

# CHAPTER 11

## STORM DRAINAGE

### 1101.0 General.

**1101.1 Where Required.** All roofs, paved areas, yards, courts, and courtyards shall be drained into a separate storm sewer system, or into a combined sewer system where a separate storm sewer system is not available, or to some other place of disposal satisfactory to the Authority Having Jurisdiction. In the case of one- and two-family dwellings, storm water may be discharged on flat areas such as streets or lawns so long as the storm water shall flow away from the building and away from adjoining property, and shall not create a nuisance.

**1101.2 Storm Water Drainage to Sanitary Sewer Prohibited.** Storm water shall not be drained into sewers intended for sanitary drainage only.

**1101.3 Material Uses.** Rainwater piping placed within the interior of a building or run within a vent or shaft shall be of cast iron, galvanized steel, wrought iron, brass, copper, lead, Schedule 40 ABS DWV, Schedule 40 PVC DWV, stainless steel 304 or 316L (stainless steel 304 pipe and fittings shall not be installed underground and shall be kept at least six inches (152 mm) aboveground), or other approved materials, and changes in direction shall conform to the requirements of Section 706.0. ABS and PVC DWV piping installations shall be installed in accordance with IS 5, IS 9, and Chapter 15 "Firestop Protection." Except for individual single-family dwelling units, materials exposed within ducts or plenums shall have a flame-spread index of not more than 25 and a smoke-developed index of not more than 50, when tested in accordance with the Test for Surface-Burning Characteristics of the Building Materials (see the Building Code standards based on ASTM E-84 and ANSI/UL 723.).

**1101.4 Expansion Joints Required.** Expansion joints or sleeves shall be provided where warranted by temperature variations or physical conditions.

### 1101.5 Subsoil Drains.

**1101.5.1** Subsoil drains shall be provided around the perimeter of buildings having basements, cellars, or crawl spaces or floors below grade. Such subsoil drains may be positioned inside or outside of the footing, shall be of perforated or open-jointed approved drain tile or pipe not less than three (3) inches (80 mm) in diameter, and shall be laid in gravel, slag, crushed rock, approved three-quarter (3/4) inch (19.1 mm) crushed recycled glass aggregate, or other approved porous material with a minimum of

four (4) inches (102 mm) surrounding the pipe on all sides. Filter media shall be provided for exterior subsoil piping.

**1101.5.2** Subsoil drains shall be piped to a storm drain, to an approved water course, to the front street curb or gutter, or to an alley, or the discharge from the subsoil drains shall be conveyed to the alley by a concrete gutter. Where a continuously flowing spring or groundwater is encountered, subsoil drains shall be piped to a storm drain or an approved water course.

**1101.5.3** Where it is not possible to convey the drainage by gravity, subsoil drains shall discharge to an accessible sump provided with an approved automatic electric pump. The sump shall be at least fifteen (15) inches (375 mm) in diameter, eighteen (18) inches (457 mm) in depth, and provided with a fitted cover. The sump pump shall have an adequate capacity to discharge all water coming into the sump as it accumulates to the required discharge point, and the capacity of the pump shall not be less than fifteen (15) gpm (1.0 L/s). The discharge piping from the sump pump shall be a minimum of one and one-half (1-1/2) inches (40 mm) in diameter and have a union or other approved quick-disconnect assembly to make the pump accessible for servicing.

**1101.5.4** For separate dwellings not serving continuously flowing springs or groundwater, the sump discharge pipe may discharge onto a concrete splash block with a minimum length of twenty-four (24) inches (610 mm). This pipe shall be within four (4) inches (102 mm) of the splash block and positioned to direct the flow parallel to the recessed line of the splash block.

**1101.5.5** Subsoil drains subject to backflow when discharging into a storm drain shall be provided with a backwater valve in the drain line so located as to be accessible for inspection and maintenance.

**1101.5.6** Nothing in Section 1101.5 shall prevent drains that serve either subsoil drains or areaways of a detached building from discharging to a properly graded open area, provided that:

- (1) They do not serve continuously flowing springs or groundwater;
- (2) The point of discharge is at least ten (10) feet (3,048mm) from any property line; and
- (3) It is impracticable to discharge such drains

to a storm drain, to an approved water course, to the front street curb or gutter, or to an alley.

**1101.6 Building Subdrains.** Building subdrains located below the public sewer level shall discharge into a sump or receiving tank, the contents of which shall be automatically lifted and discharged into the drainage system as required for building sumps.

**1101.7 Areaway Drains.** All open subsurface space adjacent to a building, serving as an entrance to the basement or cellar of a building, shall be provided with a drain or drains. Such areaway drains shall be two (2) inches (50 mm) minimum diameter for areaways not exceeding one hundred (100) square feet (9.3 m<sup>2</sup>) in area, and shall be discharged in the manner provided for subsoil drains not serving continuously flowing springs or groundwater (see Section 1101.5.2). Areaways in excess of one hundred (100) square feet (9.3 m<sup>2</sup>) shall not drain into subsoil. Areaway drains for areaways exceeding one hundred (100) square feet (9.3 m<sup>2</sup>) shall be sized according to Table 11-2.

**1101.8 Window Areaway Drains.** Window areaways not exceeding ten (10) square feet (0.9 m<sup>2</sup>) in area may discharge to the subsoil drains through a two (2) inch (50 mm) pipe. However, window areaways exceeding ten (10) square feet (0.9 m<sup>2</sup>) in area shall be handled in the manner provided for entrance areaways (see Section 1101.7).

**1101.9 Filling Stations and Motor Vehicle Washing Establishments.** Public filling stations and motor vehicle washing establishments shall have the paved area sloped toward sumps or gratings within the property lines. Curbs not less than six (6) inches (152 mm) high shall be placed where required to direct water to gratings or sumps.

**1101.10 Paved Areas.** Where the occupant creates surface water drainage, the sumps, gratings, or floor drains shall be piped to a storm drain or an approved water course.

**1101.11 Roof Drainage.**

**1101.11.1 Primary Roof Drainage.** Roof areas of a building shall be drained by roof drains or gutters. The location and sizing of drains and gutters shall be coordinated with the structural design and pitch of the roof. Unless otherwise required by the Authority Having Jurisdiction, roof drains, gutters, vertical conductors or leaders, and horizontal storm drains for primary drainage shall be sized based on a storm of sixty (60) minutes duration and 100-year return period. Refer to Table D-1 (in Appendix D) for 100-year, 60-minute storms at various locations.

**1101.11.2 Secondary drainage.** Secondary

(emergency) roof drainage shall be provided by one of the methods specified in Section 1101.11.2.1 or 1101.11.2.2.

**1101.11.2.1 Roof Scuppers or Open Side.**

Secondary roof drainage shall be provided by an open-sided roof or scuppers where the roof perimeter construction extends above the roof in such a manner that water will be entrapped. An open-sided roof or scuppers shall be sized to prevent the depth of ponding water from exceeding that for which the roof was designed as determined by Section 1101.11.1. Scupper openings shall be a minimum of 4" high and have a width equal to the circumference of the roof drain required for the area served, sized by Table 11-1.

**1101.11.2.2 Secondary Roof Drain.**

Secondary roof drains shall be provided. The secondary roof drains shall be located a minimum of 2 inches above the roof surface. The maximum height of the roof drains shall be a height to prevent the depth of ponding water from exceeding that for which the roof was designed as determined by Section 1101.11.1. The secondary roof drains shall connect to a piping system conforming to Section 1101.11.2.2.1 or 1101.11.2.2.2.

**1101.11.2.2.1 Separate Piping System.**

The secondary roof drainage system shall be a separate system of piping, independent of the primary roof drainage system. The discharge shall be above grade, in a location observable by the building occupants or maintenance personnel. Secondary roof drain systems shall be sized in accordance with Section 1101.11.1 based on the rainfall rate for which the primary system is sized.

**1101.11.2.2.2 Combined System.**

The secondary roof drains shall connect to the vertical piping of the primary storm drainage conductor downstream of any horizontal offset below the roof. The primary storm drainage system shall connect to the building storm water that connects to an underground public storm sewer. The combined secondary and primary roof drain systems shall be sized in accordance with Section 1106.0 based on double the rainfall rate for the local area.

**1101.12 Cleanouts.**

**1101.12.1 Cleanouts for building storm**

drains shall comply with the requirements of Section 719.0 of this code.

**1101.12.2** Rain leaders and conductors connected to a building storm sewer shall have a cleanout installed at the base of the outside leader or outside conductor before it connects to the horizontal drain.

**1101.13** All rainwater sumps serving “public use” occupancy buildings shall be provided with dual pumps arranged to function alternately in case of overload or mechanical failure.

## **1102.0 Materials.**

### **1102.1 Conductors.**

**1102.1.1** Conductors installed aboveground in buildings shall be constructed of materials specified in Table 14-1.

**1102.1.2** The inside of conductors installed above ground level shall be of seamless copper water tube, Type K, L, or M; Schedule 40 copper pipe or Schedule 40 copper alloy pipe; Type DWV copper drainage tube; service weight cast-iron soil pipe or hubless cast-iron soil pipe; standard weight galvanized steel pipe; stainless steel 304 or 316L (stainless steel 304 pipe and fittings shall not be installed underground and shall be kept at least 6 inches (152 mm) aboveground); or Schedule 40 ABS or Schedule 40 PVC plastic pipe.

### **1102.2 Leaders.**

**1102.2.1** Leaders shall be constructed of materials specified in Table 14-1.

**1102.2.2** Leaders shall be of seamless copper water tube, Type K, L, or M; Schedule 40 copper pipe; Schedule 40 copper alloy pipe; type DWV copper drainage tube; service weight cast-iron soil pipe or hubless cast-iron soil pipe; aluminum sheet metal, galvanized steel sheet metal, or copper sheet metal; standard weight galvanized steel pipe; Class DL or XL lead pipe; stainless steel 304 or 316L (stainless steel 304 pipe and fittings shall not be installed underground and shall be kept at least 6 inches (152 mm) aboveground); or Schedule 40 ABS or Schedule 40 PVC plastic pipe.

**1102.3 Underground Building Storm Drains.** All underground building storm drains shall be constructed of materials specified in Table 14-1.

**1102.4 Building Storm Sewers.** Building storm sewers shall be constructed of materials specified in Table 14-1.

## **1102.5 Subsoil Drains.**

**1102.5.1** Subsoil drains shall be constructed of materials specified in Table 14-1.

**1102.5.2** Subsoil drains shall be open-jointed or of perforated pipe, vitrified clay, plastic, cast iron, or porous concrete.

## **1103.0 Traps on Storm Drains and Leaders.**

**1103.1 Where Required.** Leaders and storm drains, when connected to a combined sewer, shall be trapped. Floor and area drains connected to a storm drain shall be trapped.

**Exception:** Traps shall not be required where roof drains, rain leaders, and other inlets are at locations allowed under Section 906.0, Vent Termination.

**1103.2 Where Not Required.** No trap shall be required for leaders or conductors that are connected to a sewer carrying storm water exclusively.

**1103.3 Trap Size.** Traps, when installed for individual conductors, shall be the same size as the horizontal drain to which they are connected.

**1103.4 Method of Installation of Combined Sewer.** Individual storm-water traps shall be installed on the storm-water drain branch serving each storm-water inlet, or a single trap shall be installed in the main storm drain just before its connection with the combined building sewer. Such traps shall be provided with an accessible cleanout on the outlet side of the trap.

## **1104.0 Leaders, Conductors, and Connections.**

**1104.1 Improper Use.** Leaders or conductors shall not be used as soil, waste, or vent pipes nor shall soil, waste, or vent pipes be used as leaders or conductors.

**1104.2 Protection of Leaders.** Leaders installed along alleyways, driveways, or other locations where they may be exposed to damage shall be protected by metal guards, recessed into the wall, or constructed from ferrous pipe.

**1104.3 Combining Storm with Sanitary Drainage.** The sanitary and storm drainage system of a building shall be entirely separate, except where a combined sewer is used, in which case the building storm drain shall be connected in the same horizontal plane through single wye fittings to the combined building sewer at least ten (10) feet (3,048 mm) downstream from any soil stack.

**1105.0 Roof Drains.**

**1105.1 Material.**

**1105.1.1** Roof drains shall be constructed of materials specified in Table 14-1.

**1105.1.2** Roof drains shall be of cast iron, copper or copper alloy, lead, or plastic.

**1105.2 Dome or Strainer for General Use.** All roof drains and overflow drains, except those draining to hanging gutters, shall be equipped with strainers extending not less than four (4) inches (102 mm) above the surface of the roof immediately adjacent to the drain. Strainers shall have a minimum inlet area above the roof level of not less than one and one-half (1-1/2) times the area of the conductor or leader to which the drain is connected.

**1105.3 Strainers for Flat Decks.** Roof drain strainers for use on sun decks, parking decks, and similar areas that are normally serviced and maintained may be of the flat surface type. Such roof drain strainers shall be level with the deck and shall have an available inlet area of no less than two (2) times the area of the conductor or leader to which the drain is connected.

**1105.4 Roof Drain Flashings.** Connection between the roof and roof drains that pass through the roof and into the interior of the building shall be made watertight by the use of proper flashing material.

**1105.4.1** Where lead flashing material is used, it shall be a minimum of four (4) pounds per square foot (19.5 kg/m<sup>2</sup>).

**1105.4.2** Where copper flashing material is used, it shall be a minimum of twelve (12) ounces per square foot (3.7 kg/m<sup>2</sup>).

**1106.0 Size of Leaders, Conductors, and Storm Drains.**

**1106.1 Vertical Conductors and Leaders.** Vertical conductors and leaders shall be sized on the basis of the maximum projected roof area and Table 11-1.

**1106.2 Size of Horizontal Storm Drains and Sewers.** The size of building storm drains or building storm sewers or any of their horizontal branches shall be based upon the maximum projected roof or paved area to be handled and Table 11-2.

**1106.3 Size of Roof Gutters.** The size of semi-circular gutters shall be based on the maximum projected roof area and Table 11-3.

**1106.4 Side Walls Draining onto a Roof.** Where vertical walls project above a roof so as to permit storm water to drain to the roof area below, the adjacent roof area may be computed from Table 11-1 as follows:

- (1) For one (1) wall – add fifty (50) percent of the wall area to the roof area figures.

- (2) For two (2) adjacent walls – add thirty-five (35) percent of the total wall areas.
- (3) Two (2) opposite walls of same height – add no additional area.
- (4) Two (2) opposite walls of differing heights– add fifty (50) percent of the wall area above the top of lower wall.
- (5) Walls on three (3) sides – add fifty (50) percent of the area of the inner wall below the top of the lowest wall, plus allowance for the area of the wall above the top of the lowest wall, per (2) and (4) above.
- (6) Walls on four (4) sides – no allowance for wall areas below the top of the lowest wall – add for areas above the top of the lowest wall per (1), (2), (4), and (5) above.

**1107.0 Values for Continuous Flow.**

Where there is a continuous or semi-continuous discharge into the building storm drain or building storm sewer, as from a pump, ejector, air-conditioning plant, or similar device, one (1) gpm (3.8 L/min.) of such discharge shall be computed as being equivalent to twenty-four (24) square feet (2.2 m<sup>2</sup>) of roof area, based upon a rate of rainfall of four (4) inches (102 mm) per hour.

**1108.0 Controlled-Flow Roof Drainage.**

**1108.1 Application.** In lieu of sizing the storm drainage system in accordance with Section 1106.0, the roof drainage may be sized on the basis of controlled flow and storage of the storm water on the roof, provided the following conditions are met:

- (1) The water from a 25-year-frequency storm shall not be stored on the roof for more than twenty-four (24) hours.
- (2) During the storm, the water depth on the roof shall not exceed the depths specified in Table 11-4.

**TABLE 11-4  
Controlled-Flow Maximum Roof Water Depth**

Roof Rise,*		Max Water Depth at Drain,	
Inches	(mm)	Inches	(mm)
Flat	(Flat)	3	(76)
2	(51)	4	(102)
4	(102)	5	(127)
6	(152)	6	(152)

\*Vertical measurement from the roof surface at the drain to the highest point of the roof surface served by the drain, ignoring any local depression immediately adjacent to the drain.

- (3) No less than two (2) drains shall be installed in roof areas of ten thousand (10,000) square feet (929.0 m<sup>2</sup>) or less, and no less than one (1) additional drain shall be installed for each ten thousand (10,000) square feet (929.0 m<sup>2</sup>) of roof area over ten thousand (10,000) square feet (929.0 m<sup>2</sup>).
- (4) Each roof drain shall have a precalibrated, fixed (nonadjustable), and proportional weir (notched) in a standing water collar inside the strainer. No mechanical devices or valves shall be allowed.
- (5) Pipe sizing shall be based on the pre-calibrated rate of flow (gpm) of the pre-calibrated weir for the maximum allowable water depth, and Tables 11-1 and 11-2.
- (6) The height of stones or other granular material above the waterproofed surface shall not be considered in water depth measurement, and the roof surface in the vicinity of the drain shall not be recessed to create a reservoir.
- (7) Roof design, where controlled-flow roof drainage is used, shall be such that the minimum design roof live load is thirty (30) pounds per square foot (146.5kg/m<sup>2</sup>) to provide a safety factor above the fifteen (15) pounds per square foot (73.2kg/m<sup>2</sup>) represented by the depth of water stored on the roof as indicated in Table 11-4.
- (8) Scuppers shall be provided in parapet walls. The distance of scupper bottoms above the roof level at the drains shall not exceed the maximum distances specified in Table 11-5.

circumference of the roof drain required for the area served, sized by Table 11-1.

- (10) Flashings shall extend above the top of the scuppers.
- (11) At any wall or parapet, forty-five (45) degree (0.79 rad) cants shall be installed.
- (12) Separate storm and sanitary drainage systems shall be provided within the building.
- (13) Calculations for the roof drainage system shall be submitted along with the plans to the Authority Having Jurisdiction for approval.

**1108.2 Setback Roofs.** Drains on setback roofs may be connected to the controlled-flow drainage systems provided:

- (1) The setback is designed for storing water, or
- (2) The square footage of the setback drainage area is converted as outlined in Section 1108.0 to gpm, and the storm-water pipe sizes in the controlled-flow system are based on the sum of the loads.
- (3) The branch from each of the roof drains that are not provided with controlled flow shall be sized in accordance with Table 11-1.

**1109.0 Testing.**

**1109.1 Testing Required.** New building storm drainage systems and parts of existing systems that have been altered, extended, or repaired shall be tested as described in Section 1109.2.1 to disclose leaks and defects.

**1109.2 Methods of Testing Storm Drainage Systems.** Except for outside leaders and perforated or open-jointed drain tile, the piping of storm drain systems shall be tested upon completion of the rough piping installation by water or air, and proved tight. The Authority Having Jurisdiction may require the removal of any cleanout plugs to ascertain whether the pressure has reached all parts of the system. Either of the following test methods shall be used:

**1109.2.1 Water Test.** After piping has been installed, the water test shall be applied to the drainage system, either to the entire system or to sections. If the test is applied to the entire system, all openings in the piping shall be tightly closed except for the highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged except for the highest opening of the section under test, and each section shall be filled with water, but no section shall be tested with less than a ten (10)

**TABLE 11-5**

**Distance of Scupper Bottoms Above Roof**

Roof Rise,*		Maximum Distance of Scupper Bottom Above Roof Level at Drains,	
		Inches	(mm)
Flat	(Flat)	3	(76.2)
2	(51)	4	(102.0)
4	(102)	5	(127.0)
6	(152)	6	(152.0)

\*Vertical measurement from the roof surface at the drain to the highest point of the roof surface served by the drain, ignoring any local depression immediately adjacent to the drain.

- (9) Scupper openings shall be a minimum of 4 inches high and have a width equal to the

foot (3,048 mm) head of water. In testing successive sections, at least the upper ten (10) feet (3,048 mm) of the next preceding section shall be tested so that no joint of pipe in the building (except the uppermost ten (10) foot (3,048 mm) of a roof drainage system, which shall be filled with water to the flood level of the uppermost roof drain) shall have been submitted to a test of less than a ten (10) foot (3048 mm) head of water. The water shall be kept in the system or in the portion under test for at least fifteen (15) minutes before inspection starts; the system shall then be tight at all points.

**1109.2.2 Air Test.** The air test shall be made by attaching an air compressor testing apparatus to any suitable opening after closing all other inlets and outlets to the system, forcing air into the system until there is a uniform gauge pressure of five (5) psi (34.5 kPa) or sufficient pressure to balance a column of mercury ten (10) inches (254 mm) in height. This pressure shall be held without introduction of additional air for a period of at least fifteen (15) minutes. Schedule 40 plastic DWV systems shall not be tested by the air test method.

**1109.2.3 Exceptions.** When circumstances exist that make air and water tests described in Sections 1109.2.1 and 1109.2.2 above impractical, see Section 103.5.3.3.



**TABLE 11-1**  
**Sizing Roof Drains, Leaders, and Vertical Rainwater Piping<sup>1,2,3</sup>**

Size of Drain, Leader, or Pipe, Inches	Flow, gpm	Maximum Allowable Horizontal Projected Roof Areas Square Feet at Various Rainfall Rates					
		1 in./h	2 in./h	3 in./h	4 in./h	5 in./h	6 in./h
2	23	2,176	1,088	725	544	435	363
3	67	6440	3,220	2,147	1,610	1,288	1,073
4	144	13,840	6,920	4,613	3,460	2,768	2,307
5	261	25,120	12,560	8,373	6,280	5,024	4,187
6	424	40,800	20,400	13,600	10,200	8,160	6,800
8	913	88,000	44,000	29,333	22,000	17,600	14,667

**TABLE 11-1 (Metric)**  
**Sizing Roof Drains, Leaders, and Vertical Rainwater Piping<sup>1,2,3</sup>**

Size of Drain Leader or Pipe, mm	Flow, L/s	Maximum Allowable Horizontal Projected Roof Areas Square Meters at Various Rainfall Rates					
		25 mm/h	50 mm/h	75 mm/h	100 mm/h	125 mm/h	150 mm/h
50	1.5	202	101	67	51	40	34
80	4.2	600	300	200	150	120	100
100	9.1	1,286	643	429	321	257	214
125	16.5	2,334	1,117	778	583	467	389
150	26.8	3,790	1,895	1,263	948	758	632
200	57.6	8,175	4,088	2,725	2,044	1,635	1,363

**Notes:**

1. The sizing data for vertical conductors, leaders, and drains are based on the pipes flowing 7/24 full.
2. For rainfall rates other than those listed, determine the allowable roof area by dividing the area given in the 1 inch/hour (25 mm/hour) column by the desired rainfall rate.
3. Vertical piping may be round, square, or rectangular. Square pipe shall be sized to enclose its equivalent round pipe. Rectangular pipe shall have at least the same cross-sectional area as its equivalent round pipe, except that the ratio of its side dimensions shall not exceed 3 to 1.

**TABLE 11-2**  
**Sizing of Horizontal Rainwater Piping<sup>1,2</sup>**

Size of Pipe, Inches	Flow at 1/8 in./ft. Slope, gpm	Maximum Allowable Horizontal Projected Roof Areas Square Feet at Various Rainfall Rates					
		1 in./h	2 in./h	3 in./h	4 in./h	5 in./h	6 in./h
3	34	3,288	1,644	1,096	822	657	548
4	78	7,520	3,760	2,506	1,880	1,504	1,253
5	139	13,360	6,680	4,453	3,340	2,672	2,227
6	222	21,400	10,700	7,133	5,350	4,280	3,566
8	478	46,000	23,000	15,330	11,500	9,200	7,670
10	860	82,800	41,400	27,600	20,700	16,580	13,800
12	1,384	133,200	66,600	44,400	33,300	26,650	22,200
15	2,473	238,000	119,000	79,333	59,500	47,600	39,650

  

Size of Pipe, Inches	Flow at 1/4 in./ft. Slope, gpm	Maximum Allowable Horizontal Projected Roof Areas Square Feet at Various Rainfall Rates					
		1 in./h	2 in./h	3 in./h	4 in./h	5 in./h	6 in./h
3	48	4,640	2,320	1,546	1,160	928	773
4	110	10,600	5,300	3,533	2,650	2,120	1,766
5	196	18,880	9,440	6,293	4,720	3,776	3,146
6	314	30,200	15,100	10,066	7,550	6,040	5,033
8	677	65,200	32,600	21,733	16,300	13,040	10,866
10	1,214	116,800	58,400	38,950	29,200	23,350	19,450
12	1,953	188,000	94,000	62,600	47,000	37,600	31,350
15	3,491	336,000	168,000	112,000	84,000	67,250	56,000

  

Size of Pipe, Inches	Flow at 1/2 in./ft. Slope, gpm	Maximum Allowable Horizontal Projected Roof Areas Square Feet at Various Rainfall Rates					
		1 in./h	2 in./h	3 in./h	4 in./h	5 in./h	6 in./h
3	68	6,576	3,288	2,192	1,644	1,310	1,096
4	156	15,040	7,520	5,010	3,760	3,010	2,500
5	278	26,720	13,360	8,900	6,680	5,320	4,450
6	445	42,800	21,400	14,267	10,700	8,580	7,140
8	956	92,000	46,000	30,650	23,000	18,400	15,320
10	1,721	165,600	82,800	55,200	41,400	33,150	27,600
12	2,768	266,400	133,200	88,800	66,600	53,200	44,400
15	4,946	476,000	238,000	158,700	119,000	95,200	79,300

**Notes:**

1. The sizing data for horizontal piping are based on the pipes flowing full.
2. For rainfall rates other than those listed, determine the allowable roof area by dividing the area given in the 1 inch/hour (25 mm/hour) column by the desired rainfall rate.

**TABLE 11-2 (Metric)**  
**Sizing of Horizontal Rainwater Piping<sup>1,2</sup>**

Size of Pipe, mm	Flow at 10 mm/m Slope, L/s	Maximum Allowable Horizontal Projected Roof Areas Square Meters at Various Rainfall Rates					
		25 mm/h	50 mm/h	75 mm/h	100 mm/h	125 mm/h	150 mm/h
80	2.1	305	153	102	76	61	51
100	4.9	700	350	233	175	140	116
125	8.8	1,241	621	414	310	248	207
150	14.0	1,988	994	663	497	398	331
200	30.2	4,273	2,137	1,424	1,068	855	713
250	54.3	7,692	3,846	2,564	1,923	1,540	1,282
300	87.3	12,375	6,187	4,125	3,094	2,476	2,062
375	156.0	22,110	11,055	7,370	5,528	4,422	3,683

Size of Pipe, mm	Flow at 20 mm/m Slope, L/s	Maximum Allowable Horizontal Projected Roof Areas Square Meters at Various Rainfall Rates					
		25 mm/h	50 mm/h	75 mm/h	100 mm/h	125 mm/h	150 mm/h
80	3.0	431	216	144	108	86	72
100	6.9	985	492	328	246	197	164
125	12.4	1,754	877	585	438	351	292
150	19.8	2,806	1,403	935	701	561	468
200	42.7	6,057	3,029	2,019	1,514	1,211	1009
250	76.6	10,851	5,425	3,618	2,713	2,169	1807
300	123.2	17,465	8,733	5,816	4,366	3,493	2912
375	220.2	31,214	15,607	10,405	7,804	6,248	5202

Size of Pipe, mm	Flow at 40 mm/m Slope, L/s	Maximum Allowable Horizontal Projected Roof Areas Square Meters at Various Rainfall Rates					
		25 mm/h	50 mm/h	75 mm/h	100 mm/h	125 mm/h	150 mm/h
80	4.3	611	305	204	153	122	102
100	9.8	1,400	700	465	350	280	232
125	17.5	2,482	1,241	827	621	494	413
150	28.1	3,976	1,988	1,325	994	797	663
200	60.3	8,547	4,273	2,847	2,137	1,709	1,423
250	108.6	15,390	7,695	5,128	3,846	3,080	2,564
300	174.6	24,749	12,374	8,250	6,187	4,942	4,125
375	312.0	44,220	22,110	14,753	11,055	8,853	7,367

**Notes:**

1. The sizing data for horizontal piping are based on the pipes flowing full.
2. For rainfall rates other than those listed, determine the allowable roof area by dividing the area given in the 1 inch/hour (25 mm/hour) column by the desired rainfall rate.

**TABLE 11-3  
Size of Gutters**

Diameter of Gutter in Inches	Maximum Rainfall in Inches per Hour				
	1/16 in./ft. Slope	2	3	4	5
3	340	226	170	136	113
4	720	480	360	288	240
5	1,250	834	625	500	416
6	1,920	1,280	960	768	640
7	2,760	1,840	1,380	1,100	918
8	3,980	2,655	1,990	1,590	1,325
10	7,200	4,800	3,600	2,880	2,400

Diameter of Gutter in Inches	Maximum Rainfall in Inches per Hour				
	1/8 in./ft. Slope	2	3	4	5
3	480	320	240	192	160
4	1,020	681	510	408	340
5	1,760	1,172	880	704	587
6	2,720	1,815	1,360	1,085	905
7	3,900	2,600	1,950	1,560	1,300
8	5,600	3,740	2,800	2,240	1,870
10	10,200	6,800	5,100	4,080	3,400

Diameter of Gutter in Inches	Maximum Rainfall in Inches per Hour				
	1/4 in./ft. Slope	2	3	4	5
3	680	454	340	272	226
4	1,440	960	720	576	480
5	2,500	1,668	1,250	1,000	834
6	3,840	2,560	1,920	1,536	1,280
7	5,520	3,680	2,760	2,205	1,840
8	7,960	5,310	3,980	3,180	2,655
10	14,400	9,600	7,200	5,750	4,800

Diameter of Gutter in Inches	Maximum Rainfall in Inches per Hour				
	1/2 in./ft. Slope	2	3	4	5
3	960	640	480	384	320
4	2,040	1,360	1,020	816	680
5	3,540	2,360	1,770	1,415	1,180
6	5,540	3,695	2,770	2,220	1,850
7	7,800	5,200	3,900	3,120	2,600
8	11,200	7,460	5,600	4,480	3,730
10	20,000	13,330	10,000	8,000	6,660

**TABLE 11-3 (Metric)**  
**Size of Gutters**

Diameter of Gutter in mm	Maximum Rainfall in Millimeters per Hour				
	<b>5.2 mm/m Slope</b>	<b>50.8</b>	<b>76.2</b>	<b>101.6</b>	<b>127.0</b>
80	31.6	21.0	15.8	12.6	10.5
100	66.9	44.6	33.4	26.8	22.3
125	116.1	77.5	58.1	46.5	38.7
150	178.4	119.1	89.2	71.4	59.5
175	256.4	170.9	128.2	102.2	85.3
200	369.7	246.7	184.9	147.7	123.1
250	668.9	445.9	334.4	267.6	223.0

Diameter of Gutter in mm	Maximum Rainfall in Millimeters per Hour				
	<b>10.4 mm/m Slope</b>	<b>50.8</b>	<b>76.2</b>	<b>101.6</b>	<b>127.0</b>
80	44.6	29.7	22.3	17.8	14.9
100	94.8	63.3	47.4	37.9	31.6
125	163.5	108.9	81.8	65.4	54.5
150	252.7	168.6	126.3	100.8	84.1
175	362.3	241.5	181.2	144.9	120.8
200	520.2	347.5	260.1	208.1	173.7
250	947.6	631.7	473.8	379	315.9

Diameter of Gutter in mm	Maximum Rainfall in Millimeters per Hour				
	<b>20.9 mm/m Slope</b>	<b>50.8</b>	<b>76.2</b>	<b>101.6</b>	<b>127.0</b>
80	63.2	42.2	31.6	25.3	21.0
100	133.8	89.2	66.9	53.5	44.6
125	232.3	155.0	116.1	92.9	77.5
150	356.7	237.8	178.4	142.7	118.9
175	512.8	341.9	256.4	204.9	170.9
200	739.5	493.3	369.7	295.4	246.7
250	133.8	891.8	668.9	534.2	445.9

Diameter of Gutter in mm	Maximum Rainfall in Millimeters per Hour				
	<b>41.7 mm/m Slope</b>	<b>50.8</b>	<b>76.2</b>	<b>101.6</b>	<b>127.0</b>
80	89.2	59.5	44.6	35.7	29.7
100	189.5	126.3	94.8	75.8	63.2
125	328.9	219.2	164.4	131.5	109.6
150	514.7	343.3	257.3	206.2	171.9
175	724.6	483.1	362.3	289.9	241.4
200	1,40.5	693.0	520.2	416.2	346.5
250	1,858.0	1,238.4	929.0	743.2	618.7

