PLUMBING CODE

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P L U M B I N G C O D E

BY

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PART A;

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I N T R O D U C T I O N .

The health and well-being of any community depend in no small measure on a good wholesome and adequate supply of water for drinking and other purposes, and the provision of well designed and carefully laid systems of drainage for the removal of waste water and sewage.

Very often, work that is out of sight is out of mind, and there is a tendency to think that something less than the best will meet the requirements. A drainage system designed with such thoughts in mind is likely to prove a source of great danger, producing possible contamination of the water supply, with desease and ill-health. Leakage in plumbing systems, therefore, is a menace to health whether it occurs in the house where infection of food is possible, or in the ground outside the house, where well water supply may be contaminated. Even more important is the danger that defective plumbing may allow wastes to enter the water supply pipes. Sewer Air or Sewer Gas may also make its way into buildings and possibly have some harmful physiological effect.

In order to eliminate these defects and to insure the highest standards of sanitation, the local Authorities responsible for the administration of any area should enforce by-laws controlling all plumbing installations.

Today there are thousands of cities and towns which have their own plumbing codes. Many of these codes are obsolete, contain restrictive provisions, and do not embody improvements made possible by recent research.

Generally speaking, British Plumbing Codes are more or less conservative in their requirements. However, starting with the second World War there arose a general tendency to save on plumbing materials and the British Standard Specifications, starting with the year 1940 prohibited the use of lead in plumbing systems and recommended the use of other materials such as Ternary Lead Alloys.

In the United States, government efforts to improve plumbing code requirements include the Uniform Plumbing Code, sponsored by HHFA and most recently, the National Plumbing Code issued jointly in June 1951 by NPA and HHFA, the purpose of the latter being to adjust differences in proposed standard codes prepared by various National Organizations.

In the Near East, it would be worth while noting that up to the present there is very little or even no uniformity as to the practices in plumbing. The enforcement of plumbing regulations may present some difficulties at the start but would in the long run give favorable results if effective measures are adopted.

It is therefore attempted in the following pages to formulate a code comprising recommended minimum requirements in plumbing based on a study of previously established codes. The Code is supplemented with some explanatory paragraphs including various comments pointing out as well some defects of local plumbing practices.

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SECTION 1

DEFINITIONS OF TERMS.

1.1 Plumbing: Plumbing is the art of installing, repairing, replacing and relocating in buildings the pipes, fixtures and other apparatus for bringing in and distributing the the water supply, removing liquid and water carried wastes, removing rain water and other liquid drainage and preventing trap siphonage and back pressure.

1.2 Plumbing System: The plumbing system of a building includes the water supply distributing pipes; the fixtures and fixture traps; the soil, waste, and vent pipes; the house drain and house sewer; the storm-water drainage; with their devices, appurtenances and connections all within or adjacent to the building. However, it does not include (by any code) the hot water distribution piping of a hot water heating system or connections between various pieces of apparatus of a boiler plant, engine room machines, air conditioning and refrigirating systems but such term includes the primary water supply to any of the expected systems or equipment and the main drains or wastes from such expected systems or equipments.

1.3 Water Service Pipe: The water service pipe is the pipe from the water main to the building served.

1.4 Water Distribution Pipes: The water distribution pipes are those which convey water from the service pipe to the plumbing fixtures.

1.5 Plumbing Fixtures: Plumbing fixtures are receptacles intended to receive and discharge water, liquid, or water carried wastes into a drainage system with which they are connected.

1.6 Trap: A trap is a fitting or device so constructed as to prevent the passage of air or gas through a pipe without materially affecting the flow of sewage or waste water through it.

1.7 Trap Seal: The trap seal is the vertical distance between the crown weir and the dip of the trap.

1.8 Vent Pipe: A vent pipe is any pipe provided to ventilate a house drainage system and to prevent trap siphonage and back pressure.

1.9 Local Ventilating Pipe: A local ventilating pipe is a pipe through which foul air or pipe vapors are removed from a room or fixture.

1.10 Soil Pipe: A soil pipe is any pipe which conveys the discharge of water closets, with or without the discharges from other fixtures, to the house drain.

1.11 Waste Pipe & Special Waste: A waste pipe is any pipe which receives the discharge of any fixture except water-closets, and conveys the same to the house drain, soil or waste stacks. When such pipe does not connect directly with a house drain or soil stack, it is termed a "Special Waste" or "Indirect Waste".

1.12 Main: The main of any system of horizontal, vertical, or continous piping is that part of such system which receives the wastes, vent or back vents from fixtures outlets or traps, direct or through branch pipes.

1.13 Branch: The branch of any system of piping is that part of the system which extends horizontally at a slight grade, with or without lateral or vertical extensions or vertical arms, from the main to receive fixture outlets not directly connected to the main.

1.14 Stack: Stack is a general term for any vertical line of soil, waste or vent piping.

1.15 House Drain: The house drain is that part of the lowest horizontal piping of a house drainage system which receives the discharge from soil, waste and other drainage pipes inside the walls of any building and conveys the same by gravity to the house sewer begining at a certain specified distance outside the building wall.

1.16 House Sewer: The house sewer is that part of the horizontal piping of a house drainage system extending from the house drain to its connection with the main sewer or cesspool and conveying the drainage of but one building site.

1.17 Dead End: A dead end is a branch which is terminated at a developed length of 2 ft. by a fitting not used for admitting liquids to the pipe.

1.18 Drainage System: The drainage system is that part of a plumbing system which receives, conveys and removes liquid and water-carried wastes and storm water.

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SECTION 2

GENERAL REGULATIONS

2.1. GRADE OF HORIZONTAL DRAINAGE PIPING.

2.1.1.* Horizontal Drainage Piping shall be run in practical alinement and at uniform grade of not less than 2% for pipes 3 inches in diameter or smaller and a grade of not less than 1% for pipes of a diameter larger than 3 inches; where conditions do not permit building drains and sewers to be laid with a fall as great as that specified, the following formula for the determination of the absolute minimum slope shall be applied: $S = \frac{8}{d^{4/3}}$ per cent (see derivation para 2.1. part B).

2.2 PIPES IN TRENCHES.

2.2.1* Water supply pipes, or any underground water pipes shall not be run or laid in the same trench as the building sewer or drainage piping. Where they must be laid in the same trench, the water pipe shall be laid on a bench or on solidly tamped backfill at least 30 cms. above the top of the sewer pipe.

2.3. CHANGES IN DIRECTION.

2.3.1 Fittings: Changes in direction in drainage piping shall be made by the appropriate use of 45 deg. wyes, half wyes, long-sweep quarter bends, sixth, eighth, or sixteenth bends or by combination of these types. Short quarter bends may be used in soil and waste lines where the change in direction of flow is from the horizontal to the vertical. No change in direction greater than 90 degrees in a single turn shall be made in drainage pipes.

*All paras. marked with an asterisk contain explanatory notes in part B.

2.3.2 Tees & Crosses: Tees and crosses may be used in vent pipes and in water distributing pipes. Single or double sanitary tees may be used in vertical sections of drains or stacks.

2.4 PROHIBITED FITTINGS & CONNECTIONS.

2.4.1 Prohibited Fittings: No double hub, double T or double sanitary T branch shall be used on soil or waste lines.

2.4.2 Prohibited Practices: The drilling, tapping or welding of house drains, soil, waste or vent pipes, and the use of saddle hubs or bands are prohibited.

2.4.3 Obstruction to Flow: Any fitting or connection that offers abnormal obstruction to flow through a drain is prohibited.

2.4.4 Dead Ends: In the installation of any drainage system dead ends shall be avoided.

2.5 PROTECTION OF MATERIALS.

2.5.1 Breakage & Corrosion: All pipes passing under or through walls shall be protected from breakage. Pipes passing through or under corrosive material shall be protected against external corrosion.

2.5.2 Freezing: No water supply, soil, or waste pipe shall be installed or permitted outside a building or in an exterior wall unless adequate provision is made to protect it from freezing where necessary.

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SECTION 3

MATERIALS - QUALITY & WEIGHTS

3.1 QUALITY OF MATERIALS.

3.1.1 All materials used in any part of a drainage or plumbing system shall be free from defects.

3.2 LIST OF MATERIALS.

3.2.1 Cast Iron Pipe and Fittings.

3.2.1.1 Quality & Size: All cast iron pipe and fittings shall conform to the standard specifications of the American Society for Testing Materials.

3.2.1.2 Coating: All cast iron pipe and fittings for underground use shall be coated with asphaltum or coal tar pitch.

3.2.2 Wrought Iron Pipe.

3.2.2.1 Wrought iron pipe shall conform to the standard specifications for welded wrought iron pipe of the American Society for Testing Materials.

3.2.2.2 Such pipe shall have at least the following average thickness and weight per linear foot.

Diameter in inches	Thickness in inches	Wt. per linear foot in pounds
½	0.109	0.85
¾	0.113	1.13
1	0.133	1.68
1¼	0.140	2.28
1½	0.145	2.72
2	0.154	3.65
2½	0.203	5.74
3	0.216	7.57
3½	0.226	9.11
4	0.237	10.79
5	0.258	14.62
6	0.280	18.97
8	0.322	28.55
10	0.365	40.48
12	0.375	49.56

3.2.3 Steel Pipe

3.2.3.1 Steel pipe shall conform to the standard specifications for welded and seamless steel pipe, of the Americam Society for Testing Materials (see Appendix "A")

3.2.3.2 Steel pipe shall have at least the same average thicknesses and weights per line or foot as prescribed for wrought iron pipe in para 3.2.2.2

3.2.4 Lead Pipe: All lead pipe shall be of best quality of drawn pipe of not less weight per linear foot than shown below.

3.2.4.1 Lead soil, waste, vent or flush pipes including bends and traps (extra light)

Internal Diameter Inches	Weight per foot lbs.	oz.	Internal Diameter Inches	Weight per foot lbs.	oz
1	2	-	2	4	-
1¼	2	8	3	4	12
1½	3	8	4	6	-

3.2.4.2 Lead water-supply pipe above ground (strong)

Internal Diameter Inches	Weight per foot lbs.	oz.	Internal Diameter Inches	Weight per foot lbs.	oz.
½	2	-	1¼	4	12
⅝	2	8	1½	6	-
¾	3	-	1¾	6	8
1	4	-	2	7	-

3.2.4.3 Lead water supply pipe underground (extra strong)

Internal Diameter Inches	Weight per foot lbs. oz.	Internal Diameter Inches	Weight per foot lbs. oz.
½	2 8	1¼	6 -
⅝	3 -	1½	7 8
¾	3 8	1¾	8 -
1	4 12	2	9 -

3.2.5 Brass Pipe.

3.2.5.1 Threaded Brass Pipe: Brass pipe when used with threaded fittings, shall have a copper content of not less tham sixty per cent and conform to the standard specifications for brass pipe, standard sizes of the American Society for Testing Materials. Such pipe shall have at least the following average thickness and weight per linear foot:-

Diameter in inches	Thickness in inches	Wt.per linear foot in pounds.
⅜	0.09	0.612
½	0.107	0.911
¾	0.114	1.24
1	0.126	1.74
1¼	0.146	2.56
1½	0.150	3.04
2	0.156	4.02
2½	0.187	5.83
3	0.219	8.31
3½	0.25	10.85
4	0.25	12.29
4½	0.25	13.74
5	0.25	15.40
6	0.25	18.44

3.2.5.2 Unthreaded Brass Pipe: Brass pipe, when used unthreaded and with approved welded joints shall have a copper content of at least eighty five per cent, and shall conform to the following specification:-

Diameter in inches	Thickness in inches	Wt.per linear foot in pounds
⅜	0.065	0.472
½	0.065	0.600
¾	0.065	0.763
1	0.065	0.968
1¼	0.065	1.235
1½	0.065	1.423
2	0.065	1.791
2½	0.068	2.278
3	0.083	3.384
3½	0.095	4.427
4	0.107	5.610
5	0.132	8.555
6	0.158	12.193

3.2.6 Copper Pipe

3.2.6.1 Threaded Copper Pipe: Copper pipe when used with threaded fittings, shall conform to the standard specifications for copper pipe standard sizes of the American Society for Testing Materials. Such pipe shall have at least the following average thickness and weight per linear foot:-

Diameter in inches	Thickness in inches	wt.per linear foot in pounds
⅜	0.09	0.64
½	0.107	0.95
¾	0.114	1.30
1	0.126	1.85
1¼	0.146	2.69
1½	0.150	3.20
2	0.156	4.23
2½	0.187	6.14
3	0.219	8.75
3½	0.25	11.41
4	0.25	12.94
4½	0.25	14.46
5	0.25	16.21
6	0.25	19.41

3.2.6.2 Unthreaded Copper Pipe: Copper pipe, when used unthreaded and with approved welded joints, shall conform to the following specifications:-

Diameter in inches	Thickness in inches	Wt.per linear foot in pounds
$\frac{3}{8}$	0.065	0.483
$\frac{1}{2}$	0.065	0.613
$\frac{3}{4}$	0.065	0.780
1	0.065	0.989
$1\frac{1}{4}$	0.065	1.26
$1\frac{1}{2}$	0.065	1.45
2	0.065	1.83
$2\frac{1}{2}$	0.068	2.32
3	0.083	3.45
$3\frac{1}{2}$	0.095	4.52
4	0.107	5.72
5	0.132	8.73
6	0.158	12.44

3.3 OTHER MATERIAL: Other materials than those specified above may be used provided that such materials have been tested and approved

3.4 THREADED FITTINGS.

3.4.1 Plain Screwed Fittings: Shall be of cast iron, malleable iron or brass of standard weight and dimensions.

3.4.2 Drainage Fittings: Shall be of cast iron, malleable iron or brass, with smooth interior waterway, with threads tapped out of solid metal.

3.4.3 All Cast-Iron Fittings Used for water supply distribution shall be galvanized.

3.4.4 All Malleable Iron Fittings Shall be galvanized.

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SECTION 4

HANGERS & SUPPORTS FOR PLUMBING PIPING

4.1* VERTICAL PIPING.

4.1.1 Vertical piping shall be securely supported at the base at maximum intervals of 8 meters.

4.2* HORIZONTAL PIPING.

4.2.1 Horizontal piping shall be securely supported at maximum intervals of 3 meters (10 feet)

4.3* HANGERS.

4.3.1 Hangers shall be made of adequately strong metal and shall be securely attached to the building construction.

4.4* UNDERGROUND PIPING.

4.4.1 Pipes in the ground shall be laid for their entire length on a firm bed.

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SECTION 5

JOINTS & CONNECTIONS

5.1 TIGHTNESS.

5.1.1 Joints and connections shall be made gas- and water-tight

5.2 TYPES OF JOINTS.

5.2.1 Calked Joints: Joints for bell and spigot metal drainage and vent pipe shall be firmly packed with oakum or hemp and secured with molten lead. At least 350 gms. (12 ozs.) of soft lead shall be used for each inch in diameter of the pipe used. Lead shall be run in one pouring and calked tight.

5.2.2 Screw Joints.

5.2.2.1 Screw joints shall be tapered with the threads sharp and true and all burrs due to cuttings shall be reamed out smooth.

5.2.2.2 Where fittings compound red lead, white lead or other joint material are used in making up threaded joints, such materials shall be applied to external threads only.

5.2.3 Wiped Joints: Wiped joints in lead pipe, or between lead pipe and brass or copper pipe, ferules, solder nipples, bushings, or traps, in all cases on the sewer side of the trap, shall be full-wiped joints. The solder shall have an exposed surface on each side of a joint not less than $\frac{3}{4}$ inch and a minimum thickness at the thickest part of the joint of not less than $\frac{3}{8}$ inch.

5.2.4 Cement Joints: A cement joint for clay sewer pipe or concrete sewer pipe shall be made by ramming a closely twisted hemp or oakum gasket, of suitable size to pass around the pipe and lap at the topinto the annular space between the pipes. The remaining space shall be filled with a mortar composed of one (1) part cement and two (2) parts mortar sand.

5.2.5 Burned Lead Joints: Lead "burned" (welded) joints shall be lapped and the lead shall be fused together to form a uniform weld at least one and one-half times as thick as the lead being joined.

5.3 SLIP JOINTS AND UNIONS.

5.3.1 Slip joints or unions may be used in traps seals or on the inlet side of the trap.

5.4 EXPANSION & CONTRACTION IN VERTICAL PIPES.

5.4.1 Adequate means shall be provided for taking care of the expansion and contraction of all vertical line of pipes when such provisions are deemed necessary.

5.5 USE OF JOINTS.

5.5.1 Clay Sewer Pipe: All joints in vitrified clay pipe or between such pipe and metal pipe shall be made with cement joints as specified in para 5.2.4

5.5.2 Concrete Sewer Pipe: All joints in cement sewer pipe or between such pipe and metal shall be made with cement joints as specified in para 5.2.4

5.5.3 Cast-Iron Pipe: Joints in cast-iron pipe shall be calked made as specified in para 5.2.1

5.5.4 Screw Pipe to Cast-Iron: Joints between wrought iron, steel, brass or copper pipe, and cast-iron pipe shall be either calked or screwed joints made as specified in para 5.2.1 or 5.2.2

5.5.5 Lead to Cast-Iron, Wrought Iron or Steel: Joints between lead and cast-iron, wrought iron or steel pipe shall be made by means of wiped joints to a calking ferrule, soldering nipples or bushing as specified in para 5.2.3

5.5.6 Water closet, pedestal urinals and trap-standard service sink: The connection between drainage pipes and water closets, floor outlet service sinks, pedestal urinals, and earthenware trap standard, shall be made by means of brass, hard lead, or iron flanges, calked or screwed to the drainage piping. The connection shall be bolted to the earthenware by means of brass bolts with an approved gasket or washer or setting compound between the earthenware and the connection. The floor flange shall be set on an approved firm base.

5.6 PIPES THROUGH ROOFS OR WALLS.

5.6.1 Where the pipes pass through roofs or exterior walls, the openings shall be made water tight.

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SECTION 6

WATER SUPPLY & DISTRIBUTION

6.1 QUALITY OF WATER.

6.1.1 The quality of water supply shall meet accepted standards of purity.

6.2. PROTECTION OF WATER SUPPLY.

6.2.1 Cross Connections: Potable and nonpotable water supplies shall be distributed through systems entirely independent of each other, and any cross connections between such supplies are prohibited.

6.2.2 Pumps, Wells, and other Appliances: Water pumps, wells, hydrants, filters, softeners, appliances and devices shall be protected from surface water and outside contamination by approved covers, walls, or copings.

6.2.3 Water Supply Tanks: All non-pressure potable water supply tanks shall be properly covered to prevent entrance of foreign material into the water supply.

6.2.4 Freezing: All water pipes, tanks, appliances and devices, subject to freezing temperature, shall be effectively protected against freezing.

6.2.5 Backflow: Every supply outlet or connection to a fixture or appliance shall be protected from backflow by means of an approved air gap or backflow preventer between the control valve of the outlet and the fixture or appliance (see para 6.2.5 part B)

6.3* MATERIALS FOR WATER PIPING AND TUBING.

6.3.1 All water supply pipes for a plumbing system shall be of lead, galvanized wrought iron or steel, brass or cast iron, with brass or galvanized malleable iron fittings.

6.3.2 All threaded ferrous pipe and fittings shall be galvanized (zinc coated).

6.3.3 When used underground in corrosive soil, all ferrous pipe and fittings shall be coal-tar-enamel coated.

6.3.4 No pipe or fittings that have been used for other purposes shall be used for distributing water.

6.4* SIZE OF WATER SERVICE PIPE.

6.4.1 The water service pipe shall be of sufficient size to furnish an adequate flow of water to meet the requirements of the building at peak demand, and in no case shall be less than $\frac{5}{8}$ inch diameter except that $\frac{1}{2}$ inch lead, copper or brass pipes may be used. If flush valves are installed, the building main shall be of not less than 1-inch diameter.

6.5 WATER SUPPLY TO FIXTURES.

6.5.1 Adequate Supply: All plumbing fixtures shall be provided with an adequate supply of water.

6.5.2 Size of Fixture Branches: The minimum size of fixture branches and other supply outlets shall be as follows:-

	inch
Sill Cocks	½
Hot-Water Boilers	½
Laundry Tubs	½
Sinks	½
Lavatories	⅜
Bathtubs	½
Water Closet & Urinal Tanks	⅜
Flush Valves for Water Closets and Pedestal Urinals	1
Flush Valves for Wall or Stall Urinals	½

6.6 WATER SUPPLY CONTROL

6.6.1 A main shut-off on the water service pipe shall be provided near the curb. Accessible shut-offs shall be provided on the main supply line just inside the foundation wall for each flat or appartment of a building, for supply to each hot water tank, and for each water closet.

6.7 HOT WATER SUPPLY.

6.7.1 Insulation: Where hot-water supply systems are installed, the hot-water pipes should be covered with approved insulating material.

6.7.2* Return Circulation Systems: In all buildings which are more than four stories in height and which are supplied with hot water, and in all other building where the developed lenght of the hot water piping from the source of hot water supply to the extreme fixture supplied exceeds 30 meters (100 feet), a hot water return circulation system shall be installed. The circulation return shall in all cases be one-half inch or more in diameter.

6.7.3* Relief Valves: Wherever a check valve is installed on the cold water supply pipe betweem the street main and the hot water tank there shall be installed on the hot water distributing system a suitable relief valve.

6.8. HOUSE SUPPLY TANKS.

6.8.1* Material.

6.8.1.1 Gravity supply tanks shall be built of steel or galvanized iron or reinforced concrete or copper except that where a copper service pipe is installed galvanized (zinc coated) cisterns shall not be used.

6.8.1.2 Pressure tanks shall be designed for at least the water working pressures under which they are to operate and shall be built of steel.

6.8.2 Overflow Pipes: Overflow pipes for gravity tanks shall discharge above and within 15 cms. (6 inches) of a roof or catch basin. Where such discharge is impossible, such overflow pipes shall discharge over an open water-supplied sink (see para 12.3.1), or connected through a check valve to a leader.

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SECTION 7

TRAPS & CLEANOUTS

7.1 TRAPS REQUIRED.

7.1.1 Each fixture shall be seperately trapped by an approved trap placed as near to the fixture as possible except that a battery of not more than 3 fixtures such as lavatories or laundry trays or combination sink and 2 trays may connect with a single trap, provided the trap is located centrally and not more than 60 cms. horizontally from the farthest fixture outlet.

7.2 TYPES AND SIZES OF TRAPS & FIXTURE DRAINS.

7.2.1 Every trap shall be self clearing and water-sealed and shall be of the same nominal size as the fixture drain to which it is connected.

7.2.2 The minimum size (nominal inside diameter) of trap and fixture drain for a given fixture shall be not less than specified below:-

Fixture	Minimum Size of Trap & Fixture Drain "INCHES"
Bathtubs	1½
Combination Sink & Laundry Trays	1½
Drinking Fountains	1¼
Floor Drains	2
Laundry Trays	1½
Lavatories	1¼
Shower Stalls	2
Sinks, Kitchen, Residence	1½
Sinks, Hotel or Public	2
Sinks, Pantry or Bar	1½
Sinks, Dishwasher	1½
Sinks, Service	2
Urinal, Trough or Wall	1½
Urinal, Stall	2
Water Closets	3

7.2.3 The fixture drains for water closets and other fixtures with integral traps shall not be smaller than the fixture-trap outlet.

7.3 WATER SEAL.

7.3.1 Fixture traps shall have a water seal of not less than 2 inches and not more than 4 inches.

7.4 PROHIBITED TRAPS.

7.4.1 No form of trap which depends for its seal upon the action of movable parts, or partitions that cannot be exposed for inspection (except in a trap integral with a fixture) shall be used for fixtures.

7.4.2 It shall be unlawful to use, Bell, Lip, Bottle, Ball or "D" Traps.

7.4.3 No fixture shall be double trapped.

7.4.4 No Crown vented traps shall be installed.

7.5 CLEANOUTS REQUIRED.

7.5.1 An easily accessible cleanout shall be provided at the foot of each vertical waste or soil stack or inside leader on all exposed or accessible fixture traps and at each change of direction of horizontal run.

7.5.2 Cleanouts shall be of the same nominal size as the pipes up to 4 inches, and not less than 4 inches for larger pipes.

7.5.3 Unerground cleanouts of a building (except where they are flush with the floor) shall be made accessible by manholes with proper covers.

7.5.4 The maximum distance between the cleanouts in horizontal soil lines shall be 15 meters.

7.6 BACKWATER VALVES.

7.6.1 Location: Backwater valves shall be installed in drainage lines wherever such drainage pipes are subject to backflow or back pressure. Such valves shall be so located as to be readily accessible for inspection and cleaning.

7.6.2 Material and Design: Backwater valves shall have all bearing parts or balls of corrosion-resisting metal and be so constructed as to insure a positive mechanical seal against backflow.

7.7 INTERCEPTORS AND SEPERATORS.

7.7.1 Grease Interceptors: A grease interceptor and seperator shall be installed in the waste line leading from sinks, drains or other fixtures in the following establishments when in the opinion of the administrative authority a hazard exists: restaurants, hotel kitchens or bars, factory cafeterias or restaurants, clubs or other establishments where grease can be introduced to the drainage system in qualities that can affect line stoppage, or hinder sewage disposal.

7.7.2 Oil Interceptors: An oil interceptor shall be installed in the drainage system of the following establishments when in the opinion of the administratime authority a hazard exists: gasoline service stations and garages, dry cleaners, gas and

chemical plants , paint and varnish manufacturing plants, printing ink plants, shoe polish plants, explosive plants, soap plants, cleaning fluid manufacturing plants, testing laboratories and any place of manufacture where volatile infammable liquid is on hand for use in the process and which by accident or otherwise may be admitted to the drainage system.

7.7.3 Sand Interceptors: Sand and similar interceptors shall be so designed and located as to be readily accessible for cleaning, and shall have a trap seal of not less than 6".

7.7.4 Design, Venting & Accessibility: All interceptors shall be so designed that they will not become air bound. They shall be vented and so located as to be readily accessible for cleaning.

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SECTION 8

PLUMBING FIXTURES

8.1 MATERIALS.

8.1.1 Plumbing fixtures shall be made of impervious materials with a smooth surface which shall be easily kept clean.

8.1.2 All receptacles used as water-closets, urinals or otherwise for the disposal of human excreta shall be vetrified earthenware, vitreous china, hard natural stone, or cast iron white enameled on the inside.

8.2 INSTALLATION OF FIXTURES.

8.2.1 Plumbing fixtures shall be installed in a manner to afford easy access for cleaning. Where practicable pipes from fixtures shall be run to the wall.

8.3 WATER CLOSET BOWLS.

8.3.1 Water closet bowls and traps shall be of the single piece type and shall be of such form as to hold sufficient quantity of water, when filled to the trap overflow, to prevent fouling of surfaces, and shall be provided with integral flushing rims constructed so as to flush the entire interior of the bowl.

8.4 PROHIBITED FIXTURES.

8.4.1 No dry closet or chemical closet shall be installed in a dwelling.

8.4.2 Frost-proof closets shall not be permitted.

8.5 FLOOR DRAINS & SHOWER DRAINS.

8.5.1 A floor drain or a shower drain shall be madeof metal, trapped and supplied with a strainer.

8.6 FIXTURE STRAINERS.

8.6.1 All fixtures other tham water closets and pedestal urinals shall be provided with fixed strong metallic strainers with outlet areas not less than that of the interior of the trap and waste pipe.

8.7 FIXTURE OVERFLOW.

8.7.1 The overflow pipe from a fixture shall be connected on the house or inlet side of the trap and be so arranged that it may be readily cleaned.

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SECTION 9

VENTILATION OF TOILET ROOMS

9.1 Every bathroom, toilet room or other room containing one or more water closets or urinals placed in any structure shall be ventilated in at least one of the following ways:-

9.1.1 Windows Opening to Outer Air: By one or more windows opening to a street or to a yard or court of lawful dimensions on the same lot or plot. Such windows shall have a clear area of at least 10% of the floor area (as specified in the Building Code) but in any case these windows shall not be less than one third of a square meter in area and 30 cms. in width.

9.1.2 Windows Opening on Vent Shafts or Courts: By a window of the size specified in para 9.1.1 of this section, opening on a vent shaft which extends to and through the roof, or into a court of lawful dimensions, as specified by the Building Code.

9.1.3 Individual Vent Flues or Ducts: By an individual vent flue or duct extending independently of any other flue or duct to and above the roof and having a cross section as specified in the Building Code.

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SECTION 10

SANITARY - DRAINAGE & VENTING

10.1 MATERIAL.

10.1.1 Piping within Building: All main or branch soil, waste and vent pipes within the building shall be of cast iron, galvanized steel or wrought iron, lead, brass or copper.

10.1.2 Underground Building Drain: The building drain when underground shall be of cast iron, brass pipe or copper pipe to comply with the specifications as given in Section 3.

10.1.3 Building Sewer: The building sewer shall be of vitrified clay pipe, concrete, cast iron, brass pipe or copper pipe.

10.2 FIXTURE UNITS.

* 10.2.1 Valves for Fixtures: The following table based on the rate of discharge from a lavatory as a unit, shall be employed to determine fixture equivalents:-

Fixture	Fixture Units.
One lavatory or wash basin	1
" kitchen sink with 1½" trap	2
" kitchen sink with 2" trap	2
" bathtub with 1½" trap.	2
" bathtub with 2" trap.	4
" laundry tray	2
" bidet	2
" combination fixture	3
" urinal (stall)	2
" urinal (pedestal)	4
" dish-washer with 1½" trap	2
" floor drain	2
" slop sink	3
" water closet	6
" drinking fountain	½
" dental unit	½

Fixture	Fixture Units.
One bathroom group consisting of: one water closet, one lavatory, and one bathtub with or without shower and one shower stall	6
One water closet, one lavatory, one bathtub and one shower	7
Sterilizers with ½ inch waste connections	½
Each 1000 gallon of capacity of a swimming pool	1

10.2.2* Other Fixtures: To assign fixture unit values for waste connections for fixtures other than those mentioned in para 10.2.1., the number of fixture units shall be computed by dividing the rate of discharge into the waste line in gpm by 7.5

10.3 SOIL & WASTE STACKS.

10.3.1 Stacks to be Vertical: Soil and waste stacks shall extend full size through the roof and shall be as direct as possible and free from sharp bends and turns.

10.3.2* Size of Soil & Waste Pipes: The required size of a soil or waste stack shall be determined from the distribution and total of all fixture units connected to the stack in accordance with the following table, except that no water closet shall discharge into a stack less than 3 inches in diameter and no soil or waste stack shall be smaller than the largest horizontal branch connected thereto.

1. Table 10.3.2.A Fixture-Unit load for class A Occupancy
2. " 10.3.2.B " " " " " B "

1.

PIPE SIZE IN "INCH"	Maximum Fixture Units that May Be Connected To						
	BUILDING DRAIN OR SEWER			One Hor. Branch	Vert.Soil or waste stack one and two Branch Intervals In Ht.	VERTICAL SOIL OR WASTE STACK MORE THAN 2 BRANCH INTERVALS IN HT.	
	1% Fall	2% Fall	4% Fall			In one Branch Interval	On one Stack
1¼	...	...	...	1	1	1	2
1½	...	...	...	4	3	2	8
2	...	8	14	7	6	6	24
2½	...	21	26	13	16	10	49
3	29+	32+	43+	24-	34+	14	70
4	216	260	300	192	300	100	600
5	468	576	690	432	650	230	1300
6	840	1000	1200	742	1200	420	2200
8	1920	2300	2760	1700	2550	850	4400
10	3480	4200	5000	3000	3900	1300	6800
12	5580	6700	8000	4700	5700	1900	10000
15	10000	12000	14000	8400	...	...	...

2.

1¼	...	...	...	1	1	1	1
1½	...	...	...	2	2	1	4
2	...	4	7	4	3	3	12
2½	...	10	13	7	8	5	25
3	15+	16+	22+	12-	17+	7	35
4	108	130	150	96	150	50	300
5	234	288	345	216	325	115	650
6	420	500	600	371	600	210	1100
8	960	1150	1380	850	1275	425	2200
10	1740	2100	2500	1500	1950	650	3400
12	2790	3350	4000	2350	2850	950	5000
15	5000	6000	7200	4200	...	...	...

+ Not over two Water Closets.
- " " one " " .

Note: Class A Occupancy: "Occupancy in which the fixtures are intended for use of a family or individual, such as fixtures in residences, apartments, and fixtures in private washrooms or bathrooms in hotels, clubs, hospitals or office buildings".

Class B Occupancy: "Occupancy in which the fixtures are intended for general use in all installations not covered by class A ".

N.B. The above tables are adopted from the American Standard Plumbing Code.

10.3.3 Maximum Load Within One Branch Interval: The maximum number of fixture units, of the occupancy class indicated, that may be connected to a vertical soil or waste stack within one branch interval is given in Tables 10.3.2A & 10.3.2B.

10.3.4 Dual Occupancy: If a building has both class A and class B occupancies and if fixtures for those two classes of occupancy are to be connected to the same stacks and drains, then the fixture unites computed for fixtures used for Class A occupancy may be converted to units of Class B occupancy by dividing by two, or the fixture unitscomputed for Class B occupancy may be converted to units for Class A occupancy by multiplying by 2.

10.4 PROHIBITED CONNECTIONS.

10.4.1 No fixture connection shall be made to a lead bend or branch of a water closet or similar fixture.

10.5 ROOF EXTENSIONS.

10.5.1 All roof extensions of soil and waste stacks shall be run full size at least 30 cms. above the roof, and when the roof is used for other purposes than weather protection such extension shall be not less than 160 cms. above the roof.

10.5.2 When there is danger of frost closure, no roof extension shall be less than 4 inches in diameter. Change in diameter shall be made by use of a long increaser at least 30 cms. below the roof.

10.5.3 The roof terminal of any stack, if within 4 meters of any door, window or air shaft, shall extend 1 metre above the top of such opening.

10.6 PROTECTION OF TRAP SEALS.

10.6.1 Individual Vents: Every fixture trap shall be protected against siphonage and back pressure, and air circulation assured by means of a soil or waste stack vent, a continous waste or soil vent, or a loop or circuit vent.

10.6.2 Stack Vents: Every soil or waste stack shall be extended vertically as a stack-ventto at least 15 cms. above the highest horizontal branch and then to the open air above the roof (as specified in para 10.5.1.) or otherwise terminated in the open air outside the building; or the stack-vent and vent stack may be connected together within the building at least 15 cms. above the flood level of the highest fixture, with a single extension from the connection to the open air.

10.6.3 Vent Stacks: A vent stack or main vent shall be installed with a soil or waste stack whenever back vents, relief vents, or other branch vents are required in two or more branch intervals. The vent stack shall terminate independently in the open air outside the building or may be connected with the stack-vent as prescribed in para 10.6.2.; and shall connect with the soil or waste stack through at or below the lowest horizontal waste branch or with the building drain.

10.6.4 Distance of Vent from Trap Seal: Each fixture trap shall have a protecting vent located so that the total fall in the fixture drain from the trap weir to the vent fitting is not more than 1 pipe diameter, and the developed length of drain from trap weir to vent fitting is not less than 2 nor more than 48 pipe diameters.

10.7 DUAL VENT.

10.7.1 An individual vent or a stack vent, (installed vertically) may be installed as a dual vent when both fixture drains connect with a vertical drain or stack at the same level and the developed length and total fall of each of the two fixture drains are within the limits stated in para 10.6.4. Under those conditions no additional vents for the traps are required.

10.8 CIRCUIT & LOOP VENTS.

10.8.1 A circuit or loop vent will be permitted as follows: A branch soil or waste pipe to which two, and not more than eight, water closets (except blowout type) pedestal urinals, trap standard service sinks, shower stalls, or floor drains are connected in series may be vented by a circuit or loop vent which shall be taken off in front of the last fixture connection. When other fixtures discharge above such branch, each branch

shall be provided with a relief vent taken off in front of the first fixture connection.

10.8.2 Two lines of fixtures back-to-back (double battery) shall not be installed on the same circuit- or loop-vented horizontal branch but may be installed on different branches with a dual relief-vent.

10.9* STACK VENTING.

10.9.1 A fixture on the topmost stack branch shall be considered as adequately vented when it is installed in accordance with the provisions of para 10.6.4

10.9.2 A water closet shall be considered as adequately vented if above it there are connected to the soil stack fixtures totalling not more than 2 fixture units.

10.10* VENTING OF OFFSETS.

10.10.1* Venting Required: Offsets in soil or waste stacks at an angle greater than 45 degrees from vertical serving fixtures below and on two or more floors above the offset shall be vented as provided in either 10.10.1.1. or 10.10.1.2 below.

10.10.1.1 Yoke Vents: Such offsets may be provided with a yoke vent, equal in diameter to the vent stack or soil stack. The lower endof the yoke vent shall connect to the soil or waste stack through a "Y" below the lowest horizontal branch above the offset and the upper end shall connect to the vent stack through a "Y" not less than one meter above the floor level.

10.10.1.2 Seperate Venting: Such offsets may be vented as two seperate soil or waste stacks, namely, the stack section below the offset and the stack section above the offset.

10.10.2 Connections: A branch serving any fixture on the lowest floor on the upper section of the stack shall shall be connected to the lower section of the soil or waste stack.

10.11* YOKE VENTS.

10.11.1 All soil or waste stack in building over five floors in height, shall be provided with yoke vents at each five floor interval measured from the top floor down. The size of the yoke vent shall be equal to the size of the vent stack to which it connects. The lower end of the yoke vent shall connect to the soil or waste stack through a "Y" below the horizontal branch serving that floor and the upper end shall connect to the vent stack through a "Y" not less than 1 meter above the floor level.

10.12* VENT-PIPE GRADES AND CONNECTIONS.

10.12.1 Grades: All vent and branch-vent pipes shall be free from drops or sags and be so graded and connected as to drip back to the soil or waste pipe or vent stack by gravity.

10.12.2 Connection to Soil or Waste Pipe: Where vent pipes connect to a horizontal soil or waste pipe the vent shall be taken off above the center line of the soil pipe and the vent pipe shall rise vertically or at an angle not more than 45 degrees to the vertical, to a point at least 15 cms. above the flood level rim of the fixture it is venting before offsetting horizontally or before connecting to the branch vent.

10.12.3 Connection to Vent Stack: A connection between a vent pipe and a vent stack shall be at least 15 cms. above the flood level-rim of the highest fixture served by the vent. Horizontal vent pipes forming branch vents, relief vents, circuit vents, or loop vents, shall be at least 15 cms. above the flood-level rim of the highest fixture served.

10.13 SIZE & LENGTH OF VENTS.

10.13.1 Definitions:

10.13.1.1 Length of Vent Stack: The length of a vent stack or main vent shall be its developed length from the lowest connection of the vent system with the soil stack, waste stack or building drain either to the vent stack terminal (if it terminates seperately in the open air) or to the connection of the vent stack with the stack vent plus the developed length of the stack vent from the connection to the terminal in the open air (if the two vents are connected together with a single extension to the open air);

10.13.1.2 Length of Branch Vent: The length of a branch vent shall be the developed length from its connection with the vent stack or stack vent to the fixture drain or horizontal soil or waste branch served by the branch vent.

10.13.1.3 Length of Stack Vent: The length of a stack vent shall be the developed length from the highest horizontal or fixture branch connected to the stack to the terminal of the stack vent in the open air.

10.13.2 Size of the Vent Stack: A vent stack or main vent shall have a diameter of at least one-half the diameter of the soil or waste stack, but in no case less than 2 inches, and depending on its developed length and the number of fixture units installed on the soil or waste stack shall be in accordance with table 10.13.2 (on sheet 35).

10.13.3 Size of Stack Vent: The diameter of a stack vent shall be not less than the diameter of the soil or waste stack.

10.13.4 Size of Back Vent: The diameter of an individual vent shall be not less than $1\frac{1}{4}$ inch, nor less than one-half the diameter of the drain to which it is connected.

10.13.5 Size of Relief Vent: The diameter of a relief vent shall be not less than one-half the diameter of the soil or waste branch.

10.13.6 Size of Circuit or Loop Vent: The diameter of a circuit or loop vent shall be not less than the diameter of the horizontal soil or waste branch, or the diameter of the vent stack, whichever is the smaller.

Table 11.13.2 Size and length of Vents for Soil and waste Stacks

Size of Soil or Waste Stack "Inches"	Fixture Units Connected: Class A Occupancy	Class B Occupancy	Diameter of Vent (In Inches) 1¼	1½	2	2½	3	4	5	6	8
			Maximum Length of Vent (In Feet)								
1 ¼	2	1	50	...	...	...	...	...	...	...	...
1 ½	8	4	30	75	150	...	...	...	...	...	...
2	10	5	...	100	150	...	...	...	...	...	...
2	17	8	...	75	100	...	...	...	...	...	...
2	24	12	...	60	75	...	...	...	...	...	...
3	25	13	...	40	200	400	800	...	...	...	...
3	70	35	...	20	80	250	600	...	...	...	...
4	100	50	...	...	50	150	350	600	...	...	...
4	200	100	...	...	30	90	200	450	...	...	...
4	300	150	...	...	...	50	150	400	...	...	...
4	410	205	...	...	...	40	120	300	...	...	...
4	600	300	...	...	...	...	100	200	...	...	...
5	200	100	...	...	...	50	125	400	700	...	...
5	400	200	...	...	...	40	80	250	500	...	...
5	700	350	...	...	...	...	50	150	400	...	...
5	1000	500	...	...	...	...	25	120	300	...	...
5	1300	650	...	...	...	...	...	100	250	...	...
6	350	175	...	...	...	...	40	150	450	800	...
6	700	350	...	...	...	...	30	90	250	500	...
6	1500	750	...	...	...	...	...	70	200	400	...
6	2200	1100	...	...	...	...	...	50	150	300	...
8	700	350	...	...	...	...	...	...	100	200	800
8	1500	750	...	...	...	...	...	...	75	150	500
8	4400	2200	...	...	...	...	...	...	...	100	400
10	1000	500	...	...	...	...	...	...	30	150	500
10	5000	2500	...	...	...	...	...	...	...	100	350
10	6800	3400	...	...	...	...	...	...	...	80	300

10.15 SPECIAL CONDITIONS IN DRAINAGE.

10.15.1 Drainage Below Sewer Level.

10.15.1.1 The drainage from such parts of the drainage systems as lie below the crown levels of the street sewer and also from such parts as cannot drain by gravity into the sewer shall be disposed of through a system of subdrains and shall be lifted by approved means into the sewer.

10.15.1.2 Subdrains shall discharge into an air-tight sump or receiving tank so located as to receive the sewage by gravity. From the sump or receiving tank, the sewage shall be lifted and discharged by pumps or some automatically operated device. ~~When the lifting device forms a trap, and additional trap on the drain may be omitted, but all fixtures and equivalent devices shall be trapped.~~ When subdrains do not receive the discharge of plumbing fixtures other than cellar floor drains or drips from machinery, it shall be unnecessary for the sump or receiving tank to be air-tight or vented.

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SECTION 11

STORM - WATER DRAINS

11.1 GENERAL.

11.1.1 Roofs and paved areas, yards, courts, and courtyards shall be drained into a storm-sewer system or a combined-sewer system, but shall not be drained into sewers intended for sanitary sewage only.

11.1.2 Leaders and storm drains, when connected to a combined sewer, shall be effectively trapped. When the sanitary and storm drains are combined within the building one trap on the main storm drain of the building may serve.

11.2 MATERIALS.

11.2.1 Inside Leaders: Leaders when placed within a building, or run in a vent or pipe shaft, shall be of cast iron, galvanised steel, galvanised wrought iron, brass, copper, or lead.

11.2.2 Outside Leaders: When outside leaders are of sheet metal and connected with a building storm drain or storm sewer, they shall be connected to a cast iron, brass pipe, or copper pipe, drain extending above the grade line. A sheet-metal leader along a public driveway shall be protected against injury.

11.2.3. Underground Drains: Building storm drains when underground shall be of cast iron, brass pipe, or copper pipe.

11.2.4 Building Storm Sewer: The building storm sewer shall be of vitrified-clay pipe, cast iron, brass pipe, or copper pipe.

11.3 SIZE OF LEADERS & STORM DRAINS.

11.3.1 Vertical Leaders: The size of vertical leaders shall be based upon the maximum projected roof area as given in the following table:-

Nominal Leader Size Equivalent Diameter In Inches.	Maximum Projected Roof Area in Sq. Ft.	Equivalent Area In Square Meters.
2	500	47
3	1,500	140
4	3,100	290
5	5,400	500
6	8,400	790
8	17,400	1630

Note: This table is taken from the American Standard Plumbing Code. It is based upon a maximum rate of rainfall of 4 inches per hour.

11.3.2 Storm Drains: The minimum size of building storm sewer, building storm drain or any of its branches, having a slope of 4% or less shall be based upon the maximum roof area to be handled according to table 11.3.2

Table 11.3.2 Maximum Projected Roof Area for Drains at Various Slopes

Diameter	1 % Slope		2 % Slope		4 % Slope	
Inches	Sq. Ft. of Roof Area	Sq.M. of Roof Area	Sq.Ft.of Roof Area	Sq.M. of Roof Area	Sq. ft.of Roof Area	Sq. M. of Roof Area
2	....	....	350	35	5008	47
3	750	70	1050	100	1500	140
4	1550	145	2150	200	3100	290
5	2700	250	3600	340	5400	500
6	4200	400	6000	560	8400	790
8	8700	820	11900	1060	17400	1630
10	15200	1400	19600	1830	30400	2800
12	24700	2300	31800	3000	49400	4600

11.4 COMBINED BUILDING DRAINS & BUILDING STORM DRAINS.

11.4.1 The sanitary- and storm-drainage system of a building shall be entirely seperate, except where a combined sewer is available, the building drain and building storm drain may be connected to a combined drain or combined sewer down stream and preferably at least 3 meters from any stack connection.

11.5 SIZE OF COMBINED DRAINS & SEWERS.

11.5.1 Size to Combining Point: The size of building drains and building storm drains up to the point of combining into one system shall be as required for seperate storm and sanitary systems.

11.5.2 Roof-Area Equivalents for Fixture Units: To determine the size of a combined drain or sewer the connected fixture units shall first be converted to roof area by table 11.5.2. This area shall be added to the actual roof area served by the combined drain or sewer, and the pipe size shall be determined by table 11.3.2.

Table 11.5.2 Roof Area Equivalents for Fixture Units on Combined Drains & Sewers.

Total Number Class A Units	Sq.Feet of Roof Area	Sq. Meters of Roof Area
10	650	60
15	750	70
20	900	84
25	1000	94
30	1100	103
35	1200	112
40	1300	120
45	1400	130
50	1500	140
60	1650	154
70	1800	168
80	2000	185
90	2100	195
100	2200	206
125	2500	234
150	2850	266
175	3100	300
200	3400	320
250	3900	360
300	4300	400
350	4800	450
400	5200	480
450	5600	520
500	5900	550
600	6700	630
700	7200	670
800	7900	740
900	8600	800
1000	9200	860
1200	10500	980
1400	11500	1070
1600	12600	1180
1800	13700	1280
2000	14700	1370
2500	17300	1620

Total Number Class A Units	Sq. Feet of Roof Area	Sq. Meters of Roof Area
3000	19800	1850
3500	22000	2060
4000	25000	2320
4500	27000	2500
5000	29000	2700
6000	34000	3180
7000	39000	3650
8000	43000	4000
9000	48000	4500

Note: In using this table class B occupancy units should be converted to class A by multiplying by 2.

The above table is based upon a maximum rate of rain fall of 4 inches per hour.

If in any city, the maximum rate of rainfall is more than 4 inches per hour then the above figures for roof areas must be adjusted proportionately by multiplying the figures by 4 and dividing by the maximum rate of rainfall in inches/hr.

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SECTION 12

INDIRECT WASTE CONNECTIONS TO WASTE PIPES.

12.1 INDIRECT WASTES. *

12.1.1 Direct Drainage Prohibited: Waste pipe from the following shall not connect directly with any building drain, soil, or waste pipe: a refrigirator; ice box; or receptacle wherein food is stored, prepared, or processed; a sterilizer; swimming pool; a water-treatment device or a water-operated device.

12.1.2 Drinking Fountains: Bar sinks, soda fountains and drinking fountains may be installed with indirect wastes.

12.2 INDIRECT WASTE PIPES.

12.2.1 Installation: Indirect waste pipes shall be installed in accordance with the provisions applicable to drainage piping. Such pipes shall in all cases empty into and above the flood level of an open plumbing fixture which shall be located in an accessable ventilated place. An air gap not less than twice the effective opening of the waste shall be provided between the outlet end of the waste pipe and the flood level of the receiving receptacle.

12.2.2 Size of Refrigirator Waste Pipes: The Diameter of refrigirator waste pipes shall be not less than 1½ inches.

12.2.3 Venting: Indirect waste pipes which receive the discharge from fixtures on 3 or more floors shall be extended through the roof.

12.3 OVERFLOW PIPES.

12.3.1 Overflow pipes from a water-supply tank or exhaust pipes from a water lift shall not be directly connected with any building drain or with any soil or waste pipe, but shall discharge outside the

building, upon the roof or into an open fixture as provided in para 12.2.

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SECTION 13

TESTS OF PLUMBING SYSTEM

13.1* TESTS REQUIRED.

13.1.1 Every plumbing system shall be subjected to tests for tightness.

13.1.2 The complete water-supply system of the building shall be subjected to a water or air-pressure test.

13.1.3 The drainage system within or under the building shall be subjected to a water or air-pressure test before the pipes are concealed or the fixtures are set in place.

13.1.4 The sanitary-drainage and vent system shall be subjected to a final smoke or air-pressure test after the system has been completed and the fixture traps have been connected. The removal of any plug or cap during the test may be required to determine whether the pressure has reached all parts of the system.

13.2* TESTS OF DRAINAGE SYSTEM.

13.2.1* A water test may be applied to the system in its entirety or in sections. If applied to the entire system all openings in the piping shall be tightly closed, except the highest opening and the system filled with water to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged (except the highest opening of the section under test) and the section shall be filled with water. In testing successive sections at least the upper 3 meters (10 ft.) of the next preceding section shall be retested, so that no joint or pipe in the building (except the upper most 3 meters

(or 10 ft.) of the system) shall have been subjected to less than 3 meters (or 10 ft.) head of water. The water level shall remain constant without any further addition for sufficient time to inspect the entire section under test but in no case less than 15 minutes.

13.2.2* In place of the water test, an air test may be applied as follows: With all openings tightly closed, air shall be forced into the system until there is a uniform gage pressure of about 5 psi on the entire system or section under test. This pressure shall be held without the introduction of additional air for a period of at least 15 minutes.

13.3 FINAL TEST.

13.3.1* After all fixtures have been permanently connected and all trap seals filled with water, a smoke or a peppermint test under a pressure of approximately 1-inch water column shall be applied to the sanitary system. When the smoke appears at stack openings on the roof they shall be closed and a pressure equivalent to 1-inch water column shall be maintained for at least 15 minutes.

13.4 TEST OF WATER SUPPLY SYSTEM.

13.4.1 The water supply system shall be tested and proved tight under a water pressure not less than the working pressure which it is to be used. The water used for test shall be obtained from the normal source of supply.

13.5 TEST OF LEADER PIPES.

13.5.1 Leader pipes and branches within a building shall be tested by water or air (as in para 13.2)

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PART B .

E X P L A N A T O R Y N O T E S

2.1 Grade of Horizontal Drainage Piping: "To be self cleansing, house drains should have such inclination as will produce a minimum velocity of 3 ft. per second" states E.H. Blake of London in his "Drainage and sanitation" published in 1942. American Authorities recommend a minimum velocity of 2 ft./sec. As a matter of fact, the depth of the sewer into which the house drain is to be branched, is the controlling factor in determining the inclination, and in the erection of new property, the level of the lowest point from which water or sewage has to be conveyed should be so adjusted to the level of the sewer as to allow an inclination that will produce a self-cleaning velocity in the drain throughout its length. On the other hand it should be pointed out that too steep a gradient is almost as bad as one which is too flat as there would then be an insufficient depth of sewage to keep solid matters floating.

The question of gradient should be greatly emphasized to our local plumbers who invariably install their horizontal piping with grades of 1, 2 or 3% as the case may be, and are always inclined to believe that the greater the slope the more reliable the system would be. The plumbing code of the city of New York and Vicinity of 1949, specifies a minimum slope of $\frac{1}{8}$" per foot. The American Standard Plumbing code of 1949 specifies a minimum fall of $\frac{1}{4}$" per foot for pipes of 3 inches diameter and smaller, and a fall of not less than $\frac{1}{8}$" per foot for horizontal pipes larger than 3 inches diameter. It is also stated in the American Standard Plumbing Code that when conditions do not allow a slope as great as specified above, the slope is computed for a minimum velocity of 2 ft./sec. using Manning's formula based on a value of n equal to 0.013.

That is : $V = \frac{1.49}{n} \sqrt[3]{m^2} \cdot \sqrt{S}$

where m = H.M.D. $= \frac{\text{Wetted area}}{\text{Wetted perimeter}}$

However, in order to insure a minimum velocity of 2 fps when the pipe is flowing say between one quarter and one fifth of its total capacity and equivalent velocity of $2\frac{1}{2}$ fps will be taken as a basis; that is when the pipe is full or half-full. This velocity ($2\frac{1}{2}$ fps) is established by calculations based on Manning's formula with S constant; that is $V = K \sqrt[3]{m^2}$. Thus combining this assumed self cleaning velocity with Manning's formula and substituting a value of 0.013 for n, we get:

$$2.5 = \frac{1.49}{0.013} \sqrt[3]{(d/48)^2} \cdot \sqrt{S}$$

where S is the required slope

& d the diameter of pipe in inches

Therefore $S = \frac{8}{d4/3}$ %

In general British Plumbing authorities recommend the use of Manning's formula for finding the slope of horizontal piping although all British Building Byelaws only specify that horizontal piping should be laid at a proper inclination.

Some British Plumbers apply a simple rule known as Maguire's Rule for obtaining the most suitable gradient for drains of different diameters. It is that the gradient shall equal one inch per diameter in inches x 10. Thus a 4" drain should have a fall of one in forty, 6 inch, one in sixty. Since, however, it is seldom that these ideal gradients are suitable to the available fall of the land, any gradient between twice and one-half the gradient according to Maguire's Rule is considered suitable.

Refering to the text of the specifications under this article it would be observed that a slope of 2% is approximately equivalent to a drop of $\frac{1}{4}$ inch per foot, and a slope of 1% is also approximately equivalent to a drop of $\frac{1}{8}$ inches per foot. that is, those specifications correspond to these established by the American

Society of Mechanical Engineers in the American Standard Plumbing Code of 1949. The formula $S = \frac{8}{d^{4/3}}$ % is based on the above derivation.

2.2. In the case of any leakage that might occur in a drainage system coupled with the untightness of the water service pipe there will be danger of the possible contamination of water in the service pipe if both systems are layed in one and the same trench. This article appears only in the American Standard Plumbing Code although water pipes are always expected to be laid in seperate trenches. However, due to expenses involved in making the proper backfill this article is not liable to be misused.

2.4. The use of double hubs is restricted by American Codes is due to the fact that in their use a rough end of pipe is always exposed, which is in danger of catching and holding rags, paper, etc., and also for the reason that they make an increased number of joints. The use of T's and sanitary T's is restricted in order that the freest and smoothest possible passage may be secured for the house sewage, thus giving better scouring action in the pipes of the drainage system with less danger of stoppage.

2.5.1. The protection of materials from breakage and corrosion is a general requirement of all plumbing codes. British Building Byelaws specify that pipes in such localities as mentioned in para 2.5.1 be surrounded with concrete not less than 6 inches thick.

2.5.2. The protection of materials against freezing is neglected in our country and as a result the pipes usually crack particularly in cold mountainous regions.

3.1. Quality of Materials: The freedom of materials from defects is a requirement of all codes governing plumbing installations. Some of the American Codes (such as the American Standard Plumbing Code - A.S.M.E.1949)

generally prohibit the use of second hand materials. It is also required by American Codes that all materials such as pipes, fittings, traps, fixtures and devices used in any plumbing or drainage system, be labled or marked with the weight or quality and the makers mark or name. This provision for identification of materials is required by American Standards.

3.2.1. Cast iron Pipe used in this country is very light in weight that is, it does not have enough thickness to compensate for its brittleness. The weights of cast iron pipe as recommended by the American Society for Testing Materials are actually moderate.
The following table is just intended for comparison:

Weight in Pounds per 5 feet

Size	B.S.S.	A.S.T.M.	Available in Beirut
3"	....	47.5	33
4"	87	65	41
5"	103	85	62
6"	225	100	..

3.2.2. - 3.2.3. The American Society for Testing Materials and British Standard specifications recommend practically the same thickness of wrought iron or steel pipe.
A check on the quality and weights of wrought iron and steel pipe available in our local market indicates its compliance to the B.S.S. and A.S.T.M. standard.
On sheet 51 is appended a list showing some characteristics of steel pipe found locally at most Plumbing Material's stores. The prices (as at 2-4-52) are also given just for comparison of galvanized pipe to black pipe.

Size Inch	Int.Diameter mm.	Thickness mm.	* Weight Kg/m.	Price PL/M Galv.	Black
3/8	12,25	2.25	0.810	145	110
1/2	15.75	2.75	1.27o	158	120
3/4	21.25	2.75	1.660	185	140
1	27.00	3.25	2.460	275	180
1 1/4	35.75	3.25	3.200	390	260
1 1/2	41.25	3.50	3.950	500	360
2	52.50	3.75	5.330	700	480
2 1/4	85.5o	3.75	5.93o	...	...
2 1/2	68.oo	3.75	6.870	1300	725
3	80.25	4.00	8.590	1800	950
3 1/2	92.50	4.25	10.400	....	...
4	105.00	4.25	12.000	2100	1400
4 1/2	118.00	4.25	13.40	....	....

* Weight in pounds per foot = weight in Kg. per meter x 2.2/3.28

The weights of the above sizes of steel pipe comply definitely to the recommended weights set by the B.S.S. or A.S.T.M. specifications.

3.2.4. Lead pipe is greatly recommended for use by many conservative plumbers as in fact it has some advantages over iron pipe. Lead pipe does not produce rust and is not seriously affected by the various common acids. Being soft, it yields under expansion or other strain, and also does not burst or break so easily. However, there are some objections to the use of lead pipe; being soft, it sags more easily than iron pipe, thus forming traps. ~~and when used for supply purposes some waters will take up the lead, making the water dangerous for household use.~~

The tables for the weights of lead pipe in paras.3.2.41. - 3.2.4.3. have been recommended by Whipples Report 1932 and are followed by most American Codes, in connection with ordinary pressure of about 100 psi.

The British are more economical in the use of lead pipe and in fact the British Standard specifications of 1940 generally prohibited

the use of lead in plumbing installations.

3.2.5. Brass supply pipe does not rust or corrode, and impurities in the water seldom combine with the brass sufficiently to endanger the supply for drinking purposes.

3.2.6. Copper pipe is very expensive and is not found in local markets. In the circumstances some other material has to be substituted for copper.

4.1. Supports for vertical piping are required to keep the pipe in alignment and carry the weight of the pipe and contents. The plumbing code of the city of New York and Vicinity specifies a maximum interval of 25 ft. for the spacing of supports. Other codes contain no particular specifications.

4.2. To keep horizontal piping in alignment and to prevent sagging all modern plumbing codes specify a maximum interval of 10 ft. for the spacing of supports.

4.3. In order to resist the weight of the pipe and contents, all hangers should be of heavy pattern metal and adequately fixed to the building construction to which ultimately the load is transmitted.

4.4. This item is specified by all plumbing codes just for the prevention of undue stress on the pipe and joints.

6.2.5 Air Gaps: Following is an extract from Federal Specification which gives accepted standard of air gaps for overrim water supplies:-

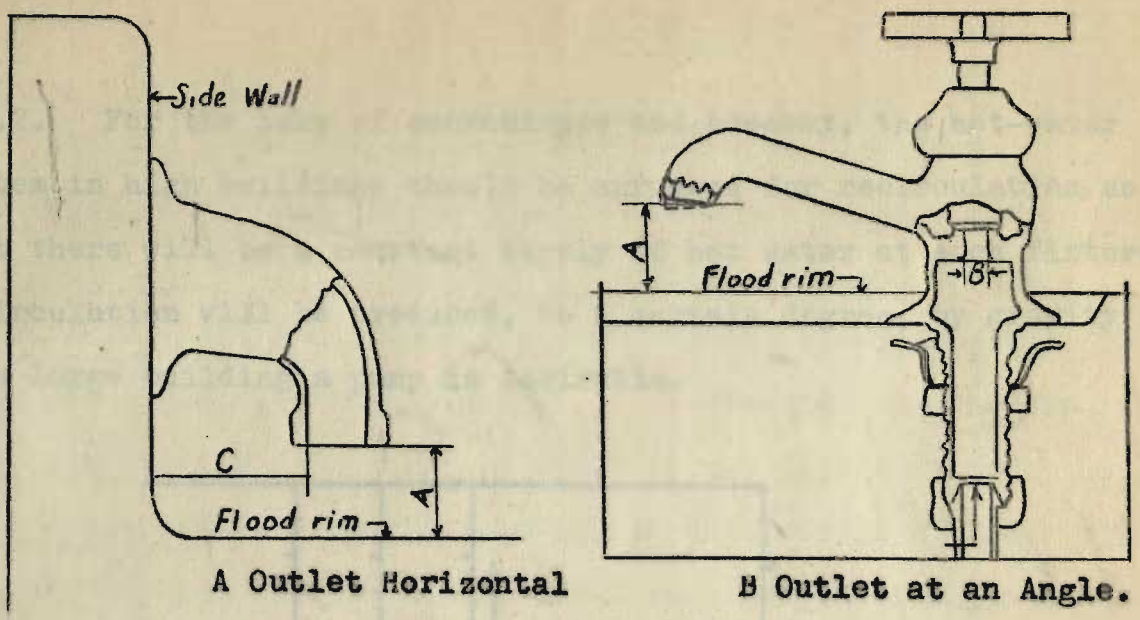
"Fixtures with faucets or other supply fittings properly assembled shall provide between the level of all supply openings and the water level at point of unrestricted external overflow a mean vertical distance or air gap as specified in the following table:-

Fixture and Fitting (1)	Minimum Air Gap For Ordinary Conditions (2)	Minimum Air Gap For Spout Near Wall (3)
	Inches	Inches
Lavatory supplies with effective opening not greater than ½ inch	1.00	1.50
Sink, Laundry tray and bath fancets with effective opening not greater than ¾ inch	1.50	2.25
Overrim bath fillers with effective opening not greater than 1 inch	2.00	3.00
Any fitting with effective opening greater than 1 inch	(a)	(b)
Drinking-fountain nozzles	0.75	-

(a) 2 x effective opening
(b) 3 x effective opening

N.B.: 1. Spout Near Wall: If any vertical wall extending to or above the horizontal plane of the spout opening is closer to the nearest inside wall of the spout opening than four times the diameter of the effective opening, the air gap shall be as specified above for spout near wall, column 3.

2. Spout Set at an Angle: Should the plane of the end of the spout be at an angle to the surface of the water, the mean gap is to be taken as the basis for measurement, except for drinking-fountain nozzles, in which case the gap to the lowest point of the nozzle opening shall be taken."



A Outlet Horizontal B Outlet at an Angle.

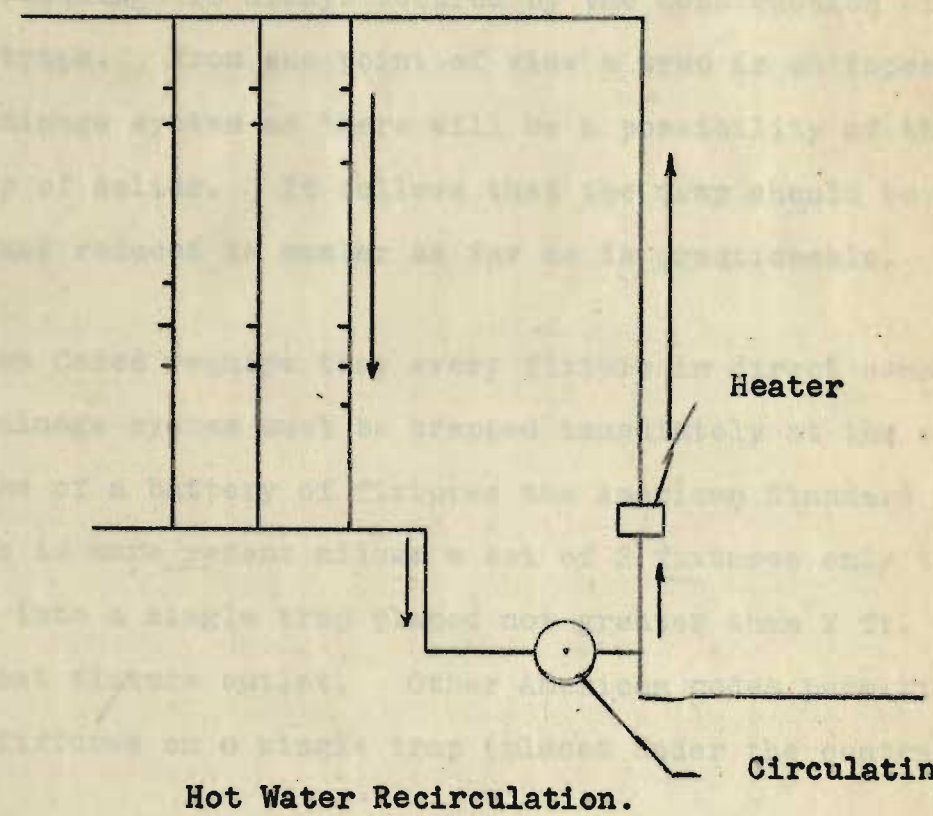
"Illustration Of Air Gap

Copied From Federal Specifications.

6.3. All materials for water piping listed in this paragraph are recommended by British and American Codes. However, there are a few considerations to be made before deciding on a certain material. Cast iron is used for exceptionally large supplies for factories. Lead pipe could always be successfully used except in places where water has a corrosive action on lead. In this case galvanized wrought iron or steel may be used. On the other hand some waters corrode iron pipe but do not affect galvanized iron.

6.4. Economy of cost of water services depends on selection of routes of pipes giving the shortest lengths possible, and on the proper sizing of pipes. The minimum possible length of pipe can be found by experimenting with different layouts to determine the best scheme. On the other hand, the determination of economic size of pipe throughout a system is generally too complicated and practically pipes are sized so as to be only approximately of economic diameter.

6.7.2. For the sake of convenience and economy, the hot-water system in high buildings should be arranged for recirculation so that there will be a constant supply of hot water at each fixture. Recirculation will be produced, to a certain degree, by gravity but in a large building a pump is desirable.



Hot Water Recirculation.

6.7.3. The relief valve will be necessary for relieving any pressure caused by the expansion of water in the hot-water tank.

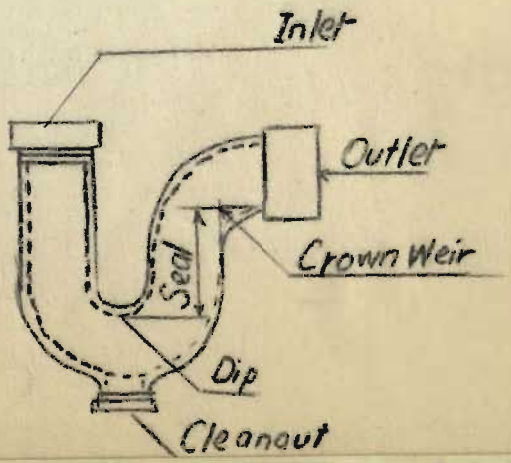
6.8.1. Copper service pipe should not deliver into galvanized-iron cisterns because copper dissolved from the pipe tends to be deposited in minute particles on the zinc where it sets up pin points of corrosion

7.1.1. The general principles of the design of plumbing systems on which all codes are based depend on two main factors: (1) The requirement that drains shall be designed as effectively to carry organic solids suspended in liquid waste; and (2) the requirement that foul gases from the sewers and drains shall be prevented from entering buildings. Prevention of sewer gas from entering buildings is always secured by the construction of water seals or traps. From one point of view a trap is an imperfection of the drainage system as there will be a possibility of the holding up of solids. It follows that the trap should be well designed and reduced in number as far as is practiceable.

All British Codes require that every fixture in direct connection with a drainage system must be trapped immediately at the outlet. In the case of a battery of fixtures the American Standard Plumbing Code which is more recent allows a set of 2 fixtures only to discharge into a single trap placed not greater than 2 ft. from the farthest fixture outlet. Other American codes permitted the use of 3 fixtures on a single trap (placed under the central fixture).

7.2. The table giving the size of traps and fixture drains for different fixtures is practically the same in all American codes.

7.3. British Authorities recommend a water seal of $1\frac{1}{2}$" - $2\frac{1}{2}$", as they believe that a deeper water seal would cause the trap to become foul because the flushing action of the water sent through the trap is not sufficient or powerful enough to clean it. All American Codes agree on a minimum trap seal of 2 inches and a maximum of 4 inches. These restrictions are based on experimental investigations.



7.4.3. The trouble that arises from double trapping is that the space between the two trap seals will become air bound and thus cause a slow passage of the waste, under which condition the stoppage of the waste is much more likely to take place.

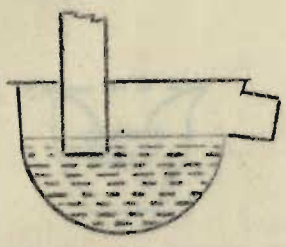
7.4.4. It is better to connect the vent several inches away from the crown, in order to reduce the rate of evaporation of the trap seal, and to make the stoppage of the vent less possible.

7.5.1. The installation of a cleanout at each change of direction of horizontal run is a requirement of the Plumbing Code of New York and Vicinity (1948). Other codes only require a cleanout when such change in direction is greater than 45 degrees.

8.1. Most of the plumbing fixtures installed in the Near East are imported from abroad. These represent the best qualities of fixtures. However, locally manufactured vitrified earthenware fixtures are not yet widely used except by third class dwellings where fixtures cannot be easily kept clean due to the lack of a perfectly smoothed surface.

8.4. Dry closets, chemical closets and frost-proof closets were prohibited only by the American Standard Plumbing Code (1949). Previously established codes permitted the installation of frost-proof closets only in compartments which have no direct access to a building used for human habitaion or occupancy.

7.4.2 Forms of Traps Prohibited.

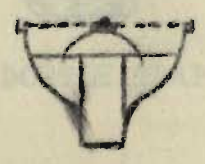


D - TRAP.

A very undesirable form, full of angles and corners in which dirt and filth can collect, and holds too much water with but a poor seal.

LIP - TRAPS.

These present lack of self cleansing power, inaccessibility with angles and cavities.



BELL TRAP

The defects of such a trap are:-

1) The perforated bell cover is easily removed thus breaking the water seal of the trap.

2) The water contained in the shallow cup is quickly evaporated

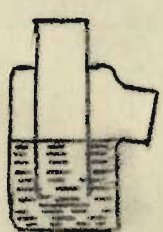
3) The bell being only rivetted to the perforated plate is often lost through being broken off, thus sewer gas can pass freely into the rooms.

JENNING'S BELL TRAP

The shallowness of the water seal is such that the water is soon evaporated and the seal of the trap broken.

BALL TRAP

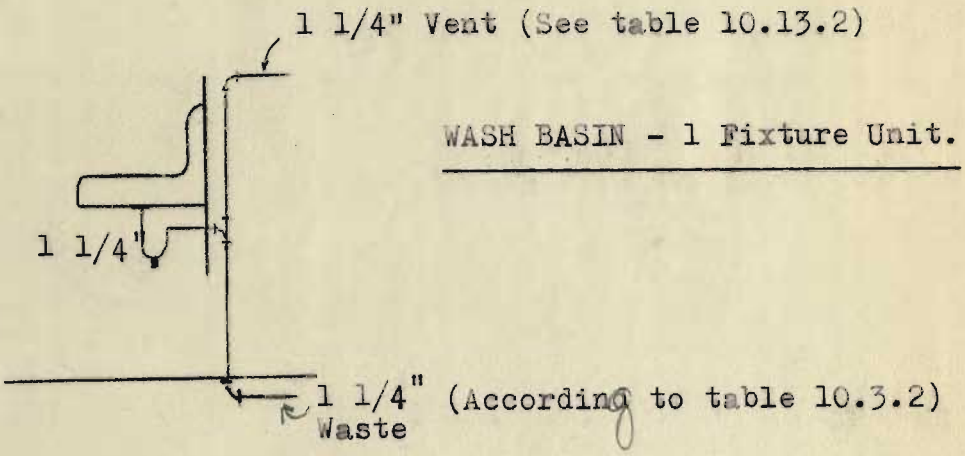
Very complicated.
The ball usually made of rubber is intended to supplement the small water seal.

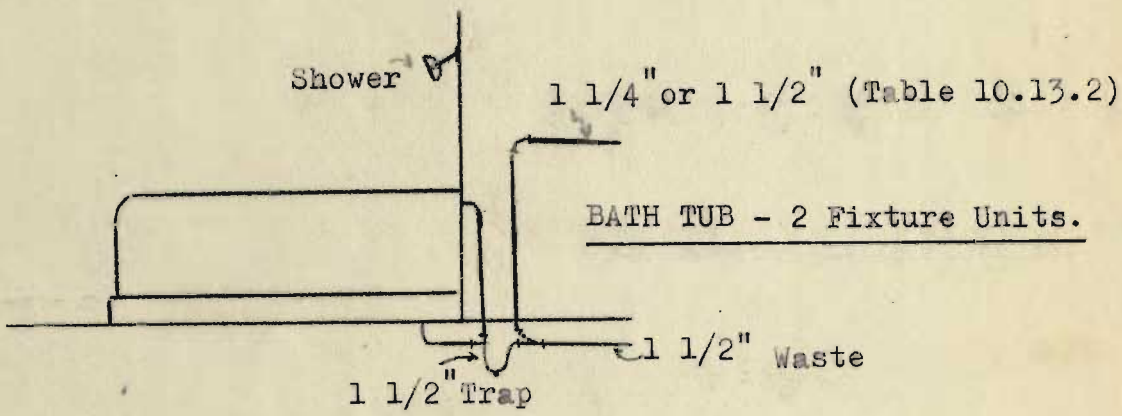


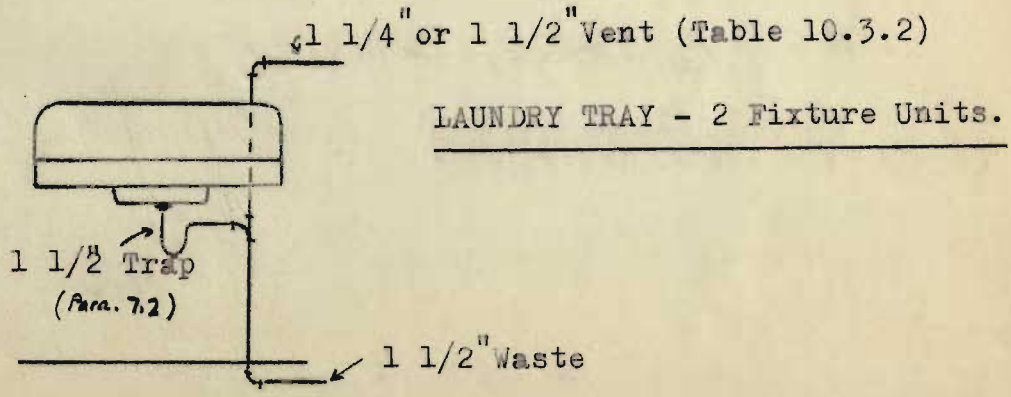
BOTTLE TRAP

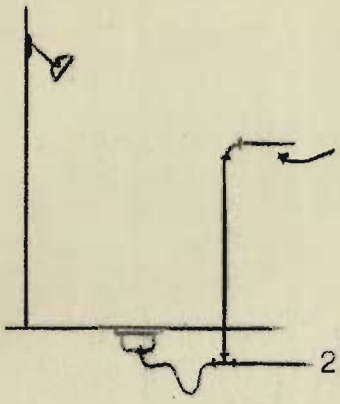
Open to serious objections unless its interior is accessible.

10.2.1 :-


1 1/4" Vent (See table 10.13.2)
WASH BASIN - 1 Fixture Unit.
1 1/4"
1 1/4" (According to table 10.3.2)
Waste


Shower
1 1/4" or 1 1/2" (Table 10.13.2)
BATH TUB - 2 Fixture Units.
1 1/2" Waste
1 1/2" Trap

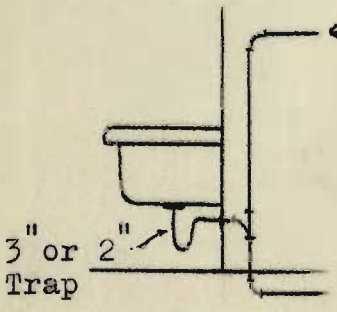

1 1/4" or 1 1/2" Vent (Table 10.3.2)
LAUNDRY TRAY - 2 Fixture Units.
1 1/2" Trap
(Para. 7.2)
1 1/2" Waste



1 1/2" Vent (See para. 10.13.2)

SHOWER - 2 Fixture Units.

2" Trap & Waste.

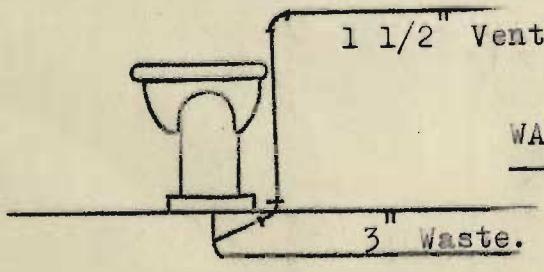


1 1/2" Vent (See para. 10.13.2)

SLOP SINK - 3 Fixture Units.

3" or 2" Trap

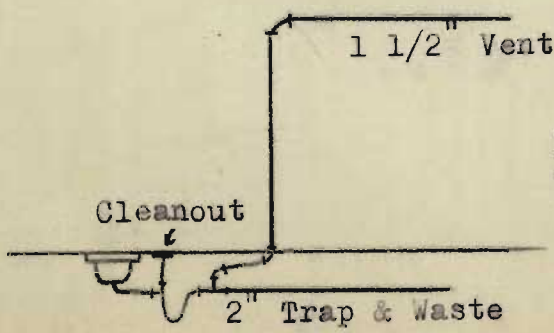
3" or 2" Waste



1 1/2" Vent (See para 10.13.2)

WATER CLOSET - 6 Fixture Units.

3" Waste.

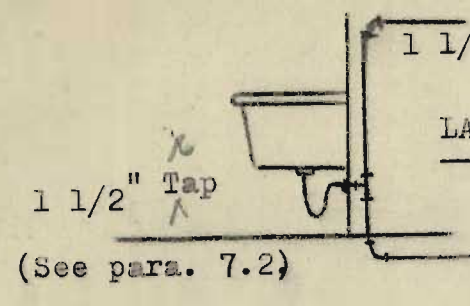


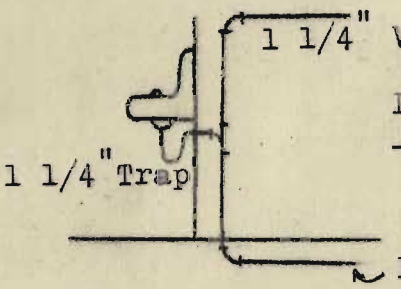
1 1/2" Vent

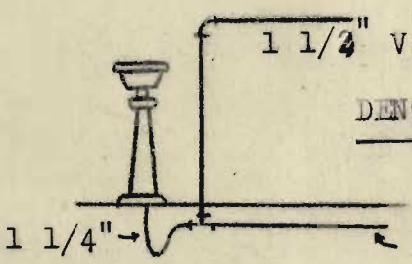
FLOOR DRAIN - 2 Fixture Units.

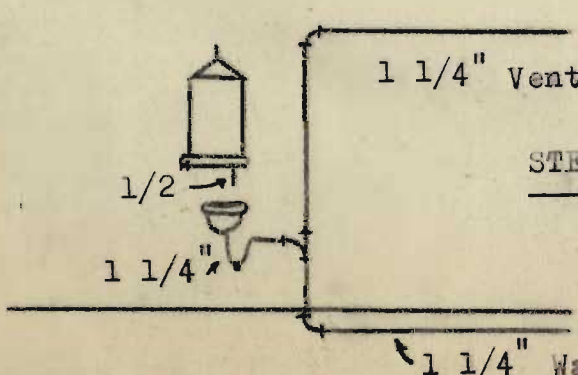
Cleanout

2" Trap & Waste


1 1/2" Vent (See Para 10.13.2)
LAUNDRY TRAYS - 2 Fixture Units.
1 1/2" Tap
(See para. 7.2)
1 1/2" Waste.


1 1/4" Vent (See para 10.13.2)
DRINKING FOUNTAIN - 1/2 Fixture Unit.
1 1/4" Trap
1 1/4" Waste.


1 1/2" Vent. (See para. 10.13.2)
DENTAL CUSPIDOR - 1/2 Fixture Unit.
1 1/4"
1 1/4" Waste.


1 1/4" Vent (See para. 10.13.2)
STERILIZER - 1/2 Fixture Unit.
1/2
1 1/4"
1 1/4" Waste.

10.2.2 One fixture unit is taken as approximately equivalent to one cubic foot per minute.

10.3.2 All Modern American Plumbing Codes recommend a minimum water closet stack of 3" diameter. British Bye-laws and obsolete American Codes require at least a 4" stack.

10.4.1 The connection of waste pipes from other fixtures into the lead bend of a water closet is a very poor practice. The reason is that a stoppage of the lead bend would also mean that the other fixtures would be thrown out of use. There is danger also that in wiping pipes onto the lead bend, solder will run through and present opportunity for the collection of paper etc., also that paper and other refuse will lodge in the entrance of the waste pipe and cause obstruction.

10.5.1 According to the present Lebanese Building Code an extension of 2 meters (for stacks) is required. American codes are not so strict, however, the required extension is only 5 feet; an extension of 160 cms will be fairly satisfactory.

10.5.2 The American Standard Plumbing Code specifies a minimum pipe diameter of 3"; all other codes specify a minimum of 4". In this country, especially in the mountainous regions, the possibility of frost closure is very likely to occur.

10.6 - 10.12 Following are a set of notes and illustrations covering the subject of venting for drainage piping. It is first attempted in this connection to define all terms which so far have not been met.

Definitions:-

Individual vent: An individual vent (sometimes referred to as a back vent) is a pipe installed to vent a trap, soil or waste pipe under or back of the fixtures it serves and connected to a point above the fixture to the general vent system.

Branch Vent: A branch vent is a vent connecting one or more individual vents with a vent stack or stack vent.

Circuit Vent: A circuit vent is a branch vent that functions for two or more traps and extends from in front of the last fixture connection of a horizontal branch to the vent stack.

Dual Vent: A dual vent is a vent connecting at the junction of two fixture drains and serving as an individual vent for both fixtures.

Loop Vent: A loop vent is the same as the circuit vent except that it loops back and connects with a soil or waste stack vent instead of the vent stack.

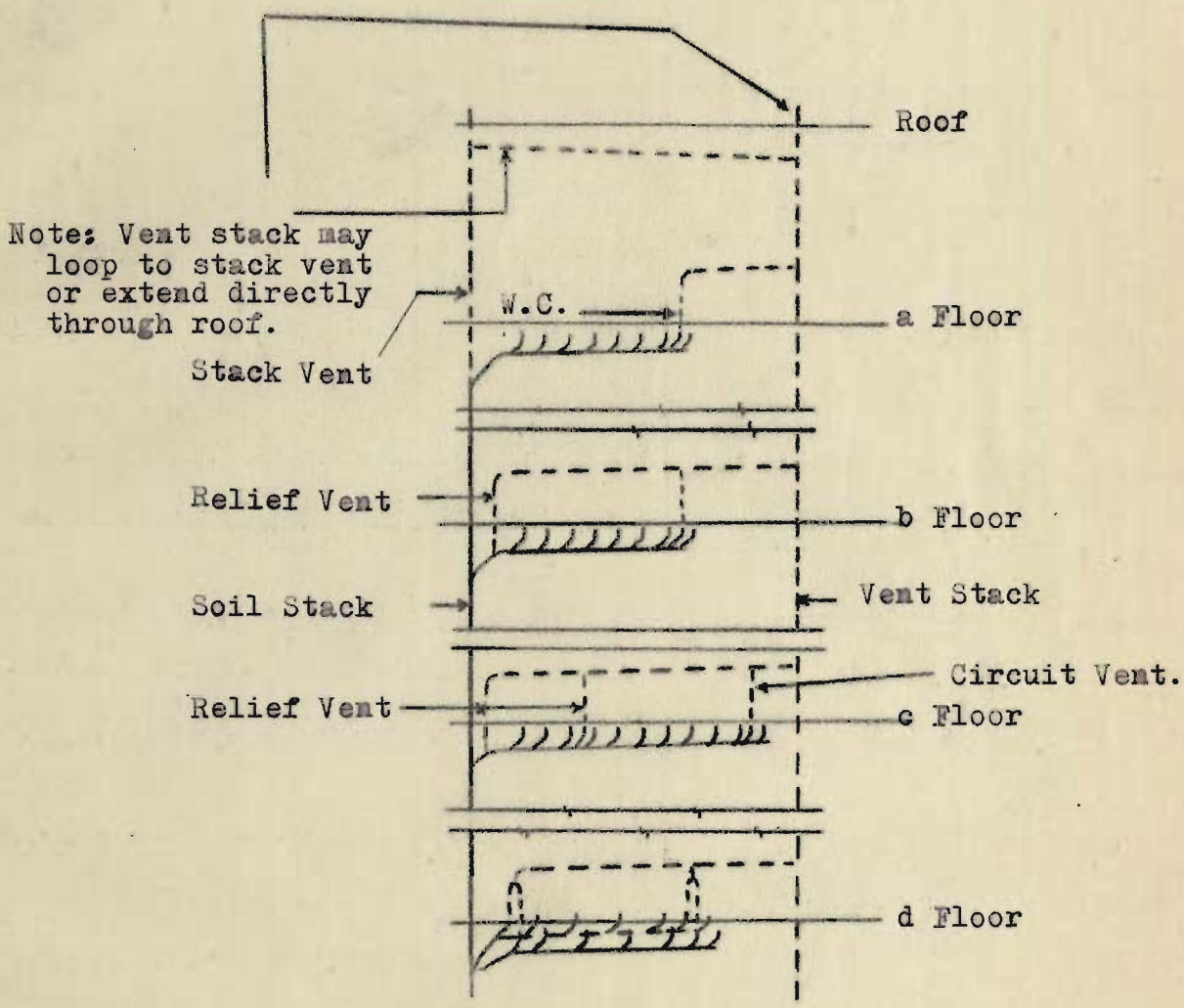
Relief Vent: A relief vent is a branch from the vent stack connected to a horizontal branch between the first fixture drain and the soil or waste stack, whose primary function is to provide for circulation of air between the vent stack and the soil or waste stack.

Stack Vent: A stack vent is the extension of a soil or waste stack above the highest horizontal branch connected to the stack.

Wet vent: Is a soil or waste pipe that serves also as a vent.

Yoke Vent: A yoke vent is a pipe connecting upward from a soil or waste stack to a vent stack for the purpose of preventing pressure changes in the stacks.

10.6.4 Old American codes fix a maximum distance of vent from trap seal of 5 feet. Based on more recent research Federal Specifications allow a distance (2 to 48 diameters) which would be above the maximum as specified by the other codes; i.e. for a pipe of 1 1/4" diameter the maximum distance equals 48 x 1 1/4 / 12 = 5 feet; and for larger pipes will be greater; max. = 48 d as shown in para. 10.6.4 Part A.

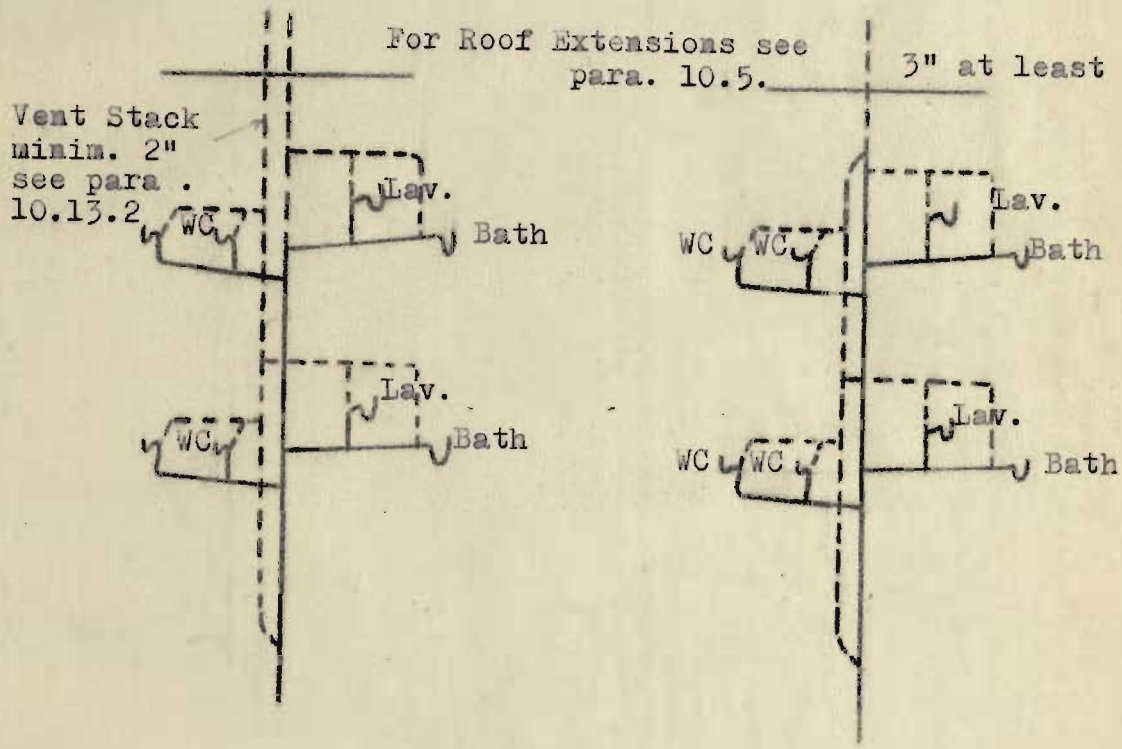


a. Top Floor without relief.

b. Intermediate floor with one relief vent.

c. Intermediate lower floor with two relief Vents.

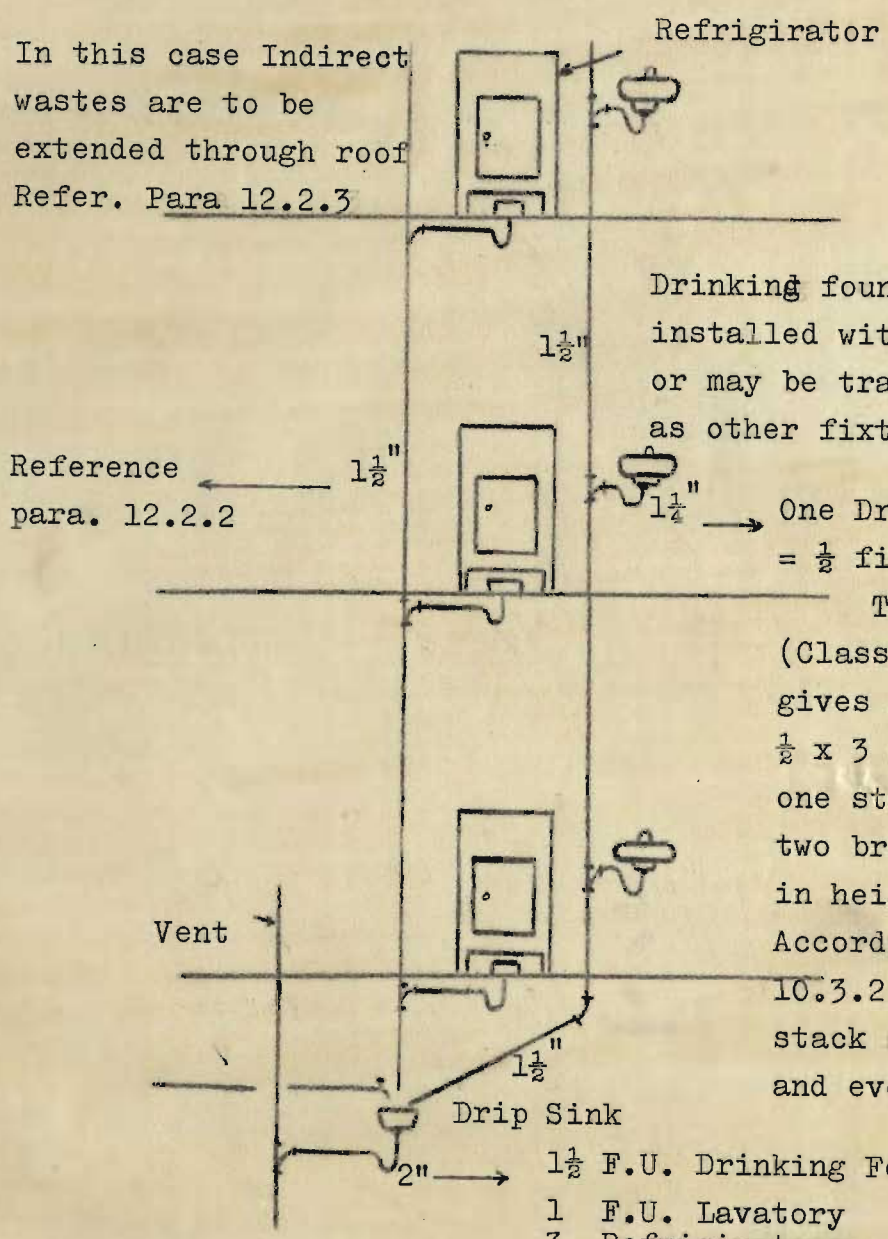
d. Intermediate or lower floor for double line of fixtures.



One Pipe System of Sanitation.

INDIRECT WASTES

Refrigirators and Drinking Fountains.



13.1. The purpose of testing the plumbing system is for revealing defects in materials and workmanship, and wrong connections. Two general tests are applied to the system. The first test (usually called the roughing test) is made when the roughing has been completed, and the final test, made when the fixtures have been placed in position and the system made entirely ready for use. It would be interesting to note that both British and American Authorities follow generally the same tests.

13.2 The plumbing system is made ready for the roughing test thus: After the roughing is complete, all waste and vent openings are capped, plugged or soldered tight with the exception of one opening through which the water or air to be used in the test is to be admitted.

13.2.1 Some American Authorities * argue that the water-test is an unfair one as it puts a greater strain on the lowermost end of the drainthan it does on the uppermost. This argument is unsound, as that is the real advantage of the water test. Almost any drain may become blocked, and if it does so at or near the lowest point, the water test will be at once applied naturally, the only difference being that the water in this case will be foul, with consequent danger in case of leakage.

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* This argument is found in "Drainage & Venting" by R.M.Starbuck.

13.2.2. Again it is argued that the air test has an advantage over the water test in that all parts of the system are tested under the same pressure, but that, as already pointed out, does not indicate what happens if a drain become blocked at its lowest point.

13.3.1 The smoke test can be used for pipes below as well as those above ground, but it is not a satisfactory test for underground drains. In the case of defects above ground the smoke is readily visible, apart from the smell, and in the case of a defective drain having only a shallow covering of porous soil the smoke will readily issue at the ground. With a considerable depth of earth over the pipes, or earth of a dense dam nature, however, the smoke will not find its way through. In order to detect such a smoke a rod of iron could be used forcing it down into the soil at frequent intervals along the course of the drain, so as to leave holes for the smoke to rise.

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