

HEED Validated using HERS BESTEST

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HEED (Home Energy Efficient Design) is an easy-to-use tool that helps homeowners, builders, and architects create more energy efficient homes. When HEED was tested using the HERS BESTEST Procedure the results show that 96% of all tests fell within the acceptance range.

TIER 1

CASE Name	Annual Heating Loads: Colorado Springs				Annual Sensible Cooling Loads: Las Vegas			
	BESTEST		HEED	Pass/Fail	BESTEST		HEED	Pass/Fail
	Max	Min	Mbtu/year		Max	Min	Mbtu/year	
L100 Base Case	79.48	48.75	75.16	PASS	64.88	50.66	56.75	PASS
L110 High Infiltration	104	71.88	99.34	PASS	68.5	53.7	62.71	PASS
L120 Well Insulated Walls	643	37.82	61.25	PASS	60.14	47.34	52.95	PASS
L130 Dbl Pane Low-E Glass	53.98	41.82	52	PASS	45.26	32.95	34.35	PASS
L140 Zero Windows	56.48	43.24	53.99	PASS	30.54	19.52	19.72	PASS
L150 All South Glass	71.33	40.95	68.07	PASS	82.33	62.41	76.84	PASS
L155 Overhang on South Glass	74.18	43.53	70.45	PASS	63.06	50.86	59.71	PASS
L160 All E+W Windows	81	48.78	76.53	PASS	72.99	59.61	65.03	PASS
L170 No Internal Gain	92.4	61.03	88.37	PASS	53.31	41.83	47.63	PASS
L200 Energy Inefficient	185.9	106.41	178.26	PASS	83.43	60.25	77.16	PASS
L202 Light Exterior Color	190.1	111.32	183.54	PASS	75.96	52.32	69.14	PASS
L302 Slab On Grade	86.9	56.12	73.08	PASS				
L304 Slab Insulated	73.15	46.11	58.86	PASS				
L322 Basement Uninsulated	11.69	73.71	107.79	PASS				
L324 Basement Insulated	77.47	46.38	75.44	PASS				

CASE	Difference in Annual Heating Colorado Springs				Difference in Annual Cooling: Las Vegas			
	BESTEST		HEED	Pass/Fail	BESTEST		HEED	Pass/Fail
	Max	Min	Mbtu/year		Max	Min	Mbtu/year	
L110-L100	28.12	19.36	24.18	PASS	7.84	-0.98	5.96	PASS
L120-L100	-7.67	-18.57	-13.93	PASS	0.68	-8.67	-3.81	PASS
L130-L100	-5.97	-27.5	-23.16	PASS	-13.7	-24.4	-22.4	PASS
L140-L100	-4.56	-24.42	-21.17	PASS	-27.1	-38.7	-37.0	PASS
L150-L100	3.02	-12.53	-7.04	PASS	20.55	7.72	20.05	PASS
L155-L150	6.88	-1.54	2.38	PASS	-9.64	-22.3	-17.1	PASS
L160-L100	5.1	-3.72	1.37	PASS	12.28	3.88	8.27	PASS
L170-L100	17.64	7.12	13.11	PASS	-4.82	15.74	-9.12	PASS
L200-L100	107.7	56.39	103.1	PASS	21.39	8.02	20.97	PASS
L202-L200	9.94	-0.51	8.28	PASS	14.86	2.03	8.02	PASS
L302-L100	14.5	-3.29	-2.08	PASS				
L302-L304	17.75	5.66	13.13	PASS				
L322-L100	39.29	15.71	30.81	PASS				
L322-L324	38.22	21.25	30.35	PASS				

TIER 2

CASE Name	Annual Heating Loads: Colorado Springs				Annual Sensible Cooling Loads: Las Vegas			
	BESTEST Max	Min	HEED Mbtu/year	Pass/Fail	BestTest Max	Min	HEED Mbtu/year	Pass/Fail
L165AC Colorado Springs E+W Glass	84.65	55.08	79.86	PASS				
L165AL Las Vegas E+W Glass					63.59	48.60	53.43	PASS
P100AC South Glass	18.40	6.02	16.07	PASS	29.03	14.11	19.37	PASS
P105AC Better Overhang	20.97	16.19	18.24	PASS	17.83	7.95	11.25	PASS
P110AC Low Mass	27.79	16.19	28.72		40.49	25.36	36.87	PASS
P140AC No Glass	32.42	21.82	28.07	PASS	6.84	-2.33	0.17	PASS
P150AC Glass on all Walls	31.99	18.58	28.50	PASS	19.03	8.42	9.26	PASS

CASE	Difference in Annual Heating Colorado Springs				Difference in Annual Cooling: Las Vegas			
	BESTEST Max	Min	HEED Mbtu/year	Pass/Fail	BestTest Max	Min	HEED Mbtu/year	Pass/Fail
L165AC-L160AC	10.43	-0.04	-1.67					
L165AL-L160AL					-1.15	-19.9	-11.6	PASS
P105AC-P100AC	6.57	-1.92	2.18	PASS	-2.16	-13.4	-7.12	PASS
P110AC-P100AC	14.17	5.39	12.69	PASS	17.45	6.79	18.50	
P140AC-0100AC	21.09	11.02	12.02	PASS	-12.4	-12.2	-18.2	PASS
P150AC-P100AC	17.60	8.56	12.43	PASS	-1.69	-12.0	-9.12	PASS

RESULTS:

Tier 1: 50 tests pass out of 50: 100% Pass

Tier 2: 19 Pass out of 22: 86%

Total Hers BestTest Results: 69 Pass out of 72: 96%

HEED (Home Energy Efficient Design) is an easy-to-use tool that helps homeowners, builders, and architects design more energy efficient homes. When HEED was tested using the HERS BESTEST evaluation protocol, the results show that 96% of the tests fell within the acceptance range.

HEED uses as its thermal analysis computation kernel a program originally called Solar-5, developed at UCLA. It uses an hourly heat balance similar to the method used in EnergyPlus. It calculates an hourly heat balance for each of the 8760 hours in a year using standard ASHRAE algorithms, the Mackey and Wright time lag and decrement factor method of accounting for heat flow through opaque walls, the Admittance Factor Method to account for internal thermal mass, and the California Energy Commissions ACM method to calculate the performance of basements and water heaters. To find the hourly heat balance it uses a successive approximation method to calculate the indoor air temperatures. Thus it can integrate loads and energy calculations at each time step, which means that the HVAC system only adds heating or cooling energy if the indoor air temperature has floated beyond the upper or lower comfort limits.

HEED has also been previously validated using the procedure as specified in the ANSI/ASHRAE Standard 140-2001, Standard Method of Test for the Evaluation of Energy Analysis Computer Programs (Tsai and Milne, 2003). This method was developed by the International Energy Agency Solar Heating and Cooling Program, Task 12, and was adopted by DOE as the accepted basis for verifying the credibility of computer simulation programs. This procedure involves calculating the annual heating and cooling energy for a series of different test case buildings, ranging from extremely abstract to quite realistic. In ANSI/ASHRAE test protocols eight different simulation programs were run to establish the maximum and minimum values for each test building, including ESP, BLAST, DOE2, SSRE/SUN, SERIRES,S3PAS,TRANSYS, and TASE. In HERS BESTEST three different simulation programs are run to establish the maximum and minimum values for each building including BLAST, DOE2.1E, and SERIRES/SUNCODE. The HERS acceptance range is created by calculating the 90% confidence interval, or by adding 4 Mbtu to the maximum value and subtracting up to 4 MBTU from the minimum value, then using the absolute value that is larger.

HEED was run for the 21 test buildings in the HERS BestTest Tier 1 and the 7 test buildings in Tier 2, each intended to test the ability of the program to simulate a different situation including high mass or low mass, internal loads, infiltration rates, surface color, glass area, window orientation, glazing properties, and window shading. These tests were run for both Colorado Springs (cold climate) and Las Vegas (hot climate). A series of Difference Tests were also run.

References:

HEED is available at no cost from www.aud.ucla.edu/heed:

HERS BESTEST, Home Energy Rating System Building Energy Simulation, Volume 1 and 2, R Judkoff and J Neymark, National Renewable Laboratory, 1617 Cole Blvd, Golden Colorado, 80401

ANSI/ASHRAE Standard 140-2001, ASHRAE Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs, American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc., 1791 Tullie Circle, NE, Atlanta, GA 30329

HEED Validation Against the ASHRAE/BESTEST Standard (ASHRAE Standard 140), Grace Tsai and Murray Milne, UCLA Department of Architecture and Urban Design, www.aud.ucla.edu/heed , 2003

HEED Validated Using HERS BestTest Tier 1 and 2: 2008, Murray Milne, UCLA Department of Architecture and Urban Design, www.aud.ucla.edu/heed , 2007