2016 Title 24 Codes & Standards Enhancement (CASE) Proposal

Window and Door Switches

CEC Pre-rulemaking Workshop, June 12th, 2014

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Pre-rulemaking Workshop: Agenda

• Proposed prescriptive requirement
• Code change overview
• Summary of current code requirements
• Typical practices
• Methodology for analyses
• Initial data and findings
• Specific stakeholder requests
Proposed Prescriptive Requirement

Any directly conditioned space with manually operable wall or roof openings to the outdoors shall be provided with interlock controls that disable mechanical heating and mechanical cooling to that space (e.g. by resetting the heating setpoint to 50°F and the cooling setpoint to 100°F) when any such opening is open. Mechanical cooling may remain enabled when an opening is open if outside air temperature is below space temperature.

Exceptions:

1. Interlocks are not required on building exits with automatic closing devices.
2. Any space without a thermostat.
3. Alterations to existing buildings.

New Definition (copied from ASHRAE 90.1):

thermostat: an automatic control device used to maintain temperature at a fixed or adjustable setpoint.
Proposed Code Change Overview

• Types of building impacted: Commercial buildings with operable windows, such as
  – Office
  – School
  – Hotel
• Building system impacted: HVAC, Envelope
• Anticipated type of change:
  – Prescriptive
  – Performance penalty for operable windows/doors without switches (Note: ACM has a performance credit for window switches in T24-2013)
Energy Savings Potential

Simulations of UC Merced Classroom/Office Building (by Allan Daly, published in HPAC in 2002)

- No Operable Windows
- Operable Windows Without Switches
- Operable Windows With Switches

Annual Energy Use (percent of base case)
How do Operable Windows/Doors Without Switches Increase Energy Use?

• Occupant wants more fresh air and does not know or care about heating/cooling energy penalty. This is particularly true when the space temperature can be maintained at setpoint despite the extra infiltration load.

• Occupant does not know the zone mode (heating/cooling) or outside temperature so cannot gauge if opening the window will reduce or increase energy use.

• Occupant opened the window under favorable conditions but left the room (with the window open) and conditions changed to unfavorable.
Non-Energy Benefits

• Occupants will quickly learn that HVAC is interlocked and thus will feel free to open windows without fear of wasting heating/cooling energy thus resulting in improved air quality and occupant satisfaction. Studies have shown that occupants are willing to accept wider temperature dead-bands in buildings with operable windows.

• Signal lights can easily be included (e.g. green light on thermostat display) that encourage occupants to open windows when conditions are favorable, thereby increasing energy savings and allowing occupants to feel good about saving energy.

• The ACM rules will encourage architects to include operable windows in their designs.
Current Code Requirements

• An incentive for window switches was added to the ACM in 2013: “…natural ventilation may only be allowed in the (proposed) model if the building has interlocks on operable windows…”
  – Additional detail should be added to the ACM for 2016

• SSPC 90.1 approved the same window switch proposal for public review in 2012
  – There were 2 negative public review comments (both did not want to discourage operable windows)
  – 90.1-2013 requires switches only on doors, not windows

• Door switches required in Hawaii?
• Window/Door switches required in Europe?
Typical Practices

• Wireless window/door sensors is a very mature and reliable technology that has been used in the home security industry for decades and used for HVAC interlocks on thousands of buildings in US and Europe.

• Most buildings in CA with operable windows/doors do not have switches
  – A recent survey of mixed-mode buildings with operable windows conducted by the UC Berkeley found that 7 of 24 buildings with operable windows also had window switches

• Integration of external inputs for HVAC controls is also mature – e.g. T24-2013 requirement for occupant sensor ventilation controls.

• We have contacted all the major packaged unit manufacturers and none see any problems.
  – York/JCI: “I don't see any problem with this. Our TEC controllers have a window sensor input for this very purpose as part of their standard programming, and our FEC controllers can do this as well.”
The ILLUMRA Wireless Door/Window Sensor maximizes the energy savings of heating and air conditioning systems by providing wireless status of windows and/or doors. The sensor uses a magnet contact switch that is powered by a solar cell and communicates with a wide variety of ILLUMRA products.

Energy waste can be reduced by 20 to 60 percent by disabling blowers and/or adjusting temperature setpoints in HVAC systems when windows and doors are left open. The wireless Door/Window Sensor is a key component to reducing energy waste in hotel, condominium and dormitory buildings.

Using a simple ‘peel and stick’ process, the Wireless Door/Window Sensor makes it quick and easy to provide energy savings.

**Features:**
- Solar powered — when fully charged, can run in total darkness for several days
- No batteries - No Maintenance
- Install in minutes
- Eliminate the need to pull wires to sensors

### E8T-MDCCP, E9T-MDCCP

<table>
<thead>
<tr>
<th>Feature</th>
<th>E8T-MDCCP</th>
<th>E9T-MDCCP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>15-60 feet</td>
<td></td>
</tr>
<tr>
<td>Power Supply</td>
<td>Integrated Solar Cell</td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>315 MHz or 968 MHz</td>
<td></td>
</tr>
<tr>
<td>EED</td>
<td>04:00:01</td>
<td></td>
</tr>
<tr>
<td>Start-up Time with empty energy storage, typical</td>
<td>2.6 min</td>
<td>4.0 min</td>
</tr>
<tr>
<td>Initial operation time in darkness, typical</td>
<td>6 days if energy storage is fully charged</td>
<td></td>
</tr>
<tr>
<td>Dimensions</td>
<td>3.86 x 6.2 x .81 inches, 98.84 x 15.75 x 20.57mm</td>
<td></td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-20 up to +60° C</td>
<td></td>
</tr>
<tr>
<td>Mounting</td>
<td>Screws or double-sided tape</td>
<td></td>
</tr>
<tr>
<td>Rating and Approvals</td>
<td>FCC, AC, pending</td>
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</tr>
</tbody>
</table>

### Dimensions

![Dimensions Diagram](image-url)
Will it Discourage Operable Windows?

• No effect where operable windows are required (e.g. low-rise residential)

• Where operable windows are not required they are a significant premium. The small incremental cost for the window switch is unlikely to change many minds, particularly with the ACM incentive.
  – Window switch costs will continue to come down once they are required

• If operable windows were needed for health and safety in other building types then they would be in the building code, i.e. they are a nice amenity but have minimal real value health/safety benefit, particularly in CA mild climate, and therefore should be used in a responsible manner, i.e. with switches.
Methodology for Savings Analysis

• Simulated open window 18% of the time when all of the following were true:
  – Normal occupied times (no penalty for leaving windows open after hours)
  – Outside temp between 50F and 85F
  – Resultant indoor temp between 68F and 77F

• Assumed occupants modulate window/door to limit infiltration to 1 cfm/ft²

• Incremental cost: $150/zone

• 500 ft²/zone

• Cost and savings will be the same for operable window or door
Results using 2013 TDV Rates

Table 7: 15-year life-cycle cost in each climate zone for prototype building.

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>City</th>
<th>15 Year TDV Non-Integrated HVAC Energy Cost [$]</th>
<th>15 Year TDV Switched Operable Windows HVAC Energy Cost [$]</th>
<th>15 Year TDV Life-Cycle Cost Savings [$]</th>
<th>Simple Payback [Years]¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Oakland</td>
<td>$77,091</td>
<td>$72,987</td>
<td>$3,237</td>
<td>4.4</td>
</tr>
<tr>
<td>12</td>
<td>Sacramento</td>
<td>$140,318</td>
<td>$136,717</td>
<td>$2,470</td>
<td>5.1</td>
</tr>
</tbody>
</table>

- Prototype building is 10,000 ft² office building with ½ perimeter zones and ½ interior zones.
Proposed Changes to ACM

- Penalize operable windows without switches by increasing the infiltration rate in the proposed design if operable-window-to-wall ratio greater than 1%.
  - It should only be increased during occupied hours when $50 < \text{OADB} < 85$.
  - Increased infiltration rate should be fixed at 0.15 cfm/ft².
- Limit the natural ventilation rate to 1 cfm/ft² if wind speed below 5 mph and 2 cfm/ft² above 5 mph. Currently the user can use any natural ventilation rate as long as “Documentation shall be provided supporting the air flow rate for the proposed design”
- Add a definition for “interlocks”: Operable window interlocks must be able to automatically disable heating and cooling to any room with operable windows and a thermostat when an operable window in that room is open.
- Fix this typo: The maximum indoor temperature below which natural ventilation is disabled
Feedback From IOU Stakeholder Meeting

- Stakeholder Meeting was held May 20\textsuperscript{th}
  - Door/window switch controls can be integrated with the building security system.
  - Doors that open and close frequently, such as doors in retail spaces, should not trigger the HVAC system to cycle down
    - Doors that have automatic closures would be exempt
  - IOU CASE Team does not expect negative impact on the longevity of HVAC systems.
Feedback From IOU Stakeholder Meeting (continued)

- Can existing building control systems can handle another input, or would this require upgrading control systems?
- Buildings with operable windows should have small zones so the full zone receives the benefit of the operable window.
- Notes and presentations from stakeholder meeting available at Title24Stakeholders.com.
Questions?

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