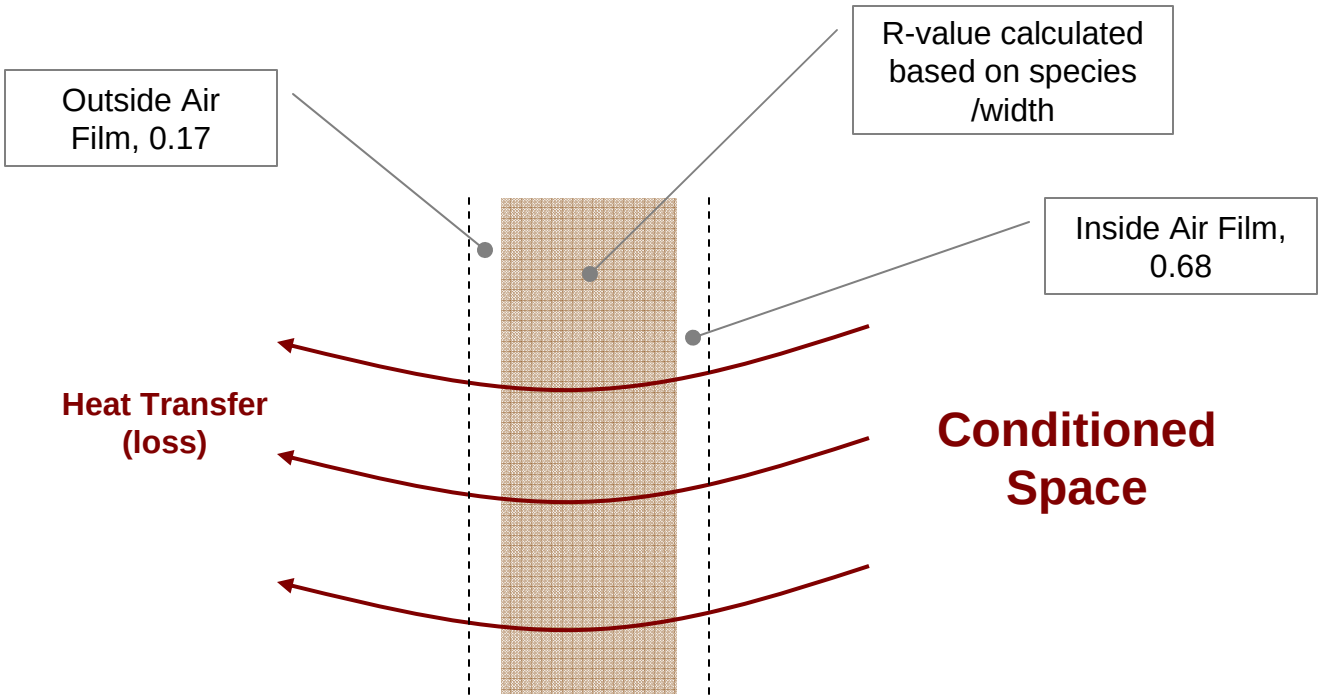
Log Homes in REScheck

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.

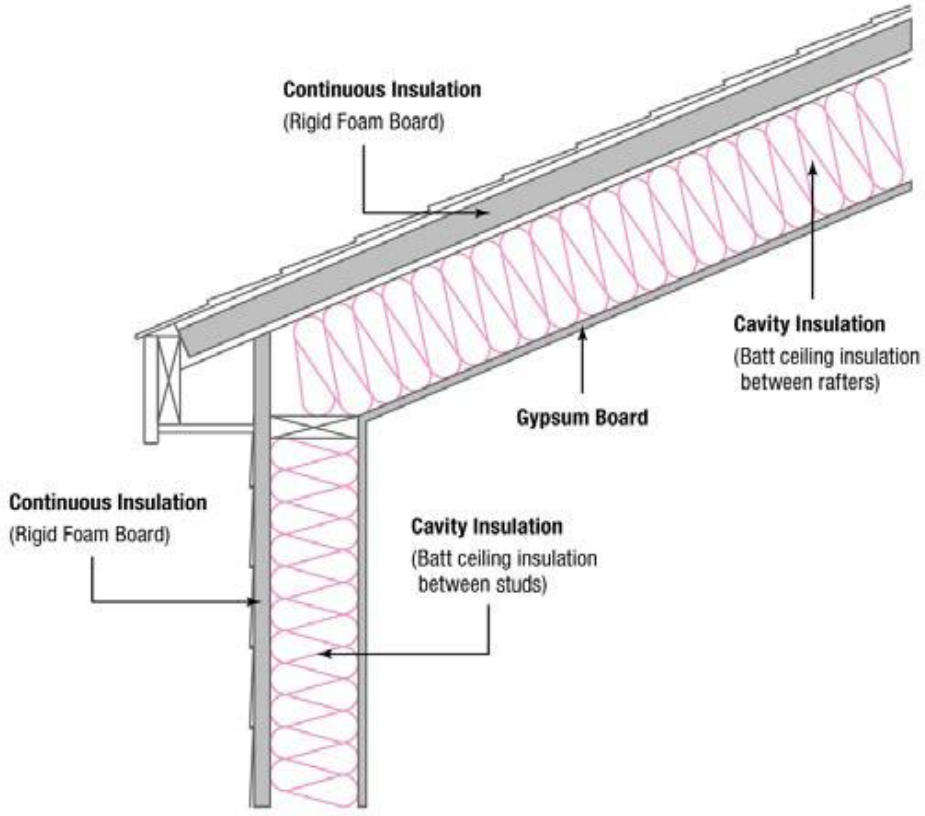
Thermal Flow Calculation



$$U = \frac{1}{(R-value \bullet width + inside\_air\_film + outside\_air\_film)}$$

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)
White Cedar (WC)	WC	0.3
Red Cedar (RC)	RC	0.31
Western Red Canadian Cedar (WRC-N)	WRC-N	0.31
Western Red Cedar (WRC)	WRC	0.31
Sugar Pine (SUP)	SUP	0.34
Incense Cedar (IC)	IC	0.35
Eastern White Pine (EWP)	EWP	0.35
Western White Pine (WWP)	WWP	0.35
White Fir (WF)	WF	0.37
W. Spruce-Pine-Fir (WSPF)	WSPF	0.37
E. Spruce-Pine-Fir (ESPF)	ESPF	0.38
Eastern Softwoods (ESW)	ESW	0.38
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

Wood Species Group	Species Label	Specific Gravity (Gu)
Red Pine (RP)	RP	0.42
Baldcypress (CYP)	CYP	0.43
Douglas Fir-Larch (DFL)	DFL	0.45
Loblolly Pine (LBP)	LBP	0.47
Shortleaf Pine (SLP)	SLP	0.47
Mixed Southern Pine (MSP)	MSP	0.48
Southern Pine (SP)	SP	0.48
Tamarack (TAM)	TAM	0.49
Longleaf Pine (LLP)	LLP	0.54
Slash Pine (SHP)	SHP	0.54
Red Oak (RO)	RO	0.57
White Oak (WO)	WO	0.62

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

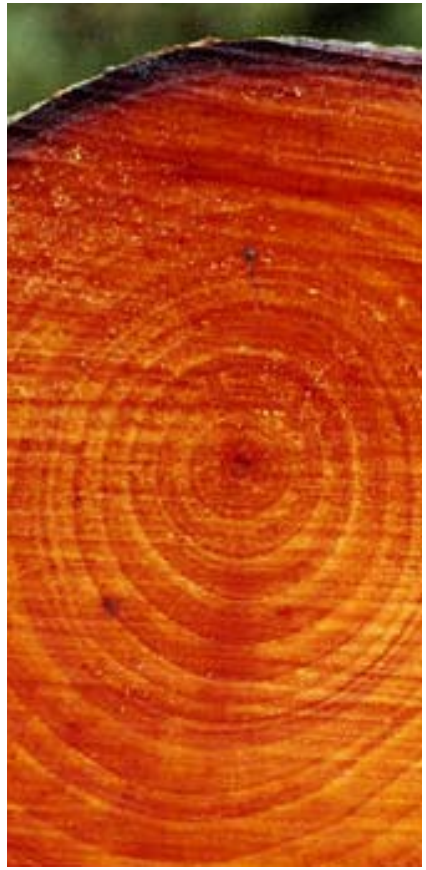


Photo by Pikaluk/http://www.flickr.com/

R-Value Calculation

- Moisture correction
  - *G = Gu / (1- (0.265 ·a·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*

Photo by Carmdir/http://www.flickr.com/

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

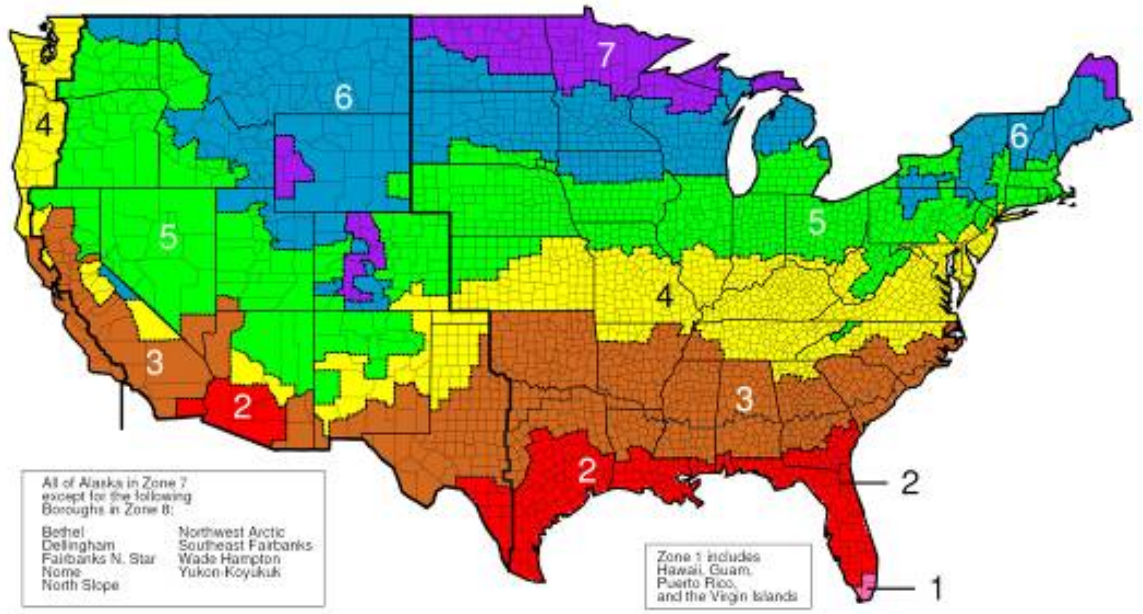
TABLE 502.2.1.1.2(3)
REQUIRED U_w FOR WALL WITH A HEAT CAPACITY EQUAL TO OR EXCEEDING 6 Btu/ft^2 · °F WITH INTEGRAL INSULATION (INSULATION AND MASS MIXED, SUCH AS A LOG WALL)

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/ft^2 · °F = 0.176 kJ/(m^2 · °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 RES*check* report matches the materials at the construction site.
- Check that the log width specified in the RES*check* 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
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Microsoft Pho...
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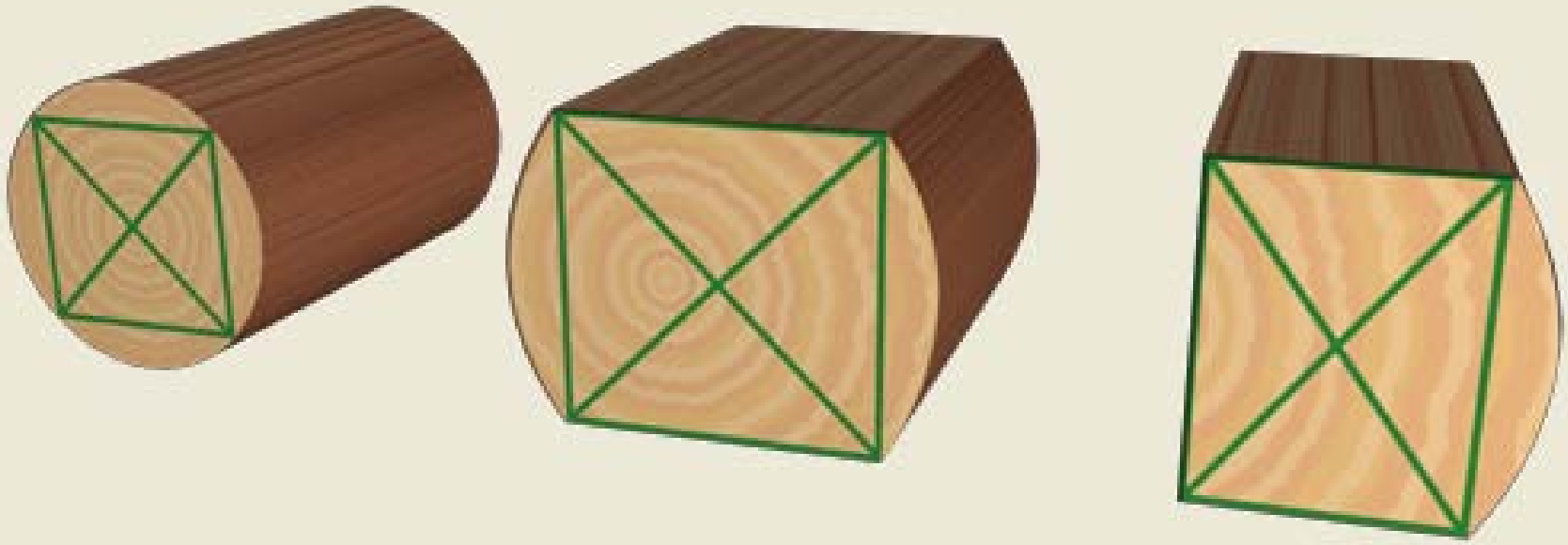
What's New with Mechanical

- 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.

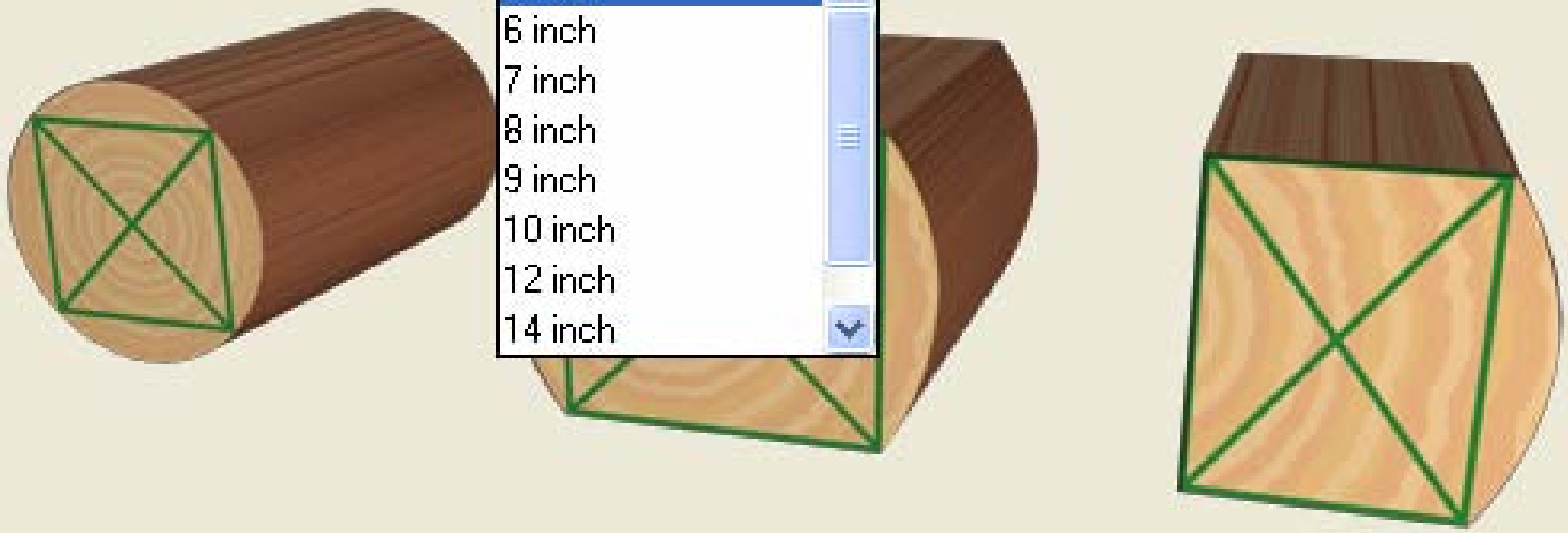
Help | OK | Cancel

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.

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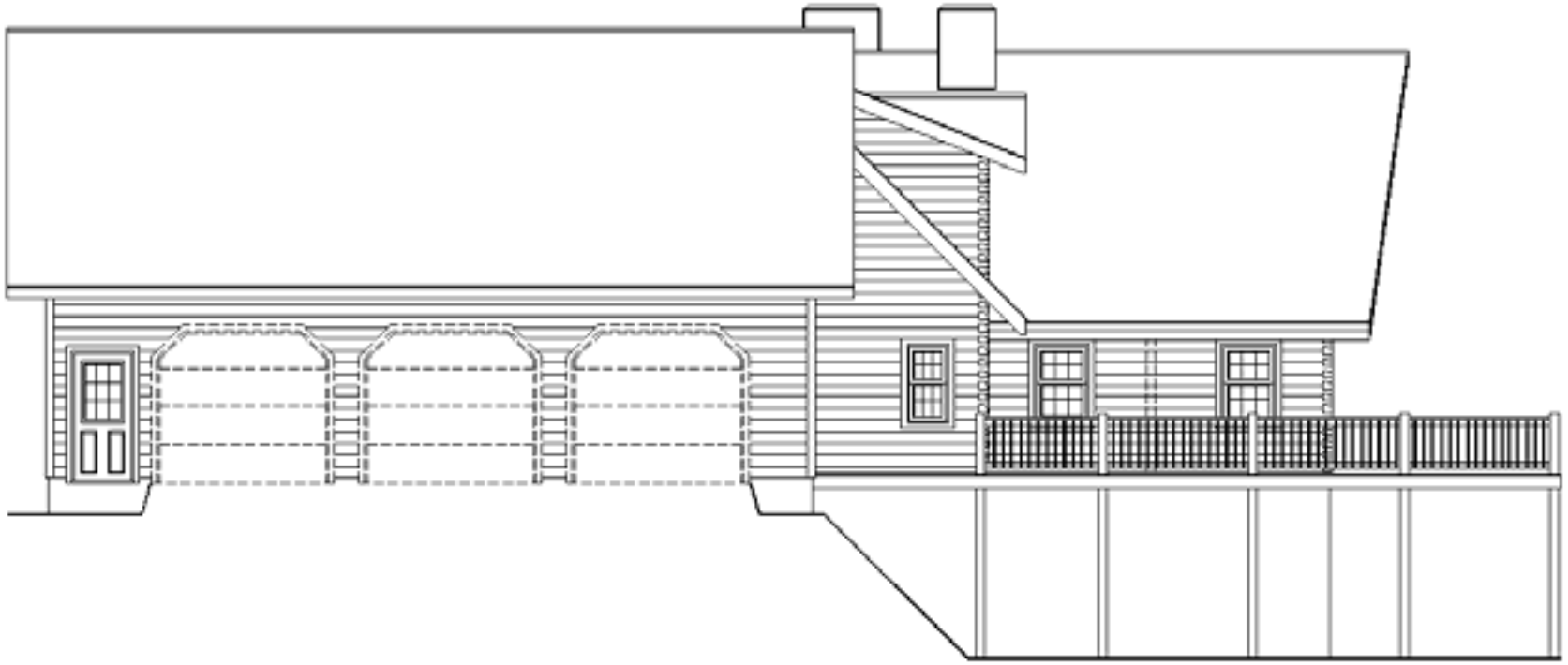
Log Home Case Studies

Simple

Complex

Courtesy of Kuhns Bros. Log Homes Inc.



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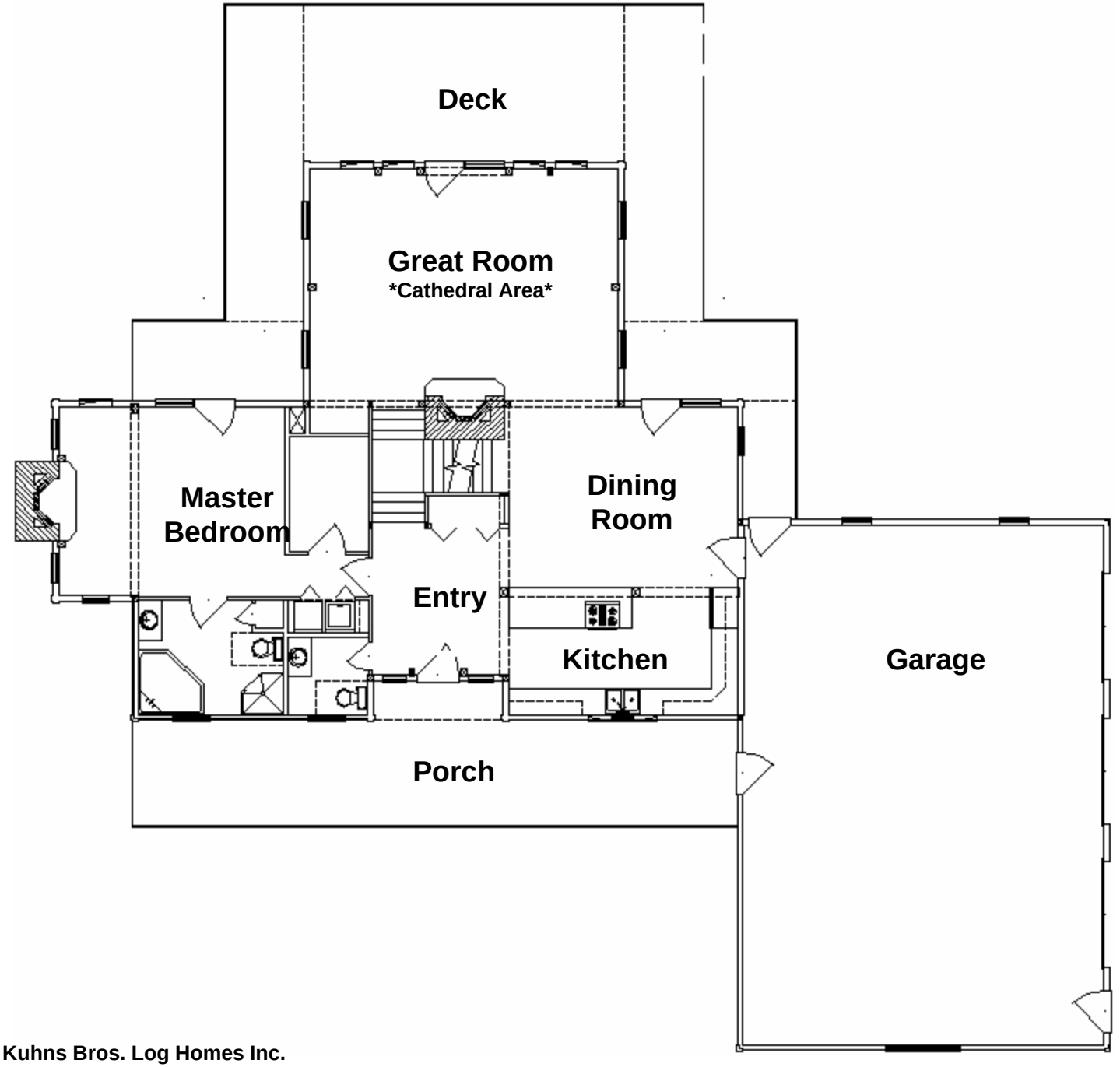

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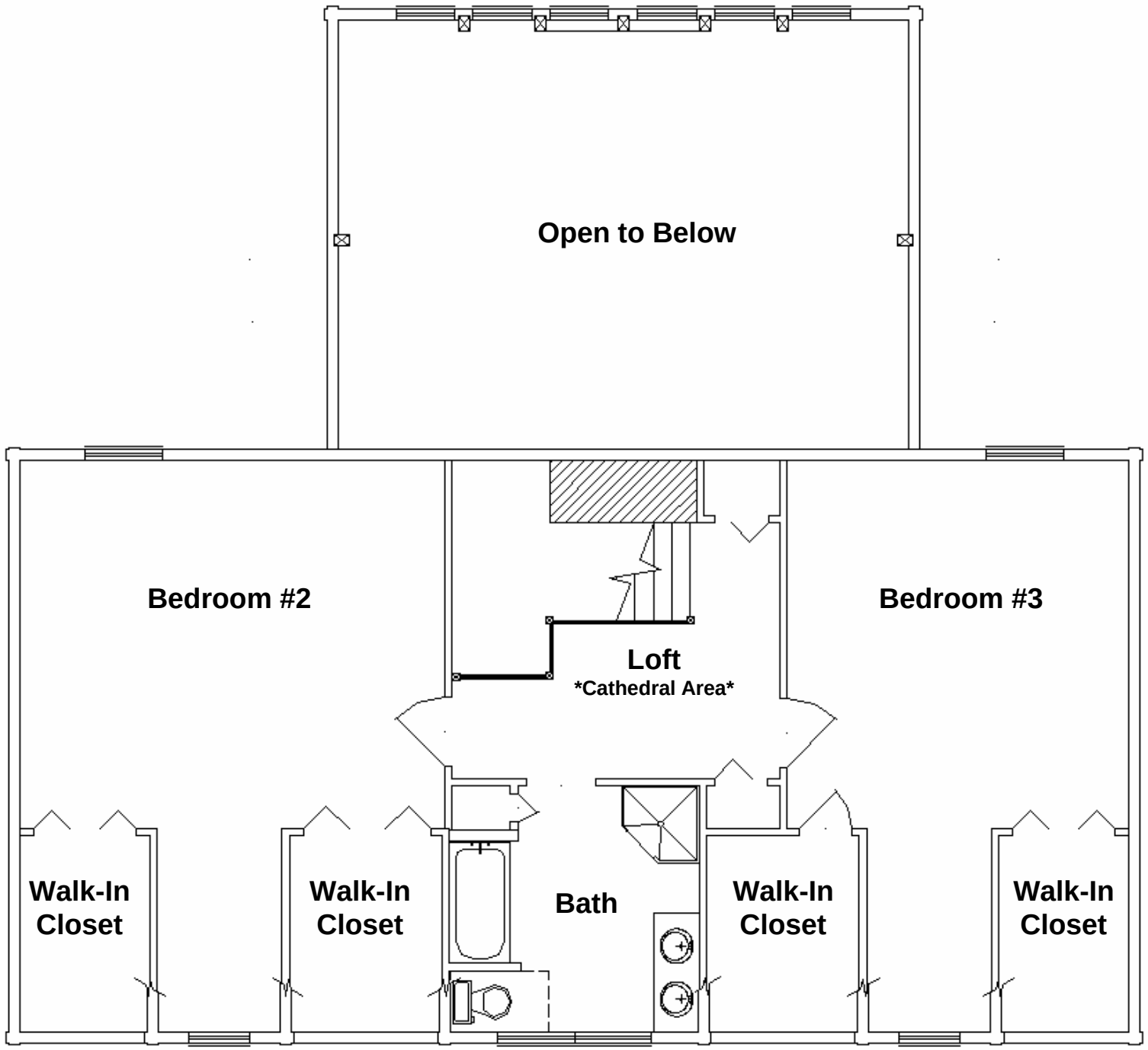
Open to Below
Bedroom #2
Bedroom #3
Loft
Cathedral Area
Walk-In Closet
Walk-In Closet
Bath
Walk-In Closet
Walk-In Closet

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