Revision to the Residential ACM Calculation for Furnace Fan Modeling

PIER Research for the 2008 Residential Building Standards
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Summary

This change extends detailed modeling of furnace fan watts added in the 2005 standards for cooling to heating as well.

Background

The RACM specifies the algorithms and modeling rules to be used in Alternative Compliance Method computer programs (ACMs) that are certified for use in compliance with the building standards. The 2005 RACM specifies that furnace fan electric energy in Btu be counted as a fixed 0.5% of furnace heating output in Btu regardless of any other characteristic of the furnace or fan. For the 2005 Standards the furnace fan BTU is converted to electric WH and then converted to TDV energy.

The field survey of 60 new home mechanical systems carried out for the PIER Research for the 2008 Residential Building Standards project[1] provided data on the relationships of heating fan energy use to cooling fan energy use and other furnace characteristics.

Proposed Changes

1. The Standard Design and the default for the Proposed Design shall assume furnace fan Watts per Cubic Feet per Minute (W/CFM) in heating mode is a function of the cooling mode W/CFM:

W/CFM Heat = 0.88 * W/CFM Cool

2. The Standard Design and the default for the Proposed Design shall assume furnace fan heating air flow in Cubic Feet per Minute (CFM) is a function of the cooling air flow for the furnace:

CFM Heat = 0.93 * CFM Cool

3. The Standard Design and the default for the Proposed Design shall assume furnace heating output in Btuh is a function of the CFM HEAT heating air flow for the furnace assuming a 40 deg F temperature rise through the furnace:

Cap Heat = 1.08 * CFM Heat * 40

4. The fan energy per Btu of heating output is equal to:

W/BtuHeat = (CFM Heat * W/CFM Heat) / Cap Heat

1 Wilcox, B. PIER Research for the 2008 Residential Building Standards PIER Agreement Number 500-04-006

Provisions for specifying alternate W/CFM Heat and CFM Heat with post construction measurement and 3rd party verification will be included in the 2008 RACM. Using those procedures credit may be taken for lower W/CFM in the ACM calculations.

Results Comparison with 2005 ACM

Table 1 Comparison of TDV Energy for 2005 and 2008 Furnace Fan Modeling

2008 TDV Energy Use (TDV/ft2)												
	2005 Heating Fan Standard				2008 Heating Fan Proposed				Percent Difference Proposed - Standard			
Climate	Heat	Cool	DHW	Total	Heat	Cool	DHW	Total	Heat	Cool	DHW	Total
1	30.8	0.5	20.4	51.6	31.1	0.5	20.4	52.0	1%	0%	0%	1%
2	36.8	15.0	19.8	71.7	37.2	15.0	19.8	72.0	1%	0%	0%	1%
3	22.4	4.6	19.8	46.7	22.6	4.6	19.8	47.0	1%	0%	0%	1%
4	27.8	6.6	19.5	53.9	28.0	6.6	19.5	54.2	1%	0%	0%	1%
5	21.7	5.2	19.7	46.6	21.9	5.2	19.7	46.8	1%	0%	0%	0%
6	8.6	4.4	19.1	32.0	8.7	4.4	19.1	32.1	1%	0%	0%	0%
7	9.3	5.7	18.9	33.9	9.4	5.7	18.9	34.0	2%	0%	0%	0%
8	11.3	13.3	18.9	43.5	11.4	13.3	18.9	43.6	1%	0%	0%	0%
9	11.8	21.1	18.7	51.6	11.9	21.1	18.7	51.7	1%	0%	0%	0%
10	14.9	32.4	18.7	66.0	15.1	32.4	18.7	66.2	1%	0%	0%	0%
11	32.9	40.8	19.2	92.9	33.2	40.8	19.2	93.2	1%	0%	0%	0%
12	29.8	25.4	19.4	74.7	30.1	25.4	19.4	75.0	1%	0%	0%	0%
13	22.8	45.0	18.7	86.4	23.0	45.0	18.7	86.7	1%	0%	0%	0%
14	31.6	45.5	19.1	96.2	31.9	45.5	19.1	96.5	1%	0%	0%	0%
15	4.9	90.9	17.1	112.9	4.9	90.9	17.1	112.9	1%	0%	0%	0%
16	63.9	18.0	21.0	102.9	64.6	18.0	21.0	103.6	1%	0%	0%	1%
Ave	23.8	23.4	19.3	66.5	24.1	23.4	19.3	66.7	1%	0%	0%	0%
CIRB	22.0	25.5	19.1	66.7	22.3	25.5	19.1	66.9	1%	0%	0%	0%

Table one shows the heating cooling, IAQ fan and total TDV energy consumption for the 1761 prototype house calculated using the 2005 and proposed 2008 furnace fan approaches. The furnace fan energy is included in the Heat column (the fan column is used for IAQ ventilation fans, not modeled in these runs). The overall impact of the modeling change is to increase the TDV energy for heating by 1% on a statewide basis. This is because the actual fan energy is larger than the fixed 2005 assumption.