Massachusetts Stretch Code and Specialized Code for Commercial buildings

(Note: please see 225 CMR 22.00 for low-rise Residential construction)

The Massachusetts Stretch energy code (Stretch Code) first became available for municipal adoption in 2009 as Appendix 110.aa and then 115.aa as part of the building code in 780 CMR. In 2021 the Massachusetts legislature passed new legislation moving authority for updates to the Stretch Code to the Department of Energy Resources and 225 CMR.

This code takes effect on ~~January~~July 1, 2023 and is designed to align with the forthcoming MA 10th edition building code promulgated under 780 CMR. Building permit applications for projects received on or after ~~Jan.~~July 1, 2023 in Stretch Code communities shall comply with this code.

As with the 10th edition building code, this energy code is based on modified versions of the 2021 code books as published by the International Code Council (ICC). Specifically, the 2021 International Energy Conservation Code (IECC 2021) as amended.

This section (225 CMR 23) covers all buildings except for low-rise residential buildings which are covered by 225 CMR 22. 225 CMR 22 and 23 in combination form the Stretch Code – and must be adopted together and not in part.

Municipalities may also elect to adopt the combination of Appendix RC of 225 CMR 22 (Low rise residential) and Appendix CC of 225 CMR 23 (all other buildings) which together form the Municipal Opt-in Specialized code (Specialized Code).

For communities that have adopted the Stretch Code, the following 225 CMR 23 amendments to the IECC 2021 apply together with 225 CMR 22 for low-rise residential buildings.

For communities that adopt the Specialized Code, the following 225 CMR 23 amendments apply in combination with Appendix CC, along with 225 CMR 22 and Appendix RC for low-rise residential buildings.

In both the Stretch Code and the Specialized Code these amendments to the IECC 2021 replace Chapter 13 – Energy Efficiency of 780 CMR in the Base energy code.

Please remember that the Massachusetts amendments posted online are *unofficial versions* that are made available for convenience. Official versions of the Massachusetts amendments may be purchased from the State House Bookstore at www.sec.state.ma.us/spr/ and the IECC 2021 can be purchased from the ICC at www.iccsafe.org

225 CMR 23: MASSACHUSETTS FRONT-END AMENDMENTS TO THE INTERNATIONAL ENERGY CONSERVATION CODE 2021

MASSACHUSETTS STRETCH ENERGY CODE – 2023 Commercial amendments to IECC2021

CHAPTER 1 [CE] SCOPE AND ADMINISTRATION

SECTION C103 CONSTRUCTION DOCUMENTS

C103.2 *Insert after Subsection C103.2(13) the following:*

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 Section 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.

C103.2.2 *Add the following Subsection:*

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 225 CMR 23.00: *Stretch Energy Code.*

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

CHAPTER 2 [CE] DEFINITIONS

SECTION C202 GENERAL DEFINITIONS

C202 *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 (1828mm) of the parking space that is~~ sufficient to ~~for *EVSE*~~ provide 240 volt AC Level 2 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*~~*glazed wall* system typically used to conceal or obscure features of the building structure or used for visual effect. A spandrel ~~beams, column, or the internal construction.~~ 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.~~

THERMAL BRIDGE: 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

C301 *Replace Section C301 as follows:*

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

CHAPTER 4 [CE] COMMERCIAL ENERGY EFFICIENCY

SECTION C401 – GENERAL

C401.2 *Replace 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:

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 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.

C401.2.4 *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.

C401.4 *Add Section C401.4 as follows:*

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~~s sized to~~ systems shall supply 25% of the building's peak space heating and ventilation air heating load ~~shall be~~ at the ASHRAE 99.6% winter climatic design condition. Heat pumps used for space and ventilation air heating shall comply with C401.4.4. ~~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 Heat Pump Primary Operation. Heat pump systems 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 sized to~~ systems 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. ~~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 sized to~~ systems 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. ~~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.~~

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 a solar fraction of 0.4 or larger.

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 Equipment Efficiencies. Heat pump equipment shall conform to the applicable efficiencies in Section C403.3.2.

C401.4.4.2 Multiple Systems. 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 Exhaust Source Heat Pumps. 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.

C402.1.5 *Replace Section C402.1.5 with the following:*

C402.1.5 Component Performance Alternative. ~~Building envelope values~~Above grade wall and fenestration values and areas determined in accordance with C402.1.5.1 or C402.1.5.2 shall be an alternative to compliance with the above grade wall *U*- factors in Table~~s~~ C402.1.4 and vertical fenestration U- factors in Table 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 90.1-2019 Appendix G shall comply with this section. Roofs, below grade walls, floors, slab-on-grade floors, and opaque doors shall comply with the values in Table C402.1.4.

C402.1.5.1 Low Glazed Wall System Buildings~~Non-*curtain wall* 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 ~~meet~~comply with Equation 4-2a and vision ~~so long as~~ glass used in the ~~*curtain wall* sections~~ *glazed wall system* ~~has~~ shall have a maximum whole assembly U factor of U-0.25.

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

where**:**

~~A = Sum of the (UA Dif) values~~

Area-weighted U proposed = U value 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 × Area Proposed.~~

C402.1.5.2 High Glazed Wall System Buildings~~Non *Curtain wall* 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 and vision ~~so long as the~~ glass used in the ~~*curtain wall* sections~~ *glazed wall system* ~~has~~ shall have a maximum whole assembly U factor of U-0.25 and the building complies with Section C401.4.2.

~~A <= Zero~~Area-weighted U proposed <= 0.1600 **(Equation 4-2b)**

where**:**

~~A = Sum of the (UA Dif) values~~

Area-weighted U proposed = U value 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 × Area Proposed.~~

Exception:

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.

C402.2.4.1 *Delete the exception in Subsection C402.2.4.1:*

C402.2.8 *Add Subsection C402.2.8 as follows:*

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.

C402.3 *Replace Section C402.3 with the following:*

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

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

CLIMATE ZONE 5 AND MARINE 4
Vertical fenestration *U*-factor

Fixed fenestration	0.30
Operable fenestration	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.

C402.5 *Replace Section C402.5 with the following:*

C402.5 Air leakage—thermal envelope. The *building thermal envelope* shall comply with Sections C402.5.1 through Section C402.5.10.1.

C402.5.1 *Replace Section C402.5.1 with the following and delete the exception:*

C402.5.1 Air barriers. A continuous *air barrier* shall be provided throughout the *building thermal envelope*. The continuous *air barrier* 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.

C402.5.1.1 *Replace Section C402.5.1.1 with the following:*

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

1. ~~Components~~Materials, assemblies, and systems 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* ~~components~~materials, assemblies, and systems 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 *Renumber Section C402.5.1.1 as Section C402.5.1.2 and make the following changes:*

In Part 3, delete "Joints and seams associated with penetrations shall be sealed in the same manner or taped"

In Part 3, replace "from wind stack effect and mechanical ventilation" *with* "pressure".

In Part 4, replace "C402.5.10" *with* "C402.5.1.2.1".

C402.5.1.2.1 *Add Section C402.5.1.2.1 as follows:*

C402.5.1.2.1 Electrical and communication boxes. Electrical and communication boxes that penetrate the air barrier of the *building thermal envelope*, and that do not comply with C402.5.1.2.1.1, 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.

C402.5.1.2.1.1 *Add Section C402.5.1.2.1.1 as follows:*

C402.5.1.2.1.1 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.

C402.5.1.3 *Delete Section C402.5.1.3*

C402.5.1.4 *Delete Section C402.5.1.4*

C402.5.1.5 *Delete Section C402.5.1.5*

C402.5.2 *Replace Section C402.5.2 with the following:*

C402.5.2 Air leakage compliance. *Air leakage* of the *building thermal envelope* shall be tested by an *approved* third party in accordance with C402.5.2.1. The measured *air leakage* shall not be greater than 0.35 cfm/ft^2 (1.8 L/s × m^2) 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*.

Exceptions:

1. Where the measured *air leakage* rate is greater than 0.35 cfm/ft^2 (1.8 L/s × m^2) but is not greater than 0.45 cfm/ft^2 (2.3 L/s × m^2), 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. All identified leaks shall be sealed where such sealing can be made without damaging existing building components. A report 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. 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/ft^2 (2.3 L/s × m^2), 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/ft^2 (1.4 L/s x m^2) of the *testing unit enclosure area* at a pressure differential of 0.2 inch water gauge (50 Pa).

C402.5.2.1 *Add Section C402.5.2.1 as follows:*

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 ft^2 (1000 m^2) 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 ft^2 (4645 m^2), 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 *Renumber Section C402.5.2 as new Section C402.5.2.2 and make the following changes:*

*Add "*ASTM E3158,*" after "*ASTM E1827*"*

Replace "Units shall be tested separately with an unguarded blower door test as follows:" *with* "Units shall be tested without simultaneously pressurizing adjacent units and shall be separately tested as follows".

*In part 2 add "*a middle floor unit*" between "*including a top floor unit*" and "*a ground floor unit*"*

*In part 2, replace "*two units shall be tested*" with "*three units shall be tested*"*

Add new Part 3 as follows: "Enclosed spaces with not less than one *exterior wall* in the *building thermal envelope* shall be tested in accordance with C402.5.3."

*Add the following exception "*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 *Renumber Section C402.5.1.5 as Section C402.5.2.3 and make the following changes:*

Add "~~Where~~In addition to the requirements of Sections C402.5.2.1 and C402.5.2.2 ~~are not applicable~~" *after* "verification criteria" *and before* "the installation of the continuous *air barrier*".

*In part 2, replace "*components and assemblies*" with "*materials, assemblies, and systems*"*

In part 2, delete "while the air barrier is still accessible for inspection"

In part 2, replace "Sections C402.5.1.3 and C402.5.1.4" *with* "Sections C402.5.2.3.1 or C402.5.2.3.2" *and add* "The air barrier shall remain accessible for inspection and repair"

C402.5.2.3.1 *Renumber Section C402.5.1.3 as new Section C402.5.2.3.1.*

C402.5.2.3.2 *Renumber Section C402.5.1.4 as new Section C402.5.2.3.2.*

C402.5.3 *Renumber Section C402.5.4 as Section C402.5.3 and make the following changes:*

Replace "shall meet the provisions of Table C402.5.4" *with* "shall comply with Table C402.5.3".

*Add "*conducted by an accredited, independent testing laboratory*" between "*Testing shall be*" and "*in accordance with*"*

Replace "reference test standard in C402.5.4 by an accredited, independent testing laboratory" *with* "reference test standard in Table C402.5.3".

*In Exception 1, replace "*C402.5.1*" with "*C402.5.1.2*"*

*In Exception 2, replace "*comply with the testing alternative of Section C402.5*," with "*are tested for air leakage in accordance with Section C402.5.2*"*

*In Exception 2, replace "*Table C402.5.4*" with "*Table C402.5.3*"*

*Relabel "*Table C402.5.4*" to "*Table C402.5.3*"*

C402.5.4 *Renumber Section C402.5.5 as Section C402.5.4 and make the following changes:*

In Part 2.1, delete "Table C402.1.3 or".

*In Part 2.2 replace "*Section C402.5.1.1*" with "*Section C402.5.1.2*".*

*In Part 2.4 replace "*Water lines*" with "*Piping serving as part of a heating or cooling system*".*

***C402.5.5** Renumber Section C402.5.6 as Section C402.5.5 and make the following changes:*

Replace "Section C402.5.4" *with* "Section C402.5.3".

***C402.5.6** Renumber Section C402.5.7 as Section C402.5.6.*

***C402.5.7** Renumber Section C402.5.8 as C402.5.7 and make the following changes:*

Replace "infiltration" *with* "air leakage".

***C402.5.8** Renumber Section C402.5.9 as Section C402.5.8 and make the following changes:*

***C402.5.9** Renumber Section C402.5.10 as Section C402.5.9.*

*In part 2 replace "*more" *with* "greater"

*In part 2 replace "*when" *with* "where"

***C402.5.10** Renumber Section C402.5.11 as Section C402.5.10 and make the following changes:*

*Replace "*and lower the heating setpoint to 55°F (13°C)" *with* "and lower the heating setpoint to 50°F (10°C)"

In Exception 1, add "operable openings into" before "separately-zoned areas"

In Exception 2, replace "warehouses" with "storage occupancies"

In Exception 3, revise to read: "Doors located in the exterior wall that are part of a vestibule system".

*Add new Exception 4, "*Operable openings used as part of a designed system for natural ventilation."

***C402.5.10.1** Renumber Section C402.5.11.1 as Section C402.5.10.1*

***C402.6** Add Section C402.6 as follows:*

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

C402.7 *Add Section C402.7 and subsections as follows:*

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 the effect of *thermal bridges* according to both C402.7.2 and C402.7.3. In addition, the thermal resistance of ~~opaque~~ *spandrel sections* within ~~*curtain*~~*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 Section~~Table~~ 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 ~~connections~~fasteners through the continuous insulation.

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

$R_{derated} = R_o$ x Derating Factor (Equation C402.7.2.1)

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 = 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 veneer anchor~~sed to the building with 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 a derating factor per Table 402.7.2.1.2

Table 402.7.2.1.2 Cladding System Derating Factors

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 have~~fasteners having thermal breaks ~~having~~which have a conductivity of 3 Btu-in/hr-ft^2-F or less on both ends of the ~~clip~~fastener are used to support external cladding, use Derating Factor of 0.8.

C402.7.2.2. ~~Modelled~~Reference Derating. Use ~~two or three-dimensional finite element analysis heat transfer model to calculate derated value. 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~~.~~ at https://www.bchydro.com

C402.7.2.3. Modelled 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.

C402.7.3. Linear Thermal Bridges. In addition to derating per Section C402.7.2, installed vertical ~~Installed~~ wall ~~and roof~~ insulation U values shall be ~~derated~~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.

$$U_{derated} = \frac{PSI * Length}{A_{total}} + U_o \qquad \text{(Equation C402.7.3)}$$

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

Table C402.7.3.1 Linear Thermal Bridge Prescriptive PSI values.

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

Table C402.7.4.1 Spandrel Section Default R values

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

~~$R = R_o \; x \; 2.95 \; x \; R_o^{-0.9}$ (Equation C402.7.4.1)~~

~~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*.~~

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.

C403.5 *Modify Section C403.5 as follows*

*Add "*Dedicated outside air systems*" as Item 4 of the list of where air or water economizers shall be provided.*

Delete exception 5 and renumber subsequent exceptions to reflect deletion.

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

Table C403.5(2). *Delete this table*

~~***C403.7*** *Replace Section C403.7 with the following:*~~

~~***C403.7 Ventilation and exhaust systems***~~

~~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 C403.7.8.~~

~~***C403.7.1*** *Replace Section C403.7.1 with the following:*~~

~~**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.~~

~~***C403.7.2** Renumber Section C403.7.1 as Section C403.7.2 and make the following changes:*~~
~~*In exception 1, replace "*Section C403.7.4.2*" with "*Section C403.7.5.2*"*~~

~~***C403.7.3** Renumber Section C403.7.2 as Section C403.7.3*~~

~~***C403.7.4** Renumber Section C403.7.3 as Section C403.7.4*~~
***C403.7.4** Replace Subsection C403.7.4 with the following:*

C403.7.4 Energy Recovery Systems. Energy recovery ventilation systems shall be provided as specified in Section C403.7.4.1, as applicable and C403.7.4.2.

~~***C403.7.4.1** Reserve this section:*~~

~~**C403.7.4.1 Nontransient Dwelling Units.** Reserved.~~
C403.7.4.1 *Modify Section C403.7.4.1 as follows:*

*Replace "*not less than 60 percent at heating design condition.*" with "*not less than 75 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."

Delete all the exceptions (exceptions 1 through 4).

~~***C403.7.4.2** Reserve this section:*~~

~~**C403.7.4.2 Spaces other than nontransient dwelling units.** Reserved~~

C403.7.4.2 *Modify Section C403.7.4.2 as follows:*

*Replace "*The energy recovery system shall provide an enthalpy recovery ratio of not less than 50% at design conditions" *with* "The energy recovery system shall result in either 1 or 2, as applicable*"*

Add 1 and 2 as follows

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 + …]

Delete exceptions 2 (including 2.1 and 2.2), 4, 5, 6, 7, and 8

Renumber exception 3 as exception 2

Renumber exception 9 as exception 3 and change from "20 hours per week" to "10 hours per week

Renumber exception 10 as exception 4

Renumber exception 11 as exception 5

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	PERCENT (%) OUTDOOR AIR AT FULL DESIGN AIRFLOW RATE

Zone	>=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	10,000	8,000	2,750	0	0	0	0	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	0	0	0	0	0	0	0	0

~~***C403.7.5** Renumber Section C403.7.4 as Section C403.7.5 and make the following changes:*~~

~~*Replace* "as specified in either Section C403.7.4.1 or C403.7.4.2" *with* "as specified in Section C403.7.5.1, as applicable, and C403.7.5.2".~~

~~***C403.7.5.1** Renumber Section C403.7.4.1 as new Section C403.7.5.1 and make the following changes:*~~

~~*Replace* "50 percent at cooling design condition and not less than 60 percent at heating design condition" *with* "75 percent at heating design condition".~~

~~*Add new sentence after* "heating design condition." *as follows:* "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"~~

~~*Delete all the exceptions*~~

~~***C403.7.5.2** Add Section C403.7.5.2 as follows:*~~

~~**C403.7.5.2 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.

(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:

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

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%~~

~~***C403.7.6** Renumber Section C403.7.5 as Section C403.7.6 and make the following changes:*~~

~~*Replace* "Each hood shall have a maximum exhaust rate as specified in Table C403.7.5 and shall comply with one of the following:" *with* "Each hood shall have a maximum exhaust rate as specified in Table C403.7.6 and shall comply with two of the following"~~

~~*Relabel* "Table C403.7.5" *to* "Table C403.7.6"~~

~~***C403.7.6.1** Reserve this section:*~~

~~**C403.7.6.1 Temperature setpoint controls.** Reserved~~

~~***C403.7.6.2** Reserve this section:*~~

~~**C403.7.6.2 Ventilation controls.** Reserved~~

~~***C403.7.7** Renumber Section C403.7.6 as Section C403.7.7 and make the following changes:~~

~~*Relabel "Section C403.7.6.1" as "Section C403.7.7.1"*~~
~~*Relabel "Section C403.7.6.2" as "Section C403.7.7.2"*~~

~~***C403.7.7.1** Renumber Section C403.7.6.1 to create new Section C403.7.7.1*~~

~~***C403.7.7.2** Renumber Section C403.7.6.2 to create new Section C403.7.7.2*~~

~~***C403.7.8** Renumber Section C403.7.7 to create new Section C403.7.8*~~

C405.2.4 *Modify Section C405.2.4 as follows*

In item 1, replace "150 watts" *with* "100 watts"
In item 3, replace "150 watts" *with* "100 watts"

C405.13 *Add Section C405.13 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 or more spaces providing Level 3 Direct Current EVSE~~with 4 or more spaces providing installed 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 *Add Section C405.13.1 as follows:*

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 *Add Section C405.13.2 as follows:*

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*.

C406.1 *Modify Section C406.1 as follows:*

Replace "shall achieve a total of 10 credits" *with* "shall achieve a total of 15 credits"

Table C406.1(1) *Modify Table C406.1(1) as follows:*

Delete rows for C406.2.1: 5% heating efficiency improvement and C406.7.3: Efficient fossil fuel water heater
Replace row for option C406.2.3: 10% heating efficiency improvement with the following:

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

Add the following row for option C406.1~~2~~3:

Section	Climate Zone 5A
C406.1~~2~~3 Heavy Timber Construction	8

Table C406.1(2) *Modify Table C406.1(2) as follows:*

Delete rows for C406.2.1: 5% heating efficiency improvement and C406.7.3: Efficient fossil fuel water heater
Replace row for option C406.2.3: 10% heating efficiency improvement with the following:

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

Add the following row for option C406.1~~2~~3:

Section	Climate Zone 5A
C406.1~~2~~3 Heavy Timber Construction	8

Table C406.1(3) *Modify Table C406.1(3) as follows:*

Delete rows for C406.2.1: 5% heating efficiency improvement and C406.7.3: Efficient fossil fuel water heater
Replace row for option C406.2.3: 10% heating efficiency improvement with the following:

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

Add the following row for option C406.1~~2~~3:

Section	Climate Zone 5A
C406.1~~2~~3 Heavy Timber Construction	8

Table C406.1(4) *Modify Table C406.1(4) as follows:*

Delete rows for C406.2.1: 5% heating efficiency improvement and C406.7.3: Efficient fossil fuel water heater
Replace row for option C406.2.3: 10% heating efficiency improvement with the following:

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

Add the following row for option C406.1~~2~~3:

Section	Climate Zone 5A
C406.1~~2~~3 Heavy Timber Construction	8

Table C406.1(5) *Modify Table C406.1(5) as follows:*

Delete rows for C406.2.1: 5% heating efficiency improvement and C406.7.3: Efficient fossil fuel water heater
Replace row for option C406.2.3: 10% heating efficiency improvement with the following:

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

Add the following row for option C406.1~~2~~3:

Section	Climate Zone 5A
C406.1~~2~~3 Heavy Timber Construction	8

C406.1.1 *Modify Section C406.1.1 as follows:*

Replace "minimum number of 5 credits" *with* "minimum number of 10 credits"

C406.2.1 *Delete this section*

C406.2.3 *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.

C406.7.3 *Delete this section*

C406.9 *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*.

C406.1~~2~~3 *Add Section C406.1~~2~~3 as follows:*

C406.1~~2~~3 Heavy Timber construction. ~~In~~For buildings with 4 stories or more of Type IV heavy timber construction either above grade, or above a podium.

C407 *Replace Section C407 in its entirety with the following:*

C407.1 Targeted Performance
This option requires compliance with Sections C407.1.1 through C407.1.2.

C407.1.1 Compliance. Buildings shall comply with Sections C407.1.1~~2~~.1 through C407.1.1.6~~2.4~~

C407.1.1~~2~~.1 Building performance modeling
Building performance modeling shall be used to show compliance with C407.1.1.5~~2.3~~. 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 and meet the requirements~~. Performance modeling shall be conducted~~ in ~~accordance with~~ ANSI/ASHRAE/IESNA 90.1-2019 Appendix G Section G2.2.1(a)-(d) and~~,~~ ~~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.~~2.2~~1.4 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.~~2.3~~1.5 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.~~ 2.3~~1.5

Table C407.1.~~ 2.3~~1.5 Thermal Energy Demand Intensity (TEDI) Limits

Use Type	Heating TEDI (kBtu/sf-yr)	Cooling TEDI (kBtu/sf-yr)
Office~~, courthouse~~, fire station, library, police station, post office, town hall >= 1~~00~~25,000-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~~, courthouse~~, fire station, library, police station, post office, town hall ~~< 100,000-sf~~<= 75,000-sf	2.5	21
K-12 School >= 1~~00~~25,000-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-sf~~<= 75,000-sf	2.4	20
Residential multifamily and dormitory >= 1~~00~~25,000-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-sf~~<= 75,000-sf	3.2	15
All other >= 1~~00~~25,000-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-sf~~<= 75,000-sf	2.5	21

C407.1.~~ 2.4~~1.6 Mixed use buildings For buildings having more than one use type where any use type is more than 10% of the total space conditioned aera, each separate use type having more than

10% of the total space conditioned area shall separately and individually show compliance with C407.1.~~2.3~~1.5 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.~~2.3~~1.5 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 the 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 of 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.

ANSI/ASHRAE/IESNA 90.1-2019 Section 4.2 *Replace 4.2.1.1 with the 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
where:
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)

ANSI/ASHRAE/IESNA 90.1-2019 Section 4.2 *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 C407.2.2.3~~ Modification to ANSI/ASHRAE/IESNA 90.1-2019 Appendix G

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"*

ANSI/ASHRAE/IESNA 90.1-2019 Appendix G *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.

ANSI/ASHRAE/IESNA 90.1-2019 Appendix G *Delete G1.3.2 Part m and Part p*

ANSI/ASHRAE/IESNA 90.1-2019 Appendix G *Delete G2.1 Part c*

ANSI/ASHRAE/IESNA 90.1-2019 Appendix G *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.

ANSI/ASHRAE/IESNA 90.1-2019 Appendix G *Delete G2.4.2*

~~G3.1.1.4 air infiltration~~

ANSI/ASHRAE/IESNA 90.1-2019 Appendix G *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. ~~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 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.

~~**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~~

C407.3.2.2 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;
    c. Evidence of project registration from 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 items 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.

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

Building Energy Sources	Maximum HERS Index score[a]		
	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. 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.

~~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".~~

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. 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

~~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.~~
~~3. 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

C501.2 *Delete the exception*

C502.1 *Revise Section C502.1 as follows:*

*Add the following first sentence "*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."

C502.2 *Revise Section C502.2 as follows:*

Remove both exceptions

C503.1 *Revise Section C503.1 as follows:*

*Replace "*the requirements of Section C503*" with "*the requirements of Sections C503, C402, C403, C404, and C405"

Replace Exception 3 with "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."

C505.1 *Revise Section C505.1 as follows:*

*Replace "*this code" *with "*Sections C401.3, C402 through C406, and Section C408"

Appendix CB *Adopt unamended*

APPENDIX CB: SOLAR-READY ZONE – COMMERCIAL.

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

CC101.1 *Replace Section CC101 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 *Replace Section CC101.2 as follows:*

CC101.2 Scope. This appendix applies to new buildings that are addressed by the Municipal Opt-in Specialized Code. The Specialized Code maintains the energy efficiency requirements of the Stretch Code for all building types except multi-family. CC103 lays out the additional clean energy requirements for all building types.
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.
3) New R-use buildings less than or equal to 12,000 square feet in conditioned floor area shall comply with Residential Appendix RC.

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~~3 *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 the following definitions:*

~~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*.

POTENTIAL SOLAR ZONE AREA. The combined area of any flat roofs, or 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.

ZERO ENERGY BUILDING. A building which through a combination of highly energy efficient~~tcy~~ 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.

CC102 *Delete the definitions for:Adjusted off-site renewable energy, zero energy performance index (ZEPI PB/EE)*

SECTION CC103 ZERO ENERGY PATHWAY MINIMUM RENEWABLE ENERGY

CC103.1 *Modify Section CC103.1 as follows (keeping Table CC103.1 unchanged):*

*Delete "*or off-site renewable energy shall be procured"

Equation CC-1 *Replace Equation CC-1 with the following:*

$$REonsite \geq Ebuilding \qquad \text{(Equation CC-1)}$$

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 *Modify Section CC103.2 as follows:*

*After "*approved by the code official*" add "*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 this section*

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~~sized 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 RC105.3.1 through RC105.3.3

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 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 RC104.3 Electric Readiness.

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 the building to accommodate future electric retrofit system, electric service to future distributed equipment within the building, conduits to accommodate controls to future distributed equipment within the 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.

REGULATORY AUTHORITY:

M.G.L. Ch. 25A, Sec. 6; St. 2021, Ch. 8.