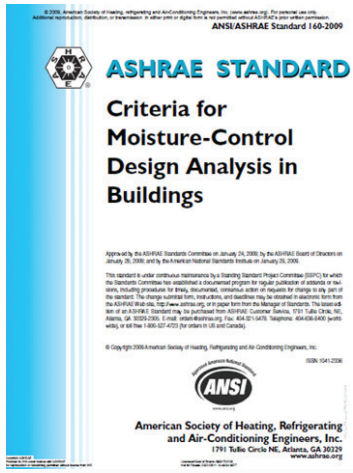
Ensuring Affordable, Efficient, Moisture-Durable Building Envelopes

Faced with rising fuel costs, building and home owners are looking for energy-efficient solutions. Improving the building envelope (roof or attic system, walls, foundation) is an obvious choice as heating, ventilating, and air-conditioning (HVAC) accounts for 17% of the nation's primary energy consumption. However, making envelopes for residential and commercial buildings more airtight and highly insulated must be done properly to avoid moisture durability issues.

ORNL, in collaboration with the Fraunhofer Institute of Building Physics (Federal Republic of Germany), has developed the world's most respected hygrothermal models for understanding the flow of heat, air, and moisture through envelope assemblies, storage of heat and moisture in the assemblies, and thresholds for onset of failure modes. Known as WUFI (Wärme Und Feuchte Instationär), the model has been validated with data from natural exposure field test facilities in Germany and North America. Scaling envelope improvements in the market is now feasible without fear of unintended consequences (mold, rot, freeze damage).

Technology Achievements

- Applying its expertise in hygrothermal performance of building systems, ORNL has assisted industry partners in developing better more durable building components. Working with the Exterior Insulation and Finish Systems Industry Members Association, ORNL has helped develop the next generation of moisture tolerant exterior insulation wall systems needed to retrofit today's poor energy performing walls.
- Partnering with the Single Ply Roofing Industry, ORNL helped in understanding the role cool roofing plays in moisture accumulation in these types of roofing systems.
- Collaborating with CertainTeed Corporation, ORNL helped define the benefits of a novel water resistive barrier material that exhibits variable performance attributes depending on its environment.
- ORNL has educated hundreds of students on the use of hygrothermal models so that architects and designers can design and specify moisture tolerant wall and roofing systems designed for the intended climate zone and application.
- ORNL has a variety of experimental apparatus that enable researchers to simultaneously impose user-specified indoor and outdoor environmental conditions on either side of large test specimens of envelope assemblies. These facilities enable researchers to measure heat, air, and moisture penetration rates; validate models; and assist industry to develop new and more energy-efficient materials and envelope assemblies for use in new construction and retrofits.



Key Accomplishments

- WUFI enables codes and standards writers to prescribe, or practitioners to design, new envelope assemblies or retrofits that are airtight, highly insulated, affordable, and moisture-durable.
- ORNL participated in the development of the first moisture control envelope design standard (ASHRAE 160), adopted by the General Services Administration (GSA P100).
- Hygrothermal expertise has enabled multiple ORNL research collaborations with industry (cool roofs, air barriers, insulation systems) resulting in affordable, moisture-durable products to increase energy efficiency.
- ORNL established test facilities to measure essential property values needed by WUFI, enabling better understanding of product performance by the entire construction materials industry.

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