MIFAB Rainfall Considerations for Roof Drains

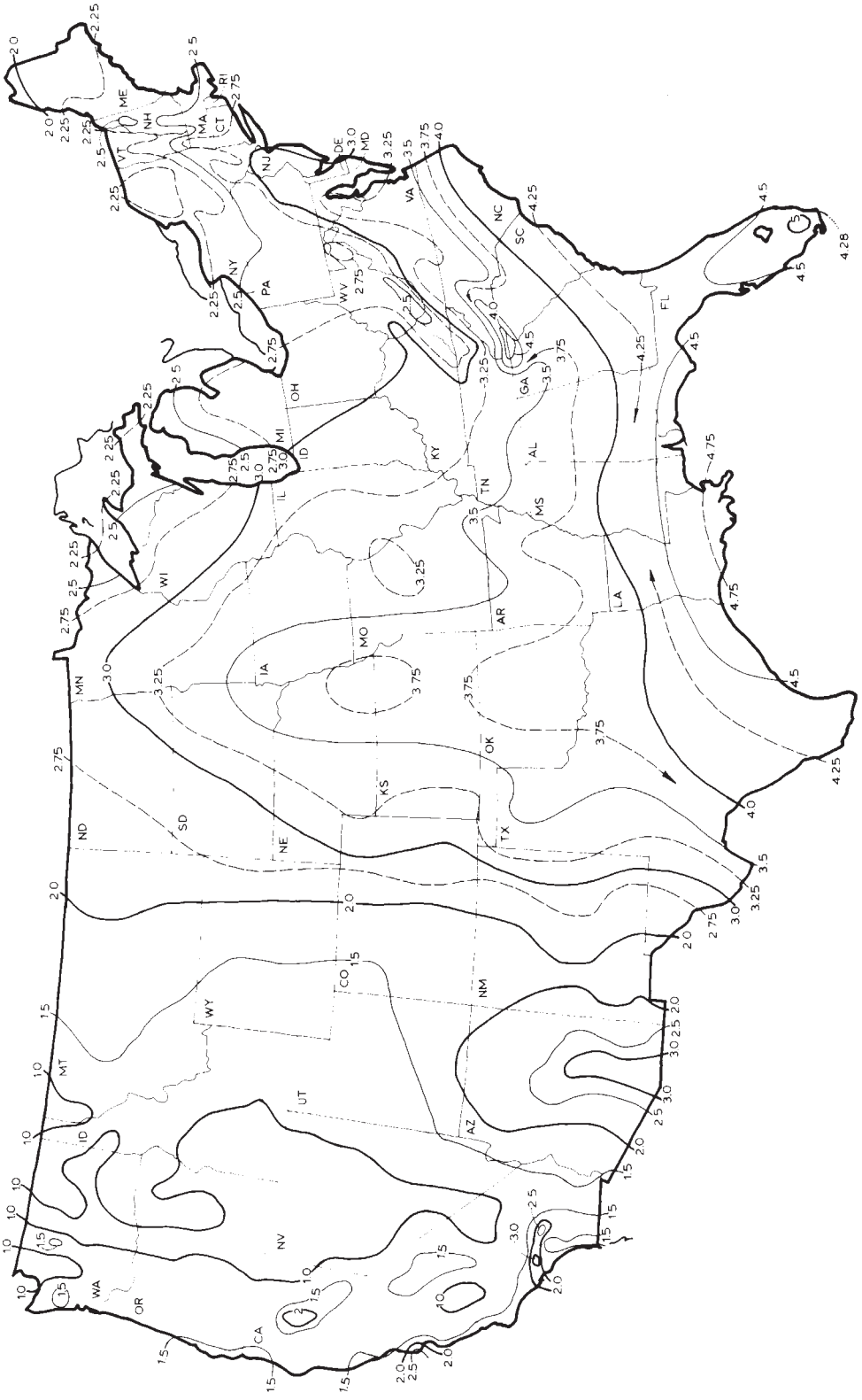
Flat roof drainage is accomplished through a system of roof drains, vertical leaders, and horizontal storm drains sized and located in accordance with established criteria in conformance with local plumbing and building codes. Therefore, when considering the design of a roof drainage system, it is recommended that local code authorities be consulted regarding the rainfall rate acceptable in their jurisdiction for design purposes. National rainfall rate information is provided in the chart below, listing rainfall rates in inches per hour for selected cities. On the next page, is an isopluvial (equal or similar rainfall line) map based on data for a storm of one hour duration and a 100 year return period from the National Weather Service, National Oceanic and Atmospheric Administration, Washington, D.C. When the rainfall rate for the locale of the project has been resolved, sizing of the roof drains, leaders and horizontal drainage piping can proceed.

Rainfall Rates for Selected Cities (inches per hour)

Based on a storm of one hour duration and a 100 year return period.
Source: National Weather Service, National Oceanic and Atmospheric Administration, Washington, DC.

ALABAMA		**IDAHO**		**MICHIGAN**		**NORTH CAROLINA**		**TEXAS**	
Birmingham	3.8	Boise	0.9	Alpena	2.5	Asheville,	4.1	Abilene	3.6
Huntsville	3.6	Pocatello	1.2	Detroit	2.8	Charlotte	3.7	Amarillo	3.5
Mobile	4.6	**ILLINOIS**		Escabana	2.4	Greensboro	3.5	Brownsville	4.5
Montgomery	4.2	Cairo	3.3	Grand Rapids	2.8	Raleigh	3.7	Corpus Christi	4.5
ALASKA		Chicago	3.0	Lansing	2.8	Wilmington	4.2	Dallas	4.0
Fairbanks	1.0	Peoria	3.1	Marquette	2.4	**NORTH DAKOTA**		El Paso	2.4
Juneau	0.6	Springfield	3.3	Sault Ste. Marie	2.2	Bismarck	2.8	Houston	4.6
ARIZONA		**INDIANA**		**MISSISSIPPI**		Fargo	3.2	Lubbock	3.3
Flagstaff	2.4	Evansville	3.2	Biloxi	4.7	Grand Forks	3.0	Odessa	3.2
Nogales	3.1	Fort Wayne	2.9	Columbus	3.9	Williston	2.6	San Antonio	4.2
Phoenix	2.5	Indianapolis	3.1	Jackson	4.0	**OHIO**		Tyler	3.9
Yuma	1.6	South Bend	3.0	Natchez	4.4	Cincinnati	3.0	**UTAH**	
ARKANSAS		Terre Haute	3.2	**MISSOURI**		Cleveland	2.8	Cedar City	1.6
Fort Smith	3.6	**IOWA**		Columbia	3.3	Columbus	2.8	Salt Lake City	1.3
Little Rock.	3.7	Burlington	3.3	Kansas City	3.6	Toledo	2.8	**VERMONT**	
Texarkana	3.8	Davenport	3.3	St. Louis	3.3	Youngstown	2.7	Brattleboro	2.5
CALIFORNIA		Des Moines	3.5	Springfield	3.4	Zanesville	2.8	Burlington	2.2
Barstow	1.4	Dubuque	3.3	**MONTANA**		**OKLAHOMA**		**VIRGINIA**	
Crescent City	1.5	Sioux City	3.6	Billings	1.9	Oklahoma City	3.8	Bristol	2.7
Fresno	1.1	**KANSAS**		Havre	1.6	Tulsa	3.8	Charlottesville	2.9
Los Angeles	2.1	Atwood	3.3	Helena	1.5	**OREGON**		Norfolk	3.4
Needles	1.6	Dodge City	3.4	Missoula	1.3	Medford	1.4	Richmond	3.3
Sacramento	1.6	Topeka	3.7	**NEBRASKA**		Pendleton	1.0	Roanoke	3.2
San Diego	1.3	Wichita	3.7	Grand Island	3.5	Portland	1.3	**WASHINGTON**	
San Francisco	1.5	**KENTUCKY**		Omaha	3.8	**PENNSYLVANIA**		Bellingham	1.1
COLORADO		Ashland	3.0	Sidney	3.2	Erie	2.6	Seattle	1.1
Denver	2.4	Bowling Green	3.2	Valentine	3.2	Harrisburg	2.8	Spokane	1.0
Durango	1.8	Lexington	3.1	**NEVADA**		Philadelphia	3.1	Yakima	1.0
Grand Junction	1.7	Louisville	3.2	Carson City	1.1	Pittsburgh	2.6	**WEST VIRGINIA**	
Pueblo	2.5	Middlesboro	2.8	Elko	1.0	Scranton	2.7	Charleston	2.8
CONNECTICUT		Paducah	3.3	Las Vegas	1.5	Williamsport	2.6	Elkins	2.7
Hartford	2.7	**LOUISIANA**		**NEW HAMPSHIRE**		**RHODE ISLAND**		Parkersburg	2.8
New Haven	2.8	Baton Rouge	4.8	Berlin	2.5	Providence	2.6	**WISCONSIN**	
DELAWARE		Lake Charles	4.7	Claremont	2.5	**SOUTH CAROLINA**		Ashland	2.5
Georgetown	3.0	New Orleans	4.8	Portsmouth	2.4	Charleston	4.3	Eau Claire	3.0
Wilmington	3.1	Shreveport	3.9	**NEW JERSEY**		Columbia	4.0	Green Bay	2.5
DISTRICT OF COLUMBIA		**MAINE**		Atlantic City	3.0	Greenville	4.2	La Crosse	3.1
Washington	3.2	Bangor	2.2	Newark	3.1	**SOUTH DAKOTA**		Madison	3.0
FLORIDA		Caribou	2.0	Trenton	3.1	Aberdeen	3.3	Milwaukee	3.0
Jacksonville	4.3	Portland	2.4	**NEW MEXICO**		Pierre	3.2	**WYOMING**	
Key West.	4.3	**MARYLAND**		Albuquerque	2.0	Rapid-City	2.9	Casper	1.9
Miami	4.7	Baltimore	3.2	Hobbs	3.0	Sioux Falls	3.6	Cheyenne	2.2
Pensacola	4.6	Hagerstown	2.8	Las Cruces	2.0	**TENNESSEE**		Rock Springs	1.3
Tampa	4.5	Salisbury	3.1	Santa Fe	2.0	Chattanooga	3.5	Sheridan	1.7
GEORGIA		**MASSACHUSETTS**		**NEW YORK**		Knoxville	3.2	Yellowstone Park	1.4
Atlanta	3.7	Boston	2.5	Albany	2.6	Memphis	3.7		
Macon	3.9	New Bedford	2.6	Binghamton	2.3	Nashville	3.3		
Savannah	4.3	Pittsfield	2.8	Buffalo					
Thomasville	4.3	Springfield	2.7	2.3New York	3.0				
HAWAII				Syracuse	2.3				
Hilo	6.2			Watertown	2.2				
Honolulu	3.0								

■ 100 YEAR, ONE HOUR RAINFALL (INCHES)



Sizing and Placement of MIFAB Roof Drains

As a first step in the sizing procedure it will be necessary to determine the quantity and placement of the drains required for the roof. Even though there are a number of opinions regarding roof areas that can be effectively drained by one drain, it is recognized that for minimized ponding with adequate drainage, two roof drains are required for roof areas of 10,000 square feet or less, and at least one drain is required per 10,000 square feet of area for larger roofs. Individual judgement will be necessary when considering quantity and placement of drains on roofs where shape and size of sections may require departure from the 10,000 square feet per drain recommendation. In the replacement of drains, uniform distribution is desirable for proper roof drainage. Locating drains within 50 feet of the roof perimeter and no more than 100 feet apart is acceptable practice. Also, careful consideration of roof structural members, dividers, expansion joints, and other projections including rooftop equipment is essential in planning the roof drainage system for adequate drainage of each area of the roof. Consultation with the architect and structural engineer regarding roof details is recommended.

RAINFALL CONVERSION:
INCHES PER HOUR TO GPM

For sizing purposes, rainfall-which is expressed in inches per hour, (in the following calculation) - is converted to gallons per minute per square foot of roof area. A one (1) inch per hour rainfall converts to .0104 GPM per square foot. For any given rainfall, multiply the inches per hour by .0104 to arrive at the GPM per square foot of roof area. Then multiply that figure by the square feet of roof area to be drained to arrive at the total gallons per minute to be handled by the drainage system.

For example: consider a 4-inch per hour rainfall on a 10,000 square foot roof:

0.0104x4x 10,000 = 4l6 GPM

• CHARTS A AND B

As an aid to the sizing and placement of MIFAB roof drains, please refer to Charts A and B, which give leader and horizontal storm drain capacities at various slopes, with capacities in GPM and maximum projected roof areas in square feet in each case. It will be noted that a 6-inch leader, thus 6-inch drain, will be indicated by the preceding example. The horizontal storm drain required, depending on slope, would be 6 or 8 inch. However, remembering that two drains are recommended for areas of 10,000 square feet or less, it would be advisable to select smaller drains with total capacity of 416 GPM or more. The maximum projected roof areas in Charts A and B are based on the flow capacity of each pipe size shown. The total of the projected flows from the vertical leaders will determine the size and slope of the horizontal storm sewer required in chart B.

CHART A:
VERTICAL LEADER CAPACITY IN GPM WITH MAXIMUM SERVICEABLE ROOF AREA IN SQUARE FEET BASED ON VARIOUS ANTICIPATED HOURLY RAINFALL RATES

VERTICAL LEADER SIZE / RAINFALL INCHES PER HOUR →	CAPACITY (GPM)	Roof Area (Square Feet) 1	Roof Area 2	Roof Area 3	Roof Area 4	Roof Area 5	Roof Area 6
2	30	2880	1440	960	720	575	480
3	92	8800	4400	2930	2200	1760	1470
4	192	18400	9200	6130	4600	3680	3070
6	563	11600	2700	17995	13500	10800	9000
8	1208	116000	58000	38660	29000	23200	19315

Sizing and Placement of MIFAB Roof Drains

CHART B:
HORIZONTAL STORM DRAIN CAPACITY IN GPM FOR SLOPES GIVEN WITH MAXIMUM SERVICEABLE ROOF AREA IN SQUARE FEET BASED ON SYSTEM CAPACITY

	1/8 INCH PER FOOT SLOPE		1/4 INCH PER FOOT SLOPE		1/2 INCH PER FOOT SLOPE	
DRAIN PIPE SIZE (INCHES)	DRAIN CAPACITY (GPM)	MAXIMUM ROOF AREA (SQUARE FEET)	DRAIN CAPACITY (GPM)	MAXIMUM ROOF AREA (SQUARE FEET)	DRAIN CAPACITY (GPM)	MAXIMUM ROOF AREA (SQUARE FEET)
3	34	822	48	1160	69	1644
4	78	1880	110	2650	157	3760
5	139	3340	197	4720	278	6680
6	223	5350	315	7550	446	10700
8	479	11500	679	16300	958	23000
10	863	20700	1217	29200	1725	14100
12	1388	33300	1958	47000	2775	66600
15	2479	59500	3500	84000	4958	11900

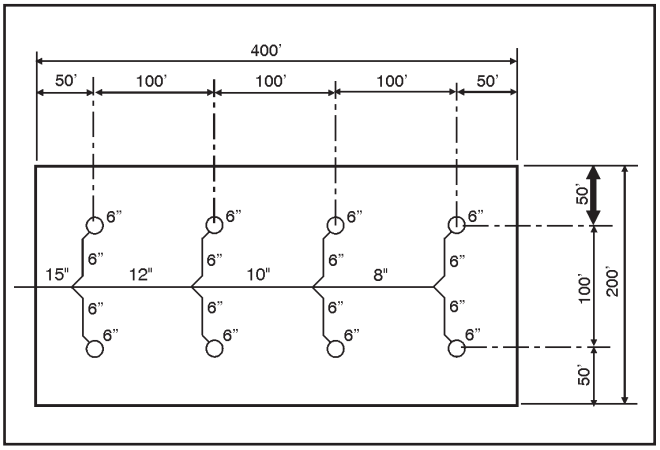
Roof Drain Sizing - Example

A warehouse is being built in a geographical area where the maximum hourly rainfall (See Page RD-6) is 2.8 inches per hour. The building will be 200'x400' and have a flat roof with no appreciable vertical surfaces.

C A L C U A T I O N S:

- Total area to be drained (200 x 400) **80,000 Sq. ft.**
- Number of drains required **8**
  (From sizing rule, one drain per 10,000 sq. Ft.)
- Rainfall conversion from in. per hour to GPM **2330**
  (0.0104 x 2.8 x 80,000)
- Expected flow from drain **292**
  (GPM÷number of drains) (2330÷8)
- Size of leader (from Chart A) **6 inch vertical**
- Size of horizontal storm sewers
  (from Chart B 1/4/ foot slope,
  combined flow of vertical leaders) **8,10,12,15 inches**

Roof Drainage System Layout indicated by the sizing example



Roof Drain Sizing: Other Considerations

• OVERFLOW DRAINAGE
Overflow scuppers and drains, as essential components of the roof drainage system, are employed to prevent potentially damaging overloading of roof structures. They must be installed in conformance with local codes. Generally, scuppers are installed in adjacent parapet walls no more than 5 inches above the low point of the roof at a ratio of at least one scupper per 20,000 sq. ft. of roof area. Overflow drains of the same size as the roof drains having above roof inlet elevation as specified by code, connected to drain lines independent from the roof drains, may be installed in lieu of scuppers.

• VERTICAL WALLS
Finally, vertical walls that project above and permit storm water to drain on the roof area to be drained must be considered when planning the roof drainage system. An acceptable rule to follow in sizing roof drains, leaders, and horizontal drainage piping is to add one half of the area of any vertical wall that diverts rainwater to the roof to the projected area of that roof. By multiplying the area thus obtained by the GPM/sq. ft. conversion of inches per hour rainfall, the new total GPM discharge requirement is determined for the roof.