Chapter C8
RAIN LOADS

C8.1 SYMBOLS

A = roof area serviced by a single drainage system, in ft^2 (m^2)
i = design rainfall intensity as specified by the code having jurisdiction, in./h (mm/h)
Q = flow rate out of a single drainage system, in gal/min (m^3/s)

C8.2 ROOF DRAINAGE

Roof drainage systems are designed to handle all the flow associated with intense, short-duration rainfall events. For example, the BOCA (1993) and Factory Mutual Engineering Corp. (1991) use a 1-h duration event with a 100-yr return period; SBCCI (1991) uses 1-h and 15-min duration events with 100-yr return periods for the primary and secondary drainage systems, respectively, and Associate Committee on the National Building Code (1990) uses a 15-min event with a 10-yr return period. A very severe local storm or thunderstorm may produce a deluge of such intensity and duration that properly designed primary drainage systems are temporarily overloaded. Such temporary loads are adequately covered in design when blocked drains (see Section 8.3) and ponding instability (see Section 8.4) are considered.

Roof drainage is a structural, architectural, and mechanical (plumbing) issue. The type and location of secondary drains and the hydraulic head above their inlets at the design flow must be known in order to determine rain loads. Design team coordination is particularly important when establishing rain loads.

C8.3 DESIGN RAIN LOADS

The amount of water that could accumulate on a roof from blockage of the primary drainage system is determined and the roof is designed to withstand the load created by that water plus the uniform load caused by water that rises above the inlet of the secondary drainage systems at its design flow. If parapet walls, cant strips, expansion joints, and other features create the potential for deep water in an area, it may be advisable to install in that area secondary (overflow) drains with separate drain lines rather than overflow scuppers to reduce the magnitude of the design rain load. Where geometry permits, free discharge is the preferred form of emergency drainage.

When determining these water loads, it is assumed that the roof does not deflect. This eliminates complexities associated with determining the distribution of water loads within deflection depressions. However, it is quite important to consider this water when assessing ponding instability in Section 8.4.

The depth of water, d_h, above the inlet of the secondary drainage system (i.e., the hydraulic head) is a function of the rainfall intensity, i, at the site, the area of roof serviced by that drainage system, and the size of the drainage system.

The flow rate through a single drainage system is as follows:

$$Q = 0.0104A\,i \qquad \text{(C8-1)}$$

(in SI: $Q = 0.278 \times 10^{-6}\,A\,i$)

The hydraulic head, d_h, is related to flow rate, Q, for various drainage systems in Table C8-1. That table indicates that d_h can vary considerably depending on the type and size of each drainage system and the flow rate it must handle. For this reason the single value of 1 in. (25 mm) (i.e., 5 lb/ft^2 (0.24 kN/m^2)) used in ASCE 7-93 has been eliminated.

The hydraulic head, d_h, is zero when the secondary drainage system is simply overflow all along a roof edge.

C8.4 PONDING INSTABILITY

Water may accumulate as ponds on relatively flat roofs. As additional water flows to such areas, the roof tends to deflect more, allowing a deeper pond to form there. If the structure does not possess enough stiffness to resist this progression, failure by localized overloading may result. Haussler (1962), Chinn (1965), Marino (1966), Salama and Moody (1967), Sawyer (1967), Chinn et al. (1969), Sawyer (1969), Heinzerling (1971), Burgett (1973), AITC (1978), Associate Committee on the National Building Code (1990), Factory Mutual Engineering Corp. (1991), SBCCI (1991), BOCA (1993), AISC (2005), and SJI (2007) contain information on ponding and its importance in the design of flexible roofs. Rational