MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

2010 Fall Program

Presented by
Building Codes and Standards Unit
Construction Codes and Licensing Division

2010 Fall Seminar

Energy Plan Review

Construction Codes and Licensing Division
Department of Labor and Industry
443 Lafayette Road North, St. Paul, Mn 55155-4341
www.doli.state.mn.us
Phone 651/284-5068, Fax 651/284-5749

Presenters:

Scott Nelson P.E, (Mechanical)	**651/284-5850**	**scott.nelson@state.mn.us**
Don Sivigny (Energy, Radon & IRC)	**651/284-5874**	**don.sivigny@state.mn.us**

Other staff in the Education Section:

Mike Godfrey (Supervisor)	651-284-5862	mike.godfrey@state.mn.us
Rich Lockrem (IRC & IBC)	651/284-5868	rich.lockrem@state.mn.us
Curt Wiehle (accessibility)	651/284-5877	curtis.wiehle@state.mn.us
Dan Kelsey P.E. (structural)	651/284-5852	dan.kelsey@state.mn.us
Kelly Denno (administrative)	651/284-5845	kelly.denno@state.mn.us

2010 Fall Seminar
Education Code Section

Sign In Sheet

NAME	AM	PM

Constructive opinions are appreciated.

These subjects are considered when developing future seminars.

2007 CONSTRUCTION CODES & LICENSING DIVISION'S FALL SEMINAR EVALUATION

Seminar Date ____________ Seminar Location ____________________

Rating of Seminar

1. Topic is timely and appropriate	A	B	C	D
2. Content is clear and informative	A	B	C	D
3. Subject is covered comprehensively	A	B	C	D
4. Handout material is beneficial	A	B	C	D

Rating of Instructor(s), General

1. Knowledgeable and informed	A	B	C	D
2. Practiced and articulate	A	B	C	D
3. Understandable and responsive	A	B	C	D
4. Professional and experienced	A	B	C	D

Overall Rating of Instructor(s)

1. **Curt Wiehle**	A	B	C	D
2. **Dan Kelsey**	A	B	C	D

Rating of This Seminar Location

1. Room seating	A	B	C	D
2. Room temperature	A	B	C	D
3. Room lighting	A	B	C	D
4. Breaks & meals	A	B	C	D

We would appreciate your comments about this seminar:

We would appreciate your suggestions for future seminars:

Name (optional)

Admin MINNESOTA Department of Administration

MINNESOTA DEPARTMENT OF ADMINISTRATION
BUILDING CODES AND STANDARDS DIVISION

CERTIFICATE OF TRAINING
Equivalent to 2.5 CEU's
Presented to

Please retain your certificate of training required for submittal with BO CEU verification……

Name of Attendee

upon successful completion of the

Title of Seminar Attended

Presented on ____________
Seminar Date

Attendee's Signature

I certify that I was in attendance for the full scheduled session.

Thomas R. Joachim

Thomas R. Joachim
State Building Official

Disclaimer

- **The text in this presentation does not necessarily represent actual code language. The presented text may summarize, highlight or generalize the code section. Additional provisions or exceptions may be included in the actual code section. Cites to the code sections are given for the purpose of verifying the complete provisions of the section.**


verizon
AUDIOVOX
MinnComm

Introduction

- **Today's class is intended to give you a better understanding in how to do a plan review using Minnesota's Energy Code.**

Introduction

- Today's class is intended to give you a better understanding in how to do a plan review using Minnesota's Energy Code.
- It Is also intended to give you the tools you need to assist others in your offices and your customers as well.

Objectives

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- **To understand a complete and Energy plan review.**

Objectives

- **To understand and complete a Energy plan review.**

- **To understand your authority and responsibilities and the reasoning for reviewing buildings to meet the Energy Code, including but not limited to:**

Objectives

- **To understand and complete a professional plan review.**

- **To understand your authority and responsibilities and the reasoning for reviewing buildings to meet the Energy Code including but not limited to:**
  - **Documentation**

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- **To understand your authority and responsibilities and the reasoning for reviewing buildings to meet the Energy Code including but not limited to:**
  - **Documentation**
  - **Recordkeeping**

Objectives

- **To understand and complete a professional plan review.**

- **To understand your authority and responsibilities and the reasoning for reviewing buildings to meet the Energy Code including but not limited to:**
  - **Documentation**
  - **Recordkeeping**
  - **U factor and R-value requirements**

Objectives

- **To understand and complete a professional plan review.**

- **To understand your authority and responsibilities and the reasoning for reviewing buildings to meet the Energy Code including but not limited to:**
  - **Documentation**
  - **Recordkeeping**
  - **U factor and R-value requirements**
  - **Others**

Objectives

- **Today when you leave here you will become the educator for others in your staff and for your customers**

Energy Code Regulation

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- The American Recovery and Re-Investment Act (ARRA)

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  - The ARRA has specified a minimum standard of compliance as a condition of federal grant dollars.
  - The conditions require and provided funding for the following
    - **Training**
    - **Job retention**
    - **Job Creation**

U.S. DEPARTMENT OF ENERGY

PNNL- 18587 Brief 7

Prepared for the U.S. Department of Energy
Under Contract DE-AC05-76RL01830

Topic Brief 7: Compliance Roadmap

12/7/2009

Pacific Northwest
NATIONAL LABORATORY

Energy Code Regulation

- The goal is to obtain a 90% compliance for all buildings within a 8 year time frame (by 2017) including;

Energy Code Regulation

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  - Enforcement on
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Energy Code Regulation

- The goal is to obtain a 90% compliance for all buildings within a 8 year time frame including;
  - Training of
    - Code officials and builders
  - Enforcement on
    - Code officials and Builders
  - Annual Measurement of how we are doing
    - Done Federally by DOE

Energy Code Regulation

- Additional Regulation is needed for a lot of reasons

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  - Infrastructure costs
    - Generating energy such as electricity
    - Transmitting this energy to the location it will eventually be used.

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    - Transmitting this energy to the location it will eventually be used.

  - **It's the Law! (Federal)**

Why do we need a Building Energy Code?

Why do we need a Building Energy Code?

- Buildings use approximately 70% of the fossil fuel in the United States.

Why do we need a Building Energy Code?

- Buildings use approximately 70% of the fossil fuel in the United States.

- Most people only consider energy costs in, cost of gas per gallon or fuel oil per gallon etc…

Why do we need a Building Energy Code?

- They do not know how much they are paying in cost per therm or cost per watt for energy purposes.

Why do we need a Building Energy Code?

- They do not know how much they are paying in cost per therm or cost per watt for energy purposes.
  - Think of the light bulbs and how things are changing

Why do we need a Building Energy Code?

- They do not know how much they are paying in cost per Therm or cost per watt for energy purposes.

- But…. Everyone believes that they are paying way too much for their energy costs.

Why do we need a Building Energy Code?

- Energy Usage is not a personal matter.

Why do we need a Building Energy Code?

- Energy Usage is not a personal matter.
- One persons usage affects us all and the rates we pay for our energy.

Other reasons

Other reasons

- Sustainability
- Limiting Climate Change
- Reduction of the carbon footprint

Other reasons

- Social reasons
  - National Security
  - Ecology- reduces Green house gases
- Financially
  - Payback costs or a ROI
- Technically
  - Building Science and research are finding better construction techniques with better performing building systems

Grab the Plans

Grab the Plans

- Lets look at and use our set of plans as we go through class today.

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- This is probably the best way to understand Residential Energy Code Plan Reviews

Grab the Plans

- Lets look at and use our set of plans as we go through class today.

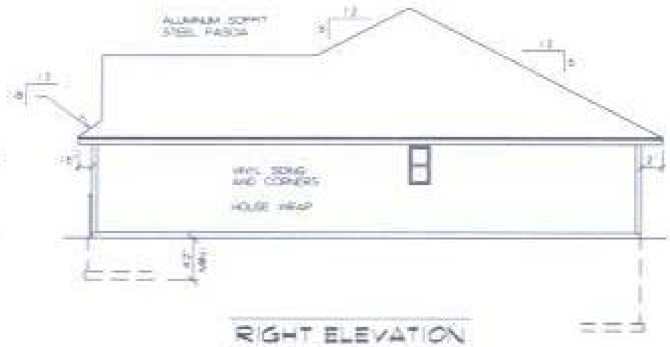
- This is probably the best way to understand Residential energy code Plan Review
- You Should have 4 total pages:
  - Elevations plan

LEFT ELEVATION

SCALE: 1/8" = 1'-0"

REAR ELEVATION

SCALE: 1/8" = 1'-0"



RIGHT ELEVATION

SCALE: 1/8" = 1'-0"

NOTE: ALL INSULATED WALLS ADJACENT TO NON-HEATED ATTIC AREAS MUST BE PROTECTED ON THE EXTERIOR SIDE WITH A WEATHER BARRIER WHICH PREVENTS WIND INTRUSION INTO THE INSULATION. COVER WITH MATERIALS LIKE PLYWOOD, WAFERBOARD, FIBERBOARD, OR HOUSE WRAPS.

ALL NON-INDICATED HEADERED OPENINGS TO BE 2-2x10's HEM-FIR #2 OR BETTER, "FB" 1000

■ -INDICATES BUILT-UP POST E.G. 3-2x6

PROVIDE SOLID BLOCKING IN JOIST SPACE BELOW ALL LOAD BEARING POSTS.

INSTALL CURVED SIDEWALK

FRONT ELEVATION

SCALE: 1/4" = 1'-0"

NOTE: ELEVATION DRAWINGS ARE FOR ILLUSTRATION PURPOSES ONLY. THEY ILLUSTRATE OUR STANDARD HOME ON A TYPICAL LOT. EXACT ELEVATION OF THE HOME TO BE CONSTRUCTED ON YOUR LOT WILL VARY DEPENDING UPON MANY FACTORS. SOME OF THE FACTORS THAT COMMONLY WILL AFFECT ELEVATION ARE THE TOPOGRAPHY OF THE LOT, THE MASTER GRADING PLAN FOR THE SUBDIVISION, NUMBER OF COURSES OF BLOCK IN BASEMENT, TYPE OF FLOOR JOISTS, HEIGHT OF FIRST FLOOR CEILING, ETC.

HOME FOR

DRAWN BY	JANUARY 1,	REVISED	ELEVATION	PLAN #
ERIK	2010		A	2601

JOB ADDRESS

XXXX MAIN STREET

CITY

SHEET

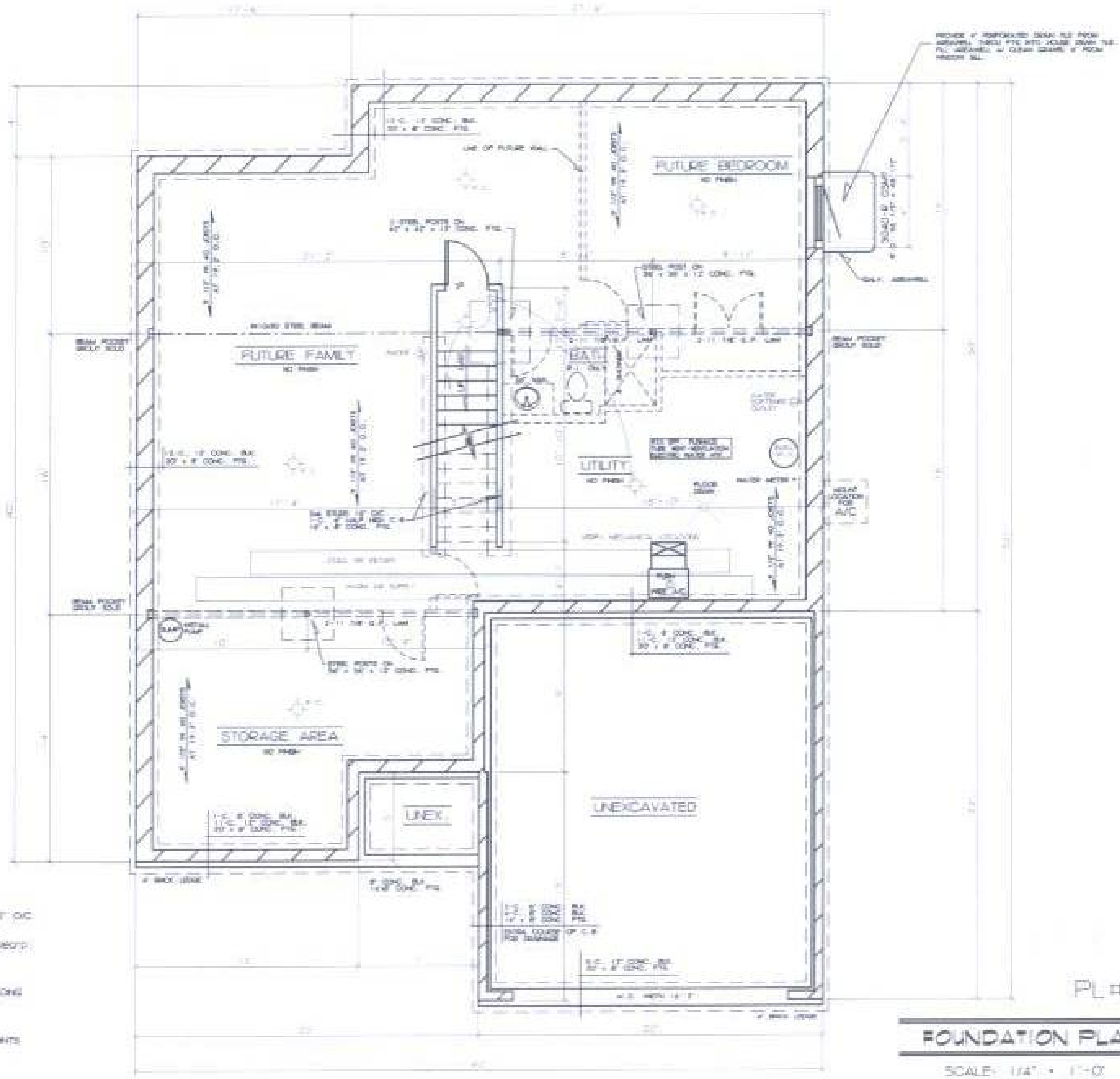
1/4

Grab the Plans

- Lets look at and use our set of plans as we go through class today.

- This is probably the best way to understand Residential energy code Plan Review
- You Should have 4 total pages:
  - Elevations plan
  - Foundation plan

SUGGESTED HEATING
PLUMBING & ELECTRIC
LAYOUTS



NOTE:
- 12" CONC. BLK.
- HORIZ. REINF. 32" O/C. AS REQ'D.
- VERTICAL REINF. FULL RSMT. NO. 4 BARS 72" O/C
- CONC. FTNGS. MIN. 42" BELOW GRADE
- ALL FTG. CONC. TO BE 3000 PSI
- REINF. & FILLED CORES AT 4'-0" O/C & AS REQ'D. BY SOIL & ON SITE CONDITIONS
- 1/2" ANCHOR BOLTS AT 6'-0" O/C MAX
- 4" CONC. FLOOR SLAB 4000 PSI
- TREATED 2x6 SILLS IN CONTACT W/ CONC.
- 9 1/2" W/ 40 JOIST's. SEE PLANS FOR SPACING
- INSUL./WATERPROOF R-5
- PROVIDE DRAIN TILE AS REQ'D BY SOIL
- ALL WOOD THAT COMES IN CONTACT W/CONC. SHALL BE TRTD.
- PROVIDE SOLID CORES UNDER ALL BEARING POINTS
- SOIL BEARING VALUE ASSUMED TO BE 3,000# P.S.F. OR BETTER

PL#2601

FOUNDATION PLAN

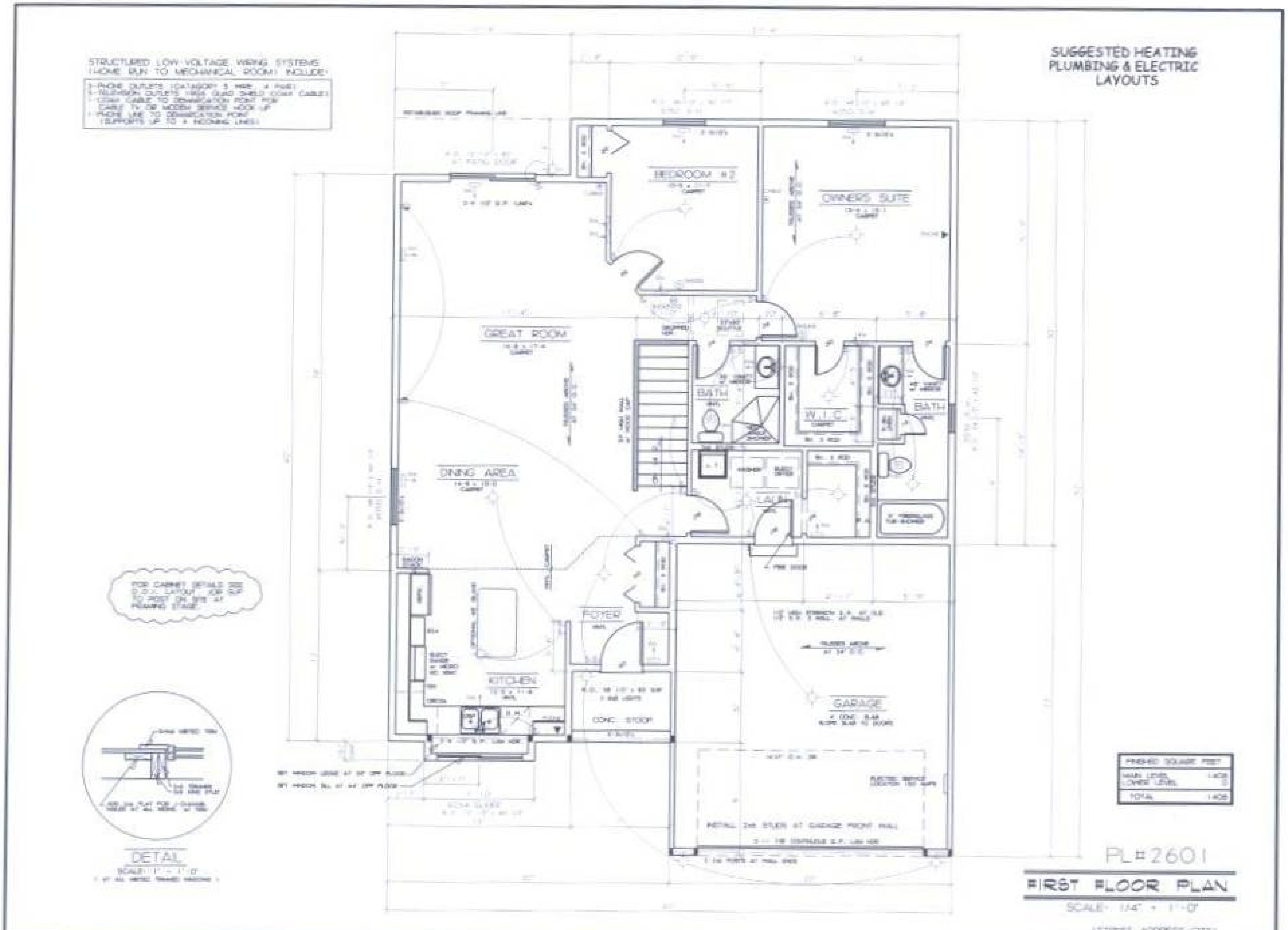
SCALE: 1/4" = 1'-0"

(STREET ADDRESS-CITY)

Grab the Plans

- Lets look at and use our set of plans as we go through class today.

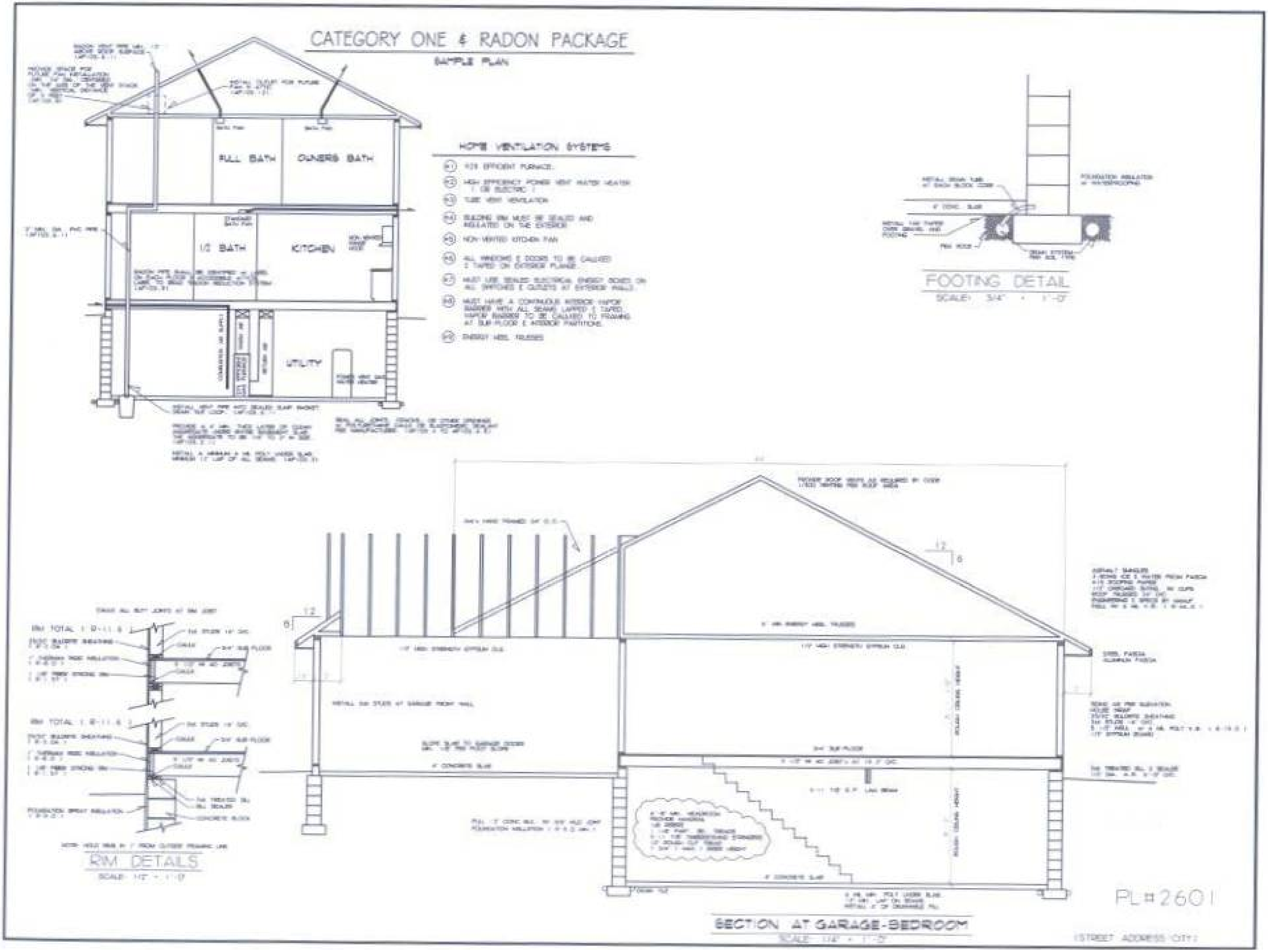
- This is probably the best way to understand Residential energy code Plan Review
- You Should have 4 total pages:
  - Elevations plan
  - Foundation plan
  - First floor plan



STRUCTURED LOW VOLTAGE WIRING SYSTEMS (HOME RUN TO MECHANICAL ROOM) INCLUDE:
SUGGESTED HEATING PLUMBING & ELECTRIC LAYOUTS
BEDROOM #2
OWNERS SUITE
GREAT ROOM
DINING AREA
BATH
W.I.C.
BATH
LAUN
FOYER
KITCHEN
CONC. STOOP
GARAGE
INSTALL 2x6 STUDS AT GARAGE FRONT WALL
DETAIL
FINISHED SQUARE FEET
MAIN LEVEL 1408
LOWER LEVEL 0
TOTAL 1408
PL#2601
FIRST FLOOR PLAN
SCALE: 1/4" = 1'-0"
(STREET ADDRESS-CITY)

Grab the Plans

- Lets look at and use our set of plans as we go through class today.
- This is probably the best way to understand Residential energy code Plan Review
- You Should have 4 total pages:
  - Elevations plan
  - Foundation plan
  - First floor plan
  - Cross section Plan



CATEGORY ONE & RADON PACKAGE
SAMPLE PLAN
FULL BATH
OWNERS BATH
1/2 BATH
KITCHEN
UTILITY
HOME VENTILATION SYSTEMS
TUBE VENT VENTILATION
NON-VENTED KITCHEN FAN
ENERGY HEEL TRUSSES
FOOTING DETAIL
SCALE: 3/4" = 1'-0"
RIM DETAILS
SCALE: 1/2" = 1'-0"
SECTION AT GARAGE-BEDROOM
SCALE: 1/4" = 1'-0"
PL#2601
(STREET ADDRESS CITY)

- You may need to look at more than one page to find the information you need for a proper energy plan review

- You may need to look at more than one page to find the information you need for a proper energy plan review
  - Ex. Where on the foundation Plan do you find the foundation insulation that is being used and its location.

- You may need to look at more than one page to find the information you need for a proper energy plan review
  - Ex. Where on the foundation Plan do you find the foundation insulation that is being used and its location.
    - You don’t find it on the foundation plan its on the cross section page

Does the Building need to comply with the energy Code?

The first item to review is…

The first item to review is….

- Does this building need to meet the requirements of the Residential Energy Code chapter

The first item to review is….

- Does this building need to meet the requirements of the Residential Energy Code chapter
  - Or is it considered a commercial building?

The first item to review is….

- Does this building need to meet the requirements of the Residential Energy Code chapter
  - Or is it considered a commercial building

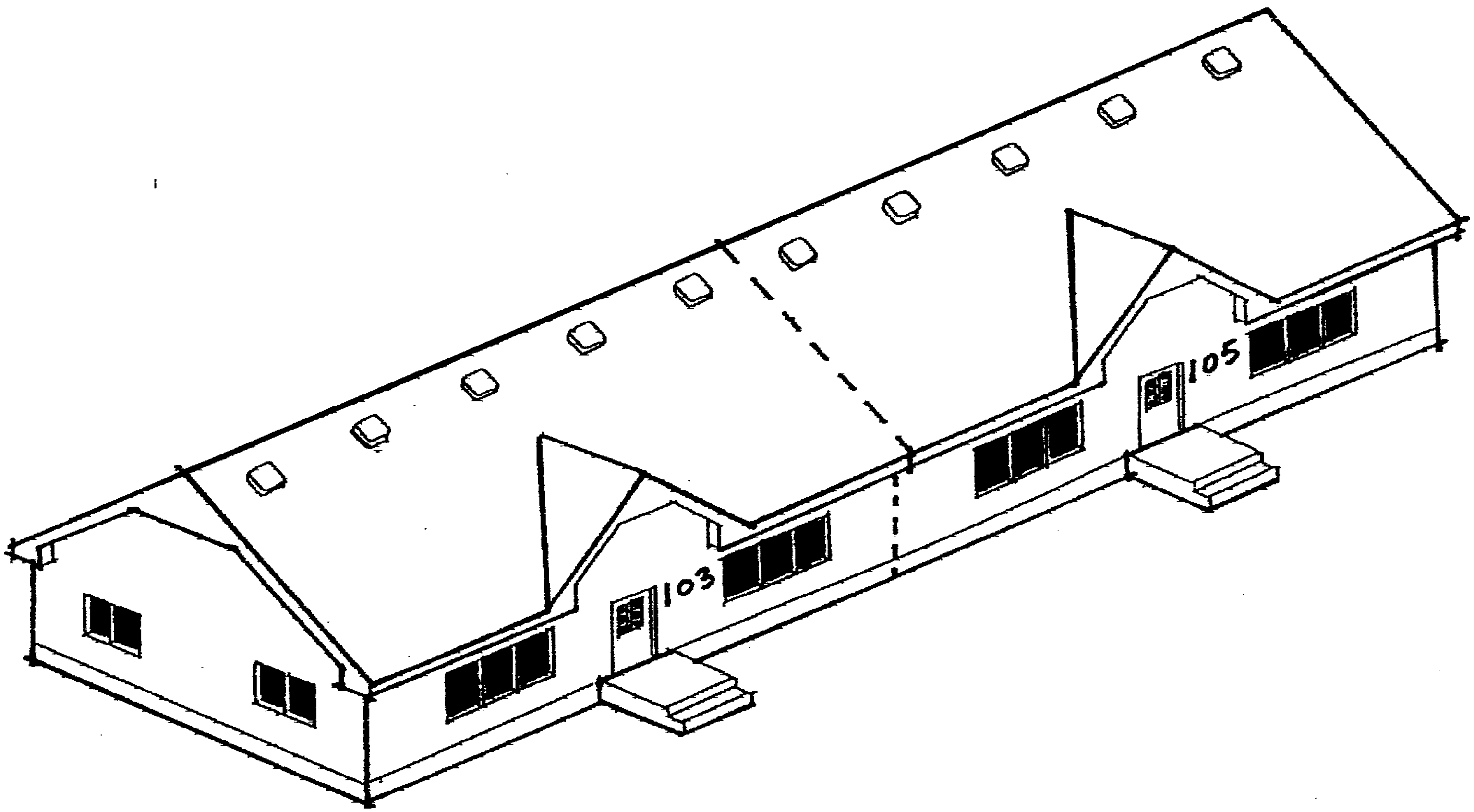
  - Or is it possible that it is exempt?

N1101.1 Scope

This chapter regulates the energy efficiency for the design and construction of buildings regulated by the International Residential Code (IRC) as adopted and amended by the State of Minnesota.

Single Family Dwellings

- Two Family Dwellings



Townhouses

N1101.1 Scope

This chapter shall also be used to meet the energy efficiency for the design and construction of new multi-family residential buildings regulated by the International Building Code (IBC) as adopted and amended by the State of Minnesota, that:

Scope

(1) are not more than three stories in height;

These would be under the Residential Energy Code

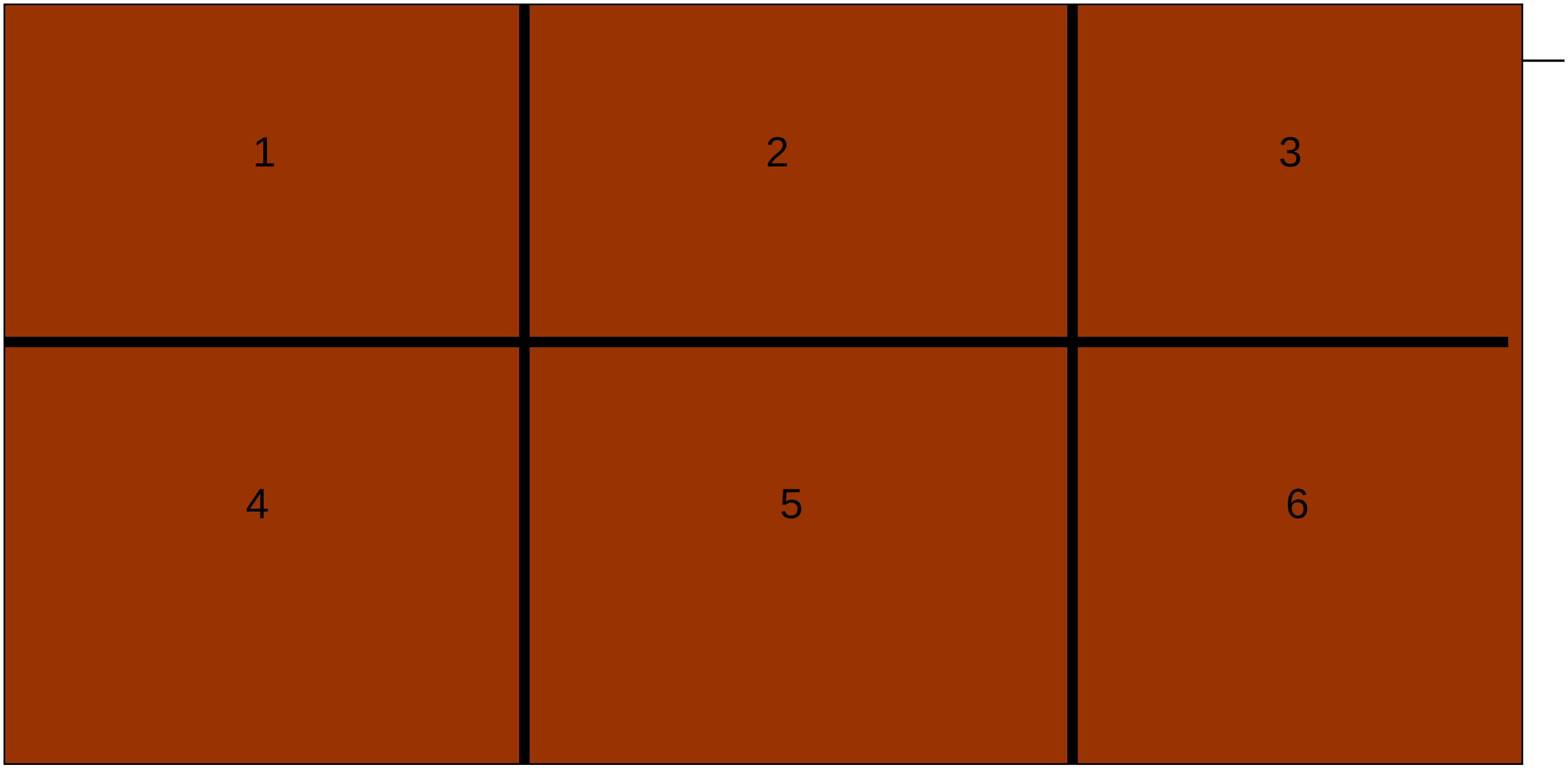
This Building would be built to the Commercial Energy Code

Scope

(1) are not more than three stories in height;

(2) contain no conditioned common space that is shared between dwellings;

This Building **would** Meet the Scoping provisions for the Residential Energy code



This Building would not Meet the Scoping provisions of the Residential Energy Code

Scope

(1) are not more than three stories in height;

(2) contain no conditioned common space that is shared between dwellings;

(3) each dwelling unit contains a separate means of egress.

What is exempt from the Residential Energy Code?

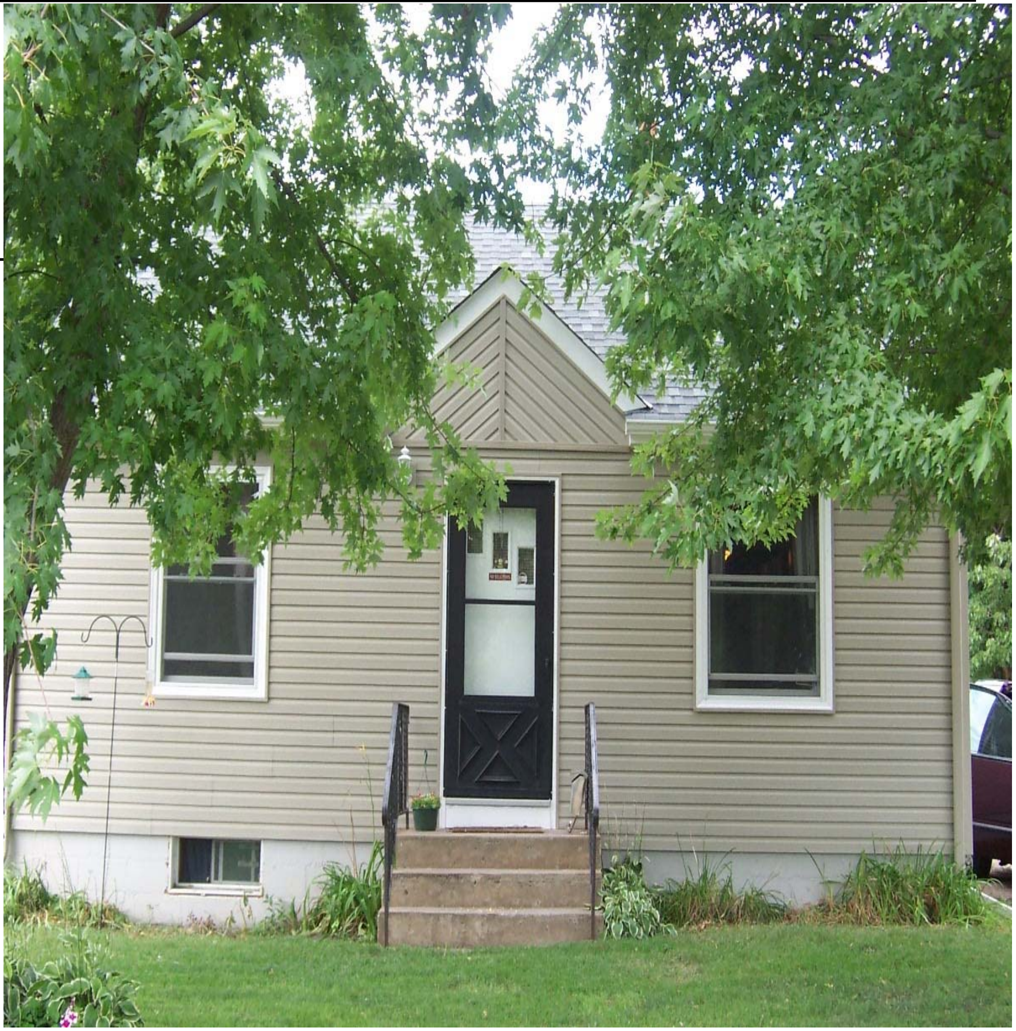
Scope

Exceptions: **There are several exceptions to the scoping provisions of this document and have been placed there by the committee to clarify its intent for construction and enforcement.**

Scope

- Portions of the building envelope that do not enclose conditioned space, including garages.

- **Insulation R-values, air barrier and vapor retarder requirements are not required for existing foundations, crawl space walls, and basements in existing dwellings or existing dwelling units whose alterations or repair require a permit, if the original dwelling's permit was issued prior to the effective date of this chapter.**



Scope

- Additions to existing dwellings or dwelling units may be made without making the entire dwelling or dwelling unit comply, provided that the addition complies with all the requirements of this chapter.

Scope

- Alterations and repairs to existing dwellings or dwelling units may be made without making the entire dwelling or dwelling unit comply.

Scope

- This chapter does not cover buildings, structures, or portions of such buildings whose peak design energy rate usage is less than 3.4 Btu per hour per square foot or 1.0 Watt per square foot of floor area for all purposes.

Knowing all that lets review…

- Does this building need to meet the requirements of the Residential Energy Code chapter

Knowing all that lets review…

- Does this building need to meet the requirements of the Residential Energy Code chapter
  - Is it considered a commercial building?

The first item to review is….

- Does this building need to meet the requirements of the Residential Energy Code chapter
  - Is it considered a commercial building?
  - NO!

The first item to review is….

- Does this building need to meet the requirements of the Residential Energy Code chapter
  - Is it considered a commercial building? No.
  - Is it exempt?

The first item to review is….

- Does this building need to meet the requirements of the Residential Energy Code chapter
  - Is it considered a commercial building?
  - Is it exempt? NO!

The first item to review is….

- Does this building need to meet the requirements of the Residential Energy Code chapter
  - Is it considered a commercial building?
  - Is it exempt? NO!

What then is my next step?

Construction/Submittal Documents

Construction/Submittal Documents

- Is the Building being built in the Northern or Southern Zone???
  - See Section and/or Table N1101.2

Construction/Submittal Documents

- Is the Building being built in the Northern or Southern Zone???

- Lets assume for class its built right here in this zone. Which is ????
  - Northern
  - Southern

Climate Zones

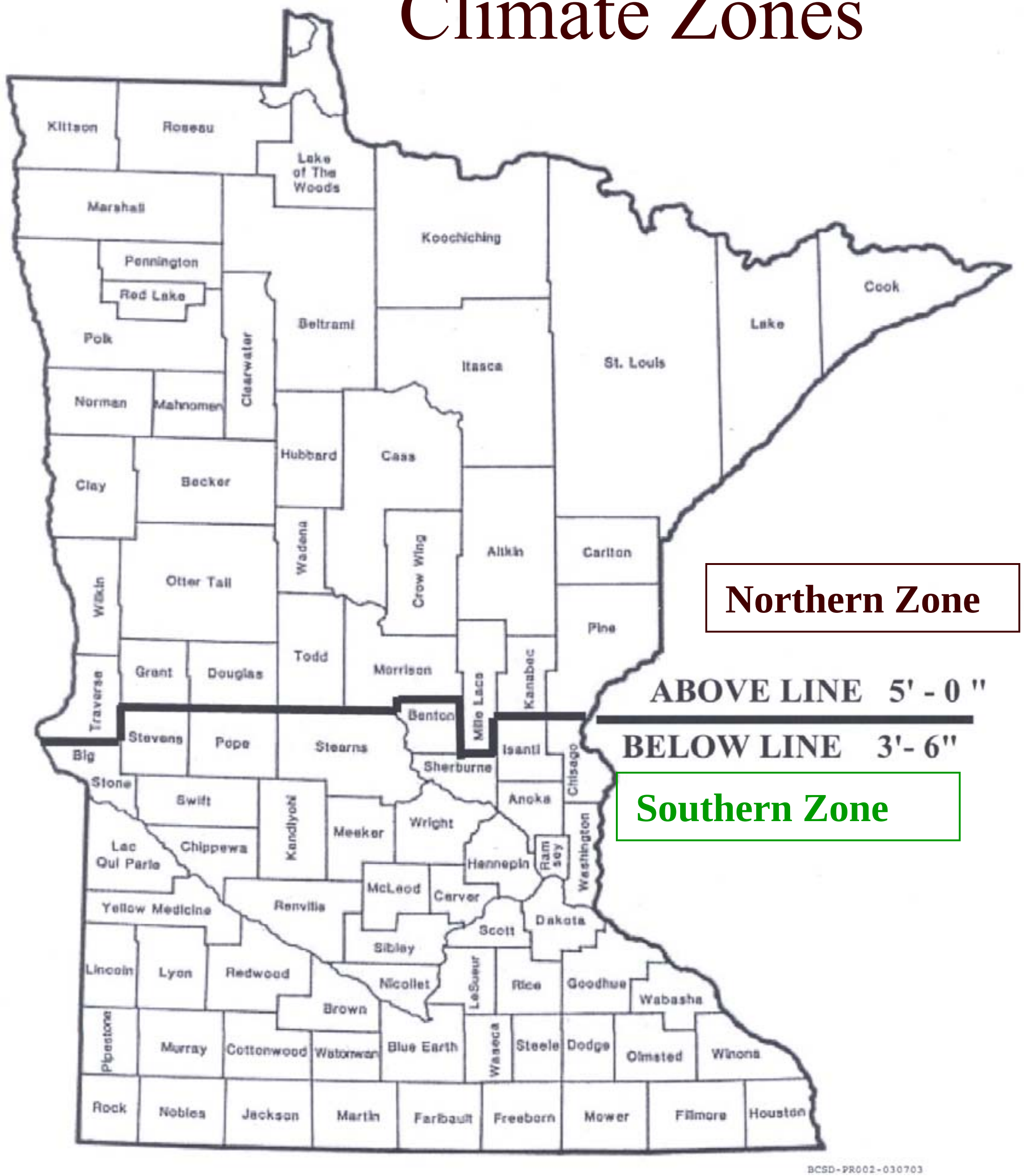


Table 1102.1(1) Insulation and Fenestration Requirements by Component[a]

Climate Zone	Fenestration[b] U-Factor	Skylight U-Factor	Glazed Fenestration SHGC	Ceiling R-Value	Wood Frame Wall R-Value	Mass Wall R-Value (f)	Floor over unconditioned space R-Value	Basement[f] Wall R-Value	Slab[c] R-Value & Depth	Crawl Space Wall R-Value	Rim Joist R-value
Southern	0.35	0.60	NR	38	19 or 13+5[e]	15	30[d]	5/10	10, 3.5 ft	10	5/10
Northern	0.35	0.60	NR	44	19	15	30[d]	10	10, 5 ft	10	10

(a) R-values are minimums. U-factors are maximums. R-19 shall be permitted to be compressed into a 2x6 cavity.
(b) The fenestration U-factor column excludes skylights.
(c) R-5 shall be added to the required slab edge R-values for heated slabs.
(d) Or insulation sufficient to fill the framing cavity, R-19 minimum.
(e) "13+5" means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25% or less of the exterior, R-5 sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25% of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.
(f) When using Log Type construction for Thermal Mass Walls the following shall apply;
1. A minimum of a 7Inch diameter log shall be used
2. The U-value of fenestration products shall be 0.31 overall on average or better

Table 1102.1(2) Equivalent U-Factors[a]

Climate Zone	Fenestration U-Factor	Skylight U-Factor	Ceiling U-Factor	Frame Wall U-Factor	Mass Wall U-Factor	Floor U-Factor	Basement Wall U-Factor	Crawl Space Wall U-Factor
South	0.35	0.60	0.026	0.060	0.077	0.033	0.10	0.10
North	0.35	0.60	0.023	0.060	0.077	0.033	0.10	0.10

(a) Non-fenestration U-factors shall be obtained from measurement, calculation or an approved source.

Information on construction documents

- Shall be dimensioned to a scale

Information on construction documents

- Shall be dimensioned to a scale
- Drawn on suitable material

Information on construction documents

- Shall be dimensioned to a scale
- Drawn on suitable material
- Products used shall be installed in accordance with the manufacturers installation instructions and in compliance with any listing or certifications required

N1101.3.1

- Provide sufficient detail, pertinent data and features of the building, the equipment, and the systems including but not limited to:

N1101.3.1

- Provide sufficient detail pertinent data and features of the building, the equipment, and the systems including but not limited to:
  - Design Criteria

N1101.3.1

- Provide sufficient detail pertinent data and features of the building, the equipment, and the systems including but not limited to:
  - Design Criteria
  - Exterior Envelope component materials
    - Their locations
    - The U factors
    - The R-values

N1101.3.1

- Provide sufficient detail pertinent data and features of the building, the equipment, and the systems including but not limited to:
  - Design Criteria
  - Exterior Envelope component materials
    - Their locations
    - The U factors
    - The R-values
  - Size and type of Equipment or apparatus
    - Their Controls

N1101.3.1

- Provide sufficient detail pertinent data and features of the building, the equipment, and the systems including but not limited to:
  - Design Criteria
  - Exterior Envelope component materials
    - Their locations
    - The U factors
    - The R-values
  - Size and type of Equipment or apparatus
    - Their Controls
  - Other pertinent data
    - (See Certificate in section N1101.8)

What If there is not enough info submitted?

What If there is not enough info submitted?

- Add it to a Plan Review Correction List, and contact the permit applicant with additional information needed after initial plan review

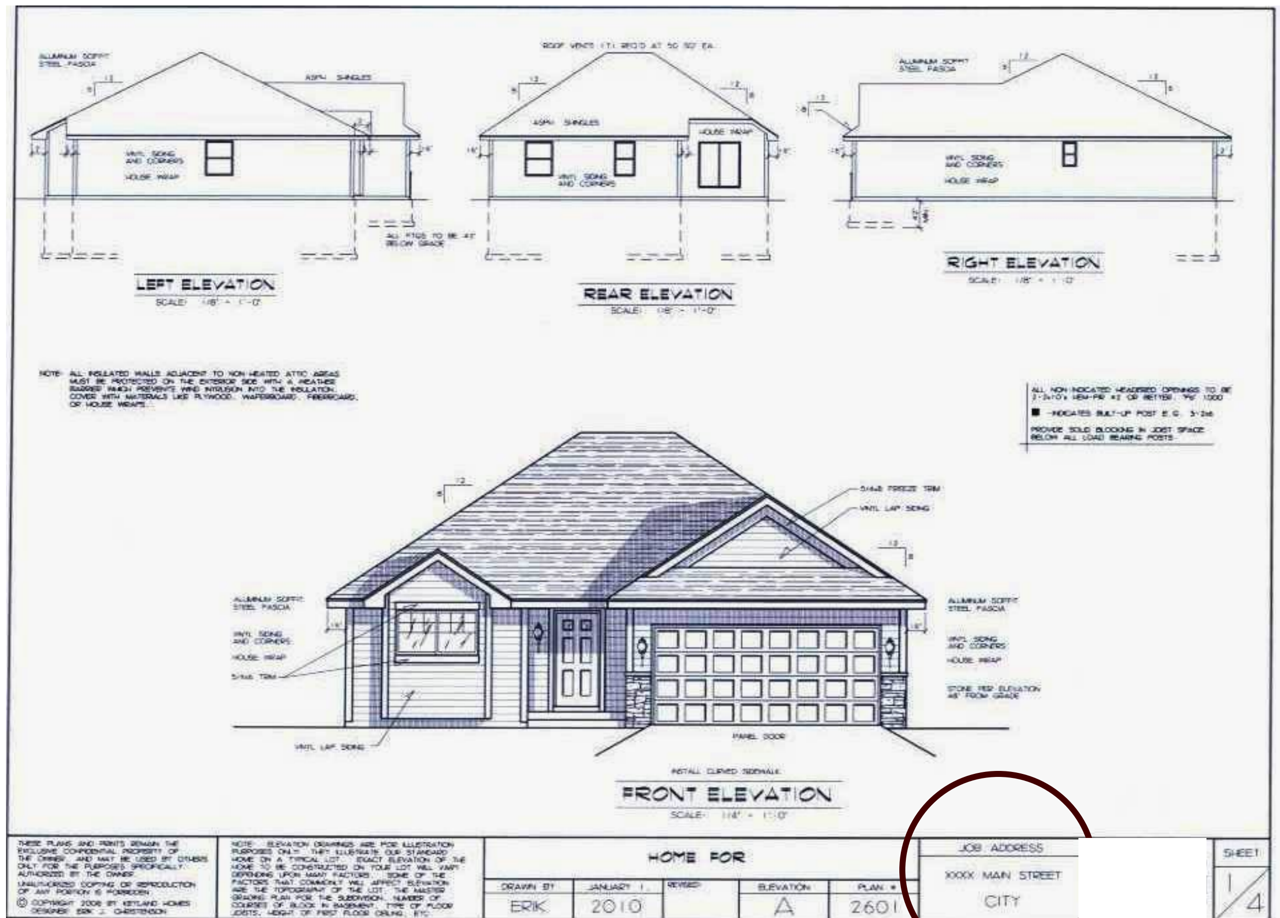
CORRECTION LIST

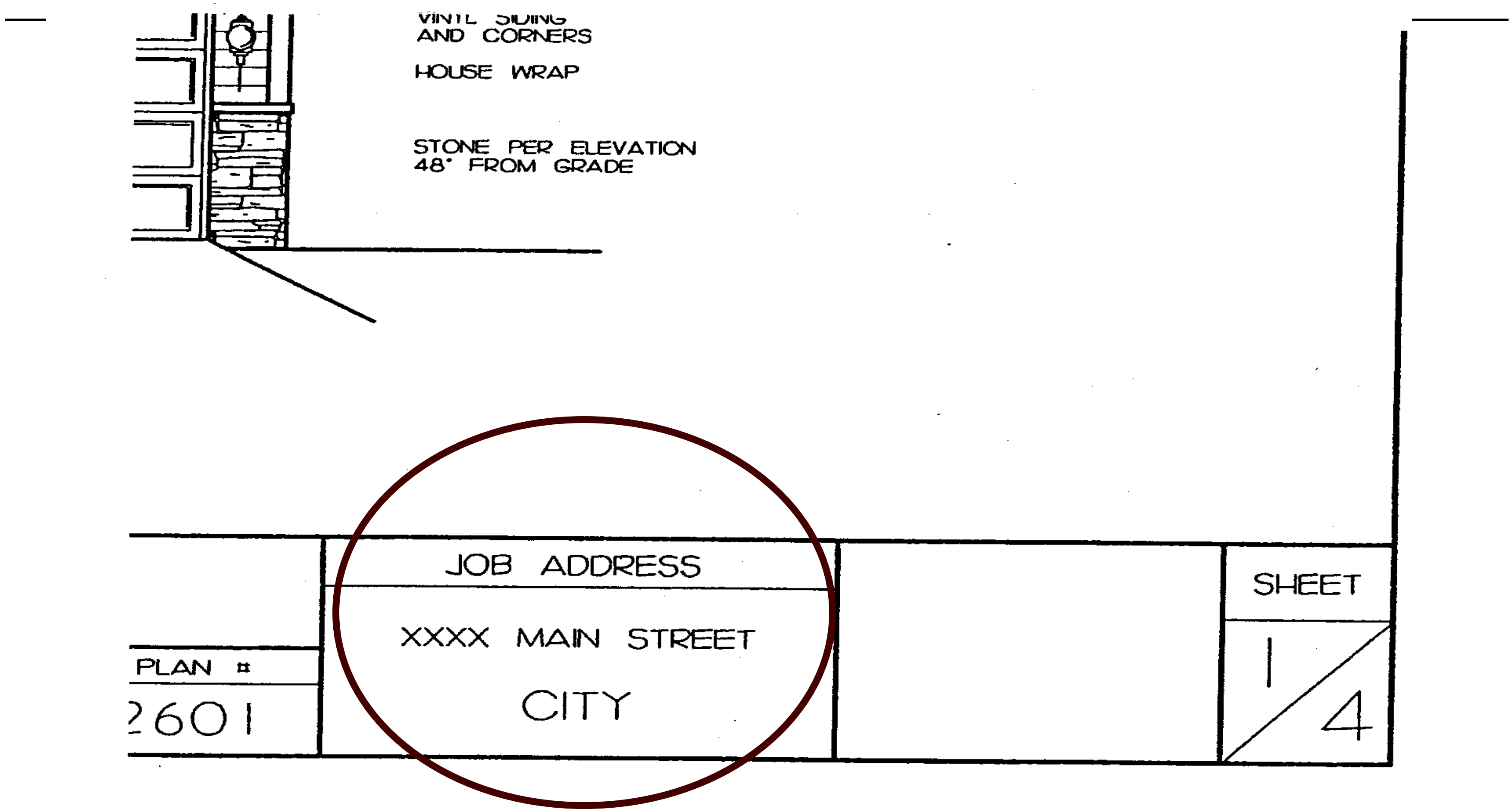
No.	DESCRIPTION	Code Section

What all do they need to submit for a proper plan review?

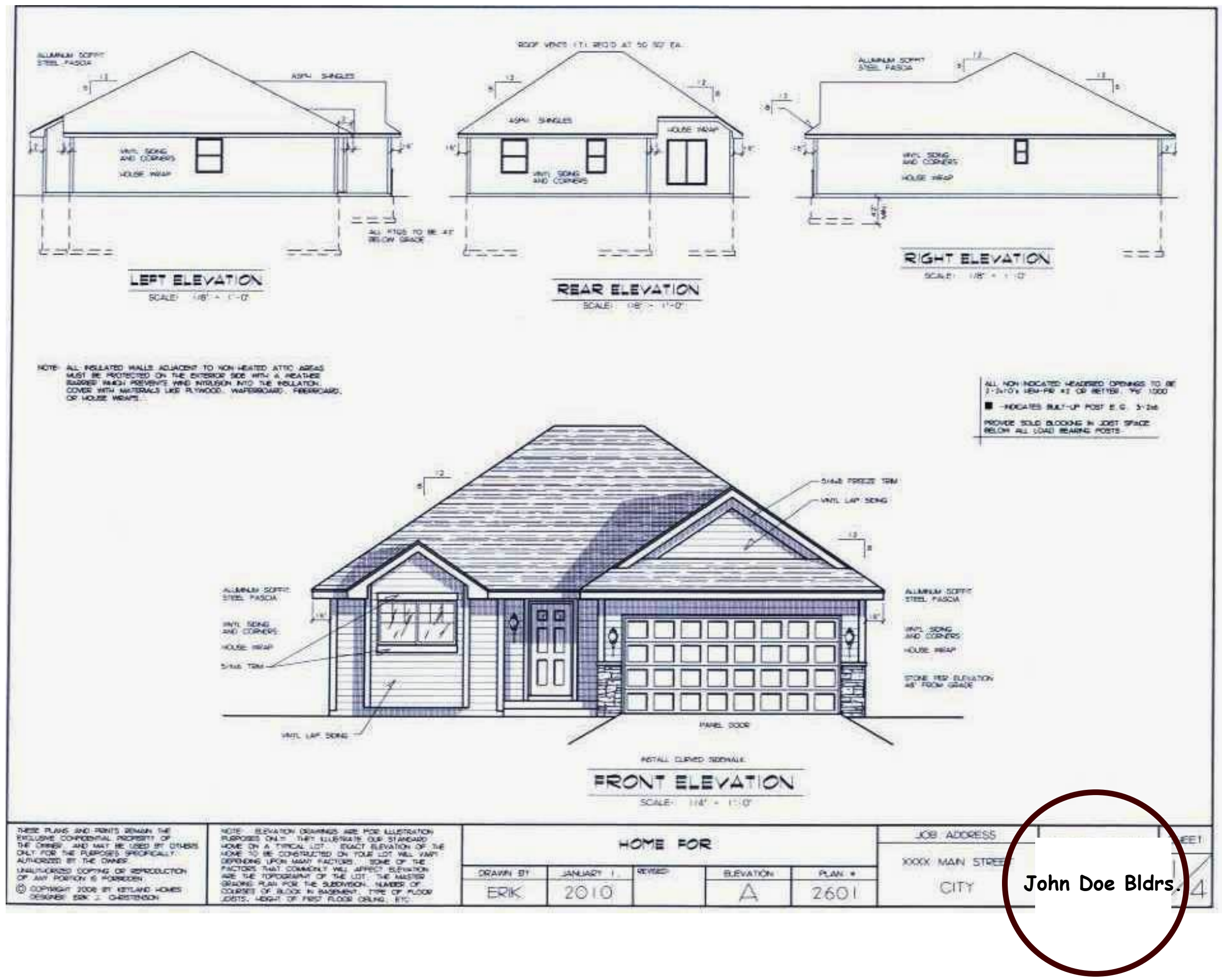
Component	Certificate requirements
Date certificate is installed	Posted date
Dwelling or dwelling unit location	Mailing address and city
Residential Contractor	Name of licensed residential contractor
Insulation installed in or on ceiling/roof, walls, slab-on-grade and floor	Type and installed R-value
Rim joist and foundation wall insulation	Installed R-value, type and whether the insulation is exterior, integral or interior
Fenestration	Average U-factor and SHGC (solar heat gain coefficient)
Ducts outside conditioned spaces	Installed R-value
Mechanical ventilation system	Type, location and design continuous & total ventilation rates
Make-up air & combustion air systems (if installed)	Type, location and size
Heating system	Type, input rating, AFUE or HSPF, manufacturer, model and the structures calculated heat loss
Domestic water heater	Type, size, manufacturer and model
Cooling system (if installed)	Type, output rating, SEER, manufacturer, model, the structures calculated cooling load and heat gain
Radon Control System	Passive or active

Dwelling or dwelling unit location/ Mailing address and city



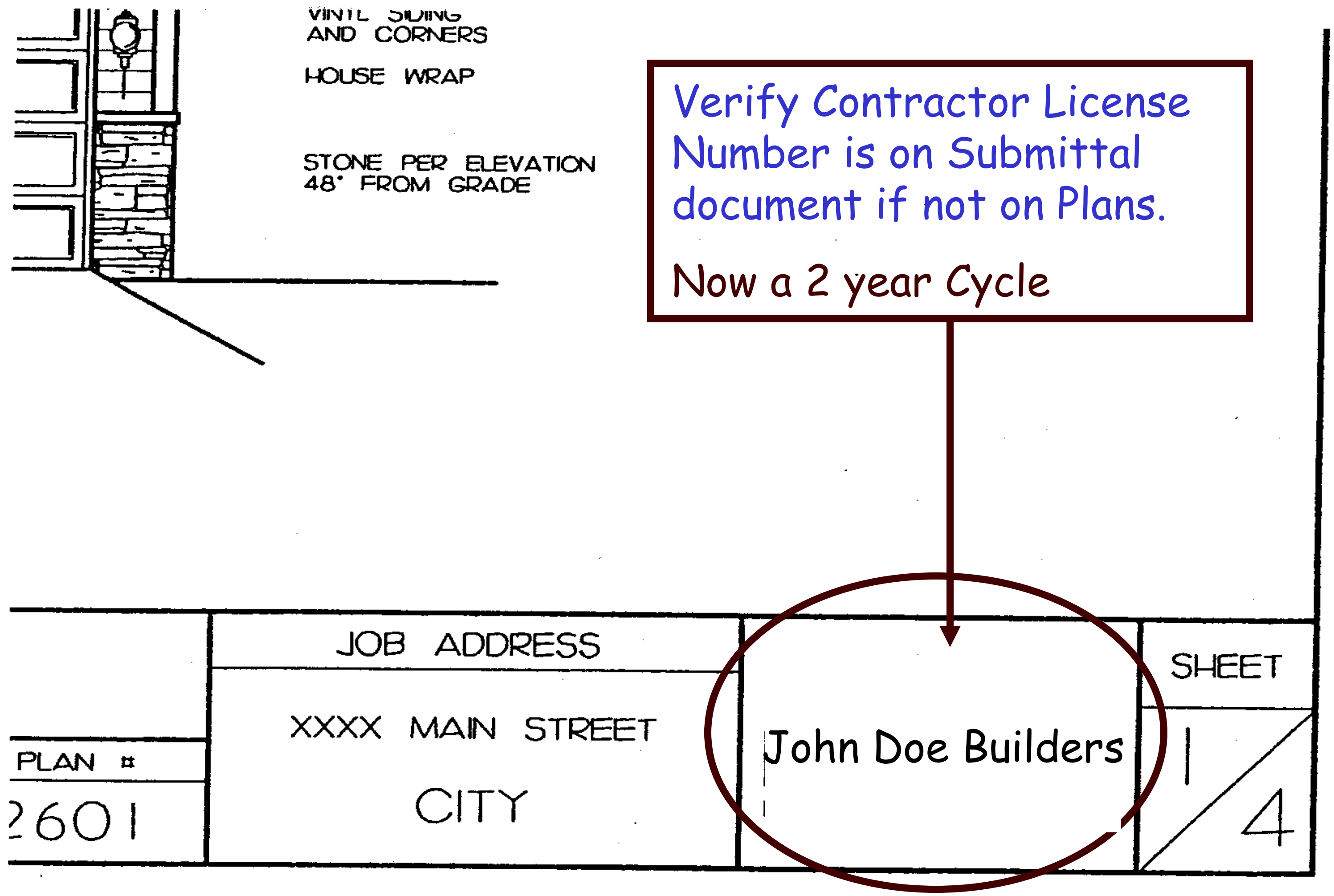

VINYL SIDING
AND CORNERS
HOUSE WRAP
STONE PER ELEVATION
48" FROM GRADE
JOB ADDRESS
XXXX MAIN STREET
CITY
PLAN #
2601
SHEET
1
4

Residential Contractors Name, and License Number

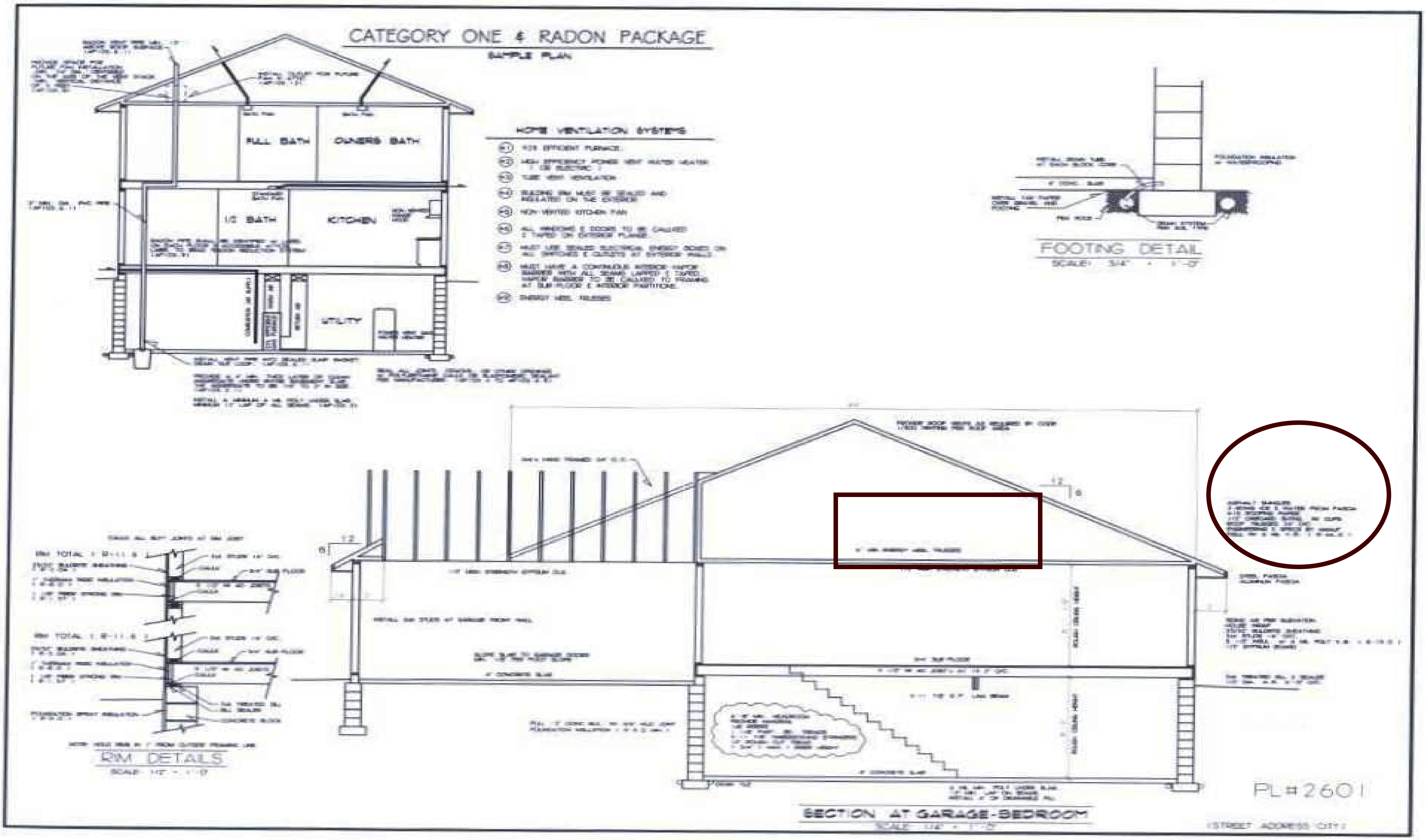


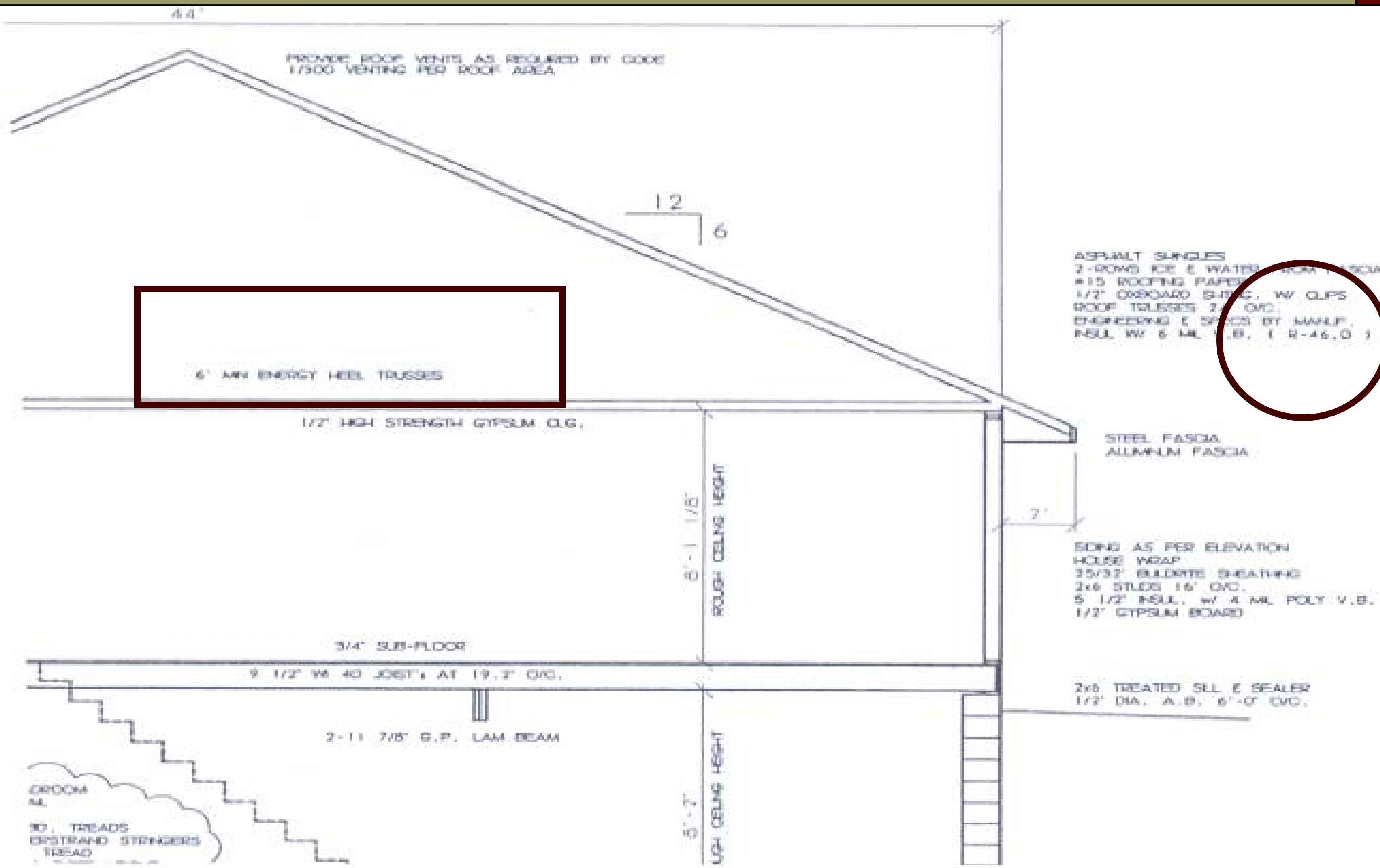
Verify Contractor License Number is on Submittal document if not on Plans.

Now a 2 year Cycle



Verify Insulation R-value for insulation installed in the Ceiling




44'
PROVIDE ROOF VENTS AS REQUIRED BY CODE
1/300 VENTING PER ROOF AREA
12
6
ASPHALT SHINGLES
2-ROWS ICE & WATER FROM FASCIA
#15 ROOFING PAPER
1/2" OXBOARD SHTG. W/ CLIPS
ROOF TRUSSES 24" O/C.
ENGINEERING & SPECS BY MANUF.
INSUL W/ 6 MIL V.B. (R-46.0)
6' MIN ENERGY HEEL TRUSSES
1/2" HIGH STRENGTH GYPSUM CLG.
STEEL FASCIA
ALUMINUM FASCIA
8'-1 1/8"
ROUGH CEILING HEIGHT
7'
SIDING AS PER ELEVATION
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2-11 7/8" G.P. LAM BEAM
8'-2"
TREADS
STRINGERS
TREAD

Table 1102.1(1) Insulation and Fenestration Requirements by Component[a]

Climate Zone	Fenestration[b] U-Factor	Skylight U-Factor	Glazed Fenestration SHGC	Ceiling R-Value	Wood Frame Wall R-Value	Mass Wall R-Value (f)	Floor over unconditioned space R-Value	Basement[f] Wall R-Value	Slab[c] R-Value & Depth	Crawl Space Wall R-Value	Rim Joist R-value
Southern	0.35	0.60	NR	38	19 or 13+5[e]	15	30[d]	5/10	10, 3.5 ft	10	5/10
Northern	0.35	0.60	NR	44	19	15	30[d]	10	10, 5 ft	10	10

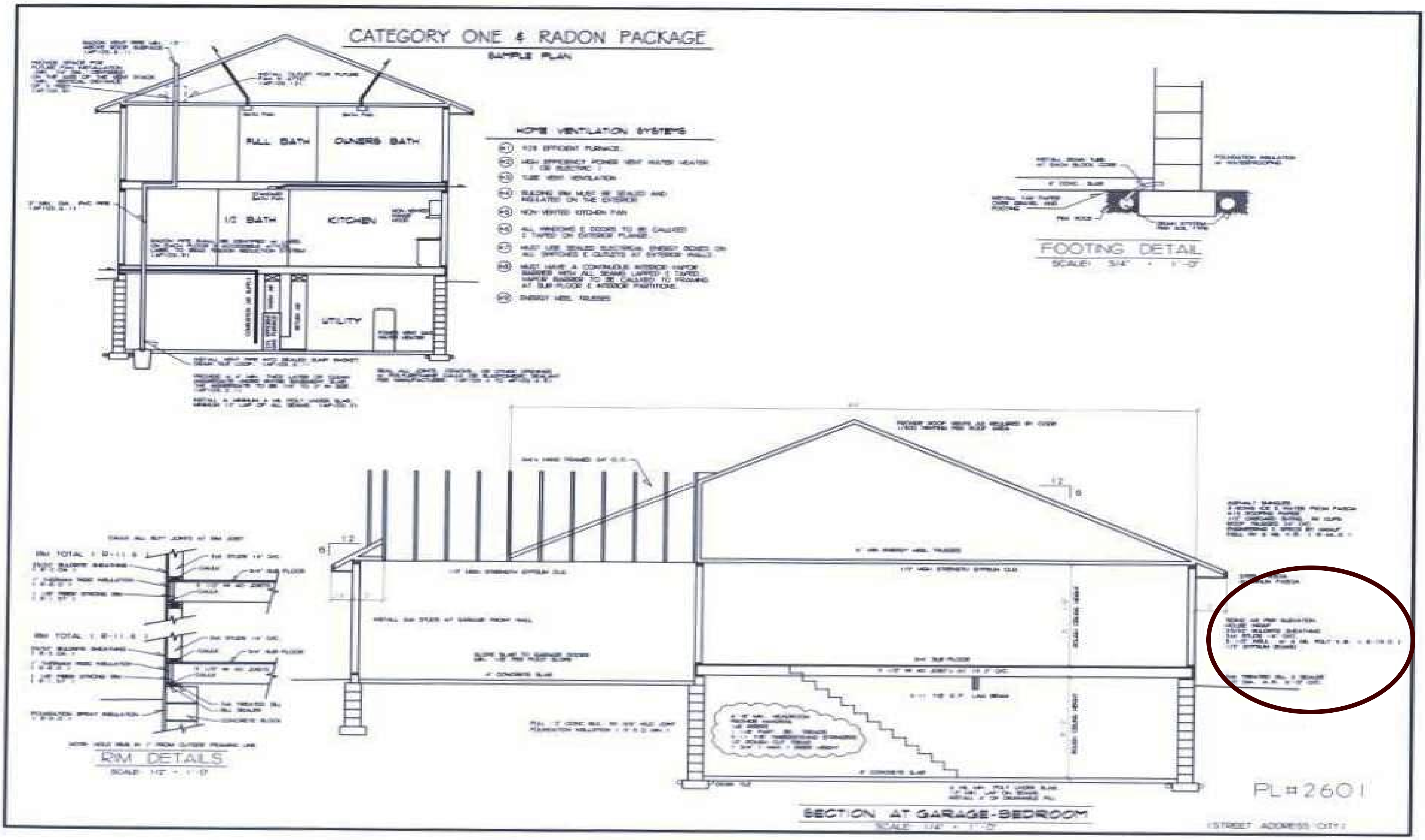
(a) R-values are minimums. U-factors are maximums. R-19 shall be permitted to be compressed into a 2x6 cavity.
(b) The fenestration U-factor column excludes skylights.
(c) R-5 shall be added to the required slab edge R-values for heated slabs.
(d) Or insulation sufficient to fill the framing cavity, R-19 minimum.
(e) "13+5" means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25% or less of the exterior, R-5 sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25% of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.
(f) When using Log Type construction for Thermal Mass Walls the following shall apply;
1. A minimum of a 7Inch diameter log shall be used
2. The U-value of fenestration products shall be 0.31 overall on average or better

Table 1102.1(2) Equivalent U-Factors[a]

Climate Zone	Fenestration U-Factor	Skylight U-Factor	Ceiling U-Factor	Frame Wall U-Factor	Mass Wall U-Factor	Floor U-Factor	Basement Wall U-Factor	Crawl Space Wall U-Factor
South	0.35	0.60	0.026	0.060	0.077	0.033	0.10	0.10
North	0.35	0.60	0.023	0.060	0.077	0.033	0.10	0.10

(a) Non-fenestration U-factors shall be obtained from measurement, calculation or an approved source.

Verify Insulation R-value for insulation installed in the Walls



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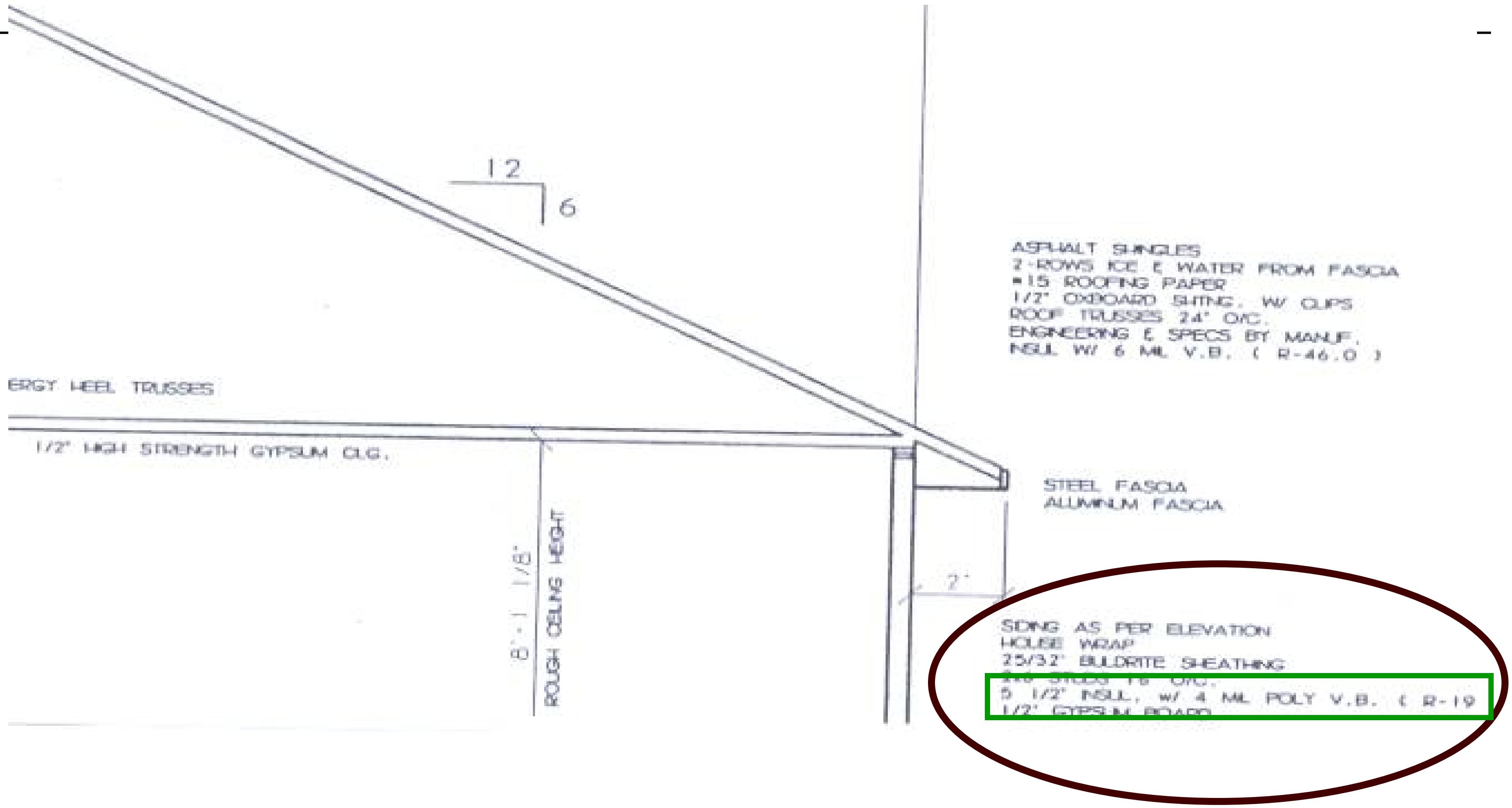

Table 1102.1(1) Insulation and Fenestration Requirements by Component[(a)]

Climate Zone	Fenestration[(b)] U-Factor	Skylight U-Factor	Glazed Fenestration SHGC	Ceiling R-Value	Wood Frame Wall R-Value	Mass Wall R-Value (f)	Floor over unconditioned space R-Value	Basement[(f)] Wall R-Value	Slab[(c)] R-Value & Depth	Crawl Space Wall R-Value	Rim Joist R-value
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North	0.35	0.60	0.023	0.060	0.077	0.033	0.10	0.10

(a) Non-fenestration U-factors shall be obtained from measurement, calculation or an approved source.

- **What if it is not a wood framed wall and it is a Steel Framed wall?**

Steel-frame ceilings, walls and floors

- Shall meet the insulation requirements of Table N1102.2.3 or shall meet the U-factor requirements in Table N1102.1(2).

- The calculation of the U-factor for a steel-frame wall shall use a series-parallel path calculation method.

Table 1102.2.3 Steel frame Ceiling, Wall and Floor Insulation (R-value)

Wood Frame R-Value Requirement	Cold-Formed Steel Equivalent R –Value[1]
Steel Truss Ceilings[2]	
R-38	R-49 or R-38+3
R-44	R-38+5
Steel Joist Ceilings[2]	
R-30	R-21 + R-6 in 2 x 6, R-21 + R-12 in 2 x 8 or 2 x 10
R-38	R-49 in 2x4 or 2x6 or 2x8 or 2x10
Steel Framed Wall	
R-19	R-13+9 or R-19+8 or R-25+7
Steel Joist Floor	
R-30	R-21+R-6 in 2x6 R-21+R-12 in 2x8 or 2x10

Footnotes:
1. Cavity insulation R-value is listed first, followed by a "+" and the continuous insulation R-value, if applicable.
2. Insulation exceeding the height of the framing shall cover the framing.

- **What if it is not a framed wall and it is a mass wall?**

Definition of Mass walls
(N1102.2.3)

- Mass walls for the purposes of this chapter shall be walls of concrete block. Concrete, Insulated concrete form (ICF), Masonry cavity, brick (other than brick veneer), earth (adobe, compressed earth block, rammed earth), and solid timber logs.

Table 1102.1(1) Insulation and Fenestration Requirements by Component[a]

Climate Zone	Fenestration[b] U-Factor	Skylight U-Factor	Glazed Fenestration SHGC	Ceiling R-Value	Wood Frame Wall R-Value	Mass Wall R-Value (f)	Floor over unconditioned space R-Value	Basement[f] Wall R-Value	Slab[c] R-Value & Depth	Crawl Space Wall R-Value	Rim Joist R-value
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(b) The fenestration U-factor column excludes skylights.
(c) R-5 shall be added to the required slab edge R-values for heated slabs.
(d) Or insulation sufficient to fill the framing cavity, R-19 minimum.
(e) "13+5" means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25% or less of the exterior, R-5 sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25% of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.
(f) When using Log Type construction for Thermal Mass Walls the following shall apply;
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Table 1102.1(2) Equivalent U-Factors[a]

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North	0.35	0.60	0.023	0.060	0.077	0.033	0.10	0.10

(a) Non-fenestration U-factors shall be obtained from measurement, calculation or an approved source.

Verify Insulation R-value for insulation installed in Slab on Grade

- Does the home have any slab on grade construction?

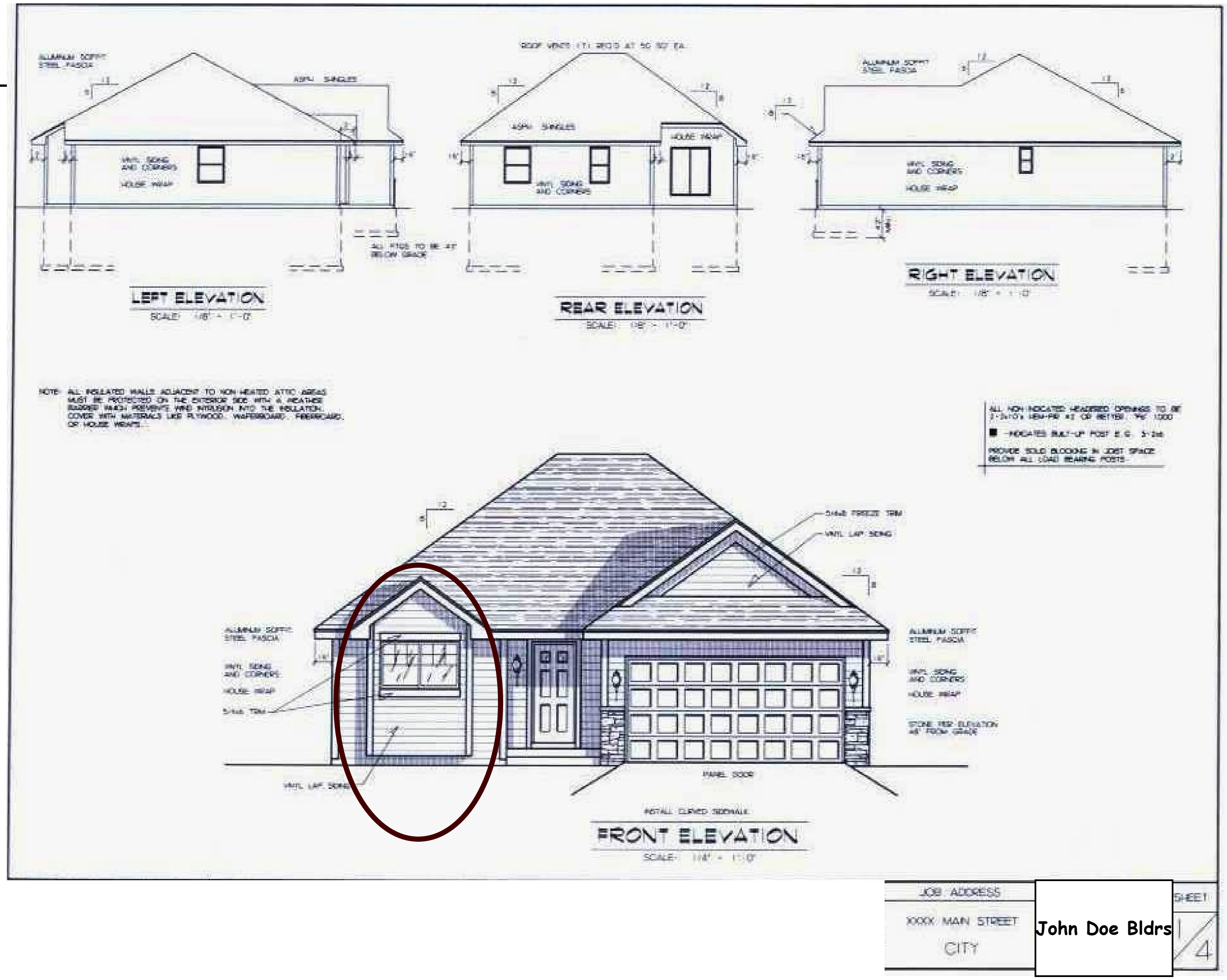
Verify Insulation R-value for insulation installed in Slab on Grade

- Does the home have any slab on grade construction?

- No. So lets move on

Verify Insulation R-value for insulation installed in the Floor over Un-Conditioned spaces

Floor over Un-Conditioned Spaces



Floor over Un-Conditioned Spaces (Practice Exercise)

- Find the detail for Floors over Unconditioned spaces and how it is being insulated

Floor over Un-Conditioned Spaces
(Practice Exercise)

- Find the detail for Floors over Unconditioned spaces and how it is being insulated

There isn't one is there so what do we need to do?   We need to add this to the plan review correction list of information needed to complete the plan review.

Table 1102.1(1) Insulation and Fenestration Requirements by Component[(a)]

Climate Zone	Fenestration[(b)] U-Factor	Skylight U-Factor	Glazed Fenestration SHGC	Ceiling R-Value	Wood Frame Wall R-Value	Mass Wall R-Value (f)	Floor over unconditioned space R-Value	Basement[(f)] Wall R-Value	Slab[(c)] R-Value & Depth	Crawl Space Wall R-Value	Rim Joist R-value
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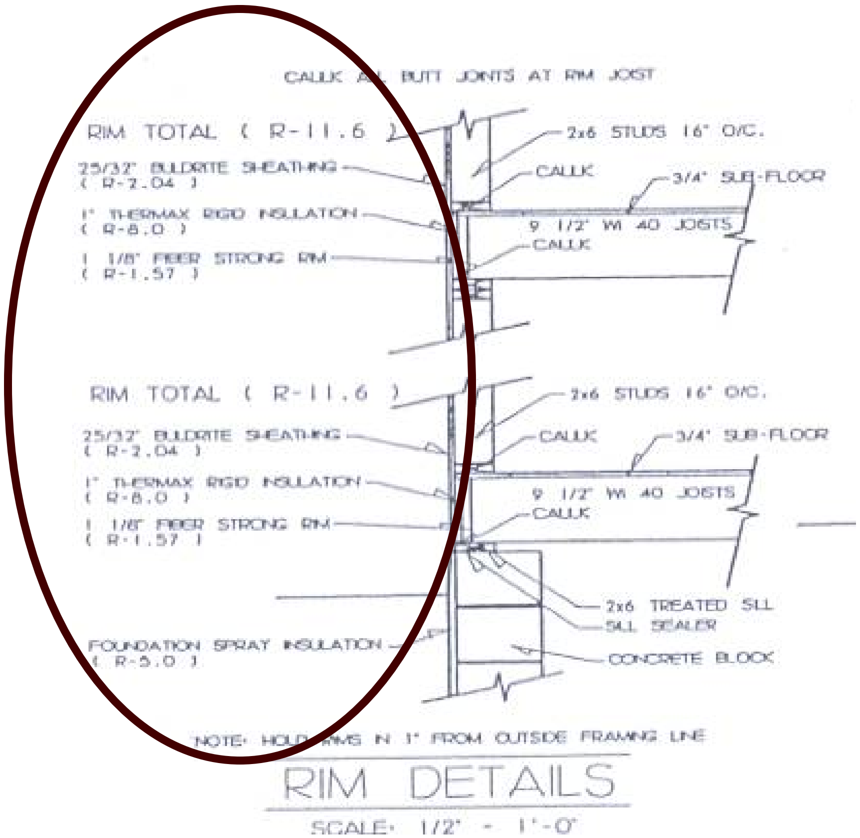
(a) Non-fenestration U-factors shall be obtained from measurement, calculation or an approved source.

Insulation R-value for insulation installed in the Rim Joist Area



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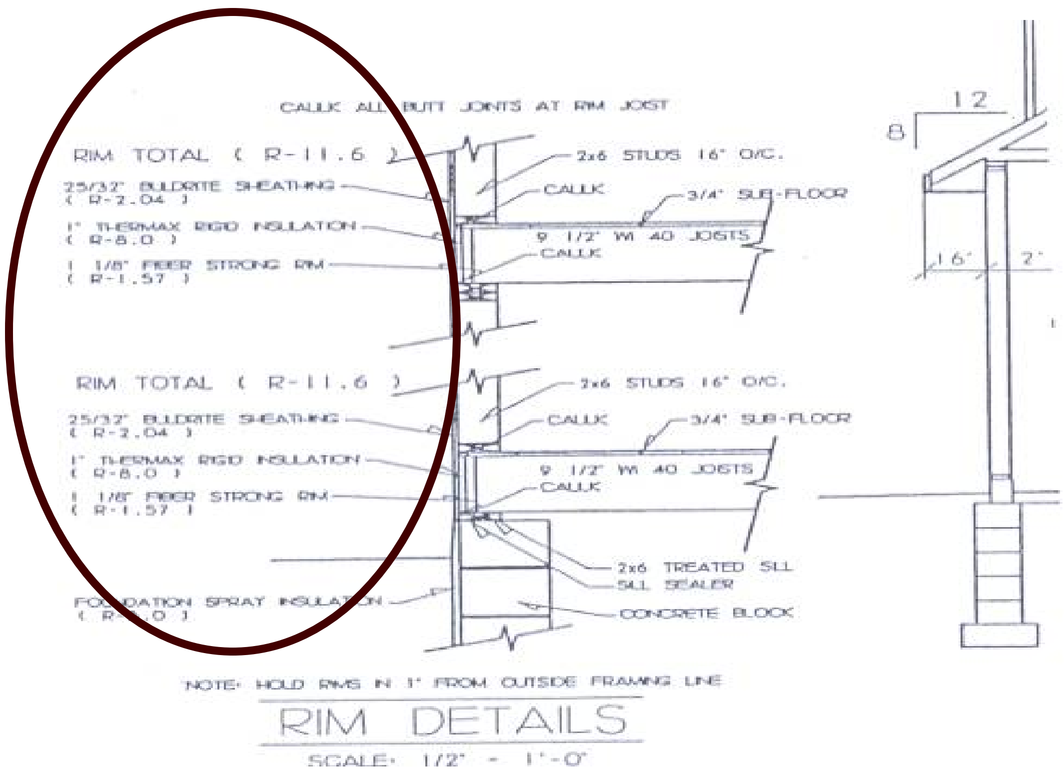
(f) When using Log Type construction for Thermal Mass Walls the following shall apply;
1. A minimum of a 7Inch diameter log shall be used
2. The U-value of fenestration products shall be 0.31 overall on average or better

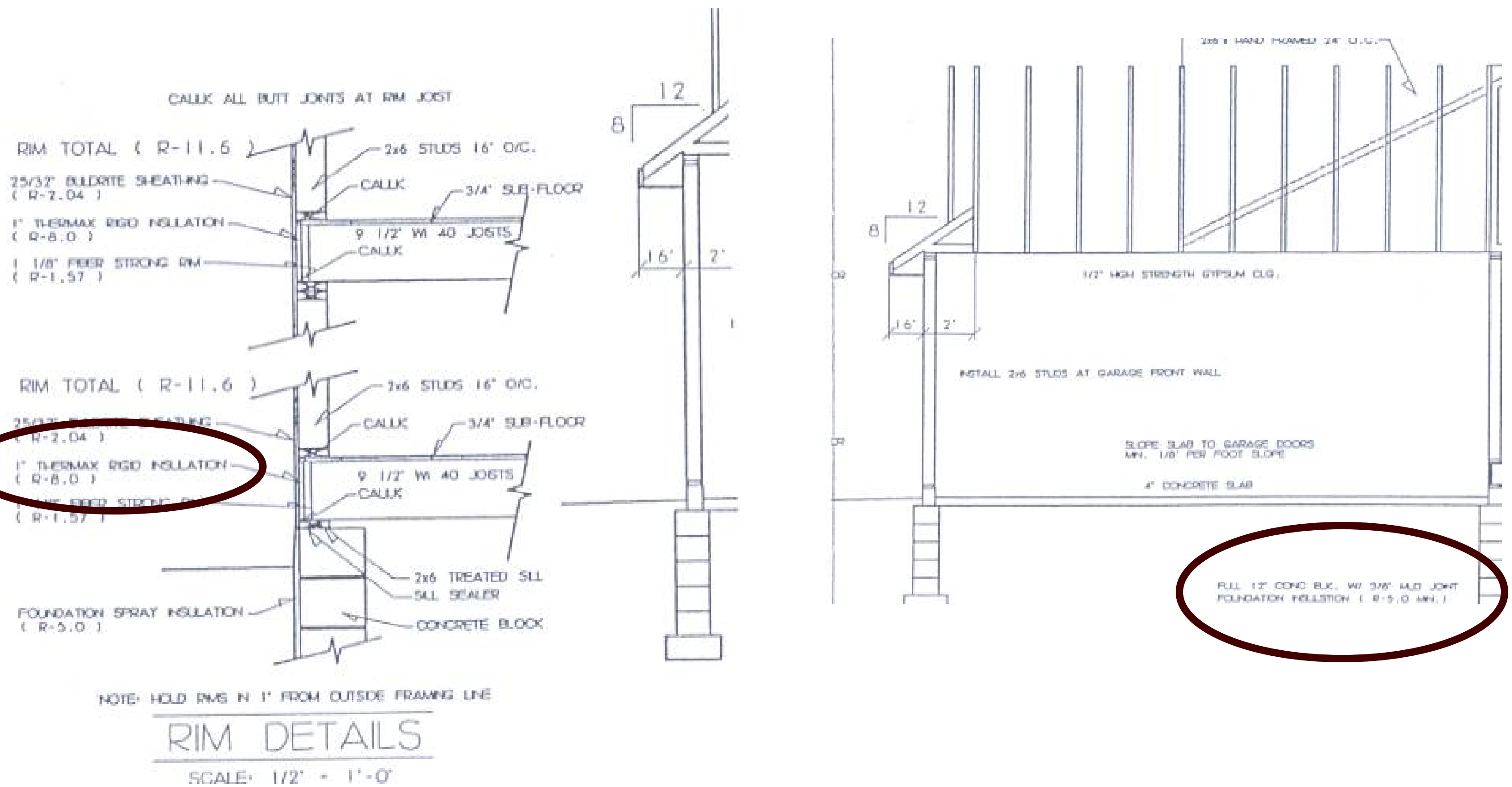
Does this meet code
(Practice Exercise)



Answer…

- No… the insulation product needs to be a R-10 as listed in the code. The other materials are not used prescriptively in the code because they are not a insulation product in accordance with Mn. Rules Chapter 7640 “Minnesota’s Thermal Insulation Standards”

Insulation R-value for insulation installed on the Foundation System



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(f) When using Log Type construction for Thermal Mass Walls the following shall apply;
1. A minimum of a 7Inch diameter log shall be used
2. The U-value of fenestration products shall be 0.31 overall on average or better

Foundation Insulation Exception of R-5 instead of a R-10

Foundation wall and rim joist area thermal insulation requirements.

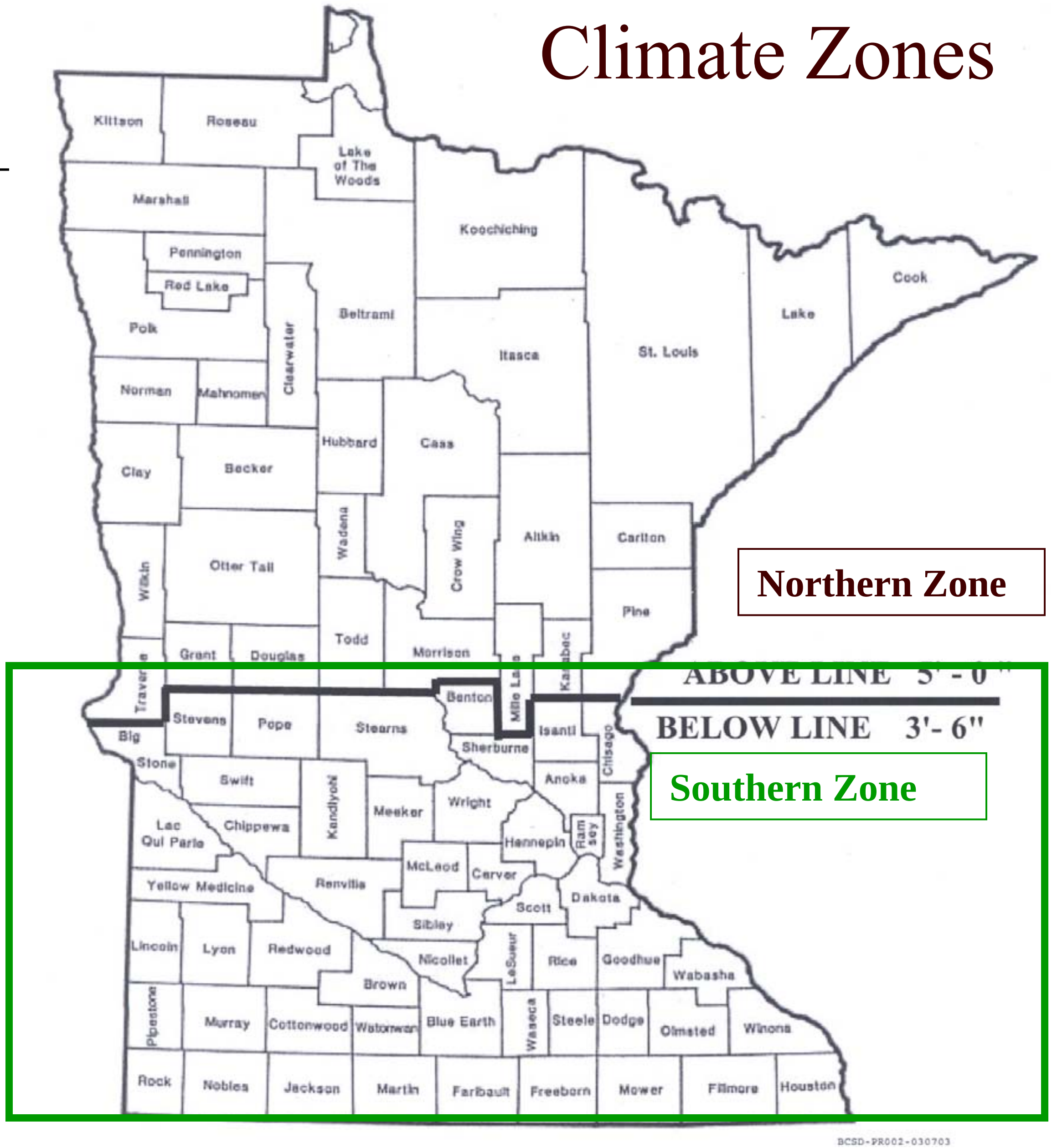
- The foundation wall system and rim joist area shall have an insulating layer with insulation thermal properties as required in this section. The insulation layer must be a minimum R-10 in accordance with Table N1102.1.

Exception

- The foundation wall system and rim joist area shall have an insulating layer with minimum thermal properties as required in this section. The insulation layer must be a minimum R-10 in accordance with Table N1102.1.

  In the Southern Zone, the foundation and rim joist area insulation may be reduced to a minimum of an R-5 if

Climate Zones



Exception

- The foundation wall system and rim joist area shall have an insulating layer with minimum thermal properties as required in this section. The insulation layer must be a minimum R-10 in accordance with Table N1102.1.

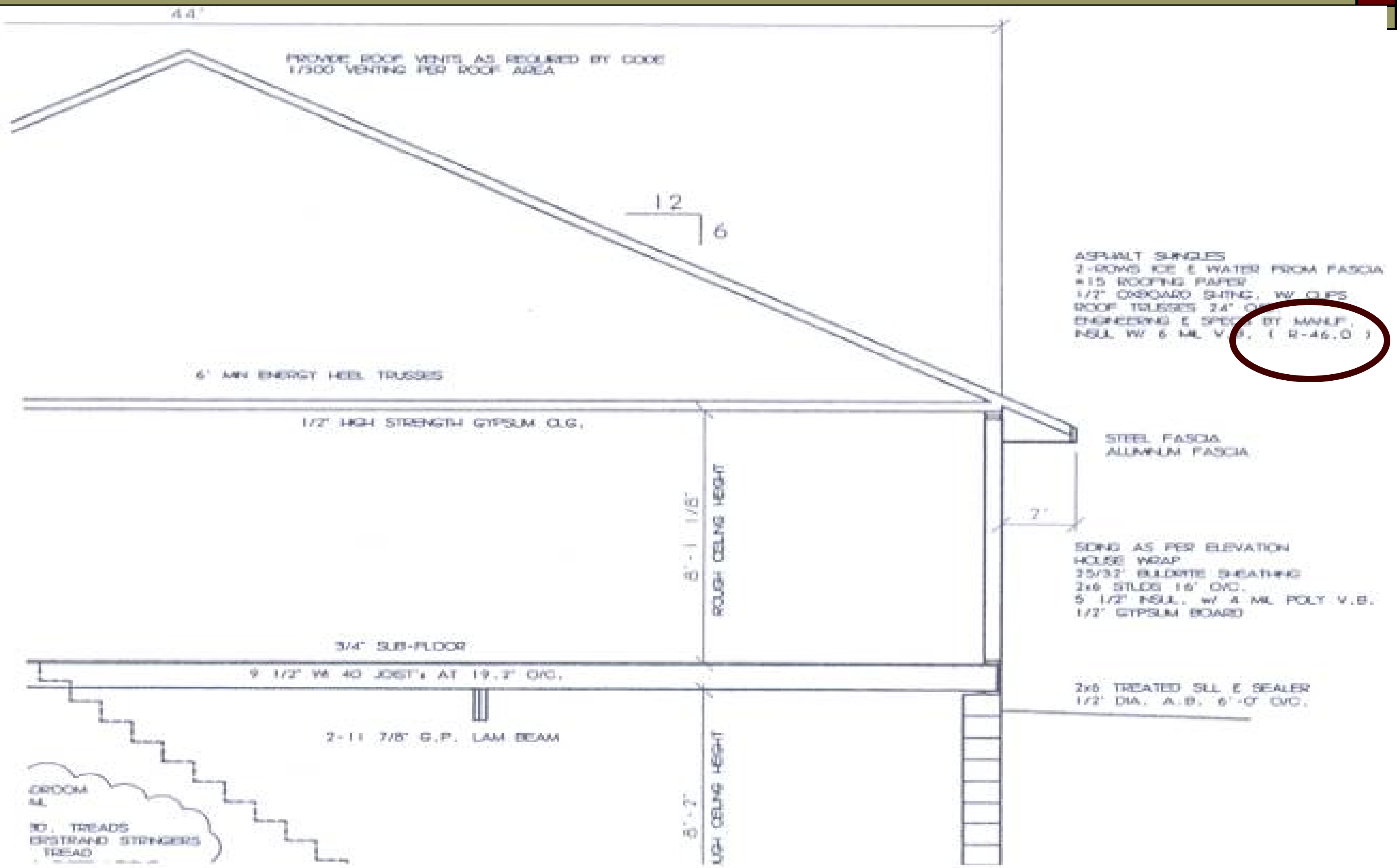
In the Southern Zone, the foundation and rim joist area insulation may be reduced to a minimum of an R-5 if

- 1. The insulation is located on the exterior or is integral to the foundation wall; and

- The foundation wall system and rim joist area shall have an insulating layer with minimum thermal properties as required in this section. The insulation layer must be a minimum R-10 in accordance with Table N1102.1.

In the Southern Zone, the foundation and rim joist area insulation may be reduced to a minimum of an R-5 if

- 1. The insulation is located on the exterior or is integral to the foundation wall; and
- 2. An additional R-5 insulation is added to the minimum attic R-value level; and



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- The foundation wall system and rim joist area shall have an insulating layer with minimum thermal properties as required in this section. The insulation layer must be a minimum R-10 in accordance with Table N1102.1.

In the Southern Zone, the foundation and rim joist area insulation may be reduced to a minimum of an R-5 if

- 1. The insulation is located on the exterior or is integral to the foundation wall; and
- 2. An additional R-5 insulation is added to the minimum attic R-value level; and.
- 3. The heating system meets the minimum efficiency ratings in Table N1102.2.6.4; and

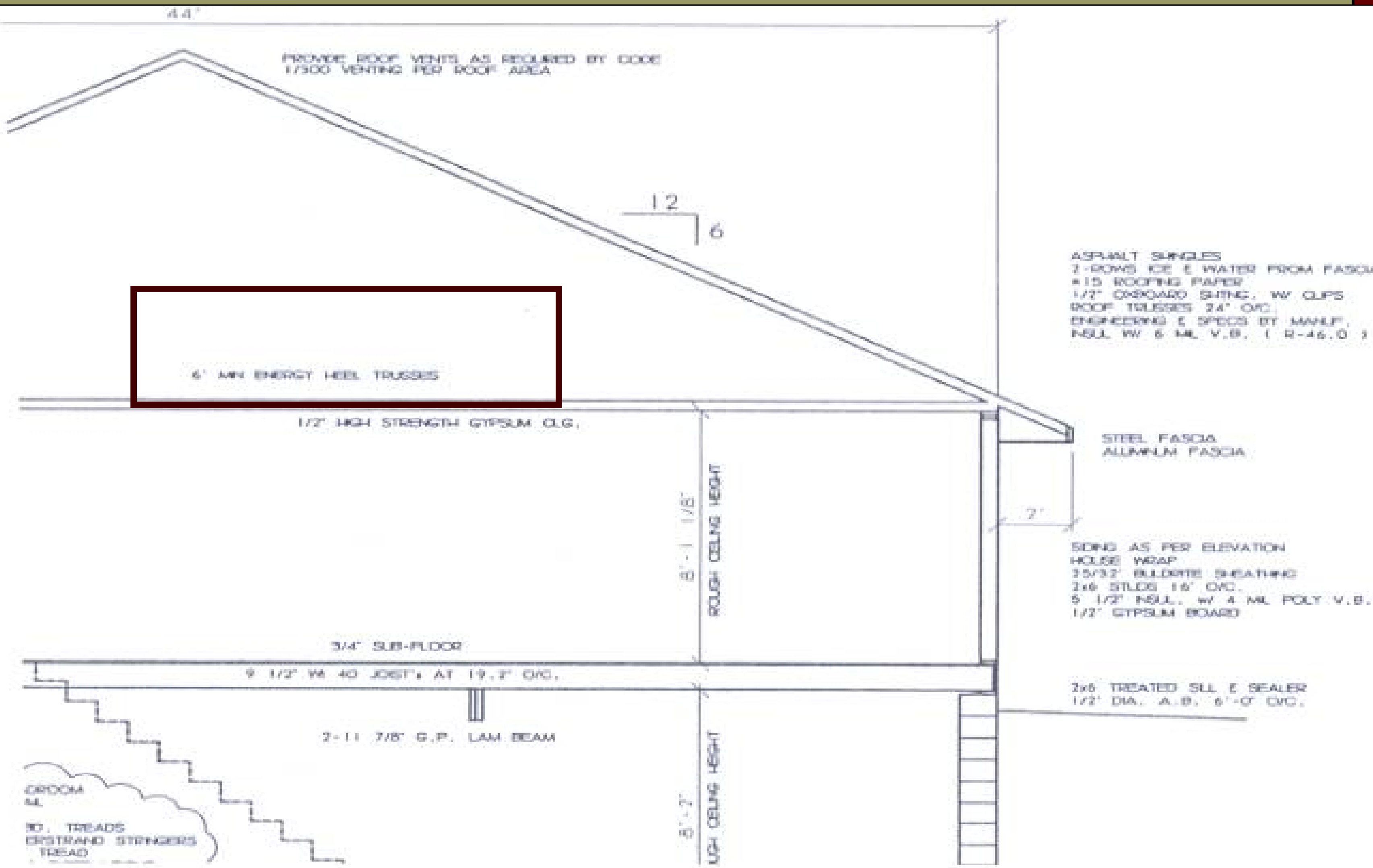
Table 1102.2.5 HVAC System Minimum Efficiency Requirement to Qualify for R-5 Exterior Insulation in the Southern Zone

Heating System Type	Minimum Efficiency Rating	
	AFUE	HSPF
Furnace, Gas or Oil Fired	90%	N/A
Boiler, Gas or Oil Fired	85%	N/A
Heat Pump, Split Systems	N/A	8.0
Heat Pump, Single Package or Equipment (including gas/electric package units)	N/A	7.6

- The foundation wall system and rim joist area shall have an insulating layer with minimum thermal properties as required in this section. The insulation layer must be a minimum R-10 in accordance with Table N1102.1.

In the Southern Zone, the foundation and rim joist area insulation may be reduced to a minimum of an R-5 if

- 1. The insulation is located on the exterior or is integral to the foundation wall; and
- 2. An additional R-5 insulation is added to the minimum attic R-value level; and
- 3. The heating system meets the minimum efficiency ratings in Table N1102.2.6.4; and
- 4. A minimum of a 6 inch energy heel is used for the roof framing and/or truss system.



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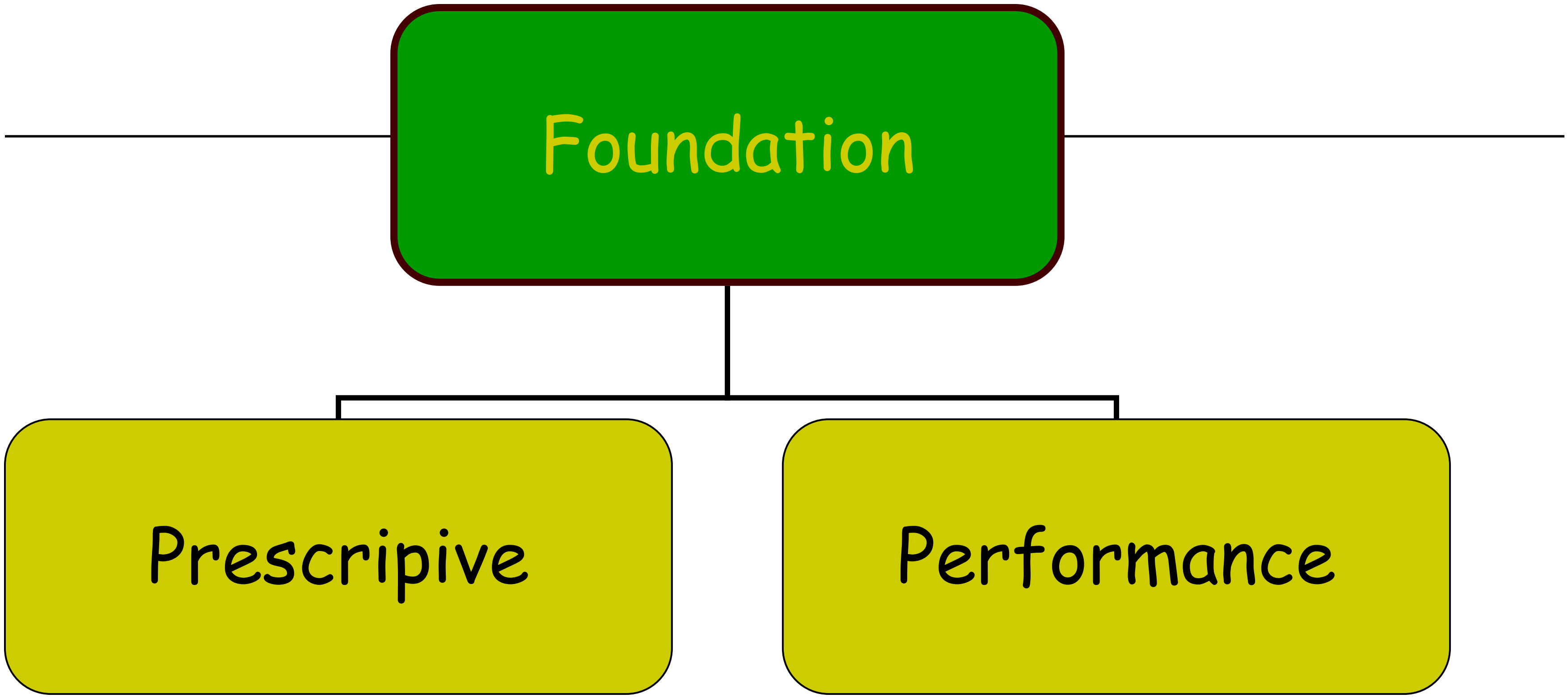
Foundation systems.

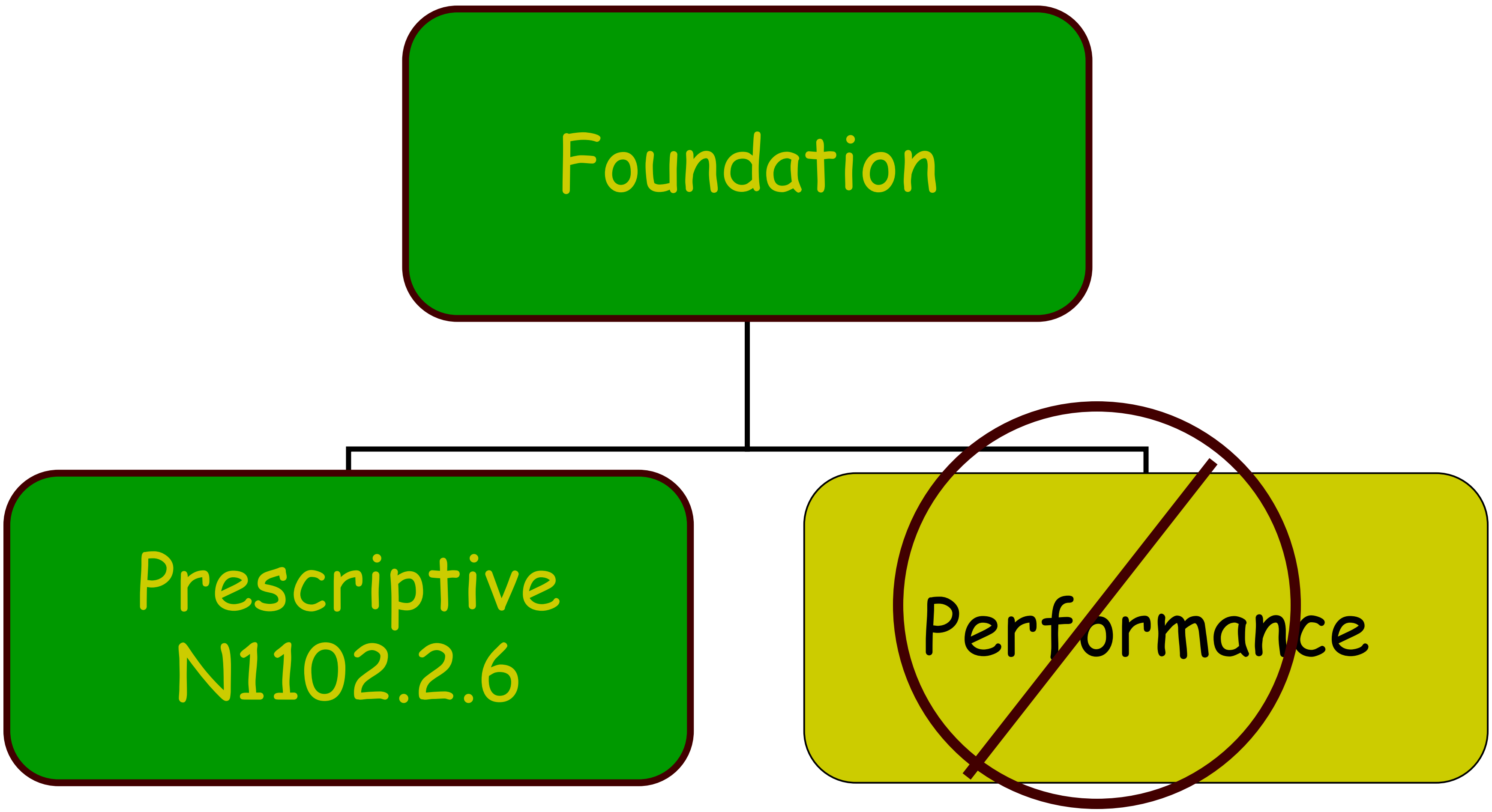
Foundation Insulation Systems

Foundation decision tree



Note: This is not a complicated process. The builder shall decide where they want to insulate the foundation and what product they are going to use and follow the code, including code sections, ASTM Standards etc…

Lets look at it as prescriptive



Foundation Wall Prescriptive Option

- **<u>Foundation insulation</u>** Foundation insulation of basement and crawl space walls and the perimeter of slab-on grade floors must comply with this section. Insulation materials shall be installed according to manufacturer's installation specifications and any additional requirements of sections N1102.2.6.1 through N1102.2.6.11.

Foundation Wall Prescriptive Option

- **Foundation insulation** Foundation insulation of basement and crawl space walls and the perimeter of slab-on grade floors must comply with this section. Insulation materials shall be installed according to manufacturer's installation specifications and any additional requirements of sections N1102.2.6.1 through N1102.2.6.11. **Adding additional insulation to increase R-values or adding an additional vapor retarder to foundation wall assemblies, other than those required in this section, is prohibited.**

Table 1102.1(1) Insulation and Fenestration Requirements by Component[a]

Climate Zone	Fenestration[b] U-Factor	Skylight U-Factor	Glazed Fenestration SHGC	Ceiling R-Value	Wood Frame Wall R-Value	Mass Wall R-Value (f)	Floor over unconditioned space R-Value	Basement[f] Wall R-Value	Slab[c] R-Value & Depth	Crawl Space Wall R-Value	Rim Joist R-value
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1. A minimum of a 7Inch diameter log shall be used
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Exceptions:

- 1. Foundation walls enclosing unconditioned spaces shall meet this requirement unless the floor overhead is insulated in accordance with Section N1102.1.

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- 3. Frost protected shallow foundations shall meet the requirements of R403.3

Exceptions:

- 1. Foundation walls enclosing unconditioned spaces shall meet this requirement unless the floor overhead is insulated in accordance with Section N1102.1.
- 2. Permanent wood foundations shall meet the requirements of R401.1.
- 3. Frost protected shallow foundations shall meet the requirements of R403.3
- 4. Insulating concrete form materials shall meet the requirements of Section R611.

General Requirements for Basement foundation and crawl space walls.

- Basement foundation and crawl space walls shall be insulated from the top of the foundation wall down to the top of the footing or from the top edge of the interior wall to the top of the slab if insulation is on the interior.

Slab-on-grade and basement walkout foundation walls.

(Stem Walls)

Slab-on-grade and basement walkout foundation walls.

(Stem Walls)

- Insulation shall extend to the design frost line or top of footing whichever is less.

Slab-on-grade and basement walkout foundation walls.

- Insulation shall extend to the design frost line or top of footing whichever is less.
- 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 angle away from the exterior wall.

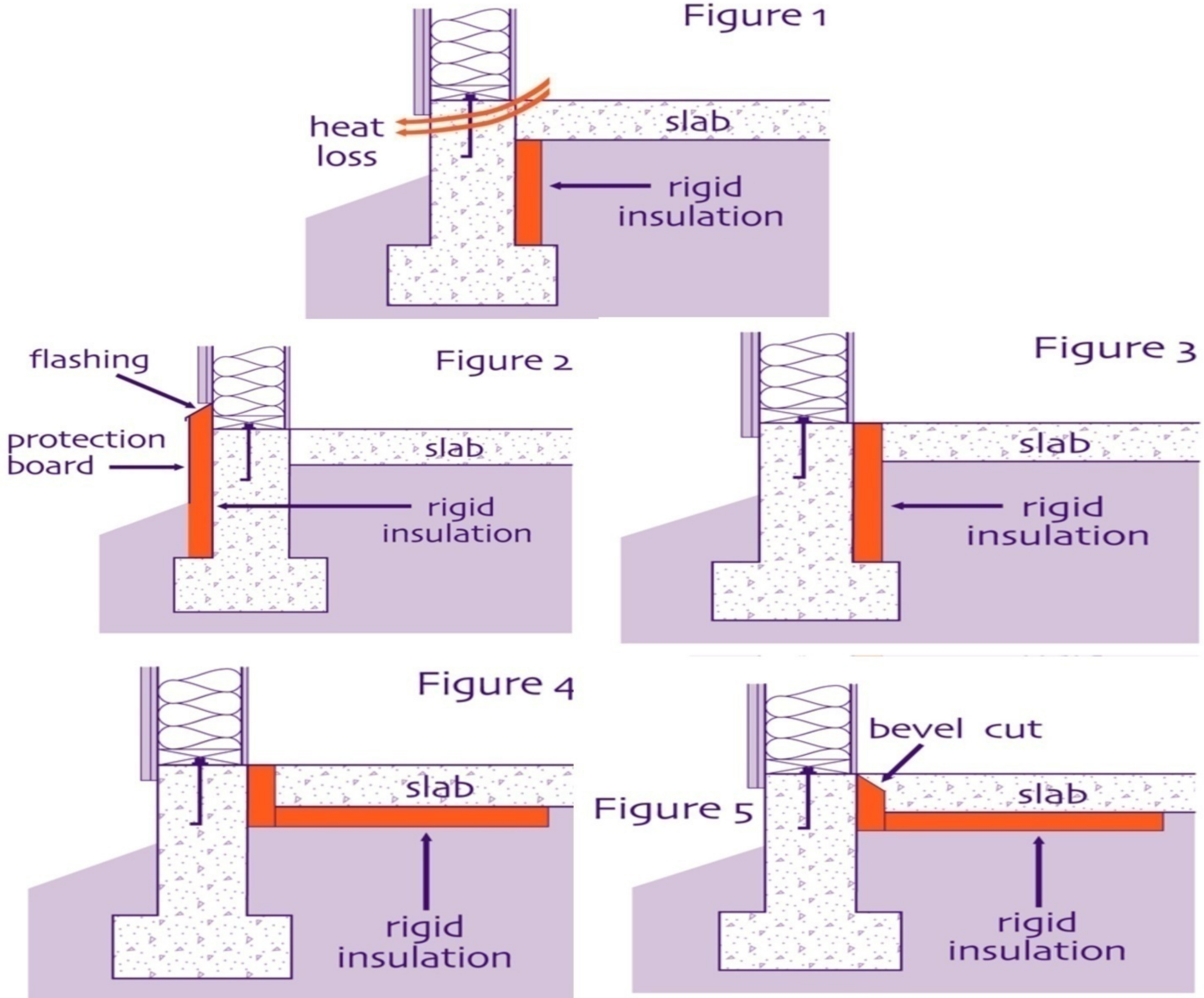

Figure 1
heat loss
slab
rigid insulation
flashing
Figure 2
protection board
slab
rigid insulation
Figure 3
slab
rigid insulation
Figure 4
slab
rigid insulation
bevel cut
Figure 5
slab
rigid insulation

Not allowed

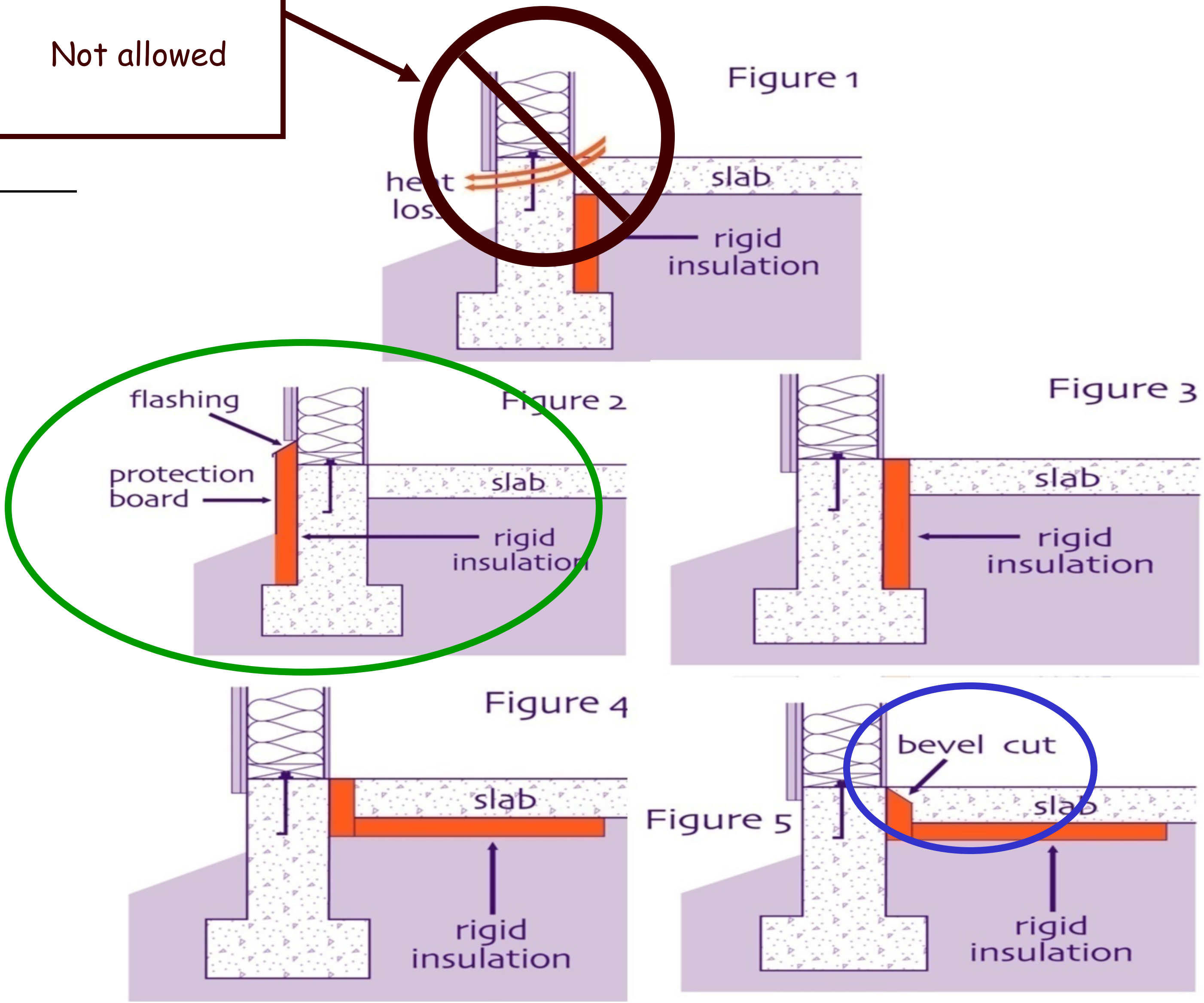

Figure 1
heat
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protection
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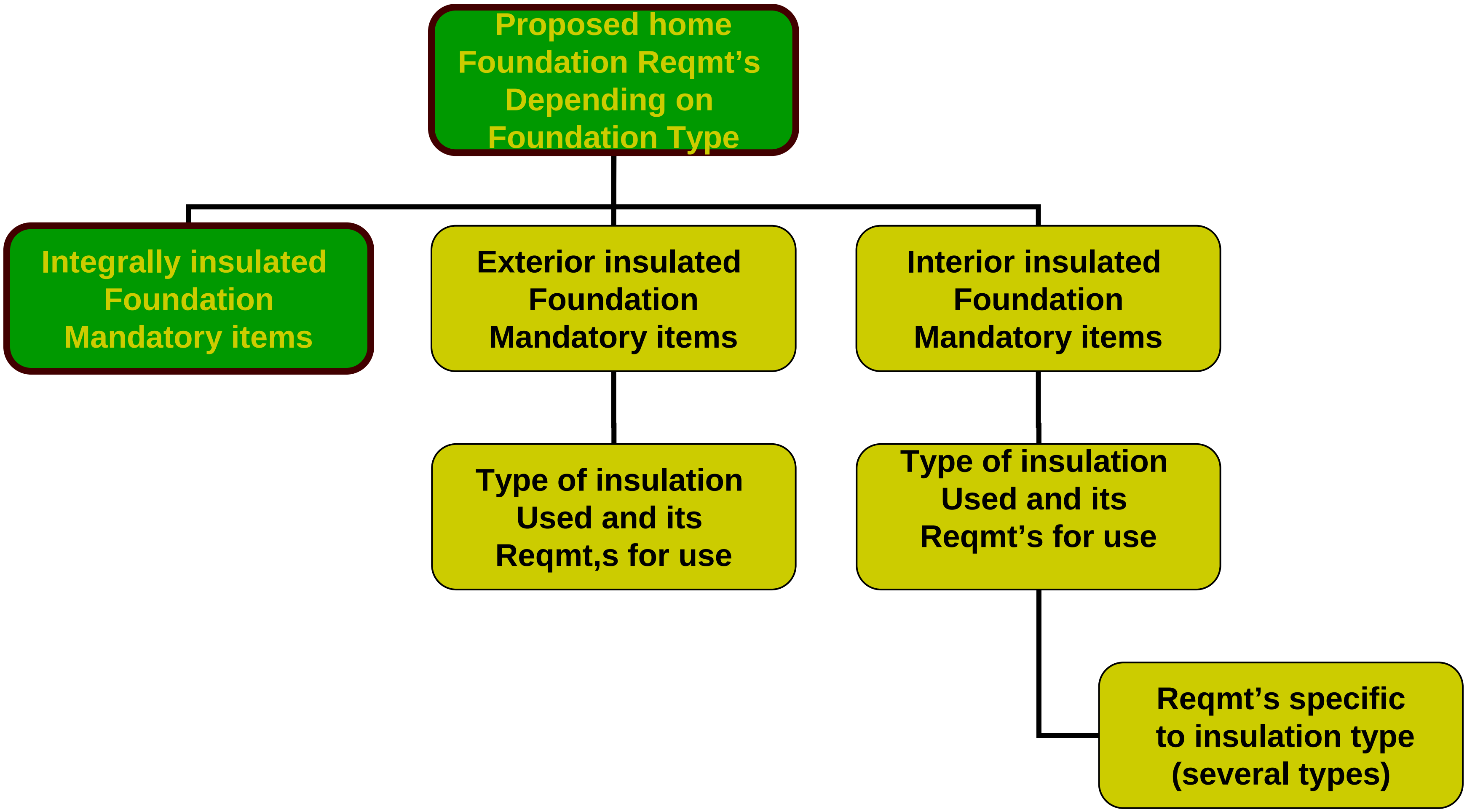
rigid
insulation
Figure 4
slab
rigid
insulation
bevel cut
Figure 5
slab
rigid
insulation

Slab-on-grade and basement walkout foundation walls.

- Insulation shall extend to the design frost line or top of footing whichever is less.
- 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 angle away from the exterior wall.
- Slab-edge insulation is not required in jurisdictions designated by the code official as having termite infestation.

Decision Tree for the "Prescriptive" approach to Residential Foundation Insulation

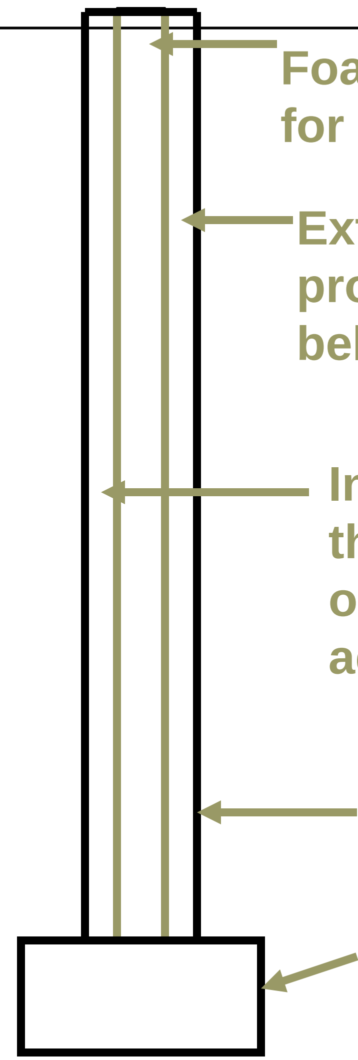


Requirements for Integral foundation insulation systems

- An insulation assembly installed integral to the foundation walls shall be manufactured for its intended use and installed according to the manufacturer's specifications.


Styrofoam
Insulated Concrete
Wall Systems

Example



Foam Insulation that meets the requirements for R-Value and Perm rating

Exterior concrete meets the requirement for protection of the foam to a point 6 inches below grade

Interior concrete meets the requirement for thermal barrier and the additional concrete on the warm in winter side can be used as additional R-value

Waterproofing or Damproofing Required in accordance with Chapter 4 of the IRC

Footing

- Lets look at the plan. Is the builder using a integral insulation system?

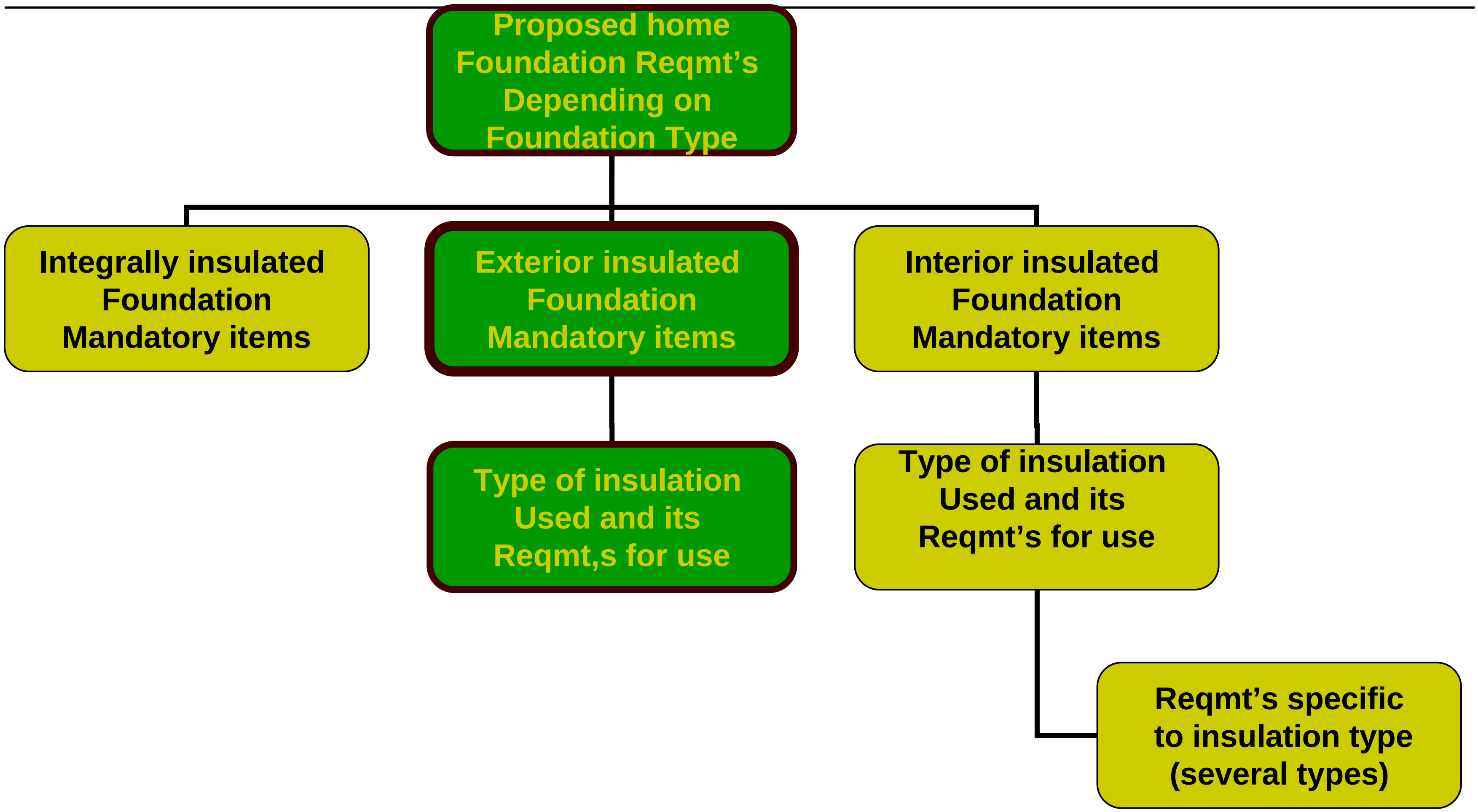
- Lets look at the plan. Is the builder using a integral insulation system?
  - NO

- Lets look at the plan. Is the builder using a integral insulation system?
  - NO
  - **What are they using?**

- Lets look at the plan. Is the builder using a integral insulation system?
  - NO
  - **What are they using?**
  - **Lets look at that system then**

Requirements for Exterior foundation insulation requirements

Decision Tree for foundation Insulation in the Residential Energy Code



- 1. Shall be of water resistant materials manufactured for its intended use;

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- 2. Installed according to the manufacturer's specifications;

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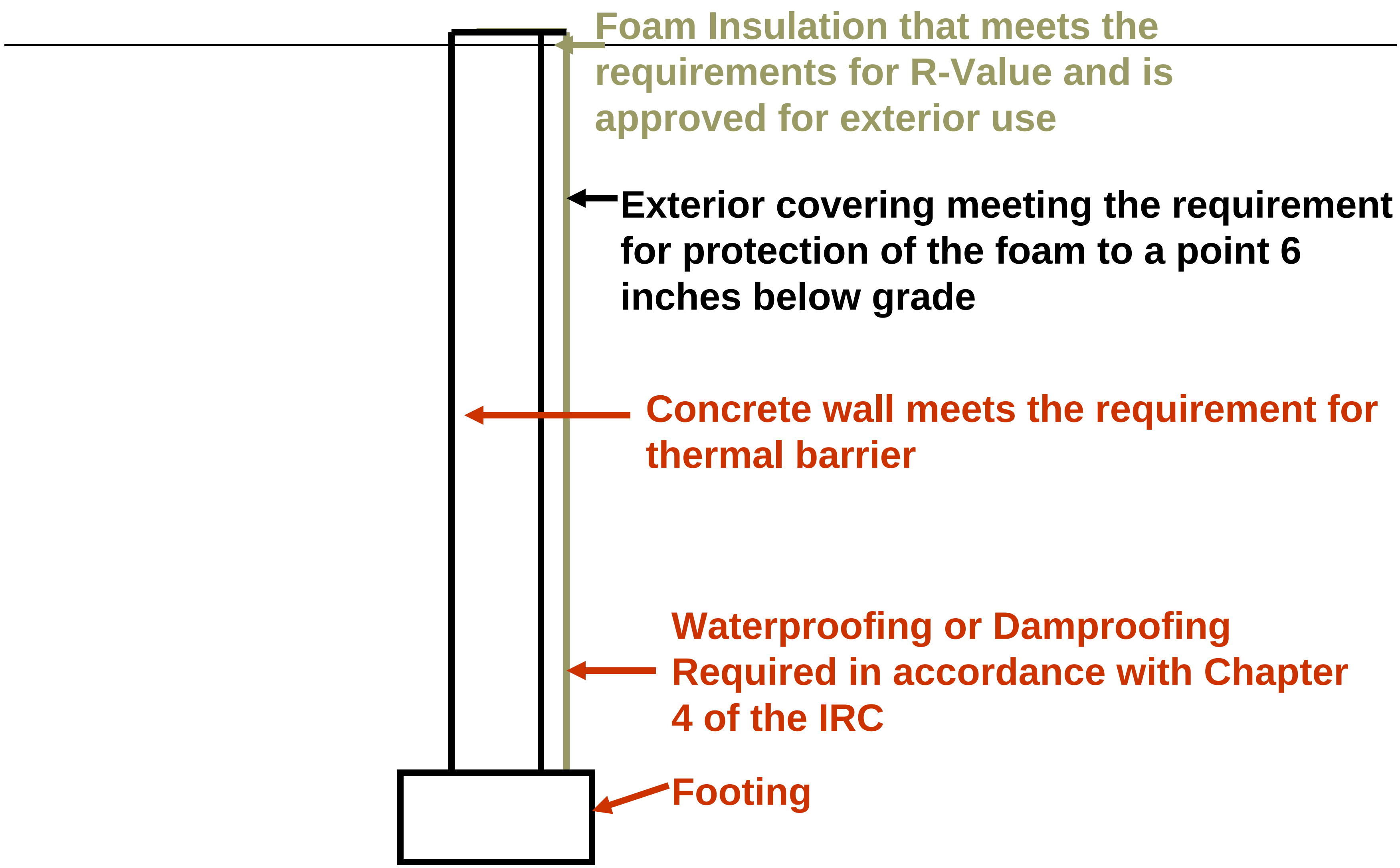
- 2. Installed according to the manufacturer's specifications;
- 3. Shall comply with either ASTM C578, C612 or C1029 as applicable and;

- 1. Shall be of water resistant materials manufactured for its intended use;
- 2. Installed according to the manufacturer's specifications;
- 3. Shall comply with either ASTM C578, C612 or C1029 as applicable and;
- 4. Shall have a rigid, opaque and weather-resistant protective covering to prevent the degradation of the insulation’s thermal performance. The protective covering shall cover the exposed exterior insulation and extend a minimum of 6 inches (152 mm) below grade. The insulation and protective covering system shall be flashed in accordance with the IRC Section R703.8.

Exterior Foundation Insulation



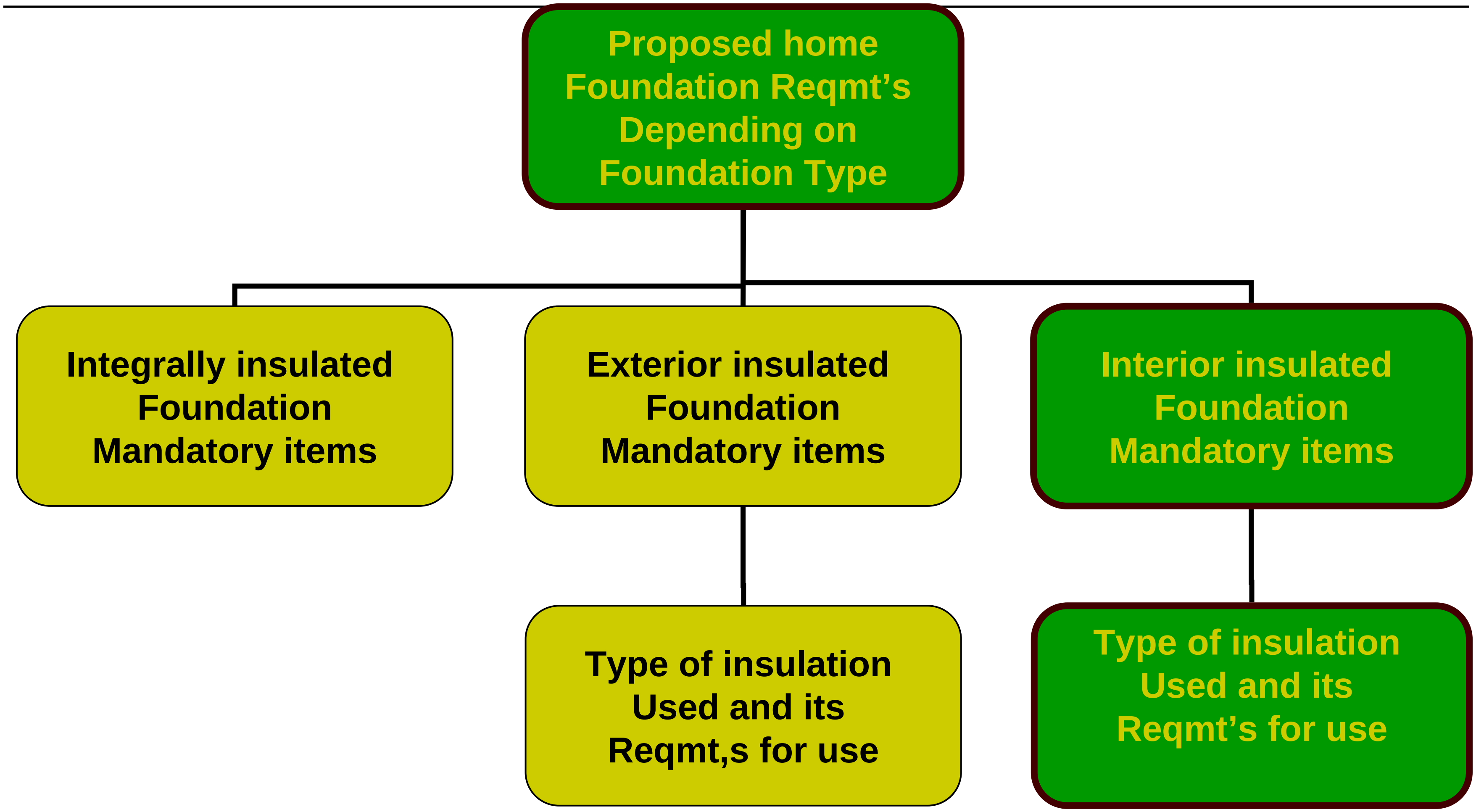

Styrofoam
TG

Other foundation systems

Lets look at the other systems briefly to understand what we will be looking for if a builder decides to insulate the interior of the building

Requirements for Interior foundation insulation

Decision Tree for foundation Insulation in the Residential Energy Code



Interior foundation insulation

- 1. Masonry foundation walls shall be drained through the masonry block cores to an approved interior drainage system.

Interior Foundation Insulation

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- 2. If a frame wall is installed it shall not be in direct contact with the foundation wall, unless that interior side of the foundation wall has been waterproofed.

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Interior foundation insulation

- 1. Masonry foundation walls shall be drained through the masonry block cores to an approved interior drainage system.
- 2. If a frame wall is installed it shall not be in direct contact with the foundation wall, unless that interior side of the foundation wall has been waterproofed.
- 3. Comply with the interior air barrier requirements in N1102.4.1

Interior Foundation Insulation

Masonry foundation walls shall be drained through the masonry block cores to an approved interior drainage system.

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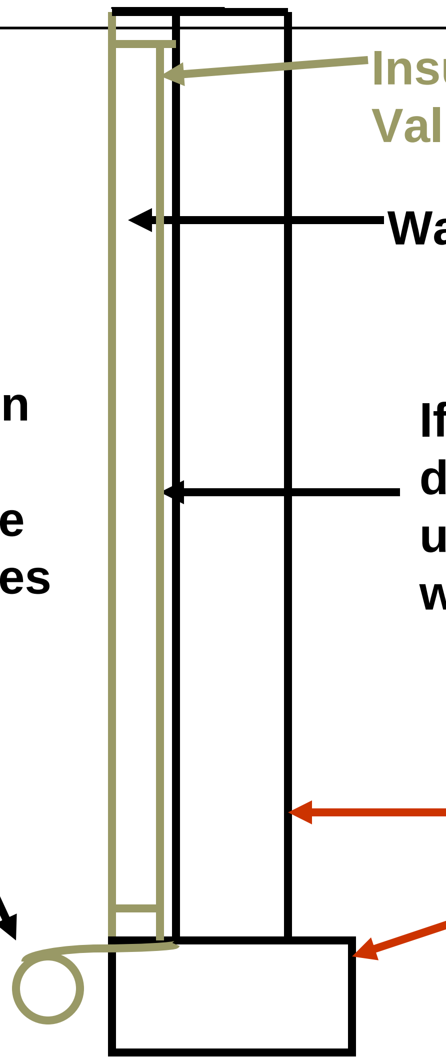
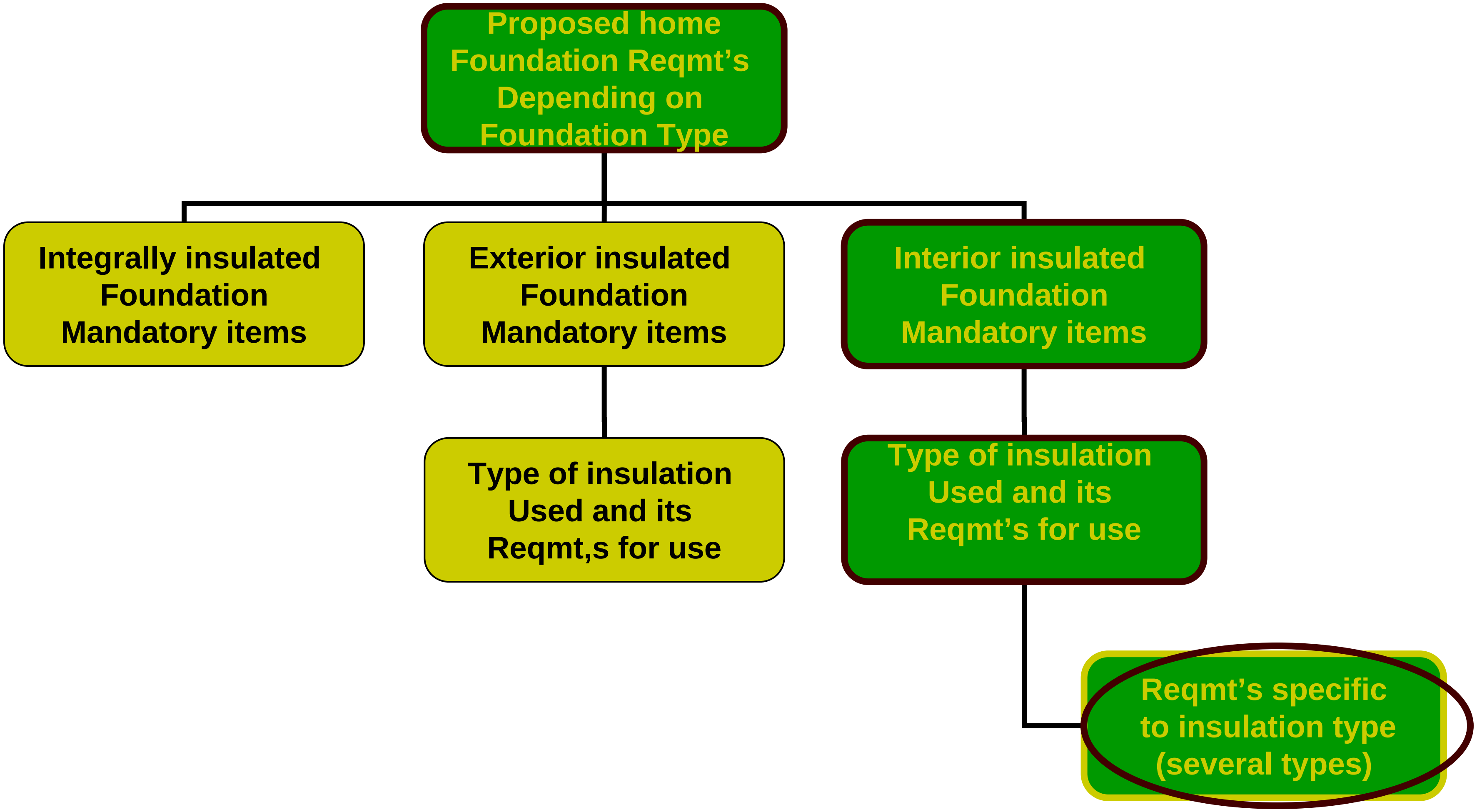
Interior Foundation Insulation



Interior foundation insulation requirements

- 1. Masonry foundation walls shall be drained through the masonry block cores to an approved interior drainage system.
- 2. If a frame wall is installed it shall not be in direct contact with the foundation wall, unless that interior side of the foundation wall has been waterproofed.
- 3. Comply with the interior air barrier requirements in N1102.4.1
- 4. Comply with section N1102.2.6.8, N1104.2.2.6.9, N1102.2.6.10, or N1102.2.6.11.

Decision Tree for foundation Insulation in the Residential Energy Code



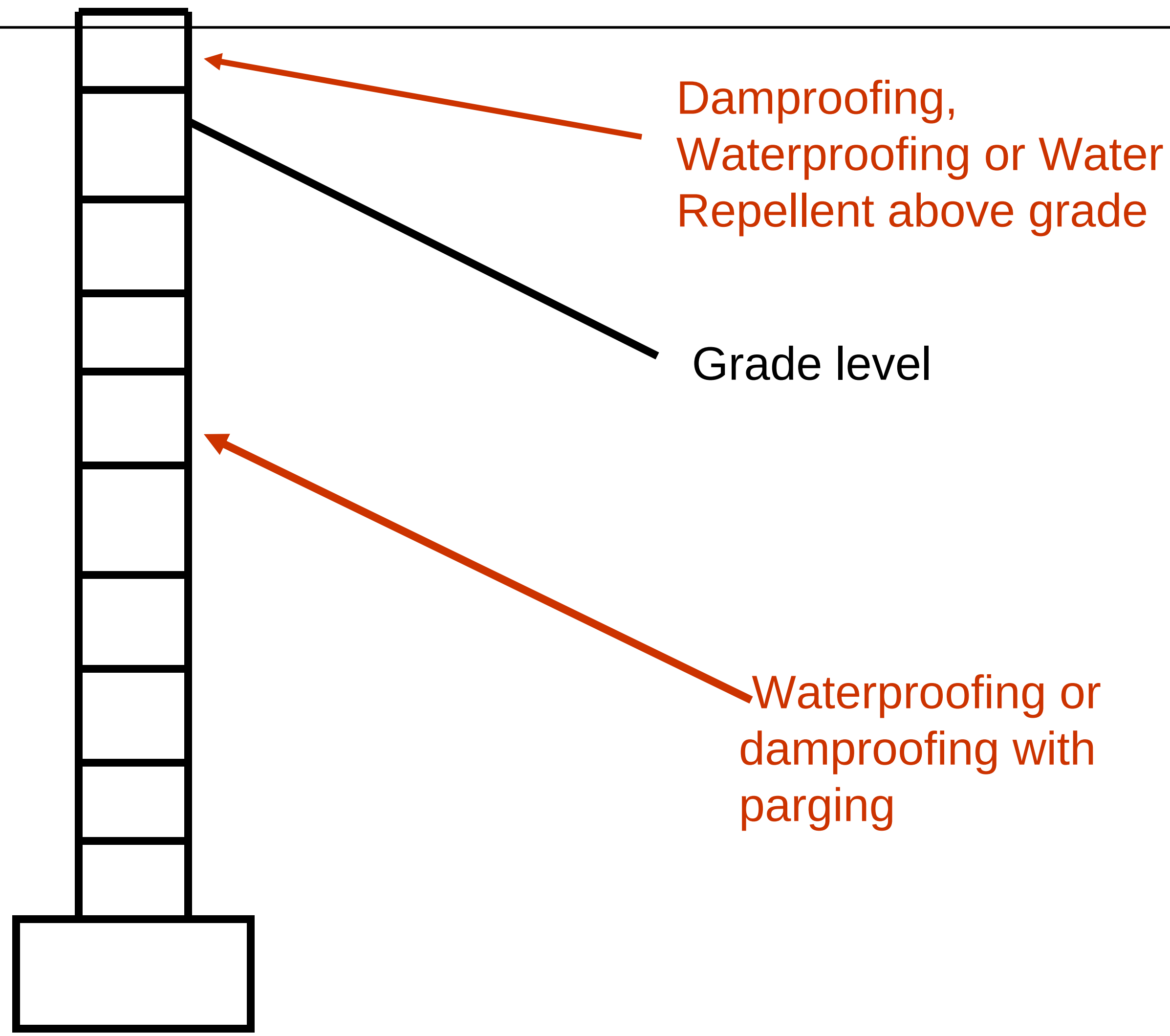
Rigid interior insulation N1102.2.6.8

- 1. Either ASTM C 578 or ASTM C 1289.

Rigid interior insulation N1102.2.6.8

- 1. Either ASTM C 578 or ASTM C 1289.
- 2. Dampproofing, waterproofing, or a water **repellant shall** be applied to the exposed above grade foundation walls or a layer of dampproofing or waterproofing shall be installed on the entire inside surface of the foundation wall. Water repellant materials shall comply with ASTM E 514 with 90% or greater reduction in water permeance when compared to an untreated sample.

Rigid Interior Foundation Insulation N1102.2.6.8



Rigid Interior Foundation Insulation N1102.2.6.8

Installation requirements

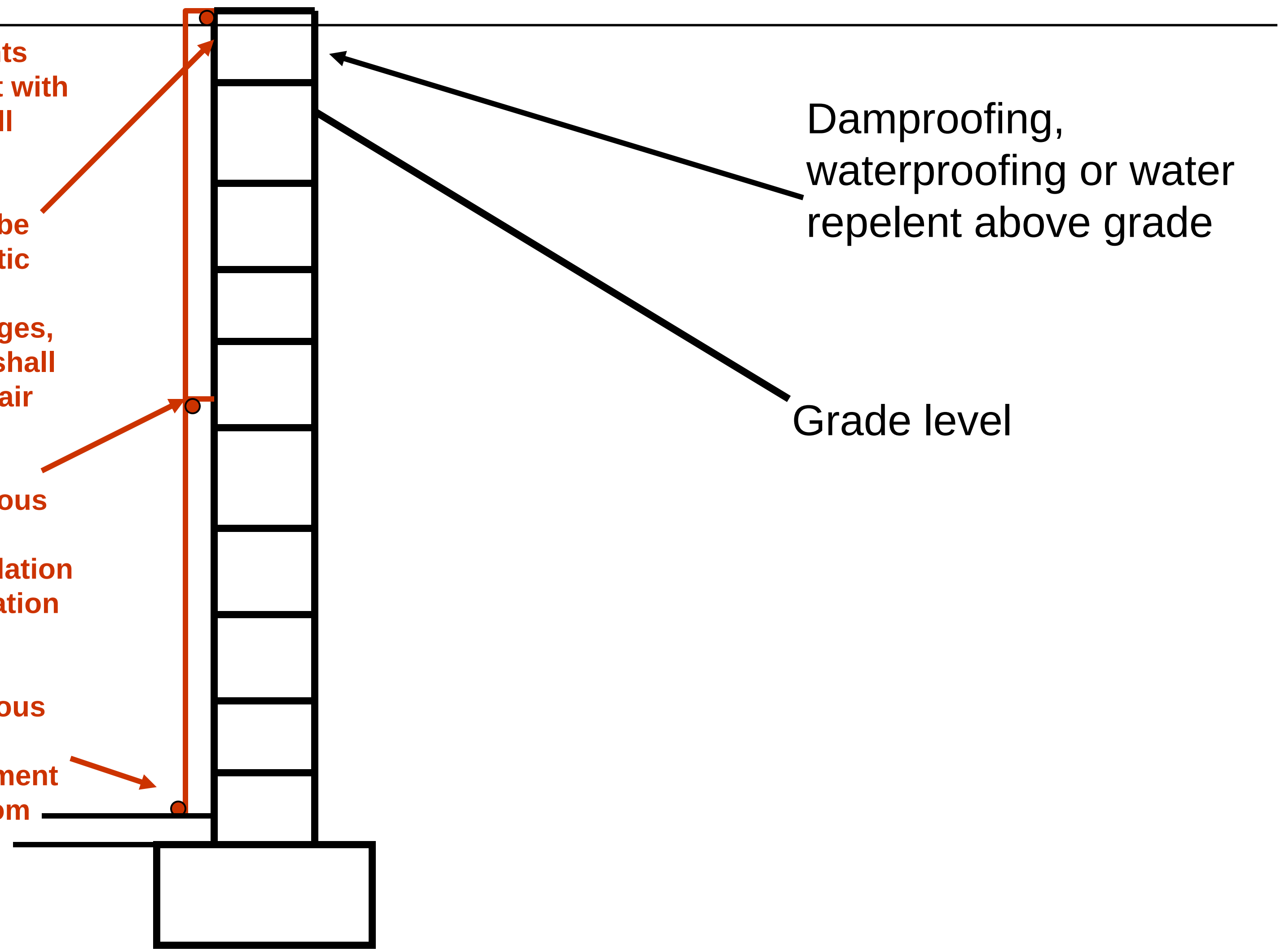
a. Must be in contact with the foundation wall surface

b. Vertical edges shall be sealed with acoustic sealant

c. All interior joints, edges, and penetrations shall be sealed against air and water vapor penetration.

d. Horizontally continuous acoustic sealant between the foundation wall and the insulation at the top of the foundation wall.

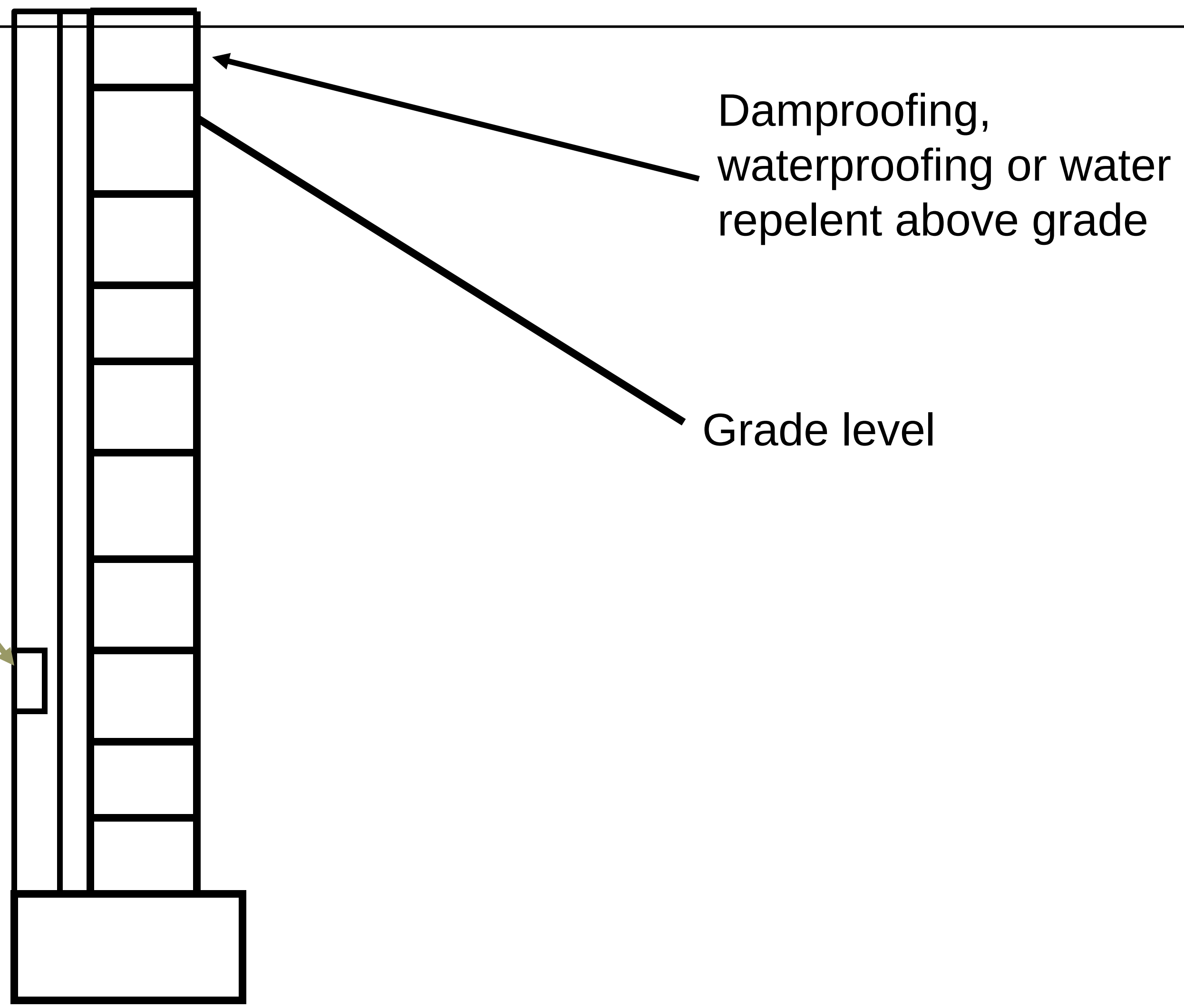
e. Horizontally continuous acoustic sealant between the basement floor and the bottom insulation edge.



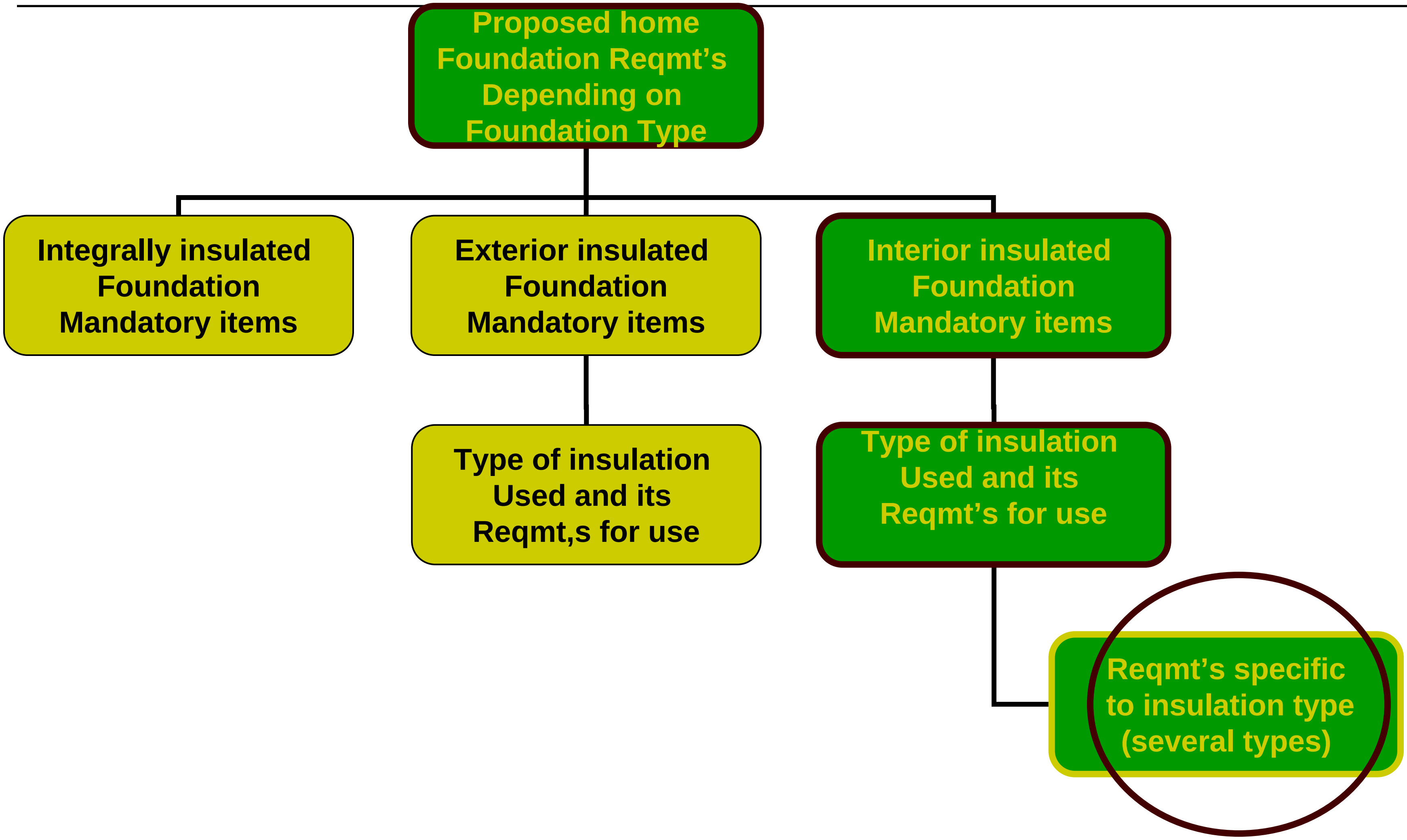
Rigid Interior Foundation Insulation N1102.2.6.8

Installation requirements

The insulation shall not be penetrated by the placement of utilities or by fasteners or connectors used to install a frame wall.



Decision Tree for foundation Insulation in the Residential Energy Code



Spray applied interior insulation N1102.2.6.9

- 1. Closed cell polyurethane
-

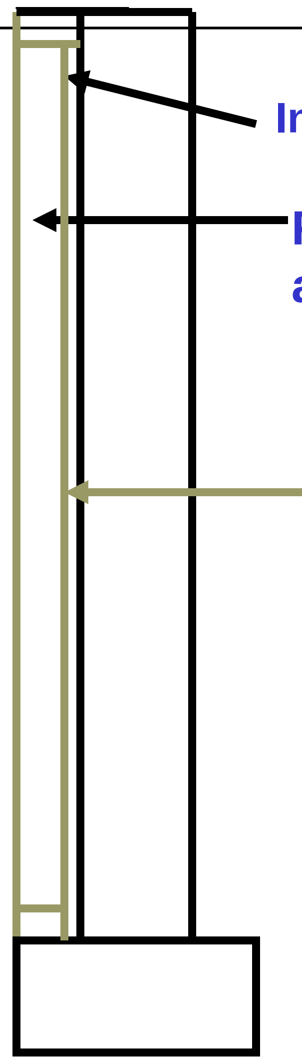
Spray applied interior insulation N1102.2.6.9

- 1. Closed cell polyurethane
- a. ASTM C 1029 compliant with a permeance not greater than 1 in accordance with ASTM E 96 procedure A.

Spray applied interior insulation N1102.2.6.9

- 1. Closed cell polyurethane
- a. ASTM C 1029 compliant with a permeance not greater than 1 in accordance with ASTM E 96 procedure A.
- b. Sprayed directly onto the foundation wall surface. There must be a 1” minimum gap between the foundation wall surface and any framing.

Interior Spray applied insulation N1102.2.6.9

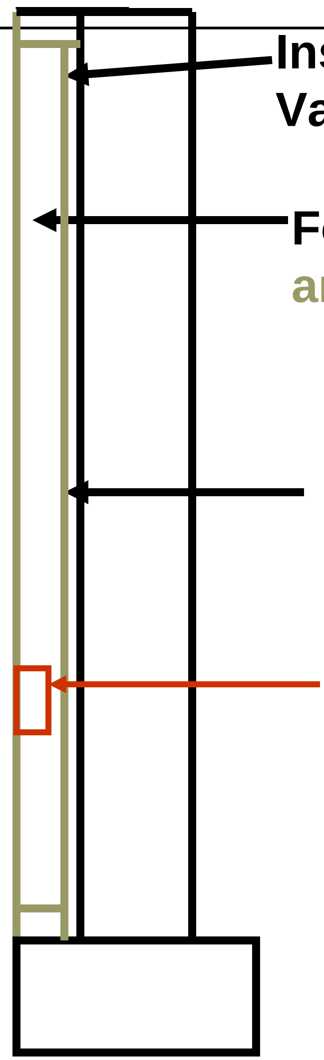


Insulation that meets the requirements for R-Value

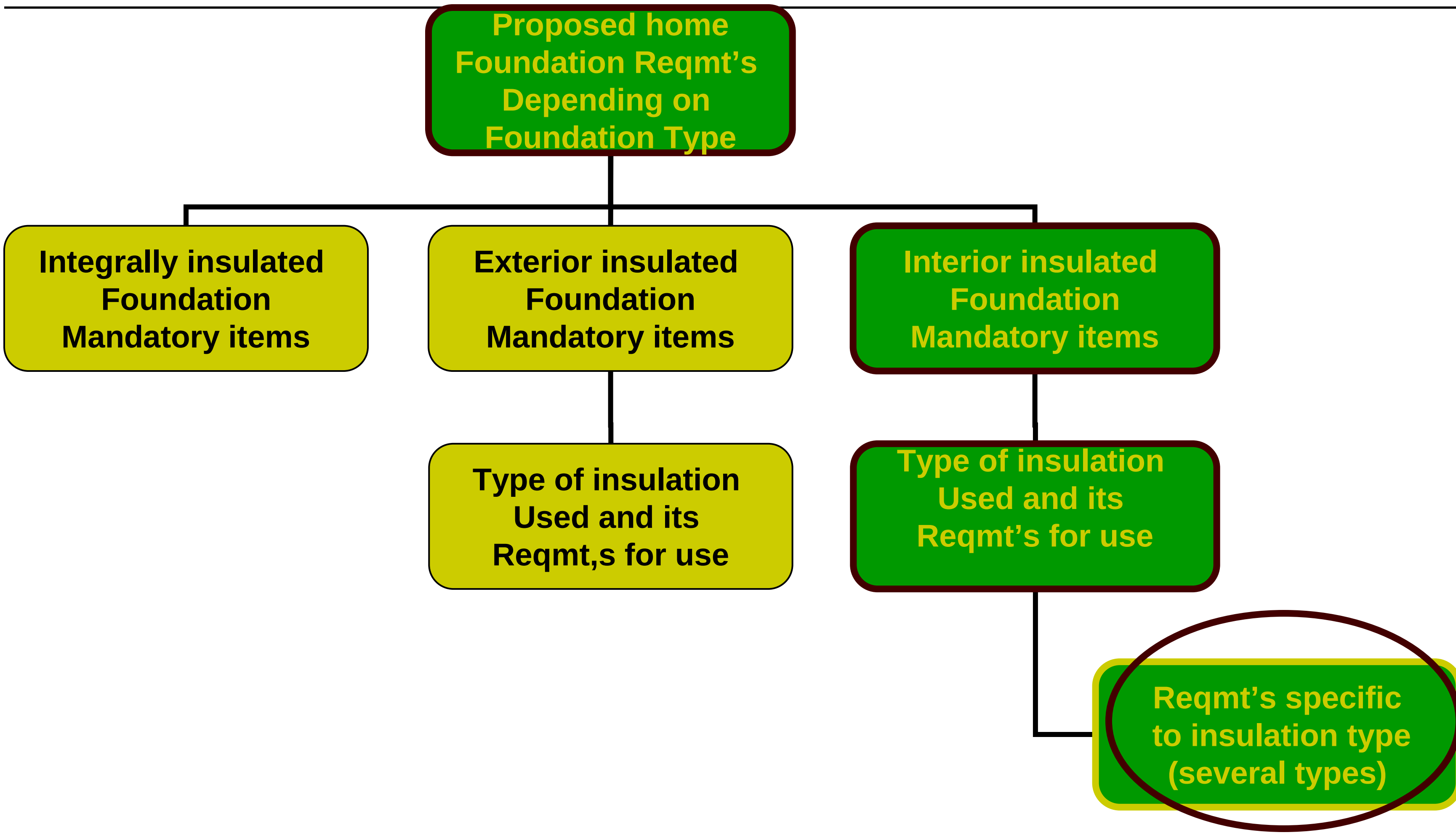
Foam may become the Warm Side vapor and Air barrier

If a frame wall is installed it shall not be in direct contact with the foundation wall

Interior Spray applied interior insulation N1102.2.6.9



Decision Tree for foundation Insulation in the Residential Energy Code



Spray applied interior insulation N1102.2.6.9

- 2. ½ pound free rise open cell foam

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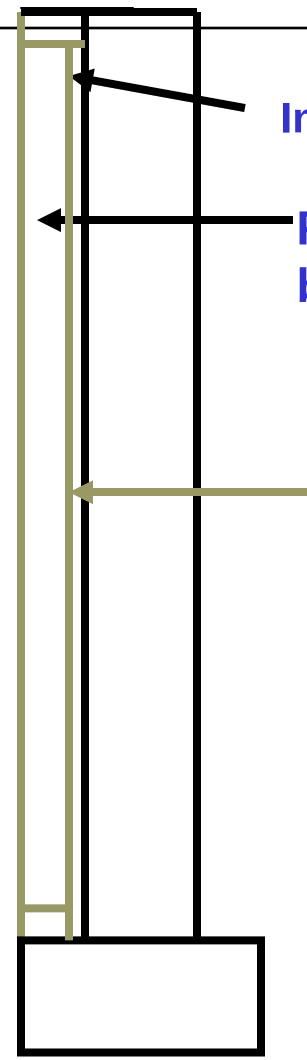
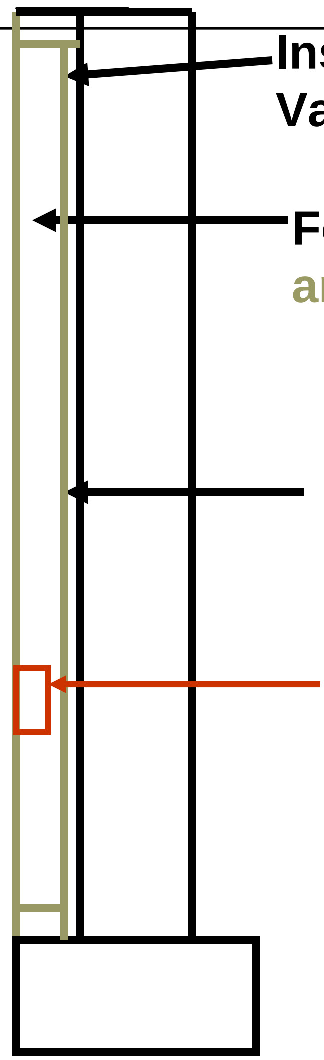
Interior Spray applied interior insulation N1102.2.6.9



Interior Spray applied interior insulation N1102.2.6.9



Insulation that meets the requirements for R-Value

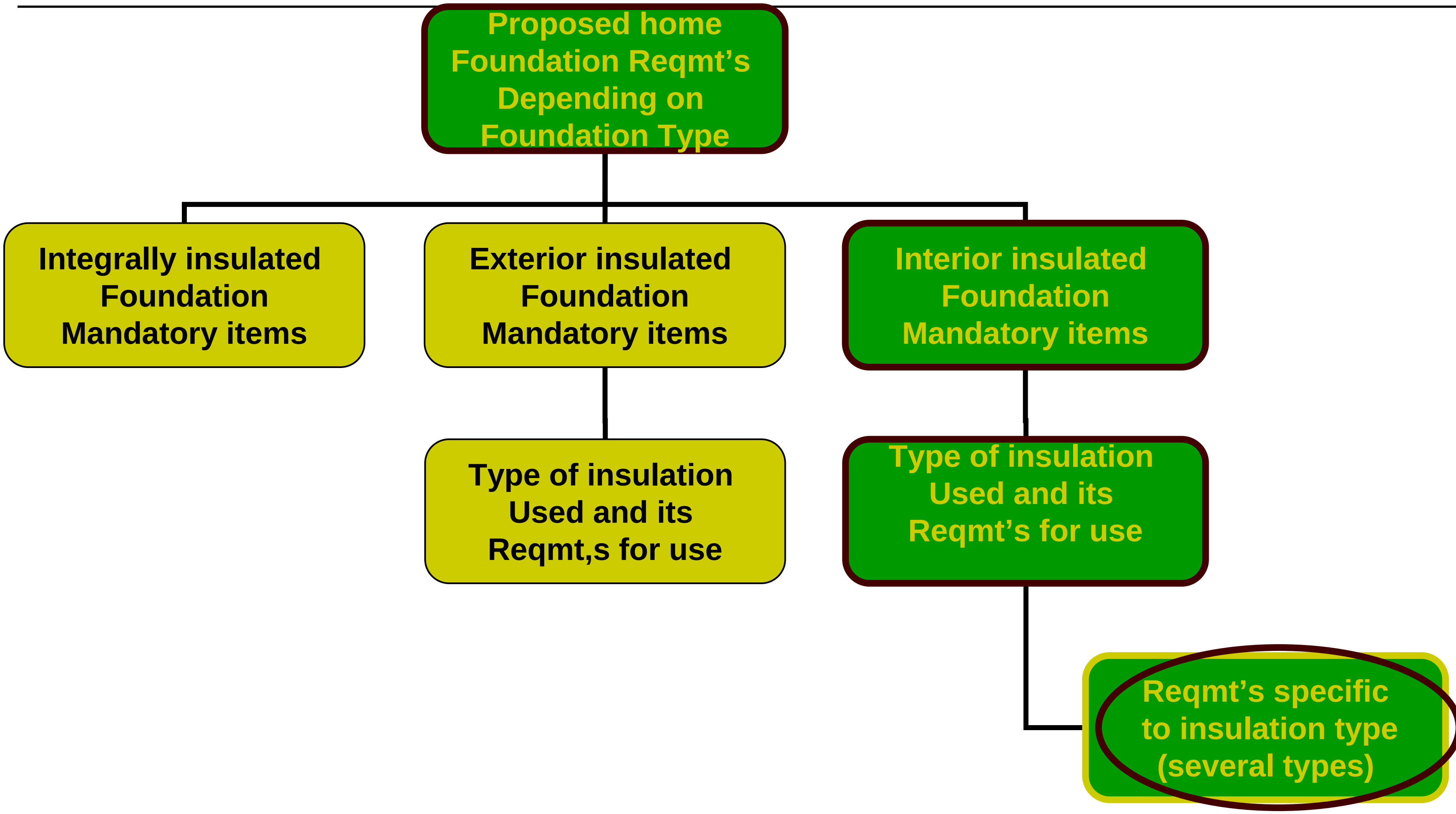
Foam may become the Warm Side vapor and Air barrier

If a frame wall is installed it shall not be in direct contact with the foundation wall

The insulation shall not be penetrated by the placement of utilities.

Through penetrations shall be sealed

Decision Tree for foundation Insulation in the Residential Energy Code



Semi-Rigid interior insulation N1102.2.6.10

Semi-rigid interior insulation N1102.2.6.10

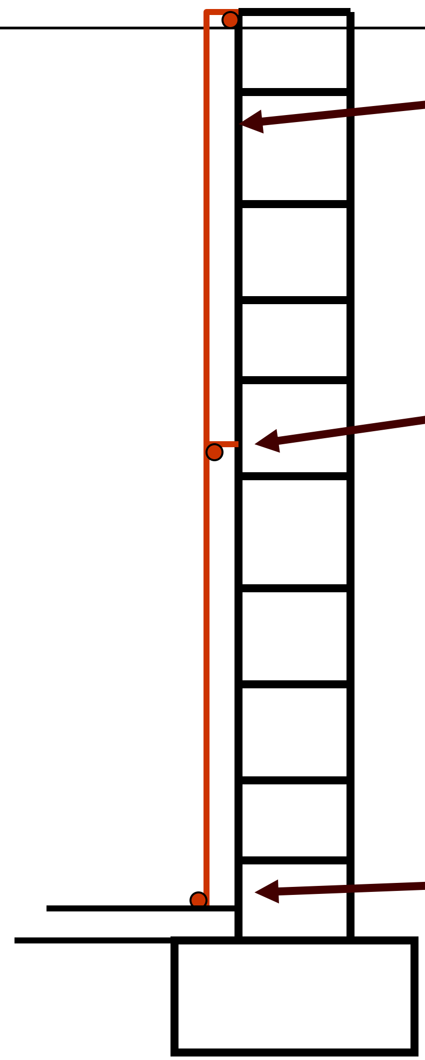
- 1. ASTM C1621 with a maximum permeance of 1.1 per inch.

Semi-rigid interior insulation N1102.2.6.10

- 1. ASTM C1621 with a maximum permeance of 1.1 per inch.
- 2. Must have a minimum density of 1.3 pcf and have a fungal resistance per ASTM C1338.

Semi-Rigid Interior Foundation Insulation N1102.2.6.8

Installation requirements



a. Must be in contact with the foundation wall surface

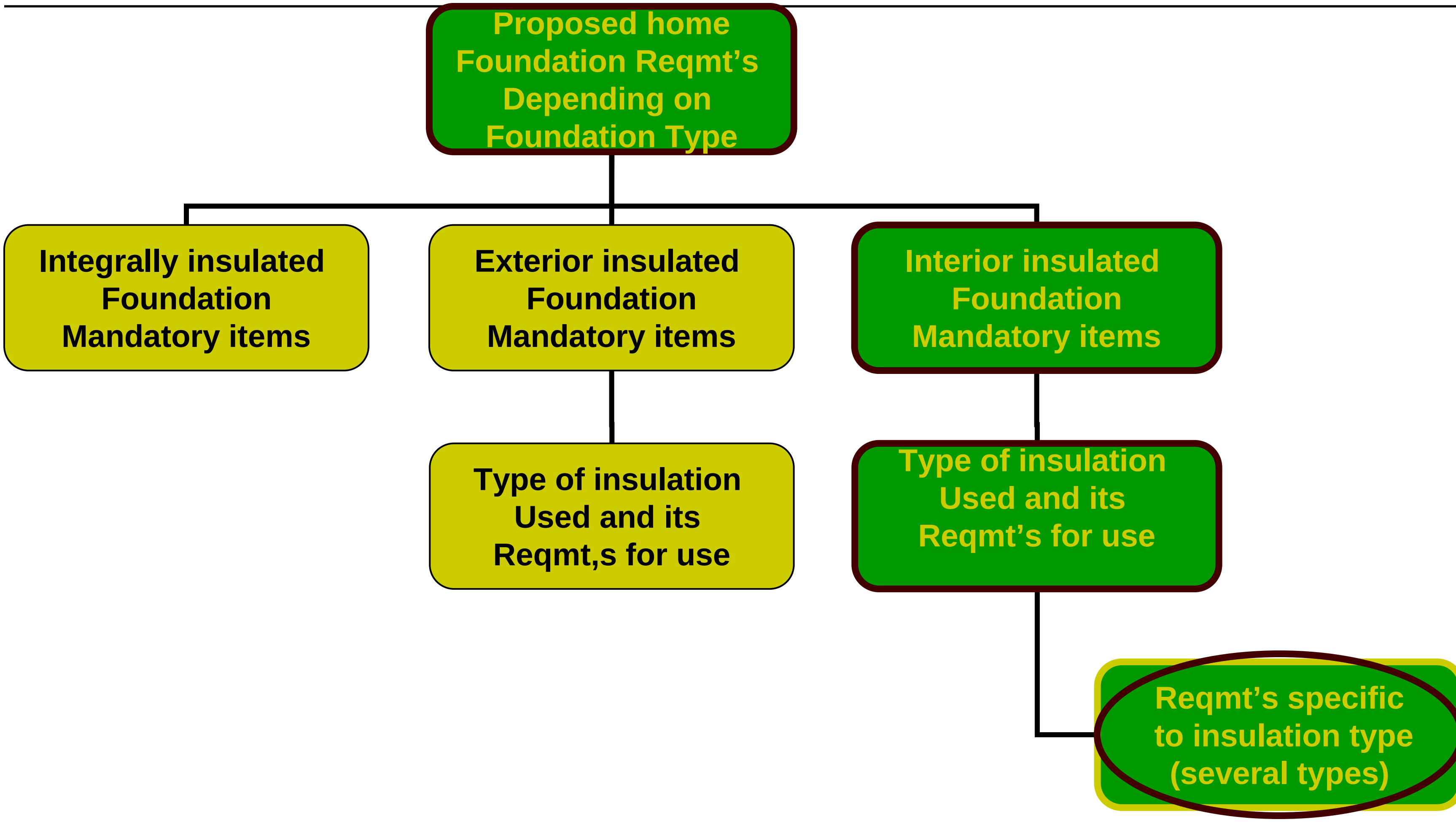
b. Vertical edges shall be sealed with acoustic sealant

c. All interior joints, edges, and penetrations shall be sealed against air and water vapor penetration.

d. Horizontally continuous acoustic sealant between the foundation wall and the insulation at the top of the foundation wall.

e. Horizontally continuous acoustic sealant between the basement floor and the bottom insulation edge.

Decision Tree for foundation Insulation in the Residential Energy Code

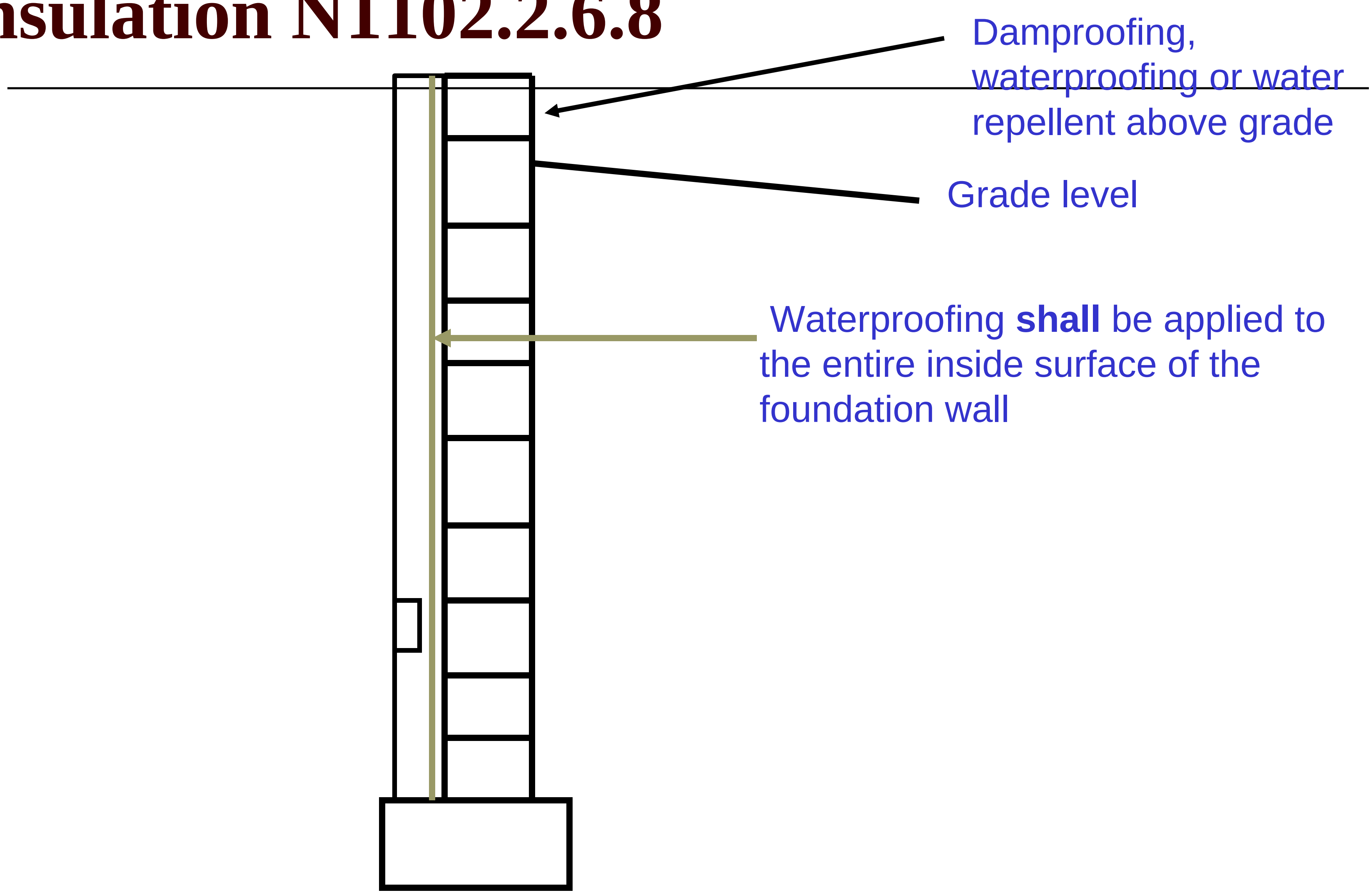


Fiberglass batt interior insulation

Fiberglass batt interior insulation

- 1. Waterproofing shall be applied to the entire inside surface of the foundation wall.

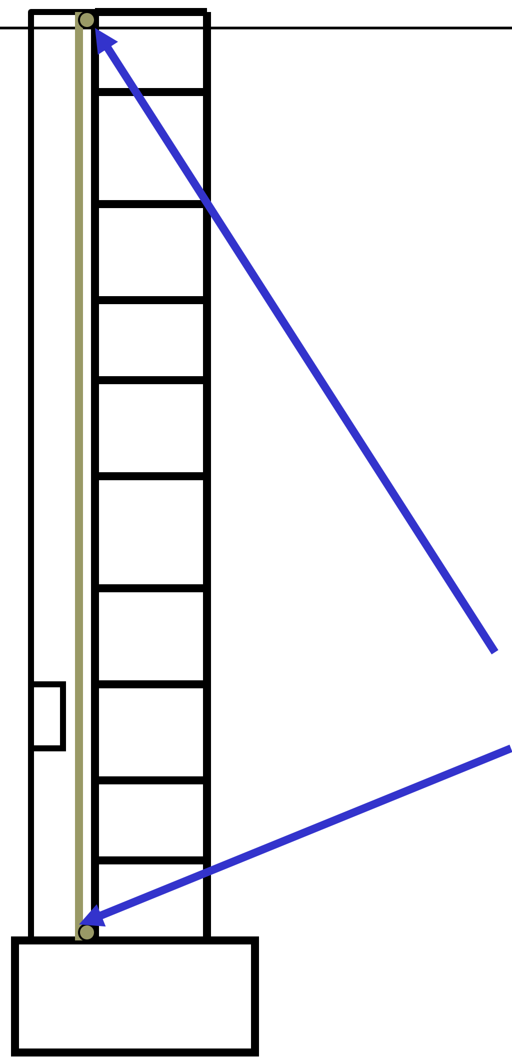
Fiberglass Interior Foundation Insulation N1102.2.6.8



Fiberglass batt interior insulation

- 1. Waterproofing shall be applied to the entire inside surface of the foundation wall.
- 2. The top and bottom plates must be air sealed to the foundation wall surface and the basement floor.

Fiberglass Foundation Insulation N1102.2.6.8



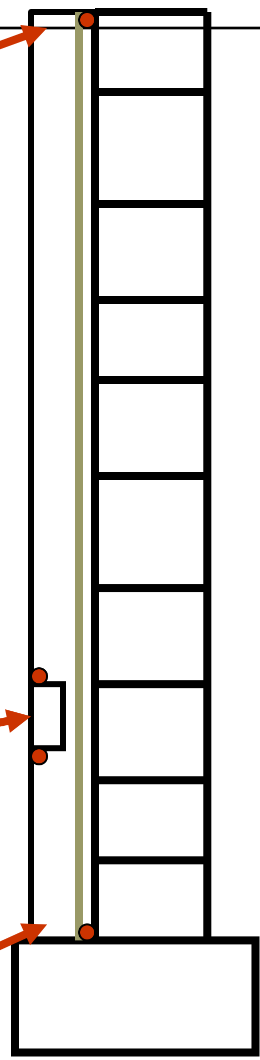
The top and bottom plates must be air sealed to the foundation wall surface and the basement floor.

In addition an air barrier material and vapor retarder material with a minimum a permeance of at least 1 in accordance with ASTM E 96 procedure A.

a. Air sealed to the framing with construction adhesive or equivalent at the top and bottom plates and where the adjacent wall is insulated, and

b. Air sealed utility boxes and other penetrations, and

•c. All seams shall be overlapped at least 6 inches and sealed with compatible sealing tape or equivalent.



Waterproofing **shall** be applied to the entire inside surface of the foundation wall

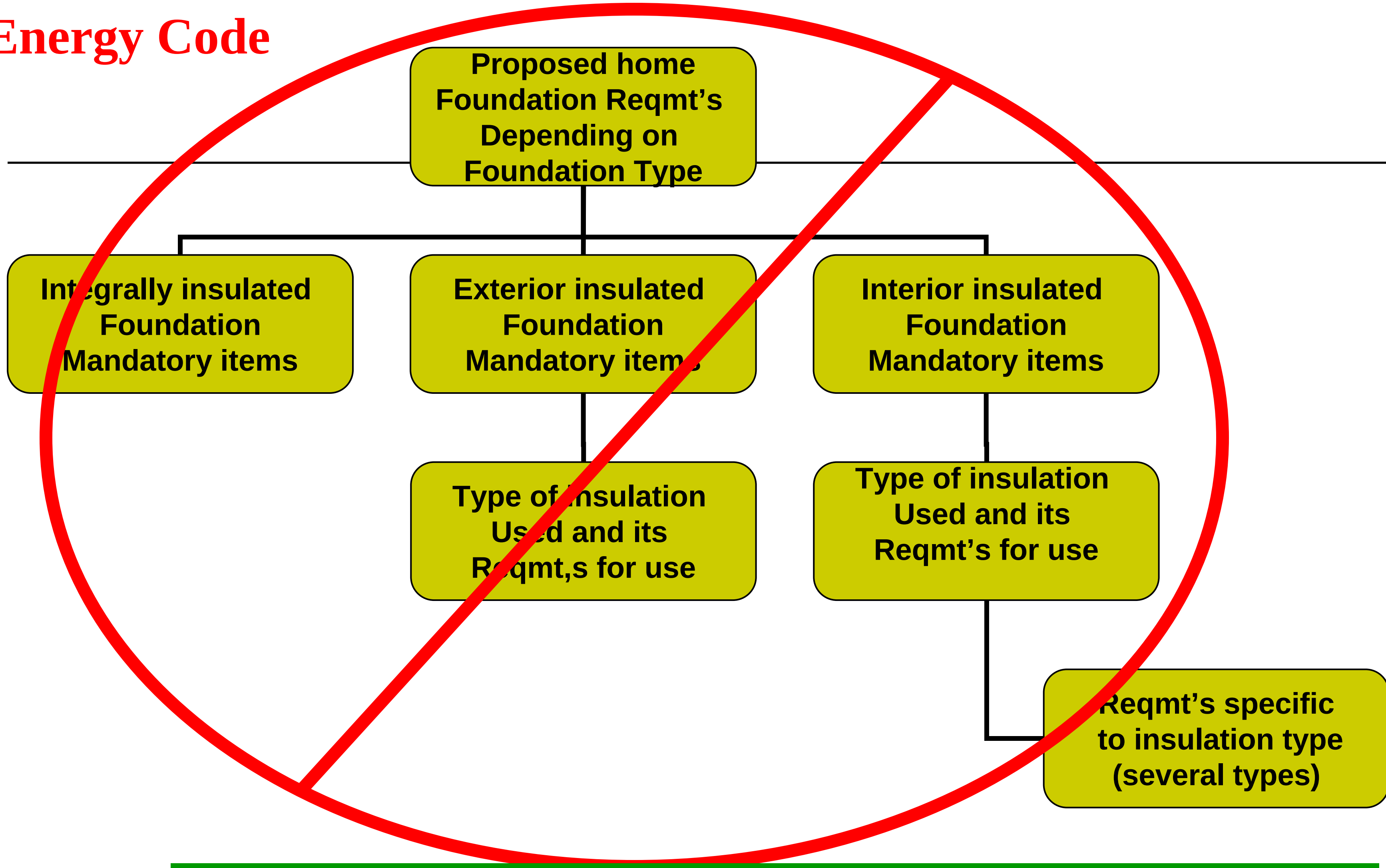
The top and bottom plates must be air sealed to the foundation wall surface and the basement floor.

Fiberglass batt interior insulation

- 1. Waterproofing shall be applied to the entire inside surface of the foundation wall.
- 2. The top and bottom plates must be air sealed to the foundation wall surface and the basement floor.
- 3. In addition an air barrier material and vapor retarder material with a minimum a permeance of at least 1 in accordance with ASTM E 96 procedure A.
- a. Air sealed to the framing with construction adhesive or equivalent at the top and bottom plates and where the adjacent wall is insulated, and
- b. Air sealed utility boxes and other penetrations, and
- c. All seams shall be overlapped at least 6 inches and sealed with compatible sealing tape or equivalent.
- d. Up to R-13 batts are allowed.

Foundation Wall Insulation Performance Option

Decision Tree for foundation Insulation in the Residential Energy Code



Note: This is not a complicated process, for the builder. However for someone else it may be

Documentation

- The foundation insulation system designer shall provide documentation certified by a professional engineer registered in Minnesota demonstrating how the requirements of this section are fulfilled. The foundation insulation system designer shall also specify the design conditions for the wall and the design conditions for the interior space for which the water separation plane will meet the requirements of this section. The foundation insulation system designer shall provide a label disclosing these design conditions and the label shall be posted in accordance with N1101.8.

FENESTRATION.

Fenestration products

- In accordance with NFRC ratings or the default table in the code.

Default Glazed Fenestration U-Factor Table N1101.5

Frame Type	Single Pane	Double Pane	Skylight	
			Single pane	Double pane
Metal **Metal w/thermal break**	1.20 **1.10**	0.80 **0.65**	1.60 **1.90**	1.05 **1.10**
Non-Metal or metal clad	0.95	0.55	1.25	0.80
Glazed Block	0.60			

Table N1101.5(2)

Default Door U-Factors

Uninsulated metal	1.2
Insulated Metal	0.6
Wood	0.5
Insulated non-metal edge, Max 45% glazing, Any glazing double pane	0.35

Fenestration products

- In accordance with NFRC ratings or the default table in the code.
- Must meet the overall average U- factor as listed in table N1102.1

Table 1102.1(1) Insulation and Fenestration Requirements by Component[a]

Climate Zone	Fenestration[b] U-Factor	Skylight U-Factor	Glazed Fenestration SHGC	Ceiling R-Value	Wood Frame Wall R-Value	Mass Wall R-Value (f)	Floor over unconditioned space R-Value	Basement[f] Wall R-Value	Slab[c] R-Value & Depth	Crawl Space Wall R-Value	Rim Joist R-value
Southern	0.35	0.60	NR	38	19 or 13+5[e]	15	30[d]	5/10	10, 3.5 ft	10	5/10
Northern	0.35	0.60	NR	44	19	15	30[d]	10	10, 5 ft	10	10

(a) R-values are minimums. U-factors are maximums. R-19 shall be permitted to be compressed into a 2x6 cavity.
(b) The fenestration U-factor column excludes skylights.
(c) R-5 shall be added to the required slab edge R-values for heated slabs.
(d) Or insulation sufficient to fill the framing cavity, R-19 minimum.
(e) "13+5" means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25% or less of the exterior, R-5 sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25% of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.
(f) When using Log Type construction for Thermal Mass Walls the following shall apply;
1. A minimum of a 7Inch diameter log shall be used
2. The U-value of fenestration products shall be 0.31 overall on average or better

Fenestration products

- In accordance with NFRC ratings or the default table in the code.
- Must meet the overall average U- factor as listed in table N1102.1
- Or must be an exception as listed in the code

Glazed fenestration exemption

- **Up to 15 ft^2** of glazed fenestration **per dwelling unit** shall be permitted to be exempt from U-factor requirements in Section N1102.1.

Opaque door exemption

- One opaque door assembly **is exempted** from the U-factor requirements in Section N1102.1

Replacement Fenestration

- Where some or all of an existing fenestration unit is replaced with a new fenestration product, including frame, sash, and glazing, the replacement fenestration unit shall meet the applicable requirements for U-factors found in Tables N1102.1, unless exempt under Section 1102.3.1.

Ducts outside Conditioned spaces.

1346.0604.1

Minimum Required Duct Insulation
(see notes for explanations)

Duct Location	Requirements
Attics, garages, and ventilated crawl spaces	R-8 and V
Exterior of building	R-8, V and W
Inside of building and in unconditioned spaces TD less than or equal to 15°F	None required
TD greater than 15°F and less than or equal to 40°F	R-3.3 and V
TD greater than 40°F	R-5 and V
Within conditioned spaces, in basements with insulated walls, and in plenums within conditioned spaces	None required
Intake and exhaust ducts within conditioned spaces*	R-3.3 and V
Within cement slab or within ground (also see IMC Section 603.7)	R-3.5

Notes:

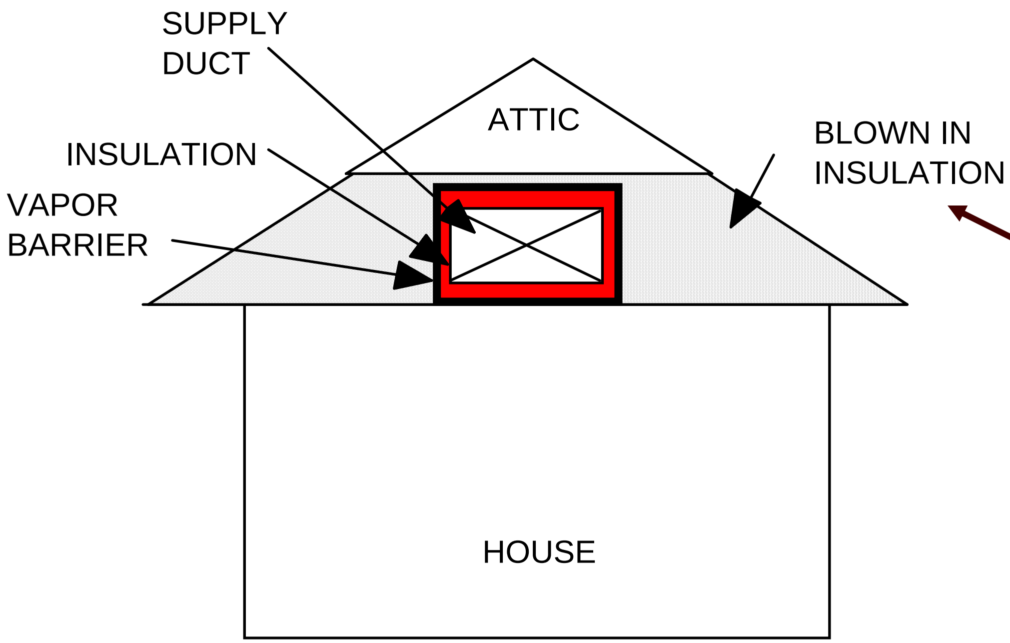
* Insulation required for a distance of 3 feet (914 mm) from the exterior.

TD = Design temperature differential between the air in the duct and the ambient temperature outside of the duct.

V = Vapor retarder required in accordance with the 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.

W = Approved weatherproof barrier.

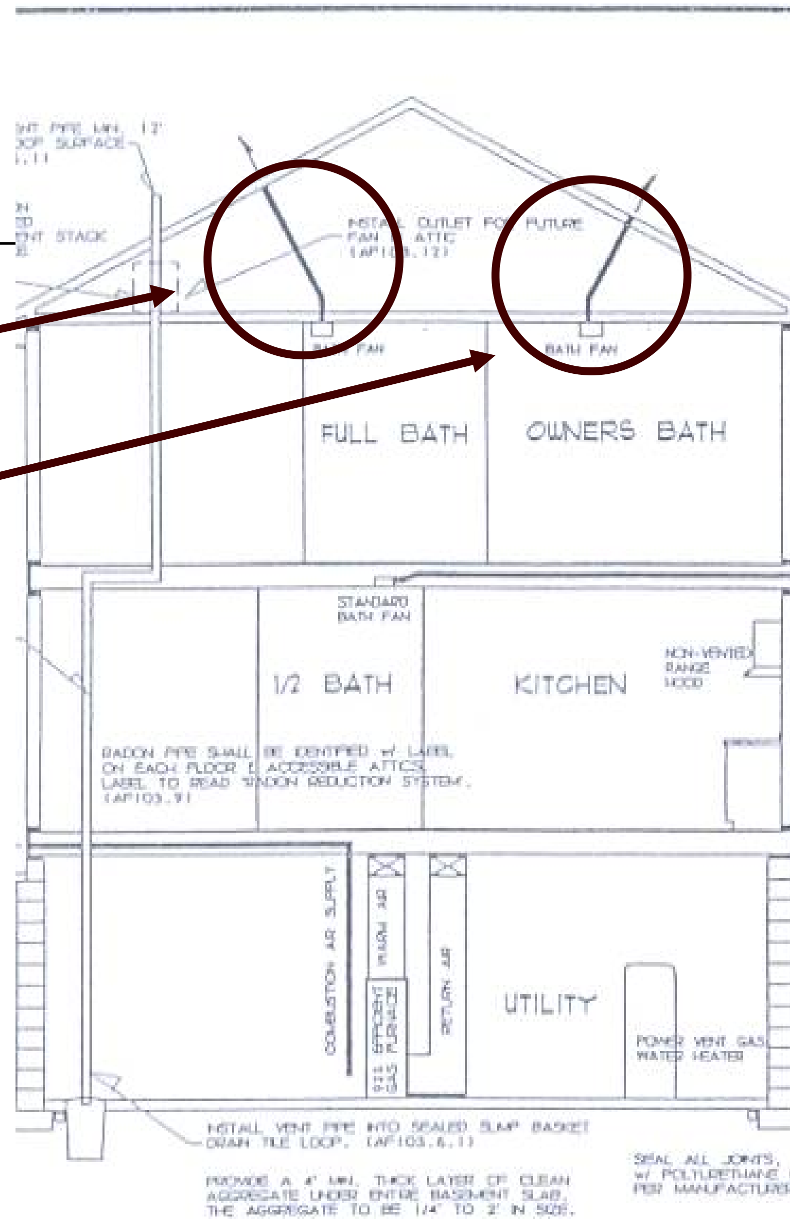
Duct Insulation



NOTE: Can't use to insulate duct

IMC 604.11: VAPOR RETARDER OF 0.05 PERM. OR 0.05 GRAINS OF MOISTURE PER SQ. FT. AT 1 INCH MERCURY PRESSURE DIFFERENCE.
7000 GRAINS = 1 POUND

- Duct insulation in attic is required to be R-8 with a vapor retarder



1346.0604.1

Minimum Required Duct Insulation
(see notes for explanations)

Duct Location	Requirements
Attics, garages, and ventilated crawl spaces	R-8 and V
Exterior of building	R-8, V and W
Inside of building and in unconditioned spaces TD less than or equal to 15°F	None required
TD greater than 15°F and less than or equal to 40°F	R-3.3 and V
TD greater than 40°F	R-5 and V
Within conditioned spaces, in basements with insulated walls, and in plenums within conditioned spaces	None required
Intake and exhaust ducts within conditioned spaces*	R-3.3 and V
Within cement slab or within ground (also see IMC Section 603.7)	R-3.5

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V = Vapor retarder required in accordance with the 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.

W = Approved weatherproof barrier.

Minimum Sealing Required:

1346.0603.8.2 table

Location	Design Static Pressure	Minimum Required Sealing
All locations	Greater than 3.0 inches (750 Pa) water gauge	All transverse joints, longitudinal seams, and duct wall penetrations shall be sealed. Ductwork shall be equal to or less than Leakage Class 6 as defined in Section 4 of the *SMACNA HVAC Duct Leakage Test Manual**.
Portions of ducts not completely inside the vapor retarder/air barrier enclosing conditioned space	3.0 inches(750 Pa) water gauge and less	All transverse joints, longitudinal seams, and duct wall penetrations shall be sealed.
Portions of return air ducts in the same space as an atmospherically vented or fan-assisted appliance.	3.0 inches(750 Pa) water gauge and less	All transverse joints, longitudinal seams, and duct wall penetrations shall be sealed.
All locations	Greater than 0.50 to 3.0 inches (125 to 750 Pa) water gauge	All transverse joints and duct wall penetrations shall be sealed.
All locations	0.50 inches (125 Pa) water gauge and less	All transverse joints, longitudinal seams, and duct wall penetrations shall have no visible gaps and shall be sufficiently airtight in accordance with Section 1.7 of the *SMACNA HVAC Duct Construction Standards - Metal & Flexible.*

Mechanical ventilation System.

Mechanical ventilation Definitions

- **Total Ventilation**
  - Ventilation rate average per hour
  - Based on number of bedrooms and square footage of conditioned space
  - Table N1104.2 or
  - Equation 11-1
    - Total Ventilation Rate = (0.02 x Sq. ft. of conditioned space) + (15 x (number of bedrooms +1))

- **Continuous ventilation**
  - Ventilation rate average per hour
  - Minimum of 50% of the total ventilation rate
  - But not less than 40 CFM
  - Table N1104.2
  - Equation 11-1
    - Total Ventilation Rate = (0.02 x Sq. ft. of conditioned space) + (15 x (number of bedrooms +1))

Intermittent ventilation = difference between the total and continuous ventilation rates

Ventilation Rates

- Lets look at our building and figure out the ventilation rates using the table and equation 11-1

- First floor
  - 1407 Square foot of Conditioned Space
  - 2 Bedrooms
- Lower Level
  - 1395 Square foot of conditioned space
  - 1 bedroom

Building Totals

-2802 Square foot of conditioned Space

- 3 bedrooms

Lets look at the table

Table N1104.2 Total and continuous ventilation rates (in CFM)

Conditioned space[1] (in sq. ft.)	Number of Bedrooms					
	1	2	3	4	5	6[2]
	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

Table N1104.2 Total and continuous ventilation rates (in CFM)

Conditioned space[1] (in sq. ft.)	Number of Bedrooms					
	1	2	3	4	5	6[2]
	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

Table N1104.2 Total and continuous ventilation rates (in CFM)

	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
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

What if they do not want to use the table?

What if they do not want to use the table?

- How else do they calculate the ventilation rate?

What if they do not want to use the table?

- How else do they calculate the ventilation rate?

- Lets look at Equation 11-1

Using Equation 11-1

- Total Ventilation Rate =
  - (0.02 x Sq. ft. of conditioned space) + (15 x (number of bedrooms +1))

(0.02 x 2802) = 56

+

(15 x (3+1)) =

(15 x 4) = 60

Total ventilation = 116

116/2 = 58 CFM Continuous ventilation

What are they using for a ventilation system?

- Is it a Exhaust only System Per Section N1104.3.1

What are they using for a ventilation system?

- Is it a Exhaust only System Per Section N1104.3.1

- Is it HRV or ERV? Per section N1104.3.2

What are they using for a ventilation system?

- Is it a Exhaust only System Per Section N1104.3.1
- Is it HRV or ERV? Per section N1104.3.2
- Or is it “Other Methods” Per section N1104.3.3

What are they using for a ventilation system?

- It appears to be a Exhaust only system however they do not tell us that on the plans.

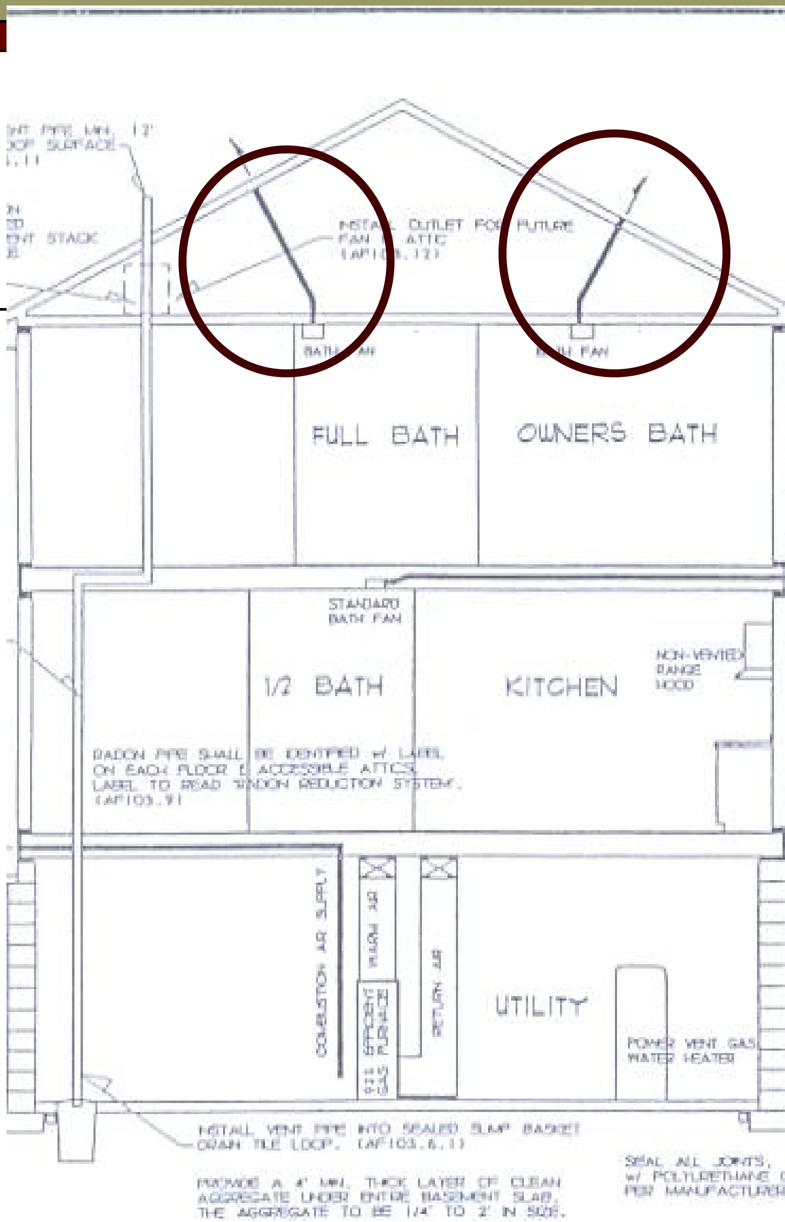
What are they using for a ventilation system?

- It appears to be a Exhaust only system however they do not tell us that on the plans.
- This would be a item for the plan review correction notice unless they have submitted some other documentation to state what they are using.

What are they using for a ventilation system?

- Lets assume they are using a Exhaust only system because it’s the least expensive…

- And there are bath fans on the plans



- However,
  - What is the CFM of each fan
  - Is it rated for continuous operation
  - Will these two fans meet the ventilation requirements of the code?

Make-Up Air and Combustion Air requirements.

Found in Minnesota Rule 1346

- Make Up Air needs to be considered and determined in accordance with Minnesota Rule 1346 (the Minnesota Mechanical Code)

Found in Minnesota Rule 1346

- Make Up Air needs to be considered and determined in accordance with Minnesota Rule 1346 (the Minnesota Mechanical Code)
- Not in the Energy Code but needs to be addressed by permit applicant.
  - Especially if using higher CFM exhaust equipment or;
  - A solid fuel burning appliance

Found in Minnesota Rule 1346

- Make Up Air needs to be considered and determined in accordance with Minnesota Rule 1346 (the Minnesota Mechanical Code)
  - In this case they will need to comply with the Minnesota mechanical code and those tables on Make up air

Procedure to Determine Makeup Air Quantity for Exhaust Equipment in Dwellings

	One or multiple power vent or direct vent appliances **or** no combustion appliances[A]	One or multiple fan-assisted appliances **and** power vent or direct vent appliances[B]	One atmospherically vented gas or oil appliance **or** one solid fuel appliance[C]	Multiple atmospherically vented gas or oil appliances **or** solid fuel appliances[D]
1. Use the Appropriate Column to Estimate House Infiltration				
a) pressure factor (cfm/sf)	0.15	0.09	0.06	0.03
b) conditioned floor area (sf) (including unfinished basements)				
Estimated House Infiltration (cfm): [1a x 1b]				
2. Exhaust Capacity				
a) continuous exhaust-only ventilation system (cfm) (not applicable to balanced ventilation systems such as HRV)				
b) clothes dryer (cfm)	135	135	135	135
c) 80% of largest exhaust rating (cfm) (not applicable if recirculating system or if powered makeup air is electrically interlocked and matched to exhaust)				
d) 80% of next largest exhaust rating (cfm) (not applicable if recirculating system or if powered makeup air is electrically interlocked and matched to exhaust)	Not Applicable			
Total Exhaust Capacity (cfm): [2a + 2b + 2c + 2d]				
3. Makeup Air Requirement				
a) Total Exhaust Capacity (from above)				
b) Estimated House Infiltration (from above)				
Makeup Air Quantity (cfm): [3a - 3b] (if value is negative, no makeup air is needed)				

4. For Makeup Air Opening Sizing, refer to Table M501.3.2

A. Use this column if there are other than fan-assisted or atmospherically vented gas or oil appliances or if there are no combustion appliances.

B. Use this column if there is one fan-assisted appliance per venting system. Other than atmospherically vented appliances may also be included.

C. Use this column if there is one atmospherically vented (other than fan-assisted) gas or oil appliance per venting system or one solid fuel appliance.

D. Use this column if there are multiple atmospherically vented gas or oil appliances using a common vent or if there are atmospherically vented gas or oil appliances and solid fuel appliance(s).

Table 501.3.2 **Makeup Air Opening Sizing Table for New and Existing Dwellings**

Type of opening or system	One or multiple power vent or direct vent appliances or no combustion appliances[A] (cfm)	One or multiple fan-assisted appliances and power vent or direct vent appliances[B] (cfm)	One atmospherically vented gas or oil appliance or one solid fuel appliance[C] (cfm)	Multiple atmospherically vented gas or oil appliances or solid fuel appliances[D] (cfm)	Passive makeup air opening duct diameter[E,F,G] (inches)
Passive Opening	1-36	1-22	1-15	1-9	3
Passive Opening	37-66	23-41	16-28	10-17	4
Passive Opening	67-109	42-66	29-46	18-28	5
Passive Opening	110-163	67-100	47-69	29-42	6
Passive Opening	164-232	101-143	70-99	43-61	7
Passive Opening	233-317	144-195	100-135	62-83	8
Passive Opening with Motorized Damper	318-419	196-258	136-179	84-110	9
Passive Opening with Motorized Damper	420-539	259-332	180-230	111-142	10
Passive Opening with Motorized Damper	540-679	333-419	231-290	143-179	11
Powered Makeup Air[H]	>679	>419	>290	>179	Not Applicable

A. Use this column if there are other than fan-assisted or atmospherically vented gas or oil appliances or if there are no combustion appliances.

B. Use this column if there is one fan-assisted appliance per venting system. Other than atmospherically vented appliances may also be included.

C. Use this column if there is one atmospherically vented (other than fan-assisted) gas or oil appliance per venting system or one solid fuel appliance.

D. Use this column if there are multiple atmospherically vented gas or oil appliances using a common vent or if there are atmospherically vented gas or oil appliances and solid fuel appliance(s).

E. An equivalent length of 100 feet of round smooth metal duct is assumed. Subtract 40 feet for the exterior hood and 10 feet for each 90 degree elbow to determine the remaining length of straight duct allowable.

F. If flexible duct is used, increase the duct diameter by one inch. Flexible duct shall be stretched with minimal sags.

G. Barometric dampers are prohibited in passive makeup air openings when any atmospherically vented appliance is installed.

H. Powered makeup air shall be electrically interlocked with the largest exhaust system.

Heating and Cooling Systems and calculated heat loss requirements.

Heating Systems: What do they need to Provide for Plan Review

What do they need to Provide for Plan Review

- Type of System

What do they need to Provide for Plan Review

- Type of System
- Input Rating of system

What do they need to Provide for Plan Review

- Type of System
- Input Rating of system
- AFUE or HSPF

What do they need to Provide for Plan Review

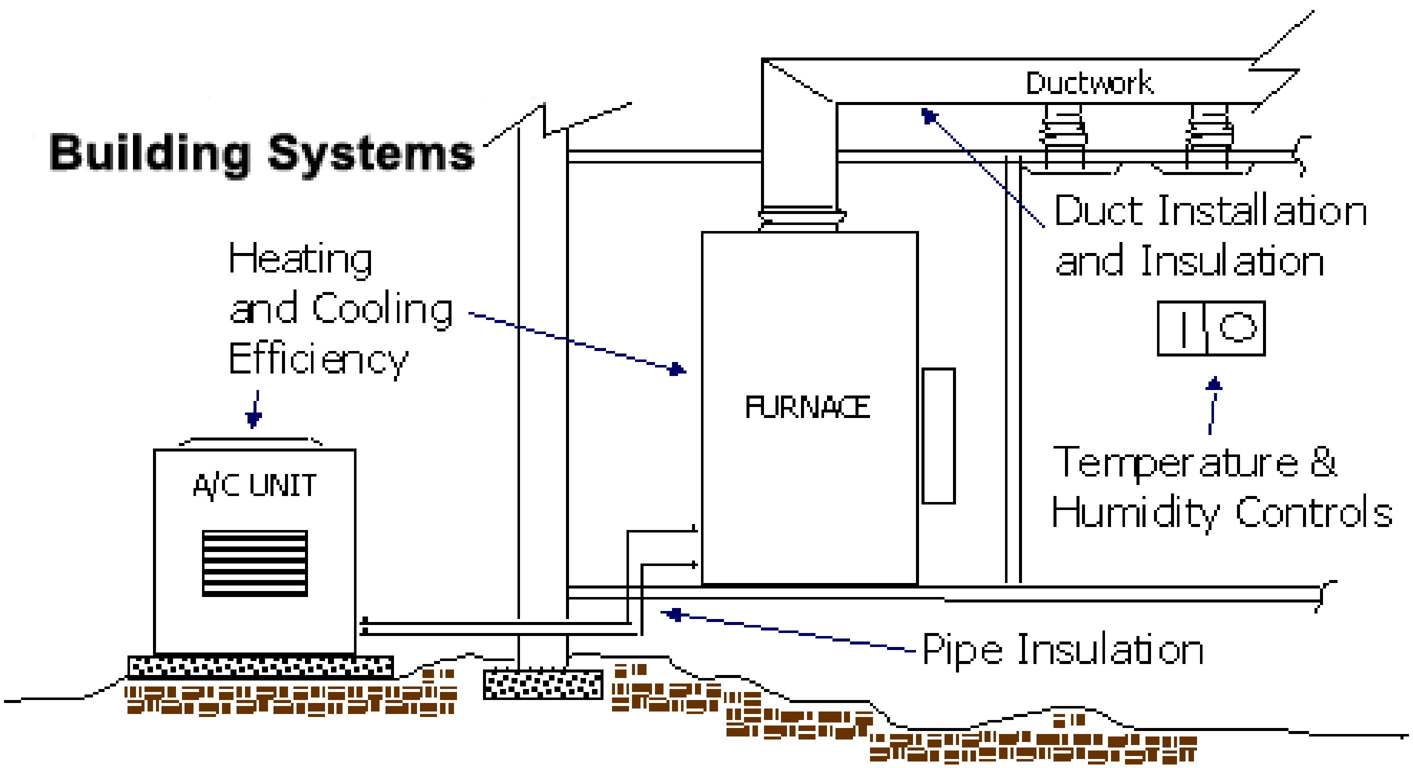
- Type of System
- Input Rating of system
- AFUE or HSPF
- Manufacturer and the model number

What do they need to Provide for Plan Review

- Type of System
- Input Rating of system
- AFUE or HSPF
- Manufacturer and the model number
- Structures calculated heat loss

Heating and Cooling Systems

The building systems addressed consist of a heating and/or cooling system, a distribution system and temperature controls.



Building Systems

– **Programmable Thermostat**

Not required currently by Minnesota Energy Code

Lets calculate a simple Heat loss of a wall

Lets calculate a simple Heat loss of a wall

- Note: In the essence of time, we are not going to calculate the entire heat loss for our Building.
-

Lets calculate a simple Heat loss of a wall

- Note: In the essence of time, we are not going to calculate the entire heat loss for our Building.
- However here is a simple example of a wall and then the same wall with a window

Lets calculate a simple Heat loss of a wall

- Note: In the essence of time, we are not going to calculate the entire heat loss for our Building.
- However here is a simple example of a wall and then the same wall with a window
- Note the changes in heat loss with the window

$Q = UA(dT)$

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

Q = UA(dT)

- Q = what we are trying to define (Btu's lost Per hour)

Q = UA(dT)

- Q = what we are trying to define
- U = the U-value of the wall

$Q = UA(dT)$

- Q = what we are trying to define
- U = the U-value of the wall
- A = Area of the wall

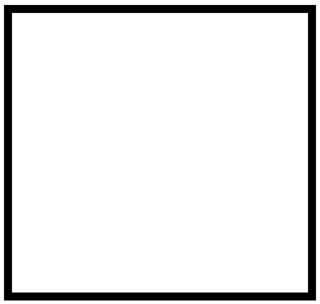
Q = UA(dT)

- Q = what we are trying to define
- U = the U-value of the wall
- A = Area of the wall
- (dt) = Delta T or temperature difference… SO………

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

Ex.

Using



Room is 10 x 10 x 10

Assuming a wall U=0.0526

(Conversion) R-19 = (1 divided by 19) = U

Lets look at just one wall

Lets look at just one wall

- **1 Wall that is 10’ tall and 10’ wide. Equals an Area (A) of 100 Sq. Ft**

Lets look at just one wall

- **1 Wall that is 10’ tall and 10’ wide. Equals an Area (A) of 100 Sq. Ft**
- **Btu’s per hour (Q) = 0.0526 (U) x 100Sq Ft. (A) x 90 (dT)**

Lets look at just one wall

- **1 Wall that is 10’ tall and 10’ wide. Equals an Area (A) of 100 Sq. Ft**
- **Btu’s per hour (Q) = 0.0526 (U) x 100Sq Ft. (A) x 90 (dT)**
- **Btu’s per wall for design loads = 474 Btu’s**

What is the total for the building in Heat Loss (Btu's)

- **Adding in all 4 walls at the exact same Btu's for each wall (4 x 474) would require a heating appliance capable of supplying a minimum of 1,896 Btu's**

What is the total for the building in Heat Loss (Btu's) when we add a 4 x 4 window meeting code to one wall

- Wall #4 was 100 Sq. Ft. at .0526 U-Factor. Now it is only 84 Sq. Ft. at the .0526 U-Factor + 16 Square foot at a 0.35 U-Factor to accommodate the window

- **Wall 1 = .0526 x 100 x 90 = 474 Btu's**
- **Wall 2 = .0526 x 100 x 90 = 474 Btu's**
- **Wall 3 = .0526 x 100 x 90 = 474 Btu's**
- **Wall 4 = .0526 x 84 x 90 = 398 Btu's**
- **Window 1 In wall 4=**

  .35 x 16 x 90 = 504 Btu's

Total Btu's now are 2324 total Btu's

-1896 Wall w/out Window

Difference of 428 Btu's

This can make a big difference in heating and cooling appliances depending on Number of windows and their U-factors

A Sample Heat Loss Calculation

Design hour temperature = -20

Footprint = 20’ x 40’

Ceiling height = 8’, R- 38

Walls = R 19

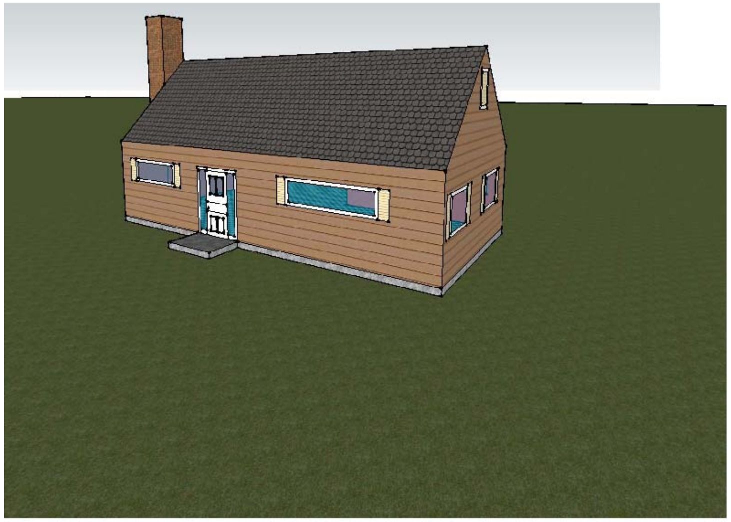
Slab Floor = R-10

Windows = 100 sf, U- 0.35

Doors = 63 sf, U- 0.35

Thermostat Setting = 70 degrees

Gound temperature = 55 degrees



A Sample Heat Loss Calculation

AREA OF FOOTPRINT		PERIMETER	
20 X40	**800 square feet**		
VOLUME OF HOUSE			
GROSS WALL AREA		FENESTRATION AREA	
NET WALL AREA		DESIGN HOUR TEMPERATURE	

A Sample Heat Loss Calculation

AREA OF FOOTPRINT		PERIMETER	
20 X40	**800 square feet**	**20+20+40+40**	**120 linear feet**
VOLUME OF HOUSE			
GROSS WALL AREA		FENESTRATION AREA	
NET WALL AREA		DESIGN HOUR TEMPERATURE	

A Sample Heat Loss Calculation

AREA OF FOOTPRINT		PERIMETER	
20 X40	**800 square feet**	**20+20+40+40**	**120 linear feet**
VOLUME OF HOUSE			
800 X 8	**6,400 cubic feet**		
GROSS WALL AREA		FENESTRATION AREA	
NET WALL AREA		DESIGN HOUR TEMPERATURE	

A Sample Heat Loss Calculation

AREA OF FOOTPRINT		PERIMETER	
20 X40	**800 square feet**	**20+20+40+40**	**120 linear feet**
VOLUME OF HOUSE			
800 X 8	**6,400 cubic feet**		
GROSS WALL AREA		FENESTRATION AREA	
120 x 8	**960 square feet**		
NET WALL AREA		DESIGN HOUR TEMPERATURE	

A Sample Heat Loss Calculation

AREA OF FOOTPRINT		PERIMETER	
20 X40	**800 square feet**	**20+20+40+40**	**120 linear feet**
VOLUME OF HOUSE			
800 X 8	**6,400 cubic feet**		
GROSS WALL AREA		FENESTRATION AREA	
120 x 8	**960 square feet**	**100+63**	**163 square feet**
NET WALL AREA		DESIGN HOUR TEMPERATURE	

A Sample Heat Loss Calculation

AREA OF FOOTPRINT		PERIMETER	
20 X40	**800 square feet**	**20+20+40+40**	**120 linear feet**
VOLUME OF HOUSE			
800 X 8	**6,400 cubic feet**		
GROSS WALL AREA		FENESTRATION AREA	
120 x 8	**960 square feet**	**100+63**	**163 square feet**
NET WALL AREA	**960-163= 797 sq ft**	DESIGN HOUR TEMPERATURE	

A Sample Heat Loss Calculation

AREA OF FOOTPRINT		PERIMETER	
20 X40	**800 square feet**	**20+20+40+40**	**120 linear feet**
VOLUME OF HOUSE			
800 X 8	**6,400 cubic feet**		
GROSS WALL AREA		FENESTRATION AREA	
120 x 8	**960 square feet**	**100+63**	**163 square feet**
NET WALL AREA	**960-163= 797 sq ft**	DESIGN HOUR TEMPERATURE	**-20F**

DESIGN HOUR HEAT LOSS					
COMPONANT	R-VALUE	U-FACTOR	AREA	ΔT	U x A x Δ T
FLOOR	R-10		800 sq ft	15	
WALL	R-19		797 sq ft	90	
WINDOW		U-0.35	100 sq ft	90	
DOOR		U-0.35	63 sq ft	90	
CEILING	R-38		800 sq ft	90	

DESIGN HOUR HEAT LOSS					
COMPONANT	R-VALUE	U-FACTOR	AREA	ΔT	U x A x Δ T
FLOOR	R-10	1/10=0.1	800 sq ft	15	
WALL	R-19	1/19= .0526	797 sq ft	90	
WINDOW		U-0.35	100 sq ft	90	
DOOR		U-0.35	63 sq ft	90	
CEILING	R-38	1/38= .0263	800 sq ft	74	
TOTAL CONDUCTIVE HEAT LOSS					

DESIGN HOUR HEAT LOSS					
COMPONANT	R-VALUE	U-FACTOR	AREA	ΔT	U x A x Δ T
FLOOR	R-10	1/10=0.1	800 sq ft	15	0.1 x 800 x 15 = 1,200
WALL	R-19	1/19= .0526	797 sq ft	90	
WINDOW		U-0.35	100 sq ft	90	
DOOR		U-0.35	63 sq ft	90	
CEILING	R-38	1/38= .0263	800 sq ft	90	
TOTAL CONDUCTIVE HEAT LOSS					

DESIGN HOUR HEAT LOSS					
COMPONANT	R-VALUE	U-FACTOR	AREA	ΔT	U x A x Δ T
FLOOR	R-10	1/10=0.1	800 sq ft	15	0.1 x 800 x 15 = 1,200
WALL	R-19	1/19= .0526	797 sq ft	90	0.0526 x 797 x 90 = 3,773
WINDOW		U-0.35	100 sq ft	90	
DOOR		U-0.35	63 sq ft	90	
CEILING	R-38	1/38= .0263	800 sq ft	90	
TOTAL CONDUCTIVE HEAT LOSS					

DESIGN HOUR HEAT LOSS					
COMPONANT	R-VALUE	U-FACTOR	AREA	ΔT	U x A x Δ T
FLOOR	R-10	1/10=0.1	800 sq ft	15	0.1 x 800 x 15 = 1,200
WALL	R-19	1/19= .0526	797 sq ft	90	0.0526 x 797 x 90 = 3,773
WINDOW		U-0.35	100 sq ft	90	0.35 x 100 x 90 = 3,150
DOOR		U-0.35	63 sq ft	90	
CEILING	R-38	1/38= .0263	800 sq ft	90	
TOTAL CONDUCTIVE HEAT LOSS					

DESIGN HOUR HEAT LOSS					
COMPONANT	R-VALUE	U-FACTOR	AREA	ΔT	U x A x Δ T
FLOOR	R-10	1/10=0.1	800 sq ft	15	0.1 x 800 x 15 = 1,200
WALL	R-19	1/19= .0526	797 sq ft	90	0.0526 x 797 x 90 = 3,773
WINDOW		U-0.35	100 sq ft	90	0.35 x 100 x 90 = 3,150
DOOR		U-0.35	63 sq ft	90	0.35 x 63 x 90 = 1,984
CEILING	R-38	1/38= .0263	800 sq ft	90	
TOTAL CONDUCTIVE HEAT LOSS					

DESIGN HOUR HEAT LOSS					
COMPONANT	R-VALUE	U-FACTOR	AREA	ΔT	U x A x Δ T
FLOOR	R-10	1/10=0.1	800 sq ft	15	0.1 x 800 x 15 = 1,200
WALL	R-19	1/19= .0526	797 sq ft	90	0.0526 x 797 x 90 = 3,773
WINDOW		U-0.35	100 sq ft	90	0.35 x 100 x 90 = 3,150
DOOR		U-0.35	63 sq ft	90	0.35 x 63 x 90 = 1,984
CEILING	R-38	1/38= .0263	800 sq ft	90	.0263 x 800 x 90 = 1,894
TOTAL CONDUCTIVE HEAT LOSS					

DESIGN HOUR HEAT LOSS					
COMPONANT	R-VALUE	U-FACTOR	AREA	ΔT	U x A x Δ T
FLOOR	R-10	1/10=0.1	800 sq ft	15	0.1 x 800 x 15 = 1,200
WALL	R-19	1/19= .0526	797 sq ft	90	0.0526 x 797 x 90 = 3,773
WINDOW		U-0.35	100 sq ft	90	0.35 x 100 x 90 = 3,150
DOOR		U-0.35	63 sq ft	90	0.35 x 63 x 90 = 1,985
CEILING	R-38	1/38= .0263	800 sq ft	90	.0263 x 800 x 90 = 1,895
TOTAL CONDUCTIVE HEAT LOSS					12002

AIR INFILTRATION CFM NATURAL	CFM NATURAL	MINUTES IN AN HOUR	Δ T	0.018 x CFM x 60 x Δ T
0.018	37 cfm	60	90	
CONDUCTIVE HEAT LOSS (FROM ABOVE)				
TOTAL HEAT LOSS DURING DESIGN HOUR CONTITIONS				
REQUIRED HEATING SYSTEM SIZE TOTAL HEAT LOSS/AFUE				TOTAL HEAT LOSS/AFUE
			78%	
			85%	
			90%	
			95%	

AIR INFILTRATION CFM NATURAL	CFM NATURAL	MINUTES IN AN HOUR	Δ T	0.018 x CFM x 60 x Δ T
0.018	**37 cfm**	**60**	**90**	**3,596 BTU**
CONDUCTIVE HEAT LOSS (FROM ABOVE)				
TOTAL HEAT LOSS DURING DESIGN HOUR CONTITIONS				
REQUIRED HEATING SYSTEM SIZE TOTAL HEAT LOSS/AFUE				TOTAL HEAT LOSS/AFUE
			78%	
			85%	
			90%	
			95%	

AIR INFILTRATION CFM NATURAL	CFM NATURAL	MINUTES IN AN HOUR	Δ T	0.018 x CFM x 60 x Δ T
0.018	**37 cfm**	**60**	**90**	**3,596 BTU**
CONDUCTIVE HEAT LOSS (FROM ABOVE)				**12,002 BTU**
TOTAL HEAT LOSS DURING DESIGN HOUR CONTITIONS				
REQUIRED HEATING SYSTEM SIZE TOTAL HEAT LOSS/AFUE				TOTAL HEAT LOSS/AFUE
			78%	
			85%	
			90%	
			95%	

AIR INFILTRATION CFM NATURAL	CFM NATURAL	MINUTES IN AN HOUR	Δ T	0.018 x CFM x 60 x Δ T
0.018	**37 cfm**	**60**	**90**	**3,596 BTU**
CONDUCTIVE HEAT LOSS (FROM ABOVE)				**12,002 BTU**
TOTAL HEAT LOSS DURING DESIGN HOUR CONTITIONS				**15,598 BTU**
REQUIRED HEATING SYSTEM SIZE TOTAL HEAT LOSS/AFUE				TOTAL HEAT LOSS/AFUE
			78%	
			85%	
			90%	
			95%	

AIR INFILTRATION CFM NATURAL	CFM NATURAL	MINUTES IN AN HOUR	Δ T	0.018 x CFM x 60 x Δ T
0.018	**37 cfm**	**60**	**90**	**3,596 BTU**
CONDUCTIVE HEAT LOSS (FROM ABOVE)				**12,002 BTU**
TOTAL HEAT LOSS DURING DESIGN HOUR CONTITIONS				**15,598 BTU**
REQUIRED HEATING SYSTEM SIZE TOTAL USING HEAT LOSS/AFUE (Output Side)				TOTAL HEAT LOSS/AFUE (Input side)
15,598/0.78			78%	**19,997 BTU**

AIR INFILTRATION CFM NATURAL	CFM NATURAL	MINUTES IN AN HOUR	Δ T	0.018 x CFM x 60 x Δ T
0.018	**37 cfm**	**60**	**90**	**3,596 BTU**
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REQUIRED HEATING SYSTEM SIZE TOTAL USING HEAT LOSS/AFUE (Output Side)				TOTAL HEAT LOSS/AFUE (input side)
15,598/0.78			78%	**19,997 BTU**
15,598/0.85			85%	**18,350 BTU**

AIR INFILTRATION CFM NATURAL	CFM NATURAL	MINUTES IN AN HOUR	Δ T	0.018 x CFM x 60 x Δ T
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CONDUCTIVE HEAT LOSS (FROM ABOVE)				**12,002 BTU**
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REQUIRED HEATING SYSTEM SIZE TOTAL USING HEAT LOSS/AFUE (Output Side)				TOTAL HEAT LOSS/AFUE (input side)
15,598 /0.78			78%	**19,997 BTU**
15,598 /0.85			85%	**18,350 BTU**
15,598 /0.90			90%	**17,331 BTU**

AIR INFILTRATION CFM NATURAL	CFM NATURAL	MINUTES IN AN HOUR	Δ T	0.018 x CFM x 60 x Δ T
0.018	**37 cfm**	**60**	**90**	**3,596 BTU**
CONDUCTIVE HEAT LOSS (FROM ABOVE)				**12,002 BTU**
TOTAL HEAT LOSS DURING DESIGN HOUR CONTITIONS				**15,598 BTU**
REQUIRED HEATING SYSTEM SIZE TOTAL USING HEAT LOSS/AFUE (Output Side)				TOTAL HEAT LOSS/AFUE (input side)
15,598 /0.78			78%	**19,997 BTU**
15,598 /0.85			85%	**18,350 BTU**
15,598 /0.90			90%	**17,331 BTU**
15,598/0.95			95%	**16,419 BTU**

Furnace Over sizing?

- Furnace sizing is done based on input rating, output rating, AFUE and efficiency of the furnace and is done using ACCA manual S or comes from the product manufacturers catalog utilizing the input/output ratings

Furnace Sizing

- We use the total Btu's (Heat Loss) of the building to size heating and cooling appliances.

Furnace Sizing

- We use the total Btu's (Heat Loss) of the building to size heating and cooling appliances.

- Here's another example

Assuming we have a total heat loss on a structure of 39,311, what is the minimum size furnace that can be installed in the building If the Furnace Efficiency rating is 80%

Assuming we have a total heat loss on a structure of 39,311, what is the minimum size furnace that can be installed in the building

- A 50,000 Btu (Input) Furnace operating at a efficiency rate of 80% would be the minimum size. (this calculation depends on input and efficiency)

Assuming we have a total heat loss on a structure of 39,311, what is the **minimum size** furnace that can be installed in the building

- A 50,000 Btu (Input) Furnace operating at a efficiency rate of 80% would be the minimum size.
- 50,000 input x .80 = 40,000 Maximum output.
  - This would be just enough to accomplish the 39,311 Btu's we need for our example.

Assuming we have a total heat loss on a structure of 39,311, what is the **minimum size** furnace that can be installed in the building

- A 50,000 Btu (Input) Furnace operating at a efficiency rate of 80% would be the minimum size.
- 50,000 x .80 = 40,000 Maximum output.
  - This would be just enough to accomplish the 39,311 Btu's we need for our example.
    - This can change depending on Furnace input and Efficiency of the furnace itself

Assuming we have a total heat loss on a structure of 39,311, what is the **maximum size** furnace that can be installed in the building

- To get the maximum sizing output allowed by code, you take the Btu's of heat loss and multiply it times 1.43.
- Remember this is Maximum output. (base on the input x the efficiency)

Assuming we have a total heat loss on a structure of 39,311, what is the maximum size furnace that can be installed in the building

- **To get the maximum you output allowed by code, you take the Btu's of heat loss and multiply it times 1.43.**
- **This is because heating appliances are allowed in ASHRAE to be oversized by 43%, and cooling appliances 21%. This is what the federal efficiencies standards are based on.**

Impact of Equipment Over sizing

- Reduces equipment life

Impact of Equipment Over sizing

- Reduces equipment life
- Reduces efficiency

Impact of Equipment Over sizing

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- Results in poor dehumidification

Impact of Equipment Over sizing

- Reduces equipment life
- Reduces efficiency
- Results in poor dehumidification
- Reduces filter effectiveness

Lets do the Math

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    - **Remember to always size the maximum out put of a furnace based on the input and its efficiency**
    - **Practice Exercise Follows**

Lets do the Math

- 39,311 + 43% of 39,311 = ?

    - 39,311 x 1.43 = 56,214 maximum Btu's of output

        - **So will a 60,000 Btu Input furnace at 80 % efficiency work.**

Lets do the Math

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    - **Do the Math.**

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    - **So will a 60,000 Btu Input furnace at 80 % efficiency work.**
    - **Do the Math.**
    - **60,000 Btu Input x .80 = 48,000 Btu output**

Lets do the Math

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    - **So will a 60,000 Btu Input furnace at 80 % efficiency work.**
    - **Do the Math.**
    - **60,000 Btu Input x .80 = 48,000 Btu output**
      - **Is this large enough?**

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      - **Is this large enough? Yes**

Lets do the Math

- 39,311 + 43% of 39,311 = ?

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    - **So will a 60,000 Btu Input furnace at 80 % efficiency work.**

    - **Do the Math.**

    - **60,000 Btu Input x .80 = 48,000 Btu output**
      - **Is this large enough? Yes**
      - **Is it too Large?**

Lets do the Math

- 39,311 + 43% of 39,311 = ?

- 39,311 x 1.43 = 56,214 maximum Btu's of output

  - **So will a 60,000 Btu Input furnace at 80 % efficiency work.**

  - **Do the Math.**

  - **60,000 Btu Input x .80 = 48,000 Btu output**
    - **Is this large enough? Yes**
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Cooling Calcs

- Cooling systems are sized using the same concepts only we use a SEER rating instead of a Btu rating and a solar heat gain as opposed to a U factor.

Cooling Calcs

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- This is a change in the calculations only

Cooling Systems: What do they need to Provide for Plan Review

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- Type of system

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- Type of system
- Output rating

Cooling Systems: What do they need to Provide for Plan Review

- Type of system
- Output rating
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Cooling Systems: What do they need to Provide for Plan Review

- Type of system
- Output rating
- SEER
- Manufacturer and model number

Cooling Systems: What do they need to Provide for Plan Review

- Type of system
- Output rating
- SEER
- Manufacturer and model number
- Buildings calculated cooling load and heat gain

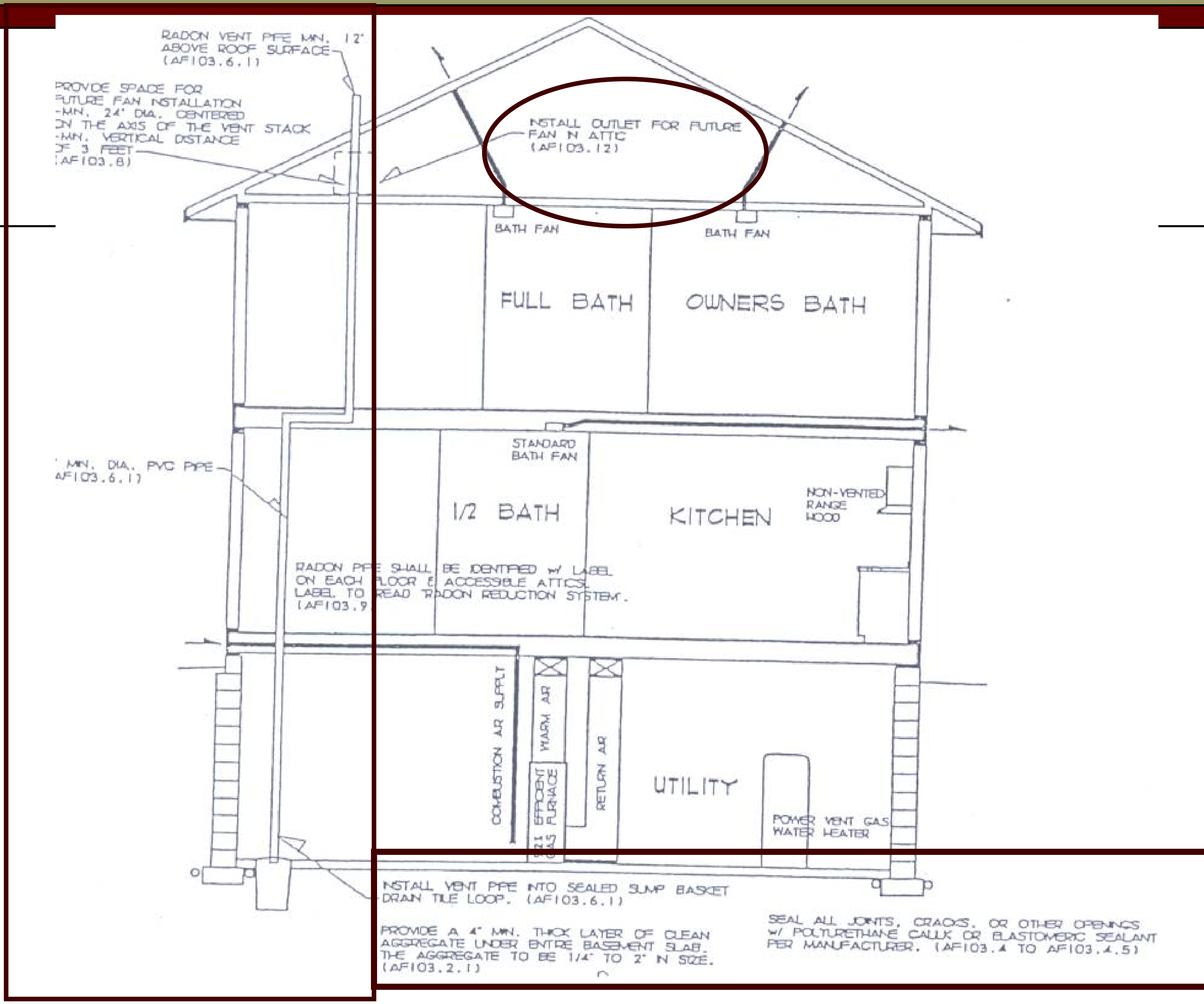
Radon Control System

Radon Control System

- The plans shall indicate the type of Radon control system they are installing in the new residence

Radon Control System

- The plans shall indicate the type of Radon control system they are installing in the new residence
- Passive
- Active


RADON VENT PIPE MIN. 12" ABOVE ROOF SURFACE (AF103.6.1)
PROVIDE SPACE FOR FUTURE FAN INSTALLATION -MIN. 24" DIA. CENTERED ON THE AXIS OF THE VENT STACK -MIN. VERTICAL DISTANCE OF 3 FEET (AF103.8)
INSTALL OUTLET FOR FUTURE FAN IN ATTIC (AF103.12)
BATH FAN
BATH FAN
FULL BATH
OWNERS BATH
STANDARD BATH FAN
MIN. DIA. PVC PIPE AF103.6.1)
1/2 BATH
KITCHEN
NON-VENTED RANGE HOOD
RADON PIPE SHALL BE IDENTIFIED w/ LABEL ON EACH FLOOR & ACCESSIBLE ATTICS. LABEL TO READ 'RADON REDUCTION SYSTEM'. (AF103.9)
COMBUSTION AIR SUPPLY
WARM AIR
RETURN AIR
EFFICIENT GAS FURNACE
UTILITY
POWER VENT GAS WATER HEATER
INSTALL VENT PIPE INTO SEALED SUMP BASKET DRAIN TILE LOOP. (AF103.6.1)
PROVIDE A 4" MIN. THICK LAYER OF CLEAN AGGREGATE UNDER ENTIRE BASEMENT SLAB. THE AGGREGATE TO BE 1/4" TO 2" IN SIZE. (AF103.2.1)
SEAL ALL JOINTS, CRACKS, OR OTHER OPENINGS w/ POLYURETHANE CAULK OR ELASTOMERIC SEALANT PER MANUFACTURER. (AF103.4 TO AF103.4.5)

End of Residential Energy

- Questions?