BY ARDIS BERGHOFF

As builders, building inspectors, homeowners and even national media continue to closely inspect exterior insulation and finish system construction techniques and performance criteria, providing solid, factual information about the benefits of water-managed EIFS is becoming increasingly vital to the continued growth of the industry.

During the past year, virtually all major EIFS manufacturers have expanded their system offerings to include water-managed or drainable systems. This effort, of course, has occurred in response to concerns over problems associated with barrier systems and the resulting marketplace demand for systems that eliminate moisture damage concerns. Whether the industry
views barrier problems as minimal or exaggerated is beside the point, if you are an EIFS homeowner you want a system that you can rely on to provide weather protection. Water-managed systems have been touted as the answer, the fix to the problem. The questions designers, installers, home builders and owners want to know are: Where’s the proof? How do we know water-managed systems won’t create the same types of problems that have occurred with barrier systems?

United States Gypsum Company, Chicago, can offer some answers. The company stopped marketing barrier systems in April 1996 and has since sold only water-managed stucco-look systems. As part of that business decision, USG has conducted in-depth research on water-managed systems. This research, according to Jim Reicherts, product manager exterior systems for U.S. Gypsum, offers definitive proof that water-managed systems do, in fact, reduce the potential for water intrusion damage.

“We feel that we’ve taken a great concept—EIFS—and improved it so that it performs as well as or better than other conventional exteriors, including brick, vinyl, aluminum and wood sidings,” Reicherts said. “That’s the message we want to convey.”

The research behind that message has been developed by USG in conjunction with the National Research Council of Canada and its Institute for Research in Construction, an internationally recognized authority on exterior building envelope construction and performance. Beginning in 1996, IRC conducted a series of in-depth studies of water-managed and barrier EIF systems in controlled laboratory environments.

THE RAINSCREEN PRINCIPLE

The key concept behind water-managed systems is the “rainscreen principle,” which assumes that some water will penetrate the exterior surface of the wall and must be removed
through a second line of defense. According to the Construction Technology Update No. 9, “Evolution of wall design for controlling rain penetration,” published by the IRC, various types of rainscreen walls have become the norm for low-rise construction.

The concept has evolved during the last 50 years to become the preferred approach for rain-penetration control and is based on the historical method of using an air space or drainage plane, a water-resistant layer, as well as joint and junction details for multiple elements of protection. Typically, building paper is wrapped around the building structure to act as the drainage plane. Any water that penetrates the exterior skin through window frames, sealant joints and other openings is stopped by the building paper and flashings. The water then flows downward due to gravity and weeps out at the bottom of the wall or other horizontal terminals to the outside surface of the cladding. Using that premise as an underlying theme behind its research and development work, USG and IRC have jointly tested and demonstrated that the “rainscreen principle” works for EIFS construction.

THE PRINCIPLE IN PRACTICE

While the research conducted by the IRC and USG over the past two and a half years has covered a number of issues relating to EIFS construction, a primary focus has been to characterize the performance of water-managed EIF systems designed around the rainscreen principle. Tests were conducted on both direct applied and insulated finish systems in a large scale wind driven rain test facility.

The direct-applied systems included Duroscreen 1000, comprised of USG’s Durock Brand Cement Board fastened directly to oriented strand board sheathing covered with a building paper, while other, non-branded DEFS included the cement board fastened over a furring lath and building paper to create a defined cavity. All DEFS were finished with basecoat and a
polymeric stucco finish. The non-branded, insulated systems included EPS foam either bonded to OSB or mechanically fastened over building paper to the OSB, with and without furring lath. All of the systems were then meshed, basecoated and finished.

The wall samples were 8 by 8 feet in size and contained a window unit and associated sealant joints. Both vinyl flanged and double-hung wood windows were evaluated in the program, which tested a total of four water-managed designs and two barrier EIFS designs. Moisture pins were used to monitor moisture levels through the walls.

The wall designs were studied under both static and dynamic wind-driven rain conditions. The depth of the wall drainage cavity was varied from zero clearance to one-half inch to evaluate its effect on air tightness, drainage potential and pressure equalization. The walls were tested “as-built” and with defects representative of those commonly found in inspected homes in the field. Those defects primarily included cracks or openings in the sealant joints between the cladding and the window unit.

Test results confirmed that all water-managed walls, both direct-applied and insulated systems, performed as effective rainscreens in preventing water from reaching the wall sheathing and framing. Water was observed to penetrate to the building paper and drain to the bottom of the wall at a maximum rate of roughly one-half gallon per hour per lineal foot of wall.

The depth of the drainage cavity affected how much water reached the “second line of defense,” or the building
paper. However, the cavity depth did not affect the ability of the system to protect the wall from water migration into the stud cavity. All walls tested exhibited partial pressure equalization, with the one-half inch drainage cavity achieving the highest performance. All wall systems performed as effective air barriers.

**WHAT THE RESULTS MEAN**

The performance of the water-managed systems in this study stands in sharp contrast to initial research done by the IRC and USG on barrier EIFS-clad walls. In that study using a solid wall test with no window, the field of the EIFS acted as a good water barrier. Under exposure conditions much like those described above, however, water was observed entering the wall cavity through window frames and through defects in the wall/window interface. In those cases, water drained into the area below windows, saturated the OSB and EPS, and entered the stud cavities to closely reflect damage found in actual homes across the country.

“We were surprised to see water get to the OSB through sealant joints in the wall sample built by our experienced technicians to our specifications,” said Robert Blancett, director of the materials and construction laboratory at the USG Research and Technology Center. “When defects were added, water quickly saturated the OSB and collected in the stud cavity. We were surprised at what we were observing.”

**TAKING IT ONE STEP FURTHER**

While earlier research demonstrated that water-managed systems act as effective rainscreen walls, USG and IRC wanted further understanding of water movement through the systems and to find out what happens to any water that remains in the systems. Additional research used both physical testing and advanced computer modeling.

The physical testing used eight wall specimens (four DEFS and four EIFS) under five different environmental cycles, including very hot and humid weather and rainstorm conditions followed by bright sunshine. Results indicated that the
water-managed EIFS and DEFS managed the moisture under each of these conditions, and the wood sheathing and structural framing members inside the walls were not exposed to excessive increases in moisture content.

The computer simulation used a state-of-the-art heat, air and moisture transport model developed by the IRC. The

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drying potential of selected systems was evaluated for four different climatic conditions across North America, ranging from warm and moist to cool and dry. Results indicated that the drying potential of the cladding system is sufficient, and that excessive moisture does not build up in wood structural members.

**THE RESEARCH CONTINUES**

Water management, like many concepts in building and construction, is subject to an ongoing process of research and performance enhancement. Most recently, USG worked with DuPont Company, which has
developed Tyvek StuccoWrap™, a weather-resistant barrier specially designed to be used with water-managed synthetic stucco systems. Its engineered surface texture, which resembles the crinkled appearance of crepe paper, creates a superior moisture drainage path while its superior water resistance and high permeability keep moisture away from water-sensitive materials and enable any residual moisture in the stud cavity to exit as vapor. The product is much lighter in weight, more flexible and more resistant to tearing than conventional building papers and felt, making it easier and more economical to install as well.

Tyvek StuccoWrap™ is not only a product of research, but helps confirm the “rainscreen” principle’s viability. The results of USGS study demonstrated under closely observed conditions that the ability of water-managed EIFS and its multiple defenses against intruding moisture are highly effective. USG continues to support research efforts at the IRC on the performance of building exterior envelopes as a partner in a major consortium of Canadian and U.S. building interests. Results are pending in the near future.

USG believes water-managed systems are more reliable and practical to build and maintain, and hopes that its research results will help provide industry-wide guidelines for evaluating the effectiveness of all EIF systems for everyone’s benefit. After all, no one wants to worry about a building after it is finished. Exterior systems that accommodate the reality of water penetrating the finish will best serve the contractor and owner.

About the Author
Ardis Berghoff is a Chicago-based freelance writer who writes about building and construction issues.