Preventing Moisture Problems in a Building Envelope

Contributed by Richard Weber and George Crow, AIA, at the 2006 AIA Convention

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SUMMARY

Preventing moisture penetration problems in a building's envelope begins in the early design phase. Effective prevention involves implementing a successful water management system, understanding the sources of moisture ingress, and identifying potential problems.

MOISTURE PROBLEMS IN EXTERIOR WALLS

Uncontrolled rainwater penetration and moisture ingress are two of the most common threats to the performance of a building's envelope. Together they represent up to 80 percent of all construction-related liability claims in the United States.

Interior water damage. Photo by Richard Weber and George Crowe

Common moisture problems include interior water leakage, condensation, rotting, mildew, corrosion, and/or air quality problems.

EFFECTIVE MOISTURE PREVENTION

For effective moisture prevention the exterior wall system designer must

- Produce a successful water management system during the design phase
- Understand sources of moisture problems
- Recognize methods to limit problems

The potential for water penetration of a building envelope must be addressed early in the design phase. Often the top priorities in the design of a building envelope are safety, aesthetic, cost, performance, and constructability in that order. For a more successful wall the order of priority needs to change to safety, *performance*, constructability, cost, and then aesthetic. The envelope's performance should be the second highest priority after safety.

DESIGN APPROACHES

The three most effective exterior water systems are the barrier system, the drainage system, and the rain screen system.

The *barrier system* relies on one line of defense against leakage. If water can penetrate the barrier, the result is leakage. Therefore joints must be watertight. High-quality installation and monitored upkeep are critical because the barrier system relies heavily on the sealant's effectiveness.

The *drainage system* assumes water will penetrate cladding and does not depend on a surface barrier. Therefore it relies on a secondary line of defense against leakage. This system uses flashing to collect and drain water penetration, which increases the likelihood for long-term success.

The *rain screen system* is similar to the drainage wall design. It relies on flashing as a secondary defense. However, this system equalizes pressure by venting the cladding to the exterior. A vented drainage cavity forces less wind-driven water through cladding. A moisture and air barrier is still required behind cladding.

SOURCES OF MOISTURE PROBLEMS

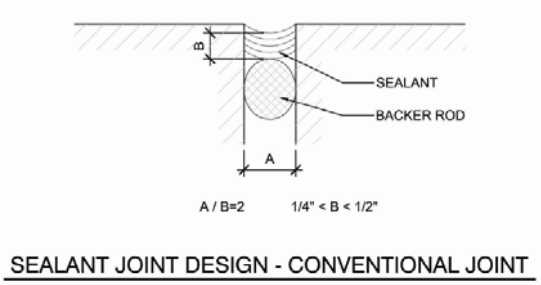
Materials and systems that amount to approximately 1 percent of the construction costs of a typical large building can lead to 90 percent of the moisture infiltration issues.

Barrier systems that rely on sealants are prone to leakage. Typically, sealants fail at flashing points and interface details. Leaks commonly occur where systems adjoin.

Adhesive sealant failures can be attributed to any one of the following mistakes: inadequate bond surface preparation, inappropriate sealant selection, poor sealant profile, poor environmental conditions during installation, and/or improper mixing of sealant components.

Cohesive sealant failures occur from poor sealant selection or profile and excessive movement. As well, improper mixing of sealant components and manufacturing defects can force failures.

This is the author's rendering of a conventional sealant joint.



SEALANT JOINT DESIGN - CONVENTIONAL JOINT

A vapor retarder prevents flow of vapor through the wall system. A vapor retarder should be installed on the warm side of insulation, be continuous, and be sealed at termination and penetration points.

The mechanical system can pull moisture into the interior if pressure is negative, air barrier is critical, and high interior RH will increase the potential for condensation.

METHODS TO LIMIT PROBLEMS

Here are some ways to identify problems before they happen:

- Develop a "team approach" to construction
- Help ensure the project conforms to plans and specifications
- Confirm constructability of details
- Determine schedule/sequencing early
- Review building enclosure design
- Coordinate/review shop drawings and submittals
- Prepare on-site, full-scale mock-ups
- Observe material characteristics on site
- Field testing

As stated earlier, 1 percent of construction costs can lead to 90 percent of potential moisture penetration issues. Therefore, it is important to collaborate with others and gain an expert's opinion when designing a building's water management system. Better to be safe than sorry when water is concerned.

ABOUT THE CONTRIBUTOR

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More Best Practices

The following AIA Best Practices provide additional information related to this topic:

18.03.01	Mold: A Design Checklist
18.03.04	Ventilation for Durability in Residential Design
18.05.01	Quality Control: A Working Drawings Preparation Checklist

Keywords

- Building performance
- Weather tightness
- Water tightness
- Leaking