CREDAI

CREDAI YOUTH WING

CREDAI women's wing

UNDERSTANDING WATER SUPPLY SYSTEMS AND MATERIAL CHOICES

0
25
50
75
100
125
150
175
200
225

FOREWORD

"In an era where sustainability and efficient resource management are paramount, a robust water supply system is crucial. The CREDAI Youth Wing is pleased to introduce this comprehensive white paper on water supply systems.

This document provides essential insights into traditional and advanced water supply methods, addressing water demand, pipe size calculations, and installation guidelines. It includes a detailed analysis of various pipe materials such as CPVC, UPVC, HDPE, and copper, aiding informed decision-making for diverse projects.

The CREDAI Youth Wing is dedicated to empowering its members with relevant knowledge in different areas of construction. By releasing this white paper, we aim to equip industry professionals with the knowledge to effectively navigate modern water supply complexities, contributing to the creation of resilient and sustainable infrastructures.

We extend our gratitude to the experts and contributors who developed this guide, reflecting our collective commitment to excellence.

We hope this white paper serves as a valuable resource, assisting in the successful execution of your projects.

Warm regards,

Nithish Reddy
Convener
CREDAI Youth Wing"

FOREWORD

"In this paper, we embark on a journey through the intricate world of plumbing pipes—an essential yet often underestimated component of our Real Estate industry. This paper sheds light on the water supply methods, various piping solutions available with its overall properties which should help us to choose the right material for different kinds of projects we undertake.

Plumbing pipes are not merely channels for water; they are linchpins of health, safety, and sustainability in our communities. The choices we make regarding materials impact everything from water quality to environmental footprint.

This white paper serves as a comprehensive resource, offering insights and recommendations to empower stakeholders in making informed decisions that prioritize durability, efficiency, and environmental responsibility. We have gone a step ahead in elaborating installation methods and guidelines which are equally important for making the right decision.

Saurav Bafna
Head – Construction and Project Management Committee
CREDAI Youth Wing"

TABLE OF **CONTENTS**

1. INTRODUCTION

Water supply systems in multi-storey buildings demand careful consideration of factors such as building height, water pressure requirements, and efficiency. This white paper delves into the two primary types of domestic water supply systems for multi-storey structures: the Gravity System and the Hydropneumatics System. It provides a detailed examination of these systems, emphasizing their components, advantages, disadvantages, and a comparative analysis essential for making informed decisions during the design and implementation phases.

2. GRAVITY WATER SUPPLY SYSTEM

A gravity-based water supply system relies on the natural force of gravity to distribute water from a source to various points within a building or community. In this system, water is typically sourced from an elevated location, such as a water tower or reservoir, allowing it to flow downhill through a network of pipes to reach its destination. The system operates based on the principle that water seeks its own level, leveraging the potential energy gained from the elevated source.

2.1 COMPONENTS:

- Source: Utilizes elevated water sources, such as rooftop tanks or elevated reservoirs.
- Distribution Pipes: Leverages gravity to create pressure in the distribution network.
- Fixtures and Appliances: Water flows from the elevated source to fixtures based on gravitational force.

2.2 ADVANTAGES:

- Simplicity and cost-effectiveness in design
- Minimal energy requirements, promoting sustainability
- Suitable for moderate-sized buildings with reasonable elevation differences

2.3 DISADVANTAGES:

- Limited pressure for higher floors, potentially impacting fixture performance
- Topography-dependent; may not be feasible in flat terrains
- Requires careful sealing to prevent contamination (This is true for all types of piping systems)

2.4 FUNCTIONALITY:

Gravity systems utilize the principle of hydraulic head to generate pressure, allowing water to flow downhill through pipelines to end-users without the need for mechanical pumps.

2.5 RELIABILITY:

Gravity-based systems are inherently reliable, as they operate passively without reliance on external power sources. They are less susceptible to mechanical failures and power outages.

2.6 EFFICIENCY:

Gravity systems can be highly efficient, especially in areas with favorable topography and sufficient elevation differentials. They require minimal energy input for water conveyance, resulting in lower operational costs.

2.7 MAINTENANCE:

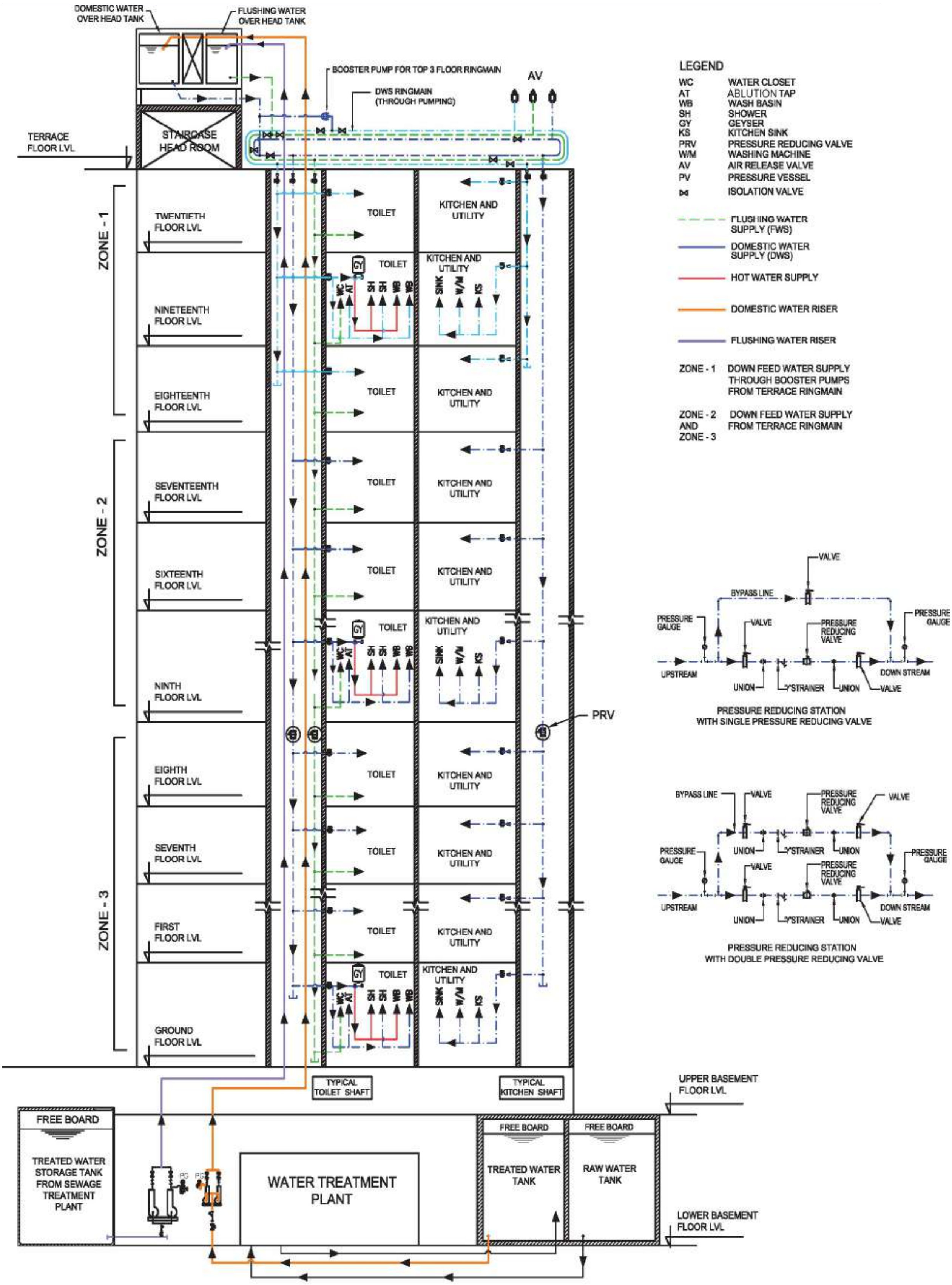
Gravity systems typically have lower maintenance requirements compared to mechanically-driven systems. However, maintenance tasks may include periodic inspection of pipelines, valves, and storage reservoirs to ensure proper functionality and integrity.

2.8 COST CONSIDERATIONS:

Capital Expenditure (CapEx): Initial investment in gravity-based systems primarily involves the construction of reservoirs, pipelines, and distribution networks. Costs may vary depending on terrain, materials, and project scope.

Operational Expenditure (OpEx): OpEx for gravity systems primarily encompasses routine maintenance, repairs, and operational monitoring. Costs associated with energy consumption are minimal or nonexistent.

GRAVITY BASED WATER SUPPLY SYSTEM



(The above diagram is taken from NBC. The UGR should be inside the premises concerned. Moreover the top of the tank should be at least 250 – 300 mm above FGL so that external contamination does not take place. It is presumed that the pumps will be in an UG pump room or basement. If not, special self priming pumps will have to be installed).

3. HYDROPNEUMATIC WATER SUPPLY SYSTEM

A hydropneumatic water supply system employs a combination of water and compressed air to create and maintain water pressure in the distribution network. This system involves the use of pumps to pressurize water and store it in a pressure tank, where the compressed air acts as a cushion. The stored pressure allows for consistent and controlled water distribution, making it suitable for buildings with varying water demands or those located in areas with inadequate natural pressure.

3.1 COMPONENTS:

- Pump: Utilizes electric or pressure-driven pumps to boost water pressure.
- Pressure Tank: Stores pressurized water for immediate use.
- Control System: Monitors and regulates pump operation.

3.2 ADVANTAGES:

- Consistent water pressure across all floors, ideal for multi-storey buildings
- Adaptable to varying water demand with automated pressure control
- Provides redundancy and reliability in water supply

3.3 DISADVANTAGES:

- Higher initial costs due to pump installation
- Relatively higher energy consumption

3.4 FUNCTIONALITY:

Hydropneumatic systems incorporate pumps and pressurized air vessels (such as pressure tanks) to maintain consistent pressure levels within the distribution network. Pumps are activated as needed to replenish pressure and ensure adequate flow rates.

3.5 RELIABILITY:

Hydropneumatic systems offer precise control over pressure levels, enhancing reliability and responsiveness to fluctuating demand conditions. (With VFD controls & cascading effect) They can adapt to varying consumption patterns and maintain uniform pressure throughout the distribution network.

3.6 EFFICIENCY:

While hydropneumatic systems provide excellent pressure control, they require energy input to operate pumps and maintain pressure levels. Energy consumption may vary depending on system design, pump efficiency, and demand patterns.

3.7 MAINTENANCE:

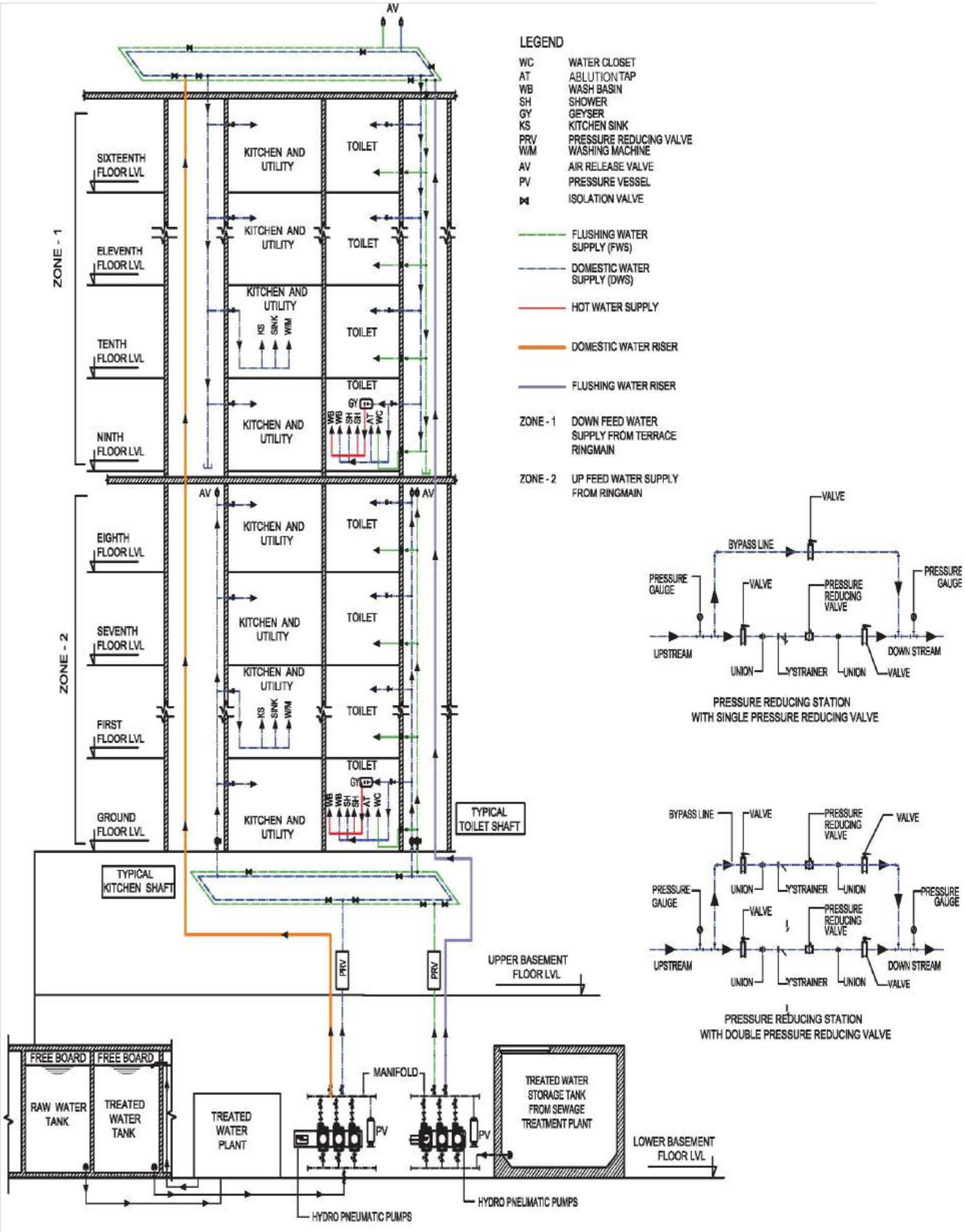
Hydropneumatic systems typically have (sometimes marginally) higher maintenance requirements compared to gravity-based systems due to the presence of mechanical components, such as pumps, pressure vessels, and control systems. Regular maintenance is essential to ensure pump performance, prevent system downtime, and address potential issues.

3.8 COST CONSIDERATIONS:

Capital Expenditure (CapEx): Initial investment in hydropneumatic systems includes the procurement and installation of pumps, pressure vessels, control equipment, and associated infrastructure. CapEx may be higher compared to gravity-based systems due to the complexity of equipment and control systems.

Operational Expenditure (OpEx): OpEx for hydropneumatic systems encompasses energy costs for pump operation, routine maintenance, repairs, and replacement of components. Energy consumption can constitute a significant portion of ongoing operational expenses.(With VFD controls the energy consumption can be further optimized).

HYDROPNEUMATIC WATER SUPPLY SYSTEM



(The above diagram is taken from NBC. The UGR should be inside the premises concerned. Moreover the top of the tank should be at least 250 – 300 mm above FGL so that external contamination does not take place. It is presumed that the pumps will be in an UG pump room or basement).

4. WATER DEMAND

Water demand calculation serves as the cornerstone for developing resilient and eco-conscious buildings. Accurate estimation not only ensures the adequacy of water supply infrastructure but also facilitates the optimization of resource usage and minimization of environmental impact. This paper presents a systematic approach to water demand calculation, augmented by illustrative examples to elucidate each step of the process.

4.1 METHODOLOGY:

Define Building Characteristics: Begin by delineating the fundamental characteristics of the building under consideration, encompassing its type (residential, commercial, industrial), size, occupancy patterns, and specific water usage requirements.

Assess Occupancy: Calculate the total number of occupants within the building by multiplying the number of units or apartments by the average number of occupants per unit.

Determine Per Capita Demand: Establish the per capita water demand, typically measured in liters per capita per day (LPCD), based on regional norms, water usage standards, and building type.

Calculate Total Water Demand: Multiply the per capita demand by the total number of occupants to ascertain the daily water demand for the building.

Consider Peak Demand: Assess peak demand periods by factoring in occupancy patterns, usage habits, and regulatory guidelines. Apply appropriate peak factors to determine the maximum water demand during peak periods.

Validate Compliance: Ensure that the calculated water demand adheres to relevant regulatory standards and guidelines governing water supply, health, and safety.

Optimize Efficiency: Explore opportunities to enhance water efficiency through the integration of water-saving fixtures, rainwater harvesting systems, and greywater recycling technologies.

EXAMPLE:

Consider a residential complex comprising 30 apartments, each accommodating an average of three occupants. Utilizing a regional per capita demand standard of 150 LPCD, the water demand calculation proceeds as follows:

Assess Occupancy: Total occupants = 30 apartments * 3 occupants/apartment = 90 occupants.

Determine Per Capita Demand: Per capita demand = 150 LPCD.

Calculate Total Water Demand: Total water demand per day = Per capita demand * Total occupants = 150 LPCD * 90 occupants = 13,500 liters per day.

Consider Peak Demand: TApply appropriate peak factors to account for maximum demand during peak periods.

Validate Compliance: Ensure that the calculated water demand complies with regulatory standards and guidelines.

Optimize Efficiency: Explore strategies to enhance water efficiency and minimize resource consumption.

4.2 CONCLUSION:

Accurate water demand calculation forms the bedrock of sustainable building practices, enabling stakeholders to optimize resource usage and promote environmental resilience. By following a structured methodology and leveraging real-world examples, architects, engineers, and policymakers can foster the development of water-efficient buildings that mitigate environmental impact and enhance community well-being.

Note: The occupancy load should be based on NBC 2016 data(Pt 9, sec 1 p.11). Per capita water requirement should be 150 LPCD for population more than 10 lakhs, otherwise it should be 135 LPCD. – ref. MANUAL OF WATER SUPPLY by Ministry of Housing & Urban Affairs; GoI.

Pump capacities that fill the overhead tanks can be further calculated based on:

- Water Demand Calculated
- Pipe Route from pump to the Overhead Tanks
- Vertical Height from Pump to OHT Inlet
- Pumping Hours

5. PIPE SIZING

Water supply pipe sizing plays a critical role in the design and functionality of residential buildings, impacting system performance, energy consumption, and overall efficiency. This paper presents a structured approach to pipe sizing, leveraging the probable simultaneous demand method and Hunter's curve to accurately estimate flow rates and select appropriate pipe diameters. By adopting this methodology, stakeholders can optimize water distribution networks to meet the demands of occupants while minimizing waste and maximizing sustainability.

5.1 METHODOLOGY:

Assess Total Fixture Count and WSFU: Begin by determining the total number of fixtures connected in the water supply line and the associated Water Supply Fixture Units (WSFU) for each fixture type, as per industry standards.

Table 2 Water Supply Fixture Units (WSFU) for Different Fixtures with Minimum Pipe Sizes
(*Clause* 4.7.3.1)

Sl No.	Type of Fixture	Application		Minimum Pipe Size mm
		Private	Public	
(1)	(2)	(3)	(4)	(6)
i)	Bathtub	4	–	15
ii)	Ablution faucet/Bidet	1	1	15
iii)	Clothes washer	4	4 (*see* Note 7)	15
iv)	Dishwasher	1.5	1.5	15
v)	Drinking fountain	–	0.5 (0.75)	15
vi)	Hose bib	2.5	2.5	15
vii)	Wash basin (with metered faucet)	1	1	15
viii)	Wash basin (with standard faucet)	1.5	1.5 (2)	15
ix)	Service sink	1.5	3	15
x)	Kitchen sink	2	4	15
xi)	Surgical sink	–	2	15
xii)	Scrub station in hospital (per outlet)	–	3	15
xiii)	Shower	2	3	15
xiv)	Bathroom group (flush tank)	5	6	20
xv)	Bathroom group (flush valve)	8	10	25/32
xvi)	Urinal (flush valve)	3	5 (6)	20
xvii)	Urinal (flush tank)	2	2 (3)	15
xviii)	Urinal (sensor operated)	2	2 (3)	15
xix)	Water closet (flush valve)	6	8 (10)	25/32
xx)	Water closet (flush tank)	2	3 (5)	15
xxi)	Combination fixture (faucet)	3	–	15
xxii)	Laundry trays (faucet)	3	–	15

NOTES
1 The above table is based on Hunter's method.
2 Hunter's method of estimating load in plumbing systems is based on assigning a fixture unit (FU) weight to the plumbing fixtures and then converting these to equivalent litre per minute, based on the theory of probability of usage and based on the observation that all fixtures are not used simultaneously.
3 The fixture unit concept is a method of calculating maximum probable water demand within large buildings based on theory of probability. The method is based on assigning a fixture unit (FU) value to each type of fixture based on its rate of water consumption, on the length of time it is normally in use and on the average period between successive uses.
4 The values of probable demand will not change in respect of systems with flush valves and flush tanks for fixture units more than 1 000.
5 The fixtures or appliances which are not included in the above table may be sized referring to fixtures having similar flow rate and frequency of usage.
6 The minimum supply branch pipe sizes for individual fixtures are nominal sizes.
7 The clothes washer for public does not include large washer extractors, and in such cases the pipe sizing shall be determined as per manufacturer's recommendations.
8 For more information on bathroom groups, reference may be made to specialist literature.
9 The fixture units listed in the above table represent the load for cold water service. The separate cold and hot water fixture unit value for fixtures having both hot and cold water connections may each be taken as three quarter of the listed total value of fixture.
10 A shower head over a bath tub does not increase the fixture unit value.
11 The values given in parentheses pertain to such public use buildings (congregation halls) where an enhanced requirement is expected to be encountered as compared to the normal maximum use in public use buildings.

Estimate Flow Rate Using Hunter's Curve: Utilize Hunter's curve, as recommended by the National Building Code (NBC) 2016, to estimate the flow rate based on the total WSFU and probable simultaneous demand. This curve provides a reliable method for predicting flow rates under varying demand scenarios.

(In residential complexes FUs should be considered as bathroom group as in (xiv & xv in table 2 above).

Table 3 Probable Simultaneous Demand
(*Clause* 4.7.3.2)

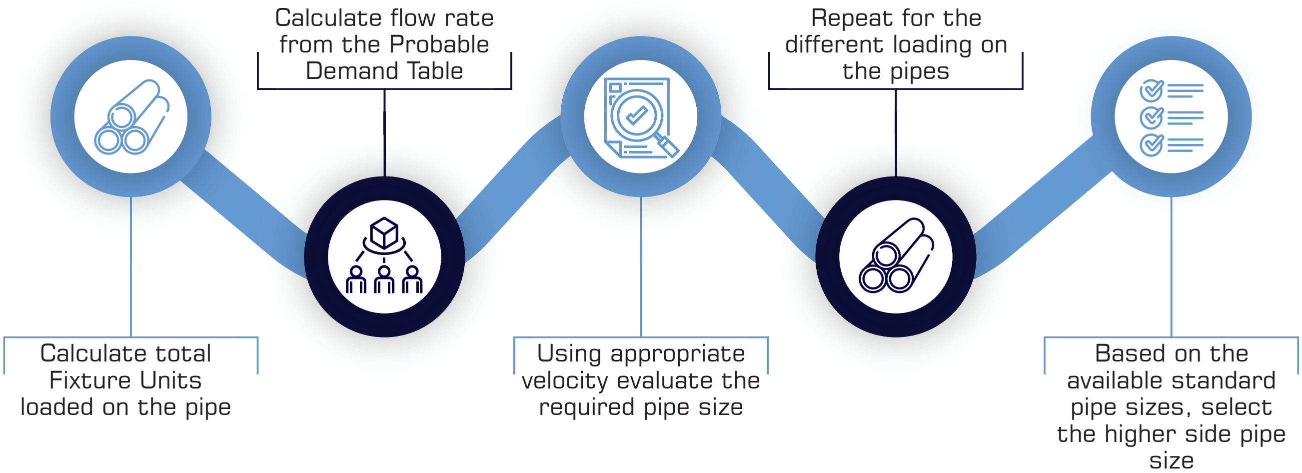
Sl No. (1)	Demand in Fixture Units (2)	Demand with Flush Tanks litre/min (3)	Demand with Flush Valves litre/min (4)
i)	1	0	—
ii)	2	3.8	—
iii)	3	11.4	—
iv)	4	15.1	—
v)	5	22.7	—
vi)	6	25.5	—
vii)	8	28.1	—
viii)	10	30.3	102.20
ix)	20	53.0	132.48
x)	30	75.7	155.19
xi)	40	94.6	177.90
xii)	50	109.8	196.82
xiii)	60	121.1	208.18
xiv)	70	132.5	223.32
xv)	80	143.8	234.67
xvi)	90	155.2	246.03
xvii)	100	166.5	257.38
xviii)	140	200.6	295.23
xix)	180	230.9	329.30
xx)	200	246.0	348.22
xxi)	250	283.9	382.29
xxii)	300	321.7	416.35
xxiii)	400	397.4	476.91
xxiv)	500	473.1	537.47
xxv)	750	643.5	673.73
xxvi)	1 000	787.3	787.28
xxvii)	1 250	908.4	908.40
xxviii)	1 500	1 010.6	1 010.60
xxix)	1 750	1 112.8	1 112.79
xxx)	2 000	1 215.0	1 214.99
xxxi)	2 500	1 419.4	1 419.38
xxxii)	3 000	1 635.1	1 635.12
xxxiii)	3 500	1 811.1	1 811.12
xxxiv)	4 000	1 987.1	1 987.13
xxxv)	4 500	2 115.8	2 115.82
xxxvi)	5 000	2 244.5	2 244.51
xxxvii)	5 500	2 312.6	2 312.64
xxxviii)	6 000	2 380.8	2 380.77
xxxix)	6 500	2 411.0	2 411.05
xl)	7 000	2 479.2	2 479.18
xli)	7 500	2 547.3	2 547.31
xlii)	8 000	2 615.4	2 615.44
xliii)	8 500	2 683.6	2 683.57
xliv)	9 000	2 751.7	2 751.70
xlv)	9 500	2 831.2	2 831.18
xlvi)	1 0000	2 910.7	2 910.67

Note: The probable simultaneous demand table 3 is very conservative & gives a very large value of water demand. For government projects one has to follow this table. For private projects this should be reduced to a practical figure. This would reduce the capital expenditure. The PSD never exceeds 20-25% of the total demand. Some people take it as 30%. British standards consider a maximum of 5% (Building Research Establishment Seminar – UK).

Calculate Pipe Size Based on Recommended Velocity: Determine the recommended velocity for the water supply system, typically ranging from 1.5 to 2 meters per second (m/s), to ensure efficient water distribution and minimize pressure losses. (a good thumb rule for velocity is to restrict it upto 1.5 mps for longer life of the pipe).

Calculate Cross-Sectional Flow Area: Utilizing the recommended velocity, calculate the cross-sectional flow area required for the desired flow rate. This step involves basic hydraulic calculations to ensure adequate water flow without exceeding velocity limits.

Select Pipe Diameter: Based on the calculated cross-sectional flow area, determine the appropriate pipe diameter using standard pipe sizing charts or equations. Select the next higher standard pipe size available to ensure compatibility with existing infrastructure and facilitate installation.



Showers give the maximum flow in any bathroom. Ordinary showers give a flow of about 4.5 lpm. If it is a rainshower it will vary from 35 to 48 lpm. depending on the size of the shower. The velocities will vary widely.

Therefore pipe sizing calculations require a lot of detailing. For tall buildings the vertical distribution has to be divided in zones. Each zone to consider is for 7 to 9 floors.

6. PRESSURE REDUCING VALVE (PRV)

Pressure Reducing Valves (PRVs) are indispensable components of water supply systems, tasked with regulating and controlling pressure levels to safeguard against potential damage, optimize system performance, and ensure consistent water distribution. This paper delves into the fundamental principles of PRVs and their significance in maintaining hydraulic equilibrium, particularly in scenarios involving variations in elevation, pressure, and the necessity of adhering to pressure limits.

Pressure Reducing Valve Functionality: Pressure Reducing Valves (PRVs) are hydraulic control devices designed to reduce and stabilize the pressure of incoming water from higher-pressure mains to a predetermined and manageable level for downstream distribution. Key functionalities of PRVs include:

Pressure Regulation: PRVs adjust the pressure of incoming water to meet the specific requirements of downstream systems, preventing over pressurization and associated risks such as pipe bursts, leaks, and equipment damage.

Pressure Maintenance: PRVs maintain consistent pressure levels within the system.

Relationship Between Pressure and Height: In water supply systems, pressure decreases with increasing elevation due to the gravitational effect on the water column. The relationship between pressure and height is governed by the hydrostatic pressure formula.

P=pgh

Where: P = Pressure (in Pascals or pounds per square inch - PSI)

p = Density of water (in kilograms per cubic meter or pounds per cubic foot)

g = Acceleration due to gravity (approximately 9.81 m/s^2 or 32.2 ft/s^2)

h = Height or elevation (in meters or feet)

As height increases, the pressure increases proportionally, following a linear relationship determined by the specific gravity of water and gravitational acceleration.

As a thumb rule for every 10 m height the pressure is 1 bar, so for 60 m height the pressure will be 6 bar approx.

Application of PRVs in Water Supply Systems: PRVs find widespread application in various segments of water supply systems, including.

High-Pressure Mains: PRVs are installed at points of connection to high-pressure mains to regulate pressure levels for downstream distribution networks, ensuring compatibility with system requirements and protecting infrastructure.

Elevated Zones: In areas characterized by significant elevation changes, PRVs are employed to reduce excessive pressures resulting from gravitational effects, preventing over- pressurization and associated risks.

Vertical Segmentation: PRVs are typically installed after every 7 to 9 floors in the downtake water supply pipe to maintain consistent pressure levels and ensure optimal performance throughout tall buildings. This segmentation helps manage pressure variations arising from height differentials and ensures uniform water distribution to upper floors.

Pressure Limitation: To adhere to pressure limits within the distribution network, PRVs are strategically located to restrict the maximum pressure in the line to a predetermined value, typically up to 4 bars (or 400 kPa). This ensures that the system operates within safe pressure thresholds, minimizing the risk of damage to infrastructure and ensuring user safety.

6.1 CONCLUSION:

Pressure reducing valves (PRVs) play a crucial role in water supply systems, offering indispensable functionalities for pressure regulation, flow control, and system optimization. By understanding the relationship between pressure and height and leveraging PRVs effectively, stakeholders can design resilient and efficient water distribution networks that meet the demands of diverse applications while ensuring reliability, safety, and sustainability. Additionally, by introducing PRVs strategically to limit maximum pressure within the system, stakeholders can mitigate risks associated with high-pressure conditions, safeguarding infrastructure and enhancing overall system performance. (It must also be remembered that the maximum inlet pressure to outlet pressure in a PRV can be division of 3. ie. If an inlet pressure at the PRV is 3 kg/cm2 the maximum reduction through the PRV can be 1 kg/cm2.)

7. PIPING MATERIAL AND TECHNICAL DATA

Selecting the right water supply pipes for buildings is a crucial decision in any construction project. The choice of pipe material can significantly impact the performance, longevity, and overall quality of the plumbing system. This white paper provides comprehensive information on various types of water supply pipes commonly used in India. Each section discusses the technical details, pressure ratings, manufacturing standards, relevant IS codes, applications, installation methods, and the advantages and disadvantages of the specific pipe type.

7.1 CPVC (CHLORINATED POLYVINYL CHLORIDE) PIPES

Assess Total Fixture Count and WSFU: Begin by determining the total number of fixtures connected in the water supply line and the associated Water Supply Fixture Units (WSFU) for each fixture type, as per industry standards.

Technical Details:

- **Diameter/Size:** Available in sizes ranging from 1/2 inch to 2 inches.
- **Wall Thickness:** Typically varies between 2.3 mm to 5.8 mm.
- **Material Composition:** Chlorinated polyvinyl chloride.
- **Temperature Ratings:** Suitable for both hot (up to 93°C) and cold water.
- **Flow Rates:** Vary based on pipe size.
- **Lengths:** Typically supplied in standard lengths.
- **Color-Coding:** Commonly color-coded for easy identification.

Pressure Rating: Suitable for high-pressure water supply systems.

Manufacturing Standards: Commonly manufactured per ASTM D2846 and ASTM F442.

IS Code: IS 15778 specifies the requirements for CPVC pipes used in India.

Applications:

- Ideal for both hot and cold potable water supply in residential and commercial buildings.
- Can be used for both Internal piping and external piping (Vertical Downtake + Terrace Looping).

Installation Methods: CPVC pipes are typically installed using solvent cement or mechanical fittings. Solvent cement creates strong, chemical-resistant joints by chemically fusing the pipe and fittings. Mechanical fittings provide a secure connection without the need for gluing, allowing for disassembly and reassembly if necessary.

Advantages:

- High-pressure rating
- Corrosion-resistant
- Ease of installation
- Resistance to certain chemicals

Disadvantages:

- Vulnerable to high-temperatures
- Not suitable for highly acidic or aggressive water

7.2 UPVC (UNPLASTICIZED POLYVINYL CHLORIDE) PIPES

Technical Details:

- **Diameter/Size:** Varies by application and requirements.
- **Wall Thickness:** Dependent on size and class.
- **Material Composition:** Unplasticized polyvinyl chloride.
- **Temperature Ratings:** Suitable for cold water supply.
- **Flow Rates:** Vary by pipe size.
- **Lengths:** Available in standard lengths.
- **Color-Coding:** Not common, as color can vary.

Pressure Rating: Tentatively varies depending on the size and class, catering to both low and high-pressure applications.

Manufacturing Standards: Manufactured following IS 4985, which defines the specifications for UPVC pipes used for potable water supplies in India.

IS Code: IS 4985 outlines the requirements for unplasticized PVC (UPVC) pipes used for potable water supplies in buildings in India.

Applications: Commonly used for cold water supply, irrigation, and drainage systems in residential and commercial buildings.

Installation Methods: UPVC pipes are installed using solvent cement for smaller sizes and gasketed joints for larger diameters. Solvent cement creates a chemical bond between the pipe and fittings, while gasketed joints use rubber gaskets to create a watertight seal.

Advantages:

- Suitable for various water types
- Lightweight and easy to handle
- Long-lasting

Disadvantages:

- Not suitable for hot water applications
- Prone to softening and deformation at elevated temperatures

7.3 HDPE (HIGH-DENSITY POLYETHYLENE) PIPES

Technical Details:

- **Diameter/Size:** Available in a wide range of sizes.
- **Wall Thickness:** Depends on the Standard Dimension Ratio (SDR).
- **Material Composition:** High-density polyethylene.
- **Temperature Ratings:** Suitable for cold water.
- **Flow Rates:** Vary by size and pressure class.
- **Lengths:** Commonly supplied in coils or straight lengths.
- **Color-Coding:** Not typical.

Pressure Rating: Tentatively, HDPE pipes have pressure ratings that vary based on the Standard Dimension Ratio (SDR), ensuring a wide range of options for different pressure requirements.

Manufacturing Standards: Manufactured in accordance with IS 4984, which outlines the requirements for high-density polyethylene (HDPE) pipes used for water supply systems in India.

IS Code: IS 4984 specifies the requirements for HDPE pipes used for water supply systems in buildings in India.

Applications: Versatile pipes used in potable water supply, sewage systems, and gas distribution in both residential and commercial buildings.

Installation Methods: HDPE pipes are commonly installed using fusion welding techniques, such as butt fusion or electrofusion. Fusion welding creates a permanent, leak-free joint by melting the pipe ends and fusing them together. Mechanical fittings can also be used for HDPE pipes in certain applications.

Advantages:

- High flexibility
- Corrosion-resistant
- Suitable for various water types
- Long service life

Disadvantages:

- Sensitive to UV exposure, requiring protection
- Not recommended for hot water applications due to sensitivity to high temperatures

7.4 PERT (POLYETHYLENE OF RAISED TEMPERATURE RESISTANCE) PIPES

Technical Details:

- **Diameter/Size:** Available in various sizes.
- **Wall Thickness:** Varies based on size and application.
- **Material Composition:** Polyethylene with raised temperature resistance.
- **Temperature Ratings:** Suitable for both hot (up to 95°C) and cold water supply.
- **Flow Rates:** Vary by size.
- **Lengths:** Typically supplied in coils or straight lengths.
- **Color-Coding:** Not common.

Pressure Rating: Tentatively offers good pressure resistance suitable for most building applications (varies by SDR).

Manufacturing Standards: PERT pipes typically adhere to international standards.

IS Code: IS 16647 specifies the requirements for PERT pipes used for hot and cold water supply in buildings in India.

Applications: Ideal for both hot and cold water supply in residential and commercial buildings.

Installation Methods: PERT pipes are commonly connected using compression fittings or push-fit connections, ensuring a reliable and leak-free joint.

Advantages:

- Excellent flexibility
- Resistant to corrosion
- High temperature resistance
- Long service life

Disadvantages:

- Requires protection from UV exposure
- Not suitable for high-pressure applications

7.5 PEX (CROSS-LINKED POLYETHYLENE) PIPES

Technical Details:

- **Diameter/Size:** Available in various sizes.
- **Wall Thickness:** Varies by size.
- **Material Composition:** Cross-linked polyethylene.
- **Temperature Ratings:** Suitable for both hot (up to 93°C) and cold water supply.
- **Flow Rates:** Vary by size.
- **Lengths:** Commonly supplied in coils.
- **Color-Coding:** Common for easy identification.

Pressure Rating: Tentatively offers excellent pressure resistance, making it suitable for a wide range of applications.

Manufacturing Standards: PEX pipes are commonly manufactured in accordance with international standards, such as ASTM F876 and ASTM F877.

IS Code: PEX pipes manufactured in accordance with international standards are commonly used in India.

Applications: Ideal for hot and cold water supply in residential and commercial buildings, particularly in cold regions.

Installation Methods: PEX pipes are typically connected using crimp fittings or push-fit connections, providing a secure and leak-free joint.

Advantages:

- High flexibility
- Freeze-resistant
- Corrosion-resistant
- Easy installation

Disadvantages:

- Sensitive to UV exposure
- Not suitable for high-temperature applications

7.6 PPR (POLYPROPYLENE RANDOM COPOLYMER) PIPES

Technical Details:

- **Diameter/Size:** Available in various sizes.
- **Wall Thickness:** Varies based on size and pressure class.
- **Material Composition:** Polypropylene random copolymer.
- **Temperature Ratings:** Suitable for both hot (up to 95°C) and cold water supply.
- **Flow Rates:** Vary by size.
- **Lengths:** Commonly supplied in straight lengths.
- **Color-Coding:** Not common.

Pressure Rating: Tentatively offers good pressure resistance suitable for most building applications.

Manufacturing Standards: PPR pipes are commonly manufactured in accordance with international standards like DIN 8077 and DIN 8078.

IS Code: While specific IS codes for PPR pipes may not exist, the use of international standards is common for manufacturing these pipes in India.

Applications: Widely used for hot and cold potable water supply in residential and commercial buildings.

Installation Methods: PPR pipes are typically connected using heat fusion or socket fusion techniques, creating strong and leak-free joints.

Advantages:

- Corrosion-resistant
- High-quality construction
- Excellent temperature resistance
- Long service life

Disadvantages:

- Limited availability of fittings in some regions
- Not suitable for outdoor use due to sensitivity to UV exposure

7.7 COPPER PIPES

Technical Details:

- **Diameter/Size:** Available in various sizes, including Type K, Type L, and Type M.
- **Wall Thickness:** Varies by type.
- **Material Composition:** Copper.
- **Temperature Ratings:** Suitable for both hot and cold water.
- **Flow Rates:** Depending on size.
- **Lengths:** Typically supplied in standard lengths.
- **Color-Coding:** Not common.

Pressure Rating: Tentatively varies by type, with Type K having the highest pressure rating.

Manufacturing Standards: Commonly manufactured in accordance with ASTM B88 or equivalent standards.

IS Code: Copper pipes are not typically governed by specific IS codes, but they are widely used in India.

Applications: Commonly used for potable water supply and heating systems in residential and commercial buildings.

Installation Methods: Copper pipes are typically joint through soldering or brazing. Proper cleaning and flux application are essential to create secure joints.

Advantages:

- Excellent corrosion-resistance
- Long-lasting and durable
- Maintains water quality
- Suitable for both hot and cold water

Disadvantages:

- Higher cost compared to plastic pipes
- Vulnerable to aggressive water conditions, especially acidic water

7.8 STAINLESS STEEL (SS) PIPES

Technical Details:

- **Diameter/Size:** Available in various sizes.
- **Wall Thickness:** Varies based on size and application.
- **Material Composition:** Stainless steel (typically SS316).
- **Temperature Ratings:** Suitable for both hot and cold water supply.
- **Flow Rates:** Vary by size.
- **Lengths:** Commonly supplied in straight lengths.
- **Color-Coding:** Not common.

Pressure Rating: Tentatively suitable for high-pressure applications, making it ideal for industrial and aggressive water conditions.

Manufacturing Standards: Typically manufactured following international standards, such as ASTM A312.

IS Code: Stainless steel pipes do not have specific IS codes in India but are used widely, especially in industrial applications.

Applications: Ideal for hot and cold water supply, industrial applications, and areas with aggressive water conditions.

Installation Methods: Stainless steel pipes are commonly connected through welding or mechanical fittings, creating durable and leak-free joints.

Advantages:

- Highly corrosion-resistant
- Durable and long-lasting
- Suitable for aggressive water conditions
- Excellent for high-pressure applications

Disadvantages:

- Higher cost compared to some other materials
- More challenging to install compared to plastic pipes

7.9 GALVANIZED IRON (GI) PIPES

Technical Details:

- **Diameter/Size:** Available in various sizes.
- **Wall Thickness:** Varies based on size and pressure class.
- **Material Composition:** Galvanized iron.
- **Temperature Ratings:** Suitable for both hot and cold water supply.
- **Flow Rates:** Vary by size.
- **Lengths:** Commonly supplied in standard lengths.
- **Color-Coding:** Not common.

Pressure Rating: Tentatively offers good pressure resistance suitable for various building applications.

Manufacturing Standards: Typically manufactured following national and international standards.

IS Code: IS 1239 Part 1 is commonly followed for GI pipes in India.

Applications: Commonly used for both hot and cold water supply, irrigation, and industrial applications.

Installation Methods: GI pipes are typically joint through threaded connections or welded joints, providing secure and durable connections.

Advantages:

- Economical choice
- Suitable for various water types
- Durable and long-lasting
- Suitable for both hot and cold water

Disadvantages:

- Prone to corrosion over time, particularly in aggressive water conditions
- Relatively heavy compared to plastic pipes

8. INSTALLATION GUIDELINE

8.1 CPVC/UPVC

1. Cutting: To achieve precise and neat joints, accurately measure the pipe length and mark it accordingly. Ensure compatibility between pipe and fittings in terms of size. Use a wheel-type plastic pipe cutter or hacksaw blade to cut the pipe squarely, providing an optimal bonding area within the joint.

2. Deburring/Beveling: Remove any burrs and filings from the outside and inside of the pipe to ensure proper contact between the tube and fitting during assembly. Tools, such as a debarking tool, pocket knife, or file are suitable for this task. Beveling the end of the tubing slightly will facilitate its entry into the fitting socket.

3. Fitting Preparation: Thoroughly clean the fitting sockets and tubing ends with a clean, dry rag to remove dirt and moisture. The tubing should make contact with the socket wall approximately 1/3 to 2/3 of the way into the fitting socket. For sizes above 65 mm (2½"), use IPS 70 primer before applying solvent cement to ensure proper fusion of surfaces.

4. Solvent Cement Application: Use only CPVC cement or an all-purpose cement conforming to ASTM F-493 to avoid joint failure. Apply a heavy, even coat of cement to the pipe end when making a joint. Use the same applicator, without additional cement, to apply a thin coat inside the fitting socket. Avoid applying too much cement to prevent clogged waterways.

5 Assembly: Immediately insert the tubing into the fitting socket upon applying solvent cement. Rotate the tube ¼ to ½ turn while inserting to ensure even distribution of cement within the joint. Properly align the fittings and hold the assembly for approximately 10 seconds to allow the joint to set-up.

6. Set and Cure: Solvent cement set and cure times depend on pipe size, temperature, and relative humidity. Curing time is shorter in drier environments, smaller sizes, and higher-temperatures. It typically takes 10 to 20 minutes for a perfect joint to set and cure effectively.

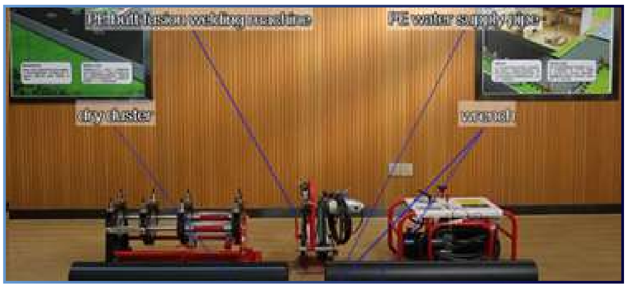
Do's:

- Cut the pipe accurately using wheel-type plastic tubing cutters or fine-tooth saws.
- Remove burrs and filings from the pipe using appropriate tools to ensure proper contact with fittings.
- Rotate the pipe 1/4 to 1/2 turn while inserting it into the fitting to evenly distribute CPVC solvent cement.
- Utilize Teflon tapes with threaded fittings for a secure seal.
- Provide vertical and horizontal supports using plastic straps to prevent stress on the pipes.
- Conduct visual inspections of joints and the entire system regularly, especially during pressure testing.
- Apply water-based paint only on exposed pipes and fittings for protection.
- Use a brass/CPVC transition adapter, when connecting CPVC to a water heater for future replacement facilitation.
- Pressure test CPVC systems according to local code requirements to ensure system integrity and safety.

Don'ts:

- Do not use metal hooks or nails to support or apply pressure on the pipes.
- Avoid exposing the pipe to open flame while attempting to bend it.
- Refrain from dropping pipes on edges from heights or subjecting them to heavy objects or walking.
- Do not dilute solvent cement with thinner or any other liquid.
- Avoid using air or gases for pressure-testing.
- Do not use any petroleum or solvent-based sealant, adhesive, lubricant, or fire hazard material on CPVC pipes and fittings.
- Do not cut corners on pipe preparation and assembly to ensure long-term system reliability and performance.

8.2 HDPE



1. Prepare Materials and Tools

- Gather all necessary tools and materials: HDPE butt fusion welding machine, HDPE pipes, dry duster, and a wrench.

2. Set-Up the Welding Machine

- Connect all parts of the welding machine as per the manual.
- Disassemble the fixture to prepare for pipe placement.

3. Inspect and Clean Heating Plate

- Check the coating on the heating plate of the welding machine to ensure it is in good condition.
- Clean the heating plate with a dry duster to remove any dust or debris.

4. Power and Set Parameters

- Connect the welding machine to the power supply.
- Set the following parameters according to the HDPE water supply pipe engineering technical manual:
    - i. Heat absorption time
    - ii. Cooling time
    - iii. Heating plate temperature
    - iv. Welding pressure

5. Place and Clamp the Pipe

- Place the HDPE pipe in the fixture of the welding machine and clamp it securely.
- Ensure enough length is reserved for welding and calibrate the pipe surface to maintain concentric alignment.

6. Milling the Butt Face

- Use a planer to mill the butt face of the pipes.
- Clean the milled surface with a dry duster.
- Ensure the gap between butt ends is less than 0.3 millimeters and the staggered edges are less than 10% of the wall thickness.
- If necessary, readjust the fixture and re-mill the pipes to meet these specifications.

7. Heating the Pipe Ends

- Place the heating plate in the machine and allow it to reach the set temperature.
- Adjust the welding machine pressure to press the pipe ends against the heating plate.
- When the crimp height reaches the specified value, start the heat absorption time.

8. Combining and Welding the Pipes

- After achieving the predetermined heat absorption time, remove the heating plate.
- Swiftly combine the heated pipe ends and adjust the welding machine pressure.
- Maintain the pressure until the pipes have cooled down.

9. Cooling and Disassembly

- Reduce the welding machine pressure to zero once the cooling time is reached.
- Disassemble the fixture and remove the welded pipe.

Do's:

- Ensure all tools and materials are ready and in good condition before starting the welding process.
- Verify that the heating plate is clean and the coating is intact.
- Set the welding parameters (heat absorption time, cooling time, heating plate temperature, and welding pressure) according to the engineering technical manual.
- Clean the pipe ends and heating plate with a dry duster to remove any contaminants.
- Calibrate the pipe surfaces to ensure they are concentric and aligned properly in the fixture.
- Adhere to the cooling time specified in the technical manual before disassembling the welded pipe.

Don'ts:

- Don't start welding if the welding machine is not properly assembled or the fixtures are not securely clamped.
- Don't guess the welding parameters; always refer to the engineering technical manual.
- Don't skip cleaning the pipe ends and heating plate, as contaminants can compromise the weld quality.
- Don't proceed with welding if the pipes are not properly aligned or if there is excessive gap or staggered edges.
- Don't remove the heating plate before the pipe ends have reached the correct heat absorption time.
- Don't disassemble the welded pipes before the specified cooling time is completed, as this can weaken the joint.

8.3 PPR

1. Preparation

- Work Area Set-Up:
- Ensure the workspace is clean and free of dust or debris.
- Gather all necessary tools and materials, including the polywelder, PPR pipes, and fittings.
- Confirm that the power supply is available and functioning (220V).

2. Setting-Up the Welding Equipment

- Connect the Polywelder:
- Plug the polywelder into a 220V power outlet.
- Wait until the green control light switches off, indicating the polywelder has reached the correct temperature of 260°C and is ready for use.

3. Heating the Pipe and Fitting

- Simultaneous Heating:
- Insert the pipe into the polywelder's heating socket to warm the entire depth of the pipe.
- Insert the fitting into the appropriate heating element to warm its end.
- Apply slight pressure to ensure consistent heating and proper contact with the heating elements.
- Follow the heating duration guidelines provided by the polywelder manufacturer for your specific pipe size and fitting.

4. Joining the Pipe and Fitting

- Once the heating period has finished, quickly remove the pipe and fitting from the heating elements.
- Immediately join the heated pipe and fitting together, inserting the pipe into the fitting without any interruptions.
- Ensure the pieces are aligned correctly and fully inserted to form a secure bond.

5. Adjustments

- During the first 3 seconds after joining, you may adjust the welded parts to ensure proper alignment.
- Do not rotate the parts more than 30º to avoid weakening the joint.

6. Cooling and Inspection

- Allow a few minutes for the joint to cool and reach its maximum strength. Avoid any stress or movement on the joint during this period.
- Inspect the joint visually to ensure it is properly aligned and that there are no visible gaps or misalignments.
- Check for a uniform weld bead around the joint, indicating a successful fusion.

Do's:

- Ensure the workspace is clean and organized.
- Plug the polywelder into a 220V outlet and wait for the green control light to switch off.
- Insert the pipe and fitting into the heating elements and apply slight pressure for consistent heating.
- Remove and join the pipe and fitting immediately after heating, ensuring proper alignment and full insertion.
- Allow a few minutes for the joint to cool and inspect for proper alignment and a uniform weld bead.

Don'ts:

- Don't work in a cluttered or dirty area.
- Don't use the polywelder before the green light switches off.
- Don't apply excessive pressure during heating or ignore the recommended heating duration.
- Don't delay joining the pipe and fitting after heating or misalign them during joining.
- Don't stress or move the joint during cooling or skip the pressure test to check for leaks.

8.4 PERT/PEX

1. Cutting the Pipe

Objective: Ensure the pipe is cut to the correct length with a clean, straight cut.

Procedure: Use a pipe cutter designed for PERT pipes to cut the pipe at a right angle, perpendicular to the pipe axis. This helps ensure a proper fit and seal with the fittings.

2. Calibration and Chamfering

Objective: Prepare the pipe ends for a secure connection.

Procedure:

Calibration: Use a pipe calibrator to ensure the pipe end is perfectly round and not deformed from cutting.

Chamfering: Use a chamfering tool to bevel the inside and outside edges of the pipe end. This helps in smoother insertion into the fitting and prevents damage to the O-ring.

Deburring: Remove any plastic chips or debris from the pipe ends to ensure a clean surface.

3. Lubrication

Objective: Facilitate easier insertion and reduce friction.

Procedure:

- If required, apply an appropriate, approved lubricant to the pipe end and fitting.
- Ensure the lubricant is suitable for drinking water installations to prevent contamination.

4. Inserting the Fitting

Objective: Ensure a proper and secure fit between the pipe and fitting.

Procedure:

- Insert the pipe fully into the fitting until it reaches the stop.
- Check through the inspection window (if available) to confirm that the pipe has been inserted to the correct depth.

5. Pressing

Objective: Create a secure and permanent connection.

Procedure:

- Position the press jaw (U profile) correctly around the fitting sleeve and pipe.
- Ensure the press jaw is aligned and positioned correctly on the fitting.
- Activate the pressing tool and perform the pressing operation continuously until you hear the sound signal indicating the process is complete.
- Avoid any interruptions during the pressing to ensure a proper seal.

6. Completion of Pressing

Objective: Finalize the connection and ensure readiness for use.

Procedure:

- Once the pressing is complete, release and remove the pressing tool and open the jaws.
- Inspect the joint to ensure it is correctly pressed and not under any tension.
- The joint should be secure and ready for installation.

Do's:

- Use a pipe cutter designed specifically for PERT or MLCP pipes to ensure a clean, straight cut.
- Cut the pipe at a right angle, perpendicular to the pipe axis, for proper fit and seal with fittings.
- Use a pipe calibrator to ensure the pipe end is perfectly round and not deformed from cutting.
- Use a chamfering tool to bevel the inside and outside edges of the pipe end for smoother insertion and to prevent O-ring damage.
- Apply an appropriate, approved lubricant to the pipe end and fitting if required.
- Insert the pipe fully into the fitting until it reaches the stop and check through the inspection window to confirm proper insertion depth.

Don'ts:

- Don't use a saw or other cutting tools not designed for PERT or MLCP pipes as they may cause an uneven cut.
- Don't cut the pipe at an angle as this can compromise the seal and fit with the fittings.
- Don't skip the calibration step, as an out-of-round pipe end can cause leaks.

Don't neglect to chamfer the pipe ends, as this can lead to difficulty in insertion and potential damage to the fitting's O-ring.

Don't use lubricants that are not approved for drinking water installations to avoid contamination.

- Don't partially insert the pipe into the fitting; always ensure it reaches the stop.

8.5 COPPER

1. Preparation

- Select the appropriate type and size of copper pipe for your application.
- Make sure you have all the necessary tools and materials, such as a pipe cutter, flux, solder, fittings, and a propane torch.
- Measure and cut the copper pipe to the required length using a pipe cutter.

2. Cleaning

- Clean the ends of the copper pipe using a suitable brush to remove any dirt, burrs, or oxidation.
- Clean the inside of fittings using a fitting brush to ensure a proper fit.

3. Flux Application

- Apply a thin, even coat of flux to the cleaned pipe ends and the inside of the fittings.
- Make sure to apply the flux sparingly to avoid excess flux inside the pipe

4. Assembly

- Insert the pipe into the fitting and ensure it is fully seated.
- Use a propane torch to heat the joint evenly.
- Once the flux starts to bubble, touch the solder to the joint, allowing it to flow into the joint through capillary action.

5. Cooling and Inspecting

- Allow the joint to cool naturally without disturbing it.
- Once the joint has cooled, inspect it for any leaks or soldering defects.

Do’s:

- Use the correct type and size of copper pipe for your specific application.
- Clean the pipe and fittings thoroughly before soldering to ensure a proper joint.
- Use the appropriate tools and materials for cutting, cleaning, and soldering the copper pipe.
- Follow the manufacturer’s instructions for installation and soldering techniques.
- Pressure test the system after installation to check for leaks and ensure proper functionality.
- Insulate any exposed copper pipes to prevent freezing in cold temperatures.
- Support the copper pipes securely to prevent sagging or movement over time.

Don’ts:

- Don’t use excessive force when inserting or connecting copper pipes and fittings, as this can damage the pipe or fitting.
- Don’t overheat the pipe or fittings when soldering, as this can cause damage to the copper or result in leaks.
- Don’t use lead-based solder on copper pipes intended for potable water systems, as lead can be harmful to health.
- Don’t mix different types of metals in the same plumbing system, as this can lead to galvanic corrosion.
- Don’t use excessive amounts of flux when soldering, as this can cause flux residue to remain inside the pipe.
- Don’t leave any sharp edges or burrs on the pipe after cutting, as this can impact the integrity of the joint.

8.6 SS316L

1. Cutting to Length

- Use a tube cutter, fine-tooth saw, or special electrical tube saw to cut the SS316L pipe to the desired length.
- Ensure the cut is completely square.
- Make sure the tube ends are clean and free from scratches, especially not less than the socket length.

2. Deburring and Calibrating

- Use a deburring tool to remove any burrs or sharp edges from both the internal and external ends of the tube.
- This prevents damage to the O-ring during insertion.
- Wipe the tube end clean with a dry duster or cloth to avoid damaging the O-ring on insertion.

3. Checking the Fittings

- Inspect each fitting to ensure that the O-rings are present and correctly seated.
- Verify that the fitting is the correct size for the tube.

4. Marking the Insertion Depth

- Fully insert the tube into the fitting until it reaches the tube stop to make a perfect joint.
- Mark the insertion depth on the tube to detect any movement, which is especially important if the joints are to be pressed later.

5. Assembling the Tube and Fitting

- Insertthetubeintothefittinguptothetube stop using the marked depth as a reference.
- Ensure the pressing operation is only undertakenwhenthetubereachesthetube stop.

6. Pressing the Fitting

- Insert the correct size jaw for the fitting into the pressing tool.
- Place the jaws squarely on the fitting.
- Depress the trigger/button to begin the compression cycle of the tool.
- The cycle is complete when the mouth of the fitting is fully enclosed by the jaws.
- Release the jaws from around the fitting.
- Caution: The joint is complete after one full cycle of the tool. Do not crimp any fitting more than once.

Do's:

- Ensure the SS316L pipe is of high-quality material and free from defects before installation.
- Use crimping joints specifically designed for SS316L pipes to ensure compatibility and proper sealing.
- Clean the pipe ends and crimping joint thoroughly before assembly to remove any debris or contaminants.
- Follow the manufacturer's instructions carefully for crimping tool selection and operation.
- Conduct pressure testing of the crimped joint according to industry standards to ensure leak-free performance.
- Inspect the crimped joint regularly for signs of wear, corrosion, or damage, and replace if necessary.

Don'ts:

- Avoid using low-quality or incompatible crimping joints with SS316L pipes, as this can compromise the integrity of the joint.
- Don't overlook cleaning the pipe ends and crimping joint before assembly, as contaminants can affect the seal.
- Avoid over-tightening the crimping tool, as this can deform the pipe or joint and lead to leaks.
- Don't skip pressure testing of the crimped joint, as it ensures the reliability and safety of the installation.
- Avoid exposing SS316L pipes to environments with high-levels of chloride or other corrosive agents, as this can lead to premature failure.
- Don't ignore signs of damage or wear on the crimped joint during inspections; prompt replacement is necessary to prevent leaks or failures.

8.7 GI

1. Preparation

- Work Area Set-Up:
- Ensure the workspace is clean and free from obstacles.
- Gather all necessary tools and materials, including pipe wrenches, pipe cutter, threading machine, sealant tape, and GI pipes and fittings.

2. Cutting the Pipe

- Measure and Mark:
- Measure the length of the pipe needed and mark it clearly.
- Use a pipe cutter or a hacksaw to cut the pipe to the required length.
- Ensure the cut is straight and smooth to avoid threading issues.

3. Threading the Pipe

- Set-Up the Threading Machine:
- Secure the pipe in the threading machine.
- Apply threading oil to the end of the pipe to facilitate smooth threading.
- Turn on the threading machine and slowly create threads on the pipe end.
- Make sure the threads are clean and well-defined.
- Remove any metal shavings and clean the threads with a brush.

4. Assembling the Pipes and Fittings

- Applying Sealant:
- Wrap PTFE (Teflon) tape or apply pipe joint compound on the male threads of the pipe.
- Ensure the tape is applied in the direction of the threads to prevent it from unraveling.
- Screw the pipe into the fitting by hand to start.
- Use a pipe wrench to tighten the connection, ensuring it is secure but not over-tightened to avoid damaging the threads.

5. Securing and Supporting

- Use pipe supports and clamps to secure the GI pipes at regular intervals.
- Ensure the pipes are properly aligned and supported to prevent sagging and strain on joints.
- Check all connections for tightness and proper alignment.
- Inspect the system for any visible leaks or misalignments.

Do's:

- Ensure the workspace is clean and free from obstacles.
- Gather all necessary tools and materials before starting the installation.
- Use a pipe cutter or hacksaw for a straight and smooth cut.
- Secure the pipe in the threading machine and apply threading oil.
- Apply PTFE tape or pipe joint compound on the male threads before assembling.

Don'ts:

- Start working without ensuring the workspace is organized and safe.
- Proceed without verifying that all tools and materials are on hand.
- Cut the pipe without measuring and marking it first.
- Skip applying threading oil, as this can cause poor-quality threads.
- Over-tighten the connections, which can damage the threads.

8.8. Installation Video Links:

CPVC/UPVC:

Installation: https://youtu.be/DrpFqBFyi30

Testing: https://youtu.be/i5sZ0IPBpxs

HDPE: https://youtu.be/6ZVLwobYwJo

PPR: https://youtu.be/PqmXxNos6ig

PERT/PEX: https://youtu.be/ThncTGgrOB4

Copper: https://youtu.be/2MhiiCsrXqY

SS: https://youtu.be/zeG9WadY7ms

GI: https://youtu.be/pVmFZz09CnU

9. COMPARATIVE TABLE

Pipe Material	Raw Material	Jointing Method	Pressure Rating (Bar)	Ease of Installtion	Tools Required	Installation Time	Durability	Food Grade	Maintenance	Cost	Temperature Resistance	Longevity/ Lifespan	Insulation Properties	Ease of Repair	Noise Transmission	Scale Buildup	Weight
CPVC (Chlorinated Polyvinyl Chloride)	PVC resin and chlorine	Solvent cement	7 to 25	Moderate	CPVC cutter, solvent	Moderate	Moderate to High	No	High	Low	High	Moderate to High	Moderate to High	Moderate to Easy	Low	Moderate to Low	Light
UPVC (Unplasticized Polyvinyl Chloride)	PVC resin	Solvent cement	3.5 - 13.8	High	PVC cutter, solvent	Moderate	High	No	High	Low	Moderate	High	Low to Moderate	Easy	Low	Moderate	Light
HDPE (High-Density Polyethylene)	Polyethylene	Fusion welding or compression fittings	7 to 17	Very easy	Fusion welding machine, compression tool	Fast	High	Yes	Low	Moderate	High	High	Moderate to High	Easy	Low	Low	Light
Copper	Copper	Soldering or compression fittings	13 to 40	Requires skilled labor	Pipe cutter, soldering tools, press tool	Moderate	High	Yes	Low	High	High	High	Low to Moderate	Moderate to Difficult	Low to Mod-erate	Low	Moderate
PERT (Polyethylene of Raised Temperature)	Polyethylene	Compression tool	5.5 - 11	Very easy	Pipe cutter, compression tool	Fast	Moderate to High	Yes	Low	Moderate	High	Moderate to High	Moderate	Moderate to Easy	Low	Low	Light
PEX (Cross-linked Polyethylene)	Polyethylene	Compression fittings	5.5 - 11	Easy	Pipe cutter, compression tool	Moderate	Moderate to High	Yes	Low	Moderate	High	Moderate to High	Moderate	Moderate to Easy	Low	Low	Light
PPR (Polypropyene Random Copolymer)	Polypropyl-ene	Fusion welding	10 to 25	Easy	Pipe Cutter, Fusion Welding	Moderate	High	Yes	Low	Moderate	High	High	Low to Moderate	Easy	Low	Low	Light
Stainless Steel (SS)	Stainless steel	Fusion welding or compression fittings	Exceeds 69	Moderate to Difficult	Fusion welding machine, compression tool	Moderate to Long	Very High	Yes	Low	High	High	Very High	Moderate to Difficult	Moderate to Difficult	Low to Mod-erate	Heavy	Heavy
GI (Galvanized Iron)	Iron coated with zinc	Welding or threading	10 to 20	Moderate	Welding equipment, cutting tools	Moderate	Moderate to High	No	Moderate	Moderate	Moderate	Moderate to High	Moderate	Moderate to Difficult	Moderate	Moderate	Moderate

10. GREEN BUILDING & SUSTAINABILITY

Green building practices aim to minimize the environmental impact of construction and operation while promoting resource efficiency, occupant health, and overall sustainability. Water supply systems represent a critical component of green building design, offering opportunities for innovation, conservation, and environmental stewardship. This paper explores the integration of sustainable principles in water supply infrastructure, focusing on material selection for residential water distribution systems.

10.1 SUSTAINABILITY IN WATER SUPPLY SYSTEMS:

Sustainability in water supply systems encompasses various strategies and initiatives aimed at minimizing water consumption, reducing energy usage, and mitigating environmental impact. Key considerations for promoting sustainability in water infrastructure include:

- **Water Conservation:** Implementing water-efficient fixtures, low-flow technologies, and leak detection systems to minimize water waste and optimize usage.
- **Energy Efficiency:** Incorporating energy-efficient pumps, filtration systems, and treatment technologies to reduce energy consumption and operational costs.
- **Resource Optimization:** Utilizing recycled or reclaimed water for non-potable applications, such as irrigation or toilet flushing, to reduce demand on freshwater resources.
- **Environmental Protection:** Implementing erosion control measures, stormwater management practices, and habitat preservation initiatives to safeguard natural ecosystems and water quality.
- **Material Selection for Residential Water Distribution Systems:** The choice of materials for residential water distribution systems significantly influences the sustainability, performance, and longevity of the infrastructure. Sustainable materials prioritize environmental responsibility, durability, and resource efficiency. Key considerations for material selection include:

Piping Materials: Opting for eco-friendly piping materials with low environmental impact, such as:

Polyethylene (PE) or High-Density Polyethylene (HDPE): Recyclable, durable, and corrosion-resistant piping options suitable for potable water distribution.

Cross-linked Polyethylene (PEX): Flexible, cost-effective piping material with minimal environmental footprint, ideal for residential plumbing applications.

Stainless Steel: Durable, long-lasting material with high-corrosion resistance and recyclability, suitable for both potable water and heating systems.

Fittings and Connectors: Choosing lead-free, non-toxic fittings made from recycled or recyclable materials to minimize environmental impact and ensure water quality.

Insulation: Selecting eco-friendly insulation materials to reduce heat loss and energy consumption in hot water distribution systems, such as recycled cellulose or natural fiber insulation.

10.2 CONCLUSION:

Integrating sustainable practices and materials into water supply infrastructure is essential for promoting environmental stewardship, resource conservation, and long-term resilience in the built environment. By prioritizing water efficiency, energy conservation, and environmentally responsible material choices, stakeholders can contribute to the advancement of green building principles and sustainability in water infrastructure development. Through collaborative efforts and adherence to best practices, the industry can collectively work towards creating water supply systems that balance the needs of communities, the environment, and future generations.

11. CONCLUSION

Selecting the right water supply pipe for your building project is a complex decision that requires consideration of numerous factors, including the specific needs of your plumbing system, budget constraints, and regional requirements. Each type of water supply pipe discussed in this white paper offers a unique set of advantages and disadvantages. By understanding the technical details, pressure ratings, manufacturing standards, IS codes, applications, and installation methods for each type of pipe, you can make an informed decision that aligns with your project's goals.

We hope this white paper has provided valuable insights into the world of water supply pipes and helps you make well-informed choices for your building projects. Always consult with local authorities, plumbing experts, and suppliers to ensure that your chosen pipes meet local building codes and regulations, while aligning with your specific project requirements.

Note: The pressure ratings provided in this white paper are tentative and may vary based on factors, such as pipe size, class, and regional regulations. Always consult with manufacturers and local authorities for precise pressure rating information relevant to your project.

CYW AND CWW

Anand Singhania
Incharge VP

Gaurav Thakker
Chairman

CREDAI YOUTH WING (CYW)

Nithish Reddy
Convener

Binitha Dalal
Co-Convener

Niliesh Vohra
Secretary

CREDAI WOMEN WING (CWW)

Rupa Shah
Convener

Sarah Jacob
Secretary

Sapna Rathi
Jt. Secretary

CONSTRUCTION AND PROJECT MANAGEMENT COMMITTEE

Saurav Bafna
Committee Head

Manas Modi
Paper Coordinator

Members: **Parth Patel | Nirmal Singh I Mayank Kapoor | Rahul Pathani | Rakesh Bura I Karteek Reddy | Abhishek Ahuja | Meghraj Pathade Suraj Mantri | Aniket Fattepurkar | Sudeep Pethe | Abhishek More | Shivam Patel | Gaurav Gharat**

SPECIAL CONTRIBUTORS:

Pradeep Kumar Chakravarti
PHE Expert
Imperial PHE Services LLP

Kapil S. Dalvi
Technical Team Leader
Huliot India

5th Floor, PHD House4/2 Siri Institutional Area, August
Kranti Marg New Delhi-110 016
(011) 43126262 / 43126200

Follow us on: