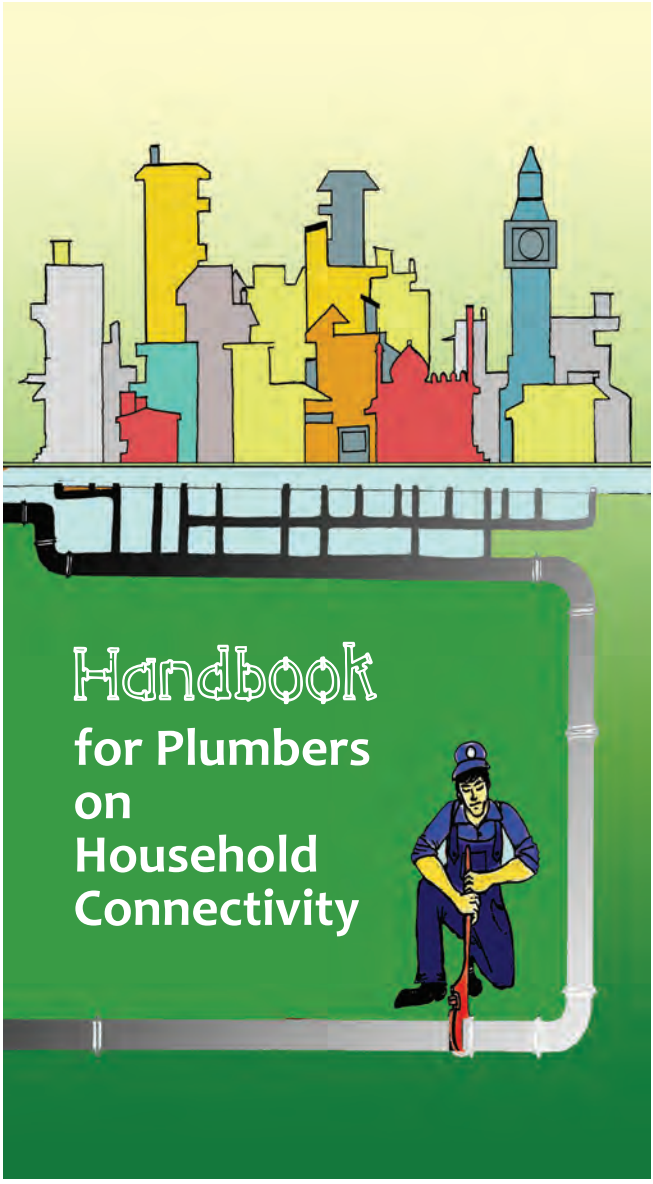
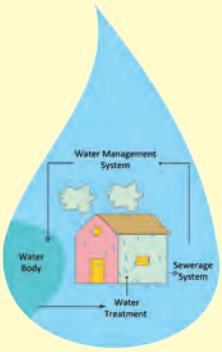


Contents

Introduction



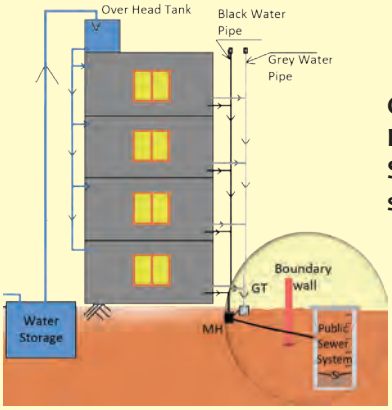
A good plumber contributes to healthy living conditions and environmental sustainability through cost effective solutions.

An irresponsible plumber provides solutions that are short-lived and cause damage to infrastructure and ill-health to users.

3 golden rules:

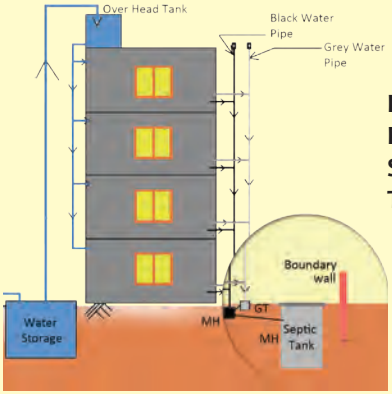
1. Avoid cross connections to mitigate contamination
2. Use Traps and Seals to manage smells
3. Regularly clean and maintain the system

About Sanitation Systems



Common Public Sewage system

OR

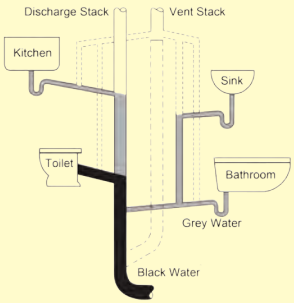


Individual Property Septic Tank

Plumbing Systems for Sanitation

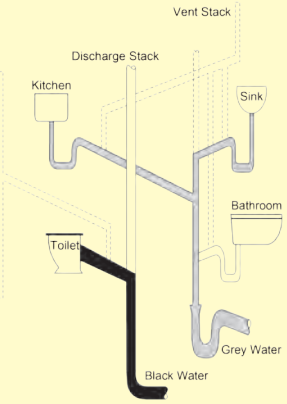
Single Pipe Sanitary System

A single pipe collects black as well as grey water and is connected to the building sewer.



Double Pipe Sanitary System

Soil pipes carrying black water and waste pipes carrying grey water are separate. Soil pipes are connected directly to the building drain.

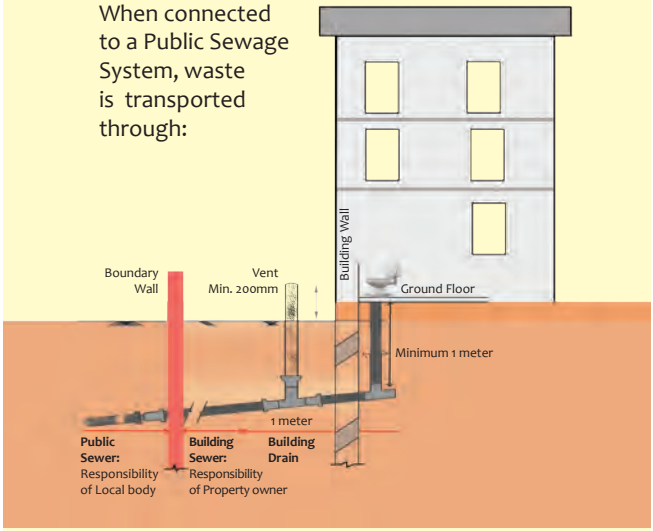


Black Water or Sewage is waste water from toilets containing faecal matter and urine. Grey water is all other domestic water except sewage

4

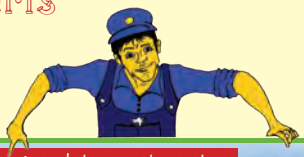
Sewerage Systems for Sanitation

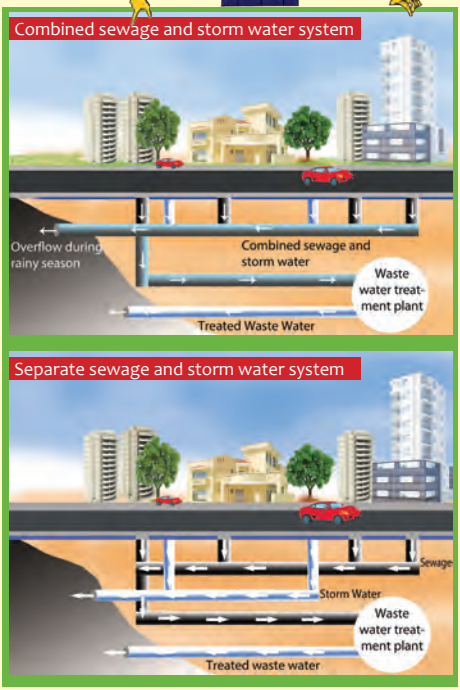
When connected to a Public Sewage System, waste is transported through:



Depending on the local law, owner may be responsible for connecting the building sewer with the public sewerage system, at his own expenses.

Types of Sewer Systems

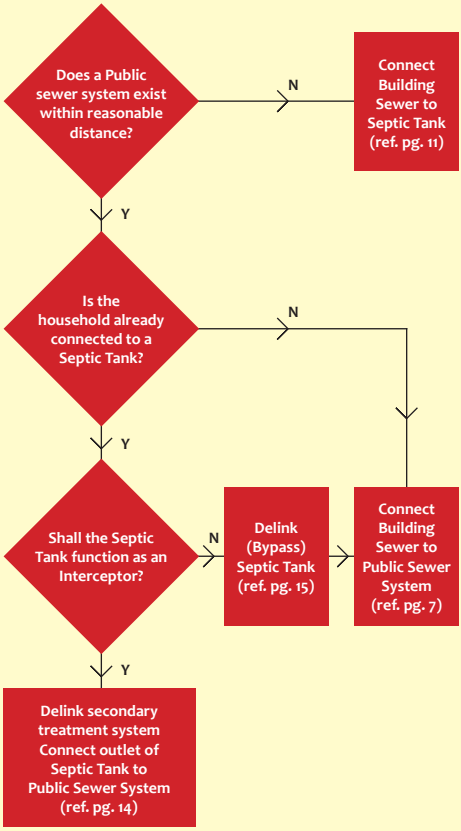




Combined Sewer system can cause serious water pollution if it overflows during rainy season.

6

Deciding Your Sewage Management System



Connecting Building Sewer to Public Sewer System

1. Check for authorized drainage plan of the building.

2. Ensure all inspection chambers in the building are inter connected & feed into a final inspection chamber within the premise.

3. Identify the nearest public sewer / manhole.

Connection to public sewer should be at an oblique angle where contained angle should not to be more than 60°.

4. Ascertain the position, depth & size of all other utilities (e.g. water supply, telephone lines, etc) in the vicinity of the proposed work.

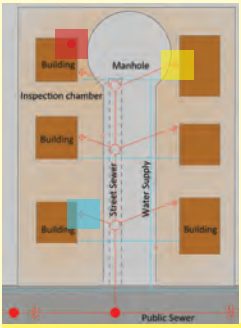
5. Owner to take prior consent where building sewer crosses land in other ownerships.

6. Building sewer should be 150 mm or more in diameter and should be laid as per design gradient. (Refer Page 19)

Where it is difficult to get the desired slope, install a flushing tank at the head of the building sewer to prevent clogging.	Construct a Drop Manhole at the end of the building sewer when the slope available is too sharp. (Ref. pg. 10)	Pump-out sewage, when the building sewer falls at a lower level than the level of the public sewer.

8

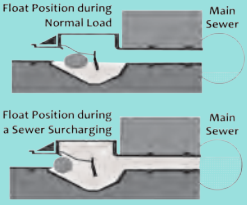
Connecting Building Sewer to Public Sewer System



7. All drainage pipes from the building are connected to inspection chamber inside the property.(Ref. pg. 9)

8. Connect the building sewer to the public sewer manhole preferably in a straight line such that building sewer invert is above the maximum flow line of the public sewer.

9. Intercepting Trap to be provided (if required by authority) at the junction of a building sewer & public sewer.



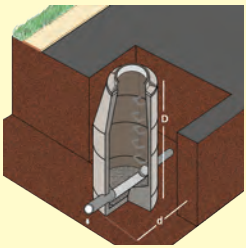
10. An anti-flood valve shall be provided in the manhole nearest to the junction of the building sewer & public sewer in case of backlogging from public sewer.

11. All works should be inspected during installation & tested (for gas tightness & hydraulic performance)on completion. No work shall be covered over or surrounded (with concrete or any other material) until it has been inspected & approved (ref. pg. 16).

About Manholes and Inspection Chambers

Inspection chambers/manhole should be provided at each corner, change in gradient, change in diameter, bends & junctions in the drain. Minimum recommended internal size of manhole (between faces of masonry) is as follows:

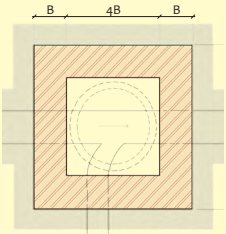
A. Circular Manholes	
Depth D (m)	Diameter d (m)
Greater than 0.90 and upto 1.65	0.90
Greater than 1.65 and upto 2.30	1.2
Greater than 2.30 and upto 9.00	1.5
Greater than 9.00 and upto 14.00	1.8



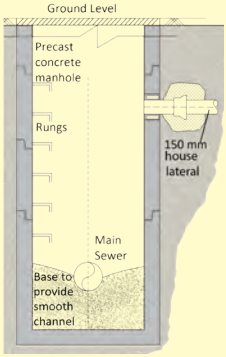
B. Size of Rectangular Manholes	
1. For depths less than 0.90 m	0.9 m × 0.8 m
2. For depths 0.90 m - up to 2.5 m	1.2 m × 0.9 m

Households can only connect to lateral sewer, never to the main sewer.

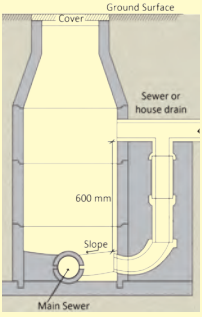
About Manholes and Inspection Chambers



INSPECTION CHAMBER:
A water-tight chamber is constructed in the house-drainage system to take waste water from gully traps and dispose off to manhole. These are shallow and meant for inspection and maintenance purpose.



150 mm lateral carries house sewage to municipal manhole.



DROP MANHOLE:
Where the difference of level between peak flow level of public sewer and invert level of building sewer is more than 600 mm, a Drop Manhole is constructed.

Connecting Building Sewer to Septic Tank

1. Check for authorized drainage plan of the building.

2. Check whether all inspection chambers in the building are inter connected and feed into a final inspection chamber/manhole within the premises.

3. Review the design of the septic tank based on the number of users.

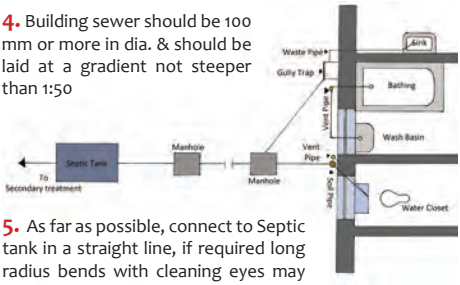
Number of Users	Length L (m)	Breadth B (m)	Liquid Depth (m) (Cleaning Interval of)	
			1 Year	2 Year
Recommended size of Septic Tanks for upto 20 users.				
5	1.5	0.75	1.0	1.05
10	2.0	0.90	1.0	1.40
15	2.0	0.90	1.3	2.00
20	2.30	1.10	1.3	1.80
Recommended size of Septic Tanks for more than 20 users. (Residential Colonies)				
50	5.0	2.0	1.0	1.24
100	7.5	2.65	1.0	1.24
150	10.0	3.0	1.0	1.24
200	12.0	3.30	1.0	1.24
300	15.0	4.0	1.0	1.24

Grey water should not be treated in septic tanks as it adversely affects the anaerobic decomposition process. Grey water may be drained to seepage pit or dispersion trench.

Under no circumstances should effluent from a septic tank be allowed into an open channel drain or body of water without adequate treatment.

Connecting Building Sewer to Septic Tank

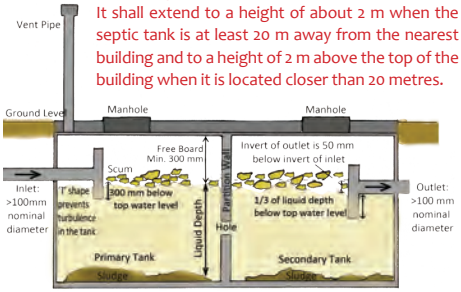
4. Building sewer should be 100 mm or more in dia. & should be laid at a gradient not steeper than 1:50



5. As far as possible, connect to Septic tank in a straight line, if required long radius bends with cleaning eyes may be used.

6. The Inlet, Outlet and Vent pipe of the septic tank should be as per IS:2470

Ventilating pipe shall be of at least 50 mm diameter. It shall extend to a height of about 2 m when the septic tank is at least 20 m away from the nearest building and to a height of 2 m above the top of the building when it is located closer than 20 metres.



Septic tanks should not be located in covered, swampy or flood prone areas. They should be easily accessible for cleaning.

When a pumping arrangement is provided before the septic tank, the sewage from the pump is first led into a tank. Sewage is then allowed to flow into the septic tank gravitationally with a slope of 1:50.

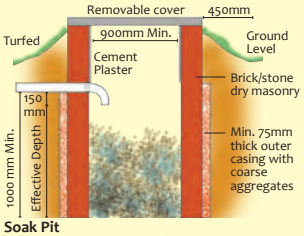
Connecting Building Sewer to Septic Tank

7. Review design of Secondary Treatment System (Soak pit, dispersion trench, biological filter, etc) based on the position of the subsoil water level, soil & subsoil conditions as under:

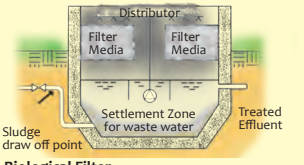
Position of the Subsoil Water from Ground Level	Soil and Subsoil Condition		
	Porous Soil with Percolation rate:		Dense and clays soil with percolation rate exceeding 60 min.
	Not exceeding 30 min.	Between 30 - 60 min.	
Within 1.8 m	Dispersion trench located partly or fully above ground level in a mound	Dispersion trench located partly or fully above ground level in a mound	Biological filter partly or fully above ground; effluent led into a surface drain or used for gardening
Below 1.8 m	Dispersion trench or Soak pit	Dispersion trench	Subsurface biological filter and the effluent led into a drain or used for gardening

8. The outlet of the septic tank should be connected to the recommended secondary treatment system.

9. All works should be inspected during installation & tested (for gas tightness & hydraulic performance) on completion. No work shall be covered or surrounded (with concrete etc.) until it has been inspected & approved. (ref. pg. 16)



Soak Pit



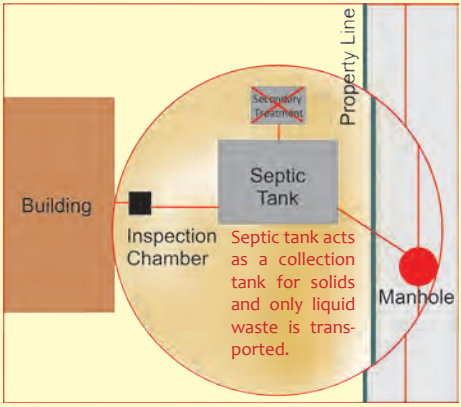
Biological Filter

Soak pits (also called Seepage pits) & trenches should be so located as to avoid contamination of watercourses or underground water supplies.

14

Connecting Existing Building Sewer to Public Sewer System

Using Septic Tank as Interceptor



1. Check for authorized drainage plan of the building (if available).

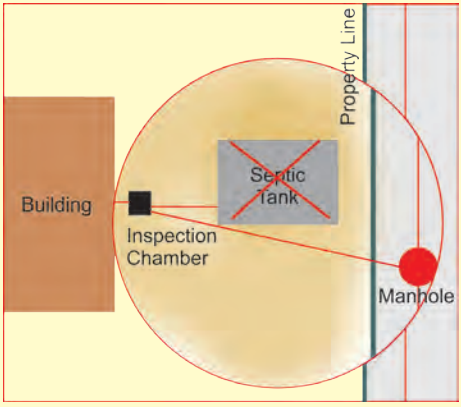
2. Seek permission from Competent Authority to use Septic Tank as Interceptor.

3. Delink the secondary treatment system (seepage pit, dispersion trench, etc.)

4. Connect the outlet (effluent) of septic tank to Public Sewer System (or small bore system) . (refer page no. 7)

Connecting Existing Building Sewer to Public Sewer System

Bypassing Septic Tank



1. Check for authorized drainage plan of the building (if available).

2. Delink the Septic Tank

3. Connect the Building Sewer to Public Sewer System as per page no. 7.

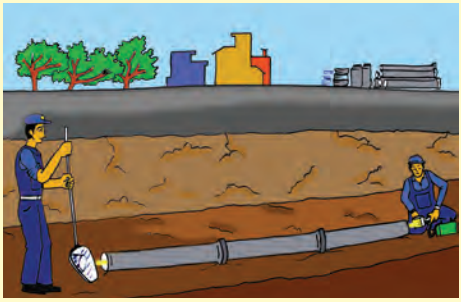
As per Uniform Plumbing Code of India, "No cesspool, septic tank, seepage pit ... shall be connected to any public sewer or to any building sewer leading to such public sewer."

Testing of Pipes

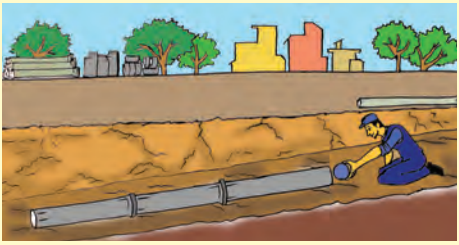
Water Test: Create Pressure of 1.5 m head of water at highest point of section being tested by closing the lower end. After 24 hours any drop in water level in the vertical end indicates leakage. This test is not used for cast iron pipes.

Smoke Test: Create thick smoke inside the pipe. Maintain a pressure of 25 mm of water for 15 minutes after all trap seals have been filled with water. Any evidence of smoke coming out of joints indicates leakage.

Testing of Pipes



Mirror Test: Hold a mirror at one end of the line and lamp at the other. Full circle reflection of light indicates that the pipe is straight and free from any obstruction.



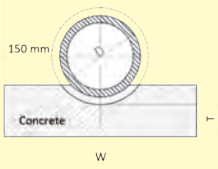
Ball Test: Insert a smooth ball of diameter 13 mm less than the pipe bore at the upper end. Smooth emergence of the ball at the lower end indicates absence of any obstruction.

Complete records shall be kept of all tests carried out of sewers and drains both during construction and after being put into service.

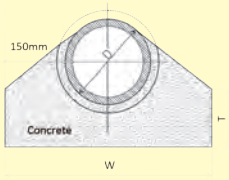
Protection of Pipes

Pipes need to be supported and protected to ensure longevity of infrastructure. It can be done through bedding and haunching as follows:

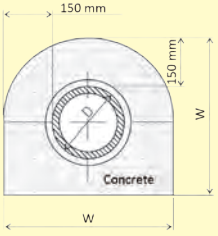
Pipe Dia (D) (External diameter)	Width of Bedding (W)	Thickness of Bedding (T)
Less than 150 mm	D+300 mm	100 mm
More than 150 mm	D+300 mm	150 mm



Bedding



Haunching

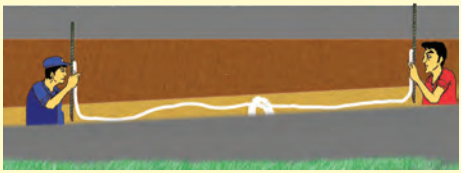


Encasing

Encasing is necessary where pipes may be prone to damage. Height of encasing is same as the width of bedding, i.e.
W = D+300 mm

Ensuring Gradient in Sewer

As far as possible, use instruments like Dumpy level to measure gradient in the system. At the minimum, use a water level pipe to ensure the desired slope.



Sewers require a minimum self cleaning velocity of 0.75 m/sec., maximum velocity allowed is 2.4 m/sec.

Recommended gradients for common pipe sizes are:

Dia mm	Minimum Gradient		Maximum Gradient	
	Gradient	Discharge m^3/min.	Gradient	Discharge m^3/min.
100	1 in 57	0.18	1 in 5.6	0.59
150	1 in 100	0.42	1 in 9.7	1.32
200	1 in 145	0.73	1 in 14	2.4
230	1 in 175	0.93	1 in 17	2.98
250	1 in 195	1.10	1 in 19	3.60
300	1 in 250	1.70	1 in 24.5	5.30

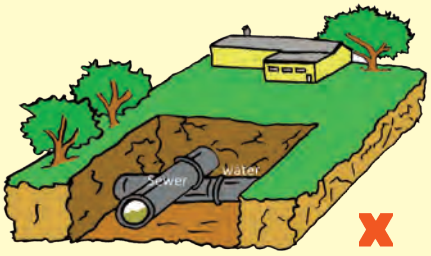
Inadequate or excess gradient can affect the efficiency of the sewage system

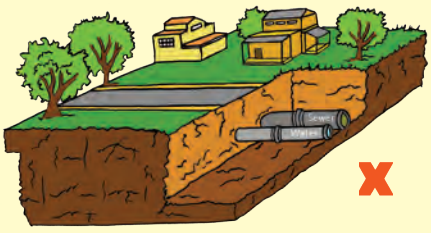
Dos and Donts for Installing Sewage and Water Supply Pipes

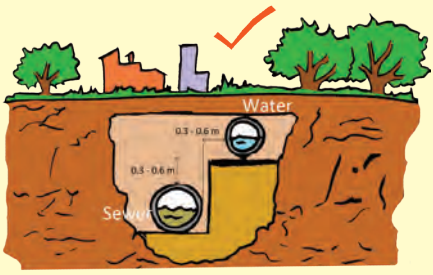
Potable water and waste piping should not be allowed to share a common trench. Saturated soil becomes a bridge for bacteria to travel between the pipes.

Solid shelf for water line is provided a minimum of 0.3 - 0.6 m above and a minimum of 0.3 - 0.6 m horizontally from the sewer line.

Location of Sewage Disposal System				
Minimum Horizontal Distance (m)	Building Sewer	Septic Tank	Disposal Field	Seepage Pit etc.
Building or structures	0.610	1.524	2.438	2.438
Property line	Clear	1.524	1.524	2.438
Water supply wells	15.240	15.240	30.5	45.7
Streams and other bodies of water	15.240	15.240	30.5	45.7
Onsite domestic water service line	0.305	1.524	1.524	1.524
Pressure public water main	3.048	3.048	3.048	3.048
Seepage pits or cesspools	—	1.524	1.524	3.658
Disposal Field	—	1.524	1.219	1.524
Trees	—	3.048	—	3.048



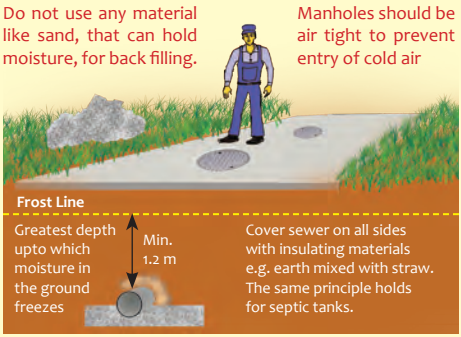




Sewer line should always be placed at a lower level in comparison to water supply.

Sewage Systems in Special Conditions

In areas of High Altitude note:



Capacity of septic tanks should be increased by 100% for operation at 10°C as compared to operation at 20°C

In areas of High Water Table note:

Oozing ground water during excavation should be removed manually or using pumps.

Sewage installation should preferably be done during dry season when the water table is lower.

Sewage disposal system should be chosen and designed considering the water table.

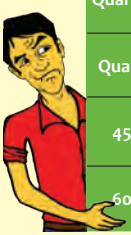
Choosing Pipes and Fittings

Pipes/ Fittings (Nominal dia range - mm)	Area of Use (Drain, Waste, Vent)			
	What they look like	Under-ground	Above ground	Build-ing Sewer
ABS / PVC (20 to 400 mm)			✓	
UPVC (20 to 400 mm)			✓	
PE (16 to 630 mm)			✓	
CI (75 to 400 mm)		✓	✓	
Stainless Steel (150 to 2500 mm)		✓	✓	✓
Cement Con-crete (80 to 1200 mm)		✓		✓
Salt Glazed stone ware (100 to 600 mm)		✓		✓

Choose appropriate pipe material for frost sensitive areas.

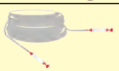
Fittings for Change in Flow Direction

Type of Fitting	What they look like	Horizontal to Vertical	Vertical to Horizontal	Horizontal to Horizontal
Wye		✓	✓	✓
Wye and 45 degree or combination		✓	✓	✓
Sanitary Tee		✓		
Long Sweep		✓	✓	✓
Quarter Sweep		✓	✓	✓
Quarter Bend		✓		
45 degree		✓	✓	✓
60 degree		✓	✓	



Plumbing Tools

A Plumber requires different tools to perform various operations. Some of the essential tools are listed below.

SN.	Tools		Use
1.	Measuring Tape		Is a flexible form of ruler to measure lengths
2.	Water Leveling Pipe		To transfer levels correctly from one vertical surface to another
3.	Spud wrench		Used for working on the fittings beneath sinks
4.	Adjustable Wrench		Used to wreck the head of the nut / bolt.
5.	Plumbing Plier		Used to do-up or undo nuts and bolts.
6.	Hacksaw		Used to cut pipes and other items
7.	Pipe Cutter		Used to cut the pipes
8.	Pipe Bending Machine		For bending pipes to minimize the need for connectors
9.	Plunger		Used for unclogging drains, though not too far into the main drain
10.	Plumbing Snake		Is “Snaked” into the piping of a drain or toilet to clear a clog

A good tool kit and its appropriate use is the hallmark of a good plumber.

Stop Manual Scavenging!

The Prohibition of Employment as Manual Scavengers and Their Rehabilitation Act, 2013 prohibits manual clearing of human excreta in an insanitary latrine or in an open drain or pit, a drain carrying sewage, sewer and on railway tracks.

To check manual scavenging you must:

1. Educate households on the issue.

2. Use mechanical devices for clearing of sewers and septic tanks.

3. Use adequate protective devices.

(Refer Page 27)

Elimination of manual scavenging is a 'National Priority' of Government of India.

'Offences under the Act are cognizable and non-bailable'

Health and Safety of Plumbers

Use Safety Equipment


Safety Helmet


Cap Lamp


Portable Air Blower


Gas Mask


Eye Protector


Safety Jacket


Protective Gloves & Boots


Gas Alert Device


First Aid Kit

Safety First- your own as well as others

References

1. IS 458 : 2003 – Precast Concrete Pipes (With and Without Reinforcement) - Specification (Fourth Revision)
2. IS 1172 : 1993 - Reaffirmed in 1998 – Code of Basic Requirements for Water Supply, Drainage and Sanitation
3. IS 1200 (Part 19) : 1981 - Reaffirmed in 2002 – Method of Measurement of Building and Civil Engineering Works
4. IS 1742 : 1983 - Reaffirmed in 2002 - Code of Practice for Building Drainage (Second Revision)
5. IS 2470 (Part 1) : 1985 - Reaffirmed in 2001 - Code of Practice for Installation of Septic Tanks IS 3589 : 2001 - Steel Pipes For Water And Sewage - Specification (Third Revision)
6. IS 5329 : 1983 - Reaffirmed in 2001 - Code of Practice for Sanitary Pipe Work Above Ground for Building (First Revision)
7. IS 6295 : 1986 - Reaffirmed in 2001 - Code of Practice for Water Supply and Drainage in High Altitudes and/or Sub-Zero Temperature Regions (First Revision)
8. IS 11208 : 1985 - Reaffirmed in 2007 - Guidelines for Registration of Plumbers
9. IS 11972 : 1987 - Reaffirmed in 2002 - Code of Practice for Safety Precautions to be Taken When Entering a Sewerage System
10. IS 12183 (Part 1) : 1987 - Reaffirmed in 2004 - Code of Practice for Plumbing in Multi-Storeyed Buildings
11. IS 13592 : 1992 - Reaffirmed in 2002 - Unplasticized Polyvinyl Chloride (UPVC) Pipes For Soil and Waste Discharge System Inside Buildings Including Ventilation and Rain Water System
12. SP 7: National Building Code of India 1983 PART IX Plumbing Services
13. SP 35: 1987 Handbook on Water Supply and Drainage (with Special Emphasis on Plumbing), Bureau of Indian Standards
14. Uniform Plumbing Code India – 2011
15. Manual on Sewerage and Sewage Treatment - Ministry of Urban Development - December 1993 & Final Draft May 2012
16. Manual on Water Supply and Treatment -Ministry of Urban Development - May 1999
17. Alternate Sewage Options for Residents - Technology Options for Urban Sanitations, Ministry of Urban Development
18. G S Bajwa, 2011, Practical Hand Book on Public Health Engineering

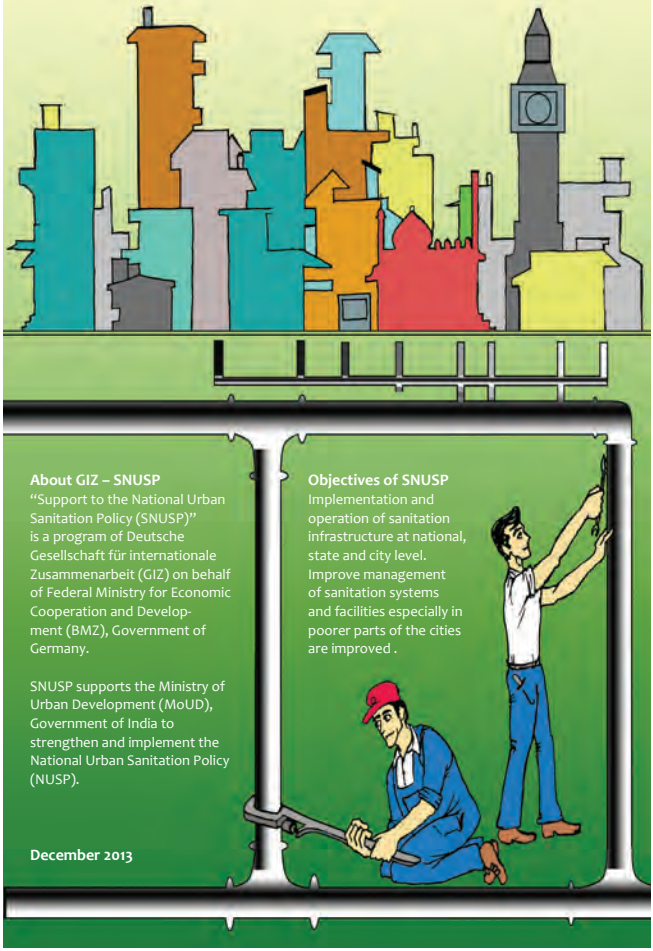
Conceptualised by
GIZ programme "Support to National Urban Sanitation Policy"

Developed by
Mona Chhabra Anand, Devanshu Pandit, Suneet Anand;
Design, Illustrations, Layout
Sumit Arora, Amaan Safavi, Pawan Kumar , Nivedita Jha
Knowledge Works, GG1 / 73 C, Vikas Puri, New Delhi 110018
www.knowledgeworksconsulting.com

Contact
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
2nd Floor, B-5/2; Safdarjung Enclave
New Delhi-110029-INDIA

Tel: +91 (0)11 4949 5353, Fax: +91 (0)11 4949 5391

GIZ Programme – Support to National Urban Sanitation Policy
Dr. Regina Dube, Programme Director – SNUSP
Dirk Walther, Senior Advisor
Jitender Yadav, Technical Expert
Rahul Sharma, Technical Expert
Soma Biswas, Communication Specialist



About GIZ – SNUSP

"Support to the National Urban Sanitation Policy (SNUSP)" is a program of Deutsche Gesellschaft für internationale Zusammenarbeit (GIZ) on behalf of Federal Ministry for Economic Cooperation and Development (BMZ), Government of Germany.

SNUSP supports the Ministry of Urban Development (MoUD), Government of India to strengthen and implement the National Urban Sanitation Policy (NUSP).

December 2013

Objectives of SNUSP

Implementation and operation of sanitation infrastructure at national, state and city level.
Improve management of sanitation systems and facilities especially in poorer parts of the cities are improved .