Revision to the Residential ACM Calculation for Indoor Air Quality Ventilation

PIER Research for the 2008 Residential Building Standards

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Summary

This change implements the proposed requirement for mechanical ventilation in the Residential Alternative Compliance Methods (RACM) calculation procedures and removes outdated procedures for indoor air quality window operation.

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 ventilation to provide acceptable Indoor Air Quality (IAQ) is assumed to be provided primarily by infiltration through the building envelope due to natural forces of wind and temperature differences. When the natural infiltration rate falls below a minimum threshold the RACM specifies how to calculate ventilation rate increases assumed to be caused by the occupants opening windows.

For the 2008 revision of the standards CEC staff is proposing to adopt a mandatory requirement for mechanical ventilation in all new homes.[1] This requirement is intended to replace the prior assumption that occupants operate their windows to maintain adequate IAQ.

The envelope leakage area in new homes has been declining since the 2005 default SLA values were established based on measurements of houses constructed between 1984 and 1987.[2] The declines are the result of a number of changes including improved components required by the standards such as air tight recessed lighting fixtures, changes in building practices such as the shift to sealed combustion gas fireplaces. Although there have been no comprehensive studies of envelope leakage in California homes since 1990, smaller studies and anecdotal evidence support lower default SLA values. For example Wilson presented data at a CEC workshop from his study of 76 Southern California homes built in 2002 that had an average SLA of 2.8. [3] The PIER study of Residential Construction Quality (RCQ) found average SLAs of 3.2 and 3.5 for 2 groups of homes built in above code incentive programs.[4] Rick Chitwood who carried out the field measurements for the RCQ project recommends an assuming 3.4 to 3.8 SLA for typical new homes.[5]

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1 Proposal to be presented

2 Wilcox, B; Lutz, J. Air Tightness and Air Change Rates in Typical New California Homes," Proceedings of the ACEEE 1990 Summer Study, American Council for an Energy Efficient Economy, Washington, DC, 1990.

3 Wilson, A.L., Bell, J., Hosler, D., Weker, R.A. Infiltration, Blower Door and Air Exchange Measurements in New California Homes. In: IAQ Problems and Engineering Solutions Specialty Conference, Research Triangle Park, NC, AWMA, July 21, 2003.

4 Davis Energy Group. Residential Construction Quality Assessment Project Phase II Final Report, California Energy Commission 400-98-004, 2002.

5 Personal communication, 3/16/2006

Proposed Changes

1. The Standard Design shall assume an exhaust fan which operates continuously at the prescriptive ventilation rate. The prescriptive ventilation rate (CFM) is equal to 0.01 * conditioned floor area + 7.5 * number of bedrooms + 1. The fan energy in the Standard Design shall be 0.25 W/CFM. This represents a new requirement in the standards.

2. The Standard Design shall assume a Specific Leakage Area (SLA) of 3.8 for homes with sealed ducts in unconditioned spaces (SLA for other cases will also be adjusted by subtracting 0.6). This is a reduction from the 2005 default SLA of 4.4 for this case.

3. The provisions for indoor air quality window operation will be removed from the RACM section 4.5.1

Results Comparison with 2005 ACM

Table 1 Comparison of TDV energy for 2005 and 2008 IAQ modeling

2008 TDV Energy Use (TDV/ft2)															
	2005 IAQ Vent Standard					Fan (48cfm,.25 W/cfm) & SLA (3.8) Proposed					Percent Difference Proposed - Standard				
Climate	Heat	Cool	Fan	DHW	Total	Heat	Cool	Fan	DHW	Total	Heat	Cool	Fan	DHW	Total
1	30.78	0.47	0.00	20.37	51.62	30.53	0.47	0.82	20.37	52.19	-1%	0%	n/a	0%	1%
2	36.82	15.04	0.00	19.79	71.65	36.77	14.97	0.82	19.79	72.35	0%	0%	n/a	0%	1%
3	22.38	4.58	0.00	19.75	46.71	22.13	4.55	0.83	19.75	47.26	-1%	-1%	n/a	0%	1%
4	27.75	6.63	0.00	19.52	53.90	27.64	6.58	0.82	19.52	54.56	0%	-1%	n/a	0%	1%
5	21.65	5.23	0.00	19.71	46.59	21.56	5.19	0.82	19.71	47.28	0%	-1%	n/a	0%	1%
6	8.56	4.36	0.00	19.10	32.02	8.55	4.35	0.83	19.10	32.83	0%	0%	n/a	0%	2%
7	9.28	5.65	0.00	18.92	33.85	9.31	5.63	1.04	18.92	34.90	0%	0%	n/a	0%	3%
8	11.32	13.29	0.00	18.86	43.47	11.34	13.25	0.83	18.86	44.28	0%	0%	n/a	0%	2%
9	11.76	21.14	0.00	18.73	51.63	11.77	21.06	0.82	18.73	52.38	0%	0%	n/a	0%	1%
10	14.94	32.35	0.00	18.74	66.03	14.92	32.27	0.82	18.74	66.75	0%	0%	n/a	0%	1%
11	32.91	40.79	0.00	19.21	92.91	32.29	40.66	0.82	19.21	92.98	-2%	0%	n/a	0%	0%
12	29.81	25.43	0.00	19.44	74.68	29.40	25.32	0.82	19.44	74.98	-1%	0%	n/a	0%	0%
13	22.76	44.95	0.00	18.71	86.42	22.59	44.87	0.83	18.71	87.00	-1%	0%	n/a	0%	1%
14	31.60	45.50	0.00	19.14	96.24	31.13	45.26	0.82	19.14	96.35	-2%	-1%	n/a	0%	0%
15	4.89	90.87	0.00	17.09	112.85	4.82	90.31	0.82	17.09	113.04	-1%	-1%	n/a	0%	0%
16	63.93	18.02	0.00	20.96	102.91	62.43	17.99	0.82	20.96	102.20	-2%	0%	n/a	0%	-1%
Ave	23.82	23.39	0.00	19.25	66.47	23.57	23.30	0.84	19.25	66.96	-1%	0%	n/a	0%	1%
CIRB	22.03	25.54	0.00	19.11	66.67	21.82	25.44	0.84	19.11	67.21	-1%	0%	n/a	0%	1%

Table one shows the heating cooling, fan and total TDV energy consumption calculated using the 2005 and proposed 2008 IAQ ventilation approaches including the addition of the mechanical ventilation required in 2008. The overall impact on a state wide basis is an approximately 1% increase in TDV energy consumption.