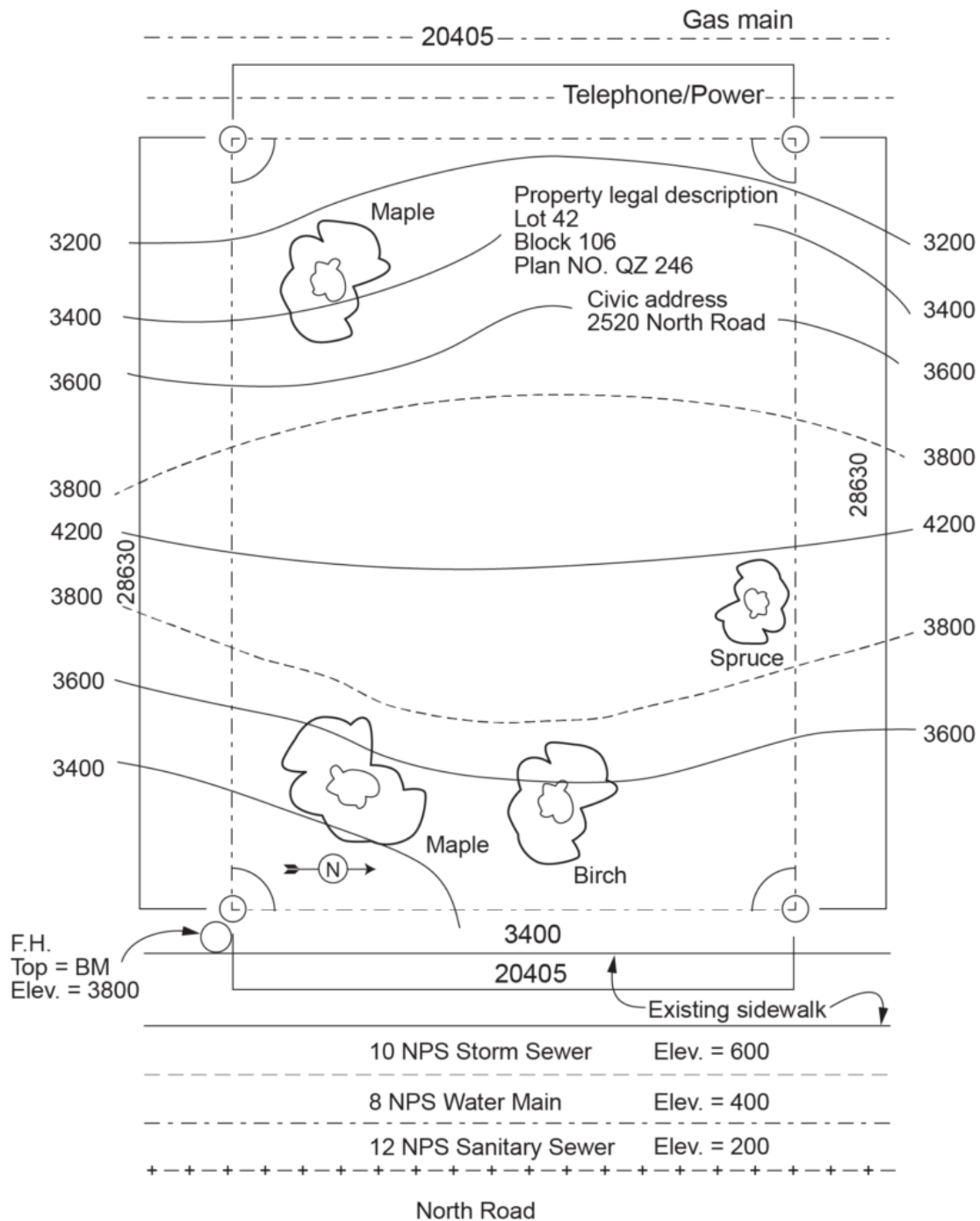


Figure 1 Plot plan. (Skilled Trades BC, 2021) Used with permission.

Site Plan

The **site plan** is a plot plan with a basic outline of the building superimposed on it. Figure 2 shows a site plan based on the plot plan of Figure 1. The site plan clearly shows the building's location and its services. The storm sewer, water main, and sanitary sewer are on the east side of the property. Their diameters are given in the legend as 10 NPS, 8 NPS, and 12 NPS, respectively.

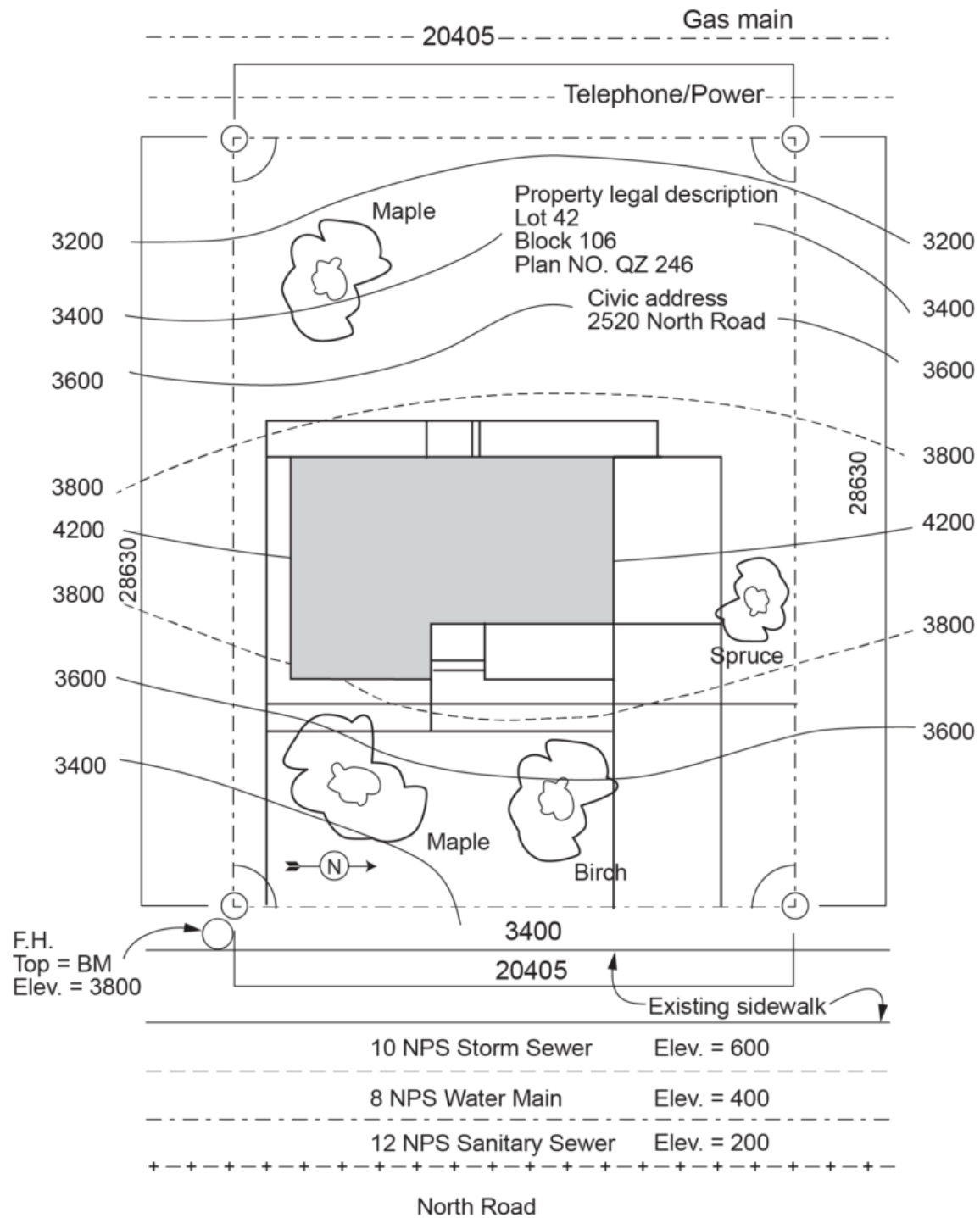


Figure 2 Site plan. (Skilled Trades BC, 2021) Used with permission.

The plot plan and site plan show the location of public utilities. This information will help us identify where building drains and supply pipes must be run to connect with municipal services (the storm sewer, sanitary sewer, water main, and gas main).

The site plan shows the horizontal distance of these utilities from the proposed building, and the elevation difference

between the public utilities and the basement. Finding the **elevations** of the utilities is a simple matter: the elevations of each utility are shown in the notes or written beside the utility on the drawing.

To determine whether the utilities can operate on gravity or if they require a pump, compare the elevations of the utilities to the basement elevation. To find the basement elevation, you will need to consult more than one drawing. The site plan shows the first-floor elevation, and an **elevation drawing** shows the distance between the first floor and the basement. To get the basement elevation, subtract the distance between floors from the first-floor elevation.

To calculate the amount of pipe you need, you need to know the horizontal and vertical distances of the utilities from the house. You also need to pay attention to the location of the property line. The city usually supplies pipe from the utilities to the property line, while the piping contractor supplies pipe from the building to the property line.

To install a septic tank, you need to check the location of the property line because septic tanks and disposal field piping cannot be located within a certain distance from neighbouring properties. You also need to check the contour lines. Septic tanks should be installed where the grade is quite level.

Landscape Plan

The **landscape plan** may or may not be part of a building contract. The landscape plan is based on the site plan. A landscape architect may design the landscape and show all the recommended trees, shrubs, flowers, grass, and structures (fences, seating, walkways, etc.) on a landscape drawing. Landscaping is important for the final appearance of a building. If plumbers will be installing lawn sprinkler systems, the landscape plan will be used to design the layout of the system and the types of sprinklers used.

Architectural Drawings

The **architectural drawing** is the main drawing of a building. It presents the overall design of the building or structure to be built. It details all the finishing of the building and the materials used. The drawings include floor plans, elevations, sections, and details. An architectural drawing is usually indicated by an “A,” which precedes the drawing page number (e.g., A-4).

When somebody wants a building built, they hire an architect (or designer) to design it. The architect finds out what type of building the customer has in mind and what the requirements are. The architect then makes a rough design for the customer’s approval. When the details of the design have been agreed upon, the architect draws a complete set of plans for the building. If the building is fairly simple, like most houses, all information can be placed on one set of drawings, from which all tradespeople can work. Houses are often built from stock plans that the owner or contractor has purchased from a design company.

Floor Plan

The **floor plan** is a plan view of one floor. Architectural floor plans generally show the layout of rooms, dimensions, types of materials used, equipment, fixtures, and appliances. Figure 3 shows a typical floor plan.

Piping plans are always developed from floor plans by either the piping contractor or the engineer. There are several things to consider when you plot piping routes from a floor plan. The locations of plumbing fixtures, components, floor drains, and vertical drainage pipe stacks play a role in determining where a pipe is routed. You need to check the floor plan for doorways and windows because you need to install the pipe around these features.

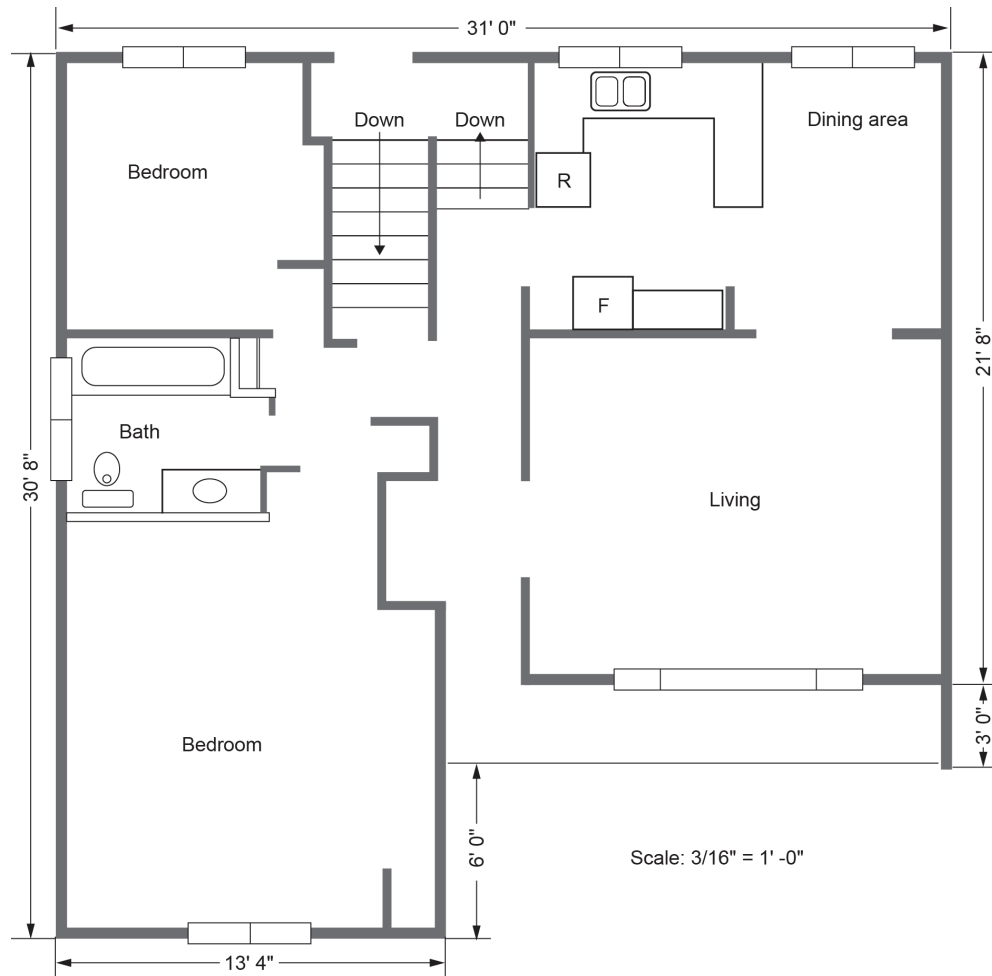


Figure 3 Main (upper) floor plan. (Skilled Trades BC, 2021) Used with permission.

Plumbing fixtures are shown as locations for drainage, waste, and vent (DWV) pipes, as well as for hot and cold water supply lines. Piping should be convenient to the fixture and concealed in walls, ceilings, floors, or in unused spaces where they do not conflict with other installations.

Figure 4 is the lower floor plan of the same house. It indicates the locations of the clothes washer, the floor drain, and the fixtures for the roughed-in half bath as well as the hot water tank and hose bibbs. You must coordinate the DWV and supply piping to these fixtures with those on the upper floor.

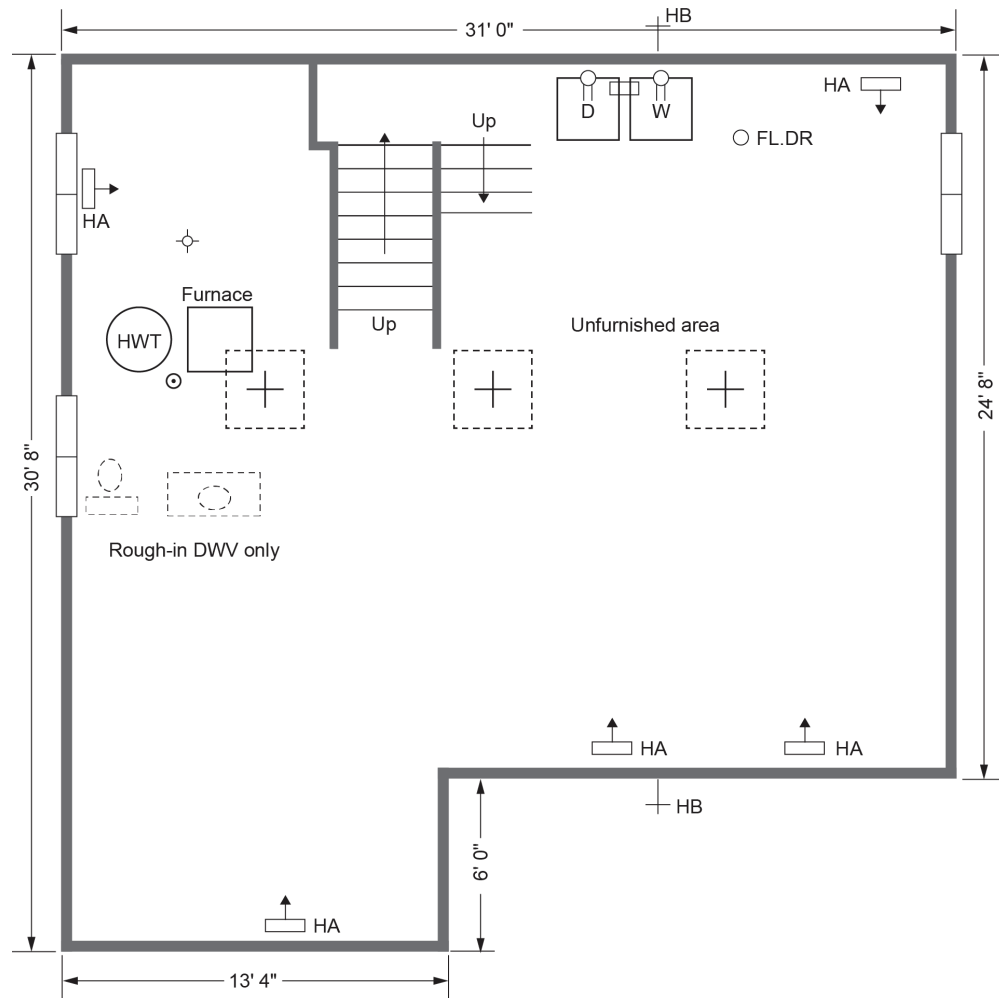


Figure 4 Lower floor plan. (Skilled Trades BC, 2021) Used with permission.

Reflected Ceiling Plan

A **reflected ceiling plan** shows an overhead plan view of a building ceiling, as if you were looking at it using a mirrored floor. These typically show tile ceiling layouts, light fixtures, speaker locations, diffuser locations, smoke detectors, and sprinkler locations, as related to the structural reference points and the floor plan. Figure 5 shows a corner portion of a reflected ceiling plan.

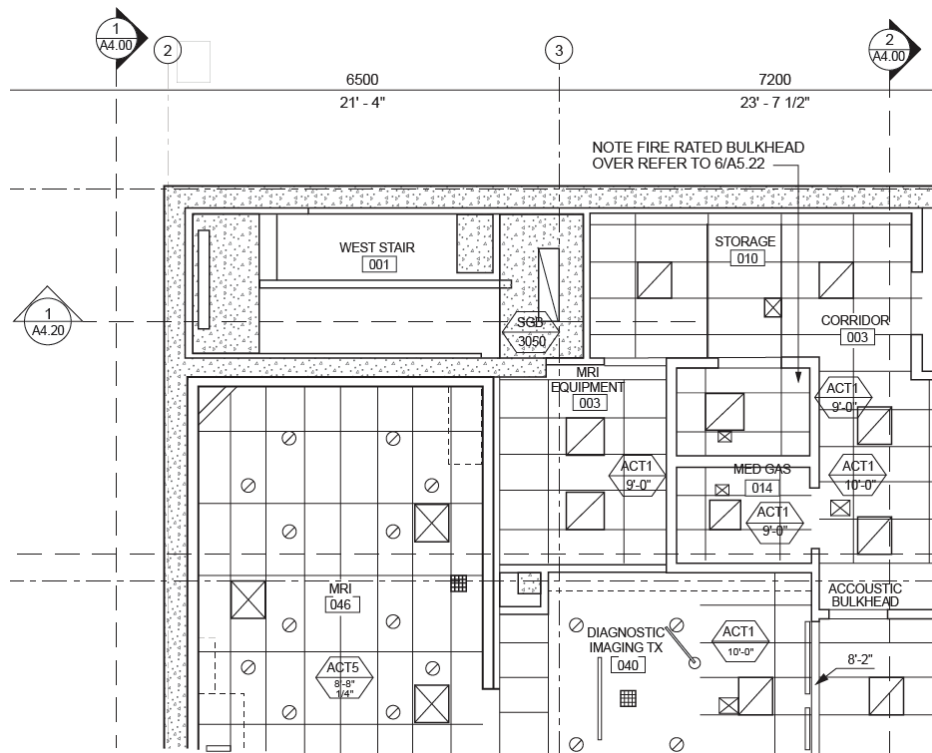


Figure 5 Portion of reflected ceiling plan. (Skilled Trades BC, 2021) Used with permission.

Elevations

Elevation drawings display the finished exterior view of the front, back, or side of a building. Together, the front, back, and two side elevation drawings give a clear idea of what the building will look like on completion. Locations and type of all wall openings and roof penetrations are shown on elevations. Elevation drawings also show the slope of the roof. A set of all four elevation drawings is shown in Figures 6 through 9. Consult the elevation drawings to calculate the total length of vertical piping needed to complete a job.

A floor plan will show a symbol for a vertical drainage stack. However, the floor plan does not indicate how long the drainage stack must be. Calculate the length of the drainage stack by checking the height of the building on the elevation drawing.

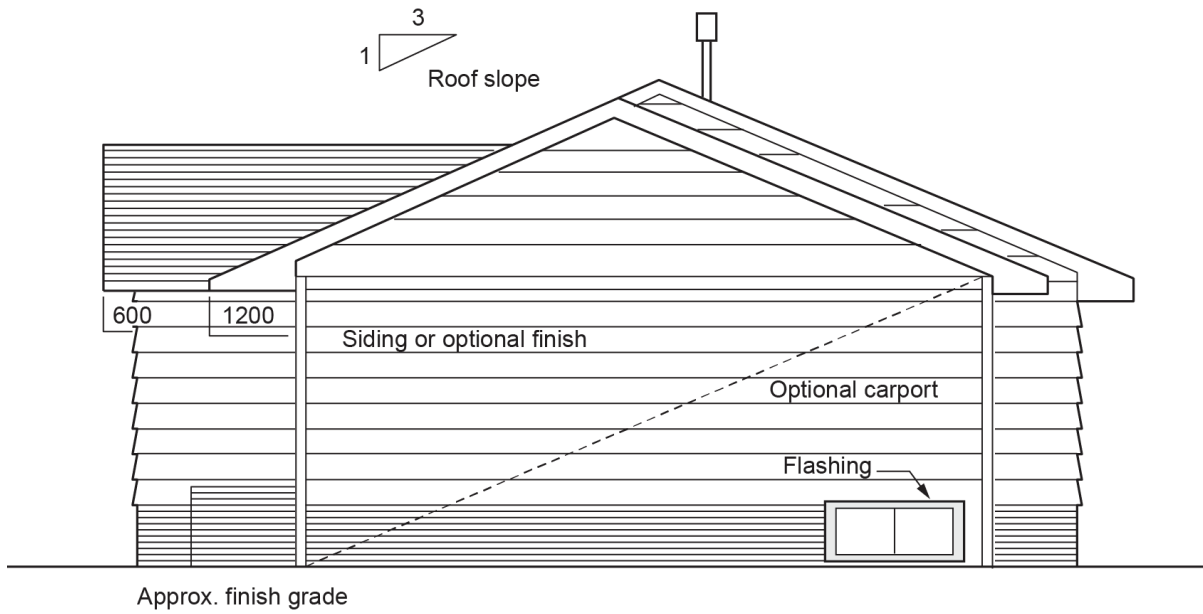


Figure 6 Right elevation. (Skilled Trades BC, 2021) Used with permission.

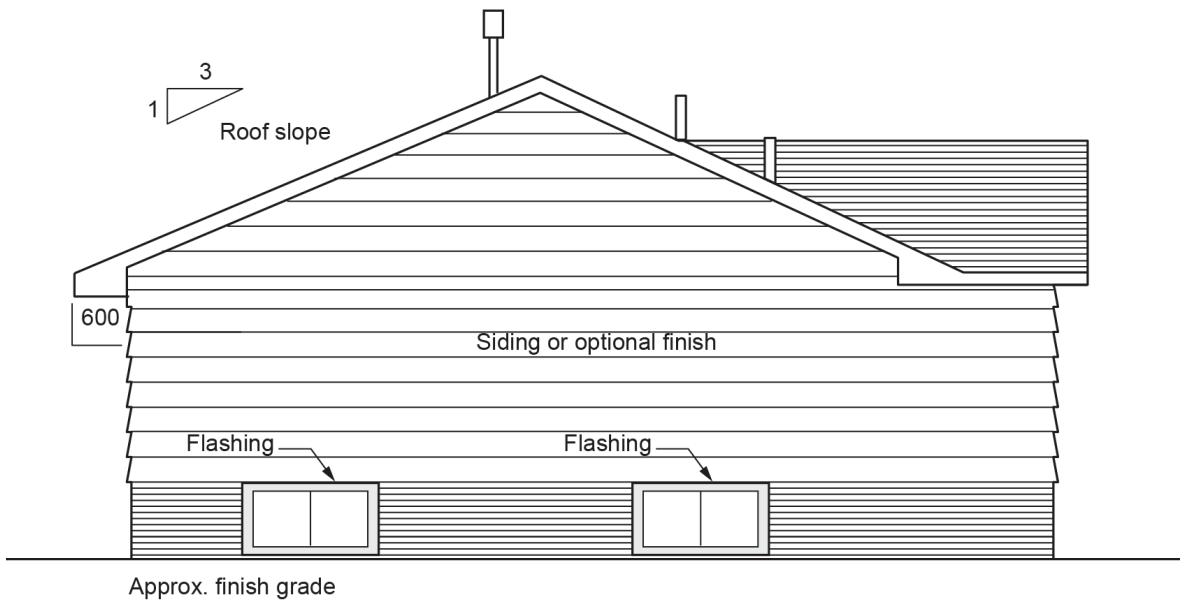


Figure 7 Left elevation. (Skilled Trades BC, 2021) Used with permission.

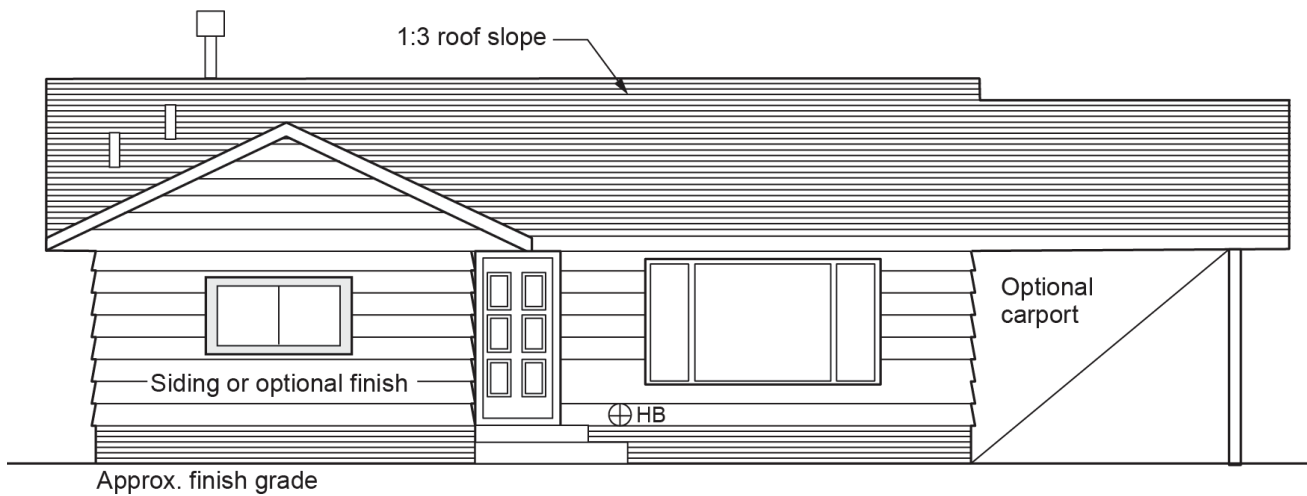


Figure 8 Front elevation. (Skilled Trades BC, 2021) Used with permission.

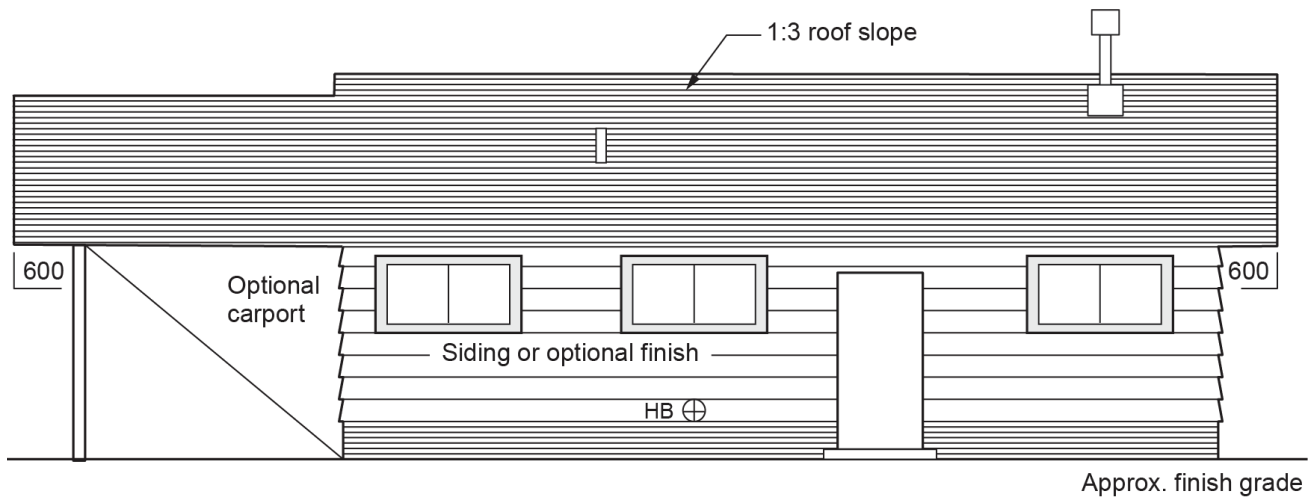


Figure 9 Rear elevation. (Skilled Trades BC, 2021) Used with permission.

Sectional Views

Sectional views give information about wall construction, the exterior wall finish, and the interior wall finish. Check these drawings for potential obstructions or conflicts for all locations where piping must penetrate walls.

Details

The details given on the floor plan give precise information on the location of sinks, showers, lavatories and other fixtures. The details on elevation drawings provide information on the heights of these fixtures. You need to know the heights of fixtures in order to correctly rough in the piping. Detailed drawing will take precedence over the regular drawings.

Structural Drawings

A **structural drawing** is required for buildings other than houses. It can be a simple one-page drawing or can include many pages of drawings. The structural drawing is usually indicated by an S, which precedes the drawing page number (e.g., S-3).

Most structural drawings are sectional views. The structural drawing gives information about the size of beams and girders, the reinforcing steel design, and the size and shape of structural members. It also details the materials to be used and the required strengths of concrete. This drawing is prepared by a structural engineer hired by the architect to design all the structural components of the building. Figures 10 and 11 show two typical structural drawings of wall cross-sections.

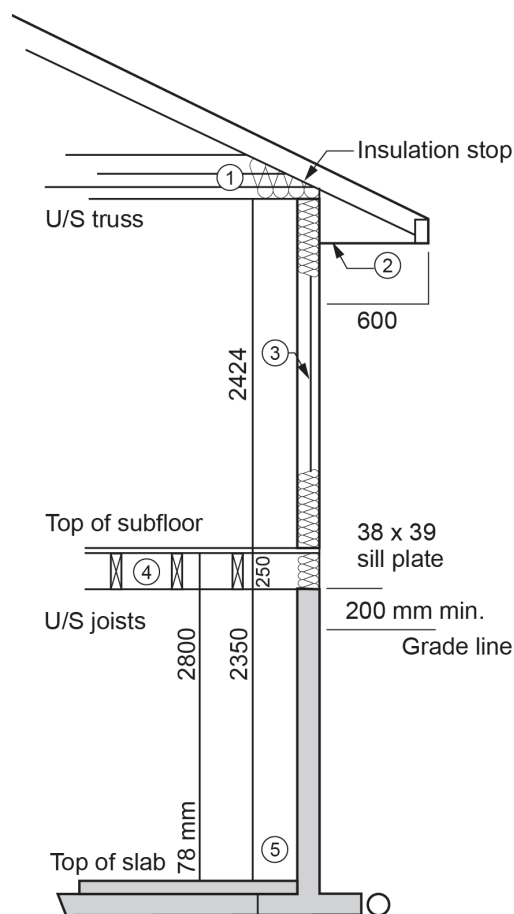


Figure 10 Full concrete lower floor. (Skilled Trades BC, 2021) Used with permission.

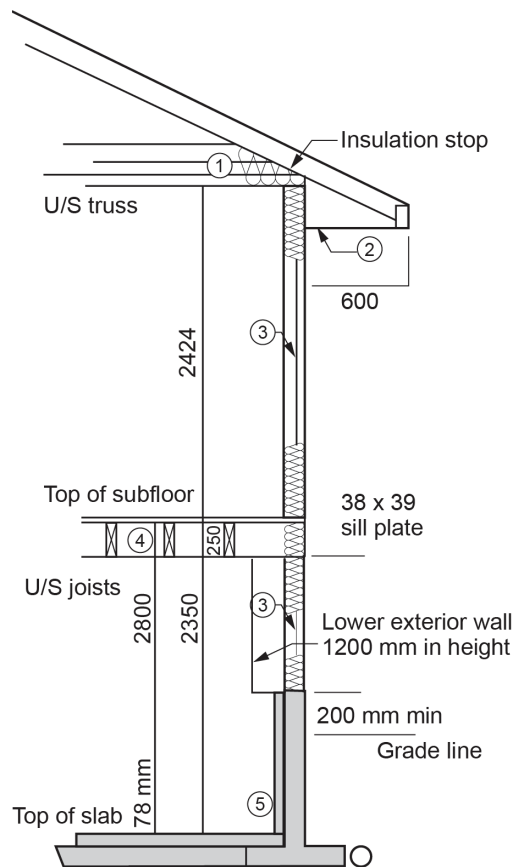


Figure 11 Lower floor partial frame. (Skilled Trades BC, 2021) Used with permission.

Mechanical Drawings

The **mechanical drawing** (or climate control plan) is used to identify and locate services for plumbing, heating, air conditioning, duct work, etc. The mechanical drawing is indicated by an M, which precedes the drawing page number (e.g., M-5).

The mechanical drawing is based on the floor plans of the architectural drawings. The architectural details are removed so that they do not interfere with the mechanical details. Sometimes, other drawings are required to complete the mechanical drawing. If there is a great deal of mechanical information, the drawing may be split into two drawings, with plumbing details on one and heating and air conditioning information on the other. In that case, the drawings are called plumbing plans and heating plans. They may also have a separate sprinkler drawing designated by F, FP, or SP.

For a small residential building, separate mechanical drawings are not usually included, and the main mechanical equipment locations will simply be shown on other drawings. For example, in the building drawing we have been looking at, the furnace location is shown in Figure 4 and the heating registers (hot air outlets) and cold air return are included on the electrical drawing in Figure 12.

Electrical Drawings

The **electrical drawing** identifies and locates services for the building's electrical system. The electrical plan is based on the floor plan. It shows the layout of wiring for lights, switches, outlets, and electrical panels. It also shows services for low-voltage systems, such as hydronic heating controls, telephone, cable television, and inter-communication network.

On large commercial buildings, factories, and high-rise office towers, the electrical services can be complicated. The electrical drawing is designed by an electrical engineer. It is indicated by an E, which precedes the drawing page number (e.g., E-2). A typical electrical plan is shown in Figure 12.

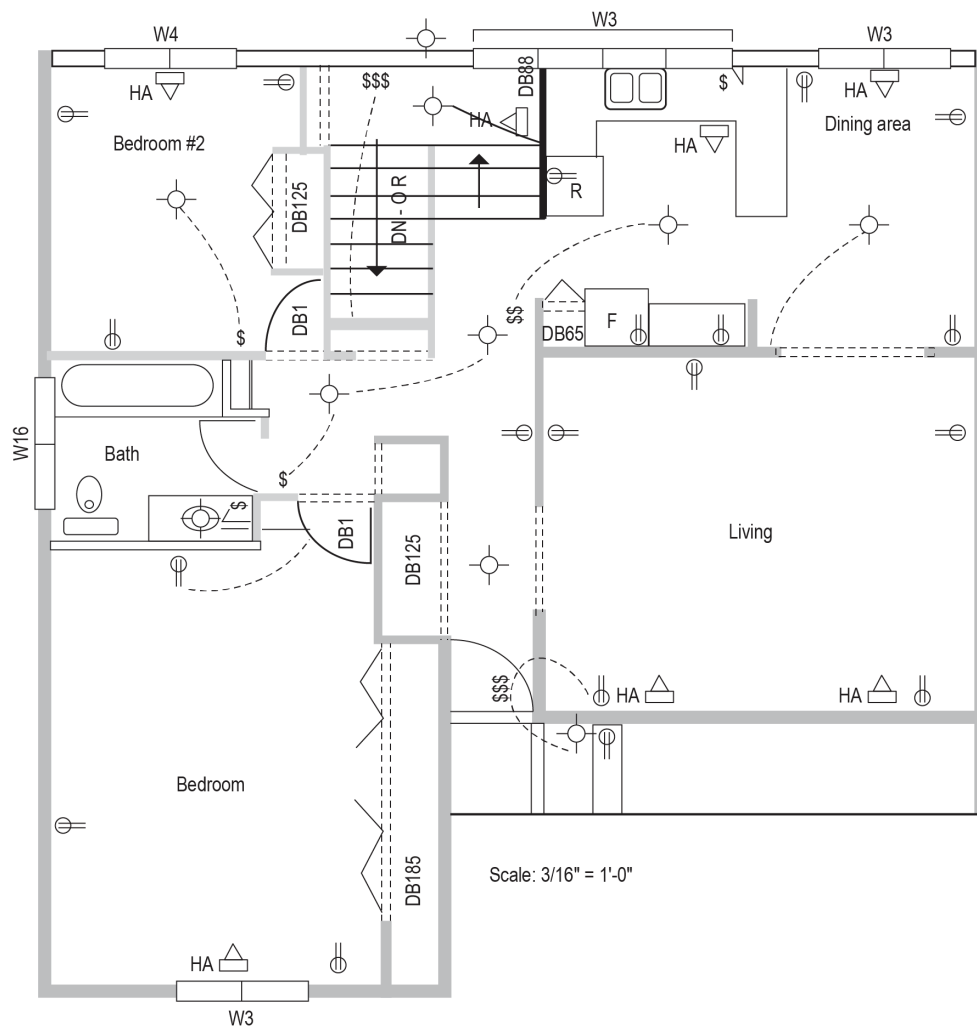


Figure 12 A typical electrical plan. (Skilled Trades BC, 2021) Used with permission.

The locations of all outlets, fixtures, and controls are shown on the electrical plan using electrical wiring symbols. A line of long dashes separated by dots indicates that a fixture and a switch will be connected by wiring. However, the dot-dash does not show the exact path of the wiring through the floor or ceiling. For example, the actual wiring from the dining area light switch to the lighting fixture might run along the wall and then perpendicular to the wall, instead of following the line shown. Plumbers can usually avoid the locations of electrical parts without any difficulty or inconvenience.

Shop Drawings

Shop drawings are used by prefabrication shops for making structural components. For example, a prefabrication shop producing steel columns for a building will take the information from the structural drawings and make detailed shop drawings that show the sizes and dimensions of all the columns. The shop drawings are then sent to the building contractor for approval of the sizes, dimensions, and quantities of each type of column. When the drawings have been approved, the fabricator starts production. Items such as beams, girders, trusses, and other fabricated members require that shop drawings be made before production starts.

As-Built or As-Constructed Drawings

In commercial buildings, changes are often made during construction to deal with conflicts discovered or changes made by the owner or architect as work proceeds. Any deviations from the original as-designed drawings must be documented on drawings. The terms **as-constructed** and **as-built** are often used interchangeably as they both refer to a drawing that indicates deviations from the as-designed drawings. These drawings are based on information provided by the installation contractor, therefore, the architect is not responsible for the information.

On some projects, the two terms might mean different things. For example:

- “**As-constructed**”: the defect and deviation to the designed model occurring during construction.
- “**As-built**”: the record drawings and documentation defining deviation to the designed information occurring during construction at the end of the project.

Typically, the contractor is required to make red-line markings on the original construction drawings to indicate any changes as work progresses. For example, when services are buried under a concrete slab or hidden behind a wall, the owners of the building often ask the sub-trades, such as plumbers and electricians, to provide detailed drawings of the exact location of the services that have been buried. That way, if there is a problem with the services, the locations of the hidden services are quickly and correctly identified.

These red-line drawings are delivered to either the general contractor or the architect, who prepares the final as-built drawings. These drawings can be vital for the proper maintenance or repair of the building's systems.

Drawing Parts

To efficiently read drawings, you will need to be able to identify some of the common general parts of a drawing, including:

- Title block
- Scale
- Key plan
- North arrow
- References
- Schedules

- Notes
- Flow diagrams

Title Block

The **title block** contains:

- Job title (including the name and nature of the project, the name of the owner, and the site address)
- Name of the architectural or engineering firm
- Date of drawing and date of completion
- Job number
- Initials of drafter and checker
- Drawing number
- Scale of the drawing

The drawing number consists of a letter (either A, S, M or E) and a number. The letter refers to the type of drawing:

- A = Architectural
- S = Structural
- M = Mechanical
- E = Electrical

For example, the drawing number A1 of 4 would be the first sheet of the four architectural drawing sheets.

Figure 13 shows a piping drawing with a title block. The upper left portion of the drawing is a plan view, simply called a plan. This drawing sheet is numbered M3 of 5, which indicates it is the third sheet of the five mechanical drawings.

Scale

The **scale** included in the title block of Figure 13 means that all views on the sheet are drawn to a scale of $\frac{3}{8}$ of an inch equals one foot. ($\frac{3}{8}$ in. = 1 ft-0 in.).

Key Plan

If a plan drawing is not of an entire floor of a building, a **key plan** is usually placed near the title block to indicate which part of the floor is shown. The key plan is a miniature outline of the entire floor, with the plan view section hatch-marked or shaded in. A key plan is included in Figure 13.

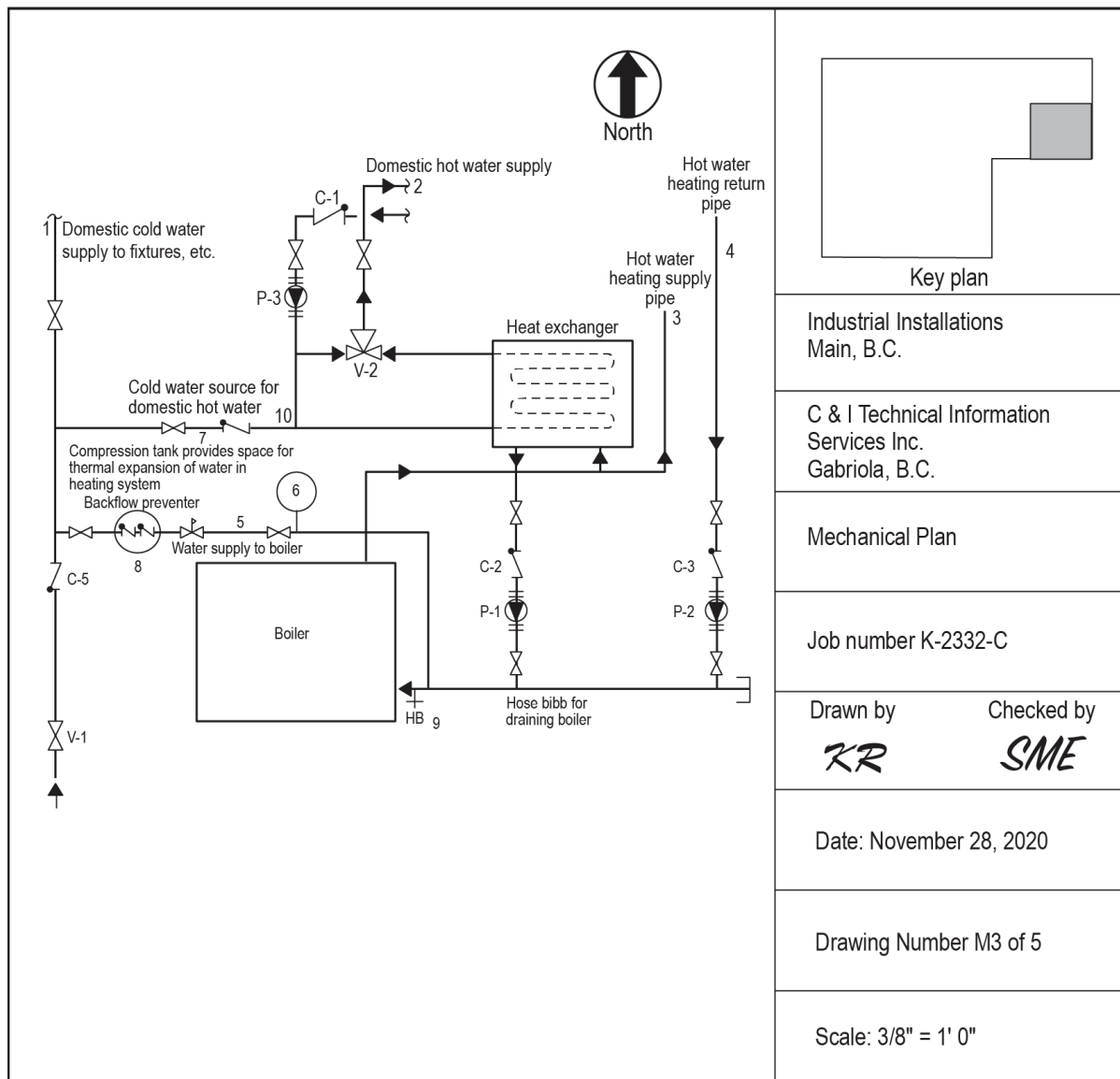


Figure 13 Heating system plans including a key plan. (Skilled Trades BC, 2021) Used with permission.

North Arrow

The arrow to the left of the key plan at the top right of Figure 13 shows which direction is north in relation to the building. This **north arrow symbol** is only used for plans on drawings. It is not used to orient any elevation or sectional views that may be on the same sheet. The direction symbol in Figure 14 is sometimes used in place of the north arrow symbol shown in Figure 13.

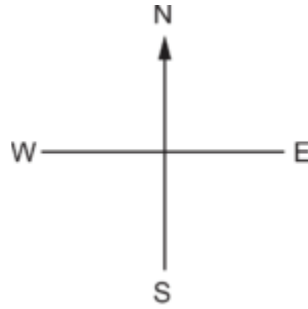


Figure 14 Direction symbol.
(Skilled Trades BC, 2021) Used
with permission.

References to Other Drawings

Other drawings may be produced for architect's drawings and show details of exterior walls or details of structural or mechanical drawings. To clarify and expand upon the information shown on a plan, it is common practice to include other drawings, such as a section or elevation drawing. These drawings show details or views of the system from other directions. Elevation drawings may be considered horizontal views of a system, while sections contain part of an elevation cut off at the reference markers.

Elevation References

The **elevation reference** symbol is shown on a plan view and indicates that an elevation drawing showing a vertical cross-section of the building at the point indicated by the symbol arrow has been prepared. The letter in the top half of the symbol identifies the elevation. The bottom half indicates the page on which the elevation drawing may be found. The symbol in Figure 15 indicates that Elevation C is shown on page A6 (one of the architectural drawings).

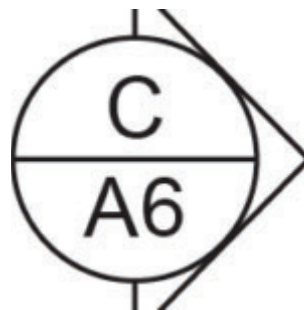


Figure 15 Elevation reference
symbol. (Skilled Trades BC,
2021) Used with permission.

Section References

A **section reference symbol**, as in Figure 16, is used to indicate that a section drawing rather than an entire elevation has been prepared. The symbol appears beside any part of a building plan that is shown in sectional view on another drawing sheet. The letter in the top half of the section reference symbol identifies the section. The number in the bottom half shows the page on which the sectional view can be found. The long and short dashed lines indicate which part of the plan is shown in the sectional view, and the arrows show the direction of the view. The section drawing appears on a different page, as indicated by the bottom of the circle. The symbol in Figure 16 indicates that Section B may be found on page A5 and that the drawing presents the section you would view facing to the right.

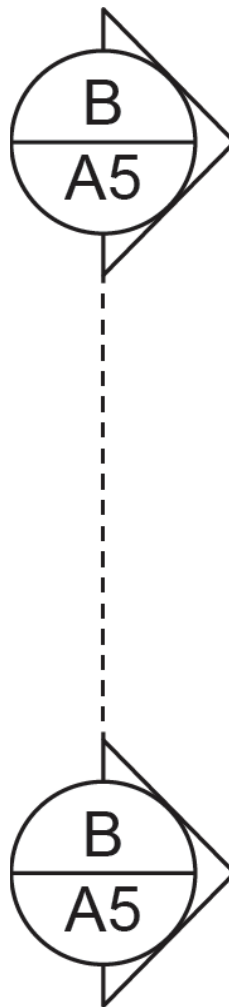


Figure 16 Section reference symbol. (Skilled Trades BC, 2021) Used with permission.

Detail References

A **detail reference** symbol, as in Figure 17, appears beside a part of a building plan that is drawn in detail at a larger scale on another page. The number in the top half of the detail reference symbol is the detail number. The number in the bottom half is the page on which the detail drawing can be found. This page number is usually a letter and number combination.



Figure 17 Detail reference symbol. (Skilled Trades BC, 2021) Used with permission.

References to detail drawings shown on the same page use the symbol in Figure 18. The detail drawing will be labelled with the number shown in the top half, and the bottom half is left blank to indicate “this page.”

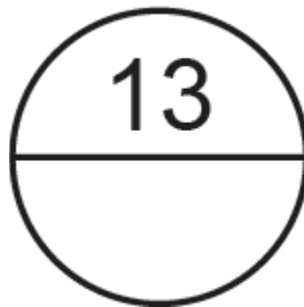


Figure 18 Reference to detail drawing on same sheet. (Skilled Trades BC, 2021) Used with permission.

Notice that the details are referenced by numbers, whereas sections and elevations are referenced by letters.

Schedules

A **schedule** is a convenient method of listing variable conditions on drawings so that similar information can be found in one handy location. For example, an architectural drawing may contain a door schedule that shows the type, size, style, drawing reference number, etc., of all the doors on a plan. Table 1 is a pump schedule that lists all circulation pumps used in the heating installation shown in Figure 13.

Table 1: Pump Schedule

Model No.	Flange Pipe Size (in.)	Face-to-Face Flange Length (in.)	HP	Volts	Phase
P3S25	0.75	6.5	0.08334	115	1
P1H32	1.25	8.5	0.1667	115	1
P2S34	1.5	8.5	0.1667	115	1

Notes

Notes are written descriptions of the materials, equipment, valves, instruments, etc., shown on a drawing. The notes can be placed beside the symbol being described, or they can be numbered and listed in a separate area to prevent crowding in the drawing.

Figure 19 is a flow diagram that contains notes. Some notes are listed with reference numbers, while others are inserted beside the objects described.

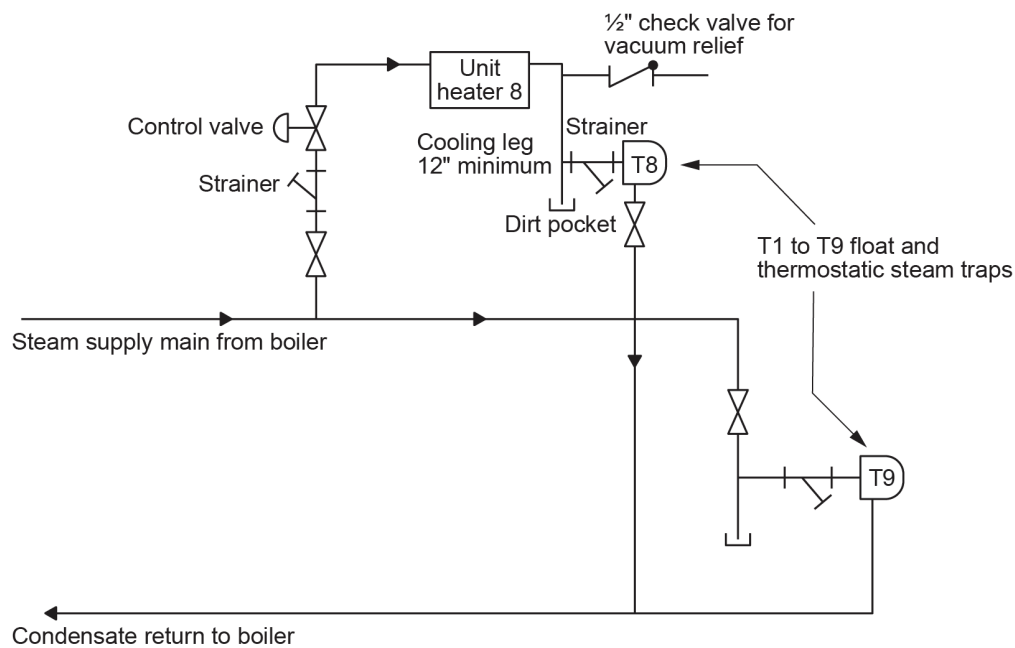


Figure 19 Flow diagram (plan). (Skilled Trades BC, 2021) Used with permission.



Self-Test D-2.1: Types of DWV Drawings

Complete Self-Test D-2.1 and check your answers.

If you are using a printed copy, please find Self-Test D-2.1 and Answer Key at the end of this section. If you prefer, you can scan the QR code with your digital device to go directly to the interactive Self-Test.



An interactive H5P element has been excluded from this version of the text. You can view it online here:
<https://d-drainagesystems-bcplumbingapprl2.pressbooks.tru.ca/?p=60#h5p-11> (<https://d-drainagesystems-bcplumbingapprl2.pressbooks.tru.ca/?p=60#h5p-11>)

References

Skilled Trades BC. (2021). *Book 2: Install fixtures and appliances, install sanitary and storm drainage systems*. Plumber apprenticeship program level 2 book 2 (Harmonized). Crown Publications: King's Printer for British Columbia.

Trades Training BC. (2021). D-2: Plan DWV systems. In: *Plumber Apprenticeship Program: Level 2*. Industry Training Authority, BC.

Media Attributions

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D-2.2 Planning Interior DWV System Layouts

The layout process of a **DWV system** requires the plumber to consider all installation aspects of the system. Because each project is different, it is essential that the installer have a thorough understanding of applicable plumbing codes and the ability to visualize the completed DWV system.

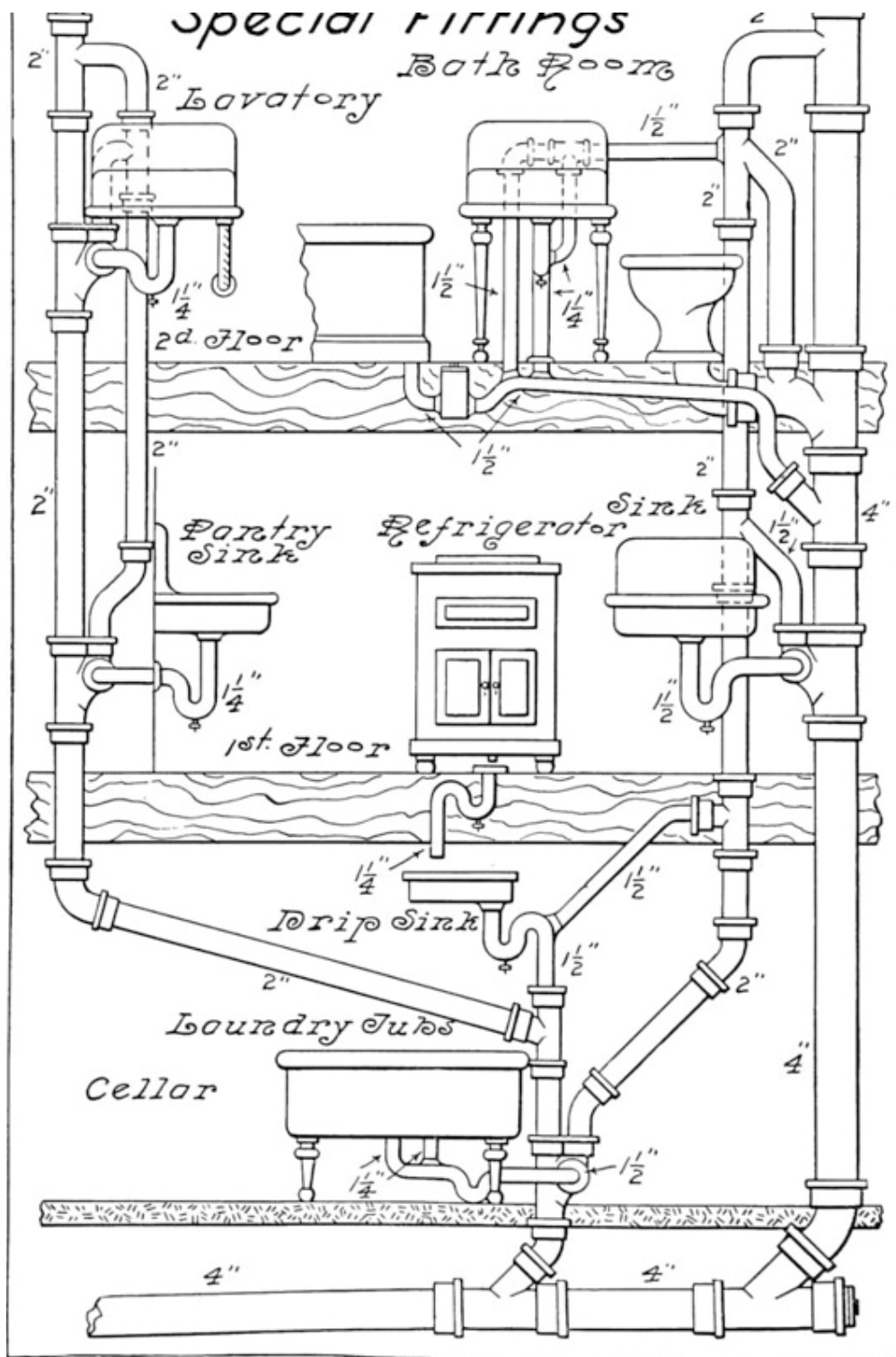


Figure 1 "Modern" Plumbing in 1907. (Starbuck, Robert Macy, 1844-/ Flickr) Public Domain (<https://creativecommons.org/publicdomain/zero/1.0/>)

Location of Structure Penetrations

In wood-frame buildings, keep the size and number of **penetrations** through structural members to a minimum. In a situation where a penetration is required, take care to not cut and notch wood joists and beams in a manner that reduces the strength and load-carrying ability of the structural member.

Regulations restrict the size and location of these penetrations, depending on the type of component. It is important to determine whether the wooden component is load bearing to correctly determine the allowable size penetration that can be drilled or notched. No penetration in the structure should be made until the entire project has been laid out.

When you are planning structural penetrations, note that commercial buildings equipped with fire separations require special considerations. Combustible DWV piping penetrations are permitted in a rated fire separation or a membrane that forms part of a rated fire separation as long as the penetration is sealed by a **fire-stop system**.

In some instances, sanitary building drains leave the building through a foundation wall due to the elevation of site services. The location and elevation of this penetration should be determined at the time of forming so that blocking or sleeves can be installed prior to the concrete pour, eliminating the need for coring expenses later.

Roof vent terminals should be located where they do not interfere with building aesthetics. In a residential installation, for example, locating the vent terminal on the back slope of the roof as opposed to the front will eliminate sighting from the street. Vent terminals should be located where they are provided with ample air supply and are not susceptible to adverse wind effects. The clearances that must be maintained from occupied spaces and building openings have already been discussed in Section D-1.1: Codes and Standards ([#chapter-d-1-1-codes-and-standards](#)).

Routing

The location of the major fixture groups determines the preferred location of stacks and branch drains. A thorough inspection of the proposed route is required to identify possible conflicts with structural components and space coordination with other trades. The **routing** should follow the lines of the building (parallel and perpendicular). This practice will limit **bulkhead** and **ceiling drop installations** to accommodate the DWV installation.

When a route is being planned, the plumber must be aware that current building codes do not allow plumbing drains and vents to be installed in the outside walls unless full insulation value can be achieved. This means the wall must be furred (built) out or the piping relocated to an interior space.

When routing drain lines in the ceiling space over sensitive areas, consideration must be given to the possibility of damage caused if there is a blockage that requires cleaning. Drains should be routed far enough away from walls and obstructions, so that the drain-cleaning machine can gain access if needed.

Pipe Supports

Underground piping from the municipal system into your home is installed in dug trenches to a depth below the **frost line** for your climate, which obviously could vary a great deal depending on your geographical location. The trench

should be constructed as narrow as is reasonable to allow proper joining of the pipes and to avoid having to dig below the depth required to support the pipe, as the undisturbed soil is naturally compacted and will not settle over time.

When laying the piping in the trench, the markings on the pipe that indicate the type and class of pipe should face up, and all the joints must be visible until an inspection by the local authority has been done.

Inside the building, the maximum distances between **pipe supports** are specified in the National Plumbing Code (NPC). The supports must be located to maintain a uniform slope that will not change with time. The pipe supports and structure connections must be able to resist forces due to hydraulic testing and the **seismic forces** imposed on them. The support locations must not introduce stresses in the piping caused by thermal expansion or contraction, and must isolate the piping from stresses caused by twisting, torsion, or lateral bending in the framing members.



Self-Test D-2.2: Planning Interior DWV System Layouts

Complete Self-Test D-2.2 and check your answers.

If you are using a printed copy, please find Self-Test D-2.2 and Answer Key at the end of this section. If you prefer, you can scan the QR code with your digital device to go directly to the interactive Self-Test.



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<https://d-drainagesystems-bcplumbingapprl2.pressbooks.tru.ca/?p=62#h5p-10> (<https://d-drainagesystems-bcplumbingapprl2.pressbooks.tru.ca/?p=62#h5p-10>)

Media Attribution

- **Figure 1** “Modern” Plumbing in 1907 – **Identifier:** cu31924015368818 (<https://www.flickr.com/photos/internetarchivebookimages/14591920039/>), at Flickr, is by Starbuck, Robert Macy, 1844-. This image is an excerpt from *Modern plumbing illustrated; a comprehensive and thoroughly practical work on the modern and most approved methods of plumbing construction* (<https://archive.org/stream/cu31924015368818/cu31924015368818#page/n203/mode/1up>), found on the Internet archive. It is in the public domain. (<https://creativecommons.org/publicdomain/zero/1.0/>)

D-2.3 Creating Plans and Isometric Drawings of DWV Systems

In this chapter, you will be asked to create plan and **isometric drawings** of residential piping systems.

The **plumbing plan** is a two-dimensional plan view drawing showing the plumbing system. It is generated from the architectural floor plan showing the types and locations of the plumbing fixtures in the building. The plumbing plan describes the location, sizes, and types of all piping and fittings used in the system rough-in. The horizontal branches and fixture drains are drawn to scale, but due to the two-dimensional properties of the drawing, only the locations of all vertical pipes are shown.

Sketching a Plan View of a Residential DWV System

The first step in creating an orthographic plumbing plan is to determine the locations of any fixtures and stacks in the basement level. The stack locations will depend on the locations of the fixtures on the floor(s) above. The exact stack locations can be added later once the upper floor piping has been designed. It is very important to note where the sanitary sewer service enters the building. This will be the design starting point, working back toward the fixture locations.

You can then tie in all of the fixtures and stacks, including all required fittings, such as the building drain cleanout and a normally open back water valve.

The stacks, branches, and fixture drains in the vertical plane are represented by open circles with a dot in the centre, while horizontal branches and fixture drains are shown as they would appear from above.

Sizing of the DWV system should be based on minimum code requirements for the fixture unit load being served. Once the sizing is complete, the next step is to determine the fittings required for the under-slab rough-in.

The DWV system for the floors above must be drawn on a separate drawing sheet using the same procedure (Figure 20). The stacks are represented by open circles without a dot in the centre that show the stacks dropping vertically to the lower floor, while horizontal branches and fixture drains are shown as they would appear from above. Ensure that the location where the stacks drop to the basement is the same location where the stack rises up through the basement floor. This will eliminate the need for an offset to connect the stack sections.

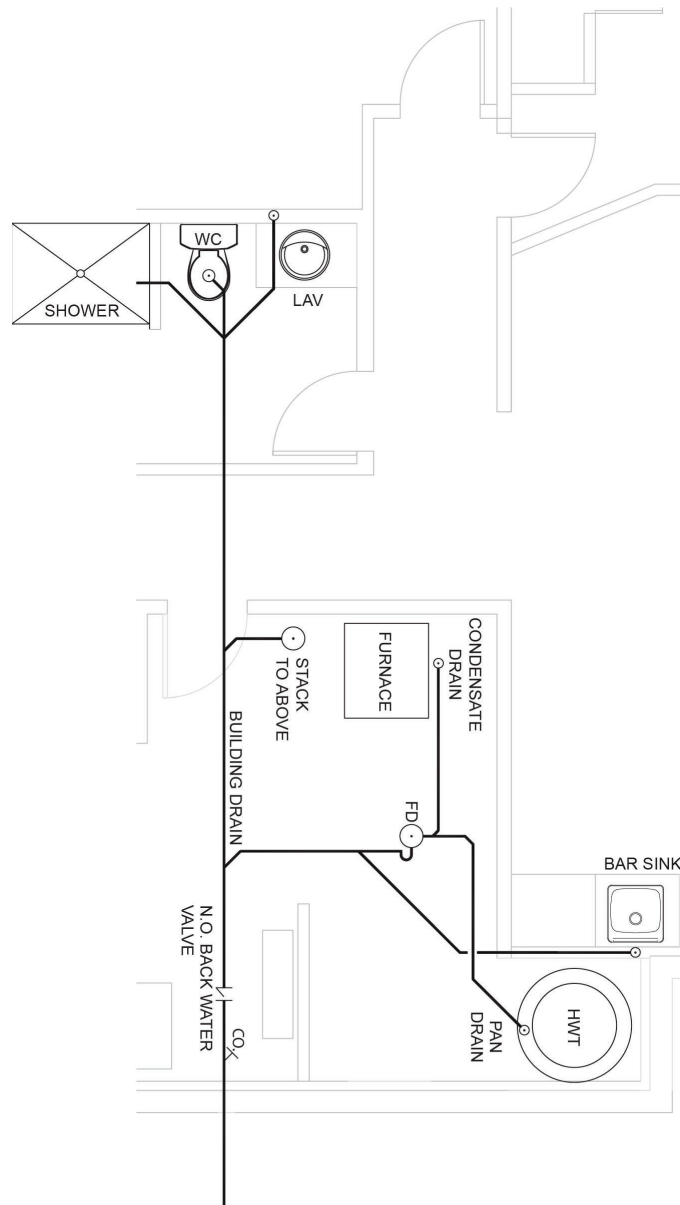


Figure 1 Architectural floor plan showing under-slab DWV rough-in.
(Skilled Trades BC, 2021) Used with permission.

Choosing a Scale

You may choose to draw the orthographic plumbing plan on the house plan, or you may want to use a separate sheet of paper. When you draw an orthographic plan or isometric sketch on a drawing sheet, you must use an appropriate scale to ensure that the amount of information you need fits on your page. When choosing a scale, it is important to consider the size of paper you wish to use. The best way to determine the proper scale is to divide the longest length of your project by the longest dimension of your drawing page.

For example, if the floor plan measures 50 ft (or 600 in.) in length and the drawing sheet is 12 in., the scale would be:

$$600 \text{ in.} \div 12 \text{ in.} = 50$$

1:50 or approx. $\frac{1}{4}$ in. per foot

Sketching Residential Plumbing Groundwork Using Isometric Techniques

Isometric drawings are generated from the information found on the orthographic plan and elevation views when available. Unlike orthographic plumbing plans, isometrics allow the DWV system to be drawn in a manner by which the length, width, and height are shown in a single view. This allows for a more complete view of the groundwork system. Like the orthographic sketch, the isometric sketch is also drawn to scale so that the exact locations of fixtures and piping can be shown. Note that non-isometric lines, such as 45° elbows and Y-fitting branches, are not to scale. In this case, you must refer to an **orthographic drawing** for dimensions.

Usually, piping isometrics are drawn on sheets pre-printed with lines drawn vertically and at 30° to the horizontal (Figure 2). The symbols that represent fittings and valves are modified to adapt to the isometric grid. Isometrics are the most important drawings for mechanical contractors during the rough-in portion of a project.

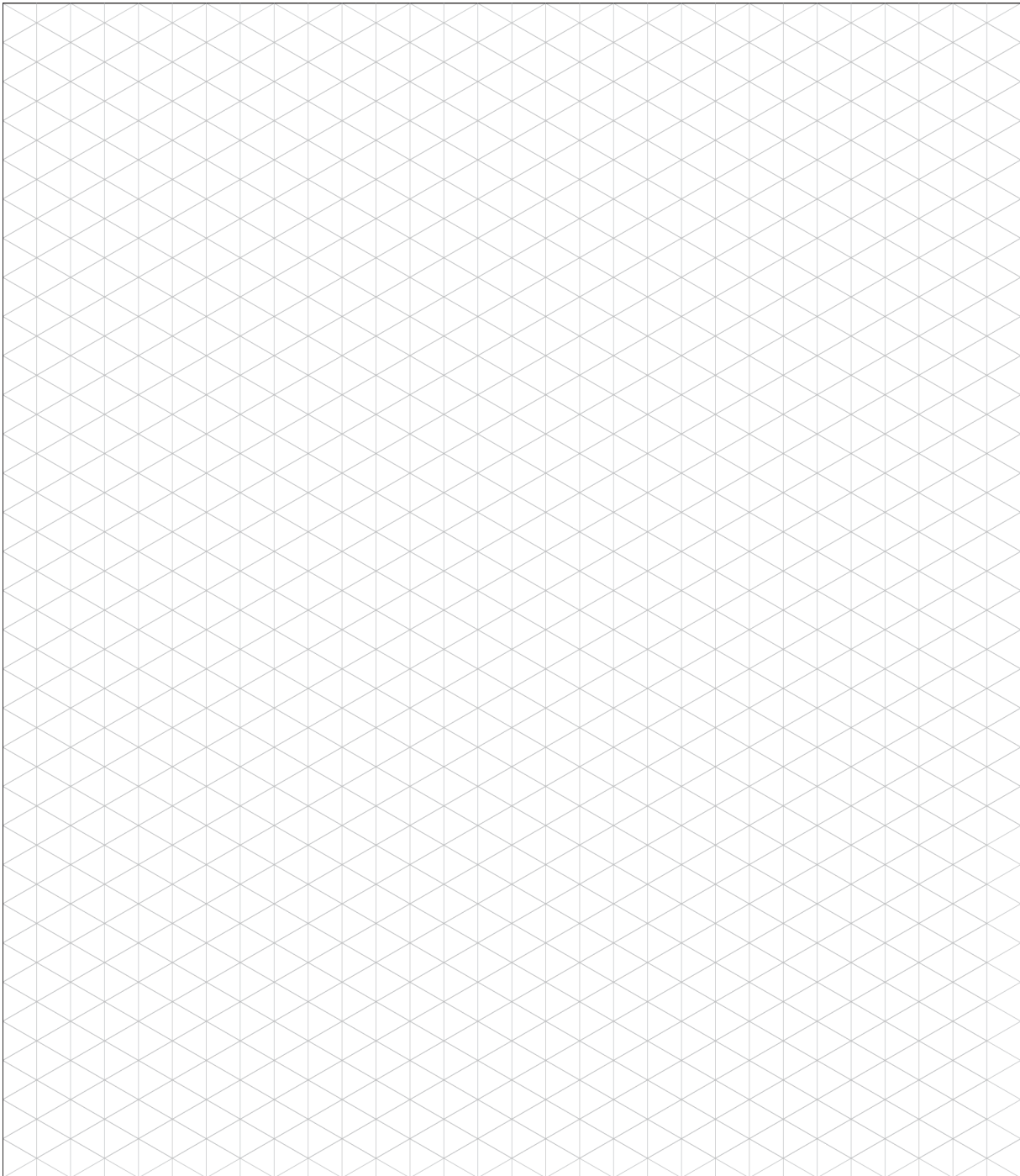


Figure 2 Example of a pre-printed isometric drawing sheet. (Skilled Trades BC, 2021) Used with permission.

As when creating an orthographic sketch, the first step in drawing an isometric sketch is to determine where the fixtures, stacks, and building sewer are to be located. This is an important step for laying out the groundwork and for deciding how to orient the sketch on the paper. The orientation on the drawing sheet is an important factor to consider because you want to avoid lines crossing one another or lines blocking the view of other piping or fittings.

Fixture Specifications

Once the fixture locations have been established on the drawing sheet, the next step is to determine the fixture manufacturer's specifications to determine the associated rough-in dimensions for the drain and water lines. This fixture model is provided in the specifications for the project, while the dimension information is available from a rough-in manual or the company website in both imperial and metric measurements (Figures 3 and 4).

The information typically found in the manufacturer's rough-in manual includes:

- Fixture dimensions
- Distance to the centre of the fixture's drain from the finished wall
- Height of the drain and water line connections from the floor
- Centre-to-centre dimensions of faucets
- Support backing for wall-hung fixtures



Toilet type:	One-piece
Bowl shape:	Compact Elongated front
Seat hinge type:	Quick-Attach®, Quiet-Close™, Quick-Release™
Trap passageway:	2-1/8" (54 mm)
Water Consumption	
Full:	1.28 gpf (4.8 lpf)
Water surface size:	9-5/8" x 6-7/8" (245 mm x 174 mm)
Rim to water surface:	5-3/8" (137 mm)
Rough-in:	12" (305 mm)
Seat-mounting holes:	5-1/2" (140 mm)

Notes

For back-to-back toilet installations: Use only a 45° double wye fitting.

Figure 3 Manufacturer's rough-in specification sheet for a residential toilet. (Image courtesy of Kohler Co.). Used with permission.

KOHLER® Roughing-In

K-2035 PINOIR® WALL-MOUNT BATHROOM SINK

Product Information

Applicable product:	
Bathroom sink with 8" (203 mm) centers	K-2035-8
Bathroom sink with 4" (102 mm) centers	K-2035-4
Bathroom sink with single hole	K-2035-1

Fixture*:	
Basin area	18" (457 mm) x 12" (305 mm)
Water depth	4" (102 mm)
Drain hole	Ø 1-3/4" (44 mm)
* Approximate measurements for comparison only.	

Recommended accessories:	
Bathroom sink supplies, 3/8" (pair)	K-7605-P
P-Trap	K-8998

Holes	K-2035-8	K-2035-4	K-2035-1
Spout	Ø 1-3/8" (35 mm)	Ø 1-1/4" (32 mm)	Ø 1-3/8" (35 mm)
Faucet	Ø 1-3/8" (35 mm)	Ø 1-1/4" (32 mm)	

Included components:	
Bathroom sink, 8" (203 mm) centers	K-2028-8
Bathroom sink, 4" (102 mm) centers	K-2028-4
Bathroom sink, single-hole	K-2028-1
Shroud	K-2057
Rubber pads	63069
Hanger	64839
Shroud accessory pack	80265

Installation Notes

Install this product according to the installation guide.

Will comply with **ADA** when installed per Section 606 Lavatories of the 2010 ADA Standards for Accessible Design.

Will comply with **CSA B651** when installed per Clause 4.3.3 of the standard.

Will comply with **OBC** when installed per Clause 3.8.3.11.

Fixture conforms to standard ASME A112.19.2/CSA B45.1. All dimensions are nominal.

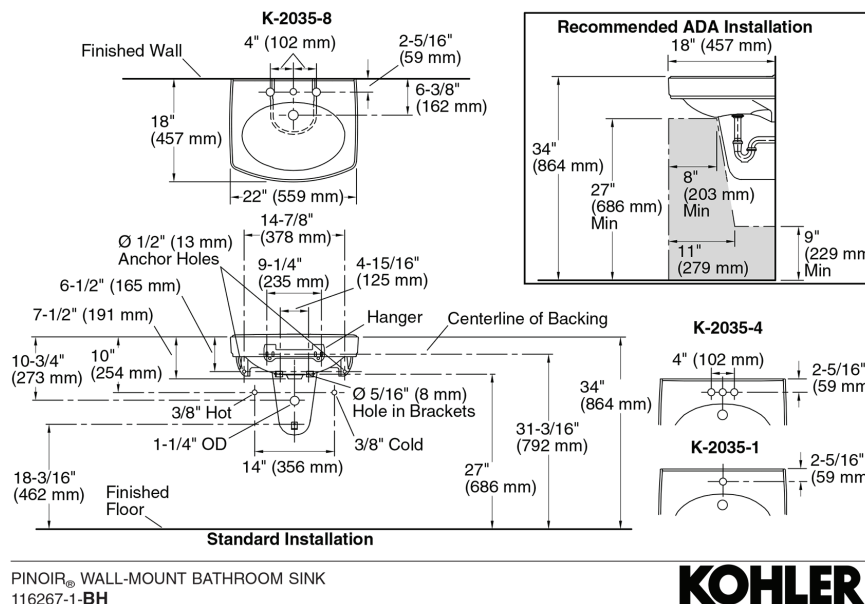


Figure 4 Manufacturer's rough-in specification sheet for a wall-hung basin (Image courtesy of Kohler Co.). Used with permission.

Plotting Fixtures

After you have obtained the rough-in dimensions for each fixture, you can begin to plot the location of the DWV slab **penetration points** on an isometric drawing. This would include the floor-mounted fixtures and any risers or waste stacks. These points should be marked with an isometric X on the drawing, as shown in Figure 5.

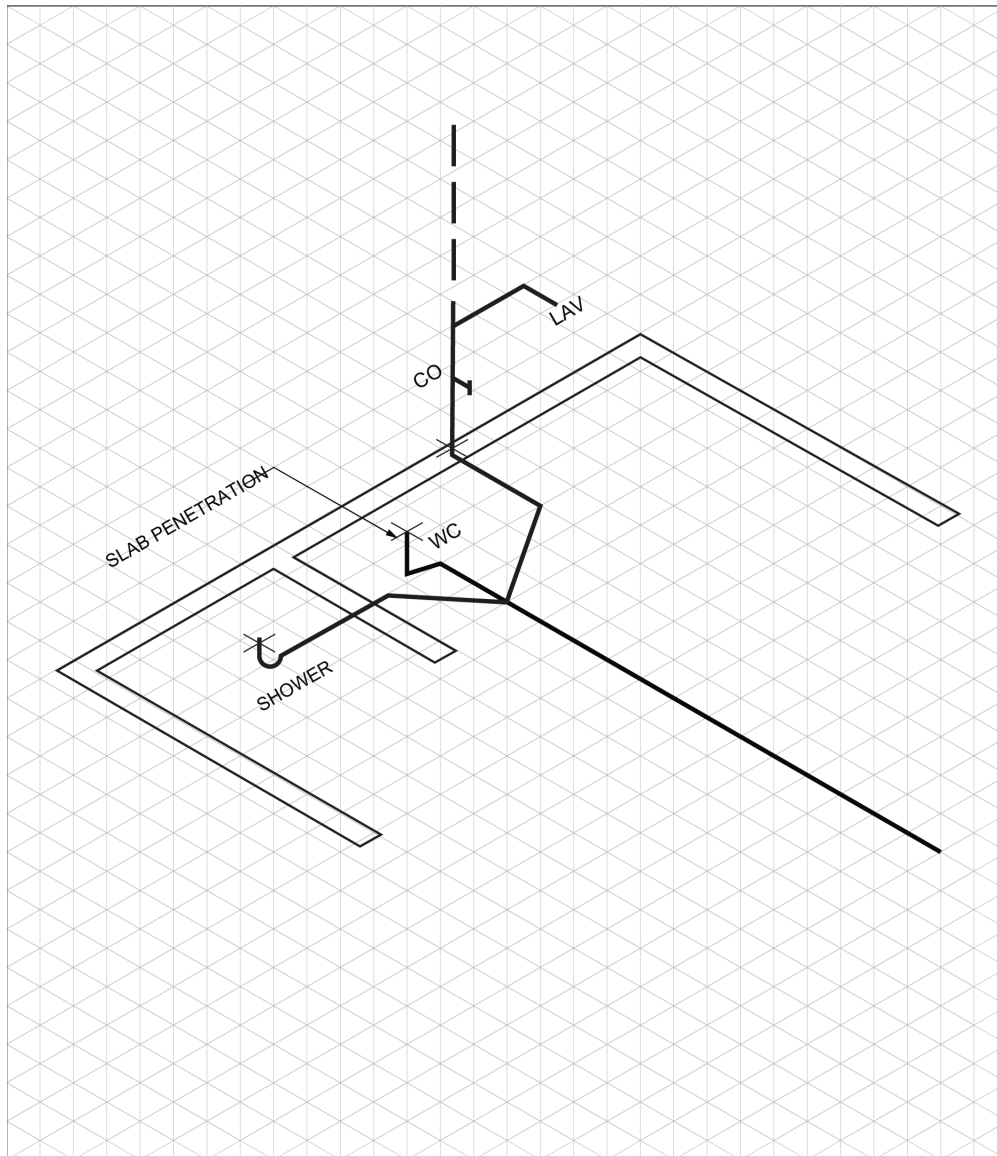


Figure 5 Three-piece bathroom group showing the slab penetrations and DWV piping connected.
(Skilled Trades BC, 2021) Used with permission.

Once the slab penetration locations are plotted, it is time to connect them. Make sure that all connections are made to minimum code requirements. Take special care to use appropriate fittings for the layout with the cleanouts properly located and accessible for future use. When drawing the sketch, the plumbing vents should be indicated using dashed lines to differentiate them from the drains (Figure 6).

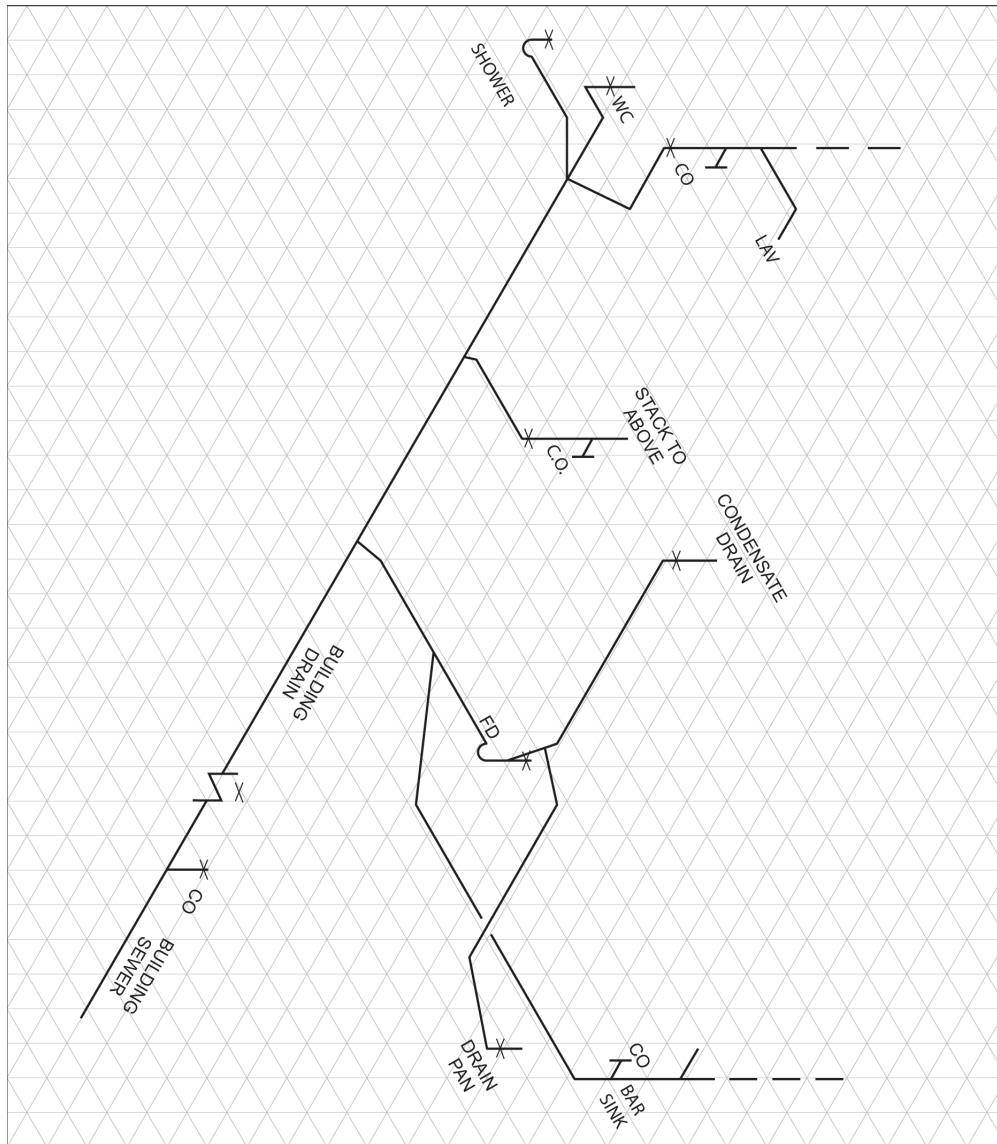


Figure 6 Full three-dimensional isometric under-slab rough-in to match plan view sketch. (Skilled Trades BC, 2021) Used with permission.

Upper Floors

As with groundwork, the DWV system drawn isometrically moving up through the structure provides a more complete three-dimensional view of the upper portion of the plumbing system (Figure 7). These sketches reveal connections to fixtures on upper floors, locations of stacks and vents within walls, and how the venting system terminates in open air.

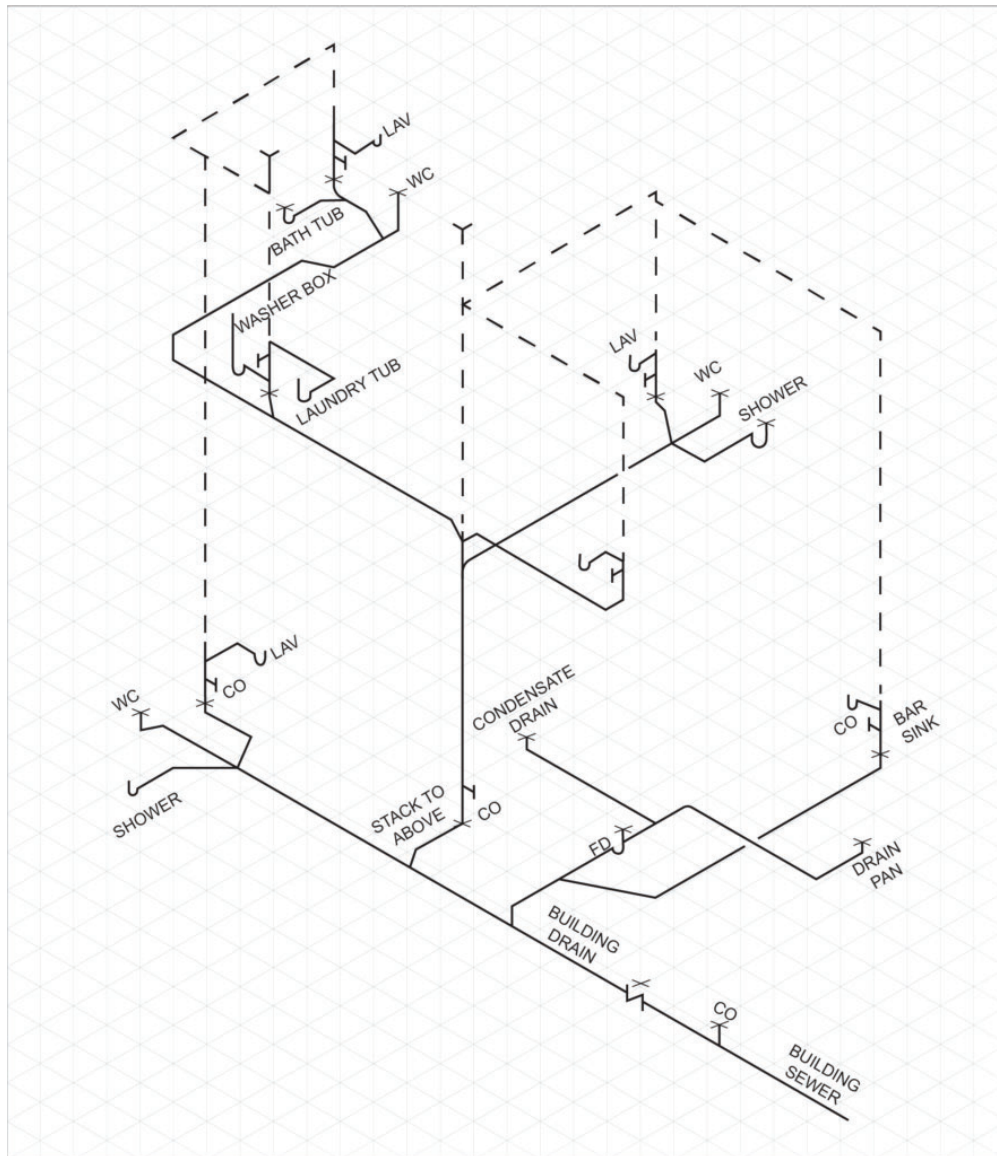


Figure 7 Full three-dimensional isometric rough-in of a residential DWV system. (Skilled Trades BC, 2021) Used with permission.

Vertical stacks, vents, and drainage branches are laid out in the same fashion as the groundwork plumbing. The floor penetrations are marked with an isometric X. The fixture connections to the DWV system must be installed to minimum code requirements.

Letters and Numbers

All drawings require some form of lettering and numbers, and these are as important as the lines. Scribbled, smudged, or badly written letters and numbers can be impossible to read. This may lead to time-consuming and costly errors.

Remember these principles when lettering and numbering:

- They should be legible and clear — especially numbers, as they often have to be read on their own.

- They should be of a suitable size and not less than 3 mm tall. Title blocks and relative information are usually larger (see Figure 8).
- All letters are written in capital (uppercase) letters.
- Letters should be correctly spaced and positioned.
- Notes and captions should be placed so that they can be read in the same direction as in the title block. In other words, it should not be necessary to turn a drawing on its side to read the information.
- Notes should be grouped together and not spread over the drawing.
- Underlining is not recommended.

Title and drawing sizes = 6 mm (1/4")

A B C D E F G H I J K L
M N O P Q R S T U V W
X Y Z 0 1 2 3 4 5 6 7 8 9

Dimension and notation sizes = 3 mm (1/8")

A B C D E F G H I J K L
M N O P Q R S T U V W
X Y Z 0 1 2 3 4 5 6 7 8 9

Figure 8 Standard lettering for drawings. (Skilled Trades BC, 2021) Used with permission.

Line Type

Standard lines have been developed so that every drawing or sketch conveys the same meaning to everyone. In order to convey that meaning, the lines used in technical drawings have both a definite pattern and a definite thickness (Figure 9). Some lines are complete and others are broken. Some lines are thick and others are thin.

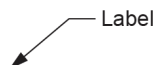
Object line Margin line	Heavy		Solid line to show visible shape, edges, and outlines.
Hidden body line	Medium		Broken line of long and short dashes to show hidden object lines not visible to the eye.
Phantom line	Light		Broken line of short dashes to show alternate positions or movement of a part.
Section line	Light	    Steel Copper/ Brass Lead Cast iron/ General purpose	Unbroken lines arranged in a pattern, usually straight and at a 45° diagonal.
Projection line	Light		Unbroken line that extend away from the object or feature for emphasis.
Centre line	Light		Broken line of long and short dashes to show the centre of an object.
Extension line/ Dimension line	Light		Extension lines are small lines that extend outward from an object or feature. Dimension lines span between the extension lines with arrowheads and a given dimension.
Leader line	Light		Unbroken line usually drawn at an angle often with a “dogleg” and an arrowhead. A dot is used in place of an arrowhead where a surface is reference. Usually accompanied by a label.
Cutting plane line	Heavy		Broken line of one long and two short dashes to show an imaginary cross-section. The arrowheads show the direction from where the cross-section is viewed. A corresponding image will show the view of A.
Break lines for wood and metal	Heavy		Unbroken freehand or straight zig-zag lines to abbreviate longer spans of wood or metal.
Break lines for piping	Heavy		Curled lines to abbreviate a longer span of pipe.

Figure 9 Standard lines. (Skilled Trades BC, 2021) Used with permission.

Study the line thicknesses (line weights) shown in Figure 10 and practise making them. Use a sharp pencil when you draw, and try to maintain an even, consistent pressure to make it easier for you to produce acceptable lines.

In computer drafting, the line shape remains the same as in manually created drawings, but line thickness may not vary. Some lines, such as centrelines, may not cross in the same manner as in a manual drawing. For most computer drafting, line thickness is not important.

Figure 10 shows the nature of each line and explains how they are used in a technical drawing. You should be able to identify each line by name and describe its application.

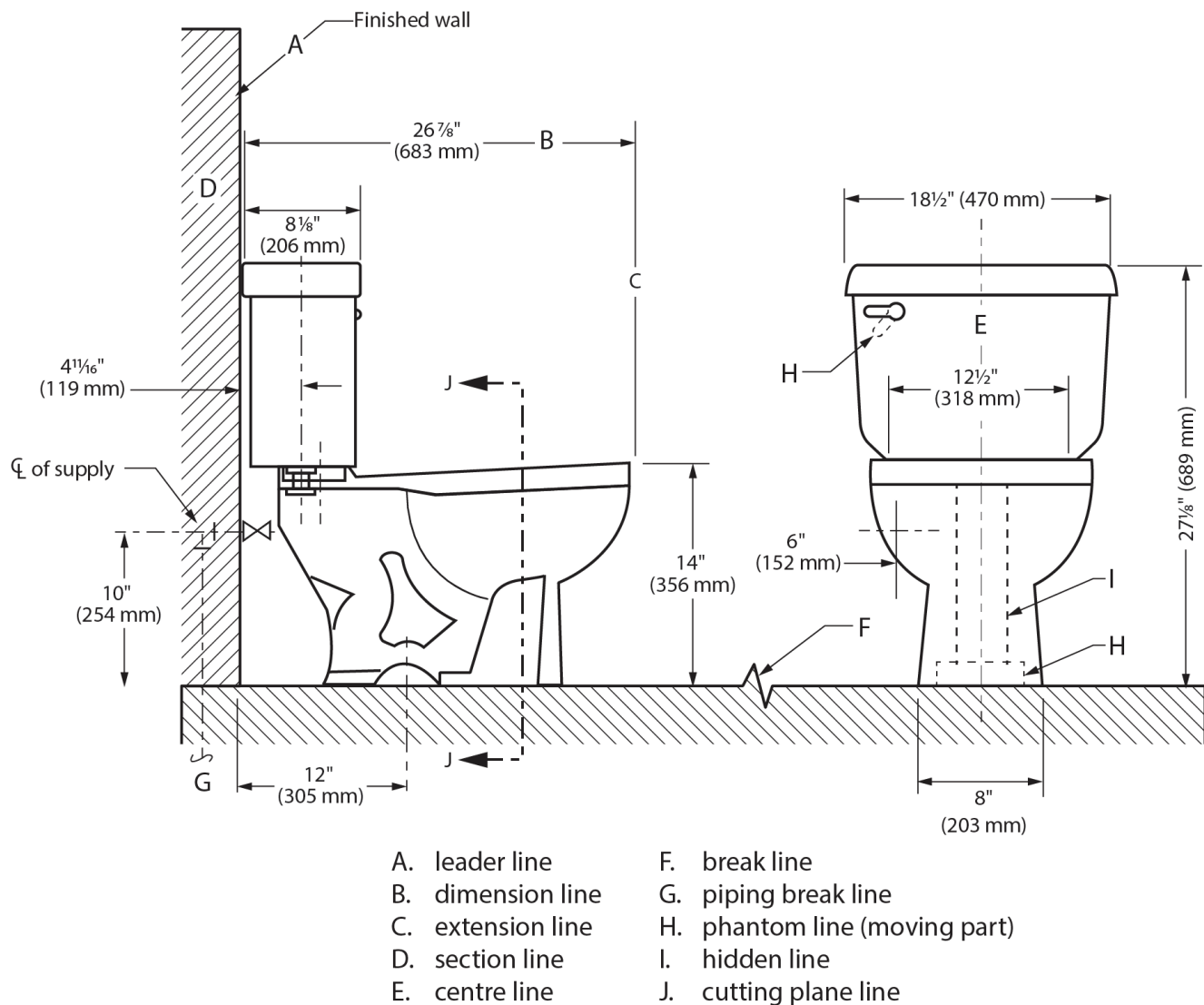


Figure 10 Use of standard lines. (Skilled Trades BC, 2021) Used with permission.

Information to be Contained in Drawings

Plan view DWV drawings and isometric DWV drawings are drawn to a specific scale and should show as much of the drainage and venting for a plumbing system as the view allows. Information such as rough-in heights, connection points to fixtures, floor penetrations, vent types, and vent locations should all be shown to enable the drawing to be as clear as possible while still fitting all information on the page.

Plumbing DWV drawings (isometric and orthographic plan) are really installation drawings. An installation drawing provides information for the proper positioning and installation of plumbing systems relative to the supporting structure and adjacent equipment, as applicable. This information may include:

- Dimensional data

- Piping configurations
- Piping materials
- Pipe sizes
- Fixture types
- General configuration information for the installation site

Dimensioning

Once the plan or isometric views of a piping assembly are created, they are not useful until they are completely and properly dimensioned. Dimensions show the length and size of DWV piping, as well as specific details that will determine how specific equipment is installed.

Dimensioning a drawing can be broken down into two steps:

1. Decide which dimensions are required.
2. Decide the best place on the drawing to place the selected dimensions.

A drawing that does not have all the required dimensions is said to be under-specified. This means that the person reading the drawing and installing the piping system does not have enough information to reproduce it. A drawing can also contain too many dimensions and, in that case, would be over-specified. Dimensions should NOT be duplicated, nor should the same information be given in two different ways.

Figures 11 and 12 show plan and isometric views of the same three-piece bathroom group. Note that the three-dimensional isometric drawing has the advantage of being able to show all of the information needed to install the rough-in. The isometric drawing is dimensioned with extension and dimension lines like a two-dimensional drawing. The extension lines extend from the drawing so the dimension lines are parallel to the object line.

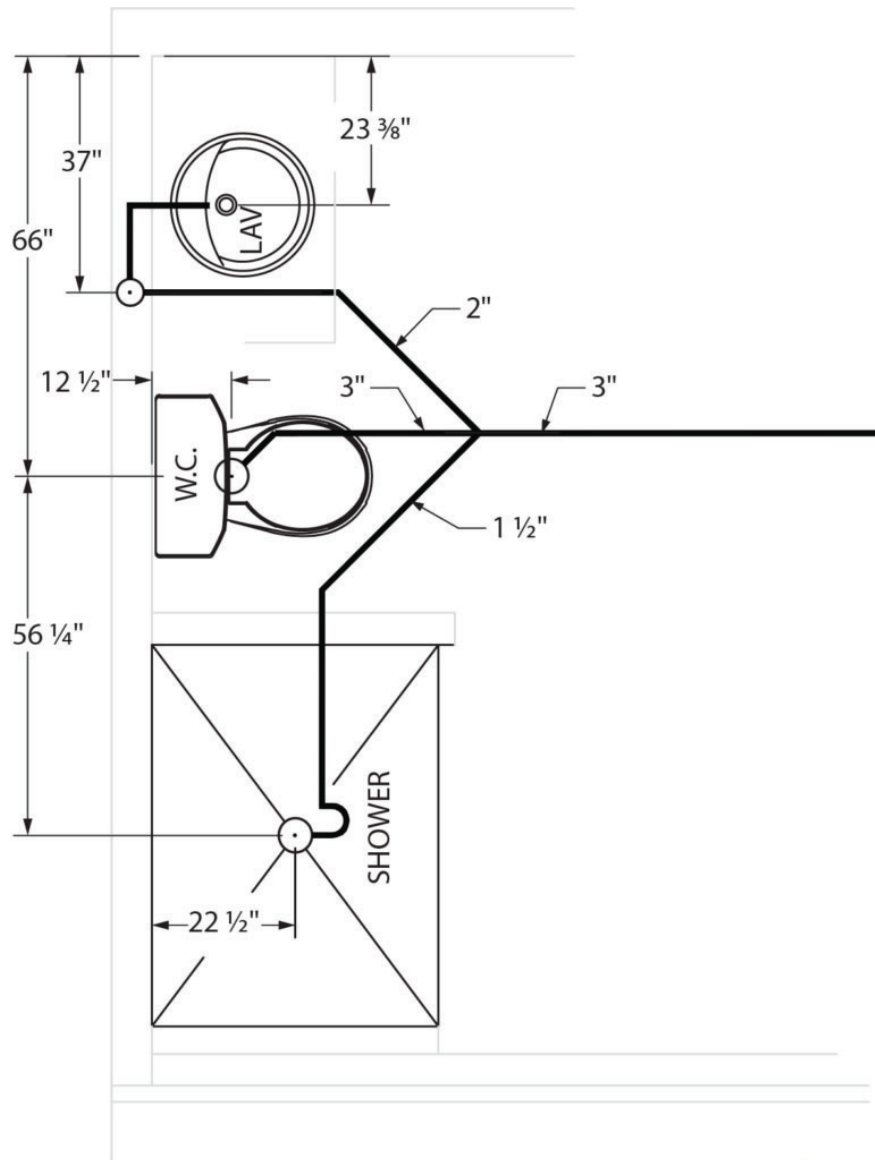


Figure 11 Dimensioned plan view of three-piece bathroom group. (Skilled Trades BC, 2021)
Used with permission.

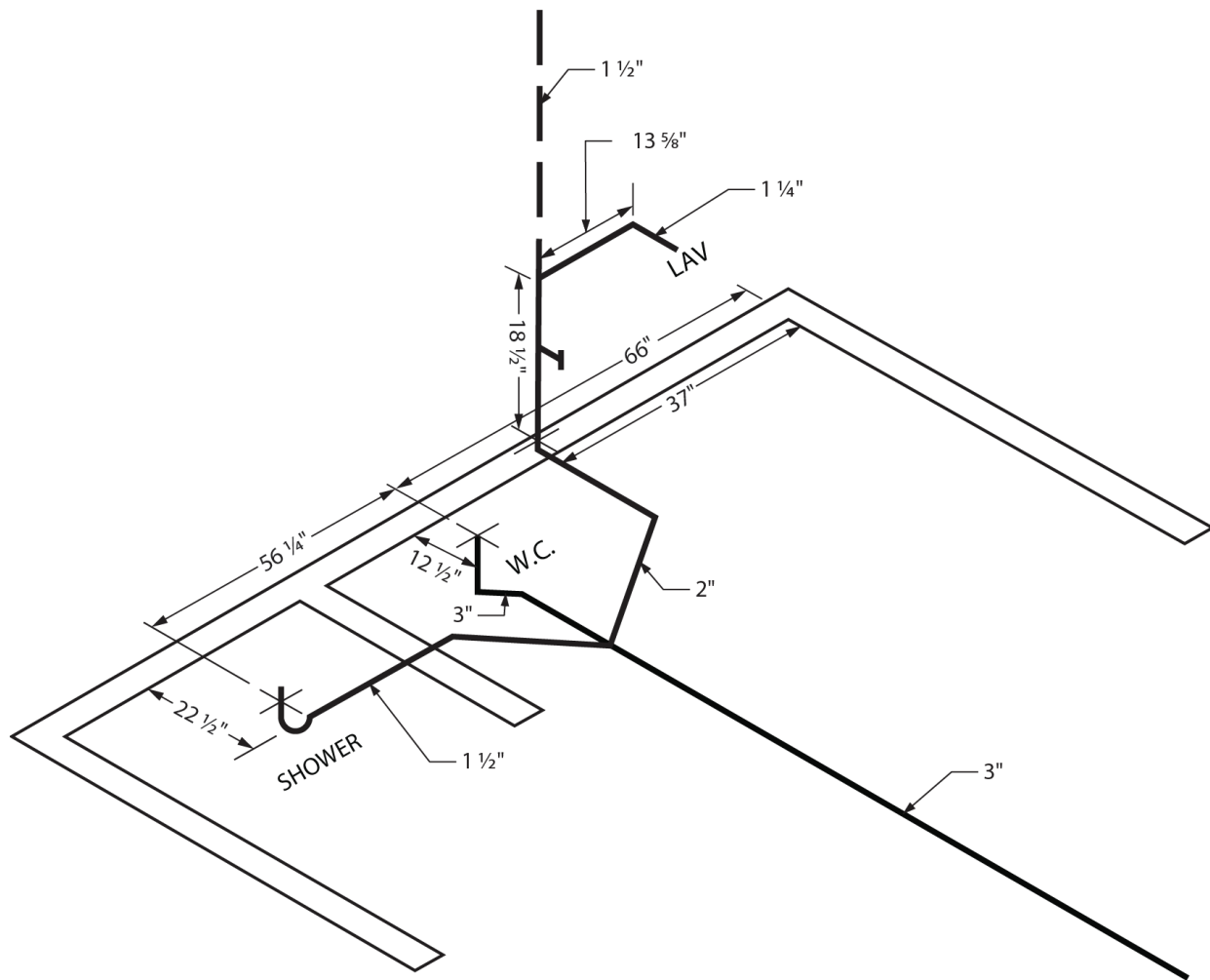


Figure 12 Dimensioned isometric view of three-piece bathroom group. (Skilled Trades BC, 2021) Used with permission.

Pipe Sizing

Sizing of the DWV system should be based on minimum code requirements. The drainage piping is only dependent on the connected load, while the size of vent piping is determined from its length and the total number of fixture units connected. Since the isometric drawing is to scale, the pipe lengths can be measured accurately with a scale rule.

Once every line is correctly sized, the next step is to determine the fittings required for the installation and the amount of piping required.



Self-Test D-2.3: Creating Plans and Isometric Drawings of DWV Systems

Complete Self-Test D-2.3 and check your answers.

If you are using a printed copy, please find Self-Test D-2.3 and Answer Key at the end of this section. If you prefer, you can scan the QR code with your digital device to go directly to the interactive Self-Test.



An interactive H5P element has been excluded from this version of the text. You can view it online here:
<https://d-drainagesystems-bcplumbingapprl2.pressbooks.tru.ca/?p=64#h5p-23> (<https://d-drainagesystems-bcplumbingapprl2.pressbooks.tru.ca/?p=64#h5p-23>)

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Trades Training BC. (2021). D-2: Plan DWV systems. In: *Plumber Apprenticeship Program: Level 2*. Industry Training Authority, BC.

Media Attributions

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- **Figure 3** Manufacturer's rough-in specification sheet for a residential toilet is courtesy of Kohler Co. and is used with permission. All rights reserved.
- **Figure 4** Manufacturer's rough-in specification sheet for a wall-hung basin is courtesy of Kohler Co. and is used with permission. All rights reserved.

D-2.4 Organizing a Plumbing Project

Project planning is crucial for successful plumbing projects, so it is important to take the time to carefully map out all aspects of the project. The first step in project planning is defining the **project scope**. This involves identifying what needs to be done, for whom, and why. Residential and commercial plumbing projects will differ in scale and complexity. Commercial projects often involve larger systems and more extensive planning and design. Once you have a clear understanding of the project scope, you can begin to develop a plan that addresses all aspects of the project.

The person responsible for managing the organization of the plumbing project could be a single plumber on site or, on larger projects, there could be a dedicated plumbing project manager.

In either case, the individual will be at the very least responsible, to varying degrees, for:

- Project specifications
- Sequence of operation
- Prioritization
- Coordination with other trades
- Material estimates
- Tools and equipment
- Materials deliveries
- Inventory requirements
- Cost efficiency

Project Specifications

Construction drawings focus on a building's shape, appearance, and dimensions, while the written construction specifications (or specs) focus on what materials will be used and how they should be installed. Which information goes into the notes on the drawings and which goes into the specs is up to the designer, but a good set of detailed specs goes far beyond what could possibly be put onto a drawing. It is acceptable for the same information to appear in both places, but if there is any contradiction, the specifications generally take priority from a legal standpoint.

Project specifications (specs) detail the performance requirements of the installations. The specification documents are the:

- Technical requirements for materials and equipment
- Standards of workmanship
- Requirements of testing and commissioning
- Requirements for document submissions for an installation

Sequence of Operation

Once the plumbing contract has been awarded, the **authority having jurisdiction (AHJ)** requires a plumbing permit to

be issued before installing or altering any plumbing work. The permit requires periodic inspections after each phase of the installation. A logical **sequence of operation** used by mechanical contractors is to divide the project into three distinct phases with an AHJ inspection showing the completion of the individual phases:

- **Groundwork inspection:** required immediately after all underground piping has been installed and before placing any material on or over the pipes. At this stage, an air or water test is required before being approved by the inspector.
- **Rough-in inspection:** required after rough-in plumbing has been completed and before installation of any wall covering that would conceal the piping. At this stage, an air or water test is conducted.
- **Final plumbing inspection:** required after the system has been completed and all fixtures have been installed and are fully functional.

Prioritization

The ability of a contractor to prioritize tasks and meet project deadlines is extremely important. A logical approach to this skill is to break the project into a list of activities that fall into each construction phase. The **prioritization** of activities in the list can use the following lettering system, which shows what must be done immediately and what can wait:

- Mark the activities that **MUST** be done today with an **A**.
- Mark the activities that you **SHOULD** be able to do today with a **B**.
- Mark the activities that you **HOPE** to be able to do today with a **C**.
- Mark the activities that **LIKELY WILL NOT** be accomplished today with a **D**.

This logical approach has a number of advantages for your company and the general contractor (GC) who has hired you. If you demonstrate a professional, organized approach to the project, the GC is more likely to hire you again. The advantages of a well-prioritized approach are:

- Reduced construction time
- Reduced costs for materials, labour, and overhead
- A more continuous work flow
- A goal for crews and subs to work toward
- Increased productivity

Coordination with Other Trades

The success of a construction project depends on proper site coordination. The general contractor is responsible for ensuring that this requirement is achieved through regular on-the-job meetings with the general contractor's authorized project representative and the onsite subcontractors.

Additional meetings may be required for subcontractors whose work might interfere with that of another at a given time during the project. The general contractor and each subcontractor should organize their own work so as not to deviate from the schedule nor to interfere with or otherwise adversely affect the work of others. The general contractor should monitor and coordinate the work of all parties to ensure compliance with the project schedule.

Estimate Materials

Installation estimates are based on the **materials take-off** (materials list). The materials list is used during two preliminary time periods of the project:

- **Job estimate:** the estimate or bid will only be as accurate as the take-off on which it is based. A properly made take-off shows everything necessary to enable a proper estimate for the installation. A full set of drawings and a set of specifications are needed for every materials list. If there are piping runs in three dimensions, begin by making an isometric drawing, which is the foundation for an accurate take-off. Another term used to describe a materials take-off is a **quantity survey**.
- **Materials acquisition:** the other function of the take-off is as the checklist for ordering materials. Any necessary materials overlooked by the take-off will not be on hand when you begin the installation. Time will be lost while you wait for the missing items. Therefore, it is very important that you can take-off materials accurately.

The isometric drawing is a valuable estimating tool because, from one drawing, you can estimate the required horizontal piping as well as the vertical risers, leaders, and stacks.

These vertical pipe sections are not represented to scale on a plan drawing. It is very important that the isometric drawing be to scale! Most isometric drawing sheets have $\frac{1}{4}$ in. isometric gridlines already printed on them, so if you scale the drawing to $\frac{1}{4}$ in. = 1 ft 0 in., then each grid box will represent one foot of pipe. If you construct the isometric drawing on paper without gridlines, use a scaling ruler to draw the system to scale. When scaling the lengths of piping, it is good practice to round up the lengths of pipe required to the nearest whole length. To stay organized when doing a DWV take-off, start at the top of the system and work toward the building sewer to avoid missing or duplicating material requirements.

Because there is so much material information that you take-off the drawings, it is best to use some kind of form to keep all of the information organized. A simple table, such as a DWV take-off worksheet (Figure 1), can be used as a starting point from which you create your own as your projects get more complex.

DWV System Piping Take-Off						
Length in ft. (m) for each pipe size						
1 ¼"	1 ½"	2"	3"	4"	Pipe Location	Misc. Items
					Under slab	
					Basement	
					Main floor	
					Second floor	
					Attic	
					Totals	

Figure 1 DWV system piping take-off list. (Skilled Trades BC, 2021). Used with permission.

The fittings should be arranged according to size and type (Figure 2). Most constructed DWV systems use more fittings than what was estimated in the take-off. These extra fittings are largely elbows used in getting around obstructions. An allowance should be made for extra fittings that are over and above the total in the estimate. The actual percentage will be refined as you become more experienced, but it will be around 5% of the total counted.

DWV System Fitting Take-Off			
Fitting Name	Size	Quantity	Installation Area
Total			

Figure 2 DWV system take-off list. (Skilled Trades BC, 2021). Used with permission.

A fixture and equipment take-off (Figure 3) is relatively straightforward because the location and required equipment will be shown on the plans or detailed in the specification. On larger projects, there would be a **fixture schedule** with

numbers that correspond to locations shown on the plans. These numbers would also correspond to the specification that would give details about each fixture.

Plumbing Fixture Take-Off				
Fixture Type	Location			Total
	Basement	1st	2nd	
Water Closets				
Lavatories				
Tubs/Showers				
Cabinet Sinks				
Floor Drains				
Total				

Figure 3 Plumbing fixture take-off list. (Skilled Trades BC, 2021). Used with permission.

Once the material quantities have been established, the next step is to take the material take-off sheets to all of your suppliers (not just one) and compare the prices each supplier offers.

Tools and Equipment

Whether constructing small residential or large commercial plumbing systems, every contractor has asked the same question at some point: “Do I rent or buy the equipment I need for the project?”

Buying Equipment

Buying equipment to use in your residential or commercial construction project can offer several benefits:

- Equipment you own is always on hand.
- You never have to worry about scheduling a time to use it.
- You also can gain a lot of experience using your own equipment so that you will be able to finish your job more quickly.

Renting Equipment

There are many benefits to renting equipment, whether it is something small like a chipping hammer or something large like an excavator:

- You will only need to pay for it when you need it, with no huge upfront cost and no worry that you may never use it again.
- You will also be able to access new equipment and never have to worry about having to pay for maintenance, repair, or even replacement.
- Renting equipment also means that you will have a better selection of tools to choose from.

Material Availability

Material availability may influence material selection decisions. Long delivery lead-in times must be allowed for, as delays may cause project holdups. Using locally available materials reduces **transportation costs**, labour costs, probability of damage to the materials, etc.

If the required material is not available at the desired time, an unavailability cost is incurred. Shortages may delay work, thereby wasting labour resources or delaying the completion of the entire project. It is difficult to forecast in advance exactly when an item may be required or when a shipment will be received. If items are unavailable when needed, it may be possible to assign workers to other activities, avoiding delays to the project.

Timing/Sequencing

The site delivery of materials at the right time is essential to an efficient material-handling system. The use of **just-in-time delivery** has reduced the time a contractor has to hold inventory from days, weeks, and months to minutes and hours. For many job sites working on a tight schedule, if materials cannot be delivered on time, it is better to have them not delivered at all until delivery can be rescheduled. Being late will cause scheduling problems, and the job site may incur associated cost overruns.

Transportation

The heavier or bulkier the materials are, the greater the transportation costs will be. Where possible, try to purchase locally, especially for heavy and bulky items. This will help to keep transportation costs to a minimum. Damage to materials occurs mainly during handling. The condition of the material when it arrives on site is highly dependent on the handling system and the distance it has travelled to the site.

Inventory Requirements

Once goods are purchased, they represent an inventory used during the construction process. **Inventory control** is an operational strategy that means stocking adequate numbers and kinds of materials so that the materials are available when and where they are needed. To accomplish this, many contractors employ an advance purchasing practice.

Advance purchasing of construction materials and equipment is a practical procedure that saves money and promotes the on-time completion of construction projects. Plumbing contractors gain the full benefit of advance purchasing by allowing progress payments to include payment for materials and equipment stored at the construction site. Early delivery of materials and equipment also guards against escalating costs, particularly in long-term contracts, and enables the contractor and subcontractors to make timely purchases when shortages may be a problem.

Secure Storage

When using an early purchase strategy on your construction site, the **secure storage** of materials is essential. For progress payment purposes, store as much material within the footprint of the new building as possible. Material storage trailers or containers should be used to store three types of things:

- Tools
- Equipment that can be carried off easily or damaged by exposure to the elements
- Materials that are targets for thieves, such as copper

Store as much material as will be used by your crews inside the work site. Keep stores secure, dry, and organized because bad storage procedures can cause considerable waste.

Unless the contract clearly assigns the responsibility for protecting equipment and materials on site solely to security personnel, the plumbing contractor is usually responsible for the safe storage of all materials and equipment that they have stored or installed.

“Just-In-Time” Delivery

When storage on the actual construction site is impractical, the only other solution is to employ a just-in-time delivery strategy. One of the challenges with a new-build project is logistics. Many different flows of materials need to come together in a precise sequence, creating a highly complex building schedule. A small delay at the start can have big effects on the timing later in the project. Ideally, one would like to have all required materials stored on site so that contractors can be called in to do their part exactly when they are needed and do not have to wait for materials to be manufactured or arrive on site. However, in practice, this is sometimes impractical, as sites need to be kept to minimal size, especially in urban areas. Scheduling materials deliveries to the job site can become critically important on some projects and requires close cooperation between the contractor and the supplier.

Many contractors now make arrangements with their suppliers for their materials to be delivered at the exact time that they are required at the job site. Many suppliers favour this process because it may reduce their inventory, storage, theft, and handling costs and also allows for planning their delivery operations.

Labelling Materials

A materials list provides a format for keeping track of the materials needed on the job site. Organizing those materials in a box or bag ensures that they will be available when needed.

Identifying the organized materials is crucial for locating the correct stored items. If a material is not available when the storing process begins, a note should be made to remind the plumber that the stock list is incomplete. Items such as washer boxes and tub and shower valves are installed in two different phases. Therefore, the trim plates must be stored, protected, or even removed from the site until required for the trim-out phase.

Consumables

Consumables (also known as consumable goods, non-durable goods, or soft goods) are goods that can be consumed, dissipated, wasted, or spent. In plumbing construction projects, these may include materials such as solder, flux, sand cloth, fasteners, Teflon tape, and glue.

Many estimators do not take the time to list the quantities of these types of goods on their estimate. Instead, they just give the whole category a fixed price and add it to the job quote. For example, a plumbing contractor may cover the cost by charging \$100.00 for consumables for an average single-family dwelling or \$10.00 per fixture on larger projects.

Cost Efficiency

The main goal of any contractor is to achieve a high-quality installation on time and on budget. Construction industry research has shown that material-handling tasks consume approximately 40% of a plumbing contractor's time — and time is money. Material handling is also recognized to be the single most common cause of unproductive time on the job. Any effort to significantly improve job-site productivity and profits can begin by addressing ways to reduce the lost time spent unnecessarily handling materials and equipment.

Plumbing project cost efficiency requires:

- Having adequate materials on hand when needed
- Paying the lowest possible prices, consistent with the requirement for quality and value for purchased materials
- Minimizing the inventory investment
- Operating efficiently

Post-job Efficiency Analysis

Project costs are measured and analyzed in many ways throughout a project — from planning, programming, and design to bidding, construction, turnover, and post-occupancy. First costs, cost-benefit ratios, and life-cycle costing are a few examples of how a project's cost-effectiveness can be evaluated. These cost-management processes start with establishing budgets based on actual estimates for the work performed. Comparing budgets to actual costs throughout the building process is critical to ensuring that the project is timely and cost effective.



Self-Test D-2.4: Organizing a Plumbing Project

Complete Self-Test D-2.4 and check your answers.

If you are using a printed copy, please find Self-Test D-2.4 and Answer Key at the end of this section. If you prefer, you can scan the QR code with your digital device to go directly to the interactive Self-Test.



An interactive H5P element has been excluded from this version of the text. You can view it online here:
<https://d-drainagesystems-bcplumbingapprl2.pressbooks.tru.ca/?p=66#h5p-9> (<https://d-drainagesystems-bcplumbingapprl2.pressbooks.tru.ca/?p=66#h5p-9>)

References

- Skilled Trades BC. (2021). *Book 2: Install fixtures and appliances, install sanitary and storm drainage systems*. Plumber apprenticeship program level 2 book 2 (Harmonized). Crown Publications: King's Printer for British Columbia.
- Trades Training BC. (2021). D-2: Plan DWV systems. In: *Plumber Apprenticeship Program: Level 2*. Industry Training Authority, BC.

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D-2.5 Installing DWV Systems

This chapter covers the two primary aspects of the actual plumbing installation:

- Material-handling procedures
- Installation process factors

Procedures for Handling Plumbing Materials

A fundamental aspect of achieving successful plumbing installations is adhering to proper procedures for handling materials. This adherence is not merely a matter of operational efficiency but is vital for ensuring safety, job control, and overall project success.

There are many aspects related to proper handling plumbing materials, including:

- Safety
- Handling procedures
- Receiving and shipping materials
- Hazardous labels
- Storage
- Moving
- Product protection
- Disposal
- Recycling

Safety

Plumbers work in a variety of settings, some of which are hazardous. When installing a DWV system, the plumber must comply with Occupational Health and Safety (OHS) policies and procedures. These requirements include the following:

- Inspect equipment and tools for safety hazards before each use.
- Handle all hand and power tools in a safe manner.
- Wear proper **personal protective equipment (PPE)** at all times.
- Follow OHS lockout/tagout and confined space procedures.
- Know where the **Safety Data Sheets (SDS)** are kept and how to interpret an SDS.
- Take precautions to avoid inhaling dangerous vapours by using proper ventilation and/or properly fitted respirators.
- Use fall protection and other precautions when working at heights.
- Ensure that use of ladders complies with OHS guidelines.
- Keep work areas clear of clutter and equipment.
- Use safe lifting techniques.
- Report all incidents to your supervisor immediately.

Considerations When Handling Materials

In addition to instruction, training, and general safety principles, job site controls can help reduce workplace accidents involving the moving, handling, and storing of materials. Whether moving materials manually or mechanically, the tradesperson should know and understand the potential hazards associated with the task at hand and how to control their workplaces to minimize the danger.

Every employer must ensure that the safe work procedures for **material handling** and storage are followed. These procedures include the following:

- Facilitate and/or provide appropriate training as necessary to workers with respect to safe material handling and storage.
- Monitor and inspect material-handling and storage facilities to ensure hazard control in these areas.
- Ensure that, where appropriate, shelving is weight-rated as required by regulations.
- Identify and select materials for sorting, stacking, and stockpiling according to supervisor instructions or workplace requirements.
- Identify handling characteristics of materials and apply safe manual handling techniques.
- Apply specific handling requirements and protection for non-hazardous materials and chemicals.
- Ensure that materials are stored, stacked, stockpiled, protected, and clear of traffic ways for ease of identification, retrieval, and prevention of damage and cross-contamination in accordance with workplace requirements.
- Erect signage and barricades to isolate stored materials from workplace traffic or access.
- Identify hazardous material for separate handling by authorized persons.
- Use dust suppression procedures to minimize health risk to personnel in the workplace vicinity.
- Assess and control manual handling risks and provide instruction, training, and supervision for manual material handling. Risk controls may include:
 - Organizing the work to reduce the number of manual handling tasks involved.
 - Not working long periods of strenuous manual material handling.
 - Making sure the workplace layout allows enough space to move and work safely and comfortably.

Packaging/Shipping

Construction materials are received at and shipped from the job site on a regular basis. When receiving materials:

- Inspect the shipment for external damage and then remove the packaging and inspect the contents for any physical damage in the presence of the delivery driver.
- If there is any damage, you must indicate such on the delivery receipt. When you sign the delivery ticket and do not note any damage, the merchandise becomes your property, and the freight company will not allow a claim.
- Make sure hazardous products are identified for separate storage, transport, and handling by authorized persons, in line with workplace and safety procedures.
- On arrival, check for any spillage or leakage. Check to see that hazardous products are properly labelled. An SDS should be readily available.

When shipping materials:

- Determine the method of shipment and prepare bills, invoices, and other shipping documents.
- Assemble containers and crates, pack goods to be shipped, and prepare identifying information and shipping

instructions.

- Ensure that pallets are safe to use and loaded and transported safely:
 - Do not use pallets that are damaged or structurally inadequate for the load.
 - Do not overload pallets.
 - Secure unstable loads to the pallet where appropriate.
- Hazardous products should be transported and handled in accordance with regulatory requirements, including appropriate signage, markings, and safety precautions. WHMIS labels and SDS are mandatory in Canada.

Labelling

All hazardous products delivered to construction sites are labelled in accordance with the Hazardous Products Regulation (Canada). When working with this type of product, follow these guidelines:

- Never accept any container of hazardous goods unless it is properly labelled.
- Never remove, deface, modify, or alter any supplier label.
- When a hazardous product is used at a work site in a container other than the original supplier's container, a workplace label must be applied to the container immediately, except if transferred by a worker into a container for use during the same shift, provided that the worker maintains control of the new container and finishes use in that shift

Storage

Some materials deteriorate rapidly. Moisture can lead to damage from corrosion or growth of mould or fungi. It is essential that construction materials have the durability required for their area of use. Materials should be stored properly in accordance with the manufacturer's instructions to afford maximum protection against damage caused by weather, corrosion, mechanical force, and other causes before installation. Materials should be stored under a cover and on level, well-drained, and well-maintained hard-standing ground. Plastic pipes and fittings must be stored so that they are not exposed to sunlight, which can cause deformation or ultraviolet damage.

Securing

Construction materials that are stored on site must be secured correctly and safely according to workplace procedures. These procedures could include the following:

- Ensure that pallets used are safe to use and loaded and transported safely:
- Do not use pallets that are damaged or structurally inadequate for the load.
- Do not overload pallets.
- Secure unstable loads to the pallet where appropriate.
- Ensure that storage racks and shelves are secure and capable of handling the loads placed on them. If there is any evidence of potential failure, discuss the situation with the site supervisor.
- Report the following to the site supervisor:
 - Deformation of the structure (e.g., sagging shelves and upright supports that are leaning or otherwise

unstable)

- Heavy weights (e.g., items that might exceed the safe load limit of the shelving)
- Excessive materials (e.g., too much material on the shelf)
- Pile materials at work sites so they do not create tripping/slipping hazards.
- Do not pile other materials on pipe or behind pipe in a manner that requires a worker to walk over the pipe to reach them.
- Pile all materials clear of walkways and entrances.
- Pile higher rather than wider in order to allow a worker to approach all materials while walking on firm, unobstructed footing rather than having to weave through materials that create a tripping hazard or walking on materials that can create a tripping hazard or a potential for falls and property damage.
- If you are searching for something specific, clean up after yourself.

Moving

Materials that have arrived on site and been securely stored will eventually have to be moved and installed. Workers can be at risk of hazards when working around vehicles and mobile construction equipment at construction projects. These hazards can result in serious injuries or death. Incidents can be prevented by ensuring that:

- Trained signallers and competent equipment operators are in place.
- Construction projects are planned and organized to eliminate or reduce vehicles and construction equipment from operating in reverse.
- Workers wear personal protective equipment (PPE), including high-visibility clothing.

Hoisting and Rigging

Choosing the correct hoists, cranes, or rigging products for an application is always critically important due to the inherent risks involved in overhead lifting. Incorrectly specified overhead lifting equipment could fail, resulting in costly equipment damage, personal injury, and lost productivity. To prevent this, when **hoisting and rigging** on a construction site, follow these guidelines:

- Before starting hoisting, be aware of all possible unsafe conditions within the area in which the hoist will take place.
- Maintain safe clearances to overhead power lines, in keeping with regulations.
- Control traffic with flag persons, traffic cones, and/or barricades if lifting in areas of public travel.
- Use ropes or safety ribbons to secure the area and keep out anyone not involved in the hoisting procedure.
- Use only proper devices specifically designed and rated for lifting.
- Do not use frayed or torn cables or slings. If possible, obtain the weight of the piece being lifted to ensure that it is within the capacity of the lifting device. If the exact weight is unknown, test the lift in a safe location before lifting.
- Persons giving instructions to operators should know the proper hand signals.
- When hoisting equipment onto roofs, anyone closer to the roof edge than allowed by regulations must wear a proper safety harness secured to the building in such a manner as to prevent injury.

Work Platforms

Work platforms are often used to move materials around on a job site or to lift them into place for overhead installations. It is therefore important to consider them when planning a project.

The two basic types of elevating work platforms are boom lifts and scissor lifts. Both types come in on-slab models for use on smooth, hard surfaces — such as concrete or pavement — and rough-terrain models for use on firm, level surfaces — such as graded and compacted soil or gravel.

Both types share three major components: base, lifting mechanism, and platform assembly. The machines come with load charts that show safe operating configurations. Machines with booms long enough to cause overturning at low boom angles are required to have radius-limiting interlocks to prevent operation in unstable configurations.

Elevated work platforms are designed for different uses. It is essential to select the right machine for the job. Typical mistakes in platform selection include the following:

- Using an on-slab machine on rough terrain
- Using a unit undersized with respect to height, reach, and lifting capacity
- Extending the platform with planks, ladders, or other devices because the machine cannot reach the required height
- Failing to assess the job needs before starting and using the wrong machine or not ordering the right machine to do the job

When selecting an elevating work platform, keep in mind the following job site considerations:

- **Capacity:** does the machine have the lifting capacity, reach, and height to complete the task?
- **Surface conditions:** are the surface conditions hard or soft, sloped or level? Will the ground have an effect on the type of machine selected?
- **Platform size and configuration:** do you need a regular or extendable platform? Is rotation required? Are there space restrictions to consider?
- **Mobility:** is a boom type better suited to the task than a scissor lift?
- **Material to be lifted:** will the machine be able to lift the size and weight of material required for the job?
- **Access:** will the machine be able to travel around the workplace safely? Are there obstructions or depressions that would restrict the use of certain machines?
- **Operator skill or training:** are the people on site that can competently operate the machine? If a propane-powered engine is used, has the operator received propane training?
- **Work environment:** if the work is to be done indoors or in a poorly ventilated area, will an electrically powered machine be required

Product Protection

Builders and contractors alike have realized that protecting installed materials in the finishing stages of a project is 10 times more cost effective than spending time making repairs after completion. Interior protections are used on installed countertops, fixtures, walls, windows, cabinetry, floors, and stairs. When installed, materials are protected and end users report significantly fewer deficiencies upon completion, which increases their satisfaction with the contractor. This also increases the likelihood that the contractor will be employed on future projects.

Disposal

Construction site material management should aim to minimize waste, thereby reducing waste disposal and the release of pollutants. The initial step in a construction waste reduction strategy is good planning. The environmental impact of the disposal of materials at the end of their serviceable life must also be considered. Follow these guidelines:

- Reduce rejects by using high-quality materials, such as engineered products.
- Set aside construction and demolition materials that are in good condition.
- Sort your materials before disposal; you may find recycling or reuse opportunities. This may save you money and reduce environmental impacts at the same time.
- Think about the types of waste you produce and whether they need to be dealt with as hazardous waste.
- Make sure you recycle any waste because many plumbing materials contain recyclables, such as copper, steel, lead, cast iron, and aluminum.

Recycling

Some construction materials can be recycled directly into the same product for reuse. Others can be reconstituted into other usable products. The most important step for recycling construction waste is onsite separation. This will take some extra initial effort and training of construction personnel. Once separation habits are established, onsite separation can be done at little or no additional cost, increasing profitability and economy for the builder and customer.

Installation

Staying educated on relevant codes, materials, tools, and hazards is an important part of every plumbing professional's job. The practice of actually installing a DWV plumbing system requires the plumber to consider a number of factors during the installation process.

Tools and Equipment

On the job site, it has always been about having the right tools and equipment. Plumbers use a variety of tools and equipment to perform a DWV installation (power and hand tools, welding and soldering/brazing equipment, hoisting and lifting equipment, etc.). Specific certification may be required to perform some of those tasks or use some of that equipment. Too often, injuries occur because corners are cut when using the wrong tools and equipment for the job. The scope of the installation will dictate the tools required. For example, routing and securing pipes within house framing requires a variety of cutting and drilling tools, including reciprocating saws, power drills, and circular saws.

On larger projects, machinery and equipment such as scissor lifts and excavators may be used. In either instance, it is very important that tools be properly maintained in accordance with the manufacturer's specifications.

Determining Slopes

Horizontal drains are designated to flow at half to two-thirds full capacity under uniform flow conditions, which minimizes pressure fluctuations in the system. The NPC dictates minimum slopes according to the size and function of the pipe. All drainage pipes must be installed with a minimum slope of 1:50. In some situations, the slope of a building drain may be reduced to 1:100 if it is at least 100 mm (4 in.) in size. This reduction in slope will allow for less fall over a given length, which may be needed to match the invert of a previously installed municipal drainage connection.

Installing Components

The installation of components in a DWV system requires the plumber to possess specific knowledge and the ability to do the following:

- Interpret codes and regulations pertaining to DWV component installation.
- Interpret information pertaining to DWV components found on drawings and specifications.
- Identify types of DWV component supports and their applications.

Cleanout Locations

When designing and installing DWV systems, it is important for the plumber to consider how the drainage system will be maintained. The NPC has requirements for the location and size of **cleanout** fittings in the drainage pipes to allow drain-cleaning machines to have access to the drainage piping. Generally, a distance of about 900 mm (3 ft) from a cleanout to any obstruction or wall is required.

When planning the route for the drainage piping, the plumber must allow for cleanouts to be installed at appropriate intervals and in a manner that will allow access without causing excessive disruption to the building finishes. For example, a building drain installed below grade can be routed in corridors or aisles so that cleanouts are easily accessible.

When drains serving floors above grade require cleanouts, consider the spaces on the floor below where the drain piping changes direction. Try not to locate cleanouts in ceiling spaces over sensitive equipment. Cleanouts and drains should be routed to avoid being over food preparation areas, hospital operating rooms, computer rooms, or other critical areas.

Testing

DWV piping systems must be tested using methods determined by the NPC. The methods and requirements are detailed in Competency D-4: Test and Commission Sanitary and Storm Drainage Systems of this series. System testing is usually done after each phase of the rough-in by sealing off all trap arms and the building drain using plugs or inflatable balls. The most common test is the “water test,” in which the plumber fills the piping system with water and then visually inspects the system for integrity. In regions that experience extremely cold weather, the water test could be used if filled and inspected in the same day. Typically, in situations where the weather does not cooperate, an air test may be applied, requiring all openings to be sealed.

Other less frequently used methods are the ball test and the smoke test.

After the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gastight and/or watertight by filling each fixture to the overflow and performing a visual inspection.

Inspection

Plumbing inspections are carried out to ensure compliance with the requirements of the code, which contains the minimum health and safety requirements for plumbing installations.

Local municipal building bylaws dictate the frequency of inspections, which are typically required after the following construction phases.

1. **Plumbing underground:** All drain and vent installations are completed with all required tests applied and prior to covering.
2. **Rough-in:** All drain and vent installations are completed with all required tests applied and prior to covering.
3. **Final plumbing:** All above plumbing and drainage inspections are approved and all plumbing fixtures are installed and operating in final condition.

A certified building/plumbing inspector reviews the assembly of the DWV system components for compliance with the applicable code. Areas where the inspector will be focusing are:

- Materials and equipment
- Testing of drainage and venting systems
- Protection of piping
- Support of piping
- Trap installation
- Arrangement of drainage piping
- Cleanout installation
- Slope and length of drainage pipes
- Arrangement and size of venting pipes

Here is a bit of advice that will make your working life as a plumber easier: get to know your inspector. Communication is a major component of any good project. Knowing the inspectors in your area and what they expect will make jobs run more smoothly. Most inspectors are approachable and helpful as long as you do not convey a bad attitude.

Sealing Penetrations

Any exterior penetrations through a building structure must be made watertight. Roof penetrations around vent pipes must be made watertight using an approved **flashing** material and shall not restrict the internal cross-sectional area of the pipe. The roof slope and cladding material used typically dictate the type of flashing required. Always refer to the manufacturer's installation instructions when installing specialty flashings.

Sloped roofs require the flashing material to be interwoven with the roofing material (Figure 1).

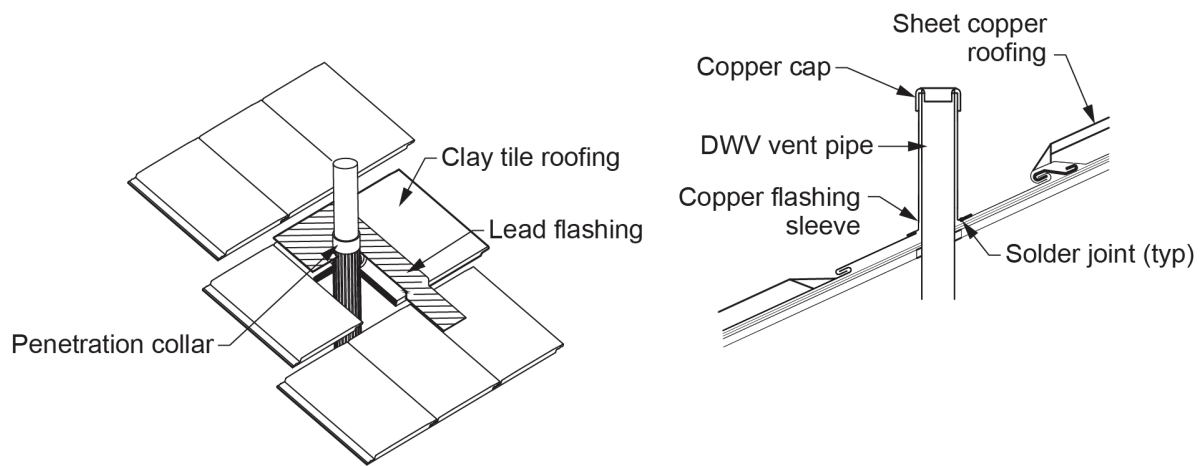


Figure 1 Specialty sloped roof flashings. (Skilled Trades BC, 2021) Used with permission.

Flat roofs, which are mostly found on commercial buildings, require the vent flashings to be “mopped” or “torched” into the roofing membrane to provide a watertight seal. Figure 2 illustrates a typical penetration through a flat roof.

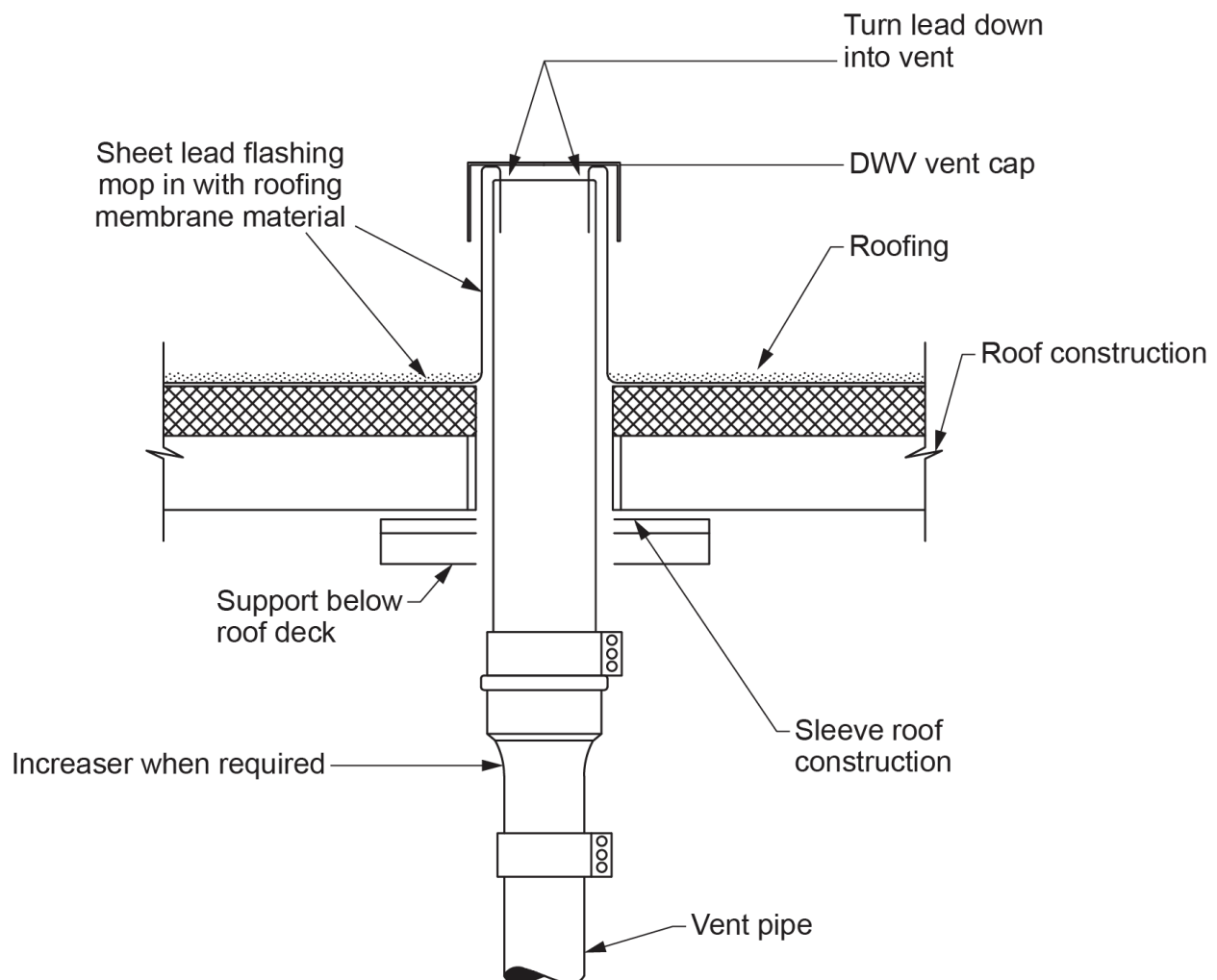


Figure 2 Flat roof flashing incorporated into roof membrane material. (Skilled Trades BC, 2021) Used with permission.

When drainage pipes are run through the foundation walls, the penetration must be sealed by one of two general methods:

1. Sleeve and caulking
2. Mechanical seals

The sleeve and caulking method can be accomplished using a non-corrosive sleeve poured in place during construction (Figure 3). The sleeve should be 50 mm (2 in.) larger than the DWV pipe passing through it. This will provide an annular space between the pipe wall and the sleeve. Caulking the gap around the pipe is typically done with high-viscosity polyurethane or another approved material. This caulking material can be used on both wet and dry installations. One advantage to this method is that the seal will be able to stretch and contract along with the natural fluctuations of the foundation walls.

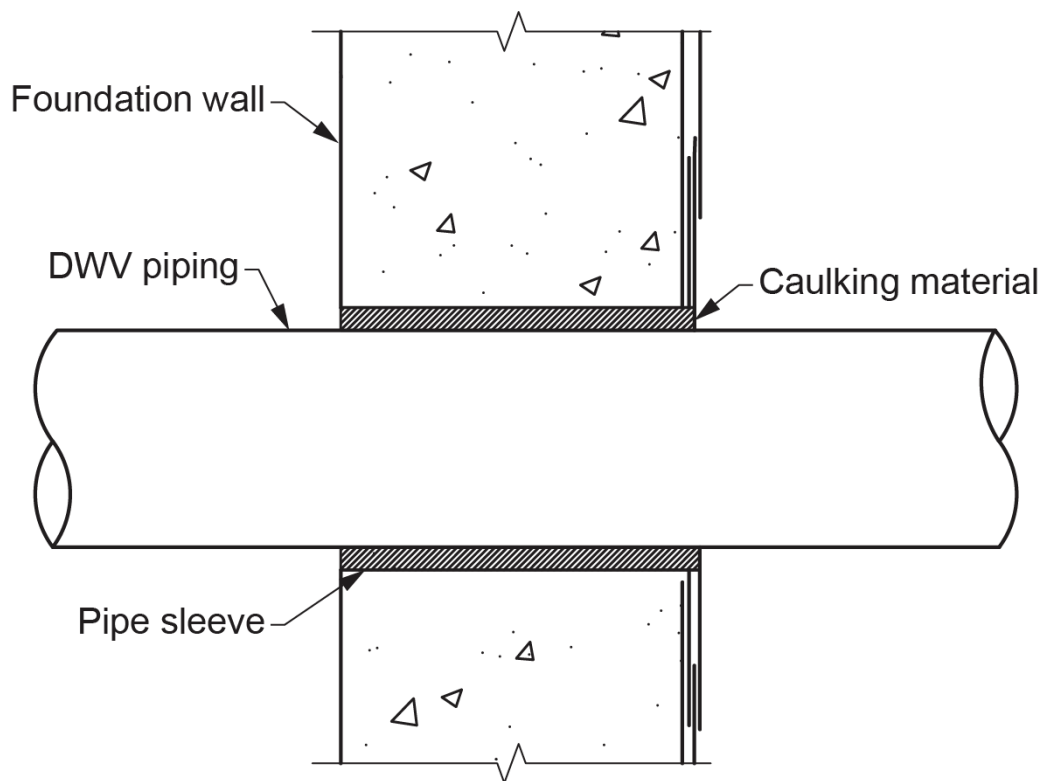


Figure 3 Piping penetration sealed using a pipe sleeve and caulking compound. (Skilled Trades BC, 2021)
Used with permission.

Mechanical seals (Figure 4) form a watertight mechanical seal between the pipe and the hole through which it passes. These sleeves use elastomeric sealing elements and adjustable pressure plates to provide the seal around the pipe.

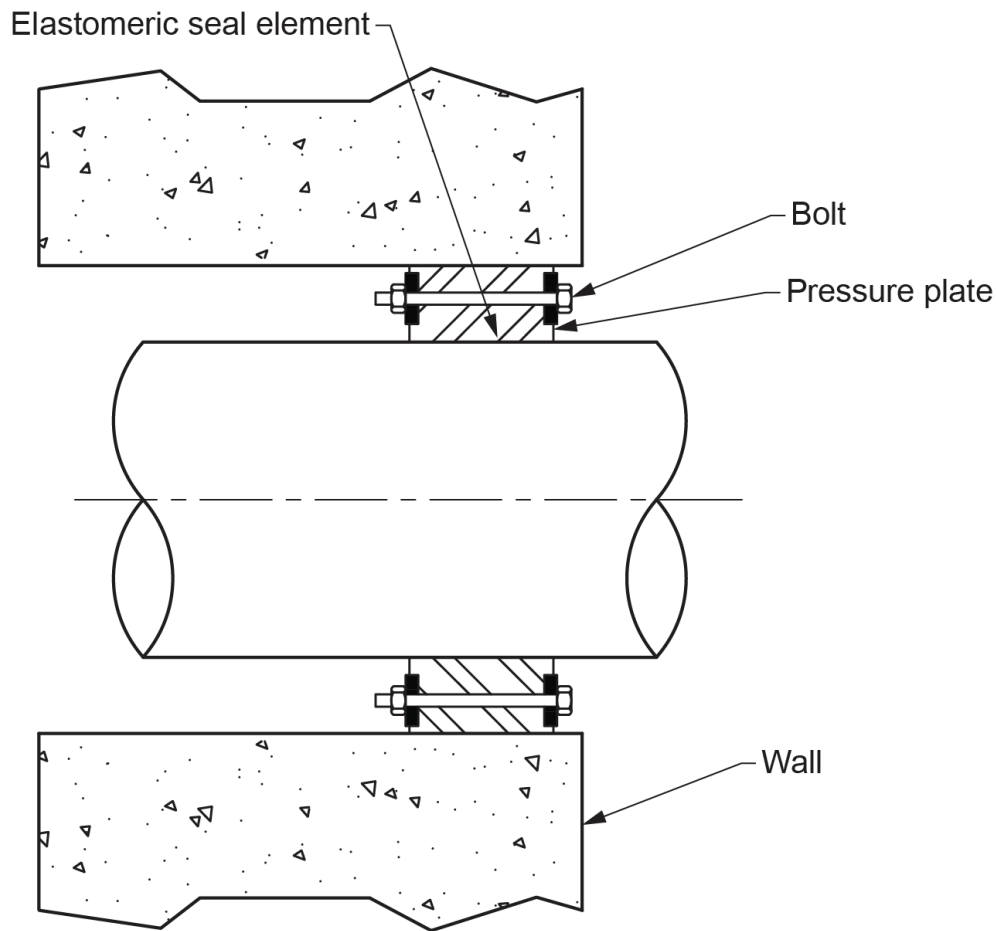


Figure 4 Piping penetration sealed using a mechanical seal. (Skilled Trades BC, 2021) Used with permission.

Fire-Stopping

Every time a fire-rated wall or floor/ceiling assembly is penetrated by DWV piping, the penetrations have to be protected by fire-rated fire-stop systems in order to maintain the assembly's intended fire rating. The size of the annular space to be filled and whether or not the pipe is combustible will dictate what type of fire-stopping system must be used.

When the annular space is relatively small — typically between 0.25 in. and 1.25 in. — the system could be special fire-rated insulation topped off with an intumescent caulking material (Figure 5). The term “intumescent” means that it swells when exposed to heat, closing off the opening.

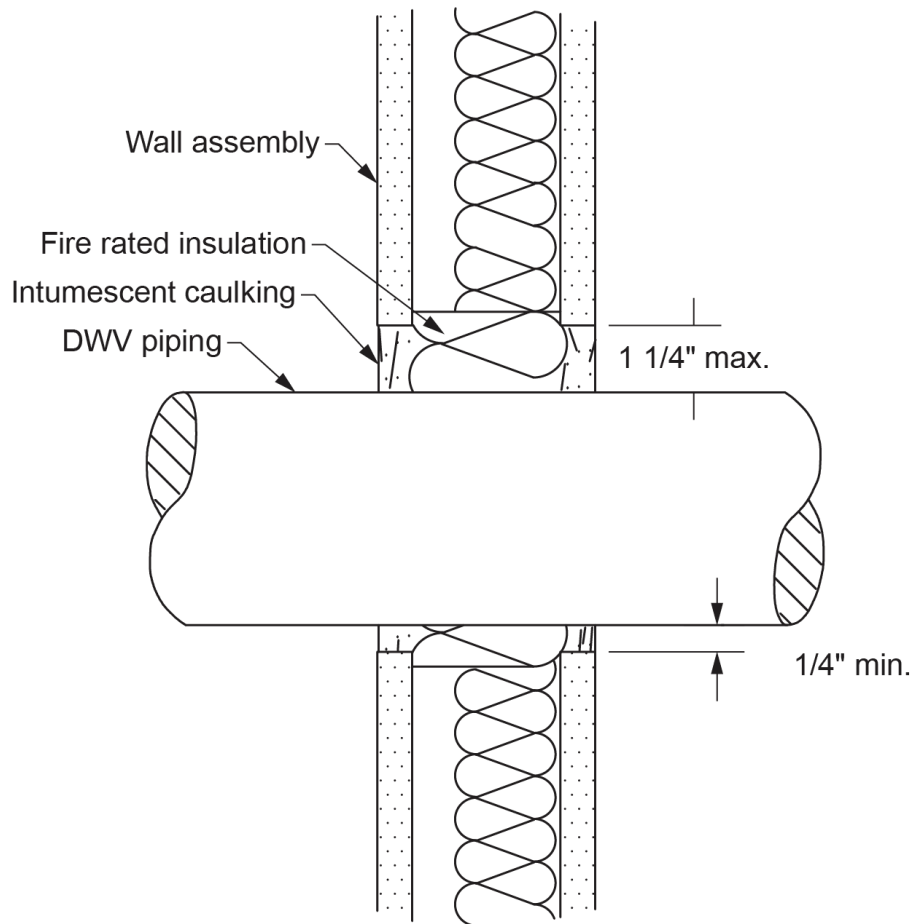


Figure 5 Piping penetration fire-stopping using caulking and insulation. (Skilled Trades BC, 2021) Used with permission.

On larger pipe penetrations resulting in a larger annular space ($\frac{3}{4}$ in. minimum), a restraining fire collar is sometimes used (Figure 6). The wrap strip on the collar uses a highly intumescent fire-stopping material. When exposed to fire, the wrap strip expands and forms a hard char to seal off the penetrating pipe and prevent the passage of fire and hot gases. The installation would be in conjunction with special fire-rated insulation and intumescent caulking of the annular space.

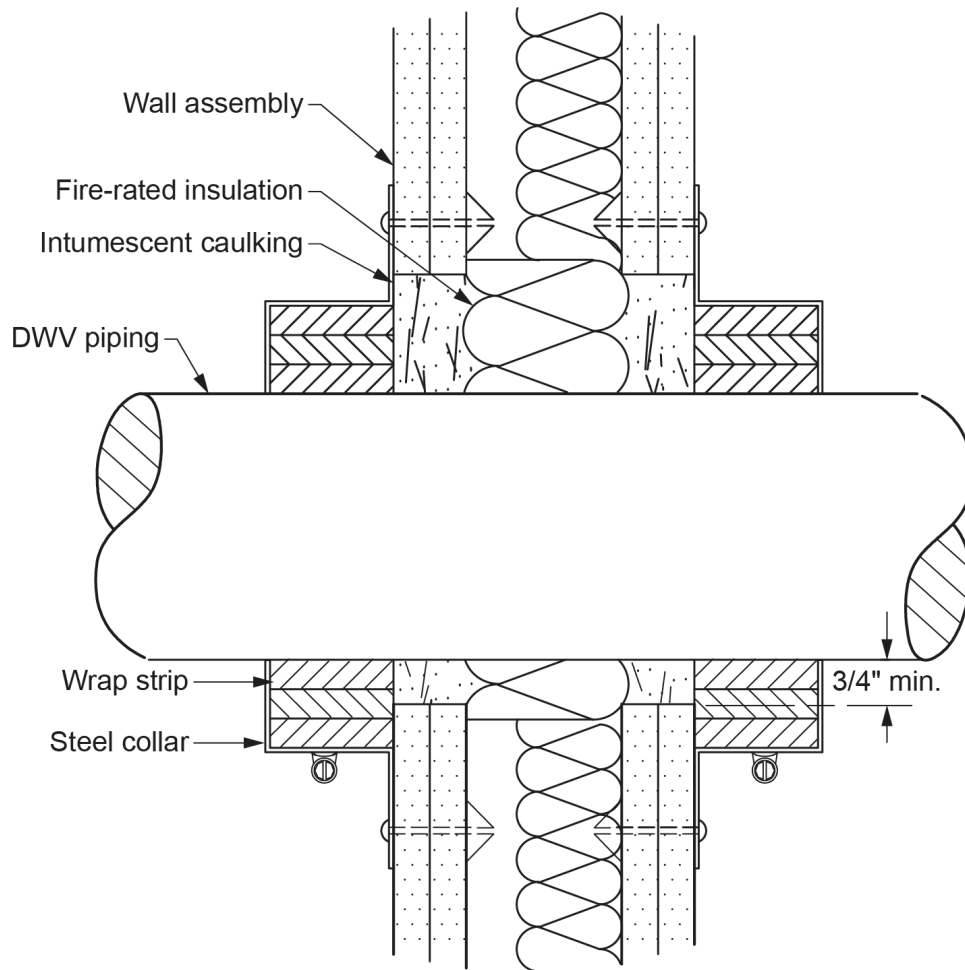


Figure 6 Piping penetration fire-stopping using a fire collar. (Skilled Trades BC, 2021) Used with permission.



Self-Test D-2.5: Installing DWV Systems

Complete Self-Test D-2.5 and check your answers.

If you are using a printed copy, please find Self-Test D-2.5 and Answer Key at the end of this section. If you prefer, you can scan the QR code with your digital device to go directly to the interactive Self-Test.



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Self-Test D-2.1 Types of DWV Drawings

Complete Self-Test D-2.1 and check your answers.

1. Architectural drawings are used to show what details?
 - a. Landscaping
 - b. Structural
 - c. Overall design and finishing
 - d. Shop

2. Structural drawings show what details?
 - a. Electrical
 - b. Beam and girder
 - c. Plumbing
 - d. Mechanical

3. Telephone locations are shown on the electrical drawings.
 - a. True
 - b. False

4. Landscape drawings are always part of a building contract.
 - a. True
 - b. False

5. When a plumbing plan is combined with a heating plan, it is known as a(n) _____.
 - a. Architectural drawing
 - b. Mechanical drawing
 - c. Site plan
 - d. Structural drawing

6. A mechanical drawing is based on a _____.
 - a. Sectional drawing
 - b. Floor plan
 - c. Site plan
 - d. Climate control plan

7. The main drawing of a building is the _____.
 - a. Plot plan
 - b. Site plan
 - c. Architectural drawing

- d. Structural drawing
8. Public utilities are shown on which type of plan?
- a. Site plan
 - b. Floor plan
 - c. Landscaping plan
 - d. Section plan
9. Which drawings show the distance from the building to the property line?
- a. Site plan
 - b. Floor plan
 - c. Mechanical plan
 - d. Section plan
10. Before drawing a pipe route on a floor plan, you need to consult the electrical drawings, the mechanical drawings, and the _____ drawings.
- a. Architectural
 - b. Elevation
 - c. Section
 - d. Structural
11. Which drawings would you consult to determine the exterior finish of walls that pipe must penetrate?
- a. Electrical
 - b. Mechanical
 - c. Elevation
 - d. Structural
12. Which drawings would you consult to determine the amount of vertical pipe needed?
- a. Electrical
 - b. Mechanical
 - c. Elevation
 - d. Structural
13. On which drawings can you find information on the heights of sinks or showers?
- a. Electrical
 - b. Mechanical
 - c. Elevation
 - d. Structural
14. To determine whether the utilities can operate on gravity or whether they require a pump, you need to compare the elevations of the _____.

- a. Utilities and basement elevation
- b. Utilities and main floor elevation
- c. Utilities and contour lines
- d. Main floor elevation and contour lines

15. To decide on the placement of the septic tank, you need to check the _____.

- a. Landscaping plans
- b. Property line and contour lines
- c. Septic tank and basement elevation
- d. Utilities and contour lines

16. Where are descriptions written of the materials, components, and valves shown in symbol form on drawings?

- a. Title block
- b. Key plan
- c. Notes
- d. Specifications

17. The scale usually appears in what part of the drawing?

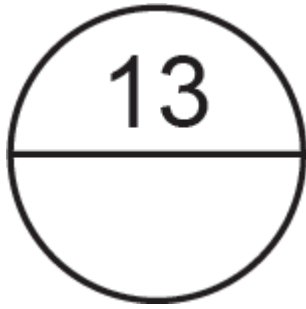
- a. Title block
- b. Key plan
- c. Notes
- d. Specifications

18. What type of drawing does this symbol refer to?



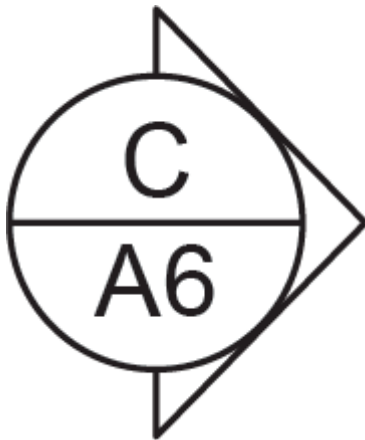
- a. Oblique
- b. Section
- c. Elevation
- d. Detail

19. What is the meaning of this symbol?



- a. Section drawing appears on page 13.
- b. Detail drawing appears on page 13.
- c. Section drawing 13 appears on the same sheet.
- d. Detail drawing 13 appears on the same sheet.

20. What type of drawing does this symbol refer to?



- a. Oblique
- b. Section
- c. Elevation
- d. Detail

21. What type of drawing does this symbol refer to?

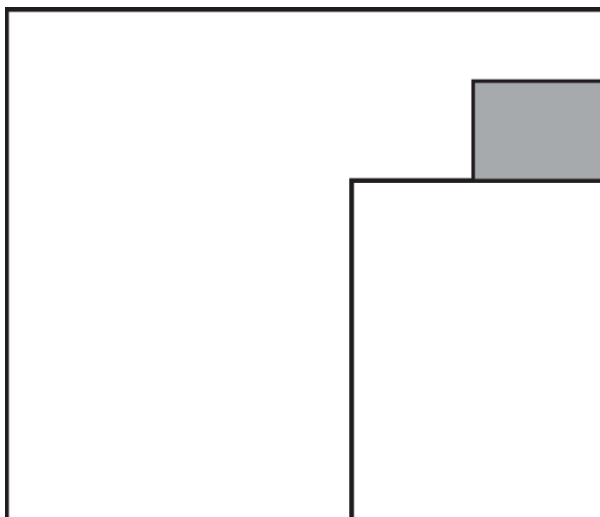


- a. Oblique
- b. Section
- c. Elevation
- d. Detail

22. What kind of drawing does E3 of 8 refer to?

- a. Architectural
- b. Structural
- c. Mechanical
- d. Electrical

23. The shaded part of the diagram indicates that _____.



- a. Another drawing covers the shaded part
- b. There is a sectional drawing of the shaded part

- c. The portion of the building plan shown by the drawing
- d. There is an elevation of the shaded part

Answer Key: Self-Test D-2.1 (#chapter-answer-key-self-test-d-2-1) is on the next page.

Answer Key: Self-Test D-2.1

1. c. Overall design and finishing details
2. b. Beam and girder details
3. a. True
4. b. False
5. b. Mechanical drawing
6. b. Floor plan
7. c. Architectural drawing
8. a. Site plan
9. a. Site plan
10. d. Structural
11. d. Structural
12. c. Elevation
13. c. Elevation
14. a. Utilities and basement elevation
15. b. Property line and contour lines
16. c. Notes
17. a. Title block
18. d. Detail
19. d. Detail drawing appears on the same sheet
20. c. Elevation
21. b. Section
22. d. Electrical
23. c. The portion of the building plan shown by the drawing

Self-Test D-2.2 Planning Interior DWV System Layouts

Complete Self-Test D-2.2 and check your answers.

1. When terminating a vent pipe through a roof structure, why is it a preferred practice to exit the building at a point that does not have sight lines from the adjoining street?
 - a. Reduces frost closure
 - b. Gives the building better aesthetics
 - c. Improves sewer gas dissipation
 - d. Usually requires a shorter vent length

2. If a building drain is to exit the building through a foundation wall, what is required during the forming stage in order to eliminate the need to core a hole in the cured concrete?
 - a. Blocking or sleeves
 - b. Flashing installation
 - c. Approved caulking
 - d. Nothing. A building drain is not allowed to penetrate a foundation wall.

3. What must be installed in conjunction with plastic DWV piping when it penetrates a fire-rated assembly?
 - a. Silicone sealant
 - b. Foam insulation
 - c. Bitumen caulking
 - d. Fire-stop system

4. Why is it important to limit the frequency and follow regulations when cutting and notching wooden framing components during a DWV Installation?
 - a. Maintains the aesthetics of the building by eliminating the need for bulkheads
 - b. Maintains the close clearances required from the pipe to the framing
 - c. Maintains the strength and load-carrying capability of the framing

5. What force(s) should you consider when selecting and locating pipe supports to maintain pipe slope and alignment?
 - a. Hydraulic testing
 - b. Seismic forces
 - c. Thermal expansion and contraction
 - d. All of the above

Answer Key: Self-Test D-2.2 (#chapter-answer-key-self-test-d-2-2) is on the next page.

Answer Key: Self-Test D-2.2

1. b. Gives the building better aesthetics.
2. a. Blocking or sleeves
3. d. Fire-stop system
4. c. Maintains the strength and load-carrying capability of the framing
5. d. All of the above

Self-Test D-2.3 Creating Plans and Isometric Drawings of DWV Systems

Complete Self-Test D-2.3 and check your answers.

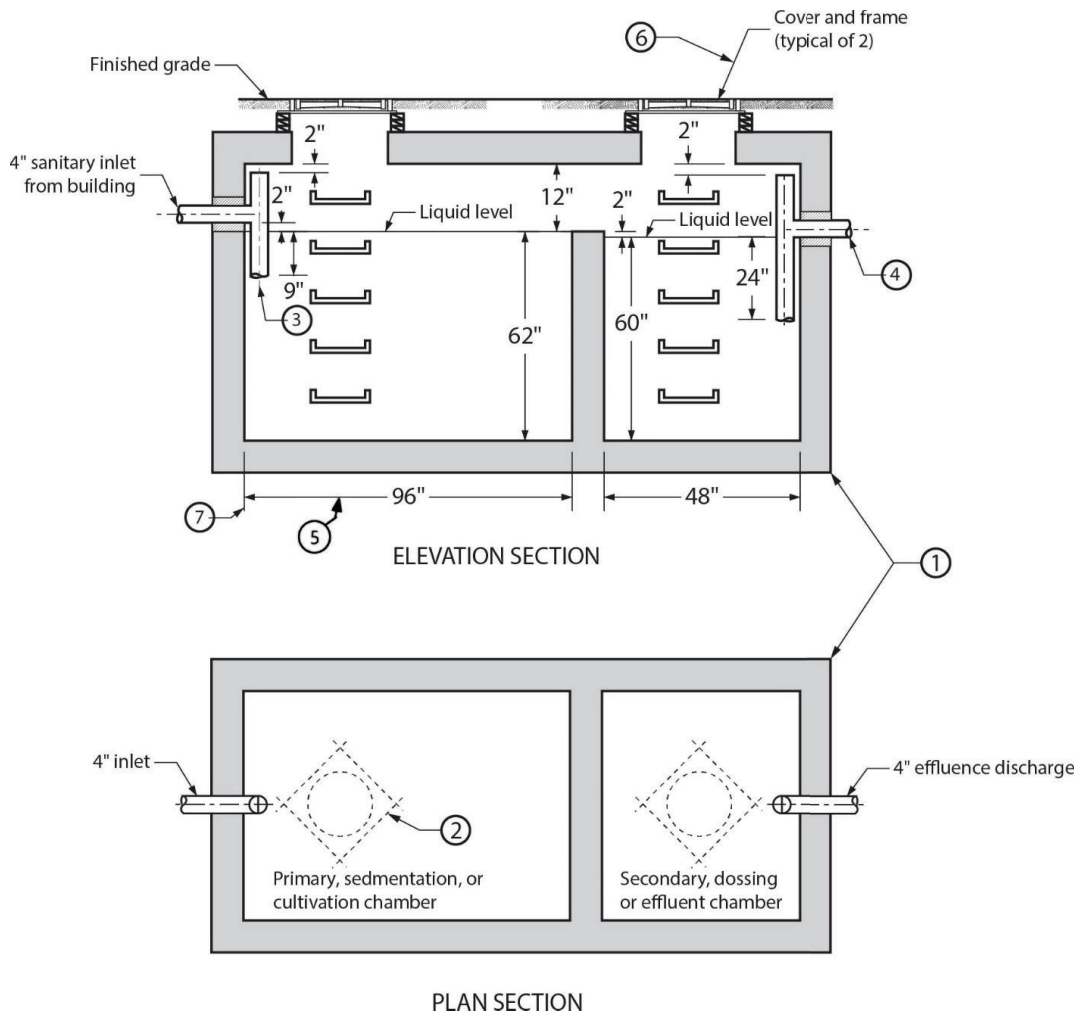


Figure 1

Using Figure 1, identify each type of line in Questions 1-7 by stating its:

- Name (e.g., body line, hidden line, centreline, etc.)
- Main use (e.g., shows object outline, shows centre of an object, shows the end of a dimension, etc.)

- Line 1
 -
 -
- Line 2
 -
 -
- Line 3
 -

- b.
- 4. Line 4
 - a.
 - b.
- 5. Line 5
 - a.
 - b.
- 6. Line 6
 - a.
 - b.
- 7. Line 7
 - a.
 - b.
- 8. What is the purpose of a cutting plane line used in technical drawings?
 - a. Indicates the centre of an object
 - b. Shows alternate positions of a part
 - c. Shows hidden object lines not visible to the eye
 - d. Indicates where an imaginary cutting plane takes place
- 9. Which of the following lines should be drawn the thinnest?
 - a. Body line
 - b. Cutting plane line
 - c. Hidden body line
 - d. Leader line
- 10. What type of DWV plumbing drawing shows only horizontal two-dimensional details of the plumbing system on a single floor?
 - a. DWV isometric drawing
 - b. Plumbing detail drawing
 - c. Plumbing rough-in drawing
 - d. Orthographic plumbing plan
- 11. Most horizontal pipelines are drawn in what way on isometric drawings?
 - a. Vertically
 - b. 300° to the vertical
 - c. 300° to the horizontal
 - d. 450° to the horizontal
- 12. Why is it preferable to align the bottom floor stacks directly under the upper floor stack and/or stack vent?
 - a. It is a plumbing code requirement
 - b. Makes it easier to clean out the system
 - c. Eliminates the need for an offset between floors

- d. Reduces the hydraulic fixture unit load on the stack vent
13. When sketching an isometric plumbing layout, which plumbing fittings are not shown to scale?
- a. 45° ells
 - b. P-traps
 - c. Wye fitting branches
 - d. All of the above
14. When preparing an orthographic drawing sheet, what would be the best scale to use when the project is 83 ft 4 in. long and the available drafting sheet is 10 in. long?
- a. 1:10
 - b. 1:100
 - c. 1:1000
 - d. 0.25 in. per foot

Answer Key: Self-Test D-2.3 (#chapter-answer-key-self-test-d-2-3) is on the next page.

Answer Key: Self-Test D-2.3

1.
 - a. Body line
 - b. Shows the edges (outline) of an object
2.
 - a. Hidden body line
 - b. Represents hidden edges and boundaries
3.
 - a. Centreline
 - b. Locates the precise centre of a pipe or fixture
4.
 - a. Break line
 - b. Shows imaginary breaks in objects
5.
 - a. Dimension line
 - b. Shows the size or length of an object
6.
 - a. Leader line
 - b. Establishes a connection between a drawing feature or item and some text
7.
 - a. Extension line
 - b. Used in conjunction with a dimension line to show where the specific dimension starts and end
8. d. Indicates where an imaginary cutting plane takes place
9. d. Leader line
10. d. Orthographic plumbing plan
11. c. 300° to the horizontal
12. c. Eliminates the need for an offset between floors
13. d. All of the above
14. b. 1:100

Self-Test D-2.4 Organizing a Plumbing Project

Complete Self-Test D-2.4 and check your answers.

1. What is the first step in project planning for plumbing projects?
 - a. Developing a schedule
 - b. Defining the project scope
 - c. Estimating costs
 - d. Procuring materials

2. In addition to a building's shape and appearance, what do construction drawings focus on?
 - a. Materials used
 - b. Electrical layout
 - c. Dimensions
 - d. HVAC system

3. Which document generally takes priority if there is a contradiction between construction drawings and specifications?
 - a. Construction drawings
 - b. Specifications
 - c. Inspection reports
 - d. Contractor notes

4. The sequence of operation in plumbing projects typically requires how many phases of AHJ inspection?
 - a. 1
 - b. 2
 - c. 3
 - d. 4

5. In project prioritization, tasks that MUST be done today are marked with a(n) _____.
 - a. A
 - b. B
 - c. C
 - d. D

6. Who is responsible for proper site coordination in construction projects?
 - a. Subcontractors
 - b. General contractor
 - c. Client
 - d. Equipment suppliers

7. What is the materials take-off list used for?
 - a. Scheduling work phases
 - b. Ordering materials
 - c. Assigning workers
 - d. Conducting inspections

8. What is one advantage of renting equipment for a plumbing project?
 - a. Lower long-term costs
 - b. Immediate availability
 - c. No maintenance responsibility
 - d. Increased project speed

9. Which of the following is a strategy to minimize inventory investment?
 - a. Buying all materials in bulk
 - b. Just-in-time delivery
 - c. Storing materials off-site
 - d. Using only high-cost materials

Answer Key: Self-Test D-2.4 (#chapter-answer-key-self-test-d-2-4) is on the next page.

Answer Key: Self-Test D-2.4

1. b. Defining the project scope
2. c. Dimensions
3. d. Specifications
4. c. 3
5. a. A
6. b. General contractor
7. b. Ordering materials
8. c. No maintenance responsibility
9. b. Just-in-time delivery

Self-Test D-2.5 Installing DWV Systems

Complete Self-Test D-2.5 and check your answers.

1. What workplace safety requirements must a plumber comply with while working?
 - a. CSA Standards
 - b. National Plumbing Code
 - c. Manufacturer's regulations
 - d. OHS Regulation

2. When a job-site tool needs maintaining and servicing, what source of information would a plumber refer to in order to find the proper procedures?
 - a. Project specifications
 - b. Manufacturer's specifications
 - c. Wholesaler's recommendations
 - d. OHS Regulation

3. The NPC requires that all gravity drainage piping be graded at least 1:50 in the direction of flow. What gravity drainage piping section is an exception to this requirement?
 - a. 3 in. branch
 - b. 3 in. building drain
 - c. 3 in. fixture drain
 - d. 4 in. building drain

4. How much distance from an obstruction should be maintained from a C/O for adequate use of drain cleaning equipment?
 - a. 1 ft (300 mm)
 - b. 2 ft (600 mm)
 - c. 3 ft (900 mm)
 - d. 4 ft (1,200 mm)

5. When determining the location of a cleanout fitting serving above-grade drainage piping, why is it important to consider the process being performed on the floor below?
 - a. Minimizes the damage caused to sensitive equipment in the event of a blockage
 - b. Minimizes the noise generated by the drain-cleaning equipment during the cleaning process
 - c. Eliminates the plumber having to work in occupied spaces during the cleaning process
 - d. Reduces the disruption of the building processes due to the blockage

6. During a typical DWV installation, how many tests are performed on the system?
 - a. 2
 - b. 3

- c. 4
- d. 5

7. What factors usually determine the type of roof flashings used when installing a vent terminal?
- a. Snow loading
 - b. Rainfall intensity
 - c. Roof slope and cladding material
 - d. Directional orientation
8. When placing a sleeve through a concrete wall for the future installation of a DWV piping section, how much larger should the ID of the sleeve be compared to the OD of the DWV piping?
- a. 1 in. (25 mm)
 - b. 2 in. (50 mm)
 - c. 3 in. (75 mm)
 - d. 4 in. (100 mm)
9. When a fire-stopping material is said to be intumescent, what property does it have?
- a. Shrinks when cooled
 - b. Expands when cooled
 - c. Shrinks when heated
 - d. Expands when heated
10. What type of device is used to fire-stop plastic DWV penetrations when a relatively large annular space is present?
- a. Mortar mix
 - b. Fire collar
 - c. Intumescent caulking
 - d. Fire flashing
11. What is the most common test for DWV piping systems?
- a. Smoke test
 - b. Ball test
 - c. Air test
 - d. Water test
12. What must be checked when receiving hazardous products?
- a. Quantity
 - b. Colour
 - c. Labels
 - d. Price
13. What should be done with construction waste?

- a. Sort before disposal
- b. Label properly
- c. Reduce quantity
- d. Plan for recycling and reuse

Answer Key: Self-Test D-2.5 (#chapter-answer-key-self-test-d-2-5) is on the next page.

Answer Key: Self-Test D-2.5

1. d. OHS Regulation
2. b. Manufacturer's specifications
3. d. 4 in. building drain
4. c. 3 ft (900 mm)
5. a. Minimizes the damage caused to sensitive equipment in the event of a blockage
6. b. 3
7. c. Roof slope and cladding material
8. b. 2 in. (50 mm)
9. d. Expands when heated
10. b. Fire collar
11. d. Water test
12. c. Labels
13. d. Plan for recycling and reuse

Plumbing Apprenticeship & Trade Resources in BC

A successful career in plumbing requires a strong foundation of skills, knowledge, and workplace safety awareness. Below are key resources to support plumbing apprentices in BC, including educational pathways, trade certifications, workplace safety guidelines, and mental health and wellness support.

Plumbing Apprenticeship & Certification Resources

- **SkilledTradesBC – Plumbing Apprenticeship** (<https://skilledtradesbc.ca/plumber>) – Overview of plumbing training, certification requirements, and apprenticeship pathways in British Columbia.
- **Red Seal Program – Plumber** (<https://www.red-seal.ca/eng/trades/plumbers/overview.shtml>) – National certification program with exam prep guides and trade mobility information.
- **BC Building Codes & Standards** (<https://www.bccodes.ca/>) – Official building and plumbing codes for British Columbia.

Workplace Safety & Regulations

- **WorkSafeBC** (<https://www.worksafebc.com/en>) – Essential safety resources for plumbers, including:
 - Health & Safety – WorkSafeBC (<https://www.worksafebc.com/en/health-safety>)
 - Report Unsafe Working Conditions (<https://www.worksafebc.com/en/contact-us/departments-and-services/health-safety-prevention>)
 - Report a Workplace Injury or Disease (<https://www.worksafebc.com/en/claims/report-workplace-injury-illness>)
 - Submit a Notice of Project Form (<https://www.worksafebc.com/en/for-employers/just-for-you/submit-notice-project>)
 - Get Health and Safety Resources (Videos, Posters, Publications, and More) (<https://www.worksafebc.com/en/resources-health-safety>)
 - Search the OHS Regulations (and Related Materials) (<https://www.worksafebc.com/en/law-policy/occupational-health-safety/searchable-ohs-regulation>)
 - Conduct an Incident Investigation (<https://www.worksafebc.com/en/health-safety/create-manage/incident-investigations/conducting-employer-investigation>)
- **CCOHS: OHS Answers Fact Sheets – Plumber** (https://www.ccohs.ca/oshanswers/occup_workplace/plumber.html) – Safety guidelines and best practices for plumbers in various work environments.

Financial Supports

- **Financial Support (SkilledTradesBC)** (<https://skilledtradesbc.ca/financial-support>) – Information about grants, tax credits, Canada apprentice loans, employment insurance, and the Indigenous Skills and Employment Training

(ISET) program.

- **StudentAidBC** (<https://studentaidbc.ca/>) – Complete post-secondary education through student loans, grants, and scholarships. There is also programs that help with loan repayment.
- **WorkBC (Government of BC)** (<https://www.workbc.ca/find-loans-and-grants/students-and-adult-learners/services-apprentices-and-employers>) – Services for apprentices and employers.

Mental Health & Wellness Support

- **HealthLink BC – Mental Health and Substance Use** (<https://www.healthlinkbc.ca/mental-health-and-substance-use>) – HealthLink BC resources for mental health and wellness support.
- **Here2Talk** (<https://here2talk.ca/>) – Free and confidential counseling services available to all post-secondary students registered at a BC school.
- **Help Starts Here** (<https://helpstartshere.gov.bc.ca/>) – A database with over 2,500 listings of services related to mental health and substance use supports.
- **Hope for Wellness Helpline** (<https://www.hopeforwellness.ca/>) – 24/7 online chat and phone line with experienced and culturally competent counselors available to all Indigenous people in Canada.
 - First Nations Health Authority Mental Health Supports Info Sheet [PDF] (<https://www.fnha.ca/Documents/FNHA-mental-health-and-wellness-supports-for-indigenous-people.pdf>) by First Nations health Authority – List of culturally safe services for Indigenous people.
- **HeretoHelp – BC** (<https://www.heretohelp.bc.ca/>) – Mental health resources, including videos, articles, and support services in BC.
- **BC Construction Industry Rehabilitation Plan** (<https://www.constructionrehabplan.com/>) – Mental health and substance use services for CLRA and BCBT members and their families.
- **Virtual Mental Health Supports (Government of BC)** (<https://www2.gov.bc.ca/gov/content/health/managing-your-health/mental-health-substance-use/virtual-mental-health-supports>) – Virtual services are available for British Columbians who are experiencing anxiety, depression, or other mental health challenges.

Crisis Support

- **Interior Crisis Line Network** – Call 1-888-353-2273 (tel:+1-888-353-2273) for 24/7 emotional support, crisis intervention, and community resource information.
- **Talk Suicide Chat Service** (<https://talksuicide.ca/>) – An alternative if calling is difficult; available for crisis intervention.
- **310Mental Health Support** – Call 250-310-6789 (tel:+1-250-310-6789) for emotional support, information, and resources specific to mental health.
- **1-800-SUICIDE** – Call 1-800-784-2433 (tel:+1-800-784-2433) if you are experiencing feelings of distress or despair, including thoughts of suicide.
- **Opioid Treatment Access Line** – Call 1-833-804-8111 (tel:+1-833-804-8111) between 9 am and 4 pm to connect with a doctor, nurse, or healthcare worker who can prescribe opioid treatment medication that same day.
- **KUU-US Crisis Response Service** – Call 1-800-588-8717 (tel:+1-800-588-8717) for culturally-aware crisis support for Indigenous peoples in BC.
- **Alcohol and Drug Information and Referral Service** – Call 1-800-663-1441 (tel:+1-800-663-1441) to find resources and support.



Emergency Services — For life-threatening situations, call 911 or visit your nearest emergency department.

Version History

This page provides a record of changes made to this learning resource, Plumbing Apprenticeship Level 2, Block D (<https://d-drainagesystems-bcplumbingapprl2.pressbooks.tru.ca/>). Each update increases the version number by 0.1. The most recent version is reflected in the exported files for this resource.

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Version	Date	Change	Details
1.0	September, 2025	Plumbing Apprenticeship Level 2 Block D learning resource from STBC content converted to open and freely accessible digital platform and published at TRU.	Published in September 2025; and released October 2025 by TRU Open Press.
1.01	November 24, 2025	Updates to Figures in D-1.10 and Figures and Answer key for Self-test D-1.8.	Figure 20 (D-1.10) – measurements removed; Figures 2P-28 and 2P-35 (Self-test D-1.8) – measurement and labels changed, Table 8 Answers key adjusted for H and I (Self-test D-1.8)