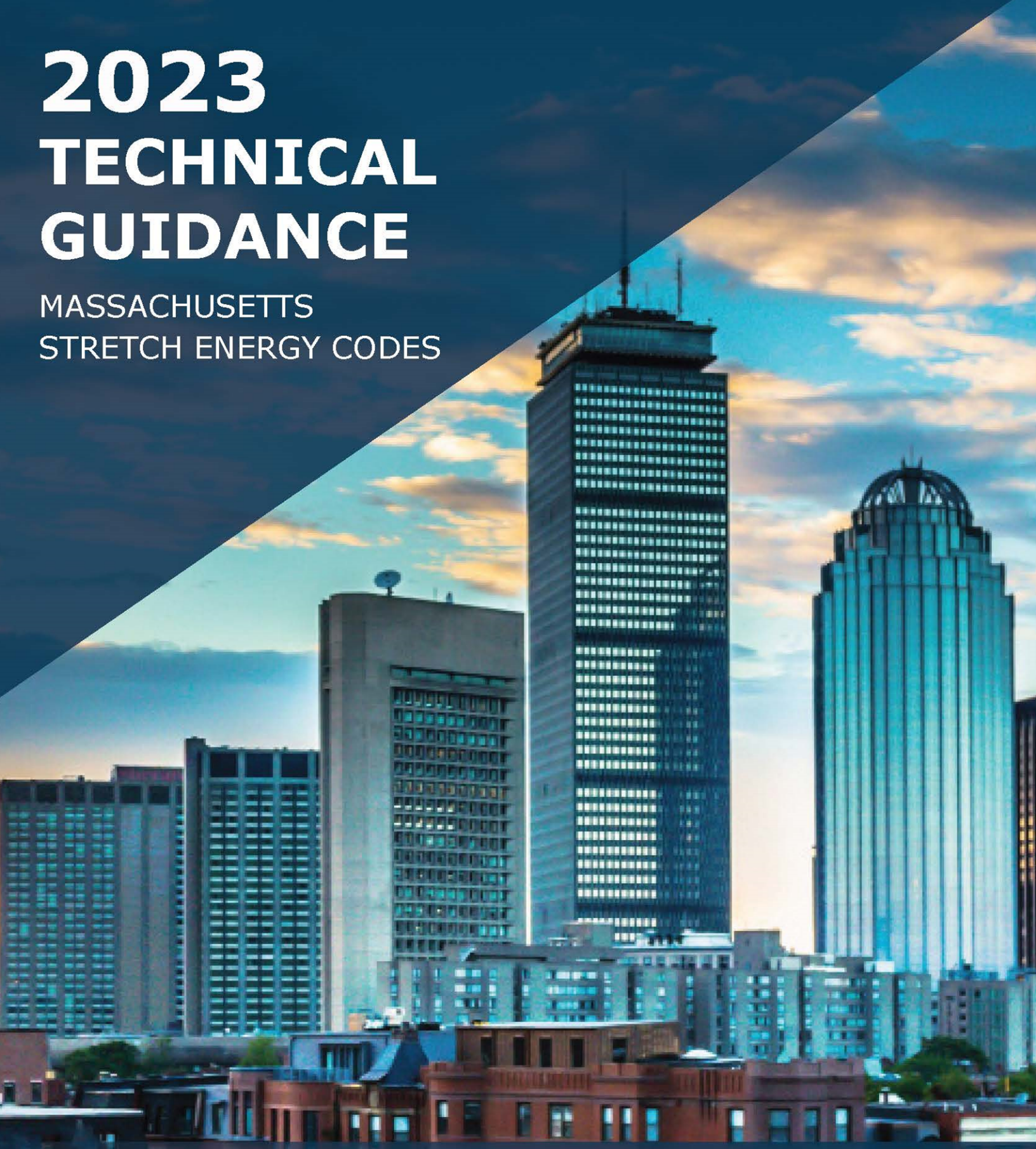
2023 TECHNICAL GUIDANCE

MASSACHUSETTS STRETCH ENERGY CODES



DOER
Massachusetts Department of Energy Resources

A reference and instructional guide for **Massachusetts Energy Stretch and Specialized Codes**

About this Guide

This guide is intended to help building officials, designers, builders, and industry professionals become more familiar with the 2023 Stretch and Specialized Codes portions of the Massachusetts Energy Codes.

The guide provides information about major revisions and additions to the Stretch and Specialized Codes in 2023, navigating compliance pathways, and application guidance for successful compliance and realized energy savings.

Massachusetts Department of Energy Resources' Energy Efficiency Division develops, implements, and oversees energy efficiency activities in the Commonwealth in conjunction with other state and federal agencies.

To learn more, visit https://www.mass.gov/orgs/energy-efficiency-division

Contact the Department of Energy Resources at stretchcode@mass.gov

DRAFT FOR PUBLIC COMMENT, DECEMBER 2022

Team

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Introduction

Overview

Model energy codes, such as the International Energy Conservation Code (IECC), are developed through a consensus process with industry experts and stakeholders. Massachusetts' energy codes are based on the 2021 edition of the IECC, a part of the I-Codes from the International Code Council (ICC). Additionally, portions of ASHRAE Standard 90.1-2019 are included by reference.

Stretch energy codes have been in place in Massachusetts for over a decade. Now overseen by the Department of Energy Resources (DOER), 225 CMR 22.00 (Residential) and 225 CMR 23.00 (Commercial) mirror the model code's division of residential and commercial chapters. New this code cycle, adopting jurisdictions have a Specialized Opt-in Code available, providing additional requirements for renewable energy generation and electric readiness as well as some additional energy efficiency.

The official Stretch and Specialized Codes can be found at the Massachusetts Bookstore. These documents show where the IECC code is amended for use in Massachusetts.
Unofficial copies of the front-end amendments for residential and commercial portions of the energy code are available for reference in PDF format on the DOER website.

Additional Information

How to Use This Guide

Visual cues have been used throughout this guide to aid navigation the content of this guide. Look for these color-coded icons and boxes with helpful context, additional information and calculation support.

 Additional Information

 Important Information

 Illustrations

 FAQ about Example Scenarios

 Example Calculations

Additional Information

The 2021 IECC will be amended to create the Massachusetts 10th edition IECC 2021 (Base Energy Code.) The MA Stretch Code and Specialized Opt-in Code further amend the IECC 2021.

2021 International Energy Conservation Code (IECC) BASIC

This resource is read-only; code sections are at the left of the page. Various paid versions of 2021 IECC (with commentary, for example) are available at the ICC Bookstore.

Tenth Edition Base Code (2021 IECC with MA amendments) for commercial and residential are adopted by the Massachusetts Board of Building Regulations and Standards (BBRS), and once finalized can be found at the Massachusetts Bookstore.
Redline for residential and commercial portions as currently proposed is available for reference on the BBRS website.

How Overlay Energy Codes Work

Each Municipality in the Commonwealth can adopt one of three levels of building energy code; the MA Base Energy Code, Stretch Code or Specialized Code.

a) Base Energy Code: By default, a municipality is on the Base energy code, which requires compliance with the 2021 IECC model code combined with the BBRS amendments in the 780

CMR building code regulations to create the Massachusetts Base Energy Code. Municipalities that remain on the Base Energy Code, refer to requirements in this code.

b) Stretch Code: Many municipalities in Massachusetts have previously voted to adopt the Stretch Code as their energy code, since it has been available since 2010. The updated Stretch code makes significant amendments to the IECC 2021 energy code with a focus on cost-effective energy efficiency. Where the Stretch Code is adopted, these requirements must be met in addition to the Base Energy Code.

c) Specialized Code: The newest option is the Specialized Opt-In Code (Specialized Code) which is focused on achieving net zero buildings in alignment with the Commonwealth's 2050 required emissions reductions. As the Specialized Code is newly available in December 2022 it will require an affirmative vote to adopt at the city or town level. Where adopted the Specialized Code requires additional measures to reduce greenhouse gas emissions and make buildings ready for a clean energy future, in addition to the energy efficiency requirements in the Base and Stretch Codes.

Project teams will need to determine which of the three energy code options is adopted in the municipality where the permit application will be filed to ascertain requirements that apply to the project.

Illustration

Additional Information

Projects must confirm the applicable code because jurisdictions can adopt any of the Massachusetts Energy Code versions (Base, Stretch, Specialized.) The following resource, maintained by the State, can help you determine which code has been adopted by each jurisdiction. It is still recommended that permit applicants confirm locally, with the Authority Having Jurisdiction, which code applies.

Stretch Code Adoption, by Community | Mass.gov

If you are a City or Town in Massachusetts(Authority Having Jurisdiction) intending to update your energy code, model language for municipal adoption for Stretch and Specialized codes can be found at the Specialized Energy Code Adoption Process website.

What's New for the 2023 Code Cycle – PLACEHOLDER for a short 3-5 page summary (based on the current DOER energy code summary document)

Important Information

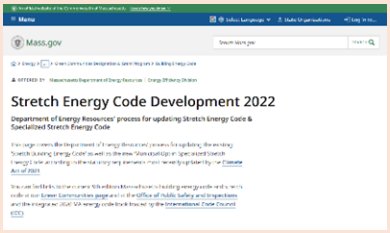
Questions about this code can be directed to the Department of Energy Resources.

Compliance Resources

Important Information

Compliance Resources
Many resources available to answer questions and assist with demonstrate compliance.

Department of Energy Resources (DOER)



MA Energy Code Development website has additional information about code development updates.

Summary: This high-level summary covers major requirements in the Stretch and Specialized Codes. https://www.mass.gov/doc/commercial-and-other-stretch-energy-code-and-specialized-opt-in-code-language/download

Checklists
Informational Appendix B includes checklists to track and document compliance.

Mass Save

The Mass Save collaborative is a rate-payer funded partnership among local electric and natural gas utilities and energy efficiency service providers to provide energy expertise and incentives to residents and businesses across Massachusetts.
Energy code questions? Call 1-855-757-9717 or email energycodesma@psdconsulting.com

Training
Building energy code compliance training sessions are available here:
https://www.masssave.com/learn/partners/energy-code-training-and-events

Commercial & High-rise Multi-family Stretch & Specialized Code Measures

This chapter applies to all nonresidential occupancies and *Group-R* occupancies not defined as *Residential Buildings* by section R202 in MA 10th edition IECC 2021. That is, all buildings other than detached one- and two-family dwellings, townhouses and Group R-2, R-3, and R-4 buildings three stories or less in height above grade are within the scope of the Commercial chapters.

The guidance in this chapter applies to projects that will permit within an Authority Having Jurisdiction that has adopted the MA Stretch Code and those that have adopted the Specialized Code. As explained earlier in this Guideline, projects subject to the Specialized Code must meet requirements of the Stretch code and additional requirements from Appendix CC. These additional requirements for the Specialized Code only are included in the next chapter.

Additional Information

The State has published resources to help users easily identify code updates and requirements.

Front-end amendments: This "clean" version of the Commercial Stretch and Specialized Codes highlights only the Massachusetts amendments to the 2021 IECC, and so should be read together with the IECC. https://www.mass.gov/doc/225-cmr-22-ma-commercial-front-end-amend-clean-december-8-

2022/download A redline version is also available that shows changes to the first public comment draft from June 2022.
Summary: This high-level summary covers major requirements in the Stretch and Specialized Codes. https://www.mass.gov/doc/commercial-and-other-stretch-energy-code-and-specialized-opt-in-code-language/download

Stretch and Specialized Codes: Stretch Code and Specialized Code (225 CMR 22.00 and 23.00) are final regulations. Residential Stretch Code is effective January 1, 2023, and Commercial Stretch Code is effective July 1, 2023. For both, effective dates apply to ALL projects with permits pulled on or after the effective date. The Specialized Code is available for adoption beginning on final promulgation date of December 23, 2022.

Some of the new requirements in the Stretch and Specialized codes are relatively straightforward and will not be discussed in detail in this Technical Guidance Document. See the table below for a summary of changes that will not be further discussed. This table does not include a comprehensive list of all code updates, refer to the code language to view all updates.

Code Section	Summary of Measure
C103.2	Adds documentation requirements for Solar Ready, EV Ready Spaces, ventilation rate for Relative Performance (see Additional Information for more guidance), and Mixed-Fuel systems' plans for electrification for the Specialized Code. Clarification of COMcheck submittal documentation.
C202	Adds definitions for All-Electric Building, Automatic Load Management System, Class 3 Exhaust, Class 4 Exhaust, Clean Biomass Heating System, Combustion Equipment, Glazed Wall System, Dedicated Outdoor Air System, Electric Vehicle, Electric Vehicle Ready Parking Space, Enthalpy Recovery Ratio, Exempt Exhaust, Fuel Gas, Fuel Oil, Mixed-Fuel Building, Other Exhaust, Sensible Energy Recovery Ratio, Spandrel Section, Thermal Bridge
C402.2.4.1	Insulation Installation, Delete C402.2.4.1 Exception
C402.2.8	New section listing specifications for fireplaces.
C402.4	Lowers fixed and operable U-factors and makes performance documentation explicit for all fenestration.
C402.6	Approved Calculation Software Tools, Allows MA Stretch COMcheck
C405.2	Lowers existing threshold requiring controls in daylight zones to 100W.
Appendix CB	Solar-Ready Zone – Commercial, included without modification

Simple code measures that don't require further explanation. Refer to code for specific requirements.

Chapter 3 Construction Documents

C103.2 Information on construction documents

Highlights. Adds new documentation requirements for high ventilation buildings and mixed fuel buildings following Appendix CC.

Compliance. Section C103.2 is required for all compliance paths, including the Specialized Code. High ventilation buildings and mixed fuel buildings now have additional information which needs to be supplied in the construction documents.

Summary.

C103.2 #16: High Ventilation Exception Documentation Requirements

Buildings using the Relative Performance pathway due to average ventilation at full occupancy exceeding 0.5 CFM/ft^2 as allowed in C401.2.1 #2, must submit the supporting information described below at building permitting including the following as required in C103.2(16):

i. Mechanical equipment schedules showing all new and/or existing air handling equipment designed to supply any quantity of outdoor air to the space indicating the total design outdoor airflow for each unit.
ii. An airflow riser diagram encompassing the complete project boundary, including all supply, exhaust, and return air systems serving the spaces.
iii. Calculations showing the total outdoor air supplied by each unit, the project *conditioned and semiheated floor area*, and the overall flow rate per area in cfm/sf using Equation 1 below

$$Average\ Ventilation\ Rate\ [\frac{CFM}{ft^2}] = \frac{\sum Design\ Outdoor\ Air\ Flow\ [CFM]}{Conditioned\ Floor\ Area\ [ft^2]} \qquad \textit{Equation 1}$$

PLACEHOLDER FOR C103.2 #17 SUMMARY

SIDEBAR: Walk through a compliance scenario

Example 1. A school projects is at the schematic design development stage and mechanical ventilation is not yet specified. Design team uses the calculations below, based on the ventilation rates and occupancy prescribed in ASHRAE 62.1, to determine whether the project qualifies for the Relative Performance pathway (C401.2.1, Part 3) on account of ventilation. Based on the calculations, the average ventilation rate at full occupancy is 0.38 CFM/SF threshold. Since this is less than 0.5 CFM/SF threshold, project does not qualify for the Relative Performance pathway (C407.2) and must use the Targeted Performance pathway (C407.2).

Occupancy Category	Floor Area	People Outdoor Air Rate	Area Outdoor Air Rate	Default Occupant Density	Ventilation	
Units	SF	CFM/Person	CFM/SF	#/1000 SF	CFM	CFM/ SF
Source of Information	**From Drawings**	**From ASHRAE 62.1 Table 6-1**			**Calculated**	
	A	B	C	D	E=A*C+A*B*D/1000	F=E/A
Classrooms (age 9 plus)	65,000	10	0.12	35	30,550	0.47
Media center	5,000	10	0.12	25	1,850	0.37
Science laboratories	5,000	10	0.18	25	2,150	0.43
Computer lab	7,500	10	0.12	25	2,775	0.37
Corridors	17,500		0.06		1,050	0.06
Total	**100,000**				**38,375**	**0.38**

Example 2 Based on mechanical equipment schedules and air-flow riser diagram included in the submittal, a veterinary office has average ventilation rate at full occupancy over 0.5 CFM/SF. The associated calculations (below) are included in the submittal package. The project may document compliance using the Relative Performance pathway in lieu of Targeted Performance on account of high ventilation rate.

Occupancy Category	Floor Area	Outdoor Air	Ventilation Rate
Units	SF	CFM	CFM/SF
Source of Information	**From Construction Documents**		**Calculated**
Animal exam rooms	16,000	10000	0.625
Animal procedure rooms	20,000	11000	0.55
Administrative offices	5,000	700	0.14
Waiting rooms	1,000	700	0.7
Corridors	500	50	0.1
Total	**42,500**	**22,450**	**0.53**

Chapter 4 Commercial Energy Efficiency

Existing buildings projects should begin in Chapter 5 before proceeding to Chapter 4.

C401.2 Application.

Highlights. Compliance with the commercial requirements has been revised to incorporate new compliance pathways, including Prescriptive, Targeted Performance, Relative Performance, and Certified Performance.

Additional Information

New Compliance Pathway Terms (more detail below)

Prescriptive (based on IECC 2021)

Reserved for nonresidential buildings not larger than 20,000ft^2. A nonresidential space within a mixed-use building also could use this path.

Targeted Performance (TEDI)
Dormitories, fire stations, libraries, offices, schools, police stations, post offices, and town halls over 20,000ft^2 and having average ventilation at full occupancy of 0.5 cfm/sf or less are required to use Targeted Performance. After 1 July 2024, residential buildings over 12,000-sf, or portions of buildings which have residential use over 12,000-sf, are required to use Targeted Performance.

Relative Performance (based on ASHRAE 90.1 Appendix G)
Buildings not required to use Targeted Performance Compliance are permitted to use Relative Performance.

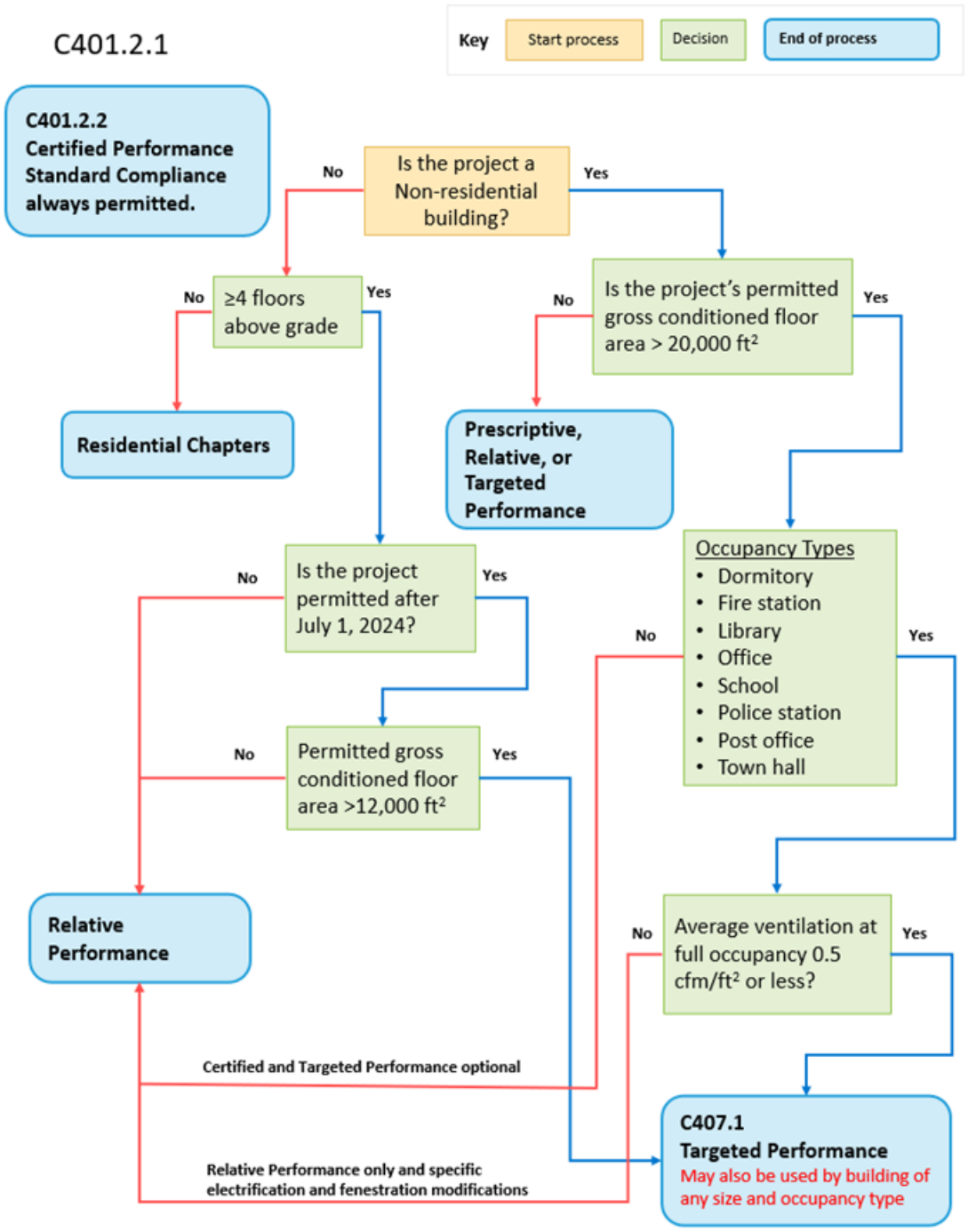
Certified Performance (Passive House or HERS)
There are two means of Certified Performance:

- **Passive House Compliance.** All buildings or spaces in buildings are permitted to use Passive House Compliance.
- **HERS Compliance.** All Group R buildings and Group R spaces in buildings with multiple dwelling units are permitted to use HERS Compliance.

Compliance. Section C401 is required for all compliance paths, including the Specialized Code, except as further modified by the Specialized Code.

Summary. For the purposes of this section, all buildings are *commercial*. The general term "residential" includes *Group R* buildings, as defined by IECC and "nonresidential" is all other construction. For core-and-shell buildings, each tenant fit-out within the building, when constructed for the first time must also show compliance as new construction within the host building. For new mixed-use buildings, each use space must follow the compliance paths and requirements for that respective space, *per* C401.2.4.

The flowchart will help determine which compliance paths are available, in addition to the descriptions below:



Prescriptive Compliance:

The prescriptive compliance path is reserved for nonresidential buildings not larger than 20,000ft^2 or portions of space within a mixed-use building less than 20,000-sf as allowed by C402.1.4. Prescriptive compliance requires a thermal envelope certificate *per* C401.3 (unchanged from IECC), the prescriptive requirements in C402 though C406, and maintenance and commissioning *per* C408 (unchanged from IECC).

Targeted Performance Compliance:
Dormitories, fire stations, libraries, offices, schools, police stations, post offices, and town halls, or portions thereof when following C401.2.4, over 20,000ft^2 and having average ventilation at full occupancy of 0.5 cfm/sf or less are required to use Targeted Performance. Starting 1 July 2024, residential buildings over 12,000-sf, or portions of buildings which have residential use over 12,000-sf, are required to use Targeted Performance, unless complying using Certified Performance *per* C401.2.2.

Buildings having average ventilation at full occupancy of more than 0.5 cfm/sf may use Relative Performance path instead of Targeted Performance path. To qualify for this, requisite documentation showing a completed ventilation system design per C103.2, item 16 is required to be produced at the time of permitting. If the building does not have a completed ventilation design and cannot produce documentation per C103.2 at the time of permitting, even if the project intends to include high ventilation uses in the future, then the building shall show compliance using Targeted Performance.

Other building types of any size are permitted to use Targeted Performance. Residential buildings permitting before 1 July 2024 as also permitted to use Targeted Performance.

This path requires a thermal envelope certificate *per* C401.3 (unchanged from IECC), the prescriptive requirements in C402 though C406, C407.1, and maintenance and commissioning *per* C408 (unchanged from IECC), and sections of ASHRAE Standard 90.1-2019 Appendix G as described in C407.1. Review C407.1 before beginning planning for this compliance path. This path includes compliance with improved Thermal Energy Demand Intensity (TEDI) requirements. Additional guidance regarding TEDI calculations is provided in this Guideline.

Relative Performance Compliance:
Only buildings not otherwise required to use Targeted Performance Compliance may use Relative Performance. This path requires a thermal envelope certificate *per* C401.3 (unchanged from IECC), C402.1.5, C402.2.8, C402.3 through C402.7, C405.2.4, C405.13, C406, C407.2, and maintenance and commissioning *per* C408 (unchanged from IECC), and Standard 90.1-2019 Appendix G, as modified by C407.2. Review C407.2 before beginning planning for this compliance path.

As noted above, there are additional construction documents required by C103.2 when following this path for buildings with completed ventilation designs having an average ventilation rate greater than 0.5 cfm/ft^2.

Certified Performance Standard Compliance:
Certified Performance, generally, provides deemed-to-comply options, leveraging the professional guidance and quality assurance of national programs. Documentation, solar ready, electric vehicle charging, and commissioning are added to the base certification. There are two means of Certified Performance, as follows:

> **Passive House Compliance.** All buildings or spaces in buildings are permitted to use Passive House Compliance. This path requires a thermal envelope certificate *per* C401.3 (unchanged from IECC), C402.3, C405, C407.3, and maintenance and commissioning *per* C408 (unchanged from IECC).

HERS Compliance. All Group R buildings and Group R spaces in buildings with multiple dwelling units are permitted to use HERS Compliance. This path requires a thermal envelope certificate *per* C401.3 (unchanged from IECC), C402.3, C405, C407.4, and maintenance and commissioning *per* C408 (unchanged from IECC).

The table below illustrates the IECC amended sections that apply for each code compliance pathway (besides the prescriptive path where all apply):

Code Requirements		C407.1 Targeted Performance	C407.2 Relative Performance	C407.3 Passive House	C407.4 HERS
C401.3 Thermal envelope certification Requirement to post thermal envelope certificate with the key performance characteristics of the opaque envelope and fenestration and air leakage testing results.		Yes	Yes	Yes	Yes
C401.4.1 Partial Space Heating Electrification		No	Yes	No	No
C401.4.2 Full Space Heating Electrification		Note 1	Note 1	No	No
C402 Building Envelope Requirements	**C402.1.5** Component Performance Alternative Maximum area-weighted U-factor of the opaque above-grade walls and the maximum U-factor of the glazed wall systems specified in either Section C402.1.5.1 or C402.1.5.2 depending on the percentage of the exterior wall taken by glazed wall systems; the maximum SHGC of the glazed wall systems	Yes	Yes	No	No
	C402.2.8 Requirement for combustion fireplaces	Yes	Yes	No	No
	C402.3 Rooftop solar readiness	Yes	Yes	Yes	Yes
	C402.4.6 Fenestration Documentation Allowed methods for determining fenestration performance.	Yes	Yes	No	No
	C402.5 Air Leakage – Thermal Envelope Air barrier design and testing requirements; maximum allowed air leakage rates.	Yes	Yes	No	No
	C402.7 Derating and Thermal Bridges Methodology that must be used to account for thermal bridging losses in exterior walls	Yes	Yes	No	No

C403 Building Mechanical Systems	Yes	No except must meet C403.5 (Economizer) and C403.7 (Exhaust Air Energy Recovery)	No	No
C404 Service Water Heating The minimum equipment efficiency and controls; piping insulation.	Yes	No	No	No
C405 Electric Power and Lighting Systems Interior and exterior lighting power and controls; electric metering; transformers; motors; vertical and horizontal transportation systems and equipment; voltage drop; automatic receptacle controls; energy monitoring; provisions for the electric vehicles ready parking spaces.	Yes	Yes	Yes	Yes
C406 Additional Efficiency Requirements Projects must implement efficiency measures to achieves at least 15 credits.	(Note 2)	(Note 2)	No	No
C408 Maintenance Information and System Commissioning Requirements related to systems commissioning, functional testing and maintenance information.	Yes	Yes	Yes	Yes

Note 1: Full heating electrification is required for high *glazed wall system* buildings (C402.1.5.2) except buildings using Relative Performance Path because average ventilation at full occupancy is greater than 0.5 cfm/sf in which case partial heating electrification is required.

Note 2: Some specified systems and equipment that contribute toward compliance with Section C406 may be included in the whole building energy models and thus contribute toward compliance with the performance thresholds of a given compliance path. Others cannot be modeled as specified following the simulation rules of the given compliance option. **Error! Reference source not found.** shows energy efficiency credits that may contribute toward modeled performance for each performance-based compliance path.

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**.

Q & A

Q: A new construction project includes an office use on the first floor (15,000 ft^2) and residential multi-family use on floors 2-5 (60,000 ft^2). Which compliance options are permitted? (Note: the requirements for multifamily residential change on 1 July 2024.)

A: The office and residential multifamily portions require separate and individual compliance.

Office portion: The total office floor area is less than 20,000 ft^2, so this portion of the building can follow Prescriptive Compliance. (Note that this portion of the building could also follow: Targeted Performance, Relative Performance, or Passive House.)

Multi-family portion (up through 1 July 2024): The multifamily residential portion can follow any compliance option in Section C401.2.1 except for the Prescriptive Compliance.

Multifamily portion (after 1 July 2024): Either the C401.2.1 Targeted Performance or any of the options in Section C401.2.2 must be used for the multi-family portion.

Alternatively, if the office was >20,000 ft^2, Prescriptive Compliance no longer would be an option. Assuming the average ventilation rate at full occupancy is under 0.5 cfm/ft^2, the office would be limited to Targeted Performance or Passive House.

Special Provision for Mixed Use Buildings Subject to Targeted Performance

Note that Section C407.1.1.6 has a special provision for use types subject to Targeted Performance. If there are two use types that are both subject to Targeted Performance (use types subject to Targeted Performance are: dormitory, fire station, library, office, school, police station, post office, town hall, and (after 1 July 2024) residential) and one of the uses is less than 10% of the total area, then the minority area can be incorporated into the majority. (See example)

Q: A new construction project being permitted after 1 July 2024 includes an office occupancy on the first few floors (16,500 ft^2) and multi-family residential occupancy on the upper floors (160,000 ft^2). Which compliance options are permitted?

A: Both the office and multifamily are uses subject to Targeted Performance. The office portion is less than 10% of the total conditioned space subject to Targeted Performance compliance (16,500 ÷ (16,500 + 160,000), or 9.3%) and separate Targeted Performance compliance is not required for the office. The office can be incorporated into the larger building and compliance can be simplified. The entire building could show compliance with Targeted Performance Compliance using the use type and appropriate TEDI limits for “Residential Multifamily and Dormitory” in Table C407.1.1.5.

Alternatively, being less than 20,000-sf, the office could follow Prescriptive compliance. If this strategy was used, the office and multifamily residential would have to be separately and individually permitted, with the office using Prescriptive compliance and, separately, the multifamily residential using Targeted compliance.

This 10% accommodation does not extend into use types not subject to Targeted Performance. See example)

Q: A new construction project consists of 15,000-sf of restaurant the first of a building and office occupancy on the upper floors (160,000 ft^2). Which compliance options are permitted?

A: The restaurant and office portions require separate and individual compliance. Even though the restaurant is less than 10% of area of the building, the 10% accommodation in Section C407.1.1.6 does not extend to the restaurant because "restaurant" is not a use type subject to Targeted Performance.

Restaurant portion: The restaurant floor area is less than 20,000 ft^2, so this portion of the building can follow Prescriptive Compliance. (Note that this portion of the building could also follow: Targeted Performance, Relative Performance, or Passive House.)

Office portion: The office portion of the building would follow Targeted Compliance. (Note that this portion of the building could also show compliance with Passive House).

C401.4 Building Electrification.

Highlights. This entire section is new language, requiring different levels of space- and water heating electrification by project type.

Compliance. This section is referenced by multiple compliance paths, including the Specialized Code. The pathway leading into this section affects the required level of electrification.

- High glazed wall system compliance in C402.1.5.2 requires C401.4.2 full space heating electrification (except that C401.4.1 is required if those buildings also have high ventilation).
- Relative performance, C407.2.1, requires partial space heating electrification in highly ventilated buildings in accordance with C401.4.1 (connected to the C402.1.5 exception).
- The All-Electric Pathway of the Specialized code, CC104.1, and the pre-wiring design in Mixed Fuel Buildings, CC106.1.6.3, requires compliance with C401.4.3 full space and water heating electrification.
- This section further references heat pump efficiencies and ventilation elsewhere in the code.

Summary. This section requires buildings to electrify space- and water heating end uses fully or partially within the building. It adds heat pump requirements. The levels of heating electrification are explained in greater detail in the sub-sections.

PLACEHOLDER FOR C401.4 FLOWCHART

The full electrification sections require no fossil fuels used for end uses in their respective scopes: space heating, or space- and water heating. A new defined term, *exhaust source heat* pump, is just that: a heat pump capturing exhaust heat. All design loads are the ASHRAE 99.6% winter condition.

PLACEHOLDER FOR EXHAUST SOURCE HEAT PUMP

C401.4.1 Partial Space Heating Electrification.

Twenty-five percent of heating design load must be met with heat pumps, as described in C401.4.4. During normal operation, controls and schedules use the heat pump before electric resistance or fossil-fuel heating.

C401.4.2 Full Space Heating Electrification

All the heating design load must be met with heat pumps, as described in C401.4.4. No fossil fuel equipment is allowed for either space heating or ventilation air heating.

C401.4.3 Full Space and Water Heating Electrification

All the heating design load must be met with heat pumps, as described in C401.4.4. Water heating must be met with heat pumps, electric resistance, or solar thermal systems. Heat pump water heaters must comply with C404.2, and solar thermal must have a solar fraction of not less than 0.4. No fossil fuel heating equipment is allowed.

C401.4.4 Heat Pump Requirements

Heat pumps must meet minimum efficiencies for ventilation air heating and space heating as specified in C403.3.2. Where multiple heat pumps are used, compliance is based on the combined capacity of all heat pump systems serving the building. For compliance calculations, no individual system capacity shall exceed the design heating load of the space it serves. For compliance calculations, the capacity of *exhaust source heat pumps* must not exceed the capacity at 50% of the design airflow and must exclude the heating capacity provided by energy recovery required in C403.7.4.

C402 Building Envelope Requirements.

Highlights. Insulation R-value compliance no longer is permitted. Except for prescriptive compliance, vertical assemblies must meet an area-weighted U-factor backstop. Fenestration U-factors are lower than the national model code and performance documentation is explicit. Air leakage testing and mitigation is required. COMcheck-Web is approved for C401.2.1(1) “Prescriptive Compliance.” Thermal bridging calculation and mitigation is required.

Compliance. Refer to individual subsections.

Summary. This section has multiple, significant revisions.

Prescriptive compliance for insulation components based on R-value tables, C402.1.3, has been removed. Compliance options in C401.2.1 must use the Assembly U-factor, C-factor, and F-factor-based method in C402.1.4 or the Component Performance Alternative in C402.1.5 (to demonstrate minimum assembly performance compliance.

C402.1.3 Insulation Component R-value-based Method.

Highlights. This entire section is deleted and reserved.

Compliance. There is no R-value-based compliance path; no references to this section are valid.

Summary. Removing this section requires compliance with U-factor performance using either C402.1.4 or C402.1.5, and C402.7.

C402.1.4 Assembly U-factor, C-factor or F-factor-based Method.

Highlights. There are no changes to this section in the Stretch and Specialized Code, but it is a requirement in additional compliance pathways.

Compliance. Where a project uses C401.2.1 "Prescriptive and Performance Compliance" (not Passive House or HERS), C402.1.4 sets the minimum opaque envelope thermal performance values. U-factors must be derated *per* C402.7 before using C402.1.4.

Summary. See C402 for an overview of new requirements affecting this section. There is no R-value compliance method in the Stretch or Specialized Codes. All projects not using C407.3 "Passive House" or C407.4 "HERS Index (HERS) for multi-family buildings" must derate above grade wall U-factors in accordance with C402.7 before complying with this section. Examples and additional background are in the Envelope Performance and Thermal Bridge Derating Appendix.

C402.1.5 Component Performance Alternative

Highlights. Splits compliance for low glazed and high glazed wall systems. This section provides an alternative to C402.1.4 to allow more flexible glazing limits. No longer allows tradeoffs between horizontal envelope (roof and floors) and vertical envelope (walls and windows). Only "intra-vertical" tradeoffs are allowed.

Compliance. Where a project uses C401.2.1 "Prescriptive and Performance Compliance" (not Certified Performance Standard through Passive House or HERS) and does not comply with Sections C402.1.4 and C402.4, C402.1.5 is required. U-factors must be derated per C402.7 before using C402.1.5.

Summary. This section performs the same function for multiple compliance options. First, it provides U-factor area-weighting for Prescriptive Compliance vertical assemblies. Second, it prepares wall and fenestration inputs for Appendix G modeling used in performance compliance. It allows performance trade-offs among vertical building envelope components (walls and vertical fenestration), but also imposes performance requirements on the vision portion of *glazed wall systems*. See examples in C402.1.4 and C402.7 below; those sections inform C402.1.5.

As noted in Section C402.7's summary, BC Hydro / BC Housing Research Center provides a Building Envelope Thermal Bridging Guide free to download or use with and online database and calculator.

PLACEHOLDER FOR C402.1.5 FLOWCHART

The flowchart shows the ways C402.1.5 fits within the larger compliance paths of C401.2.1. Certified Performance (C401.2.2) does not use this section. There are two paths in C401.2.1 circumventing C402.1.5, Prescriptive and Targeted Compliance where all building thermal envelope components comply with C402.1.4, C402.4, and C402.5. Note that all vertical envelope assemblies must use this section to prepare values for 90.1 Appendix G compliance (Targeted and Relative Performance).

The simplest way to think about this section is that all thermal performance derates are applied, then an area-weighting of derated U-factors demonstrates whole-building compliance.

C402.1.5.1 Low Glazed Wall System Buildings.

A building is "low glazed" when the *glazed wall system* area is not greater than 50% of the above-grade wall area. If a building has no *glazed wall system* area—all punched windows, for example—it would comply using this subsection.

Where the *glazed wall system* area is not greater than 50% of the above-grade wall area, the maximum allowed area-weighted U-factor is U-0.1285. The maximum allowed vision glass assembly U-factor for vision glass within a *glazed wall system* is U-0.25.

Importantly, the above-grade walls included must be part of the building thermal envelope. Unconditioned garages, loading docks, and storage should be excluded from the percentage calculation.

C402.1.5.2 High Glazed Wall System Buildings.

5 Broadgate Building, Wikimedia/Creative Commons

Where the *glazed wall system* area exceeds 50% of the above-grade wall area, the maximum allowed area-weighted U-factor is U-0.1600. The maximum allowed vision glass assembly U-factor for vison glass within a *glazed wall system* is U-0.25.

Calculations for high glazed buildings are fundamentally the same as those for low glazed buildings; see C402.1.5.1.

C402.3 Rooftop Solar Readiness.

Highlights. Rooftop solar readiness using IECC 2021 Appendix CB is required for new buildings 5 stories or less above grade.

Compliance. The existing Solar-ready appendix is unmodified from the IECC2021, but as with the prior stretch code is required for commercial buildings of 5 stories or less above grade plane. Buildings 6 stories or higher above grade do not need to comply.

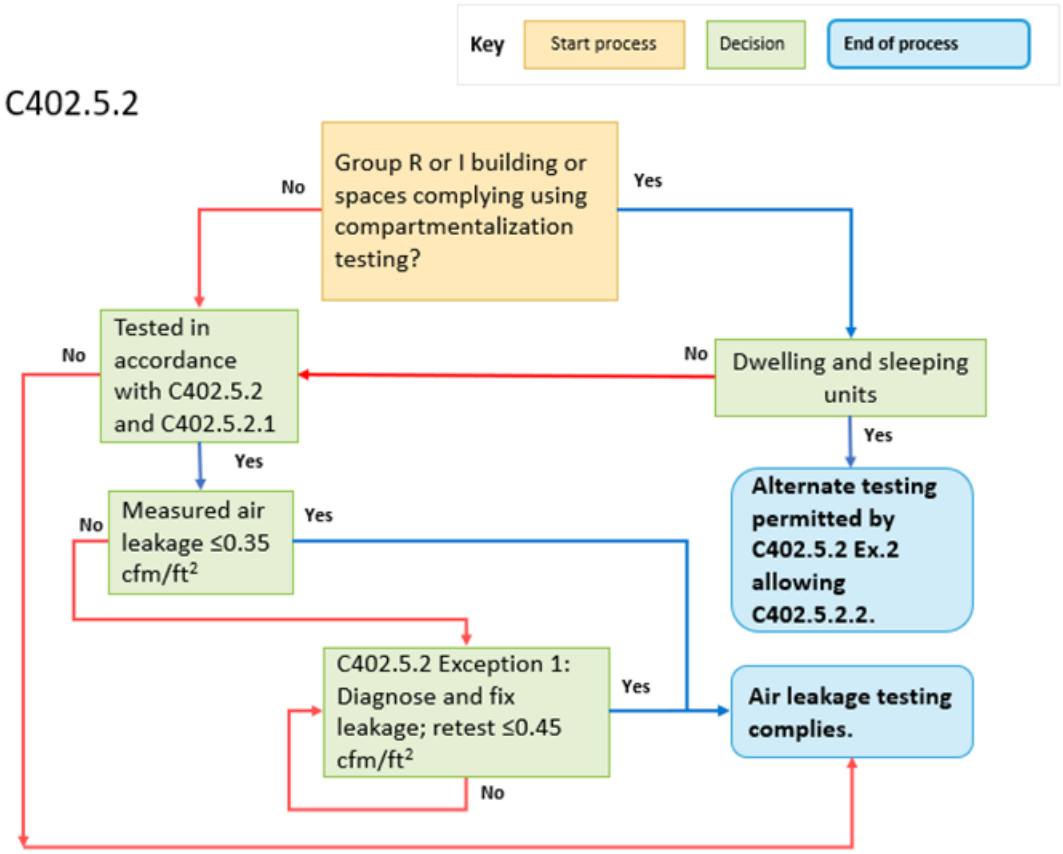
Summary. Appendix CB is unmodified and mandatory in the Stretch Code. Note that the solar ready zone must be identified on construction documents *per* C103.2(14).

C402.5 Air Leakage – Thermal Envelope.

Highlights. Air leakage testing is mandatory. Compared to the IECC, this entire section has been rearranged with changes to requirements as noted.

Compliance. All Prescriptive and Performance Compliance paths in C401.2.1 require compliance with this section.

Summary. The requirements have been rearranged to align more with the design, construction, and inspection process. All testing now flows through C402.5.2, with two testing options: whole-building and dwelling units (Exception #2, which points to C402.5.2.2), or a combination of the two.



Air barrier testing and documentation is required for all buildings. The maximum air leakage allowance has been reduced from 0.40 cfm/ft^2@75Pa to 0.35CFM/ft^2@75Pa. Sealing of electrical and communication boxes has been added *per* C402.5.1.2.2. All portions of the air barrier must be verified *per* C402.5.2.3. Where present, fenestration, vestibules, *etc.*, have requirements in C402.5.3 through C402.5.10.

Two major exceptions to whole building testing, now C402.5.2 "Air leakage testing," are retained, but modified. Exception 1 allows whole building tested leakage to increase to 0.45CFM/ft^2@75Pa after diagnostic testing and remediation has been performed. Exception 2 previously was a separate section allowing compartmentalization testing of Group R and I buildings or spaces within buildings. For stairs, corridors, and spaces other than dwelling- and sleeping units verification requirements can be found in C402.5.2.3.

C402.7 Derating and Thermal Bridges.

Highlights. This entire section is new language. Thermal bridge derating is added for exterior insulation layers, where the IECC and ASHRAE 90.1 currently only derate the interior insulation layers. This section also includes provisions to address the thermal performance of the opaque portions of *glazed wall systems*.

Compliance. Section C402.7 is required for all paths in C401.2.1 "Prescriptive and Performance Compliance." The results from these calculations adjust the performance used for compliance in

C402.1.4 “Assembly U-factor, C-factor, or F-factor-based Method” and in C402.1.5 “Component Performance Alternative.” Note that C402.1.3 no longer exists for R-value compliance.

Neither the Stretch nor Specialized Code modifies C103.2.2, which requires that the building thermal envelope be represented on the construction drawings.

Where used *per* C402.6 “Approved Calculation Software Tools,” Massachusetts Stretch-specific COMcheck is permitted to demonstrate compliance with this section, because the software automatically accounts for thermal bridging.

Summary. Thermal bridge accounting is added to the Stretch Code to represent the insulation performance of an exterior wall more accurately in the building envelope. “Prescriptive”, “reference”, and “modeled” accounting approaches are available.

When following “reference” accounting approach, the code requires using the “Building Envelope Thermal Bridging Guide”, version 1.6 or higher, published by BC Hydro Power Smart. BC Hydro / BC Housing Research Center has made available a Building Envelope Thermal Bridging Guide free to download (PDF) or use with an online database and calculator. A help page provides general background (Modules 1, 2, and 4) and specific guidance for using the database and calculator (Module 3). This background provides an understanding of thermal bridging and is suggested reading for professionals new to thermal bridging.

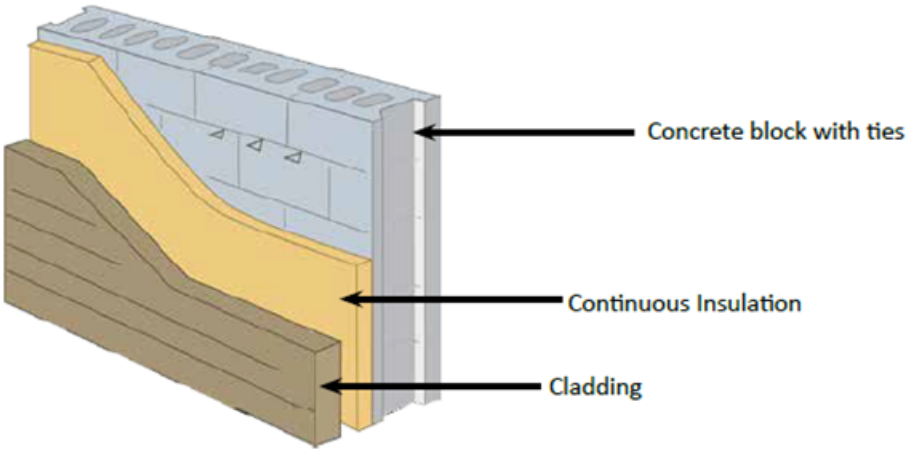
There are many ways to account for thermal bridges. The code allows the use of approved prescriptive calculations, pre-solved reference values, and modeling to demonstrate compliance. Compliance choices and details must be included in construction documents. Highlighting component manufacturers, models, performances, and method of installation is encouraged. Examples and additional background are in the Envelope Performance and Thermal Bridge Derating Appendix.

C402.7.1 General.

The calculated effects of thermal bridges in walls are required for both C402.7.2 and C402.7.3. Where spandrel sections are present in glazed wall systems, performance is calculated in C402.7.4.

C402.7.2 Continuous Insulation for Vertical Walls.

Adding uninterrupted, continuous insulation (c.i.) is one approach to reduce the heat flow through structural members. However, continuous insulation and exterior cladding requires its own connections to the structural portion of the wall which create thermal bridges through the insulation layer. These connections must be considered when estimating installed thermal performance. This section describes prescriptive calculations (C402.7.2.1), pre-solved references (C402.7.2.2) and modeled (C402.7.2.3) derating compliance options. A building may require only one option or could use all of them for a more complicated design. Any combination of prescriptive, pre-solved, and modeled can be used for different components.



C402.7.2.1 Prescriptive Derating.

Prescriptive derating calculations are detailed in this section, generally of the form in Equation C402.7.2.1:

$R_{derated}$ = R_0 x Derating Factor

The derated R-value ($R_{derated}$) is the product of the fully rated R-value (R_0) and the prescriptive Derating Factor, as determined by the subsections. Low-conductivity (≤ 3 Btu-in/hr-ft^2-F) plastic or fiberglass fasteners used in cladding systems have a unique derating factor in C402.7.2.1.3. Where present, shelf angles further derate brick veneer systems in C402.7.2.3.

C402.7.2.2 Reference Derating.

Derating can be based on the pre-solved derating information contained in the "Building Envelope Thermal Bridging Guide", version 1.6 or higher, published by BC Hydro Power Smart

C402.7.2.3 Modeled Derating.

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C402.7.3 Linear Thermal Bridges.

Inter- and intra-assembly linear thermal bridges can be significant. Derated continuous insulation (from C402.7.2) shall be further derated per C402.7.3 using Equation C402.7.3.

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

Simply, it converts a *psi* value into a U-factor by considering both the magnitude of heat transferred by the element and the relative area of that element in the assembly. Typical linear thermal bridge *psi* values are described in Table C402.7.3.1. Pre-solved and modelled *psi* values are permitted.

C402.7.3.2 Reference PSI Values.

PSI values can be based on the pre-solved PSI values contained in the "Building Envelope Thermal Bridging Guide", version 1.6 or higher, published by BC Hydro Power Smart

C402.7.3.3 Modeled PSI Values.

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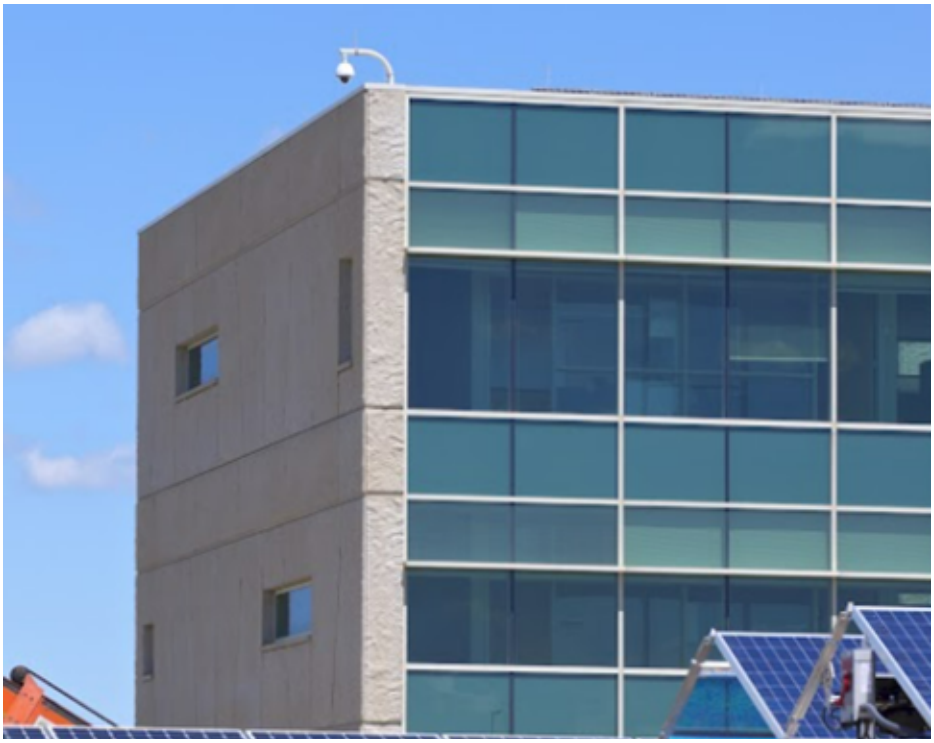
C402.7.4 Thermal Resistance of Spandrel Sections.



Mass wall (gray, left), spandrel (light blue, between floors), and vision glazing (darker blue).

Spandrels sections are the opaque portions of *glazed wall systems*. Spandrel default R-values are found in Table C402.7.4.1. All spandrel in *glazed wall systems* must have a minimum of R-12 insulation when using this table. Thermally broken spandrel has nonmetal spacers or mitigating gaps between metal components.

C402.7.4.2 Reference R-values.

The thermal performance of the opaque portion of glazed wall systems can be based on the pre-solved performance information contained in the "Building Envelope Thermal Bridging Guide", version 1.6 or higher, published by BC Hydro Power Smart

Where present in the building, pre-solved values derived from BC Hydro's Building Envelope Thermal Bridging Guide can be used for compliance.

C402.7.4.3 Modeled R-values.

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C403.5 Economizers.

Highlights. Adds a requirement that when *dedicated outside air systems* are installed, they have water economizers, if the chilled water system is required to have a water economizer per C403.5.1 and does not fall under any of the Exceptions listed in section C403.5.

Additional Information

Water economizers are defined by IECC 2021 as a system where the supply air of a cooling system is cooled indirectly with water that is itself cooled by heat or mass transfer to the environment with-out the use of mechanical cooling.

Compliance. Section C403.5 is required for all paths in C401.2.1 "Prescriptive and Performance Compliance." Tables C403.5(1) and (2) have been reduced and deleted, respectively, to highlight only requirements for climate zone 5A.

Summary. The updated Stretch Code intent is to clarify that the chilled water economizer requirements apply to buildings with DOAS systems. In addition, a new definition was added for DOAS:

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.

Further Information. The Stretch Code indicates that the chilled water economizer requirements apply to buildings with dedicated outside air systems (DOAS). While DOAS systems provide 100% outside air to serve ventilation needs, they can benefit from the use of a water economizer, when the building has a chilled water system with capacity equal to or greater than the values listed in table C403.5(1) and when the system does not fall under the Exceptions listed in section C403.5. In this case, the water economizer shall be used to provide free cooling for the DOAS unit. This will limit the amount of time that compressors serving the DOAS unit need to come on for cooling or for dehumidification of outside air.

DOAS systems do not require air economizers, as they should be sized to only provide ventilation and not provide the primary space cooling.

C403.7.4 Energy Recovery Systems.

Highlights. Expands when energy recovery systems are mandated by eliminating many exceptions and reducing minimum size thresholds. Mandates that outdoor air must be delivered directly to each dwelling unit. Adds significant specificity to energy recovery systems in *Group R* occupancies, and especially in "All Other" spaces.

Compliance. Section C403.7 is required for all paths in C401.2.1 "Prescriptive and Performance Compliance."

Summary. Ventilation energy recovery requirements are strengthened in the updated Stretch Code. Sensible or enthalpy energy recovery is required, depending on the occupancy and exhaust class.

Requirements include both sensible energy recovery and enthalpy energy recovery. The sensible energy recovery ratio refers only to transfer of sensible heat. The enthalpy recovery ratio refers to the transfer of both heat and moisture from the exhaust air stream to the supply air stream. Enthalpy recovery is sometimes referred to as total energy recovery, because it transfers both the sensible and latent heat between the two air streams.

Sensible energy recovery ratio and enthalpy recovery ratio are defined in Chapter 2 Definitions. It is important to note that the definitions specify the ratio of change required between the entering supply airflow and the leaving supply airflow, compared to the difference between the entering supply airflow and the entering exhaust airflow. This means that it is important to bring as much of the exhaust air back to the energy recovery device as possible, to help achieve compliance. The enthalpy recovery ratio also must not take credit for any air leakage from exhaust to supply airstreams.

C403.7.4.1 Non-Transient Dwelling Units

Non-transient dwelling units typically use energy recovery ventilators to provide ventilation directly to each dwelling unit. Another configuration is to have a central DOAS unit that serves several dwelling units on each building floor. Energy recovery for dwelling units with a design airflow greater than 300 cfm must have a minimum enthalpy recovery effectiveness in cooling conditions of 50%, and a minimum enthalpy recovery effectiveness of heating of 60%. If some of the units have lower ERV effectiveness, the building can still comply by showing that the airflow-weighted average effectiveness meets the Stretch Code requirements. Smaller ERV units with a design airflow of 300 cfm or less, typical for apartments, must have a sensible recovery effectiveness (SRE) of at least 65% at an outdoor design condition of 32F.

Mixed-use buildings often contain both residential dwelling units and office, retail, or other commercial spaces. The requirements of C403.7.4.1 apply only to the floor area in the dwelling units. Common areas and commercial spaces are subject to the requirements of C403.7.4.2. Compliance is determined by comparing the airflow-weighted sensible and enthalpy effectiveness with the minimum requirements of the Stretch Code. An example of energy recovery in a mixed-use building is shown below.

C403.7.4.2 Spaces Other Than Non-Transient Dwelling Spaces.

The Massachusetts Energy Code includes requirements for energy recovery, for systems with a minimum design ventilation flow rate. The Stretch Code reduces the airflow threshold above which energy recovery is required in systems serving commercial buildings. For systems operating 8,000 or more hours annually (nearly continuously), energy recovery is always required. For systems operating less than 8,000 hours annually, energy recovery is always required for systems designed to supply ≥40% outdoor air and is required for systems with lower outdoor air percentages when the system exceeds the specified airflow thresholds per table C403.7.4.2(1).

The required recovery ratio varies based on the type of air class in the spaces or being exhausted from the spaces served by the system. The air class designates the contamination level of the air, as defined by ASHRAE 62.1-2019. Class 1 air, found in many commercial spaces such as office and classroom spaces, can be recirculated to any other space type. Class 2 air, considered moderately contaminated

and possibly with odors, is found in daycare areas, dining facilities, fitness centers and certain laboratory spaces and is restricted in its circulation. Class 3 or 4 air contain contaminants that require the air to be exhausted without recirculation to other spaces or to any space, respectively. Class 4 air includes laboratory fume hood exhaust. In addition, there are certain exhaust types that are exempt from heat recovery, as defined in the Exceptions to C403.7.4.2.

The recovery ratio requirements treat systems that provide makeup for Class 3 and Class 4 air differently from all other systems. In cases where Class 3 or 4 air and other exhaust classes are combined into a single exhaust, the entire exhaust flow is typically classified as Class 3 or 4 air and therefore the associated make up air systems are regulated by section C403.7.4 as make up air systems for Class 3 or 4 air.

Systems that provide makeup for Class 3 or 4 exhaust require a sensible recovery ratio of at least 50% at heating design conditions. All other make up air systems require a minimum enthalpy recovery ratio of 70% at heating and cooling design conditions.

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. The weighted average recovery ratio is the average recovery ratio that is weighted by the outside air flow rate to each system, as defined by equations C403.7.4.2(1) and C403.7.4.2(2). Recovery ratios for recovery devices are provided in manufacturer's system specifications. The recovery ratio used in compliance calculations is the value at the design airflow rate.

For mixed-use buildings that contain both dwelling units and commercial spaces, the dwelling units are subject to the recovery requirements of Equation 403.7.5.1-1, and the commercial spaces are subject to the requirements of Equation 403.7.5.2-1 and Equation 403.7.5.2-1.

Example Calculation 1

A midrise apartment building has fifty dwelling units. Forty of these units have energy recovery ventilators with an enthalpy effectiveness of 78% at design heating conditions. These units each have a design airflow of 200 cfm through the energy recovery ventilator. Ten of the junior apartments have an ERV with an enthalpy recovery effectiveness of 70% at design heating conditions. All fifty of the energy recovery ventilators meet the required 50% enthalpy effectiveness at design cooling conditions. These smaller units each has a design airflow of 100 cfm through the energy recovery ventilator. Does this building meet the energy recovery requirements of the Stretch code? The airflow-weighted average enthalpy effectiveness can be determined by:

ENTH_EFFprop = ((200 x 40 x 0.78 + (100 x 10 x 0.70) / (200 x 40 + 100 x 10))

= 6,940 / 9,000 = 0.771 (or 77.1%)

Since the weighted average enthalpy effectiveness exceeds the Stretch code requirement of 0.75, the building complies.

Example Calculation 2

An office building has three 100% outdoor air HVAC units with enthalpy recovery wheels. The first has a supply airflow of 1,000 cfm with an enthalpy recovery ratio of 60%. The second has a ventilation airflow

of 2,000 cfm and an enthalpy recovery ratio of 80%. What is the required enthalpy recovery ratio of a third unit, if it has a design ventilation airflow of 2,000 cfm?

Answer

Compliance with the Stretch Code is verified by calculating the weighted-average enthalpy recovery ratio of the three HVAC units.

$ENTHALPY.RATIO_{PROPOSED}$ = (1,000 cfm x 0.60 + 2,000 cfm x 0.80 + 2,000 cfm x $ENTHALPY.RATIO_3$) / (5,000 cfm)

Since the required enthalpy recovery ratio of all three systems in both heating and cooling modes is 75% or 0.75, we can set the proposed enthalpy recovery ratio to 0.75, and solve for the one unknown, $ENTHALPY.RATIO_3$).

0.75 = (1,000 cfm x 0.60 + 2,000 cfm x 0.80 x 2,000 cfm x $ENTHALPY.RATIO_3$)/ 5,000 cfm

$ENTHALPY.RATIO_3$ = (0.75 x 5,000 – 1,000 cfm x 0.60 + 2,000 cfm x 0.80) / 2,000 cfm = 0.775

Therefore, the enthalpy recovery ratio of the third HVAC unit must be at least 0.775, or 77.5%, for the building to comply.

Example Calculation 3

A school building has four identical HVAC supply units, each with a ventilation airflow of 1,000 cfm and a general exhaust airflow of 500 cfm. The school also contains a kitchen exhaust system with an exhaust rate of 2,000 cfm. The makeup air for the kitchen exhaust is provided by the four HVAC supply units. The winter design heating condition is 10F dry-bulb temperature, with a heating setpoint of 70F. The HVAC units have an enthalpy recovery ratio of 35%, and the commercial kitchen hood exhaust system has no heat recovery. Does the project meet the recovery requirements of the Stretch code?

Answer

The commercial kitchen hood exhaust is exempt. Therefore, the ratio of the makeup air volume not exhausted by the kitchen hoods, divided by the total makeup air volume is used to adjust the required enthalpy recovery ratio.

In addition, since the four HVAC supply units are identical, the proposed enthalpy recovery ratio can be calculated for a single HVAC supply unit and used to demonstrate compliance for all four HVAC supply units.

$ENTHALPY.RATIO_{REQUIRED}$ = 75% x (2,000 CFM / 4,000 CFM) = 37.5%

$ENTHALPY.RATIO_{PROPOSED}$ = 35%

ENTHALPY $REATIO_{REQUIRED}$ (37.5%) > ENTHALPY RATIO PROPOSED (35%)

Therefore, the enthalpy recovery ratio requirement is not met, and the building does not comply. The enthalpy recovery ratio must be increased to at least 37.5% to achieve compliance.

Example Calculation 4

A laboratory building that includes both laboratories and non-laboratory spaces throughout the building has a single combined makeup air system and a single combined exhaust air system. A glycol run-around system recovers sensible energy between the exhaust and supply. The laboratories include fume hood exhaust that will be connected to the combined exhaust system serving the building.

The winter ambient design dry bulb condition is 0°F and the exhaust air dry bulb temperature entering the exhaust heat recovery coil is 75°F. Assuming that the exhaust heat recovery meets the sensible energy recovery ratio requirements, what would be the expected supply air temperature leaving the exhaust heat recovery device?

Answer

The expected supply air temperature leaving the heat recovery coil would be 50% of the difference between the outdoor air dry bulb temperature and the heat recovery coil entering exhaust air dry-bulb temperature.

$SENSIBLE.RATIO_{REQUIRED}$ = 50%

Expected supply air temperature leaving heat recovery coil = 50% x (75°F – 0°F) = 37.5°F

Therefore, expected supply air temperature leaving the heat recovery coil would be 37. 5°F.

C405.13 Electric Vehicle Ready Parking Spaces ("EV Ready Spaces").

Highlights. This entire section has been revised, both in Stretch Code and in the proposed 10th edition Base Energy Code.

Compliance. Section C405.13 is required for all paths in C401.2 "Application," including Certified Performance using Passive House or HERS.

Summary. The Stretch Code raises the minimum number of spaces requiring EV wiring to 20% in Group R and B occupancies (as defined in the Building Code Chapter 3 under *Group R* and *Group B*), with 10% for all other occupancies. Extensive documentation is required for compliance with Section C405.13.2.

Two definitions from section C202 are relevant when determining the requirements. The first is the definition for Electric Vehicle Supply Equipment (EVSE), which describes the scope of what is included in ESVE to transfer energy between the building and the Electric Vehicle. The second is a definition for Electric Vehicle Ready Parking Space which clarifies that the parking space must include wiring and electrical service sufficient to provide AC Level II or equivalent EV charging. This section also requires a dedicated branch circuit in the panel or subpanel labeled as "EV Ready", as well as requirements for the location and type of termination point at the parking space. The MA electrical code includes requirements for conductors and outlets within the system.

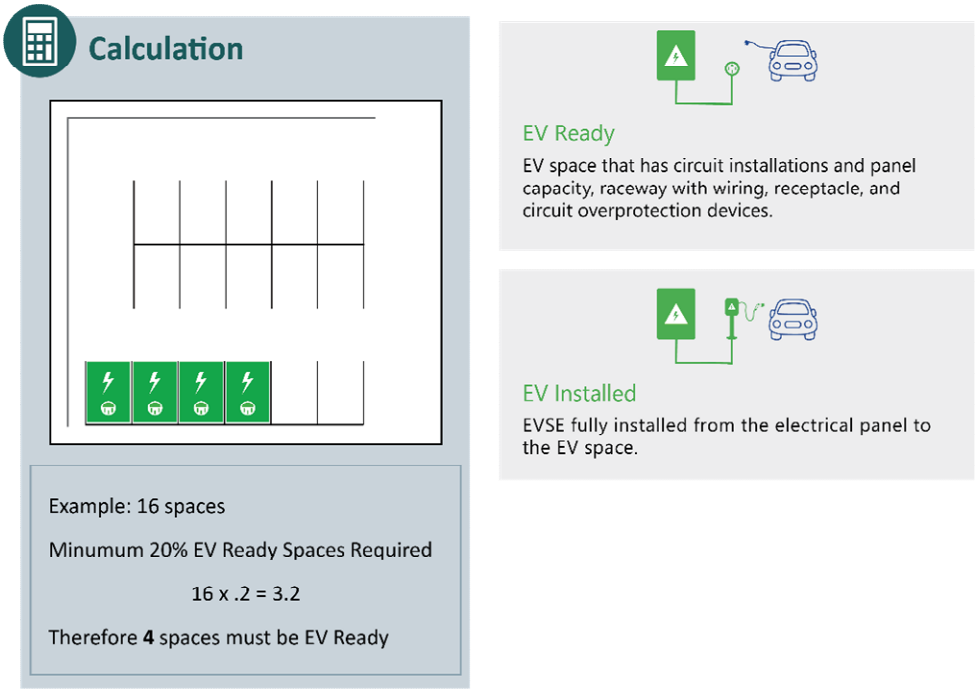
One of the design issues related to providing EV charging is appropriately sizing the electrical service. EV charging can be met with either dedicated electric branch circuits or with an automatic load management service (ALMS) that allows multiple spaces to be served by a higher amperage circuit, thus improving overall charging capacity at a lower installed cost.

C405.13 describes the installed infrastructure required for electric vehicle ready parking spaces (EV Ready Spaces), including minimum power capacity and locations of terminations. Parking spaces serving a storage, medium- or heavy-duty vehicle, or repair role are excluded. As well, tradeoffs between 40-amp Level II and 20-amp Level I spaces are permitted to add flexibility for a building's expected parking schedule. The use of DC fast chargers is also permitted as an alternative to Level II chargers.

C405.13.1 Minimum Charging Performance Requirements.

An automatic load management system (ALMS) is permitted to manage charging across multiple EV Ready or EV Service Equipment-Installed (EVSE-Installed) parking spaces. Table C405.13.1 describes the number of parking spaces permitted on a branch circuit, depending on the fraction of total spaces that are EV Ready.

Example calculations are provided, determining the *EV Ready* spaces for a sample parking lot.



C405.13.2 Identification.

The locations of EV Ready Spaces are required in construction documents *per* C103.2(15). Additionally, construction documents shall include branch circuit terminations, future electric vehicle service details, and calculations showing that all infrastructure can support the design load for EV charging.

C406.1 Additional Energy Efficiency Credit Requirements.

Highlights. Total credits to be achieved have been increased relative to the IECC2021 from 10 to 15 in new buildings and from 5 to 10 for tenant spaces. Some of the credits have been replaced and others have been removed.

Compliance. Section C406.1 is required for the Prescriptive, Targeted Performance, and Relative Performance compliance paths in Section C401.2.1 "Prescriptive and Performance Compliance."

Certified Performance Compliance (Section C401.2.2), *i.e.*, Passive House and HERS, are not required to meet the additional efficiency requirements (C406). When the Relative Performance path is used (C401.2.1(3)), the baseline model need not include credits from C406 to meet the requirements of the section; the project, however, must demonstrate compliance with the additional efficiency requirements (C406) and energy reduction from achieved credits may be counted toward compliance.

Summary. New buildings are required to achieve a total of 15 credits from the available measure options. Where there is more than one occupancy use group in the building, achieved credits from each use group must be weighted by the floor area of that group to calculate a weighted average building credit total.

Tenant spaces are required to achieve a total of 10 credits. Tenant spaces meeting existing building requirements of Section C501 are exempt from C406. When the building complies with energy measures that are applicable to the entire building—for example, reduced air infiltration—tenant spaces are deemed to comply with Section C406. This group of building measures includes provision of a dedicated on-site renewable energy (C406.5), enhanced envelope performance (C406.8), reduced air infiltration (C406.9), and Type IV heavy timber construction (C406.12). When using measures other than the three listed above, tenant spaces must choose from Section C406.2, C406.3, C406.4, C406.6, C406.7 or C406.10.

Credits related to fossil fuels and small improvements (Section C406.7.3 “Efficient fossil fuel water heater” and Section C406.2.1 “5% heating efficiency improvement”) have been removed. Section C406.2.3 “10% heating efficiency improvement” option has been replaced with a renewable space heating requirement that specifies cold-climate air-source heat pumps or ground-source heat pumps. The cold-climate heat pump must have a rated coefficient of performance (COP) of at least 1.75 at 5 °F.

To achieve the heavy timber construction credit not less than 4 stories above grade or above a podium must be constructed of Type IV heavy timber. Such timber has characteristics that comply with Table 601 “Fire-resistance rating requirements for building elements (hours)” of the MA Building Code.

A new credit for reduced air leakage is available for buildings demonstrating tested leakage not greater than 0.20 cfm/ft^2 at 75 Pa, with the calculated surface area being the sum of the above- and below-grade thermal envelope (i.e., the surfaces enclosing conditioned spaces within the building). This credit does not permit the use of the exceptions in C402.5.2.

Table of final sections with titles and credits for user reference (15 credits for new construction, 10 credits for tenant spaces).

Climate Zone 5A	Occupancy				
Section	B	R, I	E	M	Other
C406.2.2: 5% cooling efficiency improvement	2	1	1	1	1
C406.2.3: Renewable space heating	15	15	15	15	15
C406.2.4: 10% cooling efficiency improvement	4	1	2	2	2

C406.3: Reduced lighting power	7	2	8	12	7
C406.4: Enhanced digital lighting controls	2	NA	2	3	2
C406.5: On-site renewable energy	9	7	6	7	7
C406.6: Dedicated outdoor air system	5	8	NA	2	5
C406.7.2: Recovered or renewable water heating	NA	14	1	NA	14
C406.7.4: Heat pump water heater	NA	5	1	NA	5
C406.8: Enhanced envelope performance	10	4	2	4	5
C406.9: Reduced air infiltration	11	9	1	3	6
C406.10: Energy monitoring	2	1	2	3	2
C406.11: Fault detection and diagnostics system	1	1	1	1	1
C406.12 Heavy timber construction	8	8	8	8	8

Note: Confirm occupancy in the Building Code Chapter 3.

C407 Total Building Performance Certification Methods.

Highlights. This entire section has been replaced.

Compliance. Section C407 is required for all paths in C401.2 "Application," except C401.2.1(1) "Prescriptive Compliance."

Overview.

The Stretch code includes four performance-based compliance options: the Targeted Performance (Section C407.1), the Relative Performance (C407.2), Passive House (C407.3) and HERS (C407.4). Each path has different modeling rules, methodology for establishing pass/fail compliance outcomes based on modeling results, submittal requirements, minimum modeler qualification requirements, and the approved energy modeling tools. Table 1 provides side-by-side comparison of the performance-based pathways.

MA Stretch Code Performance-based Compliance Options Comparison

	Targeted Performance (C407.1)	Relative Performance (C407.2)	Passivehouse (C407.3)	HERS (C407.4)
Modeling Rules	Targeted Performance Simulation	ASHRAE 90.1 2019 Appendix	Phius CORE 2021, ZERO 2021 or PHI	RESNET/ICC 301-2019

	Guidelines in Appendix C of this document.	G with MA amendments		
Approved simulation software	eQUEST, EnergyPlus, IESVE	Any BEM tool compliant with 90.1 Appendix G	As approved by PHIUS or PHI, as applicable, ex. WUFI Passive.	As approved by Standard 301, ex. REM/Rate
Minimum Modeler Qualifications	Yes, Modeler_Quals_FINAL.pdf (energycodes.gov)		Certified Passive House Consultant, or Designer and Certifier	Certified HERS Rater
Applicable Building Types	Allowed for any, required for multifamily (after 7/1/2024), dormitory, fire station, library, office, K-12 school, police station, post office and town halls except if high ventilation	Allowed only for projects that are not required to follow the Targeted Performance path	Allowed for any building of any size.	Allowed for residential buildings and dwelling units within buildings.
Compliance Criteria	Modeled heating and cooling annual energy demand intensities of the proposed design must not exceed the set targets	Modeled site energy use of the proposed design must improve over that of the baseline by a required margin	Modeled heating and cooling demand intensity, peak heating and cooling limits, and source energy use; envelope air leakage and moisture management.	Calculations, design, and verification to compare proposed design model to a geometric equivalent IECC-2006 baseline.
Systems that may be adjusted	Envelope shape and thermal and solar properties, air infiltration, exhaust air energy recovery effectiveness.	Any system regulated by code	All.	All, limited by ENERGY STAR MFNC requirements.
Trade-off limits	Must meet all prescriptive requirements except some aspects of envelope.	Must meet 90.1 2019 mandatory requirements and certain prescriptive	Minimum heating and cooling loads may not be exceeded.	HERS Index limit may not be exceeded.

		requirements of MA Stretch.		
Prescribed modeling inputs for proposed design	HVAC system type, efficiency and controls, lighting, misc. equipment, and all schedules.	Must be modeled per design documents; schedules must reflect expected use of the building.	Operating conditions: efficiencies/capacities, schedules, loads.	Operating conditions: efficiencies/capacities, loads, generation.
Documentation in addition to design documents	COMcheck, simulation reports, average ventilation rate calculations	Filled out DOE/PNNL Compliance Form, simulation reports, average ventilation rate calculations	Extensive; see C407.3.2.1 or C407.3.2.2	Extensive; see C407.4.2.1 and C407.4.2.2

The Targeted Performance and Passive House pathways establish compliance by comparing results of a single energy simulation to the performance targets expressed as fixed numeric values. With the Relative Performance and HERS, the compliance is based on the relative energy use of two models – one representing the proposed design and another serving as a point of reference.

Targeted Performance Simulation Guidelines can be found in Appendix XXX of this document.

The pathways also differ in their scope. For example, the Targeted Performance focuses on building envelope and treatment of ventilation air – all other building systems such as lighting, HVAC, and service water heating must meet the prescriptive requirements. On the other hand, the Relative Performance allows all building systems that are regulated by the energy code to participate in the trade-offs within set limits.

All performance-based compliance options establish performance “floor” (i.e., backstops) for certain buildings systems and components. For example, both the Targeted Performance and Relative Performance paths allow contribution of air-tight envelope toward compliance, however projects must not exceed the air leakage requirements of Section C402.5.

The energy models developed for compliance with Section C407 are not predictive of the future measured post-occupancy energy use. The actual consumption will differ from the model projections due to variations in occupancy, programming, building operation and maintenance, HVAC system design, weather, and precision of the energy modelling tool. The modeled energy use of the proposed design developed following the Relative Performance path is more representative of the future energy use than models developed for other performance-based pathways because, with a few minor exceptions, the Relative Performance path requires that all systems are modeled as shown on design documents and calls for using the expected post-occupancy operating schedules. The other performance-based compliance pathways prescribe many modeling inputs, e.g., to represent standard operating conditions.

C407.1 Targeted Performance

Highlights. This is a new compliance option

Compliance with this section requires performing a whole building energy simulation using an approved energy modeling tool and following the Targeted Performance Simulation Guidelines found in Appendix XX of this document to demonstrate that project's heating and cooling Thermal Energy Demand Intensities (TEDIs) do not exceed the limits in Table C407.1.1.5. In addition, projects must demonstrate compliance with the requirements applicable to other building systems and components as prescribed in Section C401.2.1 and as shown in Table XXX of this document.

The **heating TEDI** is the annual heating energy delivered to the spaces and ventilation within the building to maintain heating thermostat setpoints normalized by the floor area. The **cooling TEDI** is the annual energy extracted from the spaces and ventilation to maintain cooling thermostat setpoint normalized by the floor area.

Q & A

Q: Is heating TEDI the same as heating Energy Use Intensity (EUI)?

A: No. Although TEDI and EUI have the same units (kBtu/sf-yr), they are not the same.

- Heating TEDI represents the annual heating load on the HVAC systems.
- Heating EUI represents the annual amount of energy used to operate equipment that heats spaces and ventilation air.

If a heat pump delivers 4.8 kBTU/SF heating energy to spaces annually and has annual average COP = 3.2, the site heating EUI is 1.5 kBTU/SF while the Heating TEDI is 4.8 kBTU/SF.

TEDI depends on performance of building envelope and ventilation energy recovery. Unlike heating EUI, heating TEDI does not depend on heating system efficiency.

- Reduced thermal bridging and high performance windows help reduce both site heating EUI and heating TEDI.
- Improved heat pump efficiency reduces site heating EUI but does not impact heating TEDI.

Q: How does one achieve low heating TEDI and low cooling TEDI?

A: Achieving low heating and cooling TEDIs requires careful attention to envelope performance (including thermal bridging), solar gains, and ventilation system design. It's important to design with all three in mind to achieve **both** low heating and cooling TEDIs. For example, improving envelope without also addressing solar gains can decrease heating TEDI while increasing cooling TEDI. Solar gains can be addressed with attention to aperture, solar heat gain coefficient, and external shading. Other factors, such as internal heat gains, also affect heating and cooling TEDI. However, the associated modeling inputs are fixed per the Targeted Performance Simulation Guidelines, and cannot be adjusted as a strategy to meet TEDI requirements.

Q: Is heating thermal energy demand intensity (TEDI) the same as "heating demand"?

A: Although the word "demand" is used in both, the term "heating demand" differs from heating TEDI in two ways.

1. "Heating TEDI" represents a **total annual** energy demand on the HVAC systems associated with heating. In contrast, the term "heating demand" usually represents a monthly or annual **peak rate** of energy consumption associated with heating - i.e., energy consumed per unit of time. The units reflect this difference: "heating TEDI" has units of kBtu/ft^2-yr, while "heating demand" is expressed in units of MBtu/hr (often abbreviated to MBH) or kW.
2. The other important difference reflects the TEDI vs EUI discussion above: "heating TEDI" is the energy demand on the HVAC system while the "heating demand" is the energy consumption associated with heating.

The Targeted Performance Simulation Guidelines (TEDI Guidelines) included in Appendix XXX of this document specify aspects of design that must be modeled based on the construction documents, prescribe simulation inputs for systems and components that are treated as energy neutral (i.e., are meant to have no impact on TEDI compliance), and describe the modeling procedures to ensure consistency of the compliance outcomes across different modelers and simulation tools.

Following the TEDI Guidelines, building envelope and certain aspects of ventilation design must be modeled as specified. The modeling inputs that are prescribed (fixed) and are independent of design include lighting and miscellaneous equipment loads; the HVAC system type, efficiency and controls; fan system design; and operating condition such as building occupancy and lighting runtime hours that are likely to change over the life of the building.

The TEDI Guidelines also require certain simplifications to the modeled interior floor plan and thermal zones. The approach is consistent with the intent of the ASHRAE Standard 209[1] Energy Simulation Aided Design Modeling Cycles #2 and #3 (Conceptual Design and Load Reduction Modeling). While additional energy modeling, other than to show TEDI compliance, is not required, projects are encouraged to complete other modeling as necessary to inform HVAC system design and minimize impact of value engineering on performance.

Q&A

Q: A school project was modeled based on the Design Development drawings and reflected simplified HVAC zoning prescribed in the TEDI Guidelines. Does the TEDI model need to be updated once design is finalized and the HVAC zones are shown on drawings?

A: In most cases, the simplified zoning does not need to be updated if it continues to comply with the TEDI Guidelines. Exceptions include cases when the programming has substantially changed, for example to add or remove gym or cafeteria that must be modeled as separate thermal blocks based on the Guidelines.

Q: The model was developed before infiltration testing was performed and includes an assumed air leakage rate. Does the TEDI model need to be updated with the measured air leakage rates once testing is completed?

A: Yes, if the measured air leakage was larger than originally modeled, a new TEDI model should be produced based on the as-measured value to ensure that project continues to comply after the

measured air leakage is entered into the TEDI model. If the air leakage was found to be less than originally modeled, it's not necessary to conduct another model

C407.1.1.1 Building performance modeling

The allowed simulation programs are listed in the TEDI Guidelines in Appendix XX

C407.1.1.2 Climatic Conditions

The simulations must be completed using the weather file included in the TEDI Guidelines supplement.

C407.1.1.3 Modeling Building Envelope Infiltration

Envelope air leakage modeling rules are described in the TEDI Guidelines.

C407.1.1.4 Internal loads, scheduling, and other modeling assumptions

The assumptions are prescribed in the TEDI Guidelines and the TEDI Guidelines Supplement.

C407.1.1.5 Thermal energy demand intensity (TEDI) limits

Project heating and cooling TEDIs must be determined using whole building energy modeling as described in the TEDI Guidelines. Heating and cooling TEDIs must not exceed the individual limits in Table C407.1.1.5 for the appropriate building use type and size. The heating TEDI should be rounded to a single decimal point and the cooling TEDI should be rounded to the nearest whole number following the standard rounding rules.

C407.1.2 Documentation

The construction documents submitted with the application for permit must be accompanied by the following documentation:

a. Completed COMcheck Envelope, Lighting and Mechanical Compliance Certificates, and a Plan Review Inspection Checklist *(C103.2.2).*

b. Simulation reports:
   - **eQUEST**: <project name>.SIM file with the complete set of simulation reports.
   - **Energy Plus / Open Studio**: Complete set of simulation reports in the HTML format. See Annex A for the report generation instructions.
   - **IESVE:** TBD (Room Loads Report, Zone Loads Report, Space Loads & Ventilation Report, System Loads Report, Energy Model Output Report, Unmet Hours Report, Detailed Simulation Report)

c. Calculation of the average ventilation rate similar to what is required by Section C103.2 #16

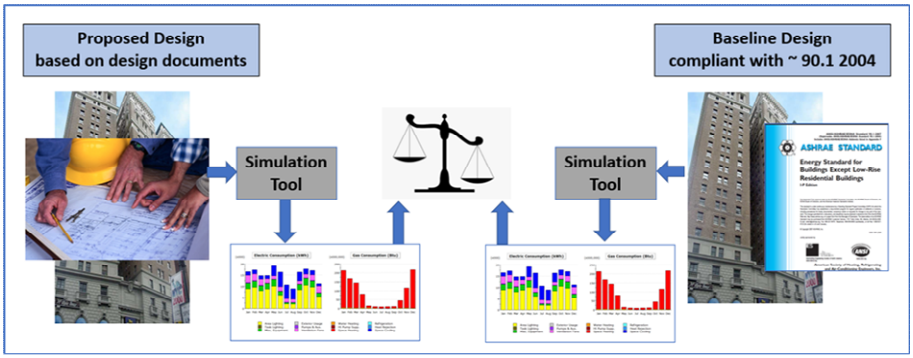
C407.2 Relative Performance

Highlights. The Relative Performance path is based on ASHRAE 90.1 Appendix G Performance Rating Method (PRM) with MA amendments. It establishes compliance based on the relative energy use of two models - the *proposed design* model and the *baseline design* model (Figure 1). The *proposed design model* must reflect design documents.

Prior to 2016 edition of 90.1, the *baseline model* represented a version of the proposed design with all its systems and components modified to minimally comply with the current edition of 90.1. Starting with 2016 edition of 90.1, the *baseline model* is fixed at the efficiency levels that are approximately aligned

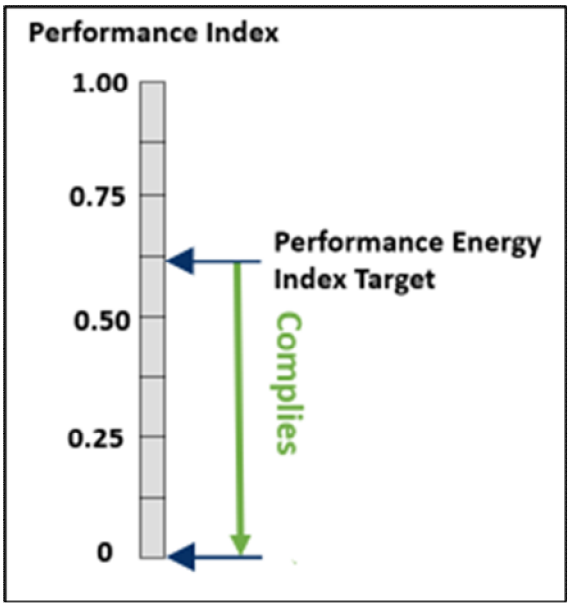
with efficiency requirements in 90.1 2004. The increase in stringency of the consecutive editions of 90.1 is achieved by increasing the margin of improvement that proposed design must demonstrate relative to this stable baseline. In addition, except for the space programming and operating schedules, configuration of the baseline model is now independent of the proposed design. For example, the baseline space and service water heating fuel and fenestration area are prescribed based on building occupancy type and climate zone and independent of the specified systems and components. The new Appendix G stable and independent baseline is conceptually similar to the numeric targets used by the Targeted Performance path.

General Concept of the Relative Performance Path



Compliance is established by calculating the *performance index* as a ratio of the proposed building energy use to the baseline building energy use and comparing this performance index to the performance index target. Projects with performance index at or below the performance index target comply with code (Figure 2). The Performance Index can go down to zero for a Net Zero building when accounting for contribution of renewable energy. While contribution of renewable energy is not allowed for demonstrating compliance with C407.2 Relative Performance, it should be considered by the design team when setting project's efficiency goals.

Compliance Using Performance Index Target



Since the baseline design is generally aligned with efficiency levels required by 90.1 2004, improvement over the baseline must not be confused with improvement over code.

Note that the code does not require energy performance improvement beyond the level mandated by the Performance Energy Index Target (Section C407.2.2.1). However, if the level of improvement over code is desired to be calculated, it may be calculated using Equation 1.

% Improvement Beyond Code = 100% x (PEIt – PEI)/PEIt *(Equation 1)*

Where

PEIt = Performance Energy Index Target calculated following Section C407.2.2.1

PEI = Performance Energy Index calculated following Section C407.2.2.2

Example Using Relative Performance Simulation Results to Demonstrate Improvement Beyond Code

Q1: A project was modeled following the Relative Performance path. The modeling results are shown below:

- Site energy use intensity of the *baseline building design* is 50 kBtu/ft^2
- Site energy use intensity of the proposed design is 25 kBtu/ft^2
- Performance Energy Index Target is 0.55
- Performance Energy Index = 25/50=0.5

Proposed design has 50%lower site EUI than the baseline. Does this mean that the project is 25/50*100=50% improved over code?

A1: No**.** The baseline design represents a building that is approximately as efficient as was necessary to comply with 90.1 2004 and the proposed design is 50% better than this inefficient baseline building.

Q2: Continuing the above example, is there a way to estimate improvement of the proposed design beyond MA Stretch code without developing an additional model of a minimally code compliant design?

A2: Yes. Improvement over code may be calculated using Equation 1**:**

Improvement Beyond Code = (0.55-0.5)/0.55=9.1%

Section C407.2 includes several impactful amendments to 90.1 2019 Appendix G that are summarized in Table 2. The amendments affect how energy modeling results are used to establish compliance and include additional requirements for building systems that projects must meet. These additional requirements are further detailed in **Table XXX** that is included in the commentary to Section C401.2.1.

Key Differences Between 90.1 2019 Appendix G and MA Stretch Code

	90.1 2019 Appendix G	C407.2 Relative Performance
Compliance Criteria	Modeled energy use of the proposed design must improve over modeled baseline energy use by a required margin	
Compliance Metric (Note 1)	energy cost	site energy
Allows contribution of renewable energy toward compliance?	Yes, up to 5% of baseline energy cost	No
Additional Efficiency Requirements (Section C406) apply?	No	Yes, the proposed design must meet C406 additional efficiency requirements. The improvement in performance due to C406 measures can contribute toward achieving building performance factors. Note that baseline is unmodified and does not need to contain C406 additional efficiency requirements.
Additional envelope requirements	90.1 mandatory provisions, must use envelope trade-off method to show that proposed envelope is not worse than prescriptively required by a set margin.	90.1 mandatory provisions, MA Stretch Section C402.1.5 (component performance alternative), prescriptive fenestration requirements
Additional lighting requirements	90.1 mandatory provisions; must not be worse than baseline lighting power (90.1 2004)	90.1 mandatory provisions, MA Stretch daylighting requirements
Additional HVAC requirements	90.1 mandatory provisions	90.1 mandatory provisions, prescriptive requirements for economizer and exhaust air energy recovery
Additional SWH requirements	90.1 mandatory provisions	90.1 mandatory provisions
Stringency (Note 2)	As prescribed in 90.1 2019	10% more stringent than 90.1 2022 on site energy bases

Note 1: The use of site energy metric instead of energy cost allows focusing on energy efficiency and eliminates impact of cost differential between gas and electricity.

Note 2: The Building Performance Factors (BPFs) adopted by Massachusetts are derived from ASHRAE 90.1-2019 Appendix CH, Table X3-1 which provides the set of BPFs for jurisdictions adopting ASHRAE Appendix G on a site basis for compliance with 90.1 2022. The BPFs from this appendix have been further reduced by 10% for the Stretch Code. This 10% reduction, therefore, is "built into" the BPFs. Proponents do not have to further improve energy efficiency of the proposed design beyond what is mandatory to achieve the Performance Energy Index Target in Section C407.2.2.1.

Compliance.

Compliance with the Relative Performance pathways (C407.2) is achieved by using whole building energy modeling following the Relative Performance Simulation Guidelines (Relative Performance Guidelines) in Appendix D of this document to demonstrate compliance with the Performance Energy Index Target (PEIt). In addition, projects must meet requirements listed in Section C401.2.1 #3 that are further described in the commentary to that section. Additionally, projects must meet all applicable mandatory requirements in 90.1 2019 Sections 5.2.1, 6.2.1, 7.2.1, 8.2.1, 9.2.1, 10.2.1 and verification, testing and commissioning requirements in Section 4.2.5 (90.1 Section G1.2.1).

C407.2.1 Electrification and Documentation for Highly Ventilated Buildings

Buildings using the Relative Performance pathway due to average ventilation at full occupancy exceeding 0.5 CFM/ft^2 as allowed in C401.2.1 #2, must submit the supporting information as described in the commentary to Section C103.2#16. Such projects must also have space heating partially electrified as described in the commentary to Section C401.4.1.

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.

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

The modifications include changes from energy cost metric to site energy metric for determining performance outcomes. In addition, Table 4.2.1.1 is modified to include the Building Performance Factors (BPFs) that are based on site energy and modifies Table G3.1.1-1 to require modeling baseline fenestration area equal to 24% of gross above-grade wall area in multifamily building types. The modeling requirements of C407.2 Relative Performance pathways are further detailed in the Relative Performance Simulation Guidelines.

C407.3 Passive House

Passive House compliance requires pre-certification either with Phius CORE 2021 or Phius ZERO 2021 with Phius-approved software and a Certified Passive House Consultant, or with the Passive House Institute (PHI) Certified Passive House standard with approved software and a Certified Passive House Designer and Certifier.

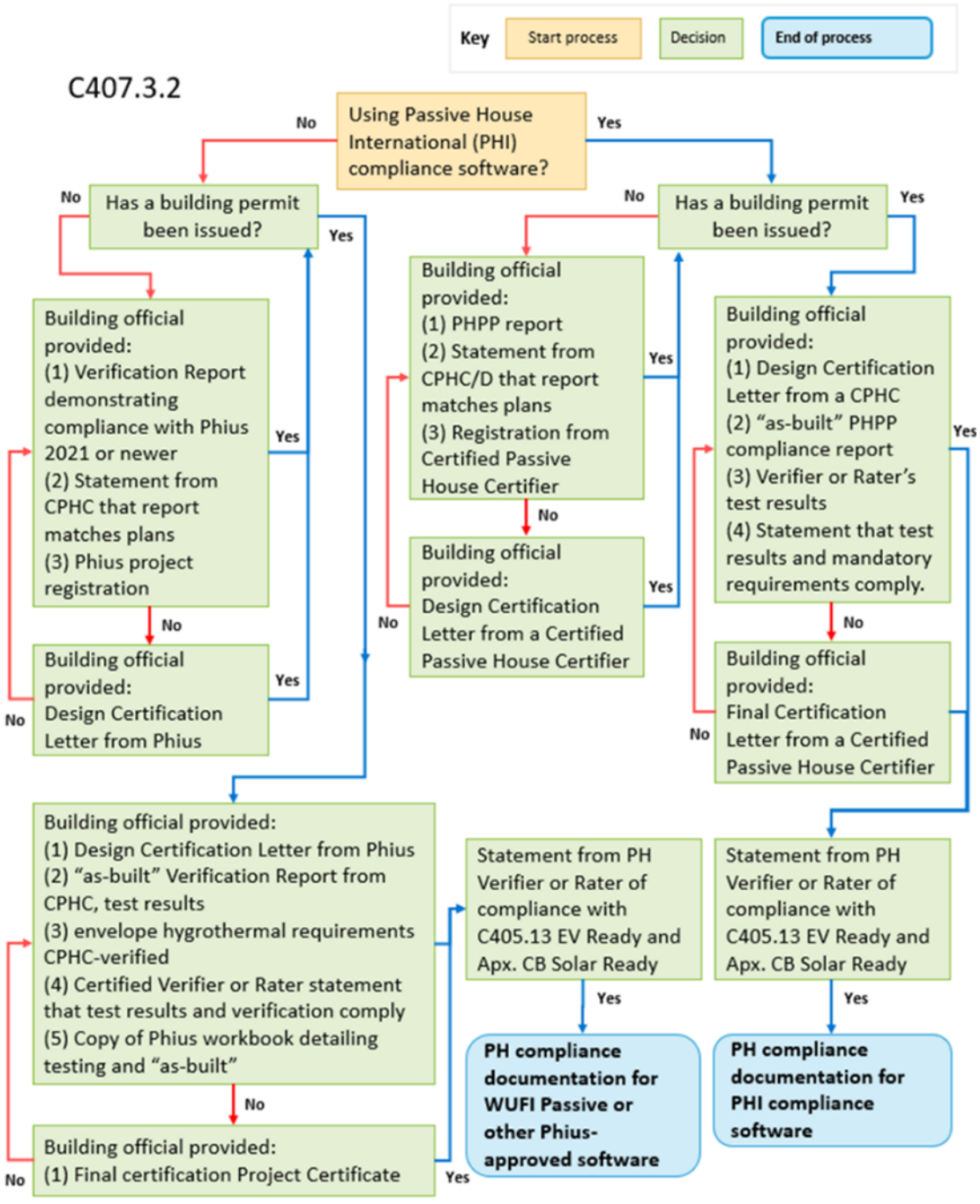
Additional Information

Passive House Building and Professional Certifications

The Passive House Institute US (Phius) is a non-profit organization which certifies professionals, buildings and products to promote climate-specific high-performance passive buildings. If pursuing Phius certification for code compliance, certified professionals to assist can be found on the Phius website:
Find a Professional | Phius

The Passive House Institute (PHI), based in Germany, maintains a separate international passive house certification program. PHI also certifies buildings, products and professionals to advance high-performance passive buildings. Certified professionals and other resources to learn more about PHI certification can be found on their website:
Passivhaus Institut (passivehouse.com)

Documentation varies by the Passive House compliance program chosen, but generally is divided into building permit and certificate of occupancy documentation phases. Requirements are detailed in C407.3.2.2 for Passive House International (PHI) compliance and C407.3.2.1 when using WUFI Passive or other Phius approved software.

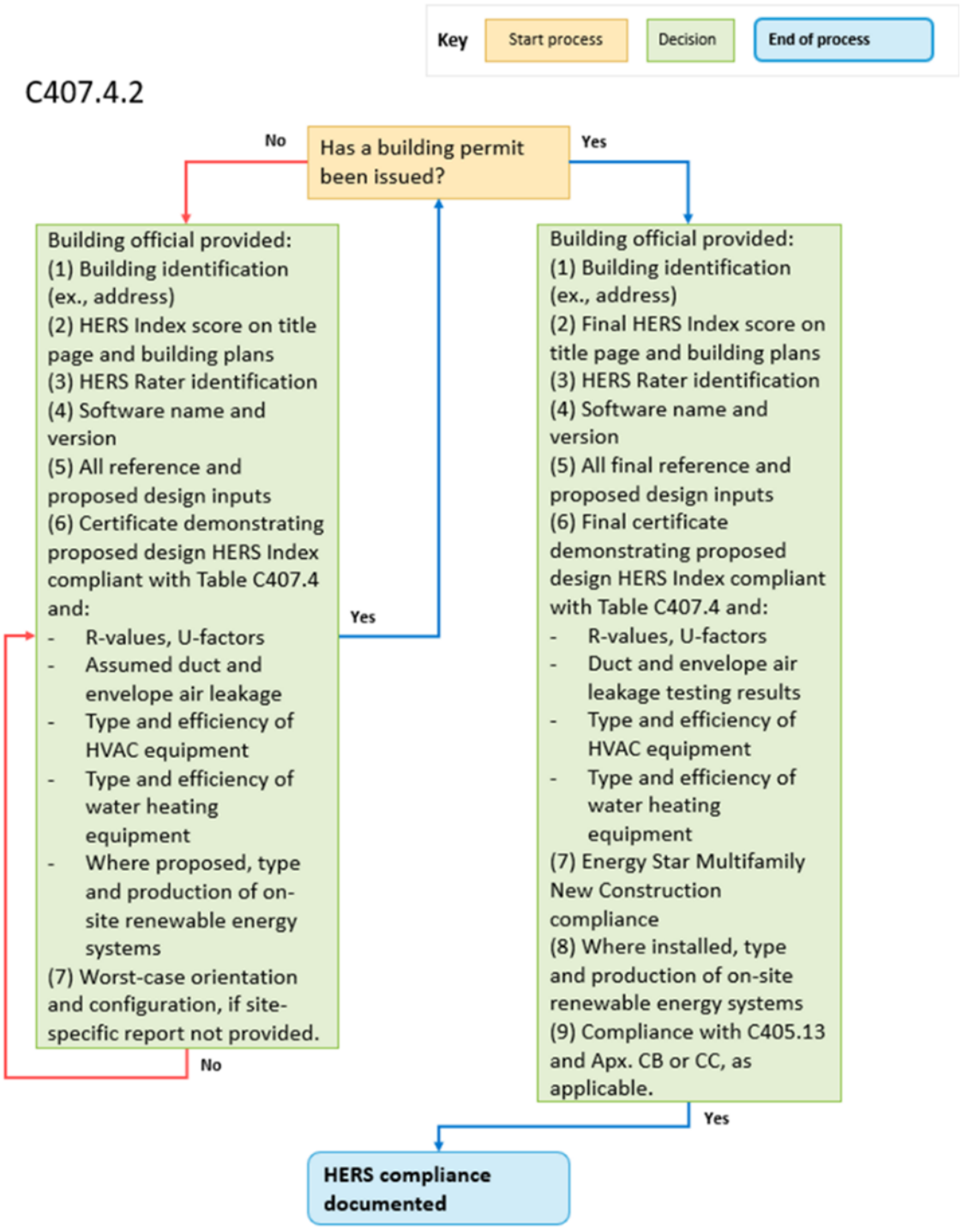


CPHC/D = Certified Passive House Consultant/Designer

C407.4 HERS Index (HERS) for multifamily buildings

The Residential Energy Services Network (RESNET) Home Energy Rating System (HERS) Index is a calculation comparing a proposed design to a 2006 IECC geometric copy, resulting in a score where 100 is equivalent to the 2006 model and zero is net-zero energy use. Unique to a HERS rating, calculation and field-verification is performed by a Certified HERS Rater. All building systems contribute to a HERS score and are tradeable to achieve the final value. Maximum HERS scores without on-site renewable energy by compliance path are in Table C407.4. Additionally, buildings must comply with ENERGY STAR Multifamily New Construction requirements, creating backstops for HVAC, envelope, lighting, appliances, and water heating.

Documentation is divided between construction and occupancy permitting.


Key
Start process
Decision
End of process
C407.4.2
Has a building permit been issued?
No
Yes
Building official provided:
(1) Building identification (ex., address)
(2) HERS Index score on title page and building plans
(3) HERS Rater identification
(4) Software name and version
(5) All reference and proposed design inputs
(6) Certificate demonstrating proposed design HERS Index compliant with Table C407.4 and:
- R-values, U-factors
- Assumed duct and envelope air leakage
- Type and efficiency of HVAC equipment
- Type and efficiency of water heating equipment
- Where proposed, type and production of on-site renewable energy systems
(7) Worst-case orientation and configuration, if site-specific report not provided.
Yes
No
Building official provided:
(1) Building identification (ex., address)
(2) Final HERS Index score on title page and building plans
(3) HERS Rater identification
(4) Software name and version
(5) All final reference and proposed design inputs
(6) Final certificate demonstrating proposed design HERS Index compliant with Table C407.4 and:
- R-values, U-factors
- Duct and envelope air leakage testing results
- Type and efficiency of HVAC equipment
- Type and efficiency of water heating equipment
(7) Energy Star Multifamily New Construction compliance
(8) Where installed, type and production of on-site renewable energy systems
(9) Compliance with C405.13 and Apx. CB or CC, as applicable.
Yes
HERS compliance documented

Chapter 5 [CE] Existing Buildings

Changes to existing buildings are treated as either: Additions, Alterations, Repairs, or Change of Use depending upon the planned changes to the existing building (see sidebar for definitions).

Additional Information

For reference, the unchanged definition from IECC:
ADDITION. An extension or increase in the conditioned space floor area, number of stories or height of a building or structure.

ALTERATION. Any construction, retrofit or renovation to an existing structure other than repair or addition. Also, a change in a building, electrical, gas, mechanical or plumbing system that involves an extension, addition or change to the arrangement, type or purpose of the original installation.

CHANGE OF OCCUPANCY. A change in the use of a building or a portion of a building that results in any of the following:
1. A change of occupancy classification.
2. A change from one group to another group within an occupancy classification.
3. Any change in use within a group for which there is a change in the application of the requirements of this code.

REPAIR. The reconstruction or renewal of any part of an existing building for the purpose of its maintenance or to correct damage.

Of particular note: Buildings or spaces changing occupancy and increasing energy use are not treated as simple alterations. These buildings must comply with Sections C401.3, C402 through C406, and Section C408. (See sidebar) Existing buildings always have the option of complying as if they were new buildings, following the requirements in C401.2. For example, converting a factory into apartments could comply with a certified Passive House design. Mixed-use buildings must comply with C401.2.4 where multiple space uses are in the scope of the project. Exceptions for historic buildings remain unchanged in C501.5.

The Chapter 5 decision tree is a high-level application of requirements for potential modifications to existing buildings.

Additional Information

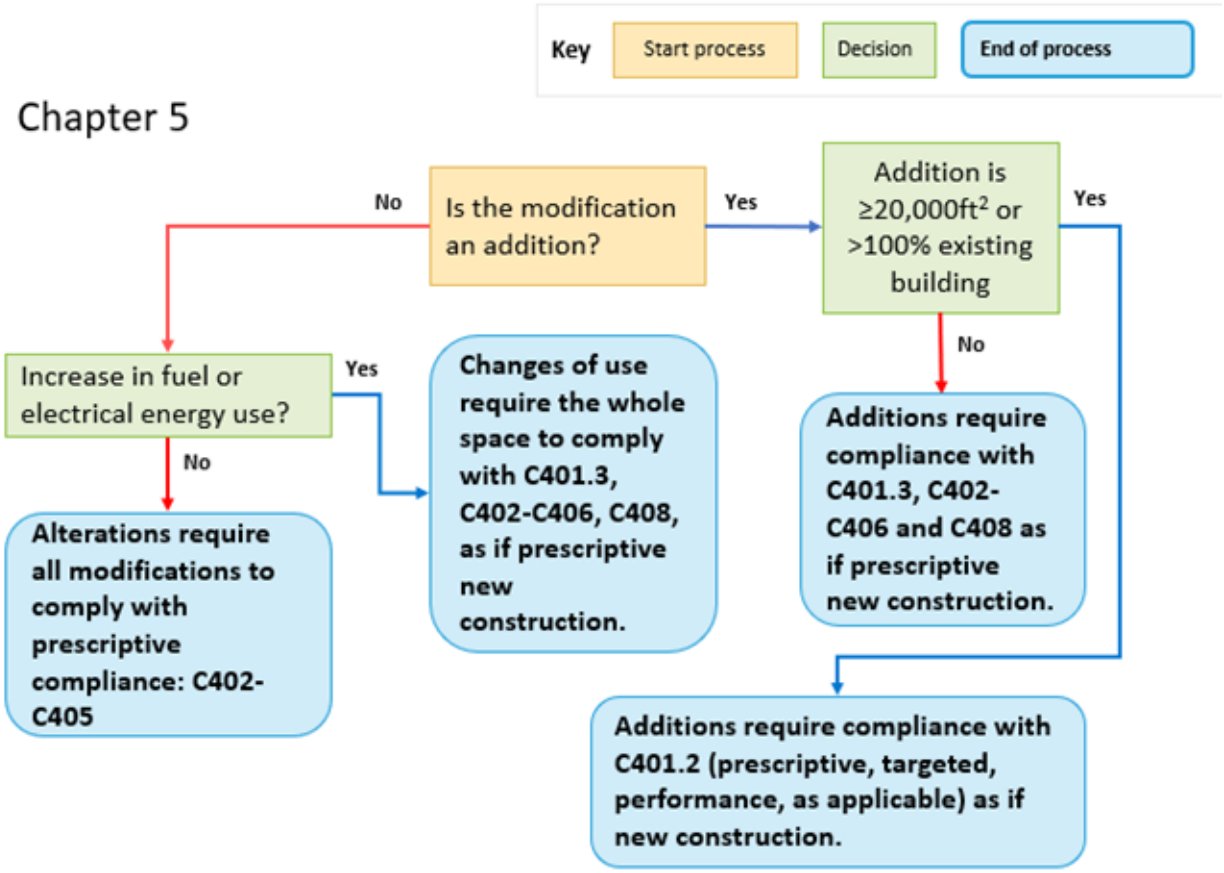
Is the proposed change an “Alteration” **or** “Change of Use”

If proposed changes to a building will increase demand for energy, including but not limited to fossil fuel, biomass or electric energy, then you have a **change of use,** not an alteration. Change of use requires the building conform to prescriptive Stretch Code provisions, like new construction, including envelope requirements, albeit with a UA accommodation.

Proposed changes are an Alteration only when you don’t increase either energy, including but not limited to fossil fuel, biomass or electric use.

IECC has always required change of use be treated like new construction. The stretch code amendments make it explicit that prescriptive stretch code is required.

While not shown in the decision tree, compliance as if new construction, *i.e.,* C401.2, always is an option for any building.



C502.1 (Additions) General.

Highlights. Requires large additions to be treated like new construction, including following TEDI, ASHRAE, etc. as applicable. Requires small additions to be treated like prescriptive new construction.

Compliance. Section C502.1 is required for all additions to existing buildings under C501.1 "Scope" and C501.2 "Compliance." Compliance paths are detailed below.

Summary. Small additions (see below) comply like prescriptive new construction. Large additions comply as if a new building.

The updated Stretch Code allows building additions which are both (a) less than 20,000ft^2 and (b) less than 100% additional floor area of original to meet the prescriptive requirements of Sections C401.3, C402 through C406, and Section C408. Additions greater than 20,000ft^2 or which are larger than 100% of the size of the existing building must meet applicable Stretch Code requirements for that building type and size as determined by C401.2. Additions can comply alone or the entire new and existing space, together, can comply. Note that C502.2 exceptions are deleted because the sections referenced have been changed significantly.

C503.1 (Alterations) General.

Highlights. Explicitly requires that any alterations shall comply to Section C402, C403, C404, C405, and C503. Adds compliance with additional sections.

Compliance. Compliance with Section C503.1 is required where work done to an existing building does not constitute an addition, repair, routine maintenance, or a change in occupancy resulting in an increase in energy use.

Summary. The Stretch Code requires altered portions of an existing building comply with the requirements of Section 503 and the prescriptive Sections C402 (envelope), C403 (mechanical), C404 (water heating), and C405 (electrical) without requiring unaltered portions of an existing building to comply.

Of primary importance, if the construction changes the occupancy and increases energy use, it is a Change of Occupancy or Use complying with C505, **not** an alteration. If construction adds conditioned space – whether new space or unconditioned existing space becoming conditioned – it is an Addition complying with C502, **not** an alteration. Repairs, C504, and Maintenance, C501.3, are not alterations.

Additional Information

In an alteration, what do I have to update?

In general – if you touch it, you have to update. If you don't touch, you don't have to update.

The key requirement in this section is (added italics):

"Alterations to an existing building, building system or portion thereof shall conform to the provisions of this code as those provisions relate to new construction *without requiring the unaltered portions of the existing building or building system to comply with this code."*

The Stretch Code replaces an existing exception, C503.1 Ex.3, which allowed exterior opaque assemblies exposed during construction to be in compliance when "filled with insulation." Instead, the Stretch Code allows walls not meeting the prescriptive envelope requirements to use an area-weighted U-factor, allowing what is permitted in C402.1.5 to be increased by 10%. Importantly, this 10% reduction in required performance still requires the derating calculations in C402.7. Because only above-grade exterior walls are in the scope of C402.1.5, other assemblies are required to comply prescriptively – which, also, allows using Massachusetts Stretch Code-specific COMcheck in accordance with Section C402.6.

Example Calculation

Area-weighted U-factor for Alterations

For low glazed wall system buildings, the area-weighted U-factor of the proposed design must be not greater than U-0.1285, the target UA. Where complying with C503.1 Ex.3, that target UA is permitted to be increased by 10%, therefore 0.1285 * 1.1 = 0.1414. Likewise, the target UA for high glazed wall system buildings, 0.1600, becomes U-0.176.

C505.1 (Change of Use or Occupancy) General.

Highlights. Explicitly adds compliance with additional sections but is functionally unchanged.

Compliance. Section C505.1 is required for spaces or buildings changing occupancy with an increase in energy demand. Compliance is detailed below.

Summary. The IECC 2021 requires buildings going through change of use or occupancy to comply prescriptively as if new construction. The Stretch Code makes that requirement explicit by referencing the prescriptive sections, but it functionally is the same as the original language. Language requiring lighting retrofit compliance is retained, as is an allowance for existing fenestration above the limits set in the prescriptive path. Three critical takeaways:
(1) Spaces where energy use is increased must comply with the requirements for new construction. Where the scope of the change is the whole building, the whole building must comply as a new building.
(2) Usually, prescriptive compliance is chosen, because it is perceived as being the easiest path. However, any new construction compliance is permitted. For example, any building could use C401.2.2 "Passive House Compliance"; buildings not required to use Targeted Performance could use C401.2(3) "Relative Performance". Sometimes certified or modeling compliance adds flexibility for existing conditions.
(3) Where an area-weighted U-factor is chosen for vertical assembly compliance, an additional 10% allowance is provided for Change of Use or Occupancy. See calculations in C503.1.

Appendix CC, Massachusetts Municipal Opt-in Specialized Energy Code 2023.

Highlights. This appendix is entirely new in MA code but utilizes the IECC 2021 Appendix CC with revisions.

Compliance. Where adopted by a jurisdiction, Appendix CC and corresponding Appendix RC (for low-rise residential buildings) define the eligible energy code compliance pathways for the Specialized opt-in energy code. Broadly, three compliance paths overlay the changes already made by the Stretch Code, these compliance paths are: Zero Energy, All-Electric, and Mixed-Fuel.

Summary. In the same way that the Massachusetts Stretch Code overlays the 2021 IECC, the Specialized Code overlays the changes in the Stretch Code. In addition, Residential buildings and dwelling units in Mixed-Use buildings have different requirements by size and are phased-in by permit date.

The Specialized Code maintains the same energy efficiency requirements as the Updated Stretch Code for all building types except multi-family, including Prescriptive, Targeted Performance, and Relative Performance Compliance.

Multi-family buildings over 12,000ft2 built to the Commercial Specialized Code must achieve precertification to Passive House standards (PHI or Phius). These requirements are phased-in for buildings up to five stories required to meet Passive House requirements if applying for permits on or after January 1, 2023, and taller buildings six stories and above required to meet Passive House for permit applications beginning on or after January 1, 2024.

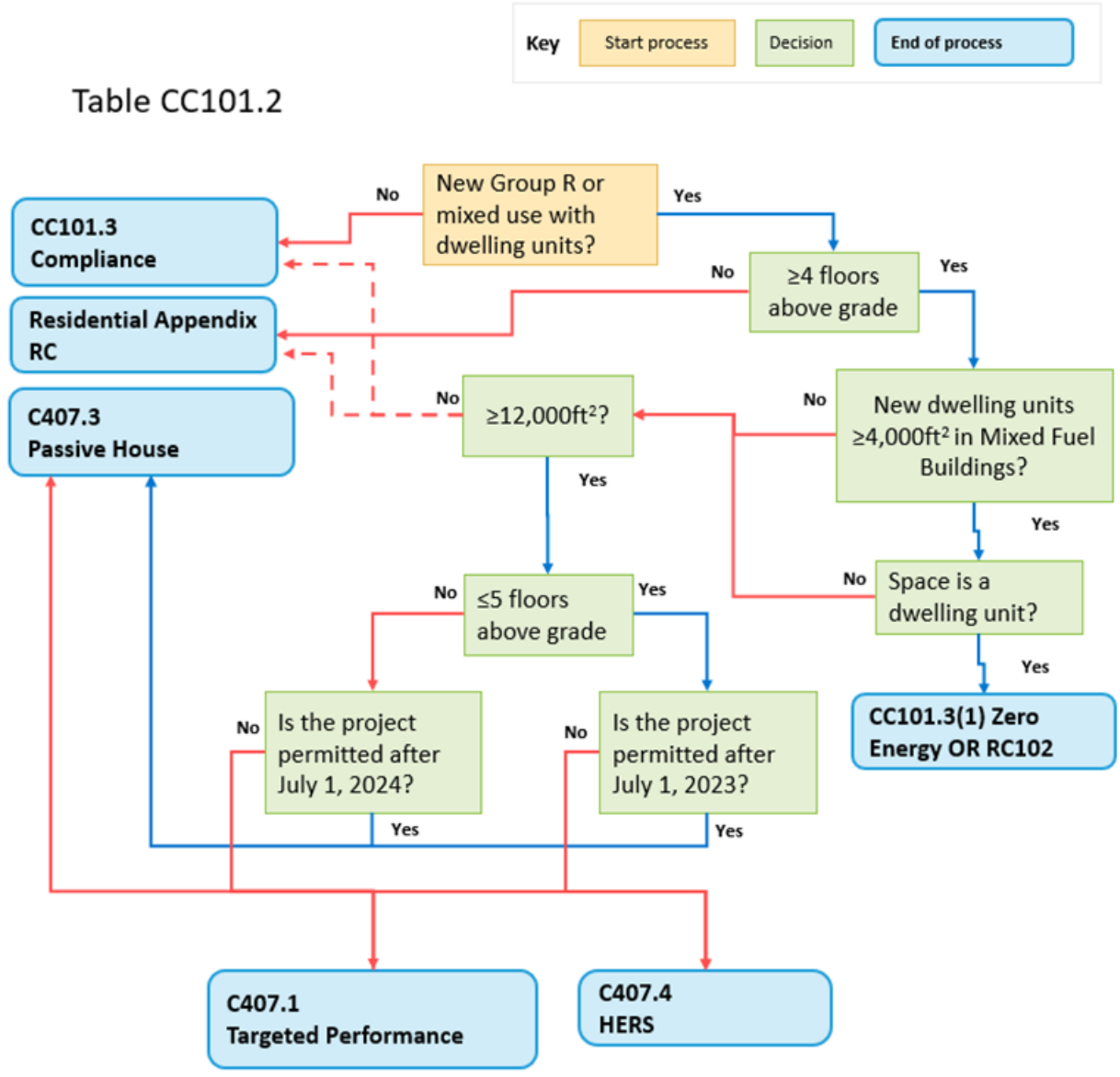
CC101.2 Scope.

Highlights. Specific requirements for all new buildings, including residential buildings and dwelling units, depending on size, fuel, and permit date.

Compliance. Where adopted by the jurisdiction, all new buildings that use energy are in scope.

Summary. Residential buildings having more than 12,000ft^2 of conditioned floor area comply with Table CC101.2 – see flowchart. Dwelling units over 4,000ft^2 in buildings using fossil fuels comply with either CC103 or RC102. Compliance for other buildings is in CC101.3. Residential buildings less than 12,000ft^2 of conditioned floor area may comply with the low-rise residential options in Appendix RC.

Residential occupancies have requirements that vary by size – floors above grade, floor area – and date permitted. This flowchart includes the project characteristics that expand or restrict compliance options.



CC101.3 Compliance.

Highlights. Entirely new language. Three primary pathways are available.

Compliance. All new buildings must comply.

Summary. Buildings must comply with CC101.4 (essentially C401.2, one of the Stretch Code compliance paths) and CC101.5 (C405.13, electric vehicle parking spaces). Additionally, in general, compliance with the Specialized Code is achieved through 1 of 3 pathways:

1. Zero Energy, CC103, where renewable energy is used to offset all annual energy used by the building, and any fossil fueled equipment is pre-wired for future electric equipment.
2. All-Electric, CC104, any Stretch code compliance pathway equipped with all-electric equipment. Note: the HERS pathway starts at HERS 45 rather than HERS 55.
3. Mixed-Fuel, CC105 and CC106, requiring the installation of on-site renewable generation, high-efficiency equipment, and pre-wiring for any buildings with fossil fueled equipment.

CC102 Definitions.

Unlike the Solar Zone from the 2021 IECC, MA Base Energy Code, or Stretch Code, the Potential Solar Zone Area as defined includes parking areas and additional roof areas; that is, the area described in the Specialized Code allows considerably more solar access for compliance with on-site generation requirements. Note that the solar zone in the Mixed Fuel pathway (CC105.2) is supplemented by the installation of on-site renewable generation.

Based on site energy, through efficiency and on-site generation, a Zero Energy Building that contributes as much to the grid as it consumes. The scope is energy consumed on-site, so EV charging is excluded.

CC103 Zero Energy Pathway.

Highlights. This is entirely new to MA code but utilizes the IECC Appendix CC with modifications to include only on-site renewable energy.

Compliance. One of three Specialized Code compliance paths in CC101.3 in addition to the portions of the Stretch Code required by building type, size, and date permitted.

Summary. This path requires building energy modeling to determine an energy utilization intensity (EUI), the annual average energy used per square foot of floor area.

CC103.1 Renewable Energy.

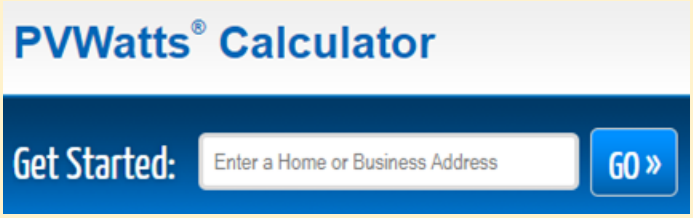
Table CC103.1 has EUI limits for climate zone 5A by use type. Ideally, the EUI is minimized so that the needed on-site renewable generation to offset it is simpler; expressed in Equation CC-1, the on-site generation must be equal to, or greater than, the building energy use. On-site back-up generators and charging/fueling stations are not included in this calculation.

CC103.2 Calculation of On-site Renewable Energy.

The National Renewable Energy Laboratory has developed the PVWatts Calculator, which is the default tool for solar energy generation estimates; other approved means are an option and likely will be necessary for larger or more complicated systems. Group R buildings can comply by demonstrating that all units achieve not greater than HERS = 0 or Phius ZERO using the Passive House pathway in Appendix RC. Note that off-site renewable generation or the purchase of Renewable Energy Credits (RECs); while allowed, are not an option for compliance with the on-site renewable energy requirements in the Specialized Code.

Additional Information

NREL's PV Watts Calculator can be used to estimate the production of on-site solar systems. A solar contractor should be consulted for an additional estimate.



PVWatts Calculator (nrel.gov)

CC104 All Electric Pathway.

Highlights. Entirely new language for All-Electric buildings compared to the IECC Appendix CC. This pathway requires all energy services to be provided by electric power, with exceptions for external back-up generation.

Compliance. One of three Specialized Code compliance paths in CC101.3 is required in addition to the portions of the Stretch Code required by building type, size, and date permitted.

Summary. There are five compliance options for *All-Electric buildings.*

1. Prescriptive Compliance and all electric equipment
2. Passive House
3. Group R before 2024 can have all units not greater than HERS 45.
4. TEDI for offices and municipal buildings
5. ASHRAE for high ventilation buildings

CC105 Mixed-Fuel Building Pathway.

Highlights. Entirely new language for Mixed-Fuel buildings compared to IECC Appendix CC.

Compliance. One of three Specialized Code compliance paths in CC101.3 in addition to the portions of the Stretch Code required by building type, size, and date permitted. CC106 also is required.

Summary. Mixed-Fuel buildings generally must install renewable energy generation and high-efficiency equipment. Under the Specialized code mixed-fuel buildings require a solar PV installation onsite in available unshaded spaces, except when complying with Passive house. In all cases mixed-fuel buildings are required to be electrification-ready including pre-wiring for future electric conversion of any fossil fuel end uses.

CC105.1.1 Biomass Heating.

If biomass combustion equipment is included in a building it puts the building in the mixed-fuel building pathway. However, where the biomass combustion equipment used meets the definition below, CC105.3 is not required.

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.

Note: This definition is also used to qualify Clean Biomass heating systems for incentives under the Alternative Portfolio Standard (APS), for more information see: https://www.mass.gov/service-details/qualifying-woody-biomass-in-the-aps

CC105.2 On-site Renewable Energy

On-site renewable energy systems must have a rated capacity of 1.5 watts multiplied by the sum of the conditioned floor area of the three largest floors. If this amount of renewable generation is not possible, a system utilizing 75% of the *Potential Solar Zone Area* can be installed.

Calculation
Solar PV Minimum Sizing Example ***Per Code:*** CC105.2 On-site renewable energy. New mixed-fuel buildings shall have equipment installed for the on-site renewable energy with a rated capacity of not the less than 1.5 W/ft^2 (16.1 W/m^2) multiplied by the sum of the gross conditioned floor area of the three largest floors. Exception: Where the building site cannot meet the requirement in full with an on-site renewable energy system, the building site shall install a partial system designed to utilize not less than 75% of the *Potential Solar Zone Area.* Examples of minimum Solar PV size: 1. Four story 200,000 ft^2 High School with 160,000 ft^2 on three largest floors Minimum Solar = 1.5 x 160,000 = 240 kW system 2. Three story 80,000 ft^2 Elementary School Minimum Solar = 1.5 x 80,000 = 120 kW system

However, in this example the elementary school is on a shaded site and a 120 kW system is not achievable. The potential solar zone area is measured to be 10,000 ft^2 of the roof in this example. Using the Exception, a system covering at least 7,500 ft^2 is permitted, and perhaps results in an approximately 75 kW system rather than 120 kW.

CC105.3 Additional Efficiency Requirements.

Additional requirements are in RC104.3.1 through RC104.3.3. Space heating, space cooling, and water heating systems are required to be more efficient in this compliance path. Additionally, where multiple systems serve the space, collectively they are sized not to exceed the heating and cooling demand; that is, no oversizing. Clean biomass heating systems are deemed to comply.

CC106 Wiring for Future Electrification.

Highlights. Entirely new language for Mixed-Fuel buildings.

Compliance. Required for compliance with CC105 Mixed-Fuel Building Pathway.

Summary. Where fossil-fueled equipment or end-uses is installed, space, access, and electric infrastructure must be provided to install equivalent electric equipment in the future; generally, that means at least a branch circuit terminated within 3 feet of the installed equipment and additional capacity at the electrical panel.

Starting with exceptions:

- *Dwelling* and *sleeping units* comply with RC104.4. Commercial kitchen equipment for business use and drying equipment for manufacturing is exempted.
- Equipment not specifically listed in this section requires continuous conduit, electrical panel space, and bus sizing to accommodate future electrification.
- Equipment not specifically listed in this section in highly ventilated buildings (average ventilation greater than 0.5cfm/ft^2) complies with CC106.1.6.

Water heating. Fossil-fueled water heaters with a capacity less than 300,000 Btu/h require a 30-amp branch circuit, a condensate drain, space, supply and exhaust air volume.

Cooking equipment. Commercial equipment likely is exempted and dwelling- and sleeping units comply with Appendix RC. What equipment remains must have a 40-amp circuit installed.

Clothes drying. A 30-amp circuit is required. Equipment for manufacturing and process loads is exempt. A commercial laundromat it would be exempt. Laundry in multifamily must meet this requirement.

Other equipment. Uninterrupted conduit and increased sizing of electrical infrastructure for each combustion device. Again, the intent is that fossil-fueled equipment energy needs are translated to electrical energy when sizing all components and paths to connect the future electrical equipment are installed and labeled.

Additional Information

What Needs to Be Shown on Contract Documents?
Section C103.2 has additional documentation requirements, including a new item, #17, showing the future electric HVAC retrofit design required in CC106.1.6 for Mixed-Fuel Buildings. Fossil-fueled HVAC equipment replacement plans must include the existing pre-installed electric infrastructure, the structural and architectural infrastructure installed, the equipment to be replaced, the space for it, and the specifications the new equipment must meet.

Other equipment in highly ventilated buildings. For HVAC, an approved design must be provided in construction documents *per* C103.2(17) with fossil-fueled equipment, detailing retrofits for electrification serving all current loads without altering distribution systems. Efficiencies for retrofit space and water heating are in C401.4.3. Like other electric-ready requirements in this section, infrastructure for electric equipment must be installed at the time of initial construction, including electric service, controls conduit, future interior and exterior space, and structural and architectural elements.

Additional Information

What needs to be installed during original building construction?

Reference Section: C106.1.6.4

- Power infrastructure to building to accommodate future electric retrofit system
- Electric service to future distributed equipment within building
- Conduits to accommodate controls to future distributed equipment within building

Structural and architectural elements to accommodate future retrofit equipment

Additional Information

What space needs to be aside for future electrification during original construction?

Reference Section: C106.1.6.5

- 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.

Residential and Low-rise Multi-family Stretch and Specialized Code Measures

This chapter applies to low-rise R-use occupancies defined as *Residential Buildings* by section R202 in MA 10th edition IECC 2021. This includes detached one- and two-family dwellings, townhouses and Group R-2, R-3 and R-4 buildings three stories or less in height above grade. Buildings with 4 stories or more above grade plane follow the commercial chapter, except that multi-family buildings less than 12,000 sf of total conditioned floor area of any height may follow this chapter.

The guidance in this chapter applies to projects that will permit within an Authority Having Jurisdiction that has adopted the MA Stretch Code and those that have adopted the Specialized Code. As explained earlier in this Guideline, projects subject to the Specialized Code must meet the requirements of the Stretch code and additional requirements from Appendix RC. These additional requirements for the Specialized Code only are included in the next chapter.

Additional Information

The State has published some resources to help users easily identify code updates and requirements.
Summary: This high-level summary covers major requirements in the Stretch and Specialized Codes.
https://www.mass.gov/doc/summary-document-explaining-stretch-energy-code-and-specialized-opt-in-code-language/download
Residential Stretch and Specialized Codes Massachusetts front-end amendments to the IECC 2021:
https://www.mass.gov/doc/225-cmr-2200-residential-specialized-stretch-energy-code-clean-front-end-amendment-for-december-8-2022/download

Some new requirements in the Stretch and Specialized codes are relatively straight forward and do not warrant additional guidance. Although not a comprehensive list of all code updates, the table below includes brief summaries of key new requirements that should be reviewed in the relevant code sections. Additional guidance for more complex or nuanced code updates has been included in this chapter.

Table: Brief Summaries of Key New Requirements Not Included in Chapter

Code Section	Summary of Measure
R103.2	Requires Solar Zone Area to be shown on construction documents when complying with Appendix RC for fossil-fuel heated homes and Solar-Ready Zone to be shown when complying with Appendix RB.
R202	Adds definitions for All-Electric Building, Combustion Equipment, Enthalpy Recovery Ratio, Mixed-fuel Building and Potential Solar Zone Area. Modifies definitions for Clean Biomass Heating System, Electric Vehicle Charging Space and High-efficacy Lamps.
R405.2	Modifies requirements for proof of project registration, Design certification with PHIUS or pre-certification approval at time of permit application or Certificate of Occupancy. Also requires compliance with Appendix RB: Solar Ready Provisions.
R406.2	Adds Heat or Energy Recovery Ventilation to requirements for Energy Rating Index.
R502.2	Unconditioned or low-energy spaces that are altered to become conditioned space are required to meet code requirements without exception.
R502.3	Only new envelope assemblies in additions less than 1,000sf can be exempted from insulation installation criteria requirements.
RB103.1	Solar Ready Zone requirements in Appendix RB apply to all R-use buildings, not only one- and two-family dwellings and townhouses.

R202 General Definitions

Highlights. New definitions have been added while others have been modified.

Compliance. Section R202 is applicable to all projects utilizing the Stretch Code.

Summary. The definitions for All-Electric Building and Mixed-Fuel Building are of particular importance because they dictate compliance requirements in the Stretch Code.

In particular, the definition for *All-Electric Building* dictates that no combustion equipment can be used on-site for space heating, water heating, cooking or drying appliances (clothes drying). Exterior generators and outdoor propane grills may be included in All-Electric buildings, however indoor gas fireplaces and propane/ gas cooktops may not be included. Homes built with non-electric fireplaces and gas, or propane cooking equipment are instead required to comply with the Mixed-Fuel compliance path.

All-Electric buildings must comply with both space heating and water heating requirements from R408 and have higher allowed HERS Scores, compared to Mixed-Fuel buildings, when using the HERS compliance path in R406.

Mixed-Fuel Buildings on the other hand do include combustion equipment or piping for combustion equipment. Fossil fuel fireplaces or biomass heating equipment also trigger the Mixed-fuel pathway. The maximum allowed HERS scores are also lower, when compared to All-Electric Buildings, when using the HERS compliance path in R406.

Additions, Alterations and Change of Use requirements in Chapter 5 depend on the square footage of the project or dwelling unit. Large additions, specified in R502.1.1 as additions to a dwelling unit exceeding 1,000 ft^2 or exceeding 100% of the existing conditioned floor area, have different requirements than additions 1,000 ft^2 or less. Requirements for Alteration and Change of Use projects also depend on whether or not the project exceeds 1,000 ft^2.

Historic Buildings, as defined in Chapter 2, are exempt from these code requirements for repairs, restorations, alterations and change of occupancy per R501.6 and with the approval of the Authority Having Jurisdiction.

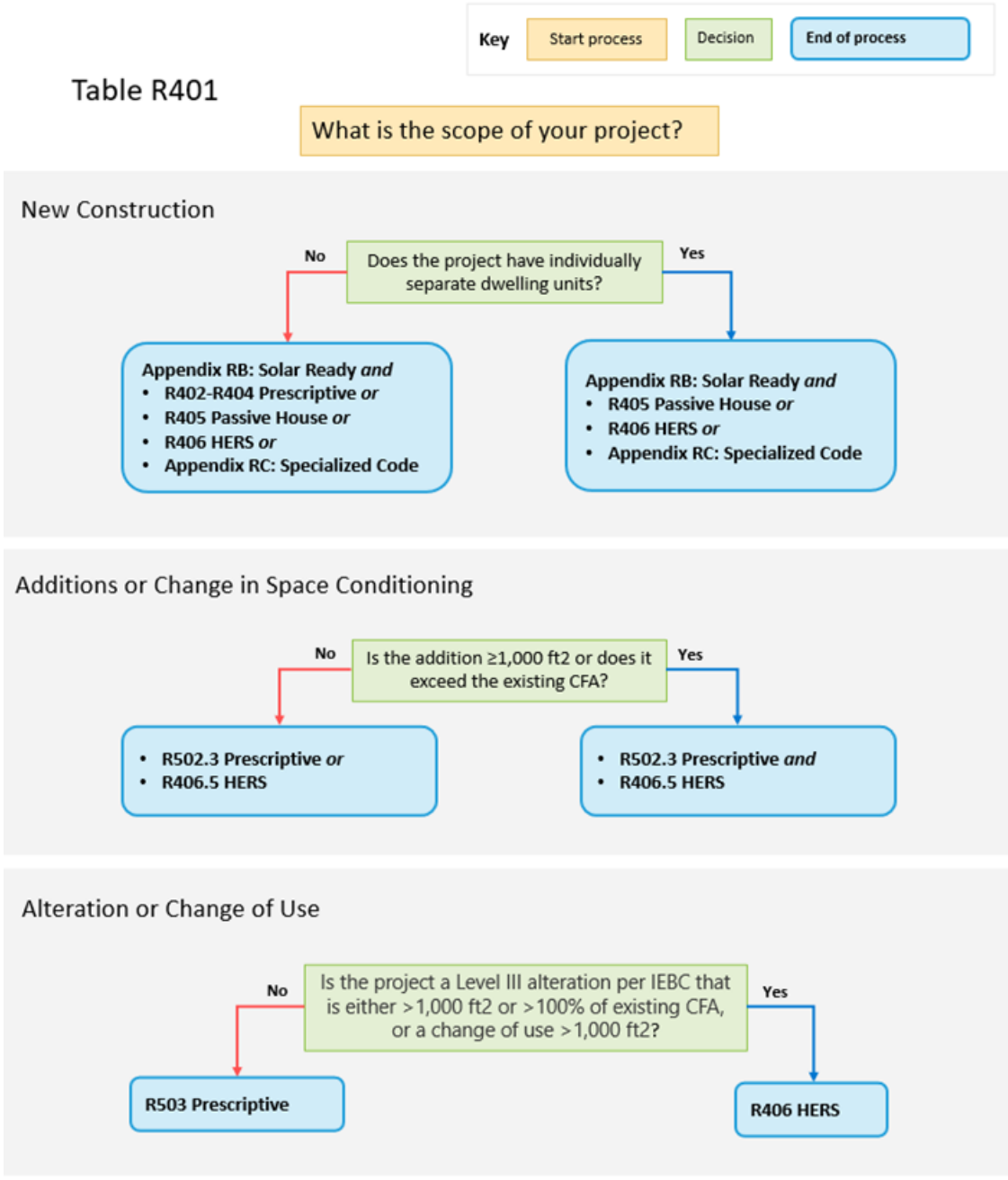
R401 General

Highlights. The residential Stretch Code continues with HERS rating as the primary pathway for new construction. ENERGY STAR® is dropped as a compliance path, while Passive House options remain. Compliance pathways for HERS and Passive House have been updated. Projects eligible for prescriptive compliance are limited, and primarily apply to existing building alterations and additions.

Compliance. Section R401 is applicable to all projects utilizing the Stretch Code.

Summary. Compliance paths available to each project depend on the scope of the project as well as other factors such as size of project (square footage) or level of alteration. The following flowchart can help you identify which compliance paths are available to your project.

Table R401



Additional Information

Individually separate dwelling units.

Individually separate dwelling units are units that provide complete independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking and sanitation (i.e., do not share cooking, bathing, or toilet facilities.) Apartments, condominiums, townhomes and single-family homes are examples of individually separate dwelling units. Examples of buildings that may not have individual separate dwelling units are dormitories, barracks, and assisted living facilities.

Each compliance path is summarized below, though code sections should be reviewed in detail for requirements.

HERS Index Score: Sections R403.6 (Ventilation), R404.4 (EV Ready), R406 (HERS) & Appendix RB (Solar Ready)

Complying via the HERS Certification pathway involves meeting lowered HERS score maximums as well as providing a balanced mechanical ventilation system, EV Ready parking and meeting Solar Ready provisions per Appendix RB.

The HERS score maximums have been revised and vary based on whether the building is Mixed-Fuel, All-Electric and whether onsite solar is included. The allowed maximums for new construction reduce for projects permitted after June 30, 2024. Major alterations, additions and changes of use have their own scores in Table R406.5.

Table R406.5 MAXIMUM ENERGY RATING INDEX

Clean Energy Application	Maximum HERS Index Score [a, b]		
	New Construction until 6/30/24	New Construction after 7/1/24	Major alterations, additions, Change of Use [c]
Mixed-Fuel Bldg	52	42	52
Solar Electric Generation	55	42	55
All-Electric Bldg	55	45	55
Solar Electric & *All-Electric Bldg*	58	45	58

[a] Maximum HERS rating prior to onsite renewable electric generation in accordance with Section R406.5

[b] The building shall meet the mandatory requirements of Section R406.2, and the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or Table R402.1.4 of the 2015 IECC.

[c] Alterations, Additions or Change of Use covered by Section R502.1.1 or R503.1.5 are subject to this maximum HERS rating.

In addition to meeting HERS scores, projects must meet mechanical ventilation requirements. Minimum system airflow, heat or energy recovery, field testing, fan sound ratings, and air inlet and exhaust locations are all regulated in R403.6. Electric Vehicle (EV) Ready requirements include pre-wiring, a connection point and dedicated panel capacity. Projects must also either install solar systems per Appendix RC102/RC105 or be Solar Ready which includes dedicating a solar zone for future solar system installation, confirming structural loads, providing electrical interconnection pathways and reserved panel space.

Additional Information

HERS Index Score vs. Energy Rating Index (ERI)
Massachusetts amendments to the IECC 2021 require projects to demonstrate compliance with the R406 Energy Rating Index compliance path using the HERS® Index rating. This means all maximum HERS scores in the Stretch and Specialized codes are utilizing the HERS Index rating determined in accordance with the latest version of RESNET/ICC 301. Massachusetts' amendment to only utilize HERS scores

ensures that ratings are subject to quality assurance reviews for consistency, and avoids confusion related to differing ERI and HERS scores. Lists of HERS raters working in Massachusetts are available on the Mass Save website, and from the Northeast HERS Alliance: www.NEHERS.org

For more information on why the two scores differ, refer to this article by RESNET®.

The IECC Energy Rating Index and HERS Index: What's the Difference? - RESNET

HERS Index and Energy Codes - RESNET

Passive House: Sections R404.4 (EV Ready), R405 (Passive House) & Appendix RB (Solar Ready)

Projects utilizing the Passive House Building Certification compliance path can comply via Phius certification or PHI certification per R405, must include EV Ready Spaces per R404.4 and meet Solar Ready provisions from Appendix RB. Approved software must be used to demonstrate compliance with Phius and a Certified Passive House Consultant must be used for design-certification while a Phius Certified Verifier or Rater is used during construction. For the alternate PHI certification, projects are pre-certified using a Certified Passive House Designer and Certified Passive House Certifier.

Both Passive House Building Certification options must also meet Electric Vehicle (EV) Ready requirements including pre-wiring, a connection point and dedicated panel capacity. Both options must also either install solar systems per Appendix RC102/RC105 or be Solar Ready which includes dedicating a solar zone for future solar system installation, confirming structural loads, providing electrical interconnection pathways and reserved panel space.

Additional Information

Passive House Building and Professional Certifications

The Passive House Institute US (Phius) is a non-profit organization which certifies professionals, buildings and products to promote climate-specific high-performance passive buildings. If pursuing Phius certification for code compliance, certified professionals to assist can be found on the Phius website: Find a Professional | Phius

The Passive House Institute (PHI), based in Germany, maintains a separate international passive house certification program. PHI also certifies buildings, products and professionals to advance high-performance passive buildings. Certified professionals and other resources to learn more about PHI certification can be found on their website:

Passivhaus Institut (passivehouse.com)

New Construction Prescriptive: Sections R401- R404 (Prescriptive), R408 (Additional Efficiency Packages) & Appendix RB (Solar Ready)

Prescriptive compliance is only allowed for new construction buildings that do not include individually separate dwelling units, as well as small additions and building alterations. The prescriptive sections include requirements for envelope (R402), HVAC and service water heating systems (R403), and electrical and lighting systems- including EV Ready (R404.) Massachusetts has amended the prescriptive requirements for software eligible for the opaque envelope UA alternative, insulation installation, duct testing, mechanical ventilation, and EV Ready parking, so be sure to reference the base code and Stretch Code amendments if complying prescriptively.

In addition to sections R402-R404, Prescriptive compliance also requires the project to implement two of the additional efficiency packages from R408. Three packages are available including enhanced envelope performance, more efficient HVAC equipment and reduced energy use in service water heating. These packages have also been amended by the State, so reference the Stretch Code for amended requirements.

Like the HERS and Passive House compliance paths, the prescriptive path requires either installation of solar systems per Appendix RC102/RC105 or Solar Ready which includes dedicating a solar zone for future solar system installation, confirming structural loads, providing electrical interconnection pathways and reserved panel space per Appendix RB.

Appendix RC- Specialized Code: Sections R404 (Electrical/Lighting/EV Ready) & Appendix RC (Specialized Code)

Even if the Authority Having Jurisdiction (town or city) has not adopted the Specialized Code, meeting the requirements in Appendix RC may be used for compliance with the Stretch Code. Electrical and lighting system requirements in section R404, including EV Ready amendments, are also required when using Appendix RC to comply. As the Specialized Code builds upon the Stretch Code, guidance in this chapter is relevant for projects electing to comply with Appendix RC. Additional guidance is provided in the Residential Specialized Code chapter.

Existing Buildings Chapter 5: Sections R502 (Additions), R503 (Alterations), R504 (Repairs)

Additions, alterations, repairs, changes of use and converting unconditioned to conditioned space must comply with the relevant sections of Chapter 5 of the residential code. The Stretch Code amends how requirements apply to additions and changes in space conditioning (which must meet the same requirements as additions.) Additions less than 1,000 ft^2 can demonstrate compliance for the addition only or for the addition and the existing building together using prescriptive requirements in R502.3, or for the addition and the existing building together using the HERS certification requirements in R406.5. Additions equal or greater than 1,000 ft^2 or when the addition exceeds the existing building's conditioned floor area must meet the HERS certification requirements of R406.5 together with the prescriptive requirements in R502.3. HERS certification can be demonstrated on just the addition or for the addition and the existing building together.

Alterations or Change in Use (treated the same as alterations) depend upon the scope of the alteration. Level 3 alterations (as defined in the IEBC) or Extensive alternations (as defined in the IRC Appendix AJ), or a change of use, that are greater than 1,000 ft^2 must demonstrate a certified HERS rating at or below

the maximum HERS rating in Table R406.5. Level one or two alterations, or any alterations less than 1,000 ft^2 can use the prescriptive pathway from R503.

R403.6 Mechanical Ventilation

Highlights. Requires site verified continuously operating balanced mechanical ventilation for each dwelling unit, with either heat or energy recovery.

Compliance. Section R403.6 is required for all projects complying via the HERS Index or Prescriptive compliance pathways.

Summary. Balanced ventilation systems utilize supply and exhaust fans to intake and exhaust ventilation air with the intention of providing good indoor air quality, but proper filtration, design and installation are key. R403.6 requires heat recovery or energy recovery ventilators to reclaim heat (while in heating mode) or remove heat (while in cooling mode) from the supply or exhaust air. Generally speaking, heat recovery ventilators work well in dry climates while energy recovery ventilators work well in humid climates. It's important to note balanced ventilation systems do not preclude the need for local exhaust in bathrooms and kitchens, which are intended to exhaust moisture and odors right where they are produced.

Adequate airflow is critical to the performance of balanced ventilation systems emphasizing proper equipment and duct system design. R403.6 requires airflow to be verified in the field per RESNET/ICC Standard 301, or ASHRAE Standard 62.2 (2019 or 2022 acceptable), or the formula included in R403.6 which utilizes the verified blower door air leakage rate. The formula also uses a shielded weather factor (WSF) shown in the code language for counties in Massachusetts. See example below for calculating airflow using the formula.

Heat or energy recovery ventilators must be included in the system design per R403.6.1. The required system efficiency depends upon whether the rated airflow is greater than 300 cfm (considered a "large" system.) Large systems may apply for a central balanced dedicated outdoor air system (DOAS) for a low-rise multi-family building, for example one with six or more units each with a ventilation rate of ~50 cfm (= 300cfm total.) The installed equipment also must be HVI 920 certified (or equivalent) and fans must be rated at a maximum of 1 sone with limited exceptions. Regulations on air inlet and exhaust locations are included to avoid contaminated air being drawn into the residence as well as inadequate airflow.

The code also requires the homeowner and occupants be provided with instruction on maintenance and control requirements.

Example Calculation

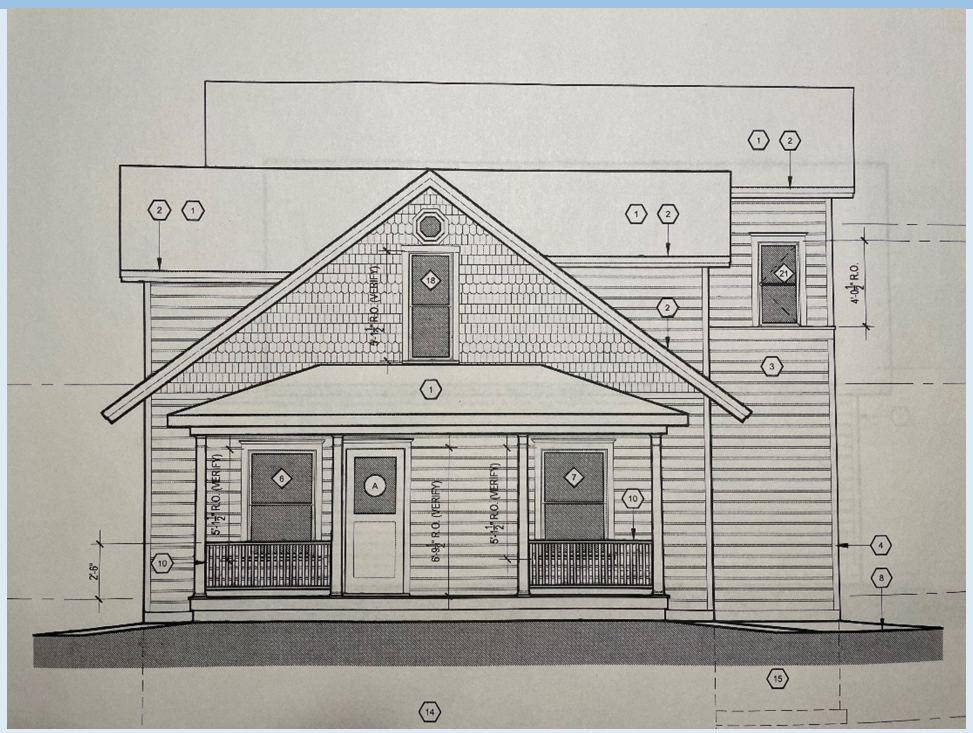


Image Courtesy of NORESCO

This 2,700 ft^2 single-family, four-bedroom home in Essex County includes a balanced ventilation system. The blower door air leakage rate was measured at 2 ACH_{50}, which must be converted to CFM using Conditioned Volume (V) based on the home's average ceiling height (9ft in this example) using the equation below:

$$Q_{50} = (V \times 2\ ACH_{50})/\ 60 = (24{,}300\ ft^3 \times 2\ ACH_{50})/60 = 810\ CFM$$

Where $V = 2{,}700\ ft^2 \times 9ft = 24{,}300\ ft^3$

The formula in R403.6 can be used to determine minimum airflow for this home:

$$Q = 0.03 \times CFA + 7.5 \times (N_{br} + 1) - 0.052 \times Q_{50} \times S \times WSF$$

$$= 0.03 \times 2{,}700\ ft^2 + 7.5 \times (4 + 1) - 0.052 \times 810CFM \times 1.32 \times 0.58 = 86.25\ CFM$$

Where:

CFA is conditioned floor area (2,700 ft2 in this example)

N_{br} is number of bedrooms (4 in this example)

Q_{50} is blower door air leakage rate in CFM measured at 50 Pascals (810 in this example)

S is the building height factor from the table in R403.6 (1.32 for two stories)

WSF is the shielded weather factor from the table in R403.6 (0.58 for Essex County)

R404.4 Wiring for Electric Vehicle Charging Spaces (EV Ready)

Highlights. This section is entirely new for the MA base code with Stretch Code amendments.

Compliance. The EV Ready requirements in R404.4 apply to all new construction projects, regardless of compliance pathway.

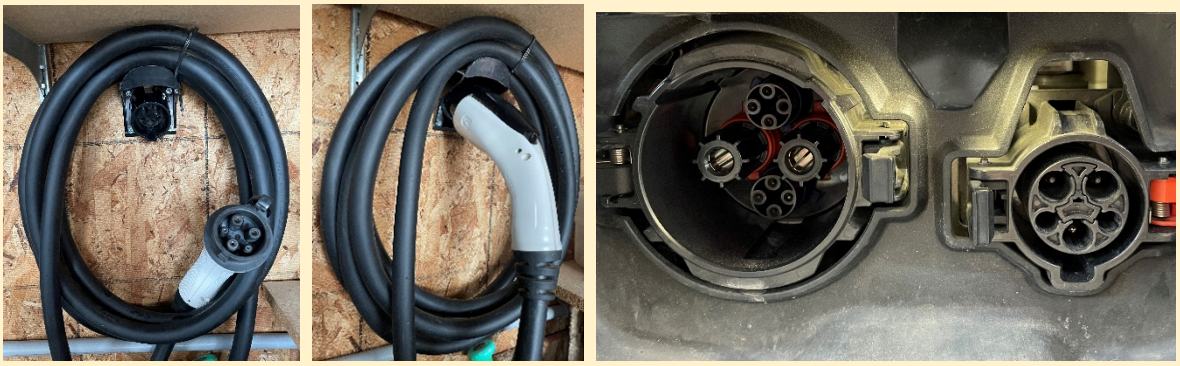
Summary. Two definitions from section R202 are relevant when determining the requirements to comply with R404.4. The first is the definition for Electric Vehicle Supply Equipment (EVSE) which describes the scope of what is included in ESVE to transfer energy between the building and the Electric Vehicle. The second is a definition for Electric Vehicle Ready Parking Space which clarifies that the parking space must include wiring and electrical service sufficient to provide AC Level II or equivalent EV charging. Section R404.4 also requires a dedicated branch circuit in the panel or subpanel labeled as "EV Ready", as well as requirements for the location and type of termination point at the parking space. The MA electrical code includes requirements for conductors and outlets within the system.

Additional information

Standard SAE J1772 Electrical Connectors (J Plug)

The Society of Automotive Engineers has been publishing Standard SAE J1772 since 1996 to standardize physical, electrical, functional and performance requirements for EV chargers. Connectors following this Standard, known as "J Plugs," are the most common type of Level 2 connector in the U.S.

J1772_201710: SAE Electric Vehicle and Plug in Hybrid Electric Vehicle Conductive Charge Coupler - SAE International



Images courtesy of NORESCO

One of the design issues related to providing EV charging is appropriately sizing the electrical service. To optimize panel capacity, there are power-sharing switch devices that can be used to share power between 240V outlets. This is especially useful when the home includes an EV charger that can share power with an intermittently used appliance such as a clothes dryer or cooking range. New homes may also install smart electrical panels to allow for peak load management and to allow for lower total electrical service requirements while complying with the MA electrical code.

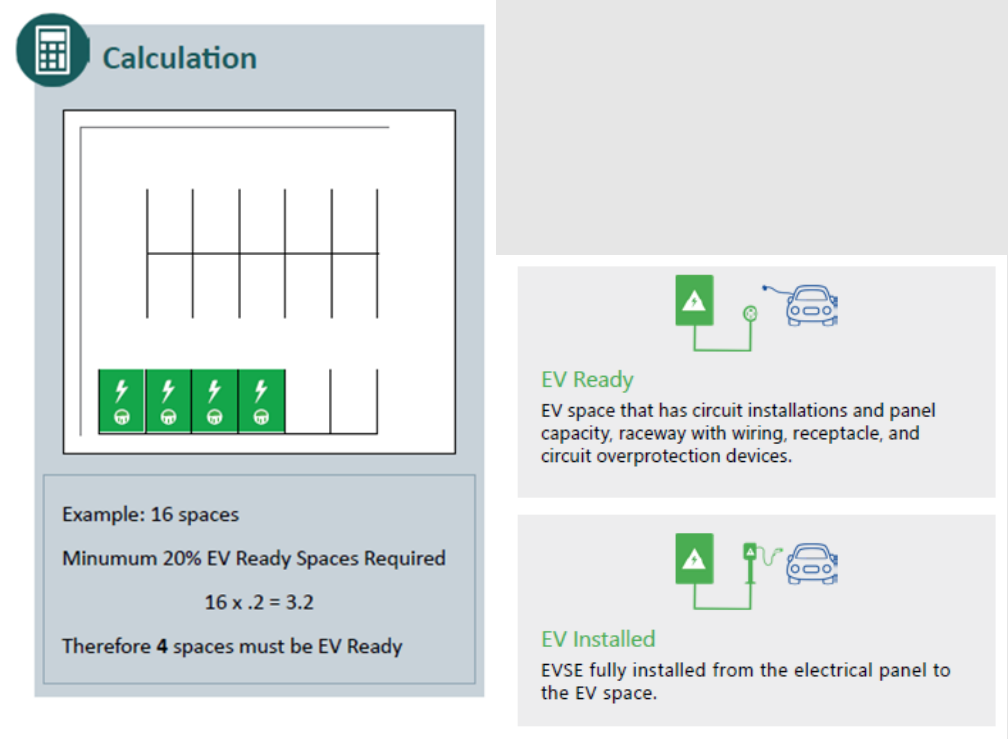
The number of EV Ready Spaces required depends on whether the building is a one- or two-family dwelling or townhome, or another R-use occupancy. For one- or two-family dwellings or townhomes, Table R404.4 requires at least one 50-amp branch circuit per dwelling unit to provide AC Level II charging.

For all other R-use occupancies, example calculations are provided below to illustrate the minimum number of EV Ready Spaces that would need to be shown on the site plan. Note the footnote in Table R404.4 that allows substitution of Level II chargers for Level I chargers, with conditions.

Example Calculation:

R Occupancies Other Than One- and Two-family Dwellings and Town Homes

Table R404.4 requires at least 20% of parking spaces be served by a 40-amp, 208/240-volt circuit with a minimum capacity of 9.6 kVA. The calculation below shows the number of spaces that would need to be at least EV Ready (EV Installed would also comply.)



Note R-2 multi-family properties may elect to comply with Commercial EV Ready requirements in C405.13 Electric Vehicle Ready Parking Spaces (“EV Ready Spaces”)..

R406 Energy Rating Index Compliance Alternative (HERS Index Score)

Highlights. Maximum HERS Index scores have been modified in the Stretch code, including using a phase-in approach based on permit application date for new construction and specific maximum scores for additions, alterations or changes of use.

Compliance. This section is relevant to new construction projects using the HERS compliance path as well as additions, alterations or changes of use demonstrating compliance with a HERS score. See flowchart on page X of this Guideline for details on when HERS is required and when it is an option.

Summary. The Stretch Code modifies Table R406.5 to reduce the maximum allowed HERS score after June 30th, 2024, for new construction projects. Mixed-Fuel Buildings, All-Electric Buildings and buildings with solar electric systems have different allowance levels as seen below. The project HERS score used to demonstrate compliance with this table must be without any onsite solar electric generation.

TABLE R406.5 MAXIMUM ENERGY RATING INDEX

Clean Energy Application	Maximum HERS Index score[a, b]		
	New construction until June 30, 2024	New construction permits after July 1, 2024	Major-alterations, additions, or Change of use[c]
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 R406.5
[b] The building shall meet the mandatory requirements of Section R406.2, and the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or Table R402.1.4 of the 2015 International Energy Conservation Code.
[c] Alterations, Additions or Change of use covered by Section R502.1.1 or R503.1.5 are subject to this maximum HERS rating.

The Massachusetts code allows an increased maximum allowable score when dwelling units are All-Electric or served by solar electric systems per added Section R406.5.1. Note that for new construction, the additional points resulting from solar electric systems are only available for projects permitted through June 30, 2024. Starting July 1, 2024, additional points are only available for All-Electric buildings. For alterations, additions and changes in use, the points for solar electric systems remain regardless of permit date.

R408 Additional Efficiency Package Options

The additional efficiency package options in R408 only apply to new construction projects which don't have individually separate dwelling units and are using the prescriptive compliance path, as well as projects that are complying via the All-Electric path in the Specialized Code.

Projects complying prescriptively have the option to choose two of the three packages. Note that Massachusetts has amended all three packages to increase stringency and promote decarbonization. The amendment to the enhanced envelope performance option lowers the allowed building thermal envelope UA as compared to the code baseline UA, requiring a higher performing envelope to comply with this option. The HVAC amendment eliminates the option for gas furnace plus AC thereby requiring either air-source or ground-source heat pumps if selecting this option. It also dictates minimum equipment efficiencies and requires all heating systems to be sized to serve 100% of the cooling and heating design loads. The water-heating option has also been amended to disallow fossil fuel equipment

in this option, requiring minimum efficiencies for electric or solar systems. Large additions and alternations over 1,000 ft^2 that must comply with new construction requirements are thereby incentivized to electrify space and water heating systems if pursuing prescriptive compliance.

For All-Electric homes, both the more efficient HVAC equipment and reduced energy use in service water-heating options are required. The requirement to use heat pumps for space heating along with the equipment efficiency requirements in both subsections effectively prevents projects from using electric resistance heating as the primary heating system.

R502 Additions or Change in Space Conditioning

Large additions (those that are greater than 1,000 sf or exceed the existing building's conditioned floor area) are required to comply with the maximum allowed HERS scores in Table 406.5. The Table includes a separate column for additions though the maximum allowed score still depends on whether the project is Mixed-Fuel or All-Electric and whether onsite solar is included. For example, a Mixed-Fuel large addition must not exceed a HERS Index score of 52 while an All-Electric addition must not exceed a score of 55. Three additional HERS points are given to projects that include onsite solar systems, bringing the maximum allowed to 55 for Mixed-Fuel and 58 for All-Electric. However, these maximum HERS scores must be complied with without counting any onsite solar in the project's HERS score.

Additions that are not considered large may utilize the prescriptive requirements in Section R502.3 or may elect to meet the HERS score requirements from Table 406.5. An amendment to prescriptive envelope requirements under R502.3.1 exempts additions less than 1,000 sf from air leakage testing requirements in R402.4.1.2.

Changes in space conditioning (i.e., unconditioned or low-energy spaces that are being altered to conditioned space) are treated the same as additions in the Massachusetts code. The State amended Section R502.2 to delete the exceptions that relaxed requirements for change in space conditioning.

R503 Level 3 Alterations or Change of Use

Major alterations, defined as Level 3 alterations in the International Existing Building Code (IEBC) or as Extensive Alterations in the International Residential Code (IRC) Appendix J (section AJ501.3) as projects where the reconfigured space exceeds 50% of the existing building area also requires compliance with the HERS Index maximum scores in Table R406.5. Changes of use that exceed 1,000 sf or 100% of the existing building conditioned floor area also require HERS compliance. Table R406.5 includes alterations and change of use in the same column as additions to set maximum HERS scores.

Important Information

Change of Occupancy and Change of Use
Section 202 of the International Existing Building Code defines Change of Occupancy and Change of Use. These definitions are important to the Massachusetts code because application of code requirements depends on correctly classifying the project scope.
Change of Use: A change in the use of a building or a portion of a building, within the same group classification, for which there is a change in application of the code requirements.
Change of Occupancy: Any of the following shall be considered as a change of occupancy where the

current International Building Code requires a greater degree of safety, accessibility, structural strength, fire protection, means of egress, ventilation or sanitation than is existing in the current building or structure:

- Any change in the occupancy classification of a building or structure. Any change in the purpose of, or a change in the level of activity within, a building or structure.
- A change of use.

Massachusetts Municipal Opt-in Specialized Energy Code 2023 (Appendix RC)

New for this 2023 code cycle jurisdictions have the option of adopting the Specialized Opt-in Energy Code (Specialized Code) instead of the Massachusetts 10th edition IECC2021 (Base Energy Code) or the 2023 updated Stretch Code. As explained earlier in this Guideline, the Specialized Code builds upon the Stretch Code which builds upon the IECC 2021 edition. This means for projects permitting in jurisdictions that have adopted the Specialized Code, the Stretch Code requirements apply where not amended by the Specialized Code. Therefore, it is recommended that the previous chapter which provides guidance on the Stretch Code be reviewed in addition to the guidance provided here on Specialized Code amendments.

Just as the Massachusetts Stretch Code is predicated on the 2021 IECC, the Specialized Code is based on the 2021 IECC Appendix RC, Zero Energy Residential Buildings. Significant amendments have been made by the State to create the Specialized Code.

Generally, the Specialized Code requires Zero Energy or All-Electric buildings, with limited compliance options for electric-ready Mixed-Fuel buildings. All compliance options require EV Ready and either on-site renewables or Solar-Ready. Passive House certification can be used by any project complying with the Specialized Code while HERS compliance is limited to small buildings 12,000 ft^2 or less.

RC101 Compliance

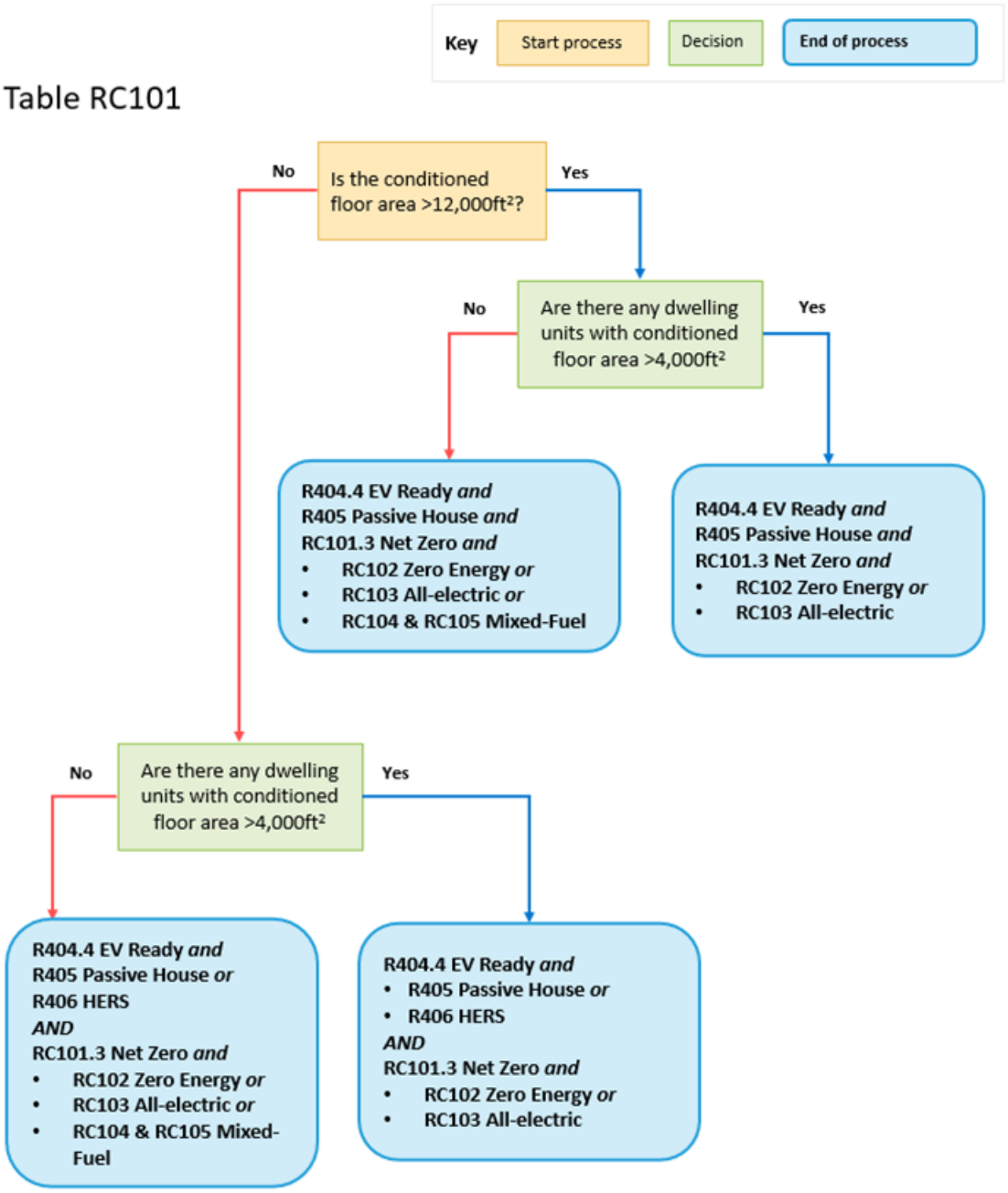
Highlights. The Specialized Code Appendix RC is new for this code cycle.

Compliance. Where adopted by a jurisdiction, requirements in Appendix RC are in addition to requirements in the MA 2023 Residential Stretch code.

Summary. New construction low-rise residential buildings must follow the compliance paths and associated requirements in the Specialized Code. Additions, alterations, changes in use or conversions of unconditioned to conditioned space must meet requirements in the Stretch Code (see previous chapter for guidance.)

There are several compliance paths available for projects based on the building size and dwelling unit size (square footage).

Table RC101



Each compliance path is summarized below, though code sections should be reviewed in detail for requirements.

Passive House: Sections RC101.3 (Net Zero), R404.4 (EV Ready) and R405 (Passive House)

Any project complying with the Specialized Code can use the Passive House compliance path. Projects using this compliance path must meet Passive House requirements from Section R405 of the Stretch Code. See the residential chapter of this Guideline for more details on complying with Section R405. In addition to meeting Passive House requirements, projects using this path must also comply with EV

Ready requirements in R404.4 of the Stretch Code. The previous chapter also includes additional guidance on EV Ready compliance.

Projects complying using Passive House for the Specialized Code that do not have dwelling units with greater than 4,000 ft^2 of condition floor area must also choose to meet the Zero Energy requirements in RC102, the All-Electric requirements in RC103 or the Mixed-Fuel requirements in RC104 and RC105. Dwelling units with greater than 4,000 sf of conditioned floor area may not use the Mixed-Fuel option and therefore must choose either the Zero Energy or All-Electric option.

HERS Score: Sections RC101.3 (Net Zero), R404.4 (EV Ready) and R406 (HERS)

HERS may only be used for compliance with the Specialized Code for new residential buildings 12,000 sf or less, or where applicable to large additions and alterations. These buildings may choose between the Passive House compliance path or the HERS compliance path, with maximum HERS scores of 42, or 45 for all-electric units that are new construction. The HERS compliance path requires the project to meet requirements in Section R406 of the Stretch Code, however through June 30, 2024, the required HERS scores are lower when complying with the Specialized Code as seen in Table RC102.2. Compliance for large additions and alterations is unchanged from the Stretch code. EV Ready requirements in Section R404.4 are also required to comply. The previous chapter on the Stretch Code provides guidance on complying with these sections.

Buildings that do not have dwelling units with greater than 4,000 sf of conditioned floor area can choose to meet the Zero Energy requirements in RC102, or the All-Electric requirements in RC103, the Mixed-Fuel requirements in RC104 and RC105. Buildings that do have individual dwelling units greater than 4,000 ft^2 of conditioned floor area may not use the Mixed-Fuel option.

Additional Information

Additions, Alterations, Change of Use

There are no additional requirements in the Specialized Code for Existing Buildings that are undergoing Additions, Alterations or Changes of Use. If the permitting Authority Having Jurisdiction has adopted the Specialized Code, Existing Building projects should comply with the requirements in the Stretch Code.

RC101.3 & R202 Definitions

Highlights. Two new definitions have been added in the Specialized Code; definitions from R202 in the Stretch Code are also relevant.

Compliance. Sections RC101.3 and R202 are applicable to all projects utilizing the Specialized Code.

Summary.

The definition for *Zero Energy Building* is important because it lays the foundation for the requirements in RC102 (see flowchart above for more details.) A Zero Energy Building has sufficient onsite renewable energy generation (typically Solar PV) that it is expected to achieve net zero annual site energy excluding energy used for EV charging. This net zero on an annual basis can include fossil fuel use, provided that it is offset on an equal or greater energy (MMBTU) basis with onsite renewable energy generation.

Several definitions in the Stretch Code Section R202 are of particular importance because they dictate compliance requirements. In particular, the definition for *All-Electric Building* dictates that no combustion equipment can be used on-site for space heating, water heating, cooking or drying appliances (clothes drying.) Exterior generators and freestanding outdoor propane grills may be included in All-Electric buildings, however indoor gas fireplaces and propane/ gas cooktops may not be included. Requirements for All-Electric Buildings are found in RC103 and can be used by any project for partial compliance.

Mixed-Fuel Buildings on the other hand do include combustion equipment or piping for combustion equipment. Under the Specialized Code, Mixed-Fuel Buildings are only allowed for dwelling units with conditioned floor area no more than 4,000 sf and they must be electric ready, EV Ready, and include onsite solar systems where feasible based on the available potential solar roof zone area . Where the exception in RC105.1 solar-roof zone applies due to shading, a solar installation is not required.

If biomass combustion equipment is included in a building it puts the building in the mixed-fuel building pathway. This means that fireplaces and wood stoves are permitted in this pathway. However, any biomass combustion equipment used as the primary heating system must meet the Clean Biomass Heating System definition from Section R202 shown here:

CLEAN BIOMASS HEATING SYSTEM. Wood-pellet fired central boilers and furnaces 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.

Note: This definition is also used to qualify Clean Biomass heating systems for incentives under the Alternative Portfolio Standard (APS), for more information see: https://www.mass.gov/service-details/qualifying-woody-biomass-in-the-aps

RC102 Zero Energy Pathway

The Zero Energy Pathway is one option to meet the Specialized Code. There are two ways to demonstrate compliance with the Zero Energy Pathway:

1. Comply with HERS in Section R406 of the Stretch Code and achieve a HERS rating of 0 or less
2. Comply with Passive House in Section R405 of the Stretch Code and achieve a Phius ZERO standard Design Certification.

If complying with the HERS 0 option #1 above, Table RC102.2 requires a maximum allowable HERS Rating Index of 45 for all-electric homes or 42 for mixed-fuel homes, prior to counting on-site power production in the score. This means the project must achieve a compliant score without on-site power and then must achieve a score of zero or less after on-site power is included. Envelope assembly U-factor or R-value requirements from Section R402.1 of the IECC-2021 also apply to these projects setting minimum assembly performance requirements.

Additional Information

HERS Index Score of Zero

The HERS Index is a scale used to communicate the energy performance of a residence. The higher the score, the worse the energy performance. HERS scores are determined by RESNET® accredited HERS

energy raters and compare a reference design against the home's design (rated design.) When the expected energy performance of the rated design does not require an annual net purchase of energy (i.e., it produces as much as it consumes), the HERS Index score is 0. This includes not only offsetting electricity use in the home, but also offsetting fossil fuel or biomass fuel use on a site MMBtu basis. This means solar systems should be sized to offset all energy use, both electric and non-electric.

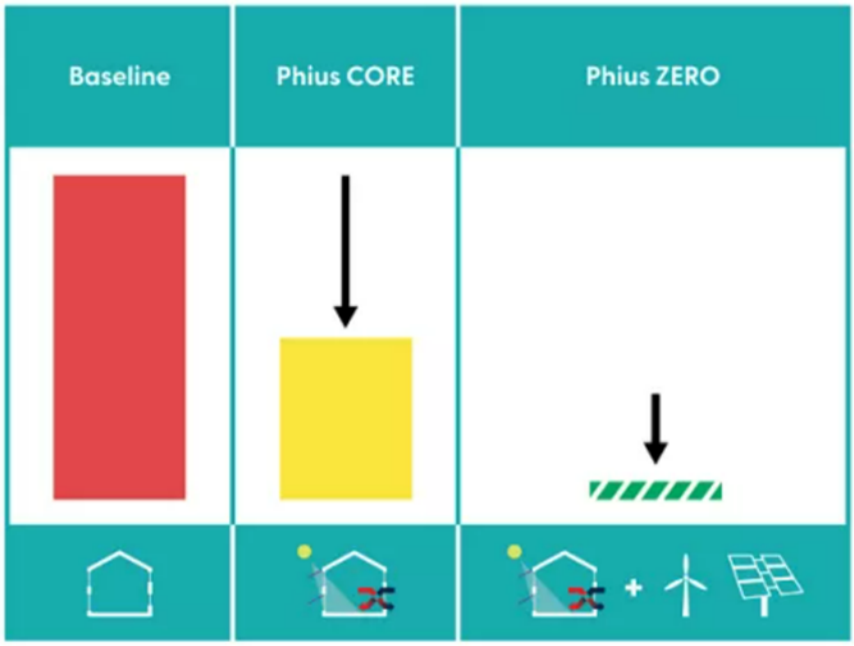
Understanding the HERS Score - HERS Index | Home Energy Rating System | Energy Audit & Ratings | RESNET

The Phius ZERO option is the only option in the Specialized code that allows for credit for off-site renewable energy. Under this compliance path both on-site and off-site renewables can count toward the Phius ZERO certification when approved by Phius.

Additional Information

Phius ZERO Standard

Phius ZERO is the Passive House US net zero standard. The same Passive House principles apply (Phius CORE) but then on-site or off-site renewable energy is used to offset energy consumption reaching a net zero status.



Both on-site and off-site renewables can be used.

Phius ZERO | Phius Phius ZERO for New Construction

RC103 All-Electric Pathway

The All-Electric pathway is another option to comply with the Specialized Code and can be used by any project pursuing compliance. This is anticipated to be the most commonly used option to comply. Projects using this option must comply with HVAC and water-heating additional efficiency packages in Section R408.2 of the Stretch Code which preclude use of electric resistance heating in primary systems.

EV Ready requirements in R404.4 and Solar Ready requirements in Appendix RB are required, plus one of the following:

1. Achieve a Certified Final HERS rating without on-site power of 45 or less, and
    a. Comply with heat/ energy recovery ventilation, and
    b. Meet lighting requirements in R406.2 of the Stretch Code, and
    c. Meet U-factor/R-value requirements in R402.1 of the base code
2. Comply with Passive House in Section R405 of the Stretch Code and achieve a pre-certification to Phius CORE or PHI Standard.

Additional guidance for the Additional Efficiency Packages, EV Ready, Solar Ready and Phius CORE/ PHI certifications can all be found in the Residential Stretch Code chapter of this Guideline.

RC104 Mixed-Fuel Pathway

The Mixed-Fuel pathway may only be used to comply with the Specialized Code for dwelling units with conditioned floor area less than 4,000 ft^2. Mixed-Fuel buildings include space or water heating systems or appliances capable of using fossil fuels. Buildings using *Clean Biomass Heating Systems* also must comply with the Mixed-Fuel option. Complying with this option entails meeting one of the two options below:

1. Achieve a HERS index without on-site power of 42 or less, and
    a. Comply with heat/ energy recovery ventilation and lighting requirements in R406.2 of the Stretch Code, and
    b. Meet U-factor/R-value requirements in R402.1 of the base code, and
    c. Meet electric readiness requirements in RC104.3, and
    d. Meet on-site renewable requirements in RC104.4/RC105, and
    e. Comply with EV Ready requirements in R404.4 of the Stretch Code.
2. Pre-certify using Passive House from Section R405 of the Stretch Code, and
    a. Meet electric readiness requirements in RC104.3, and
    b. Comply with EV Ready requirements in R404.4 of the Stretch Code.

If space conditioning or water-heating requirements are being met with fossil fuel equipment the project must include the infrastructure to change that equipment to electric with minimal impact in the future. This includes planning for a heat-pump space heating system, which requires designing with proper equipment location for future indoor and outdoor units. Outdoor units need to be located without close obstructions so there is adequate airflow, at a location where sound will not impact the occupants or neighbors and have an appropriate place for the condensate to drain without causing a slip hazard if frozen. Electrical requirements include a dedicated branch circuit reserved and labeled.

Design considerations for future heat pump water heating equipment will also need to be taken into account in the building design. This includes a location indoors that meets the size requirements listed in RC104.3.4 as well as considering sound attenuation, if necessary, based on surrounding space uses. Heat pump water heaters utilize heat from the surrounding air to heat the water in the tank so locating the water heating equipment with other appliances such as a clothes dryer that heat surrounding air should be considered. Heat pump water heaters are also typically taller than traditional gas tank water heaters, so a minimum height of 7 feet is required for any installed hot water heating equipment.

Electric readiness is also required for cooking and clothes drying appliances. Induction cooking and electric clothes dryers require higher voltage (220 - 240Volts), so this needs to be considered when calculating the correct electrical service size. Section RC104.3 requires a 250-volt, 40 Amp outlet within three feet of any gas or propane range or cooktop, and a 250-volt, 30 Amp outlet within three feet of the clothes dryer. This pre-wiring will allow a homeowner to more easily exchange gas or propane appliances for electric ones in the future, without tearing out drywall to add electric infrastructure.

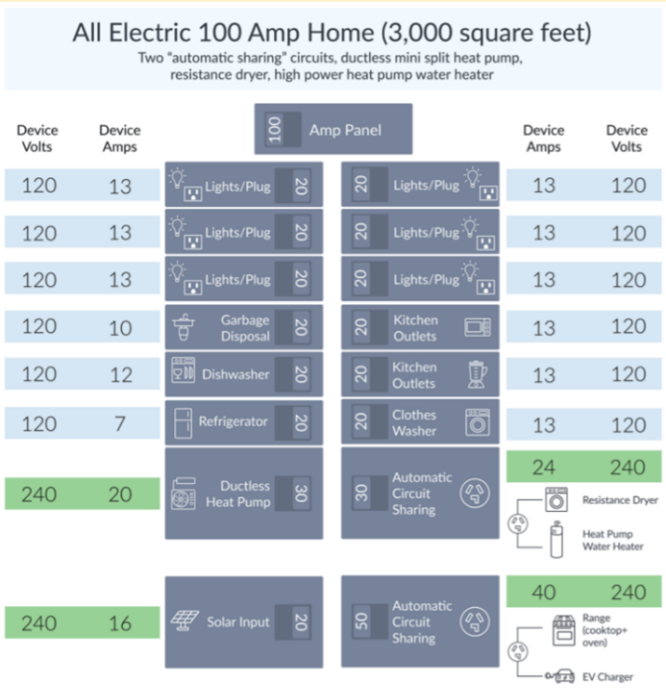
Additional Information

The Watt Diet

Appropriately sizing the electrical service is an important consideration when planning for a future All-Electric home. Upsizing the service has cost implications, so carefully planning the electric load in the home is critical. There are design approaches that can be used to minimize the required panel size including implementing automatic circuit sharing as shown in the image below for the clothes dryer/ water heater and cooking range/ EV charger. Smart service panels are also available that easily integrate PV, battery, EV chargers and demand response and connect to Wi-Fi to enable more efficient operation through homeowner alerts.

Through load management and intentional design, residential units can be All-Electric on a 200 Amp panel (or even smaller.) Building or renovating for All-Electric or pre-wiring a mixed-fuel home to be All-Electric capable doesn't necessarily mean increased electrical service capacity.

The example panel diagram below shows conceptually how All-Electric homes can be intentionally designed to be on a lower amperage service. This diagram is not meant to provide design direction or imply code compliance.



Example panel diagram created and designed by: Josie Gaillard, Courtney Beyer and Tom Kabat

Watt Diet Calculator (redwoodenergy.net)

Mixed-Fuel buildings with a potential solar zone of at least 300 ft^2 must install on-site renewable energy to comply. One- and two-family dwellings must install solar photovoltaic panels, while multi-family occupancies can install solar PV or solar water heating; the minimum system size is dictated in Section RC104.4.

RC105 Solar Roof Zone

Designated Solar Roof Zones are areas on the roof that have adequate solar access and can be set aside for future solar system installations. These areas must be shown on the roof plan free of obstructions such as roof vents or exhaust fans, meeting MA Fire Code setbacks and must be at least 5 feet wide and 80 ft^2 to accommodate solar panels. The minimum total area that must be designated depends on the building's height and square footage, per RC105.3. Restrictions on shading from nearby architectural or natural elements apply and structural design loads to accommodate solar systems must be calculated and documented on the construction documents.

Electrical infrastructure must also be installed including a designated interconnection pathway from the zone to the water heater (for future solar water heating) and electrical service (for future PV panels.) The electrical panel must also have a reserved space for a dual pole circuit breaker and a capped roof penetration sleeve must be included at the zone for future conduit (minimum size designated in RC105.)

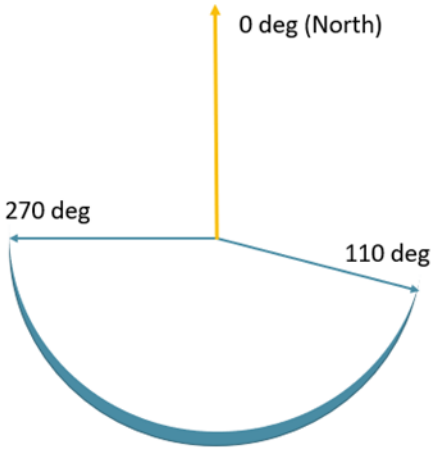
The homeowner or building owner must be made aware of the solar infrastructure included in their building via a certificate indicating the solar system size the infrastructure can accommodate & detailing the infrastructure provided.

There are two exceptions to providing a solar roof zone when the building's roof is not amenable to solar systems. Specifically, the following exceptions do not need to comply with RC105:

- Detached one- and two-family dwellings or townhomes with less than 600 ft^2 of roof area oriented between 110 & 270 degrees of true North*
- Buildings where all areas of the roof are in full or partial shade for more than 70% of annual daylight hours (demonstrate with a solar shading study)

* Unshaded flat roofs count as being oriented between 110-270 degrees of true North and therefore should be counted as eligible for the Solar Roof Zone.

The roof plan below depicts roughly 400 ft^2 of roof area eligible for the solar zone on this single-family home (within orientation and at least 80 ft^2 of unobstructed roof.) Because this is less than 600 ft^2, this home would be excepted from the requirements in RC105.



Eligible Orientation for Solar Zone

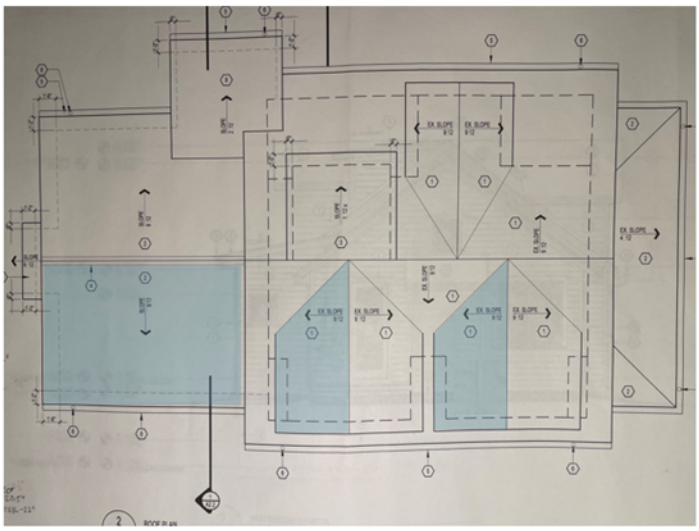

Eligible Roof Areas for Solar Zone

Image credit: NORESCO

Informative Appendices.

A. Model bylaw language for municipal adoption for specialized code and stretch code

B. Plans examiner & building inspector checklists

Massachusetts Energy Stretch and Specialized Codes

The Massachusetts Department of Energy Resources (DOER) mission is to develop and implement policies and programs aimed at ensuring the adequacy, security, diversity, and cost-effectiveness of the Commonwealth's energy supply to create a clean, affordable and resilient energy future for all residents, businesses,

Massachusetts Department of Energy Resources' Energy Efficiency Division develops, implements, and oversees energy efficiency activities in the Commonwealth in conjunction with other state and federal agencies.