CHAPTER 1: ELEMENTS OF PLUMBING

PLUMBING

Plumbing the art and technique of installing pipes, fixtures, and other apparatuses in buildings for bringing in the supply of liquids, substances and/or ingredients and removing them; and such water, liquid and other carried-wastes hazardous to health, sanitation, life and property pipes and fixtures after installation i.e., the ‘plumbing system’. (Section 217.6 The Revised National Plumbing Code of the Philippines 1999)

PLUMBING SYSTEM

Plumbing System includes all potable water supply and distribution pipes, all plumbing fixtures and traps; all sanitary and storm drainage systems; vent pipes, roof drains, leaders and downspouts; and all building drains and sewers, including their respective joints and connections; devices, receptacles, and appurtenances within the property; water lines in the premises; potable, tap, hot and chilled water piping; potable water treating or using equipment; fuel gas piping; water heaters and vents for same. (Section 217.12 NPC 1999)

A Plumbing system, reduced to its simplest terms, consists of a supply pipe leading to a fixture and a drainpipe taking the used water away from this fixture.

The system constitutes the following:

1. The water supply and water distribution system. Carries water from the water source, street main or a pump to the building and to various points in the building at which water is used.
2. The plumbing fixtures. The receptacles that receive the supplied water and allow the occupants of the building to use the water.
3. The drainage system. The piping network within the building which conveys from the plumbing fixtures all wastes and fecal matter (sanitary drainage) as well as rainwater (storm drainage) to a point of disposal or a treatment facility.

THE PLUMBER

The plumber is the one who works or engages in the business of installing in buildings the pipes fixtures and other apparatus for bringing in the water supply and removing liquid and waterborne wastes.

There are three categories of plumbers based upon their graces of experiences. They are:

1. Apprentice plumber- a beginner at the trade who usually serves for 3 to 5 years as helper to a journeyman.
2. Journeyman plumber- has served his apprenticeship and is competent to perform the tasks of installing and repairing plumbing.

3. Master plumber- a person technically and legally qualified and licensed to practice the profession of master plumbing without limitations in accordance with Republic Act 1378, having passed the examinations conducted by the Professional Regulation Commission (PRC), has received a certificate of registration from the board of master plumbing and possesses the current license to practice. (Section 214.5 NPC 200)

THE PLUMBING CODE

The improper installation of plumbing may affect the health of the occupants of a building and create a center point for the spread of disease. The possibility is of sufficient public interests to require the regulation of plumbing by law. The right of the government to regulate the details of plumbing is based on the principle of the protection of public health.

The basic goal of the National Plumbing Code of the Philippines is to ensure the qualified observance of the latest provision of the plumbing and environmental laws.

THE BASIC PRINCIPLES GOVERNING THE NATIONAL PLUMBING CODE

1. All premises intended for human use or habitation shall be provided with a supply of pure and wholesome water, neither connected to unsafe water supply nor subject to backflow or back- siphonage.
2. Plumbing fixtures, devices and appurtenances shall be supplied with water in sufficient volume and pressure adequate to function satisfactorily and without undue noise.
3. Plumbing shall be designed and adjusted to use the minimum quantity of water consistent with proper performance and cleaning.
4. Devices for heating and storing water shall be so designed and installed as to prevent dangers from explosion through overheating.
5. Every building abutting on a street, alley or easement with a public sewer shall connect its plumbing fixtures to the sewer system.
6. Each family dwelling unit shall have at least one water closet, one kitchen type sink, a lavatory and a bathtub or shower to meet the basic requirements of sanitation and personal hygiene.
7. Plumbing fixtures shall be made of smooth non-absorbent material, free from concealed fouling surfaces and shall be located in ventilated enclosures.
8. The drainage system shall be designed, constructed and maintained to safeguard against fouling, deposit of solids, clogging and with adequate cleanouts so arranged that the pipes may be readily cleaned.
9. All piping shall be of durable NAMPAP-approved materials, free from defective workmanship, designed and constructed by Registered Master Plumbers to ensure satisfactory service.
10. Each fixture directly connected to the drainage system shall be equipped with a water-sealed trap.
11. The drainage pipes piping system shall be designed to provide adequate circulation of air free from siphonage, aspiration or forcing of trap seals under ordinary use.

12. Vent terminals shall extend to the outer air and installed to prevent clogging and the return of foul air to the building.

13. Plumbing systems shall be subjected to such tests to effectively disclose all leaks and defects in the workmanship.

14. Substance which will clog the pipes, produce explosive mixtures, destroy the pipes or their joints or interfere unduly with the sewage-disposal process shall not be allowed to enter the building drainage system.

15. Proper protection shall be provided to prevent contamination of food, water, sterile goods and similar materials by backflow of sewage. When necessary, the fixture, device or appliance shall be connected indirectly with the building drainage system.

16. No water closet shall be located in a room or compartment which is not properly lighted and ventilated.

17. If there is no sewer system in the area, suitable provision shall be made for the disposal of building sewage by some accepted method of sewage treatment and disposal, such as a septic tank.

18. Where a plumbing drainage system may be subject to backflow of sewage, suitable provision shall be made to prevent its overflow in the building.

19. Plumbing systems shall be maintained in serviceable condition by Registered Master Plumbers.

20. All plumbing fixtures shall be installed properly spaced, to be accessible for their intended use.

21. Plumbing shall be installed with due regard to the preservation of the strength of structural members and the prevention of damage to walls and other surfaces through fixture usage.

22. Sewage or other waste from plumbing systems, which may be deleterious to surface or sub-surface waters shall not be discharged into the ground or into any waterway, unless first rendered innocuous through subjection to some acceptable form of treatment.

BRIEF HISTORY OF PLUMBING PRACTICE IN THE PHILIPPINES

- In 1902, the Plumbing Trade was duly recognized by the government in the City of Manila. Master Plumber John F. Haas became the first Chief of the Division of Plumbing Construction and Inspection. A Plumbing Code based on the Plumbing Code of the United States was incorporated into the Building Code for the City of Manila.

- In 1935, the National Master Plumbers Association of the Philippines (NAMPAP) was formally organized.

- Manila City Ordinance 2411, the “Plumbing Code of the City of Manila” was enacted and placed under the Department of Public Services, Manila.

- In 1954, the Third Congress approved House Bill No. 962 which in June 18, 1955, became R.A. 1378 “Plumbing Law of the Philippines” upon ratification of President Ramon Magsaysay.

- On January 28, 1959, the National Plumbing Code of the Philippines prepared by NAMPAP was promulgated and approved by Malacañang.

- Before Martial Law in 1972, Republic Act No. 6541 otherwise known as the “Building Code of the Philippines” was passed with the “National Plumbing Code of 1959” as referral code in full text.
• The Professional Regulation Commission (PRC) adopted the Revised Plumbing Code of 1999 which President Joseph Estrada approved December 21, 1999 pursuant to Section 4 of R.A. 1378 known as the Plumbing Law.
TYPICAL PLUMBING SYSTEM OF A TOILET AND BATH

WATER CYCLE OF THE PLUMBING SYSTEM
CHAPTER 2: PROPERTIES OF WATER

GENERAL

Water plays an important part in the plumbing system. It is a common, but in many ways, an unusual liquid. Large quantities of water are required in buildings for personal use, food preparation, cleaning and general domestic purposes, and possibly also for fire fighting, laundries, swimming pools, irrigation and recreational use.

We sometimes tend to think of water as an inexhaustible natural resource. However, our supply of fresh water is definitely limited, and improved conservation practices are necessary if our needs are to be supplied.

THE DEMAND OF WATER

<table>
<thead>
<tr>
<th>DEMAND</th>
<th>REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drinking, Cooking, Dishwashing</td>
<td>Must be pure, sterilized and protected from contamination. Supplies taken direct from mains or from exclusive storage.</td>
</tr>
<tr>
<td>Personal Washing and Domestic Cleaning</td>
<td>Similar but moderated to allow cold and hot supplies to be drawn from main storage tank or cistern via distribution network.</td>
</tr>
<tr>
<td>Laundry</td>
<td>Generally clean and wholesome, soft and free form Iron and Manganese staining.</td>
</tr>
<tr>
<td>Fire Fighting</td>
<td>High Pressure. Connections must not permit contamination of mains water.</td>
</tr>
<tr>
<td>Swimming</td>
<td>Clean, filtered and sterilized with free chlorine residue for post-sterilization. Can be recirculated.</td>
</tr>
<tr>
<td>Boilers and Heating Plants</td>
<td>Soft treated water, stored and circulated separate from domestic supplies.</td>
</tr>
<tr>
<td>Irrigation</td>
<td>No special requirement, except reasonably free from solids and sludge. (result in blocked pipes and nozzles) and undecomposed material (pollution).</td>
</tr>
</tbody>
</table>

THE WATER CYCLE

The cycle basically consists of water entering the atmosphere through evaporation and returning through condensation is that these processes result in natural
water purification. When water evaporates, only water molecules leave the surfaces; salts and other solids in solution remain behind. The condensed water is thus purified water- except in so far as it picks up pollutants in the air. Thus evaporation and condensation of water vapor are the source of all natural fresh water on earth.

Fresh water from precipitation falling on the ground gradually make its way through streams, rivers and lakes to oceans or seas as a result. As precipitation hits the ground, it may follow either of two alternative pathways, which are

A molecule of H₂O can absorb a maximum capacity of 12 grains.

(Relative Humidity)
RH= (4/12) x 100= 33%
RH= (10/12) x 100= 83.33%

Impervious Layer- does not allow H₂O to pass through.

9. **Purified Water**- water that undergoes a process where the pollutants are removed or rendered harmless.
10. **Polluted Water**- water that contains one or more impurities that make the water unsuitable for a desired use.
11. **Gray Water**- water drained from lavatories, sink, laundry trays and showers; contains minor pollutants.
12. **Black Water**- water drained from water closets and urinals; carries body wastes and contains major pollutants.
13. **Storm Water**- rainwater drained from roof gutters and downspouts.

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**WATER QUALITY PROBLEMS AND THEIR CORRECTION**

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>CAUSE</th>
<th>EFFECT</th>
<th>CORRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Acidity</td>
<td>Contains carbon dioxide. Cistern and pond waters containing decaying vegetation are likely to be acidic</td>
<td>Corrosion of non-ferrous pipes, rusting and clogging of steel pipes.</td>
<td>Passing the water through a bed of crushed marble or limestone to achieve alkalinity, or adding sodium silicate.</td>
</tr>
<tr>
<td>2. Hardness</td>
<td>Presence of Magnesium and Calcium</td>
<td>Clogging of pipes. Impaired laundering and food preparation.</td>
<td>Introduction of water softeners made up of Zeolite (a greenish granular material)</td>
</tr>
<tr>
<td>3. Turbidity</td>
<td>Silt or suspended matters picked up in surface or near surface flow.</td>
<td>Discoloration and bad taste.</td>
<td>Filtration</td>
</tr>
<tr>
<td>4. Color</td>
<td>Presence of Iron and Manganese</td>
<td>Discoloration of fixtures and Laundry</td>
<td>Precipitation by filtration through manganese zeolite (oxidizing filter)</td>
</tr>
<tr>
<td>5. Pollution</td>
<td>Contamination by organic matter or sewage</td>
<td>Disease</td>
<td>Chlorination</td>
</tr>
</tbody>
</table>

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**WATER PURIFICATION**

Water purification is any method that will remove one or more materials that make the water unsuitable for a given use. The methods that are commonly used in water purification are:

1. Settling or Sedimentation
2. Filtration
3. Adsorption/ Flocculation-Coagulation
4. Aeration
5. Distillation
6. Disinfection/ Chlorination

The natural water includes all of these purification methods except disinfection. Sitting in lakes, ponds, or the oceans, water is subject to settling (sedimentation). As it percolates through soil or porous rocks, it is filtered (filtration). Soil and humus are also good chemical adsorbents (coagulation/ flocculation). As water flows down streams and rivers, detritus is removed by biological oxidation (aeration). As water evaporates and condenses, it is distilled (distillation).

Thus, numerous freshwater sources might be safe to drink were it no for human pollution. The most serious threat to human health is contamination with disease-causing organisms and parasites, which come from the excrements of humans and their domestic animals. In human settlements, one can see how the organisms may get into water and be passed onto people before any of the natural purification processes can work.

THE METROPOLITAN CEBU WATER DISTRICT (MCWD)

The Metropolitan Cebu Water District (MCWD) is the sole commercial provider in Metro Cebu comprising of four cities and four municipalities. As of year 2000, MCWD served 40% of the total population of Metro Cebu.

MCWD is primarily tasked to deliver adequate, safe, potable and affordable water to its concessionaires.

MCWD has two sources or its water supply:

1. Ground Water
2. Surface Water

GROUND WATER TREATMENT PROCESS USED BY MCWD

Ground water sources are naturally and presumably purified by a compact thick filter media layer of ungraded sands, soils and rocks at considerable depth. Hence, disinfection using Chlorine Gas and other Chlorine Salts is the only treatment process employed. Here, water that is extracted from their ground through a pumping equipment is allowed to pass through chlorination facility using chlorine gas to kill any presence of coliform organisms and other froms of bacteria. Water is the stored in a reservoir ready for distribution into each concessionaire’s faucet.

At certain areas in the distribution network, Direct feed pumping stations are employed to augment the water supply. These are strategically located in different areas Metro Cebu.

SURFACE WATER BASIC TREATMENT PROCESS EMPLOYED BY MCWD
Runoff or surface water is first stored in dam. From this, water goes through a series of treatment processes.

The Buhisan Dam (Tisa Filtration)

Buhisan Dam is Cebu’s first and only dam MCWD’s only surface water source. It supplies the Tisa (Labangon) filter plant with up to 600 cubic meter per hour (600,000 liters per hour or 158,400 gallons per hour) or about an average of 4,000 cubic meter daily (4 million liters or 1.05 million gallons).

This dam is located in Buhisan, a southern mountain baranggay of Cebu City. This was designed by 27 year-old Eusebius Julius Halsema. AG and P, the winning bidder, asked Php 463, 628.00 to do the work. On November 10, 1911, the dam was completed and ready to be filled.

With a height of 27 meters, the concrete dam has a conical arch design which transfers the stress in the reservoir (caused by water strain) to the sides of the dam thereby anchoring it firmly in place.

Three 4.5 meter wide flood gates exist for flood control purposes. Its long concrete spillway allows overflow water to escape safely when the dam gates are raised.

Two kilometers of raw water main pipes extend from the dam to the distribution reservoir in Tisa. From the latter, a four kilometer pipeline distributes water to concessionaires in Cebu City. Another 21 kilometers of pipelines were also laid for improved water distribution.

Today the almost 100 year old Buhisan Dam is as strong as when it first operated.

TREATMENT PROCESS

MCWD treats the surface water using the conventional process comprising of the following:

1. Aeration
2. Coagulation- Flocculation
3. Sedimentation
4. Filtration
5. Disinfection/ Chlorination

1. Aeration- Water is sprayed into the air to release any trapped gases and absorb additional oxygen for better taste.
2. **Coagulation- Flocculation-** This is the process by which small sediment particles which do not settle well combine together to form larger particles which can be removed by sedimentation. This process includes physical and chemical process:

   a. Coagulation- is the chemical process in which the coagulant reacts with the sediment to make it capable of combining into larger particles. This is called destabilization.
   b. Flocculation- is the physical process in which the sediment particles collide with each other and stick together.

3. **Sedimentation-** This is the process by which suspended solids are removed from the water by gravity settling and deposition. This process usually follows coagulation-flocculation. The objective of this process is to remove most of the suspended solids, reducing the loads on the filters.

4. **Filtration-** This is the passage of fluid through a porous medium suspended matter which did not settle by gravity. In water purification, matter to be removed includes suspended silt, clay, colloids, and microorganisms including algae, bacteria, and viruses. A filter bed consists of a granular non-porous material held in place by the force of gravity or by the direction of flow.

5. **Disinfection/ Chlorination-** This is the most important process used in the production of water of a safe and sanitary quality. Chlorination is the method of introducing a controlled amount of chlorine to the water in order to attain a desired degree of disinfection.

*After the processes, water is stored in a reservoir, then to the transmission mains, then to the, distribution lines, down to the service connections and lastly to the concessionaire’s faucet.*
GROUND WATER SUPPLY AND TREATMENT SYSTEM
Water is taken from the water shed reservoir and piped to the treatment plant. At the plant, (1) water is aerated to release trapped gases and to absorb oxygen for better taste, (2) Alum/tawas (aluminum sulfate) is added to coagulate organic particles, and (3) the water is put into a settling basin for several hours to allow coagulated particles to settle. It is then (4) filtered through sand filters, (5) Chlorine is added to kill bacteria and put into a storage tank for distribution to concessionaires.
CHAPTER 3: PLUMBING FIXTURES

FIXTURES- receptacles attached to a plumbing system other than a trap in which water or waste may be collected or retained for ultimate discharge into the plumbing system.

COMMON TYPES OF PLUMBING FIXTURES USED IN RESIDENCES

1. Water closet 4. Urinal
2. Lavatory 5. Bidet

WATER CLOSET- A plumbing fixture used to receive human excremental and to discharge it through a waste pipe, using water as a conveying medium. Water closets are classified according to design, make, flushing mechanism, shape and installation.

A. TYPES OF WATER CLOSET AS TO DESIGN

1. Siphon washdown 3. Siphon Vortex
2. Siphon jet 4. Reverse trap

1. SIPHON WASHDOWN- The least expensive but the noisiest; only small amount of standing water-susceptible to fouling, staining and contamination. It is mechanically satisfactory and is lower in price. Hence, it is widely used and entirely acceptable where price is the main consideration.

2. SIPHON JET- The jet being submerged introduces its water underwater so that its operation is entirely muffled. It has a large amount of standing water to prevent fouling. It is mechanically efficient but expensive.

3. SIPHON VORTEX- this type of bowl develops its flushing action through the water entering through diagonal holes around the rim which creates a swirling action which forms a vortex in the center. It is considered to be the most quiet, most efficient and most sanitary water closet.
4. **REVERSE TRAP** – the trap way located at the rear of the water closet eliminated the buldge at the front. The design and appearance of the bowl plus its large water area and quietness in operation, make it desirable than siphon wash down.

**B. TYPES OF WATER CLOSET AS TO MAKE**

1. One-piece
2. Close Coupled
3. Pail Flush
4. Squat bowl

1. **ONE-PIECE WATER CLOSET**- The water closet fixture is manufactured with the bowl and the flush tank molded into a single unit. Usually used in tandem with the bidet.

2. **CLOSED COUPLED WATER CLOSET**- a water closet where in the flush tank is separate but is attached to the toilet bowl. It is a two-piece model.

3. **PAIL FLUSH WATER CLOSET**- a water closet comprising only of a bowl without a flush tank. Flushing action is obtained only through water poured from a pail or bucket. This is used in areas where running water systems are not available.
4. SQUAT BOWL WATER- A water closet that is otherwise known as “Eastern type” since the user assumes a squatting position rather than a sitting position.

C. TYPES OF WATER CLOSET AS TO FLUSING MECHANISM

1. Flush tank
2. Flush Valve (flushometer)

1. FLUSH TANK- holds a supply of water for flushing a fixture such as the water closet. It has a capacity of 5 to 6 gallons.

2. FLUSH VALVE- valve designed to supply a fixed quantity of water for flushing purposes. It is activated by direct water pressure without the use of a flush tank. It is also known as Flushometer or Flushometer valve. The flush valve requires 10 to 20 psi flow pressure.

D. TYPES OF WATER CLOSET AS TO SHAPE

1. Round Front
2. Elongated Front

1. ROUND FRONT - intended for installation on a limited space.

2. ELONGATED FRONT - is more comfortable but occupies a larger space.

E. TYPES OF WATER CLOSET AS TO INSTALLATION

1. Free Standing (Flour mounted)

2. Wall Hung (Wall Mounted)
- **MINIMUM WATER CLOSET CLEARANCES**

- **ROUGHING-IN DIMENSIONS OF WATER CLOSET**

- **PLUMBING FIXTURE MATERIALS (GENERAL REQUIREMENTS)**
  - **QUALITY OF FIXTURES**
    - i. Dense
    - ii. Durable
    - iii. Non-absorbent
    - iv. Smooth, Impervious Surface
    - v. Free form unnecessary concealed fouling surfaces
  - **MINIMUM TRAP DIAMETER AND DFU VALUE**
    - i. Water closet private installation → 76mm Φ (3") → 4 DFU, 4" Φ
    - ii. Water closet public installation → 76mmv Φ (3") → 6 DFU, 4" Φ
      *use 6 DFU when computing for septic tank size
  - **SIZE OF WATER SUPPLY AND WSFU VALUE**
i. Water closet, Flush tank → 12 mm Φ (1/2") → 3 (Private) → 5 (Public)
ii. Water closet, Flush Valve → 25mm Φ (1") → 6 (Private) → 10 (Public)

- **MINIMUM SIZE OF VENT**
  
i. The minimum size of vent for water closet is 51mm Φ.

- **VENTILATION OF T &B**
  
i. Ceiling mount exhaust fan duct type.
  ii. Thermal exhaust fan

- **TILES IN TERMS OF DESIGN FOR T&B**
  
i. 200mm x 200mm for ceramic

**LAVATORY**- a fixture designed for the washing of the hands or face. It is also known as wash basin.

- **TYPES OF LAVATORY**
  
1. Wall Hung lavatory

![Wall Hung Lavatory Diagram]

2. Pedestal Lavatory

![Pedestal Lavatory Diagram]

3. Counter Type Lavatory

![Counter Type Lavatory Diagram]
4. One-Piece Lavatory

- **TYPES OF LAVATORY FAUCET**
  
a. Center Set  
b. Wide Spread

- **ROUGHING-IN OF LAVATORY**
• MINIMUM LAVATORY CLEARANCE

• MATERIALS FOR LAVATORIES
  a. Vitreous China
  b. Enameled Cast Iron
  c. Stainless Steel
  d. Plastic

• MINIMUM TRAP DIAMETER & DFU VALUE
  o Wash basin, in sets → 38mmΦ → 2 DFU
  o Wash basin, single → 38mm Φ → 1 DFU

• SIZE OF WATER SUPPLY PIPE & WSFU VALUE
  o Lavatory→ 12mmΦ (1/2”) → 1 (Private use)
    → 2(Public use)

• MINIMUM SIZE OF VENT FOR LAVATORY
  o The minimum size of vent for a lavatory is 32mmΦ.

BIDET- a plumbing fixture used for washing the middle part of the body, especially the genitals. It is also known as the Sitz Bath.
Setting and clearance for bidet shall be the same as in the water closet. 
- Bidet minimum trap diameter is 38mm and its DFU value is 2. 
- Size of water supply is 12mm and WSFU is 2 (private) or 4 (public)

BATH TUB- a tube for bathing, usually a fixed plumbing installation designed for one person. It is available in left outlet and right outlet.

*BATH TUB* 
- Minimum size of vent is 38mmΦ (1 ½")
- Bathtub minimum trap diameter is 38mm and the DFU value is 2.
- Size of supply pipe is 12mm and WSFU value is 2 (private) and 4 (public).

*REQUIREMENTS FOR WHIRLPOOL BATHTUBS* (SEC. 411 NPC 1999)

a. Provide removable access panel to the pump.
b. Locate the circulation pump above the crown weir of the trap.
c. The pump and the circulation piping shall be self-draining to minimize water retention.
d. Suction fittings on whirlpool bathtubs shall comply with the listed standards.

URINAL- A sanitary fixture equipped with a water supply and drain for flushing away urine.

*TYPES OF URINAL*
1. Wall hung Urinal

2. Pedestal Urinal

3. Stall Urinal
4. Trough Urinal

MINIMUM CLEARANCES FOR URINALS
MINIMUM TRAP DIAMETER AND DFU VALUE

- Urinal, Wall-mounted → 51mm (2") → 6 DFU
- Urinal, Stall → 51mm (2") → 6 DFU
- Urinal, Trap arm → 51mm (2") → 3 DFU

SIZE OF SUPPLY PIPE AND WSFU VALUE

- Urinal, Wall-mounted → 19mm (3/4") → 5 WSFU
- Urinal, Stall → 19mm (3/4") → 5 WSFU

MINIMUM SIZE OF VENT

- The minimum size of vent is 38mmΦ

SINKS

MINIMUM TRAP DIAMETER AND DFU VALUE

- Kitchen Sink (Residential); 1 ½ “Φ → 38 mm Φ → 2 DFU
  51mm minimum waste pipe
- Bar Sink (Commercial) 1 ½ “Φ → 38 mm Φ → 2 DFU
  51mm minimum waste pipe
- Bar Sink (Private) 1 ½ “Φ → 38 mm Φ → 1 DFU
  38mm minimum waste pipe
- Sink (Commercial, Industrial, Institutional) 1 ½ “Φ → 38 mm Φ → 3 DFU
  58mm minimum waste pipe
- Sink (Clinic); Flushing Rim 3 “Φ → 76mm Φ → 6 DFU
- Service sink (Slop) 2 “Φ → 51 mm Φ → 3DFU
- Laundry Tub 1 ½ “Φ → 38 mm Φ → 2 DFU

SIZE OF SUPPLY PIPE AND WSFU VALUE

- Kitchen sink ½ “Φ → 38 mm Φ → 2 (Private); 4 (Public)
- Scullery sink 3/4 “Φ → 38 mm Φ → 2 (Private); 4 (Public)
- Slop Sink ½ “Φ → 38 mm Φ → 2 (Private); 10 (Public)
- Laundry Tub ½ “Φ → 38 mm Φ → 2 (Private); 4 (Public)
- Bar sink ½ “Φ → 38 mm Φ → 1 (Private); 2 (Public)

DRINKING FOUNTAIN

- Minimum trap diameter is 31mm and DFU value is 1.
- Size of waste supply is 12mm Φ and the WSFU value (each faucet) is 1 (private use) or 2 (public use).
- Minimum size of vent is 32mm Φ (1 ¼")

SHOWER BATH

- Minimum trap diameter is 51mm and the DFU value is 2.
- Size of water supply is 12mm Φ and the WSFU value (each head) is 2 (private use) or 4 (public use).
- Minimum size of vent is 38mm Φ.

**FLOOR DRAINS**

- Minimum trap diameter is 51mm and the DFU value is 2.

**HOSE BIBB**

- Size of water supply is 12mm Φ and the WSFU value is 3 (private use) or 5 (public use)

**KITCHEN SINK** - a plumbing fixture usually consisting of a basin with a water supply, connected with a drain.

**TYPES OF KITCHEN SINK**

a. Single Bowl- Single Drain

b. Double Bowl- Single Drain

c. Double Bowl- Double Drain
OTHER PLUMBING FIXTURES

- SLOP SINK- A deep sink, usually set low and used by janitors for emptying pails of dirty water and mop cleaning.
- DRINKING FOUNTAIN- A fixture consisting of a shallow basin, together with a water jet designed to provide potable water for human consumption.
- LAUNDRY TUB- A deep wide sink or but used for washing clothes. It is also known as Laundry Tray or Set Tub.
- SHOWER BATH- An apparatus for spraying water on the body, usually from above. Drain is through the shower bath floor drain.
- SCRUB SINK- A plumbing fixture usually located in the operating room in a hospital to enable personnel to scrub their hands prior to a surgical procedure; the hot and cold water supply is activated by a knee-action mixing valve or by wrist or pedal control.
**PLUMBING UNIT (Sec. 217.13 NPC 1999)**

The minimum standard quantities of plumbing fixtures that discharge waste into a plumbing installation include:

- 1 water meter
- 1 water closet
- 1 lavatory
- 1 shower head and drain for a bathtub or shower stall
- 1 kitchen sink
- 1 laundry tray
- 3 floor drains
- 4 faucets/ hose Bibb

13 Total numbers of fixtures and fittings that comprise a plumbing unit

**NOTES ON SHOWER RECEPTOR (NPC 1999)**

1. Each shower receptor shall be constructed to have a finished dam, curb or threshold of at least 25.4 mm lower than the outside floor.

![Diagram of shower receptor with dam and curb or threshold dimensions](image)

2. The dam or threshold shall not be less than 51mm nor more than 228mm in depth, when measured from the top of the dam or threshold to the top of the drain.

![Diagram showing dam or threshold depth](image)
1. Soap holder

2. Paper holder
3. Toothbrush and tumbler holder

4. Towel holder/tower bar

5. Seat Cover

**TYPICAL FIXTURE LAYOUT FOR TOILET AND BATH (minimum dimensions)**
TOILET FIXTURE CLEARANCES FOR DISABLED PERSONS (per BP 344 The Accessibility Law)
WHEELCHAIR TURNING SPACE AND TOILET CLEARANCE

GRABRAIL HEIGHTS AT WATERCLOSET STALL

GRABRAIL HEIGHTS AT URINALS

MINIMUM CLEAR DIMENSION FOR WHEELCHAIR IN WASHROOMS

MOUNTING DIMENSIONS FOR TOILET & BATHROOM ACCESSORIES
MOUNTING DIMENSIONS OF ACCESSORIES AND FITTINGS AT SHOWER AREA
MOUNTING DIMENSIONS OF ACCESSORIES AND FITTINGS AT BATH TUB/SHOWER
CHAPTER 4: DRAINAGE SYSTEM

The drainage system is composed of the piping network within a structure which conveys sewage, rainwater, or other wastes from their point of origin to a point of disposal, such as a public sewer or a private treatment facility (septic tank). This system is often known as the DWV System (Drainage, Waste and Vent). The complete drainage system is subdivided into four (4) sub-systems, as follows.

1. SOIL DRAINAGE SYSTEM- The piping that conveys the discharge of water closets or fixtures having similar functions (containing fecal matter), with or without the discharges from other fixtures.

2. WASTE DRAINAGE SYSTEM or SANITARY DRAINAGE SYSTEM- The piping that receives the liquid discharge, from plumbing fixtures other than those fixtures (water closets) receiving fecal matter. This piping is free of fecal flow.

3. STORM DRAINAGE SYSTEM- The piping system that receives clear water drainage from leaders, downspouts, surface run-off, ground water, subsurface water, condensate water, cooling water or other similar discharges and conveys them to the point of disposal. All sanitary wastes must be excluded.

4. VENT SYSTEM- the piping system that receives a flow or air to or from a drainage system or to provide a circulation of air within such system to protect trap seals from siphonage or back pressure.

GENERAL REQUIREMENTS FOR A PROPERLY DESIGNED DRAINAGE SYSTEM

a. The piping must be air tight, gas tight and water tight.

b. Each plumbing fixture, except those with integral traps, shall be separately trapped by an approved type water seal trap. This is to prevent odor-laden and germ-laden to rise out of the drainage system and contaminate the surrounding air in the room.

c. Each plumbing fixture trap shall be provided with vent pipes. This is to protect the drainage system against siphonage and back pressure and to assure air circulation throughout the drainage system.

d. A cleanout, easily accessible, shall be provided for inspection or cleaning of the pipe run. The location of the cleanout shall be:
   - At the upper end of every horizontal waste or soil pipe.
   - At every change of horizontal direction of not more than 22.5 degrees
- Within 1.5 m (5') inside the property line before the house sewer connection
- At every 15m (50') to a horizontal run of a soil or waste pipe

e. All horizontal piping shall be run in practical alignment and at a uniform grade of not less than 2% or 2 cm per meter toward the point of disposal.

f. All horizontal piping shall be supported and anchored at intervals not to exceed 3 meters.

g. Vertical piping shall be secured at sufficiently close intervals to keep the pipe in alignment. Stacks shall be properly supported at their bases.
DEFINITION FROM NPC 1999 EDITION

HOUSE / BUILDING DRAIN- part of the lowest horizontal piping of a plumbing system, which receives the discharges from the soil, waste and other drainage pipes inside of a building and conveys it to the house sewer outside of the building.
**HOUSE / BUILDING SEWER** - extends from the house drain at a point 0.60 meters from the outside face of the foundation wall of a building to the junction with the street sewer or to any point of discharge, and conveying the drainage of one building site. No house/building sewer shall be smaller than 150mm in diameter, nor less in size than the house/building drain.

**WASTE PIPE** - conveys only wastewatet or liquid waste free of fecal matter.

**SOIL PIPE** - any pipe which conveys the discharge of water closet, urinal or fixtures having similar functions, with or without the discharges from other fixtures to the building drain or building sewer.

**SOIL STACK PIPE** - a vertical soil pipe conveying fecal matter and waste water.

**VENT PIPE** - used for ensuring the circulation of air in a plumbing system and for relieving the negative pressure exerted on trap seals.

**VENT STACK** - the vertical vent pipe installed primarily for providing circulation of air to and from any part of the soil, waste of the drainage system.

**SEPTIC TANK** - A watertight covered receptacle designed and constructed to receive the discharge of sewage from a building sewer, separate solids from the liquid, digest organic matter and store digested solids the clarified liquids to discharge for final disposal.

**PRIVATE SEWAGE DISPOSAL SYSTEM** - a septic tank with the effluent discharging into a subsurface disposal field, seepage pits or of such other facilities or may be permitted by the plumbing code.

**ROOF GUTTER** - the water collector at the eaves of the building.

**DOWN SPOUT** - A vertical pipe which conveys rain water, also known as conductor or rain water.

**STORM DRAIN** - Receives storm water, clear, rain or surface-water waste (SD).

**CATCH BASIN** - A receptacle in which liquids are retained for a sufficient period of time to allow materials to settle to deposit.

**TRAP** - A fitting or device designed and constructed to provide, when properly vented, a liquid seal which prevents the backflow of foul air or methane gas without materially affecting the flow of sewage or waste water through it.
DETAIL A

DETAIL B

DETAIL C

DETAIL D

DETAIL E

DETAIL F

BRANCH WASTE TO SOIL STACK
PIPE JOINT (HOR. TO YIELD)

SOIL STACK TO HOUSE DRAIN PIPE
JOINT DETIL (VERT. + HORIZ.)
MATERIALS USED FOR THE PLUMBING DRAINAGE SYSTEM APPROVED BY THE 1999 NATIONAL PLUMBING CODE.

EXCRETA DRAINAGE PIPING

1. Cast iron
2. Ductile iron
3. Galvanized steel (shall not be used underground. Kept at least 152mm above ground)
4. Galvanized wrought iron (shall not be used underground. Kept at least 152mm above ground)
5. Lead
6. Copper
7. Brass
8. Series 1000, pvc, dmv
9. Extra strength vitrified clay pipe (shall not be used above ground. At least 300mm below finish ground level.)
10. Approved material having smooth and uniform bore

NOTE: ABS and PVC DWV can be used in high rise buildings at the discretion of the RMP and with the full consent of the owner.

DRAINAGE FITTING

1. Cast Iron
2. Malleable
3. Lead
4. Brass
5. Copper
6. ABS
7. PVC
8. Vitrified clay

VENT PIPES

1. Cast iron
2. Ductile cast iron
3. Galvanized steel
4. Galvanized wrought iron
5. Lead
6. Copper
7. Brass
8. Schedule 40, ABS, DWV
9. Series 1000, PVC, DWV

VENT STACKS
1. Copper
2. Cast iron
3. Galvanized wrought iron
4. PVC

**VENT FITTINGS**

1. Cast Iron
2. Galvanized malleable iron
3. Galvanized steel
4. Lead
5. Copper
6. Brass
7. ABS
8. PVC

**DOWN SPOUT (INTERIOR)**

1. Cast iron
2. Galvanized steel
3. Iron
4. Brass
5. Copper
6. Lead
7. Sched 40, ABS, DMV
8. Series 1000, PVC, DWV

**DOWNSPOUT (MEDIUM HEIGHT BUILDING)**

1. G.I. pipe, sch. 30
2. CISP, S.W.
3. Copper tube, type DWV
4. Sch. 40, ABS, DWV
5. Series 1000, PVC, DWV

**DOWN SPOUT (EXTERIOR/ LOW HT. BLDG)**

1. 26 GA, Galvanized sheet metal with steel pipe or cast iron at its lowest section draining to the catch basin.

**DOWN SPOUT (HIGH RISE)**

1. Shall be of stronger pipe materials to resist the high hydrostatic pressure.
1. Cast iron
2. Copper
3. Other corrosion resistant materials

**TRAPS (SEC. 1003 NPC 1999)**
1. ABS
2. Cast brass
3. Cast iron
4. Lead
5. PVC

Figure 2- The function of the trap and one of the several functions of a vent preventing siphonage.
LOSS OF TRAP SEAL - This failure can be attributed directly to inadequate ventilation of the trap and the subsequent minus and plus pressures which occur in the piping system. See figure 3.

Five (5) Cause of Trap Seal Loss

1. **Siphonage** - The withdrawal of a liquid from a trap due to a suction caused by liquid flow in a pipe.
   a. Direct Self-siphonage

   ![Diagram of Direct Self-siphonage](image1)

   2. Indirect or Momentum Siphonage

   ![Diagram of Indirect or Momentum Siphonage](image2)
2. **Back Pressure**- pressure developed in opposition to the flow of liquid in a pipe due to friction, gravity or some other restriction to flow of the conveyed fluid. Excessive pressure at the lowest branch causing trap seal to look for opening.

![Diagram of Trap Seal](image)

3. **Evaporation**- Occurs when a fixture is not used for a long time. A Deep seal is the best solution but clogs the pipe due to accumulated solid wastes.

4. **Capillary Attraction**- foreign objects in the traps absorbing trap seal

![Diagram of Capillary Attraction](image)

5. **Wind Effects**- strong winds through the vent system forcing water out of the trap

![Diagram of Wind Effects](image)

**SUPPORTS**- are devices for holding and securing pipes and fixtures to walls, ceiling, floors or structural members. Supports include hangers, anchors, brackets, and cradles.

**INDIRECT WASTE PIPING** (Section 810 NPC 1999)
- The drains of the following equipments shall not be directly connected to any soil, waste and vent pipes.

1. Evaporative cooler
2. Air Washer
3. Air Conditioner
4. Cold Storage Room
5. Refrigerator
6. Cooling Counter
7. Food and Drinks Storage
8. Culinary/ Dishwashing Sink for food preparation Room

- Cooling and air conditioning equipments may be separated by an *airbreak.
- Food equipments shall be separated from the drainage system by a full *airgap.

*Airbreak- a physical separation, which may be a low inlet into the indirect waste receptor from the fixture, appliance or device indirectly connected, at least 25mm.

*Airgap, drainage.- the unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe, plumbing fixture, appliance or appurtenance conveying waste to the flood level rim of the receptor.
DRAINAGE, WASTE AND VENT (DWV) PIPING SYSTEM

The drainage system is composed of groups of pipes and fittings that convey waste from the building to the proper means of disposal system.

1. **Building Sewer** - That part of the horizontal piping of a drainage system which extends from the end of the building and which receives the discharge of the building drain and conveys it to the public sewer, private sewer, individual sewage disposal system or other point of disposal.

2. **Building drain** - the part of the lowest horizontal piping of a plumbing system which receives the discharge from soil, waste and other drainage pipes inside of a building and conveys it to the house sewer.

3. **Sewage Disposal System**. A system for the treatment and disposal of domestic sewage by means of a septic tank, cesspool, or mechanical treatment, all designed to serve a single establishment, development or building.

   The drainage piping system contains fittings that serve as **drains, traps and vents**.

**Drains** - fittings used for draining fluid from point of use to the piping system.

**Traps** - fittings or device designed and constructed to provide a liquid seal which prevent the back passage of air without materially affecting the flow of sewage or water through it.

**Vents** - pipes and fittings installed in the system to provide air circulation so as to protect trap seals from siphonage and back pressure.
1. P-Trap→ used at lavatories, sinks, floor drain and scuppers.
2. Drum Trap→ used at bathtubs and bidets
3. House Trap
4. Other Appliances
   a. Back flow valve
   b. Flow control valve
   c. Grease trap/ grease interceptor
Drum Trap—A cylindrical trap commonly used on the drain pipe from a bathtub or under the bathroom floor.
**Sizes and Capacities of Grease Traps**

<table>
<thead>
<tr>
<th>Sizes</th>
<th>Dimensions (mm)</th>
<th>Pipe Size Inlet and Outlet (mmΦ)</th>
<th>Flow Rate GPM</th>
<th>Flow Rate LPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>279 Φ x 216</td>
<td>51</td>
<td>2</td>
<td>0.13</td>
</tr>
<tr>
<td>-</td>
<td>301 Φ x 203</td>
<td>51</td>
<td>3</td>
<td>0.19</td>
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<tr>
<td>-</td>
<td>330 Φ x 241</td>
<td>51</td>
<td>4</td>
<td>0.25</td>
</tr>
<tr>
<td>-</td>
<td>356 x 279</td>
<td>51</td>
<td>5</td>
<td>0.32</td>
</tr>
<tr>
<td>100</td>
<td>381 x 305 x 283</td>
<td>51</td>
<td>7</td>
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<tr>
<td>200</td>
<td>406 x 356 x 298</td>
<td>51</td>
<td>10</td>
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<tr>
<td>300</td>
<td>470 x 400 x 302</td>
<td>51</td>
<td>15</td>
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<tr>
<td>400</td>
<td>629 x 495 x 381</td>
<td>51</td>
<td>20</td>
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<tr>
<td>500</td>
<td>699 x 429 x 441</td>
<td>76</td>
<td>25</td>
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<tr>
<td>600</td>
<td>762 x 470 x 470</td>
<td>76</td>
<td>35</td>
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<tr>
<td>700</td>
<td>832 x 502 x 518</td>
<td>76</td>
<td>50-55</td>
<td>3.15</td>
</tr>
<tr>
<td>800</td>
<td>873 x 559 x 584</td>
<td>76</td>
<td><strong>House Trap</strong></td>
<td><strong>installed to prevent circulation of air between the building sewer.</strong></td>
</tr>
<tr>
<td>900</td>
<td>902 x 724 x 890</td>
<td>76</td>
<td></td>
<td>6.00</td>
</tr>
<tr>
<td>1000</td>
<td>1083 x 851 x 953</td>
<td>76</td>
<td></td>
<td>6.31</td>
</tr>
<tr>
<td>1100</td>
<td>1248 x 1016 x 1006</td>
<td>76</td>
<td></td>
<td>7.89</td>
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<tr>
<td>1200</td>
<td>1422 x 1054 x 1029</td>
<td>102</td>
<td></td>
<td>9.46</td>
</tr>
<tr>
<td>1300</td>
<td>1549 x 1105 x 1156</td>
<td>102</td>
<td>200</td>
<td>12.62</td>
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<tr>
<td>1400</td>
<td>1800 x 1308 x 1270</td>
<td>102-127</td>
<td>250</td>
<td>15.77</td>
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<tr>
<td>1500</td>
<td>2029 x 1486 x 1416</td>
<td>127-152</td>
<td>300</td>
<td>18.93</td>
</tr>
</tbody>
</table>

**Back Flow Valve** - Device that prevents the reversal of flow which might flood and cause damage to the building.

**House Trap** - Device installed to prevent circulation of air between the building sewer.
Note: Minimum height of 89mm required from cover of grease trap to bottom of fixtures served.

Source: Metma Trading and Industrial corporation
CAT. No. 1005
POT. No. 24187

FREE LEVEL HANDLE DRAIN (METMA BRAND)

USING FREE LEVEL HANDLE DRAIN IS FOR EASY DRIPPING OF WASTE WATER FROM KITCHEN SINK.

FLOW CONTROL VALVE IS RECOMMENDED FOR INSTALLATION BETWEEN FREE LEVEL HANDLE DRAIN AND GREASE TRAP TO PREVENT FATS FROM CLOGGING INTO PIPES.
GREASE TRAP, A DEVICE FOR REMOVING FAT AND GREASE FROM WASTE WATER BY ALLOWING THE RETAINED LIQUID TO COOL AND THE GREASE TO SOLIDIFY; THEN THE GREASE IS SEPARATED BY FLOATATION; IT RISES TO THE TOP OF THE TRAP, WHERE IT IS HELD. THE PRIME PURPOSE OF A GREASE TRAP IS TO ASSURE A FREE FLOWING DRAINAGE THROUGH PIPE LINES AT ALL TIMES BY INTERCEPTING, ACCUMULATING AND RECOVERING GLOBULES OF GREASE FAT AND OILS FROM WASTE WATER.

GREASE TRAP/ GREASE INTERCEPTOR

NOTE:
Grease trap is not required for individual dwelling units or for any private living quarters. (sec. 1011.1, NPC 1999)
: No food waste disposal unit shall be connected to or discharged into any grease trap. (Sec 1013, NPC 1999)

SIZING OF GREASE INTERCEPTORS (TABLE 10-4, NPC 1999)

C = M x W x R x F

NOTE:
1 Cubic meter = 264 gallons
WHERE:

C = size of grease interceptors (liquid capacity)

M = Number of meals served at peak hour

R = Waste flow rate;
- With dishwashing machine → 6 gallon flow (per meal/day)
- Without dishwashing machine → 5 gallon flow (per meal/day)
- Single service kitchen → 2 gallon flow (per meal/day)
- Food waste disposer → 1 gallon flow (per meal/day)
- Hospital kitchen → 25 gallon/bed/day

F = Storage Factors
- Fully equipped commercial kitchen
  8 hour operation: 1
  18 hour operation: 2
  24 hour operation: 3
- Single service kitchen: 1.5

SAMPLE PROBLEM;

Determine the capacity and volume of the grease trap for a canteen that serves an average of 50 meals a day that is open from 11:00 am to 7:00 pm.

SOLUTION: S = M x W x R x F = 50 x 5 x 2.5 x 1
S = ?
= 625 gallons

M = 50 meals
W = 5 cal/meal/day
R = 2.5 hours
F = 1

Solve for volume of grease trap (V) m³ (cubic meter)

V = 625/264 = 2.37 cubic meter ← volume of grease trap

OTHER METHODS USED FOR SIZING THE GREASE INTERCEPTOR

- For grease traps that serve non-scheduled meals to a nonspecific number of occupants, as in restaurants, fast foods services and luncheonettes;

C = 0.09 (K x N x H x G x S)
Where:

C = Liquid capacity
K = Facility access coefficient
   = 1.25 for freeways
   = 1.00 for recreation areas
   = 0.80 for main highways
   = 0.5 for lesser roads
N = number of seats (use fractional value if occupancy is rarely full)
H = Number of hours per day of operation
G = Waste flow rate (general value is 4.5 Gals)
S = Sewage capacity factor
   = 1.7 for outflow to public sewer
   = 2.5 for outflow to opposite disposal
   - For grease traps that serve scheduled meals to a specific number of occupants
     as in hospitals, nursing homes and schools;

C = 0.14 (M x G x S)

Where;

M = number of scheduled meals served per day; 1, 2 or 3

**TYPES OF VENTS**

1. Main soil and waste vent
2. Main vent
3. Individual vent or back vent
4. Unit vent
5. Circuit vent or loop vent
6. Relief vent
7. Yoke vent
8. Wet vent
9. Looped vent
10. Utility vent
Main soil and waste vent. The portion of soil stack pipe above the highest installed fixture branch extending through the roof.

Main vent. The principal portion of the vent pipe system to which vent branches may be connected. It serves as a collecting vent line.

Individual vent or back vent. The portion of the vent pipe system which serves a single fixture.

Unit vent. The portion of the vent pipe system which ventilates two fixture of similar design installed on opposite sides of a partition.
The vent stack is installed between the 2nd and 3rd fixture as a precaution. In the case the soil branch becomes clogged, the 3rd fixture scours the pipe of fecal waste which may obstruct the vent.

Circuit vent or loop vent. The portion of the drainage system which ventilates two or more fixture traps that discharge into a soil or waste branch.

<table>
<thead>
<tr>
<th>SOIL PERCOLATION RATE (25mm) (1&quot;)</th>
<th>APPLICATION RATE (GPD/ SQ. METER)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 minute</td>
<td>57.00</td>
</tr>
<tr>
<td>2 minutes</td>
<td>46.22</td>
</tr>
<tr>
<td>5</td>
<td>34.40</td>
</tr>
<tr>
<td>10</td>
<td>24.73</td>
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<td>15</td>
<td>19.35</td>
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<td>20</td>
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<tr>
<td>30</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
</tr>
</tbody>
</table>

Disposal field area:

\[ A = (1.50 + 25 + 1.50) \times 1.80 \]
\[ A = 50.4 \text{ m}^2 \leq 70 \text{ m}^2 \text{ (rule of thumb)} \]

Reuse distance of trenches:

\[ D = 70 / 28 = 2.5 \text{ m} \]
Relief Vent. The portion of the vent pipe installation that permits additional circulation of air around the drainage pipes to eliminate back pressure and retardation of waste flow.