



HELIOS EESim™

Performance Simulation for Energy Efficiency Retrofit Projects

Validation Report in accordance with
ASHRAE STANDARD 140-2011



Contents

Overview of HELiOS EESim ASHRAE 140-2011 Tests	3
ASHRAE 140 Testing Overview	3
Testing Scope	3
<i>Case 600 – Base Case Low Mass Building</i>	4
<i>Case 610 – South Shading Test for Low Mass Building</i>	4
<i>Case 620 – East/West Window Orientation Test for Low Mass Building</i>	5
<i>Case 630 – East/West Shading Test for Low Mass Building</i>	5
<i>Case 640 – Thermostat Setback Test for Low Mass Building</i>	5
Testing Results	5
Summary	8
References	9
About Helios Exchange	10

HELIOS EESim Validation Report in accordance with ASHRAE STANDARD 140-2011

Overview of HELIOS EESim ASHRAE 140-2011 Tests

This report describes the building thermal envelope and fabric testing results in accordance with ASHRAE 140-2011 titled Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs with HELIOS EESim. The testing results of HELIOS EESim are compared with BESTEST results that simulated the same test cases from other whole building energy analysis programs approved by DOE. The report shows that computing results using HELIOS EESim are reasonable compared to other energy simulation applications.

ASHRAE 140 Testing Overview

ASHRAE Standard 140-2011 provides the standard method of test for the evaluation of building energy analysis computer programs to compare a program to itself or to other energy simulation applications. There are many energy simulation programs developed to model aspects of the whole building energy performance. It is important to test the validity of such programs. The United States Department of Energy's National Renewable Energy Laboratory (NREL) has developed an overall methodology to evaluate the accuracy of whole-building energy simulation programs, and to identify and diagnose differences in simulation predictions that may be caused by algorithmic differences, modeling limitations, coding errors, or input errors (NREL 2006). This method has been adopted by ANSI/ASHRAE Standard 140-2001 and 2004: Method of Test for the Evaluation of Building Energy Analysis Computer Programs (ASHRAE 2001, 2004). The method has been enhanced in ANSI/ASHRAE 140-2011 (ASHRAE 2011). ASHRAE 140 Standard is for benchmarking energy engine results by analyzing multiple test cases, and comparing results against a specified set of engines, which provides an acceptable range of testing results comparing results of other energy simulation engines tested to the same methodology (ASHRAE, 2011).

Testing Scope

HELIOS EESim validation follows the ASHRAE 140 Class I test procedures that require the energy simulation with: 1) time-steps of one hour or less, 2) full annual simulation, and 3) weather data, DRYCOLD.TMY file. The weather file used for all simulations is provided along with Standard 140-2011, which contains hourly weather for an entire year which is characterized as "cold clear winters/hot dry summers."

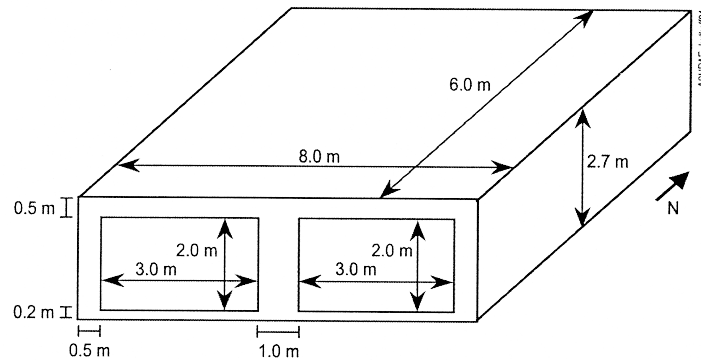


Figure 1: ASHRAE 140 Standard Geometry

The base building plan shall be a 48 m² floor area, single story, low mass building with rectangular shape geometry and 12 m² of south-facing windows as shown in Figure 1. Please refer to ASHRAE 140-2011 Section 5 for modeling assumption details.

This report provides the testing description and results of the building thermal envelope and fabric load tests: base case (Case 600) and basic low mass tests (Case 610 to 640).

Comparison measures are the calculated thermal loads:

- Annual heating in MWh
- Annual cooling in MWh
- Peak heating in kW
- Peak cooling in kW

The thermal load simulation results from HELiO5 EESim are compared to see the results fall within the range of spread of results for other whole building energy simulation programs that include BLAST, DOE2.1D, DOE2.1E, EnergyPlus 8.0, ESP, SRE/SUN, SERIRES, S3PAS, TASE, and TRNSYS.

Case 600 – Base Case Low Mass Building

The basic test building (Figure 1) is a rectangular single zone (8 m wide x 6 m long x 2.7 m high) with no interior partitions and 12 m² of windows on the south exposure. The building is of lightweight construction with characteristics as described below. For further details refer to Section 5.2.1 of ANSI/ASHRAE Standard 140-2011.

Case 610 – South Shading Test for Low Mass Building

Case 610 uses the Base Building modeled in Case 600 and adds a 1 m horizontal overhang across the entire length of south wall over the south facing windows at the roof level. See Figure 2. All other characteristics of the building were identical to the Base Case building. This case tests the ability of a program to treat shading of a south exposed window.

Case 620 – East/West Window Orientation Test for Low Mass Building

Case 620 uses the Base Building modeled in Case 600 with the following changes: a) The window orientation was modified as shown in Figure 3 such that 6 m² b) The south windows were eliminated and replaced with the wall construction used throughout the building of window area was added to both the east and west walls. The window properties are exactly the same as in Case 600

Case 630 – East/West Shading Test for Low Mass Building

Case 630 is exactly the same as Case 620 except that a shade overhang and shade fins were added around the east and west window. See Figure 4. A 1 m horizontal overhang is located at the roof level and extends across the 3 m width of each window. The 1 m wide right and left vertical shade fins are located at the edge of each window and extend from the roof down to the ground.

Case 640 – Thermostat Setback Test for Low Mass Building

Case 640 is identical to the Base Case building of Case 600 except the following heating and cooling temperature setback schedule with a non-proportional thermostat was used:

- a) From 2300 hours to 0700 hours, heat = on if zone temperature <10°C
- b) From 0700 hours to 2300 hours, heat = on if zone temperature <20°C
- c) All hours, cool = on if zone temperature >27°C
- d) Otherwise, mechanical equipment is off.
- e) See Figure 1 for schematic of building.

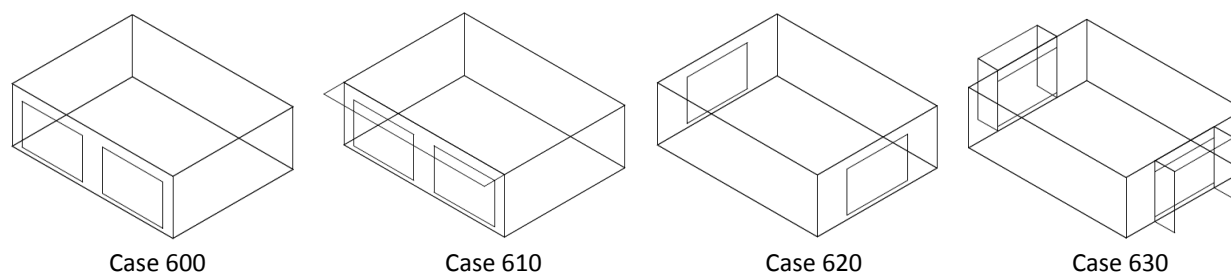


Figure 2 Isometric View of ASHRAE 140-2011 Testing Cases

Testing Results

The energy simulation results from HELiOS EESim are compared with the suite of tests based on Building Energy Simulation Test (BESTEST) (IEA 1995) and EnergyPlus 8.0 (GARD Analytics 2013). Figures 3, 4, 5, 6, and 7 show the testing results. The computing results of EESim are compared to that of BESTTEST minimum, maximum and EnergyPlus. Each compares annual heating and cooling, peak heating and cooling.

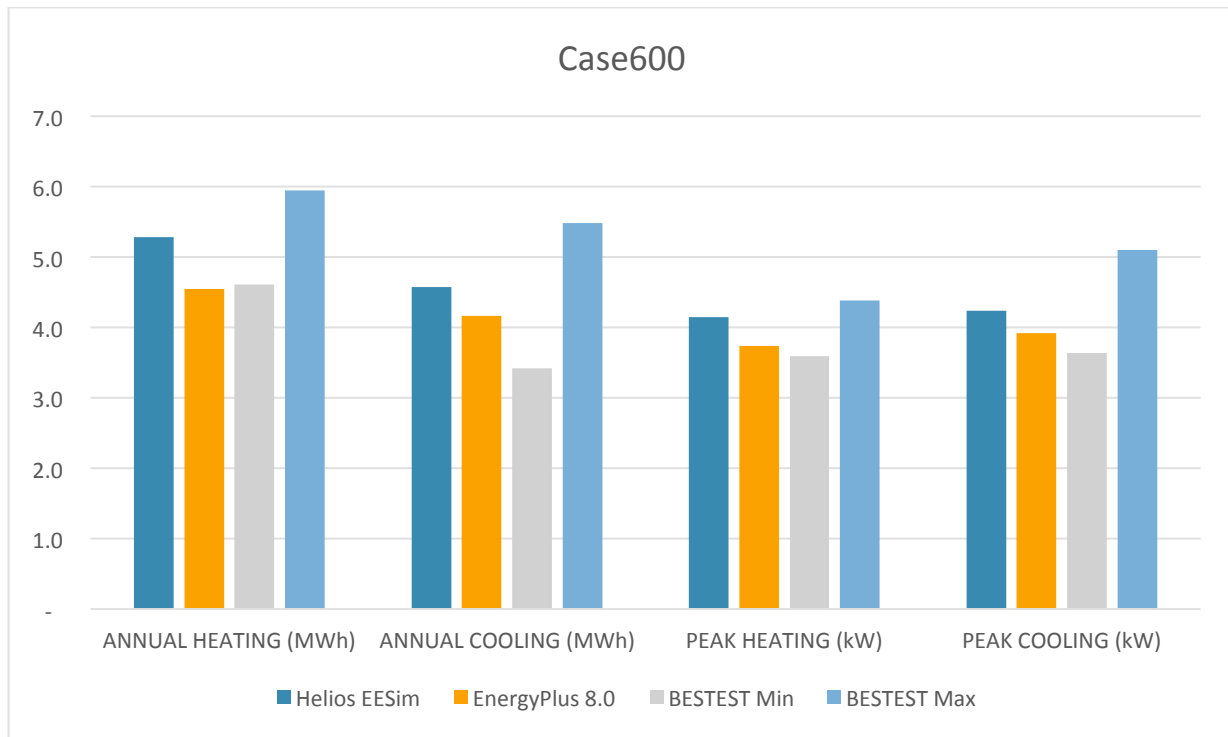


Figure 3 CASE 600 results

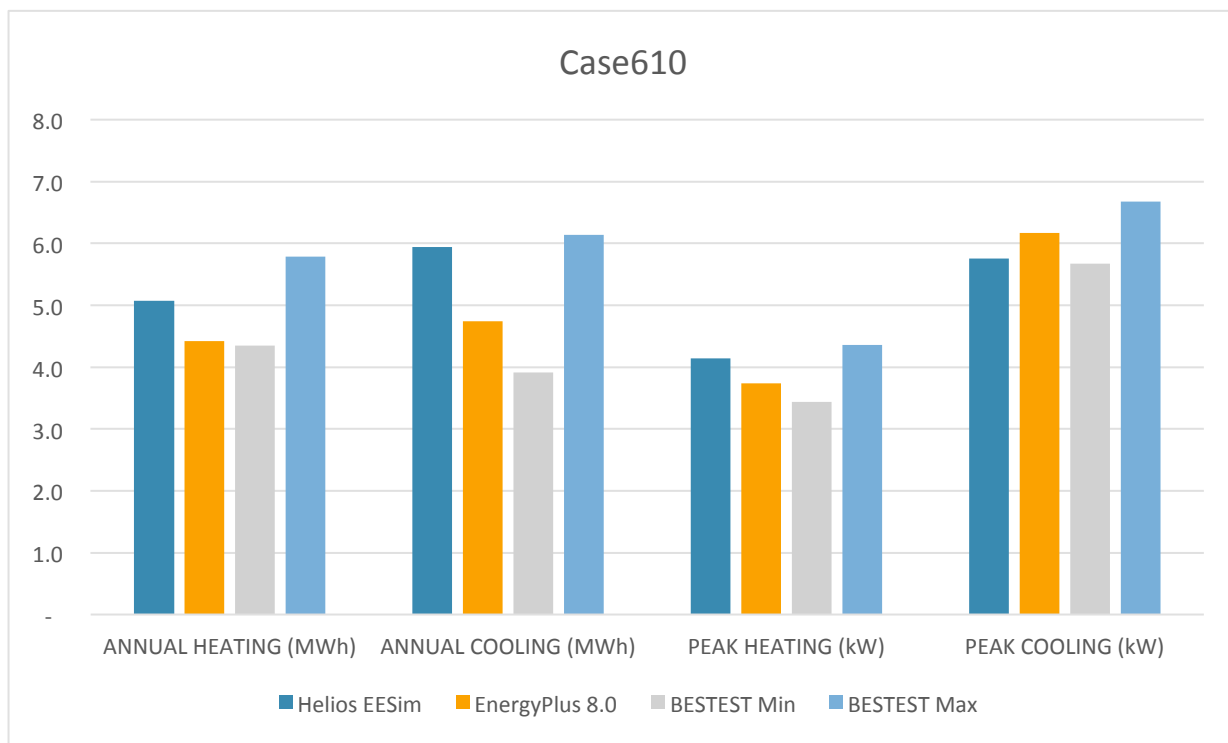


Figure 3 CASE 610 results

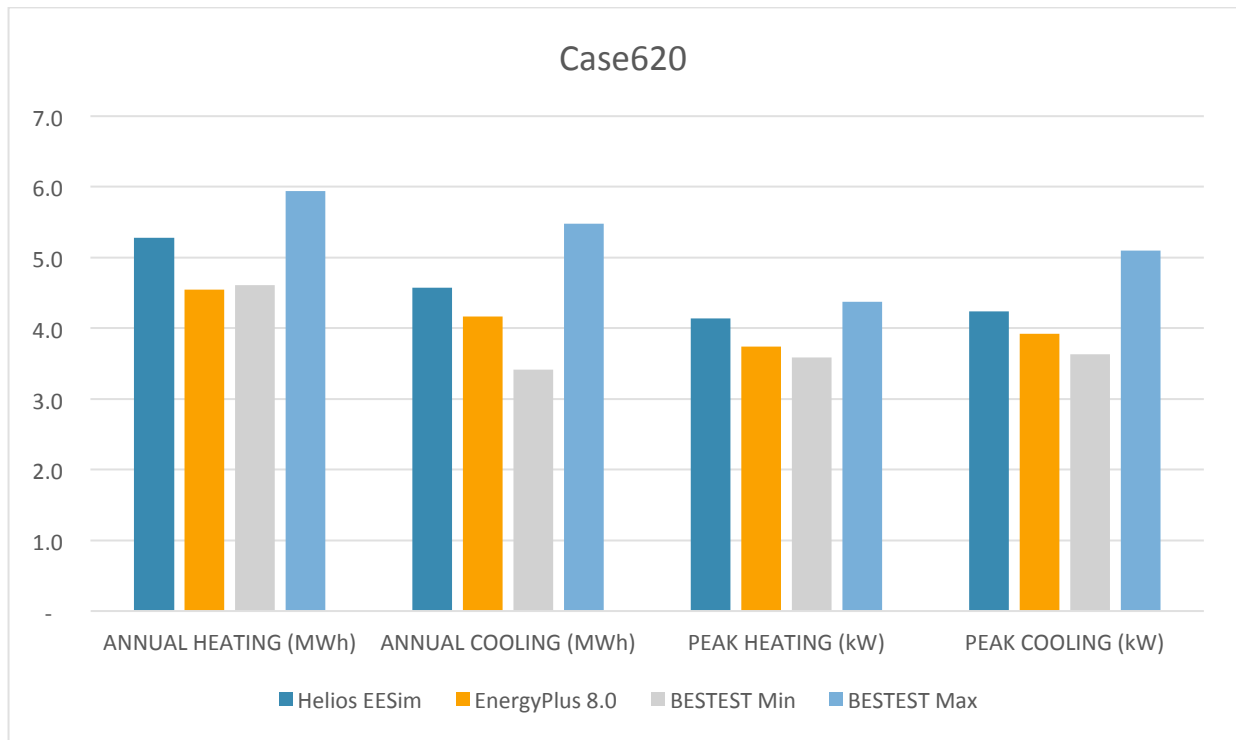


Figure 3 CASE 620 results

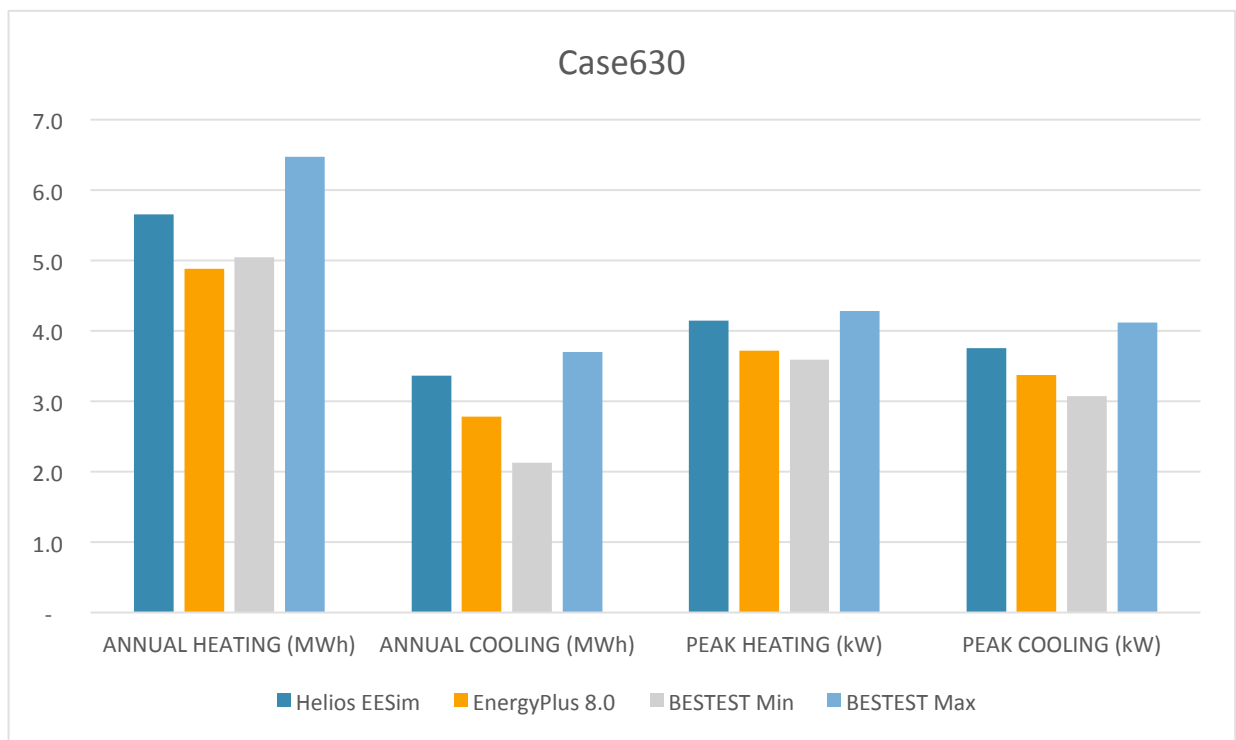


Figure 3 CASE 630 results

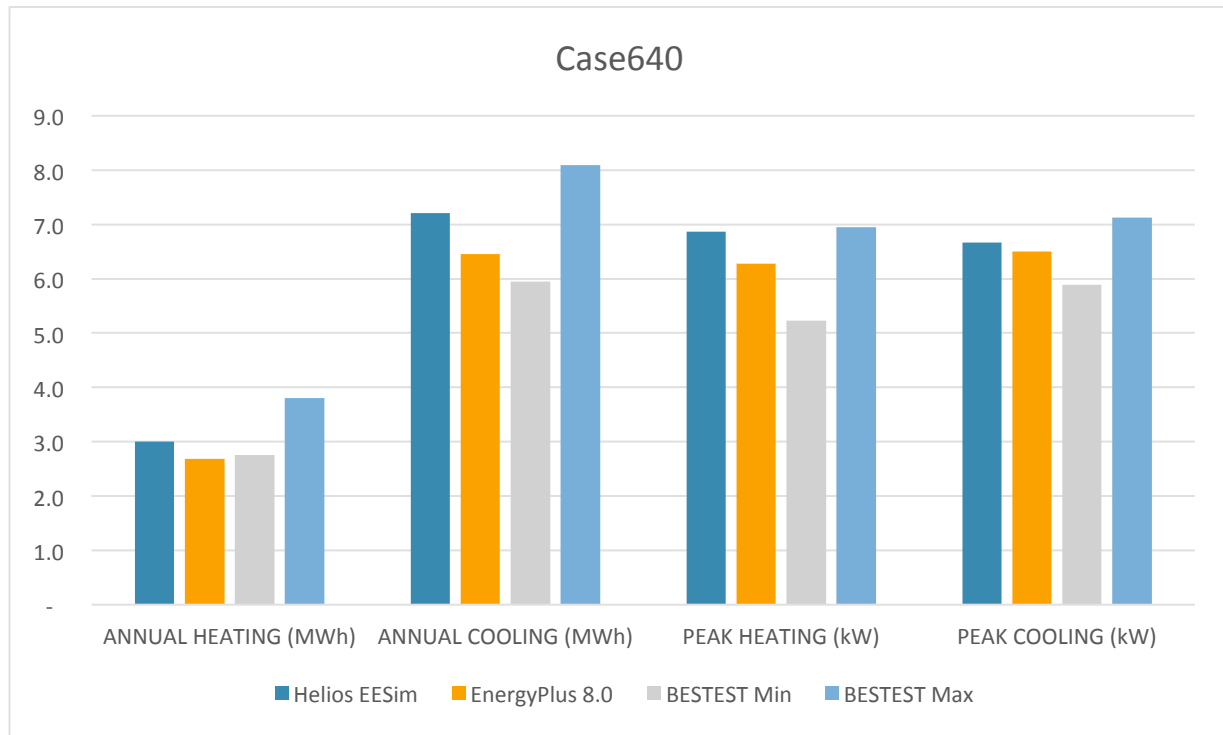


Figure 3 CASE 640 results

Summary

HELiOS EESim is the energy simulation engine that models the whole building for the energy performance evaluation. ASHRAE 140-2011 testing was conducted using EESim to evaluate the validity of the simulation engine. The testing results for building thermal envelope and fabric load using EESim are all within the range of BESTEST minimum and maximum.

References

ASHARE. 2001. ANSI/ASHRAE Standard 140-2001, Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs. Atlanta, GA: ASHRAE.

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GARD Analytics. 2013. EnergyPlus Testing with Building Thermal Envelope and Fabric Load Tests from ANSI/ASHRAE Standard 140-2011

NREL. 2006. Model Validation and Testing: The Methodological Foundation of ASHRAE Standard 140. NREL/CP-550-40360

About Helios Exchange

Helios Exchange is the world's first commercial real estate platform for energy retrofit project development, insurance and financing. Helios provides building owners and facility managers with turnkey solutions to discover, insure and finance their energy improvement projects with ease and confidence, and capture the resulting green premium on asset valuation. The rapidly growing Helios' database covers over 150,000 commercial properties, 15 Billion square feet of small to large size commercial real estate in major U.S. cities with high-energy prices, stringent energy disclosure and improvement mandates, and legislative support for innovative clean energy project financing such as PACE programs.

Thanks to its city-scale smart building energy analytics, Helios Exchange has identified over \$10 Billion in annual energy savings and profile compelling business cases. Through its network of financing partners, Helios can provide up to \$500 Million in project finance across a variety of financing models for small to large scale clean energy projects. Helios partners with a nation-wide network of Energy Service Professionals to complement them with energy analytics, insurance and financing, enabling them to close more business. With the maturing of financing models such as Energy Savings Agreements and PACE financing, the emergence of big data analytics, and our innovative technology to quantify the performance risk of clean energy projects, Helios can offer zero-down financing solutions, insure the performance risk to bring confidence to the retrofit transactions, and do this at city-scale.

Founded by sustainable investing pioneers Pierre Trevet, former Head of Sustainability Finance at C3 Energy and Hewson Baltzell, former Managing Director at MSCI, Helios Exchange has offices in San Francisco and New York City.