Rooftop Storage Guidance and Criteria

Appendix H

H.1 Roof Top Storage Design Guidance and Criteria

1. Roof top storage shall be designed to detain the 15-year, 80-minute storm, and emergency overflow provisions must be adequate to discharge the 100-year, 45-minute storm.

Frequency (years)	Duration, t (minutes)	Depth, d (inches)	Intensity, i (inches/hour)
15	80	2.96	2.22
100	45	2.96	3.94

2. If a proper design is submitted for the 15-year storm, sufficient storage will normally be provided for the two-year storm, and separate calculations need not be made.

3. Rainfall from this design storm results in an accumulated storage depth of 2.96 inches (approximately 3 inches).

   A. Based on a snow load of 30 pounds per square foot or 5.8 inches of water, properly designed roofs are structurally capable of holding three inches of detained storm water with a reasonable factor of safety.

   B. Roofs calculated to store depths greater than three inches shall be required to show structural adequacy of the roof design.

4. No less than two roof drains shall be installed in roof areas of 10,000 square feet or less, and at least four drains in roof areas over 10,000 square feet in area. Roof areas exceeding 40,000 square feet shall have one drain for each 10,000 square foot area.

5. Emergency overflow measures adequate to discharge the 100-year, 45-minute storm must be provided.

   A. If parapet walls exceed 3 inches in height, the designer shall provide openings (scuppers) in the parapet wall sufficient to discharge the design storm flow at a water level not exceeding 5 inches.

   B. One scupper shall be provided for every 20,000 square feet of roof area, and the invert of the scupper shall not be more than 3.5 inches above the roof level. (If such openings are not practical, then detention rings shall be sized accordingly).

6. Detention rings shall be placed around all roof drains that do not have controlled flow.

A. The number of holes or size of openings in the rings shall be computed based on the area of roof drained and run-off criteria.

B. The minimum spacing of sets of holes is 2 inches center-to-center.

C. The height of the ring is determined by the roof slope and shall be 3 inches maximum.

D. The diameter of the rings shall be sized to accommodate the required openings and, if scuppers are not provided, to allow the 100-year design storm to overtop the ring (overflow design is based on weir computations with the weir length equal to the circumference of the detention ring).

E. Conductors and leaders shall also be sized to pass the expected flow from the 100-year design storm.

7. The maximum time of drawdown on the roof shall not exceed 17 hours.

8. Josam Manufacturing Company and Zurn Industries, Inc. market "controlled-flow" roof drains. These products, or their equivalent, are acceptable.

9. Computations required on plans:

a) Roof area in square feet.
b) Storage provided at three-inch depth.
c) Maximum allowable discharge rate.
d) Inflow-outflow hydrograph analysis or acceptable charts (for Josam Manufacturing Company and Zurn Industries, Inc. standard drains, the peak discharge rates as given in their charts are acceptable for drainage calculation purposes without requiring full inflow-outflow hydrograph analysis).
e) Number of drains required.
f) Sizing of openings required in detention rings.
g) Sizing of ring to accept openings and to pass 100-year design storm.

H.2 Roof Top Storage Design Example

Given:

- A flat-roofed building with the following dimensions: 200 ft by 50 ft
- Predevelopment runoff coefficient, C = 0.40
- Predevelopment time of concentration, T_c = 10 minutes

Computations:

a) Roof area in square feet:

Roof area = (200 feet) (50 feet) = 10,000 ft^2

b) Storage provided at three-inch depth:

Storage volume = (10,000 ft^2) (3 in) (1 ft /12 in) = 2,500 ft^3

c) Maximum allowable discharge rate:

Maximum allowable discharge rate = predevelopment rate of runoff

Q = CIA = (0.40) (5.92) (10,000 ft^2 / 43,560) = 0.54 cfs

d) Inflow-outflow hydrograph analysis:

From Figure H.1, one set of holes with 3 inches of water will produce runoff or discharge of 6 gpm (0.0134 cfs). See Figure H.2 for a diagram of a typical ponding ring.

e) Number of drains required:

Number of drains required for 10,000 square feet of roof area = 2

f) Sizing of openings required in detention rings:

Number of hole = allowable discharge (Q) divided by 0.0134 cfs per l set of holes.

(0.54 cfs) / (2 drains) = 0.27 cfs per drain

Number of holes = (0.27 cfs) / (0.0134 cfs / set of holes) = 20.1 sets

20.1 sets of holes per drain (Use 20 sets of holes)

g) Sizing of ring to accept openings and to pass 100-year design storm:

Hole sets are spaced 2 inches on center

Circumference = π * diameter

(20 sets) (2 inches / set) = π * diameter

Diameter, D = 12.73 inches

Use 15 inches (see below if separate emergency overflow is not provided)

h) If detention rings are to act as emergency overflow measures:

Q_{100} = CIA

Where: t_c = 5 minutes
C = 1.0
A = 10,000 square feet / 43,560

Q_{100} = (1.0) (9.84) (10,000 ft^2 / 43,560) = 2.26 cfs

Weir formula: $Q = CLH^{3/2}$

Where: C = 3.33
L = circumference = π D
D = diameter
H = 2 inches = 0.17 feet

Assume all hole sets are clogged and the maximum allowable water depth on the roof is 5 inches, or 2 inches above the 3-inch high ring.

Q per drain = (2.26 cfs) / (2 drains) = (3.33) (π D) $(0.17 \text{ feet})^{3/2}$

D = 1.54 feet = 18.5 inches

Use diameter of 20 inches

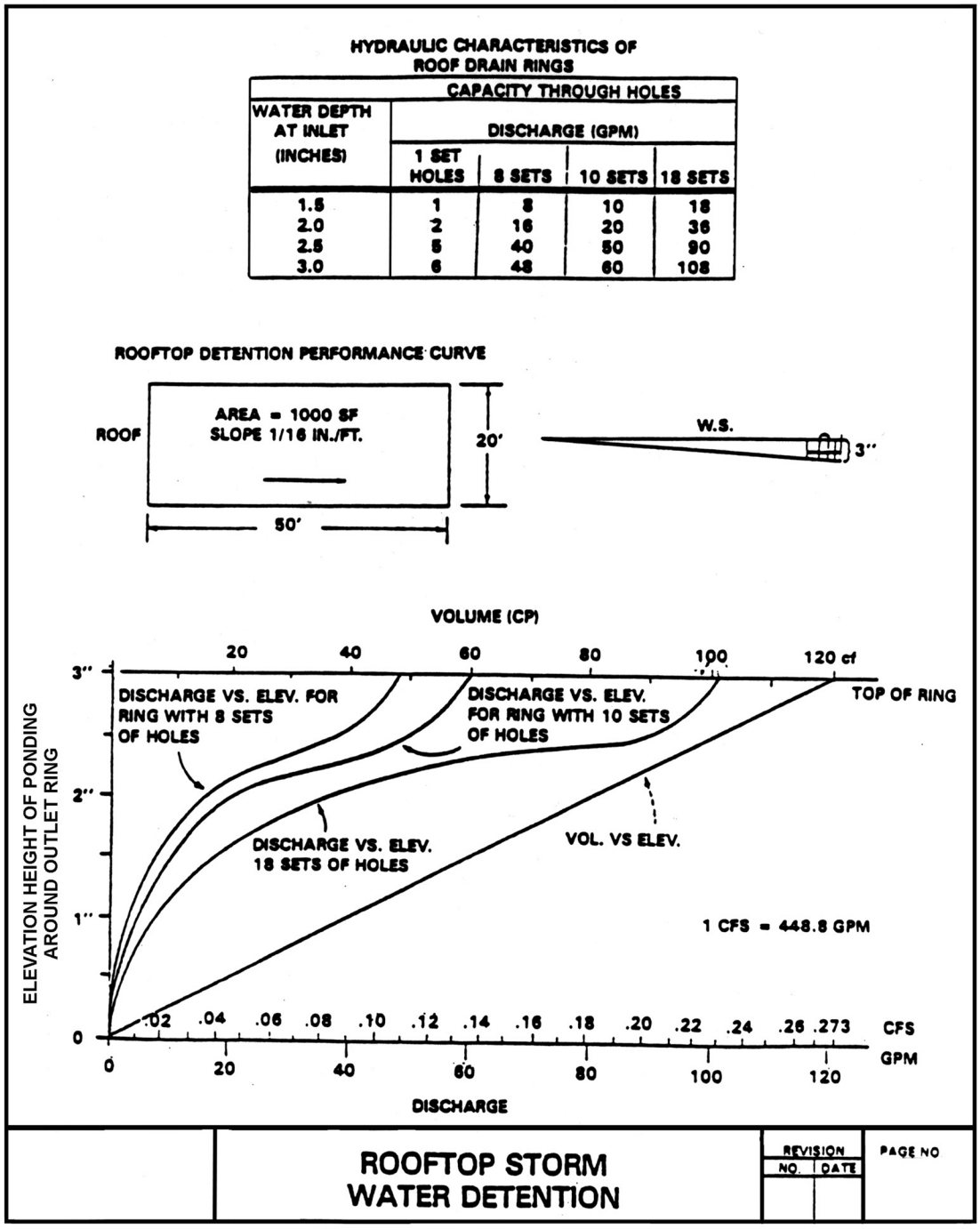

Figure H.1 Rooftop Storm Water Detention

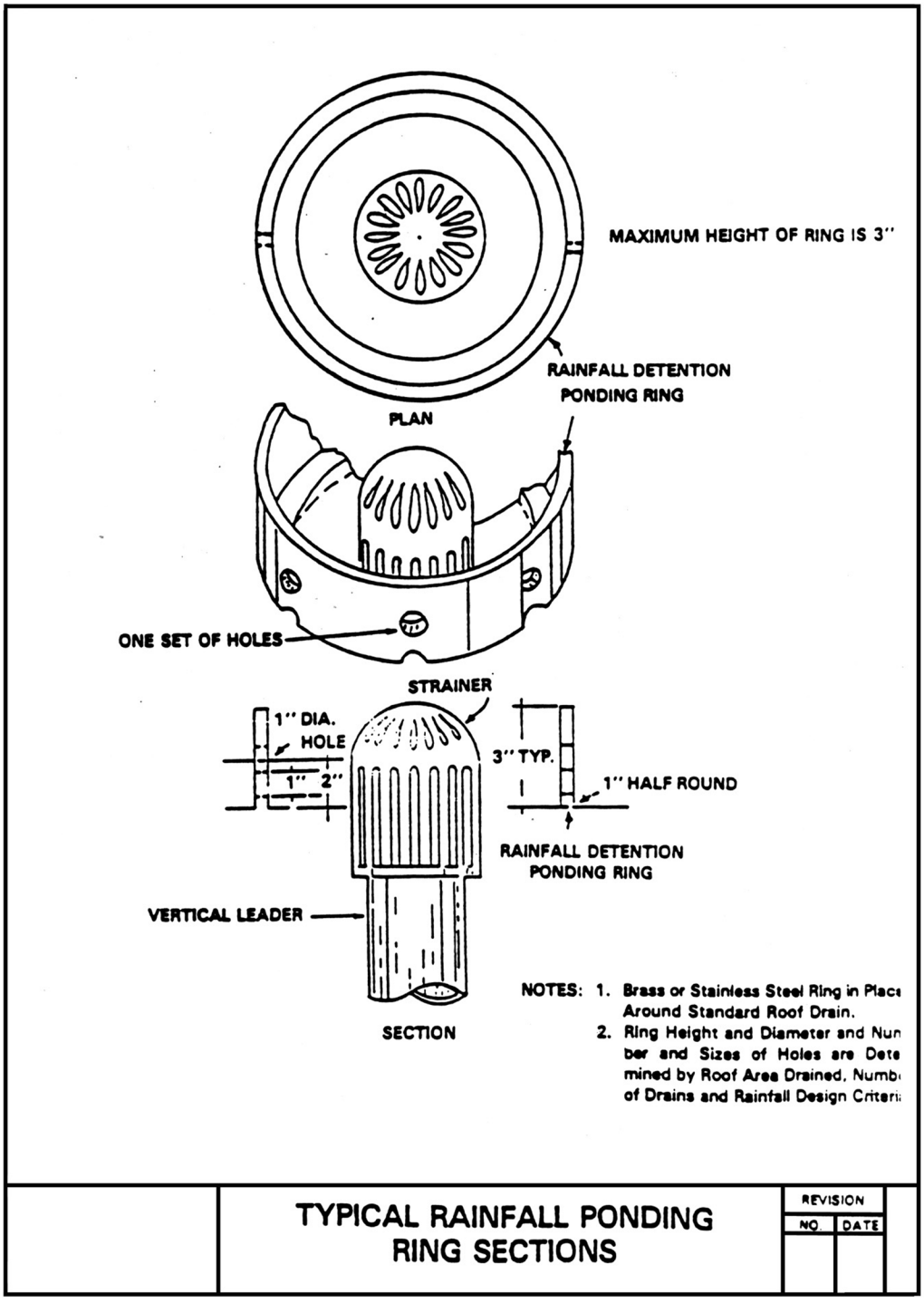

Figure H.2 Typical Rainfall Ponding Ring Sections