

# BUILDING ENCLOSURES AND MATERIALS



1 *Outdoor test huts used by the Building Enclosures and Materials Group for field testing in Albuquerque, NM*

## Fraunhofer Center for Sustainable Energy Systems CSE

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## About Fraunhofer CSE

Fraunhofer CSE is an applied research and development laboratory dedicated to building tomorrow's energy future today. Our staff's expertise in solar photovoltaics, smart energy-efficient buildings, and grid technologies provides a platform for deeply integrating distributed energy resources through collaborative R&D with private companies, government entities, and academic institutions.

## Building Enclosures and Materials at CSE

Fraunhofer CSE's Building Enclosures and Materials Group works to analyze and develop building enclosure designs and components. We characterize performance in lab and field conditions - both for new construction and existing historical building retrofits. Our team focuses on novel building materials, thermal insulations, heat storage technologies, dynamic building components, and building-integrated solar PV (BIPV) technologies.

## Areas of Research

As in many similar building science laboratories worldwide, an important part of the Fraunhofer CSE research program in the area of building envelopes is associated with the following scales of experimental analysis:

- Material Scale Testing
- System-Scale Laboratory and Environmental Exposure Testing
- Full-Scale Field Testing

In addition to the experimental work, Fraunhofer CSE has unique capabilities allowing detailed **numerical analysis** of building materials, building envelope systems, and whole buildings.

### CFD Modeling

Furthermore, we perform numerical performance analysis of building envelope components containing ventilated and unvented air cavities and air spaces (such as wall cavities or attics) exhibiting relatively complex heat and mass transport mechanisms.



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## Building Enclosures

The Building Enclosures and Materials Group evaluates the performance of building enclosures and their components. This research program tests and analyzes novel building materials, thermal insulations, modern building envelope systems, and hybrid dynamic building enclosures with solar components in both small-scale laboratory and field conditions.

The Enclosures team works with major US and international building material manufacturers in the following areas:

- Applied R&D of novel energy-efficient materials and systems, including advanced thermal insulations and environmental barriers, phase change materials (PCMs), advanced ventilation strategies, and systems to control radiation heat transfer
- Deployment and integration of these technologies
- Development and testing of novel building-integrated solar systems
- Advanced thermal, hygrothermal modeling
- Whole building energy analysis
- Laboratory thermal / hygrothermal testing
- In situ performance, monitoring and long-term evaluations

## New Enclosures Materials

Developing energy-efficient enclosure materials to support new and existing building construction and retrofits, including:

- Phase Change Materials
- Vacuum Insulation Panels
- Aerogel Technologies and Nano Foams
- Bio-based Foam Insulations and Composites
- Lightweight Concretes

## Retrofits & New Construction

Assisting clients with energy-efficiency retrofits that leverage innovative enclosure materials and practices in both new, existing, and historical buildings.

## Field Testing & Performance Analysis

Validating innovative building enclosure materials through advanced indoor and outdoor field testing at our laboratories in Albuquerque and Boston and at field sites across the United States. With a wide array of test sites, our researchers can analyze enclosure materials and products at different stress levels and determine performance capabilities in various climate conditions.

## Advanced Building Enclosures Simulations & Tools

Assessing building energy consumption and efficiency through: whole building energy simulations, including attic and roof thermal modelings; and thermal bridging analysis.

Fraunhofer CSE has unique capabilities for thermal modeling of phase change processes and thermal performance of building technologies containing phase changing components.

- 2 *The Building Enclosures and Materials Group investigates the thermal and hygrothermal envelopes, components and materials*
- 3 *Durability testing of building materials*