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Occupant Sensor Ventilation

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Acknowledgements

California Statewide Codes and Standards Team

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Background

- Occupant Sensor Ventilation Control Requirements were introduced during the 2013 Building Energy Efficiency Standards update
- In response to ASHRAE 62.1 Standards committee
- Addendum to 62.1 was not adopted in time for 2013 update
- Addendum allowed certain spaces to completely shut off the ventilation

Background

Current requirements in Title 24, Part 6

- Section 120.2(e)3 includes requirements for spaces where occupant sensor ventilation controls are required, including:
  - Multipurpose rooms < 1000 ft_2
  - Classrooms > 750 ft_2
  - Conference, auditorium and meeting center rooms > 750 ft_2
- Section 120.1(c)5 includes current requirements for occupant sensor ventilation control devices
  - When unoccupied first shut off supply air then cycle it to average 25% of ventilation rate over 2 hours

Background

- ASHRAE 62.1 Standards now allow "occupied standby mode"

  Occupied standby mode: when a building space conditioning zone is scheduled to be occupied and an occupant sensor indicates no one is in the zone

- ASHRAE 90.1 has approved a proposal for occupied standby mode, currently out for public review

Background

Occupied Standby controls require an occupancy sensor that can communicate with the thermostat or building automation system (BAS).

This technology has improved due to lighting controls

Current lighting requirements specify occupant sensing controls

Proposed Code Change

The proposal is to completely shut off ventilation rather than maintaining 25% ventilation rate over 2 hours

Also, modifies the zones to which occupant sensor ventilation control applies recommending mandatory

Existing Spaces covered by requirement	Proposed Spaces covered by requirement
Multipurpose < 1000 ft_2	Multipurpose/assembly/ < 1000 ft_2
Classrooms > 750 ft_2	Lecture Classrooms
Convention/Auditorium/Meeting > 750 ft_2	Conference rooms
	Corridor
	Enclosed offices < 250 ft_2
	Hotel Guestrooms
	Lobbies

Proposed Code Change

Additionally, the CASE Team is proposing that these zones be eligible for compliance credit when incorporating occupant sensor controlled ventilation.

Examples include:

- Open plan offices
- Museums
- Religious worship
- Supermarkets
- Sports arena spectator areas
- Courtrooms
- Auditorium
- Multipurpose/assembly rooms greater than 1000 ft^2
- Enclosed offices more than 250 ft^2

Energy Analysis

Default small office prototype only has five open office zones. For this analysis the CASE Team modified the building to include closed office and conference room spaces

Prototype ID	Occupancy Type (Residential, Retail, Office, etc.)	Area (ft2)	Number of Stories
Prototype 1	Small Office	5,502	1

Space	Space Type	Thermal Zone	% of floor area	Floor Area (ft^2)
Attic	<no space type>	Attic Thermal Zone		6,114
Core_ZN	OpenOffice	Core_ZN Thermal Zone	29%	1,611
Perimeter_ZN_1	Conference	Perimeter_ZN_1 Thermal Zone	5%	275
Perimeter_ZN_2	ClosedOffice	Perimeter_ZN_2 Thermal Zone	18%	994
Perimeter_ZN_3	ClosedOffice	Perimeter_ZN_3 Thermal Zone	17%	952
Perimeter_ZN_4	ClosedOffice	Perimeter_ZN_4 Thermal Zone	18%	994
Perimeter_ZN_5	ClosedOffice	Perimeter_ZN_5 Thermal Zone	7%	362
Perimeter_ZN_6	OpenOffice	Perimeter_ZN_6 Thermal Zone	6%	315

Energy Analysis – First Year Impact per ft^2

Climate Zone	Electricity Savings (kWh/yr)	Peak Electricity Demand Reductions (kW)	Natural Gas Savings (therms/yr)	TDV Energy Savings (TDV kBtu/yr)
1	0.15	1.09E-04	7.91E-03	5.68
2	0.18	3.88E-05	5.50E-03	6.77
3	0.17	7.12E-05	4.34E-03	5.48
4	0.18	6.35E-05	4.00E-03	6.27
5	0.17	1.39E-04	4.76E-03	5.50
6	0.18	2.05E-04	2.03E-03	5.37
7	0.18	2.84E-07	1.15E-03	5.08
8	0.19	-1.88E-05	1.81E-03	5.56
9	0.20	-1.28E-05	2.31E-03	5.63
10	0.20	-2.13E-06	2.60E-03	5.80
11	0.21	1.64E-05	5.01E-03	9.13
12	0.19	7.23E-05	4.81E-03	8.57
13	0.21	5.94E-05	4.39E-03	9.31
14	0.21	2.34E-05	5.00E-03	7.84
15	0.27	2.26E-05	1.10E-03	8.85
16	0.18	4.02E-05	9.10E-03	7.33

Energy Analysis – 15 Year Costs per ft^2

Climate Zone	15-Year TDV Electricity Cost Savings (2020 PV$)	15-Year TDV Natural Gas Cost Savings (2020 PV$)	Total 15-Year TDV Energy Cost Savings (2020 PV$)
1	$0.37	$0.13	$0.51
2	$0.51	$0.10	$0.60
3	$0.41	$0.08	$0.49
4	$0.49	$0.07	$0.56
5	$0.41	$0.08	$0.49
6	$0.44	$0.04	$0.48
7	$0.43	$0.02	$0.45
8	$0.46	$0.03	$0.49
9	$0.46	$0.04	$0.50
10	$0.47	$0.05	$0.52
11	$0.72	$0.09	$0.81
12	$0.68	$0.09	$0.76
13	$0.75	$0.08	$0.83
14	$0.61	$0.09	$0.70
15	$0.77	$0.02	$0.79
16	$0.49	$0.16	$0.65

Lifecycle Cost-Effectiveness per ft^2

Climate Zone	Benefits TDV Energy Cost Savings + Other PV Savings1 (2020 PV$)	Costs Total Incremental PV Costs2 (2020 PV$)	Benefit-to- Cost Ratio
1	$0.51	$0.25	2.0
2	$0.60	$0.25	2.4
3	$0.49	$0.25	1.9
4	$0.56	$0.25	2.2
5	$0.49	$0.25	1.9
6	$0.48	$0.25	1.9
7	$0.45	$0.25	1.8
8	$0.49	$0.25	1.9
9	$0.50	$0.25	2.0
10	$0.52	$0.25	2.0
11	$0.81	$0.25	3.2
12	$0.76	$0.25	3.0
13	$0.83	$0.25	3.3
14	$0.70	$0.25	2.7
15	$0.79	$0.25	3.1
16	$0.65	$0.25	2.6

Statewide Energy and Cost Impact

Climate Zone	Statewide Construction in 2020 (million ft2)	First-Year Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Natural Gas Savings (million therms)	Lifecycle2 Present Valued Energy Cost Savings (PV$ million)
1	0.0253	0.004	0.003	0.000	$0.01
2	0.3398	0.060	0.013	0.002	$0.20
3	2.1972	0.364	0.156	0.010	$1.07
4	0.7627	0.137	0.048	0.003	$0.43
5	0.1481	0.025	0.021	0.001	$0.07
6	1.3842	0.254	0.283	0.003	$0.66
7	0.7213	0.129	0.000	0.001	$0.33
8	2.0219	0.385	-0.038	0.004	$1.00
9	2.7095	0.529	-0.035	0.006	$1.36
10	0.7406	0.148	-0.002	0.002	$0.38
11	0.1461	0.030	0.002	0.001	$0.12
12	1.4610	0.276	0.106	0.007	$1.11
13	0.2818	0.058	0.017	0.001	$0.23
14	0.1789	0.038	0.004	0.001	$0.12
15	0.0936	0.025	0.002	0.000	$0.07
16	0.4013	0.073	0.016	0.004	$0.26
Total	**13.6134**	**2.536**	**0.598**	**0.044**	**$7.44**

Proposed Code Language

SECTION 120.1- REQUIREMENTS FOR VENTILATION 120.1(c)5

5. **Occupant Sensor Ventilation Control Devices.** When occupancy sensor ventilation devices are required by Section 120.2(e)3 ~~or when meeting EXCEPTION 5 to Section 120.1(c)3,~~ occupant sensors shall be used to reduce the rate of outdoor air flow when occupants are not present in accordance with the following:

   A. […]

   B. […]

   ~~C. Within 30 minutes after being vacant for all rooms served by a zone damper on a multiple zone system, and the space temperature is between the heating and cooling setpoints, then no outside air is required and supply air shall be zero.~~

   ~~D. Within 30 minutes after being vacant for all rooms served by a single zone system, the single zone system shall cycle off the supply fan when the space temperature is between the heating and cooling setpoints.~~

   ~~E. In spaces equipped with an occupant sensor, when vacant during hours of expected occupancy and the occupied ventilation rate required by Section 120.1(b)2 is not provided, then the system or zone controls shall cycle or operate to maintain the average outdoor air rate over an averaging period of 120 minutes equal to 25percent of the rate listed in TABLE 120.1-A.~~

~~**Exception to 120.1(c)5:** If Demand Control Ventilation is implemented as required by Section 120.1(4).~~

Proposed Code Language

SECTION 120.2- REQUIRED CONTROLS FOR SPACE-CONDITIONING SYSTEMS 120.2(e)3

e. Shut-off and Reset Controls for Space-conditioning Systems. Each space-conditioning system shall be installed with controls that comply with the following:

1. *[omitted]*
2. *[omitted]*
3. ~~Multipurpose room less than 1000 square feet, classrooms greater than 750 square feet and conference, convention, auditorium and meeting center rooms greater than 750 square feet that do not have processes or operations that generate dusts, fumes, vapors or gasses shall be equipped with occupant sensor(s) to accomplish the following during unoccupied periods:~~

   A. ~~Automatically setup the operating cooling temperature setpoint by 2°F or more and setback the operating heating temperature setpoint by 2˚F or more; and~~

   B. ~~Automatically reset the minimum required ventilation rate with an occupant sensor ventilation control device according to Section 120.1(c)5.~~

Proposed Code Language

SECTION 120.2- REQUIRED CONTROLS FOR SPACE-CONDITIONING SYSTEMS 120.2(e)3

e. Shut-off and Reset Controls for Space-conditioning Systems. Each space-conditioning system shall be installed with controls that comply with the following:

3. Occupied Standby Controls. Zones serving only room(s) that are required to have occupant sensing lighting controls per sections 130.1(c)5 to 130.1(c)8, and where ~~the ASHRAE Standard 62.1~~ Table 120.1-A occupancy category permits ventilation air to be reduced to zero when the space is in occupied-standby mode, shall have all airflow supplied to the zone shall be shut-off whenever the space temperature is between the active heating and cooling setpoints

EXCEPTION 1 to Sections 120.2(e)1, 2~~, and 3~~: Where it can be demonstrated to the satisfaction of the enforcing agency that the system serves an area that must operate continuously.

~~**EXCEPTION 2 to Sections 120.2(e)1, 2, and 3:** Where it can be demonstrated to the satisfaction of the enforcing agency that shutdown, setback, and setup will not result in a decrease in overall building source energy use.~~

Proposed Code Language

SECTION 120.2- REQUIRED CONTROLS FOR SPACE-CONDITIONING SYSTEMS 120.2(e)3

e. Shut-off and Reset Controls for Space-conditioning Systems. Each space-conditioning system shall be installed with controls that comply with the following:

3. [...]

EXCEPTION 3 to Sections 120.2(e)1, 2~~, and 3~~: Systems with full load demands of 2 kW or less, if they have a readily accessible manual shut-off switch.

EXCEPTION 4 to Sections 120.2(e)1 and 2: Systems serving hotel/motel guest rooms, if they have a readily accessible manual shut-off switch.

~~**EXCEPTION 5 to Sections 120.2(e)3:**. If Demand Control Ventilation is implemented as required by Section 120.1(c)3 and 120.1(c)(4).~~

SECTION 100.1- DEFINITIONS

Occupied-standby mode: when a building space conditioning zone is scheduled to be occupied and an occupant sensor indicates no one is in the zone.

Questions?

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Comments Due by July 7th
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