New ballast guidelines may be just a stone's throw away

Loose-laid, ballasted single-ply roofing is a great idea, but it's not perfect. As some have discovered recently, a strong gale or a heavy rain can turn a simple, efficient and inexpensive loose-laid system into a costly and possibly dangerous failure. Ballast too small for an area's high winds has blown off roofs and damaged surrounding buildings. And roofs that have been loaded down with added ballast have collapsed under weight they weren't designed to support. Because of these incidents, finding ways to preserve loose-laid's advantages while solving its problems has become an industry-wide concern.

The value of staying loose

In a loose-laid system, only the edges of the single-ply membrane are attached to the building. The rest of the roof is weighted down with smooth river-washed stone ballast. Contractors have found that a loose-laid installation requires less material, time and personnel. Also, because a loosely laid roof is isolated from the substrate, building and deck movement can't exert destructive forces on the membrane.

The simplicity and efficiency of the loose-laid concept has made it one of the most popular single-ply specifications. Carlisle SynTec, manufacturer of EPDM roofing, says its loose-laid design is the company's most requested system.

However, a loose-laid system's ballast may be both a blessing and a curse. Using a topcoat of river-washed stones to weight the roof down avoids the costly and time-consuming process of adhering the membrane to the substrate. On the other hand, the added weight of the stone, necessary to hold the roof in place during high winds, may be too much for structures to support that were originally designed for lighter systems. There may also be a problem with individual ballast stones being blown off the roof during severe storms, a phenomenon called wind scour.

ICBO to receive SPRI guidelines soon

by Martin Eastman

The Midwest Roofing Contractors Association (MRCA) addressed these problems at its annual meeting last October during a session titled "Reroofing against wind." Speaking at the session, former NRCA president Bill Kugler said the problems of weight and wind scour can work together to put the contractor between a rock and a hard place. According to Kugler, the contractor may apply the ballast at the specified size and rate, and find later that it was not enough to prevent wind scour. But adding pavers or heavier stones to the roof to prevent further scouring may overload the roof's structural support.

Ballast specs called to task

MRCA isn't the only group concerned about the problems of loose-laid single-ply roofing. Several organizations have formed task groups to develop standards, specifications and guidelines that will help the industry design and install sound loose-laid systems. An American Society for Testing and Materials (ASTM) task group is revising ASTM's ballast standards, while the Single Ply Roofing Institute (SPRI) and the Rubber Manufacturers Association are working independently on loose-laid system specifications and guidelines.

Carl Marston, chairman of SPRI's task group, said it has completed its ballasted system guidelines and has submitted the work to SPRI's research committee for approval. Once that committee has reviewed and approved the guidelines, they will be sent to the International Congress of Building Owners (ICBO) for review. If ICBO approves SPRI's guidelines, it will incorporate them into its Uniform Building Code.

"The current state-of-the-art recommendations of 10 pounds per square foot minimum just aren't enough" —Kugler

In the meantime, ICBO's model code incorporates an interim standard based on Carlisle's specifications for loose-laid roofing, according to John Nosse, ICBO's assistant technical director. Carlisle's specifications make it the responsibility of the building owner or his representative to determine the proper weight per square foot of ballast to be applied. Carlisle's only requirement is that the ballast weight must exceed 10 pounds per square foot. The specifications also require that 50 percent of the stones used should be retained by a 3/4-inch screen, which means that 50 percent of the stone used may be smaller than 3/4 inch.

Much of the criticism of current loose-laid practice heard at the MRCA conference centered around this standard specification. According to session speaker Rene Dupuis of Structural Research, Inc., Madison, Wis., Carlisle's specified range of ballast size allows stones to be used that are small enough to be blown off during high winds.

Dupuis said that a wind tunnel test of a system using 3/4- to 1 1/2-inch ballast applied at 10 pounds per square foot had to be stopped at 80 mph because the researchers feared the flying rock would damage the test equipment. Applying the ballast at a rate of 15 pounds per square feet yielded the same results, he added. "Simply going back up to this roof and adding additional stone of the same size will get you no further in terms of resistance to scour," Dupuis said. "It could be suggested that you either use a larger diameter stone or perhaps it's a maintenance item, and you should clean up the corners that have scoured."

Dupuis, Kugler and Professor Tom Phalen of Northeastern University in Boston all showed films during the MRCA session that demonstrated the effects of high winds on ballasted systems. Dupuis' film showed model roofs being tested in a wind tunnel while Phalen's film showed a test roof constructed outdoors being subjected to artificially created winds. Kugler's film was shot by a contractor on the top of an actual roof during a severe storm. All three films showed ballast being scoured or completely blown off roofs at wind speeds between 80 and 100 mph.

Kugler summed up the conclusions MRCA has drawn from the evidence presented in the films and in other research it has reviewed by saying, "The current state-of-the-art recommendations of 10 pounds per square foot minimum just aren't enough. We need better guidelines."

SPRI develops guidelines

SPRI is hoping to provide ballast guidelines to the industry soon. Marston said his task group's work will offer criteria that designers and code officials can use to determine each building's ballast needs.

SPRI's guidelines feature a chart that will help building code officials determine the highest wind speeds an area's roofs must be designed to withstand. The chart is based on the American National Standards Institute's (ANSI) 1982 wind isotach charts along with information about the effects of building design and topography on wind behavior, Marston explained. The guidelines translate this information into ballast criteria such as the nominal stone size and the amount of coverage necessary to meet a roof's expected wind load.

The SPRI task group studied many sources of information before penning its own criteria, according to Marston. Test data from manufacturers and design consultants was used as well as the extensive wind design work conducted by R.J. Kind of Carleton University, Ottowa, Ontario, and R.L. Wardlaw of the National Research Council of Canada, Ottowa, Ontario.

Even though SPRI's task group attempted to create broad, generic guidelines represent extensive research, a local code that has incorporated them still may not be adequate for every roof. It must be understood that the guidelines offer only minimum specifications, according to Marston. Each manufacturer must decide if local codes meet its membrane's requirement for wind uplift, scour and ultraviolet resistance. It is the manufacturer's responsibility to inspect each roof to determine if more ballast is needed than the local code calls for, Marston said.

Test standards coming

One problem the industry has encountered as it attempts to develop wind design criteria is the lack of a wind test standard that will accurately predict how a particular roof system will react to wind forces. Marston said SPRI is developing such a test. The test will show the effects of wind scour and uplift as these forces act together on a roof. The development of the test standard is going slowly, however, because SPRI is hoping the test will address as many rooftop conditions as possible. Once completed, the final test standard will be reviewed by ICBO, ANSI and Factory Mutual.