MINNESOTA DEPARTMENT OF
LABOR & INDUSTRY

2008 Spring Program

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

2008 Spring Seminar
Education Code Section

Sign In Sheet

NAME	AM	PM

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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:

_____

_____

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We would appreciate your suggestions for future seminars:

_____

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Name (optional)

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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……

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Title of Seminar Attended

Presented on _____
Seminar Date

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Attendee's Signature

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

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.

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

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Workers' Compensation Basics

Workers' Compensation Basics

- Covers work-related injuries or illnesses

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Workers' Compensation Basics

- Covers work-related injuries or illnesses
- Any employer that has employees must have coverage (through an insurance policy or self-insurance) --- very few exceptions

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Workers' Compensation Basics

- Covers work-related injuries or illnesses
- Any employer that has employees must have coverage (through an insurance policy or self-insurance) --- very few exceptions
- The department provides assistance to parties that have questions or disputes --- call our hot line at (651) 284-5032 or toll free at (800) 342-5354

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Workers' Compensation Employer Training

Workers' Compensation Employer Training

The department can provide training for employers which may include:

Workers' Compensation Employer Training

The department can provide training for employers which may include:

- Workers' compensation basics
- What to do before and after an injury occurs
- Benefits provided
- What is/is not covered by workers' compensation

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Workers' Compensation Employer Training

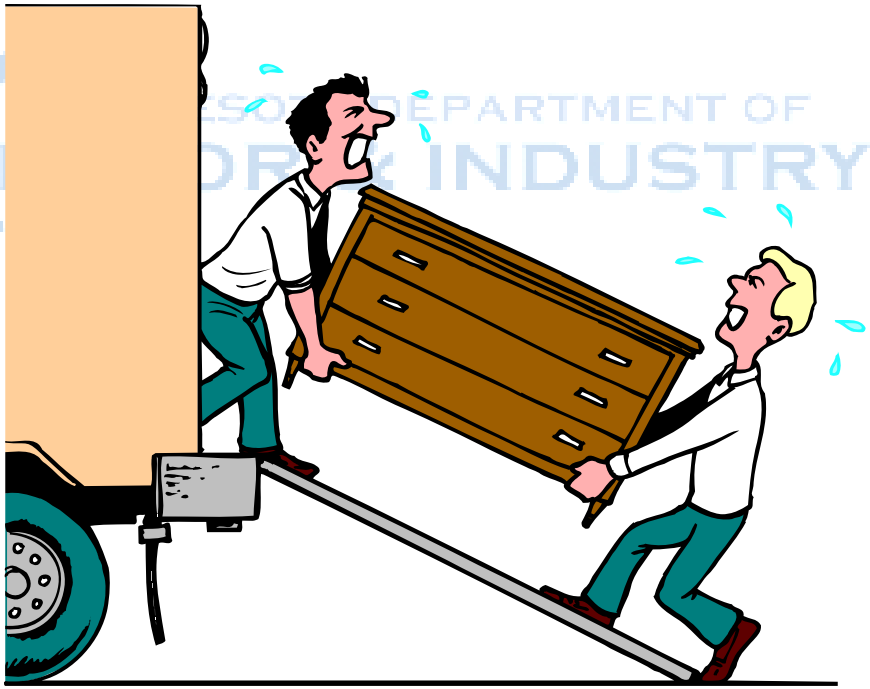
The department can provide training for employers which may include:

- **Workers' compensation basics**
- **What to do before and after an injury occurs**
- **Benefits provided**
- **What is/is not covered by workers' compensation**

For more information, visit our web site at:
www.doli.state.mn.us/workcomp.html

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

“The best way to avoid workers’ compensation problems is to avoid as many injuries as possible.”



Minnesota Rules Chapter 1301

- Inspector Competency Rules

MINNESOTA DEPARTMENT OF
LABOR & INDUSTRY

Definitions

MINNESOTA DEPARTMENT OF
LABOR & INDUSTRY

Definitions

- **Building Construction means;**

MINNESOTA DEPARTMENT OF
LABOR & INDUSTRY

Definitions

- **Building Construction means;**
  - Soils supporting buildings

MINNESOTA DEPARTMENT OF
LABOR & INDUSTRY

Definitions

- **Building Construction means;**
  - Soils supporting buildings
  - Foundations

MINNESOTA DEPARTMENT OF
LABOR & INDUSTRY

Definitions

- **Building Construction means;**
  - Soils supporting buildings
  - Foundations
  - Superstructures

MINNESOTA DEPARTMENT OF
LABOR & INDUSTRY

Definitions

- **Building Construction means;**
  - Soils supporting buildings
  - Foundations
  - Superstructures
  - Building Envelope

MINNESOTA DEPARTMENT OF
LABOR & INDUSTRY

Definitions

- **Building Construction means;**
  - Soils supporting buildings
  - Foundations
  - Superstructures
  - Building Envelope
  - Site work

MINNESOTA DEPARTMENT OF
LABOR & INDUSTRY

Definitions

- **Building Inspection Technology (BIT) course**
  - A building Inspection technology course from a **accredited college or university**.
    - NHCC
    - IHCC
    - SW State
    - Others

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Definitions

- **Designated Building Official**
  - An individual who, as a certified building official, has been designated by a municipality, pursuant to Minnesota Statutes.
  - This has not changed.

MINNESOTA DEPARTMENT OF
LABOR & INDUSTRY

Definitions

- **Construction Code Inspector**
  - A building inspector, mechanical inspector, plumbing inspector, or combination inspector who, under the supervision of a designated Building Official, performs building, plumbing or mechanical inspections.

LABOR & INDUSTRY

Definitions

– **Building Inspector**
  - An individual who, under the supervision of a designated Building Official, inspects building construction and meets the requirements of 1301.1400 subpart 2

MONTANA DEPARTMENT OF
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Definitions

– **Mechanical Inspector**

- An individual who, under the supervision of a designated Building Official, inspects mechanical systems and meets the requirements of 1301.1400 subpart 3.

MINNESOTA DEPARTMENT OF
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Definitions

– **Mechanical Systems**

- A system within the scope of Minnesota Rule Chapter 1346, composed of devices, appliances and equipment

MINNESOTA DEPARTMENT OF
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Definitions

– **Plumbing Inspector**

- An individual who, under the supervision of a designated Building Official, inspects plumbing systems and meets the requirements of 1301.1400 subpart 4.

MINNESOTA DEPARTMENT OF
LABOR & INDUSTRY

Definitions

- **Plumbing system**
  - A system within the scope of Minnesota Rule Chapter 4715, composed of devices, appliances and equipment

MINNESOTA DEPARTMENT OF
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Definitions

– **Combination Inspector;**
  - An individual who, under the supervision of a designated Building Official, inspects building construction, mechanical systems, and plumbing systems.

MINNESOTA DEPARTMENT OF
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Definitions

– **One Year Experience**

- One year of experience means 1800 hours of time occurring within 12 consecutive months.

MINNESOTA DEPARTMENT OF
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Minimum Competency Criteria

- An individual conducting construction code inspections **MUST** meet minimum competency criteria
  - Exemption;
    - Individuals holding a current certification as a “building official” or “building official, limited”under Minnesota Statute.

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Minimum Competency Criteria

- All construction code inspectors hired on or after January 1, 2008, shall within one year of hire, be in compliance with the Competency Criteria.

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Minimum Competency Criteria

MINNESOTA DEPARTMENT OF
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Minimum Competency Criteria

- **Building Inspector;** to conduct the activities of a building inspector, an individual must **meet at least one of the following minimum competency criteria**

MINNESOTA DEPARTMENT OF
LABOR & INDUSTRY

Minimum Competency Criteria

- **Building Inspector;** to conduct the activities of a building inspector, an individual must meet at least one of the following minimum competency criteria
  - 3 years experience in construction with specific skilled participation in the construction of foundations and superstructures

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Minimum Competency Criteria

- **Building Inspector;** to conduct the activities of a building inspector, an individual must meet at least one of the following minimum competency criteria
  - 3 years experience in construction with specific skilled participation in the construction of foundations and superstructures
  - 5 years experience in the complete design of buildings

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Minimum Competency Criteria

- **Building Inspector;** to conduct the activities of a building inspector, an individual must meet at least one of the following minimum competency criteria
  - 3 years experience in construction with specific skilled participation in the construction of foundations and superstructures
  - 5 years experience in the complete design of buildings
  - Successful completion of 2 or more BIT courses in building construction

Minimum Competency Criteria

- **Building Inspector (cont.)**
  - Vocational or trade school diploma or equivalent education related to building construction

MINNESOTA DEPARTMENT OF
LABOR & INDUSTRY

Minimum Competency Criteria

- **Building Inspector (cont.)**
  - Vocational or trade school diploma or equivalent education related to building construction
  - Bachelors degree or more in architecture, engineering, or construction management

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Minimum Competency Criteria

- **Building Inspector (cont.)**
  - Vocational or trade school diploma or equivalent education related to building construction
  - Bachelors degree or more in architecture, engineering, or construction management
  - National certification as a building inspector by a national code group

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Minimum Competency Criteria

- **Building Inspector (cont.)**
  - Vocational or trade school diploma or equivalent education related to building construction
  - Bachelors degree or more in architecture, engineering, or construction management
  - National certification as a building inspector by a national code group
  - 2 years experience conducting building inspections while under the supervision of a Minnesota Certified Building Official

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Minimum Competency Criteria

- **Mechanical Inspector** to conduct the activities of a mechanical inspector, an individual must **meet at least one of the following minimum competency criteria**

MINNESOTA DEPARTMENT OF
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Minimum Competency Criteria

- **Mechanical Inspector** to conduct the activities of a mechanical inspector, an individual must meet at least one of the following minimum competency criteria
  - 3 years experience in the installation or design of mechanical systems

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Minimum Competency Criteria

- **Mechanical Inspector** to conduct the activities of a mechanical inspector, an individual must meet at least one of the following minimum competency criteria
  - 3 years experience in the installation or design of mechanical systems
  - Successful completion of 2 or more BIT courses with at least 1 course specifically related to mechanical systems

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Minimum Competency Criteria

- **Mechanical Inspector** to conduct the activities of a mechanical inspector, an individual must meet at least one of the following minimum competency criteria
  - 3 years experience in the installation or design of mechanical systems
  - Successful completion of 2 or more BIT courses with at least 1 course specifically related to mechanical systems
  - Vocational or trade school diploma or equivalent education related to mechanical systems

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Minimum Competency Criteria

- **Mechanical Inspector** to conduct the activities of a mechanical inspector, an individual must meet at least one of the following minimum competency criteria
  - 3 years experience in the installation or design of mechanical systems
  - Successful completion of 2 or more BIT courses with at least 1 course specifically related to mechanical systems
  - Vocational or trade school diploma or equivalent education related to mechanical systems
  - Bachelors degree or more in architecture or engineering.

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Minimum Competency Criteria

- **Mechanical Inspector** to conduct the activities of a mechanical inspector, an individual must meet at least one of the following minimum competency criteria
  - National certification in mechanical systems inspections

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Minimum Competency Criteria

- **Plumbing Inspector** to conduct the activities of a plumbing inspector, an individual **must meet at least one of the following minimum competency criteria**

MINNESOTA DEPARTMENT OF
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Minimum Competency Criteria

- **Plumbing Inspector** to conduct the activities of a plumbing inspector, an individual must meet at least one of the following minimum competency criteria
  - 3 years experience in the installation or design of plumbing systems, that is obtained in compliance with Minnesota plumbing license laws

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Minimum Competency Criteria

- **Plumbing Inspector** to conduct the activities of a plumbing inspector, an individual must meet at least one of the following minimum competency criteria
  - 3 years experience in the installation or design of plumbing systems, that is obtained in compliance with Minnesota plumbing license laws
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MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

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  - 3 years experience in the installation or design of plumbing systems, that is obtained in compliance with Minnesota plumbing license laws
  - Successful completion of 2 or more BIT courses with at least one course specifically related to plumbing systems
  - Vocational or trade school diploma or equivalent education related to plumbing systems
  - Bachelors degree or more in architecture or engineering.

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Minimum Competency Criteria

- **Plumbing Inspector;** to conduct the activities of a plumbing inspector, an individual must meet at least one of the following minimum competency criteria
  - National certification in plumbing systems inspections

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Minimum Competency Criteria

- **Combination Inspector;** to conduct the activities of a combination inspector, an individual **must meet the minimum competency criteria for building, mechanical, and plumbing inspectors.**

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Continuing Education

- **Mandatory education; each construction code inspector must annually meet the requirements for continuing education and provide that documentation to the designated building official, who must retain this evidence for 3 years.**

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Continuing Education

- **Building, Mechanical and Plumbing Inspectors**
  - 15 hours annually is required
  - 6 hours must be in the discipline in which the individual meets the competency criteria

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Continuing Education

- **Combination Inspectors**
  - 20 hours annually is required
  - 6 hours must be each discipline

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Minnesota's New Commercial Energy Code

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History

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History

- First Energy Code Became effective on January 30, 1976

MINNESOTA DEPARTMENT OF
LABOR & INDUSTRY

History

- First Energy Code Became effective on January 30, 1976
- Model Energy Code Phase
  - 1982-1992

MINNESOTA DEPARTMENT OF
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History

- First Energy Code Became effective on January 30, 1976
- Model Energy Code Phase
  - 1982-1992
- Chapter 7676
  - July 20, 1999

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Objective

- To provide a look at the **new** Minnesota Commercial Energy Code that, when adopted, will replace the existing Chapter 7676 (All buildings except low-rise Residential).
- Note:
  1. 7676 based heavily on ASHRAE 90.1-1989
  2. New Energy code is called Minnesota Rule Chapter 1323 and uses ASHRAE 90.1-2004 as amended

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Why is Standard 90.1-2004 important?

- It replaces ANSI/ASHRAE/IESNA Standard 90.1-2001

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Why is Standard 90.1-2004 important?

- It replaces ANSI/ASHRAE/IESNA Standard 90.1-2001
- It is the reference standard for the 2006 IECC

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Why is Standard 90.1-2004 important?

- It replaces ANSI/ASHRAE/IESNA Standard 90.1-2001
- It proposed to be the reference standard for the 2006 IECC
- It is proposed to be the commercial building energy reference in NFPA 5000, NFPA's family of building codes

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Why is Standard 90.1-2004 important?

- It replaces ANSI/ASHRAE/IESNA Standard 90.1-2001
- It proposed to be the reference standard for the 2006 ICC IECC
- It is proposed to be the commercial building energy reference in NFPA 5000, NFPA's family of building codes
- It is the professional "standard of care" set by ASHRAE

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Energy Efficient

- Of the energy used in the operation of buildings today, 1/3 is directly effected by the efficiency of the building envelope.

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- The remaining 2/3 is mechanical

Department of Energy (DOE) Interest

- As required in the Energy Policy Act of 1992, DOE has “determined” that Standard 90.1-1999 saves energy over Standard 90.1-1989 and states now have two years from July 15, 2002 to notify DOE that they have adopted a commercial energy code that meets or exceeds Standard 90.1-1999
- DOE has determined the savings for Standard 90.1-2004 meets or exceeds the 1999 document.

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Minnesota Rule Chapter 1323 will replace Chapter:

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Chapter 7676 “All Buildings Except for Low-Rise Residential”

7676 – 1999 Minnesota Energy Code

- Based heavily on ASHRAE 90.1 – 1989
  - 90.1 – 1989 was intended to be a guideline - not a code.

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7676 – 1999 Minnesota Energy Code

- Based heavily on ASHRAE 90.1 – 1989
  - 90.1 – 1989 was intended to be a guideline - not a code.
  - Used "non-code" language

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7676 – 1999 Minnesota Energy Code

- Based heavily on ASHRAE 90.1 – 1989
  - 90.1 – 1989 was intended to be a guideline - not a code.
  - Used "non-code" language
  - Rule of thumb requirements that were not based on research or calculations.

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Standard 90.1-2004

- Developed jointly by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) and the Illuminating Engineering Society of North America (IESNA)

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- Developed under American National Standards Institute (ANSI) consensus guidelines

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- Developed under American National Standards Institute (ANSI) consensus guidelines

- Modified to meet the particular conditions in Minnesota

Standard 90.1-2004

- Developed with participation from many building and construction organizations including:
  - American Institute of Architects (AIA)

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Standard 90.1-2004

- Developed with participation from many building and construction organizations including:
  - American Institute of Architects (AIA)
  - Building Owners and Managers Association (BOMA)

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Standard 90.1-2004

- Developed with participation from many building and construction organizations including:
  - American Institute of Architects (AIA)
  - Building Owners and Managers Association (BOMA)
  - North American Insulation Manufacturer's Association (NAIMA)

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  - North American Insulation Manufacturer's Association (NAIMA)
  - Air-Conditioning and Refrigeration Institute (ARI)

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  - Air-Conditioning and Refrigeration Institute (ARI)
  - Gas Appliance Manufacturers Association (GAMA)

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Key Features of Recent Versions of Standard 90.1

1. Mandatory, enforceable language

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2. Based on life cycle costing

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1. Mandatory, enforceable language
2. Based on life cycle costing
3. True prescriptive (vs performance) paths

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Key Features of Recent Versions of Standard 90.1

1. Mandatory, enforceable language
2. Based on life cycle costing
3. True prescriptive (vs performance) paths
4. Extensive treatment of retrofits and renovations

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Key Features of Recent Versions of Standard 90.1

1. Mandatory, enforceable language
2. Based on life cycle costing
3. True prescriptive (vs performance) paths
4. Extensive treatment of retrofits and renovations
5. Explicit treatment of minimally conditioned buildings

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Key Features of Recent Versions of Standard 90.1

1. Mandatory, enforceable language
2. Based on life cycle costing
3. True prescriptive (vs performance) paths
4. Extensive treatment of retrofits and renovations
5. Explicit treatment of minimally conditioned buildings
6. Simplified climate zones

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1:Mandatory, Enforceable Language

- Standard 90.1-2004 is a code-intended standard. As such, it is written in **unambiguous language** intended to allow a code official to say "**that complies" or "that doesn't"**

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

1:Mandatory, Enforceable Language

- Standard 90.1-2004 is a code-intended standard. As such, it is written in unambiguous language intended to allow a code official to say “that complies” or “that doesn’t”
- There are no “shoulds”, “coulds” or “shall consider” phrases – just lots of “shalls”

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

1:Mandatory, Enforceable Language

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- There are no “shoulds”, “coulds” or “shall consider” phrases – just lots of “shalls”
- It’s a DECISION TOOL

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#2: Based on Consistent Economic Criteria-Life Cycle Costing

- "SAVE THE GREENBACKS"

- While previous ASHRAE standards were based on professional judgment combined with analysis of energy and cost impacts, Standard 90.1-2004 is the most recent attempt to use consistent economic criteria as the basis for requirements. (ROI)

#3: True Prescriptive Paths

- Anyone who has ever tried to use the tables in Standard 90.1-1989 knows that there is not a true prescriptive path for envelope in the older ASHRAE standards.

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#3: True Prescriptive Paths

- Anyone who has ever tried to use the tables in Standard 90.1-1989 knows that there is not a true prescriptive path for envelope in the older ASHRAE standards.
- One of the “code friendly” features of codes is that they do have a simple prescriptive path for all buildings.

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#4: Renovations and Retrofits

- ASHRAE Standards before Standard 90.1-1999 were more or less silent on the concept. All standards were designed for "new construction" but what does that mean?

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#4: Renovations and Retrofits

- ASHRAE Standards before Standard 90.1-1999 were more or less silent on the concept. All standards were designed for "new construction" but what does that mean?
- ASHRAE worked with BOMA on Chapter 4 to develop detailed rules for how Standard 90.1-2004 should be applied to renovations and retrofits.

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#5: Minimally Conditioned Buildings

- Buildings that are minimally conditioned or minimally used should not need as stringent energy requirements as buildings that are fully conditioned or fully used.

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#5: Minimally Conditioned Buildings

- Buildings that are minimally conditioned or minimally used should not need as stringent energy requirements as buildings that are fully conditioned or fully used.
- Standard 90.1-1999 took a first step in dealing with minimally conditioned buildings in its' semi-heated space envelope requirements, and these requirements are contained in Standard 90.1-2004

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#6: Simplified Climate Zones

- Standard 90.1-2004 uses climate zones developed for the the US on a county-by-county basis and expressed in map form.

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#6: Simplified Climate Zones

- Standard 90.1-2004 uses climate zones developed for the the U.S. on a county-by-county basis and expressed in map form.
- The map is the same map used in recent versions of the IECC, and above code documents like ASHRAE's Advanced Energy Design Guide for Small Office Buildings.

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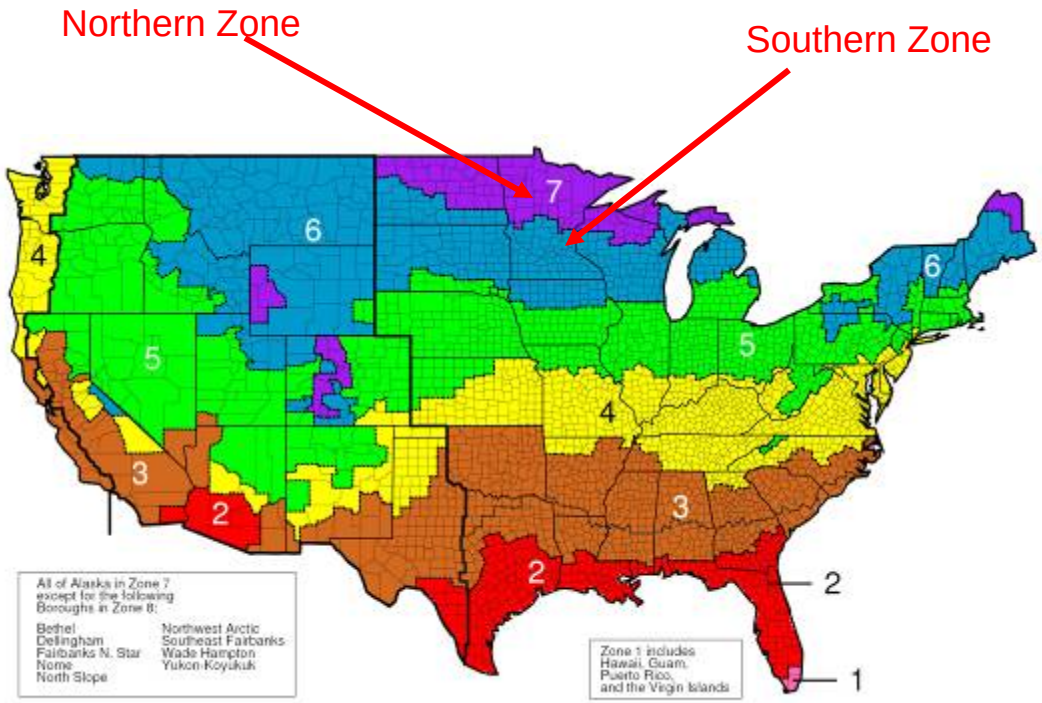
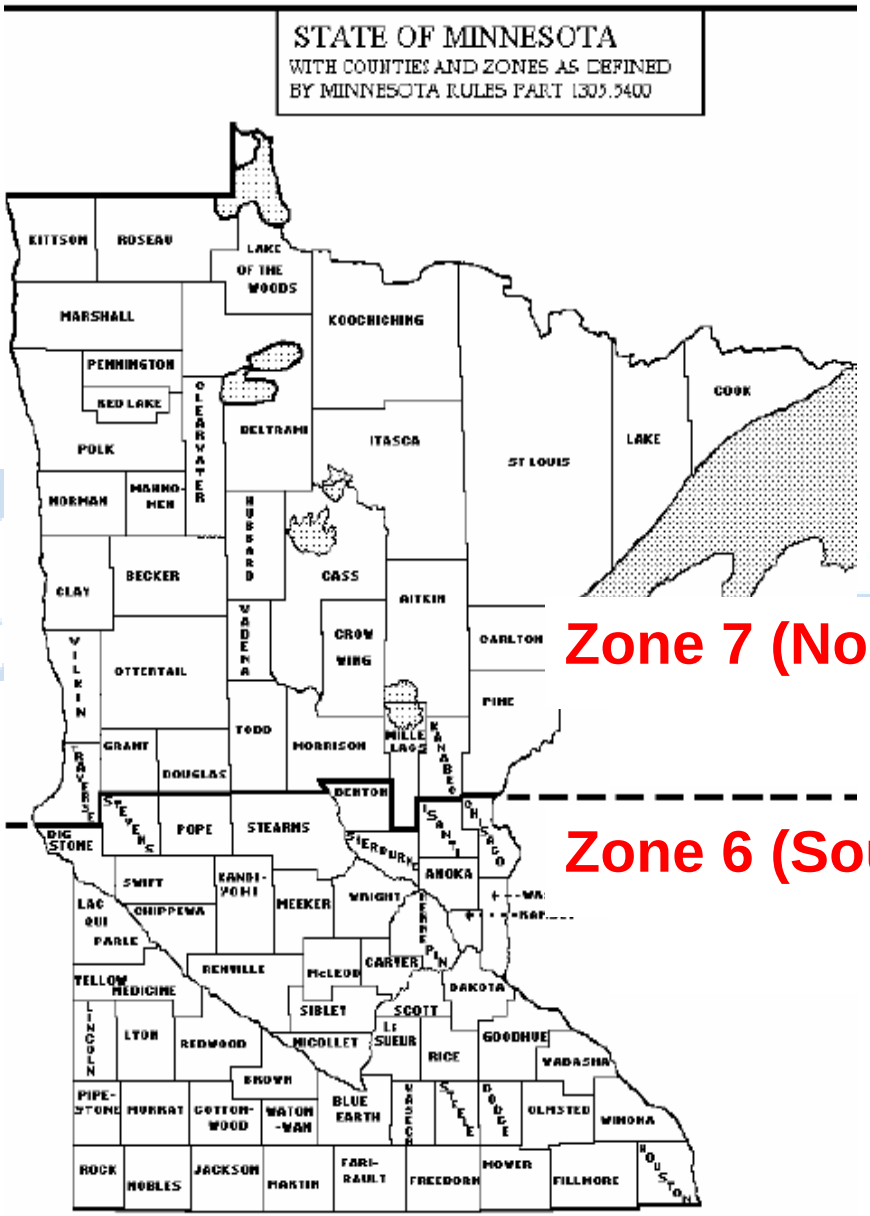
Climate

- Zones based on several climatic parameters and expressed in map shown in Figure B-1.



Climate Zones



Zone 7 (Northern)

Zone 6 (Southern)

Organization of Standard 90.1

1 Purpose
2 Scope
3 Definitions
4 Administration and Enforcement
5 Building Envelope
6 Heating, Ventilating, and Air-Conditioning
7 Service Water Heating
8 Power
9 Lighting
10 Other Equipment
11 Energy Cost Budget Method
12 Normative References

Appendices-----

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Appendices

NORMATIVE

A Rated R-value of Insulation and Assembly U-, C-, and F-Factor Determinations

B Building Envelope Climate Criteria

C Methodology for Building Envelope Trade-Off in Subsection 5.6

D Climatic Data

INFORMATIVE

E Informative References

F Addenda Description Information

G Performance Rating Method

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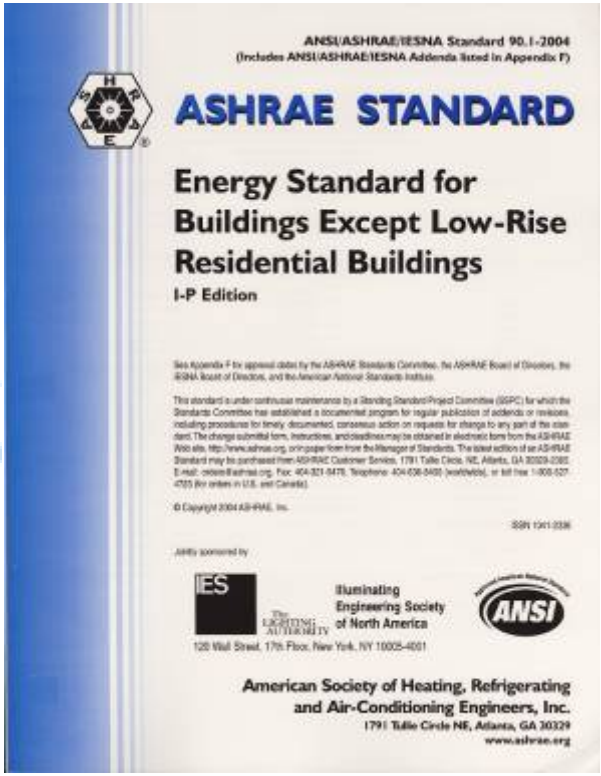
Section 1 - Purpose

The purpose of this standard is to provide minimum requirements for the energy-efficient design of buildings except low-rise residential buildings


ANSI/ASHRAE/IESNA Standard 90.1-2004
(Includes ANSI/ASHRAE/IESNA Addenda listed in Appendix F)

ASHRAE STANDARD

Energy Standard for Buildings Except Low-Rise Residential Buildings

I-P Edition

Illuminating Engineering Society of North America

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
1791 Tullie Circle NE, Atlanta, GA 30329
www.ashrae.org

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Section 2 - Scope

- New buildings and their systems
- New *portions* of buildings and their systems (additions)
- New systems and equipment in *existing* buildings (alterations)

Section 2 – Scope *(cont'd)*

- Envelope
  - if heated by a heating system with an output capacity $\geq$ 3.4 btu/h-ft^2 or
  - if cooled by a cooling system with a sensible output $\geq$ 5 btu/h-ft^2
- Virtually all mechanical and lighting systems are covered
- **MA: Covers bldgs not regulated by MR 1322 (Residential Energy Code).**

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Scope

- Chapter 2 lists what types of construction and building systems fall within the standard and what types of construction and systems fall outside the standard.

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Scope

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- The point of this in the codes world is “what is exempt?” So, what are some exemptions……?

Scope Exemptions (4 examples)

1. Single-family houses, multi-family structures of 3 stories or fewer above grade, manufactured houses (mobile homes- addressed with MN Rule 1350-Federal), and manufactured houses (modular- addressed with MN Rules 1360, 1361)

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Scope Exemptions (4 examples)

2. Buildings that do not use either electricity or fossil fuel

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Scope Exemptions (4 examples)

3. Equipment and portions of building systems that use energy primarily to provide for industrial, manufacturing, or commercial purposes.

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Scope Exemptions (4 examples)

4. Envelope may be exempt if building has small enough heating and cooling systems

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Chapter 3: Definitions

- Provides over 11 pages of specifically defined terms, abbreviations, and acronyms
- These are definitions that are “above and beyond” ordinarily excepted meanings.
- Defined terms are noted in *italics* in the text of the standard.

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Definitions- Example

- *R-value computation for concrete masonry block wall assembly with integral insulation:* The thermal performance of a concrete masonry block wall assembly with integral insulation must be determined by one of the two following methods. Foundation wall assembly R-values must exclude air film coefficients and the R-value of the surrounding soil.
  - (a) Thermal performance must be calculated in accordance with ASHRAE Handbook of Fundamentals isothermal planes calculation method. The calculation must be certified by a professional engineer licensed in Minnesota.
  - (b) Thermal performance must be measured in accordance with ASTM C236 test procedure for thermal transmittance measurement performed by an approved laboratory as defined by Minn. Rules Chapter 7640.

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Chapter 4: Administration and Enforcement

- Covers compliance for new buildings, existing buildings, additions to existing buildings, alterations to existing buildings, and changes in space conditioning in existing buildings
- However, Minnesota will use MN Rules Chapter 1300

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Overview – Std 90.1 Building Envelope Requirements- Chapter 5

- Regulates the construction and performance of the exterior building envelope

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- 90.1-Chapter 5 **explicitly does not address moisture control or provide guidance on moisture migration that may lead to condensation, mold, mildew, or insulation or equipment deterioration (MN amendments do)**

Changing Design Conditions

City	Summer Db/Wb ºF 1999	Summer Db/Wb ºF 2006	Winter Db ºF 1999	Winter Db ºF 2006
Albert Lea	87/72	**85/72**	-17	**-15**
Alexandria	88/72	**86/70**	-22	**-21**
Bemidji	85/69	**84/68**	-31	**-24**
Brainerd	87/71	**86/71**	-20	**-20**
Duluth	82/68	**81/67**	-21	**-20**
Faribault	88/72	**86/73**	-17	**-16**
Fergus Falls	88/72	**86/71**	-21	**-21**
Virginia	83/72		-25	
International Falls	83/68	**83/67**	-29	**-28**
Mankato	88/72	**86/72**	-17	**-15**
Minneapolis/St. Paul	89/73	**88/72**	-16	**-15**
Rochester	87/72	**85/72**	-17	**-17**
St. Cloud	88/72	**86/71**	-15	**-20**
Willmar	88/72	**85/71**	-15	**-20**
Winona	88/73	**88/74**	-14	**-13**

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Chapter 5: Envelope Key Concepts

1. Conditioned versus semiheated versus unconditioned space
   - In MN, "…..a space may be designated as either semiheated or unconditioned only if approved by the building official."

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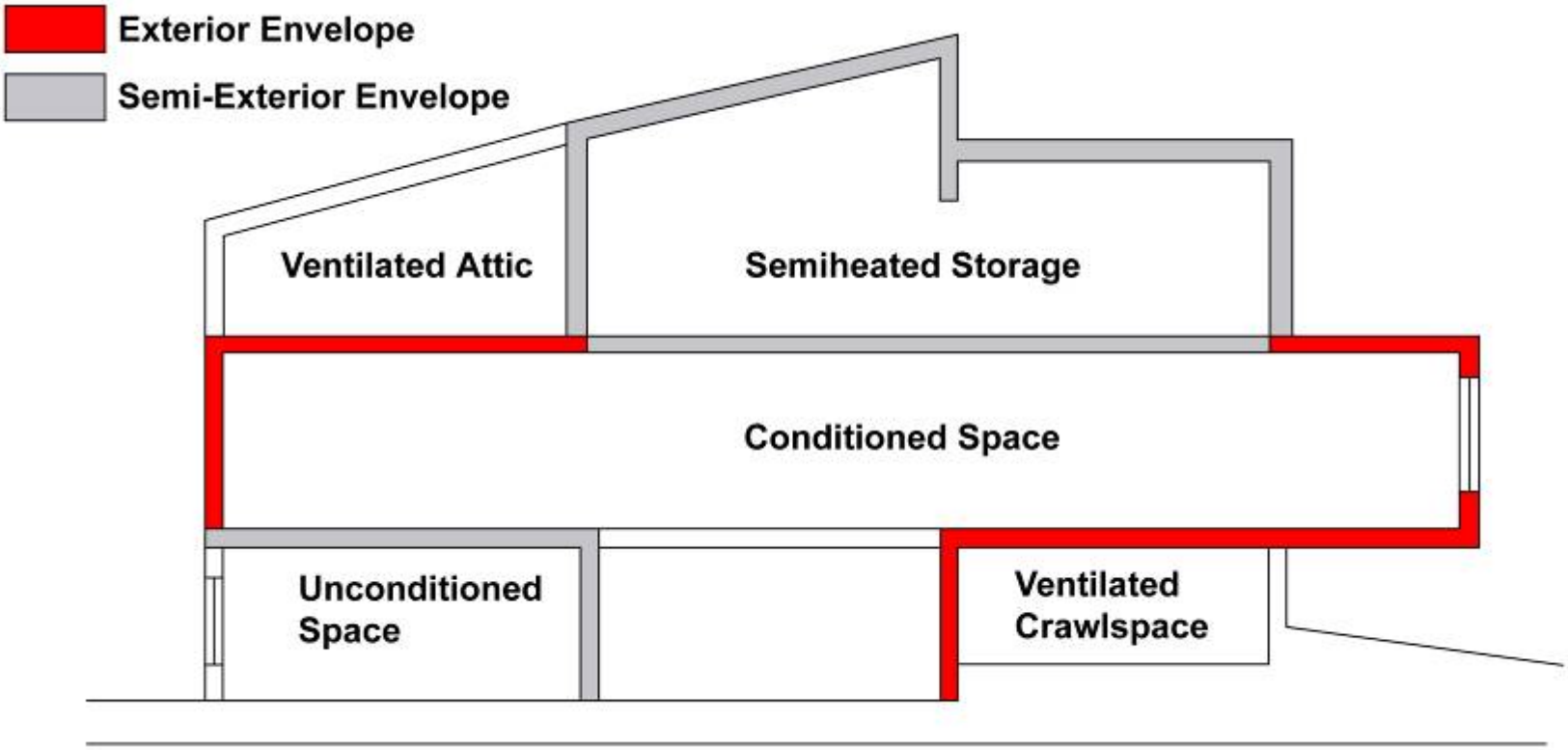
2. 3 categories of CONDITIONED SPACE: Residential versus Nonresidential versus Semi-Heated space
3. Assembly (How is it put together)
4. Climate and building envelope requirements.

Building Envelope



Overview – Std 90.1
Mechanical Requirements

- Chapter 6 (Heating, Ventilating, and Air Conditioning) regulates all mechanical equipment serving building HVAC needs
- Chapter 7 (Service Water Heating) regulates all SWH systems and equipment
- Chapter 10 (Other Equipment) regulates electric motors

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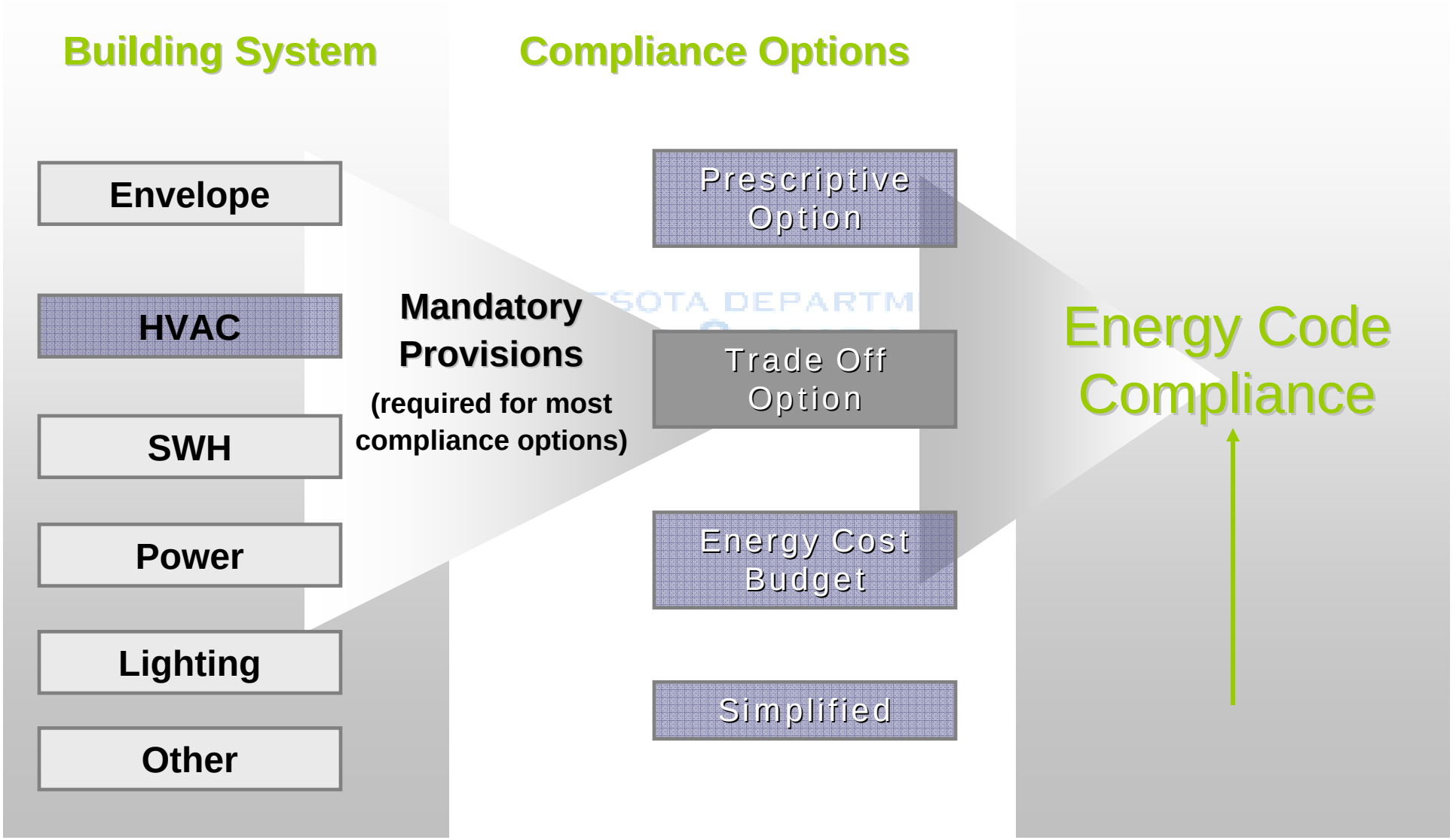
HVAC Compliance



Chapter 6 (Heating, Ventilating and Air Conditioning)

- Offers a simplified approach for small (less than 25,000 ft2), short (less than two stories) buildings with single zone HVAC

- This section is inspiring the development of “small” or “simple” building sections in each chapter of Standard 90.1

Chapter 6 (HVAC for Not-So-Simple Buildings)

- Requires load calculations
- Regulates equipment efficiency
- Requires controls
  - Zone thermostatic, off-hour, ventilation system, heat pump auxiliary heat, humidifier preheat, humidification and dehumidification, freeze protection and snow/ice melting systems, ventilation controls for high-occupancy areas

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Chapter 6 (HVAC for Not-So-Simple Buildings)

- Regulates HVAC system construction and insulation
  - Duct and plenum insulation, piping insulation
  - Duct and plenum leakage
- Requires that construction documents and manuals be provided to the owner
- Requires system balancing in all buildings and *"acceptance testing"* in large buildings

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Chapter 6 (HVAC for Not-So-Simple Buildings)

- Requires economizers (with lots of exceptions)

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Chapter 6 (HVAC for Not-So-Simple Buildings)

- Requires economizers (with lots of exceptions)
- Regulates simultaneous heating and cooling

MINNESOTA DEPARTMENT OF
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Chapter 6 (HVAC for Not-So-Simple Buildings)

- Requires economizers (with lots of exceptions)
- Regulates simultaneous heating and cooling
- Regulates air system design and control

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Chapter 6 (HVAC for Not-So-Simple Buildings)

- Requires economizers (with lots of exceptions)
- Regulates simultaneous heating and cooling
- Regulates air system design and control
- Regulates hydronic system design and control

MINNESOTA DEPARTMENT OF
LABOR & INDUSTRY

Chapter 6 (HVAC for Not-So-Simple Buildings)

- Requires economizers (with lots of exceptions)
- Regulates simultaneous heating and cooling
- Regulates air system design and control
- Regulates hydronic system design and control
- Regulates heat rejection equipment

MINNESOTA DEPARTMENT OF
ENERGY

Chapter 6 (HVAC for Not-So-Simple Buildings)

- Requires economizers (with lots of exceptions)
- Regulates simultaneous heating and cooling
- Regulates air system design and control
- Regulates hydronic system design and control
- Regulates heat rejection equipment
- Requires energy recovery (with exceptions)

MINNESOTA DEPARTMENT OF
ENERGY

Chapter 6 (HVAC for Not-So-Simple Buildings)

- Requires economizers (with lots of exceptions)
- Regulates simultaneous heating and cooling
- Regulates air system design and control
- Regulates hydronic system design and control
- Regulates heat rejection equipment
- Requires energy recovery (with exceptions)
- Regulates exhaust hoods

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Chapter 6 (HVAC for Not-So-Simple Buildings)

- Requires economizers (with lots of exceptions)
- Regulates simultaneous heating and cooling
- Regulates air system design and control
- Regulates hydronic system design and control
- Regulates heat rejection equipment
- Requires energy recovery (with exceptions)
- Regulates exhaust hoods
- Regulates radiant heating systems

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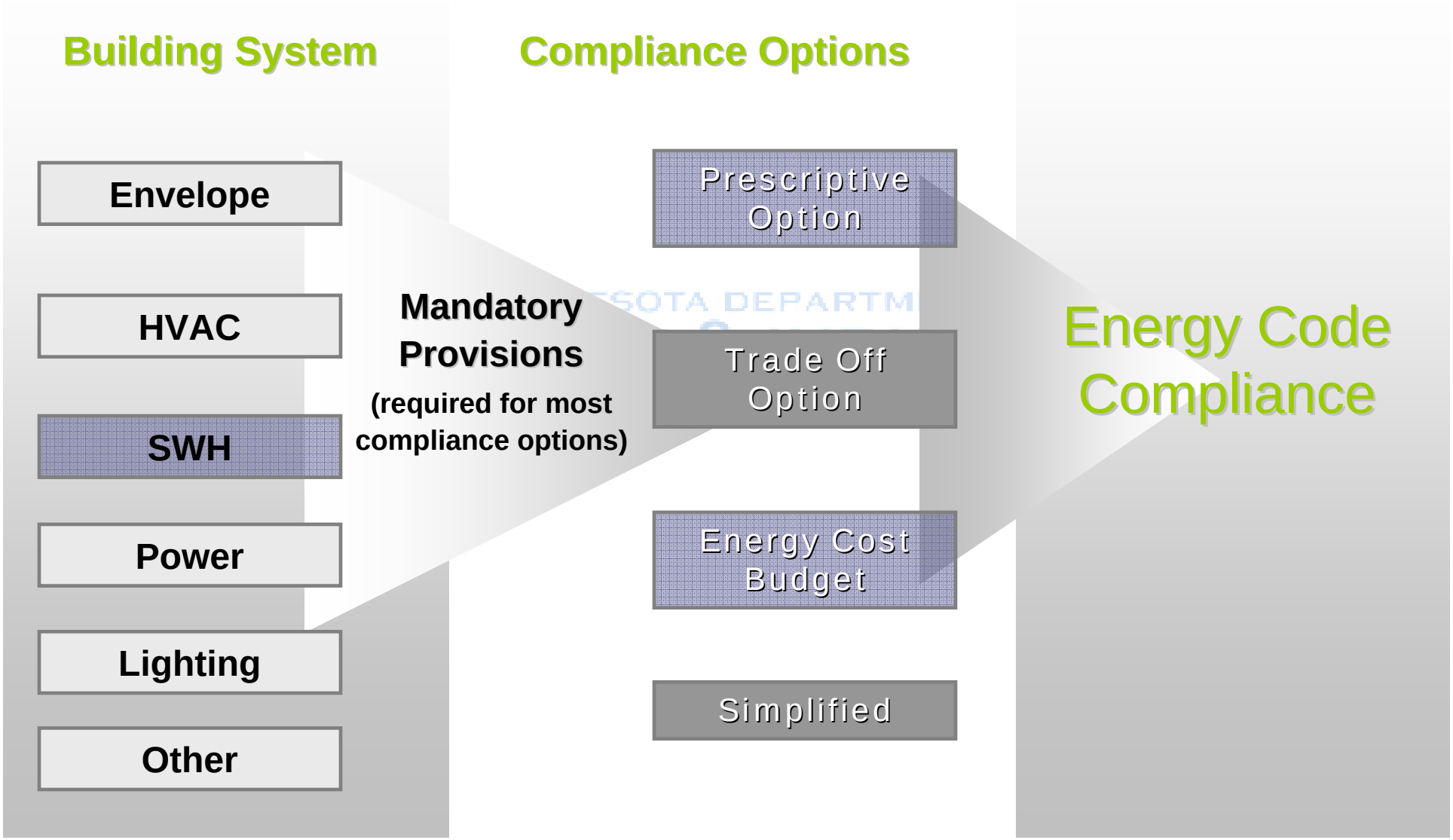
SWH Compliance



Chapter 7 (Service Water Heating)

- Requires load calculations

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Chapter 7 (Service Water Heating)

- Requires load calculations
- Regulates equipment efficiency

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- Requires load calculations
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- Requires SWH piping insulation

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- Requires load calculations
- Regulates equipment efficiency
- Requires SWH piping insulation
- Requires SWH temperature controls

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Chapter 7 (Service Water Heating)

- Requires load calculations
- Regulates equipment efficiency
- Requires SWH piping insulation
- Requires SWH temperature controls
- Requires pool heater shut-off controls, pool covers, and pool heater/pump shut-off controls

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Chapter 7 (Service Water Heating)

- Requires load calculations
- Regulates equipment efficiency
- Requires SWH piping insulation
- Requires SWH temperature controls
- Requires pool heater shut-off controls, pool covers, and pool heater/pump shut-off controls
- Requires heat traps

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Chapter 8 (Power)

- Regulates voltage drop in feeders and branch circuits

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- Regulates voltage drop in feeders and branch circuits
- Requires construction drawing and manuals be supplied to owner

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Chapter 8 (Power)

- Regulates voltage drop in feeders and branch circuits
- Requires construction drawing and manuals be supplied to owner
- Chapter was carefully constructed to regulate only aspects of building power systems that are NOT covered in electrical codes

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Overview – Std 90.1 Lighting and Power Requirements

- Chapter 9 (Lighting) regulates the wattage of lighting installed inside or outside a building, how that lighting should be installed, and how it should be controlled.

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Chapter 9 (Lighting) I

- Requires interior lighting controls

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Chapter 9 (Lighting) I

- Requires interior lighting controls
- Requires tandem wiring of ballasts

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Chapter 9 (Lighting) I

- Requires interior lighting controls
- Requires tandem wiring of ballasts
- Regulates exit signs

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Chapter 9 (Lighting) I

- Requires interior lighting controls
- Requires tandem wiring of ballasts
- Regulates exit signs
- Defines installed interior lighting power

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Chapter 9 (Lighting) I

- Requires interior lighting controls
- Requires tandem wiring of ballasts
- Regulates exit signs
- Defines installed interior lighting power
- Defines luminaire wattage

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Chapter 9 (Lighting) I

- Requires interior lighting controls
- Requires tandem wiring of ballasts
- Regulates exit signs
- Defines installed interior lighting power
- Defines luminaire wattage
- Regulates exterior lighting efficacy

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Chapter 9 (Lighting) II

- Provides two options for regulating interior lighting power
  - Building Area Method
  - Space-By-Space Method

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Chapter 9 (Lighting) II

- Provides two options for regulating interior lighting power
  - Building Area Method
  - Space-By-Space Method
- Provides additional interior lighting power allowances for specific situations

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Chapter 10 (Other Equipment)

- Sole requirement is to require the use of motors that meet the requirements of the Energy Policy Act of 1992. Since this Act sets manufacturing standards for motors, all motors in the US meet this requirement.

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What About COM*check-EZ*?

- DOE has developed a software program originally intended as a “deemed to comply” approach for ASHRAE Standard 90.1-1989.

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- Will we still be able to use COMcheck-EZ?

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What About COM*check-EZ*?

- DOE has developed a software program originally intended as a "deemed to comply" approach for ASHRAE Standard 90.1-1989.

- Will we still be able to use COMcheck-EZ?

  Yes

Latest COM*check-EZ*

- The latest version of COM*check-EZ* has a “deemed to comply” option for Standard 90.1-2004.

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Latest COM*check-EZ*

- The latest version of COM*check-EZ* has a “deemed to comply” option for Standard 90.1-2004.

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- Details of the development of all COM*check-EZ* versions are available in technical support documents from DOE

Helps and Interpretations for Standard 90.1-2004

- Users Manual
  - Provides much of the background
- Formal Interpretations
  - Formal written interpretations take time
- Informal Interpretations
  - Quick, informal answers to questions
- Interpretations in Minnesota
  - ASHRAE’s interpretations' are not part of the Minnesota Energy Code

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How can I get a copy?

- Standard 90.1-2004 and the Standard 90.1-2004 Users Manual are available from ASHRAE
  www.ashrae.org

404-636-8400

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ASHRAE
Engineering for the World We Live In

Minnesota’s Residential Energy Code and Radon What’s Changing

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Minnesota Rules Chapter 1322

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The New Residential Energy Code, Incorporating Provisions for Radon Control

Proposed adoption timeline.

- The State is currently working on the adoption process and hopes to have them adopted next Fall. With enforcement soon there after.

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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.

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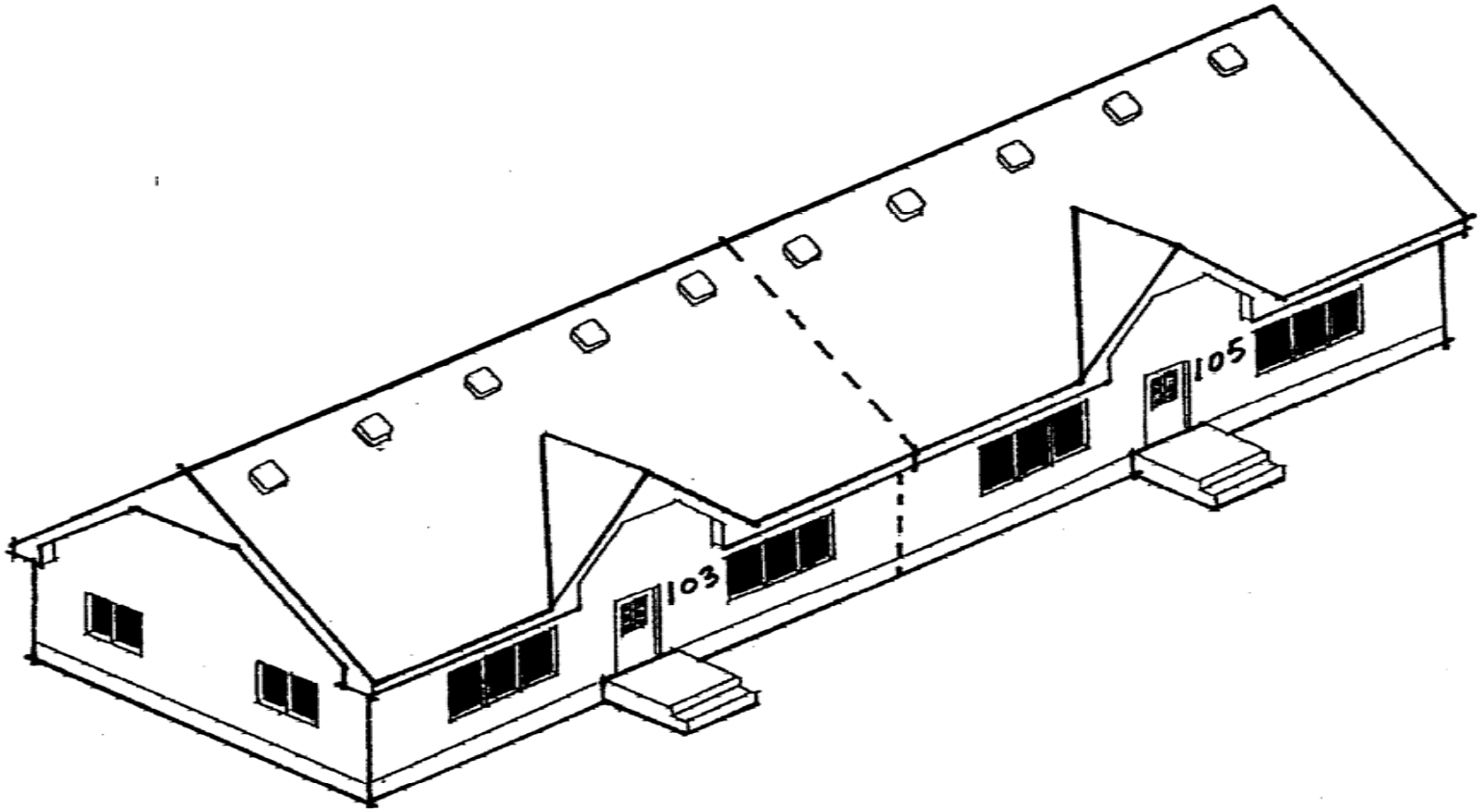
Single Family Dwellings

- 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:

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Scope

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

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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;

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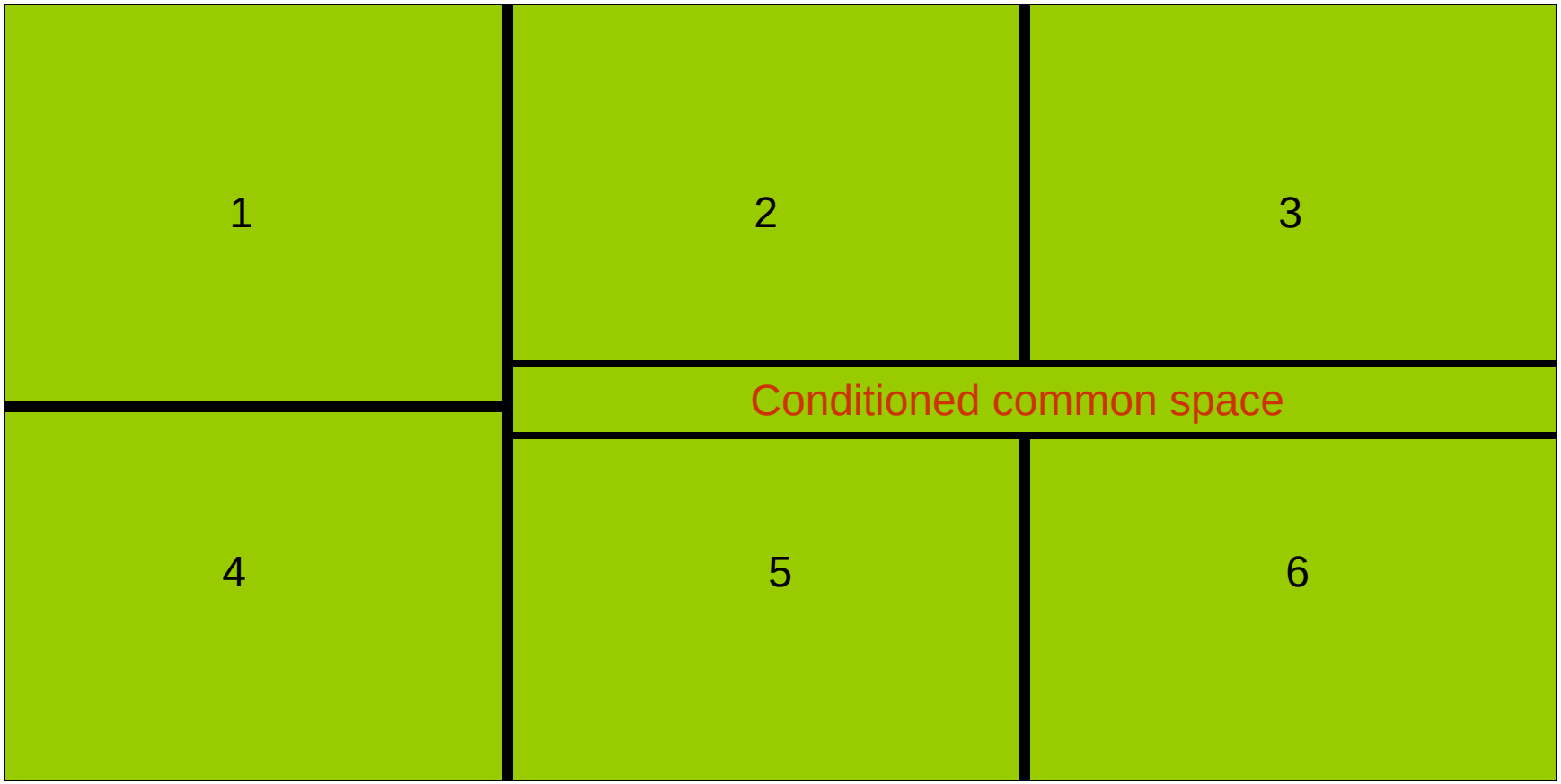
This Building **would** Meet the Scoping Provisions

1	2	3
4	5	6

This Building **would not** Meet the Scoping Provisions



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.

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Scope

The intent of these criteria is to provide a means for furnishing

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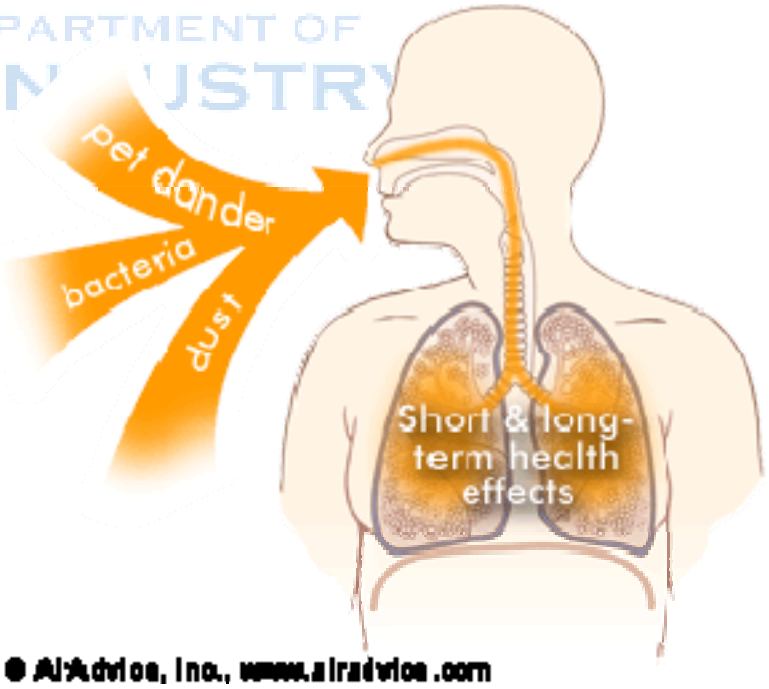
Scope

The intent of these criteria is to provide a means for furnishing

1. quality indoor air



Scope

The intent of these criteria is to provide a means for furnishing

1. **quality indoor air**
2. **assuring building durability**

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What is meant by durable buildings?

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What is meant by durable buildings?

- Insurance company point of view

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What is meant by durable buildings?

- Insurance company point of view
- Mortgage company point of view

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What is meant by durable buildings?

- Insurance company point of view
- Mortgage company point of view
- Contractor point of view

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- Insurance company point of view
- Mortgage company point of view
- Contractor point of view
- Code/Building Inspector point of view

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What is meant by durable buildings?

- Insurance company point of view
- Mortgage company point of view
- Contractor point of view
- Code/Building Inspector point of view
- Owner/occupant point of view

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What is meant by durable buildings?

- Insurance company point of view
- Mortgage company point of view
- Contractor point of view
- Code/Building Inspector point of view
- Owner/occupant point of view
- Other points of view

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Why and where do the codes address durability?

- Energy code

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Why and where do the codes address durability

- Energy code
  - Required by the legislature to address it.

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Why and where do the codes address durability

- Energy code
  - Required by the legislature to address it.
  - Should it be only a BTU code?

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- Radon Code Requirements

Why and where do the codes address durability

- Energy code
  - Required by the legislature to address it.
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- Radon Code Requirements
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- Energy code
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- Radon Code Requirements
  - Required by the legislature to address it.
  - Stops All soil Gases from Entering Home

Why and where do the codes address durability

- Energy code
  - Required by the legislature to address it.
  - Should it be only a BTU code?

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- Radon Code Requirements
  - Required by the legislature to address it.
  - Stops All Soil Gases from Entering Home
    - Radon (Health Issues)

Why and where do the codes address durability

- Energy code
  - Required by the legislature to address it.
  - Should it be only a BTU code?

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- Radon Code Requirements
  - Required by the legislature to address it.
  - Stops All soil Gases from Entering Home
    - Radon (Health Issues)
    - Moisture

Vapor Retarders/Wall Durability

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Vapor Retarders/Wall Durability

- Durability and moisture control are directly related

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Vapor Retarders/Wall Durability

- Durability and moisture control are directly related
- Controlling moisture means controlling wetting and drying

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Vapor Retarders/Wall Durability

- Durability and moisture control are directly related
- Controlling moisture means controlling wetting and drying
- Wetting is primarily controlled by air barriers, flashing and drainage plane improvements

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Vapor Retarders/Wall Durability

- Durability and moisture control are directly related
- Controlling moisture means controlling wetting and drying
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- Drying is primarily controlled by air barriers and vapor retarders

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Vapor Retarders/Wall Durability

- Durability and moisture control are directly related
- Controlling moisture means controlling wetting and drying
- Wetting is primarily controlled by air barriers, flashing and drainage plane improvements
- Drying is primarily controlled by air barriers and vapor retarders
- This is true on both the cold and warm sides of the wall

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Why and where do the codes address durability

- What about the building codes

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Why and where do the codes address durability

- What about the building codes
  - Flashings

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Why and where do the codes address durability

- What about the building codes
  - Flashings
  - Weather resistive barriers

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Why and where do the codes address durability

- What about the building codes
  - Flashings
  - Weather resistive barriers
  - Drainage – (above and below grade)

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Why and where do the codes address durability

- What about the building codes
  - Flashings
  - Weather rssistive barriers
  - Drainage– (above and below grade)
  - Ventilation

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Why and where do the codes address durability

- What about the building codes
  - Flashings
  - Weather resistive barriers
  - Drainage
  - Ventilation
  - Others?

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Water/Moisture/Bulk/Diffusion

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Water/Moisture/Bulk/Diffusion

- When the rate of wetting exceeds the rate of drying accumulation occurs

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Water/Moisture/Bulk/Diffusion

- When the rate of wetting exceeds the rate of drying accumulation occurs
- The drying potential of an assembly decreases with the thickness of the insulation and increases with the rate of air flow

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Water/Moisture/Bulk/Diffusion

- When the rate of wetting exceeds the rate of drying accumulation occurs
- The drying potential of an assembly decreases with the thickness of the insulation and increases with the rate of air flow
- Energy conservation increases the thickness of the insulation and decreases the air flow

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Water/Moisture/Bulk/Diffusion

- When the rate of wetting exceeds the rate of drying accumulation occurs
- The drying potential of an assembly decreases with the thickness of the insulation and increases with the rate of air flow
- Energy conservation increases the thickness of the insulation and decreases the air flow
- Energy conservation has a potential to increase moisture wall problems

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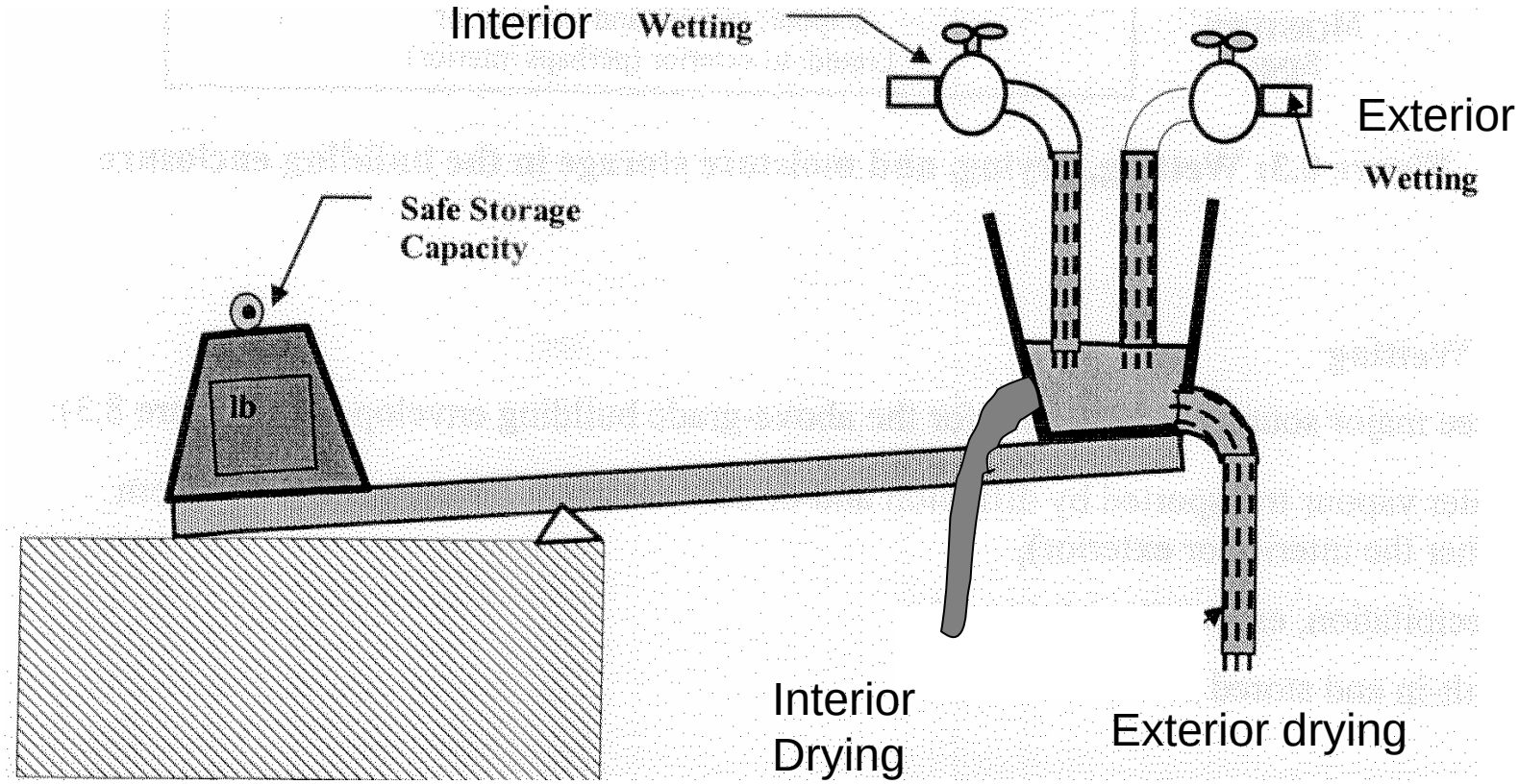
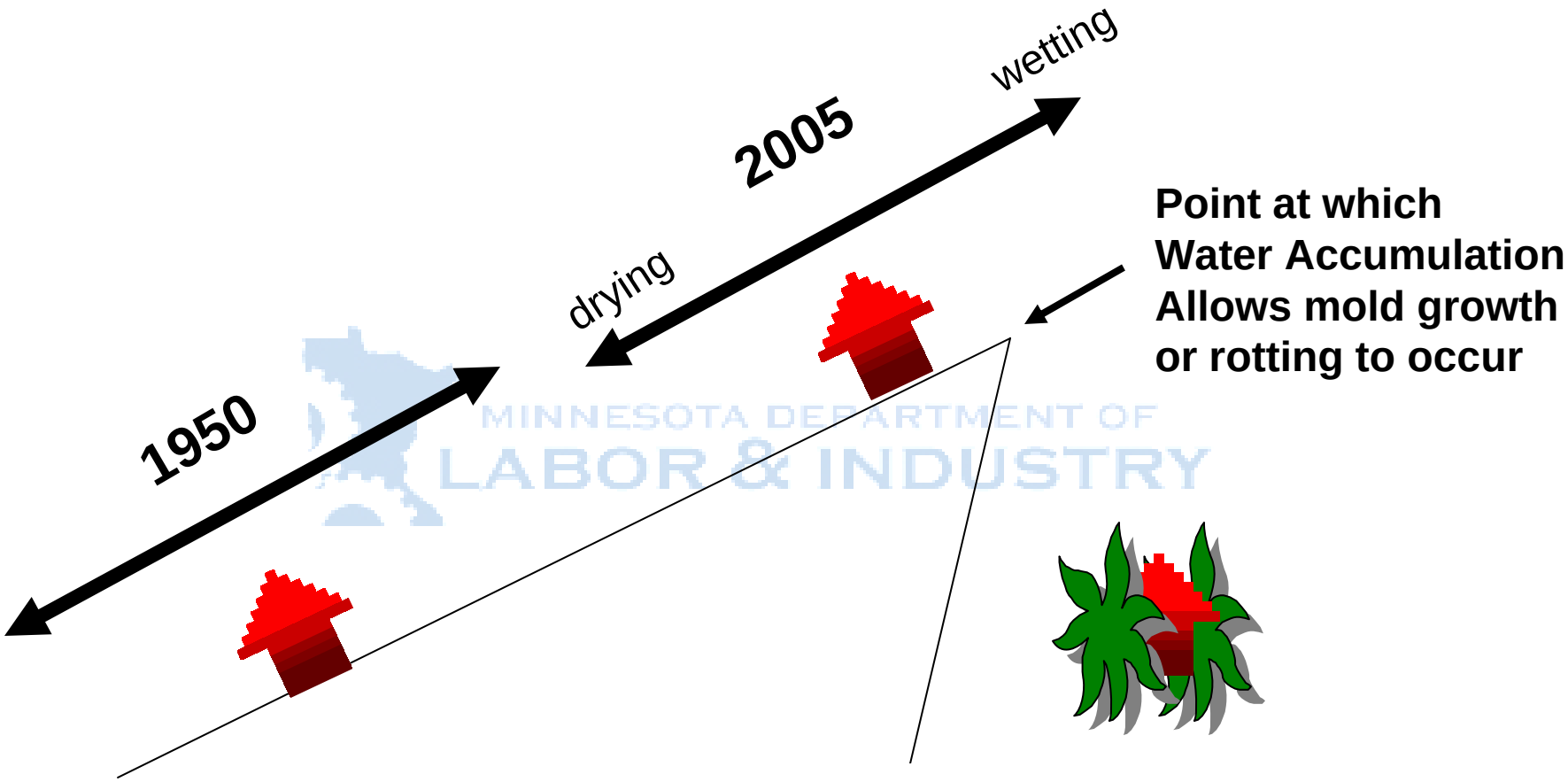
Moisture Balances Occurring In the Exterior Wall



A typical house can have 10,000 pounds of studs and sheathing
10% moisture is 1,000 pounds or 125 gallons of water capacity

Building's Today are too close to the Edge of the Cliff



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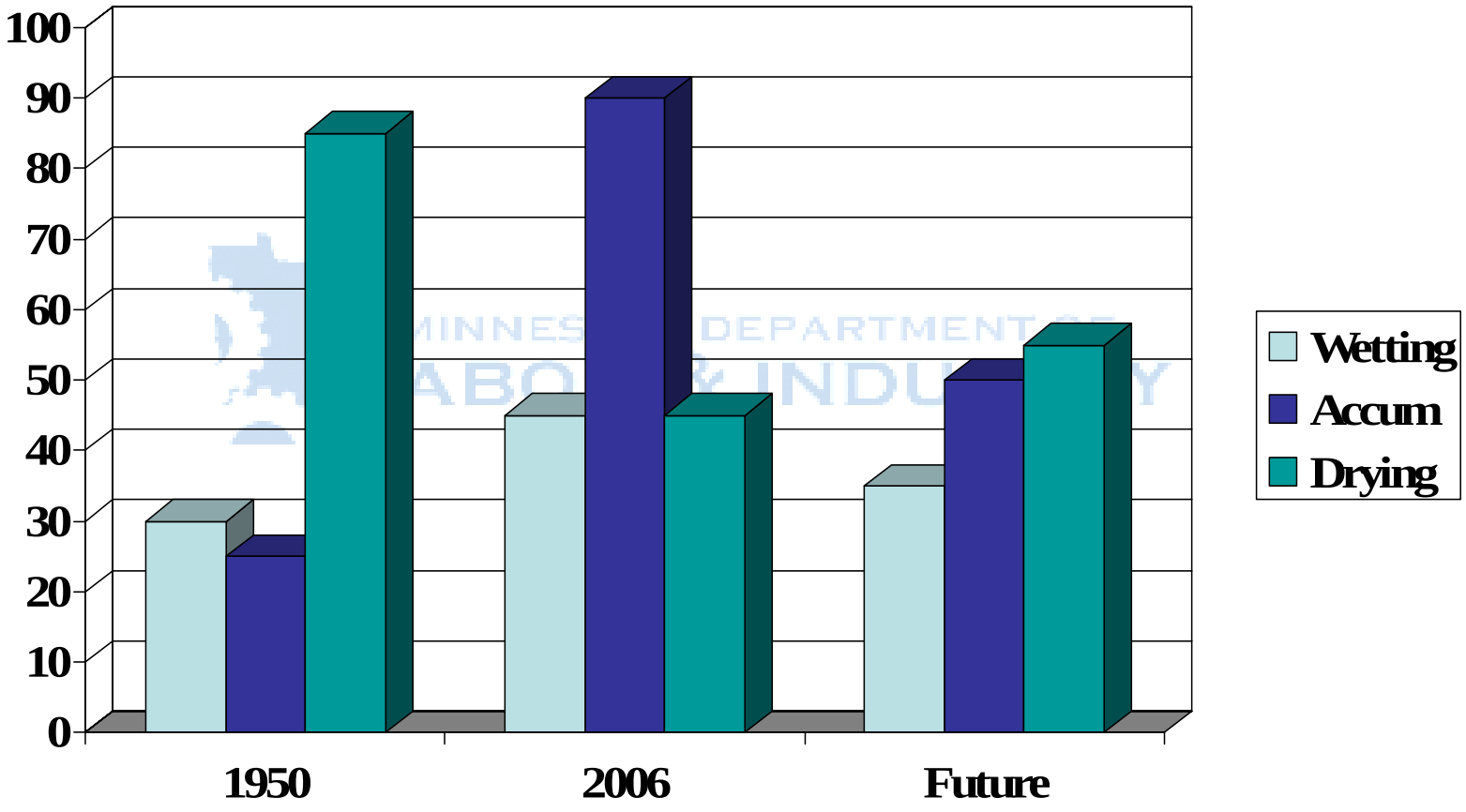
National Experts have stated that moldy buildings today likely make up 5-10% of all housing.
Before 1990 the failure rate was less than 0.1%

Moisture Balance in Walls



Scope

The intent of these criteria is to provide a means for furnishing

1. quality indoor air
2. assuring building durability
3. permitting energy efficient operation

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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.**

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Scope

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

Scope

- 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.

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Scope

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

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Scope

- Buildings that have been specifically designated as historically significant by the state or local governing body or, listed or, determined to be eligible for listing in the National Register of Historical Places.

Scope

- If a building houses more than one occupancy, each portion of the building must conform to the requirements for the occupancy housed in that portion.

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.

Compliance
Climate Zones

Climate zones from Table N1101.2 or Figure 1101.2 shall be used in determining the applicable requirements from this chapter.

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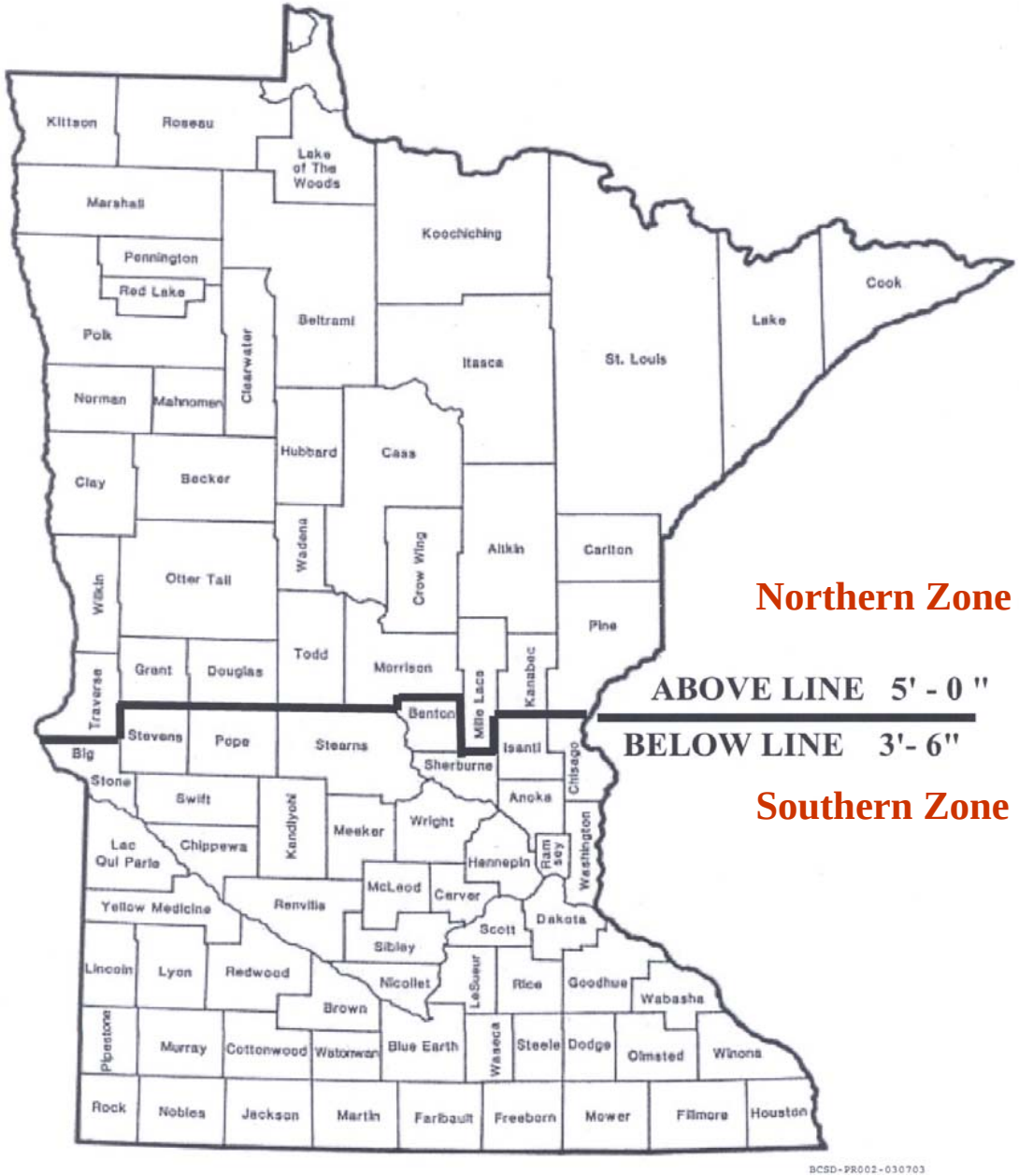
Please note: These are different than what is in the national document. We are adopting the state map for frost and snow load but it is not consistent with the wind load chart that the structural committee adopted.

Climate Zones

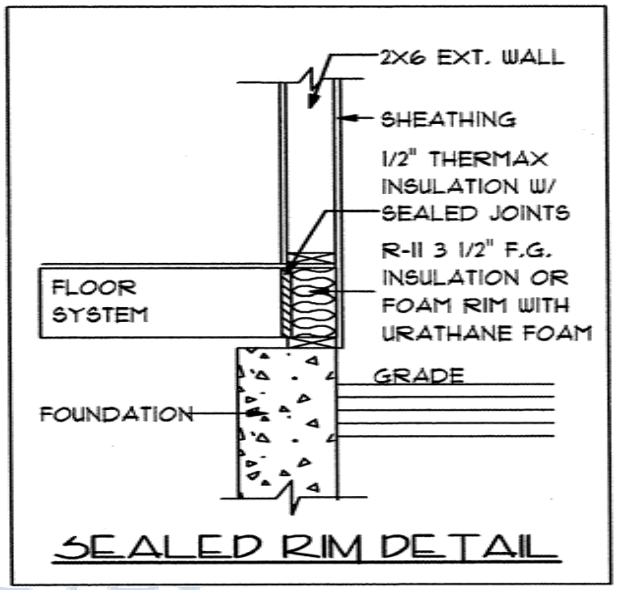


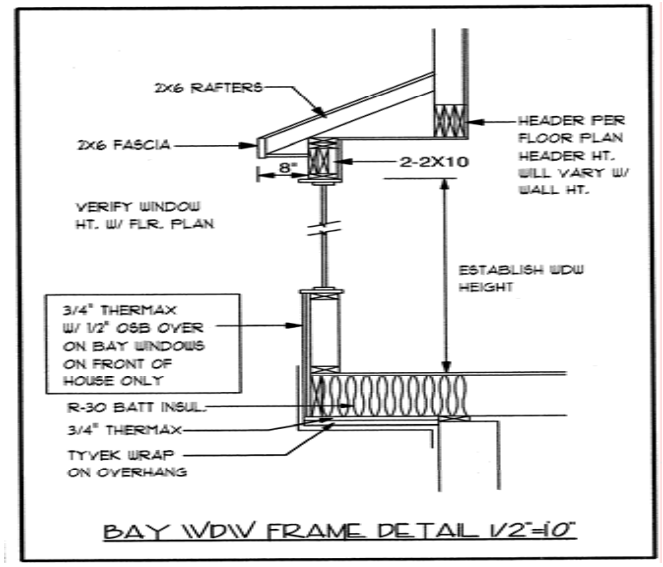
Identification/Insulation Mark

- Materials, systems and equipment shall be identified in a manner that will allow a determination of compliance with the applicable provisions of this chapter.

Plans & Specs

- Plans and specifications shall show in sufficient detail, pertinent data and features, of the building, the equipment, and the systems as herein governed, including, but not limited to:





Building Thermal Insulation.

- All thermal insulation must conform to Minnesota Rules Chapter 7640, "Minnesota Thermal Insulation Standards" adopted by the Department of Commerce.

- For Foam Insulation we need to know and use the aged R-value

Building Thermal Insulation.

- Insulation shall be manufactured for its intended use, and installed according to the manufacturer's specifications.
- Insulation materials used on the exterior for the purpose of insulating foundation walls shall be a water resistant material and shall comply with ASTM C578, C612 or other approved standards.

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Attic thickness markers.

- The thickness of blown or sprayed roof and/or ceiling insulation shall be written in inches on markers that are installed at least one for every 100 ft^2 (9.3 m^2) throughout the attic space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness, with numbers a minimum of 1 inch (25 mm) in height. Each marker shall face the attic access opening.

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Attic insulation card.

- A signed and dated insulation receipt attic card must be attached to the framing near the access opening, in a clearly visible place and posted with the certificate required by N1101.8. The attic card must identify the type of insulation installed, the manufacturer, the installer, the R-value per inch, the designed settled thickness, the square footage of attic coverage area, and the number of bags installed.

Fenestration Products

- **Fenestration product rating. U-factors of fenestration products (windows, doors and skylights) shall be determined in accordance with NFRC 100, and air leakage by NFRC 400, by an accredited, independent laboratory, and labeled and certified by the manufacturer. Products lacking such a labeled U-factor, shall be assigned a default U-factor from Table N1101.6.**

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Default Glazed Fenestration U-Factor Table

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

Installation of Materials

- **Installation. All materials, systems and equipment shall be installed in accordance with the manufacturer's installation instructions and the conditions of any listing or required certifications.**

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Building Certificate

- **A certificate shall be posted in a permanently visible location inside the building. The certificate shall list information and the values of components listed in Table 1101.8.**

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Table

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

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Building Thermal Envelope Requirements

- **Based on the climate zone specified in Table N1101.2, the building thermal envelope shall meet the requirements of Table N1102.1(1) or Table N1102.1(2).**

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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
Southern	0.35	0.60	NR	38	19 or 13+5[e]	15	30[d]	5/10	10, 3.5 ft	10	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

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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.

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Mass walls.

- 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.

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- Mass walls shall comply with Section 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	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.
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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

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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.

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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.

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Foundation Wall Performance

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.

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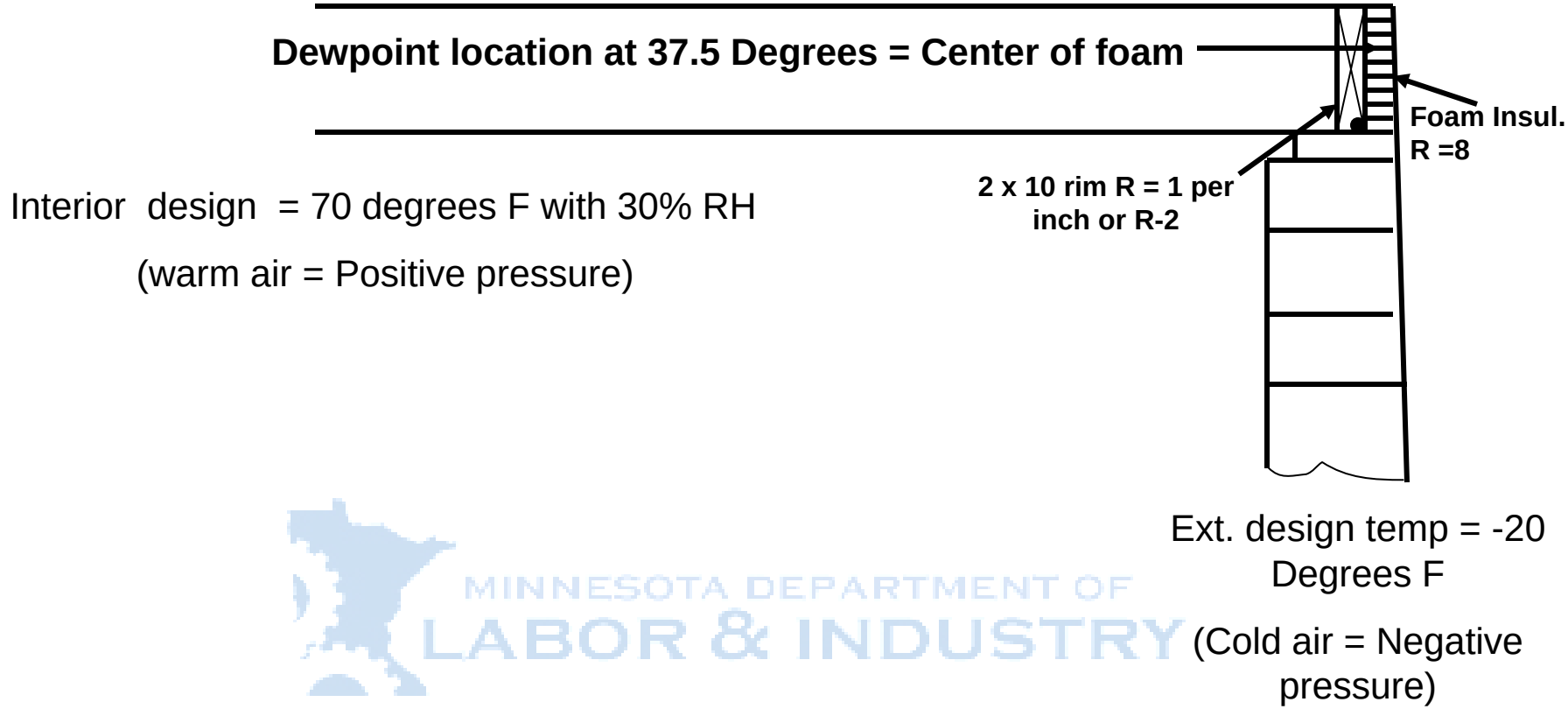

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Total R Value = 10 **Delta T = 90** **See Dew Point Calculations Below**

R-8 (Foam insulation) Divided by 10 (Total R Value) Multiplied by 90 (Delta T) = Temperature change from one side of foam to other side of foam. Ex. (8/10 x 90 = 72 Degrees temperature Change) The temperature between the foam insulation and the 2 x 10 rim is now at 52 Degrees. (-20 + 72 = 52)

The dew point temperature for a building with a interior temp of 70 degrees F and a interior RH of 30% is 37.5 degrees. (see Psychrometric Chart) This is the condensation point in this assembly. If moisture condenses there how will it get out or dry out. Remember it will condensate to the first plane or surface to the cold side. Heat and moisture always flow from warm to cold.

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.

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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.

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Slab-on-grade and basement walkout foundation walls.

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Slab-on-grade and basement walkout foundation walls.

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

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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.

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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.

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Foundation wall and rim joist area thermal insulation requirements.

- 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.

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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

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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

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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
- 2. An additional R-5 insulation is added to the minimum attic R-value level; and

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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
- 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

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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

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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
- 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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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.

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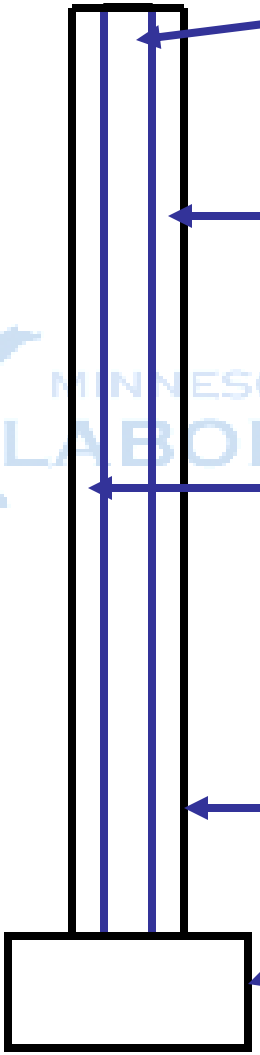
Styrofoam
Insulated Concrete Wall Systems
Styrofoam
Insulated Concrete Wall Systems
Styrofoam



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Requirements for Exterior foundation insulation requirements

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

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- 1. Shall be of water resistant materials manufactured for its intended use;
- 2. Installed according to the manufacturer's specifications;

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- 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;

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Exterior foundation insulation

- 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.

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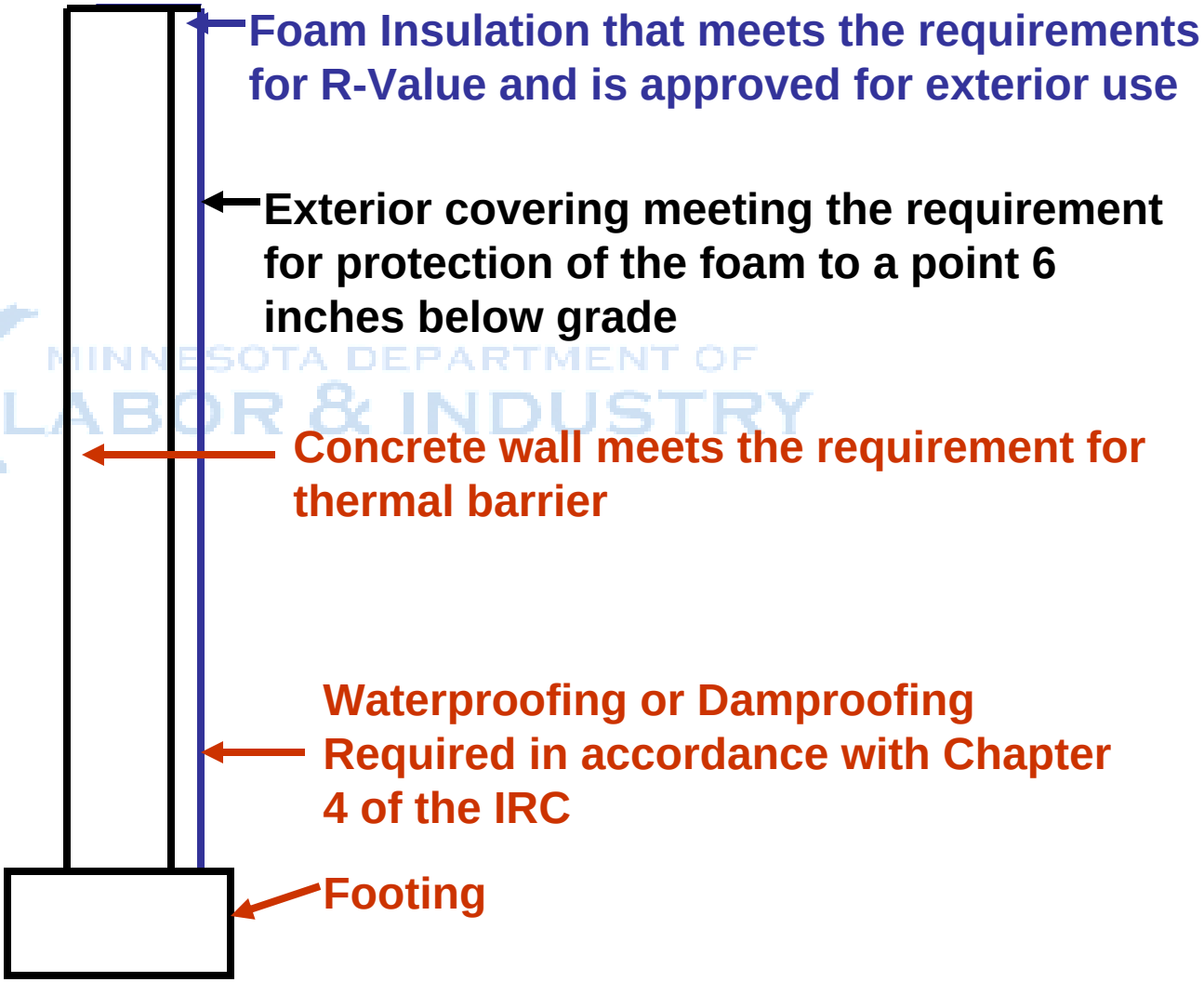
Exterior Foundation Insulation



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Styrofoam
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Requirements for Interior foundation insulation

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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.

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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

- 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.

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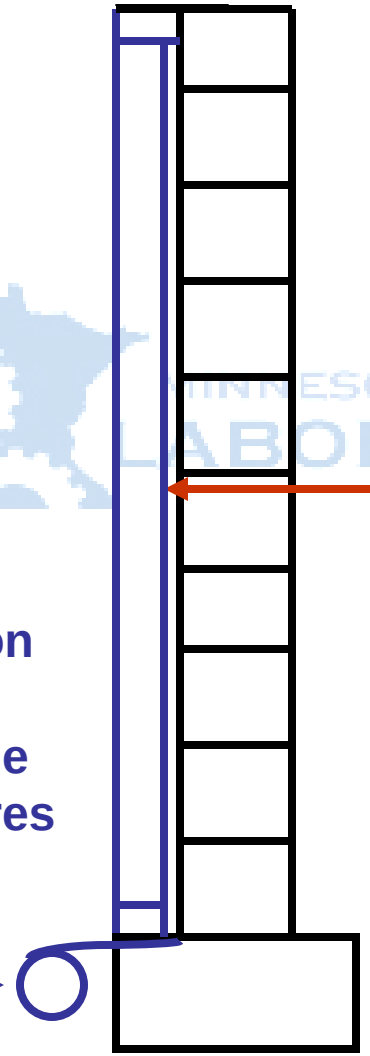
Interior Foundation Insulation



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.

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

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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

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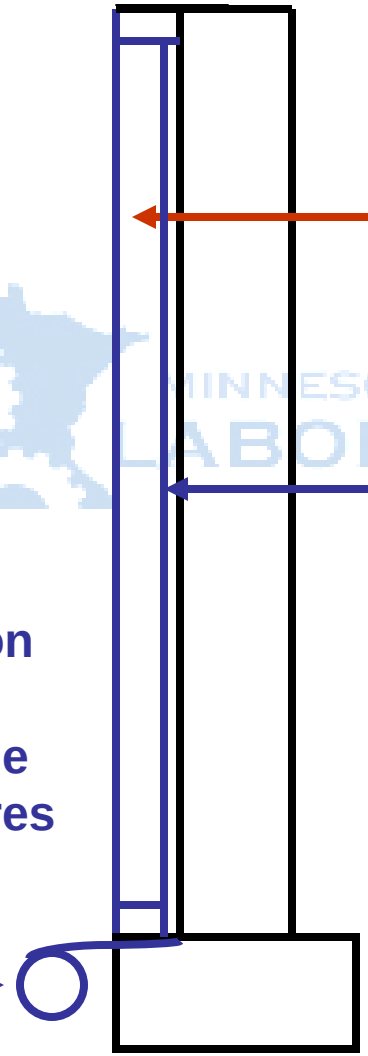
Interior Foundation Insulation



Warm Side Vapor and Air barrier

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.

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

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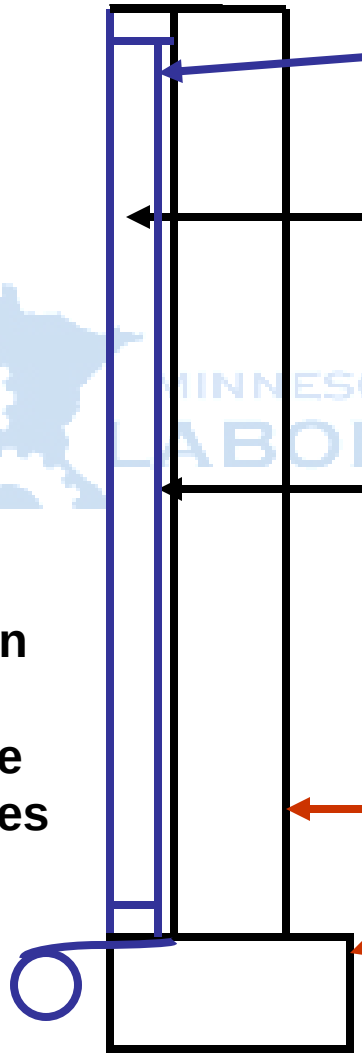
Interior Foundation Insulation



Insulation that meets the requirements for R-Value

Warm Side vapor and Air barrier

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.

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

Footing

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

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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.

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Rigid interior insulation N1102.2.6.8

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

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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.

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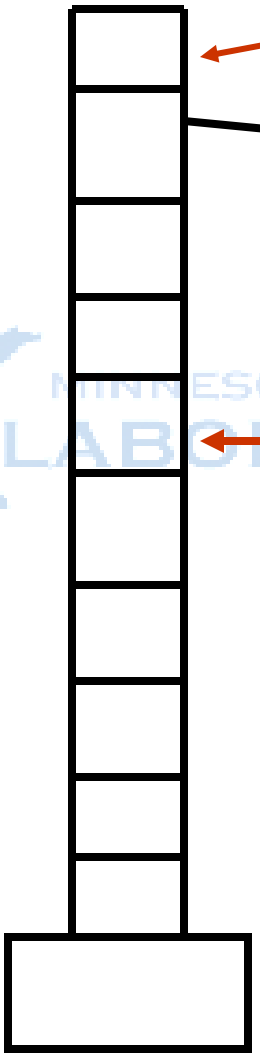
Rigid Interior Foundation Insulation N1102.2.6.8



MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Rigid Interior Foundation Insulation N1102.2.6.8

Installation requirements

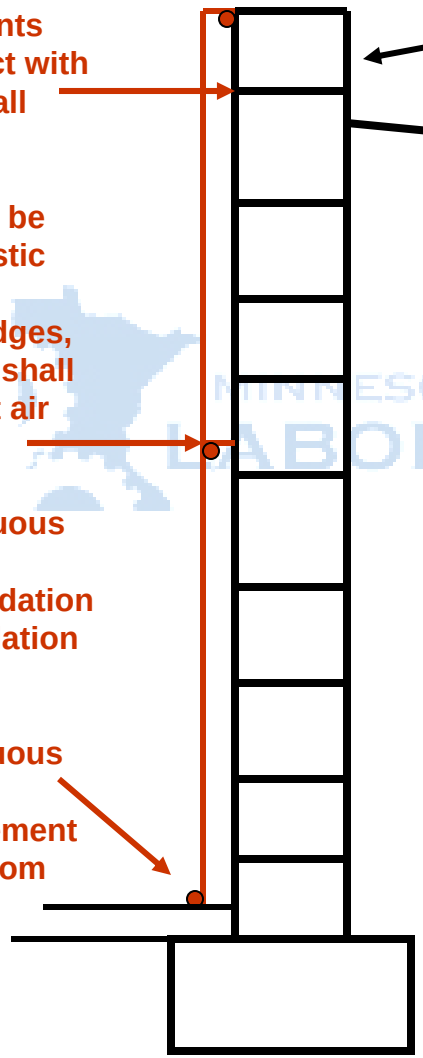
a. Must be in contact with the foundation wall surface

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.



Damproofing, waterproofing or water repelent above grade

Grade level

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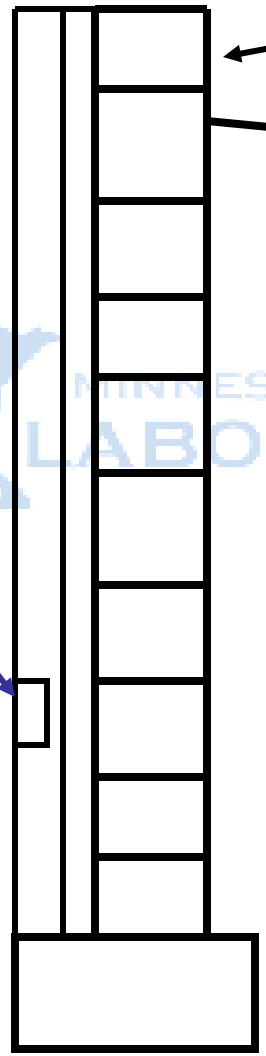
Rigid Interior Foundation Insulation N1102.2.6.8

Installation requirements

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



Damproofing, waterproofing or water repelent above grade

Grade level

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Spray applied interior insulation N1102.2.6.9

- 1. Closed cell polyurethane
-

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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.

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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.

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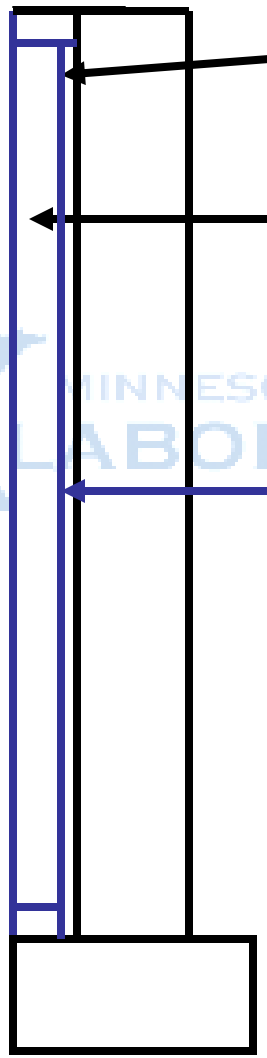
Interior Spray applied interior insulation N1102.2.6.9



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

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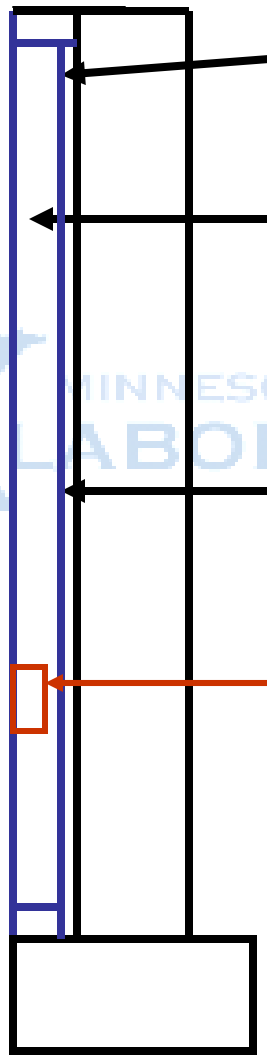
Interior Spray applied interior insulation N1102.2.6.9



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

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Spray applied interior insulation N1102.2.6.9

- 2. ½ pound free rise open cell foam

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Spray applied interior insulation
N1102.2.6.9

- 2. ½ pound free rise open cell foam
- a. Sprayed directly onto the foundation wall surface. There must be a 1” minimum gap between the foundation wall surface and any framing.

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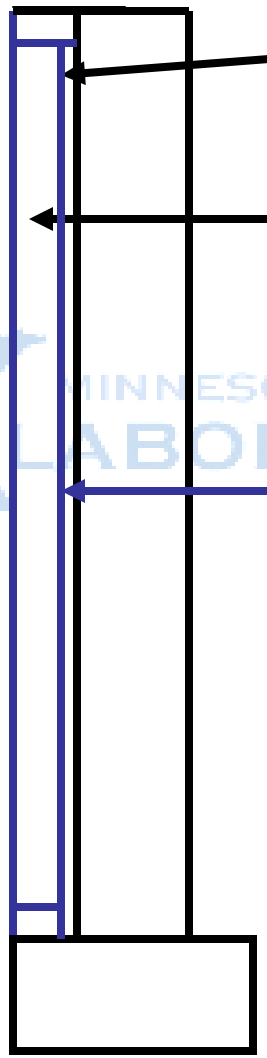
Interior Spray applied interior insulation N1102.2.6.9



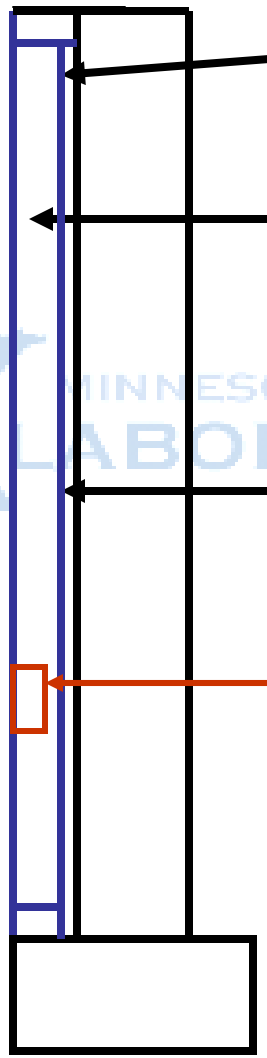
Insulation that meets the requirements for R-Value

Foam may become the Warm Side Air barrier

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

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

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

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Semi-rigid interior insulation N1102.2.6.10

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Semi-rigid interior insulation
N1102.2.6.10

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

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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.

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Semi-Rigid Interior Foundation Insulation N1102.2.6.8

Installation requirements

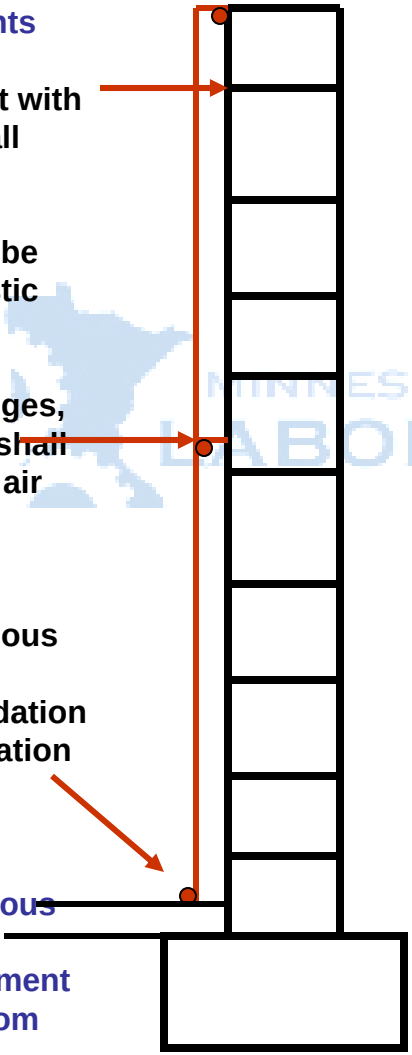
a. Must be in contact with the foundation wall surface

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.



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Unfaced fiberglass batt interior insulation

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Unfaced fiberglass batt interior insulation

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

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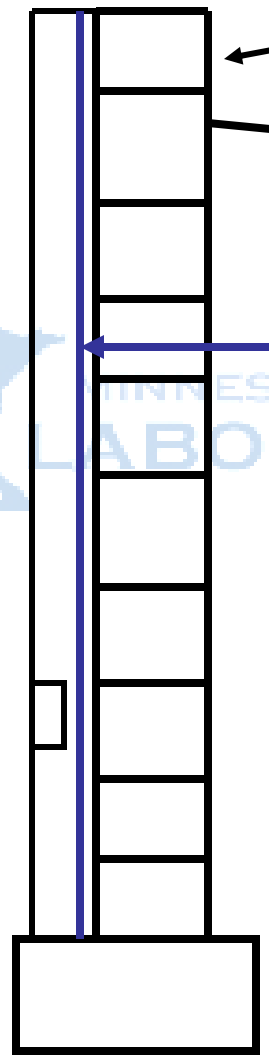
Unfaced fiberglass Interior Foundation Insulation N1102.2.6.8



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Unfaced 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.

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Unfaced 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.

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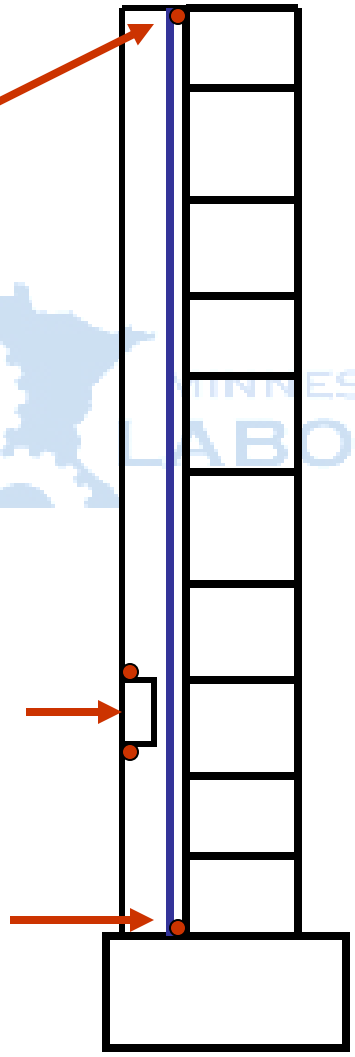
Unfaced fiberglass Foundation Insulation N1102.2.6.8

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.

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Unfaced 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.

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Foundation Wall Insulation Performance Option

- **Insulated foundation systems designed and installed under the performance option shall meet the requirements of this section.**

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Water separation plane

- The foundation shall be designed and built to have a continuous water separation plane between the interior and exterior. The interior side of the water separation plane must:

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Water separation plane

- 1. Have a stable annual wetting/drying cycle whereby foundation wall system water (solid, liquid and vapor) transport processes produce no net accumulation of ice or water over a full calendar year and the foundation wall system is free of adsorbed water for at least 4 months over a full calendar year;

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Water separation plane

- 1. Have a stable annual wetting/drying cycle whereby foundation wall system water (solid, liquid and vapor) transport processes produce no net accumulation of ice or water over a full calendar year and the foundation wall system is free of adsorbed water for at least 4 months over a full calendar year;
- 2.Prevent conditions of moisture and temperature to prevail for a time period favorable to mold growth for the materials used; and

Water separation plane

- 1. Have a stable annual wetting/drying cycle whereby foundation wall system water (solid, liquid and vapor) transport processes produce no net accumulation of ice or water over a full calendar year and the foundation wall system is free of adsorbed water for at least 4 months over a full calendar year;
- 2.Prevent conditions of moisture and temperature to prevail for a time period favorable to mold growth for the materials used; and
- 3.Prevent liquid water from the foundation wall system reaching the foundation floor system at any time during a full calendar year.

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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.

Installation

- **The *water separation plane* shall be designed and installed to prevent external liquid or capillary water flow across it after the foundation is backfilled.**

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Foundation air barrier.

- **The foundation insulation system shall be designed and installed to have a foundation air barrier system between the interior and the exterior.**

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Foundation air barrier.

- **The foundation insulation system shall be designed and installed to have a foundation air barrier system between the interior and the exterior.**
- **The foundation air barrier system must be a material or combination of materials that is continuous with all joints sealed and is durable for the intended application.**

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Foundation air barrier.

- **The foundation insulation system shall be designed and installed to have a foundation air barrier system between the interior and the exterior.**
- **The foundation air barrier system must be a material or combination of materials that is continuous with all joints sealed and is durable for the intended application.**
- **Material used for the foundation air barrier system must have an air permeability not to exceed 0.004 ft3/min.ft2 under a pressure differential of 0.3 in. water (1.57psf) (0.02 L/s.m2 at 75Pa) as determined by either commonly accepted engineering tables or by being labeled by the manufacturer as having these values when tested in accordance with ASTM E2178.**

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FENESTRATION.

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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.

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Opaque door exemption

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

Thermally isolated sunroom U-factor

- New windows and doors separating the sunroom from conditioned space shall meet the building thermal envelope requirements.

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.

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Ventilation

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Ventilation
Minnesota Rules, Chapter 1322, Residential Energy Code- DRAFT

Agenda:

1. Ventilation Overview
   - -What is ventilation
   - -Why ventilate
   - -How much should we ventilate

2. Mechanical Ventilation Systems
   - -Total and continuous ventilation rates
   - -Ventilation System Requirements (3 types)
     - Exhaust only
     - Balanced
     - Other methods

3. Air distribution/circulation

4. Insulation, labeling, documentation

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Ventilation Systems-Overview

- Goals of Mechanical Ventilation
  - To maintain good indoor air quality
  - To control indoor moisture

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Ventilation Systems-Overview

- **ASHRAE 62.1-2004**
  - **"Acceptable indoor air quality: air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which a substantial majority (80% or more) of the people exposed do not express dissatisfaction."**

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Ventilation Systems

- When to Ventilate?
  - Primarily when the home is occupied
  - May need to continue after or purge before

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- Where to Ventilate?
  - Ideally where the pollutants are concentrated
  - Remove point source pollutants immediately
  - Use general ventilation for disperse pollutants

Overview- What is Ventilation?

"The process of supplying air to or removing air from a space for the purpose of controlling air contaminant levels, humidity, or temperature within the space."

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Overview- Ventilation Systems

- **Why** Ventilate?
  - People pollutants
    - human respiration, body odors
    - water vapor
  - Building pollutants
    - VOCs, Combustion gases, radon
    - water vapor
  - Activity pollutants
    - VOCs, odors
    - water vapor

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Overview-Ventilation Systems

- Types of Air Exchange in Houses
  - Infiltration/Exfiltration
  - Natural ventilation
  - Chimneys
  - Exhaust devices
  - Mechanical ventilation

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Why Ventilate?

Athletic equipment

Mold

Bathroom exhaust

Smoke

Diapers

Pet odors

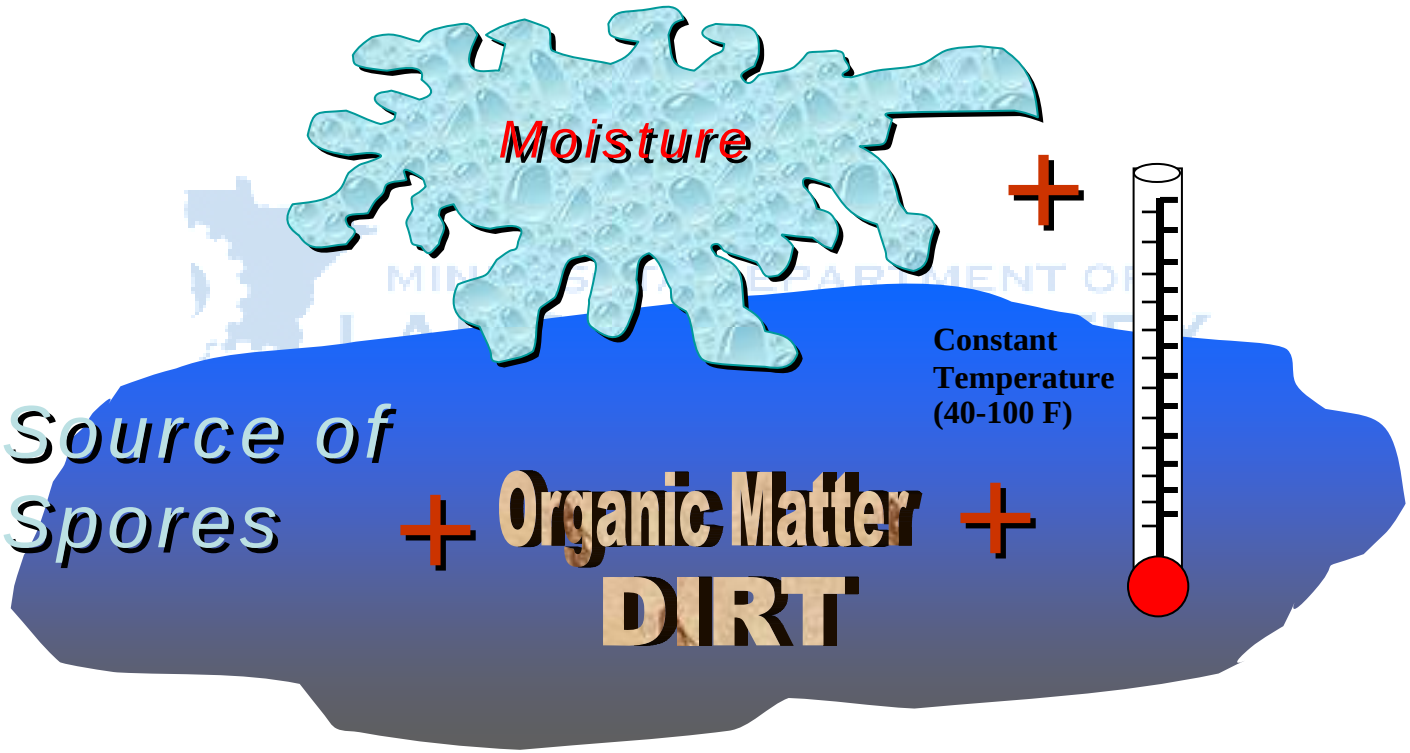
Cleaning supplies

Window condensation

Dust Mites

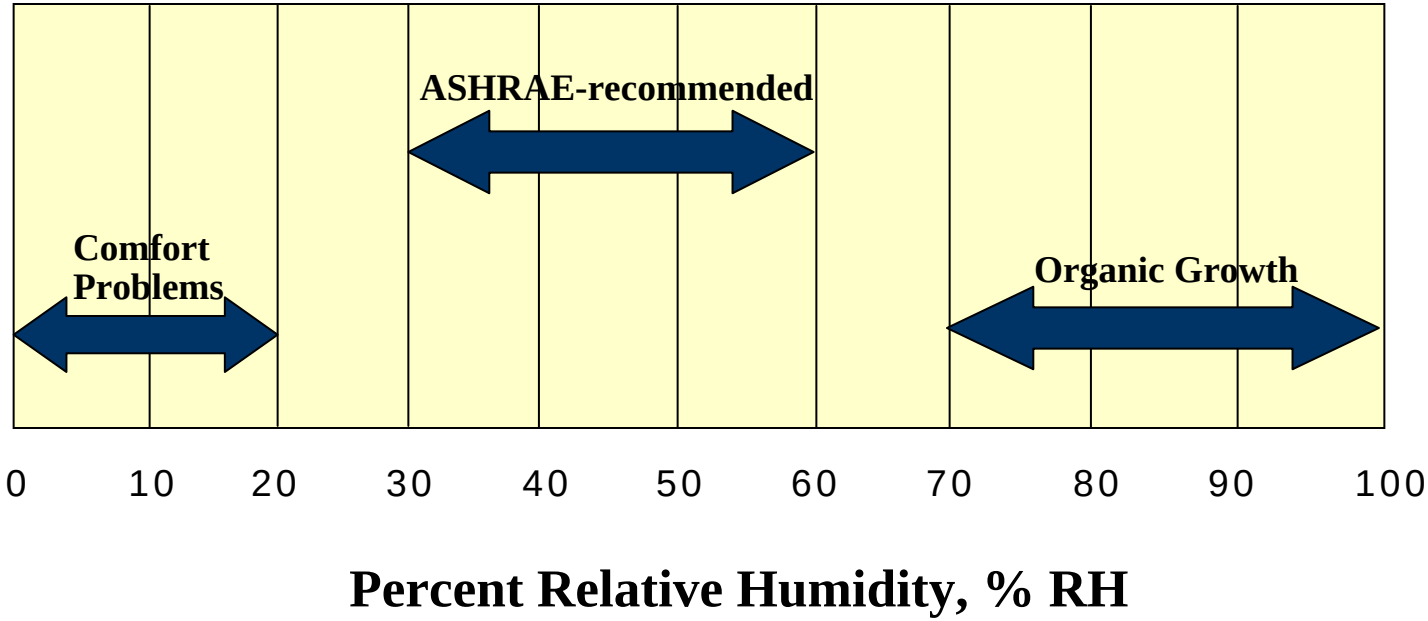
IAQ Solutions - HUMIDITY CONTROL

Why Manage Humidity?



= **Prerequisites for Microbial Growth**

OVERVIEW- HUMIDITY CONTROL



Overview- Ventilation Systems

- **How Much** to Ventilate, considering:?
  - Moisture generation rates
    - people
    - building
  - Other pollutants
    - type of pollutant
    - source strength
  - Occupant sensitivity
  - Continuous ventilation

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Overview-Ventilation Systems

- **How Much** to Ventilate?
- Chapter 1322: Total ventilation rate: "…shall provide sufficient outdoor air = total ventilation rate average, for each one hour period in accordance with Table N1104.2, or equation 11-1.
- Equation 11-1
  - Total ventilation rate (CFM) = (0.02 x square feet of conditioned space) + (15 x (number of bedrooms +1)).
  - Includes the basement but excludes conditioned crawl spaces.

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Overview-Ventilation Systems

- **Equation 11-1**
  - **Total ventilation rate (CFM) = (0.02 x square feet of conditioned space) + (15 x (number of bedrooms +1)).**
  - Example 1:
    - 2300 square feet of conditioned space house
      - Conditioned space = "An area, room or space being heated or cooled by any equipment or appliance."
    - 3 bedrooms
    - .02 x square feet of conditioned space = .02 x 2300 = 46 CFM
    - Number of bedrooms (3) + 1 = 4
    - 15 x 4 = 60 CFM
    - Total ventilation rate (CFM) = 46 CFM + 60 CFM = 106 CFM

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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

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

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

	Number of Bedrooms					
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Conditioned space[1] (in sq. ft.)	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous
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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
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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

Overview-Ventilation Systems

- Continuous Ventilation:
  - N1104.2.1: "… a minimum of 50% of the total ventilation rate, but not less than 40 CFM, on a continuous rate average for each one hour period in accordance with Table N1104.2 or Equation 11-2.
  - Equation 11-2: Continuous ventilation (CFM)= total ventilation rate /2.
  -

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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
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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

Overview-Ventilation Systems

- Total Ventilation : equation 11-1 total ventilation rate = 106 CFM and Table N1104.2 total ventilation rate = 110 CFM.

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- Continuous ventilation rate = 53 CFM (if equation 11-2 is used) or 55 CFM = 55 CFM if table N1104.2 is used.

Supplemental Ventilation

- Kitchen Exhaust
- Bathroom Exhaust
- ETC.

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Ventilation Systems
Required ventilation rate
Example 2

(.02 x square feet of conditioned space + (15x (number of bedrooms +1)) = **Total Ventilation Rate**

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Example: 4 bedroom, 2 bathroom, 2,000 sq.ft. house

(4 Bedrooms + 1) X 15 (cfm)	5 X 15 =75
+ (0.02 (cfm) X 2000 sq.ft.)	+ 40
115 cfm	**115 cfm**

Continuous Ventilation Rate

- 50% of **Total Ventilation Rate**

- Example:

  115 cfm ÷ 2 = 57.5 cfm > **60 cfm**

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Draft rule Chapter 1322
N1104.2.1

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

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	Number of Bedrooms					
	1	2	3	4	5	6[2]
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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
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4001 – 4500	120/60	135/68	150/75	165/83	180/90	195/98
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5501 – 6000[2]	150/75	165/83	180/90	195/98	210/105	225/113

Ventilation Systems
Required ventilation rate
Example 3

(.02 x square feet of conditioned space) + (15 x (number of bedrooms +1)) = **Total Ventilation Rate**

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6 bedroom, 3 bathroom, 5,000 sq.ft. house

(6 Bedrooms + 1) X 15 (cfm)	7 X 15 =105
+ (0.02 (cfm) X 5000 sq.ft.)	= 100
205	**205**

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

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5501 – 6000[2]	150/75	165/83	180/90	195/98	210/105	225/113

Ventilation Systems
Required ventilation rate
Example 4

(.02 X square feet of conditioned space) + (15 x (number of bedrooms +1))= **Total Ventilation Rate**

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Example: 6 bedroom, 3 bathroom, 7,000 sq.ft. house

(6 Bedrooms + 1) X 15 (cfm)	7 X 15 =105
+ (0.02 (cfm) X 7000 sq.ft.)	+ 140
	245 cfm

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
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5501 – 6000[2]	150/75	165/83	180/90	195/98	210/105	225/113

Sub-script 2 to the table

- If conditioned space exceeds 6000 sq. ft. or there are more than 6 bedrooms, use Equation 11-1 from section N1104.2 to calculate total ventilation rate.

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Ventilation Systems

- Framework for Mechanical Ventilation
  - Quantity and location of exhaust (stale, moist) air
  - Quantity and location of supply (fresh, outdoor) air
  - Pressure imbalances (unbalanced exhaust & supply)
  - Internal distribution/circulation patterns
  - Controls

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Overview-Ventilation Systems

N1104.3 Ventilation system requirements. The mechanical ventilation system shall be one of 3 types:

1. Exhaust in accordance with N1104.2.1 (Continuous ventilation section).
2. Balanced, and HRV/ERV in accordance with N1104.3.2
3. Other method in accordance with N1104.3.3

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Overview-Ventilation Systems

- N1104.3.1 Exhaust Systems. Fans used to comply with the continuous ventilation part of the mechanical ventilation system shall:

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Overview-Ventilation Systems

- N1104.3.1 Exhaust Systems. Fans used to comply with the continuous ventilation part of the mechanical ventilation system shall:
  1. Meet minimum continuous rate in N1104.2.1

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Overview-Ventilation Systems

- N1104.3.1 Exhaust Systems. Fans used to comply with the continuous ventilation part of the mechanical ventilation system shall:
  1. Meet minimum continuous rate in N1104.2.1
  2. Designed and certified by equipment manufacturer as capable of continuous operation at rated CFM

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Overview-Ventilation Systems

- N1104.3.1 Exhaust Systems. Fans used to comply with the continuous ventilation part of the mechanical ventilation system shall:
  1. Meet minimum continuous rate in N1104.2.1
  2. Designed and certified by equipment manufacturer as capable of continuous operation at rated CFM
  3. Have a 1.0 sone maximum per HVI Standard 915 for surface mounted fans

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  3. Have a 1.0 sone maximum per HBI Standard 915 for surface mounted fans
  4. Be permitted to use a required overcurrent protection device as a disconnect per the NEC.

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  2. Designed and certified by equipment manufacturer as capable of continuous operation at rated CFM
  3. Have a 1.0 sone maximum per HBI Standard 915 for surface mounted fans
  4. Be permitted to use a required overcurrent protection device as a disconnect per the NEC.
  5. Comply with the MN Mechanical Code 1346 which may require additional makeup air.

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- Exhaust-only systems
  1. Decentralized fans in baths, kitchen, laundry, etc.
  2. Centralized exhaust system
     - with or without heat recovery

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Ventilation System Requirements

- Exhaust Systems
  - Exhaust Fans operating @ the Continuous Ventilation Rate
  - Plus “supplemental/intermittent ventilation” system
  - ***Make up air into home?***
- Note:
  - Surface mounted fan runs continuously at
    - **1 sone fan**
  - In-line fan (outside conditioned space) and intermittent fans run continuously at
    - **2.5 sone fan**

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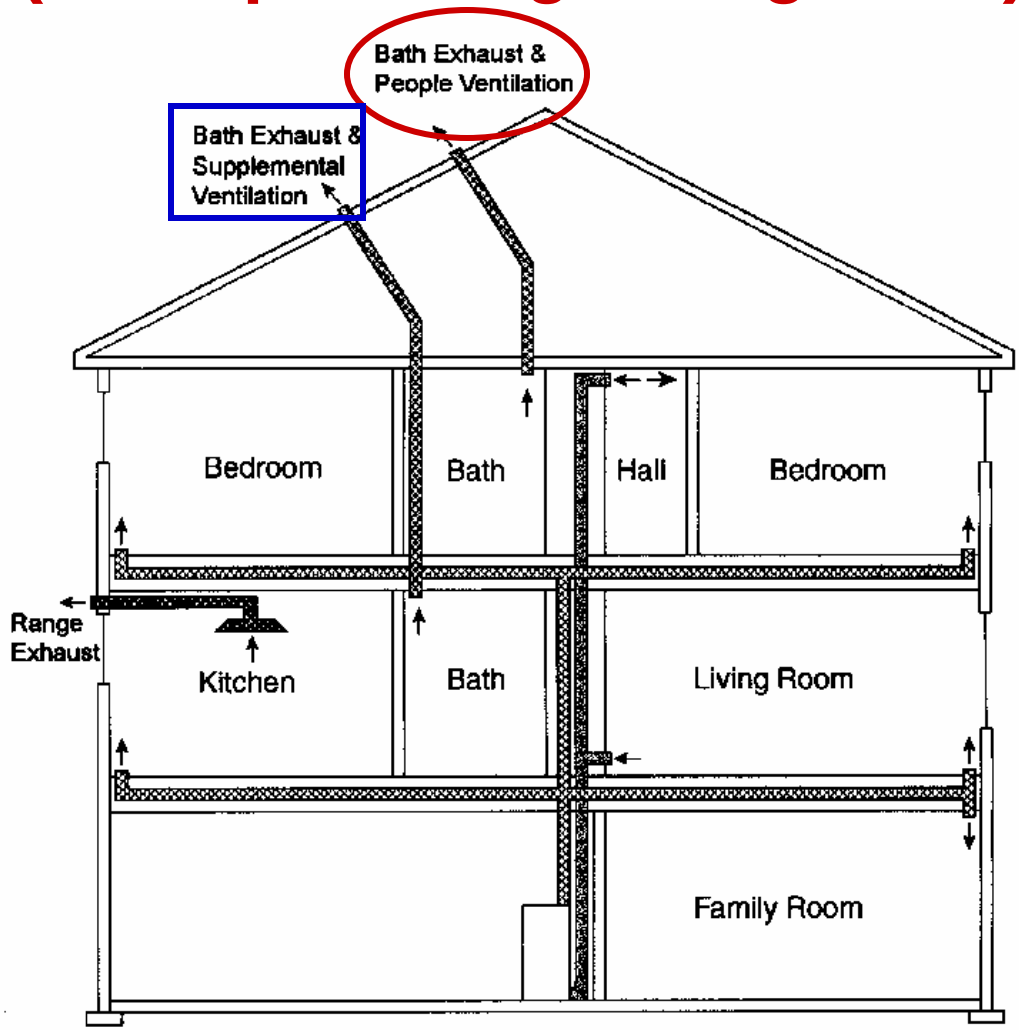
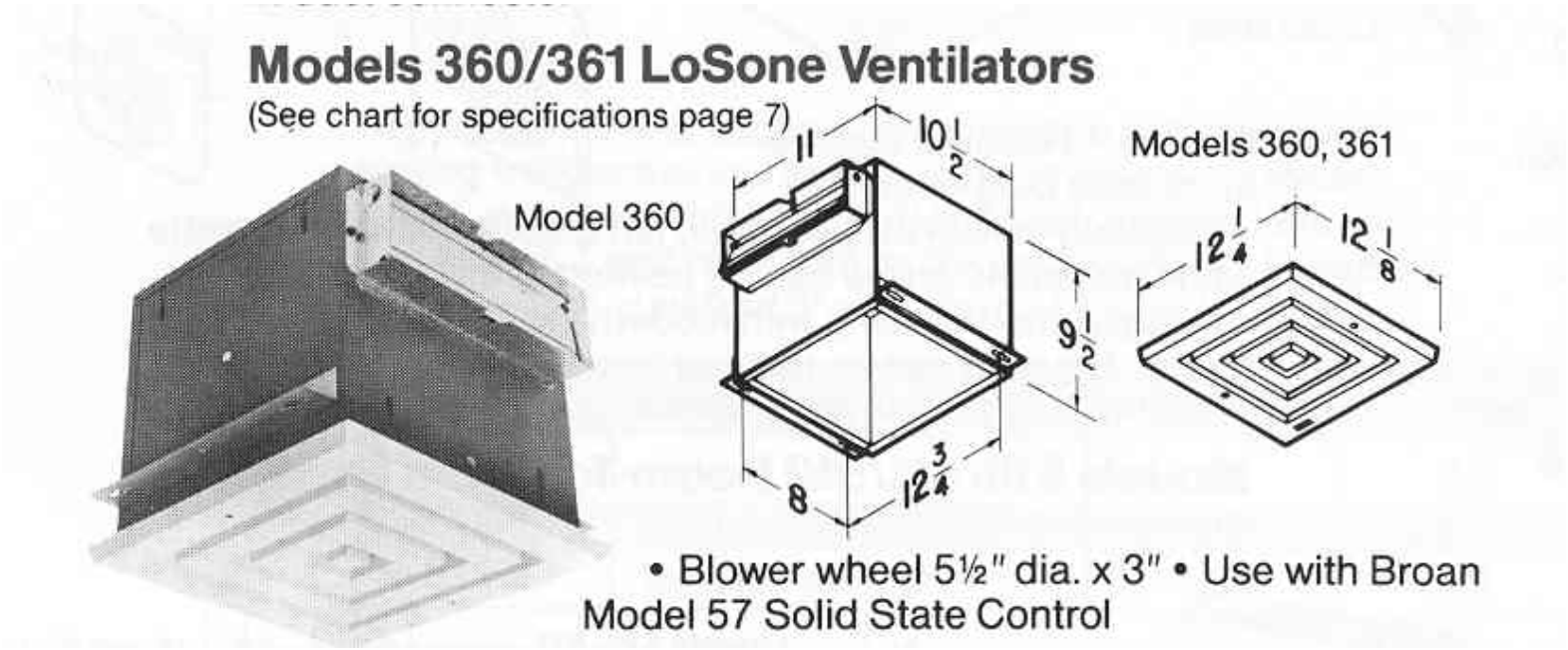
Decentralized Exhaust-Only

Point Source Approach
(Example using a single fan)



Decentralized Exhaust-Only

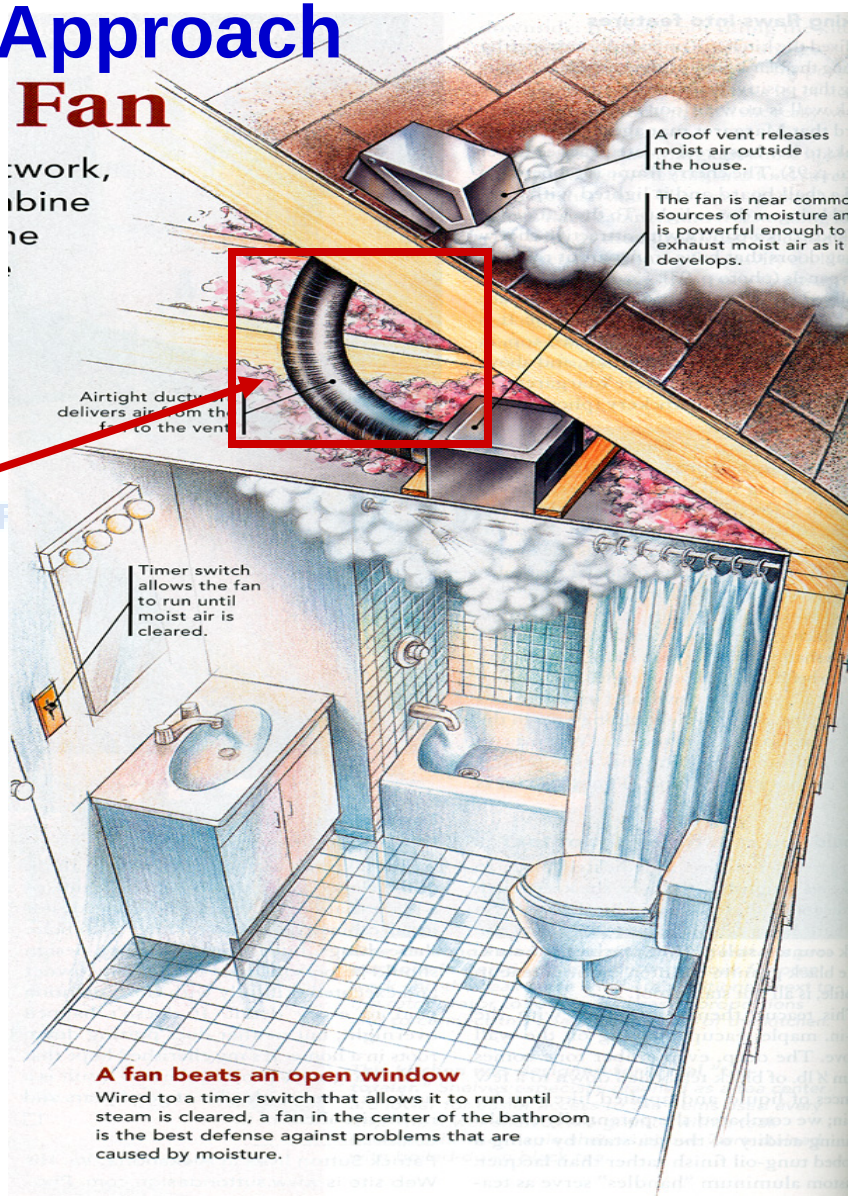
Point Source Approach



Decentralized Exhaust-Only

Point Source Approach

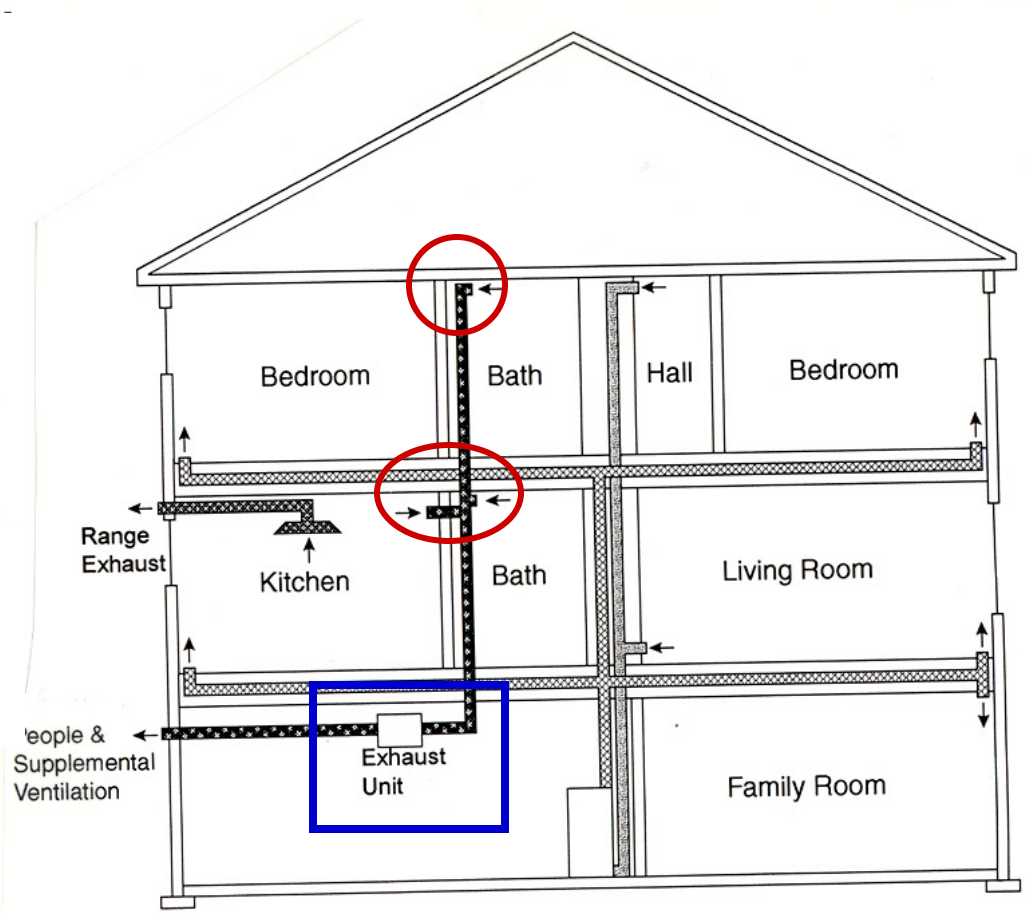
Flex Duct installations shall be stretched tight with no sags and excess duct cut off to allow for less static pressure loss and a more effective system.



A fan beats an open window
Wired to a timer switch that allows it to run until steam is cleared, a fan in the center of the bathroom is the best defense against problems that are caused by moisture.

Centralized Exhaust-Only

Point Source Approach
(Example using a dedicated exhaust Unit)



Centralized Exhaust-Only

Point Source Approach

Ventilation Systems

- **Balanced systems**
  - **integrated supply and exhaust system**
    - HRV/ERV most common system

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Ventilation Systems

- Balanced systems
  - integrated supply and exhaust system
  - **separate supply and exhaust fans**

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Overview-Ventilation Systems

- Mechanical ventilation is required:
  - "Balanced ventilation systems"
    - Energy Recovery Ventilator (ERV)
    - Heat Recovery Ventilator (HRV)
    - Fans

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Overview-Ventilation Systems

N1104.3.2 Balanced, and HRV/ERV Systems.

Shall meet either:

1. The requirements of HVI Standard 920, 72 hour minus 13 F cold weather test, or

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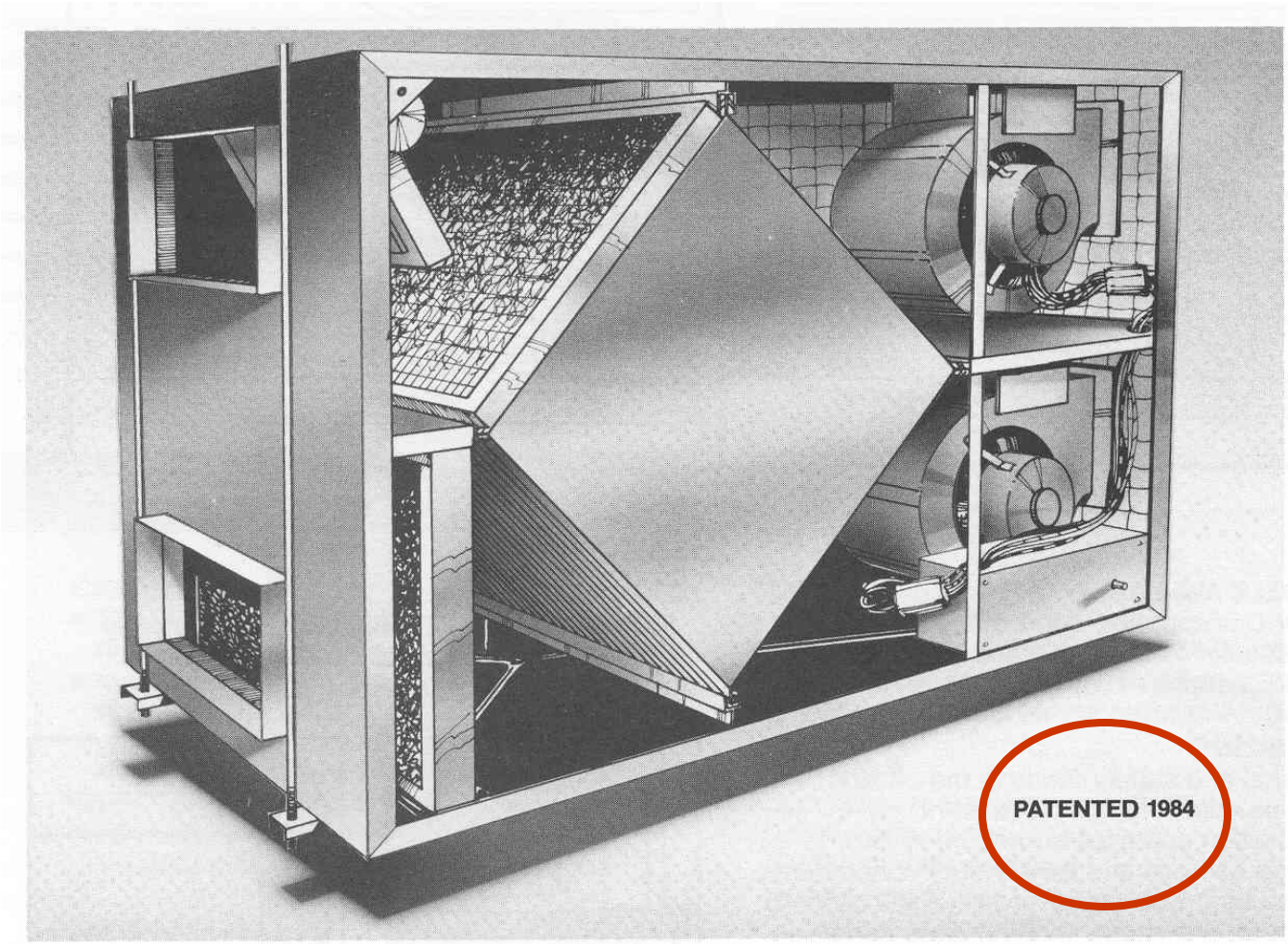
2. Certified by a registered professional engineer and installed per manufacturers installation instructions.

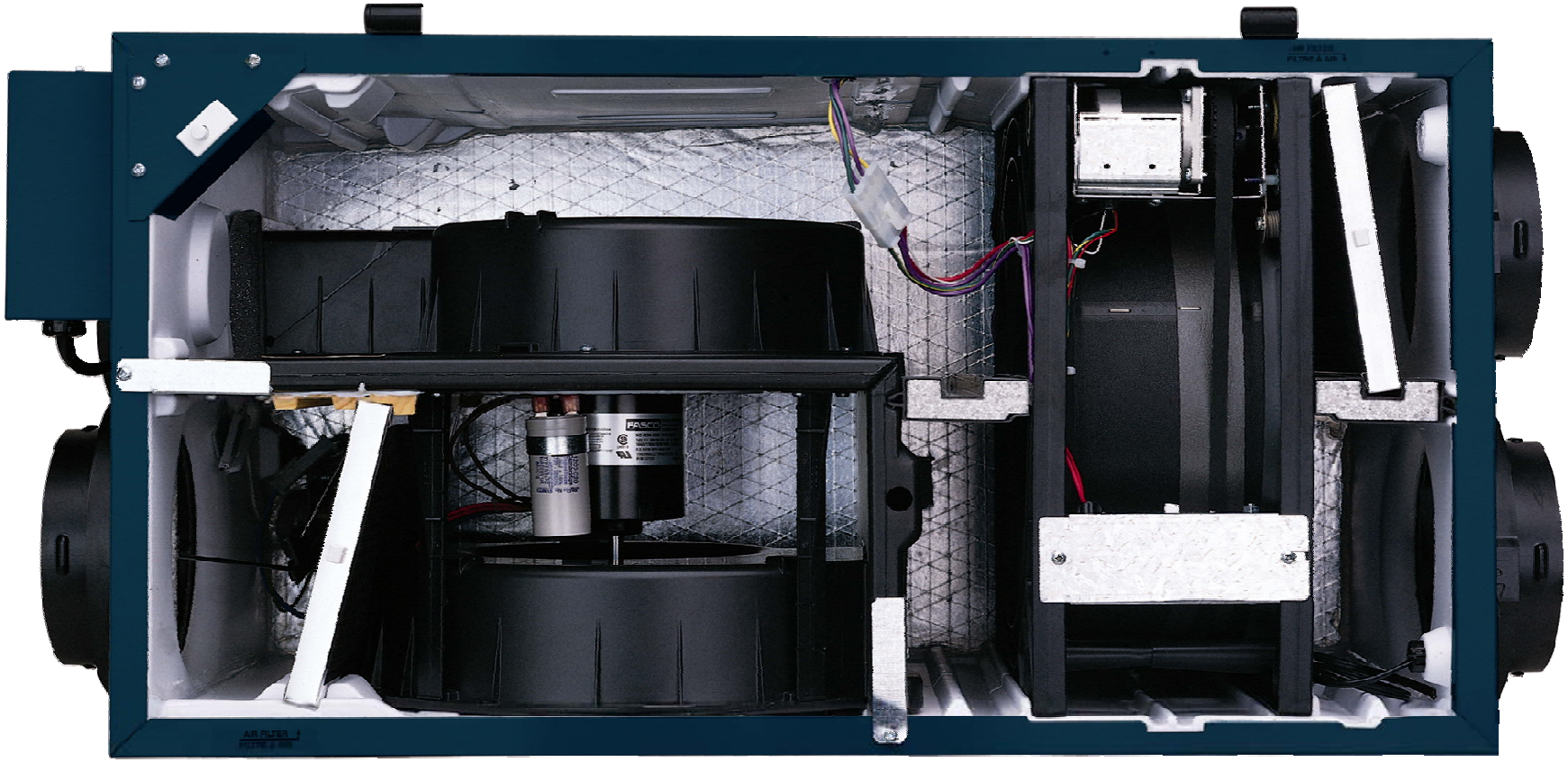
Balanced Ventilation

Heat Recovery Ventilator



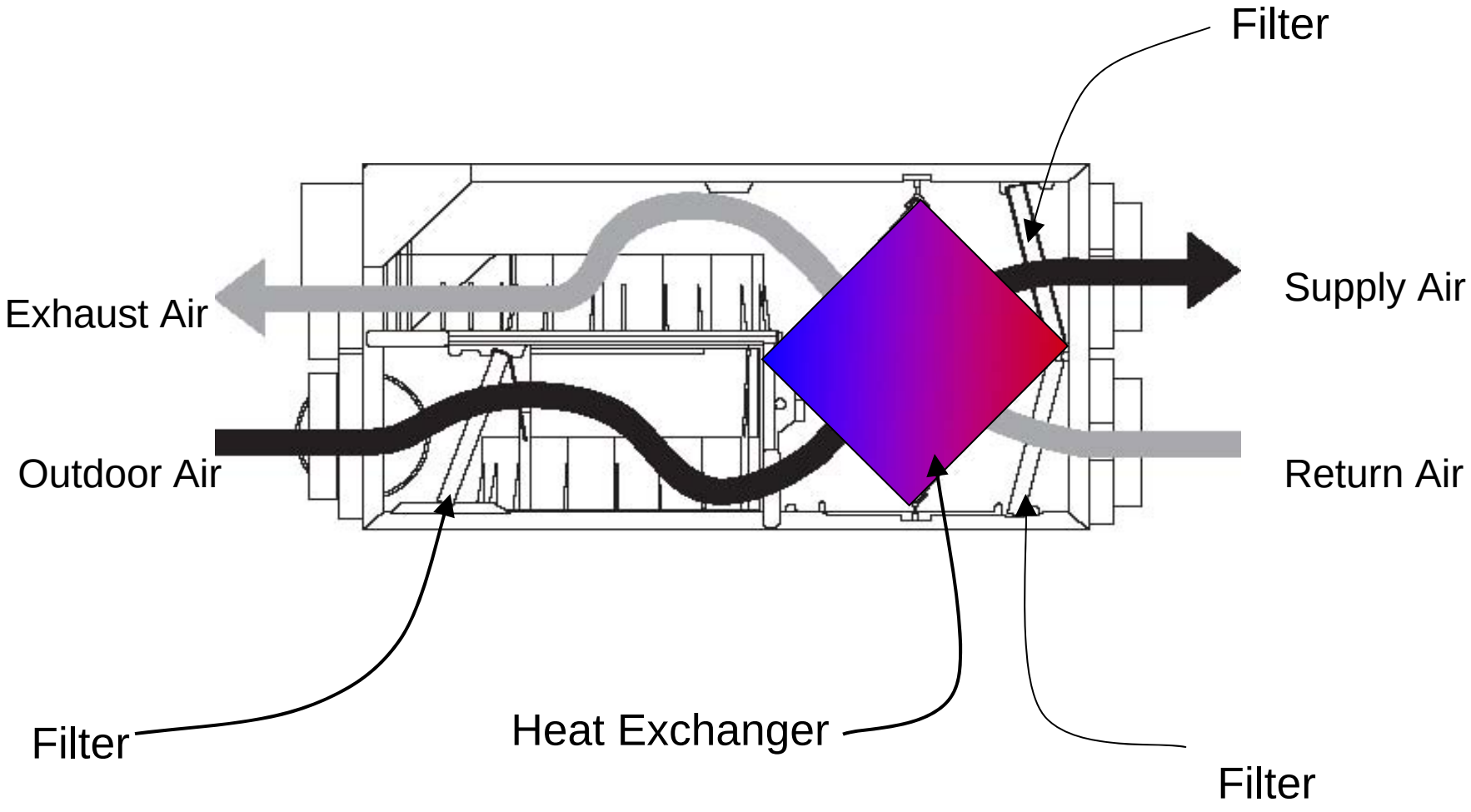
Balanced Ventilation

Energy Recovery Ventilator

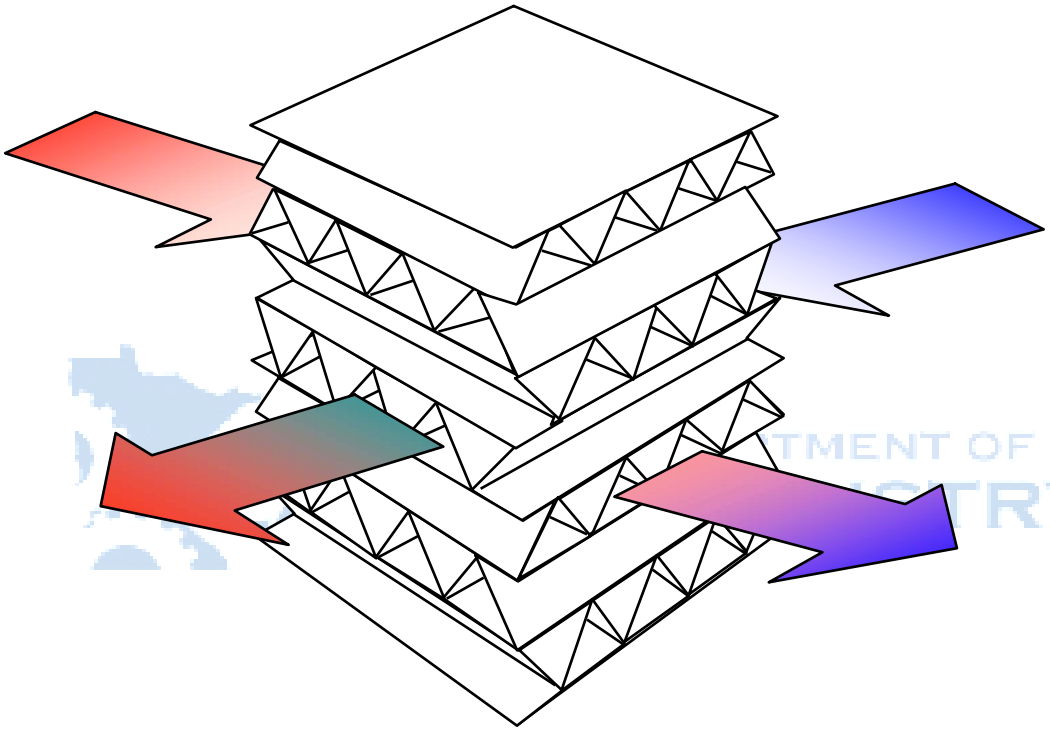


Heat Recovery Ventilator

Heat Recovery Ventilator

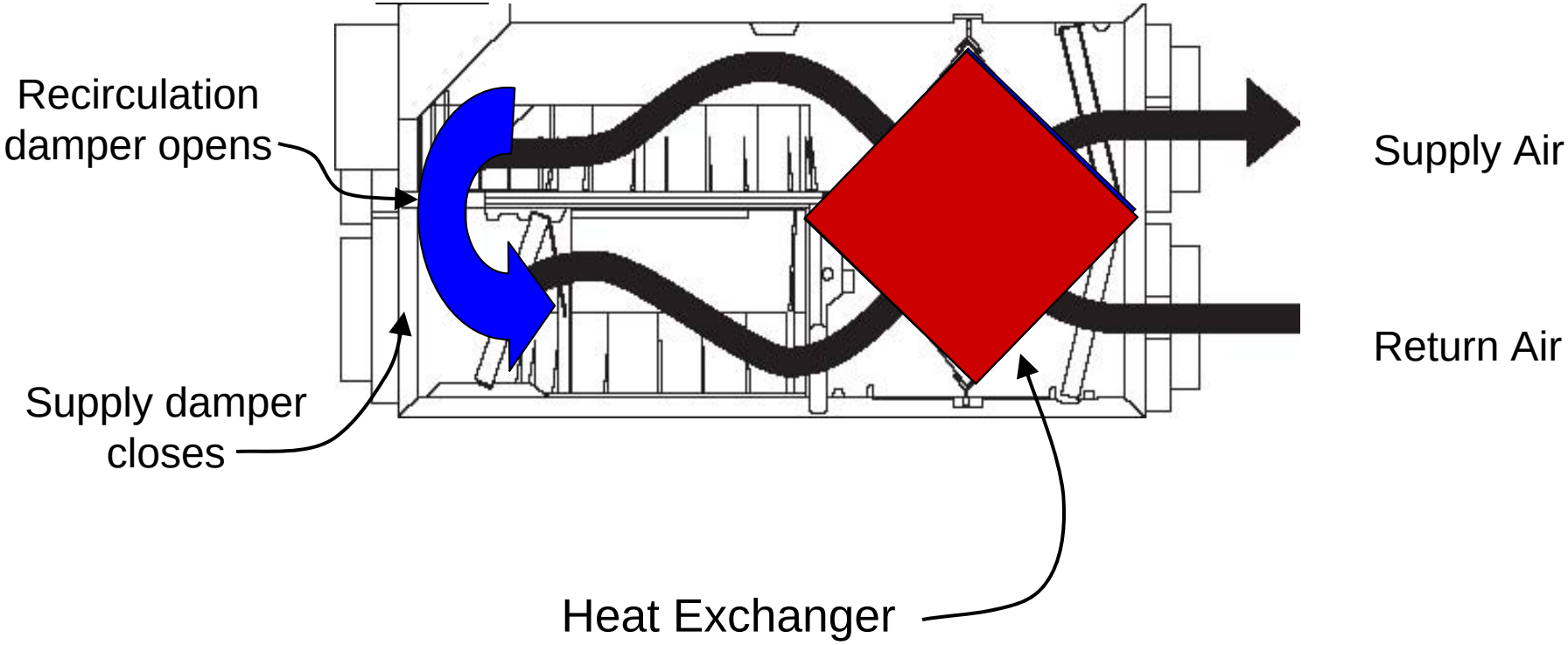


Heat Recovery Ventilator

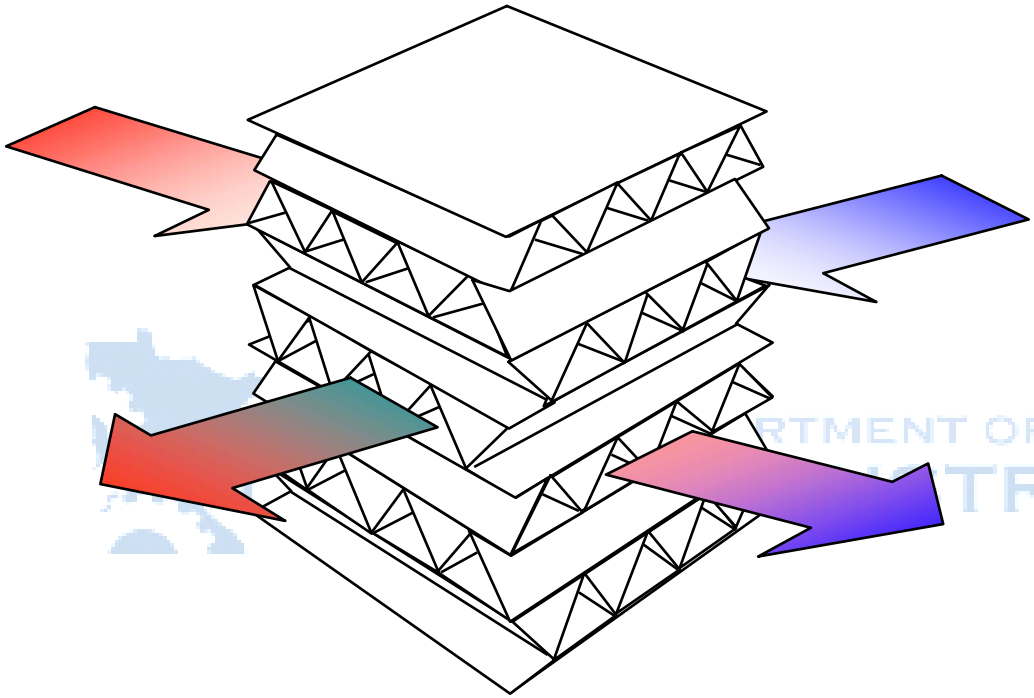


1. Transfers heat by conduction

HRV Defrost Operation



Energy Recovery Ventilator



1. Transfers heat by conduction

2. Transfers humidity using *hygroscopic* resin

Ventilation System Requirements (Example)

- "Balanced Systems" (HRV or ERV)
  - Provides an "average" of 60 cfm
    - **Provide (60 cfm X 60 min) = 3,600 cfh**

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Ventilation System Requirements

- Exhaust Systems
- “Balanced Systems” (ERV)
  - Provides an “average” of 60 cfm
    - Provide (60 cfm X 60 min) = 3,600 cfh
      - 120 cfm for 30 minutes (120 X 30 = 3,600)
      - 180 cfm for 20 minutes (180 X 20 = 3,600)
      - 240 cfm for 15 minutes (240 X 15 = 3,600)

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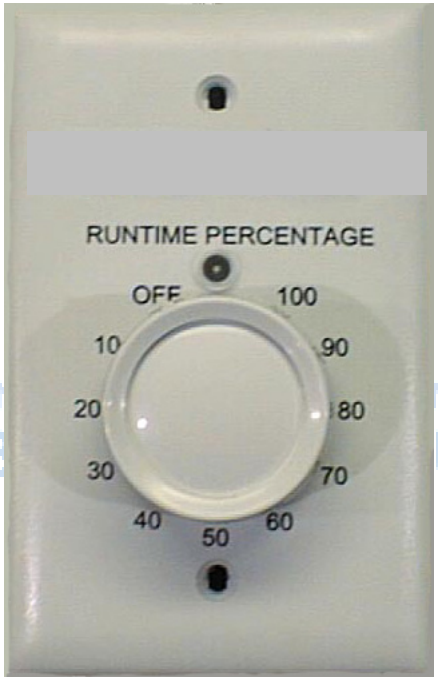
Proportional Timer



Turns unit on and off a percentage of each hour

Overview-Ventilation Systems

N1104.3.3 Other methods.

– Any mechanical ventilation system consisting of exhaust fans, supply fans or combination of both (that comply with N1104) shall be allowed.

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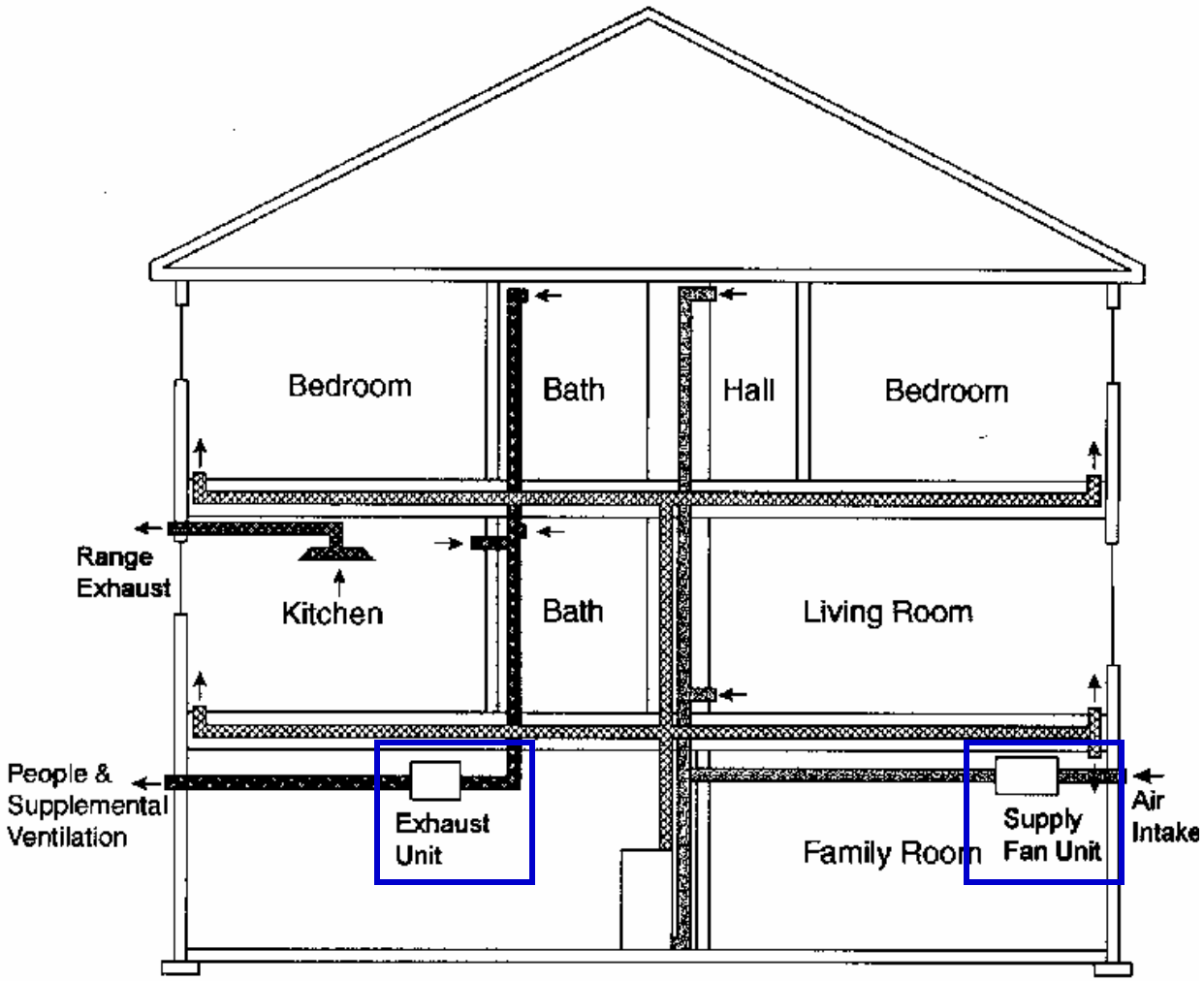
Other Methods-complies with N1104

Separate Exhaust and Supply



Installation Requirements

- Installed in accordance with MN Rule 1346

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Air distribution/circulation

- Outdoor air shall be delivered to each habitable space by:
  - a forced air circulation system (Furnace)

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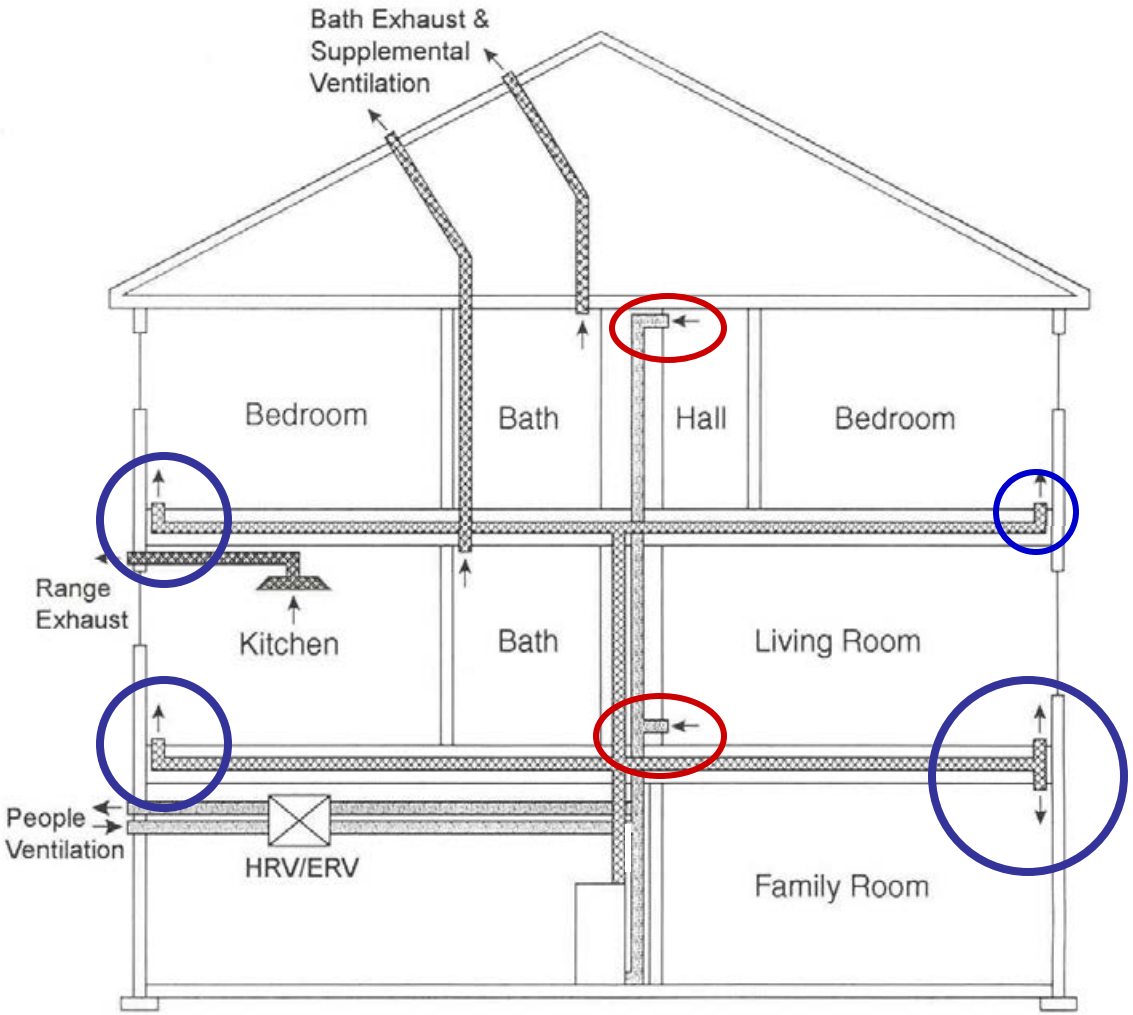
Balanced Ventilation

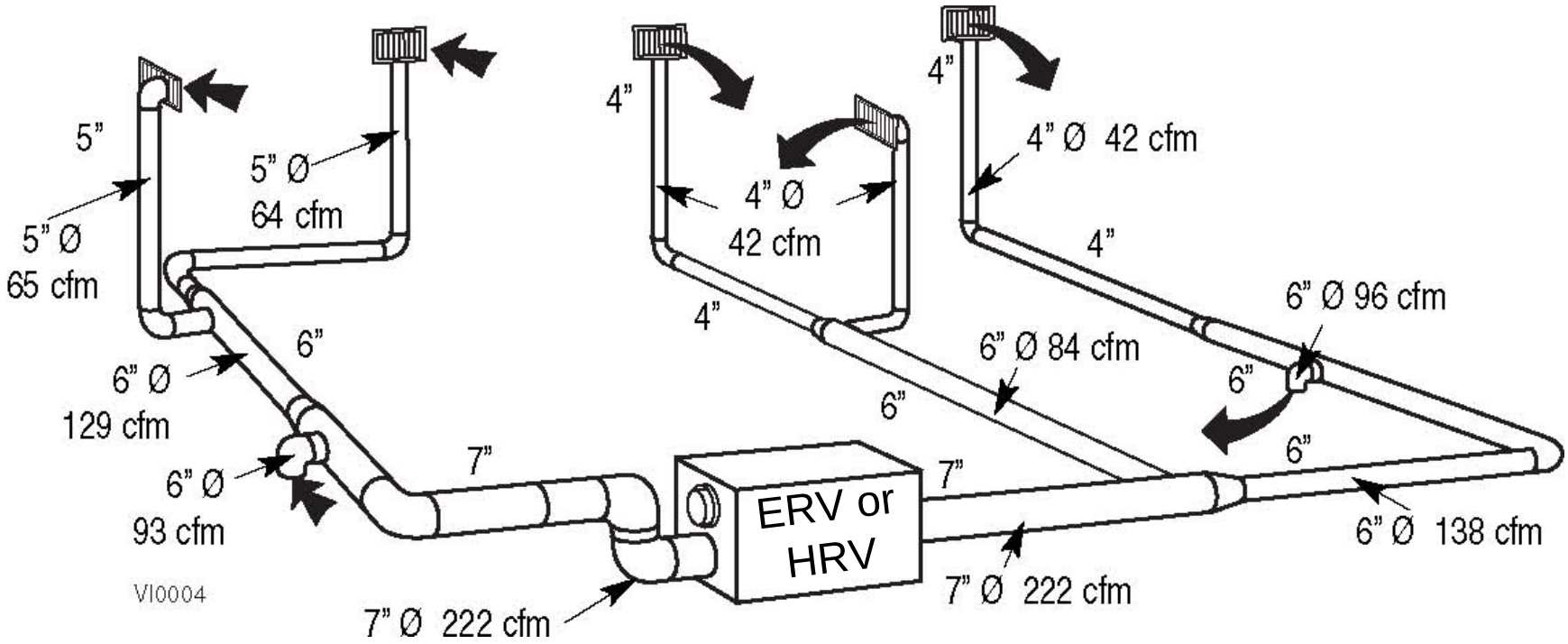
Volume Source Approach



Air distribution/circulation

- Outdoor air shall be delivered to each habitable space by:
  - a forced air circulation system (Furnace)
    - (a) When an outdoor air supply is ***not ducted*** to the forced air system, controls shall be installed to allow the forced air system to provide an average circulation flow rate each hour, of not less than **0.15 cfm/sq.ft**. of the conditioned floor area.

“Not ducted” through Furnace



Intake openings

- Exterior air intake openings shall be located in accordance Minnesota Rules Chapter 1346.

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Filtration

- All mechanically supplied outdoor air shall have a filter with a designated minimum efficiency of MERV 4 (i.e. good furnace filter) The filter shall be located on the inlet of the appliance and shall be installed to be readily accessible and facilitate regular service.

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Controls.

Mechanical ventilation system controls shall be provided in accordance with the following:

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1. **If required by the equipment (i.e. HRV or ERV) manufacturer's installation instructions, controls shall be installed to ensure that the forced air circulation system is operating whenever the mechanical ventilation system is operating.**

Controls.

Mechanical ventilation system controls (N1104.4.10) shall be provided in accordance with the following:

2. Controls shall be installed to **ensure** that whenever the mechanical ventilation system is operating, the forced air circulation system **provides indirect circulation of 0.15 cfm** per square foot of conditioned floor area or **direct distribution of 0.075 cfm** per square foot of conditioned floor area.

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Controls.

Mechanical ventilation system controls (N1104.4.10) shall be provided in accordance with the following:

3. If the mechanical **ventilation system is not designed** to operate whenever the forced air circulation system is operating, the mechanical ventilation system shall **incorporate an accessible backflow damper** to prevent flow from the outside when the mechanical ventilation system is off.

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Controls.

Mechanical ventilation system controls (N1104.4.10) shall be provided in accordance with the following:

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4. Controls shall be compatible with the mechanical ventilation system.

Controls.

Mechanical ventilation system controls (N1104.4.10) shall be provided in accordance with the following:

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5. Controls shall be installed to operate the mechanical ventilation system as designed.

Controls.

Mechanical ventilation system controls (N1104.4.10) shall be provided in accordance with the following:

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6. Controls shall be **readily accessible** to occupants and shall be labeled to indicate their function.

Controls.

Mechanical ventilation system controls (N1104.4.10) shall be provided in accordance with the following:

7. If a switch is used to control the continuous ventilation system, it can be centrally or remotely located. If remotely located, it shall NOT be in a bath or toilet room. If centrally located, it shall be properly labeled and lighted when the system is on. If remotely located, there shall be a lighted status indicator in a central location that will be lighted when the system is on.

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Push Button “Switch”

Labeling

- The outdoor air intake and exhaust air outlet shall include a permanent, weather resistant identification label stating:
  - “OUTDOOR AIR INTAKE” or
  - “EXHAUST AIR OUTLET”.

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Labeling

- The outdoor air intake and exhaust air outlet shall include a permanent, weather resistant identification label stating:
  - Controls provided for continuous and intermittent ventilation shall be provided with a label stating “VENTILATION SYSTEM” or “VENTILATION FAN” or “INTERMITTENT FAN” or ventilation symbols, as appropriate.

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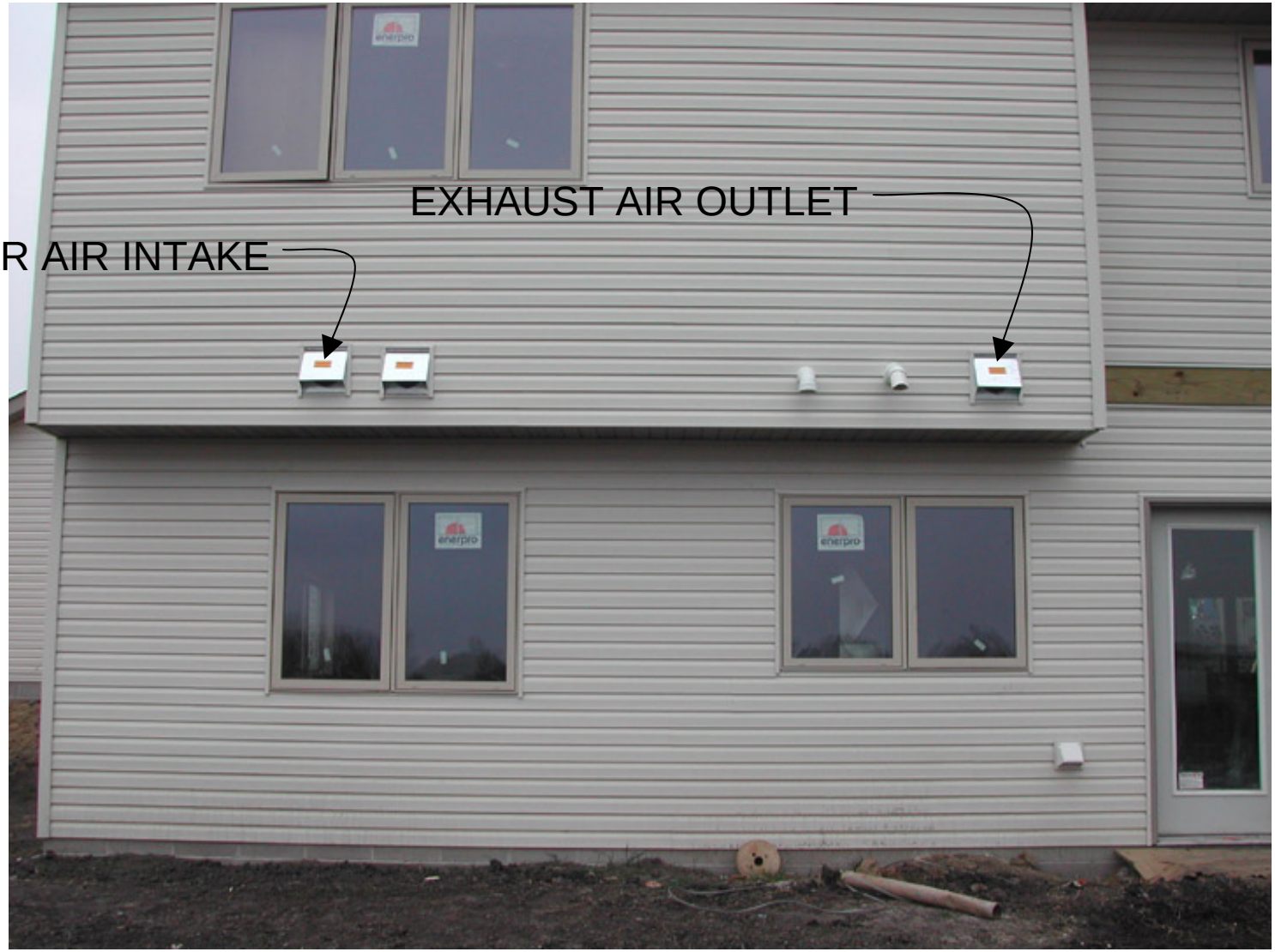
Labeling



Documentation

- *(ALL)* Mechanical ventilation systems shall be provided with documentation that includes proper operation and maintenance instructions and a warning regarding potential problems if the system is not operated and maintained.
  - Bathroom fans
  - ERV's & HRV's
  - Furnaces
  - "Other equipment"

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Documentation

- A permanent warning label shall be affixed to mechanical ventilation systems if it is readily accessible. If the mechanical ventilation system is not readily accessible, the documentation shall be in a conspicuous readily accessible location. (i.e. on the furnace or ERV)

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Changing Design Conditions

City	Summer Db/Wb ºF 1999	Summer Db/Wb ºF 2006	Winter Db ºF 1999	Winter Db ºF 2006
Albert Lea	87/72	**85/72**	-17	**-15**
Alexandria	88/72	**86/70**	-22	**-21**
Bemidji	85/69	**84/68**	-31	**-24**
Brainerd	87/71	**86/71**	-20	**-20**
Duluth	82/68	**81/67**	-21	**-20**
Faribault	88/72	**86/73**	-17	**-16**
Fergus Falls	88/72	**86/71**	-21	**-21**
Virginia	83/72		-25	
International Falls	83/68	**83/67**	-29	**-28**
Mankato	88/72	**86/72**	-17	**-15**
Minneapolis/St. Paul	89/73	**88/72**	-16	**-15**
Rochester	87/72	**85/72**	-17	**-17**
St. Cloud	88/72	**86/71**	-15	**-20**
Willmar	88/72	**85/71**	-15	**-20**
Winona	88/73	**88/74**	-14	**-13**

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Changing Design Conditions

	Summer Db/Wb ºF		Winter Db ºF	
City	1999	2006	1999	2006
Aitkin		82/72		-24
Cloquet		82/68		-20
Crookston		84/70		-27
Ely		82/68		-29
Eveleth		82/68		-26
Hibbing		82/68		-19
Montevideo		86/72		-17
Mora		84/70		-21
Morris		84/72		-21
New Ulm		87/73		-15
Owatonna		86/73		-16
Pequot Lake		84/68		-23
Pipestone		85/73		-15
Redwood Falls		89/73		-17
Roseau		82/70		-29
Thief River		82/68		-25
Tofte		75/61		-14
Warroad		83/67		-29
Wheaton		84/71		-20
Worthington		84/71		-14

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Residential Thermostats

- At least one thermostat shall be provided for each separate heating and cooling system
  - Does not require a programmable ‘stat!

DEPARTMENT OF LABOR & INDUSTRY

Duct Insulation

- Ducts shall be insulated in accordance with Minnesota Rule Chapter 1346

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LABOR & INDUSTRY

Residential Duct Insulation

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 Sealing

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.*

No Change!

Supply Ducts

- Supply ducts shall be continuously ducted from the point of origin to the point of discharge . . . ***building framing cavities and building components shall not be used as supply ducts***.

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Domestic Water Piping Insulation

A. **Cold Water:** No insulation required.

Exception:

1. Piping within 6 inches of any heating pipes, . . .

   and underground piping, . . . minimum of 1” insulation with . . . vapor jacket.

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Domestic Water Piping Insulation

B. **Hot Water**: No insulation required.

Exceptions:

1. All recirculating systems . . . 0.5” . . . on the entire loop with vapor jacket.
2. Underground piping, underground piping, . . . minimum of 1” insulation with . . . vapor jacket.

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HVAC Piping Insulation

Hydronic, steam, and condensate piping . . . insulated in accordance with Minnesota Chapter Rule 1346 and shall have vapor appropriate jacket.

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HVAC Piping Insulation

Hydronic, steam, and condensate piping . .

Exceptions:

1. Piping installed ***within*** HVAC equipment; or
2. Piping installed in basements, crawl spaces, and cellars.

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Insulation Thickness for Nominal Pipe Diameters

Fluid Temperature Range °F	Runouts (See item C)	1 inch (25.4 mm and less)	1.25 to 2" (31.7 to 50.8 mm)	2.5 to 4" (63.5 to 101.6 mm)	5 to 6" (127 to 152 mm)	8" (203 mm) and Larger
Piping System Type - Heating						
Above 350	1.5	2.5	2.5	3.0	3.5	3.5
251-350	1.5	2.0	2.5	2.5	3.5	3.5
201-250	1.0	1.5	1.5	2.0	[illegible]	3.5
141-200	0.5	1.5	1.5	1.5	1.5	1.5
105-140	0.5	1.0	1.0	[illegible]	1.5	1.5
Piping System Type - Cooling						
40-55	0.5	0.5	[illegible].75	1	1	1
Below 40 (see item D)	1	1	1.5	1.5	1.5	1.5

A. Insulation thickness in this section assumes a k-value of 0.27. If the k-value of a product is less than 0.22, then the thickness must be adjusted to have an equivalent R-value.

B. For piping exposed to outdoor air, insulation thickness must be 0.5 inch (12.7 mm) greater than required in the table.

C. This column applies only to runouts (branches) 2 inches (50.8 mm) in diameter and less, not exceeding 12 feet (3658 mm) in length, to individual terminal units. All other runouts shall meet the requirements given in other columns in the table, as appropriate.

D. For applications with fluid temperatures of 32°F (0°C) and below, a vapor retarder shall be installed in accordance with IMC Section 604.11.

No Change!

Circulating hot water systems

Include controls that turn the circulating pump off when the system is not in use or when the circulating loop temperature is satisfied.

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Equipment sizing

Heating and cooling equipment shall be sized per Minnesota Mechanical codes

and an approved equivalent (method such as **ACCA Manual J**)

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Draft rule Chapter 1346.0312

Radon Control Methods

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What About the Health Concerns of Radon and Moisture

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Radon Is An Equal Opportunity Hazard!

- Radon in homes can present an unhealthy environment.
- Radon concerns are not dependent upon the age of a home.
- Radon concerns affect expensive and affordable homes alike.

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Radon – What is it Anyway?

- Radon is a cancer-causing, radioactive gas that can be found in homes all across the U.S.
  - Minnesota especially high
    - Geology
    - Climate
    - Housing stock
- 2nd leading cause of lung cancer
  - Deadliest and most preventable cancer
- Colorless, tasteless and odorless gas
- Radon comes from radioactive breakdown (decay) of uranium in soil and rock.

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Radon

- Enters homes through cracks and holes in the foundation and floors
  - Pressure differences
  - Stack effect
- Radon gets into the air we breathe and as it decays, it gives off radiation
  - This energy is the risk
  - Kill or otherwise mutate lung cells
- Radon can get into any type of building, including homes, offices, and schools.
- <u>Testing is the only way to know</u> if you or your family is at risk.

MINNESOTA DEPARTMENT OF HEALTH INSTITUTE

National Average Radon Levels

- Indoor-
  1.3 Pico curies/liter
- Outdoor-
  0.4 Pico curies/liter

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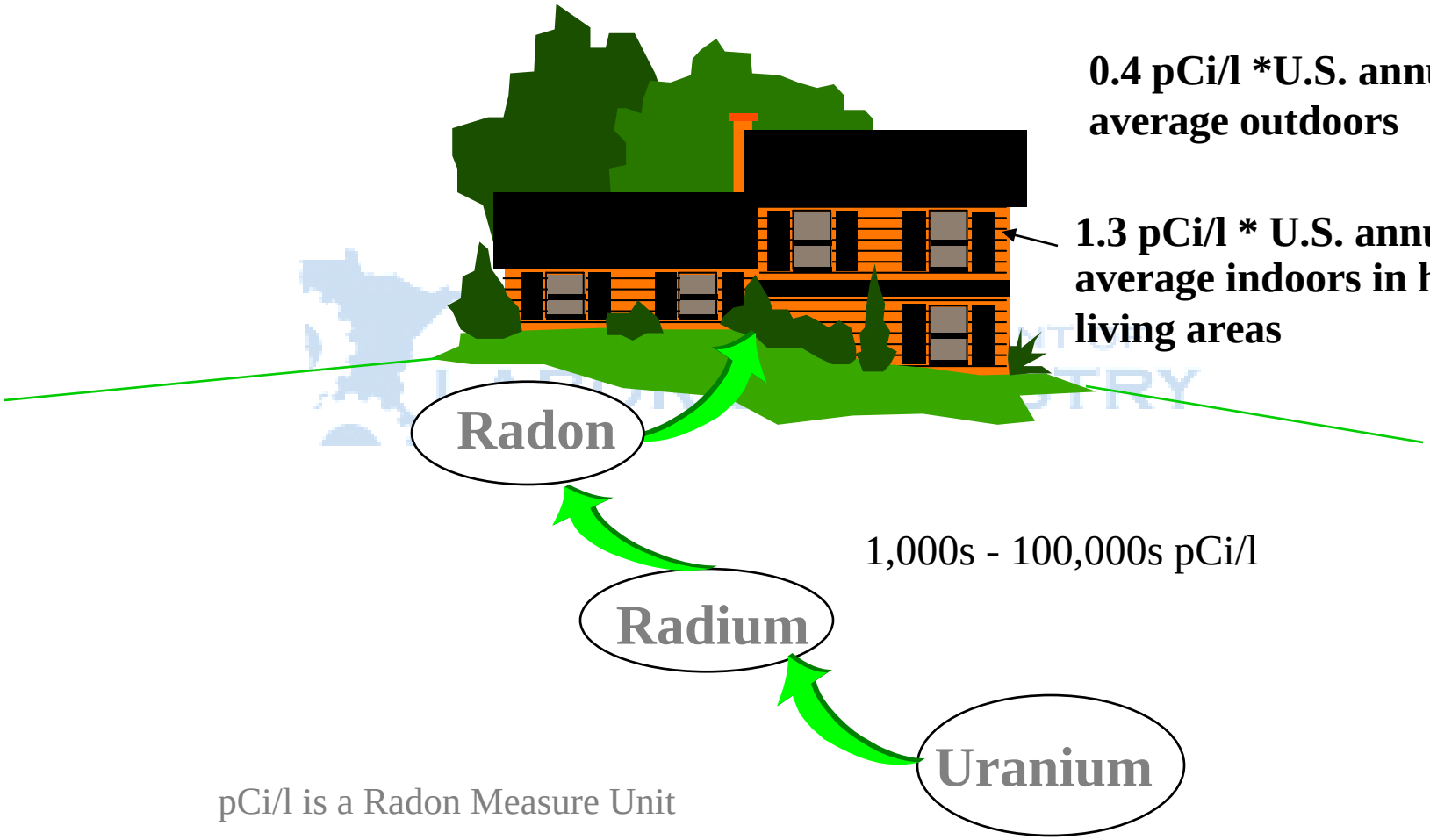
LABOR & INDUSTRY

- Minnesota-
  - About 4.0 pCi/L
    - Long-term average

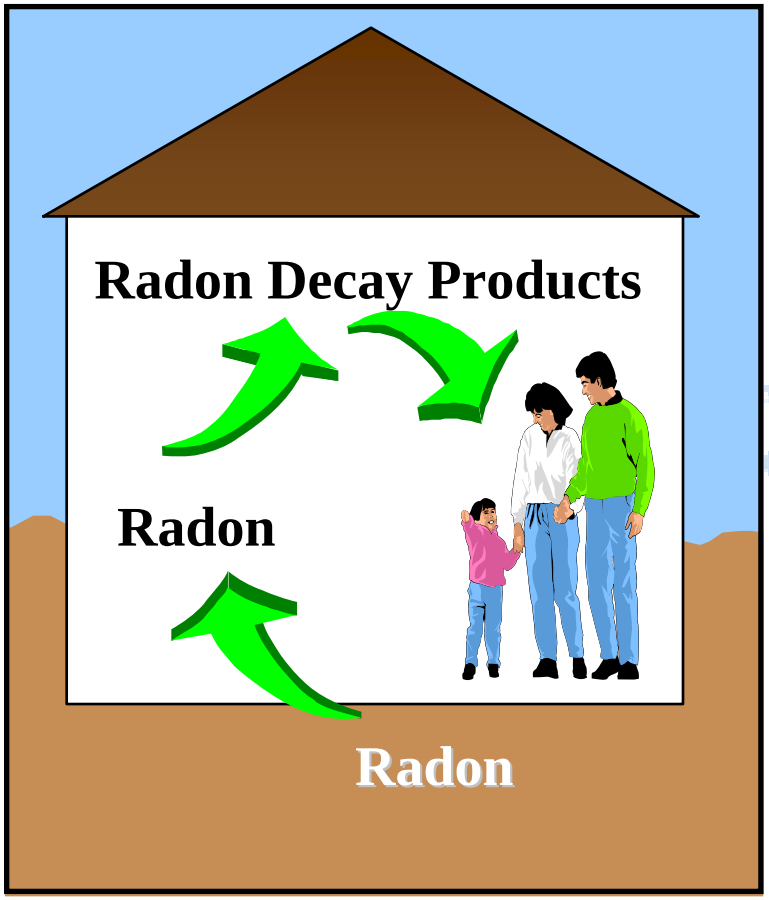
Radon Entry



pCi/l is a Radon Measure Unit

NOTE: Minnesota has the fourth highest portion of homes above EPA's 4 pCi/l Threshold for Action

Why Is Radon a Concern?



- Radon decays into radioactive particles known as radon decay products.
- These particles are easily inhaled and deposited in the lungs where they can damage sensitive lung tissue.

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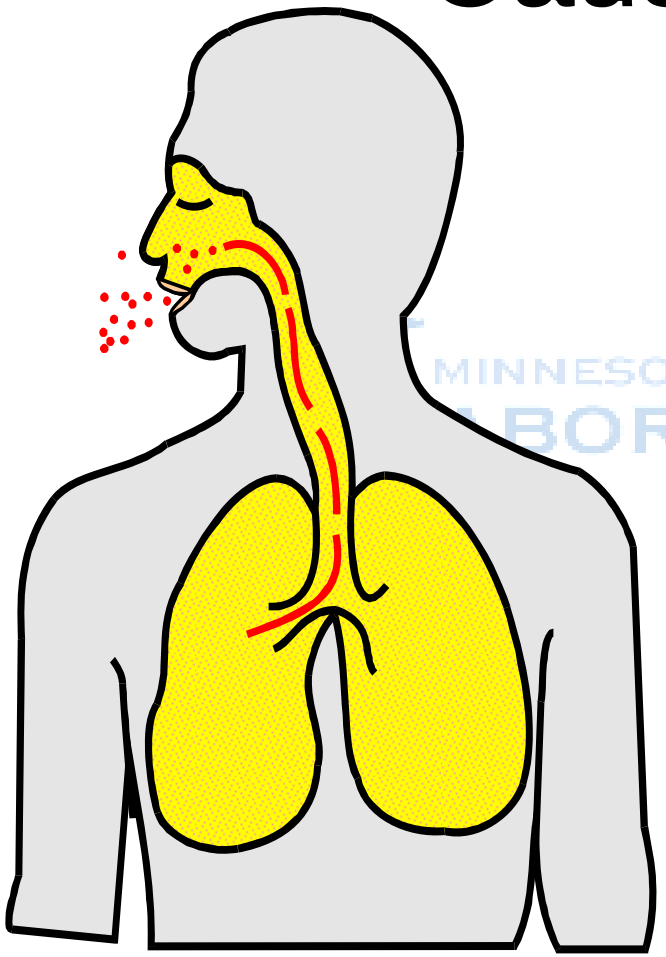
Radon Is A Lung Cancer Causing Gas



- Radon decay products inhaled.
- Particles irradiate lungs.
- Irradiation can cause lung

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Alpha Particles Are Strong Enough To Pit Plastic

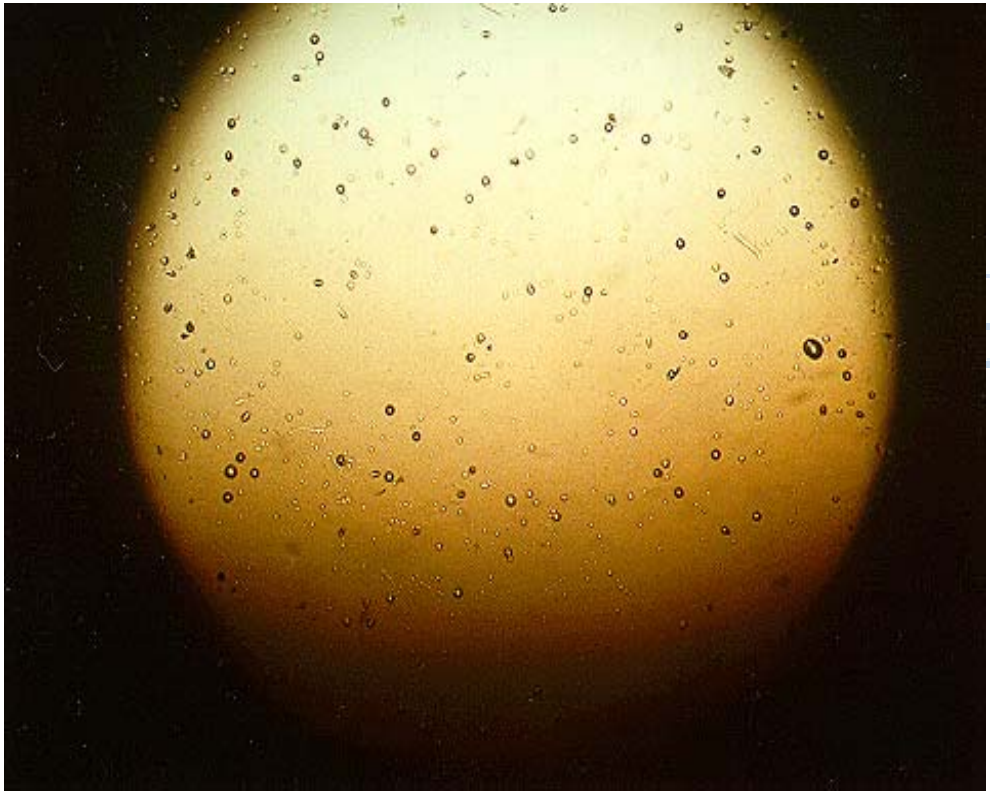
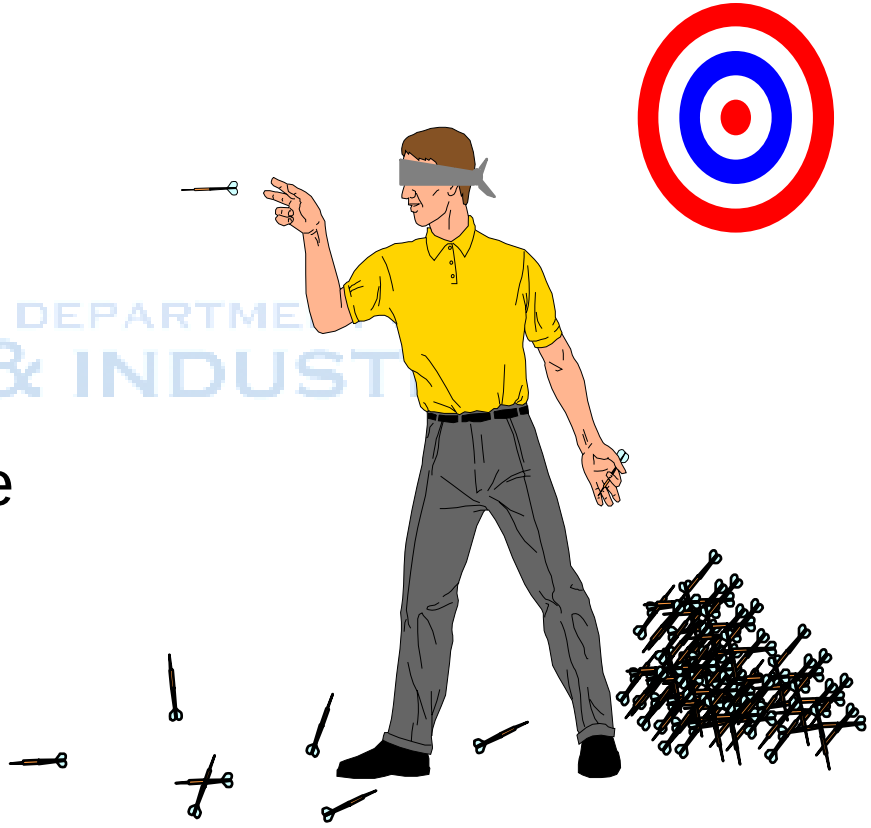


Photo by Dr. J.F. Burkhart

- Plastic chip from passive radon test (alpha track).
- Magnified only 100 times.
- 3 months at EPA Action Level of 4 pCi/L.

Radon Induced Lung Cancer

- Risk increased equally by both duration and concentration of exposure
- One dart at a time for a long time, or handfuls of darts over a short time



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Number Of Homes With High Radon Levels In Minnesota

The Minnesota Department of Health estimates that 1 in 3 homes in Minnesota have radon concentrations above the EPA recommended action level of 4.0 pCi/L.

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Radon and its Decay Products are Known Human Carcinogens

- Alpha particles from the radon decay products (RDPs) can damage living tissue including lung tissue.
  - Lung cancer is, scientifically, the best documented health effect of radon and its decay products.

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Lifetime Lung Cancer Death Risk Per Person (out of 1,000; 2003 Updated)

pCi/L	Never Smokers	Current Smokers	General Population
20	36	260	110
10	18	150	56
8	15	120	45
4	**7**	**62**	**23**
2	4	32	12
1.3	2	20	7

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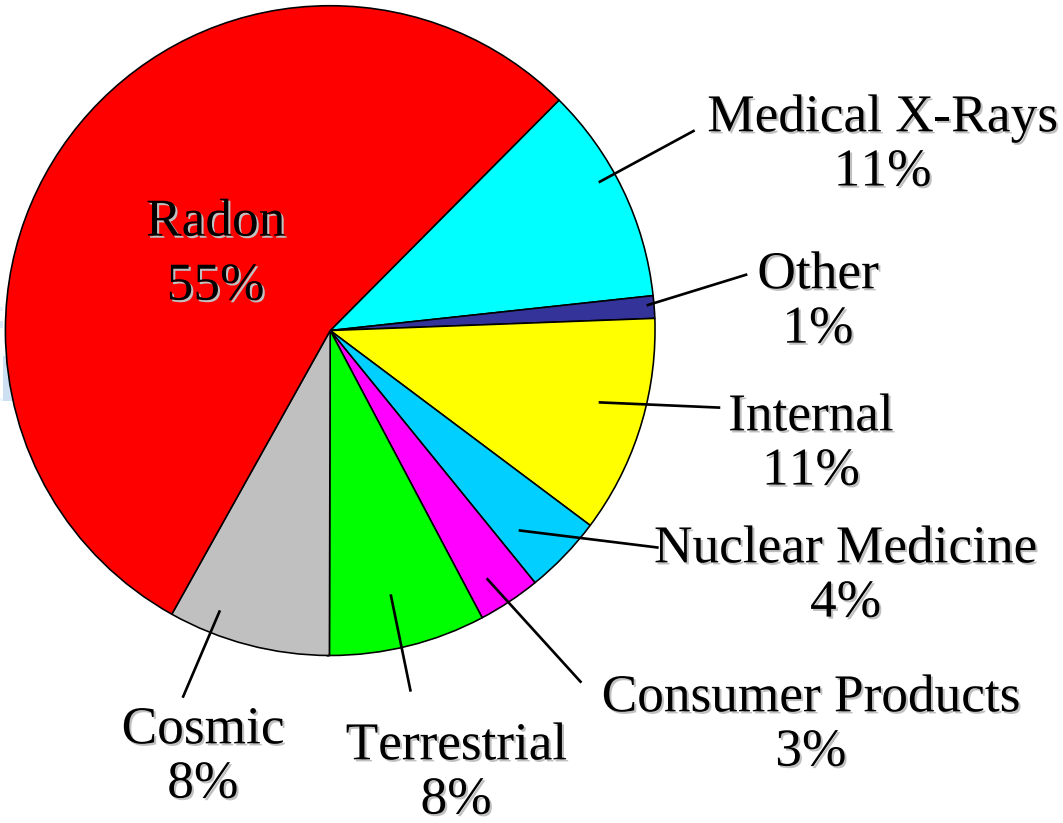
'Remember, each of these numbers represent a real person with a loving family,' Dr. William Field, University of Iowa

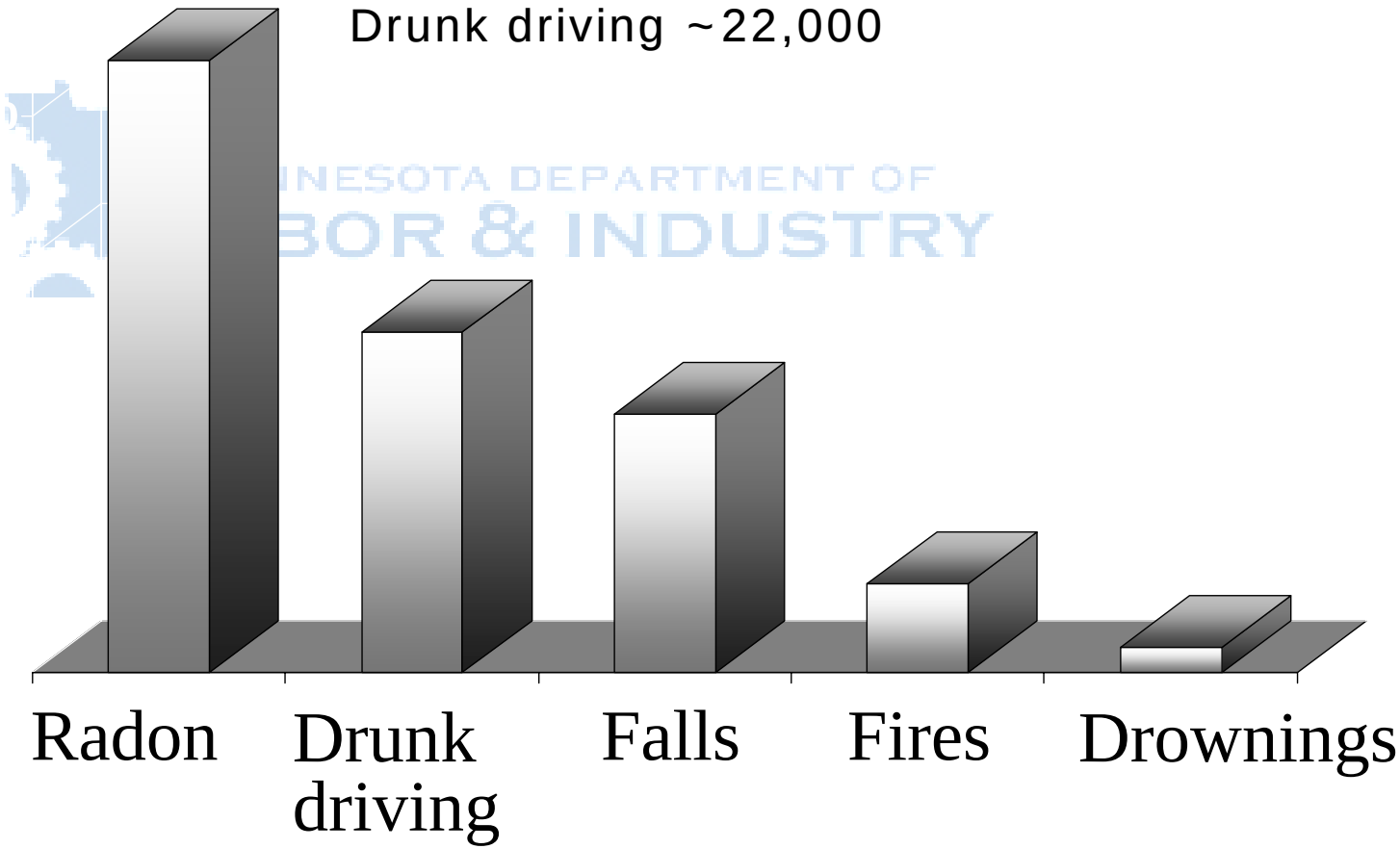
Sources of Radiation Exposure to the U.S. Population

- Assumes average indoor radon concentration of 1.3 pCi/L.
- Radon is by far the greatest single source of radiation to the general public.



Radon Compared to Other Risks (A Citizen's Guide to Radon, 2003, EPA)

Perspective: ten years ago, radon ~14,000
Drunk driving ~22,000



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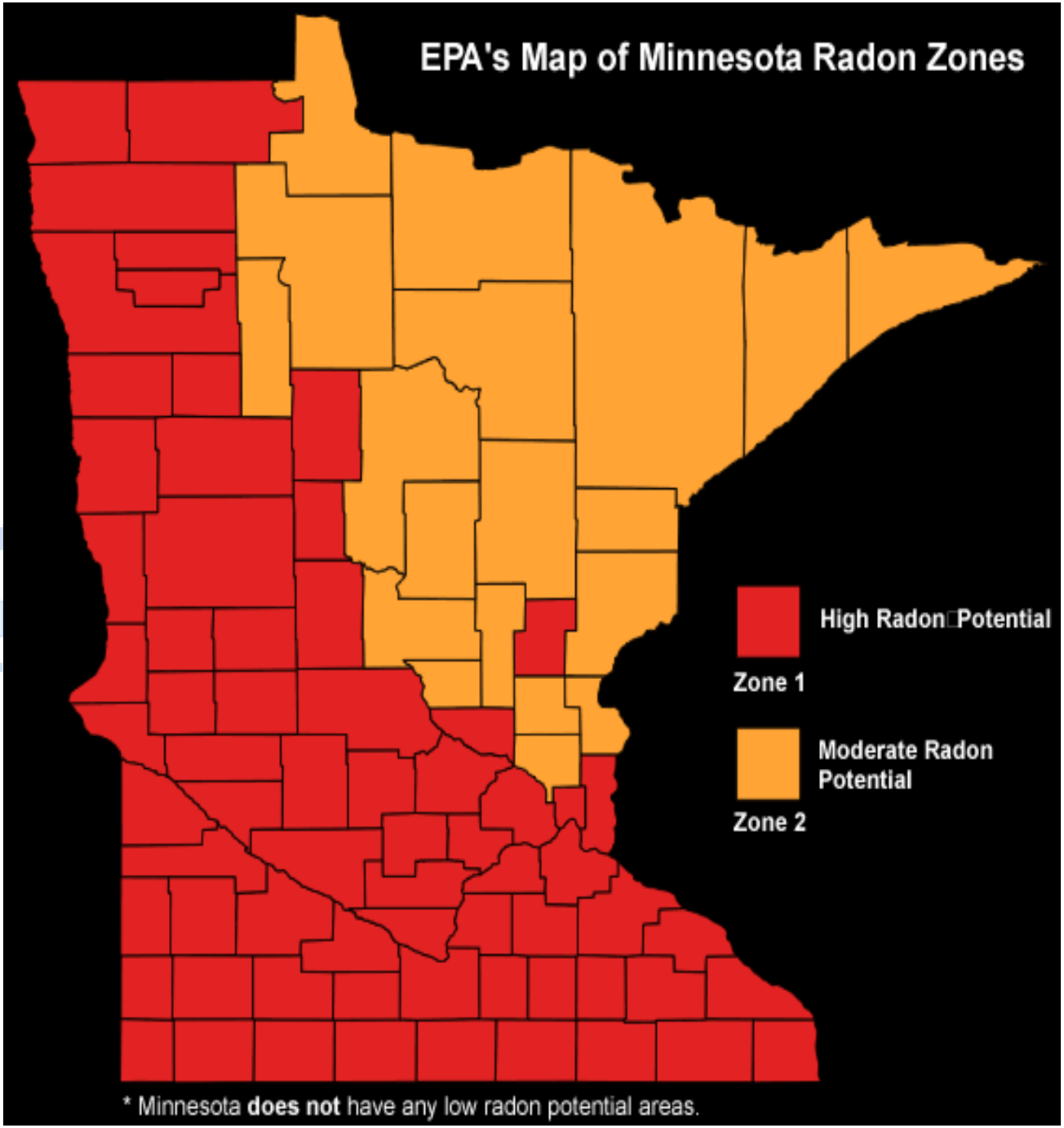
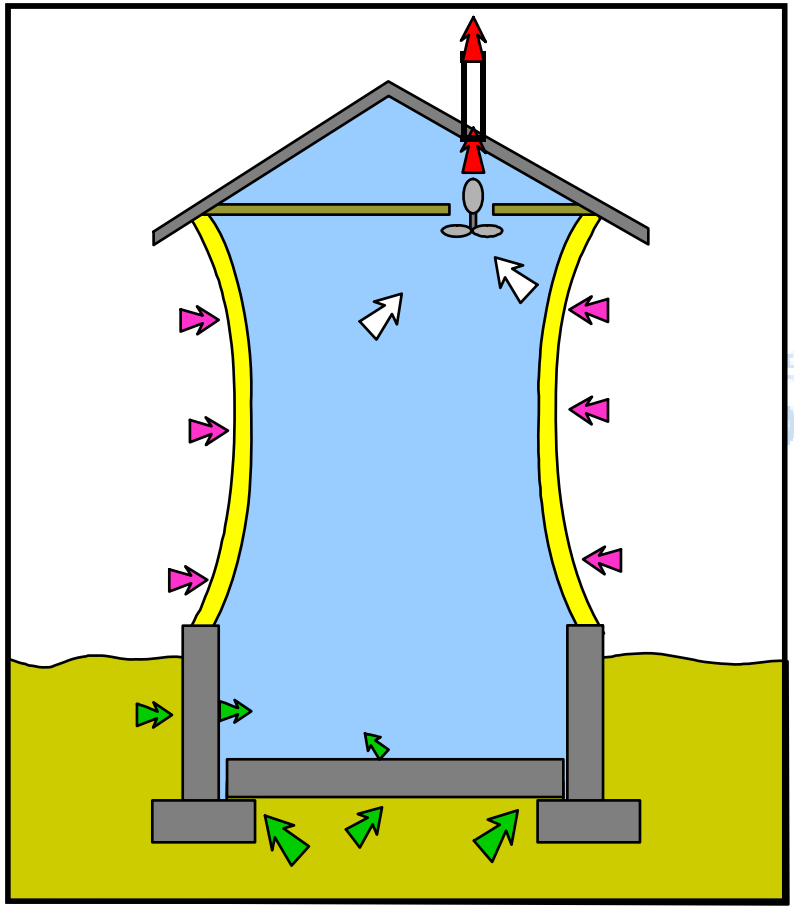
Mn. Statue requires Radon Control systems be installed across the entire state wherever the code is adopted and enforced



How Is Radon Drawn Into A Building?



- Vacuums created by:
  - Exhaust systems
  - Thermal stack effects

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Why worry about new homes?

- It makes sense to put RRNC features in while a home is being built -- before the structure is closed in because:
  - It's cheaper than having to fix a radon problem after the house is built.
  - It helps protect everyone, not just those who can afford to fix an existing home.
  - Most features of radon-resistant construction are common building practices since it only involves a few extra steps to prevent radon entry.

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Benefits of Passive RRNC System

- Reduces radon levels by about 50%, on average.
- Allows for easy addition of a fan later if activation is needed to further reduce radon levels.
- Helps reduce entry of moisture and other soil gases in the home (e.g., methane, pesticides, termiticides).
- Low-cost when compared with fixing a radon problem in an existing home.
- Added resale value, especially as radon testing and mitigation are more frequently a part of real estate transactions.
- RRNC techniques are consistent with energy-efficient construction (e.g., sealing and weatherization).

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INCORPORATION BY REFERENCE

- Appendix F, Radon Control Methods, of the 2006 edition of the International Residential Code
- Amended by the State of Minnesota in Minnesota Rules, chapter 1300, in parts 1322.2101 to 1322.2103.
- Persuant to Minnesota Statues 2006 16B.61 section 1 subd. 3b

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SUBSLAB DEPRESSURIZATION SYSTEM

- **Passive.** A system designed to achieve lower sub-slab air pressure relative to indoor air pressure by use of a vent pipe routed through the conditioned space of a building and connecting the sub-slab area with outdoor air, thereby relying on the convective flow of air upward in the vent to draw air from beneath the slab.

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SUBSLAB DEPRESSURIZATION SYSTEM

- **Active.** A system designed to achieve lower sub-slab air pressure relative to indoor air pressure by use of a fan-powered vent drawing air from beneath the slab.

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RADON GAS

- A naturally-occurring, chemically inert, radioactive gas that is not detectable by human senses. As a gas, it can move readily through particles of soil and rock and can accumulate under the slabs and foundations of homes where it can easily enter into the living space through construction cracks and openings.

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Subfloor preparation

- A layer of gas-permeable material shall be placed under all concrete slabs and other floor systems that directly contact the ground and are within the walls of the living spaces and conditioned crawl spaces, of the building, to facilitate the installation of an active sub-slab depressurization system if needed.

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Subfloor preparation

- The gas-permeable layer shall consist of one of the following:

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Subfloor preparation

- The gas-permeable layer shall consist of one of the following:
  - 1. A uniform layer of clean aggregate, a minimum of 4 inches (102 mm) thick. The aggregate shall consist of material that will pass through a 2-inch (51 mm) sieve and be retained by a 1/4 inch (6.4 mm) sieve.

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Subfloor preparation

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  - 1. A uniform layer of clean aggregate, a minimum of 4 inches (102 mm) thick. The aggregate shall consist of material that will pass through a 2-inch (51 mm) sieve and be retained by a 1/4 inch (6.4 mm) sieve.
  - 2. A uniform layer of sand (native or fill), a minimum of 4 inches (102 mm) thick, overlain by a layer or strips of **geotextile drainage matting** designed to allow the lateral flow of soil gases.

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– A uniform layer of sand (native or fill), a minimum of 4 inches (102 mm) thick, overlain by a layer or strips of geotextile drainage matting designed to allow the lateral flow of soil gases.

Subfloor preparation

- The gas-permeable layer shall consist of one of the following:
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  - 2. A uniform layer of sand (native or fill), a minimum of 4 inches (102 mm) thick, overlain by a layer or strips of geotextile drainage matting designed to allow the lateral flow of soil gases.
  - 3. **Other materials, systems or floor designs with demonstrated capability to permit depressurization across the entire sub-floor area.**

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SOIL-GAS RETARDER

- A continuous membrane of 6-mil (0.15 mm) polyethylene, 3 mil (0.075 mm) cross-laminated polyethylene, or other equivalent material used to retard the flow of soil gases into a building.

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SOIL-GAS RETARDER

- Installed prior to casting the concrete slab

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SOIL-GAS RETARDER

- Installed prior to casting the concrete slab
- Cover the entire floor area

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SOIL-GAS RETARDER

- Installed prior to casting the concrete slab
- Cover the entire floor area
- Seams lapped at least 12 inches
  - R506.2.3 requires 6 inch overlap
  - The most restrictive shall apply

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SOIL-GAS RETARDER

- The sheathing shall fit closely around any pipe, wire or other penetration of the material.
- All punctures, tears or cuts shall be sealed or covered with additional sheathing.

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Entry routes

- Potential radon entry routes shall be closed or sealed.

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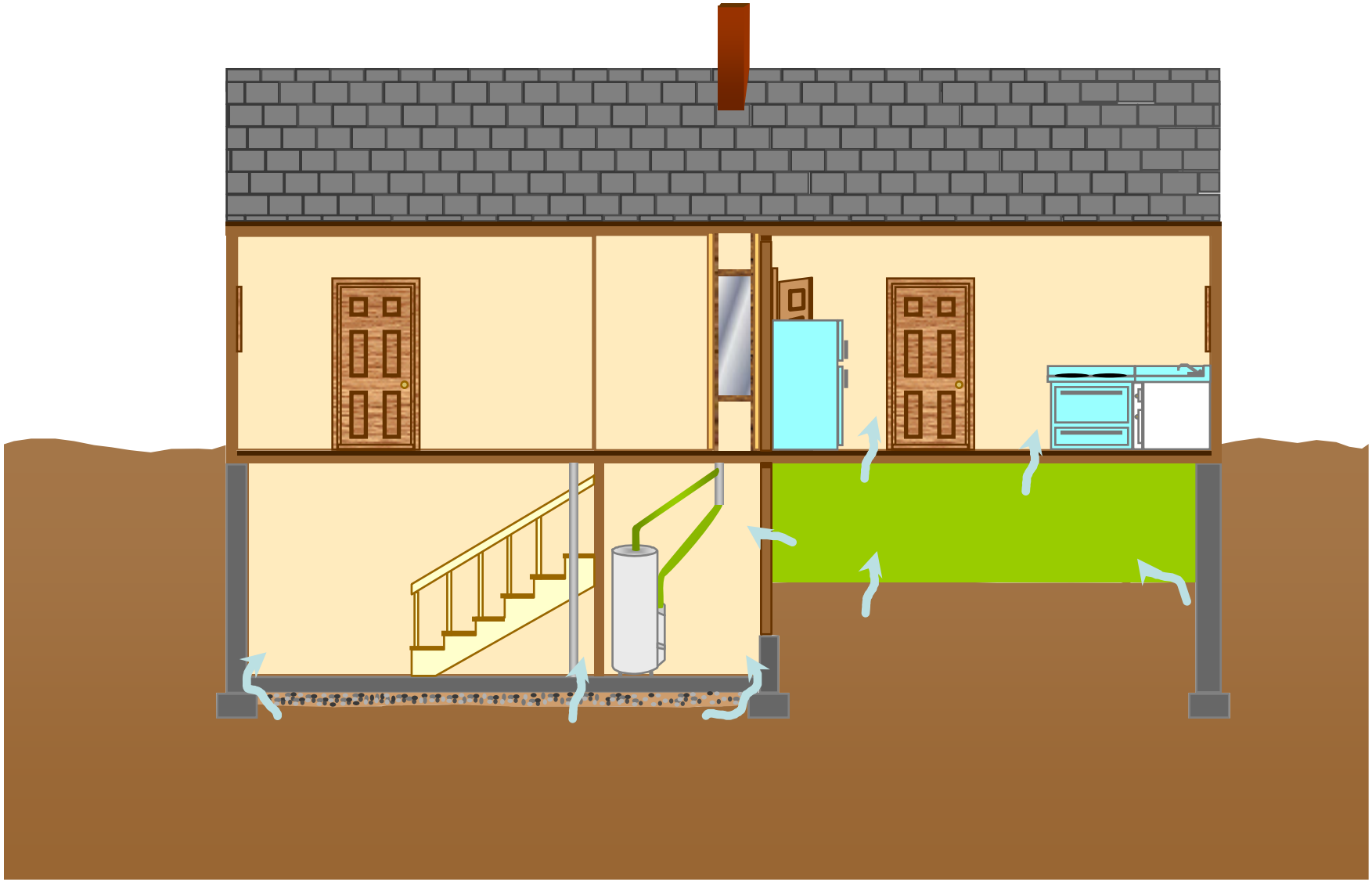
Entry routes

- **Floor openings**
  - **Openings around bathtubs, showers, water closets, pipes, wires or other objects that penetrate concrete slabs or other floor assemblies shall be filled with a polyurethane caulk or equivalent sealant applied in accordance with the manufacturer's recommendations.**

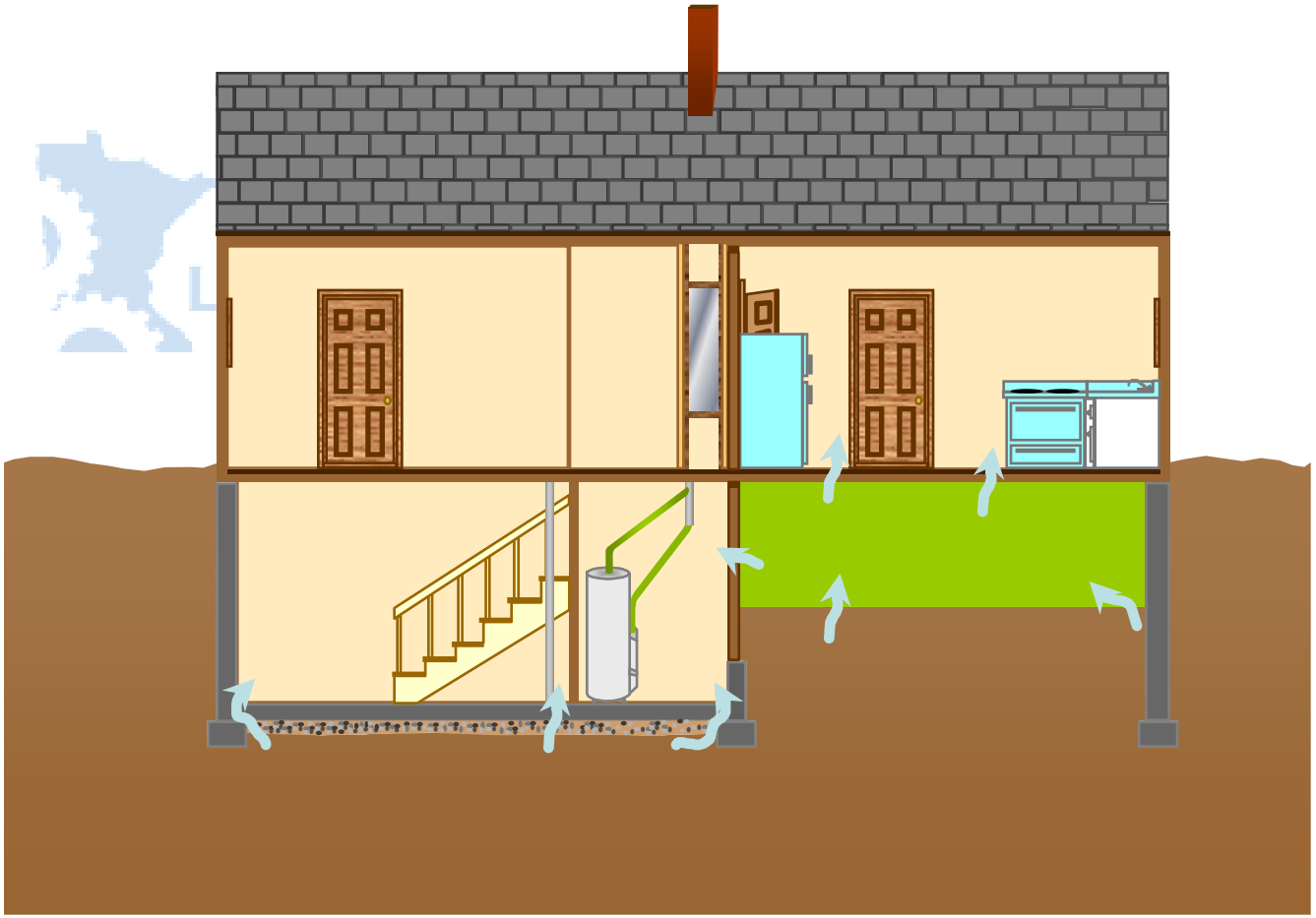
Entry routes

- **Floor openings**
  - **Openings around bathtubs, showers, water closets, pipes, wires or other objects that penetrate concrete slabs or other floor assemblies shall be filled with a polyurethane caulk or equivalent sealant applied in accordance with the manufacturer's recommendations.**

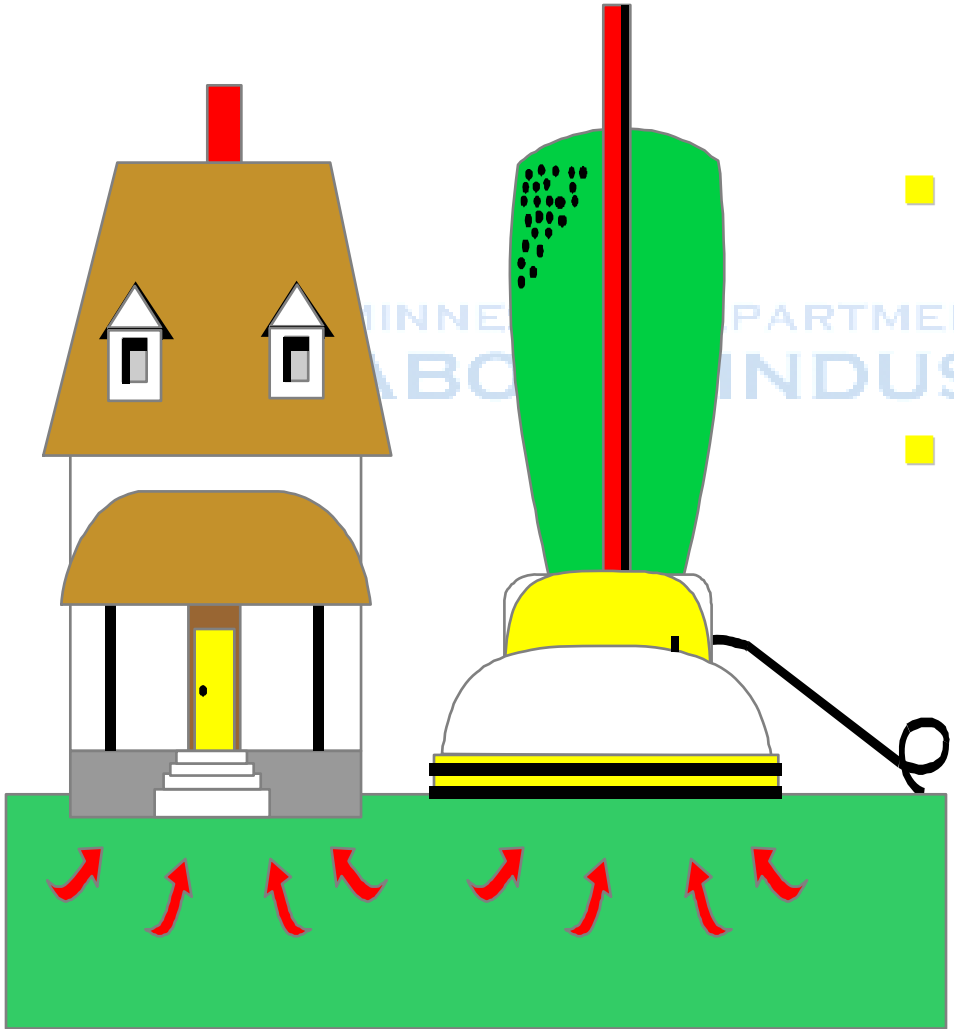
Entry routes



Untreated Home Draws Radon In



The Predominant Driving Force is Building Induced Soil Suction



- Buildings create vacuums that draw in soil gas.
- These vacuums may be very small and are referred to as air pressure differentials.

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Entry routes

Entry routes

Sumps

- **Sumps must be sealed…**

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Sumps

Foundation Walls

- Hollow block masonry foundation walls shall be constructed with either
  - a continuous course of solid masonry,
  - one course of masonry grouted solid, or
  - a solid concrete beam at or above finished grade.
- Where a brick veneer or other masonry ledge is installed, the course immediately below that ledge shall be sealed.

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Unconditioned Crawl Space Floors

- Openings around all penetrations through floors above unconditioned crawl spaces shall be caulked or otherwise filled to prevent air leakage.

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Unconditioned Crawl Space Access

- Access doors and other openings or penetrations between basements and adjoining unconditioned crawl spaces shall be closed, gasketed or otherwise filled to prevent air leakage.

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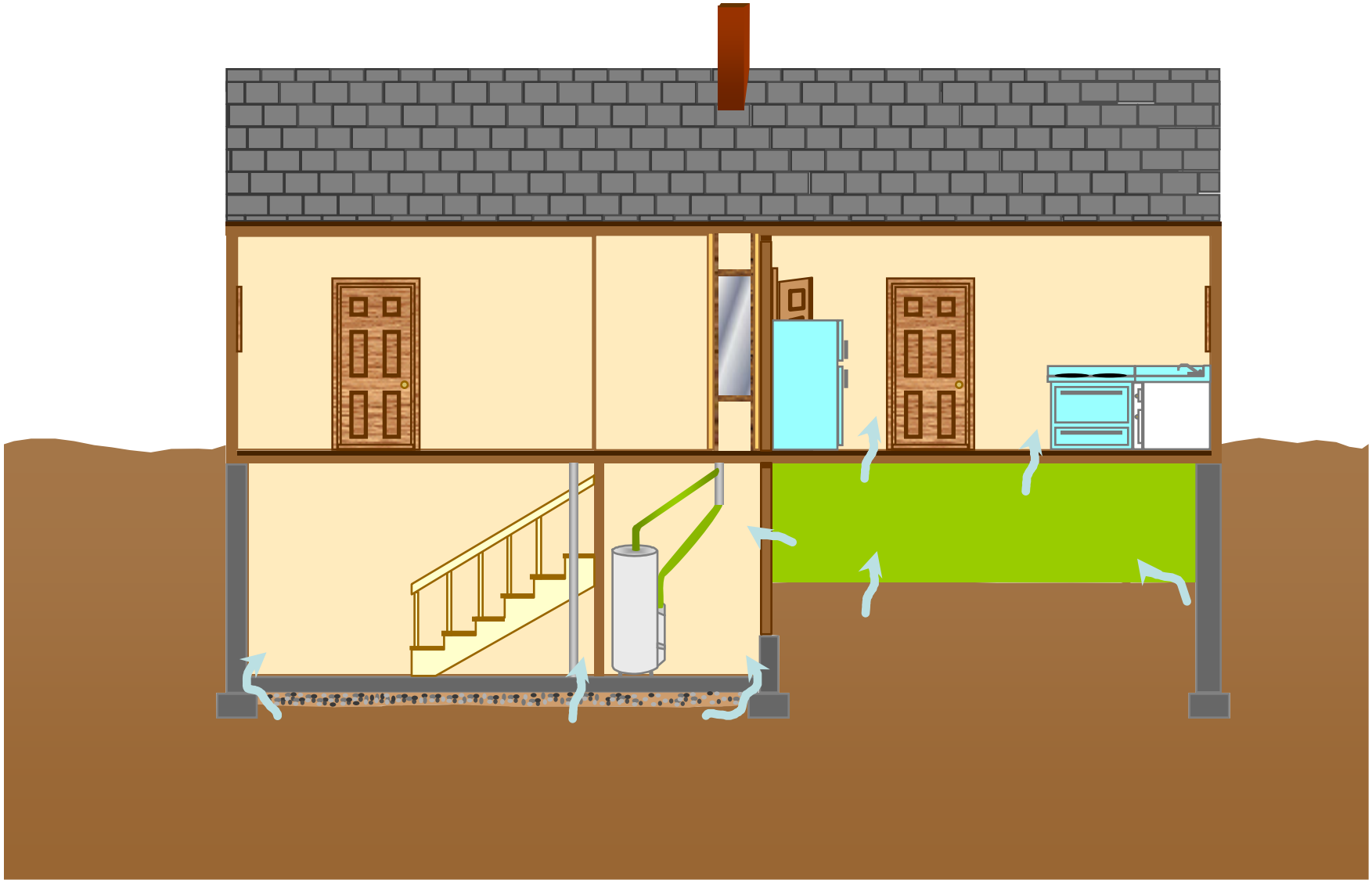
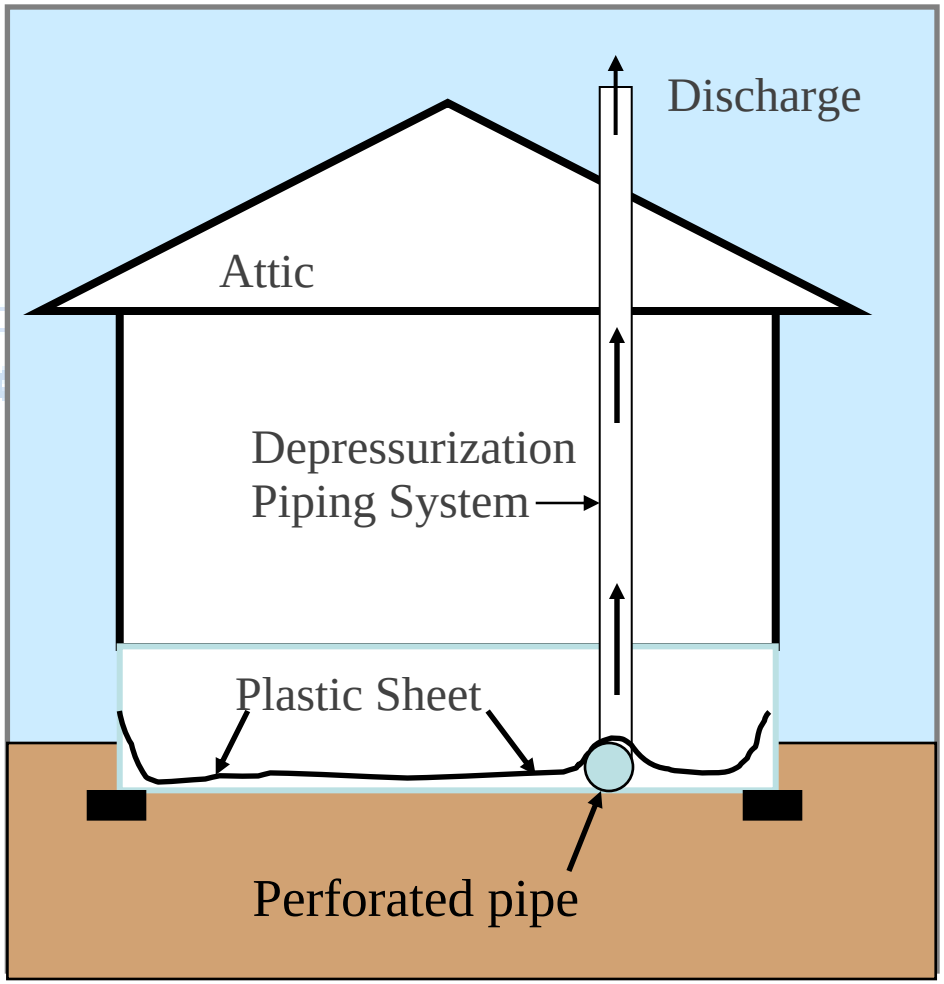
Entry routes



Passive System Concept for Crawl Spaces

- Suction point is under plastic sheet placed over exposed soil or rock
- Radon is collected and exhausted outdoors
- Seams and edges are sealed
  - Polyurethane caulk
  - Duct Tape



Vent Pipe

- A plumbing tee or other approved connection with one ten foot section of a perforated pipe connected to each side shall be inserted horizontally beneath the sheeting and connected to a 3” or 4” vertical pipe extended up through the building floors and terminate at least 12” above the roof in a location at least 10 feet away from any window or other opening into the conditioned space…

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AF103.6.1 Vent Pipe

- Connect vent pipe to aggregate layer.
- Tee beneath slab
- Add one ten foot section of perforated pipe in each direction

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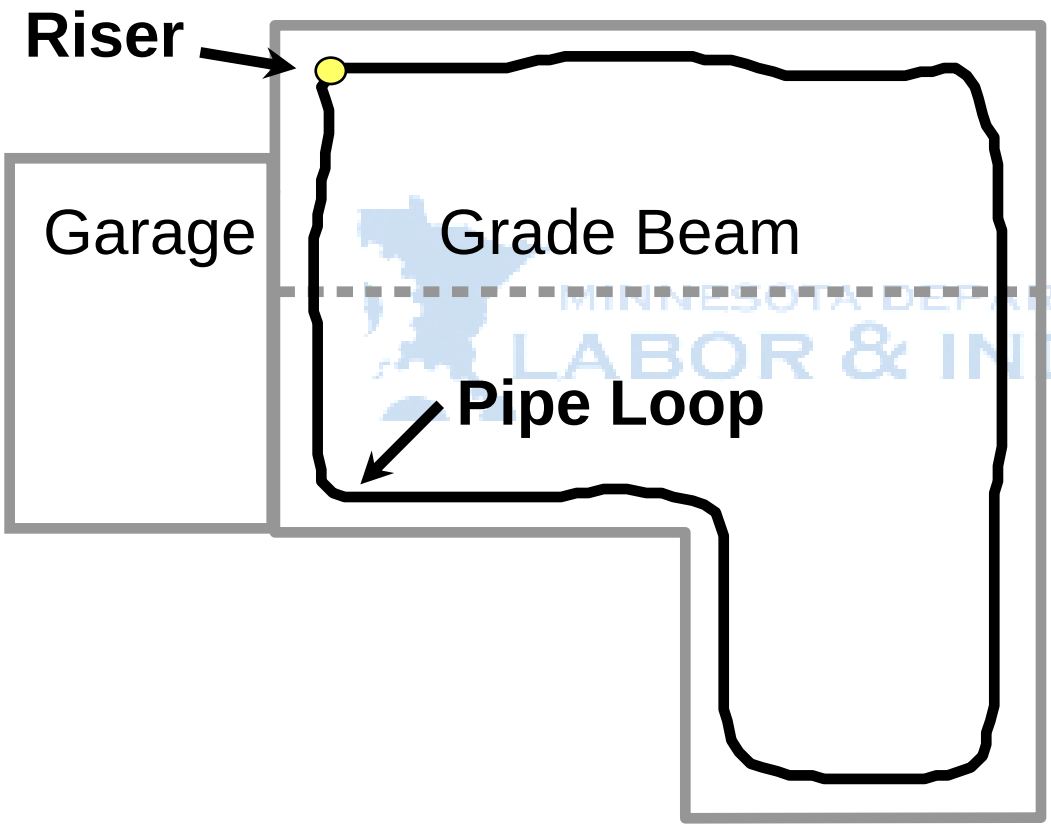
Vent Pipe



- Connect vent pipe to interior perimeter drain tile.
- Make provisions for pipe to penetrate obstructions.

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Vent Pipe

- Sump basket option using the draintile system loop

Vent Pipe

The pipe shall be extended up through the building floors and terminate 12” above the roof…

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Multiple Vent Pipes

- In Buildings where interior footings or other barriers separate the sub slab aggregate or other gas permeable material, each area shall be fitted with an individual vent pipe

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Vent Pipe Drainage

- All components of the radon vent pipe system shall be installed to provide positive drainage to the ground beneath the slab or soil gas retarder.

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Vent Pipe Accessibility

- **Radon vent pipes shall provide enough space around the pipe for future installation of a fan system.**

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Vent Pipe Accessibility

- Radon vent pipes shall provide enough space around the pipe for future installation of a fan system.
  - **This space shall be a minimum of 24 inches in diameter, centered on the axis of the vent stack**

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Vent Pipe Accessibility

- Radon vent pipes shall provide enough space around the pipe for future installation of a fan system.
  - This space shall be a minimum of 24 inches in diameter, centered on the axis of the vent stack
  - **Extending a minimum vertical distance of three feet**

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Vent Pipe Identification

- All radon vent pipes shall be identified with at least one label on each floor and in accessible attics. The label shall read: “Radon Reduction System.”

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Vent Pipe Identification

- **Clearly label the vent pipe as a "Radon Reduction System" to avoid it being misused for plumbing or drainage.**

Warning System

- In case of failure in the active system, an audible or visible warning system should be installed in a frequently visited area.

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Combination Foundations

- Combination basement/crawl space or slab-on-grade/crawl space foundations shall have separate radon vent pipes installed in each type of foundation area.

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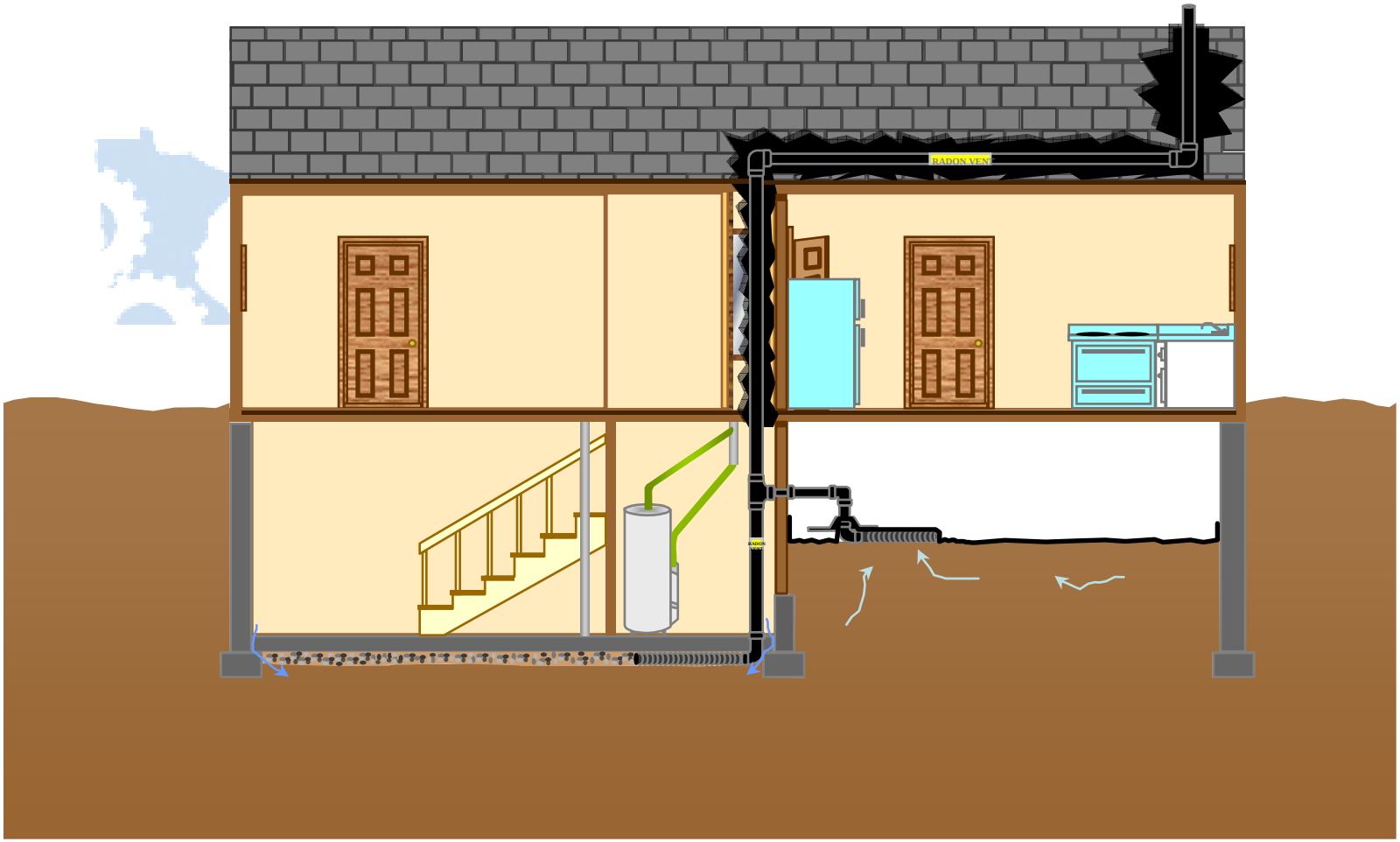
- Exception: A single vent pipe is allowed in a building with a combination foundation as long as soil gasses can flow freely between the areas of the combination foundations and it is connected to an approved vent pipe.

Combination Foundations



Power Source

To provide for future installation of an active sub-membrane or sub-slab depressurization system, an electrical circuit terminated in an approved box shall be installed during construction in the attic or other anticipated location of vent pipe fans.

Installing a Fan

- When a fan is added in the radon vent pipe.
- The fan shall be placed outside the habitable spaces, such as in an attic.

6 items to address for the foundation using the Energy Code, Radon Provisions and the IRC

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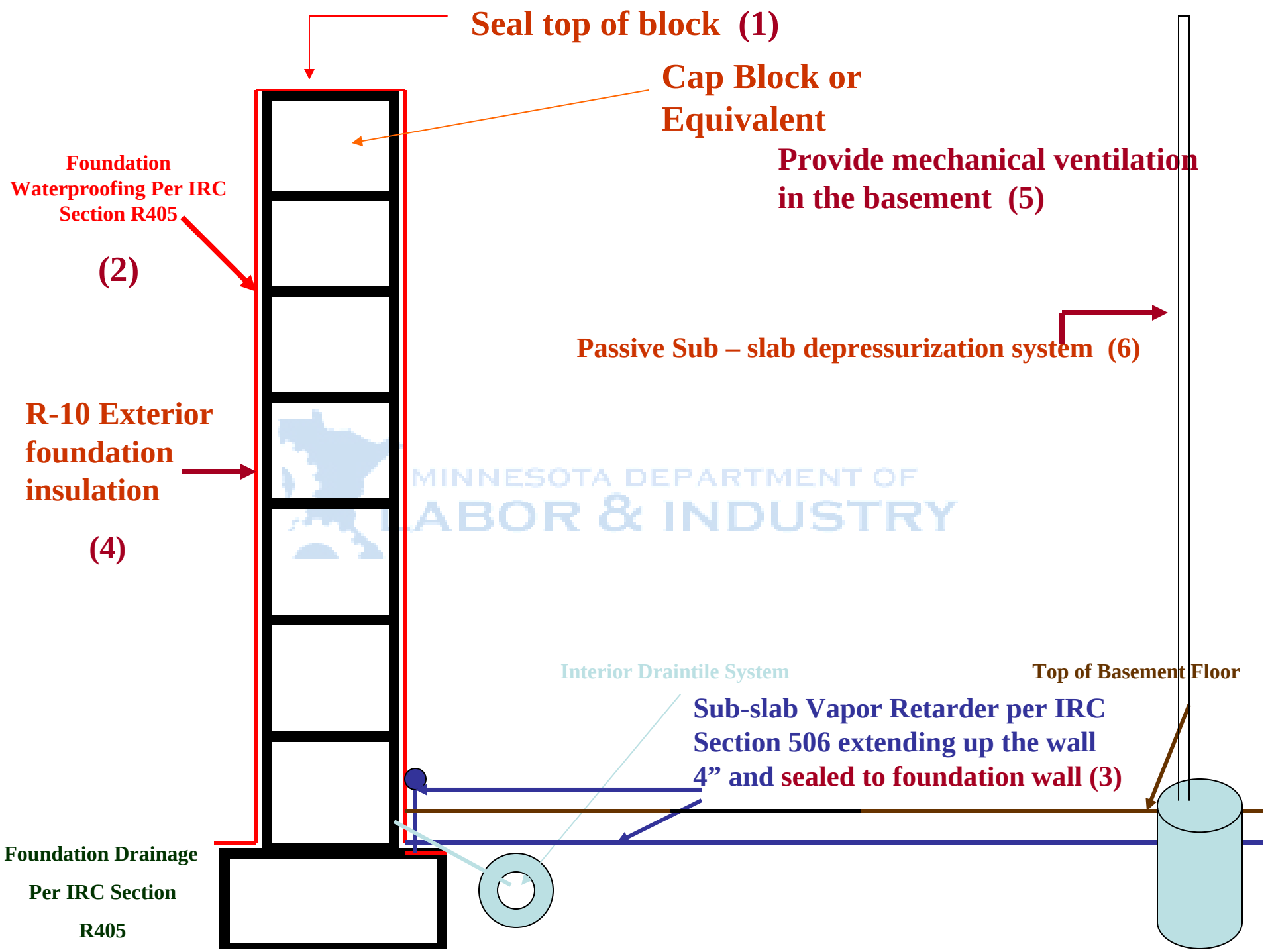
Here is one version of what it may look like



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The start of another one!
Thank You!