Moisture management of high-R walls is important to ensure optimal performance. This case study focuses on how eight high-R walls handle the three main sources of moisture—construction moisture, air leakage condensation, and bulk water leaks.

A high-R wall is defined as a wall with an effective R-value that at least doubles the code-required R-value. This includes framing members and any other thermal bridges. Eight wall types were considered in this analysis, divided into four categories: advanced framed walls with exterior insulation, double stud walls with vapor permeable cavity insulation, hybrid wall assemblies using closed cell spray foam cavity insulation, and a structural insulated panel system (SIPS).

Researchers from Building Science Corporation, a U.S. Department of Energy Building America team, used a series of hygrothermal simulations to assess the moisture durability of these eight walls, as identified by the peak daily annual moisture contents, when exposed to three main moisture sources. The walls were simulated in several cities that present a range of climate zones—International Falls, Minnesota; Chicago, Illinois; St. Louis, Missouri; Seattle, Washington; Atlanta, Georgia; and Houston, Texas.

Under idealized circumstances, all of the walls perform well. However, as soon as adverse conditions occur, some of the walls did not adequately manage the moisture problems. The hygrothermal simulations are intended to provide a good, preliminary estimate of wall performance, but additional analysis may be required on a project-by-project basis.

Materials used in the walls should not be installed if they are saturated with water. Proper air barriers should be installed and detailed accordingly. All wall penetrations should be detailed with proper water shedding materials and details.
The above table demonstrates the moisture durability risk for each wall assembly in a range of climates. These risk levels assume air leakage effects for a 2.5 ACH50 home. A “high risk level” indicates that mold growth is likely and that this design is not recommended. A “moderate risk” level suggests a potential for mold growth eventually, depending on frequency and length of wetting, and temperature during wetting. This design can be successful but conservative durability assessments usually require corrective action. A “low risk level” suggests no mold growth or biodeterioration problems.

The conclusions from this research include:

**Advanced frame wall with exterior insulation:**
- Maintains elevated sheathing temperatures and minimizes air leakage condensation.
- Vapor permeable cavity insulation allows for inward drying.

**Hybrid advanced framed wall with exterior insulation:**
- Closed cell spray foam (ccSPF) helps isolate the sheathing from interior moisture and air leakage.

**Double stud wall/truss wall with cellulose insulation:**
- Sheathing susceptible to air leakage condensation.

**Double stud wall with ccSPF or open cell spray foam (ocSPF):**
- The ccSPF protects the sheathing from air leakage condensation.
- The ocSPF is susceptible to moisture diffusion and requires smart vapor control.

**Structural insulated panel:**
- Susceptible to significant damage from air leakage at joints. Center of panel poses no significant moisture susceptibility.