When an architect or specifier chooses an exterior insulation and finish system, it’s doubtful the first consideration that comes to mind is the system’s substrate. Water-managed vs. barrier-type, color and texture options, or competitive cost come to mind, but not the sheathing material used as the substrate. The substrate is a crucial component, however. It’s the foundation of performance, so to speak, of a long-lasting EIFS system.

Choose a system with under-performing sheathing and you, or, most definitely the building owner, will pay for it later in the hard currency of water damage and costly repairs or replacement. Choose a sheathing that offers more than you need, and the project price may balloon beyond budget. But opt for the sheathing appropriate to the local climate, building project and budget, and you will be assured of top system performance and a satisfied client.
Most specifiers know that there are many kinds of sheathing materials on the market. But different EIFS systems use different substrates, and new developments are bringing even more choices to architects and specifiers—choices you should know about.

**A Word on Water Management**

When we discuss EIFS in this article, we are referring to water-managed, or drainable, EIF systems. If the objective of installing a stucco-look exterior is to specify and use the most reliable and cost-effective system for aesthetics, performance and insulation value, increasingly more people in the EIFS and construction industries believe that a water-managed system is the only way to go.

No one builds a perfect exterior wall. That’s why other correctly built cladding systems, including traditional stucco, brick and clapboard siding, incorporate basic water-management principles such as a drainage plane, flashing and weep. As long as water has a way out of a cladding system, it won’t degrade framing, insulation and other water-sensitive elements. Even in drier climates, a water-managed system is a wise choice. Water damage can occur during the occasional flash rainstorm if sealants have cracked and weakened from prolonged exposure to ultraviolet light and heat.

So-called barrier-type EIF systems are designed to provide a watertight seal at the surface. They rely solely on the premise that moisture will not penetrate the surface and that windows, doors and other openings are perfectly sealed, thus keeping water out for the life of the system.

But no matter how well constructed the building assembly is, between normal construction defects, naturally occurring aging of the system and delayed maintenance, cracks and other damage will result that can allow moisture into the system and inner wall cavity, spelling potential disaster for the substrate and inner building components.

**What’s There to Consider about Substrates?**

With the exception of applying EIFS directly over concrete or concrete-unit masonry, there are five basic sheathing materials used as substrates over wood or metal framing in water-managed EIF systems: cement board, high-performance gypsum-fiber panels, standard glass-mat panels, paper-faced gypsum panels and wood-based sheathing.

While there is no single substrate perfect for every job, there are criteria by which sheathing materials should be judged to achieve the best performance and value for a particular job. Those criteria include water sensitivity, strength, thermal and hygroscopic stability, installation productivity and cost.

What follows is an overview of the various EIFS substrates based on these criteria.

**Water Sensitivity.** This is probably the most critical factor in choosing a substrate. Any EIF system incorporating expanded polystyrene foam adhesively applied to the substrate should use a water-durable sheathing. Otherwise, water that comes into contact with the sheathing repeatedly or for an extended period of time can cause the sheathing to swell, buckle or rot, lead-
ing to delamination of the system or separation of the sheathing from the framing. Thus, the specifier should match a substrate’s moisture tolerance to the local average rainfall.

- Specify cement board for wet climates such as coastal areas and regions with moderate to heavy rainfall, especially those areas with average annual rainfall exceeding 50 inches. Made from portland cement, the board will not be damaged by water.

- Specify the more economical, high-performance gypsum-fiber panels in climates with moderate moisture levels. USG Corporation, Chicago, has produced a board with water resistance and strength infused throughout the board.

- Specify wood-based, standard glass-mat or paper-faced gypsum panels in drier, less windy climates, and only when a weather-resistant barrier is installed between the sheathing and the expanded polystyrene foam. Otherwise, these substrates can be compromised when wet and lead to extensive damage and repair costs.

**Strength** Both positive and negative wind loads stress substrates, so whether the sheathing is wet or dry it should be strong enough to withstand even a region’s greatest wind pressures. Otherwise, panels can break or be pulled right off of framing and take the remaining system layers with them. The panel must sustain a strong connection (fastener pull-resistance) for long-term reliability.

- Specify cement board where wind loads exceed 40 pounds per square foot. Even when very wet, cement board has an average fastener pull-resistance exceeding 120 pounds per fastener. It is the choice for exposure to wind-driven tins.

- Specify high-performance gypsum-fiber panels where fastener pull-resistance is still important (this panel will withstand 100 pounds per fastener), but where value engineering indicates a balance between longevity and cost. Otherwise, in dry low-wind-pressure climates, mechanically attached EIFS over standard wood or gypsum sheathing
Thermal and Hygrometric Stability, Substrate panels of different materials will expand or contract to different degrees when exposed to heat and moisture. The more stable the material, the less potential there is for cracking and buckling to occur on the building exterior. Once again, the specifier should consider the local climate before choosing a substrate.

Specify cement board for the greatest advantage here, too. Its moisture tolerance, combined with its fire resistance, makes it the most stable substrate. High-performance gypsum-fiber panels are a close second choice. While they’re not as moisture-resistant, their thermal properties are excellent, as demonstrated in fire-resistant assemblies.

Glass-mat and paper-faced gypsum sheathing have the best fire-resistant properties, and when exposed to low moisture levels, their minimal dimensional changes do not impact system performance. While temperature changes do not typically create problems for wood-based sheathings, they readily warp and swell when wet. They can shrink considerably under prolonged high temperatures, and, of course, they are combustible.

Installation Productivity. Installation boils down to three factors: handling, cutting and fastening. The easier a substrate is to handle, the more likely it will be installed correctly and efficiently. Smaller, lighter and more rigid panels are easier to lift and put into place, while larger, heavier and more flexible panels are more difficult to erect.

How panels are cut also should be considered. While core-reinforced panels require cutting with a circular saw, surface-reinforced panels are simply scored and snapped apart for quicker, faster installation.

Once cut to size, the ease with which panels are fastened to the framing can save time and labor.

- While cement board is heavier, installation is easier using narrower boards (32-inch by 8-foot boards versus 48-inch by 8-foot boards). High-performance gypsum-fiber panels are lighter and more rigid for better handling.
Standard gypsum panels are the lightest and easiest to lift and carry. Cement board, glass-mat panels and gypsum board all can be scored and snapped. While high-performance gypsum panels also can be cut to fit this way, it is faster and easier to cut them with a circular saw. All wood sheathing must be saw-cut.

- All the substrates are easily fastened using nails or screws, although hammer strikes can more readily damage softer standard gypsum board and glass-mat panels than cement and gypsum-fiber board. Overdriven screws are common with both paper-faced gypsum and glass-mat panels, but the high-performance gypsum-fiber panel’s core reinforcement virtually eliminates this occurrence.

- Overall, high-performance gypsum-fiber panels and cement board offer the easiest, strongest connections.

Cost. Ultimately, the choice of substrate comes down to cost vs. performance—getting the best sheathing value for the money. Substrates vary in price and, thus, affect the overall system price. However, the costliest substrate (cement board) also offers the longest-term performance and is probably the most economical in the long run. For very rainy climates, systems featuring this substrate are an excellent choice. For all other climates, high-performance gypsum-fiber panels are the cost and performance value for adhesively attached EIFS. Lower-priced gypsum or glass-mat substrates provide an acceptable value, particularly for mechanically attached systems.

About the Author
Jim Reicherts is product line business manager, exterior systems, for USG Corporation, Chicago.