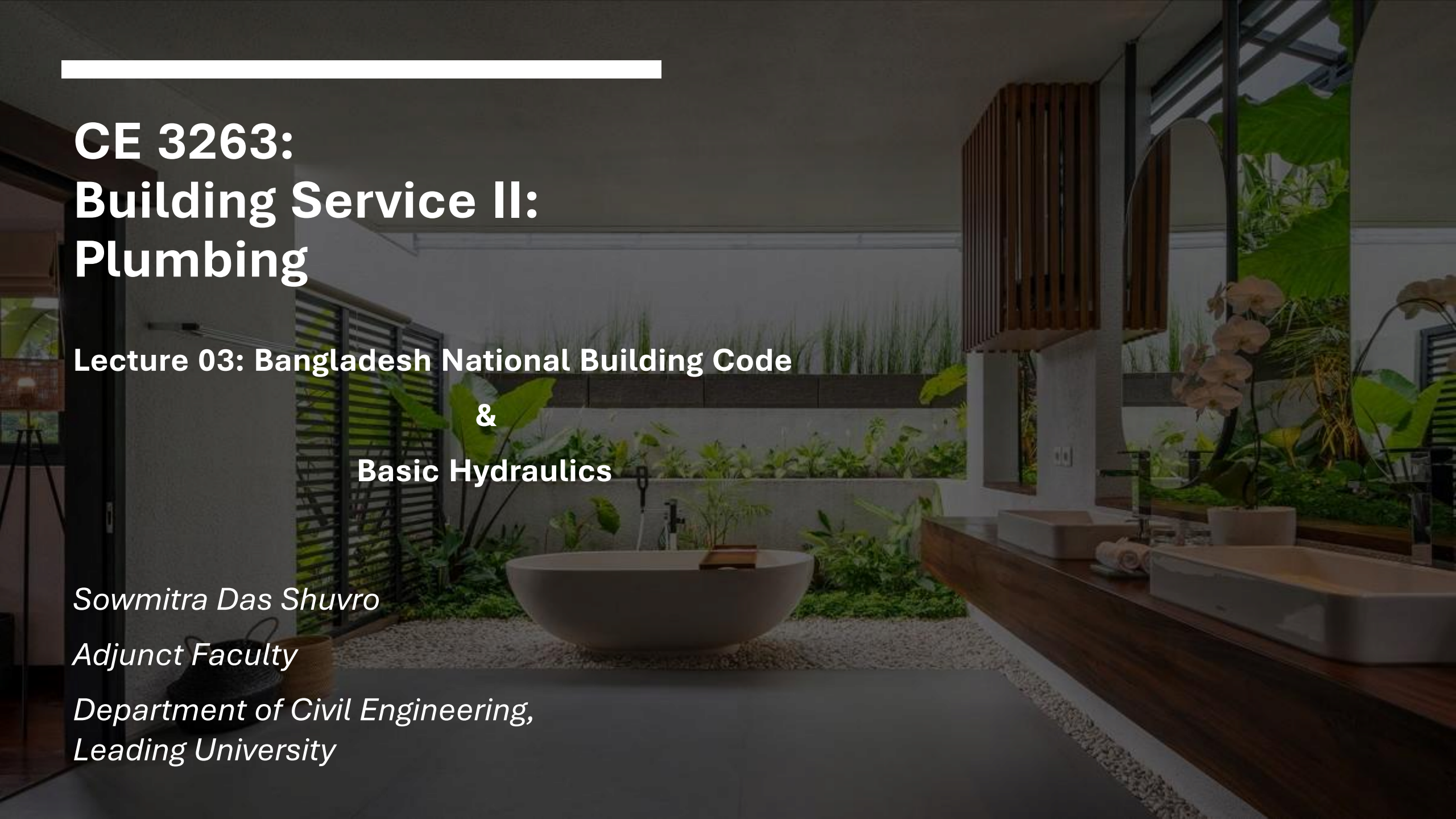

CE 3263:
Building Service II:
Plumbing

Lecture 03: Bangladesh National Building Code

&

Basic Hydraulics

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Department of Civil Engineering,
Leading University

Fixture Requirements (BNBC)

Table 8.6.1: Plumbing Fixtures Requirement

Type of Building Occupancy	Water Closets*	Wash Basins ***	Bathtubs or Shower	Urinals** (For male)	Drinking Fountains	Other Fixtures
A Residential						
A1 Single Family Dwelling A3 Flats or Apartments	1 per dwelling or apartment	1 per dwelling or apartment	1 per dwelling or apartment	-	-	1 kitchen sink per dwelling/apartment
A2 Two Families Dwelling	2 per dwelling	2 per dwelling	2 per dwelling	-	-	2 kitchen sink per dwelling
A4 Mess, Boarding Houses and Hostels						
For residence and residential staff	**MALE**			1 per 25-150 Add 1 per additional 50	1 per 75	1 kitchen sink in each kitchen
	1 per 8	1 per 8	1 per 8			
	FEMALE					
	1 per 6	1 per 6	1 per 6			
For nonresidential staff	**MALE**		-	0 up to 6 1 per 7-20 2 per 21-45 3 per 46-70 4 per 71-100	1 per 100	-
	1 per 1-15 2 per 16-35 3 per 36-65 4 per 66-100	1 per 1-15 2 per 16-35 3 per 36-65 4 per 66-100				
	FEMALE					
	1 per 1-12 2 per 13-25 3 per 26-40 4 per 41-57 5 per 58-77 6 per 78-100	1 per 1-12 2 per 13-25 3 per 26-40 4 per 41-57 5 per 58-77 6 per 78-100				

Type of Building Occupancy	Water Closets*	Wash Basins ***	Bathtubs or Shower	Urinals** (For male)	Drinking Fountains	Other Fixtures
B Educational Facilities						
B1 Education Facilities up to Higher Secondary Levels	**BOYS**		-	1 per 20	1 per 50	Service sink: 1 per floor.
	1 per 40	1 per 60 but minimum 2				
	GIRLS					
	1 per 25	1 per 40 but minimum 2				
B2 Facilities for Training and Above Higher Secondary Levels	**MALE**		-	1 per 20	1 per 50	Service sink: 1 per floor.
	1 per 30	1 per 40 but minimum 2				
	FEMALE					
	1 per 20	1 per 30 but minimum 2				
B3 Preschool Facilities	1 per 15 children	1 per 15 children	-	-	1 per 50 children	Service sink: 1 per floor

Fixture Load (BNBC)

Fixture Unit

Table 8.5.4: Fixture Unit for different Types of Fixtures with Inlet Pipe Diameter

Sl. No.	Type of Fixture	Fixture Unit (FU) as Load Factor	Minimum Size of Fixture Branch, mm
1	Ablution Tap	1	15
2	Bath tub supply with spout	3	15
3	Shower Stall Domestic	2	15
4	Shower in Group per head	3	15
5	Wash Basin (Domestic Use)	1	15
6	Wash Basin (Public Use)	2	15
7	Wash Basin (Surgical)	2	15
8	Kitchen Sink (Domestic Use)	2	15/20
9	Washing Machine	3	15/20
10	Drinking Fountain	0.5	15

Unit Rate of Flow = Effective Fixture Unit

Table 8.5.5: Probable Simultaneous Demand

No. of Fixture Units	System with Flush Tanks Demand (Based on Fixture Units)		System with Flush Valves Demand (After Hunter)	
	Unit Rate of FIow[1])	Flow in Litre/Minute	Unit Rate of FIow[1])	Flow (Litre/Minute)
20	2.0	56.6	4.7	133.1
40	3.3	93.4	6.3	178.4
60	4.3	121.8	7.4	209.5
80	5.1	144.4	8.3	235.0
100	5.7	161.4	9.1	257.7
120	6.4	181.2	9.8	277.5
140	7.1	201.0	10.4	294.5
160	7.6	215.2	11.0	311.5
180	8.2	232.2	11.6	328.5
200	8.6	243.5	12.3	348.3
220	9.2	260.5	12.7	359.6

Required Flow Rate (BNBC)

Example 03) A higher secondary school constructed a new building to house 150 students (120 boys, 30 girls). Find out the **Probable Simultaneous Demand** of water flow (L/min) for this building. (Assume the water supply system only contains flush tank.)

Fixture unit value for, Water Closet = 4 FU, Wash Basin (Public) = 2 FU, Urinal = 2 FU, Drinking Fountain = 0.5, & Service Sink = 2 FU.

Type of Building Occupancy	Water Closets*	Wash Basins ***	Bathtubs or Shower	Urinals** (For male)	Drinking Fountains	Other Fixtures
B Educational Facilities						
B1 Education Facilities up to Higher Secondary Levels	**BOYS**		-	1 per 20	1 per 50	Service sink: 1 per floor.
	1 per 40	1 per 60 but minimum 2				
	GIRLS					
	1 per 25	1 per 40 but minimum 2				

Table 8.5.5: Probable Simultaneous Demand

No. of Fixture Units	System with Flush Tanks Demand (Based on Fixture Units)		System with Flush Valves Demand (After Hunter)	
	Unit Rate of FIow[1])	Flow in Litre/Minute	Unit Rate of FIow[1])	Flow (Litre/Minute)
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60	4.3	121.8	7.4	209.5
80	5.1	144.4	8.3	235.0

Basic Hydraulics – Static Water Pressure

Static water pressure, also known as hydrostatic pressure, is the pressure exerted by water when it is at rest.

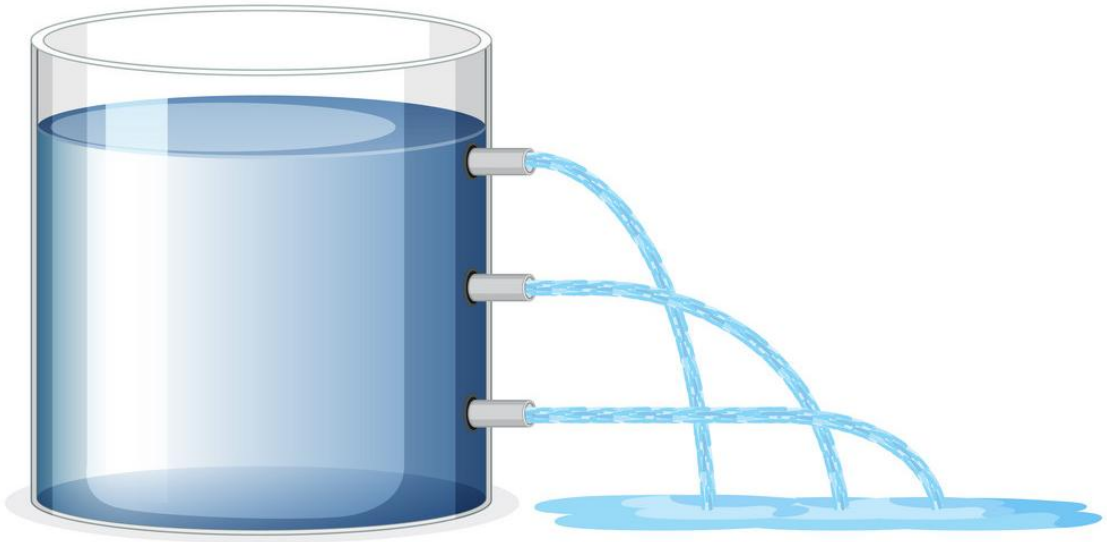
The formula of static water pressure is,

$P = h\rho g$ (Pa or N/m^2)

h = height of water column (m)

ρ = density of water (kg/m^3)

g = gravitational acceleration (m/s^2)

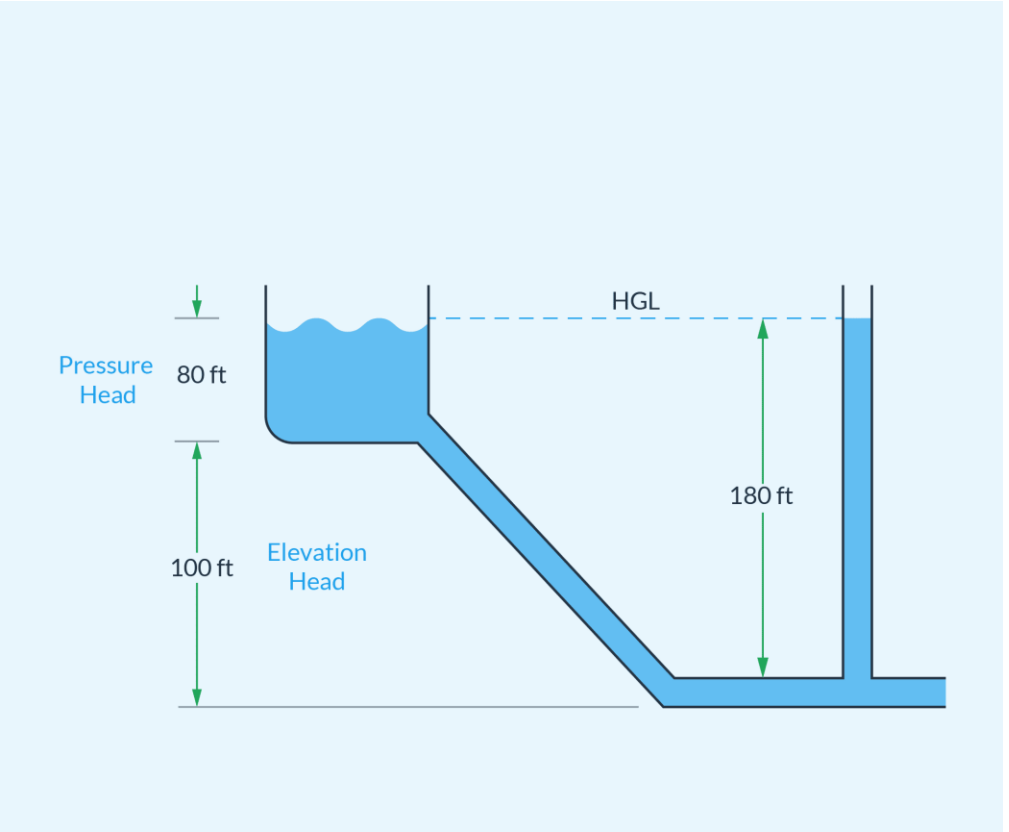


Calculate static water pressure of **1 m** water column

Basic Hydraulics – Flow of Water

Flow of water can be divided into 2 main categories,

1) Gravity Flow
2) Pressure Flow



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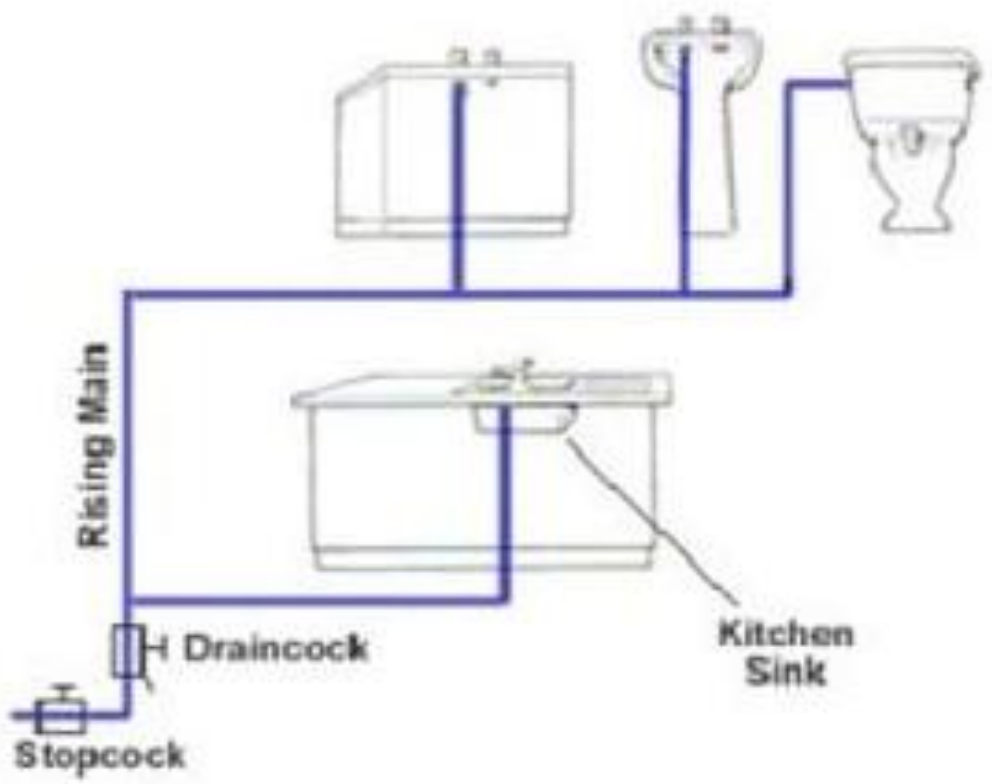
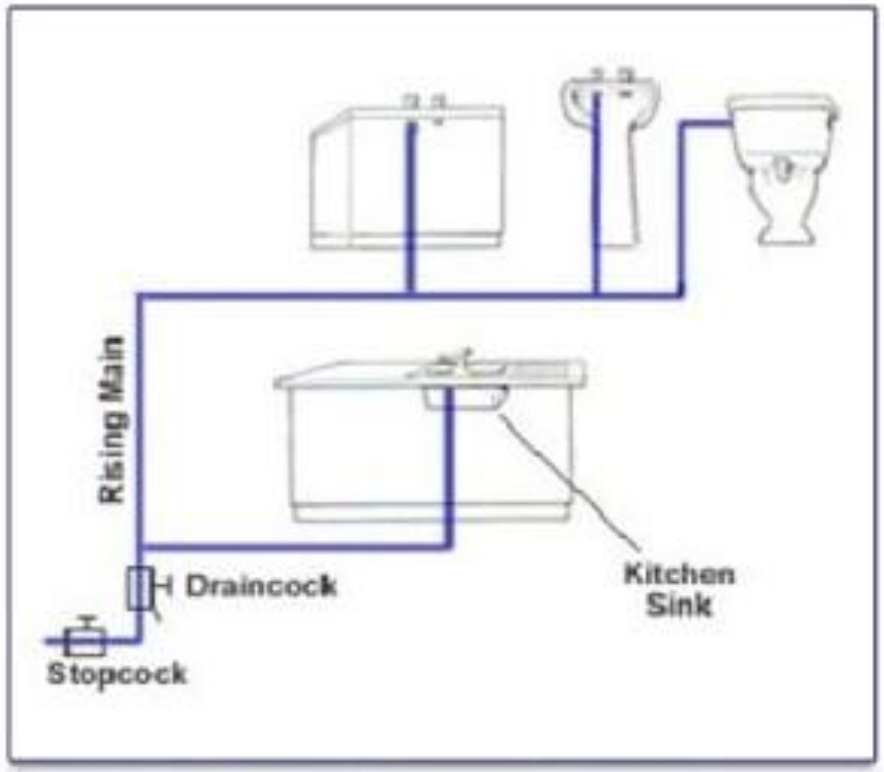
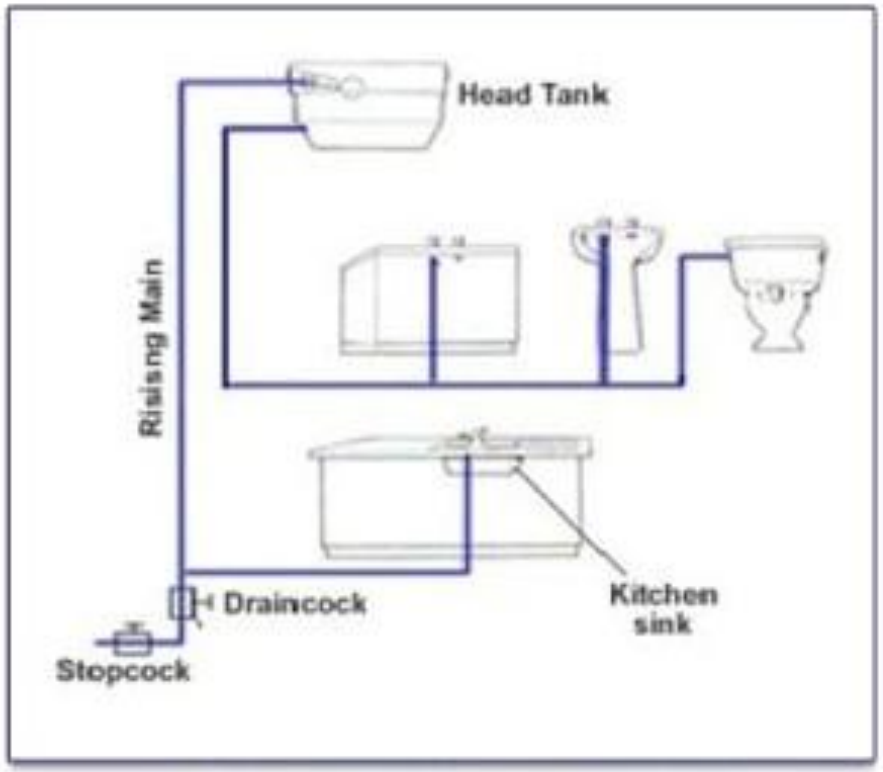


Basic Hydraulics – Flow of Water





Direct Water Supply System VS **Indirect Water Supply System**

Basic Hydraulics – Manning's Formula

Flow rate of water from higher elevation to lower elevation due to gravity force can be calculated using Manning's Formula

$$V = \frac{1}{n} R^{2/3} \sqrt{S}$$

V = is the average flow velocity in meters per second (m/s).

N = is Manning's roughness coefficient (unitless).

R = is the hydraulic radius in meters (m), calculated as the cross-sectional flow area divided by the wetted perimeter (A/P).

S = is the channel slope (dimensionless), expressed as the change in elevation per unit length (e.g., meters per meter).

Basic Hydraulics – Manning's Formula

Flow rate, $$V = \frac{1}{n} R^{2/3}\sqrt{S}$$

V = is the average flow velocity in meters per second (m/s).

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R = is the hydraulic radius in meters (m), calculated as the cross-sectional flow area divided by the wetted perimeter (A/P).

S = is the channel slope (dimensionless), expressed as the change in elevation per unit length (e.g., meters per meter).

Table 2.2. Value of n for Flow in Channels

Sl No.	Pipe material	n
1.	Earthen rough channels	0.05
2.	(a) Regular-shaped earth channel	
	(b) Tubular steel and	0.02
	(c) Fine well-packed stone	
3.	(a) R.C.C. pipes	0.015
	(b) Bricks in smooth condition and	
	(c) Smooth stone	
4.	Stoneware pipes, Cast-iron pipes and Welded steel pipes	0.013
5.	Asbestos cement pipes	0.012
6.	Plastic pipes	0.011

Example 04) Water is flowing through a **plastic pipe (0.2 m diameter)** due to gravitational force with **full flow**. The **slope of the pipe is 0.01**. Find out the velocity of the water.