Integrated heat and moisture calculation tool for building envelopes - THERMM

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

LBNL / ORNL
D. Charlie Curcija, Staff Engineer

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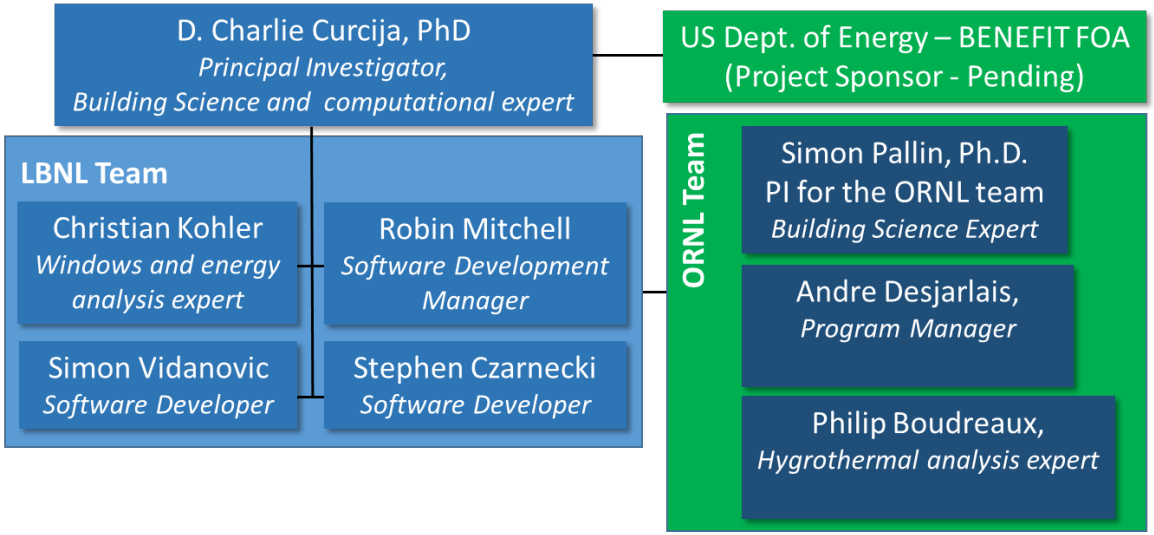
Team



The Windows and Daylighting Group at LBNL is a core DOE program in the area of windows and building façade energy performance. LBNL team develops software tools that are widely used for modeling energy and daylight performance of windows and envelopes, including THERM. THERMM development is based on THERM software tool and is led by Dr. Charlie Curcija, who is the leader of the team that develops THERM.

The ORNL Building Envelope Center of Excellence is the DOE's lead laboratory for performing research on the opaque portion of the building envelope. Members of the group have been involved in hygrothermal durability since 1998. In this area, we have collaborated with the Fraunhofer Institute of Building Physics in the development of the WUFI family of hygrothermal models and brought WUFI to the US market

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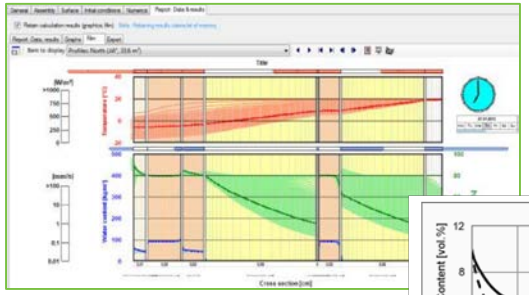
"What If" Future or Problem Definition

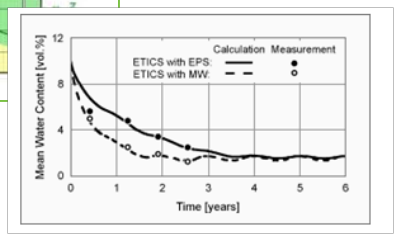
Analysis of moisture migration through building structures is primarily done by engineers using 1-D simplified models (e.g., WUFI).

These models ignore or make crude assumptions about thermal bridges and non-homogeneities in building construction.

Considering that such elements are primary pathways and causes for condensation and moisture buildups, it is important to properly consider them in thermal/moisture analysis.

By failing to account for the moisture characteristics in the thermal envelope, designers and builders can introduce problems that endanger the health and safety of building occupants as well as the durability of the building itself.





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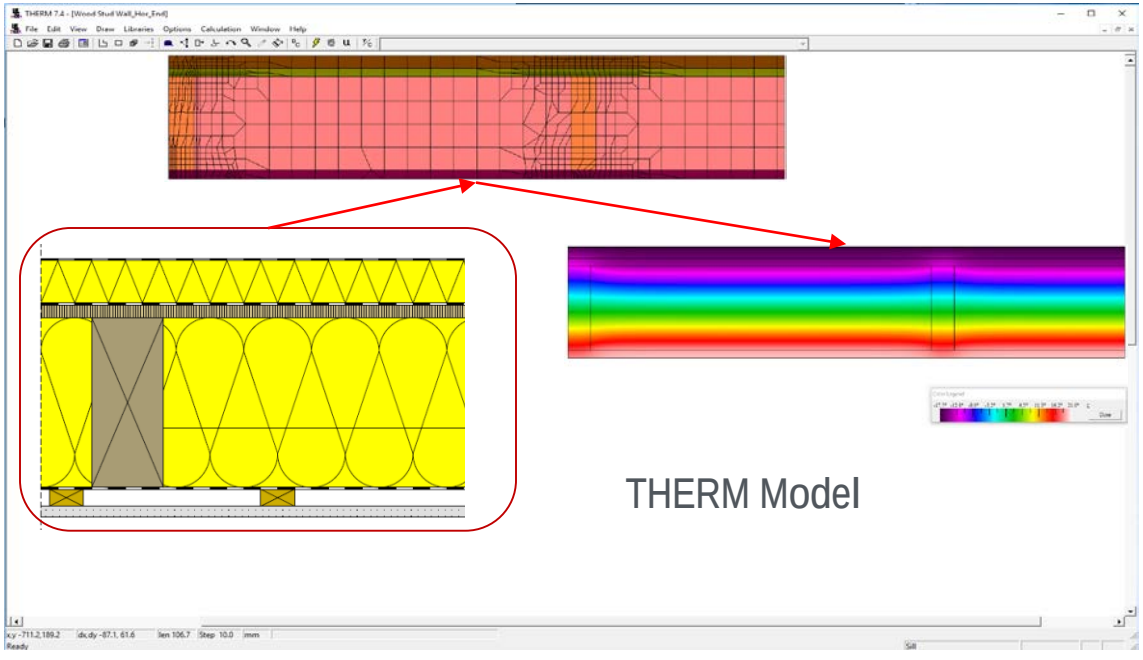
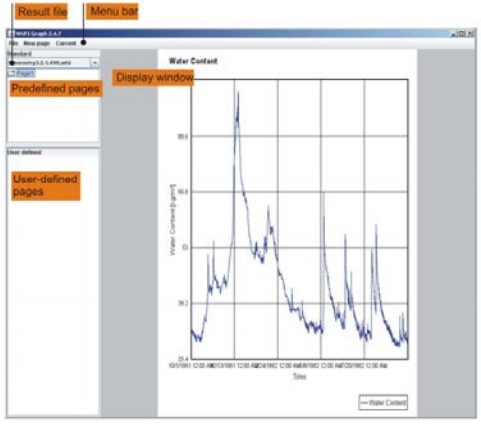
Technology Solution

The project is structured in three phases:

- Year 1 the scientific foundation for the new computational engine will be developed. Dynamic modeling and the relevant moisture equations will be added to the existing thermal modeling and 2-D dynamic thermal and moisture equations will be integrated into one joint set
- Year 2 the equations and models will be implemented in THERM/THERMM, and the THERM GUI will be extended to support the new input and result presentation
- Year 3, the implementation will be tested and verified.



THERM Model



WUFI Results

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Advantage, Differentiation, and Impact

This project aims to unify strengths and expertise of the two prominent national lab teams, by combining LBNL's expertise in thermal modeling and software development and user-support, embodied in THERM program and ORNL's expertise in moisture transport and hygro-thermal modeling and associated test facilities, to produce new software tool for 1-D and 2-D heat and moisture modeling in building construction. This is especially true for 2-D analysis, where thermal bridges in building envelope can create conduits for moisture condensation and accompanying damage.

The new integrated heat and moisture analysis tool would inherit strong features from the THERM program, such as user-friendly GUI, FEM engine, meshing and error estimation, strong reporting capabilities and will offer a level of familiarity that thousands of building professionals are already accustomed with.

Our proposed software tool THERMM brings the promise of routine and cost-effective integrated thermal and moisture transfer modeling. We expect that the new tool will evolve similarly to the original THERM tool, bringing simplicity and ease of use to engineers and architects when they perform complex thermal analyses.

Our vision is that by offering such tool at no cost and as open source software, that this will help ensure that the tool will be widely used and will not become obsolete in the future.

Thank You

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