



Minnesota Residential Energy Code

Steve Shold – Construction Code Representative
Certified Building Official
ICC Residential Energy Inspector/Plans Examiner
651-284-5312
steve.shold@state.mn.us

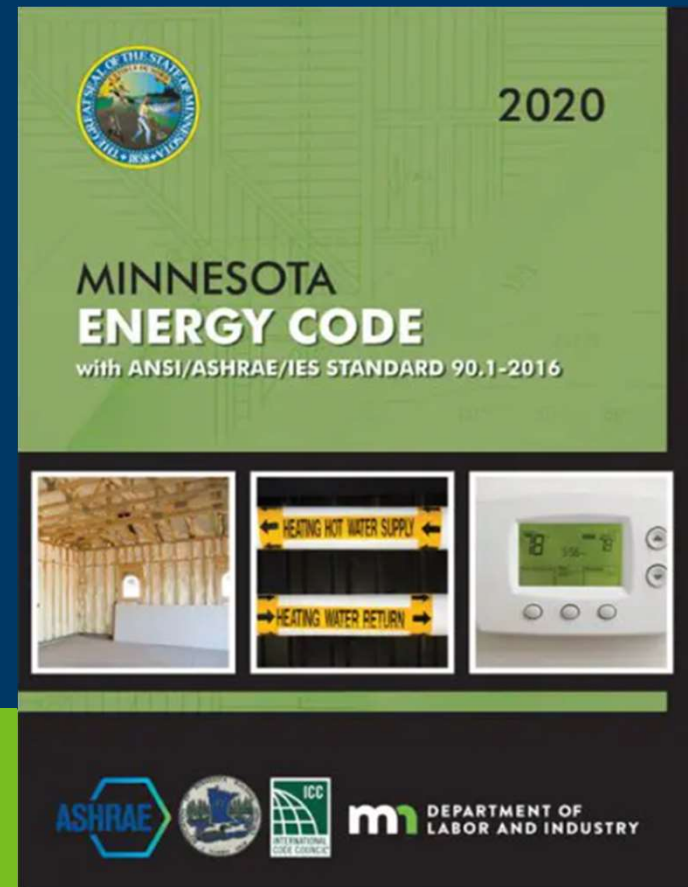
Topics

- What is the purpose of the Energy Code?
- Overview of the 2015 MN Residential Energy Code sections
- What are the building's energy systems?
- What is required for a plan review?
- Field inspections: What to look for and when
- Questions?

Things to note:

- Slides may not include the *entire* code section or *all* exceptions. Always defer to the actual code text.
- Images in the presentation are intended to convey a point and may not necessarily represent compliance with the code.
- Always defer to the Building Official of the local Authority Having Jurisdiction for help with interpretation.
- This is not an exhaustive review of the MN Residential Energy Code in its entirety.

Energy Code: Purpose & Intent



Purpose of the Energy Code - ICC

- **2018 IECC (RE) Scope & General Requirements:**

R101.3 Intent. This code shall regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

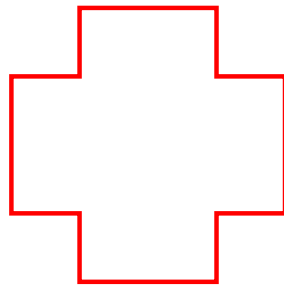
Purpose of the Energy Code - MN

- **2015 MN Residential Energy Code 1322.0015 Administration & Purpose:**

Subp. 2. Purpose. The purpose of this chapter is to establish a minimum code of standards for the construction, reconstruction, alteration, and repair of residential buildings governing matters including design and construction standards regarding heat loss control, illumination, and climate control, pursuant to Minnesota Statutes, Sections 326B.101, 326B.106, and 326B.13.

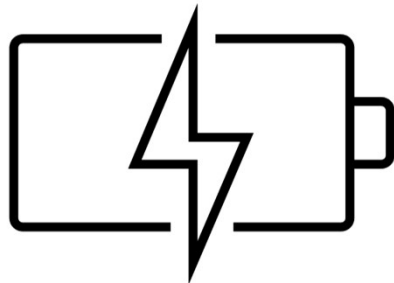
Purpose of the Energy Code

- This will impact:
 - The durability of the building (moisture issues).
 - Health of occupants (air quality).
 - Operational cost savings over the life of the building.



Purpose of the Energy Code

- Structural vs Energy?
 - Energy always yields to structural requirements if you can't get both.



VS.



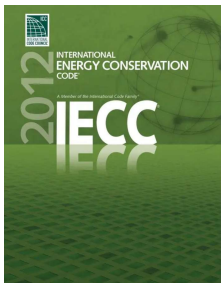
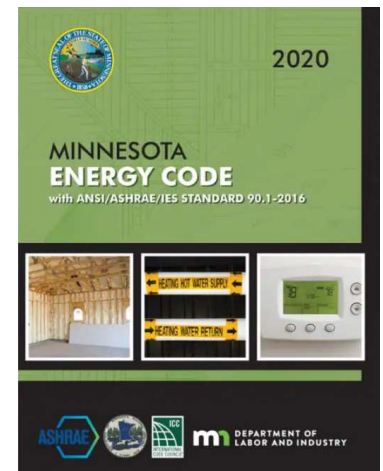


Overview of the Energy Code

MN Energy Code

MN Energy Code – Residential *and* Commercial provisions.

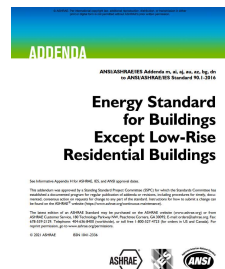
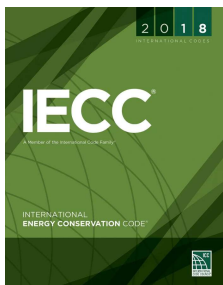
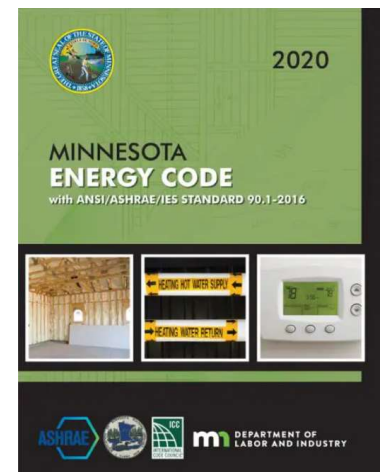
- **Residential** Energy Code - rule chapter 132².
 - Based on the **2012** IECC with MN amendments.
 - Pages R1 – R44 (front of green book)



MN Energy Code

MN Energy Code – Residential *and* Commercial provisions.

- **Commercial** Energy Code - rule chapter 132³.
 - Based (mostly) on the **2018** IECC with MN amendments.
 - Pages C1 – C122 (middle of green book)
 - 6 chapters.
 - Also contains ANSI/ASHRAE/IES 90.1-2016, essentially another CE Code path option.
- Pages 1-380 (last part of book)



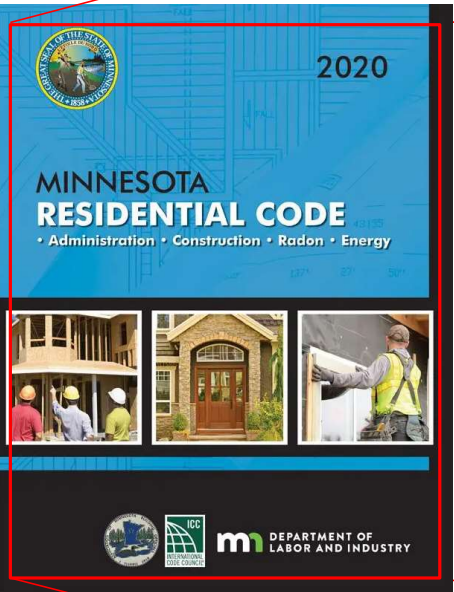
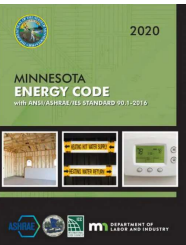


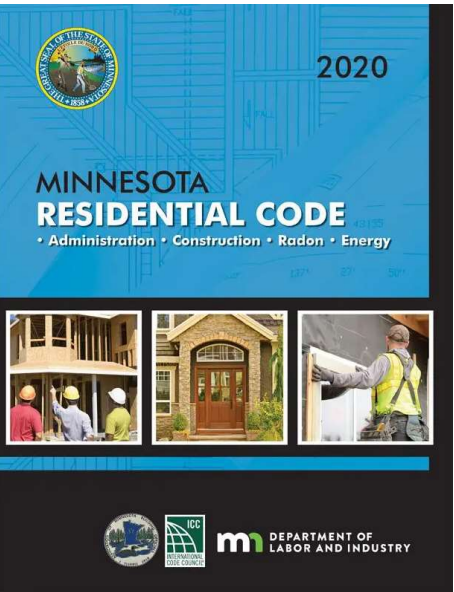
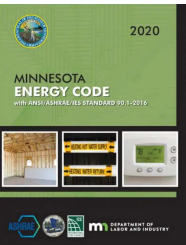
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2015 MINNESOTA RESIDENTIAL ENERGY CODE **23**

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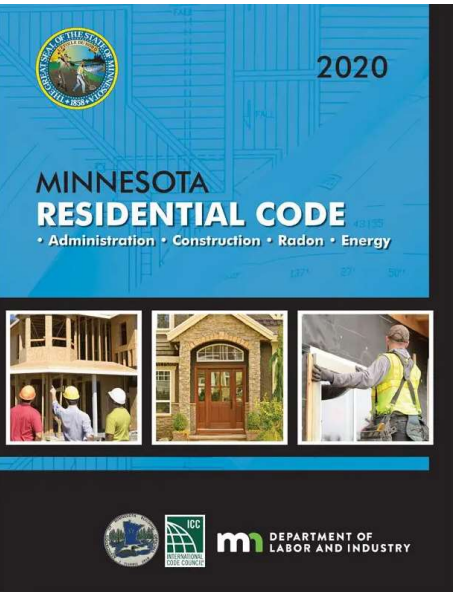
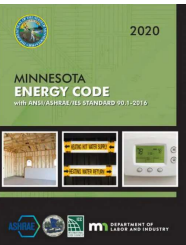
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Administration

Energy Sections

Residential Building

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Section		M
1322.0010 Adoption of International Energy Conservation Code (IECC) by Reference	23	N
1322.0015 Administration and Purpose	23	M
1322.0030 References to Other International Code Council (ICC) Codes	23	N
1322.0040 Administrative Procedure Criteria	23	N
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1322.0103 Construction Documents	24	M
R201 General	25	N
R202 General Definitions	25	M
R301 Climate Zones	27	N
R302 Design Conditions	42	N
R303 Materials, Systems and Equipment	42	M
R401 General	43	N
R402 Building Thermal Envelope	43	M
R403 Systems	48	N
R404 Electrical Power and Lighting Systems (Mandatory)	54	M
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Administration

2015 MINNESOTA RESIDENTIAL ENERGY CODE	23	N
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1322.0010 Adoption of International Energy Conservation Code (IECC) by Reference	23	N
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R201 General	25	N
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R303 Materials, Systems and Equipment	42	N
R401 General	43	N
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MR 1322.0010 Subp. 2

Subp. 2. Mandatory chapters. Chapters 2(RE) to 5(RE) of the Residential Provisions of the 2012 IECC shall be administered by any municipality that has adopted the *Minnesota State Building Code*, except as qualified by applicable provisions in Minnesota Rules, Chapter 1300, and as amended by this chapter.

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MR 1322.0100 Subp. 1 & 2

Subpart 1. Administration. In addition to the application of Minnesota Rules, Chapter 1300, the administrative requirements in this part shall apply.

Subp. 2. Scope. This code applies to residential buildings and associated systems and equipment as defined in the Residential Provisions of the 2012 IECC.

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Scoping

- RE Chapter 2, Definitions:

RESIDENTIAL BUILDING. For this code, includes detached one- and two-family dwellings and multiple single-family dwellings (townhouses) as well as Group R-2, R-3 and R-4 buildings three stories or less in height above grade plane.



<https://www.phillyaptrentals.com/blog/what-makes-a-good-apartment-building/>



MR 1322.0100 Subp. 3A

Subp. 3. Applicability.

A. Additions, alterations, renovations, or repairs. Additions, alterations, renovations, or repairs to an existing building, building system, or portion of a building shall conform to the provisions of this code as they relate to new construction without requiring the unaltered portion of the existing building or building system to comply with this code. Additions, alterations, renovations, or repairs shall not create an unsafe or hazardous condition or overload existing building systems. An addition shall comply with this code if the addition alone complies or if the existing building and addition comply with this code as a single building. Attic insulation shall not be installed unless accessible attic bypasses have been sealed. An attic bypass is any air passageway between a conditioned space and an unconditioned attic.

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Applicability - Exceptions

- MN Rules 1322.0100 Subp. 3 A.

- Exceptions...

Exceptions: The following are excepted from this part provided the energy use of the building is not increased:

1. Storm windows installed over existing windows.
2. Glass only replacements in an existing sash and frame.
3. Existing ceiling, wall, or floor cavities exposed during construction provided that these cavities are filled with insulation.
4. Construction where the existing roof, wall, or floor cavity is not exposed.
5. Reroofing and residing.

6. Replacement of existing doors that separate conditioned space from the exterior do not require the installation of a vestibule or revolving door; provided that an existing vestibule that separates a conditioned space from the exterior shall not be removed.

7. Alterations that replace less than 50 percent of the luminaires in a space, provided that the alterations do not increase the installed interior lighting power.

8. Alterations that replace only the bulb and ballast within the existing luminaires in a space, provided that the alteration does not increase the installed interior lighting power.

9. Insulation R-value, air barrier, and vapor retarder requirements are not applicable to existing foundations, crawl space walls, and basements in existing dwellings or dwelling units when the alteration or repair requires a permit if the original dwelling or dwelling unit permit was issued before June 1, 2009.

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- MN Residential Energy Code
 - **Prescriptive** – R402 & R403
 - R-value
 - U-Factor Alternative
 - Total UA Alternative
 - **Simulated Performance Alternative (Performance)** – R405

- MN Residential Energy Code
 - Prescriptive
 - R-value

Prescriptive Path – R-value

TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT^a

CLIMATE ZONE	FENESTRATION U-FACTOR ^b	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b,e}	CEILING ^j R-VALUE	WOOD FRAME WALL R-VALUE ^f	MASS WALL R-VALUE ^{i,g,h}	FLOOR R-VALUE	BASEMENT ^{c,i} WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE ^{c,i} WALL R-VALUE
6	0.32	0.55	NR	49	20, 13+5	15/20	30 ^e	15	10, 3.5 ft	15
7	0.32	0.55	NR	49	21	19/21	38 ^e	15	10, 5 ft	15

For SI: 1 foot = 304.8 mm.

- R-values are minimums. U-factors and SHGC are maximums. When insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall not be less than the R-value specified in the table.
- The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
- See Section R402.2.8.
- Insulation R-values for heated slabs shall be installed to the depth indicated or to the top of the footing, whichever is less.
- Or insulation sufficient to fill the framing cavity, R-19 minimum.
- First value is cavity insulation, second is continuous insulation or insulated siding, so "13+5" means R-13 cavity insulation plus R-5 continuous insulation or insulated siding. If structural sheathing covers 40 percent or less of the exterior, continuous insulation R-value shall be permitted to be reduced by no more than R-3 in the locations where structural sheathing is used to maintain a consistent total sheathing thickness.
- The second R-value applies when more than half the insulation is on the interior of the mass wall.
- When using log-type construction for thermal mass walls the following applies:
 - a minimum of a 7-inch diameter log shall be used; and
 - the U-value of fenestration products shall be 0.29 overall on average or better.
- See Section 402.2.8. A minimum R-19 cavity insulation is required in wood foundation walls.
- Roof/ceiling assemblies shall have a minimum 6-inch energy heel.

Prescriptive Path – R-value

TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT^a

CLIMATE ZONE	FENESTRATION U-FACTOR ^b	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b,e}	CEILING ^j R-VALUE	WOOD FRAME WALL R-VALUE ^f	MASS WALL R-VALUE ^{i,g,h}	FLOOR R-VALUE	BASEMENT ^{c,i} WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE ^{c,i} WALL R-VALUE
6	0.32	0.55	NR	49	20, 13+5	15/20	30 ^e	15	10, 3.5 ft	15
7	0.32	0.55	NR	49	21	19/21	38 ^e	15	10, 5 ft	15

R402.1.2 R-value computation. Insulation material used in layers, such as framing cavity insulation and insulating sheathing, shall be summed to compute the component R-value. The manufacturer's settled R-value shall be used for blown insulation. **Computed R-values shall not include an R-value for other building materials or air films.**

- MN Residential Energy Code
 - Prescriptive
 - R-value
 - U-Factor Alternative – R402.1.3

Prescriptive Path – U-Factor Alternative

R402.1.3 U-factor alternative. An assembly with a U-factor equal to or less than that specified in Table R402.1.3 shall be permitted as an alternative to the R-value in Table R402.1.1.

**TABLE R402.1.3
EQUIVALENT U-FACTORS^a**

CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT U-FACTOR	CEILING U-FACTOR	FRAME WALL U-FACTOR	MASS WALL U-FACTOR ^b	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR	CRAWL SPACE WALL U-FACTOR
1	0.50	0.75	0.035	0.082	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.082	0.165	0.064	0.360	0.477
3	0.35	0.55	0.030	0.057	0.098	0.047	0.091 ^c	0.136
4 except Marine	0.35	0.55	0.026	0.057	0.098	0.047	0.059	0.065
5 and Marine 4	0.32	0.55	0.026	0.057	0.082	0.033	0.050	0.055
6	0.32	0.55	0.026	0.048	0.060	0.033	0.050	0.055
7 and 8	0.32	0.55	0.026	0.048	0.057	0.028	0.050	0.055

a. Nonfenestration U-factors shall be obtained from measurement, calculation or an approved source.

b. When more than half the insulation is on the interior, the mass wall U-factors shall be a maximum of 0.17 in Climate Zone 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

c. Basement wall U-factor of 0.360 in warm-humid locations as defined by Figure R301.1 and Table R301.1.

- MN Residential Energy Code
 - Prescriptive
 - R-value
 - U-Factor Alternative – R402.1.3
 - Total UA Alternative – R402.1.4



Prescriptive Path – Total UA Alternative

R402.1.4 Total UA alternative. If the total *building thermal envelope* UA (sum of U-factor times assembly area) is less than or equal to the total UA resulting from using the U-factors in Table R402.1.3 (multiplied by the same assembly area as in the proposed building), the building shall be considered in compliance with Table R402.1.1. The UA calculation shall be done using a method consistent with the ASHRAE *Handbook of Fundamentals* and shall include the thermal bridging effects of framing materials. The SHGC requirements shall be met in addition to UA compliance.

- MN Residential Energy Code
 - Simulated Performance Alternative (Performance) – R405
 - Sections unamended from 2012 IECC.
 - Must still meet all other provisions marked as “Mandatory”.
 - Comparison to a standard reference design.
 - Computer software.
 - Allows greater flexibility for the design – looks at all R-Values and U-Factors.
 - Credit for orientation, building & duct tightness, exterior shading, thermal mass, solar heat gain coefficients (Low E windows), etc.

Energy Systems



What are the Building's "Energy" Systems?

Energy Systems



Building Envelope
R402

Energy Systems



Building Envelope
R402



Mechanical Systems
R403 & R403.5

Energy Systems



Building Envelope
R402



Mechanical Systems
R403 & R403.5



Service Water Heating
R403.3 & R403.4

Energy Systems



Building Envelope
R402



Mechanical Systems
R403 & R403.5

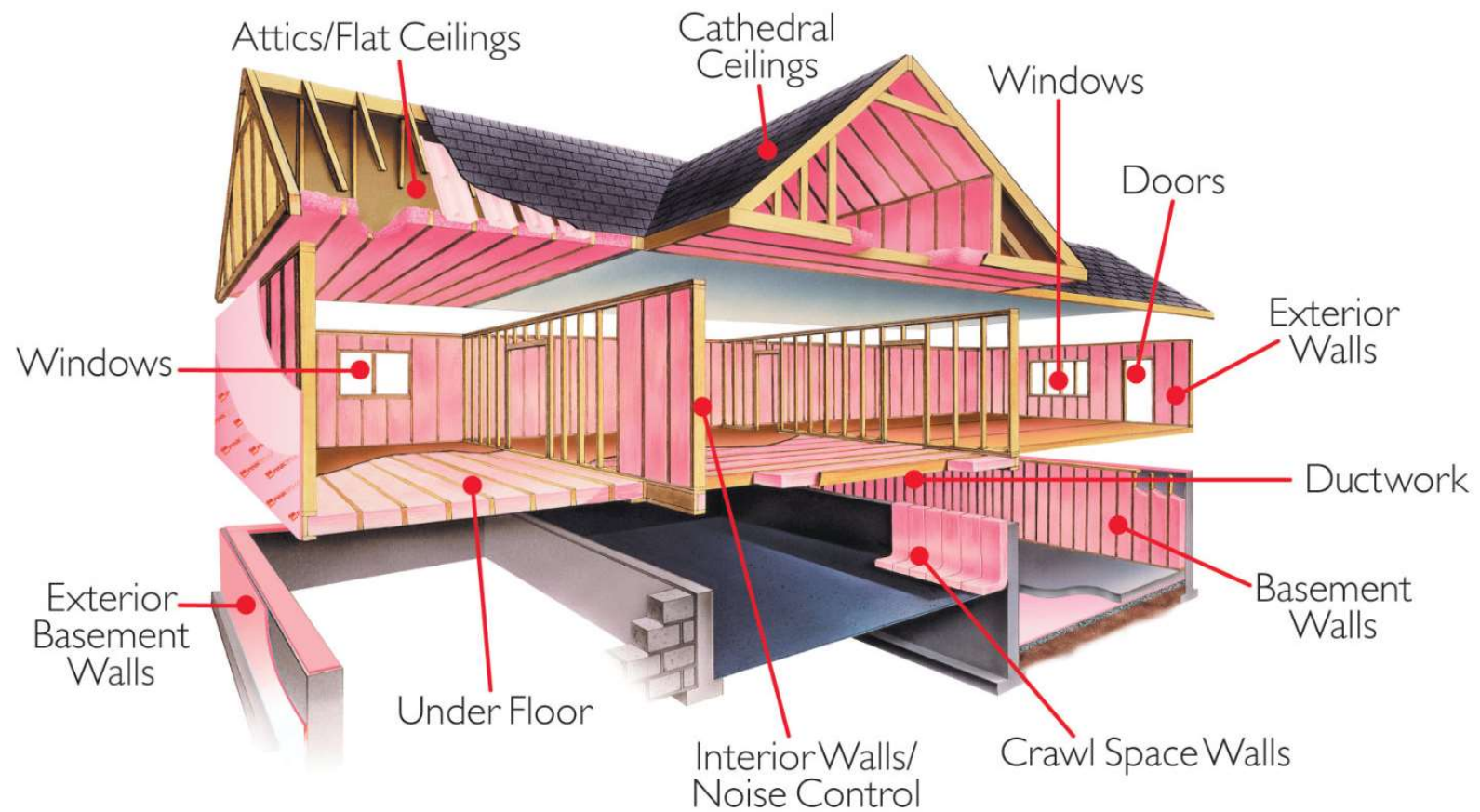


Service Water Heating
R403.3 & R403.4



Electrical Systems
R404

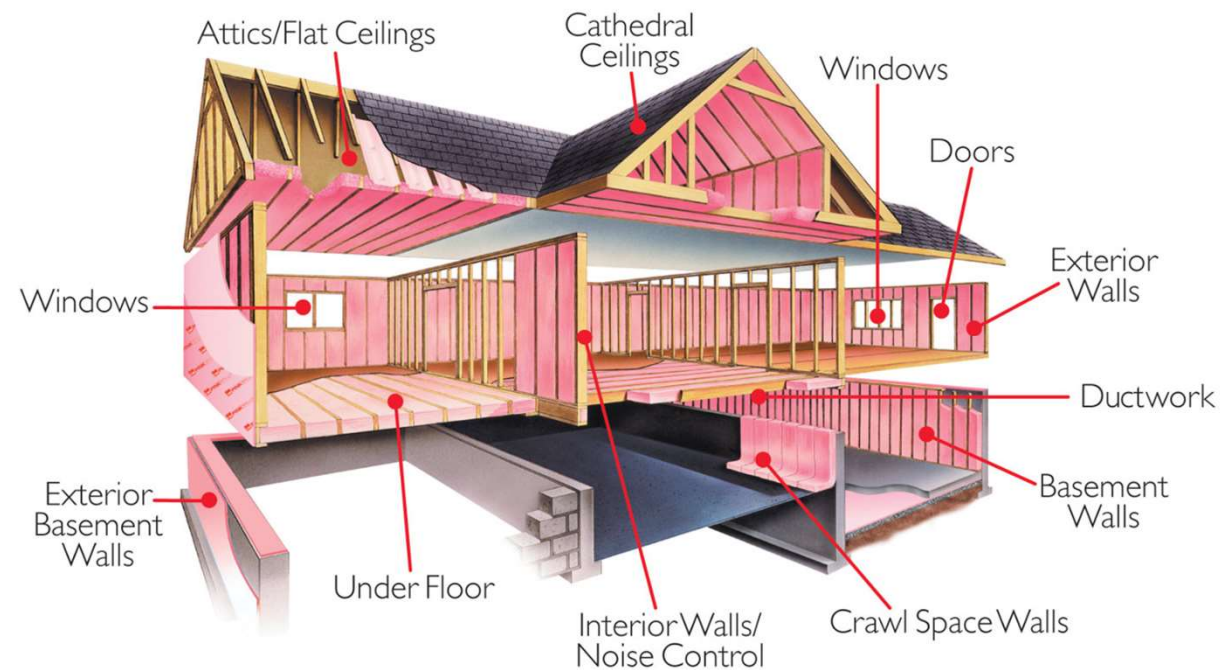
Building Envelope



<https://lynchinsulation.com/services/why-insulate/>

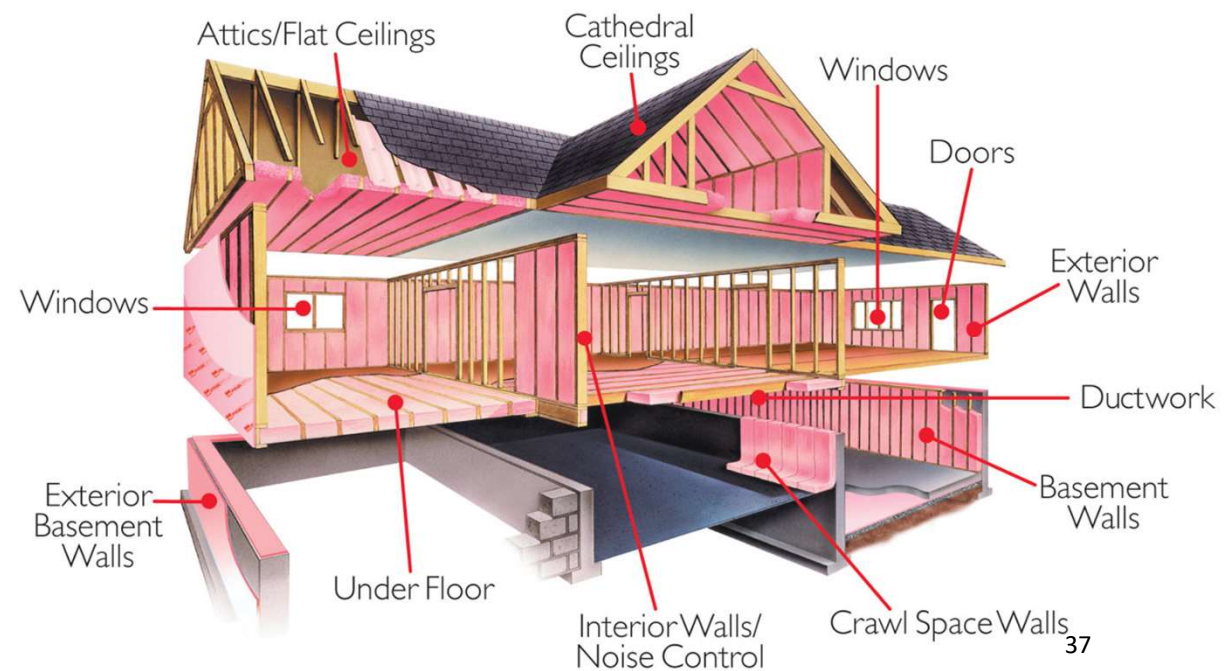
Building Envelope

- Exterior walls, including the rim joist area.
(Regarding insulation, consider the rim joist area a short wall.)

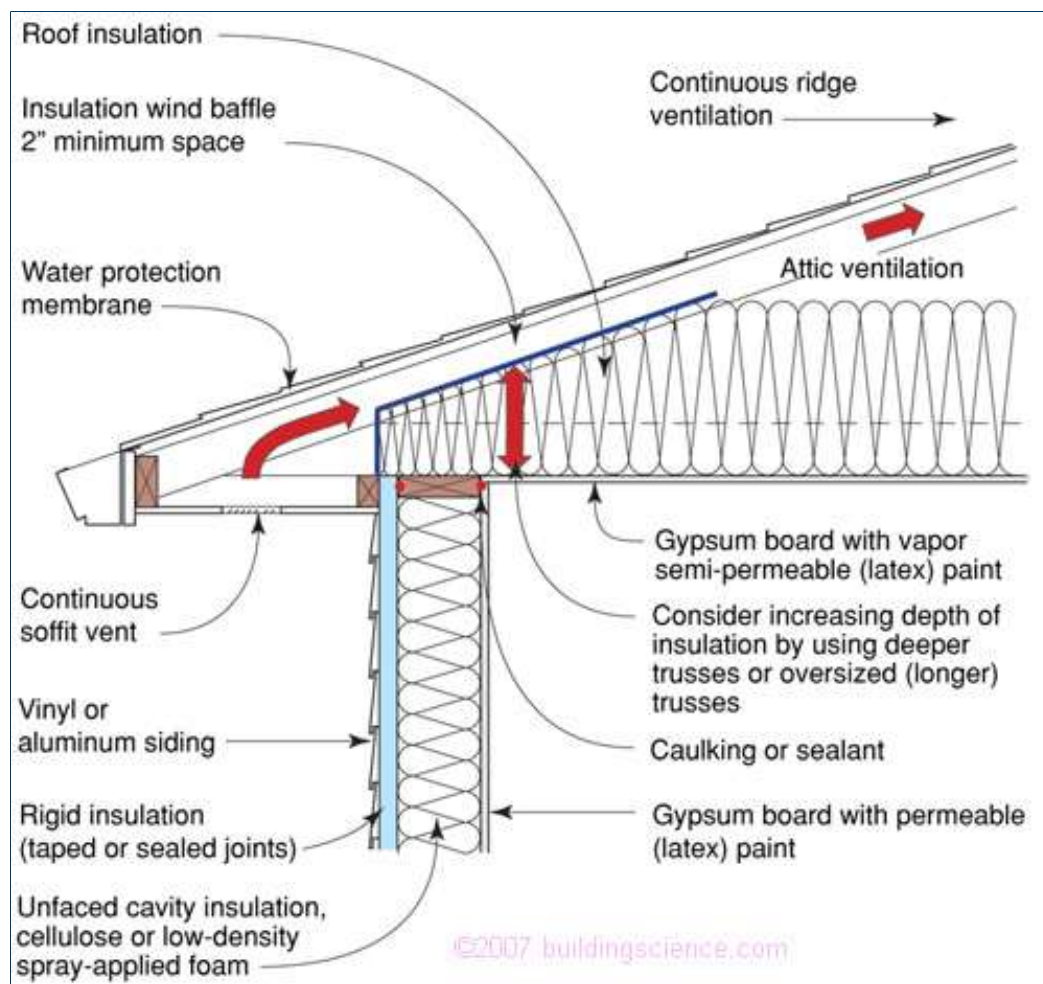


Building Envelope

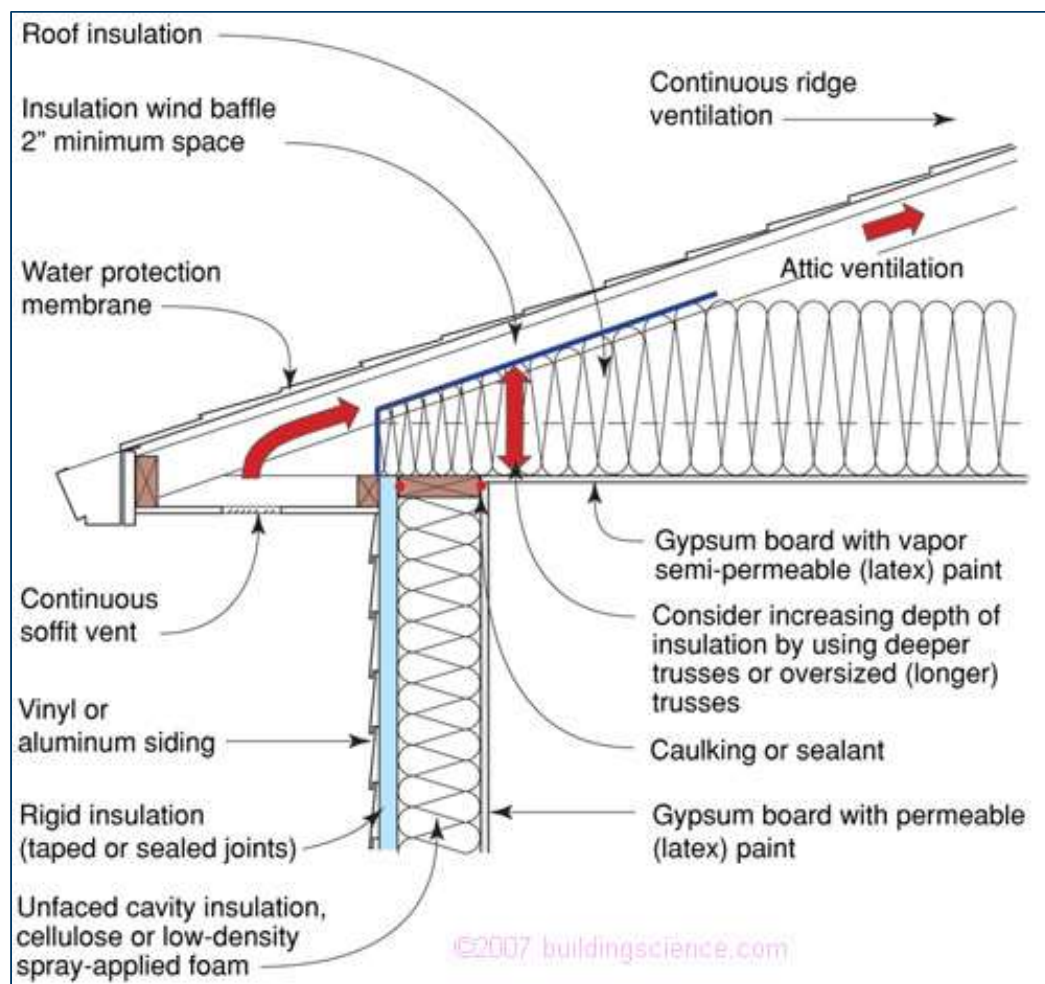
- Exterior walls, including the rim joist area.
- Ceiling/attic areas.



Vented attic assembly



Vented attic assembly

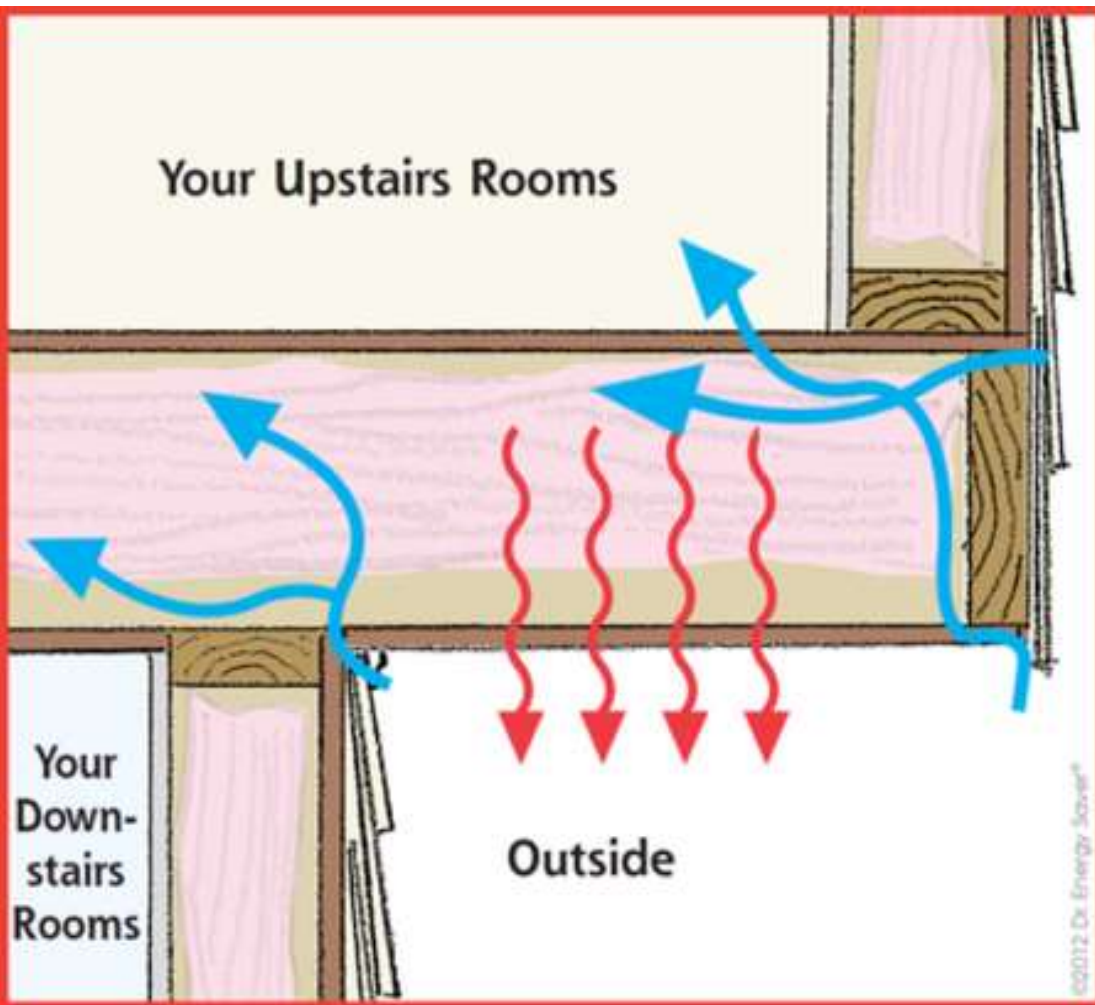


Unvented attic and unvented rafter assemblies - "Hot Roof"



Building Envelope

- Exterior walls, including the rim joist area.
- Ceiling/attic areas.
- Floor area over an unconditioned space (Ex. cantilever, bonus room).



Your Upstairs Rooms

Your Downstairs Rooms

Outside

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Baseplate sealed to subfloor

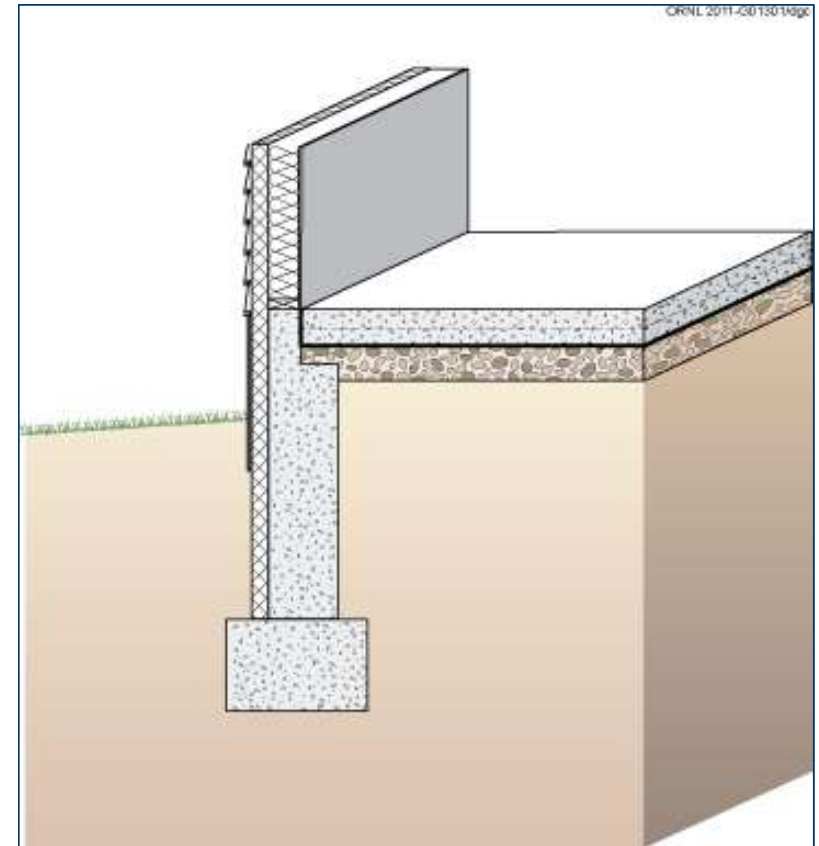
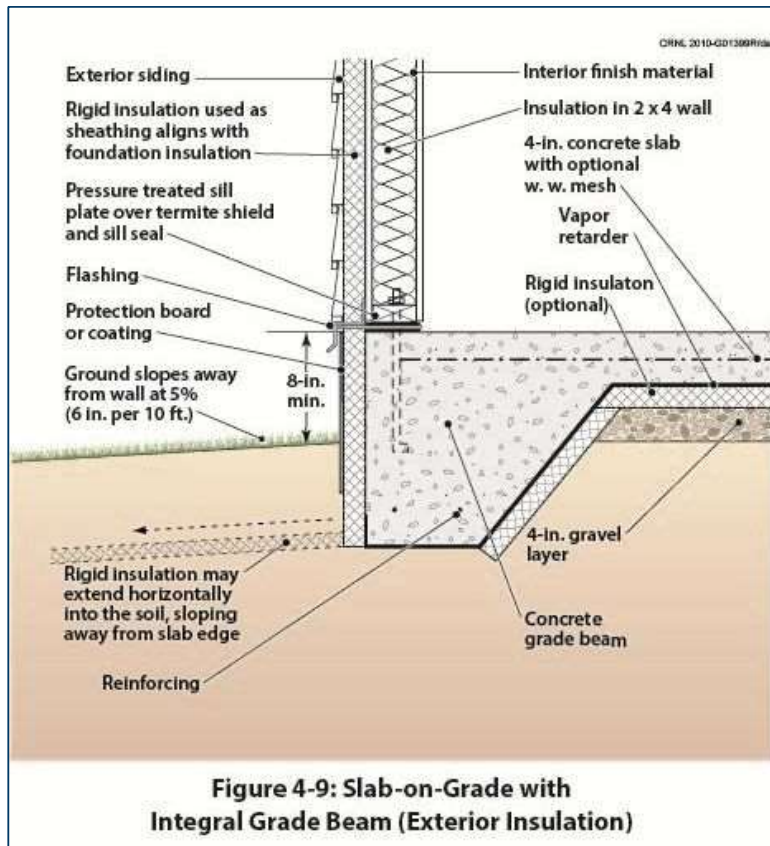
Insulation in permanent contact with subfloor

Blocking between joists, sealed at perimeter

Building Envelope

- Exterior walls, including the rim joist area.
- Ceiling/attic areas.
- Floor area over an unconditioned space (Ex. cantilever, bonus room).
- **Basement floor, or slab of a slab-on-grade system.**

Different Types of Slab-on-Grade Floors



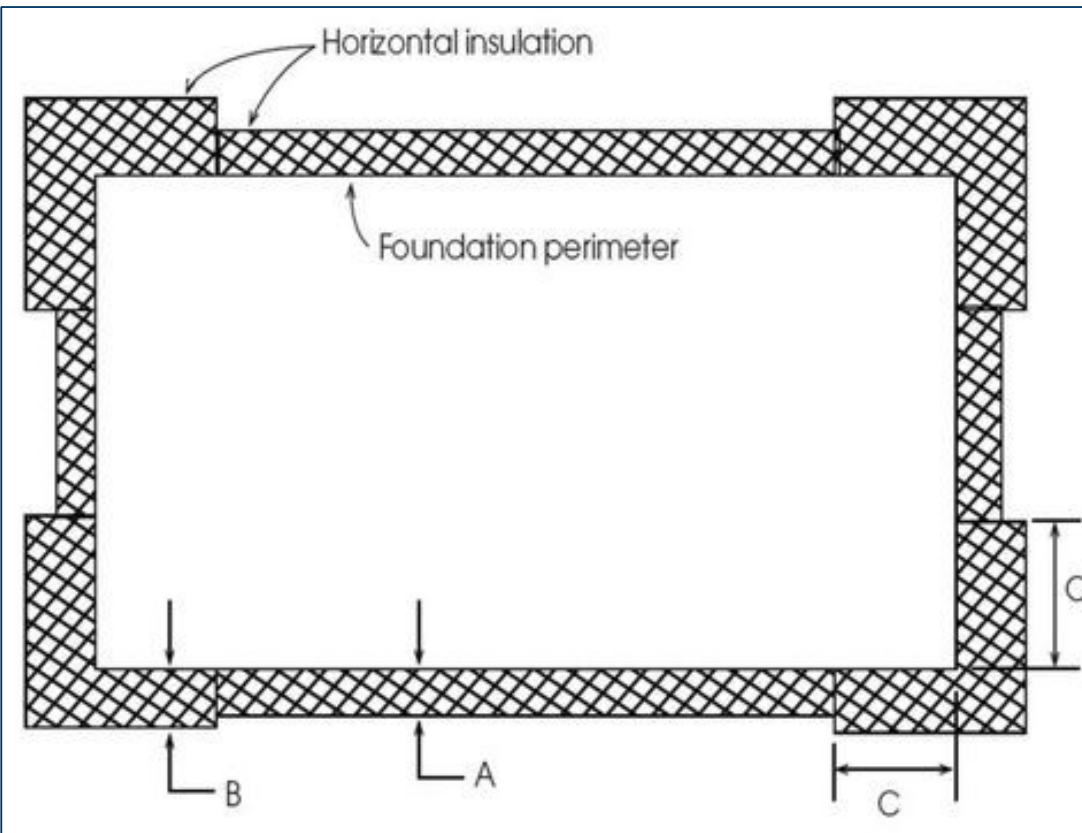
MRC R403.3 & Table R403.3(1)

R403.3 Frost-protected shallow foundations. For buildings where the monthly mean temperature of the building is maintained at not less than 64°F (18°C), footings are not required to extend below the frost line where protected from frost by insulation in accordance with Figure R403.3(1) and Table R403.3(1). Foundations protected from frost in accordance with Figure R403.3(1) and Table R403.3(1) shall not be used for unheated spaces such as porches, utility rooms, garages and carports, and shall not be attached to *basements* or *crawl spaces* that are not maintained at a minimum monthly mean temperature of 64°F (18°C).

Materials used below *grade* for the purpose of insulating footings against frost shall be *labeled* as complying with ASTM C578.

Frost-Protected Shallow Foundation systems

See Table R 403.3(1) of the MRC and footnotes for minimum insulation location and thickness.



MRC R403.3 & Table R403.3(1)

TABLE R403.3(1)

MINIMUM FOOTING DEPTH AND INSULATION REQUIREMENTS FOR FROST-PROTECTED FOOTINGS IN HEATED BUILDINGS^a

AIR FREEZING INDEX (°F-days) ^b	MINIMUM FOOTING DEPTH, D (inches)	VERTICAL INSULATION R-VALUE ^{c, d}	HORIZONTAL INSULATION R-VALUE ^{c, e}		HORIZONTAL INSULATION DIMENSIONS PER FIGURE R403.3(1) (inches)		
			Along walls	At corners	A	B	C
1,500 or less	12	4.5	Not required	Not required	Not required	Not required	Not required
2,000	14	5.6	Not required	Not required	Not required	Not required	Not required
2,500	16	6.7	1.7	4.9	12	24	40
3,000	16	7.8	6.5	8.6	12	24	40
3,500	16	9.0	8.0	11.2	24	30	60
4,000	16	10.1	10.5	13.1	24	36	60

For SI: 1 inch = 25.4 mm, °C = [(°F) - 32]/1.8.

- a. Insulation requirements are for protection against frost damage in heated buildings. Greater values could be required to meet energy conservation standards.
- b. See Figure R403.3(2) or Table R403.3(2) for Air Freezing Index values.
- c. Insulation materials shall provide the stated minimum R-values under long-term exposure to moist, below-ground conditions in freezing climates. The following R-values shall be used to determine insulation thicknesses required for this application: Type II expanded polystyrene (EPS)-3.2 R per inch for vertical insulation and 2.6 R per inch for horizontal insulation; Type IX expanded polystyrene (EPS)-3.4 R per inch for vertical insulation and 2.8 R per inch for horizontal insulation; Types IV, V, VI, VII, and X extruded polystyrene (XPS)-4.5 R per inch for vertical insulation and 4.0 R per inch for horizontal insulation.
- d. Vertical insulation shall be expanded polystyrene insulation or extruded polystyrene insulation.
- e. Horizontal insulation shall be expanded polystyrene insulation or extruded polystyrene insulation.

MRE R402.2.9 & Table R402.1.1

R402.2.9 Slab-on-grade floors. Slab-on-grade floors with a floor surface less than 12 inches (305 mm) below grade shall be insulated in accordance with Table R402.1.1. The insulation shall extend downward from the top of the slab on the outside or inside of the foundation wall. Insulation located below grade shall be extended the distance provided in Table R402.1.1 by any combination of vertical insulation, insulation extending under the slab or insulation extending out from the building. Insulation extending away from the building shall be protected by pavement or by a minimum of 10 inches (254 mm) of soil. The top edge of the insulation installed between the *exterior wall* and the edge of the interior slab shall be permitted to be cut at a 45-degree (0.79 rad) angle away from the *exterior wall*. Slab-edge insulation is not required in jurisdictions designated by the *code official* as having a very heavy termite infestation.

MRE R402.2.9 & Table R402.1.1

TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT^a

CLIMATE ZONE	FENESTRATION U-FACTOR ^b	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b,e}	CEILING ^j R-VALUE	WOOD FRAME WALL R-VALUE ^f	MASS WALL R-VALUE ^{g,h}	FLOOR R-VALUE	BASEMENT ^{c,i} WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE ^{c,i} WALL R-VALUE
6	0.32	0.55	NR	49	20, 13+5	15/20	30 ^e	15	10, 3.5 ft	15
7	0.32	0.55	NR	49	21	19/21	38 ^e	15	10, 5 ft	15

For SI: 1 foot = 304.8 mm.

- R-values are minimums. U-factors and SHGC are maximums. When insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall not be less than the R-value specified in the table.
- The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
- See Section R402.2.8.
- Insulation R-values for heated slabs shall be installed to the depth indicated or to the top of the footing, whichever is less.
- Or insulation sufficient to fill the framing cavity, R-19 minimum.
- First value is cavity insulation, second is continuous insulation or insulated siding, so "13+5" means R-13 cavity insulation plus R-5 continuous insulation or insulated siding. If structural sheathing covers 40 percent or less of the exterior, continuous insulation R-value shall be permitted to be reduced by no more than R-3 in the locations where structural sheathing is used to maintain a consistent total sheathing thickness.
- The second R-value applies when more than half the insulation is on the interior of the mass wall.
- When using log-type construction for thermal mass walls the following applies:
 - a minimum of a 7-inch diameter log shall be used; and
 - the U-value of fenestration products shall be 0.29 overall on average or better.
- See Section 402.2.8. A minimum R-19 cavity insulation is required in wood foundation walls.
- Roof/ceiling assemblies shall have a minimum 6-inch energy heel.

MRE vs. MRC

TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT^a

CLIMATE ZONE	FENESTRATION U-FACTOR ^b	SKYLIGHT U-FACTOR	GLAZED FENESTRATION SHGC ^{b,e}	CEILING ^j R-VALUE	WOOD FRAME WALL R-VALUE ^f	MASS WALL R-VALUE ^{i,g,h}	FLOOR R-VALUE	BASEMENT ^{c,i} WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE ^{c,i} WALL R-VALUE
6	0.32	0.55	NR	49	20, 13+5	15/20	30 ^e	15	10, 3.5 ft	15
7	0.32	0.55	NR	49	21	19/21	38 ^e	15	10, 5 ft	15

TABLE R403.3(1)
MINIMUM FOOTING DEPTH AND INSULATION REQUIREMENTS FOR FROST-PROTECTED FOOTINGS IN HEATED BUILDINGS^a

AIR FREEZING INDEX (°F-days) ^b	MINIMUM FOOTING DEPTH, D (inches)	VERTICAL INSULATION R-VALUE ^{c,d}	HORIZONTAL INSULATION R-VALUE ^{c,e}		HORIZONTAL INSULATION DIMENSIONS PER FIGURE R403.3(1) (inches)		
			Along walls	At corners	A	B	C
1,500 or less	12	4.5	Not required	Not required	Not required	Not required	Not required
2,000	14	5.6	Not required	Not required	Not required	Not required	Not required
2,500	16	6.7	1.7	4.9	12	24	40
3,000	16	7.8	6.5	8.6	12	24	40

Building Envelope

- Exterior walls, including the rim joist area.
- Ceiling/attic areas.
- Floor area over an unconditioned space (Ex. cantilever, bonus room).
- Basement floor or slab of a slab-on-grade system.
- **Foundation walls.**



Building Envelope

- Exterior walls, including the rim joist area.
- Ceiling/attic areas.
- Floor area over an unconditioned space (Ex. cantilever, bonus room).
- Basement floor or slab of a slab-on-grade system.
- Foundation walls.
- Vapor Retarder.



Building Envelope

- Exterior walls, including the rim joist area.
- Ceiling/attic areas.
- Floor area over an unconditioned space (Ex. cantilever, bonus room).
- Basement floor or slab of a slab-on-grade system.
- Foundation walls.
- Vapor Retarder.
- **Air Barrier.**



Vapor Retarder vs. Air Barrier

- A vapor ~~barrier~~ **retarder** does not provide a *seal* of the building components.



Vapor Retarder vs. Air Barrier

- An **air barrier** provides a seal of the building components



3/15/2022

Vapor Retarder – RB Definitions

- **VAPOR RETARDER CLASS.** *(located in Residential **Building** Code definitions)* A measure of the ability of a **material or assembly** to limit the amount of moisture that passes through that material or assembly. Vapor retarder class shall be defined using the desiccant method with Procedure A of ASTM E 96 as follows:



Vapor Retarder – RB Definitions

- **VAPOR RETARDER CLASS.** *(located in Residential **Building** Code definitions)* A measure of the ability of a **material or assembly** to limit the amount of moisture that passes through that material or assembly. Vapor retarder class shall be defined using the desiccant method with Procedure A of ASTM E 96 as follows:
 - Class I: ≤ 0.1 perm rating
 - Class II: > 0.1 to ≤ 1.0 perm rating
 - Class III: > 1.0 to ≤ 10 perm rating



Vapor Retarder

- The vapor retarder class shall be based on the manufacturer's certified testing or a tested assembly.

Vapor Retarder

- The vapor retarder class shall be based on the manufacturer's certified testing or a tested assembly.
- The following shall be deemed to meet the class specified:

Vapor Retarder

- The vapor retarder class shall be based on the manufacturer's certified testing or a tested assembly.
- The following shall be deemed to meet the class specified:
 - Class I: Sheet polyethylene, unperforated aluminum foil.



Vapor Retarder

- The vapor retarder class shall be based on the manufacturer's certified testing or a tested assembly.
- The following shall be deemed to meet the class specified:
 - Class I: Sheet polyethylene, unperforated aluminum foil.
 - Class II: Kraft-faced fiberglass batt. (Does not mean it is an air barrier)



Vapor Retarder

- The vapor retarder class shall be based on the manufacturer's certified testing or a tested assembly.
- The following shall be deemed to meet the class specified:
 - Class I: Sheet polyethylene, unperforated aluminum foil.
 - Class II: Kraft-faced fiberglass batt. (Does not mean it is an air barrier)
 - Class III: Latex or enamel paint.

Vapor Retarder – MRC R702.7

R702.7 Vapor retarders. A class I or II vapor retarder is required on the interior side of frame walls in Climate Zones 6 and 7. Class II vapor retarders are permitted only when specified on the construction documents.

Paint as a Vapor Retarder – When?

R702.7.1 Class III vapor retarders. Class III vapor retarders shall be permitted where any one of the conditions in Table R702.7.1 is met.

**TABLE R702.7.1
CLASS III VAPOR RETARDERS**

CLIMATE ZONE	CLASS III VAPOR RETARDERS PERMITTED FOR: ^a
Marine 4	Vented cladding over wood structural panels. Vented cladding over fiberboard. Vented cladding over gypsum. Continuous insulation with R -value ≥ 2.5 over 2×4 wall. Continuous insulation with R -value ≥ 3.75 over 2×6 wall.
5	Vented cladding over wood structural panels. Vented cladding over fiberboard. Vented cladding over gypsum. Continuous insulation with R -value ≥ 5 over 2×4 wall. Continuous insulation with R -value ≥ 7.5 over 2×6 wall.
6	Vented cladding over fiberboard. Vented cladding over gypsum. Continuous insulation with R -value ≥ 7.5 over 2×4 wall. Continuous insulation with R -value ≥ 11.25 over 2×6 wall.
7 and 8	Continuous insulation with R -value ≥ 10 over 2×4 wall. Continuous insulation with R -value ≥ 15 over 2×6 wall.

For SI: 1 pound per cubic foot = 16 kg/m³.

a. Spray foam with a maximum permeance of 1.5 perms at the installed thickness, applied to the interior cavity side of wood structural panels, fiberboard, insulating sheathing or gypsum is deemed to meet the continuous insulation requirement where the spray foam R -value meets or exceeds the specified continuous insulation R -value.

Paint as a Vapor Retarder - Challenges

- How to verify the coverage and application?
- If you do not use a Class I vapor retarder (for example, 3 mil poly), what is the *air barrier*?

Paint as a Vapor Retarder - Challenges

- If the house is in Climate Zone 6, and continuous insulation is **NOT** used, how does this affect our wall bracing?
- Challenges working with R-7.5+ continuous insulation?
- Spray foam is an option (footnote a.)

TABLE R702.7.1 CLASS III VAPOR RETARDERS	
CLIMATE ZONE	CLASS III VAPOR RETARDERS PERMITTED FOR: ^a
6	Vented cladding over fiberboard.
	Vented cladding over gypsum.
	Continuous insulation with R -value ≥ 7.5 over 2×4 wall.
	Continuous insulation with R -value ≥ 11.25 over 2×6 wall.
7 and 8	Continuous insulation with R -value ≥ 10 over 2×4 wall.
	Continuous insulation with R -value ≥ 15 over 2×6 wall.

For SI: 1 pound per cubic foot = 16 kg/m³.

a. Spray foam with a maximum permeance of 1.5 perms at the installed thickness, applied to the interior cavity side of wood structural panels, fiberboard, insulating sheathing or gypsum is deemed to meet the continuous insulation requirement where the spray foam R -value meets or exceeds the specified continuous insulation R -value.

Paint as a Vapor Retarder - Challenges

- What is required for vented cladding?

R702.7.3 Minimum clear airspaces and vented openings for vented cladding. For the purposes of this section, vented cladding shall include the following minimum clear airspaces. Other openings with the equivalent vent area shall be permitted.

1. Vinyl polypropylene or horizontal aluminum siding applied over a weather-resistive barrier as specified in Table R703.3(1).
2. Brick veneer with a clear airspace as specified in Table R703.8.4.
3. Other approved vented claddings.

Air Barrier – RE Definitions

- **AIR BARRIER.** Material(s) assembled and **joined together** to provide a barrier to air leakage through the building envelope.

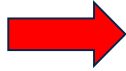


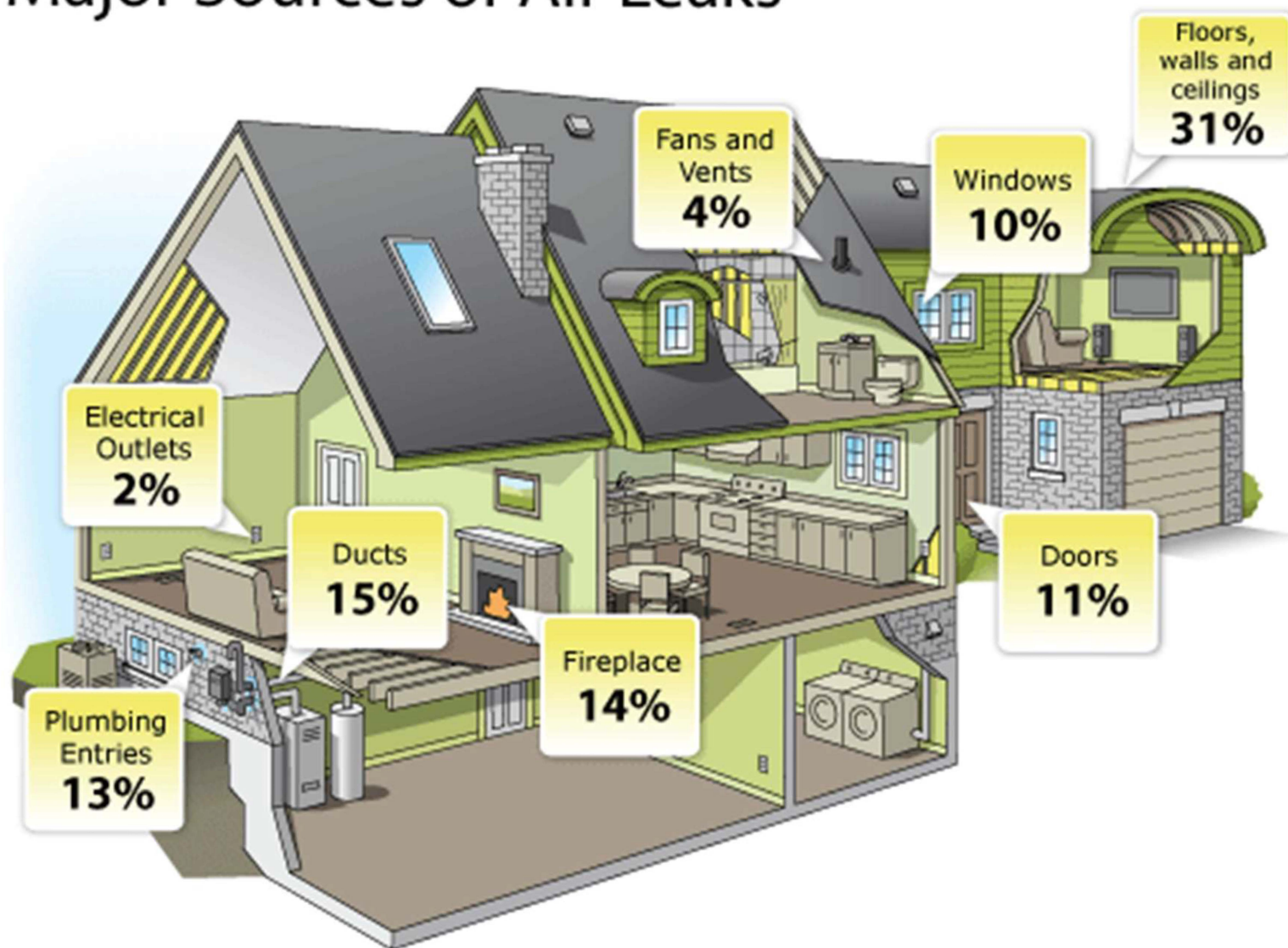
TABLE R402.4.1.1 AIR BARRIER AND INSULATION INSTALLATION	
COMPONENT	CRITERIA ^a
Air barrier and thermal barrier	A continuous air barrier shall be installed in the building envelope. Exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier shall be sealed. Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling/soffit shall be aligned with the insulation and any gaps in the air barrier sealed. Access openings, drop down stair or knee wall doors to unconditioned attic spaces shall be sealed.
Walls	Comers and headers shall be insulated and the junction of the foundation and sill plate shall be sealed. The junction of the top plate and top of exterior walls shall be sealed. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier. Knee walls shall be sealed.
Windows, skylights and doors	The space between window/door jambs and framing and skylights and framing shall be sealed.
Rim joists	Rim joists shall be insulated and include the air barrier.
Floors (including above-garage and cantilevered floors)	Insulation shall be installed to maintain permanent contact with underside of subfloor decking. The air barrier shall be installed at any exposed edge of insulation.
Crawl space walls	Where provided in lieu of floor insulation, insulation shall be permanently attached to the crawlspace walls. Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.
Narrow cavities	Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air tight, IC rated, and sealed to the drywall.
Plumbing and wiring	Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	Exterior walls adjacent to showers and tubs shall be insulated and the air barrier installed separating them from the showers and tubs.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical or communication boxes or air sealed boxes shall be installed.
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.
Fireplace	An air barrier shall be installed on fireplace walls. Fireplaces shall have gasketed doors.
a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.	

Sealed:

To close or make secure against access, leakage, or passage by a fastening or coating.

TABLE R402.4.1.1 AIR BARRIER AND INSULATION INSTALLATION	
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Ceiling/attic	The air barrier in any dropped ceiling/soffit shall be aligned with the insulation and any gaps in the air barrier sealed . Access openings, drop down stair or knee wall doors to unconditioned attic spaces shall be sealed .
Walls	Corners and headers shall be insulated and the junction of the foundation and sill plate shall be sealed . The junction of the top plate and top of exterior walls shall be sealed . Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier. Knee walls shall be sealed.
Windows, skylights and doors	The space between window/door jambs and framing and skylights and framing shall be sealed .
Rim joists	Rim joists shall be insulated and include the air barrier.
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Shower/tub on exterior wall	Exterior walls adjacent to showers and tubs shall be insulated and the air barrier installed separating them from the showers and tubs.
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HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the sub-floor or drywall.
Fireplace	An air barrier shall be installed on fireplace walls. Fireplaces shall have gasketed doors.
a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.	

Major Sources of Air Leaks



Air Barrier

- An air barrier may be a single material or a combination of materials



3/15/2022



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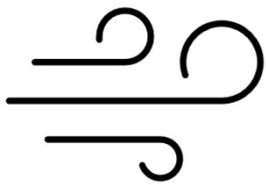
Section RE402.4

R402.4 Air leakage (Mandatory). The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.4.

R402.4.1 Building thermal envelope. The *building thermal envelope* shall comply with Sections R402.4.1.1 and R402.4.1.2. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

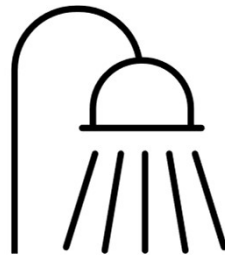
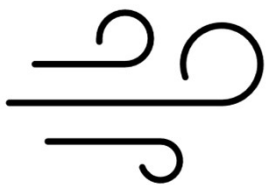
Air Leakage – Why Regulate?

- Reduce energy consumption due to air leakage.



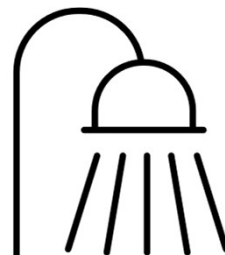
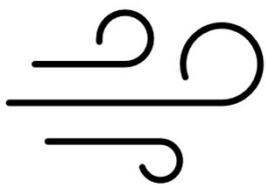
Air Leakage – Why Regulate?

- Reduce energy consumption due to air leakage.
- Avoid moisture migration issues.



Air Leakage – Why Regulate?

- Reduce energy consumption due to air leakage.
- Avoid moisture migration issues.
- Avoid uncomfortable drafts caused by cold air leaking in from the outdoors.



R402.3.4 Opaque door exemption. One side-hinged opaque door assembly up to 24 square feet (2.22 m²) in area is exempted from the U-factor requirement in Section R402.1.1. This exemption shall not apply to the U-factor alternative approach in Section R402.1.3 and the total UA alternative in Section R402.1.4.

R402.3.5 Sunroom U-factor. All *sunrooms* enclosing conditioned space shall meet the fenestration requirements of this code.

Exception: For *sunrooms* with thermal isolation and enclosing conditioned space, in Climate Zones 4 through 8, the following exceptions to the fenestration requirements of this code shall apply:

1. The maximum fenestration U-factor shall be 0.45; and
2. The maximum skylight U-factor shall be 0.70. New fenestration separating the *sunroom* with thermal isolation from conditioned space shall meet the building thermal envelope requirements of this code.

R402.3.6 Replacement fenestration. Where some or all of an existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable requirements for U-factor and SHGC in Table R402.1.1.

R402.4 Air leakage (Mandatory). The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.4.

R402.4.1 Building thermal envelope. The *building thermal envelope* shall comply with Sections R402.4.1.1 and R402.4.1.2. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

R402.4.1.1 Installation. The components of the *building thermal envelope* as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table R402.4.1.1, as applicable to the method of construction. Where required by the *code official*, an *approved* third party shall inspect all components and verify compliance.

R402.4.1.2 Testing. The building or dwelling unit shall be tested and verified as having an air leakage rate of not exceeding 5 air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8. Testing shall be conducted with a blower door at a pressure of 0.2 inches w.g. (50 Pascals). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope*.

During testing:

Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the

intended weatherstripping or other infiltration control measures;

2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures;
3. Interior doors, if installed at the time of the test, shall be open;
4. Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
5. Heating and cooling systems, if installed at the time of the test, shall be turned off, and
6. Supply and return registers, if installed at the time of the test, shall be fully open.

R402.4.2 Fireplaces. New wood-burning fireplaces shall have tight-fitting flue dampers and outdoor combustion air.

R402.4.3 Fenestration air leakage. Windows, skylights and sliding glass doors shall have an air infiltration rate of no more than 0.3 cfm per square foot (1.5 L/s/m²), and swinging doors no more than 0.5 cfm per square foot (2.6 L/s/m²), when tested according to NFRC 400 or AAMA/WDMA/CSA 101/LS 2/A440 by an accredited, independent laboratory and *listed* and *labeled* by the manufacturer.

Exception: Site-built windows, skylights and doors.

R402.4.4 Recessed lighting. Recessed luminaires installed in the *building thermal envelope* shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and *labeled* as having an air leakage rate not more than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E 283 at a 1.57 psf (75 Pa) pressure differential. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.

R402.5 Maximum fenestration U-factor and SHGC (Mandatory). The area-weighted average maximum fenestration U-factor permitted using tradeoffs from Section R402.1.4 or R405 shall be 0.48 in Climate Zones 4 and 5 and 0.40 in Climate Zones 6 through 8 for vertical fenestration, and 0.75 in Climate Zones 4 through 8 for skylights. The area-weighted average maximum fenestration SHGC permitted using tradeoffs from Section R405 in Climate Zones 1 through 3 shall be 0.50.

SECTION R403 SYSTEMS

R403.1 Controls (Mandatory). At least one thermostat shall be provided for each separate heating and cooling system.

R403.1.1 Programmable thermostat. Where the primary heating system is a forced-air furnace, at least one thermostat per dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of

Section RE402.4.1.2 Air Leakage (Mandatory)

R402.3.4 Opaque door exemption. One side-hinged opaque door assembly up to 24 square feet (2.22 m²) in area is exempted from the U-factor requirement in Section R402.1.1. This exemption shall not apply to the U-factor alternative approach in Section R402.1.3 and the total UA alternative in Section R402.1.4.

R402.3.5 Sunroom U-factor. All sunrooms enclosing conditioned space shall meet the fenestration requirements of this code.

Exception: For sunrooms with thermal isolation and enclosing conditioned space, in Climate Zones 4 through 8, the following exceptions to the fenestration requirements of this code shall apply:

1. The maximum fenestration U-factor shall be 0.45; and
2. The maximum skylight U-factor shall be 0.70. New fenestration separating the sunroom with thermal isolation from conditioned space shall meet the building thermal envelope requirements of this code.

R402.3.6 Replacement fenestration. Where some or all of an existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable requirements for U-factor and SHGC in Table R402.1.1.

R402.4 Air leakage (Mandatory). The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.4.

R402.4.1 Building thermal envelope. The building thermal envelope shall comply with Sections R402.4.1.1 and R402.4.1.2. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

R402.4.1.1 Installation. The components of the building thermal envelope as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table R402.4.1.1, as applicable to the method of construction. Where required by the code official, an approved third party shall inspect all components and verify compliance.

R402.4.1.2 Testing. The building or dwelling unit shall be tested and verified as having an air leakage rate of not exceeding 5 air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8. Testing shall be conducted with a blower door at a pressure of 0.2 inches w.g. (50 Pascals). Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the

intended weatherstripping or other infiltration control measures;

2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures;
3. Interior doors, if installed at the time of the test, shall be open;
4. Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
5. Heating and cooling systems, if installed at the time of the test, shall be turned off; and
6. Supply and return registers, if installed at the time of the test, shall be fully open.

R402.4.2 Fireplaces. New wood-burning fireplaces shall have tight-fitting flue dampers and outdoor combustion air.

R402.4.3 Fenestration air leakage. Windows, skylights and sliding glass doors shall have an air infiltration rate of no more than 0.3 cfm per square foot (1.5 L/s/m²), and swinging doors no more than 0.5 cfm per square foot (2.6 L/s/m²), when tested according to NFRC 400 or AAMA/WDMA/CSA 101/LS-2/A440 by an accredited, independent laboratory and listed and labeled by the manufacturer.

Exception: Site-built windows, skylights and doors.

R402.4.4 Recessed lighting. Recessed luminaires installed in the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and labeled as having an air leakage rate not more than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E 283 at a 1.57 psf (75 Pa) pressure differential. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.

R402.5 Maximum fenestration U-factor and SHGC (Mandatory). The area-weighted average maximum fenestration U-factor permitted using tradeoffs from Section R402.1.4 or R405 shall be 0.48 in Climate Zones 4 and 5 and 0.40 in Climate Zones 6 through 8 for vertical fenestration, and 0.75 in Climate Zones 4 through 8 for skylights. The area-weighted average maximum fenestration SHGC permitted using tradeoffs from Section R405 in Climate Zones 1 through 3 shall be 0.50.

SECTION R403 SYSTEMS

R403.1 Controls (Mandatory). At least one thermostat shall be provided for each separate heating and cooling system.

R403.1.1 Programmable thermostat. Where the primary heating system is a forced-air furnace, at least one thermostat per dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of

R402.4.1.2 Testing. The building or dwelling unit shall be tested and verified as having an air leakage rate of not exceeding 5 air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8. Testing shall be conducted with a blower door at a pressure of 0.2 inches w.g. (50 Pascals). Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope.

Section RE402.4.1.2 Air Leakage (Mandatory)

Air Leakage Test

- Max 3 ACH in zones 6 & 7.
- Max 2.6 ACH if using R10 foundation insulation exception.



Energy Systems



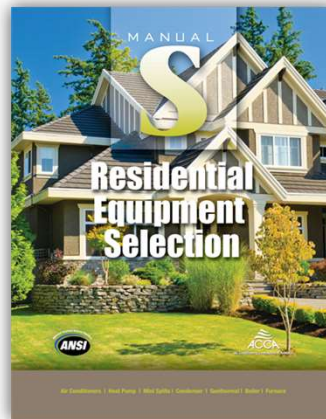
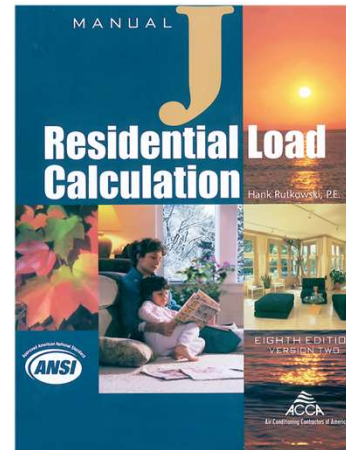
Building Envelope
R402



Mechanical Systems
R403 & R403.5

Mechanical Systems

- Heat loss.
- Equipment sizing.
- Mechanical ventilation.



Heat Loss

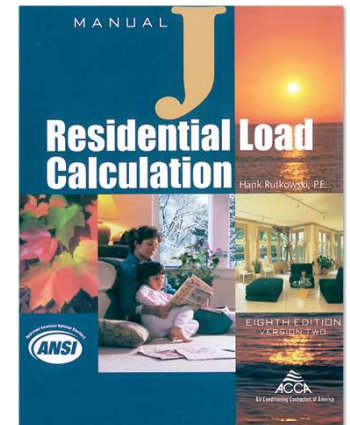


Sizing the Mechanical Equipment

How is Heat Loss Calculated?

R403.5.17 Climatic design Conditions.

- ASHRAE Handbook of Fundamentals
- ACCA Manual J (Air Conditioning Contractors of America)



Formula for Heat Loss

$Q=UA(dT)$ is the general formula for heat loss.

$$Q=UA(dT)$$

$Q=UA(dT)$ is the general formula for heat loss.

- **Q = Heat loss (what we are trying to define)**
 - Specifically, the Btu's/Hour of heat loss.
 - Btu = British Thermal Units.
 - 1 Btu = amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit.

$$Q=UA(dT)$$

What exactly is this equation? Why do we need to understand it?

- Q = Heat loss (what we are trying to define)
- **U = U-factor of the assembly**
 - U-value (U-factor): a measure of the **heat transmission** through a building part (such as a wall or window) or a given thickness of a material (such as insulation) with **lower** numbers indicating better insulating properties. - *Merriam Webster*
 - R-value: a measure of **resistance to the flow of heat** through a given thickness of a material (such as insulation) with **higher** numbers indicating better insulating properties. - *Merriam Webster*

$$Q=UA(dT)$$

What exactly is this equation?... And why do we need to understand it?

- Q = Heat loss (what we are trying to define)
- U = U-factor of the assembly
- **A = the Area of the assembly**
 - Length (width) of wall x height.

$$Q=UA(dT)$$

What exactly is this equation?... And why do we need to understand it?

- Q = Heat loss (what we are trying to define)
- U = the U-factor of the assembly
- A = the Area of the assembly
- **(dT) = Delta T (ΔT) or temperature difference**
 - Minimum outdoor *design* temperature plus the interior *design* temperature = ΔT
 - 70 degree indoor & -20 degree outdoor = **90 degree ΔT .**
 - Said differently, there is a 90 degree temperature swing from -20 to 70.

Example

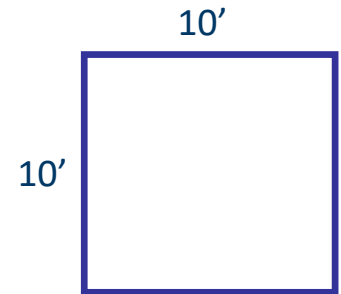
Simple heat loss calculation:

- Heat loss calculation for one wall.
- Then, adding a window to same wall.
 - Note the changes in heat loss due to the window.



Example

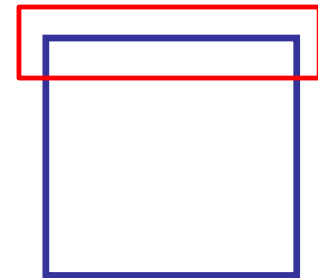
$Q = UA(dT) =$ heat load assessment = defines equipment sizing.



- Example: Room is 10' x 10' x 10'
- Using: 2x6 wall, fiberglass insulation, R-value ~R20.
- Convert: R-value (R20) to U-factor by dividing 1 by the R-value.
 - $\frac{1}{R-Val} = U \text{ Factor} \rightarrow \frac{1}{20} = 0.05 \rightarrow \text{The U-factor is 0.05}$

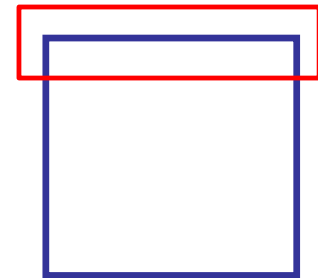
Example – 1 Wall

One wall only



Example – 1 Wall

- One wall that is 10' tall and 10' wide equals an Area (A) of 100 Sq. Ft



Example – 1 Wall

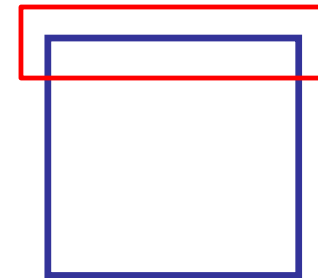
- One wall that is 10' tall and 10' wide equals an Area (A) of 100 Sq. Ft

(Heat loss) (U-factor of assembly) (Area) (Temperature delta)

• Btu's per hour (Q) = 0.05 (U) x 100 Sq Ft. (A) x 90 (dT)

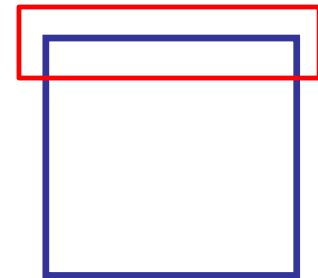
$Q = UA(dT)$

The diagram illustrates the components of the heat loss equation. Red brackets above the equation identify the terms: (Heat loss) for Btu's per hour (Q), (U-factor of assembly) for 0.05 (U), (Area) for 100 Sq Ft. (A), and (Temperature delta) for 90 (dT). Below the equation, the formula $Q = UA(dT)$ is shown. Four blue arrows point from the variables in this formula to the corresponding terms in the equation above: from Q to (Heat loss), from U to (U-factor of assembly), from A to (Area), and from dT to (Temperature delta).



Example – 1 Wall

- 1 Wall that is 10' tall and 10' wide. Equals an Area (A) of 100 Sq. Ft
- Btu's per hour (Q) = $0.05 (U) \times 100 \text{ Sq Ft. (A)} \times 90 (dT)$
- Btu's per wall for design loads = **450 Btu's** heat loss
 - $Q = 0.05 \times 100 \times 90$
 - $Q = 450$



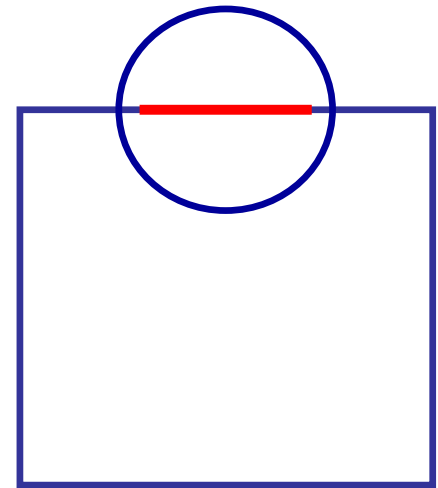
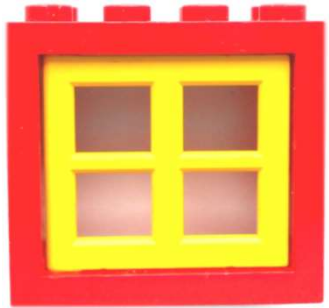
Example – 4 Walls

- 4 walls at 450 Btu's each (4×450) = 1800 Btu's of heat loss every hour through the walls.
- Requires a heating appliance capable of supplying a minimum of **1,800 Btu's** per hour.
- Should we oversize?
 - Up to 40% (Section 403.5.17 A.)
 - More is not good.



Example – 4 Walls + 1 Window

- Wall #4 *was* 100 Sq Ft at 0.05 U-Factor.
- Now, the wall is only 84 Sq Ft ($100 - 16$ Sq Ft window) at the .05 U-Factor, **plus** add a 16 Sq Ft window at a 0.32 U-Factor.



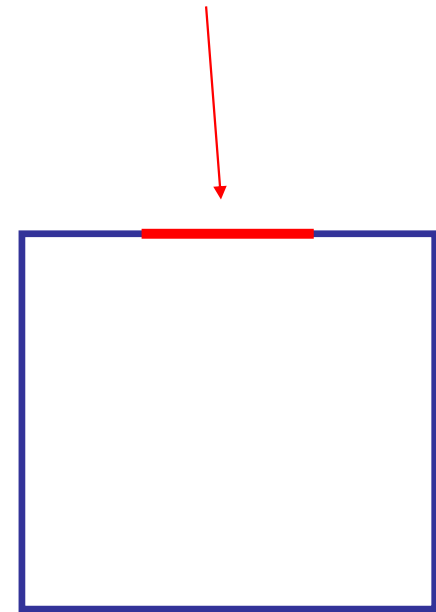
Example – 4 Walls + 1 Window

- Wall 1 = $.05 \times 100 \times 90 = 450$ Btu's
- Wall 2 = $.05 \times 100 \times 90 = 450$ Btu's
- Wall 3 = $.05 \times 100 \times 90 = 450$ Btu's
- Wall 4 = $.05 \times 84 \times 90 = 378$ Btu's
- **Walls** = 1,728 Btu's
- Add window in wall 4 =

$$.32 \times 16 \text{ Sq Ft} \times 90 = 461 \text{ Btu's}$$

- **Total Btu's heat loss = 2,189.** Without the window, the total Btu's were 1800. The window adds 389 Btu's of heat loss.

Windows can make a big overall difference



Example - Floor

- Basement floor with areas of 66' x 30' and 14' x 8'
 - Remember the equation $Q = UA(dT)$
- The following are the given:
 - R value of 2 for the basement floor.
 - Under slab ground temperature of 55 degrees.
 - Interior design temperature of 70 degrees.
- What is the total heat loss of the floor only?

Example - Floor

- $Q = UA (dT)$
 - Figure out (U) and (dT)
- R2 basement floor, convert to U-factor.
 - $\frac{1}{R \text{ value}} = \frac{1}{2}$
 - $U \text{ Factor} = 0.5$
- Under slab ground temperature of 55 degrees, interior design temperature of 70 degrees.
 - Difference is $70 - 55$
 - $\Delta T = 15$

Example - Floor

- Floor area #1:

- $66 \times 30 = 1,980 \text{ SqFt}$

- Floor Area #2:

- $14 \times 8 = 112 \text{ SqFt}$

- Total floor area: $1,980 \text{ SqFt} + 112 \text{ SqFt} = \mathbf{2,092 \text{ SqFt}}$

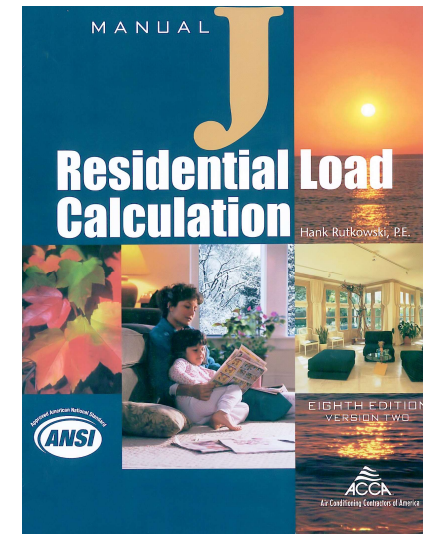
- Floor area heat loss: $Q = (U) 0.5 \times (A) 2,092 \times (dT) 15 = \mathbf{15,690 \text{ Btu's}}$

Equipment Sizing

How is sizing determined?

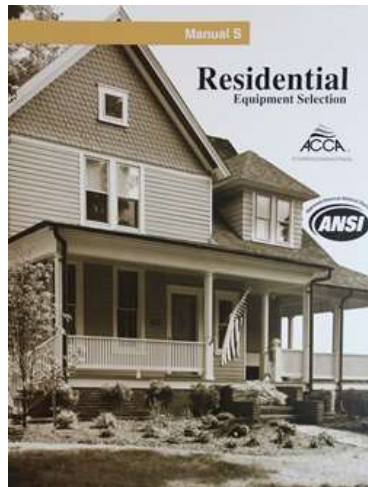
RE403.6 - Equipment Sizing ACCA Manual 'J', Manual 'S'

- RE403.5.17 A.
 - *(Residential heating and cooling) HVAC equipment shall be sized according to ACCA **Manual S** or an equivalent method, based on the building's heating and cooling load calculations by using ASHRAE Handbook of Fundamentals or the ACCA **Manual J**. ...*
- ACCA = Air Conditioning Contractors of America



RE403.6 - Equipment Sizing ACCA Manual 'J', Manual 'S'

- **Manual J** establishes the heating and cooling load calculations, and guides HVAC designers to use ACCA *Manual S* to select equipment that is the right size.
- **Manual S** sets equipment sizing limits, as summarized in Table 1.



ACCA Manual S = Sizing of Equipment

<i>Manual S</i> Equipment Selection Sizing Limitations		
Equipment	Sizing Limits	Reference
Furnaces	100% - 140% of total heating load	Section 2-2
Boilers	100% - 140% of total heating load	Section 2-2
Air conditioners	115% of total cooling load*	Section 3-4
Heat pumps	115% ¹ or 125% ² of total cooling load*	Section 4-4
Supplemental heat (heat pumps)		
• Electric	Based on equipment balance point	Section 4-8
• Dual fuel	100% - 140% of total heating load	Section 6-8
Emergency Heat (heat pumps)	Based on local codes	Section 4-9
<i>Manual S</i> Input for Design Air Flow (<i>Manual D</i>)		
Mode of Operation	Requirement	Reference
• Heating	Temperature rise requirement	Section 2-6
• Cooling	Air flow associated with the selected equipment's capacity	Section 3-11
¹ Heat pumps in a <i>cooling</i> dominant climate are allowed to be 115% of the cooling load. ² Heat pumps in a <i>heating</i> dominant climate are allowed to be 125% of the cooling load. * The size of the cooling equipment must be based on the same temperature and humidity conditions that were used to calculate the <i>Manual J</i> loads.		

- Why is proper sizing so important?

Ventilation

Mechanical ventilation requirements in the Energy code

Definition of Mechanical Ventilation

- RE202 Definitions:

MECHANICAL VENTILATION. *The mechanical process of supplying conditioned or unconditioned air to, or removing it from, any space.*

Why Ventilate?

- Homes are built tighter now. Need to address:
 - Air quality concerns: stagnant air, viruses, mold, odors, synthetic materials off-gassing, etc.
 - Moisture management.



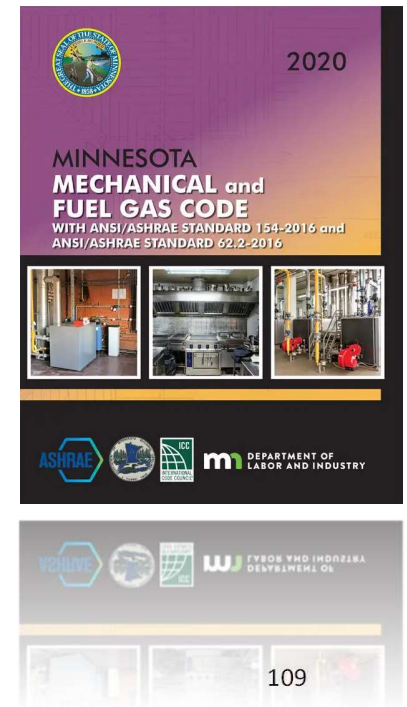
3/15/2022



MN Mechanical Code

401.2.1 Ventilation in IRC buildings. Ventilation in buildings constructed in accordance with the IRC shall comply with Minnesota Rules, Chapter 1322.

401.2.2 Ventilation in Group R-2, R-3, and R-4 occupancies three stories and less in height. Ventilation in Group R-2, R-3, and R-4 occupancies three stories and less in height shall be provided with a balanced ventilation system and shall comply with the fan efficacy requirements located in Minnesota Rules, Chapter 1322, and the ventilation requirements in (1) Minnesota Rules, Chapter 1322, or (2) ASHRAE 62.2 *Ventilation and Acceptable Indoor Air Quality in Residential Buildings*.



Balanced Ventilation

- R403.5 Mechanical ventilation (mandatory).

The building shall be provided with a balanced mechanical ventilation system that is +/-10 percent of the system's design capacity and meets the requirements of Section R403.5.5, which establishes the continuous and total mechanical ventilation requirements for dwelling unit ventilation. ...

Why Balanced?

- Provide acceptable indoor air quality.

Why Balanced?

- Provide acceptable indoor air quality.
- Balancing the ventilation keeps more of a neutral pressure on the building envelope, saving energy.

Why Balanced?

- Provide acceptable indoor air quality.
- Balancing the ventilation keeps more of a neutral pressure on the building envelope, saving energy.
- Evens out temperatures in the house for hot and cold spots.

Quantity and Type of Ventilation

- Total Ventilation Rate:
 - Shall provide sufficient outdoor air = total ventilation rate average, for each one-hour period in accordance with Table R403.5.2 .
- Continuous Ventilation:
 - A **minimum of 50% of the total** ventilation rate, but **not less than 40 CFM**, on a continuous rate average for each one-hour period in accordance with Table R403.5.2 or Equation 403.5.2

[illegible]

	1	2	3	4	5	6 ²
Conditioned space ¹ (in sq. ft.)	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous
1000-1500	60/40	75/40	90/45	105/53	120/60	135/68
1501-2000	70/40	85/43	100/50	115/58	130/65	145/73
2001-2500	80/40	95/48	110/55	125/63	140/70	155/78
2501-3000	90/45	105/53	120/60	135/68	150/75	165/83
3001-3500	100/50	115/58	130/65	145/73	160/80	175/88
3501-4000	110/55	125/63	140/70	155/78	170/85	185/93
4001-4500	120/60	135/68	150/75	165/83	180/90	195/98
4501-5000	130/65	145/73	160/80	175/88	190/95	205/103
5001-5500	140/70	155/78	170/85	185/93	200/100	215/108
5501-6000 ²	150/75	165/83	180/90	195/98	210/105	225/113

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[illegible]

TABLE R403.5.2
NUMBER OF BEDROOMS

	1	2	3	4	5	6 ²
Conditioned space ¹ (in sq. ft.)	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous
1000-1500	60/40	75/40	90/45	105/53	120/60	135/68
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3001-3500	100/50	115/58	130/65	145/73	160/80	175/88
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4001-4500	120/60	135/68	150/75	165/83	180/90	195/98
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5001-5500	140/70	155/78	170/85	185/93	200/100	215/108
5501-6000 ²	150/75	165/83	180/90	195/98	210/105	225/113

1. Conditioned space includes the basement and conditioned crawl spaces.
2. If conditioned space exceeds 6000 sq. ft. or there are more than 6 bedrooms, use Equation R403.5.2.

[illegible]

TABLE R403.5.2
NUMBER OF BEDROOMS

	1	2	3	4	5	6 ²
Conditioned space ¹ (in sq. ft.)	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous
1000-1500	60/40	75/40	90/45	105/53	120/60	135/68
1501-2000	70/40	85/43	100/50	115/58	130/65	145/73
2001-2500	80/40	95/48	110/55	125/63	140/70	155/78
2501-3000	90/45	105/53	120/60	135/68	150/75	165/83
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[illegible]

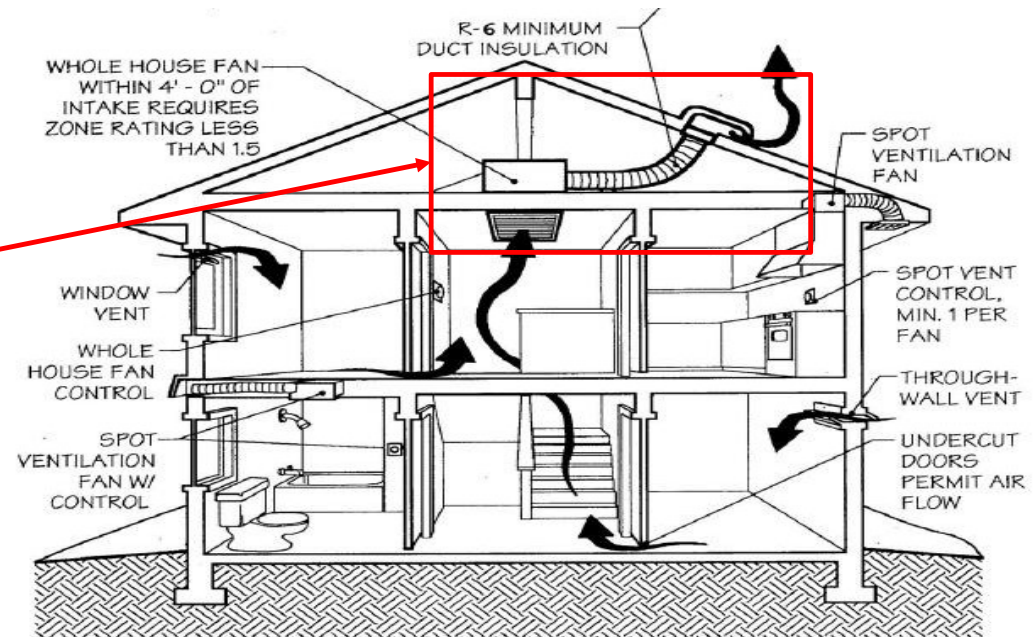
TABLE R403.5.2
NUMBER OF BEDROOMS

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Conditioned space ¹ (in sq. ft.)	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous
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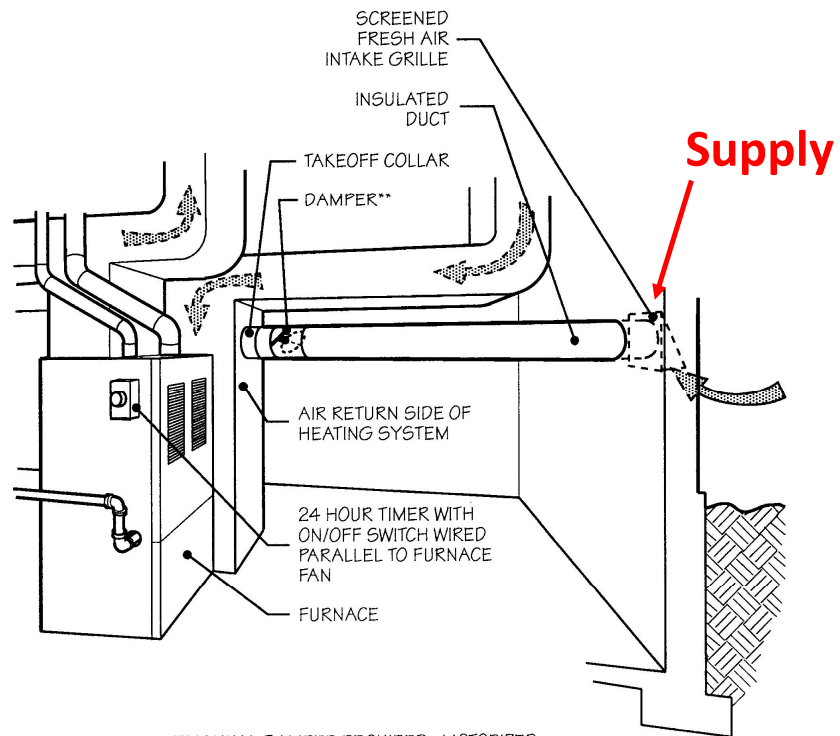
1. Conditioned space includes the basement and conditioned crawl spaces.
2. If conditioned space exceeds 6000 sq. ft. or there are more than 6 bedrooms, use Equation R403.5.2.

Mechanical Ventilation

Exhaust Only Systems
(no longer Allowed)

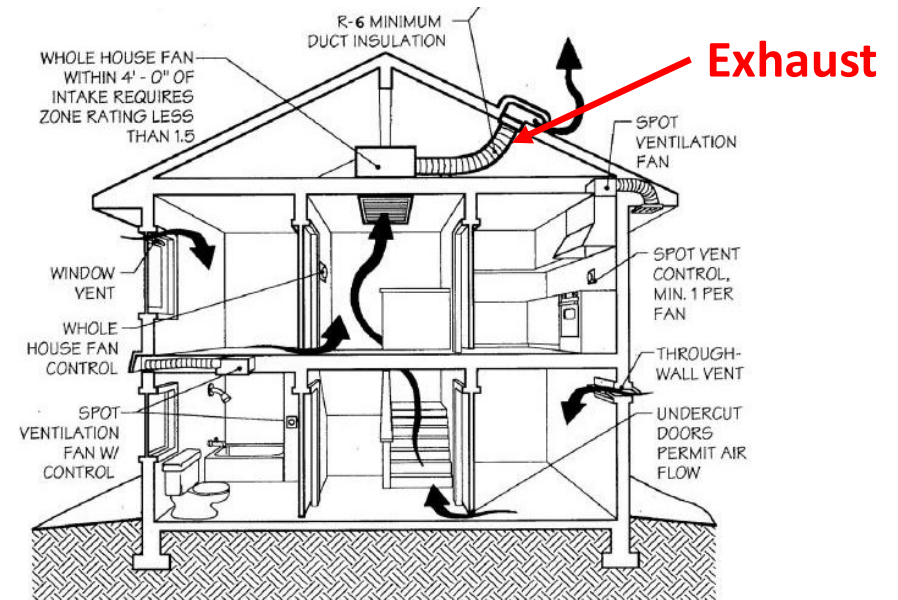


Ventilation must be Balanced



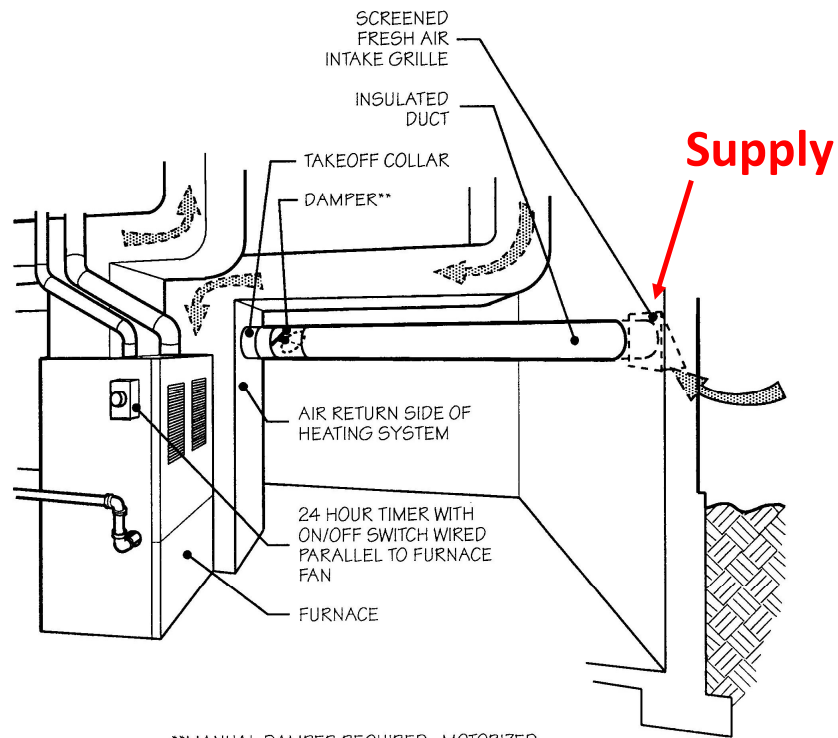
**MANUAL DAMPER REQUIRED. MOTORIZED DAMPER RECOMMENDED IN SOME LOCATIONS.

Supply Only System

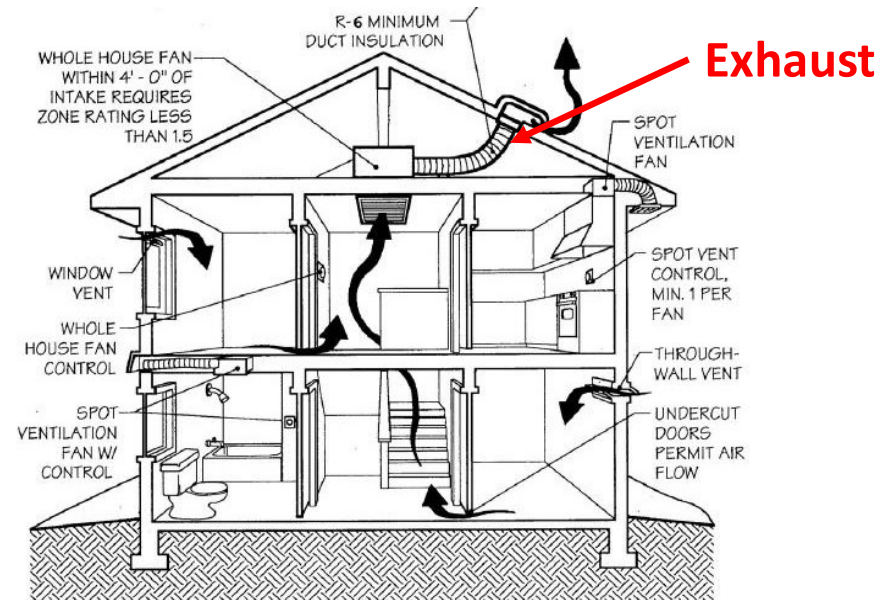


Exhaust-Only System

Ventilation must be Balanced

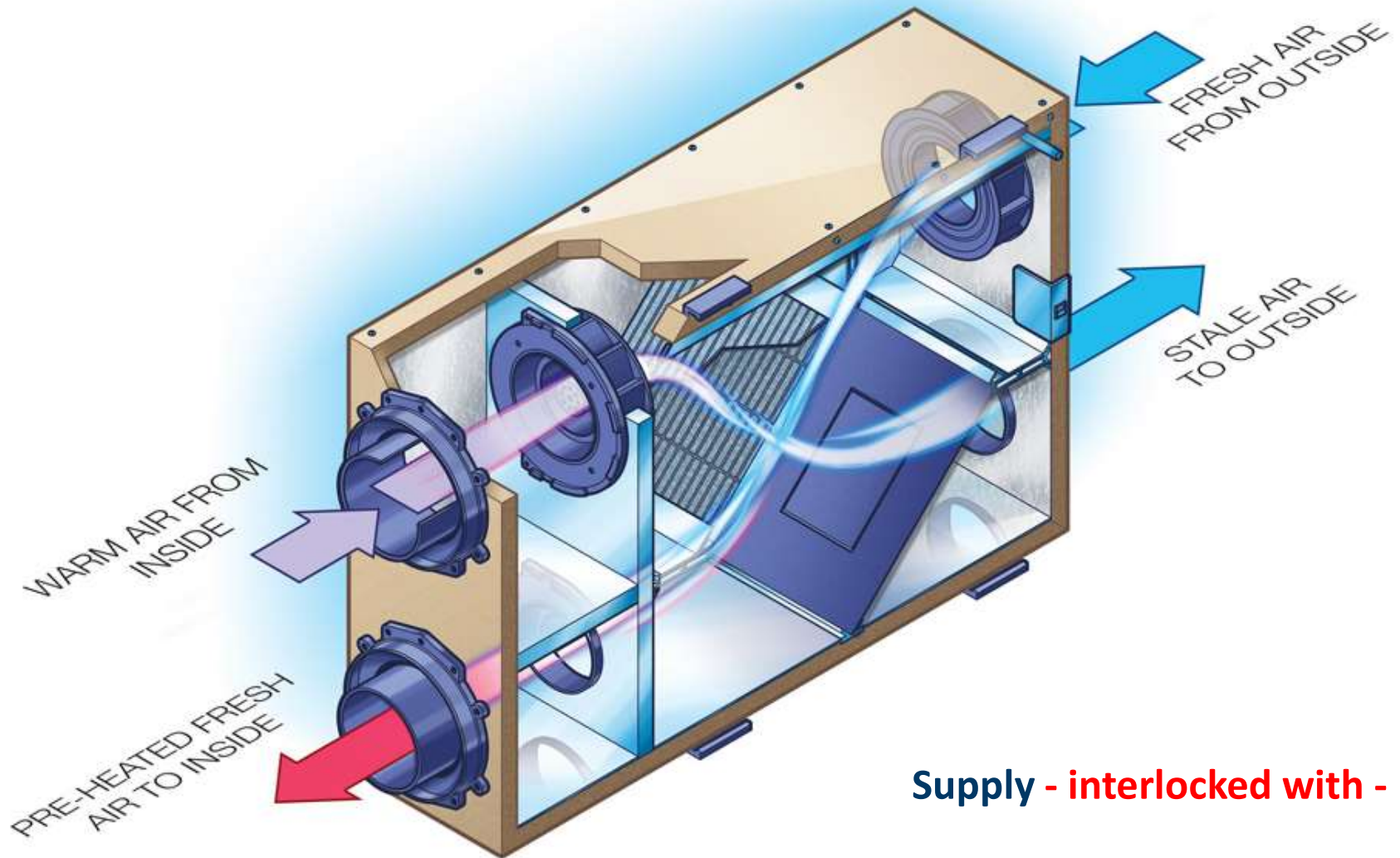


**MANUAL DAMPER REQUIRED. MOTORIZED DAMPER RECOMMENDED IN SOME LOCATIONS.



Supply Only System - interlocked with an - Exhaust-only System

HEAT RECOVERY VENTILATION SYSTEM



Supply - interlocked with - Exhaust

Energy Systems



Building Envelope
R402



Mechanical Systems
R403 & R403.5



Service Water Heating
R403.3 & R403.4

Service Water Heating

- Pipe insulation on hot water lines.

R403.4.2 Hot Water Pipe Insulation

- Hot water piping will be insulated to at least R-3 as follows:
 1. Piping larger than 3/4" diameter.
 2. Piping serving more than one dwelling unit.
 3. Piping from water heater to kitchen outlets.
 4. Piping located outside the conditioned space.
 5. Piping from the water heater to a distribution manifold.
 6. Piping located under a floor slab.
 7. Buried piping.
 8. Supply and return piping in recirculation systems other than demand recirculation systems.
 9. Piping with run lengths greater than the max run lengths for the nominal pipe diameter given in Table R403.4.2.



R403.4.2 – Hot water pipe insulation

All remaining piping shall be insulated to at least R-3 or meet the run length requirements of Table R403.4.2.

**TABLE R403.4.2
MAXIMUM RUN LENGTH (feet)^a**

Nominal Pipe Diameter of Largest Diameter Pipe in the Run (inch)	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{3}{4}$	$> \frac{3}{4}$
Maximum Run Length	30	20	10	5

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

a. Total length of all piping from the distribution manifold or the recirculation loop to a point of use.



Energy Systems



Building Envelope
R402



Mechanical Systems
R403 & R403.5



Service Water Heating
R403.3 & R403.4



Electrical Systems
R404

Prescriptive Lighting Equipment



Prescriptive Lighting Equipment

RE Section R404

A minimum of 75 % of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps or a minimum of 75% of permanently installed lighting fixtures shall contain only high efficacy lamps.



Prescriptive Lighting Equipment

RE Section R404

A minimum of 75 % of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps or a minimum of 75% of permanently installed lighting fixtures shall contain only high efficacy lamps.

Exception:

- ✓ Low-voltage lighting



Recessed Lighting Fixtures

RE Section R402.4.4

- ✓ Type IC rated and labeled as meeting ASTM E 283 when tested at 1.57 psf (75 Pa) pressure differential with no more than 2.0 cfm of air movement

R402.4.4 Recessed lighting. Recessed luminaires installed in the *building thermal envelope* shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and *labeled* as having an air leakage rate not more than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E 283 at a 1.57 psf (75 Pa) pressure differential. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.



Recessed Lighting Fixtures

RE Section R402.4.4

- ✓ Type IC rated and labeled as meeting ASTM E 283 when tested at 1.57 psf (75 Pa) pressure differential with no more than 2.0 cfm of air movement
- ✓ Sealed with a gasket or caulk between the housing and interior wall or ceiling covering

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Submittal Documents



What is Required for Plan Review?

Submittal Documents

- What is required for a proper plan review of the building and the buildings “Energy” systems?



MN Residential Energy Code Administration 1322.0103

- 1322.0103 Construction Documents



1322.0103 CONSTRUCTION DOCUMENTS

Construction documents shall be drawn to scale upon suitable material. Electronic media documents are permitted to be submitted when approved by the building official. Construction documents shall be of sufficient clarity to indicate the location; nature, and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems, and equipment as herein governed. The details shall include the following when applicable:

- A. Insulation materials and their R-values;
- B. Fenestration U-factors and SHGCs;
- C. Area-weighted U-factor and SHGC calculations;
- D. Mechanical system design criteria;
- E. Mechanical and service water heating system and equipment types, sizes, and efficiencies;
- F. Equipment and systems controls;
- G. Fan motor horsepower (hp) and controls;
- H. Duct sealing, and the location and insulation of ducts and pipes;
- I. Lighting fixture schedule with wattage and control narrative; and
- J. Air sealing details.

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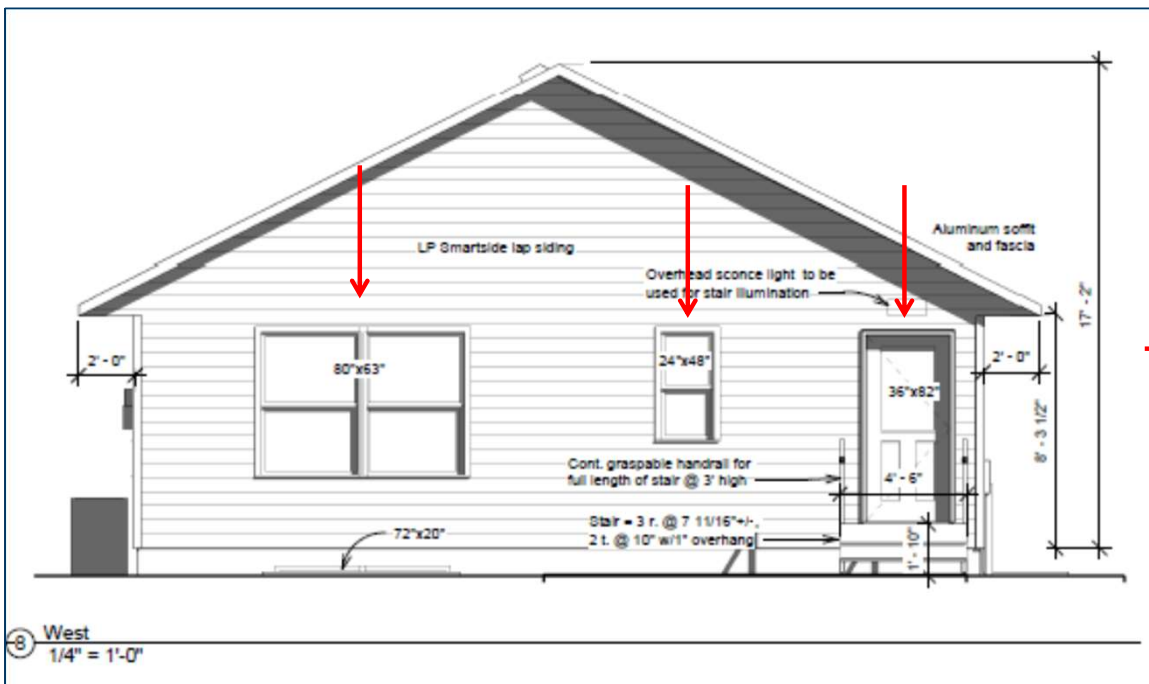
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3/15/2022

Table RE402.1.1

**TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT^a**

CLIMATE ZONE	FENESTRATION U-FACTOR ^b	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b,e}	CEILING ^j R-VALUE	WOOD FRAME WALL R-VALUE ^f	MASS WALL R-VALUE ^{g,h}	FLOOR R-VALUE	BASEMENT ^{c,i} WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE ^{c,i} WALL R-VALUE
6	0.32	0.55	NR	49	20, 13+5	15/20	30 ^e	15	10, 3.5 ft	15
7	0.32	0.55	NR	49	21	19/21	38 ^e	15	10, 5 ft	15

For SI: 1 foot = 304.8 mm.

- R-values are minimums. U-factors and SHGC are maximums. When insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall not be less than the R-value specified in the table.
- The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
- See Section R402.2.8.
- Insulation R-values for heated slabs shall be installed to the depth indicated or to the top of the footing, whichever is less.
- Or insulation sufficient to fill the framing cavity, R-19 minimum.
- First value is cavity insulation, second is continuous insulation or insulated siding, so "13+5" means R-13 cavity insulation plus R-5 continuous insulation or insulated siding. If structural sheathing covers 40 percent or less of the exterior, continuous insulation R-value shall be permitted to be reduced by no more than R-3 in the locations where structural sheathing is used to maintain a consistent total sheathing thickness.
- The second R-value applies when more than half the insulation is on the interior of the mass wall.
- When using log-type construction for thermal mass walls the following applies:
 - a minimum of a 7-inch diameter log shall be used; and
 - the U-value of fenestration products shall be 0.29 overall on average or better.
- See Section 402.2.8. A minimum R-19 cavity insulation is required in wood foundation walls.
- Roof/ceiling assemblies shall have a minimum 6-inch energy heel.

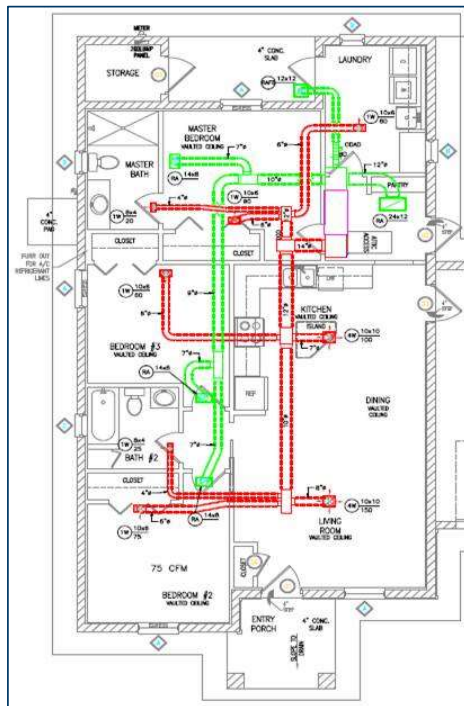
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R403.6 Equipment Sizing (Mandatory). Heating and cooling equipment shall be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other *approved* heating and cooling calculation methodologies.



<https://basc.pnnl.gov/images/compact-duct-design-layout>

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R401.3 Certificate (mandatory). A building certificate shall be completed and posted on or in the electrical distribution panel by the builder or registered design professional. The certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label, or other required labels. The certificate shall list: the date the certificate is installed; the dwelling address; residential contractor name and contractor license number, or homeowner name, if acting as the general contractor; the predominant installed R-values, their location, and type of insulation installed in or on ceiling/roof, walls, rim/band joist, foundation, slab, basement wall, crawl space wall or floor, and ducts outside conditioned spaces; U-factors for fenestration and the solar heat gain coefficient (SHGC) of fenestration; and the results of any required duct system and building envelope air leakage testing done on the building. Where there is more than one value for each component, the certificate shall list the value covering the largest area. The certificate shall list the types, input ratings, manufacturers, model numbers and efficiencies of heating, cooling, and service water heating equipment. The certificate shall also list the structure's calculated heat loss, calculated cooling load, and calculated heat gain. Where an electric furnace or baseboard electric heater is installed in the residence, the certificate shall list "electric furnace" or "baseboard electric heater," as appropriate. An efficiency shall not be listed for electric furnaces or electric baseboard heaters. The certificate shall list the mechanical ventilation system type, location, and capacity, and the building's designated continuous and total ventilation rates. The certificate shall also list the type, size, and location of any make-up air system installed and the location or future location of the radon fan.

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New Construction Energy Code Compliance Certificate

Per R401.3 Certificate. A building certificate shall be posted on or in the electrical distribution panel.

Date Certificate Post

Place your
logo here

Mailing Address of the Dwelling or Dwelling Unit

City

Name of Residential Contractor

MN License Number

THERMAL ENVELOPE

RADON CONTROL SYSTEM

Insulation Location	Total R-Value of all Types of Insulation	Type: Check All That Apply								RADON CONTROL SYSTEM	
		Non or Not Applicable	Fiberglass, Blown	Fiberglass, Battls	Foam, Closed Cell	Foam Open Cell	Mineral Fiberboard	Rigid, Extruded Polystyrene	Rigid, Isocynurate	Passive (No Fan)	Active (with fan and manometer or other system monitoring device.)
Below Entire Slab											
Foundation Wall											
Perimeter of Slab on Grade											
Rim Joist (1st Floor)											
Rim Joist (2nd Floor+)											
Wall											
Ceiling, flat											
Ceiling, vaulted											
Bay Windows or cantilevered areas											
Floors over unconditioned area											
Describe other insulated areas											

Location (or future location) of Fan:

Other Please Describe Here

Per R401.3 Certificate. A building certificate shall be posted on or in the electrical distribution panel.

Place your
logo here

Mailing Address of the Dwelling or Dwelling Unit	City
Name of Residential Contractor	MN License Number

RADON CONTROL SYSTEM

[illegible]

New Construction Energy Code Compliance Certificate

Per R401.3 Certificate. A building certificate shall be posted on or in the electrical distribution panel.

Date Certificate Posted

Mailing Address of the Dwelling or Dwelling Unit

City

Name of Residential Contractor

MN License Number

Place your
logo here

THERMAL ENVELOPE

IRADON CONTROL SYSTEM

Insulation Location	Total R-Value of all Types of Insulation	Type: Check All That Apply								RADON CONTROL SYSTEM	
		Non or Not Applicable	Fiberglass, Blown	Fiberglass, Battls	Foam, Closed Cell	Foam Open Cell	Mineral Fiberboard	Rigid, Extruded Polystyrene	Rigid, Isocynurate	<input type="checkbox"/> Passive (No Fan)	<input type="checkbox"/> Active (with fan and manometer or other system monitoring device.)
Below Entire Slab											
Foundation Wall											
Perimeter of Slab on Grade											
Rim Joist (1st Floor)											
Rim Joist (2nd Floor+)											
Wall											
Ceiling, flat											
Ceiling, vaulted											
Bay Windows or cantilevered areas											
Floors over unconditioned area											
Describe other insulated areas											

Location (or future location) of Fan:

Other Please Describe Here

Blower door test. Will not have this information at the time of application.

Building envelope air tightness:				Duct system air tightness:			
Blower door) U:				Heating or Cooling Ducts Outside Conditioned Spaces			
				Not applicable, all ducts located in conditioned space			
				R-value			
				Make-up Air Select a Type			
Appliances		Heating System		Domestic Water Heater		Cooling System	
						Not required per mech. code	
Fuel Type						Passive	
Manufacturer						Powered	
Model						Interlocked with exhaust device. Describe:	
Rating or Size		Input in BTUS:		Capacity in Gallons:		Output in Tons:	Other, describe:
Efficiency		AFUE or HSPF%				SEER /EER	Location of duct or system:
Residential Load Calculation		Heating Loss		Heating Gain		Cooling Load	
						Cfm's	
						" round duct OR	
						" metal duct	
MECHANICAL VENTILATION SYSTEM							
Describe any additional or combined heating or cooling systems if installed: (e.g. two furnaces or air source heat pump with gas back-up furnace):						Combustion Air Select a Type	
Select Type						Not required per mech. code	
Heat Recover Ventilator (HRV) Capacity in cfm's: Low: High:						Passive	
Energy Recover Ventilator (ERV) Capacity in cfm's: Low: High:						Other, describe:	
Balanced Ventilation capacity in cfm's:						Location of duct or system:	
Location of fan(s), describe:						Cfm's	
Capacity continuous ventilation rate in cfm's:						" round duct OR	
Total ventilation (intermittent + continuous) rate in cfm's:						" metal duct	

R403.2.2 Sealing (Mandatory). Ducts, air handlers, and filter boxes shall be sealed. Joints and seams shall comply with either the *International Mechanical Code* or *International Residential Code*, as applicable.

Exceptions:

1. Air-impermeable spray foam products shall be permitted to be applied without additional joint seals.
2. Where a duct connection is made that is partially inaccessible, three screws or rivets shall be equally spaced on the exposed portion of the joint so as to prevent a hinge effect.
3. Continuously welded and locking-type longitudinal joints and seams in ducts operating at static pressures less than 2 inches of water column (500 Pa) pressure classification shall not require additional closure systems.

Duct tightness shall be verified by either of the following:

1. Postconstruction test: Total leakage shall be less than or equal to 4 cfm (113.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. All register boots shall be taped or otherwise sealed during the test.
2. Rough-in test: Total leakage shall be less than or equal to 4 cfm (113.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure. All registers shall be taped or otherwise sealed during the test. If the air handler is not installed at the time of the test, total leakage shall be less than or equal to 3 cfm (85 L/min) per 100 square feet (9.29 m²) of conditioned floor area.

Exception: The total leakage test is not required for ducts and air handlers located entirely within the building thermal envelope.

Duct system air tightness:									
Heating or Cooling Ducts Outside Conditioned Spaces									
e door) U:		Not applicable, all ducts located in conditioned space							
		R-value							
						Make-up Air Select a Type			
ng System		Domestic Water Heater		Cooling System		Not required per mech. code			
						Passive			
						Powered			
						Interlocked with exhaust device. Describe:			
		Capacity in Gallons:		Output in Tons:		Other, describe:			
				SEER /EER		Location of duct or system:			
ing Loss		Heating Gain		Cooling Load					
						Cfm's			
						" round duct OR			
TEM						" metal duct			
or cooling systems if installed: (e.g. two furnaces or air						Combustion Air Select a Type			
						Not required per mech. code			
						Passive			
						Other, describe:			
						Location of duct or system:			
						Cfm's			
cfms:						" round duct OR			
(us) rate in cfms:						" metal duct			

R403.2.2 Sealing (Mandatory). Ducts, air handlers, and filter boxes shall be sealed. Joints and seams shall comply with either the *International Mechanical Code* or *International Residential Code*, as applicable.

Exceptions:

1. Air-impermeable spray foam products shall be permitted to be applied without additional joint seals.
2. Where a duct connection is made that is partially inaccessible, three screws or rivets shall be equally spaced on the exposed portion of the joint so as to prevent a hinge effect.
3. Continuously welded and locking-type longitudinal joints and seams in ducts operating at static pressures less than 2 inches of water column (500 Pa) pressure classification shall not require additional closure systems.

Duct tightness shall be verified by either of the following:

1. Postconstruction test: Total leakage shall be less than or equal to 4 cfm (113.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. All register boots shall be taped or otherwise sealed during the test.
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Exception: The total leakage test is not required for ducts and air handlers located entirely within the building thermal envelope.

building thermal envelope.

Duct system air tightness:

Heating or Cooling Ducts Outside Conditioned Spaces

☐ Not applicable, all ducts located in conditioned space

☐ R-value

Will not have duct air tightness at the time of application. May not be required at all.

**TABLE R403.2.1
MINIMUM REQUIRED DUCT AND PLENUM
INSULATION FOR DWELLING UNITS**

DUCT TYPE/LOCATION	REQUIREMENTS
Exterior of building	R-8, V and W
Attics, garages, and ventilated crawl spaces	R-8 and V
Outdoor air intakes within conditioned spaces	R3.3 and V
Exhaust ducts within conditioned spaces	R3.3 and V
Within concrete slab or within ground	R3-5 and V
Within conditioned spaces and in basements with insulated walls	None Required

High:		Other, describe:
Low:		Location of duct or system:
		Cfm's
		" round duct OR
		" metal duct

Building envelope air tightness:		Duct system air tightness:	
Windows & Doors		Heating or Cooling Ducts Outside Conditioned Spaces	
Average U-Factor (excludes skylights and one door) U:		Not applicable, all ducts located in conditioned space	
Solar Heat Gain Coefficient (SHGC):		R-value	
MECHANICAL SYSTEMS			
Appliances	Heating System	Cooling System	
			Not required per mech. code
			Passive
			Powered
			Interlocked with exhaust device
			Describe:
		Output in Tons:	Other, describe:
		SEER /EER	Location of duct or system:
		Cooling Load	
			Cfm's
			" round duct OR
			" metal duct
Describe any additional or combined heating or cooling systems if installed: (e.g. two furnaces or air		Combustion Air Select a Type	
		Not required per mech. code	
		Passive	
		Other, describe:	
		Location of duct or system:	
		Cfm's	
		" round duct OR	
		" metal duct	

GLAZED FENESTRATION SHGC^{b,e}

NR

NR

R402.3.1 U-factor. An area-weighted average of fenestration products shall be permitted to satisfy the U-factor requirements.

R402.3.3 Glazed fenestration exemption. Up to 15 square feet (1.4 m²) of glazed fenestration per dwelling unit shall be permitted to be exempt from U-factor and SHGC requirements in Section R402.1.1. This exemption shall not apply to the U-factor alternative approach in Section R402.1.3 and the Total UA alternative in Section R402.1.4.

R402.3.4 Opaque door exemption. One side-hinged opaque door assembly up to 24 square feet (2.22 m²) in area is exempted from the U-factor requirement in Section R402.1.1. This exemption shall not apply to the U-factor alternative approach in Section R402.1.3 and the total UA alternative in Section R402.1.4.

SHGC not required in climate zones 6 & 7.

Building envelope air tightness:				Duct system air tightness:			
Windows & Doors				Heating or Cooling Ducts Outside Conditioned Spaces			
Average U-Factor (excludes skylights and one door) U:				Not applicable, all ducts located in conditioned space			
Solar Heat Gain Coefficient (SHGC):				R-value			
MECHANICAL SYSTEMS						Make-up Air <i>Select a Type</i>	
Appliances	Heating System		Domestic Water Heater		Cooling System		Not required per mech. code
Fuel Type							Passive
Manufacturer							Powered
Model							Interlocked with exhaust device. Describe:
Rating or Size	Input in BTUS:		Capacity in Gallons:		Output in Tons:		Other, describe:
Efficiency	AFUE or HSPF%				SEER /EER		Location of duct or system:
Residential Load Calculation	Heating Loss		Heating Gain		Cooling Load		
							Cfm's
						" round duct OR	
MECHANICAL VENTILATION SYSTEM						" metal duct	
Describe any additional or combined heating or cooling systems if installed: (e.g. two furnaces or air source heat pump with gas back-up furnace):						Combustion Air <i>Select a Type</i>	
Select Type						Not required per mech. code	
Heat Recover Ventilator (HRV) Capacity in cfm's: Low: High:						Passive	
Energy Recover Ventilator (ERV) Capacity in cfm's: Low: High:						Other, describe:	
Balanced Ventilation capacity in cfm's:						Location of duct or system:	
Location of fan(s), describe:						Cfm's	
Capacity continuous ventilation rate in cfm's:						" round duct OR	
Total ventilation (intermittent + continuous) rate in cfm's:						" metal duct	

Building envelope air tightness:				Duct system air tightness:			
Windows & Doors				Heating or Cooling Ducts Outside Conditioned Spaces			
Average U-Factor (excludes skylights and one door) U:				Not applicable, all ducts located in conditioned space			
Solar Heat Gain Coefficient (SHGC):				R-value			
MECHANICAL SYSTEMS							
Appliances		Heating System		Domestic Water Heater		Cooling System	
						<input type="checkbox"/> Not required per mech. code	
Fuel Type						<input type="checkbox"/> Passive	
Manufacturer						<input type="checkbox"/> Powered	
Model						<input type="checkbox"/> Interlocked with exhaust device. Describe:	
Rating or Size		Input in BTUS:		Capacity in Gallons:		Output in Tons:	<input type="checkbox"/> Other, describe:
Efficiency		AFUE or HSPF%				SEER /EER	Location of duct or system:
Residential Load Calculation		Heating Loss		Heating Gain		Cooling Load	
							<input type="checkbox"/> Cfm's
							<input type="checkbox"/> " round duct OR
							<input type="checkbox"/> " metal duct
MECHANICAL VENTILATION SYSTEM							
Describe any additional or combined heating or cooling systems if installed: (e.g. two furnaces or air source heat pump with gas back-up furnace):						Combustion Air Select a Type	
Select Type						<input type="checkbox"/> Not required per mech. code	
Heat Recover Ventilator (HRV) Capacity in cfm's: Low: High:						<input type="checkbox"/> Passive	
Energy Recover Ventilator (ERV) Capacity in cfm's: Low: High:						<input type="checkbox"/> Other, describe:	
Balanced Ventilation capacity in cfm's:						Location of duct or system:	
Location of fan(s), describe:						<input type="checkbox"/> Cfm's	
Capacity continuous ventilation rate in cfm's:						<input type="checkbox"/> " round duct OR	
Total ventilation (intermittent + continuous) rate in cfm's:						<input type="checkbox"/> " metal duct	

Building envelope air tightness:				Duct system air tightness:																											
Windows & Doors				Heating or Cooling Ducts Outside Conditioned Spaces																											
Average U-Factor (excludes skylights and one door) U:				Not applicable, all ducts located in conditioned space																											
Solar Heat Gain Coefficient																															
MECHANICAL																															
<div style="border: 1px solid black; padding: 5px;"> R403.5.17 Climatic design conditions. A. HVAC equipment shall be sized according to the ACCA Manual S or an equivalent method, based on the building's heating and cooling load calculations by using ASHRAE Handbook of Fundamentals or the ACCA Manual J. Oversizing of heating equipment shall not exceed 40 percent of the calculated load requirements and oversizing of cooling equipment shall not exceed 15 percent of the calculated load requirements. </div>																															
<table border="1"> <tr> <td>Appliance</td> <td></td> </tr> <tr> <td>Fuel Type</td> <td></td> </tr> <tr> <td>Manufacturer</td> <td></td> </tr> <tr> <td>Model</td> <td></td> </tr> <tr> <td>Rating or Size</td> <td></td> </tr> <tr> <td>Efficiency</td> <td></td> </tr> </table>				Appliance		Fuel Type		Manufacturer		Model		Rating or Size		Efficiency		<table border="1"> <tr> <td colspan="2">Make-up Air <i>Select a Type</i></td> </tr> <tr> <td></td> <td>Not required per mech. code</td> </tr> <tr> <td></td> <td>Passive</td> </tr> <tr> <td></td> <td>Powered</td> </tr> <tr> <td></td> <td>Interlocked with exhaust device. Describe:</td> </tr> <tr> <td></td> <td>Other, describe:</td> </tr> </table>				Make-up Air <i>Select a Type</i>			Not required per mech. code		Passive		Powered		Interlocked with exhaust device. Describe:		Other, describe:
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Fuel Type																															
Manufacturer																															
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	Other, describe:																														
<table border="1"> <tr> <td>HSPF%</td> <td></td> <td>/EER</td> <td></td> </tr> </table>				HSPF%		/EER		Location of duct or system:																							
HSPF%		/EER																													
<table border="1"> <tr> <td>Heating Loss</td> <td>Heating Gain</td> <td>Cooling Load</td> </tr> </table>				Heating Loss	Heating Gain	Cooling Load	<table border="1"> <tr> <td>Cfm's</td> </tr> <tr> <td>" round duct OR</td> </tr> <tr> <td>" metal duct</td> </tr> </table>				Cfm's	" round duct OR	" metal duct																		
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Select Type				Combustion Air <i>Select a Type</i>																											
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Building envelope air tightness:				Duct system air tightness:			
Windows & Doors				Heating or Cooling Ducts Outside Conditioned Spaces			
Average U-Factor (excludes skylights and one door) U:				Not applicable, all ducts located in conditioned space			
Solar Heat Gain Coefficient (SHGC):				R-value			
MECHANICAL SYSTEMS						Make-up Air <i>Select a Type</i>	
Appliances	Heating System	Domestic Water Heater		Cooling System			
						Not required per mech. code	
Fuel Type						Passive	
Manufacturer						Powered	
Model						Interlocked with exhaust device. Describe:	
Rating or Size	Input in BTUS:		Capacity in Gallons:		Output in Tons:		Other, describe:
Efficiency	AFUE or HSPF%				SEER /EER		Location of duct or system:
Residential Load Calculation	Heating Loss		Heating Gain		Cooling Load		
							Cfm's
						" round duct OR	
MECHANICAL VENTILATION SYSTEM						" metal duct	
Describe any additional or combined heating or cooling systems if installed: (e.g. two furnaces or air source heat pump with gas back-up furnace):						Combustion Air <i>Select a Type</i>	
Select Type							
<input type="checkbox"/> Heat Recover Ventilator (HRV) Capacity in cfm's: Low: High:						Not required per mech. code	
<input type="checkbox"/> Energy Recover Ventilator (ERV) Capacity in cfm's: Low: High:						Passive	
<input type="checkbox"/> Balanced Ventilation capacity in cfm's:						Other, describe:	
Location of fan(s), describe:						Location of duct or system:	
Capacity continuous ventilation rate in cfm's:						Cfm's	
Total ventilation (intermittent + continuous) rate in cfm's:						" round duct OR	
						" metal duct	

Building envelope air tightness:				Duct system air tightness:			
Windows & Doors				Heating or Cooling Ducts Outside Conditioned Spaces			
Average U-Factor (excludes skylights and one door) U:				Not applicable, all ducts located in conditioned space			
Solar Heat Gain Coefficient (SHGC):				R-value			
MECHANICAL SYSTEMS						Make-up Air Select a Type	
Appliances	Heating System		Domestic Water Heater		Cooling System		
							Not required per mech. code
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Model							Interlocked with exhaust device. Describe:
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New Construction Energy Code Compliance Certificate																																																																																																																																																			
Per R401.3 Certificate. A building certificate shall be posted on or in the electrical distribution panel.								Date Certificate Post																																																																																																																																											
Mailing Address of the Dwelling or Dwelling Unit						City		Place your logo here																																																																																																																																											
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Field Inspections

What to see, and when to see it...

Energy Efficiency Inspections

- MN Rule 1300.0210 Inspections
 - Subp. 6. Required inspections.

Subp. 6. Required inspections. The building official, upon notification, shall make the inspections in this part. In addition to the inspections identified in this subpart, see applicable rule chapters in part 1300.0050 for specific inspection and testing requirements.

Energy Efficiency Inspections

- MN Rule 1300.0210 Inspections
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Subp. 6. Required inspections. The building official, upon notification, shall make the inspections in this part. In addition to the inspections identified in this subpart, see applicable rule chapters in part 1300.0050 for specific inspection and testing requirements.

F. Energy efficiency inspections shall be made to determine compliance with *Minnesota Energy Code* requirements.

Footing Inspection

- Setbacks
- Soil Conditions
- Strip Footings Width/Thickness
- Pad Footings Size/Thickness
- Depth/Frost Coverage
- Rebar – Per Drawings, Grounding Rod

Foundation Wall - CIP (Pre-Pour)

- Forms – Height/Thickness
- Form placement on footing – footing projection
- Rebar – Dowels, Verticals, & Horizontals

Foundation Wall – Block or CIP (Post-Pour)

- Gaps/Cracks/Flaws? Block arrangement
- Waterproofing
- Insulation - R10 Min
 - Draining
 - Non-Draining – Poly Slipsheet Required
- Walls braced for backfill
- Drain Tile
- Rock Base, Sock/Fabric

Plumbing Rough-In

- Underground – Visual & Air Test
- Above Ground – Visual & Air Test
- Supply Piping: Support, Hots Insulated
- Mixing Valves
- Tile shower Pan

Framing

- Roof Truss & Bracing/Energy Heel
- Roof covering, Ice & Water, Roof Vents
- Attic Access
- Headers
- Columns/Blocking – Follow Load Paths
- Floor Framing (Truss, I-Joist, Lumber)
- Treated Sills/Plates & Anchor Bolts
- Narrow Wall Bracing
- Sheathing
- Stair Rise/Run
- Headroom
- Hallways
- Boring/Notching
- Fireblocking/Draftstopping
- Tempered Glazing/U-factor of Glazing
- Window Fall Protection
- Smoke Alarms
- Outlet in Attic for Future Radon Fan
- Water Resistive Barrier/House Wrap
- Flashing: Drip Caps, Pan Flashing, Kick-out Flashing, Foundation Insulation Flashing, Other

Electrical Rough-in

Mechanical Rough-In

- Supply & Return Ducting
- Exhaust fans
 - Bath
 - Dryer
- Gas Lines
 - Visual
 - Air Test
- Fireplace

Slab

- Rock
- Poly
- Radon Tee (or use Drain Tile)

Lath (Adhered Masonry Veneer)

- Paper
- Mesh
- Fastening
- Flashing
- Weep Screed

Insulation

- Vapor Retarder
- Air Barrier
- Wall Insulation – R20 Min
- Rim Joist – R20 Min
- Window Jambs
- Penetrations sealed (Fireblocking/Air Sealing)
- Radon Piping & Labeling

Mechanical Final

- Furnace
- Water Heater
- A/C Unit
- ERV/HRV
- Vent Terminations Hoods/Locations
- Intake/Exhaust Labeled
- Gas Connections & Sediment Traps
- Supply/Return Air Grills

Plumbing Final

- Manometer Test
- Fixtures set
- Dishwasher Air Gap & Water Hammer
- Washer Water Hammer
- Water Softener: Bonding jumper, Air Gap
- Shower Tile Height
- Backwater Valve Accessible

Building Final

- Insulation Installation Certificate
- Blower Door Test
- Plumbing Vent Roof Caps Removed
- Guards/Handrails
- Smoke/CO Alarm Operation
- Patio Door Blocked (if no Deck)
- Window Fall Protection
- Garage Wall/Ceiling Gypsum
- Basement Ceiling & Under Stair Gypsum
- Mechanical Room – 80sf Max Unprotected, Blocked to Floor
- Radon Labeled
- Sump Lid Sealed (if used for Radon)
- Siding: Installation, Distance to Grade
- Final Grading
- Required Vegetation/Landscaping
- Required Hardcover: Driveway, Sidewalk

Electrical Final

Energy Related Inspections

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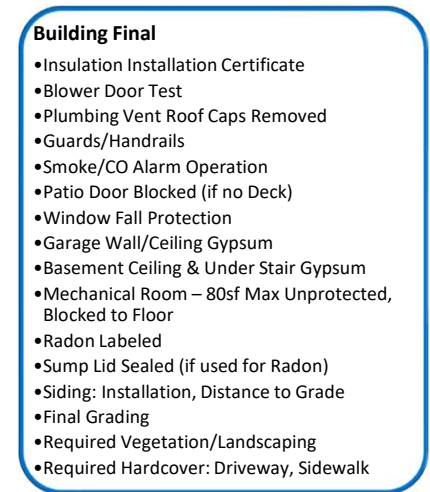
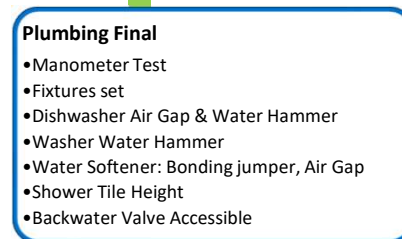
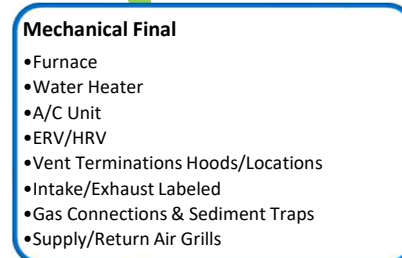
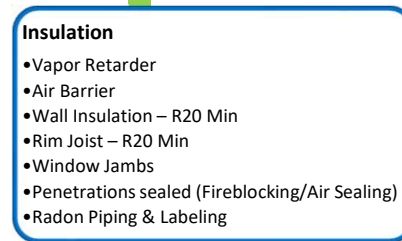
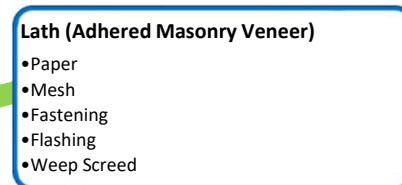
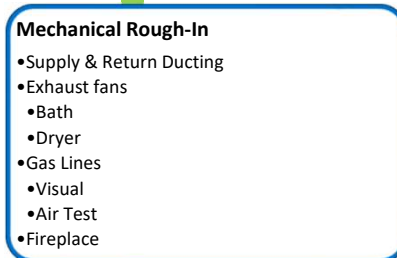
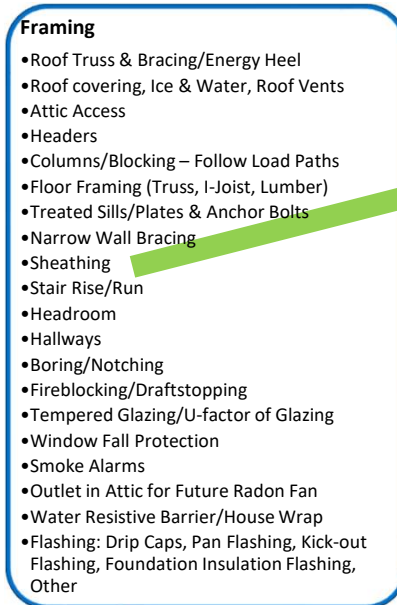
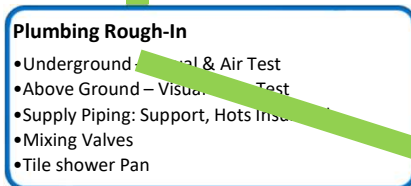
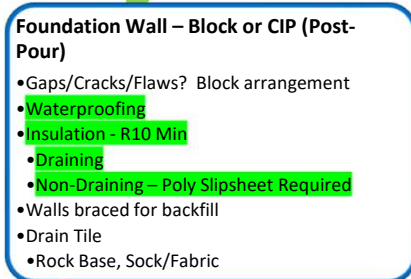
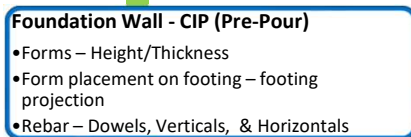
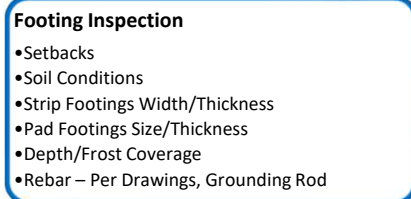
Plumbing Final

- Manometer Test
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- Required Hardcover: Driveway, Sidewalk

Electrical Final



Basement/Foundation Wall – Waterproofing MRC 406

SECTION R406 FOUNDATION WATERPROOFING AND DAMPPROOFING

R406.1 Concrete and masonry foundation dampproofing.
Deleted.

R406.2 Concrete and masonry foundation waterproofing.
Exterior foundation walls that retain earth and enclose below grade interior spaces, floors, and crawl spaces shall be waterproofed. **Waterproofing shall be installed at a minimum from the top of the footing to the finished grade** or in accordance with the manufacturer's installation instructions. Walls shall be waterproofed in accordance with one of the following:

1. Two-ply hot-mopped felts.
2. Fifty-five-pound (25 kg) roll roofing.
3. Six-mil (0.15 mm) polyvinyl chloride.
4. Six-mil (0.15 mm) polyethylene.
5. Forty-mil (1 mm) polymer-modified asphalt.
6. Sixty-mil (1.5 mm) flexible polymer cement.
7. One-eighth-inch (3 mm) cement-based, fiber-reinforced, waterproof coating.
8. Sixty-mil (1.5 mm) solvent-free liquid-applied synthetic rubber.

Exception: Organic-solvent-based products such as hydrocarbons, chlorinated hydrocarbons, ketones, and esters shall not be used for ICF walls with expanded polystyrene form material. Use of plastic roofing cements, acrylic coatings, latex coatings, mortars, and parings to seal ICF walls is permitted. Cold-setting asphalt or hot asphalt shall conform to Type C of ASTM D449. Hot asphalt shall be applied at a temperature of less than 200°F (93°C).

All joints in membrane waterproofing shall be lapped and sealed with an adhesive compatible with the membrane.



Basement/Foundation Wall – Waterproofing MRE 402

SECTION R402 BUILDING THERMAL ENVELOPE

R402.1 General (Prescriptive). The *building thermal envelope* shall meet the requirements of Sections R402.1.1 through R402.1.4.

R402.1.1 Insulation, waterproofing, and fenestration criteria. The building thermal envelope shall meet the requirements of Table R402.1.1 based on the climate zone specified in Chapter 3, and the requirements contained in Section R402.2. Cast-in-place concrete and masonry block foundation walls **shall be waterproofed according to IRC Section R406 and the following requirements:**



1. The waterproofing shall extend from the top interior wall edge, across the top of the wall, and down the exterior wall face to the top of the footing. If a full width, closed-cell material is installed to create a seal between the sill plate and the top of the foundation wall, the installation is deemed to meet the requirements for the top of the wall waterproofing.
2. If the walls are exposed to the exterior environment, the waterproofing system shall have a rigid, opaque, and weather-resistant protective covering to prevent degradation of the waterproofing system. The protective covering shall cover the exposed waterproofing and extend a minimum of 6 inches (152 mm) below grade. The protective covering system shall be flashed in accordance with IRC Section R703.8.



VS.



Basement/Foundation Wall - Insulation

TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT^a

CLIMATE ZONE	FENESTRATION U-FACTOR ^b	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b,e}	CEILING ^j R-VALUE	WOOD FRAME WALL R-VALUE ^f	MASS WALL R-VALUE ^{i,g,h}	FLOOR R-VALUE	BASEMENT ^{c,i} WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE ^{c,i} WALL R-VALUE
6	0.32	0.55	NR	49	20, 13+5	15/20	30 ^e	15	10, 3.5 ft	15
7	0.32	0.55	NR	49	21	19/21	38 ^e	15	10, 5 ft	15

For SI: 1 foot = 304.8 mm.

- a. R-values are minimums. U-factors and SHGC are maximums. When insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall not be less than the R-value specified in the table.
- b. The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
- c. See Section R402.2.8.
- d. Insulation R-values for heated slabs shall be installed to the depth indicated or to the top of the footing, whichever is less.
- e. Or insulation sufficient to fill the framing cavity, R-19 minimum.
- f. First value is cavity insulation, second is continuous insulation or insulated siding, so "13+5" means R-13 cavity insulation plus R-5 continuous insulation or insulated siding. If structural sheathing covers 40 percent or less of the exterior, continuous insulation R-value shall be permitted to be reduced by no more than R-3 in the locations where structural sheathing is used to maintain a consistent total sheathing thickness.
- g. The second R-value applies when more than half the insulation is on the interior of the mass wall.
- h. When using log-type construction for thermal mass walls the following applies:
 - (1) a minimum of a 7-inch diameter log shall be used; and
 - (2) the U-value of fenestration products shall be 0.29 overall on average or better.
- i. See Section 402.2.8. A minimum R-19 cavity insulation is required in wood foundation walls.
- j. Roof/ceiling assemblies shall have a minimum 6-inch energy heel.

R402.2.8 Basement walls. Walls associated with conditioned basements shall be insulated from the top of the basement wall down to 10 feet (3048 mm) below grade or to the top of the footing, whichever is less. Foundation insulation shall be installed according to the manufacturer's installation instructions. Walls associated with unconditioned basements shall meet the requirements of this section unless the floor overhead is insulated in accordance with Sections R402.1.1 and R402.2.7 and the following requirements:

- a. **R-15 insulation** for concrete and masonry foundations shall be installed according to R402.1.1.1 to R402.1.1.8 and a minimum of a R-10 shall be installed on the exterior of the wall. Interior insulation, other than closed cell spray foam, shall not exceed R-11. Foundations shall be waterproofed in accordance with the applicable provisions of the *International Residential Code (IRC)*.

Exception: R-10 continuous insulation on the exterior of each foundation wall shall be permitted to comply with this code if the tested air leakage rate required in Section R402.4.1.2 does not exceed 2.6 air changes per hour and the total square feet between the finished grade and the top of each foundation wall does not exceed 1.5 multiplied by the total lineal feet of each foundation wall that encloses conditioned space. Interior insulation, other than closed cell spray foam, shall not exceed R-11. See footnote c to Table R402.2.1.



Foundation Wall – Block or CIP (Post-Pour)

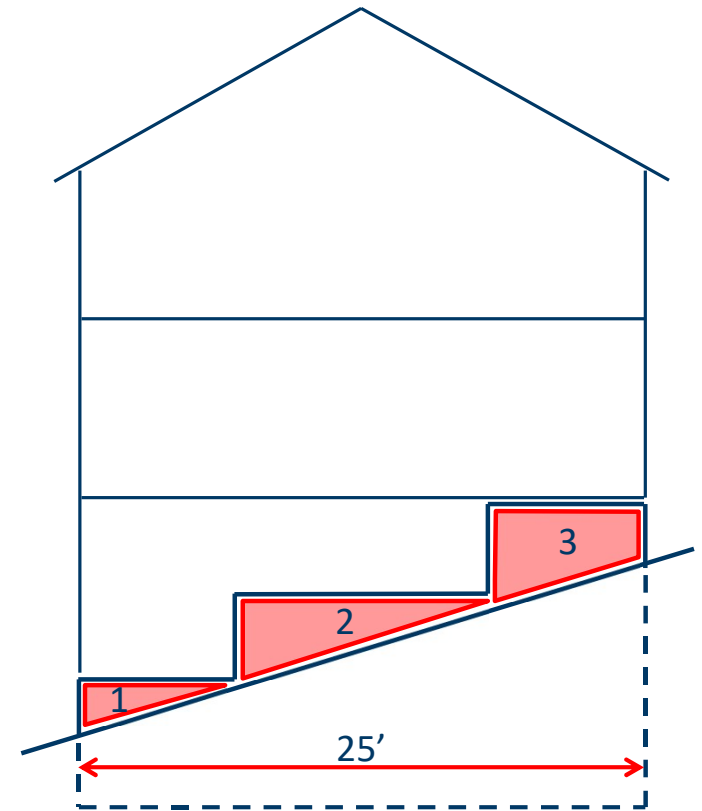
- Gaps/Cracks/Flaws? Block arrangement
- Waterproofing
- Insulation – R10 Min
- Draining
- Non-Draining – Poly Slipsheet Required
- Walls braced for backfill
- Drain Tile
- Rock Base, Sock/Fabric



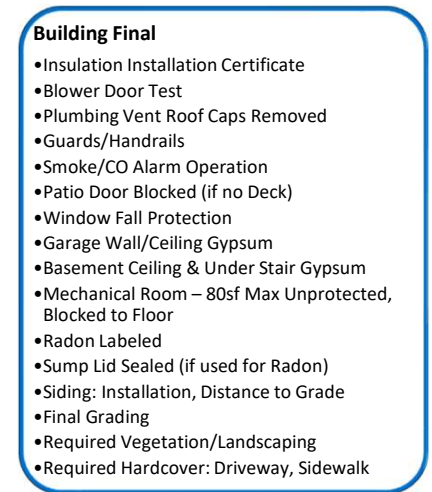
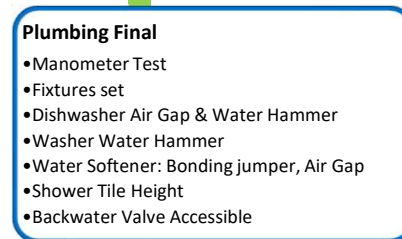
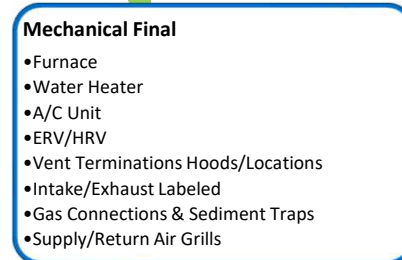
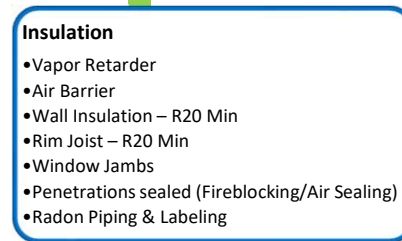
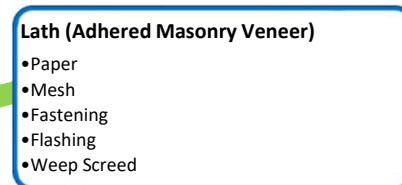
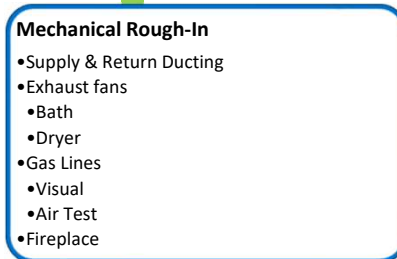
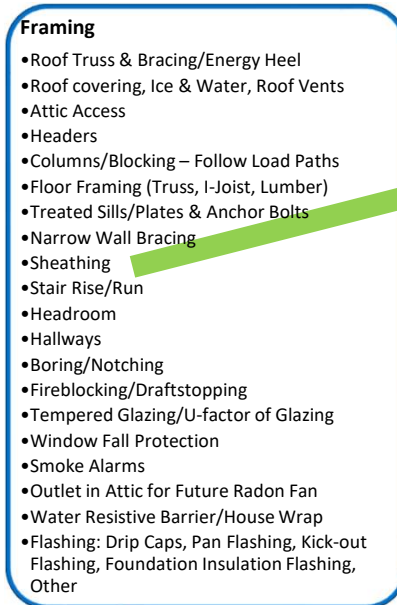
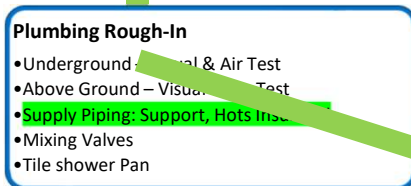
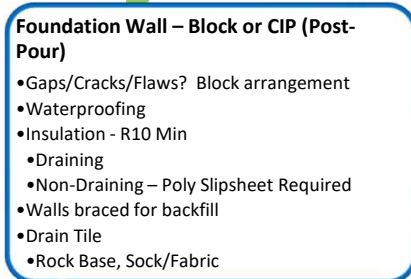
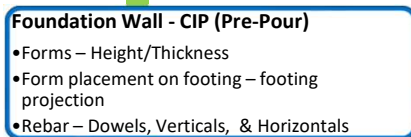
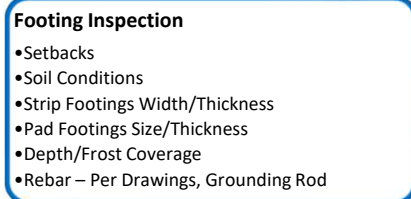


International Residential Code (IRC).

Exception: R-10 continuous insulation on the exterior of each foundation wall shall be permitted to comply with this code if the tested air leakage rate required in Section R402.4.1.2 does not exceed 2.6 air changes per hour and the total square feet between the finished grade and the top of each foundation wall does not exceed 1.5 multiplied by the total lineal feet of each foundation wall that encloses conditioned space. Interior insulation, other than closed cell spray foam, shall not exceed R-11. See footnote c to Table R402.2.1.



SF of 1+2+3 cannot exceed $1.5 \times 25'$



Footing Inspection

- Setbacks
- Soil Conditions
- Strip Footings Width/Thickness
- Pad Footings Size/Thickness
- Depth/Frost Coverage
- Rebar – Per Drawings, Grounding Rod

Foundation Wall - CIP (Pre-Pour)

- Forms – Height/Thickness
- Form placement on footing – footing projection
- Rebar – Dowels, Verticals, & Horizontals

Foundation Wall – Block or CIP (Post-Pour)

- Gaps/Cracks/Flaws? Block arrangement
- Waterproofing
- Insulation - R10 Min
 - Draining
 - Non-Draining – Poly Slipsheet Required
- Walls braced for backfill
- Drain Tile
- Rock Base, Sock/Fabric

Plumbing Rough-In

- Underground – Visual & Air Test
- Above Ground – Visual & Air Test
- Supply Piping: Support, Hots Insulated
- Mixing Valves
- Tile shower Pan

Framing

- Roof Truss & Bracing/Energy Heel
- Roof covering, Ice & Water, Roof Vents
- Attic Access
- Headers
- Columns/Blocking – Follow Load Paths
- Floor Framing (Truss, I-Joist, Lumber)
- Treated Sills/Plates & Anchor Bolts
- Narrow Wall Bracing
- Sheathing
- Stair Rise/Run
- Headroom
- Hallways
- Boring/Notching
- Fireblocking/Draftstopping
- Tempered Glazing/U-factor of Glazing
- Window Fall Protection
- Smoke Alarms
- Outlet in Attic for Future Radon Fan
- Water Resistive Barrier/House Wrap
- Flashing: Drip Caps, Pan Flashing, Kick-out Flashing, Foundation Insulation Flashing, Other

Electrical Rough-in

Mechanical Rough-In

- Supply & Return Ducting
- Exhaust fans
 - Bath
 - Dryer
- Gas Lines
 - Visual
 - Air Test
- Fireplace

Slab

- Rock
- Poly
- Radon Tee (or use Drain Tile)

Lath (Adhered Masonry Veneer)

- Paper
- Mesh
- Fastening
- Flashing
- Weep Screed

Insulation

- Vapor Retarder
- Air Barrier
- Wall Insulation – R20 Min
- Rim Joist – R20 Min
- Window Jambs
- Penetrations sealed (Fireblocking/Air Sealing)
- Radon Piping & Labeling

Mechanical Final

- Furnace
- Water Heater
- A/C Unit
- ERV/HRV
- Vent Terminations Hoods/Locations
- Intake/Exhaust Labeled
- Gas Connections & Sediment Traps
- Supply/Return Air Grills

Plumbing Final

- Manometer Test
- Fixtures set
- Dishwasher Air Gap & Water Hammer
- Washer Water Hammer
- Water Softener: Bonding jumper, Air Gap
- Shower Tile Height
- Backwater Valve Accessible

Building Final

- Insulation Installation Certificate
- Blower Door Test
- Plumbing Vent Roof Caps Removed
- Guards/Handrails
- Smoke/CO Alarm Operation
- Patio Door Blocked (if no Deck)
- Window Fall Protection
- Garage Wall/Ceiling Gypsum
- Basement Ceiling & Under Stair Gypsum
- Mechanical Room – 80sf Max Unprotected, Blocked to Floor
- Radon Labeled
- Sump Lid Sealed (if used for Radon)
- Siding: Installation, Distance to Grade
- Final Grading
- Required Vegetation/Landscaping
- Required Hardcover: Driveway, Sidewalk

Electrical Final

Slab Inspection

Subp. 2. Soil-gas membrane installation. A soil-gas membrane shall be placed on top of the gas-permeable material prior to placing a floor on top of or above the soil. The soil-gas membrane shall cover the entire floor area. Separate sections of membrane must be lapped at least 12 inches (305 mm). The membrane shall fit closely around any penetration of the membrane to reduce the leakage of soil gases. All punctures or tears in the soil-gas membrane shall be repaired by sealing and patching the soil-gas membrane with the same kind of material, maintaining a minimum 12-inch (305 mm) lap.

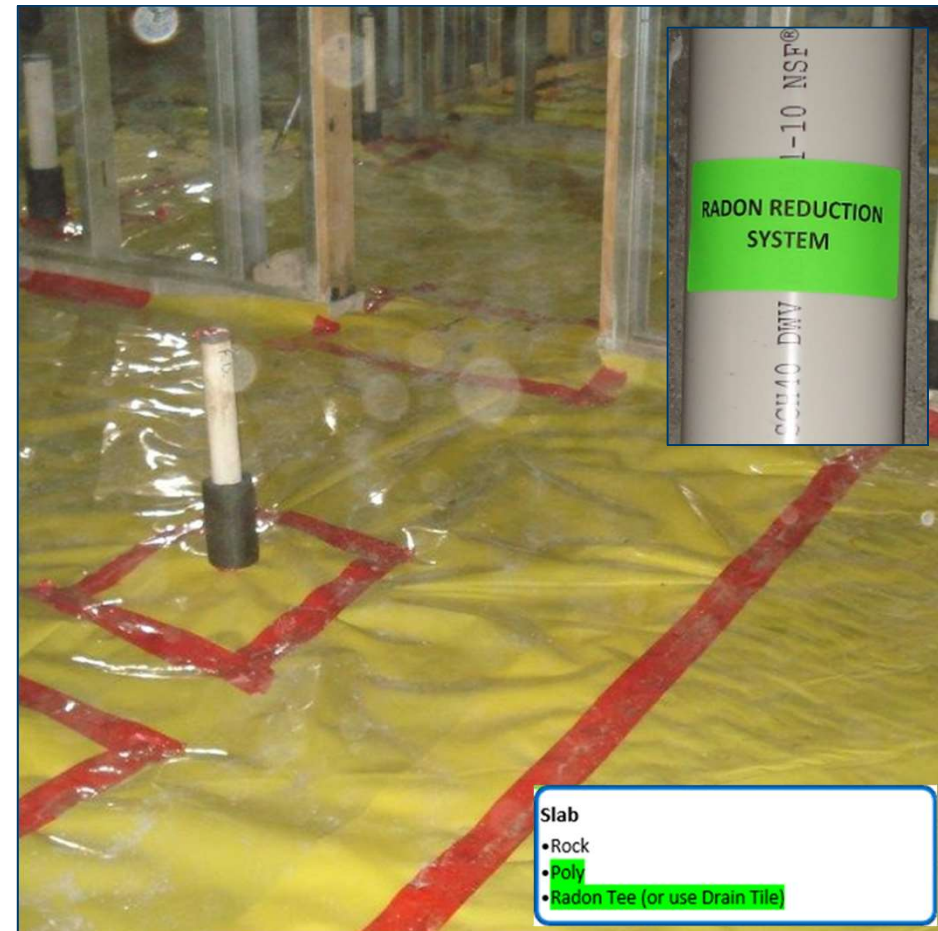


Slab Inspection

R506.2.3 Vapor retarder. A 6-mil (0.006 inch; 152 μm) polyethylene or *approved* vapor retarder with joints lapped not less than 6 inches (152 mm) shall be placed between the concrete floor slab and the base course or the prepared subgrade where a base course does not exist.

Exception: The vapor retarder is not required for the following:

1. Garages, utility buildings and other unheated *accessory structures*.
2. For unheated storage rooms having an area of less than 70 square feet (6.5 m^2) and carports.
3. Driveways, walks, patios and other flatwork not likely to be enclosed and heated at a later date.
4. Where *approved* by the *building official*, based on local site conditions.



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- Forms – Height/Thickness
- Form placement on footing – footing projection
- Rebar – Dowels, Verticals, & Horizontals

Foundation Wall – Block or CIP (Post-Pour)

- Gaps/Cracks/Flaws? Block arrangement
- Waterproofing
- Insulation - R10 Min
 - Draining
 - Non-Draining – Poly Slipsheet Required
- Walls braced for backfill
- Drain Tile
- Rock Base, Sock/Fabric

Plumbing Rough-In

- Underground – Visual & Air Test
- Above Ground – Visual & Air Test
- Supply Piping: Support, Hots Insulated
- Mixing Valves
- Tile shower Pan

Framing

- Roof Truss & Bracing/Energy Heel
- Roof covering, Ice & Water, Roof Vents
- Attic Access
- Headers
- Columns/Blocking – Follow Load Paths
- Floor Framing (Truss, I-Joist, Lumber)
- Treated Sills/Plates & Anchor Bolts
- Narrow Wall Bracing
- Sheathing
- Stair Rise/Run
- Headroom
- Hallways
- Boring/Notching
- Fireblocking/Draftstopping
- Tempered Glazing/U-factor of Glazing
- Window Fall Protection
- Smoke Alarms
- Outlet in Attic for Future Radon Fan
- Water Resistive Barrier/House Wrap
- Flashing: Drip Caps, Pan Flashing, Kick-out Flashing, Foundation Insulation Flashing, Other

Electrical Rough-in

Mechanical Rough-In

- Supply & Return Ducting
- Exhaust fans
- Bath
- Dryer
- Gas Lines
 - Visual
 - Air Test
- Fireplace

Slab

- Rock
- Poly
- Radon Tee (or use Drain Tile)

Lath (Adhered Masonry Veneer)

- Paper
- Mesh
- Fastening
- Flashing
- Weep Screed

Insulation

- Vapor Retarder
- Air Barrier
- Wall Insulation – R20 Min
- Rim Joist – R20 Min
- Window Jambs
- Penetrations sealed (Fireblocking/Air Sealing)
- Radon Piping & Labeling

Mechanical Final

- Furnace
- Water Heater
- A/C Unit
- ERV/HRV
- Vent Terminations Hoods/Locations
- Intake/Exhaust Labeled
- Gas Connections & Sediment Traps
- Supply/Return Air Grills

Plumbing Final

- Manometer Test
- Fixtures set
- Dishwasher Air Gap & Water Hammer
- Washer Water Hammer
- Water Softener: Bonding jumper, Air Gap
- Shower Tile Height
- Backwater Valve Accessible

Building Final

- Insulation Installation Certificate
- Blower Door Test
- Plumbing Vent Roof Caps Removed
- Guards/Handrails
- Smoke/CO Alarm Operation
- Patio Door Blocked (if no Deck)
- Window Fall Protection
- Garage Wall/Ceiling Gypsum
- Basement Ceiling & Under Stair Gypsum
- Mechanical Room – 80sf Max Unprotected, Blocked to Floor
- Radon Labeled
- Sump Lid Sealed (if used for Radon)
- Siding: Installation, Distance to Grade
- Final Grading
- Required Vegetation/Landscaping
- Required Hardcover: Driveway, Sidewalk

Electrical Final

Ducting, Exhaust Fans

R403.2.1 Insulation (prescriptive). All exhaust, supply, and return air ducts and plenums shall be insulated according to Table R403.2.1.

For the purposes of Table R403.2.1, the following applies:

- a. Insulation is only required in the conditioned space for a distance of 3 feet (914 mm) from the exterior or unconditioned space.
- b. V means the vapor retarder in accordance with IMC Section 604.11. When a vapor retarder is required, duct insulation required by this section shall be installed without respect to other building envelope insulation.
- c. W means an approved weatherproof barrier.

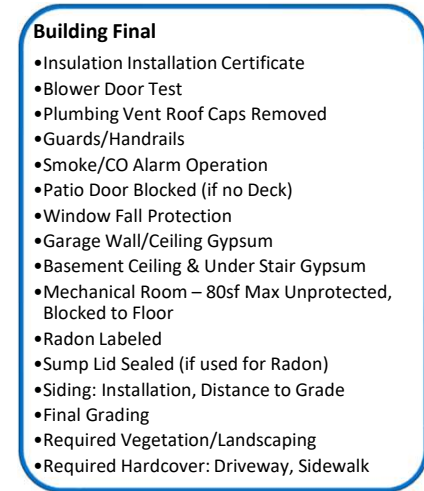
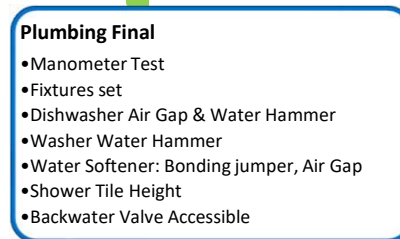
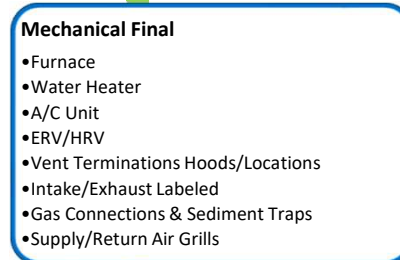
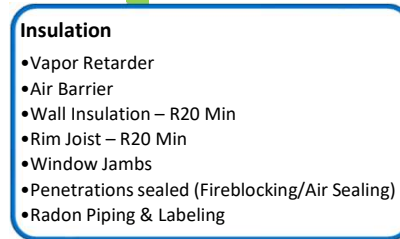
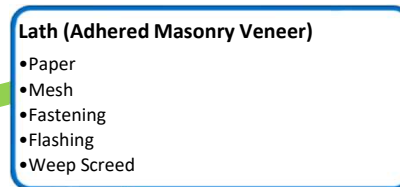
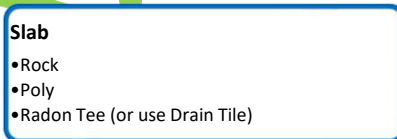
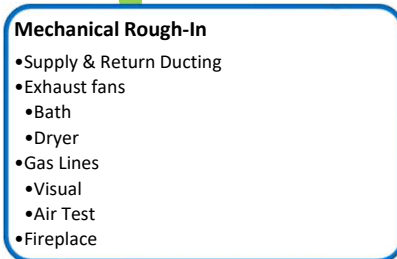
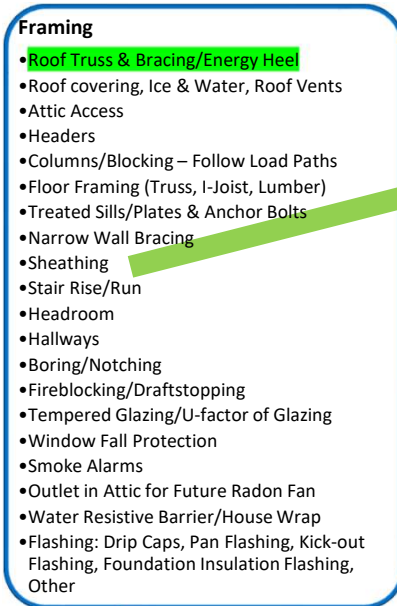
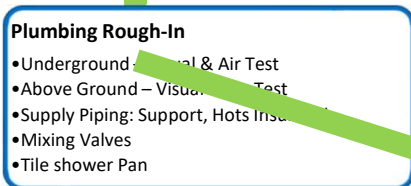
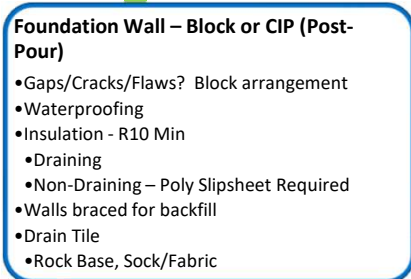
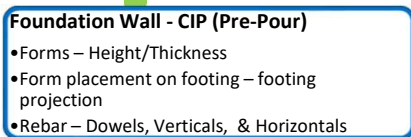
**TABLE R403.2.1
MINIMUM REQUIRED DUCT AND PLENUM
INSULATION FOR DWELLING UNITS**

DUCT TYPE/LOCATION	REQUIREMENTS
Exterior of building	R-8, V and W
Attics, garages, and ventilated crawl spaces	R-8 and V
Outdoor air intakes within conditioned spaces	R3.3 and V
Exhaust ducts within conditioned spaces	R3.3 and V
Within concrete slab or within ground	R3-5 and V
Within conditioned spaces and in basements with insulated walls	None Required

Mechanical Rough-In

- Supply & Return Ducting
- Exhaust fans
- Bath
- Dryer
- Gas Lines
- Visual
- Air Test
- Fireplace





Energy Heel

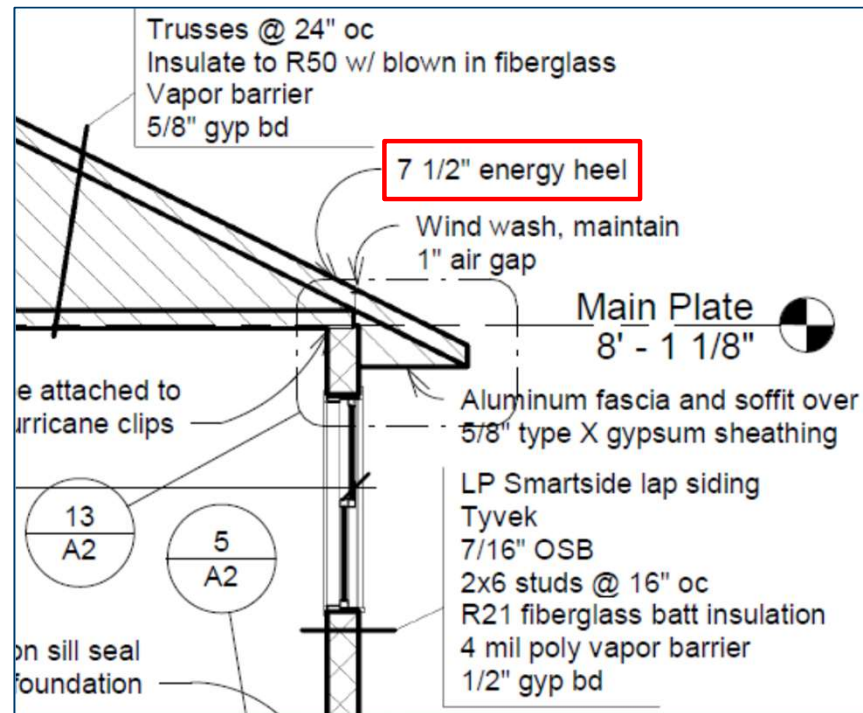
TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT^a

CLIMATE ZONE	FENESTRATION U-FACTOR ^b	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b,e}	CEILING ^j R-VALUE	WOOD FRAME WALL R-VALUE ^f	MASS WALL R-VALUE ^{g,h}	FLOOR R-VALUE	BASEMENT ^{c,i} WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE ^{c,i} WALL R-VALUE
6	0.32	0.55	NR	49	20, 13+5	15/20	30 ^e	15	10, 3.5 ft	15
7	0.32	0.55	NR	49	21	19/21	38 ^e	15	10, 5 ft	15

For SI: 1 foot = 304.8 mm.

- a. R-values are minimums. U-factors and SHGC are maximums. When insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall not be less than the R-value specified in the table.
- b. The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
- c. See Section R402.2.8.
- d. Insulation R-values for heated slabs shall be installed to the depth indicated or to the top of the footing, whichever is less.
- e. Or insulation sufficient to fill the framing cavity, R-19 minimum.
- f. First value is cavity insulation, second is continuous insulation or insulated siding, so "13+5" means R-13 cavity insulation plus R-5 continuous insulation or insulated siding. If structural sheathing covers 40 percent or less of the exterior, continuous insulation R-value shall be permitted to be reduced by no more than R-3 in the locations where structural sheathing is used to maintain a consistent total sheathing thickness.
- g. The second R-value applies when more than half the insulation is on the interior of the mass wall.
- h. When using log-type construction for thermal mass walls the following applies:
 - (1) a minimum of a 7-inch diameter log shall be used; and
 - (2) the U-value of fenestration products shall be 0.29 overall on average or better.
- i. See Section 402.2.8. A minimum R-19 cavity insulation is required in wood foundation walls.
- j. Roof/ceiling assemblies shall have a minimum 6-inch energy heel.

Energy Heel



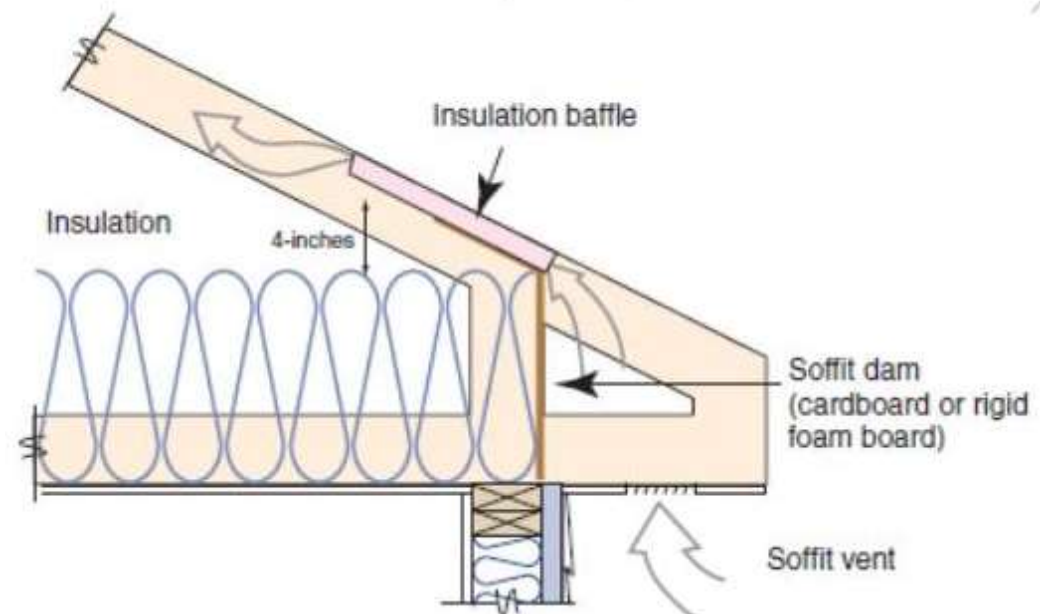
Framing

- **Roof Truss & Bracing/Energy Heel**
- Roof covering, Ice & Water, Roof Vents
- Attic Access
- Headers
- Columns/Blocking – Follow Load Paths
- Floor Framing (Truss, I-Joist, Lumber)
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- Water Resistant Barrier/House Wrap
- Flashing: Drip Caps, Pan Flashing, Kick-out Flashing, Foundation Insulation Flashing, Other

Energy Heel

R402.2.3 Eave baffle. For air permeable insulations in vented attics, a baffle shall be installed adjacent to soffit and eave vents. Baffles shall maintain an opening equal or greater than the size of the vent. The baffle shall extend over the top of the attic insulation. The baffle shall be permitted to be any solid material.

R806.3 Vent and insulation clearance. Where eave or cornice vents are installed, blocking, bridging and insulation shall not block the free flow of air. Not less than a 1-inch (25 mm) space shall be provided between the insulation and the roof sheathing and at the location of the vent.

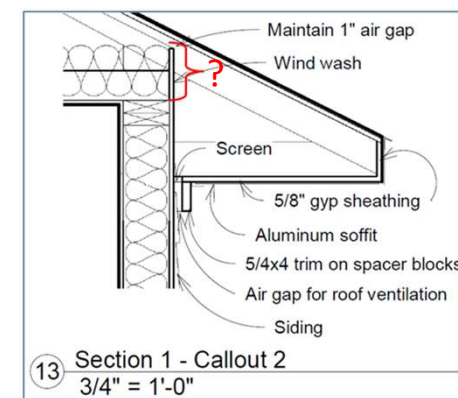


Energy Heel

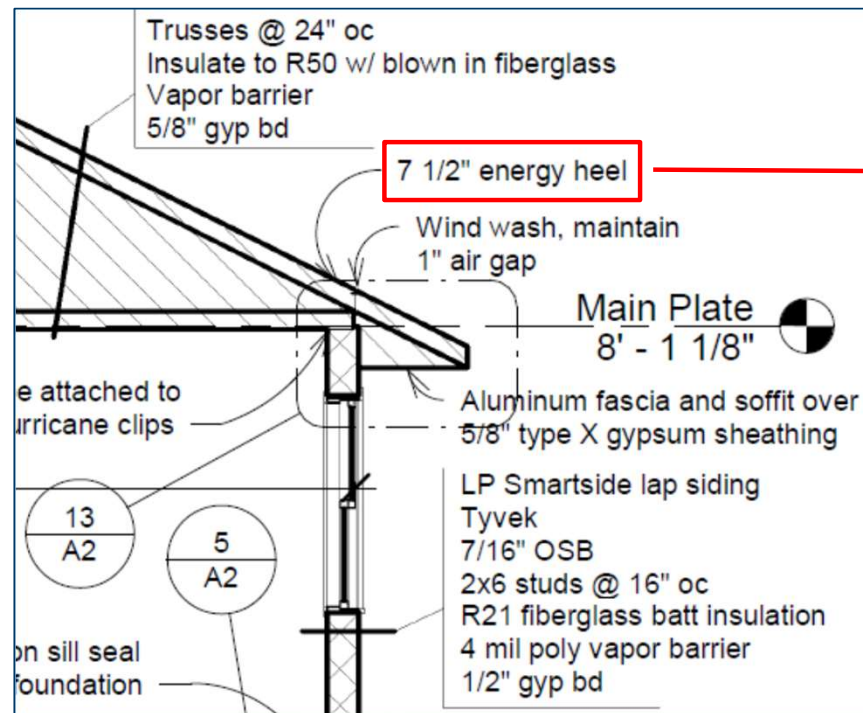
R402.2 Specific insulation requirements (Prescriptive). In addition to the requirements of Section R402.1, insulation shall meet the specific requirements of Sections R402.2.1 through R402.2.12.

R402.2.1 Ceilings with attic spaces. When Section R402.1.1 would require R-38 in the ceiling, R-30 shall be deemed to satisfy the requirement for R-38 wherever the full height of uncompressed R-30 insulation extends over the wall top plate at the eaves. Similarly, R-38 shall be deemed to satisfy the requirement for R-49 wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. This reduction shall not apply to the U-factor alternative approach in Section R402.1.3 and the total UA alternative in Section R402.1.4.

- Blown/Loose fill insulation:
~R-3.5/inch +/-
- $R-38 \div 3.5 = \sim 11''$
- R-49 with 6" min heel.
- or R-38 with min ~12" (+ baffle space) heel.



Energy Heel



$$7 \frac{1}{2} \times 3.5 = R 26.25$$

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- Rock Base, Sock/Fabric

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Electrical Rough-in

Mechanical Rough-In

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 - Bath
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Electrical Final

Windows/Doors

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6	0.32	0.55	NR	49	20, 13+5	15/20	30 ^e	15	10, 3.5 ft	15
7	0.32	0.55	NR	49	21	19/21	38 ^e	15	10, 5 ft	15

R402.4.3 Fenestration air leakage. Windows, skylights and sliding glass doors shall have an air infiltration rate of no more than 0.3 cfm per square foot (1.5 L/s/m²), and swinging doors no more than 0.5 cfm per square foot (2.6 L/s/m²), when tested according to NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440 by an accredited, independent laboratory and *listed* and *labeled* by the manufacturer.

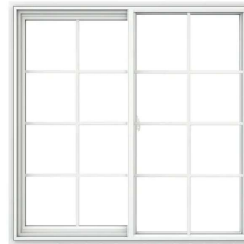
Exception: Site-built windows, skylights and doors.

Framing

- Roof Truss & Bracing/Energy Heel
- Roof covering, Ice & Water, Roof Vents
- Attic Access
- Headers
- Columns/Blocking – Follow Load Paths
- Floor Framing (Truss, I-Joist, Lumber)
- Treated Sills/Plates & Anchor Bolts
- Narrow Wall Bracing
- Sheathing
- Stair Rise/Run
- Headroom
- Hallways
- Boring/Notching
- Fireblocking/Draftstopping
- Tempered Glazing/**U-factor of Glazing**
- Window Fall Protection
- Smoke Alarms
- Outlet in Attic for Future Radon Fan
- Water Resistive Barrier/House Wrap
- Flashing: Drip Caps, Pan Flashing, Kick-out Flashing, Foundation Insulation Flashing, Other

What does the NFRC label tell you?

The NFRC label helps you compare between energy-efficient windows, doors, and skylights by providing you with energy performance ratings in multiple categories.



<https://www.homedepot.com/s/jeldwen%2520windows?NCNI-5>

Window Label

U-Factor measures how well a product can keep heat from escaping from the inside of a room. The lower the number, the better a product is at keeping heat in. **Range:** 0.20-1.20 **Look for:** Low numbers

Visible Transmittance measures how well a product is designed to effectively light your home with daylight, potentially saving you money on artificial lighting. The higher the number, the more natural light is let in. **Range:** 0-1 **Look for:** High numbers

Door Label

 World's Best Window Co. Series "2000" Casement Vinyl Clad Wood Frame Double Glazing • Argon Fill • Low E XYZ-3-1-00001-00001	
ENERGY PERFORMANCE RATINGS	
U-Factor (U.S./I-P) 0.27	Solar Heat Gain Coefficient 0.25
ADDITIONAL PERFORMANCE RATINGS	
Visible Transmittance 0.51	Air Leakage (U.S./I-P) ≤ 0.3
<small>Manufacturer stipulates that these ratings conform to the applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for fixed set of environmental conditions and a specific product size. NFRC does not recommend any product and does not warrant the suitability of any product for any specific use. Consult manufacturer's literature for other product performance information. www.nfrc.org</small>	

NFRC also has a condensation rating that is optional for manufacturers to include, so you may or may not see it on the label. The higher the number, the better a product resists condensation. [Download](#) the optional label.

Solar Heat Gain Coefficient measures how well a product can resist unwanted heat gain, which is especially important during summer cooling season. The lower the number, the less you'll spend on cooling. **Range:** 0-1 **Look for:** Low numbers

Air Leakage measures how much air will enter a room through a product. The lower the number, the fewer drafts you'll experience. **Range:** ≤ 0.3 **Look for:** Low numbers

Framing

- Roof Truss & Bracing/Energy Heel
- Roof covering, Ice & Water, Roof Vents
- Attic Access
- Headers
- Columns/Blocking – Follow Load Paths
- Floor Framing (Truss, I-Joist, Lumber)
- Treated Sills/Plates & Anchor Bolts
- Narrow Wall Bracing
- Sheathing
- Stair Rise/Run
- Headroom
- Hallways
- Boring/Notching
- Fireblocking/Draftstopping
- Tempered Glazing/**U-factor of Glazing**
- Window Fall Protection
- Smoke Alarms
- Outlet in Attic for Future Radon Fan
- Water Resistive Barrier/House Wrap
- Flashing: Drip Caps, Pan Flashing, Kick-out Flashing, Foundation Insulation Flashing, Other

<https://www.nfrc.org/#tabs-nfrclabels>

Footing Inspection

- Setbacks
- Soil Conditions
- Strip Footings Width/Thickness
- Pad Footings Size/Thickness
- Depth/Frost Coverage
- Rebar – Per Drawings, Grounding Rod

Foundation Wall - CIP (Pre-Pour)

- Forms – Height/Thickness
- Form placement on footing – footing projection
- Rebar – Dowels, Verticals, & Horizontals

Foundation Wall – Block or CIP (Post-Pour)

- Gaps/Cracks/Flaws? Block arrangement
- Waterproofing
- Insulation - R10 Min
 - Draining
 - Non-Draining – Poly Slipsheet Required
- Walls braced for backfill
- Drain Tile
- Rock Base, Sock/Fabric

Plumbing Rough-In

- Underground – Visual & Air Test
- Above Ground – Visual & Air Test
- Supply Piping: Support, Hots Insulated
- Mixing Valves
- Tile shower Pan

Framing

- Roof Truss & Bracing/Energy Heel
- Roof covering, Ice & Water, Roof Vents
- Attic Access
- Headers
- Columns/Blocking – Follow Load Paths
- Floor Framing (Truss, I-Joist, Lumber)
- Treated Sills/Plates & Anchor Bolts
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- Hallways
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- Fireblocking/Draftstopping
- Tempered Glazing/U-factor of Glazing
- Window Fall Protection
- Smoke Alarms
- Outlet in Attic for Future Radon Fan
- Water Resistive Barrier/House Wrap
- Flashing: Drip Caps, Pan Flashing, Kick-out Flashing, Foundation Insulation Flashing, Other

Electrical Rough-in

Mechanical Rough-In

- Supply & Return Ducting
- Exhaust fans
 - Bath
 - Dryer
- Gas Lines
 - Visual
 - Air Test
- Fireplace

Slab

- Rock
- Poly
- Radon Tee (or use Drain Tile)

Lath (Adhered Masonry Veneer)

- Paper
- Mesh
- Fastening
- Flashing
- Weep Screed

Insulation

- Vapor Retarder
- Air Barrier
- Wall Insulation – R20 Min
- Rim Joist – R20 Min
- Window Jambs
- Penetrations sealed (Fireblocking/Air Sealing)
- Radon Piping & Labeling

Mechanical Final

- Furnace
- Water Heater
- A/C Unit
- ERV/HRV
- Vent Terminations Hoods/Locations
- Intake/Exhaust Labeled
- Gas Connections & Sediment Traps
- Supply/Return Air Grills

Plumbing Final

- Manometer Test
- Fixtures set
- Dishwasher Air Gap & Water Hammer
- Washer Water Hammer
- Water Softener: Bonding jumper, Air Gap
- Shower Tile Height
- Backwater Valve Accessible

Building Final

- Insulation Installation Certificate
- Blower Door Test
- Plumbing Vent Roof Caps Removed
- Guards/Handrails
- Smoke/CO Alarm Operation
- Patio Door Blocked (if no Deck)
- Window Fall Protection
- Garage Wall/Ceiling Gypsum
- Basement Ceiling & Under Stair Gypsum
- Mechanical Room – 80sf Max Unprotected, Blocked to Floor
- Radon Labeled
- Sump Lid Sealed (if used for Radon)
- Siding: Installation, Distance to Grade
- Final Grading
- Required Vegetation/Landscaping
- Required Hardcover: Driveway, Sidewalk

Electrical Final

TABLE R402.1.1 INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT ^a										
CLIMATE ZONE	FENESTRATION U-FACTOR ^b	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b,e}	CEILING ^c R-VALUE	WOOD FRAME WALL R-VALUE ^f	MASS WALL R-VALUE ^{g,h}	FLOOR R-VALUE	BASEMENT ^{c,i} WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE ^{c,i} WALL R-VALUE
6	0.32	0.55	NR	49	20, 13+5	15/20	30 ^e	15	10, 3.5 ft	15
7	0.32	0.55	NR	49	21	19/21	38 ^e	15	10, 5 ft	15

Insulation

- Vapor Retarder
- Air Barrier
- Wall Insulation – R20 Min
- Rim Joist – R20 Min
- Window Jambs
- Penetrations sealed (Fireblocking/Air Sealing)
- Radon Piping & Labeling

**TABLE R402.4.1.1
AIR BARRIER AND INSULATION INSTALLATION**

COMPONENT	CRITERIA ^a
Air barrier and thermal barrier	A continuous air barrier shall be installed in the building envelope. Exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier shall be sealed. Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling/soffit shall be aligned with the insulation and any gaps in the air barrier sealed. Access openings, drop down stair or knee wall doors to unconditioned attic spaces shall be sealed.
Walls	Corners and headers shall be insulated and the junction of the foundation and sill plate shall be sealed. The junction of the top plate and top of exterior walls shall be sealed. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier. Knee walls shall be sealed.
Windows, skylights and doors	The space between window/door jambs and framing and skylights and framing shall be sealed.
Rim joists	Rim joists shall be insulated and include the air barrier.
Floors (including above-garage and cantilevered floors)	Insulation shall be installed to maintain permanent contact with underside of subfloor decking. The air barrier shall be installed at any exposed edge of insulation.
Crawl space walls	Where provided in lieu of floor insulation, insulation shall be permanently attached to the crawlspace walls. Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.
Narrow cavities	Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air tight, IC rated, and sealed to the drywall.
Plumbing and wiring	Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	Exterior walls adjacent to showers and tubs shall be insulated and the air barrier installed separating them from the showers and tubs.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical or communication boxes or air sealed boxes shall be installed.
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.
Fireplace	An air barrier shall be installed on fireplace walls. Fireplaces shall have gasketed doors.

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Insulation

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- Window Jambs
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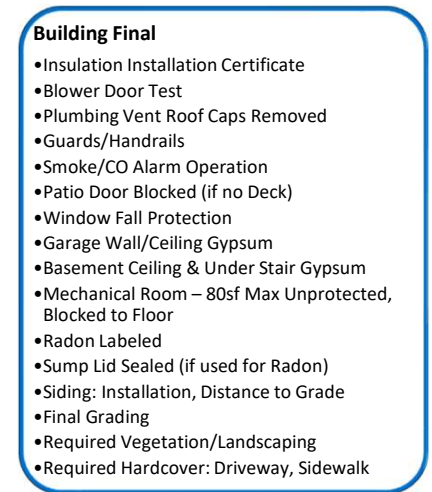
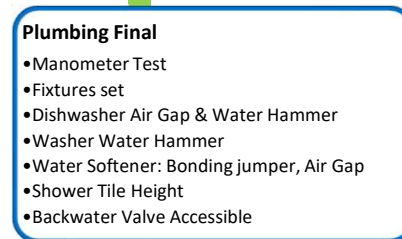
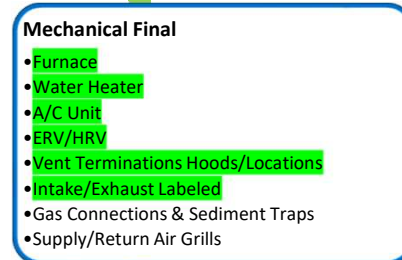
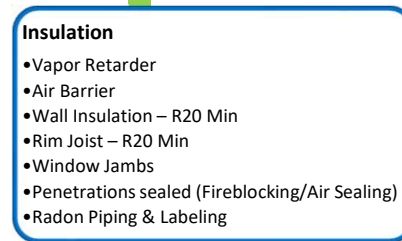
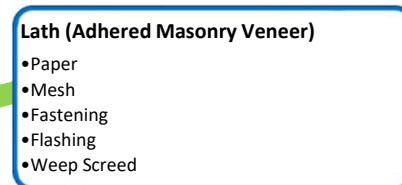
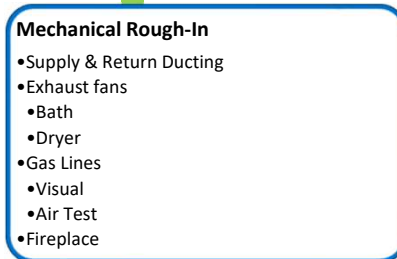
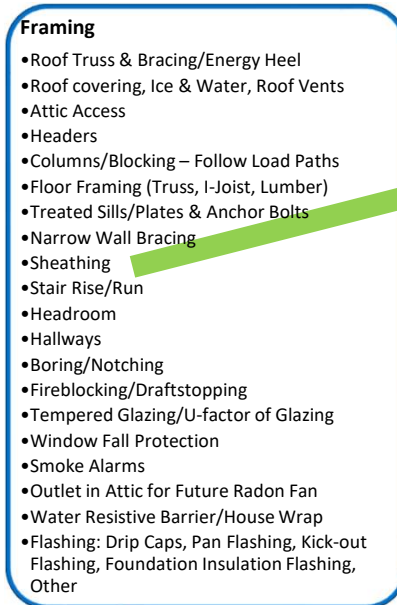
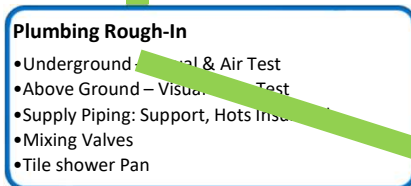
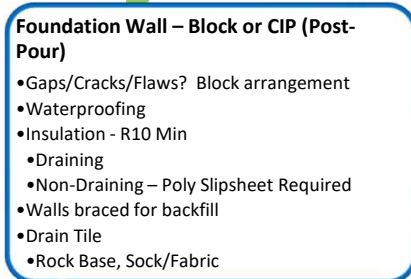
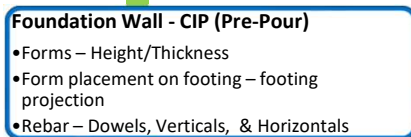
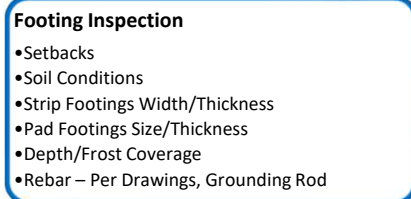
Insulation

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- Air Barrier
- Wall Insulation – R20 Min
- Rim Joist – R20 Min
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Insulation

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- Air Barrier
- Wall Insulation – R20 Min
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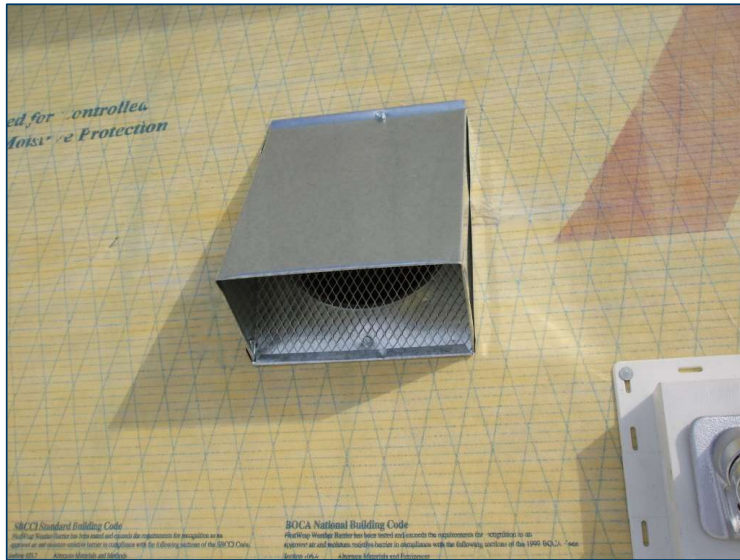


New Construction Energy Code Compliance Certificate									
Per R401.3 Certificate. A building certificate shall be posted on or in the electrical distribution panel.								Date Certificate Post	
Mailing Address of the Dwelling or Dwelling Unit						City		Place your logo here	
Name of Residential Contractor						MN License Number			
THERMAL ENVELOPE				RADON CONTROL SYSTEM					
Insulation Location				Total R-Value of all Types of Insulation		Type: Check All That Apply		Passive (No Fan)	
								Active (with fan and monometer or other system monitoring device)	
						Location (or future location) of Fan:			
						Other Please Describe Here			
Below Entire Slab									
Foundation Wall									
Perimeter of Slab on Grade									
Rim Joist (1st Floor)									
Rim Joist (2nd Floor+)									
Wall									
Ceiling, flat									
Ceiling, vaulted									
Bay Windows or cantilevered areas									
Floors over unconditioned area									
Describe other insulated areas									
Building envelope air tightness:				Duct system air tightness:					
Windows & Doors				Heating or Cooling Ducts Outside Conditioned Spaces					
Average U-Factor (excludes skylights and one door) U:				Not applicable, all ducts located in conditioned space					
Solar Heat Gain Coefficient (SHGC):				R-value					
MECHANICAL SYSTEMS				Make-up Air Select a Type					
Appliances		Heating System		Domestic Water Heater		Cooling System		Not required per mech. code	
Fuel Type								Passive	
Manufacturer								Powered	
Model								Interlocked with exhaust device. Describe:	
Rating or Size		Input in BTUS:		Capacity in Gallons:		Output in Tons:		Other, describe:	
Efficiency		AFUE or HSPF%				SEER / EER		Location of duct or system:	
Residential Load Calculation		Heating Loss		Heating Gain		Cooling Load			
								Cfm's	
								* round duct OR	
								* metal duct	
MECHANICAL VENTILATION SYSTEM				Combustion Air Select a Type					
Describe any additional or combined heating or cooling systems if installed: (e.g. two furnaces or air source heat pump with gas back-up furnace):				Not required per mech. code					
Select Type				Passive					
Heat Recover Ventilator (HRV) Capacity in cfm's: Low: High:				Other, describe:					
Energy Recover Ventilator (ERV) Capacity in cfm's: Low: High:				Location of duct or system:					
Balanced Ventilation capacity in cfm's:				Cfm's					
Location of fan(s), describe:				* round duct OR					
Capacity continuous ventilation rate in cfm's:				* metal duct					
Total ventilation (intermittent + continuous) rate in cfm's:									



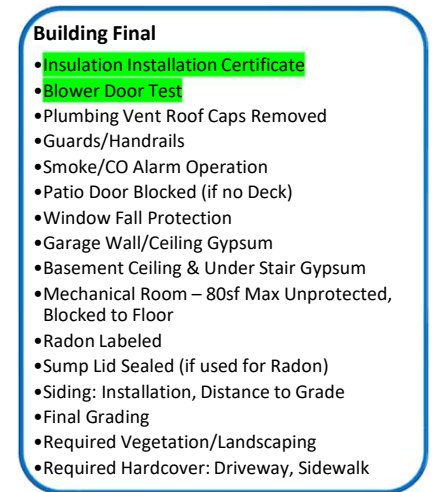
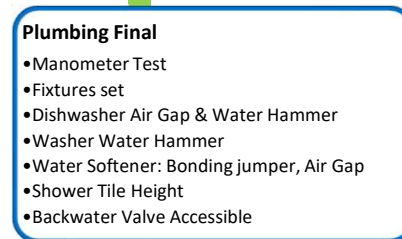
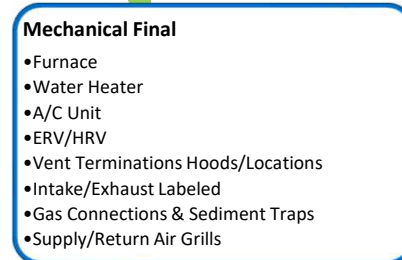
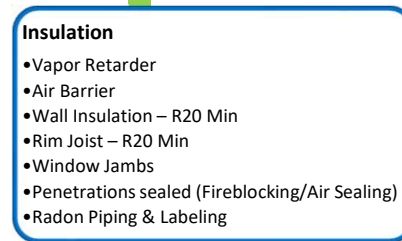
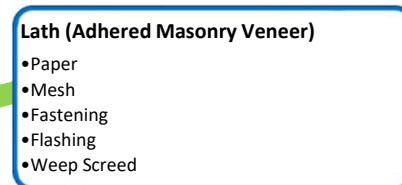
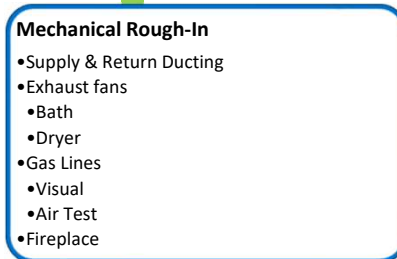
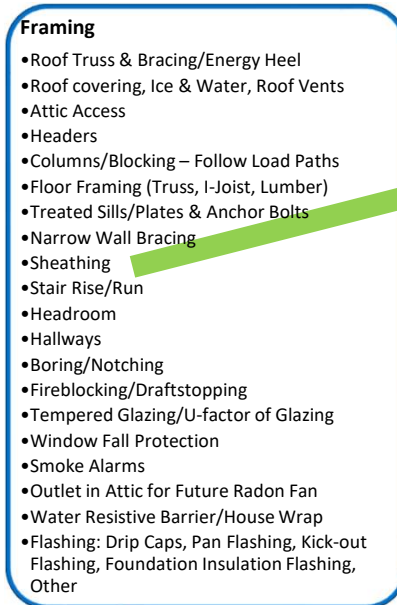
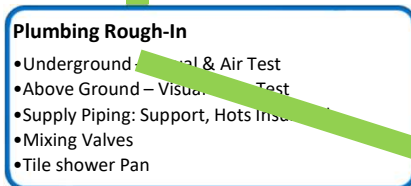
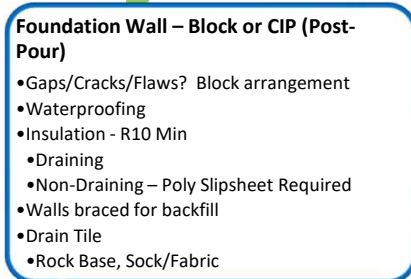
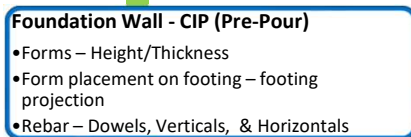
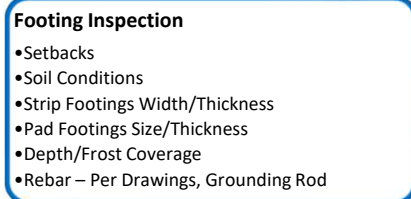
Mechanical Final

- Furnace
- Water Heater
- A/C Unit
- ERV/HRV
- Vent Terminations Hoods/Locations
- Intake/Exhaust Labeled
- Gas Connections & Sediment Traps
- Supply/Return Air Grills



Mechanical Final

- Furnace
- Water Heater
- A/C Unit
- ERV/HRV
- Vent Terminations Hoods/Locations
- Intake/Exhaust Labeled
- Gas Connections & Sediment Traps
- Supply/Return Air Grills





INNOVATIONS FOR LIVING®

This home has been professionally insulated with
Esta vivienda ha sido aislada profesionalmente con

Owens Corning AttiCat® Expanding Blown-In PINK Fiberglas™ Insulation

Aislamiento expansible PINK Fiberglas™ para soplar AttiCat® de Owens Corning

(Job Site Address) (Dirección del sitio del trabajo)

Name Nombre _____

Address Dirección _____

City Ciudad _____ State Estado _____ Zip Código postal _____

Please see the chart of the back of this page for further specifications about
Owens Corning AttiCat® Expanding Blown-In PINK Fiberglas™ Insulation.

Por favor, consulte el reverso de esta página donde encontrará las especificaciones del
aislamiento expansible PINK Fiberglas™ para soplar AttiCat® de Owens Corning.

Blanket Insulation

Aislamiento en mantas

Blanket and batt fiber glass insulation, when installed according to the manufacturers recommendations, will provide the stated R-Value.
El aislamiento de fibra de vidrio en mantas y bloques, proporcionará el valor R estipulado siempre que se instale respetando las recomendaciones del fabricante.

R-VALUE

To obtain an insulation resistance (R) of
VALOR R

Para obtener una resistencia del aislamiento (valor R) de:

MINIMUM THICKNESS

Installed insulation should be:

ESPESOR MÍNIMO

El aislamiento instalado debe ser:

12" 10.25" 9.5" 8.25" 8.0" 6.75" 5.5" 6.25" 3.5" 3.5" 3.5"

R-18 in a 5.5" cavity / R-18 en una cavidad de 5,5 pulgadas

THE FOLLOWING PRODUCTS HAVE BEEN INSTALLED AS SPECIFIED ABOVE:

LOS SIGUIENTES PRODUCTOS HAN SIDO INSTALADOS COMO SE ESPECIFICA MÁS ARRIBA:

	kraft con revestidor de vapor	unfaced sin revestidor de vapor	foil con revestimiento metálico	FS-25 FS-25	R-Value Valor R	Thickness Espesor	No. pkgs. Cantidad de paquetes	Coverage Area Superficie de cobertura
Ceilings Techos	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
Floors Pisos	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
Walls Paredes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
Basement Sótanos	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
Crawlspace Área de poca altura	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				

Contractor/Constructor _____ Date /Fecha _____ Builder/Constructor _____ Date /Fecha _____
(Signature) (Firma) (Signature) (Firma)

Company /Compañía _____ Company /Compañía _____

Address /Dirección _____ Address /Dirección _____

Phone /Número de teléfono _____ Phone /Número de teléfono _____



OWENS CORNING INSULATING SYSTEMS, LLC
ONE OWENS CORNING PARKWAY
TOLEDO, OHIO, USA 43659

1-800-GET-PINK®
www.owenscorning.com

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- Building Final
- Insulation Installation Certificate
 - Blower Door Test
 - Plumbing Vent Roof Caps Removed
 - Guards/Handrails
 - Smoke/CO Alarm Operation
 - Patio Door Blocked (if no Deck)
 - Window Fall Protection
 - Garage Wall/Ceiling Gypsum
 - Basement Ceiling & Under Stair Gypsum
 - Mechanical Room – 80sf Max Unprotected, Blocked to Floor
 - Radon Labeled
 - Sump Lid Sealed (if used for Radon)
 - Siding: Installation, Distance to Grade
 - Final Grading
 - Required Vegetation/Landscaping
 - Required Hardcover: Driveway, Sidewalk

TEST RESULTS AND SAMPLE TEST FORMS

Sample blank form

Envelope Leakage Test

Testing Company

Name:
Address:

Phone:

Technician

Name:
Credentials:

Email:

Building Information

Project ID:
Address:

Customer Information

Name:
Address:

Phone:
Email:

Test Results

Measured Leakage:
Leakage Target:
Compliance with Leakage Target: Pass Fail

Test ID:

Measured CFM50:

Building Volume:

Enclosure Surface Area:

ACH50 = (CFM50 x 60)/Volume:

CFM50/Sq Feet of Surface Area:

Test Characteristics

Indoor Temp:
Outdoor Temp:
Altitude:
Time Average Period:
Test Date:

Test Equipment

Flow Device: Serial Number:
Pressure Gauge: Serial Number: Calibration Date:

Comments:

Technician Signature:

Date:



<https://energyconservatory.com/wp-content/uploads/2017/08/Test-Results-and-Sample-Test-Forms-Guide-.pdf>

6

Building Final

- Insulation Installation Certificate
- Blower Door Test
- Plumbing Vent Roof Caps Removed
- Guards/Handrails
- Smoke/CO Alarm Operation
- Patio Door Blocked (if no Deck)
- Window Fall Protection
- Garage Wall/Ceiling Gypsum
- Basement Ceiling & Under Stair Gypsum
- Mechanical Room – 80sf Max Unprotected, Blocked to Floor
- Radon Labeled
- Sump Lid Sealed (if used for Radon)
- Siding: Installation, Distance to Grade
- Final Grading
- Required Vegetation/Landscaping
- Required Hardcover: Driveway, Sidewalk

TEST RESULTS AND SAMPLE TEST FORMS

Sample completed form
(From TEC Auto Test app)

Envelope Leakage Test

Testing Company:

Name:
Address:

Technician:

Name: Erik S.
Credentials: BPI Building Analyst Certification
3/18/2015.
Email: info@energyconservatory.com

Building Information:

Project ID: Example
Address: 2801 21st Ave S
Suite 160
Minneapolis, MN 55407
Geo-Tag Data: Latitude: 44.951044
Longitude: -93.241572
Timestamp: 2016-09-02 14:04:04

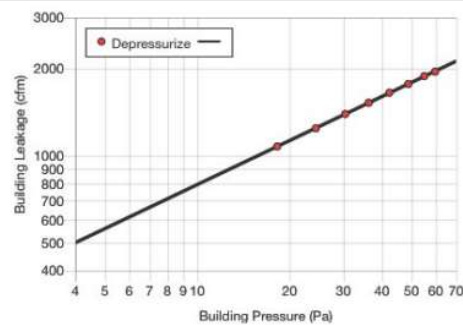
Customer Information:

Name: The Energy Conservatory
Address: 2801 21st Ave. South
Suite 160
Minneapolis, MN 55407
Phone: (612) 827-1117
Email: info@energyconservatory.com

Test Results: Measured Leakage: 3.76 ACH50
Leakage Target: 3.00 ACH50
Compliance with Leakage Target: Fail

Test ID: Final Envelope Inspection
Purpose of Test: IECC 12/15 Env. Leakage
Measured CFM50: 1,791.8 (+/- 0.2%)
Building Volume: 28,560.0 ft³
Flow Coefficient (C): 247.9 (+/- 1.8%)
Correlation Coefficient: 0.99995
Test Standard: ASTM E779 (single mode)
Test Characteristics: Pre Indoor Temp: 70 °F
Pre Outdoor Temp: 34 °F
Altitude: 856.0 ft
Test Date and Time: 2016-09-02 14:45:58

Effective Leakage Area: 141.8 in²
Enclosure Surface Area: 0.0 ft²
Exponent (n): 0.506 (+/- 0.005)
Test Mode: Depressurize
Post Indoor Temp: 70 °F
Post Outdoor Temp: 34 °F
Time Average Period: 10 seconds



<https://energyconservatory.com/wp-content/uploads/2017/08/Test-Results-and-Sample-Test-Forms-Guide-.pdf>

Building Final

- Insulation Installation Certificate
- Blower Door Test
- Plumbing Vent Roof Caps Removed
- Guards/Handrails
- Smoke/CO Alarm Operation
- Patio Door Blocked (if no Deck)
- Window Fall Protection
- Garage Wall/Ceiling Gypsum
- Basement Ceiling & Under Stair Gypsum
- Mechanical Room – 80sf Max Unprotected, Blocked to Floor
- Radon Labeled
- Sump Lid Sealed (if used for Radon)
- Siding: Installation, Distance to Grade
- Final Grading
- Required Vegetation/Landscaping
- Required Hardcover: Driveway, Sidewalk

Footing Inspection

- Setbacks
- Soil Conditions
- Strip Footings Width/Thickness
- Pad Footings Size/Thickness
- Depth/Frost Coverage
- Rebar – Per Drawings, Grounding Rod

Foundation Wall - CIP (Pre-Pour)

- Forms – Height/Thickness
- Form placement on footing – footing projection
- Rebar – Dowels, Verticals, & Horizontals

Foundation Wall – Block or CIP (Post-Pour)

- Gaps/Cracks/Flaws? Block arrangement
- Waterproofing
- Insulation - R10 Min
 - Draining
 - Non-Draining – Poly Slipsheet Required
- Walls braced for backfill
- Drain Tile
- Rock Base, Sock/Fabric

Plumbing Rough-In

- Underground – Visual & Air Test
- Above Ground – Visual & Air Test
- Supply Piping: Support, Hots Insulation
- Mixing Valves
- Tile shower Pan

Framing

- Roof Truss & Bracing/Energy Heel
- Roof covering, Ice & Water, Roof Vents
- Attic Access
- Headers
- Columns/Blocking – Follow Load Paths
- Floor Framing (Truss, I-Joist, Lumber)
- Treated Sills/Plates & Anchor Bolts
- Narrow Wall Bracing
- Sheathing
- Stair Rise/Run
- Headroom
- Hallways
- Boring/Notching
- Fireblocking/Draftstopping
- Tempered Glazing/U-factor of Glazing
- Window Fall Protection
- Smoke Alarms
- Outlet in Attic for Future Radon Fan
- Water Resistive Barrier/House Wrap
- Flashing: Drip Caps, Pan Flashing, Kick-out Flashing, Foundation Insulation Flashing, Other

Electrical Rough-in

Mechanical Rough-In

- Supply & Return Ducting
- Exhaust fans
 - Bath
 - Dryer
- Gas Lines
 - Visual
 - Air Test
- Fireplace

Slab

- Rock
- Poly
- Radon Tee (or use Drain Tile)

Lath (Adhered Masonry Veneer)

- Paper
- Mesh
- Fastening
- Flashing
- Weep Screed

Insulation

- Vapor Retarder
- Air Barrier
- Wall Insulation – R20 Min
- Rim Joist – R20 Min
- Window Jambs
- Penetrations sealed (Fireblocking/Air Sealing)
- Radon Piping & Labeling

Mechanical Final

- Furnace
- Water Heater
- A/C Unit
- ERV/HRV
- Vent Terminations Hoods/Locations
- Intake/Exhaust Labeled
- Gas Connections & Sediment Traps
- Supply/Return Air Grills

Plumbing Final

- Manometer Test
- Fixtures set
- Dishwasher Air Gap & Water Hammer
- Washer Water Hammer
- Water Softener: Bonding jumper, Air Gap
- Shower Tile Height
- Backwater Valve Accessible

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Electrical Final

Questions?

Steve Shold

steve.shold@state.mn.us

651-284-5312

