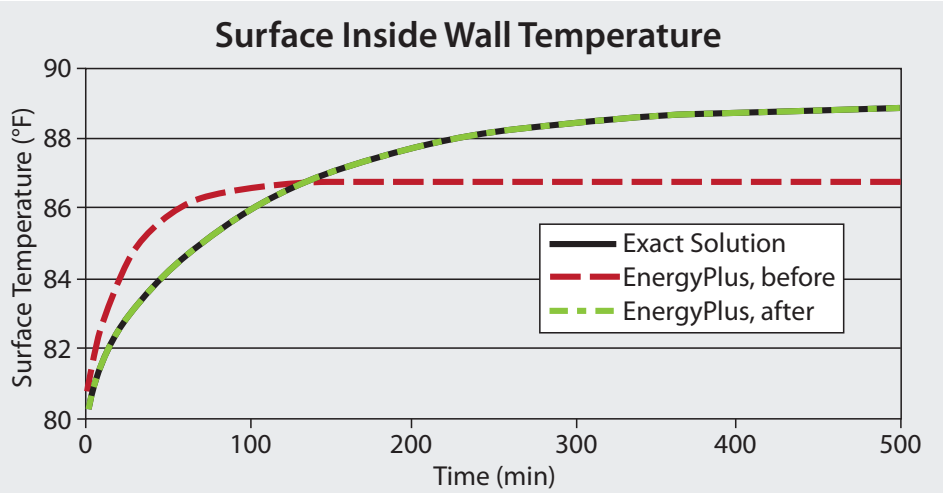
Building America *Technical Highlight*

NREL Develops Diagnostic Test Cases To Improve Building Energy Simulation Programs

The National Renewable Energy Laboratory (NREL) Residential and Commercial Buildings research groups developed a set of diagnostic test cases for building energy simulations.

Eight test cases were developed to test surface conduction heat transfer algorithms of building envelopes in building energy simulation programs. These algorithms are used to predict energy flow through external opaque surfaces such as walls, ceilings, and floors. The test cases consist of analytical and vetted numerical heat transfer solutions that have been available for decades, which increases confidence in test results. NREL researchers adapted these solutions for comparisons with building energy simulation results. Testing the new cases with EnergyPlus identified issues with the conduction finite difference (CondFD) heat transfer algorithm in versions 5 and 6. NREL researchers resolved these issues for EnergyPlus version 7 (see figure).

The new test cases will help users and developers of EnergyPlus and other building energy tools to identify and fix problems associated with solid conduction heat transfer algorithms of building envelopes and their boundary conditions. In the long term, improvements to software algorithms will result in more accurate energy use and savings predictions. NREL researchers plan to document the set of test cases and make them available for future consideration by validation standards such as ASHRAE *Standard 140: Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs.* EnergyPlus users will also have access to the improved CondFD model in version 7 after its next scheduled release.



Surface inside temperature calculated from analytical solution (Exact Solution), EnergyPlus before testing (EnergyPlus, before) and EnergyPlus after testing and bug fixing (EnergyPlus, after)

Key Research Results

Achievement

NREL researchers developed diagnostic test cases to improve the accuracy of conduction heat transfer modeling in building energy simulation programs.

Result

Eight test cases can be used to diagnose and fix errors in solid conduction heat transfer algorithms in building envelopes. NREL researchers used the cases to repair parts of the implementation for conduction finite difference algorithms in EnergyPlus.

Potential Impact

Software developers can use the test cases to improve algorithms and thus achieve more accurate energy use and savings predictions.

Funding Support

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For more information

Tabares-Velasco, P.C. and Griffith, B. (2011). "Diagnostic Test Cases for Verifying Surface Heat Transfer Algorithms and Boundary Conditions in Building Energy Simulation Programs." *Journal of Building Performance Simulation*, doi: JA-5500-52448, http://dx.doi.org/10.1080/10789669.2011.564260.

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