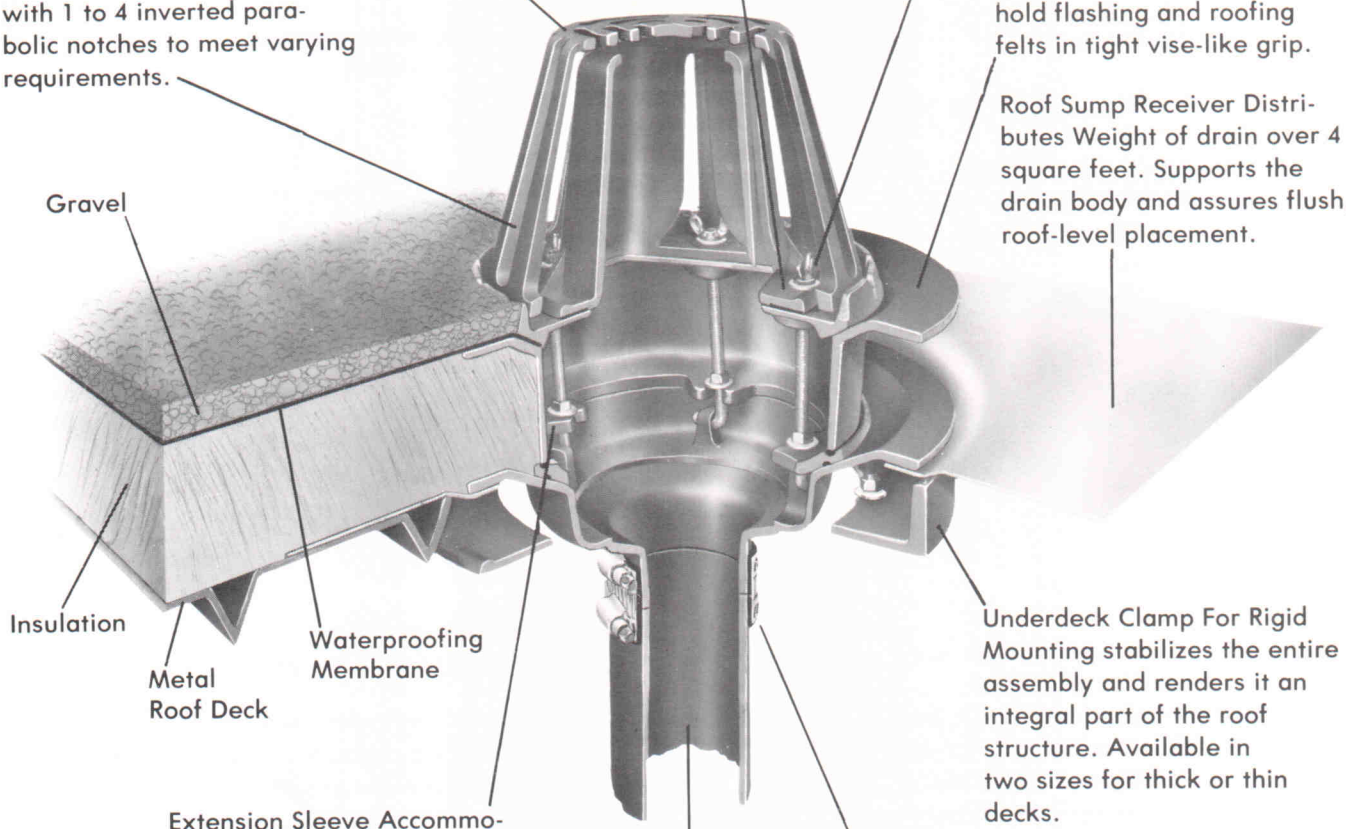
"Control-Flo®" Roof Drains



W-3504-DF/FCS/D/BP

The "Control-Flo" Method:
"Control-Flo" is a new way to remove rain water from dead-level or sloped roofs. Ordinary roof drains are designed with maximum openings to drain off storm water as quickly as it falls on the roof's surface; a practice which can result in occasional flooding, back-flows, or an overtaxed storm drainage system. "Control-Flo" drains the roof at controlled flow rates. Excess water accumulates on the roof under controlled conditions, and drains off at a predetermined rate, after a storm has passed.

With a "Control-Flo" roof drainage system, fewer roof drains with smaller diameter piping, smaller sewer sizes and corresponding lower installation costs are possible because every roof becomes a temporary storage reservoir.

By reducing the rate of water drain from roof tops, the specifier lightens the total load on combination sewers and reduces the probability of flooding and consequent backflow into basements and other low areas.

How it Works
Predetermined flow rates determine shape and size of notches on a special weir. Sides are formed by parabolic curves to provide flow rates directly proportional to the head, and assure permanent regulation of drainage flow rates for specific geographic locations and rainfall intensities.

Level Roof Application

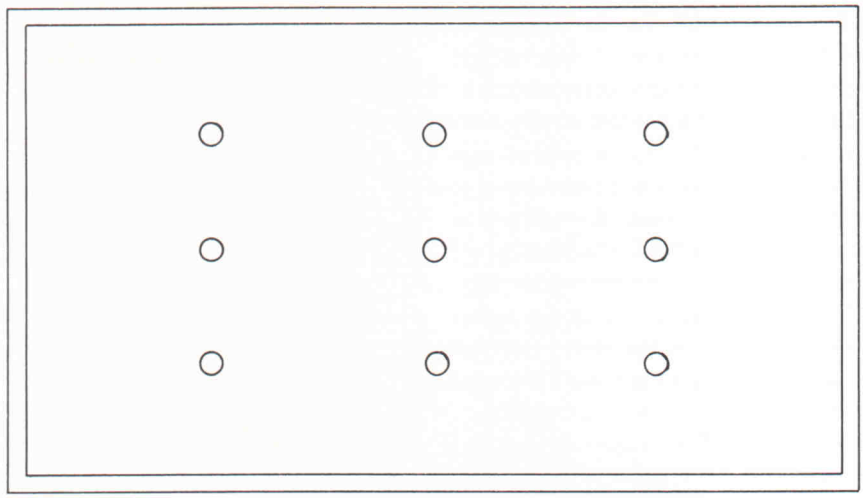
General Recommendations/ Level Roofs

On level roofs, design for a 3" depth for the 10-year storm. In this case, even the 100-year storm will not result in a maximum depth of 6". (A 6" depth represents a roof load of 31.2 pounds per square foot which approximates the 30 pounds per square foot factor commonly used in roof design.)

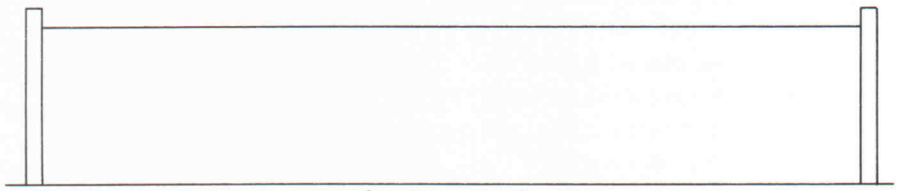
Roofing design should include protection to prevent roof overloading by specifying adequate overflow scuppers in parapet walls.

NOTE: A conservative practice used by some engineers in the past has been to design for a 3" depth with the 25, 50, or even 100-year storm; and also to lower scuppers to 5" or 4" above roof level. In either case, the final determination rests with the design engineer.

Level roof - A level roof for purposes of applying Wade "Control-Flo" drainage principles is one with zero slope across its entire surface.

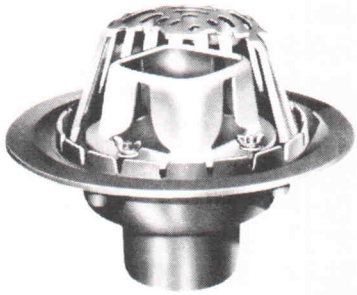


(plan view)

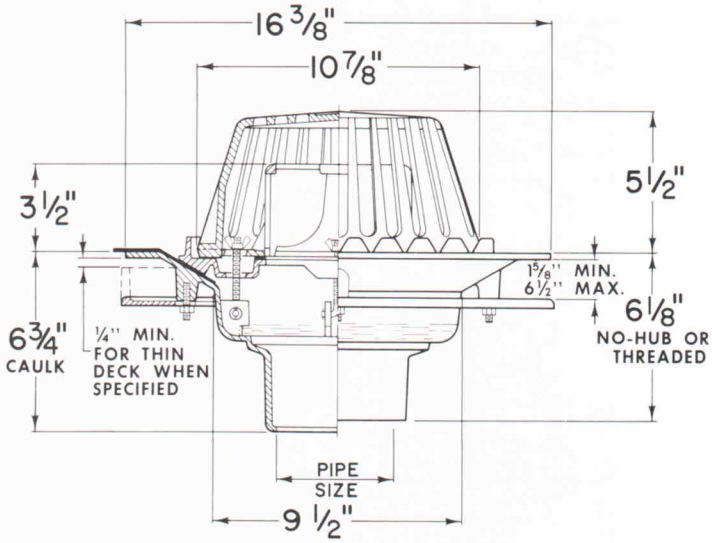


(section view)

Typical level roof plan



W-3500-FC



Specification Data/Level Roofs

Engineering Specification - Wade W-3500-FC (number of notches) "Control-Flo" cast iron roof drain with low-silhouette dome strainer, multi-weir barrier with integral clamping collar and gravel guard, and large protected sump. Available when specified with extension (DF), roof sump receiver (BP) and underdeck clamp (D).

Sloped Roof Application

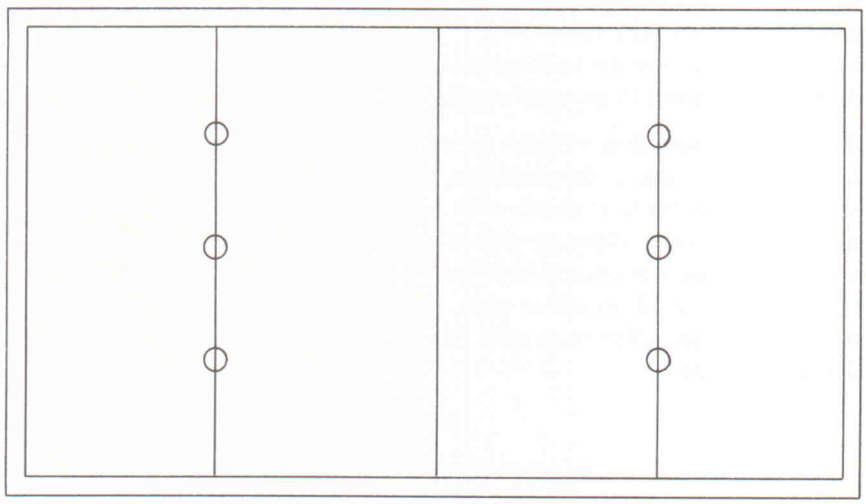
General Recommendations/ Sloped Roofs

On sloping roofs, we again recommend a 3" design depth for the 10-year storm, but by 3" we refer to an equivalent depth of 3". An equivalent depth is the depth of water attained at the drains that results in the same roof stresses as those realized on a dead-level roof. In all cases this equivalent depth is almost equal to that attained by using the same notch area rating for the different rises to 6". With the same depth of water at the drain the roof stresses will decrease with increasing total rise. Therefore, it would be possible to have a depth in excess of 6" at the drain on a sloping roof without exceeding stresses normally encountered in a 6" depth on a dead-level roof. However, it is recommended that scuppers be placed to limit the maximum water depth on any roof to 6" to prevent the over flow of the weirs on the drains and consequent overloading of drain piping.

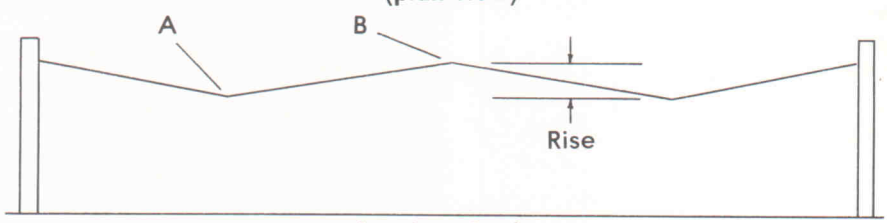
NOTE: An equivalent depth is that depth of water attained at the drains at the lowest line or valley of the roof with all other conditions such as notch area and rainfall intensity being equal. For Galveston, Texas a notch area of 1800 square feet results in a 3" depth on a **dead-level** roof for a 10-year storm. For the same notch area and a 10-year storm, equivalent depths for a 2", 4", and 6" rise respectively on a **sloped roof** would be 3.4", 3.8", and 4.6". Roof stresses will be approximately equal in all cases.

Sloped roof - A sloped roof is one with a shallow slope. The Wade "Control-Flo" drainage system can be applied to any slope which results in a total rise up to 6"; and data can be calculated for rises exceeding 6".

Total Rise of a roof as calculated for "Control Flo" application is the vertical increase in height from the low point or valley of a sloping roof (A) to the top of the sloping section (B).
Example: A roof that slopes ⅛" per foot having a 24' span would have a rise of 24x⅛ or 3".

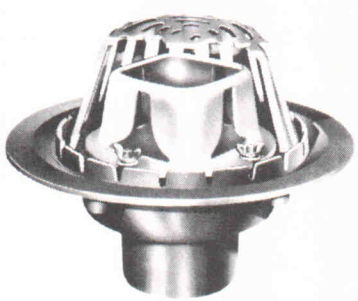


(plan view)

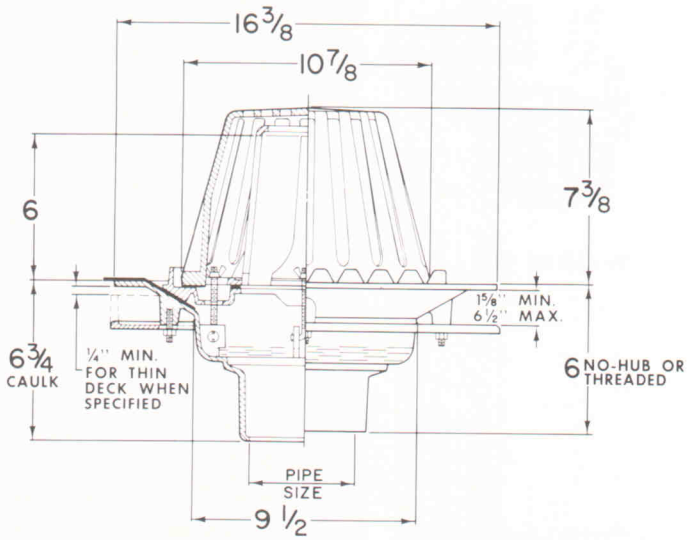


(section view)

Typical sloped roof plan



W-3500-FCS



Engineering Specification - Wade W-3500-FCS (number of notches) "Control-Flo" cast iron roof drain with extra large dome strainer, multi-weir barrier with integral clamping collar and gravel guard, and large protected sump. Available when specified with extension (DF), roof sump receiver (BP), and underdeck clamp (D).

Rainfall Data
"Control-Flo" drainage uses large roof areas to temporarily store maximum amounts of rain water without overloading average roofs or creating excessive drainage delays during heavy rains. The data in the roof drain selector takes these factors into consideration, and represents only one point on a series of curves prepared for each location.

Roof Loading and Run-Off Rates
The values for notch areas selected from the design curves are based on a **3" head** on a **level roof** for a **10-year storm.**

In low rainfall regions, the area per notch is limited to 25,000 square feet. This keeps the draindown time within reasonable limits. The same area was used for the various roof rises for sloping roofs. Stresses due to water load on a sloping roof for any fixed set of conditions are very nearly the same as those on a level roof. A sloping roof tends to concentrate more water in the valleys and increase water depth at this point. The greater depth around the drain causes faster run-off rates, particularly a faster early run-off. So, there is less total volume of water stored on the roof, and less total load on a sloping roof. Roof stresses caused by increased water depth in the valleys is offset by the decrease in the total load because less water is stored. Maximum roof stresses are approximately the same for any single span, rise, and fixed set of conditions. (A fixed set of conditions would be the same notch area, the same frequency storm and the same locality.)

Notch Flow and Water Depth
The flow of each notch of the "Control-Flo" weir is 10 GPM per inch of head. To compute the depth of water in inches at the drain, obtain the total flow for any fixed set of conditions and locale from the Roof Drain Selector and divide by 10. For example, in Dallas, Texas the discharge rates are 30, 36, 40 and 44 GPM for 10, 25, 50 and 100-year storms on a level roof. Since the possibility of exceeding 4.4" of water exists only once every 100 years, the drains can be sized to carry 44 GPM per notch and the scuppers can be set at a height of 4.4" above the roof to prevent overloading the drains if a worse than 100-year storm occurs. The same method applies for drain pipe sizing and scupper height selection for various roof slopes and storm frequencies.

Additional Notch Ratings
The Roof Drain Selector along with Tables 1 and 2 allows the engineer to select "Control-Flo" drains and drain pipe sizes for most applications. Tables 1 and 2 are computed for a proportional flow weir sized for 10 GPM per inch of head. This data can be applied to other sizes of proportional flow weirs by multiplying or dividing. For example, if a similar weir sized for 5 GPM per inch is substituted, the notch area and discharge in GPM would be divided by two.

Drain Location
On level roofs, drains should be located no further than 50 feet from each edge of the roof to assure good run-off regardless of wind direction. Weir should be flush with roof surface, not recessed.

On sloping roofs, drains should be located in the valleys at a distance no greater than 50 feet from each end of the valleys. Weir should be flush with the valley roof surface, not recessed.

On large roof areas, drains should not be spaced at a distance greater than 200 feet.

Parapets, Flashing and Curbs
A 3" water level for the 10-year storm represents a roof load of approximately 15 lbs. per sq. ft. This is only half the usual minimum design roof load rating. However, since it is desirable to contain the design depth of water on the roof in high wind conditions, it is recommended that roof construction, parapets, flashing and curbs should be high enough to prevent flooding over them.

Water-Cooled Roofs
The "Control-Flo" principle can be used on water cooled roofs. An adjustable collar on the drain body will retain a pool of water 0 to 3" deep. A 3" "Control-Flo" weir on top of the adjustable collar will control storm water falling on this pool. This restricts the maximum depth on the roof to 6" and scuppers should be located at this height. Since the weirs are 3" high on this drain they should be selected for a 3" head based on the 100-year frequency storm.

Special Considerations for Structural Safety
Roofing members and understructures, weakened by seepage and rot resulting from improper drainage and roof construction can give way under the weight of rapidly accumulated water during flash storms. It is recommended and often required by building codes that scuppers and overflow drains be installed in parapet type roofs. Properly selected and sized scuppers and overflow drains are vital to a well engineered drainage system to prevent excessive loading, erosion, seepage and rotting.

How to Use the Roof Drain Selector

The Roof Drain Selector (pages 15, 16, 17, 18) in combination with the steps below, should save countless hours of engineering specification time. This data permits the proper selection of drains for over 200 cities. If a city does not appear in this tabulation, choose the nearest listed city and select the proper drain using these factors.

Follow These Six Steps
(Example uses Anniston, Alabama; the first city listed in the Roof Drain Selector Guide.)

1. Determine total roof area (individual areas when roof is divided by expansion joints or peaks of sloping roof.)
2. Divided roof area or individual areas by Wade Notch Area Rating to determine the total number of notches required.
3. Determine the total number of drains required (do not exceed maximum spacing dimensions in the preceding instructions.)
4. Divide total number of notches required to determine the number of notches per drain.
5. Note flow rate for the 100-year storm and divide by 10 to determine maximum water depth at drain and use this dimension to determine scupper height. (Maximum scupper height to be used if 6".)
6. Use the flow rate from step 5 to size leaders and drain lines.

Three Typical Examples for Applications of "Control-Flo" Drains on Level and Sloping Roofs

Level Roof

1. Roof Area:
   192 ft. x 500 ft. = 96,000 sq. ft.
2. Notch Area Rating for Anniston, Alabama = 13,300 from Roof Drain Selector.
   Total Notches Required =
   $\frac{\text{96,000 sq. ft. roof area}}{\text{13,300 sq. ft. notch area}} =$
   7.2 notches — USE 8 PER AREA.
3. Six drains required. Three along each side within 50 ft./200 ft./200 ft./50 ft.
4. Two drains must have two notches for a total of eight notches. Locate at opposite corners.
5. Flow rate for the 100-year storm is 43 GPM. Maximum water depth and scupper height equals 4.3".
6. Size leaders from single notch drains for 43 GPM and leaders from double notch drains for 86 GPM.

Sloped Roof, 4 Inch Rise

1. Three individual roof areas:
   64 ft. x 500 ft. = 32,000 sq. ft.
   Valleys 500 ft. long
   3 x 32,000 ft. = 96,000 sq. ft.
2. Wade Notch Area Rating for Anniston, Alabama = 13,300 from Roof Drain Selector.
   Total Notches Required =
   $\frac{\text{32,000 sq. ft. roof area}}{\text{13,300 sq. ft. notch area}} =$
   2.4 notches — USE 3 PER AREA.
3. Three drains per area required located in the valleys 50 ft. from each end with one in the middle.
4. All Drains will have one notch.
5. Flow rate for the 100 year storm is 59 GPM maximum. Water depth and scupper height equals 5.9".
6. Size leaders for 59 GPM.

Sloped Roof, 6 Inch Rise

1. Two Individual Roof Areas:
   98 ft. x 500 ft. = 48,000 sq. ft.
   Valleys 500 ft. long
   2 x 48,000 = 96,000 sq. ft.
2. Wade Notch Area Rating for Anniston, Alabama = 13,300 from Roof Drain Selector.
   Total Notches Required =
   $\frac{\text{48,000 sq. ft. roof area}}{\text{13,300 sq. ft. notch area}} =$
   3.6 notches — USE 4 PER AREA.
3. Three drains per area required located in the valleys 50 ft. from each end with one in the middle.
4. Four notches are required therefore one drain must have two notches. Locate this one in the middle.
5. Flow rate for the 100-year storm is 67 GPM. Locate scuppers at 6" and use 60 GPM as the maximum flow rate and 6" for the maximum depth. The probabilityof water flowing out scuppers is now less than once every 50 years instead of every 100 years.
6. Size leaders for 60 GPM.

Wade Roof Drain Selector

LOCATION	Notch Area	LEVEL								2 INCH RISE								4 INCH RISE								6 INCH RISE							
		Discharge G.P.M. Draindown Time Hrs.								Discharge G.P.M. Draindown Time Hrs.								Discharge G.P.M. Draindown Time Hrs.								Discharge G.P.M. Draindown Time Hrs.							
		10 Yrs.		25 Yrs.		50 Yrs.		100 Yrs.		10 Yrs.		25 Yrs.		50 Yrs.		100 Yrs.		10 Yrs.		25 Yrs.		50 Yrs.		100 Yrs.		10 Yrs.		25 Yrs.		50 Yrs.		100 Yrs.	
Anniston Ala.	13,300	30	26	35	28	39	29	43	30	37	22	43	24	47	26	50	27	45	16	51	18	55	19	59	21	53	12	59	14	63	15	67	16
Birmingham, Ala.	10,200	30	20	36	22	40	23	44	24	36	17	41	19	46	20	50	21	44	12	49	13	53	14	57	15	52	9	57	10	61	11	64	12
Mobile, Ala.	4,000	30	7.8	36	8.5	40	9	44	9.8	36	6.4	40	7	45	7.5	50	8	44	4.5	48	5.1	52	5.5	57	6	52	3.6	56	3.9	59	4	62	4.3
Montgomery, Ala.	5,330	30	9.5	36	10.5	40	11	44	11.5	35	8	39	9	43	9.5	48	10	43	5.5	47	6	51	6.6	55	7.1	50	4.2	55	4.8	58	5.2	61	5.5
Fairbanks, Alaska	25,000	14	26	16	30	18	32	19	33	18	22	20	23	22	25	25	28	24	15	27	16	30	18	33	21	30	12	33	14	37	15	39	16
Juneau, Alaska	25,000	27	41	30	44	31	45	34	48	30	34	33	37	35	38	38	41	37	23	39	24	41	25	44	27	42	17	44	18	47	19	51	21
Phoenix, Ariz.	25,000	19	33	23	37	26	40	29	43	26	30	30	34	33	37	36	39	33	21	37	23	40	25	44	27	39	16	45	19	48	20	52	22
Bentonville, Ark.	22,000	30	40	36	44	40	46	43	48	38	38	44	40	47	42	50	44	44	24	50	28	54	30	58	33	52	20	57	22	61	23	64	24
Fort Smith, Ark.	16,000	30	31	36	34	40	36	45	38	37	28	43	30	46	31	51	32	45	19	50	21	54	23	59	25	52	15	57	16	61	18	65	19
Little Rock, Ark.	9,500	30	18	36	20	40	21	44	22	36	16	40	17	45	19	50	20	43	11	48	12	51	13	56	14	51	8.5	56	9.5	59	10.5	62	11.5
Eureka, Calif.	25,000	28	42	33	47	37	50	43	54	32	36	36	39	41	44	45	46	39	24	44	27	48	30	53	32	44	18	49	20	53	22	56	24
Fresno, Calif.	25,000	15	28	17	32	19	33	21	35	21	24	24	27	26	30	28	32	28	17	32	20	34	21	36	23	33	14	37	15	40	16	43	18
Los Angeles, Calif.	20,000	30	38	38	44	44	46	49	47	33	30	40	36	46	38	52	42	37	19	44	21	49	26	55	29	42	15	50	18	55	20	60	21
Mt. Tamalpias, Calif.	25,000	22	36	24	38	26	40	27	41	25	28	28	32	30	34	31	35	32	20	35	22	37	23	39	24	37	15	40	16	42	17	44	18
Port Reyes, Calif.	25,000	19	33	22	36	25	39	27	41	23	26	27	31	29	33	31	35	31	19	35	22	37	23	39	24	36	15	40	16	43	18	46	19
Red Bluff, Calif.	25,000	27	41	31	45	36	49	41	52	33	37	38	41	43	45	46	47	40	25	46	28	51	32	56	35	47	19	53	22	57	24	61	26
Sacramento, Calif.	25,000	22	36	25	39	28	42	31	45	25	28	28	32	30	34	33	37	32	20	36	23	38	24	41	25	37	15	42	17	45	19	48	20
San Diego, Calif.	25,000	19	33	23	37	26	40	29	43	24	27	27	31	29	33	31	35	32	20	35	22	37	23	39	24	37	15	40	16	43	18	46	19
San Francisco, Calif.	25,000	22	36	25	39	28	42	30	44	25	28	28	32	30	34	33	38	33	21	36	23	38	24	40	25	37	15	41	17	45	19	47	19
San Luis Obispo, Calif.	17,000	30	33	37	36	43	39	47	41	33	27	38	30	44	32	48	33	38	17	44	19	48	21	53	23	43	12	49	15	54	16	58	17
Denver, Colo.	25,000	17	32	20	34	23	37	25	39	25	28	28	32	31	35	34	38	33	21	37	23	39	24	42	26	39	16	45	19	48	20	52	22
Grand Junction, Colo.	25,000	12	22	14	26	16	30	18	32	16	20	18	22	20	23	22	25	23	14	25	15	27	16	29	18	27	11	30	12	32	13	34	14
Pueblo, Colo.	25,000	18	32	21	35	24	38	26	40	26	30	30	34	33	37	37	40	34	21	38	24	41	25	45	28	42	17	46	19	51	21	54	23
Wagon Wh. Gap, Colo.	25,000	14	26	16	30	18	32	19	33	18	22	21	24	23	26	25	28	25	15	29	18	31	19	33	21	30	12	34	14	36	15	38	16
Hartford, Conn.	25,000	29	43	34	48	38	50	42	53	35	38	39	42	42	45	46	47	41	25	46	28	50	31	54	33	48	20	54	23	57	24	60	25
New Haven, Conn.	19,000	30	36	36	40	40	42	45	44	36	31	41	34	45	36	49	38	43	21	49	24	53	27	57	29	48	16	53	18	57	19	60	20
Washington, D.C.	13,300	30	25	37	27	40	28	44	30	38	22	44	24	48	26	51	27	46	16	52	17	56	19	59	20	54	12	59	14	62	15	64	16
Apalachicola, Fla.	2,670	30	5.1	37	5.8	41	6	46	6.2	35	4.5	40	5	44	5.2	49	5.5	43	3.2	47	3.5	50	3.7	55	4	48	2.2	53	2.4	57	2.6	60	2.8
Jacksonville, Fla.	4,670	30	8.5	36	9.5	40	10	45	11	36	7.5	40	8	45	9	50	9.5	43	5	48	5.6	52	6	56	6.6	51	4	56	4.5	59	4.8	63	5
Key West, Fla.	3,300	30	6.2	37	7	42	7.5	47	7.8	35	5.5	41	6	46	6.3	51	6.8	43	3.7	48	4	53	4.7	58	5.2	50	2.8	55	2.9	58	3.3	63	3.7
Miami, Fla.	2,100	30	4	37	4.5	42	4.8	47	5	35	3.6	41	3.9	46	4.2	50	4.5	43	2.5	48	2.8	52	3.1	56	3.3	50	1.8	54	1.9	57	2.1	61	2.2
Pensacola, Fla.	1,900	30	3.6	37	4	43	4.5	47	4.7	35	3.2	41	3.6	46	3.8	50	4	43	2	48	2.5	53	2.8	57	3.1	50	1.7	55	1.8	59	2	62	2.1
Tampa, Fla.	3,600	30	7	36	7.5	39	7.9	42	8	35	5.9	40	6.3	44	6.9	48	7.2	43	4	48	4.5	52	5	56	5.4	51	3.2	56	3.5	58	3.6	62	3.8
Atlanta, Ga.	12,100	30	24	35	25	37	26	41	28	36	21	40	22	44	23	48	24	44	14	47	15	50	16	54	17	52	11	55	12	58	12	62	13
Augusta, Ga.	16,700	30	32	36	36	40	38	45	40	37	29	43	31	47	33	51	36	45	20	51	23	55	25	59	27	53	16	58	17	62	19	66	21
Macon, Ga.	8,000	30	16	37	18	42	19	48	20	37	14	44	15	49	16	56	17	45	10	51	11	56	12	60	13	53	7.5	59	8.2	63	9	67	10
Savannah, Ga.	3,800	30	7.2	36	8	40	8.4	43	8.9	35	6.1	39	6.8	43	7.1	48	7.6	42	4.1	47	4.8	51	5.1	54	5.4	51	3.3	55	3.6	58	3.8	61	3.9
Thomasville, Ga.	4,600	30	8.5	36	9.5	39	10	42	10.5	36	7.2	40	8	44	8.5	47	9	43	5	47	5.5	51	6	54	6.4	51	4	55	4.3	58	4.5	61	4.9
Honolulu, Hawaii	7,300	30	14	37	16	42	17	47	18	36	12	42	13	47	14	52	15	43	8	49	9.5	54	10.5	58	11.5	50	6.5	56	7.2	60	7.8	63	8.1
Boise, Idaho	25,000	12	22	14	26	15	28	16	30	17	21	19	23	20	23	22	25	23	14	26	16	28	17	29	18	27	11	30	12	32	13	34	14
Lewiston, Idaho	25,000	13	24	15	28	16	30	17	32	17	21	19	23	20	23	22	25	23	14	25	15	27	17	29	18	27	11	30	12	32	13	34	14
Pocatello, Idaho	25,000	12	22	14	26	16	30	17	32	18	22	21	24	23	26	25	28	26	16	29	18	31	19	33	21	31	13	35	14	37	15	39	16
Cairo, Ill.	15,300	30	29	37	32	40	33	45	36	37	26	43	28	47	29	50	30	45	18	51	20	55	22	59	23	53	14	58	15	62	16	66	18
Chicago, Ill.	25,000	28	42	33	47	37	50	41	52	36	39	41	44	45	46	49	49	44	27	49	31	53	32	57	35	52	22	57	24	61	26	65	27
Peoria, Ill.	25,000	30	44	35	48	39	51	43	54	37	40	42	45	46	47	49	49	45	28	50	31	54	33	58	36	53	22	57	24	61	26	64	27

LOCATION	Notch Area	LEVEL								2 INCH RISE								4 INCH RISE								6 INCH RISE							
		Discharge G.P.M. Draindown Time Hrs.								Discharge G.P.M. Draindown Time Hrs.								Discharge G.P.M. Draindown Time Hrs.								Discharge G.P.M. Draindown Time Hrs.							
		10 Yrs.		25 Yrs.		50 Yrs.		100 Yrs.		10 Yrs.		25 Yrs.		50 Yrs.		100 Yrs.		10 Yrs.		25 Yrs.		50 Yrs.		100 Yrs.		10 Yrs.		25 Yrs.		50 Yrs.		100 Yrs.	
Springfield, Ill.	25,000	30	44	36	49	40	52	44	54	37	40	42	45	46	47	50	50	44	27	50	31	55	34	58	36	52	22	58	24	61	26	65	27
Evansville, Ind.	25,000	30	44	36	49	40	52	44	54	37	40	42	45	46	47	49	49	45	28	50	31	53	32	57	35	53	22	57	24	60	25	64	27
Fort Wayne, Ind.	25,000	27	41	30	44	34	48	38	50	34	38	38	41	41	44	44	46	40	25	44	27	48	30	51	32	49	20	53	22	56	24	59	25
Indianapolis, Ind.	24,000	30	44	37	48	41	51	45	54	38	40	45	44	49	46	53	48	46	28	53	32	57	36	62	39	54	22	60	24	63	26	66	27
Terre Haute, Ind.	17,000	30	33	36	36	39	38	44	40	37	29	42	31	46	32	50	34	45	20	50	23	54	24	57	26	53	16	57	17	60	18	64	20
Charles City, Iowa	25,000	30	44	36	49	41	52	45	55	37	40	43	45	47	47	50	50	45	28	50	31	55	34	59	37	53	22	57	24	61	26	65	27
Davenport, Iowa	25,000	30	44	36	49	41	52	45	55	38	41	44	46	48	48	52	52	46	28	52	32	56	35	60	38	54	23	59	25	63	27	66	28
Des Moines, Iowa	16,700	30	32	37	37	41	39	46	41	38	30	44	32	48	33	53	36	46	21	53	24	56	25	60	27	54	16	59	18	63	19	66	21
Dubuque, Iowa	16,700	30	32	36	36	40	38	45	40	37	29	43	31	47	33	51	36	46	21	52	23	57	26	60	27	54	16	58	17	62	19	65	20
Keokuk, Iowa	20,000	30	38	36	42	40	44	44	46	38	34	43	37	47	40	51	42	46	24	51	27	56	29	60	31	54	19	58	20	62	22	66	23
Sioux City, Iowa	25,000	27	41	31	45	38	50	42	53	35	38	40	43	45	46	49	49	43	26	49	31	54	33	59	37	53	22	58	24	61	26	64	27
Concordia, Kan.	14,100	30	27	36	29	41	31	46	32	38	22	45	25	49	26	54	27	46	15	53	19	57	21	61	23	54	13	57	14	61	15	66	16
Dodge City, Kan.	15,800	30	30	36	33	40	36	46	38	38	28	45	30	40	32	54	33	46	19	53	22	57	24	62	26	54	15	61	17	63	18	68	20
Iola, Kan.	10,000	30	19	36	21	39	22	42	23	37	17	41	19	45	20	49	21	44	11.5	48	12.5	52	13.5	56	14.5	52	9	56	10	59	10.5	63	11.3
Topeka, Kan.	8,000	30	15	35	17	40	18	44	19	37	14	42	15	46	16	50	16.5	45	9.5	50	10.5	54	11.5	58	12	53	7.5	58	8	62	9	67	10
Wichita, Kan.	10,300	30	20	36	22	40	23	44	24	37	18	42	19	47	20	51	21	46	12.5	50	14	55	15	59	16	55	10	58	11	62	11.5	66	12
Lexington, Ky.	16,000	30	31	36	34	41	37	46	39	37	28	43	30	48	31	53	33	45	19	51	21	56	23	60	25	53	16	58	17	62	18	65	19
Louisville, Ky.	23,000	30	42	36	46	40	49	45	52	34	36	38	39	41	41	43	42	40	24	46	27	50	30	53	31	47	18	53	21	56	22	58	23
New Orleans, La.	3,000	30	6	36	6.2	40	6.8	44	7.2	35	5.0	40	5.5	44	5.8	47	6.0	42	3.4	46	3.7	50	4.0	54	4.3	49	2.6	53	2.8	57	3.0	60	3.2
Shreveport, La.	5,100	30	9.5	36	10.5	41	10.9	45	11.6	36	8.2	40	9	45	9.7	50	10.2	43	5.5	48	6	52	6.7	57	7.5	51	4.5	55	4.9	59	5.2	62	5.5
Eastport, Me.	25,000	24	38	27	41	30	44	32	46	30	34	34	38	37	40	40	43	37	23	42	26	44	27	48	30	44	18	50	21	53	22	56	24
Portland, Me.	25,000	27	41	31	45	34	48	38	50	31	35	35	38	38	41	41	44	38	24	44	27	47	29	50	31	46	19	50	21	53	22	56	24
Baltimore, Md.	16,700	30	32	36	36	40	38	45	40	37	27	42	30	46	32	50	34	46	20	51	22	55	24	59	26	52	15	57	17	62	20	66	22
Boston, Mass.	25,000	28	42	33	47	37	50	41	52	35	38	40	43	43	45	47	47	42	26	46	28	50	31	54	33	50	21	54	23	57	24	61	26
Nantucket, Mass.	25,000	27	41	32	46	37	50	41	52	35	38	39	42	42	45	46	47	42	26	46	28	50	31	54	33	51	21	55	23	58	24	61	27
Alpena, Mich.	25,000	20	34	23	37	26	40	28	42	28	32	32	36	36	39	39	42	36	23	40	25	43	26	47	29	44	18	49	20	53	22	56	24
Detroit, Mich.	25,000	25	39	30	44	34	48	38	50	34	38	39	42	43	45	47	47	42	26	47	29	51	32	55	34	51	21	56	24	60	25	63	27
East Lansing, Mich.	25,000	21	35	25	39	27	41	29	43	28	32	33	37	36	39	38	41	37	23	40	25	43	26	46	28	44	18	49	20	53	22	56	24
Escanaba, Mich.	25,000	23	37	27	41	30	44	33	47	30	34	35	38	38	41	41	44	38	24	43	26	46	28	50	31	47	19	51	21	55	23	58	24
Grand Haven, Mich.	25,000	24	38	28	42	33	47	37	50	32	36	36	39	41	44	45	46	40	25	45	28	49	31	53	32	48	20	53	22	57	24	60	25
Grand Rapids, Mich.	25,000	24	38	27	41	30	44	34	48	32	36	36	39	39	42	42	45	39	24	43	26	46	28	49	31	46	19	52	22	55	23	57	24
Houghton, Mich.	25,000	22	36	24	38	27	41	30	44	28	32	31	35	35	38	38	41	36	23	38	24	41	25	44	27	42	17	46	19	49	20	52	22
Marquette, Mich.	25,000	24	38	28	42	32	46	34	48	32	36	36	39	40	43	43	45	40	25	44	27	48	30	52	32	48	20	53	22	57	24	60	25
Port Huron, Mich.	25,000	23	37	27	41	29	43	32	46	30	34	35	38	37	40	40	43	37	23	42	26	45	28	48	30	45	19	50	21	54	23	56	24
Sault St. Marie, Mich.	25,000	17	32	21	35	24	38	28	42	25	28	29	33	32	36	35	38	32	20	37	23	40	25	43	26	39	16	44	18	47	19	50	21
Duluth, Minn.	25,000	24	38	27	41	30	44	34	48	32	36	35	38	38	41	42	45	39	24	43	26	47	29	50	31	47	19	52	22	55	23	59	25
Minneapolis, Minn.	25,000	27	41	33	47	37	50	41	52	36	39	41	44	45	46	49	48	44	27	50	31	54	33	58	38	52	22	58	24	62	26	66	28
Moorhead, Minn.	25,000	27	41	33	47	37	50	43	54	36	39	41	44	45	46	51	51	44	27	50	31	54	33	59	37	52	22	58	24	62	26	67	28
St. Paul, Minn.	25,000	27	41	31	45	35	48	40	52	36	39	39	42	43	45	48	47	44	27	48	30	52	32	56	35	52	22	56	24	60	25	64	27
Meridian, Miss.	7,800	30	15	36	16	41	18	44	19	38	14	45	14.7	49	15.5	52	16	47	9.5	53	11	57	11.8	61	12.3	56	7.5	61	8	65	9	69	10
Vicksburg, Miss.	7,300	30	14	35	15	39	16	42	17	37	12	40	13	43	14	48	15	44	8	47	9	50	9.5	55	10.5	51	6.5	54	6.9	57	7.2	62	8
Columbia, Mo.	21,000	30	39	36	44	40	46	44	47	37	36	41	38	46	40	48	42	45	24	49	27	53	29	57	31	53	19	57	21	60	22	64	24
Hannibal, Mo.	16,700	30	32	37	36	42	38	49	42	38	28	45	31	50	34	59	38	46	20	53	23	58	25	65	30	54	16	60	19	65	21	72	22
Kansas City, Mo.	6,700	30	13	36	14.5	41	15.5	46	16	37	12	42	13	47	14	51	14.5	44	8	49	9	54	10	58	11	52	6.2	57	7	61	7.5	65	8
St. Joseph, Mo.	13,300	30	26	36	28	40	30	45	31	37	23	43	25	47	26	50	27	45	16	50	18	55	20	58	21	53	12	58	14	62	15	65	16
St. Louis, Mo.	8,300	30	16	36	18	41	20	46	21	37	15	42	16	47	17	51	18	45	10	50	11	55	12	59	13	53	7.5	57	8.5	61	9	65	10
Springfield, Mo.	17,000	30	33	36	35	40	38	44	40	37	27	42	30	46	32	50	34	44	19	50	22	54	24	58	25	52	15	56	16	60	19	64	21
Havre, Mont.	25,000	17	32	19	33	21	35	23	37	22	25	25	28	27	31	29	33	30	18	33	21	35	22	37	23	36	14	39	16	42	17	45	19
Helena, Mont.	25,000	15	28	18	32	20	34	22	36	18	22	20	23	22	25	24	27	24	15	28	17	30	18	32	20	29	12	33	13	35	14	37	1
Kalispell, Mont.	25,000	14	26	16	30	18	32	20	34	18	22	20	23	22	25	24	27	25	15	28	17	30	18	32	20	30	12	33	13	35	14	37	15
Miles City, Mont.	25,000	16	30	19	33	21	35	23	37	22	25	25	28	27	31	29	33	30	18	33	21	35	22	37	23	35	15	38	16	42	17	44	18
Missoula, Mont.	25,000	13	23	15	28	17	32	19	33	17	21	20	23	22	25	24	27	24	15	27	16	29	18	31	19	29	12	32	13	34	14	36	15

LOCATION	Notch Area	LEVEL								2 INCH RISE								4 INCH RISE								6 INCH RISE							
		Discharge G.P.M. Draindown Time Hrs.								Discharge G.P.M. Draindown Time Hrs.								Discharge G.P.M. Draindown Time Hrs.								Discharge G.P.M. Draindown Time Hrs.							
		10 Yrs.		25 Yrs.		50 Yrs.		100 Yrs.		10 Yrs.		25 Yrs.		50 Yrs.		100 Yrs.		10 Yrs.		25 Yrs.		50 Yrs.		100 Yrs.		10 Yrs.		25 Yrs.		50 Yrs.		100 Yrs.	
incoln, Neb.	18,000	30	34	37	38	42	41	46	43	36	30	41	32	45	34	49	36	44	21	51	24	56	27	60	29	53	16	59	18	62	20	65	22
North Platte, Neb.	25,000	27	41	33	47	39	51	43	54	36	39	43	45	47	47	51	51	44	27	51	32	56	35	60	38	52	22	59	25	63	27	66	28
Omaha, Neb.	22,000	30	40	38	46	43	48	48	52	39	38	44	40	49	43	54	45	46	26	52	29	57	32	62	36	54	21	60	23	64	24	67	26
Valentine, Neb.	25,000	26	40	31	45	36	49	41	52	35	38	40	43	44	46	49	48	43	26	49	31	54	33	59	37	52	22	58	24	62	26	66	28
Reno, Nev.	25,000	14	26	16	30	17	32	18	32	17	21	19	23	21	24	22	25	24	15	26	16	28	17	30	18	29	12	32	13	34	14	36	15
Tonopah, Nev.	25,000	13	23	15	28	17	32	19	33	16	20	18	22	19	23	21	24	20	13	23	14	26	16	28	17	25	10.5	27	11.5	29	12	32	13
Winnemucca, Nev.	25,000	10	20	12	22	13	23	15	28	16	20	18	22	19	23	20	23	22	14	25	15	27	16	28	17	26	11	29	12	32	13	34	14
Concord, N. H.	25,000	27	41	32	46	37	50	41	52	32	36	37	40	40	43	44	46	40	25	45	28	49	31	51	32	46	19	51	21	55	23	58	24
Atlantic City, N. J.	7,800	30	44	38	50	43	54	48	58	37	40	43	45	48	48	54	52	44	27	50	31	55	34	60	38	51	21	57	24	62	26	66	28
Sandy Hook, N. J.	17,000	30	33	36	36	40	38	44	40	37	27	43	30	47	32	50	34	45	20	50	22	54	24	58	25	53	16	58	17	62	20	65	21
Trenton, N. J.	25,000	28	42	33	47	38	50	42	53	36	39	40	43	44	46	47	47	43	26	48	30	52	32	56	35	51	21	56	24	59	25	63	27
Albuquerque, N. M.	25,000	15	28	18	32	20	34	22	36	23	26	26	30	29	33	31	35	31	19	34	21	37	23	39	24	37	15	41	17	44	18	47	19
Roswell, N. M.	25,000	23	37	27	41	30	44	33	47	31	35	36	39	39	42	43	45	39	24	43	26	47	29	51	32	47	19	52	22	56	24	59	25
Santa Fe, N. M.	25,000	16	30	18	32	20	34	22	36	23	26	26	30	28	32	30	34	31	19	34	21	36	23	38	24	37	15	40	16	43	18	46	19
Albany, N. Y.	25,000	23	37	26	40	29	43	32	46	28	32	32	36	35	38	37	40	36	23	39	24	42	26	45	28	43	18	47	19	50	21	53	22
Binghamton, N. Y.	25,000	23	37	27	41	30	44	33	47	30	34	34	38	37	40	40	43	38	24	42	26	46	28	49	31	46	19	51	21	55	23	58	24
Buffalo, N. Y.	25,000	23	37	26	40	29	43	32	46	31	35	36	39	39	42	42	45	39	24	43	26	47	29	50	31	47	19	52	22	56	24	59	25
Canton, N. Y.	25,000	25	39	30	44	35	48	39	51	33	37	39	42	43	45	47	47	40	25	46	28	51	32	56	35	48	20	55	23	59	25	63	27
Ithaca, N. Y.	20,000	30	38	35	41	39	44	43	45	35	32	40	36	45	38	48	40	40	21	46	24	51	27	56	30	47	16	54	19	58	21	62	22
New York, N. Y.	15,800	30	31	36	34	41	37	46	38	38	28	43	30	48	31	52	32	46	19	51	22	56	23	60	24	54	15	59	17	64	18	68	19
Oswego, N. Y.	25,000	19	33	22	36	24	38	26	40	25	28	28	32	30	34	32	36	33	21	36	23	38	24	40	25	38	16	42	17.5	45	19	48	20
Rochester, N. Y.	25,000	22	36	26	40	29	43	31	45	30	34	35	38	37	40	41	44	38	24	42	26	45	28	49	31	45	19	51	21	54	23	56	23.7
Syracuse, N. Y.	25,000	26	40	32	46	36	49	41	52	34	38	40	43	45	46	49	49	42	26	48	30	53	32	57	37	50	21	56	23.7	61	26	65	27
Asheville, N. C.	21,000	30	39	37	44	43	47	47	50	37	36	43	39	47	42	51	43	45	24	51	28	55	30	58	32	52	19	57	21	61	22	65	24
harlotte, N. C.	17,000	30	33	35	35	39	38	42	39	35	26	40	29	45	31	50	34	43	19	48	22	52	23	55	24	51	15	55	16	59	18	62	19
Greensboro, N. C.	16,700	30	32	36	35	41	38	46	40	35	26	38	28	42	30	46	31	41	18	45	20	49	22	52	23	49	15	54	16	57	17	60	18
Hatteras, N. C.	2,500	30	4.6	38	5.5	43	5.8	48	6.2	34	4	41	4.7	46	5	51	5.2	40	2.7	46	3	50	3.4	56	3.6	46	1.9	52	2.2	57	2.5	62	2.7
Raleigh, N. C.	9,000	30	17	36	18	40	20	44	21	37	15	42	17	46	17.5	50	18	45	11	50	12	55	13	59	14	53	8	58	9	61	10	64	11
Wilmington, N. C.	6,800	30	13	36	14	40	15	45	16	36	11	41	12	46	13	50	14	43	7.5	48	9	52	9.8	56	10	51	6	56	6.8	59	7.2	62	7.5
Bismarck, N. D.	25,000	22	36	26	40	29	43	33	47	30	34	35	38	38	41	41	44	38	24	43	26	47	29	50	31	46	19	52	22	55	23.3	58	24
Devils Lake, N. D.	25,000	23	37	27	41	30	44	34	48	30	34	35	38	38	41	41	44	38	24	43	26	47	29	50	31	46	19	52	22	55	23.3	58	24
Williston, N. D.	25,000	21	35	25	39	28	42	31	45	29	33	34	38	38	41	41	41	37	23	42	26	46	28	50	31	45	19	52	22	55	23.3	59	25
Cincinnati, Ohio	25,000	27	41	31	45	35	48	39	51	34	38	39	42	42	45	45	46	42	26	47	29	50	31	53	32	50	21	54	23	57	24	60	25
Cleveland, Ohio	25,000	23	37	26	40	29	43	32	46	30	34	34	38	37	40	40	43	38	24	42	26	45	28	48	30	46	19	50	21	53	22	56	23.7
Columbus, Ohio	25,000	22	36	26	40	28	42	30	44	30	34	34	38	37	40	40	43	38	24	42	26	45	28	48	30	46	19	50	21	53	22	56	23.7
Dayton, Ohio	25,000	24	38	28	42	31	45	34	48	32	36	36	39	39	42	41	44	39	24	43	26	47	29	50	31	47	19	52	22	56	23.7	59	25
Sandusky, Ohio	25,000	28	42	34	48	39	51	43	54	36	39	42	45	47	47	51	51	44	27	50	31	55	34	59	37	52	22	58	24	63	27	66	28
Toledo, Ohio	25,000	26	40	30	44	35	48	39	51	34	38	38	41	43	45	46	47	42	26	46	28	51	32	54	33	50	21	54	23	58	24	62	26
Oklahoma City, Okla.	7,500	30	14	36	16	40	17	44	18	36	12	42	14	46	15	50	16	44	8.5	50	10	54	10.5	58	11.5	52	6.6	57	7.5	60	7.9	64	8.5
Baker, Ore.	25,000	10	20	12	22	13	24	14	26	17	21	19	23	20	23	21	24	23	14	25	15.5	27	16	29	18	26	11	30	12	32	13	34	14
Portland, Ore.	25,000	22	36	25	39	29	43	32	46	26	30	30	34	33	37	36	39	34	21	38	24	41	25	44	27	38	16	42	17.5	46	19	48	20
Roseburg, Ore.	25,000	22	36	25	39	29	43	32	46	26	30	30	34	33	37	36	39	34	21	38	24	41	25	44	27	37	15	42	17.5	45	19	47	19
Erie, Pa.	21,000	30	39	38	44	44	47	48	50	38	36	45	40	49	42	54	44	45	24	52	29	57	31	62	33	53	19	58	21	63	23	67	25
Harrisburg, Pa.	25,000	28	42	33	47	37	50	41	52	35	38	40	43	44	46	48	48	43	26	48	30	52	32	56	35	51	21	56	24	60	25	64	27
Philadelphia, Pa.	25,000	29	43	34	48	38	50	41	52	36	39	40	43	43	45	47	47	43	26	48	30	52	32	56	35	51	21	56	24	59	25	62	26
Pittsburgh, Pa.	25,000	22	36	25	39	27	41	29	43	29	33	33	36	35	38	37	40	37	23	40	25	43	26	45	28	45	19	49	20	51	21	54	23
Reading, Pa.	25,000	30	44	37	50	42	53	46	56	38	41	45	46	49	49	52	52	45	28	52	32	57	35	60	38	53	22	59	25	63	27	67	28
Scranton, Pa.	25,000	26	40	30	44	34	48	38	50	34	38	38	41	41	44	44	46	41	25	46	28	49	31	52	32	49	20	54	23	57	24	60	25
ock Island, R. I.	25,000	26	40	30	44	34	48	38	50	34	38	38	41	41	44	44	46	41	25	46	28	49	31	52	32	48	20	54	23	57	24	59	25
Providence, R. I.	25,000	30	44	37	50	42	53	47	57	38	41	44	46	48	48	53	53	46	28	51	32	56	35	61	38.5	54	23	58	24	62	26	66	28
Charleston, S. C.	3,800	30	7.2	37	8	41	8.5	46	9	36	6.2	40	6.8	46	7.2	51	7.8	44	4.2	48	4.8	54	5.4	59	5.9	51	3.4	56	3.6	60	3.8	63	4
Columbia, S. C.	16,700	30	32	36	35	40	38	44	39.2	37	27.5	43	30.5	46	32	49	33.5	44	19.4	50	22.2	54	23.8	57	24.6	52	15.5	58	17.5	61	19.5	64	21

LOCATION	Notch Area	LEVEL								2 INCH RISE								4 INCH RISE								6 INCH RISE							
		Discharge G.P.M.								Discharge G.P.M.								Discharge G.P.M.								Discharge G.P.M.							
		Draindown Time Hrs.								Draindown Time Hrs.								Draindown Time Hrs.								Draindown Time Hrs.							
		10 Yrs.		25 Yrs.		50 Yrs.		100 Yrs.		10 Yrs.		25 Yrs.		50 Yrs.		100 Yrs.		10 Yrs.		25 Yrs.		50 Yrs.		100 Yrs.		10 Yrs.		25 Yrs.		50 Yrs.		100 Yrs.	
Greenville, S. C.	11,700	30	24	36	25.5	39	26.5	43	28	36	20	41	21.5	45	22.5	49	23	44	13	48	14	52	15.5	56	17	52	11	56	12	60	13	64	1
Huron, S. D.	25,000	24	38	27	41	30	44	34	48	32	36	36	39	39	42	43	45	39	24	44	27	48	30	52	32	47	19	53	22	56	23.7	59	25
Pierre, S. D.	25,000	23	37	26	40	28	42	31	45	31	35	35	38	37	40	40	43	38	24	43	26	46	28	49	31	46	19	51	21	54	23	57	24
Rapid City, S. D.	25,000	25	39	31	45	35	48	39	51	32	36	37	40	40	43	44	46	39	24	45	28	49	31	52	32	46	19	52	22	56	23.7	59	25
Yankton, S. D.	25,000	27	41	31	45	36	49	41	52	36	39	40	43	45	46	49	49	44	27	49	31	54	33	58	36	53	22	58	24	62	26	66	28
Chattanooga, Tenn.	17,000	30	33	35	35	38	37	41	38	36	27	40	29	43	30.5	46	32	43	19	47	20.7	51	22.7	55	24.3	51	14.8	55	16.7	58	17.5	61	19.5
Knoxville, Tenn.	25,000	29	43	36	49	40	52	44	54	37	40	43	45	47	47	51	51	45	28	51	32	55	34	59	37	53	22	59	25	63	27	66	28
Memphis, Tenn.	9,000	30	17	36	18	40	20	45	21	36	15	41	17	45	17.5	49	18	43	10	48	11	52	12	56	13	51	8	55	9	59	9.5	62	10.2
Nashville, Tenn.	25,000	29	43	35	48	39	51	42	53	37	40	43	45	46	47	49	48	45	28	50	31	55	34	58	36	53	22	58	24	62	26	65	27
Abilene, Tex.	8,500	30	16	37	17.5	41	18.5	46	20	37	14.5	43	16	47	17	51	18	44	10	50	11	55	12	59	13	52	7.8	58	8.5	61	9	64	9.5
Amarillo, Tex.	25,000	30	44	37	50	42	53	46	56	38	41	43	45	48	48	52	52	46	28	51	32	56	35	60	38	54	23	59	25	63	27	67	28
Austin, Tex.	4,300	30	8.5	36	9.5	41	10	46	10.5	36	7.2	40	7.8	46	8.5	51	9	44	5	49	5.7	54	6.2	59	6.8	52	3.8	57	4.2	61	4.7	65	5
Brownsville, Tex.	3,500	30	6.8	36	7.2	41	7.8	46	8	36	5.8	40	6.2	45	6.8	50	7.2	44	4	49	4.5	54	5	58	5.5	52	3.1	56	3.3	60	3.5	64	4
Corpus Christi, Tex.	7,000	30	13.5	35	14	39	15	43	16	36	11.5	41	12.5	45	13.5	49	14	44	8	48	9	52	9.8	56	10.6	51	6	56	6.4	59	7	62	7.5
Dallas, Tex.	4,500	30	8.5	36	9.5	40	10	44	10.4	36	7.2	40	7.8	45	8.4	50	8.9	43	4.9	48	5.7	52	6	56	6.5	50	3.5	56	4	59	4.4	62	4.7
Del Rio, Tex.	4,200	30	8.5	38	9.5	43	10.3	48	11	36	7.2	41	8	48	8.8	53	9.2	43	4.9	49	5.7	55	6.2	60	7	50	3.8	56	4.2	61	4.7	66	5
El Paso, Tex.	25,000	16	29	18	32	20	34	22	36	24	27	27	31	29	33	31	35	32	20	36	23	38	24	40	25	38	16	43	18	46	19	49	20
Fort Worth, Tex.	6,500	30	12.4	36	13	40	13.5	44	14.8	37	11	41	11.9	45	12.2	49	13	44	7.2	49	8	52	8.8	56	9.5	51	5.7	56	6.2	59	6.5	62	7
Galveston, Tex.	1,800	30	3.5	38	3.9	45	4.2	49	4.5	36	3.1	43	3.5	49	3.7	53	3.9	44	2.1	49	2.5	54	2.8	59	3	50	1.6	56	1.8	61	2	66	2.2
Houston, Tex.	2,450	36	4.6	37	5.2	41	5.5	45	5.7	35	4	40	4.3	44	4.7	48	5	43	2.9	47	3.1	51	3.5	54	3.8	50	2.1	54	2.3	57	2.5	60	2.6
Port Arthur, Tex.	2,600	30	4.6	38	5.5	43	5.8	47	6	36	4.2	41	4.7	45	5	49	5.3	44	3	49	3.3	53	3.7	57	4	49	2	54	2.3	58	2.7	62	2.8
San Antonio, Tex.	8,150	30	15	37	17	41	18	46	19	37	14	42	15.2	47	16	52	17	45	9.5	50	10.5	55	11.5	60	13	53	7.2	57	8	60	8.5	64	9.5
Taylor, Tex.	2,100	30	4	40	4.7	47	5	53	5.3	37	3.7	44	4	51	4.3	57	4.6	44	2.5	50	3	56	3.2	62	3.6	49	1.8	56	2	62	2.3	67	2.7
Tyler, Tex.	5,800	30	11	36	12	40	13	44	13.8	37	10	41	10.5	45	11	49	11.5	44	6.5	49	7.5	53	8	57	9	52	5.4	57	5.9	60	6.2	64	6.6
Modena, Utah	25,000	16	29	18	32	20	34	22	36	24	27	27	31	30	34	32	36	32	20	36	23	38	24	40	25	38	16	42	17.5	46	19	50	2
Salt Lake City, Utah	25,000	13	23	15	28	16	30	17	32	18	22	20	23	22	25	24	27	25	15	28	17	30	18	32	20	31	13	34	14	36	14	38	16
Burlington, Vt.	25,000	22	36	25	39	28	42	32	46	26	30	29	33	32	36	35	38	34	21	38	24	40	25	42	26	40	17	44	18	46	19	49	20
Northfield, Vt.	25,000	26	40	31	45	36	49	41	52	31	35	36	39	40	43	45	46	38	24	43	26	47	29	51	32	45	19	50	21	54	23	57	24
Cape Henry, Va.	15,300	30	30	36	32	40	34	45	37	38	27	45	29	49	31	54	32	47	19	53	21	58	24	62	26	56	15	61	17	66	19	70	20
Lynchburg, Va.	18,000	30	34	36	38	41	41	45	43	38	30	44	33	48	36	52	38	45	21	51	24	55	26	60	29	52	16	58	19	62	20	66	22
Norfolk, Va.	8,300	30	16	35	18	40	19	44	20	36	14	41	15	46	16	49	17	44	9.5	49	10.5	53	12	57	13	52	7.5	56	8	60	9	63	9.5
Richmond, Va.	8,000	30	16	37	18	42	19	47	20	37	14	44	15	49	16	54	17	45	9.5	51	10.5	56	12	61	13	53	7.5	58	8	63	9	68	10.5
Wytheville, Va.	25,000	26	40	30	44	34	48	38	50	34	38	38	41	42	45	45	46	41	25	46	28	50	31	54	33	49	20	54	23	57	24	61	26
North Head, Wash.	25,000	22	36	24	38	26	40	28	42	26	30	28	32	29	33	31	35	33	21	36	23	38	24	40	25	37	15	41	17	43	18	45	19
Port Angeles, Wash.	25,000	15	28	18	32	20	34	22	36	19	23	22	25	23	26	25	28	26	16	29	18	31	19	34	21	29	12	33	13	35	14	37	15
Seattle, Wash.	25,000	16	30	19	33	21	35	23	37	21	24	24	27	26	30	28	32	27	16	31	19	33	21	36	23	32	13	36	15	38	16	40	17
Spokane, Wash.	25,000	12	22	14	26	15	28	16	30	17	21	19	23	20	23	22	25	21	13	24	15	26	16	29	18	27	12	30	12	32	13	34	14
Tacoma, Wash.	25,000	17	32	20	34	22	36	24	38	23	26	26	30	28	32	30	34	30	18	33	21	37	23	39	24	35	14	38	16	41	17	44	18
Tatoosh, Wash.	25,000	27	41	32	46	33	47	39	51	32	36	36	39	39	42	42	45	40	25	44	27	47	29	50	31	46	19	49	20	52	22	56	24
Walla Walla, Wash.	25,000	13	23	15	28	16	30	18	32	16	20	18	22	19	23	20	23	22	14	24	15	26	16	27	17	26	11	28	12	30	12	31	13
Yakima, Wash.	25,000	7	17	9	19	10	20	11	21	16	20	18	22	19	23	20	23	21	13	24	15	27	16	29	18	26	11	29	12	32	13	34	14
Elkins, W. Va.	25,000	27	41	32	46	37	50	41	52	34	38	40	43	44	46	48	48	42	26	48	30	52	32	56	35	50	21	56	24	59	25	62	26
Parkersburg, W. Va.	25,000	25	39	28	42	31	45	34	48	32	36	36	39	39	42	42	45	40	25	44	27	47	29	50	31	48	20	53	22	56	24	59	25
Green Bay, Wis.	25,000	24	38	28	42	31	45	35	48	32	36	36	39	39	42	43	45	39	24	44	27	47	29	51	32	47	19	53	22	56	23	59	25
La Crosse, Wis.	25,000	28	42	31	45	35	48	39	51	35	38	40	43	43	45	46	47	43	26	48	30	52	32	56	35	51	21	56	24	59	25	62	26
Madison, Wis.	25,000	29	43	36	49	40	52	44	54	37	40	43	45	47	47	50	50	46	28	51	32	55	34	60	38	54	23	60	25	62	26	65	28
Milwaukee, Wis.	25,000	26	40	30	44	35	48	39	51	34	38	38	41	42	45	45	46	41	25	45	28	49	31	53	32	49	20	54	23	57	24	60	25
Cheyenne, Wyo.	25,000	17	32	19	33	21	35	23	37	24	27	27	31	30	34	33	37	32	20	36	23	38	24	40	25	39	16	44	18	47	19	50	21
Lander, Wyo.	25,000	15	28	19	33	21	35	23	37	21	24	25	28	27	31	29	33	28	17	32	20	35	22	37	23	33	13	36	14	39	16	42	1
Sheridan, Wyo.	25,000	19	33	24	38	27	41	30	44	26	30	30	34	33	37	36	39	34	21	38	24	41	25	44	27	39	16	44	18	48	20	52	22
Yellowstone Pk., Wyo.	25,000	12	22	14	26	15	28	16	30	16	20	17	21	18	22	19	23	22	14	24	15	25	15	26	16	26	11	28	12	29	12	30	12
San Juan, Puerto Rico	3,000	30	5.9	38	6.6	44	7	48	7.3	37	5.3	43	5.7	44	5.8	52	6	45	3.6	50	4	54	4.3	58	4.8	51	2.7	55	2.9	60	3.2	64	3.5

Vertical Drain Leader Selection

While the flow rate for any design condition can be determined from the data on the preceding pages, tabulations below and on the following page can be used to simplify specification of drain line diameters.

Table 1 — Suggested Relation of Drain Outlet and Vertical Leader Size to Wade "Control-Flo" Roof Drains (Based on National Plumbing Code ASA-A40.8 Data on Vertical Leaders.

Table 1 illustrates gallons per minute from each notch that can be carried off by various leader sizes.

Once the drains are selected for a given roof per this manual, read the GPM flow per notch from the chart, refer to Table 1 and select the smallest drain line that will accommodate that flow. Drain pipes should be sized for the 100-year storm unless scuppers are located at a height that will not permit a 100-year storm depth of water to accumulate on the roof.

Table 1

No. of Notches In Drain	Max. Flow per Notch in GPM			
	Pipe Size, Inches			
	2	3	4	5
1	30	60*	—	—
2	15	46	60*	—
3	—	31	60*	—
4	—	23	48	60*

*Maximun flow obtainable from 1 notch.

LOCATION	Notch Area	DEAD-LEVEL				2 INCH RISE				4 INCH RISE				6 INCH RISE			
		Discharge G.P.M. Draindown Time Hrs.				Discharge G.P.M. Draindown Time Hrs.				Discharge G.P.M. Draindown Time Hrs.				Discharge G.P.M. Draindown Time Hrs.			
		10 Yrs.	25 Yrs.	50 Yrs.	100 Yrs.	10 Yrs.	25 Yrs.	50 Yrs.	100 Yrs.	10 Yrs.	25 Yrs.	50 Yrs.	100 Yrs.	10 Yrs.	25 Yrs.	50 Yrs.	100 Yrs.
Tyler, Tex.	5,800	30 11	36 12	40 13	44 13.8	37 10	41 10.5	45 11	49 11.5	44 6.5	49 7.5	53 8	57 9	52 5.4	57 5.9	60 6.2	64 6.6
Modena, Utah	25,000	16 29	18 32	20 34	22 36	24 27	27 31	30 34	32 36	32 20	36 23	38 24	40 25	38 16	42 17.5	46 19	50 21
Salt Lake City, Utah	25,000	13 23	15 28	16 30	17 32	18 22	20 23	22 25	24 27	25 15	28 17	30 18	32 20	31 13	34 14	36 14	38 16
Burlington, Vt.	25,000	22 36	25 39	28 42	32 46	26 30	29 33	32 36	35 38	34 21	38 24	40 25	42 26	40 17	44 18	46 19	49 20
Northfield, Vt.	25,000	26 40	31 45	36 49	41 52	31 35	36 39	40 43	45 46	38 24	43 26	47 29	51 32	45 19	50 21	54 23	57 24

For example, if your installation is in Tyler, Texas, on a level roof the data for the 100-year storm shows a discharge of 44 GPM per notch. For this applications scuppers would be located at a 4.4" height. Using Table 1, a 3" drain pipe or vertical leader would be used for a drain with one or two notches. A 4" leader would be used for a drain with three or four notches.

For Tyler, Texas, and a roof with a 2" rise, the 100-year storm shows a flow rate of 49 GPM. In this case scuppers should be located at a height of 4.9". A 3" leader would be used with a single notch drain, a 4" leader with a two or three notch drain. The same type of selection would be made for a roof with a 4" rise; for Tyler, Texas, the flow rate for the 100-year storm is 57 GPM per notch.

For the roof with a 6" rise, the data for Tyler, Texas, shows a flow rate greater than 60 GPM for the 100-year storm. In these cases the scuppers will be located at the maximum recommended height of 6" and the vertical leaders will be sized for a maximum flow rate of 60 GPM per notch.

In the few cases where data shows a flow rate in excess of 60 GPM for the 100-year storm, if all drains and drain lines are sized according to the recommendations, the only consequence will be a brief flow through the scuppers about once every 100 years.

Horizontal Storm Drain Piping Selection

Table 2 is similar to Table 1 but is used to determine the size of the building storm drain. Use the same flow rate established for sizing the vertical leaders to size the storm drain. Count the total number of notches feeding any one drain or branch to the drain. Enter the table at the total number of notches, and under the proper storm drain slope, select the column that gives a flow rate equal to or larger than the established notch flow rate. Read the storm drain size required at the top of this column.

Table 2 — Suggested Relation of Horizontal Storm Drain Size to Wade "Control-Flo" Roof Drainage. (Based on National Plumbing Code ASA-A40.8 Data on Horizontal Storm Drains with ⅛", ¼" and ½" per foot slope.)

Total No. of Notches Discharging to Storm Drain	MAX. FLOW PER NOTCH IN GPM								MAX. FLOW PER NOTCH IN GPM								MAX. FLOW PER NOTCH IN GPM							
	Storm Drain Size 1/8" per ft. slope								Storm Drain Size 1/4" per ft. slope								Storm Drain Size 1/2" per ft. slope							
	3	4	5	6	8	10	12	15	3	4	5	6	8	10	12	15	3	4	5	6	8	10	12	15
1	34	60*	—	—	—	—	—	—	48	60*	—	—	—	—	—	—	60*	—	—	—	—	—	—	—
2	17	39	60*	—	—	—	—	—	24	55*	60*	—	—	—	—	—	34	60*	—	—	—	—	—	—
3	11	26	46	60*	—	—	—	—	16	37	60*	—	—	—	—	—	22	52*	60*	—	—	—	—	—
4	8	19	34	55	60*	—	—	—	12	28	49	60*	—	—	—	—	17	39	60*	—	—	—	—	—
5	—	15	28	44	60*	—	—	—	—	22	39	60*	—	—	—	—	13	31	60*	—	—	—	—	—
6	—	13	23	37	60*	—	—	—	—	18	33	52*	60*	—	—	—	11	26	46	60*	—	—	—	—
7	—	11	20	32	60*	—	—	—	—	16	28	45	60*	—	—	—	—	22	39	60*	—	—	—	—
8	—	—	17	28	60*	—	—	—	—	14	25	39	60*	—	—	—	—	19	36	55*	60*	—	—	—
9	—	—	15	25	53	60*	—	—	—	12	22	35	60*	—	—	—	—	17	30	49	60*	—	—	—
10	—	—	14	22	48	60*	—	—	—	—	20	31	60*	—	—	—	—	15	27	44	60*	—	—	—
11	—	—	12	20	43	60*	—	—	—	—	18	29	60*	—	—	—	—	14	25	40	60*	—	—	—
12	—	—	—	18	40	60*	—	—	—	—	16	26	56	60*	—	—	—	13	23	37	60*	—	—	—
13	—	—	—	17	37	60*	—	—	—	—	15	24	52	60*	—	—	—	12	21	34	60*	—	—	—
14	—	—	—	16	34	60*	—	—	—	—	14	22	48	60*	—	—	—	—	19	31	60*	—	—	—
15	—	—	—	15	32	57	60*	—	—	—	13	21	45	60*	—	—	—	—	18	29	60*	—	—	—
16	—	—	—	14	30	54	60*	—	—	—	—	20	42	60*	—	—	—	—	17	27	60*	—	—	—
17	—	—	—	13	28	51	60*	—	—	—	—	18	40	60*	—	—	—	—	16	26	56	60*	—	—
18	—	—	—	12	26	48	60*	—	—	—	—	17	37	60*	—	—	—	—	15	24	53	60*	—	—
19	—	—	—	—	25	45	60*	—	—	—	—	16	35	60*	—	—	—	—	14	23	50	60*	—	—
20	—	—	—	—	24	43	60*	—	—	—	—	16	34	60*	—	—	—	—	13	22	47	60*	—	—
23	—	—	—	—	20	37	60*	—	—	—	—	14	29	53	60*	—	—	—	12	19	41	60*	—	—
25	—	—	—	—	19	34	55	60*	—	—	—	13	27	49	60*	—	—	—	—	17	38	60*	—	—
30	—	—	—	—	16	28	46	60*	—	—	—	—	22	40	60*	—	—	—	—	14	31	57	60*	—
35	—	—	—	—	13	24	39	60*	—	—	—	—	19	35	56	60*	—	—	—	12	27	49	60*	—
40	—	—	—	—	12	21	34	60*	—	—	—	—	17	30	49	60*	—	—	—	—	23	43	60*	—
45	—	—	—	—	—	19	31	55*	—	—	—	—	15	27	44	60*	—	—	—	—	21	38	60*	—
50	—	—	—	—	—	17	27	49*	—	—	—	—	13	24	39	60*	—	—	—	—	19	34	55	60*
55	—	—	—	—	—	15	25	45*	—	—	—	—	—	22	35	60*	—	—	—	—	17	31	50	60*
60	—	—	—	—	—	14	23	41*	—	—	—	—	—	20	32	58*	—	—	—	—	15	28	46	60*
65	—	—	—	—	—	13	21	38*	—	—	—	—	—	18	30	54*	—	—	—	—	14	26	42	60*
70	—	—	—	—	—	12	20	35*	—	—	—	—	—	17	28	50*	—	—	—	—	13	24	39	60*

***Maximum flow obtainable from 1 notch.**

Special Considerations for Structural Safety

RIGID ROOF DESIGN

Normal practice of roof design calls for a roof load rating of 30 lbs. per sq. ft. This factor should definitely be kept in mind as a prime requirement for assuring a structurally sound roof. Otherwise, roof deflection may minimize the advantage of a well-designed roof drainage system.

Failure to recognize the adverse effects of roof deflection, even with conventional roof drainage, may lead to roof failure. If severe deflection is permitted, rain water will simply seek low areas and intensify the degree of deflection. It is extremely important that flat roofs are designed in accordance with normal load factors so that deflection will be slight enough in any bay to prevent progressive deflection which could cause water depths to load the roof beyond its design limits.