



U.S. Department of Energy
Energy Efficiency and Renewable Energy

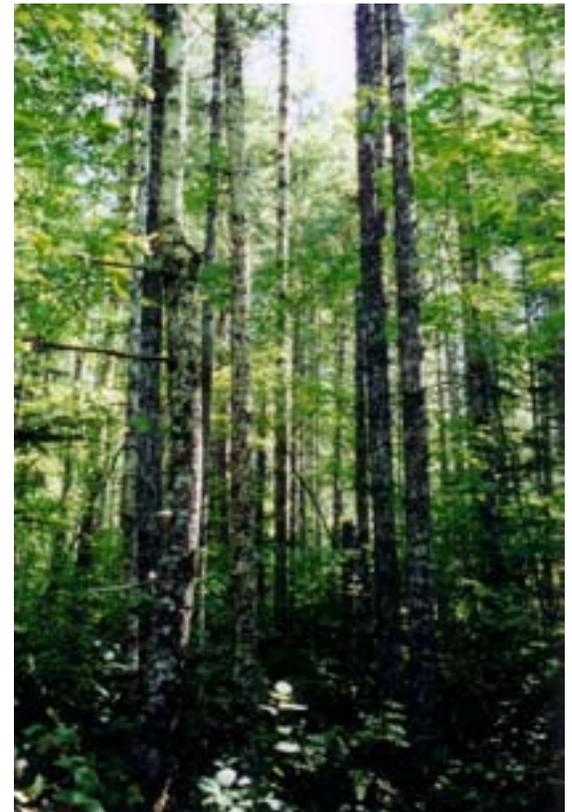


Building Energy Codes

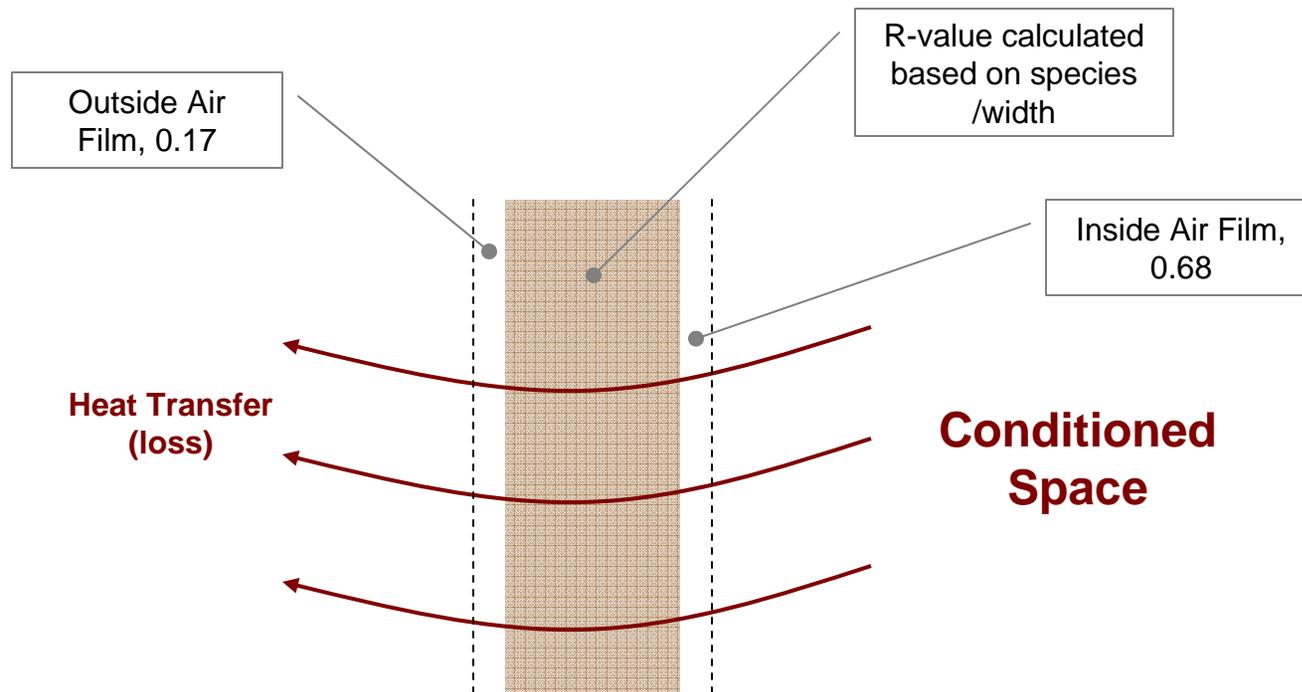
Log Homes in REScheck *Calculations and Demonstration*

Calculation Background

- REScheck versions prior to 3.7.1 calculated log wall u-values based on nominal width and assumed average weights.
 - Provided a calculation based only on the nominal width.
 - Assumed 12% moisture content 0.39 Btu/lb-F. (ASHRAE 1985)
 - Average weight on the basis of wood density (12% moisture) for west coast woods and cedar. (ASHRAE 1985)
 - Mass wall credit for heat capacity greater than 6 Btu/ft²-F, or 7"+ log walls.



Thermal Flow Calculation



$$U = \frac{1}{(R\text{-value} \cdot \text{width} + \text{inside_air_film} + \text{outside_air_film})}$$

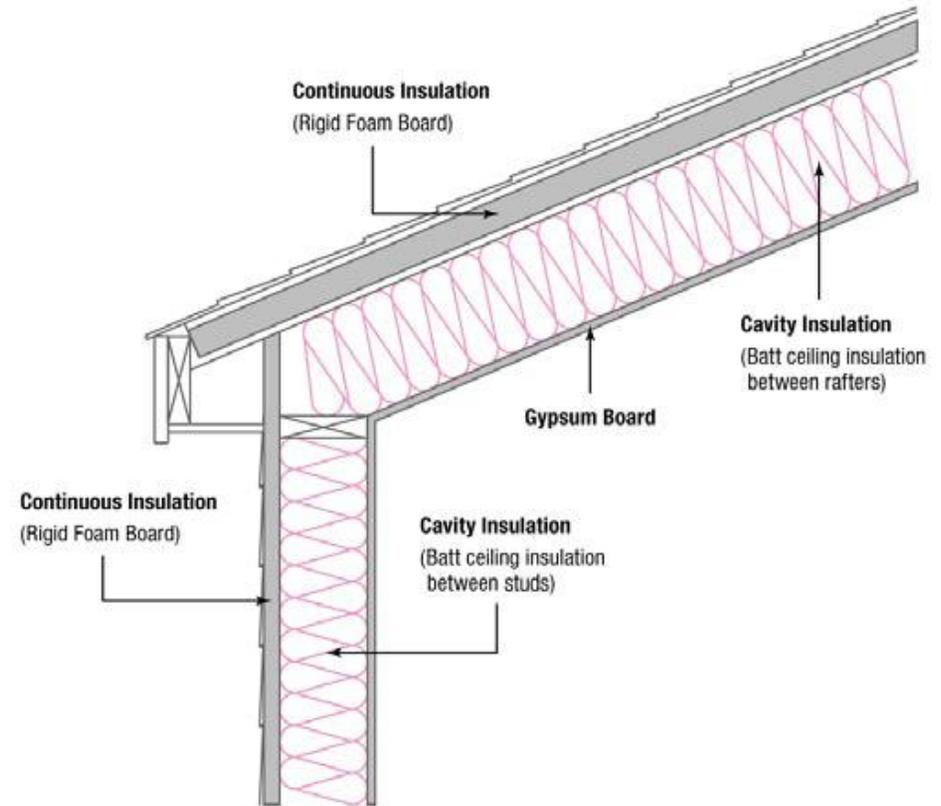
Cavity and Continuous Insulation

➤ Cavity Insulation

- Insulation installed between structural members such as wood studs, metal framing, and Z-clips.

➤ Continuous Insulation

- Insulation that runs continuously over structural members and is free of significant thermal bridging; such as rigid foam insulation above the ceiling deck. It is installed on the interior, exterior, or is integral to any opaque surface of the building envelope.

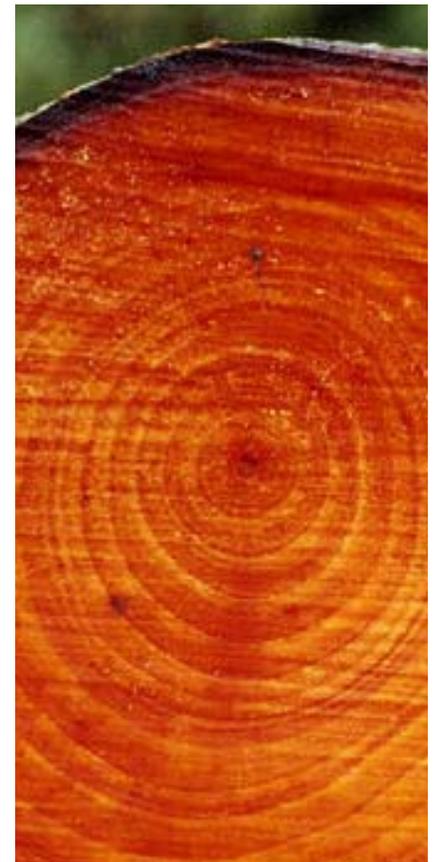


Wood Species and Specific Gravity

| Wood Species Group | Species Label | Specific Gravity (Gu) | Wood Species Group | Species Label | Specific Gravity (Gu) |
|---------------------------------------|---------------|--------------------------|---------------------------|---------------|--------------------------|
| White Cedar (WC) | WC | 0.3 | Red Pine (RP) | RP | 0.42 |
| Red Cedar (RC) | RC | 0.31 | Baldcypress (CYP) | CYP | 0.43 |
| Western Red Canadian Cedar (WRC-N) | WRC-N | 0.31 | Douglas Fir-Larch (DFL) | DFL | 0.45 |
| Western Red Cedar (WRC) | WRC | 0.31 | Loblolly Pine (LBP) | LBP | 0.47 |
| Sugar Pine (SUP) | SUP | 0.34 | Shortleaf Pine (SLP) | SLP | 0.47 |
| Incense Cedar (IC) | IC | 0.35 | Mixed Southern Pine (MSP) | MSP | 0.48 |
| Eastern White Pine (EWP) | EWP | 0.35 | Southern Pine (SP) | SP | 0.48 |
| Western White Pine (WWP) | WWP | 0.35 | Tamarack (TAM) | TAM | 0.49 |
| White Fir (WF) | WF | 0.37 | Longleaf Pine (LLP) | LLP | 0.54 |
| W. Spruce-Pine-Fir (WSPF) | WSPF | 0.37 | Slash Pine (SHP) | SHP | 0.54 |
| E. Spruce-Pine-Fir (ESPF) | ESPF | 0.38 | Red Oak (RO) | RO | 0.57 |
| Eastern Softwoods (ESW) | ESW | 0.38 | White Oak (WO) | WO | 0.62 |
| Eastern Spruce (ES) | ES | 0.38 | | | |
| Western Softwoods (WS) | WS | 0.38 | | | |
| Hem-Fir (HF) | HF | 0.39 | | | |
| Lodgepole Pine (LPP) | LPP | 0.39 | | | |
| Ponderosa Pine (PP) | PP | 0.39 | | | |
| Red-Canadian Pine (RP-N) | RP-N | 0.39 | | | |
| Yellow Cedar (YC) | YC | 0.42 | | | |

Mass Wall Calculation

- Mass walls simply have different heat storage capabilities.
- For a wall to receive the Mass Wall credit in the IECC, the wall must have a heat capacity (HC) of 6 Btu/ft² F.
- Density Calculation (lb/ft³)
 - $D = 62.4 \cdot [G / (1 + (0.009 \cdot G \cdot MCs))] \cdot (1 + MCs/100)$
- Heat Capacity Calculation
 - $HC = D \cdot c \cdot (Nd/12)$
 - c is specific heat 0.39 lb-F for all species
 - Nd is the Nominal Width of the log wall in inches



R-Value Calculation



➤ Moisture correction

- $G = Gu / (1 - (0.265 \cdot a \cdot Gu))$
- Where Gu is the specific gravity as noted and a is calculated for each species

➤ Thermal Conductivity (Btu-in/(h-ft²-F))

- $k = G (B + C(MCs)) + A$
- $A = 0.129$ (Specific gravity greater than 0.30)
- $B = 1.34$ (Design temperature at 75 F)
- $C = 0.028$ (Moisture content less than 25%)
- $MCs = 12\%$ for all other climates

Mass Wall Overview

| species | 5 inch | 6 inch | 7 inch | 8 inch | 9 inch | 10 inch | 12 inch | 14 inch | 16 inch |
|---------|--------|--------|--------|--------|--------|---------|---------|---------|---------|
| WC | | | | | | | | | |
| RC | | | | | | | | | |
| WRC-N | | | | | | | | | |
| WRC | | | | | | | | | |
| SUP | | | | | | | | | |
| IC | | | | | | | | | |
| EWP | | | | | | | | | |
| WWP | | | | | | | | | |
| WF | | | | | | | | | |
| WSPF | | | | | | | | | |
| ESPF | | | | | | | | | |
| ESW | | | | | | | | | |
| ES | | | | | | | | | |
| WS | | | | | | | | | |
| HF | | | | | | | | | |
| LPP | | | | | | | | | |
| PP | | | | | | | | | |
| RP-N | | | | | | | | | |
| YC | | | | | | | | | |
| RP | | | | | | | | | |
| CYP | | | | | | | | | |
| DFL | | | | | | | | | |
| LBP | | | | | | | | | |
| SLP | | | | | | | | | |
| MSP | | | | | | | | | |
| SP | | | | | | | | | |
| TAM | | | | | | | | | |
| LLP | | | | | | | | | |
| SHP | | | | | | | | | |
| RO | | | | | | | | | |
| WO | | | | | | | | | |

2003 IECC Mass Wall Table

TABLE 502.2.1.1.2(3)
 REQUIRED U_w FOR WALL WITH A HEAT CAPACITY EQUAL
 TO OR EXCEEDING 6 Btu/ft² · °F WITH INTEGRAL
 INSULATION (INSULATION AND MASS MIXED, SUCH AS A LOG WALL)

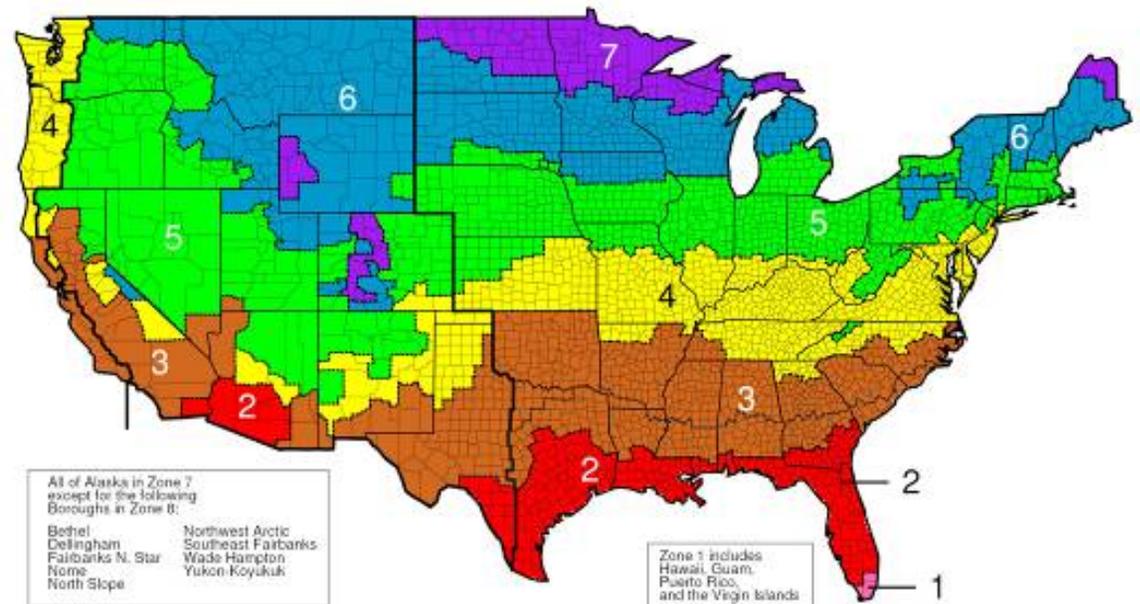
| HEATING DEGREE DAYS | U_w REQUIRED FOR WALLS WITH A HEAT CAPACITY LESS THAN 6 Btu/ft ² · °F AS DETERMINED BY USING EQUATION 5-1 AND FIGURE 502.2(1) | | | | | | | | | | |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|------|------|------|------|------|------|
| | 0.24 | 0.22 | 0.20 | 0.18 | 0.16 | 0.14 | 0.12 | 0.10 | 0.08 | 0.06 | 0.04 |
| 0 - 2,000 | 0.33 | 0.31 | 0.28 | 0.25 | 0.23 | 0.20 | 0.17 | 0.15 | 0.12 | 0.09 | 0.07 |
| 2,001 - 4,000 | 0.32 | 0.30 | 0.27 | 0.24 | 0.22 | 0.19 | 0.17 | 0.14 | 0.11 | 0.09 | 0.06 |
| 4,001 - 5,500 | 0.30 | 0.28 | 0.26 | 0.23 | 0.21 | 0.18 | 0.16 | 0.13 | 0.11 | 0.08 | 0.06 |
| 5,501 - 6,500 | 0.28 | 0.26 | 0.24 | 0.21 | 0.19 | 0.17 | 0.14 | 0.12 | 0.10 | 0.08 | 0.05 |
| 6,501 - 8,000 | 0.26 | 0.24 | 0.22 | 0.20 | 0.18 | 0.15 | 0.13 | 0.11 | 0.09 | 0.07 | 0.05 |
| > 8,000 | 0.24 | 0.22 | 0.20 | 0.18 | 0.16 | 0.14 | 0.12 | 0.10 | 0.08 | 0.06 | 0.04 |

For SI: °C = [(°F)-32]/1.8, 1 Btu/ft² · °F = 0.176 kJ/(m² · °K).

Calculation Future

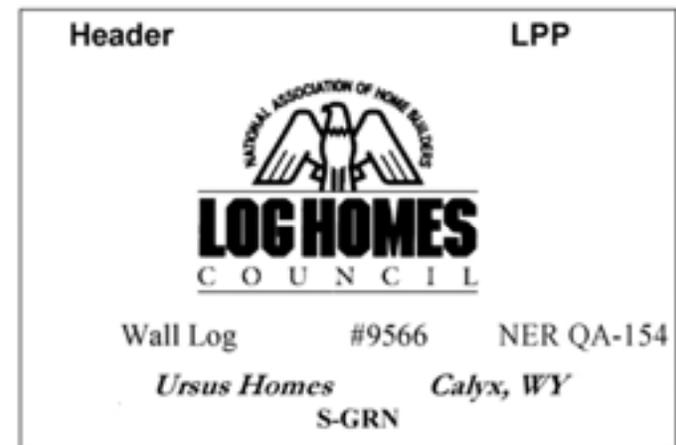
➤ Moisture content may vary by location.

- MCs = 10% for Dry climate
- MCs = 13% for Moist climates
- MCs = 15% for Marine climates
- MCs = 14% for Warm-Humid climates
- MCs = 12% for all other climates



Calculation Changes

- Code officials should now check that the letter code specified in the REScheck report matches the materials at the construction site.
- Check that the log width specified in the REScheck report matches the material at the construction site.



Troubleshooting

- Consider lower glazing areas.
 - This will have an impact on compliance with codes prior to the 2004 IECC.
- Consider more efficient windows if you are not already using them.
 - Many windows have become less expensive in recent years. Look for low u-values on the order of 0.40 or less.
- Add insulation to the log wall.
 - As little as R-4 may mean the difference in compliance in some areas and will improve the comfort of the occupants.
- Seal the home carefully. Air leakage is a major source of heat loss in many homes.

www.energycodes.gov techsupport@becp.pnl.gov

Building Energy Codes Program



About the Program

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- Residential (REScheck)
- Commercial (COMcheck)
- On-line Compliance Tools
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- Commercial Training
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- Status of State Energy Codes
- Setting the Standard

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- Code Notes



DOE's Building Energy Codes Program is an information resource on national model energy codes. We work with other government agencies, state and local jurisdictions, national code organizations, and industry to promote stronger building energy codes and help states adopt, implement, and enforce those codes.

The Program recognizes that energy codes maximize energy efficiency only when they are fully embraced by users and supported through education, implementation, and enforcement.

Free Software



REScheck

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COMcheck

[COMcheck](#), [COMcheck-Web](#), [COMcheck Package Generator](#)

Technical Support



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NEWS

Notice Requesting Public Input on Further Analysis Related to Wall Insulation Requirements for Residential Buildings in the IECC and Other Potential Code Change Proposals

Statement of the Department of Energy - State Energy Code Criteria for Residential AC and HP

[2005 ICC Final Action Hearings](#)

Residential Compliance Tools

Free

Desktop Software Tools



Web-Based Tools



Printed Materials

Compliance Guides

Prescriptive Tables



The image shows a Windows XP desktop environment with a blue sky and green field background. A central window titled "REScheck" is in the process of loading. The desktop contains various application icons such as Microsoft Outlook, Internet Explorer, Firefox Setup, ETR, Microsoft Photo Editor, Mozilla Firefox, Adobe Reader, Work_Pkg, URL's and Emails, Software Analysis, URL's, Attendee_List, Microsoft PowerPoint, Link Check, Implementati..., Microsoft Word, Desktop Stuff, COMcheck-EZ, Microsoft Outlook, Emails, Microsoft Excel, Articles, PhotoStudio 5, and Adobe Acrobat. The taskbar at the bottom shows the Start button and several open applications including "Inbox - Micro...", "Windows Me...", "2 Microsoft ...", "EZ-Casestud...", "Microsoft Pho...", and "Untitled.rck - ...". The system tray on the right shows the Recycle Bin and the time 1:26 PM.

REScheck™

DOE's Building Energy Codes Program
Internet Address: www.energycodes.gov
Technical Support: techsupport@becp.pnl.gov

Energy Efficiency and Renewable Energy · U.S. Department of Energy

Loading...

What's New with Mechanical

- Updated Version 3.7 Release 1b
- Time clock – January 23, 2006 implemented
- Baseline for equipment trade-offs is now
 - SEER 13
 - HSPF 7.7
- No penalty for pre-2006 efficiencies
 - envelope trade-offs only
- Update will affect all code compliance options in RES*check*
 - national codes
 - state-specific codes

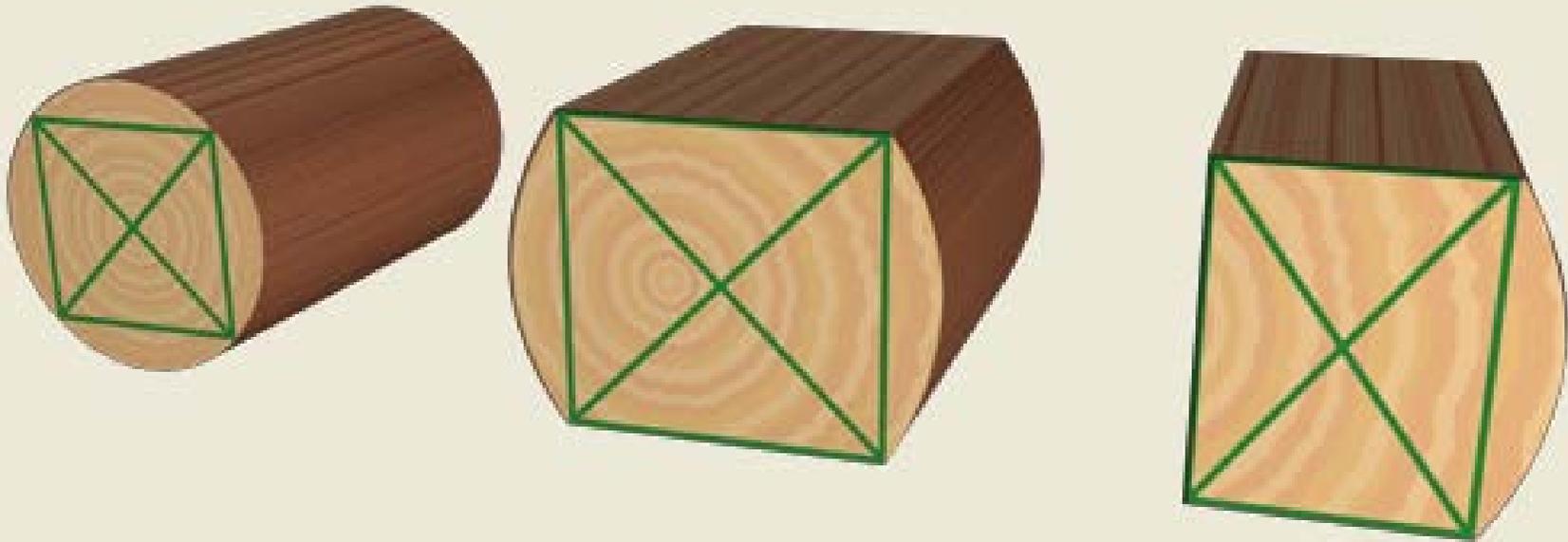
Log Wall Details



Wood Species: Not selected



Log Thickness (nominal width): 5 inch



The log thickness is the area of the log profile divided by its stack height, rounded to the nearest inch. The inscribed rectangle may be used to establish dimensions of non-rectangular log profiles.

Help

OK

Cancel

Log Wall Details



Wood Species: Not selected

Log Thickness (nominal width):

Not selected

Baldcypress (CYP)

Douglas Fir-Larch (DFL)

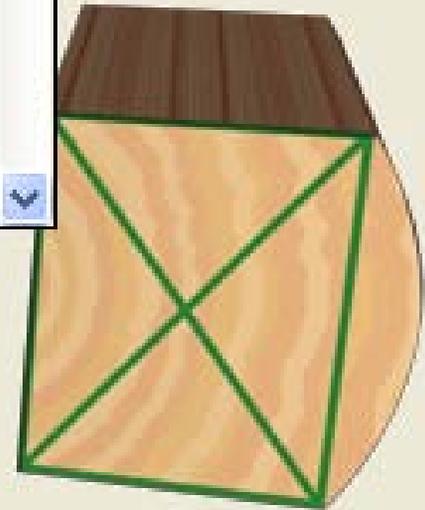
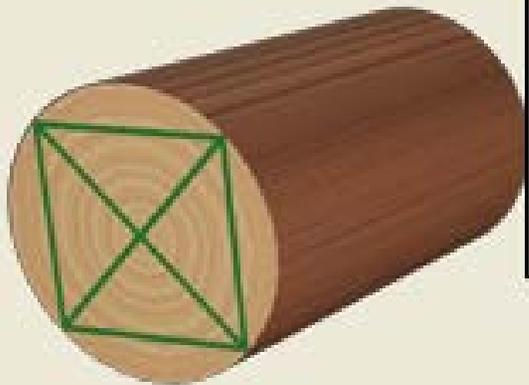
E. Spruce-Pine-Fir (ESPF)

Eastern Softwoods (ESW)

Eastern Spruce (ES)

Eastern White Pine (EWP)

Hem-Fir (HF)



The log thickness is the area of the log profile divided by its stack height, rounded to the nearest inch. The inscribed rectangle may be used to establish dimensions of non-rectangular log profiles.

Help

OK

Cancel

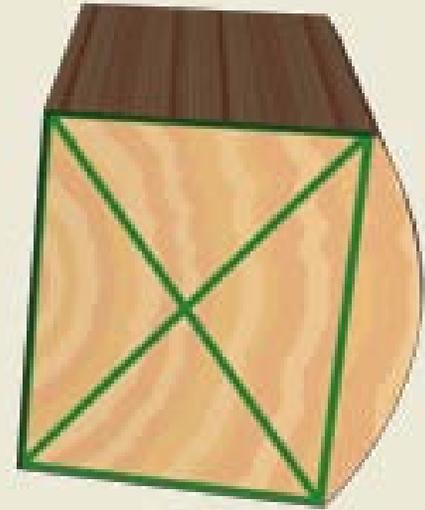
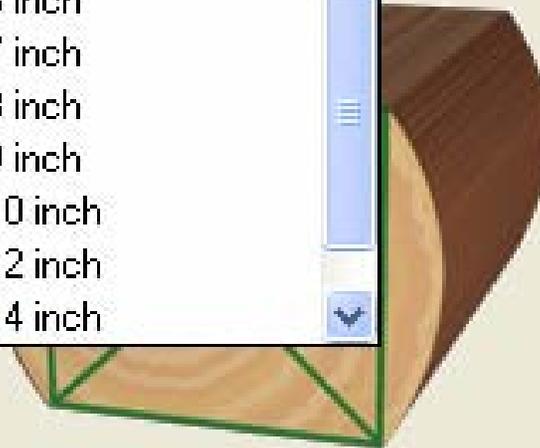
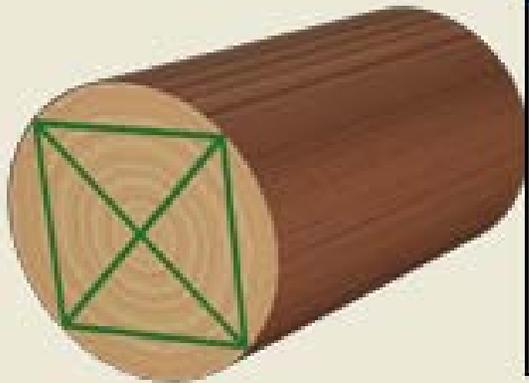
Log Wall Details



Wood Species: Not selected

Log Thickness (nominal width): 5 inch

5 inch
6 inch
7 inch
8 inch
9 inch
10 inch
12 inch
14 inch



The log thickness is the area of the log profile divided by its stack height, rounded to the nearest inch. The inscribed rectangle may be used to establish dimensions of non-rectangular log profiles.

Help

OK

Cancel

Log Home Case Studies



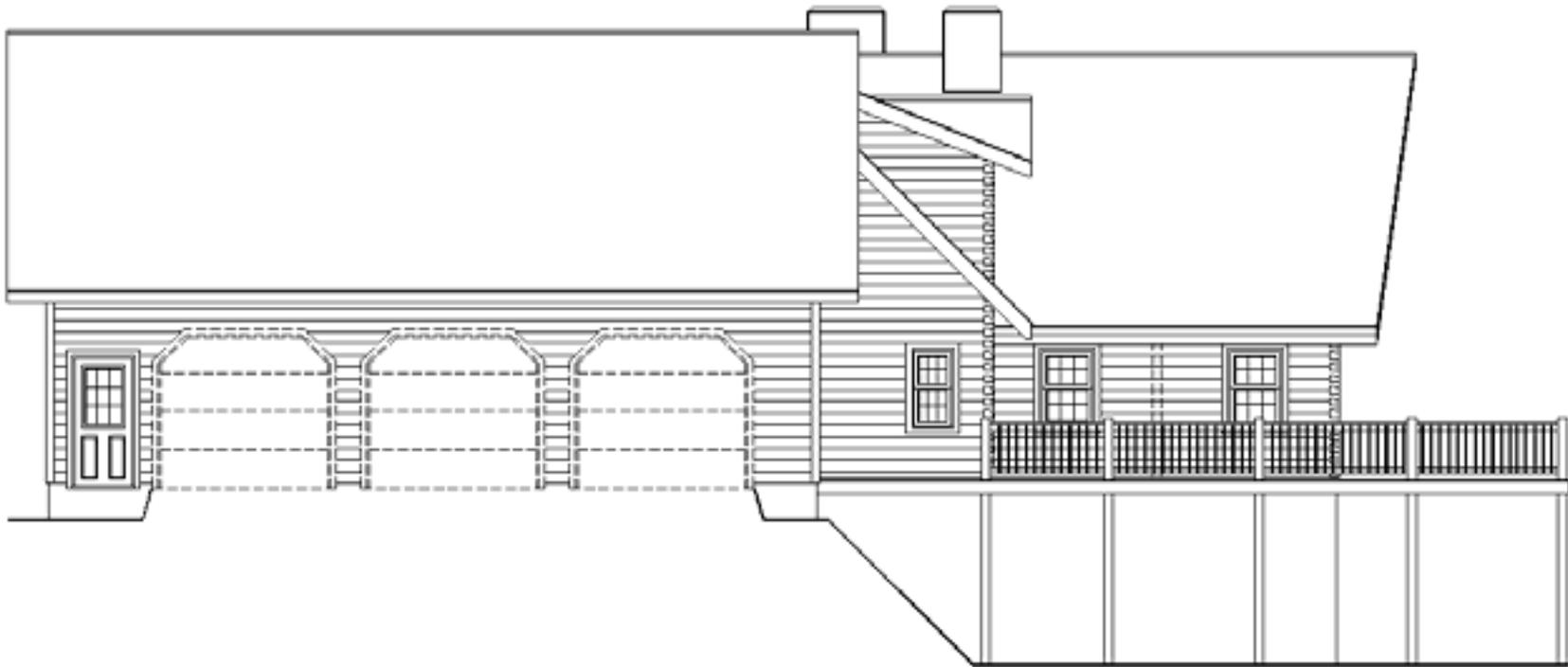
Simple



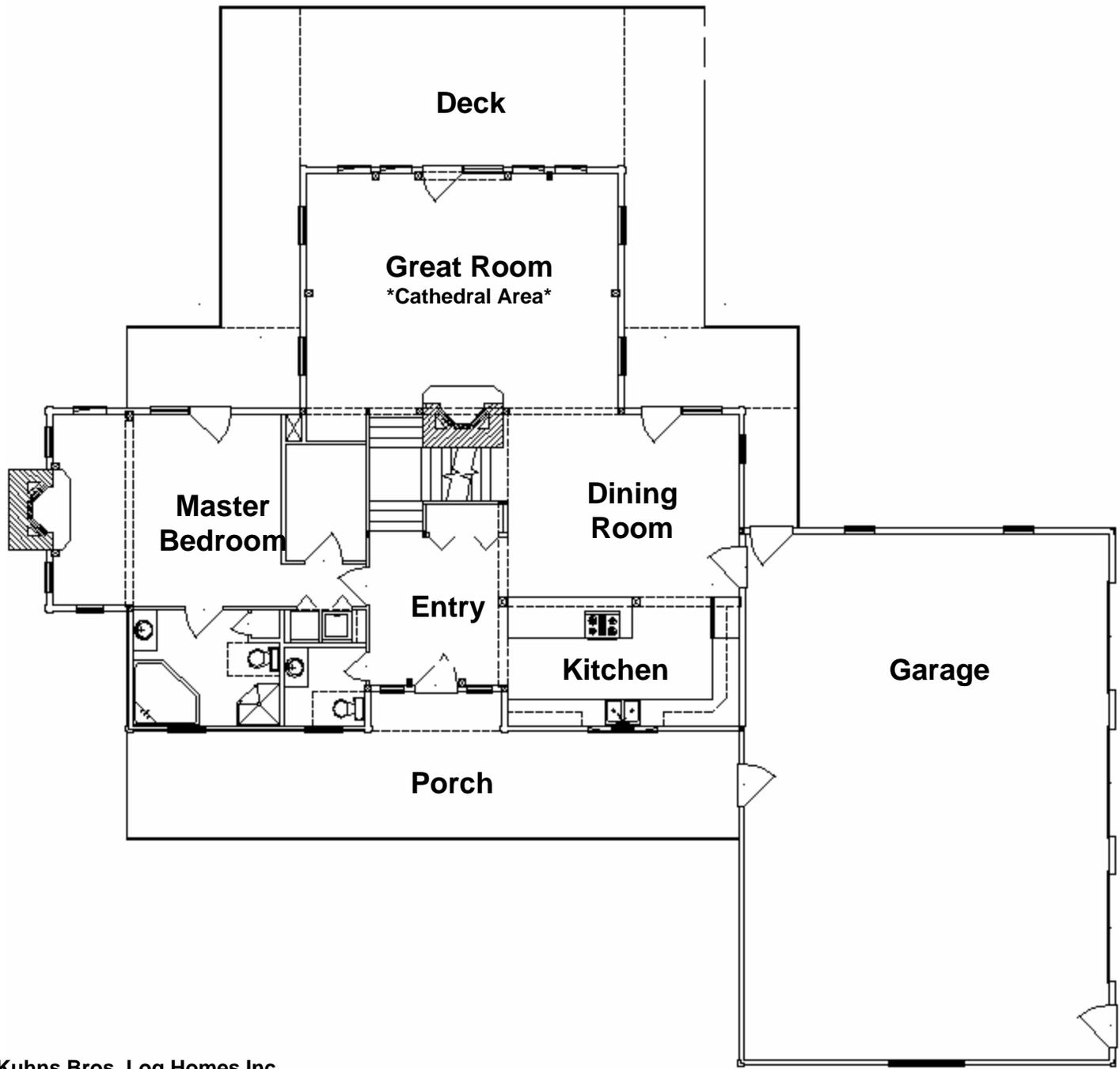
Complex



Courtesy of Kuhns Bros. Log Homes Inc.



Courtesy of Kuhns Bros. Log Homes Inc.



Courtesy of Kuhns Bros. Log Homes Inc.

Open to Below

Bedroom #2

Bedroom #3

Loft

Cathedral Area

Walk-In Closet

Walk-In Closet

Bath

Walk-In Closet

Walk-In Closet

Setting the Standard Newsletter

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Newsletter

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Basements: Advantages and Disadvantages of Finishing Basements During Initial Construction of the Home

The 2000 and 2003 Editions of the International Energy Conservation Code (IECC) require basement walls to be insulated if the basement is considered part of the heated and/or cooled living space (conditioned space). If the basement is initially designed to be unfinished, insulation is required in the basement ceiling. The 2003 IECC requires floor over unheated spaces or basement walls that define the conditioned space (Section 502.2.3.3 or 502.2.3.4) to meet the applicable overall thermal transmittance factor (U-factor) or the minimum R-value based on the prescriptive specifications on an individual component basis. In basic terms, this means, if the basement is unconditioned, the floor above the basement (basement ceiling) must be insulated and meet all the requirements of the IECC for floors over unconditioned space. If the basement is considered part of the conditioned building envelope, the basement walls must be insulated and meet all the requirements of the IECC for basement walls. The requirements in the code vary depending on location and climate conditions. Requirements in the IECC include some of the following: insulation installation (Section 502.4), Moisture Control (Section 502.1.1), and Cracking and Seals (Section 502.1.4.2).

Many homes are being constructed with unfinished basements to reduce initial costs. In many cases, the homeowner eventually finishes the basement for additional living space by installing basement wall insulation. Because most basements are eventually occupied, the advantages and disadvantages of conditioning the basement should be thoroughly reviewed prior to permitting and construction.

Table 1 provides a list of advantages and disadvantages of basement wall insulation compared to basement ceiling insulation.

Questions/Comments

➤ Help Desk – on-line electronic form

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Email

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