lMA 2023 Commercial Stretch code and Specialized Opt-in code (IECC2021 with MA amendments) DOER Final Draft 9-19-22 REDLINE

Black text is original **IECC2021** language

MA draft amendments: Blue underline and ~~Blue strike-out~~ designates **MA amendments** to the IECC2021, both base code and stretch code amendments.

Pages 3 to 41: MA **stretch code amendments** to the Massachusetts 10th edition IECC2021.

Page 42 onwards: **Municipal Opt-in Specialized code amendments** to the IECC2021 Appendix RC.

Changes to the June 24th Draft Regulations: Red underline and ~~Red strike-out~~ designates changes to the draft regulations made based on Public comments and the Stretch energy code Technical Advisory Committee input.

List of **stretch code amendments to the IECC2021**:

a) C401 – modified to update prescriptive and ASHRAE 90.1 pathways and add TEDI pathway for studied building types.
b) C402.1.5 – Envelope backstop updated to simplify the 9th edition version and provide a separate backstop for curtainwall buildings.
c) C402.2.8 – Brings in language on fireplaces to match the IECC residential code.
d) C402.5 – Clean up and clarify language around IECC2021 new air barrier testing requirements in Climate Zone 5.
e) C402.7 – New section on accounting for thermal bridging
f) C403.7 – Adds requirements for dedicated outdoor air systems (DOAS) to minimize use of reheat, and improve energy recovery system performance requirements.
g) C405.13 – Updated EV ready wiring requirements with addition of ALMS options to mitigate cost and lower electrical service requirements.
h) C406 – minor edits to accommodate move to points based system in IECC2021.
i) C407 – Adds TEDI path to performance options and updates ASHRAE 90.1 appendix G to 2019 level, updates HERS values (with phase-in to 42/45) and updated Passivehouse certification to 2021 levels.
j) C502.1 – Clarifies thresholds and code compliance pathways for commercial building additions.
k) C503.1 – Clarifies thresholds and code compliance pathways for commercial building alterations
l) C505.1 – Clarifies thresholds and code compliance pathways for commercial building change of use

List of **Specialized code** amendments (in addition to stretch code amendments):

m) CC101 – Adds the adoption timeline for Passive house multi-family and the 3 code

compliance pathways for new construction under the Specialized Code – Zero Energy Bldg, All-electric Blgd, or Mixed-fuel bldg. with GHG mitigation.

n) CC103.3 – Edits the Zero Energy pathway to remove requirements for RECs from IECC appendix CC and limit off-site renewable energy procurement options.

o) CC104 – additional requirements for the all-electric pathway – efficient electric appliances (no electric resistance heating for primary systems)

p) CC105 & CC106 - additional requirements for the mixed-fuel pathway – minimum efficiency equipment, onsite solar where unshaded, and pre-wiring.

MASSACHUSETTS STRETCH ENERGY CODE – 2023 amendments to IECC2021

CHAPTER 1 [CE] SCOPE AND ADMINISTRATION

SECTION C103 - CONSTRUCTION DOCUMENTS

Add the following to Section C103.2:

C103.2 Information on construction documents.

14. Solar Ready roof zone in accordance with Appendix CB, or *Potential Solar Zone Area* in accordance with Appendix CC.

15. EV Ready Spaces locations in accordance with C405.13

16. For buildings using the Relative Performance Pathway (C407.2) because average ventilation at full occupancy is greater than 0.5 cfm/sf, submit mechanical equipment schedules for all new and/or existing air handling equipment designed to supply any quantity of outdoor air to the space, and an airflow riser diagram encompassing the complete project boundary. Mechanical equipment schedules shall clearly indicate the total design outdoor airflow for each unit. The air riser diagram shall include all supply, exhaust, and return air systems serving the space. The air riser diagram shall also include a summary of the total outdoor air supplied, the total gross square footage served by the ventilation system, and the overall flow rate per area in cfm/sf.

17. For mixed fuel building following Appendix CC, construction documents showing electric HVAC retrofit design prepared by the HVAC engineer. The contract documents shall show future replacement of *combustion equipment* based HVAC system with an equivalent all electric system. Contract documents shall show *combustion equipment* to be replaced, future electric equipment, supporting electric, structural, and architectural infrastructure to be installed during building construction, and space allotments for future equipment.

Add the following Section C103.2.2:

C103.2.2 COMcheck submittal.

The construction documents submitted with the application for permit shall be accompanied by completed COMcheck Envelope, Lighting and Mechanical Compliance Certificates, and a Plan Review Inspection Checklist for the purposes of demonstrating compliance with the energy provisions of 780 CMR 13.00: *Energy Efficiency*.

Exception: Projects documenting compliance following Section C407.2 (ASHRAE 90.1 Appendix G) shall follow applicable reporting requirements

CHAPTER 2 [CE]
DEFINITIONS

Add the following definitions:

ALL-ELECTRIC BUILDING. A building with no on-site *combustion equipment* for fossil fuel use or capacity for including fossil fuel use in space heating, water heating, cooking, or drying appliances.

AUTOMATIC LOAD MANAGEMENT SYSTEMS (ALMS). A control system that allows multiple connected *electric vehicle supply equipment (EVSE)* to share a circuit or panel and automatically manage power at each charger, reducing the total connected electrical capacity of all *EVSE*.

CLASS 3 EXHAUST. Exhaust meeting the definition of Class 3 air in ASHRAE/ASHE Standard 62.1-2019, including air with significant contaminant concentration, significant sensory-irritation intensity, or offensive odor. The Class 3 Exhaust system must be capable of reducing exhaust and makeup airflow rates to 50% of the zone design values or the minimum required to maintain pressurization relationship requirements.

CLASS 4 EXHAUST. Exhaust meeting the definition of Class 4 air in ASHRAE/ASHE Standard 62.1-2019, including laboratory fume hood exhaust, exhaust where energy recovery is not allowed by ASHRAE/ASHE Standard 170 for use in energy recovery systems with leakage potential, and systems exhausting toxic, flammable, paint or corrosive fumes or dust. The Class 4 Exhaust system must be capable of reducing exhaust and makeup airflow rates to 50% of the zone design values or the minimum required to maintain pressurization relationship requirements. Excludes *exempt exhaust*.

CLEAN BIOMASS HEATING SYSTEM. Wood-pellet fired central boilers and furnaces with less than 3 million Btu/hour rated heat input, where the equipment has a thermal efficiency rating of 85% (higher heating value) or greater; and a particulate matter emissions rating of no more than 0.08 lb. $PM_{2.5}$/MMBtu heat output. Or wood chip fired central boilers and furnaces with less than 3 million Btu/hour rated heat input, where the equipment has a thermal efficiency rating of 80% or greater and a particulate matter emissions rating of no more than 0.10 lb. $PM_{2.5}$/MMBtu heat output.

COMBUSTION EQUIPMENT. Any *equipment* or *appliance* used for space heating, *service water heating*, cooking, clothes drying and/or lighting that can use *fuel gas*, *fuel oil* or solid fuel and that is not a *clean biomass heating system*.

~~**CURTAIN WALL.** Product consisting of both vision glass and opaque glass areas to create external non-load bearing wall that is designed to separate the exterior and interior environments.~~

DEDICATED OUTSIDE AIR SYSTEM (DOAS): A ventilation system that supplies 100 percent outdoor air primarily for the purpose of ventilation and that is a separate system from the zone space-conditioning system.

ELECTRIC VEHICLE. An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, electric motorcycles, and the like, primarily powered by an electric motor that draws current from a rechargeable storage battery, fuel cell, photovoltaic array, or other source of electric current.
Informational note: defined as in 527 CMR 12 section 625.2.

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE): The conductors, including the ungrounded, grounded, and equipment grounding conductors, and the e*lectric vehicle* connectors, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for the purpose of transferring energy between the premises wiring and the *electric vehicle*.
Informational note: defined as in 527 CMR 12 section 625.2.

ELECTRIC VEHICLE READY PARKING SPACE ("EV Ready Space"). A designated parking space which is provided with wiring and electrical service ~~located within 6 feet (1828 mm) of the parking space that is~~ sufficient to provide AC level II or equivalent EV charging, as defined by Standard SAE J1772 for *EVSE* servicing light duty *Electric Vehicles*.

ENTHALPY RECOVERY RATIO. The ratio of change in enthalpy of the entering supply airflow and the leaving supply airflow to the difference in enthalpy between the entering supply airflow and the entering exhaust airflow, with no adjustment to account for that portion of the psychrometric change in the leaving supply airflow that is the result of leakage of entering exhaust airflow rather than exchange of heat or moisture between the airstreams.

EXEMPT EXHAUST. Exhaust for which energy recovery systems are prohibited by the applicable International Mechanical Code.

EXHAUST SOURCE HEAT PUMP. A type of electric heat pump that utilizes ventilation exhaust air as the thermal energy source.

FUEL GAS. A natural gas, manufactured gas, liquified petroleum gas or a mixture of these.
Informational note: Definition of fuel gas is mirrored from 2021 IMC to be useful in defining combustion equipment. It typically refers to natural gas and propane.

FUEL OIL. Kerosene or any hydrocarbon oil having a flash point not less than 100°F (38°C).
Informational note: Definition of fuel oil is mirrored from 2021 IMC to be useful in defining combustion equipment. It typically refers to heating oil products

GLAZED WALL SYSTEM. System consisting of any combination of both vision glass and/or *spandrel sections* to create an above-grade wall that is designed to separate the exterior and interior environments. These systems include, but are not limited to, curtain walls, window walls, and storefront windows.

MIXED-FUEL BUILDING. A *building* that contains *combustion equipment* or includes piping for such *equipment*.

OTHER EXHAUST. Any exhaust that does not fall under the categories of *Exempt Exhaust*, *Class 4 Exhaust*, or *Class 3 Exhaust*.

SENSIBLE ENERGY RECOVERY RATIO. The change in the dry-bulb temperature of the outdoor air supply divided by the difference between the outdoor air and entering exhaust air dry-bulb temperatures, expressed as a percentage.

SPANDREL SECTION: The opaque portion of a ~~*curtain wall* system~~ *glazed wall system* typically used to conceal or obscure features of the building structure or used for visual effect ~~spandrel beams, column, or the internal construction~~. A spandrel section may consist of, but is not limited to, an exterior exposed cladding layer (glazing or opaque material) with an interior insulated panel.

TENANT SPACE FIT OUT ZONE. Portion of a building in which only the envelope is completed, and the mechanical, lighting, and other interior systems are either incomplete or partially complete at the time of building permitting. Mechanical, lighting, and other interior systems may be completed under either the same building permit or a different building permit from the host building.

THERMAL BRIDGE: ~~A localized area of the *building thermal envelope* which has a higher thermal conductivity than the surrounding area.~~ Part of the *building envelope* where otherwise uniform thermal resistance is changed by full or partial penetration of the thermal insulation by materials with higher thermal conductivities and/or where the interior and exterior areas of the envelope are different, such as, but not limited to, parapets and corners.

CLEAR FIELD: A *thermal bridge* that is uniformly distributed throughout an assembly such that accounting for the *thermal bridge* individually is impractical for whole-building calculations.

LINEAR: A *thermal bridge* that is continuous in one direction of the exterior envelope.

POINT A *thermal bridge* that is discrete and countable on an individual basis for whole-building calculations.

CHAPTER 3 [CE]
GENERAL REQUIREMENTS

SECTION C301
CLIMATE ZONES

Abbreviate Section C301 as follows:

C301.1 General. Massachusetts is in *climate zone* 5A

CHAPTER 4 [CE]
COMMERCIAL ENERGY EFFICIENCY

SECTION C401 GENERAL
Revise Section C401.2 as follows:

C401.2 Application. Commercial buildings shall comply with either Section C401.2.1 or C401.2.2. When constructed for the first time, all requirements imposed on the building housing a *tenant space fit out zone* shall also apply to the *tenant space fit out zone*. Commercial buildings containing multiple use type classifications (mixed-use buildings) shall comply with C401.2.4

C401.2.1 Prescriptive and Performance Compliance. Commercial buildings shall comply with one of the following:

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1. **Prescriptive Compliance:** This pathway may only be used for any nonresidential building, or portions thereof when following C401.2.4, up to 20,000-sf. The Prescriptive Compliance pathway requires compliance with Sections C401.3, C402 through C406, and Section C408.

2. **Targeted Performance Compliance:** This pathway shall be used for ~~courthouse,~~ dormitory, fire station, library, office, school, police station, post office, and town hall buildings, or portions thereof when following C401.2.4, over 20,000-sf which have average ventilation at full occupancy of 0.5 cfm/sf or less. This pathway can also be used for any building of any size. After 1 July 2024, this pathway shall be used for residential buildings, or portions thereof when following C401.2.4, over 12,000-sf, or the building may comply with Section C401.2.2. The Targeted Performance Compliance pathway requires compliance with Section C401.3, Sections C402 through C406, Section C407.1, Section 408, and select sections of ANSI/ASHRAE/IESNA 90.1-2019 Appendix G as described in Section 407.1.

3. **Relative Performance Compliance:** This pathway may be used by buildings not required to use ~~either~~ Option ~~1 or~~ 2. The Relative Performance Compliance pathway requires that the Proposed building complies with Sections C401.3, C402.1.5, C402.2.8,

C402.3, C402.4, C402.5, C402.6, C402.7, C403.5, C403.7, C405.2.4, C405.13, C406, C407.2, C408, and ANSI/ASHRAE/IESNA 90.1-2019 using the Appendix G compliance pathway as modified in Section C407.2.

Exception: Additions, alterations, repairs and changes of occupancy to existing buildings complying with Chapter 5. This exception does not include *tenant space fit out zones* when constructed for the first time.

C401.2.2 Certified Performance Standard Compliance. Commercial buildings or portions thereof when following C401.2.4 shall comply with one of the following certified performance standards:

1. **Passive~~house~~ House Compliance:** This pathway can be used for any building of any size. The ~~Prescriptive~~Passive House Compliance pathway requires compliance with Sections C401.3, C402.3, C405, C407.3 and C408.

2. **HERS Compliance:** This pathway can be used for any Group R building with multiple individual *dwelling units*. The HERS pathway requires compliance with Section C401.3, C402.3, C405, C407.4 and C408.

Add Section C401.2.4 Mixed Use Buildings

C401.2.4 Mixed Use Buildings. Where different building use types within a new building require different Section C401.2 Compliance Pathways, each use type shall separately and individually show compliance with C401.2.1 or C401.2.2 for that respective use type.

Add Section C401.4 Building Electrification

C401.4 Building electrification. Building projects which utilize Section C407.2.1 shall conform with C401.4.1. Building projects which utilize Section C402.1.5.2 shall conform with C401.4.2 except for buildings using the Relative Performance pathway because average ventilation at full occupancy is greater than 0.5 cfm/sf which shall comply with C401.4.1 rather than C401.4.2. Building projects which utilize Section CC104.1, Part 1 shall conform with C401.4.3.

C401.4.1 Partial Space Heating Electrification. Electric air source, *exhaust source*, or ground source heat pump systems shall supply 25% of the building's peak space heating and ventilation air heating load at the ASHRAE 99.6% winter climatic design condition. Heat pumps used for space and ventilation air heating shall comply with C401.4.4. ~~shall be used for space heating. Air source heat pumps shall have greater than or equal to 10 HSPF and ground source heat pumps shall have seasonal heating COP of greater than or equal to 3.5. For multiple heating and cooling systems, all primary systems shall meet or exceed the minimum efficiency requirements in this section and in aggregate shall be sized to serve 25 percent of the heating and cooling design load.~~

C401.4.1.1 The heat pumps shall be controlled to prioritize their primary operation, prior to operation of supplemental fossil-fuel equipment, during non-emergency conditions.

C401.4.2 Full Space Heating Electrification. Electric air source, *exhaust source*, or ground source heat pump~~s~~ systems ~~sized to~~ shall supply 100% of the building's peak space heating and ventilation air heating load at the ASHRAE 99.6% winter climatic design condition. No fossil

fuel heating equipment shall be used for space heating or ventilation air heating. Heat pumps used for space and ventilation air heating shall comply with C401.4.4. ~~shall be used for space heating. Air source heat pumps shall have greater than or equal to 10 HSPF and ground source heat pumps shall have seasonal heating COP of greater than or equal to 3.5. For multiple heating and cooling systems, all primary systems shall meet or exceed the minimum efficiency requirements in this section and in aggregate shall be sized to serve 100 percent of the heating and cooling design load.~~

C401.4.3 Full Space and Water Heating Electrification. Electric air source, *exhaust source*, or ground source heat pump~~s~~ systems ~~sized to~~ shall supply 100% of the building's peak space heating and ventilation air heating load at the ASHRAE 99.6% winter climatic design condition. Electric air source, ground source, electric resistance, or solar thermal systems shall supply 100% of the building's service water. No fossil fuel equipment shall be used for space heating, ventilation air heating, or service water heating. Heat pumps used for space and ventilation air heating shall comply with C401.4.4. Heat pump service water heating shall conform to the applicable efficiencies in Section C404.2. Solar thermal service water shall have solar fraction of 0.4 or larger. ~~Air source heat pumps shall have greater than or equal to 10 HSPF and ground source heat pumps shall have seasonal heating COP of greater than or equal to 3.5. For multiple heating and cooling systems, all primary systems shall meet or exceed the minimum efficiency requirements in this section and in aggregate shall be sized to serve 100 percent of the heating and cooling design load. Service hot water system shall meet one of the following efficiencies:~~

~~1. Greater than or equal to 2.0 UEF electric service water heating system.~~
~~2. Greater than or equal to 0.4 solar fraction solar water heating system.~~

C401.4.4 Heat Pump Requirements. Heat pumps used for space heating and ventilation air heating shall comply with C401.4.4.1 through C401.4.4.3.

C401.4.4.1 Heat pump equipment shall conform to the applicable efficiencies in Section C403.3.2.

C401.4.4.2 For buildings with multiple heat pump systems, compliance shall be based on the combined capacity of all heat pump systems serving the building. For purposes of this calculation, the heating capacity of a heat pump system shall not exceed the heating load of that system and the portion of the building served by that system.

C401.4.4.3 For purposes of this calculation, the capacity of *exhaust source heat pumps* shall only include the heating capacity that exceeds the energy recovered by the minimum ventilation heat recovery required by C403.7.4. In addition, for purposes of this calculation, the capacity of the *exhaust source heat pumps* shall not exceed the heat pump capacity when the exhaust airflow is at 50% of design airflow.

***C402.1.3** Delete Subsection C402.1.3 and Table C402.1.3 and mark as Reserved.*

C402.1.3 Reserved.

Revise Section C402.1.5 as follows:

C402.1.5 Component performance alternative. Building envelope values and fenestration areas determined in accordance with ~~Equation 4-2~~ C402.1.5.1 or C402.1.5.2 shall be an alternative to

compliance with the *U*- factors in Tables C402.1.4 and C402.4 and the maximum allowable fenestration areas in Section C402.4.1. *Fenestration* shall meet the applicable SHGC requirements of Section C402.4.3. Buildings following ANSI/ASHRAE/IESNA 90.1-20139 Appendix G or 90.1-2016 Appendix G shall comply with this section.

Exception: Buildings demonstrating a vertical UA equal or lower than a prescriptive UA calculated in accordance with TABLE C402.1.4

A + B + C <=Zero (Equation 4-2)
where:
A = Sum of the (UA Dif) values for each distinct assembly type of the *building thermal envelope*, other than slabs on grade and below-grade walls.
UA Dif = UA Proposed – UA Table.
UA Proposed = Proposed *U* value × Area Proposed.
UA Table = (*U* factor from Table C402.1.3, C402.1.4 or C402.4) × vertical fenestration Area baseline.
B = Sum of the (FL Dif) values for each distinct slab-on-grade perimeter condition of the *building thermal envelope.*
FL Dif = FL Proposed – FL Table.
FL Proposed = Proposed F-value × Perimeter length.
FL Table = (F-factor specified in Table C402.1.4) × Perimeter length.
C = Sum of the (CA Dif) values for each distinct below-grade wall assembly type of the *building thermal envelope.*
CA Dif = CA Proposed – CA Table.
CA Proposed = Proposed C-value × Area.
CA Table = (Maximum allowable C-factor specified in Table C402.1.4) × Area.

C402.1.5.1 Non-*curtain wall* Low *glazed wall system* buildings. Buildings in which less than or equal to 50% of the total, above-grade wall portion area of the *building thermal envelope* is *curtain wall* a *glazed wall system* shall meetcomply with Equation 4-2a so long as and vision glass used in the *curtain wall* sections *glazed wall system* has shall have a maximum whole assembly U factor of U-0.25.

Area-weighted U proposed <= 0.1285 A <= Zero (Equation 4-2a)

where:
Area-weighted U proposed = U value A = Sum of the (UA Dif) values for each distinct assembly type of the above grade wall portion of the *building thermal envelope*, weighted by vertical area for each distinct assembly type.
UA Dif = UA Proposed – 0.1285.
UA Proposed = Proposed *U*-value.

C402.1.5.2 *Curtain wall* High *glazed wall system* buildings. Buildings in which more than 50% of the total, above-grade wall portion area of the *building thermal envelope* is *curtain wall* a *glazed wall system* shall meet comply with Equation 4-2b, so long as the vision glass used in the *curtain wall* *glazed wall system* sections has shall have a maximum whole assembly U factor of U-0.25, and the building shall comply with Section C401.4.2.

Area-weighted U proposed <= 0.1600 A <= Zero (Equation 4-2b)
where:
Area-weighted U proposed = U value A = Sum of the (UA Dif) values for each distinct assembly type of the above grade wall portion of the *building thermal envelope*, weighted by vertical area for each distinct assembly type.

~~UA Dif = UA Proposed – 0.1600.~~
~~UA Proposed = Proposed *U*-value.~~

Exception: ~~and, excepting~~

1. Buildings using the Relative Performance pathway because average ventilation at full occupancy is greater than 0.5 cfm/sf shall comply with C401.4.1 rather than C401.4.2.

Delete the exception in Section C402.2.4.1:

C402.2.4.1 Insulation installation.

~~**Exception:** Where the slab-on-grade floor is greater than 24 inches (61 mm) below the finished exterior grade, perimeter insulation is not required.~~

Add Subsection C402.2.8:

C402.2.8 Fireplaces. New combustion fireplaces shall have tight-fitting flue dampers or doors, and outdoor combustion air as required by the fireplace construction provisions of MA Construction Codes, as applicable. Where using tight-fitting doors on factory-built fireplaces listed and labeled in accordance with UL 127, the doors shall be tested and listed for the fireplace.

Replace C402.3 with the following:

C402.3 Rooftop solar readiness (Mandatory).
Follow Appendix CB: Solar-ready zone – Commercial.

Modify Vertical fenestration U-factors in TABLE C402.4:

TABLE C402.4
BUILDING ENVELOPE FENESTRATION MAXIMUM *U*-FACTOR AND SHGC REQUIREMENTS

CLIMATE ZONE	5 AND MARINE 4
Vertical fenestration	
U-factor	
Fixed fenestration	~~0.36~~ 0.30
Operable fenestration	~~0.45~~ 0.32

Add Subsection C402.4.6:

C402.4.6 Fenestration Documentation. In accordance with Section 303.1.3 fenestration performance shall be documented according to C402.4.6.1 or C402.4.6.2.

C402.4.6.1 Labeled Performance. The thermal transmittance of glazed fenestration products within the scope of NFRC shall be indicated by labels applied to the products at the manufacturing location or by a label certificate produced by an NFRC Approved Calculation Entity.

C402.4.6.2 Calculated Performance. Fenestration products outside the scope of NFRC may demonstrate compliance by submitting a thermal simulation report prepared by a registered design

professional for each product as defined by NFRC 100. Thermal simulations shall be performed in accordance with the NFRC 100-2020 simulation procedures at the size and configuration defined in NFRC 100 Table 4-3.

Revise Section C402.5 as follows:

C402.5 Air leakage—thermal envelope. The *building thermal envelope* shall comply with Sections C402.5.1 through Section C402.5.10.1. ~~C402.5.11.1, or the *building thermal envelope* shall be tested in accordance with Section C402.5.2 or C402.5.3. Where compliance is based on such testing, the building shall also comply with Sections C402.5.7, C402.5.8, and C402.5.9.~~

C402.5.1 Air barriers. A continuous *air barrier* shall be provided throughout the *building thermal envelope*. The continuous *air barrier* ~~shall be located on the inside or outside of the *building thermal envelope*, located within the assemblies composing the *building thermal envelope*, or any combination thereof.~~ is permitted to be any combination of inside, outside, or within the *building thermal envelope.* The *air barrier* shall comply with Sections C402.5.1.1, and C402.5.1.2. The *air leakage* performance of the *air barrier* shall be verified in accordance with Section C402.5.2.

Delete the exception in Section C402.5.1

C402.5.1.1 Air barrier design and documentation requirements. Design of the continuous *air barrier* shall be documented in the following manner:

1. Materials, assemblies, and systems ~~Components~~ comprising the continuous *air barrier* and their position within each *building thermal envelope* assembly shall be identified.
2. Joints, interconnections, and penetrations of the continuous *air barrier* materials, assemblies, and systems~~components~~ shall be detailed.
3. The continuity of the *air barrier* at building element assemblies that enclose conditioned space or provide a boundary between conditioned space and unconditioned space shall be identified.
4. Documentation of the continuous air barrier shall detail methods of sealing the air barrier such as wrapping, caulking, gasketing, taping or other *approved* methods at the following locations:
    i. Joints around fenestration and door frames.
    ii. Joints between walls and floors, between walls at building corners, between walls and roofs including parapets and copings, where above-grade walls meet foundations and similar intersections.
    iii. Penetrations or attachments through the continuous *air barrier* in building envelope roofs, walls, and floors.
    iv. Building assemblies used as ducts or plenums.
    v. Changes in continuous *air barrier* materials and assemblies.
    vi. Transition from one wall or roof assembly type to another such as, but not limited to, transition between opaque wall system and *glazed wall system*, and transition between a curtain wall *glazed wall system* and a storefront *glazed wall system.*
5. Identify where testing will or will not be performed in accordance with Section C402.5.2. Where testing will not be performed, a plan for field inspections required by C402.5.2.3 shall be provided that includes the following:
    i. Schedule for periodic inspection(s),
    ii. Continuous air barrier scope of work,

iii. List of critical inspection items,
iv. Inspection documentation requirements, and
v. Provisions for corrective actions where needed.

~~**C402.5.1.2**~~

~~A continuous air barrier for the opaque building envelope shall comply with the following:~~

~~1. Bulidings or portions of buildings, including Group R and I occupancies, shall meet the provisions of Section 402.5.2.~~

~~**Exception**: Buildings in Climate Zones 2B, 3C, and 5C.~~

~~2. Buildings or portions of buildings other than Group R and I occupancies shall meet the provisions of Section C402.5.3~~

~~**Exceptions:**~~

~~1. Buildings in Climate Zones 2B, 3B, 3C, and 5C.~~
~~2. Buildings larger than 5,000 square feet (464.5 m^2) floor area in Climate Zones 0B, 1, 2A, 4B, and 4C.~~
~~3. Buildings between 5,000 square feet (464.5 m^2) and 50,000 square feet (4645 m^2) floor area in Climate Zones 0A, 3A, and 5B.~~

~~3. Buildings or portions of buildings that do not complete air barrier testing shall meet the provisions of Section 402.5.1.3 or C402.5.1.4 in addition to Section C402.5.1.5~~

C402.5.1.2 ~~C402.5.1.1~~ Air barrier construction. The *continuous air barrier* shall be constructed to comply with the following:

1. The *air barrier* shall be continuous for all assemblies that comprise the *building thermal envelope* and across the joints and assemblies.
2. Air barrier joints and seams shall be sealed, including sealing transitions in places and changes in materials. The joints and seals shall be securely installed in or on the joint for its entire length so as not to dislodge, loosen or otherwise impair its ability to resist positive and negative pressure differentials such as those from design wind load, stack effect and mechanical ventilation.
3. Penetrations of the *air barrier* shall be caulked, gasketed or otherwise sealed in a manner compatible with the construction materials and location. Sealing shall allow for expansion, contraction and mechanical vibration. ~~Joints and seams associated with penetrations shall be sealed in the same manner or taped.~~ Sealing materials shall be securely installed around the penetration so as not to dislodge, loosen or otherwise impair the penetrations' ability to resist positive and negative pressure ~~from wind, stack effect and mechanical ventilation.~~ Sealing of concealed fire sprinklers, where required, shall be in a manner that is recommended by the fire sprinkler manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.
4. Recessed lighting fixtures shall comply with ~~C402.5.10~~ C402.5.1.2.1. Where similar objects are installed that penetrate the *air barrier*, provisions shall be made to maintain the integrity of the *air barrier*.
5. Electrical and communication boxes shall comply with C402.5.1.2.2

C402.5.2 ~~C402.5.3 *Building thermal envelope* testing~~ Air leakage compliance. *Air leakage* of the *building thermal envelope* shall be tested by an *approved* third party in accordance with ~~ASTM E779, ANSI/RESNET/ICC 380, ASTM E3158 or ASTEM E1827 or an equivalent method approved by the~~

~~code office~~ C402.5.2.1. The measured *air leakage* shall not ~~exceed 0.4 cfm/ft² (2.0 L/s x m²)~~ be greater than 0.35 cfm/ft² (1.8 L/s × m²) of the *building thermal envelope* area at a pressure differential of 0.3 inch water gauge (75 Pa) with the calculated *building thermal envelope* surface area being the sum of the above- and below-grade *building thermal envelope*. ~~Alternatively, portions of the building shall be tested and the measured air leakages shall be area weighted by the surface areas of the building envelope in each portion. The weighted average test results shall not exceed the whole building leakage limit. In the alternative approach, the following portions of the building shall be testing:~~

~~2. The entire envelope area of all stories that have any spaces directly under a roof~~
~~3. The entire envelope area of all stories that have a building entrance, exposed floor, or loading dock, or are above grade.~~
~~4. Representative above-grade sections of the building totally at least 25 percent of the wall area enclosing the remaining conditioned space.~~

Exceptions:

1. Where the measured *air leakage* rate ~~exceeds~~ is greater than ~~0.40~~ 0.35 cfm/ft² (1.8 L/s × m²) but ~~does not exceed~~ is not greater than ~~0.6~~ 0.45 cfm/ft² (2.3 L/s × m²), the *approved* third party shall perform a diagnostic evaluation ~~using smoke tracer or infrared imaging~~. ~~The evaluation shall be conducted while the building is pressurized along with a visual inspection of the *air barrier*~~ in accordance with ASTM E1186. ~~Any leaks noted~~ All identified leaks shall be sealed where such sealing can be made without ~~destruction of~~ damaging existing building components. A~~n additional~~ report ~~identifying~~ specifying the corrective actions taken to seal leaks shall be deemed to establish compliance with the requirements of this section where submitted to the code official and the building owner.~~, and shall be deemed to comply with the requirements of this section~~. Where the measured *air leakage rate* is greater than 0.45 cfm/ft2 (2.3 L/s × m2), corrective actions must be made to the building and an additional test completed for which the results are 0.45 cfm/ft² (2.3 L/s × m²), or less.
2. As an alternative, buildings or portions of buildings, containing Group R and I occupancies, shall be permitted to be tested by an *approved* third party in accordance with C402.5.2.2. The reported *air leakage* of the *building thermal envelope* shall not be greater than 0.27 cfm/ft² (1.4 L/s x m²) of the *testing unit enclosure area* at a pressure differential of 0.2 inch water gauge (50 Pa).

C402.5.2.1 Whole building test method and reporting. The *building thermal envelope* shall be tested for *air leakage* in accordance with ASTM E3158 or an equivalent *approved* method. A report that includes the tested surface area, floor area, air by volume, stories above grade, and leakage rates shall be submitted to the code official and the building owner.

Exceptions:

1. For buildings less than 10,000 ft² (1000 m²) the entire *building thermal envelope* shall be permitted to be tested in accordance with ASTM E779, ASTM E3158 or ASTM E1827 or an equivalent *approved* method.
2. For buildings greater than 50,000 ft² (4645 m²), portions of the building shall be permitted to be tested and the measured *air leakage* shall be area-weighted by the surface areas of the *building thermal envelope* in each portion. The weighted average tested *air leakage* shall not be greater than the whole building leakage limit. The following portions of the building shall be tested:
    i. The entire *building thermal envelope* area of stories that have any conditioned spaces directly under a roof.

ii. The entire *building thermal envelope* area of stories that have a building entrance, a floor over unconditioned space, a loading dock, or that are below grade.

iii. Representative above-grade portions of the building totaling not less than 25 percent of the wall area enclosing the remaining conditioned space.

C402.5.2.2 ~~C402.5.2~~ Dwelling and sleeping unit enclosure test~~ing~~ method and reporting. The *building thermal envelope* shall be tested for *air leakage* in accordance with ASTM E779, ANSI/RESNET/ICC 380, ASTM E1827, ASTM E3158, or an equivalent *approved* method ~~by the code official~~. Where multiple *dwelling units* or *sleeping units* or other occupiable conditioned spaces are contained within one *building thermal envelope*, each unit shall be considered an individual testing unit, and the building *air leakage* shall be the weighted average of all testing unit results, weighted by each testing unit enclosure area. Units shall be tested ~~separately with an unguarded blower door test~~ without simultaneously pressurizing adjacent units and shall be separately tested as follows:

1. Where buildings have ~~fewer~~ less than eight testing units, each testing unit shall be tested.
2. ~~For~~ Where buildings ~~with~~ have eight or more testing units, the greater of seven units or 20 percent of the testing units in the building shall be tested, including a top floor unit, a middle floor unit, a ground floor unit and a unit with the largest testing unit enclosure area. For each tested unit that exceeds the maximum air leakage rate, an additional ~~two~~ three units shall be tested, including a mixture of testing unit types and locations.
3. *Enclosed spaces* with not less than one *exterior wall* in the *building thermal envelope* shall be tested in accordance with C402.5.3.

Exception: Corridors, stairwells, and *enclosed spaces* having a *conditioned floor area* not greater than 1,500 ft^2 shall be permitted to comply with Section C402.5.1.5 and either Section C402.5.1.3 or C402.5.1.4.

C402.5.2.3 ~~C402.5.1.5~~ Building envelope design and construction ~~performance~~ verification criteria. In addition to the requirements of ~~Where~~ Sections C402.5.2.1 and C402.5.2.2 ~~are not applicable~~, the installation of the continuous *air barrier* shall be verified by the *code official*, *a registered design professional* or *approved agency* in accordance with the following:

1. A review of the construction documents and other supporting data shall be conducted to assess compliance with the requirements in Section C402.5.1.
2. Inspection of continuous air barrier materials, assemblies, and systems~~components and assemblies~~ shall be conducted during construction ~~while the air barrier is still accessible for inspection~~ to verify compliance with the requirements of Sections ~~C402.5.1.3~~ C402.5.2.3.1 ~~and~~ or ~~C402.5.1.4~~ C402.5.2.3.2. The air barrier shall remain accessible for inspection and repair.
3. A final ~~commissioning~~ inspection report shall be provided for inspections completed by the *registered design professional* or *approved* agency. The ~~commissioning~~ inspection report shall be provided to the building owner or owner's authorized agent and the *code official*. The report shall identify deficiencies found during ~~the review of the construction documents and~~ inspection and details of corrective measures taken.

C402.5.2.3.1 ~~C402.5.1.3~~ Materials. Materials with an air permeability not greater than 0.004 cfm/ft^2 (0.02 L/s × m^2) under a pressure differential of 0.3 inch water gauge (75 Pa) ~~when~~ where tested in accordance with ASTM E2178 shall comply with this section. Materials in Items 1 through 16 below shall be deemed to comply with this section, provided that joints

are sealed and materials are installed as air barriers in accordance with the manufacturer's instructions.

i. Plywood with a thickness of not less than 3/8 inch (10 mm).
ii. Oriented strand board having a thickness of not less than 3/8 inch (10 mm).
iii. Extruded polystyrene insulation board having a thickness of not less than 1/2 inch (12.7 mm).
iv. Foil-back polyisocyanurate insulation board having a thickness of not less than 1/2 inch (12.7 mm).
v. Closed-cell spray foam having a minimum density of not less than 1.5 pcf (2.4 kg/m3) and having a thickness of not less than 1 1/2 inches (38 mm).
vi. Open-cell spray foam with a density between greater than 0.4 and less than 1.5 pcf (0.6 and 2.4 kg/m3) and having a thickness of not less than 4.5 inches (113 mm).
vii. Exterior or interior gypsum board having a thickness of not less than 1/2 inch (12.7 mm).
viii. Cement board having a thickness of not less than 1/2 inch (12.7 mm).
ix. Built-up roofing membrane.
x. Modified bituminous roof membrane.
xi. Single-ply roof membrane.
xii. A Portland cement/sand parge, or gypsum plaster having a thickness of not less than 5/8 inch (15.9 mm).
xiii. Cast-in-place and precast concrete.
xiv. Fully grouted concrete block masonry.
xv. Sheet steel or aluminum.
xvi. Solid or hollow masonry constructed of clay or shale masonry units.

C402.5.2.3.2 ~~C402.5.1.4~~ Assemblies. Assemblies of materials and components with an average air leakage not greater than 0.04 cfm/ft^2 (0.2 L/s × m^2) under a pressure differential of 0.3 inch of water gauge (75 Pa) ~~when~~ where tested in accordance with ASTM E2357, ASTM E1677, ASTM D8052 or ASTM E283 shall comply with this section. Assemblies listed in Items 1 through 3 below shall be deemed to comply, provided that joints are sealed and the requirements of Section C402.5.1.1 are met.

1. Concrete masonry walls coated with either one application of block filler or two applications of a paint or sealer coating.
2. Masonry walls constructed of clay or shale masonry units with a nominal width greater than or equal to ~~of~~ 4 inches (102 mm) ~~or more~~.
3. A Portland cement~~/~~sand parge, stucco or plaster not less than 1/2 inch (12.7 mm) in thickness.

C402.5.3 ~~C402.5.4~~ Air leakage of fenestration. The air leakage of fenestration assemblies shall ~~meet~~ comply with ~~the provisions of~~ Table ~~C402.5.4~~ C402.5.3. Testing shall be conducted by an accredited, independent testing laboratory in accordance with the applicable reference test standard in Table ~~C402.5.4~~ C402.5.3 ~~by an accredited, independent testing laboratory~~ and *labeled* by the manufacturer.

Exceptions:

1. Field-fabricated fenestration assemblies that are sealed in accordance with Section ~~C402.5.1~~ C402.5.1.2.
2. Fenestration in buildings that ~~comply with the testing alternative of~~ are tested for *air leakage* of in accordance with Section ~~C402.5~~ C402.5.2 are not required to meet the air leakage requirements in Table ~~C402.5.4~~ C402.5.3.

TABLE ~~C402.5.4~~ C402.5.3

MAXIMUM AIR LEAKAGE RATE FOR FENESTRATION ASSEMBLIES

FENNESTRATION ASSEMBLY	MAXIMUM RATE (CFM/FT^2)	TEST PROCEDURE
Windows	0.20[a]	AAMA/WDMA/CSA101/I.S.2/A440 or NRFC 400
Sliding doors	0.20[a]	
Swinging doors	0.20[a]	
Skylights – with condensation weepage openings	0.30	
Skylights – all other	0.20[a]	
Curtain walls	0.06	NRFC 400 or ASTM E283 at 1.57 psf (75 Pa)
Storefront glazing	0.06	
Commercial glazed swinging entrance doors	1.00	
Power-operated sliding doors and power operated folding doors	1.00	
Revolving doors	1.00	
Garage doors	0.40	ANSI/DASMA 105, NRFC 400, or ASTM E283 at 1.57 psf (75 Pa)
Rolling doors	1.00	
High-speed doors	1.30	

For SI: 1 cubic foot per minute = 0.47 L/s, 1 square foot = 0.093 m^2

a. The maximum rate for windows, sliding and swinging doors, and skylights is permitted to be 0.3 cfm per square foot of fenestration or door area when tested in accordance with AAMA/WDMA/CSA101/I.S.2/A440 at 6.24 psf (300 Pa).

C402.5.4 ~~C402.5.5~~ **Rooms containing fuel-burning appliances.** In *Climate Zones* 3 through 8, where combustion air is supplied through openings in an exterior wall to a room or space containing a space-conditioning fuel-burning appliance, one of the following shall apply:

1. The room or space containing the appliance shall be located outside of the *building thermal envelope.*
2. The room or space containing the appliance shall be enclosed and isolated from conditioned spaces inside the *building thermal envelope*. Such rooms shall comply with all of the following:
    1. The walls, floors and ceilings that separate the enclosed room or space from conditioned spaces shall be insulated to be not less than equivalent to the insulation requirement of below-grade walls as specified in ~~Table C402.1.3 or~~ Table C402.1.4.
    2. The walls, floors and ceilings that separate the enclosed room or space from conditioned spaces shall be sealed in accordance with Section ~~C402.5.1.1~~ C402.5.1.2.
    3. The doors into the enclosed room or space shall be fully gasketed.
    4. Piping serving as part of a heating or cooling system ~~Water lines~~ and ducts in the enclosed room or space shall be insulated in accordance with Section C403. Service water piping shall be insulated in accordance with Section C404.
    5. Where an air duct supplying combustion air to the enclosed room or space passes through *conditioned space*, the duct shall be insulated to an R-value of not less than R-8.

Exception: Fireplaces and stoves complying with Sections 901 through 905 of the *International Mechanical Code*, and Section 2111.14 of the *International Building Code*.

C402.5.5 ~~C402.5.6~~ **Doors and access openings to shafts, chutes, stairways and elevator lobbies.** Doors and *access* openings from conditioned space to shafts, chutes stairways and elevator lobbies not

within the scope of the fenestration assemblies covered by Section ~~C402.5.4~~ C402.5.3 shall be gasketed, weather-stripped or sealed.

Exceptions:
1. Door openings required to comply with Section 716 of the *International Building Code*.
2. Doors and door openings required by the *International Building Code* to comply with UL 1784 ~~by the *International Building Code*~~.

C402.5.6 ~~C402.6.7~~ Air intakes, exhaust openings, stairways and shafts. Stairway enclosures, elevator shaft vents and other outdoor air intakes and exhaust openings integral to the building envelope shall be provided with dampers in accordance with Section C403.7.7.

C402.5.7 ~~C402.5.8~~ Loading dock weather seals. Cargo door openings and loading door openings shall be equipped with weather seals that restrict ~~infiltration~~ *air leakage* and provide direct contact along the top and sides of vehicles that are parked in the doorway.

C402.5.8 ~~C402.5.9~~ Vestibules. Building entrances shall be protected with an enclosed vestibule ~~with all~~. ~~d.~~ Doors opening into and out of the vestibule shall be equipped with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior doors to open at the same time. The installation of one or more revolving doors in the *building entrance* shall not eliminate the requirement that a vestibule be provided on any doors adjacent to revolving doors.
Exceptions: Vestibules are not required for the following:

~~1. Building in *Climate Zones* 0 through 2.~~

~~2.~~ 1 Doors not intended to be used by the public, such as doors to mechanical or electrical equipment rooms, or intended solely for employee use.

~~3.~~ 2 Doors opening directly from a *sleeping unit* or dwelling unit.

~~4.~~ 3 Doors that open directly from a space less than 3,000 square feet (298 m^2) in area.

~~5.~~ 4 Revolving doors.

~~6.~~ 5 Doors used primarily to facilitate vehicular movement or material handling and adjacent personnel doors.

~~7.~~ 6 Doors that have an air curtain with a velocity of not less than 6.56 feet per second (2 m/s) at the floor that have been tested in accordance with ANSI/AMCA 220 and installed in accordance with the manufacturer's instructions. Manual or automatic controls shall be provided that will operate the air curtain with the opening and closing of the door. Air curtains and their controls shall comply with Section C408.2.3.

C402.5.9 ~~C402.5.10~~ Recessed lighting. Recessed luminaires installed in the *building thermal envelope* shall be all of the following:

1. IC-rated.
2. Labeled as having an air leakage rate of not ~~more~~ greater than 2.0 cfm (0.944 L/s) ~~when~~ where tested in accordance with ASTM E283 at a 1.57 psf (75 Pa) pressure differential.
3. Sealed with a gasket or caulk between the housing and interior wall or ceiling covering.

C402.5.1.2.2 Electrical and communication boxes. Electrical and communication boxes that penetrate the air barrier of the *building thermal envelope*, and that do not comply with C402.5.1.2.2.1, shall be caulked, taped, gasketed, or otherwise sealed to the air barrier element being penetrated. All openings on the concealed portion of the box shall be sealed. Where present, insulation shall rest against all concealed portions of the box.

C402.5.1.2.2.1 Air-sealed boxes. Where air-sealed boxes are installed, they shall be marked in accordance with NEMA OS 4. Air-sealed boxes shall be installed in accordance with the manufacturer's instructions.

C402.5.10 ~~C402.5.11~~ Operable openings interlocking. Where occupancies ~~utilize~~ have operable openings to the outdoors that are larger than 40 square feet (3.7 m2) in area, such openings shall be interlocked with the heating and cooling system ~~so as~~ to raise the cooling setpoint to 90°F (32°C) and lower the heating setpoint to ~~55~~ 50°F (~~10~~13°C) whenever the operable opening is open. The change in heating and cooling setpoints shall occur ~~within 10 minutes of opening~~ when the operable opening has been open for a period not to exceed 10 minutes.

Exceptions:

1. Operable openings into separately-zoned areas associated with the preparation of food that contain appliances that contribute to the HVAC loads of a restaurant or similar type of occupancy.
2. ~~Warehouses~~ Storage occupancies that utilize overhead doors for the function of the occupancy, where approved by the code official.
3. ~~The first entrance d~~Doors ~~where~~ located in the exterior wall ~~and~~ that are part of a vestibule system.
4. Operable openings used as part of a designed system for natural ventilation.

C402.5.10.1 ~~C402.5.11.1~~ Operable controls. Controls shall comply with Section C403.13.

Add Section C402.6

C402.6 Approved calculation software tools. The following software tools are sufficient to demonstrate compliance with Sections C401.2.1 Prescriptive Compliance and C402.7.

1. COMcheck-Web available at: https://www.energycodes.gov/comcheck

Add Section C402.7

C402.7 Derating and *Thermal Bridges*

C402.7.1 General. ~~Where otherwise not included in~~ In addition to pre-calculated assembly U-factors, C-factors, or F-factors outlined in Appendix A of ASHRAE 90.1 2019, vertical envelope performance shall also take into account effect of *thermal bridges* according to both C402.7.2 and C402.7.3. In addition, ~~T~~ the thermal resistance of ~~opaque~~ *spandrel sections* within ~~*curtain wall*~~ *glazed wall systems* shall be according to C402.7.4. Together with Appendix A of ASHRAE 90.1 2019, these derated values and *spandrel section* values shall be used when showing compliance with ~~Table~~ Section C402.1.4 or Section C402.1.5, as applicable.~~and Equation 4-2.~~

C402.7.2 Continuous Insulation for Vertical Walls. Installed vertical wall continuous insulation shall be derated using either C402.7.2.1, ~~or~~ C402.7.2.2, or C402.7.2.3 to account for the effect of fasteners ~~connections~~ through the continuous insulation.

C402.7.2.1. Prescriptive Derating. Derate vertical wall ~~exterior~~ continuous insulation using Equation C402.7.2.1 and Derating Factor from C402.7.2.1.1 for portions of wall having brick veneer systems and C402.7.2.1.2 or C402.7.2.1.3 for portions of wall having cladding systems.

(Equation C402.7.2.1)

$R_{derated}$ = R_o x Derating Factor

Where

$R_{derated}$:	R value after derating, to be used when showing compliance R402.7.2
R_o:	R value of the ~~exterior~~ continuous insulation prior to derating
Derating Factor:	From C402.7.2.1.1, ~~and~~ C402.7.2.1.2, or C402.7.2.1.3

C402.7.2.1.1 Brick Veneer Systems. Wall systems comprised of brick anchor~~s~~ fasteners supporting brick veneer shall use a Derating Factor of 0.7 to account for the *clear field thermal bridge* derating effect of the fasteners. In addition, brick shelf angles shall be derated according to Section C402.7.3 to account for the *linear thermal bridge* derating effect of any brick shelf angles.

C402.7.2.1.2 Cladding Systems. Wall systems comprised of cladding systems shall use Derating Factor per Table 402.7.2.1.2

Table 402.7.2.1.2

Thickness of R_o	Derating Factor
R_o is less than or equal to R-15	Derating Factor = 0.74 – 0.021 x R_o
R_o is greater than R-15	Derating Factor = 0.55 – 0.007 x R_o

C402.7.2.1.3~~2~~. Cladding Systems with Qualifying Thermal Breaks. If plastic or fiberglass ~~clips~~ fasteners entirely comprised of material having thermal conductivity of 3 Btu-in/hr-ft^2-F or less are used to support external cladding; or, if ~~clips~~ fasteners having thermal breaks which have~~ing~~ a conductivity of 3 Btu-in/hr-ft^2-F or less on both ends of the fastener ~~connector~~ ~~clip~~ are used to support external cladding, use Derating Factor of 0.8.

C402.7.2.2 Reference Derating. Use pre-solved, derated continuous insulation values contained in Building Envelope Thermal Bridging Guide, version 1.6 or higher, published by BC Hydro Power Smart.

C402.7.2.~~2~~3. Modeled Derating Use two or three-dimensional finite element analysis heat transfer model to calculate derated value. A three-dimensional model shall be used when there are *point thermal bridges* or thermal bridging in multiple planes. ~~Alternatively, use pre-solved, derated continuous insulation values contained in Building Envelope Thermal Bridging Guide, version 1.6 or higher, published by BC Hydro Power Smart.~~

C402.7.3. Linear *Thermal Bridges*. In addition to derating per Section C402.7.2, i~~I~~nstalled vertical wall ~~and roof~~ insulation U values shall be further derated for *linear thermal bridges* where the vertical wall intersects the following: brick shelf angles, balconies, vertical interior walls, horizontal interior walls, windows, roof, other vertical walls on different plane, and grade using Equation C402.7.3.

(Equation C402.7.3)

$$U_{derated} = \frac{\text{PSI} * Length}{A_{total}} + U_o$$

Where

$U_{derated}$	Derated wall ~~or roof~~ U value (Btu/hr-ft^2-F)
PSI	Value from Section C402.7.3.1, C402.7.3.2, or C402.7.3.3 (Btu/hr-ft-F)
Length	Length of linear *thermal bridge* (ft)
A_{total}	Area of derated wall ~~or roof~~ (ft^2)
U_o	Wall or roof U value prior to *linear thermal bridge* derating

C402.7.3.1 ~~Table~~ Prescriptive PSI values. Use PSI values from Table C402.7.3.1

Table C402.7.3.1

Type of *Linear Thermal Bridge*	**PSI-value (Btu/hr - ft – F)**
Balcony to exterior vertical wall intersection	1.00
Intermediate floor to exterior vertical wall intersection	0.60
Interior vertical wall to exterior vertical wall intersection	0.50
Fenestration to exterior vertical wall intersection	0.32
Parapet (vertical wall to roof intersection)	0.60
Brick shelf angle	0.35
Vertical wall to grade intersection	0.52
Vertical wall plane transition (building corners and other changes in vertical wall plane)	0.25

C402.7.3.2. Reference PSI Values. Use pre-solved PSI values contained in Building Envelope Thermal Bridging Guide, version 1.6 or higher, published by BC Hydro Power Smart.

C402.7.3.3. Modelled PSI Values. Use a two or three-dimensional finite element analysis to calculate PSI values. A three-dimensional model shall be used when there are *point thermal bridges* or thermal bridging in multiple planes.

C402.7.4 Thermal Resistance of *Spandrel Sections*. The R-factor of opaque *spandrel sections* within *curtain wall* systems shall be accordance with C402.7.4.1, C402.7.4.2, or C402.7.4.3.

C402.7.4.1 Prescriptive R value. Opaque *spandrel sections* within ~~*curtain wall*~~ *glazed wall systems* shall have at least R-12 insulation. For the purpose of calculating weighted U in accordance with Section C402.1.5, *spandrel sections* shall use the default R values in Table C402.7.4.1. ~~R value in accordance with Equation C402.7.4.1~~

~~(Equation C402.7.4.1)~~

$$~~R = R_o \times 2.95 \times R_o^{-0.9}~~$$

~~Where~~

~~R R value of opaque *spandrel section* within *curtain wall*~~

~~Ro Installed R value of the insulation behind the opaque *spandrel section* within the *curtain wall*.~~

Table C402.7.4.1: Default R values for *Spandrel Sections*

Type	Default R-Value
Thermally broken	3.5
Non-thermally broken	2

C402.7.4.2. Reference R values. Use pre-solved opaque *spandrel sections* R values contained in Building Envelope Thermal Bridging Guide, version 1.6 or higher, published by BC Hydro Power Smart.

C402.7.4.3. Modelled R values. Use a two or three-dimensional finite element analysis to calculate R value of opaque *spandrel section*. A three-dimensional model shall be used when there are *point thermal bridges* or thermal bridging in multiple planes.

SECTION C403
BUILDING MECHANICAL SYSTEMS

Revise Section C403.5 as follows (Sections C403.5.1 through C403.5.5 remain unchanged):

C403.5 Economizers. Economizers shall comply with Sections C403.5.1 through C403.5.5. An air or water economizer shall be provided for the following cooling systems:

1. Chilled water systems with a total cooling capacity, less cooling capacity provided with air economizers, as specified in Table C403.5(1).

2.*Dedicated outside air systems*

~~2~~ 3 Individual fan systems with cooling capacity greater than or equal to 54,000 Btu/h (15.8 kW) in buildings having other than a *Group R* occupancy,

The total supply capacity of all fan cooling units not provided with economizers shall not exceed 20 percent of the total supply capacity of all fan cooling units in the building or 300,000 Btu/h (440 kW), whichever is greater.

~~3~~ 4 Individual fan systems with cooling capacity greater than or equal to 270,000 Btu/h (79.1 kW) in buildings having a *Group R* occupancy.

The total supply capacity of all fan cooling units not provided with economizers shall not exceed 20 percent of the total supply capacity of all fan cooling units in the building or 1,500,000 Btu/h (440 kW), whichever is greater.

Exceptions: Economizers are not required for the following systems.

1. Individual fan systems not served by chilled water for buildings located in *Climate Zones* 0A, 0B, 1A and 1B.
2. Where more than 25 percent of the air designed to be supplied by the system is to spaces that are designed to be humidified above 35°F (1.7°C) dew-point temperature to satisfy process needs.
3. Systems expected to operate less than 20 hours per week.
4. Systems serving supermarket areas with open refrigerated casework.
5. ~~Where the cooling efficiency is greater than or equal to the efficiency requirements in Table C403.5(2)~~

6 5 Systems that include a heat recovery system in accordance with Section C403.10.5.

7 6 VRF systems installed with a *dedicated outdoor air system*.

Show only Climate Zone 5A in Table C403.5(1)

TABLE C403.5(1) MINIMUM CHILLED-WATER SYSTEM COOLING CAPACITY FOR DETERMINING ECONOMIZER COOLING REQUIREMENTS

TOTAL CHILLED-WATER SYSTEM CAPACITY LESS CAPACITY OF COOLING UNITS WITH AIR ECONOMIZERS (Climate Zone 5A)	
Local water-cooled chilled-water systems	**Air-cooled chilled- water systems or district chilled-water systems**
1,320,000 Btu/h	1,720,000 Btu/h

For SI: 1 British thermal unit per hour = 0.2931 W.

Delete Table C403.5(2)

~~*Revise C403.7 as follows:*~~

~~In addition to other requirements of Section C403 applicable to the provision of ventilation air or the exhaust air, ventilation and exhaust systems shall be in accordance with Sections C403.7.1 through C403.7.78.~~

~~*Renumber the following sections, all effected subsections, and redirect references, as follows:*~~

~~***Existing Section Number***~~	~~***New Section Number***~~	~~***Reference Redirect***~~
~~*C403.7.1*~~	~~*C403.7.2*~~	~~*Reference to C403.7.4.2 in exception 1 is redirected to C403.7.5.2*~~
~~*C403.7.2*~~	~~*C403.7.3*~~	~~*No references to redirect*~~
~~*C403.7.3*~~	~~*C403.7.4*~~	~~*No references to redirect*~~
~~*C403.7.4*~~	~~*C403.7.5*~~	~~*Reference to C403.7.4.1 is redirected to C403.7.5.1*~~ ~~*Reference to C403.7.4.2 is redirected to C403.7.5.2*~~
~~*C403.7.5*~~	~~*C403.7.6*~~	~~*Reference to Table C403.7.5 is redirected to Table C403.7.6*~~
~~*C403.7.6*~~	~~*C403.7.7*~~	~~*Reference to C403.7.6.1 is redirected to C403.7.7.1*~~

		Reference to C403.7.6.2 is redirected to C403.7.7.2
C403.7.7	*C403.7.8*	*No references to redirect*

Add Section C403.7.1 as follows.

C403.7.1 Minimize Reheat. Outdoor air shall be provided to each occupied space by a *dedicated outdoor air system* (DOAS) which delivers 100 percent outdoor air. Ventilation rates shall not exceed 135% of the ventilation rates required by ASHRAE 62.1-2019.

Exceptions

1. Occupied spaces that are not ventilated by a mechanical ventilation system and are only ventilated by a natural ventilation system per Section 402 of the International Mechanical Code.

2. Systems installed for the sole purpose of providing makeup air for systems exhausting *Class 4 exhaust* or *Class 3 exhaust* that is exempt from heat recovery requirements, as defined by C403.7.5.

3. Systems where 100% of the energy for reheating or for providing warm air in mixing systems is provided from site-recovered energy, using air-to-air heat recovery devices or electric heat pumps.

4. Air-to-air heat recovery devices shall be in addition to exhaust heat recovery required per C403.7.5. Therefore, air-to-air heat recovery devices used for compliance with C403.7.1 shall not contribute to compliance with the exhaust heat recovery effectiveness requirement per C403.7.5.

5. Heat pumps recovering site energy to meet C403.7.1 may only recover energy from cooling demands within the building and building systems.

6. Systems where 100% of the energy for reheating or for providing warm air in mixing systems is provided from air-source or ground-source heat pumps.

Revise C403.7.4 (renumbered to C403.7.5 per above), as follows:

C403.7.454 Energy recovery systems. Energy recovery ventilation systems shall be provided as specified in either Section C403.7.454.1, as applicable or and C403.7.454.2, as applicable.

Revise C403.7.4.1 (renumbered to C403.7.5.1 per above), as follows:

C403.7.454.1 Nontransient dwelling units. Nontransient dwelling units shall be provided with outdoor air energy recovery ventilation systems with an *enthalpy recovery ratio* of not less than 50 percent at cooling design condition and not less than 6075 percent at heating design condition. Outdoor air must be delivered directly to the dwelling unit. The building weighted average sensible energy recovery effectiveness must meet the requirements of C403.7.4.2.

Exceptions:

1. Nontransient dwelling units in Climate Zone 3C.
2. Nontransient dwelling units with not more than 500 square feet (46 m2) of conditioned floor area in Climate Zones 0, 1, 2, 3, 4C and 5C.
3. *Enthalpy recovery ratio* requirements at heating design condition in Climate Zones 0, 1 and 2.

4. ~~*Enthalpy recovery ratio* requirements at cooling design condition in Climate Zones 4, 5, 6, 7 and 8.~~

~~*Replace C403.7.4.2, including all exceptions, (renumbered to C403.7.5.2, per above), with the following:*~~

~~**C403.7.54.2 Spaces Other Than Nontransient Dwelling Spaces.** All mechanical ventilation systems serving spaces other than Group R shall include an energy recovery system, regardless of the minimum fan system supply airflow rate and percent outdoor air. The weighted average sensible energy recovery ratio of the building ventilation systems shall be calculated in accordance with Equation C403.7.5.2-1 and not be less than 1.0. The sensible energy recovery ratios used for the Required values in the equation shall be the values listed in Table C403.7.5.2(1). The sensible energy recovery ratios used for the Proposed values in the equation shall be based on the proposed design. All values and calculations shall be based on the winter design condition.~~

~~In addition, the weighted average *enthalpy recovery ratio* of the building ventilation systems shall be calculated in accordance with Equation C403.7.5.2-2 and not be less than 1.0. The *enthalpy recovery ratios* used for the Required values in the equation shall be the values listed in Table C403.7.5.2(2). The enthalpy recovery ratios used for the Proposed values in the equation shall be based on the proposed design. All values and calculations shall comply at both winter and summer design conditions.~~

~~**Exception:** An energy recovery ventilation system shall not be required in any of the following conditions. These exhaust flow rates shall be considered Exempt and shall not be included in the calculation of Equation C403.7.5.2-1 and Equation C403.7.5.2-2.~~

~~1. Where energy recovery systems are prohibited by the applicable International Mechanical Code. This includes exhaust from commercial kitchen hoods used for collecting and removing grease vapors and smoke.~~

~~2. Systems serving spaces that are heated to less than 32°F (0°C) and that are not cooled.~~

Revise C403.7.4.2 as follows:

C403.7.4.2 Spaces other than nontransient dwelling units. Where the supply airflow rate of a fan system serving a space other than a nontransient dwelling unit exceeds the values specified in Tables C403.7.4.2(1) and C403.7.4.2(2), the system shall include an energy recovery system. The energy recovery system shall result in either 1 or 2, as applicable: ~~provide an enthalpy recovery ratio of not less than 50% at design conditions.~~

1. A *sensible recovery ratio* of at least 50% at heating design conditions for systems that provide makeup for *Class 3 or 4 exhaust*. The requirement can be satisfied either for each fan system individually or based on a weighted average of the ventilation air flow for all applicable fan systems in the entire building per Equation C403.7.4.2(1).

   Equation C403.7.4.2(1)

   Weighted average *sensible energy recovery ratio* = [*sensible energy recovery ratio* for fan system 1 x outside air flow for system 1 + *sensible energy recovery ratio* for fan system 2 x outside air flow for system 2 + …]/[outside air flow for system 1 + outside air flow for system 2 + …]

2. An *enthalpy recovery ratio* of not less than 70% at heating and cooling design conditions

for all other systems. The requirement can be satisfied either for each fan system individually or based on a weighted average of the ventilation air flow for all applicable fan systems in the entire building per Equation C403.7.4.2(2).

Equation C403.7.4.2(2)

Weighted average *enthalpy energy recovery ratio* = [*enthalpy recovery ratio* for fan system 1 x outside air flow for system 1 + *enthalpy recovery ratio* for fan system 2 x outside air flow for system 2 + …]/[outside air flow for system 1 + outside air flow for system 2 + …]

Where an air economizer is required, the energy recovery system shall include a bypass or controls that permit operation of the economizer as required by Section C403.5.

Exception: An energy recovery ventilation system shall not be required in any of the following conditions:

1. Where energy recovery systems are prohibited by the *International Mechanical Code*.

~~2. Laboratory fume hood systems that include not fewer than one of the following features:~~

~~2.1. Variable-air-volume hood exhaust and room supply systems configured to reduce exhaust and makeup air volume to 50 percent or less of design values.~~

~~2.2. Direct makeup (auxiliary) air supply equal to or greater than 75 percent of the exhaust rate, heated not warmer than 2°F (1.1°C) above room setpoint, cooled to not cooler than 3°F (1.7°C) below room setpoint, with no humidification added, and no simultaneous heat- ing and cooling used for dehumidification control.~~

~~3.~~2 Systems serving spaces that are heated to less than ~~60°F (15.5°C)~~ 40°F (10°C) and that are not cooled.

~~4.Where more than 60 percent of the outdoor heating energy is provided from site-recovered or site-solar energy.~~

~~5. Enthalpy recovery ratio requirements at heating design condition in Climate Zones 1 and 2.~~

~~6. Enthalpy recovery ratio requirements at cooling design condition in Climate Zones 3C, 4C, 5B, 5C, 6B, 7 and 8.~~

~~7. Systems requiring dehumidification that employ energy recovery in series with the cooling coil.~~

~~8. Where the largest source of air exhausted at a single location at the building exterior is less than 75 percent of the design outdoor air flow rate.~~

~~9~~ 3. Systems expected to operate less than ~~20~~ 10 hours per week at the *outdoor air* percentage covered by Table C403.7.4.2(1).

~~10~~ 4. Systems exhausting toxic, flammable, paint or corrosive fumes or dust.

~~11~~ 5. Commercial kitchen hoods used for collecting and removing grease vapors and smoke.

Revise Tables C403.7.4.2(1) and C403.7.4.2(2) and show only Climate Zone 5A row, as follows:

Table C403.7.4.2(1)

ENERGY RECOVERY REQUIREMENT (Ventilation systems operating less than 8,000 hours per year)

Climate Zone	PERCENT (%) OUTDOOR AIR AT FULL DESIGN AIRFLOW RATE							
	>=10% and <20%	>=20% and < 30%	>=30% and < 40%	>=40% and <50%	>=50% and <60%	>=60% and <70%	>=70% and <80%	>=80%
	Design Supply Fan Airflow Rate (cfm)							
5A	>= ~~26,000~~ 10,000	>= ~~16,000~~ 8,000	>= ~~5,500~~ 2,750	>= ~~4,500~~ 0	>= ~~3,500~~ 0	>= ~~2000~~ 0	>= ~~1,000~~ 0	>= ~~120~~ 0

Table C403.7.4.2(2)

ENERGY RECOVERY REQUIREMENT (Ventilation systems operating note less than 8,000 hours per year)

Climate Zone	PERCENT (%) OUTDOOR AIR AT FULL DESIGN AIRFLOW RATE							
	>=10% and <20%	>=20% and < 30%	>=30% and < 40%	>=40% and <50%	>=50% and <60%	>=60% and <70%	>=70% and <80%	>=80%
	Design Supply Fan Airflow Rate (cfm)							
5A	>= ~~200~~ 0	>= ~~130~~ 0	>= ~~100~~ 0	>= ~~80~~ 0	>= ~~70~~ 0	>= ~~60~~ 0	>= ~~50~~ 0	>= ~~40~~ 0

~~(Equation C403.7.5.2-1 Sensible Energy Recovery Ratio)~~

~~$SENSIBLE.RATIO_{PROPOSED} / SENSIBLE.RATIO_{REQUIRED} \geq 1.0$~~

~~where:~~

~~$SENSIBLE.RATIO_{PROPOSED} = [(VENT.\Delta T_1 \times VENT.CFM_1) + (VENT.\Delta T_2 \times VENT.CFM_2) + (VENT.\Delta T_3 \times VENT.CFM_3) + \ldots] / VENT.CFM_{TOTAL}$~~

~~and:~~

~~$SENSIBLE.RATIO_{REQUIRED} = [(EXH.\Delta T_{OTHER} \times EXH.CFM_{OTHER} \times EXH.EF_{OTHER}) + (EXH.\Delta T_{CLASS\ 4/3} \times EXH.CFM_{CLASS\ 4/3} \times EXH.EF_{CLASS\ 4/3})] / EXH.CFM_{TOTAL}$~~

where:

$SENSIBLE.RATIO_{PROPOSED}$ = Weighted average sensible energy recovery ratio of all mechanical ventilation systems.

$SENSIBLE.RATIO_{REQUIRED}$ = Minimum average sensible energy recovery ratio required by code.

$VENT.\Delta T_X$ = Change in the dry-bulb temperature of each individual mechanical ventilation system, calculated by subtracting the outdoor air dry-bulb temperature from the ventilation air temperature leaving the heat recovery device. This value shall be based on the change in dry-bulb temperature achieved by the heat recovery system alone, not including heat input from return air, fans, heat pumps, or active heating systems.

$VENT.CFM_X$ = Ventilation rate in cubic feet per minute of each individual mechanical ventilation system.

$VENT.CFM_{TOTAL}$ = Total volume of mechanical ventilation in cubic feet per minute.

$EXH.CFM_{TOTAL}$ = Total volume of mechanical exhaust in cubic feet per minute.

$EXH.\Delta T_{OTHER}$ = Dry-bulb temperature difference between the exhaust air and the ambient outdoor air, calculated by subtracting the ambient outdoor air temperature from the exhaust air temperature. The exhaust air temperature shall be based on the weighted average exhaust air temperature of all exhaust sources other than *Exempt exhaust*, *Class 4 exhaust* and *Class 3 exhaust*. The value shall be based on the exhaust air temperature prior to exhaust heat recovery.

$EXH.\Delta T_{CLASS\ 4/3}$ = Similar definition as $EXH.\Delta T_{OTHER}$ except limited to Class 4 and *Class 3 exhaust*.

$EXH.CFM_{OTHER}$ = Exhaust rate in total cubic feet per minute of all exhaust sources other than *Exempt exhaust*, *Class 4 exhaust*, and *Class 3 exhaust*.

$EXH.CFM_{CLASS\ 4/3}$ = Exhaust rate in total cubic feet per minute of all *Class 4 exhaust* and *Class 3 exhaust* sources.

$EXH.EF_{OTHER}$ = Sensible energy recovery ration requirement for ventilation air associated with all exhaust sources other than *Exempt exhaust*, *Class 4 exhaust*, and *Class 3 exhaust*. See table C403.7.5.2(1).

$EXH.EF_{CLASS\ 4/3}$ = Sensible energy recovery ration requirement for ventilation air associated with all *Class 4 exhaust* and *Class 3 exhaust* sources. See table C403.7.5.2(1).

Table C403.7.5.2(1) Sensible Energy Recovery Ratio

EXHAUST TYPE	**SENSIBLE ENERGY RECOVERY RATIO**
$EXH.EF_{OTHER}$	75%
$EXH.EF_{CLASS\ 4/3}$	50%

(Equation C403.7.5.2-2 *Enthalpy Recovery Ratio*)

~~$ENTHALPY.RATIO_{PROPOSED} / ENTHALPY.RATIO_{REQUIRED} \geq 1.0$~~

~~where:~~

~~$ENTHALPY.RATIO_{PROPOSED} = [(VENT.\Delta H_1 \times VENT.CFM_1) + (VENT.\Delta H_2 \times VENT.CFM_2) + (VENT.\Delta H_3 \times VENT.CFM_3) + \ldots] / VENT.CFM_{TOTAL}$~~

~~and:~~

~~$ENTHALPY.RATIO_{REQUIRED} = [(EXH.\Delta H_{OTHER} \times EXH.CFM_{OTHER} \times EXH.EF_{OTHER})] / EXH.CFM_{TOTAL}$~~

~~where:~~

~~$ENTHALPY.RATIO_{PROPOSED}$~~	~~=~~	~~Weighted average *enthalpy recovery ratio* of all mechanical ventilation systems.~~
~~$ENTHALPY.RATIO_{REQUIRED}$~~	~~=~~	~~Minimum average *enthalpy recovery ratio* required by code.~~
~~$VENT.\Delta H_X$~~	~~=~~	~~Change in the enthalpy of each individual mechanical ventilation system, calculated by subtracting the outdoor air enthalpy from the ventilation air enthalpy leaving the heat recovery device. This value shall be based on the change in enthalpy achieved by the heat recovery system alone, not including enthalpy input from return air, fans, heat pumps, or active heating systems.~~
~~$VENT.CFM_X$~~	~~=~~	~~Ventilation rate in cubic feet per minute of each individual mechanical ventilation system.~~
~~$VENT.CFM_{TOTAL}$~~	~~=~~	~~Total volume of mechanical ventilation in cubic feet per minute.~~
~~$EXH.CFM_{TOTAL}$~~	~~=~~	~~Total volume of mechanical exhaust in cubic feet per minute.~~
~~$EXH.\Delta H_{OTHER}$~~	~~=~~	~~Enthalpy difference between the exhaust air and the ambient outdoor air, calculated by subtracting the ambient outdoor air enthalpy from the exhaust air enthalpy. The exhaust air temperature shall be based on the weighted average exhaust air enthalpy of all exhaust sources other than *Exempt exhaust*, *Class 4 exhaust*, and *Class 3 exhaust*. exhaust. The value shall be based on the exhaust air enthalpy prior to exhaust heat recovery.~~
~~$EXH.CFM_{OTHER}$~~	~~=~~	~~Exhaust rate in total cubic feet per minute of all exhaust sources other than *Exempt exhaust*, *Class 4 exhuast*, and *Class 3 exhaust*.~~
~~$EXH.EF_{OTHER}$~~	~~=~~	~~*Enthalpy recovery ratio* requirement for ventilation air associated with all exhaust sources other than *Exempt exhaust*, *Class 4 exhaust*, and *Class 3 exhaust*. See table C403.7.5.2(2).~~

~~Table C403.7.5.2(2) *Enthalpy Recovery Ratio*~~

~~**EXHAUST TYPE**~~	~~***ENTHALPY RECOVERY RATIO***~~
~~$EXH.EF_{OTHER}$~~	~~50%~~

Revise C403.7.5 ~~(renumbered to C403.7.6 per above)~~, as follows:

C403.7.~~5~~6~~5~~ Kitchen exhaust systems. Replacement air introduced directly into the exhaust hood cavity shall not be greater than 10 percent of the hood exhaust airflow rate. Conditioned supply air delivered to any space shall not exceed the greater of the following:

1. The ventilation rate required to meet the space heating or cooling load.
2. The hood exhaust flow minus the available transfer air from adjacent space where available transfer air is considered to be that portion of outdoor ventilation air not required to satisfy other exhaust needs, such as restrooms, and not required to maintain pressurization of adjacent spaces.

Where total kitchen hood exhaust airflow rate is greater than 5,000 cfm (2360 L/s), each hood shall be a factory-built commercial exhaust hood listed by a nationally recognized testing laboratory in compliance with UL 710. Each hood shall have a maximum exhaust rate as specified in Table C403.7.~~565~~ and shall comply with ~~one~~ ~~two~~ one of the following:

1. Not less than 50 percent of all replacement air shall be transfer air that would otherwise be exhausted.
2. Demand ventilation systems on not less than 75 percent of the exhaust air that are configured to provide not less than a 50-percent reduction in exhaust and replacement air system airflow rates, including controls necessary to modulate airflow in response to appliance operation and to maintain full capture and containment of smoke, effluent and combustion products during cooking and idle.
3. Listed energy recovery devices with a sensible heat recovery effectiveness of not less than 40 percent on not less than 50 percent of the total exhaust airflow.

Where a single hood, or hood section, is installed over appliances with different duty ratings, the maximum allowable flow rate for the hood or hood section shall be based on the requirements for the highest appliance duty rating under the hood or hood section.

Exception: Where not less than 75 percent of all the replacement air is transfer air that would otherwise be exhausted.

TABLE C403.7.~~565~~ MAXIMUM NET EXHAUST FLOW RATE

CFM PER LINEAR FOOT OF HOOD LENGTH

TYPE OF HOOD	LIGHT-DUTY EQUIPMENT	MEDIUM-DUTY EQUIPMENT	HEAVY-DUTY EQUIPMENT	EXTRA-HEAVY-DUTY EQUIPMENT
Wall-mounted canopy	140	210	280	385
Single island	280	350	420	490
Double island (per side)	175	210	280	385
Eyebrow	175	175	NA	NA
Backshelf/Pass-over	210	210	280	NA

For SI: 1 cfm = 0.4719 L/s; 1 foot = 304.8 mm.

NA = Not Allowed.

SECTION C404

SERVICE WATER HEATING

SECTION C405
ELECTRICAL POWER AND LIGHTING SYSTEMS

C405.2.4 Daylight-responsive controls. *Daylight responsive controls* complying with Section C405.2.4.1 shall be provided to control the general lighting within *daylight zones* in the following spaces:

1. Spaces with a total of more than ~~150~~100 watts of *general lighting* within primary sidelit daylight zones complying with Section C405.2.4.2.
2. Spaces with a total of more than 300 watts of *general lighting* within sidelit daylight zones complying with Section C405.2.4.2.
3. Spaces with a total of more than ~~150~~100 watts of *general lighting* within toplit daylight zones complying with Section C405.2.4.3.

Section C405.13 Add new text as follows:

C405.13 *Electric Vehicle Ready Parking* Spaces ("EV Ready Spaces") (Mandatory). New parking spaces shall provide *EV Ready Spaces* in accordance with Table C405.13. Installed wiring suitable for 6.6kW or higher SAE J1772-2017 AC Level II EVSE shall be connected to the service panel and run to within 6 feet (1828mm) of any qualifying parking space. Conductors and outlets for *EVSE* shall be sized and installed in accordance with the MA electrical code.

TABLE C405.13 EV-READY SPACE REQUIREMENTS

Occupancy Classification	Minimum percentage of EV-Ready Spaces	EV Charging Performance Requirements
Group R and Group B	20%	40-amp dedicated branch circuit or larger branch circuit with ALMS in accordance with Table C405.13.1
All Other Occupancies	10%	40-amp dedicated branch circuit or larger branch circuit with ALMS in accordance with Table C405.13.1

Exceptions:

1. Parking spaces and garage spaces intended exclusively for storage of vehicles for retail sale or vehicle service are excluded from the EV-ready space percentage calculation.
2. Any parking facility with ~~2~~4 or more spaces providing installed ~~Level 3~~ Direct Current fast charging EVSE with a minimum charging speed of 150 kW to each space.
3. One or more AC Level II spaces may be substituted with multiple AC Level I spaces provided with wiring for a minimum 20amp 120 volt EVSE, with a ratio of at least 3 AC Level I spaces for each AC Level II space required.
4. Parking spaces specifically designated for medium or heavy duty vehicles are excluded from the EV-ready space percentage calculation.

C405.13.1 Minimum Charging Performance Requirements. *Automatic Load Management System (ALMS)* may be used to control *electric vehicle* loads for EV-Ready or EVSE-Installed Spaces with AC

Level II or Level I charging, subject to the performance requirements in Table C405.13.1. The maximum number of parking spaces that may share a single branch circuit varies based on the percentage of all parking spaces to be provided with *EVSE*.

TABLE C405.13.1 EV-READY PERFORMANCE REQUIREMENTS

Circuit Breaker Amperage	Maximum Parking Spaces that May Share a Branch Circuit with 10%-60% EV Ready spaces	Maximum Parking Spaces that May Share a Branch Circuit with 61-100% EV Ready spaces
40A	1	2
50A	1	2
60A	2	4
70A	3	6
80A	4	8
90A	5	9
100A	6	10

C405.13.2 Identification. *Construction documents* shall indicate the branch circuit termination point and proposed location of future EVSE. *Construction documents* shall also provide information on amperage of future EVSE, wiring schematics, *Automatic Load Management Systems*, and electrical load calculations to verify that the electrical panel service capacity and electrical system, including any on-site distribution transformers, have sufficient capacity to simultaneously charge all EVs at all required *EV ready spaces*.

~~**SECTION C406**~~
~~**ADDITIONAL EFFICIENCY REQUIREMENTS**~~
~~**C406.1 Additional energy efficiency credit requirements.**~~
~~New buildings shall achieve a total of 150 credits from Tables C406.1(1) through C406.1(5) where the table is selected based on the use group of the building and from credit calculations as specified in relevant subsections of Section C406.~~
~~Where a building contains multiple use groups, credits from each use group shall be weighted by floor area of each group to determine the weighted average building credit. Credits from the tables or calculation shall be achieved where a building complies with one or more of the following:~~
~~1. More efficient HVAC performance in accordance with Section C406.2.~~
~~2. Reduced lighting power in accordance with Section C406.3.~~
~~3. Enhanced lighting controls in accordance with Section C406.4.~~
~~4. On-site supply of renewable energy in accordance with Section C406.5.~~
~~5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.~~
~~6. High-efficiency service water heating in accordance with Section C406.7.~~
~~7. Enhanced envelope performance in accordance with Section C406.8.~~
~~8. Reduced air infiltration in accordance with Section C406.9~~
~~9. Where not required by Section C405.12, include an energy monitoring system in accordance with Section C406.10.~~
~~10. Where not required by Section C403.2.3, include a fault detection and diagnostics (FDD) system in accordance with Section C406.11.~~
~~11. Efficient kitchen equipment in accordance with Section C406.12.~~
~~12.9.Renewable space heating in accordance with Section C406.130.~~

~~13. 10.*Type IV* heavy timber construction in accordance with Section C406.141~~

~~**C406.1310 Renewable space heating.** All space heating shall be provided with cold-climate air source heat pumps having rated coefficient of performance (COP) of at least 1.75 at 5 degrees Fahrenheit source air. (10 points)~~

~~**C406.1411 Heavy Timber construction.** In buildings with 4 stories or more of *Type IV* heavy timber construction either above grade, or above a podium. (8 points)~~

Revise C406.1 as follows:

C406.1 Additional energy efficiency credit requirements.

New buildings shall achieve a total of 15~~0~~ credits from Tables C406.1(1) through C406.1(5) where the table is selected based on the use group of the building and from credit calculations as specified in relevant subsections of Section C406. Where a building contains multiple-use groups, credits from each use group shall be weighted by floor area of each group to determine the weighted average building credit. Credits from the tables or calculation shall be achieved where a building complies with one or more of the following:

In Table C406.1(1) through Table C406.1(5), delete rows for C406.2.1 and C406.7.3

In Table C406.1(1) through Table C406.1(5), replace row for option C406.2.3 with the following:

Section	Climate Zone 5A
C406.2.3 Renewable space heating	15

In Table C406.1(1) through Table C406.1(5), add the following row for option C406.12:

Section	Climate Zone 5A
C406.12 Heavy Timber Construction	8

C406.1.1 Tenant Spaces

Tenant spaces shall comply with sufficient options from Tables C406.1(1) through C406.1(5) to achieve a minimum number of ~~5~~10 credits, where credits are selected from Section C406.2, C406.3, C406.4, C406.6, C406.7 or C406.10. Where the entire building complies using credits from C406.5, C406.8, or C406.9, tenant spaces shall be deemed to comply with this section.

Exception: Previously occupied tenant spaces that comply with this code in accordance with Section C501.

Delete Section C406.2.1

Replace Section C406.2.3 with the following:

C406.2.3. Renewable space heating. All space heating shall be provided with cold-climate air source heat pumps having rated coefficient of performance (COP) of at least 1.75 at 5 degrees Fahrenheit source air, or ground source heat pumps.

Delete Section C406.7.3

Replace Section C406.9 with the following:

C406.9 Reduced air leakage. *Air leakage* of the *building thermal envelope* shall be tested by an *approved* third party in accordance with Section C402.5.2.1. The measured *air leakage* shall not exceed 0.20 cfm/ft^2 (1.1 L/s × m^2) of the *building thermal envelope* at a pressure differential of 0.3 inch~~es~~ water gauge (75 Pa), with the calculated surface area being the sum of the above- and below-grade *building thermal envelope*.

Add Section C406.12

C406.12~~11~~ Heavy Timber construction. In buildings with 4 stories or more of Type IV heavy timber construction either above grade, or above a podium.

SECTION C407
TOTAL BUILDING PERFORMANCE CERTIFICATION METHODS

Replace Section C407 as follows

C407.1 Targeted Performance

This option requires compliance with Section C407.1.1 through C407.1.2.

C407.1.1 Compliance

Building shall comply with ~~s~~Sections C407.1.1.1~~2.1~~ through C407.1.1.6~~2.4~~

C407.1.1.1~~2.1~~ Building performance modeling

Building performance modeling shall be used to show compliance with C407.1~~.2.3~~1.5. The simulation program shall be a computer-based program for the analysis of energy consumption in buildings ~~(a program such as, but not limited to, DOE-2, BLAST, or Energy Plus)~~. The simulation shall include calculation methodologies for the building components being modeled~~.~~, ~~Performance modeling shall be conducted in accordance with~~ and meet the requirements in ANSI/ASHRAE/IESNA 90.1-2019 Section G2.2.1(a)-(d) and ~~Appendix G Section G2.2.1, Section G2.2.3, Section~~ G2.2.4. ~~Section G2.3, and Section G3.1.1.4.~~

C407.1.1.2 Climatic Conditions

The simulation program shall perform the simulation using hourly values of climatic data using representative weather files prescribed by the Massachusetts Department of Energy Resources.

C407.1.1.3 Modeling Building Envelope Infiltration

The air leakage rate of the building envelope shall be modeled following ANSI/ASHRAE/IESNA 90.1-2019 Section G3.1.1.4.

C407.1.1.4~~2.2~~ Internal loads, scheduling, and other modeling assumptions
Performance modeling shall use the internal load, scheduling, and other assumptions ~~published in DOER Guidelines~~ as prescribed by the Massachusetts Department of Energy Resources.

C407.1.1.5~~2.3~~ Thermal energy demand intensity (TEDI) limits
Performance modeling shall show that the building's heating thermal energy demand intensity and cooling thermal energy demand intensity are less than or equal to the values in Table C407.1.1.5~~2.3.~~

Table C407.1.1.5~~2.3~~ Thermal Energy Demand Intensity (TEDI) Limits

Use Type	Heating TEDI (kBtu/sf-yr)	Cooling TEDI (kBtu/sf-yr)
Office, ~~court house,~~ fire station, library, police station, post office, town hall >= ~~100,000~~ 125,000-sf	1.5	23
Office, fire station, library, police station, post office, town hall between 75,000 and 125,000-sf	4 – 0.00002 * Area (sf)	18 + 0.00004 * Area (sf)
Office, ~~court house,~~ fire station, library, police station, post office, town hall <= ~~100,000~~ 75,000-sf	2.5	21
K-12 School >= ~~100,000~~ 125,000-sf	2.2	12
K-12 School between 75,000 and 125,000-sf	2.7 – 0.000004 * Area (sf)	32 - 0.00016 * Area (sf)
K-12 School <=~~100,000~~ 75,000-sf	2.4	20
Residential multifamily and dormitory >= ~~100,000~~ 125,000-sf	2.8	22
Residential multifamily and dormitory between 75,000 and 125,000-sf	3.8 – 0.000008 * Area (sf)	4.5 + 0.00014 * Area (sf)
Residential multifamily and dormitory <=~~100,000~~ 75,000-sf	3.2	15
All other >= ~~100,000~~ 125,000-sf	1.5	23
All other between 75,000 and 125,0000-sf	4 – 0.00002 * Area (sf)	18 + 0.00004 * Area (sf)

All other < = ~~100,000~~ 75,000-sf	2.5	21

C407.1.1.6~~2.4~~ Mixed use buildings
For buildings having more than one use type where any use type is more than 10% of the total space conditioned area, each separate use type having more than 10% of the total space conditioned area shall separately and individually show compliance with C407.1.1.5~~2.3~~ for that respective use type. Use types having less than or equal to 10% of the total space conditioned area do not have to show separate, individual compliance with C407.1.1.5~~2.3~~ but can be incorporated into and treated as the majority use type.

C407.1.2 Documentation

Simulated performance shall be documented, and documentation shall be submitted to rating authority. Documentation shall include all the assumptions used in the performance modeling such that the documentation can be used as a specification checklist for implementation during design and construction. The information shall be submitted in a report and shall include the items described in ANSI/ASHRAE/IESNA 90.1-2019 Appendix G Section G1.3.2 Parts b, g, h, i, j, k, l, n, o, and q, and Section G1.3.3. ~~as well as the following:~~

1. ~~A description of the energy features and building characteristics mandated by C407.1.1.~~
2. ~~A description of the energy features and building characteristics used to achieve heating and cooling TEDI limits in C407.1.2.3.~~
3. ~~Schedules, uses, occupancies, and other assumptions used in the model required by DOER Guidelines.~~
4. ~~Building envelope details, including *thermal bridge* mitigation and air infiltration assumptions.~~
5. ~~Details on building ventilation systems, ventilation rates, and ventilation energy recovery strategies~~

C407.2 Relative Performance. This option requires compliance with Section C407.2.1 and C407.2.2.

C407.2.1 Electrification and Documentation for Highly Ventilated Buildings. Buildings using the Relative Performance Pathway (C407.2) because average ventilation at full occupancy is greater than 0.5 cfm/sf shall have space heating electrified in accordance with Section C401.4.1 and shall submit design documents showing ventilation system design and air flow rates as required by Section C103.2 part 16.

C407.2.2 Compliance. Building shall comply with ANSI/ASHRAE/IESNA 90.1-2019 Section 4.2 using the Appendix G pathway as modified by C407.2.2.1~~,~~ and C407.2.2.2~~., C407.2.2.3~~

C407.2.2.1 Modification to ANSI/ASHRAE/IESNA 90.1-2019 Section 4.2.

Replace 4.2.1.1 with following:

New buildings shall comply with 4.2.2 through 4.2.5 and normative Appendix G. When using Normative Appendix G, the Performance Energy Index (PEI) of new buildings, additions to existing buildings, and alterations to existing buildings shall be less than or equal to the Performance Energy Index Target (PEI_t) when calculated in accordance with the following:

PEI_t = [BBUE + (BPF x BBRE)]/BBSE

PEI = Performance Energy Index calculated in accordance with Section G1.2
BBUE = Baseline building unregulated site energy
BBRE = Baseline building regulated site energy
BPF = Building performance factor from Table 4.2.1.1 For building area types not listed in Table 4.2.1.1 use "All others". Where a building has multiple area types, the required BPF shall be equal to the area-weighted average of the building area types.
BBSE = Baseline building site energy (sum of BBUE and BBRE)

Revise Table 4.2.1.1 to show only Climate Zone 5A; remove multifamily, office, and school; and adjust the BPFs as follows:

Table 4.2.1.1 Building Performance Factor (BPF)

Building Area Type	Climate Zone 5A
Health care/hospital	0.59
Hotel/motel	0.57
Restaurant	0.62
Retail	0.47
Warehouse	0.41
All others	0.51

~~**C407.2.2.2 Modification to ANSI/ASHRAE/IESNA 90.1-2019 Chapters 5 and 9**~~

C407.2.2.2~~3~~ Modification to ANSI/ASHRAE/IESNA 90.1-2019 Appendix G

In all Sections of Appendix G, replace references to "baseline building performance" with "baseline building site energy", replace "proposed building performance" with "proposed building site energy", replace "energy cost savings" with "site energy savings"

Replace G1.2.2 with following, keeping the exception unchanged:

The site energy of the proposed design is calculated in accordance with the provisions of this appendix using the following formula:

Performance energy index (PEI) =
Proposed building site energy / baseline building site energy (BBSE)

Both the proposed building site energy and the baseline building site energy shall include all end use load components within and associated with the building when calculating the performance energy index.

Delete G1.3.2 Part m and Part p

Delete G2.1 Part c

Revise G2.4.1 as follows

Site recovered energy shall be subtracted from the proposed building site energy when calculating performance. Energy used to recharge vehicles that are used for on-road and off-site transportation purposes, or energy losses from use of behind-the-meter energy storage, should not be included when calculating performance. On-site renewable energy shall not be subtracted from the proposed building site energy when calculating performance.

Delete G2.4.2

Add the following row to Section G Table G3.1.1-1.

TABLE G3.1.1-1 BASELINE BUILDING VERTICAL FENESTRATION PERCENTAGE OF GROSS ABOVE-GRADE-WALL AREA

Building Area Types	Baseline Building Gross Above-Grade-Wall Area
Multifamily	24%

Section C407.3 *Add Section C407.3 as follows:*

C407.3 Passive House. This option requires compliance with Section C407.3.1~~,~~ and C407.3.2.~~, C407.3.3~~

C407.3.1 Compliance. Buildings shall be pre-certified as meeting the Phius CORE 2021 or Phius ZERO 2021 Passive Building Standard – North America, or newer, demonstrated using Phius-approved software, where Phius Design-Certification is demonstrated by Phius and a Certified Passive House Consultant (CPHC); or, Projects pre-certified as meeting the Certified Passive House standard using the current software and program criteria by the Passive House Institute (PHI), where PHI certification is demonstrated by a Certified Passive House Designer and a Certified Passive House Certifier.

~~**Compliance**. Buildings shall be pre-certified through Passive House Institute US (Phius) or Passive House Institute (PHI) and shall be have an "as-built" report from a Passivehouse Consultant or certified Passivehouse designer demonstrating compliance with the Phius CORE 2021 or PHI standard. Software tools for determining Passive House certification shall be approved software tools by Phius or PHI.~~

C407.3.2 Documentation. Compliance with Phius or PHI shall be in accordance with C407.3.3.1 ~~and~~ or C407.3.3.2

~~**C407.3.2.1 Prior to building permit.** Prior to the issuance of a building permit, the following items must be provided to the rating authority:~~

1. ~~A WUFI or PHPP compliance report which demonstrates project compliance with PHIUS CORE 2021 (or newer) or PHI performance requirements;~~
2. ~~A statement that the WUFI or PHPP results are "based on plans";~~
3. ~~Evidence of project registration from PHIUS or PHI.~~

~~**C407.3.2.2 Prior to issuance of certificate of occupancy.** Prior to the issuance of a certificate of occupancy, the following item(s) must be provided to the rating authority:~~

1. ~~Documentation of Design certification from PHIUS or Pre-certification approval from a PHI certified consultant;~~

~~2. An updated WUFI or PHPP compliance report which demonstrates project compliance with Design Certification through PHIUS CORE 2021 (or newer) or PHI performance requirements;~~
~~3. A copy of the Passive House Rater's blower door test results;~~
~~4. A statement that the WUFI or PHPP results are "based on 'as-built' conditions, incorporating the relevant test results and documented changes to equipment, materials, and assemblies that impact performance".~~
~~5. Compliance with C405.13, and Appendix CB~~

C407.3.2.1 Phius Documentation. When using WUFI Passive or other Phius approved software:

1. Prior to the issuance of a building permit, the following item(s) must be provided to the Building Official:
    a. A Phius 2021 (or newer) Verification Report which demonstrates project compliance with Phius 2021 (or newer) performance requirements.
    b. A statement from the CPHC that the verification report results accurately reflect the plans submitted.
    c. Evidence of project registration from Phius.

OR

    a. A Design Certification Letter from Phius.

2. Prior to the issuance of a certificate of occupancy, the following items must be provided to the building official:
    a. Design Certification Letter from Phius.
    b. An updated Verification Report by the CPHC which reflects "as-built" conditions and test results that demonstrate project compliance with Phius (blower door and ventilation results).
    c. A statement from the CPHC that the envelope meets the Phius hygrothermal requirements found in Appendix B of the Phius 2021 Certification guidebook
    d. A statement from the Phius Certified Verifier or Rater that the project test results and other Phius verification requirements are met.
    e. A copy of the Phius workbook listing all testing results and as-built conditions.

OR

    a. A Project Certificate demonstrating final certification awarded by Phius.

AND

    f. A statement from the Phius Verifier or Rater of compliance with C405.13: EV ready, and Appendix CB: Solar Ready Provisions.

C407.3.2.2 Passive House International (PHI) Documentation.

1. If using PHI Passive House software, prior to the issuance of a building permit, the following item(s) must be provided to the Building Official:
    a. A PHPP compliance report which demonstrates project compliance with current PHI performance requirements;
    b. A statement from the Certified Passive House Consultant/Designer (CPHC/D) that the PHPP results and compliance report accurately reflect the plans submitted; ~~are "based on plans";~~

c. Evidence of ~~precertification approval~~ project registration from ~~PHI.~~a Certified Passive House Certifier.

OR

a. A Design Certification Letter from a Certified Passive House Certifier.

2. Prior to the issuance of a certificate of occupancy, the following item(s) must be provided to the building official:
   a. A Design Certification Letter from a Certified Passive House Certifier.
   b. An updated PHPP compliance report which reflects "as-built" conditions and test results (blower door and ventilation results) that demonstrates project compliance with PHI performance requirements;
   c. A copy of the Passive House Verifier's or Rater's test results;
   d. A statement from the CPHD that the project test results meet the model performance requirements, all the mandatory limits and any other mandatory requirements. ~~A statement that the PHPP results are "based on 'as-built' conditions, incorporating the relevant test results and documented changes to equipment, materials, and assemblies that impact performance".~~

OR

a. A Final Certification Letter from a Certified Passive House Certifier

AND

e. A statement from the Passive House Verifier or Rater of compliance with C405.13: EV ready, and Appendix CB: Solar Ready Provisions.

~~**C407.3.3 Verification by approved agency.** Verification of compliance shall be completed by a certified Passive House consultant.~~

Section C407.4 *Add Section C407.4 as follows:*

C407.4 HERS Index (HERS) for multi-family buildings

This option requires compliance with Section C407.4.1, C407.4.2, C407.4.3

C407.4.1 Compliance

Each dwelling unit shall have a certified HERS Index (HERS) rating less than or equal to the appropriate value indicated in Table C407.4 when compared to the *HERS index reference design* for each dwelling unit prior to credit for onsite renewable electric generation. Buildings shall meet or exceed ENERGY STAR Multifamily New Construction (MFNC) program requirements. The Home Energy Rating Index (HERS) shall be determined in accordance with RESNET/ICC Standard 301-2019. Software tools used for determining HERS Index shall be Approved Software Rating Tools in accordance with RESNET/ICC 301. Where calculations require input values not specified by Sections R402, R403, R404 and R405, those input values shall be taken from RESNET/ ICC 301.

TABLE C407.4 MAXIMUM ENERGY RATING INDEX

	Maximum HERS Index score[a],

Building Energy Sources	New construction permits until June 30, 2024	New construction permits after July 1, 2024	Major alterations, additions, or Change of use[b]
Mixed-fuel building	52	42	52
Solar Electric Generation	55	42	55
All-Electric building	55	45	55
Solar Electric & *All-Electric building*	58	45	58

[a] Maximum HERS rating prior to onsite renewable electric generation in accordance with Section C407.4

[b] Alterations, Additions or Change of use covered by Section R503.1.5 are subject to this maximum HERS rating.

C407.4.2 Documentation. Documentation verifying that the methods and accuracy of compliance software tools conform to the provisions of this section shall be provided to the *building official* in accordance with C407.4.3.1 and C407.4.3.2:

C407.4.2.1 Prior to issuance of building permit. Prior to the issuance if a building permit, the following items must be provided to the Building Official:

~~1. A HERS compliance report which includes a proposed HERS index score less than or equal to the appropriate value indicated in Table C407.4;~~
~~2. A description of the unit's energy features;~~
~~3. A statement that the rating index score is "based on plans".~~

1. Building street address, or other *building site* identification.
2. Declare the HERS Index on title page and building plans.
3. The name of the individual performing the analysis and generating the compliance report.
4. The name and version of the compliance software tool.
5. Documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.
6. A certificate indicating that the proposed design has a HERS Index less than or equal to the appropriate score indicated in Table C407.4 when compared to the ERI reference design. The certificate shall document the building component energy specifications that are included in the calculation, including: component level insulation *R*-values or *U*-factors; assumed duct system and building envelope air leakage testing results; and the type and rated efficiencies of proposed heating, cooling, mechanical ventilation, and service water-heating equipment to be installed. If on-site renewable energy systems will be installed, the certificate shall report the type and production size of the proposed system.
7. When a site-specific report is not generated, the proposed design shall be based on the worst-case orientation and configuration of the rated home.

C407.4.2.2 Prior to issuance of certificate of occupancy. Prior to the issuance of a certificate of occupancy, the following items must be provided to the Building Official:

~~1. A copy of the final certificate indicating that the HERS rating index score for each unit is verified to be less than or equal to the appropriate value indicated in Table C407.4;~~
~~2. A completed HERS rater verified ENERGY STAR Thermal Enclosure System Rater Checklist.~~

1. Building street address or other *building site* identification.
2. Declaration of the Final HERS Index on title page and on building plans.
3. The name of the individual performing the analysis and generating the report.
4. The name and version of the compliance software tool.

5. Documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.
6. A final confirmed certificate indicating that the confirmed rated design of the built home complies with Sections C407.4. The certificate shall report the energy features that were confirmed to be in the home, including: component-level insulation *R*-values or *U*-factors; results from any required duct system and building envelope air leakage testing; and the type and rated efficiencies of the heating, cooling, mechanical ventilation, and service water-heating equipment installed.
7. Documentation that each unit meets or exceeds ENERGY STAR Multifamily New Construction (MFNC) program requirements.
8. Where on-site renewable energy systems have been installed on or in the home, the certificate shall report the type and production size of the installed system.
9. Compliance with C405.13, and either Appendix CB or Appendix CC as applicable.

C407.4.3 Verification by approved agency. Verification of compliance shall be completed by a certified HERS rater.

CHAPTER 5 [CE] EXISTING BUILDINGS

ADDITIONS

Revise C502.1 as follows:

C502.1 General
Additions to an existing building where the addition is up to 100% of the size of the existing building and less than 20,000-sf shall comply with Sections C401.3, C402 through C406, and Section C408. Additions which exceed either of these limits shall comply with the applicable pathway for new construction in C401.2. Additions shall not create an unsafe or hazardous condition or overload existing building systems. An addition shall be deemed to comply with this code if the addition alone complies or if the existing building and addition comply with this code as a single building.

Remove both exceptions in C502.2

ALTERATIONS

Revise C503.1 as follows:

C503.1 General.
Alterations to any *building* or structure shall comply with the requirements of Section C503, and Sections C402, C403, C404, C405 of the code for new construction. *Alterations* shall be such that the existing *building* or structure is not less conforming to the provisions of this code than the *existing building* or structure was prior to the *alteration*. *Alterations* to an existing *building*, *building* system or portion thereof shall conform to the provisions of this code as those provisions relate to new construction without requiring the unaltered portions of the existing *building* or *building* system to comply with this code. *Alterations* shall not create an unsafe or hazardous condition or overload existing *building* systems.

Replace Exception 3 in Section C503.1 with the following:

Where the component performance alternative in Section 402.1.5 is used to comply with this section, the proposed UA shall not be greater than 110 percent of the target UA.

CHANGE OF USE OR OCCUPANCY

Revise Section C505.1, keeping the exceptions, as follows:

C505.1 General
Spaces undergoing a change in occupancy that would result in an increase in demand for either fossil fuel or electrical energy shall comply with ~~this code~~ Sections C401.3, C402 through C406, and Section C408. Where the use in a space changes from one use in Table C405.3.2(1) or C405.3.2(2) to another use in Table C405.3.2(1) or C405.3.2(2), the installed lighting wattage shall comply with Section C405.3. Where the space undergoing a change in occupancy or use in a building with a fenestration area that exceeds the limits of Section C402.4.1, the space is exempt from Section C402.4.1 provided that there is not an increase in fenestration area.

APPENDIX CB
SOLAR-READY ZONE—COMMERCIAL

Adopted unamended

APPENDIX CC - MASSACHUSETTS MUNICIPAL OPT-IN SPECIALIZED ENERGY CODE 2023

COMMERCIAL BUILDING PROVISIONS

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance. The provisions contained in this appendix together with referenced sections from the Stretch energy code constitute the Specialized opt-in code for commercial buildings, and may be adopted by a city or town together with the Residential Specialized code Appendix RC as their stretch energy code. When adopted by the local municipality, the provisions in this appendix are mandatory in combination with the IECC2021 with Massachusetts Stretch code amendments.

SECTION CC101 GENERAL

Section CC101 Revise as follows:

CC101.1 Purpose. The purpose of this appendix is to form the commercial building provisions of the Massachusetts Municipal Opt-in Specialized Code to supplement the Massachusetts Stretch Energy Code and to provide a compliance pathway for buildings that require renewable energy systems of adequate capacity to achieve net zero carbon.

CC101.2 Scope. This appendix applies to new buildings that are addressed by the Municipal Opt-in Specialized Code.
Residential buildings and *dwelling units* within mixed use buildings shall comply as follows:

1) New *dwelling units* over 4,000 square feet in conditioned floor area in *Mixed Fuel Buildings* shall comply with the Zero Energy pathway and Section CC103 or with residential code Section RC102.
2) New R-use buildings over 12,000 square feet in conditioned floor area shall comply in accordance with Table CC101.2.

TABLE CC101.2 MULTI-FAMILY AND R-USE COMPLIANCE

R-Use buildings over 12,000 sf, or R-Use portions over 12,000 sf in mixed-use buildings	Compliance Path options by permit submittal date		
	C407.3 Passive house	C407.1 Targeted Performance	C407.4 HERS Index
Up to 5 stories	Required from Jan 1, 2023		
6 stories and higher	Required from Jan 1, 2024	Optional until Jan 1, 2024	Optional until Jan 1, 2024

Exceptions:

1. Detached one- and two-family dwellings and townhouses as well as Group R-2 buildings three stories or less in height above grade plane, manufactured homes (mobile dwellings), and manufactured houses (modular dwellings). These buildings and dwelling units shall comply with Residential Appendix RC under the Specialized energy code.

2. Buildings that use neither electricity nor fossil fuel.

CC101.3 *Add Section CC101.3 as follows:*

CC101.3 Compliance. New buildings shall demonstrate compliance with Sections CC101.4, CC101.5 and one of the following pathways:

1. **Zero Energy pathway**: Buildings shall comply with Section CC103 and demonstrate that they are *Zero Energy Buildings* in accordance with Equation CC-1. *Mixed Fuel Buildings* with any capacity for on-site fossil fuel use shall be pre-wired for future electrification of all fuel uses in accordance with Section CC105.
2. **All-Electric pathway:** Buildings shall comply with Section CC104.
3. **Mixed Fuel pathway:** *Mixed Fuel Buildings* other than *Zero Energy Buildings* with any capacity for on-site fossil fuel use shall comply with CC105 and CC106. The following uses shall be excluded when determining whether new buildings will have on-site fossil fuel use:
    1) On-site back-up generators using fossil fuels
    2) On-site refuelling of vehicles or outdoor equipment using fossil fuels

CC101.4 *Add Section CC101.4 as follows:*

CC101.4 Minimum building energy efficiency. New buildings shall comply with Section C401.2.1 or C401.2.2. as prescribed in Section C401. Existing buildings shall comply with Chapter 5 as amended.

CC101.5 *Add Section CC101.5 as follows:*

CC101.5 Minimum *electric vehicle ready parking* requirements. New parking spaces shall provide *electric vehicle ready spaces* in accordance with Section C405.13 and Table C405.13.

SECTION CC102 DEFINITIONS

CC102 *Add definitions to Section CC102 as follows:*

CC102.1 Definitions. The definitions contained in this section supplement or modify the definitions in the MA amended *International Energy Conservation Code*, in Section C202.

BUILDING ENERGY. All energy consumed at the *building site* as measured at the site boundary. Contributions from onsite or off-site renewable energy systems shall not be considered when determining the building energy.

ENERGY UTILIZATION INTENSITY (EUI). The site energy for either the baseline building or the proposed building divided by the gross *conditioned floor area* plus any semi-heated floor area of the building. For the baseline building, the EUI can be divided between regulated energy use and unregulated energy use.

~~2050~~ **NET ZERO EMISSIONS BUILDING.** A building which is consistent with achievement of MA 2050 net zero emissions, through a combination of highly energy efficient design together with being either a *Zero Energy Building*, or an *All-Electric Building*, or where fossil fuels are utilized, ~~*Mixed Fuel buildings*, may also meet this standard where~~ the building is fully pre-wired for future electrification and generates solar power on-site from the available *Potential Solar Zone Area*.

OFF-SITE RENEWABLE ENERGY SYSTEM. Renewable energy system not located on the building project.

ON-SITE RENEWABLE ENERGY SYSTEM. Renewable energy systems on the building project.

POTENTIAL SOLAR ZONE AREA. The combined area of any low-sloped roofs and any steep-sloped roofs oriented between 90 degrees and 300 degrees of true north where the annual solar access is 70 percent or greater. Annual solar access is the ratio of "annual solar insolation with shade" to the "annual solar insolation without shade". Shading from obstructions located on the roof or any other part of the building shall not be included in the determination of annual solar access.

RENEWABLE ENERGY SYSTEM. Photovoltaic, solar thermal, geothermal energy and wind systems used to generate energy.

SEMIHEATED SPACE. An enclosed space within a building that is heated by a heating system whose output capacity is greater than or equal to 3.4 Btu/h × ft2 of floor area but is not a conditioned space.

ZERO ENERGY BUILDING. A building which through a combination of highly energy efficiency design and onsite ~~or community based~~ renewable energy generation is designed to result in net zero energy consumption over the course of a year as measured in MMBtus or KWh_{eq}, on a site energy basis, excluding energy use for charging vehicles.

SECTION CC103 ZERO ENERGY PATHWAY MINIMUM RENEWABLE ENERGY

CC103.1 *Revise Section CC103.1 as follows (Table CC103.1 for climate zone 5A remains unchanged):*

CC103.1 Renewable energy. On-site renewable energy systems shall be installed to offset the building energy as calculated in Equation CC-1.

$REonsite \geq Ebuilding$ (Equation CC-1)

where:

REonsite = Annual site energy production from on-site renewable energy systems (see Section CC103.2).
Ebuilding = Building energy use without consideration of renewable energy systems, on-site energy storage, on-site back-up generators, or on-site refuelling of vehicles or outdoor equipment.

When Section C401.2.1(1) is used for compliance with the Section CC101.4, building energy shall be determined by multiplying the gross *conditioned floor area* plus the gross semi-heated floor area of the proposed building by an EUI selected from Table CC103.1.
Use a weighted average for mixed-use buildings.
When any compliance pathway other than Section C401.2.1 Part 1 is used for compliance with CC101.4, building site energy use shall be determined from energy simulations.

CC103.2 *Revise Section CC103.2 as follows*

CC103.2 Calculation of on-site renewable energy. The annual energy production from on-site renewable energy systems shall be determined using the PVWatts software or other software approved by the code official. Commercial R-use buildings may comply using the Zero Energy Buildings pathways in Appendix RC by certifying that all units meet HERS 0 or lower with on-site renewable generation or by following the on-site renewable energy calculation used in the Phius ZERO certification standard when following the Passive house compliance pathway.

CC103.3 *Delete Section CC103.3:*

CC104 *Add Section CC104 as follows:*

SECTION CC104 ALL ELECTRIC PATHWAY

CC104.1 General. New a*ll-electric buildings* shall comply with Sections CC101.4, CC101.5 and with one of the following:

1) Section C401.2.1 and Section C401.4.3
2) Section C407.3 Passive House
3) Exclusively R-use buildings permitted prior to January 2024 may comply with Section C407.4 when all dwelling units have a HERS rating of 45 or less.

CC105 *Add Section CC105 as follows:*

SECTION CC105 MIXED-FUEL BUILDING PATHWAY

CC105.1 General. This section together with Section CC106 establishes additional minimum requirements for new *mixed-fuel buildings*.

CC105.1.1 Biomass heating. New buildings using *clean biomass heating systems* may comply with this section without meeting CC105.3.1 and CC105.3.2. Buildings with any *combustion equipment* using biomass that does not meet the performance standards of

clean biomass heating systems shall be deemed *mixed-fuel buildings* and shall comply with this section in full.

CC105.2 On-site renewable energy. New mixed-fuel buildings shall have equipment installed for on-site renewable energy with a rated capacity of not less than 1.5 W/ft² (16.1 W/m²) multiplied by the sum of the gross conditioned floor area of the three largest floors.

Exception: Where the building site cannot meet the requirement in full with an on-site renewable energy system, the building site shall install a partial system designed to utilize not less than 75% of the *Potential Solar Zone Area*.

CC105.3 Additional efficiency requirements. Additional efficiency requirements for compliance with this Section are set forth in Sections RC104.3.1 through RC104.3.3

CC105.3.1 More efficient HVAC equipment performance. Primary heating and cooling *equipment* shall meet the following efficiencies as applicable:
1. Space heating *combustion equipment* shall be rated at greater than or equal to 95 AFUE.
2. All refrigerant-based air conditioning equipment shall be a heat pump with greater than or equal to 10 HSPF rated heating performance and greater than or equal to 16 SEER rated cooling performance.
3. Ground source heat pump systems shall be rated at greater than or equal to 3.5 COP at design temperature.

For multiple cooling systems, all systems shall meet or exceed the minimum efficiency requirements in this section and collectively shall be sized to serve 100 percent of the cooling design load. For multiple heating systems, all systems shall meet or exceed the minimum efficiency requirements in this section and collectively shall be sized to serve 100 percent of the heating design load.

Exception:
Clean biomass heating systems used as the primary heating system.

CC105.3.2 Reduced energy use in service water-heating option. The hot water system shall meet one of the following efficiencies:

1. Greater than or equal to 82 EF *combustion equipment* service\water-heating system.
2. Greater than or equal to 2.0 UEF electric service water-heating system.
3. Greater than or equal to 0.4 solar fraction solar water-heating system.
4. *Clean biomass heating system* supplied water-heating system.

CC106 *Add new Section CC106 as follows:*

SECTION CC106 WIRING FOR FUTURE ELECTRIFICATION

CC106.1 Additional electric infrastructure. All *combustion equipment* and end-uses shall be installed in accordance with this section. Capacity for the future electric circuits required in this

section shall be included in the load calculations of the original installation of electric service to the building, and each *dwelling unit* for R-use buildings or portions thereof.

CC106.1.1 Electric infrastructure for dwelling and sleeping units. *Combustion equipment* and end-uses serving individual *dwelling units* or *sleeping units* shall comply with Section RC104.4.

CC106.1.2 Combustion water heating equipment. Gas-fired or oil-fired water heaters with a capacity less than 300,000 Btu/h (88 kW) shall be installed in accordance with the following:

1. A dedicated 208/240-volt branch circuit with a minimum capacity of 30 amps shall terminate within 3 feet (914 mm) from the water heater and be accessible to the water heater with no obstructions. Both ends of the branch circuit shall be labeled with the words "For Future Heat Pump Water Heater" and be electrically isolated,
2. A condensate drain that is no more than 2 inches (51 mm) higher than the base of the installed water heater and allows natural draining without pump assistance shall be installed within 3 feet (914 mm) of the water heater,
3. The water heater shall be installed in a space with minimum dimensions of 3 feet (914 mm) by 3 feet (914 mm) by 7 feet (2134 mm) high, and
4. The water heater shall be installed in a space with a minimum volume of 700 cubic feet (20,000 L) or the equivalent of one 16-inch (406 mm) by 24-inch (610 mm) grill to a heated space and one 8-inch (203 mm) duct of no more than 10 feet (3048 mm) in length for cool exhaust air.

CC106.1.3 Cooking ranges, ovens and cooktops. An individual branch circuit outlet with a minimum rating of 250-volts, 40-amperes shall be installed within three feet of each gas or propane range or any permanently installed *combustion equipment* oven or cooktop.

Exception: Commercial kitchens for cafeteria, restaurant or commercial catering business use

CC106.1.4 Clothes Dryers. An individual branch circuit outlet with a minimum rating of 250-volts, 30-amperes shall be installed within three feet of each gas or propane clothes dryer.

Exception: commercial drying equipment used for manufacturing and process loads

CC106.1.5 Other *combustion equipment*. *Combustion equipment* not covered by Sections CC106.1.1 and CC106.1.4 and within buildings having average ventilation at full occupancy of 0.5 cfm/sf or less shall be provided with conduit that is continuous between a junction box located within 3 feet (914 mm) of the *appliance* or *equipment* and an electrical panel. The junction box, conduit and bus bar in the electrical panel shall be rated and sized to accommodate a branch circuit with sufficient capacity for an equivalent

electric appliance, equipment or end use with an equivalent equipment capacity. The electrical junction box and electrical panel shall have labels stating, “For future electric equipment”.

CC106.1.6 Other *combustion equipment*, highly ventilated buildings. *Combustion equipment* not covered by Sections CC106.1.1 and CC106.1.4 and within buildings having average ventilation at full occupancy of greater than 0.5 cfm/sf shall comply with Section CC106.1.6.1 through CC106.1.6.5.

CC106.1.6.1 HVAC Design and Installed Associated Electric Service. An all electric HVAC retrofit design shall be prepared by the HVAC engineer for approval by the authority having jurisdiction. The electric service installed with the building shall be sufficient to accommodate the all electric HVAC retrofit design. The contract documents shall show future replacement of *combustion equipment* based HVAC system with an equivalent all electric system. Contract documents shall show *combustion equipment* to be replaced, future electric equipment, supporting electric, structural, and architectural infrastructure to be installed during building construction, and space allotments for future equipment.

CC106.1.6.2 Heating, Ventilation, and Air Conditioning (HVAC) Compatibility. HVAC design shall ensure that air, water, or other systems serviced by *combustion equipment* can also be serviced by future electric retrofit equipment without having to upgrade, alter, or update such systems.

CC106.1.6.3 Equipment Efficiencies. Electric retrofit equipment used for space and water heating shall conform to Section C401.4.3.

CC106.1.6.4 Installed Infrastructure. Infrastructure shall be installed as part of building construction to accommodate future electric retrofit in order to minimize cost and disruption during retrofit. Infrastructure to be installed as part of building construction shall include, but is not limited to, power infrastructure to building to accommodate future electric retrofit system, electric service to future distributed equipment within building, conduits to accommodate controls to future distributed equipment within building, and structural and architectural elements to accommodate future retrofit equipment.

CC106.1.6.5 Space for Future Retrofit Equipment. Interior and exterior space shall be allotted to accommodate all future electric retrofit equipment. Where interior or exterior allotted space exceeds the space used for *combustion equipment* to be replaced, and/or does not correspond to the *combustion equipment* locations to be replaced, such space shall be set aside and may not be used for any other purpose. Signage, labels, and borders shall be used to prominently display areas and limits set aside for future equipment to prevent encroachment.