



DENVER AMENDMENT PROPOSAL FORM FOR PROPOSALS TO THE 2019 DENVER BUILDING CODE AMENDMENTS AND THE 2021 INTERNATIONAL CODES

DENVER
THE MILE HIGH CITY

2021 CODE DEVELOPMENT CYCLE

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2) One proposal per this document is to be provided with clear and concise information.

Is a separate graphic file provided ("X" to answer): ___ Yes or X No

3) Highlight the code and acronym that applies to the proposal

<u>Acronym</u>	<u>Code Name</u>	<u>Acronym</u>	<u>Code Name</u>
DBC-AP	Denver Building Code–Administrative Provisions	IPC	International Plumbing Code
IBC	International Building Code	IRC	International Residential Code
IECC	International Energy Conservation Code	IFGC	International Fuel Gas Code
IEBC	International Existing Building Code	IMC	International Mechanical Code
IFC	International Fire Code	DGC	Denver Green Code

Please provide all the following items in your amendment proposal.

Code Sections/Tables/Figures Proposed for Revision:

Section C406.6

Proposal:

Instructions: Show the proposal using ~~strikeout~~, underline format.

Place an "X" next to the choice that best defines your proposal: _ Revision X New Text X Delete/Substitute ___ Del

This proposal added a revision to Section C406.6, and replaces values in Tables C406.1(1), C406.1(2), C406.1(3), C406.1(4), and C406.1(5).

C406.6 Dedicated outdoor air system. Buildings containing equipment or systems regulated by Section C403.3.4, C403.4.3, C403.4.4, C403.4.5, C403.6, C403.8.4, C403.8.6, C403.8.6.1, C403.10.1, C403.10.2, C403.10.3 or C403.10.4 shall be equipped with an independent ventilation system designed to provide not less than the minimum 100-percent outdoor air to each individual occupied space, as specified by the International Mechanical Code. The ventilation system shall be capable of total energy recovery. The HVAC system shall include supply-air temperature controls that automatically reset the discharge-air temperature in response to outdoor air temperatures. The energy credit achievable from Table C406.1(1) through Table C406.1(5) will be prorated by the fraction of floor area served by systems that do not require variable-speed drives for supply fans, under C403.8.6.1.

The ventilation system shall ~~capable of include~~ meet the following criteria:

1. ~~total~~ DOAS units shall include energy recovery with a minimum sensible energy recovery ratio of 60 percent at design conditions, according to AHRI 1060 ratings. Systems shall include an energy recovery bypass when ventilation conditions are suitable for direct air delivery without heat recovery.
2. DOAS shall disable heating and employ bypass as needed to maintain a 60F or cooler supply air temperature when the majority of zones served by the DOAS require cooling.
3. Heating and cooling equipment fans, heating and cooling circulation pumps, and series terminal unit fans shall cycle off and terminal unit primary cooling air shall be shut off when there is no call for heating or cooling in the zone.
4. All DOAS systems with design airflow of 1,000 cfm or greater shall include a variable speed drive for the supply fan, for system balancing and commissioning.

**TABLE C406.1(1)
ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP B OCCUPANCIES**

	5B
C406.2.1: 5% heating efficiency improvement	NA
C406.2.2: 5% cooling efficiency improvement	2
C406.2.3: 10% heating efficiency improvement	1
C406.2.4: 10% cooling efficiency improvement	5
C406.3: Reduced lighting power	8
C406.4: Enhanced digital lighting controls	2
C406.5: On-site renewable energy	9
C406.6: Dedicated outdoor air	≥ 6
C406.7.2: Recovered or renewable water heating	NA
C406.7.3: Efficient fossil fuel water heater	NA
C406.7.4: Heat pump water heater	NA
C406.8: Enhanced envelope performance	7
C406.9: Reduced air infiltration	4

C406.10: Energy monitoring	2	2
C406.11: Fault detection and diagnostics system	1	1

**TABLE C406.1(2)
ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP R AND I OCCUPANCIES**

	5 B
C406.2.1: 5% heating efficiency improvement	1
C406.2.2: 5% cooling efficiency improvement	1
C406.2.3: 10% heating efficiency improvement	2
C406.2.4: 10% cooling efficiency improvement	1
C406.3: Reduced lighting power	2
C406.4: Enhanced digital lighting controls	N A
C406.5: On-site renewable energy	7
C406.6: Dedicated outdoor air system	5 8
C406.7.2: Recovered or renewable water heating	14
C406.7.3: Efficient fossil fuel water heater	9
C406.7.4: Heat pump water heater	5

C406.8: Enhanced envelope performance	5
C406.9: Reduced air infiltration	5

**TABLE C406.1(3)
ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP E OCCUPANCIES**

	5 B
C406.2.1: 5% heating efficiency improvement	2
C406.2.2: 5% cooling efficiency improvement	1
C406.2.3: 10% heating efficiency improvement	4
C406.2.4: 10% cooling efficiency improvement	2
C406.3: Reduced lighting power	9
C406.4: Enhanced digital lighting controls	2
C406.5: On-site renewable energy	6
C406.6: Dedicated outdoor air system	N A
C406.7.2: Recovered or renewable water heating ^a	1
C406.7.3: Efficient fossil fuel water heater ^a	3
C406.7.4: Heat pump water heater ^a	1

C406.8: Enhanced envelope performance	3
C406.9: Reduced air infiltration	N A

**TABLE C406.1(4)
ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP M OCCUPANCIES**

	5 B
C406.2.1: 5% heating efficiency improvement	2
C406.2.2: 5% cooling efficiency improvement	2
C406.2.3: 10% heating efficiency improvement	4
C406.2.4: 10% cooling efficiency improvement	3
C406.3: Reduced lighting power	14
C406.4: Enhanced digital lighting controls	3
C406.5: On-site renewable energy	7
C406.6: Dedicated outdoor air system	3 8
C406.7.2: Recovered or renewable water heating	N A
C406.7.3: Efficient fossil fuel water heater	N A
C406.7.4: Heat pump water heater	N A

C406.8: Enhanced envelope performance	5
C406.9: Reduced air infiltration	2

**TABLE C406.1(5)
ADDITIONAL ENERGY EFFICIENCY CREDITS FOR OTHER^a OCCUPANCIES**

	5 B
C406.2.1: 5% heating efficiency improvement	2
C406.2.2: 5% cooling efficiency improvement	2
C406.2.3: 10% heating efficiency improvement	3
C406.2.4: 10% cooling efficiency improvement	3
C406.3: Reduced lighting power	8
C406.4: Enhanced digital lighting controls	3
C406.5: On-site renewable energy	7
C406.6: Dedicated outdoor air system	4 7
C406.7.2: Recovered or renewable water heating ^b	1 4
C406.7.3: Efficient fossil fuel water heater ^b	9
C406.7.4: Heat pump water heater ^b	5

C406.8: Enhanced envelope performance	5
C406.9: Reduced air infiltration	4

Supporting Information (DRAFT):

All proposals must include a written explanation and justification as to how they address physical, environmental, and/or customary characteristics that are specific to the City and County of Denver. The following questions must be answered for a proposal to be considered.

- Purpose: What does your proposal achieve?
- Reason: Why is your proposal necessary?
- Substantiation: Why is your proposal valid? (i.e. technical justification)

Purpose: Small commercial buildings with one or two stories, especially retail, warehouse, office and school buildings, typically use large numbers of single zone packaged rooftop air conditioners to both heat, cool, and ventilate the space. Since ventilation and space conditioning functions are combined into one unit, the supply fans run continuously during operating hours. This consumes a lot of energy, especially for small (5 tons capacity or less) units that use constant volume fans. A better solution is to separate the ventilation functions and space conditioning functions by using dedicated outside air systems (DOAS) for ventilation, and zonal systems for space conditioning. The zonal systems can cycle on and off with the load. DOAS systems are specified in the Washington State Energy Code (WSEC) and are often included in high performance building designs. A major retailer is moving to specify DOAS systems in all of their big-box retail stores. While in Colorado there is no need for dehumidification of outside air, the use of DOAS systems saves considerable fan energy while ensuring proper ventilation air.

This proposal modifies the energy credits in C406.6 to reflect the performance of DOAS systems meeting the additional specifications in this proposal. This incentivizes projects that are able to separate sensible heating and cooling from ventilation loads. The proposal will revise credit point totals for DOAS systems in C406, as appropriate, to reflect energy benefits.

Reason:

This proposal modifies the energy credits in C406.6 to reflect the performance of DOAS systems meeting the additional specifications in this proposal. This incentivizes projects that are able to separate sensible heating and cooling from ventilation loads.

The proposal does not mandate the use of DOAS systems but specifies additional requirements when DOAS systems are used so that potential energy savings can be realized.

Dedicated outside air systems can be effective at saving energy in commercial buildings, but the existing IECC code covers only basic requirements. Adding requirements for energy recovery will save considerable heating and cooling energy for central DOAS systems. The use of a bypass will allow direct introduction of ventilation air when outside conditions are appropriate. At times, contractors may be unfamiliar with control sequences for DOAS system operation. Specification of appropriate settings for supply air temperature control will ensure that they operate according to their design intent.

Dedicated outside air systems typically provide 100% outside air. With sufficient size, the systems can utilize variable speed drives for fan energy savings, from easier balancing adjustments to match airflow requirements.

Another design strategy used for DOAS systems that include direct expansion cooling (DX-DOAS systems) would be to require a design airflow that is at least 150 percent of the design ventilation load, to provide partial economizer cooling. Typically, when DOAS are paired with zonal systems that cycle with the load, the heat pumps or air conditioning units will not include economizer capability. Some benefits can be achieved by providing partial economizer cooling to meet the load.

A survey by the New Buildings Institute revealed that a disproportionately high percentage of zero net energy and high-performance buildings use dedicated outside air systems. This allows for decoupling of ventilation loads from building loads

and provides opportunities for large reduction in fan power for office, retail and other building types. A higher credit point assigned to DOAS systems is recommended.

Bibliography and Access to Materials (as needed when substantiating material is associated with the amendment proposal):

2020 Energy Solutions, Red Car Analytics. Nonresidential HVAC Controls, Final CASE Report. California Statewide Codes and Standards Enhancement Program, September 2020.

New Buildings Institute. 2016. Zero Net Energy Building Controls: Characteristics, Impacts and Lessons. white paper, ACEEE.

New Buildings Institute. 2019. NBI Releases Zero Energy Building Count and Trends for 2019. 5 9. Accessed 02 12, 2020. <https://newbuildings.org/nbi-releases-zeroenergy-building-count-and-trends-for-2019/>.

Other Regulations Proposed to be Affected (DRAFT)

***For proposals to delete content from the 2019 Denver Green Code in conjunction with adding it to other mandatory Denver codes and/or regulations, only.**

Please identify which other mandatory codes or regulations are suggested to be updated (if any) to accept relocated content.

Referenced Standards (DRAFT):

List any new referenced standards that are proposed to be referenced in the code.

Impact (DRAFT):

How will this proposal impact cost and restrictiveness of code? ("X" answer for each item below)

Cost of construction: Increase ___ Decrease* ___ No Impact
Cost of design: Increase ___ Decrease ___ No Impact
Restrictiveness: ___ Increase ___ Decrease No Impact