The importance of proper slope

by **Mark S. Graham**

Most roofing professionals understand how important it is to incorporate proper slope in low-slope membrane roof system design. However, many existing roof systems and even some newly designed ones have little or no slope to assist in proper drainage.



This column addresses building code requirements for low-slope membrane roof systems' minimum slopes, provides NRCA's recommendations for minimum roof system slope and offers data that illustrate the importance of adequate slope.

Code requirements

Most building codes provide prescriptive requirements for the minimum slope necessary to achieve low-slope membrane roof system drainage. Following is a review of the model building codes' minimum slope requirements:

- According to *The BOCA* [Building Officials and Code Administrators International] *National Building Code/1996,* "Roofs shall have a design slope of a minimum of one-fourth unit vertical in 12 units horizontal (¼:12) [2 percent] for drainage, except for coal-tar built-up roofs [BUR membrane systems], which shall have a design slope of a minimum one-eighth unit vertical in 12 units horizontal (⅛:12) [1 percent]." For reroofing situations, the same design minimum slope requirements apply.
- The *Standard Building Code* [SBC], *1997 Edition,* indicates, "Low-slope roofs shall be designed for a minimum ¼ inch/ft [sic] (20.8 mm/m) [2 percent] slope unless specific water-retaining roof materials are to be installed."

  SBC does not specify what constitutes water-retaining roofing materials; however, the *SBCCI* [Southern Building Code Congress International Inc.] *Building Code Commentary, 1997 Edition,* (SBC Commentary) indicates coal-tar BUR membrane systems can be considered water-retaining.

  For reroofing situations, SBC notes the prescribed design slope requirements need not be met "... for roofs that provide positive drainage." SBC does not specifically define positive drainage; however, the SBC Commentary references NRCA's positive drainage definition. *The NRCA Roofing and Waterproofing Manual, Fourth Edition,* defines positive drainage as "the drainage condition in which consideration has been made during the design for all loading deflections of the deck, and additional roof slope has been provided to ensure drainage of the roof area within 48 hours of rainfall during ambient drying conditions."
- The *1997 Uniform Building Code* indicates, "Roofs shall be sloped a minimum of 1 unit vertical in 48 units horizontal (2 percent slope) for drainage unless designed for water accumulation in accordance with Section 1611 and approved by the building official." Section 1611 of the code provides a requirement that a roof system be designed to resist the additional ponding load of any water accumulation.

  For reroofing, the same requirements apply, except for re-cover applications. In a re-cover situation, a building official may approve an existing substrate's slope provided the roof drains and drainage are sufficient to prevent extensive water accumulation.
- *The CABO* [Council of American Building Officials] *One- and Two-Family Dwelling Code, 1995 Edition,* which applies to one- and two-family residential construction in certain jurisdictions, does not contain specific minimum slope requirements for low-slope membrane roof systems.

NRCA's recommendations

Because every building and roof system has specific conditions and design criteria, rather than simply specifying a ¼ inch per foot (2 percent) slope, NRCA recommends designers specify roof systems to have slopes adequate to provide positive drainage.

Consideration of roof deck deflection and camber (i.e., upward curvature) is important when selecting adequate roof system slope. Generally, roof deck structural design methods are intended to limit deck deflection to $\frac{1}{240}$ of a deck's span (i.e., about $\frac{1}{16}$ inch per foot [0.5 percent]). Deck camber generally is not limited by most structural design methods.

NRCA suggests designers provide additional slope of a minimum of ⅛ inch per foot (1 percent) beyond what is necessary to compensate for deck deflection to achieve an actual slope and ensure positive drainage.

For roof decks designed with deflection limits more rigid than $\frac{1}{240}$, actual roof system slopes of less than ¼ inch per foot (2 percent) are possible to achieve positive drainage. For these situations, a roof deck's ponding load and ponding stability may need to be verified.

Is it important?

NRCA frequently is asked whether adequate slope to provide for proper drainage of a low-slope membrane roof system is an important consideration in a system's performance.

Data included in NRCA's Project Pinpoint reveal that more than 66 percent of all problem jobs had roof system slopes of less than ¼ inch per foot (2 percent). It can be concluded that proper slope is a crucial component in low-slope membrane roof assemblies' performances. PR

Mark S. Graham is NRCA's associate executive director of technical services.