CHAPTER 3

GENERAL REQUIREMENTS

SECTION 301
GENERAL

301.1 General. Log structures shall comply with the general requirements of this chapter.

SECTION 302
MATERIALS

302.1 Materials. Materials used in the construction of log structures shall conform to the provisions of this Section. Materials used to conform to the applicable provisions of this standard shall be installed in accordance with the installation instructions provided for those materials.

302.2 Logs. Log styles shall include, but are not limited to, round, rectangular or other shapes (profiles) that are peeled, notched, coped, hewn, sawn, milled, or otherwise profiled into their final form for installation.

302.2.1 Stress grading. All logs shall be stress graded and identified by the grade mark or Certificate of Inspection issued by an accredited log grading agency.

302.2.1.1 Log grades and design values. Log grades and design values shall be developed in accordance with one of the following standards:

1. ASTM D 3957
2. ASTM D 3737
3. ASTM D 245

302.2.1.2 Species. Logs shall be of species that are listed with clear wood strength values as published in ASTM D 2555.

302.2.1.3 Grade marks. Grade marks or Certificates of Inspection shall include the following information:

1. Name or registered trade mark of the accredited grading agency.
2. Name or identification number of the manufacturer.
3. Species of logs.
4. Grade name or designation.
5. Moisture content at time of grading, if moisture content is other than green in conformance with Section 302.2.2.1.

302.2.1.4 Log profile. The average log profile shall be drawn and dimensioned.

302.2.2 Moisture content. Moisture content (*MC*) shall be evaluated in accordance with the requirements of this section.

302.2.2.1 Design moisture content. The design moisture content (MC_D) shall be determined in accordance with the requirements of Section 302.2.2.1.1 or 302.2.2.1.2.

302.2.2.1.1 Prescriptive specification. Logs shall be evaluated as green and shall have design moisture content (MC_D) equal to the average moisture content at fiber saturation (MC_{FSP}), in accordance with Table 304.2(1).

302.2.2.1.2 Certified specification. The design moisture content shall be equal to the moisture content determined and certified by methods prescribed by an accredited third-party grading agency.

302.2.2.2 Service moisture content. The service moisture content (MC_S) shall be determined in accordance with the requirements of Section 302.2.2.2.1 or 302.2.2.2.2.

302.2.2.2.1 Prescriptive specification by climate zone. Prescribed by geographic climate zone using Figure 304.2.2.3 and Table 304.2(4).

302.2.2.2.2 Calculation procedure. Calculated in accordance with ASTM D 4933.

302.2.3 Design values. Elements of log structures shall have design values as prescribed in this section.

302.2.3.1 Sawn lumber and glued laminated timber. Design values, adjustment factors and section properties for visually-graded and mechanically-graded dimension lumber and glued laminated timber shall be as specified in the AFPA NDS.

302.2.3.2 Logs. Design values for softwood and hardwood logs shall be as specified in Tables 302.2(1) through 302.2(5) or as established by an accredited grading agency. Tabulated design values shall be multiplied by all applicable adjustment factors listed in Table 302.2(6) to determine allowable design values.

302.2.3.3 Specific gravity. The specific gravity (*G*) for wood species or species groups shall be obtained in accordance with one of the conditions listed in this section.

302.2.3.3.1 Prescriptive specification for wood in unseasoned condition. Specific gravity shall be obtained from ASTM D 2555.

302.2.3.3.2 Prescriptive specification for wood in oven-dry condition. Specific gravity shall be taken from AF&PA NDS.

302.2.3.3.3 Calculation procedure. Specific gravity shall be calculated by the equation $G = \mathrm{Gu} / [1-(0.265a\mathrm{Gu})]$

where:

Gu = specific gravity based on unseasoned condition (ASTM D 2555).

$a = (MC_{FSP} - MC_S) / MC_{FSP}$.

**TABLE 302.2(1)
LIST OF SPECIES COMBINATIONS**

Species or Species Combination[b]	Species Permitted To Be Included in Combination[c]	Source Agencies[a]	Design Values Provided in Tables
Appalachian Softwoods	Fir: Balsam Fir: Balsam – Canadian Hemlock: Eastern Hemlock: Eastern – Canadian Pine: Eastern White Pine: Eastern White - Canadian Pine: Jack Pine: Jack – Canadian Pine: Red Pine: Red - Canadian Southern Pine: Loblolly Southern Pine: Longleaf Southern Pine: Shortleaf Southern Pine: Slash Pine: Pitch Pine: Pond Pine: Sand Pine: Spruce Pine: Virginia Spruce: Black – Canadian Spruce: Red Spruce: Red – Canadian Spruce: White Spruce: White – Canadian Tamarack Tamarack - Canadian	TP	SRTB, Wall-Log
Aspen	Aspen: Bigtooth Aspen: Largetooth-Canadian Aspen: Quaking Aspen: Trembling-Canadian	LHC, TP	SRTB, Wall-Log
Bald Cypress		TP	SRTB, Wall-Log
Beech		TP	SRTB
Cedar: Incense (IC)		LHC, TP	SRTB, Wall-Log
Cedar: Northern White		TP	SRTB, Wall-Log
Cedar, Red (Western, RC)	Cedar: Incense (IC) Cedar: Western red (WRC) Cedar: Western red-Canadian (WRC-N)	LHC	SRTB, Wall-Log
Cedar: Western red (WRC)		LHC, TP	SRTB, Wall-Log
Cedar: Western red-Canadian (WRC-N)		LHC	SRTB, Wall-Log
Cedar: White (WC)	Cedar: Atlantic white Cedar: Eastern white-Canadian Cedar: Northern white	LHC	Wall-Log
Douglas Fir	—	TP	SRTB, Wall-Log
Douglas Fir - N	—	TP	SRTB, Wall-Log
Douglas Fir - S	—	TP	SRTB, Wall-Log
Douglas Fir-Larch (DFL)	Douglas fir: Interior West Douglas fir-Canadian Douglas fir: Coast Douglas fir: Interior North Douglas fir: Interior South Larch, western Larch, western-Canadian	LHC, TP	SRTB, Wall-Log

(continued)

TABLE 302.2(1) —continued
LIST OF SPECIES COMBINATIONS

Species or Species Combination	Species Permitted To Be Included in Combination	Grading Rules Agencies	Design Values Provided in Tables
Eastern Spruce-Pine-Fir (ESPF)	Fir: Balsam Fir: Balsam-Canadian Pine: Jack Pine: Jack-Canadian Pine: Red (RP) Pine: Red-Canadian (RP-N) Spruce: Black Spruce: Black-Canadian Spruce: Red Spruce: Red-Canadian Spruce: White Spruce: White-Canadian	LHC	SRTB, Wall-Log
Eastern Softwoods (ESW)	Fir: Balsam Fir: Balsam-Canadian Hemlock: Eastern Hemlock: Eastern-Canadian Pine: Eastern white (EWP) Pine: Eastern white-Canadian Pine: Jack Pine: Jack-Canadian Pine: Pitch Pine: Red (RP) Pine: Red-Canadian (RP-N) Spruce: Black Spruce: Black-Canadian Spruce: Red Spruce: Red-Canadian Spruce: White Spruce: White-Canadian Tamarack (TAM) Tamarack-Canadian	LHC, TP	SRTB, Wall-Log
Eastern Woods		TP	SRTB, Wall-Log
Fir: Alpine		TP	SRTB, Wall-Log
Fir: Balsam		TP	SRTB, Wall-Log
Fir: White WF)		LHC	Wall-Log
Hem-Fir (HF)	Fir: Amabilis-Canadian Fir: California red Fir: Grand Fir: Noble Fir: Pacific silver Fir: White (WF) Hemlock: Western Hemlock: Western-Canadian	LHC, TP	SRTB, Wall-Log
Hemlock: Eastern		TP	SRTB
Eastern Hemlock - Tamarack		TP	SRTB, Wall-Log
Hemlock: Western		TP	SRTB, Wall-Log
Larch: Western		TP	SRTB, Wall-Log
Mixed Oak		TP	SRTB, Wall-Log
Mixed Southern Pine (MSP)	Pine: Loblolly (LBP) Pine: Longleaf (LLP) Pine: Slash (SHP) Pine: Shortleaf (SLP) Pine: Pond Pine: Sand Pine: Spruce Pine: Virginia	LHC, TP	SRTB, Wall-Log

(continued)

TABLE 302.2(1) —continued
LIST OF SPECIES COMBINATIONS

Species or Species Combination	Species Permitted To Be Included in Combination	Grading Rules Agencies	Design Values Provided in Tables
Oak, Red (RO)	Oak, Black Oak, Cherrybark Oak, Northern red Oak, Southern red Oak, Laurel Oak, Pin Oak, Scarlet Oak, Water Oak, Willow	LHC, TP	SRTB, Wall-Log
Oak, White (WO)	Oak, Chestnut Oak, Live Oak, Post Oak, Swamp chestnut Oak, White Oak, Bur Oak, Overcup Oak, Swamp white	LHC, TP	SRTB, Wall-Log
Pine: Eastern white (EWP)		LHC, TP	SRTB, Wall-Log
Pine: Idaho White		TP	SRTB, Wall-Log
Pine: Loblolly (LBP)		LHC	SRTB, Wall-Log
Pine: Lodgepole (LPP)		LHC, TP	SRTB, Wall-Log
Pine: Longleaf (LLP)		LHC	SRTB, Wall-Log
Pine: Northern		TP	SRTB, Wall-Log
Pine: Ponderosa (PP)		LHC, TP	SRTB, Wall-Log
PP - LP	Pine: Ponderosa (PP) Pine: Lodgepole (LPP)	TP	SRTB, Wall-Log
PP - SP	Pine: Ponderosa (PP) Pine: Sugar (SP)	TP	SRTB, Wall-Log
Pine: Red (RP)		LHC	SRTB, Wall-Log
Pine: Red-Canadian (RP-N)		LHC	SRTB, Wall-Log
Pine: Shortleaf (SLP)		LHC	SRTB
Pine: Slash (SHP)		LHC	SRTB
Pine: Sugar (SUP)		LHC, TP	SRTB, Wall-Log
Pine: Western white (WWP)		LHC	SRTB, Wall-Log
Redwood		TP	SRTB, Wall-Log
Southern Pine (SP)	Pine: Loblolly (LBP) Pine: Longleaf (LLP) Pine: Slash (SHP) Pine: Shortleaf (SLP)	LHC, TP	SRTB, Wall-Log
Spruce: Eastern (ES)	Spruce: Black Spruce: Black-Canadian Spruce: Red Spruce: Red-Canadian Spruce: White Spruce: White-Canadian	LHC, TP	SRTB, Wall-Log
Spruce: Engelmann		TP	SRTB, Wall-Log
ES-AF	Spruce: Engelmann Alpine Fir	TP	SRTB, Wall-Log
ES-LP	Spruce: Engelmann Pine: Lodgepole	TP	SRTB, Wall-Log

(continued)

TABLE 302.2(1) —continued
LIST OF SPECIES COMBINATIONS

Species or Species Combination	Species Permitted To Be Included in Combination	Grading Rules Agencies	Design Values Provided in Tables
ES-AF-LP	Spruce: Engelmann Alpine Fir Pine: Lodgepole	TP	SRTB, Wall-Log
Spruce-Pine-Fir		TP	SRTB, Wall-Log
Tamarack (TAM)		LHC, TP	SRTB, Wall-Log
Western Spruce-Pine-Fir (WSPF)	Fir: Alpine-Canadian Pine: Lodgepole (LPP) Pine: Lodgepole-Canadian (LPP-N) Spruce: Engelmann Spruce: Engelmann-Canadian Spruce: Sitka Spruce: Sitka-Canadian	LHC	SRTB, Wall-Log
Western Softwoods (WS)	Fir: Subalpine Hemlock: Mountain Pine: Lodgepole (LPP) Pine: Lodgepole-Canadian (LPP-N) Pine: Monterey Pine: Ponderosa (PP) Pine: Ponderosa-Canadian Pine: Sugar (SUP) Pine: Western white (WWP) Pine: Western white-Canadian Spruce: Engelmann Spruce: Engelmann-Canadian Spruce: Sitka	LHC	SRTB, Wall-Log
Western Woods		TP	SRTB, Wall-Log
White Woods		TP	SRTB, Wall-Log

a. Source agencies:
1. LHC: Log Home Council, National Association of Home Builders
2. TP: Timber Products Inspection, Inc.

b. Species combinations listed represent typical combinations utilized by TP or LHC member clients. Other species combinations published by accredited grading agencies are permissible. The grading agencies listed here do not preclude the use of other accredited grading agencies.

c. Identified species and their subsequent design values were obtained from clear wood test data as shown within ASTM D 2555.

TABLE 302.2(2)
SECTION PROPERTIES OF SAWN AND UNSAWN ROUND TIMBER BEAMS

	Sawn Round Timber Beams[a]			Unsawn (Full Round) Timber Beams		
		(x-x axis)				
	Area of Section (in^2)	Section Modulus (in^3)	Moment of Inertia (in^4)	Area of Section (in^2)	Section Modulus (in^3)	Moment of Inertia (in^4)
Nominal Diameter (inches)	2.8461 *$radius^2$	0.6159 *$radius^3$	0.5612 *$radius^4$	3.1416 *$radius^2$	0.7854 *$radius^3$	0.7854 *$radius^4$
5	17.79	9.62	21.92	19.63	12.27	30.68
5.5	21.52	12.81	32.09	23.76	16.33	44.92
6	25.61	16.63	45.45	28.27	21.21	63.62
6.5	30.06	21.14	62.61	33.18	26.96	87.62
7	34.86	26.41	84.21	38.48	33.67	117.86
7.5	40.02	32.48	110.97	44.18	41.42	155.32
8	45.54	39.42	143.66	50.27	50.27	201.06
8.5	51.41	47.28	183.08	56.75	60.29	256.24
9	57.63	56.13	230.11	63.62	71.57	322.06
9.5	64.21	66.01	285.67	70.88	84.17	399.82
10	71.15	76.99	350.72	78.54	98.17	490.87
10.5	78.45	89.13	426.31	86.59	113.65	596.66
11	86.09	102.47	513.49	95.03	130.67	718.69
11.5	94.1	117.09	613.42	103.87	149.31	858.54
12	102.46	133.04	727.26	113.1	169.65	1017.88
14	139.46	211.26	1347.34	153.94	269.39	1885.74
15	160.09	259.84	1775.54	176.71	331.34	2485.05
16	182.15	315.35	2298.5	201.06	402.12	3216.99
18	230.53	449	3681.75	254.47	572.56	5153
20	284.61	615.92	5611.57	314.16	785.4	7853.98
24	409.84	1064.31	11636.16	452.39	1357.17	16286.02

For SI: 1 inch = 25.4 mm.
Note: Maximum allowable taper is $^1/_8$ inch per 12 inches (3.175 mm per 305 mm) from tip to 36 inches (914 mm) from butt.
a. Sawn round timber beams are sawn or shaved along only one surface such that the sawing or shaving does not exceed $^3/_{10}$ of the radius of the log at any point.

TABLE 302.2(3)
BASE DESIGN VALUES FOR SAWN ROUND AND UNSAWN ROUND TIMBER BEAMS

These values are for timbers that are either completely round or that are sawn or shaved along only one surface such that the sawing or shaving does not exceed $^3/_{10}$ of the radius of the log at any point.

Species and commercial grade[d]	Design values in pounds per square inch (lbf/in^2) [b,e,f,g,h]						Source Agency[a]
	Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain $F_{c\parallel}$	Modulus of Elasticity E*10^6	
Appalachian Softwoods							
Unsawn	1350	750	125	350	725	1.1	TP
No. 1	1100	600	125	350	600	1.1	
No. 2	925	500	125	350	500	1.1	
No. 3	525	300	125	350	275	0.8	
Aspen							
Unsawn	1400	775	115	245	650	0.9	TP
No. 1	1150	625	115	245	525	0.9	
No. 2	975	525	115	245	425	0.9	
No. 3	550	300	115	245	250	0.7	
Bald Cypress (CYP) G=0.43 unseasoned condition							
Unsawn	1850	1000	150	615	1050	1.3	TP
No. 1	1500	825	150	615	875	1.3	
No. 2	1250	675	150	615	725	1.3	
No. 3	725	400	150	615	425	1	
Beech							
Unsawn	2350	1300	230	815	1050	1.5	TP
No. 1	1950	1050	230	815	875	1.5	
No. 2	1600	875	230	815	725	1.5	
No. 3	925	500	230	815	425	1.2	
Cedar Insence (IC) G=0.35 unseasoned condition							
No. 1	1400	775	160	630	925	0.9	LHC
No. 2	1150	650	160	630	775	0.9	
No. 1 unsawn	1650	900	160	630	925	0.9	
Unsawn	1700	950	150	565	950	0.9	TP
No. 1	1400	775	150	565	775	0.9	
No. 2	1150	650	150	565	650	0.9	
No. 3	675	375	150	565	375	0.7	

(continued)

TABLE 302.2(3)—continued
BASE DESIGN VALUES FOR SAWN ROUND AND UNSAWN ROUND TIMBER BEAMS

Species and commercial grade[d]	Design values in pounds per square inch (lbf/in^2) [b,e]						Source Agency[a]
	Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain $F_{c\|}$	Modulus of Elasticity E*10[6]	
Cedar (North White)							
Unsawn	1150	650	110	370	600	0.7	TP
No. 1	950	525	110	370	475	0.7	
No. 2	800	450	110	370	400	0.7	
No. 3	450	250	110	370	225	0.5	
Cedar, Red (Western, RC) G=0.31 unseasoned condition							
No. 1	1250	675	140	490	825	1.0	LHC
No. 2	1000	550	140	490	700	1.0	
No. 1 unsawn	1450	775	140	490	825	1.0	
Cedar: Western red (WRC) G=0.31 unseasoned condition							
No. 1	1200	650	145	430	825	1.0	LHC
No. 2	1000	550	145	430	700	1.0	
No. 1 unsawn	1400	775	145	430	825	1.0	
Unsawn	1500	800	135	385	825	1	TP
No. 1	1200	650	135	385	675	1	
No. 2	1000	550	135	385	575	1	
No. 3	575	325	135	385	325	0.8	
Cedar: Western red-Canadian (WRC-N) G=0.31 unseasoned condition							
No. 1	1200	650	135	485	825	1.1	LHC
No. 2	1000	550	135	485	700	1.1	
No. 1 unsawn	1400	775	135	485	825	1.1	
Douglas fir							
Unsawn	2050	1150	160	630	1100	1.6	LHC
No. 1	1700	925	160	630	900	1.6	
No. 2	1400	775	160	630	750	1.6	
No. 3	800	450	160	630	425	1.3	
Douglas Fir – N							
Unsawn	2050	1150	175	600	1050	1.5	TP
No. 1	1700	925	175	600	850	1.5	
No. 2	1400	775	175	600	725	1.5	
No. 3	800	450	175	600	400	1.2	
Douglas Fir – S							
Unsawn	2000	1100	170	520	975	1.2	T
No. 1	1600	900	170	520	800	1.2	P
No. 2	1350	750	170	520	675	1.2	
No. 3	775	425	170	520	375	1	

(continued)

TABLE 302.2(3)—continued
BASE DESIGN VALUES FOR SAWN ROUND AND UNSAWN ROUND TIMBER BEAMS

Species and commercial grade[d]	Design values in pounds per square inch (lbf/in^2)[b,e]						Source Agency[a]
	Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain $F_{c\parallel}$	Modulus of Elasticity $E*10^6$	
Douglas Fir-Larch (DFL) G=0.45 unseasoned condition							
No. 1 Dense	2000	1100	175	805	1250	1.5	LHC
No. 1	1700	925	175	710	1100	1.4	LHC
No. 2 Dense	1650	925	175	805	1050	1.5	LHC
No. 2	1400	775	175	710	900	1.4	LHC
No. 1 Dense unsawn	2350	1300	175	805	1250	1.5	LHC
No. 1 unsawn	2000	1100	175	710	1100	1.4	LHC
Unsawn	2050	1150	175	600	1050	1.5	TP
No. 1	1700	925	175	600	850	1.5	TP
No. 2	1400	775	175	600	725	1.5	TP
No. 3	800	450	175	600	400	1.2	TP
E. Spruce-Pine-Fir (ESPF) G=0.38 unseasoned condition							
No. 1	1150	625	135	480	725	1.2	LHC
No. 2	950	525	135	480	600	1.2	LHC
No. 1 unsawn	1350	725	135	480	725	1.2	LHC
Eastern Softwoods (ESW) G=0.38 unseasoned condition							
No. 1	1150	625	125	480	725	1.2	LHC
No. 2	950	525	125	480	600	1.2	LHC
No. 1 unsawn	1350	725	125	480	725	1.2	LHC
Unsawn	1350	750	125	350	725	1.1	TP
No. 1	1100	600	125	350	600	1.1	TP
No. 2	925	500	125	350	500	1.1	TP
No. 3	525	300	125	350	275	0.8	TP
Eastern Woods							
Unsawn	1350	750	125	350	725	1.1	TP
No. 1	1100	600	125	350	600	1.1	TP
No. 2	925	500	125	350	500	1.1	TP
No. 3	525	300	125	350	275	0.8	TP
Fir: Alpine							
Unsawn	1450	775	125	405	750	1.3	TP
No. 1	1150	650	125	405	600	1.3	TP
No. 2	975	525	125	405	500	1.3	TP
No. 3	550	300	125	405	300	1.1	TP

(continued)

TABLE 302.2(3)—continued
BASE DESIGN VALUES FOR SAWN ROUND AND UNSAWN ROUND TIMBER BEAMS

Species and commercial grade[d]	Design values in pounds per square inch (lbf/in^2)[b,e]						Source Agency[a]
	Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain $F_{c\|}$	Modulus of Elasticity E*10^6	
Fir: Balsam							
Unsawn	1750	950	125	305	925	1.3	TP
No. 1	1400	775	125	305	750	1.3	
No. 2	1200	650	125	305	625	1.3	
No. 3	675	375	125	305	350	1.1	
Hem-Fir (HF) G=0.39 unseasoned condition							
No. 1	1300	700	140	535	850	1.4	LHC
No. 2	1050	600	140	535	725	1.4	
No. 1 unsawn	1500	825	140	535	850	1.4	
Unsawn	1650	900	135	370	850	1.2	TP
No. 1	1350	725	135	370	700	1.2	
No. 2	1100	600	135	370	575	1.2	
No. 3	625	350	135	370	325	1	
Hemlock: Eastern							
Unsawn	1800	975	155	550	925	1.1	TP
No. 1	1450	800	155	550	750	1.1	
No. 2	1200	675	155	550	625	1.1	
No. 3	700	375	155	550	350	0.9	
Eastern Hemlock -Tamarack							
Unsawn	1800	975	155	550	925	1.1	TP
No. 1	1450	800	155	550	750	1.1	
No. 2	1200	675	155	550	625	1.1	
No. 3	700	375	155	550	350	0.9	
Hemlock: Western							
Unsawn	1800	1000	160	410	1000	1.4	TP
No. 1	1500	825	160	410	825	1.4	
No. 2	1250	675	160	410	675	1.4	
No. 3	700	400	160	410	400	1.1	
Larch: Western							
Unsawn	2250	1250	175	605	1200	1.6	TP
No. 1	1850	1000	175	605	975	1.6	
No. 2	1550	850	175	605	825	1.6	
No. 3	875	475	175	605	475	1.2	

(continued)

TABLE 302.2(3)—continued
BASE DESIGN VALUES FOR SAWN ROUND AND UNSAWN ROUND TIMBER BEAMS

Species and commercial grade[d]	Design values in pounds per square inch (lbf/in²)[b,e]						Source Agency[a]
	Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain $F_{c\|}$	Modulus of Elasticity E*10[6]	
Mixed Oak							
Unsawn	1900	1050	170	820	900	1.2	TP
No. 1	1550	850	170	820	750	1.2	
No. 2	1300	725	170	820	625	1.2	
No. 3	750	400	170	820	350	1	
Mixed Southern Pine (MSP) G=0.48 unseasoned condition							
No. 1 Dense	1550	850	175	755	975	1.2	LHC
No. 1	1350	725	175	670	825	1.2	
No. 2 Dense	1300	725	175	755	825	1.2	
No. 2	1100	625	175	670	700	1.2	
No. 1 Dense unsawn	1850	1000	175	755	975	1.2	
No. 1 unsawn	1600	875	175	670	825	1.2	
Unsawn	2050	1100	160	595	1000	1.3	TP
No. 1	1650	900	160	595	825	1.3	
No. 2	1400	750	160	595	700	1.3	
No. 3	800	425	160	595	400	1	
Oak, Red (RO) G=0.57 unseasoned condition							
No. 1	1500	800	160	985	850	1.3	LHC
No. 2	1250	675	160	985	700	1.3	
No. 1 unsawn	1750	950	160	985	850	1.3	
Unsawn	1900	1050	170	820	900	1.2	TP
No. 1	1550	850	170	820	750	1.2	
No. 2	1300	725	170	820	625	1.2	
No. 3	750	400	170	820	350	1	
Oak, White (WO) G=0.62 unseasoned condition							
No. 1	1550	850	210	1225	925	1	LHC
No. 2	1300	700	210	1225	775	1	
No. 1 unsawn	1800	1000	210	1225	925	1	
Unsawn	2000	1100	220	795	975	0.9	TP
No. 1	1600	900	220	795	800	0.9	
No. 2	1350	750	220	795	675	0.9	
No. 3	775	425	220	795	375	0.7	

(continued)

TABLE 302.2(3)—continued
BASE DESIGN VALUES FOR SAWN ROUND AND UNSAWN ROUND TIMBER BEAMS

Species and commercial grade[d]	Design values in pounds per square inch (lbf/in²) [b,e]						Source Agency[a]
	Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain $F_{c\|}$	Modulus of Elasticity E*10[6]	
Pine: Eastern White (EWP) G=0.35 unseasoned condition							
No. 1	1100	600	130	390	725	1.1	LHC
No. 2	925	500	130	390	600	1.1	
No. 1 unsawn	1300	725	130	390	725	1.1	
Unsawn	1350	750	125	350	725	1.1	TP
No. 1	1100	600	125	350	600	1.1	
No. 2	925	500	125	350	500	1.1	
No. 3	525	300	125	350	275	0.8	
Pine: Idaho White							
Unsawn	1350	725	125	310	750	1.3	TP
No. 1	1100	600	125	310	600	1.3	
No. 2	900	500	125	310	500	1.3	
No. 3	525	275	125	310	300	1	
Pine: Loblolly (LBP) G=0.35 unseasoned condition							
No. 1	1650	900	170	660	1050	1.5	LHC
No. 2	1350	750	170	660	875	1.5	
No. 1 unsawn	1900	1050	170	660	1050	1.5	
Pine: Lodgepole (LPP) G=0.39 unseasoned condition							
No. 1	1250	675	130	445	775	1.1	LHC
No. 2	1050	575	130	445	650	1.1	
No. 1 unsawn	1450	800	130	445	775	1.1	
Unsawn	500	825	125	395	775	1.1	TP
No. 1	1250	675	125	395	625	1.1	
No. 2	1050	575	125	395	525	1.1	
No. 3	600	325	125	395	300	0.9	
Pine: Longleaf (LLP) G=0.54 unseasoned condition							
No. 1	1950	1100	210	805	1350	1.7	LH
No. 2	1650	900	210	805	1100	1.7	
No. 1 unsawn	2300	1250	210	805	1350	1.7	
Pine: Northern							
Unsawn	1600	875	125	405	825	1.1	TP
No. 1	1300	725	125	405	675	1.1	
No. 2	1100	600	125	405	550	1.1	
No. 3	625	350	125	405	325	0.9	

(continued)

TABLE 302.2(3)—continued
BASE DESIGN VALUES FOR SAWN ROUND AND UNSAWN ROUND TIMBER BEAMS

Species and commercial grade[d]	Design values in pounds per square inch (lbf/in^2)[b,e]						Source Agency[a]
	Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain $F_{c\|}$	Modulus of Elasticity E*10[6]	
Pine: Ponderosa (PP) G=0.39 unseasoned condition							
No. 1	1150	625	135	490	725	1.1	LHC
No. 2	975	525	135	490	600	1.1	LHC
No. 1 unsawn	1350	750	135	490	725	1.1	LHC
Unsawn	1400	775	130	440	725	1.1	TP
No. 1	1150	625	130	440	600	1.1	TP
No. 2	975	525	130	440	500	1.1	TP
No. 3	550	300	130	440	275	0.8	TP
Ponderosa Pine –Lodgepole Pine (PP-LP)							
Unsawn	1400	775	125	395	725	1.1	TP
No. 1	1150	625	125	395	600	1.1	TP
No. 2	975	525	125	395	500	1.1	TP
No. 3	550	300	125	395	275	0.8	TP
Ponderosa Pine – Sugar Pine (PP-SP)							
Unsawn	1450	775	130	345	725	1.1	TP
No. 1	1150	650	130	345	600	1.1	TP
No. 2	975	525	130	345	500	1.1	TP
No. 3	550	300	130	345	275	0.8	TP
Pine: Red (RP)							
No. 1	1300	725	130	455	800	1.4	LHC
No. 2	1100	600	130	455	675	1.4	LHC
No. 1 unsawn	1550	850	130	455	800	1.4	LHC
Pine: Red-Canadian (RP-N) G=0.39 unseasoned condition							
No. 1	1150	625	135	490	700	1.1	LHC
No. 2	950	525	135	490	600	1.1	LHC
No. 1 unsawn	1350	725	135	490	700	1.1	LHC
Pine: : Shortleaf (SLP)							
No. 1	1700	925	175	575	1100	1.5	LHC
No. 2	1400	775	175	575	925	1.5	LHC
No. 1 unsawn	2000	1100	175	575	1100	1.5	LHC
Pine: Slash (SHP)							
No. 1	2100	1150	190	885	1250	1.6	LHC
No. 2	1750	950	190	885	1050	1.6	LHC
No. 1 unsawn	2450	1350	190	885	1250	1.6	LHC

(continued)

TABLE 302.2(3)—continued
BASE DESIGN VALUES FOR SAWN ROUND AND UNSAWN ROUND TIMBER BEAMS

Species and commercial grade[d]	Design values in pounds per square inch (lbf/in^2)[b,e]						Source Agency[a]
	Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain $F_{c\|}$	Modulus of Elasticity E*10^6	
Pine: Sugar (SUP) G=0.34 unseasoned condition							
No. 1	1150	650	135	380	775	1.1	LHC
No. 2	975	525	135	380	650	1.1	
No. 1 unsawn	1350	750	135	380	775	1.1	
Unsawn	1450	775	130	345	775	1.1	TP
No. 1	1150	650	130	345	625	1.1	
No. 2	975	525	130	345	525	1.1	
No. 3	550	300	130	345	300	0.9	
Pine: Western White (WWP) G=0.35 unseasoned condition							
No. 1	1100	600	130	350	750	1.3	LHC
No. 2	900	500	130	350	625	1.3	
No. 1 unsawn	1300	700	130	350	750	1.3	
Redwood							
Unsawn	1650	900	150	420	925	1	TP
No. 1	1350	725	150	420	750	1	
No. 2	1100	600	150	420	625	1	
No. 3	650	350	150	420	375	0.8	
Southern Pine (SP) G=0.48 unseasoned condition							
No. 1 Dense	2000	1100	175	755	1300	1.6	LHC
No. 1	1700	950	175	670	1100	1.5	
No. 2 Dense	1700	925	175	755	1100	1.6	
No. 2	1450	800	175	670	925	1.5	
No. 1 Dense unsawn	2400	1300	175	755	1300	1.6	
No. 1 unsawn	2050	1100	175	670	1100	1.5	
Unsawn	2000	1100	160	515	1050	1.5	TP
No. 1	1650	900	160	515	875	1.5	
No. 2	1350	750	160	515	725	1.5	
No. 3	775	425	160	515	425	1.2	

(continued)

TABLE 302.2(3)—continued
BASE DESIGN VALUES FOR SAWN ROUND AND UNSAWN ROUND TIMBER BEAMS

Species and commercial grade[d]	Design values in pounds per square inch (lbf/in²)[b,e]						Source Agency[a]
	Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain $F_{c\|}$	Modulus of Elasticity E*10[6]	
Spruce: Eastern (ES) G=0.38 unseasoned condition							
No. 1	1150	625	135	480	725	1.3	LHC
No. 2	950	525	135	480	600	1.3	
No. 1 unsawn	1350	725	135	480	725	1.3	
Unsawn	1400	775	125	390	750	1.2	TP
No. 1	1150	625	125	390	600	1.2	
No. 2	950	525	125	390	500	1.2	
No. 3	550	300	125	390	300	1	
Spruce: Engelmann G=0.33 unseasoned condition							
Unsawn	1350	725	125	320	625	1.1	TP
No. 1	1100	600	125	320	500	1.1	
No. 2	900	500	125	320	425	1.1	
No. 3	525	275	125	320	250	0.9	
Engelmann Spruce — Alpine Fir (ES-AF)							
Unsawn	1350	725	125	320	625	1.1	TP
No. 1	1100	600	125	320	500	1.1	
No. 2	900	500	125	320	425	1.1	
No. 3	525	275	125	320	250	0.9	
Engelmann Spruce – Lodgepole Pine (ES-LP)							
Unsawn	1350	725	125	320	625	1.1	TP
No. 1	1100	600	125	320	500	1.1	
No. 2	900	500	125	320	425	1.1	
No. 3	525	275	125	320	250	0.9	
Engelmann Spruce – Alpine Fir – Lodgepole Pine (ES-AF-LP)							
Unsawn	1350	725	125	320	625	1.1	TP
No. 1	1100	600	125	320	500	1.1	
No. 2	900	500	125	320	425	1.1	
No. 3	525	275	125	320	250	0.9	
Spruce-Pine-Fir							
Unsawn	1350	725	125	305	625	1.1	TP
No. 1	1100	600	125	305	500	1.1	
No. 2	900	500	125	305	425	1.1	
No. 3	525	275	125	305	250	0.9	

(continued)

TABLE 302.2(3)—continued
BASE DESIGN VALUES FOR SAWN ROUND AND UNSAWN ROUND TIMBER BEAMS

Species and commercial grade[d]	Design values in pounds per square inch (lbf/in²)[b,e]						Source Agency[a]
	Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain[c] $F_{c\parallel}$	Modulus of Elasticity E*10[6]	
Tamarack (TAM)							
No. 1	1600	900	165	660	1050	1.3	LHC
No. 2	1350	750	165	660	875	1.3	
No. 1 unsawn	1900	1050	165	660	1050	1.3	
Unsawn	2000	1100	155	595	1050	1.3	TP
No. 1	1600	875	155	595	850	1.3	
No. 2	1350	750	155	595	700	1.3	
No. 3	775	425	155	595	400	1.1	
W. Spruce-Pine-Fir (WSPF) G=0.37 unseasoned condition							
No. 1	1150	625	125	455	650	1.2	LHC
No. 2	950	525	125	455	550	1.2	
No. 1 unsawn	1350	725	125	455	650	1.2	
Western Softwoods (WS) G=0.38 unseasoned condition							
No. 1	1100	625	125	460	6550	1.2	LHC
No. 2	925	525	125	460	550	1.2	
No. 1 unsawn	1300	725	125	460	650	1.2	
Western Woods							
Unsawn	1300	725	125	310	625	1	
No. 1	1100	600	125	310	500	1	
No. 2	900	500	125	310	425	1	
No. 3	525	275	125	310	250	0.8	
White Woods							
Unsawn	1300	725	125	310	625	1	TP
No. 1	1100	600	125	310	500	1	
No. 2	900	500	125	310	425	1	
No. 3	525	275	125	310	250	0.8	

For SI: 1 lbf/in^2 = 6.894 kPa

a. Source Agencies:
1. LHC: Log Home Council, National Association of Home Builders
2. TP: Timber Products Inspection, Inc.

b. The provided design values are to be used only with logs and/or timbers graded and grade marked by the respective grading rules agency or by one of the manufacturers trained, approved and licensed by the grading rules agency to apply grademarks.

c. Compression parallel to the grain values have been increased by 10 percent to account for seasoning. For logs that are unseasoned, the design value for compression parallel to the grain shall be multiplied by 0.91.

d. Values listed represent the typical species or species combination design values. Some species, specie combinations, and/or specie designations are not listed due to limited use. Other species combinations published by accredited grading agencies are permissible.

e. All appropriate adjustment factors shall be applied in accordance with Tables 302.2(4) and 302.2(6).

f. For sawn round timber beams the repetitive member factor, C_r, for bending design values, F_b, shall not apply to sawn round timber beams in any condition or use.

g. Sawn round timber beams shall be installed and protected against end moisture so as to achieve equilibrium moisture content in-service. Therefore, the Wet Service Factor, C_m, shall not apply.

h. For sawn round timber beams appropriate form adjustment factors, C_f, have already been incorporated in the tabulated design values.

TABLE 302.2(4)
ADJUSTMENT FACTORS FOR WALL LOGS

Diameter (inches)	Width of Inscribed Rectangle (inches)	Size Factor, *CF*	Diameter (inches)	Width of Inscribed Rectangle (inches)	Size Factor, CF
4	3-13/16	1.14	13	10-3/16	1.02
5	4-1/2	1.12	14	10-7/8	1.01
6	5-1/4	1.1	15	11-9/16	1.0
7	5-15/16	1.08	16	12-5/16	1.0
8	6-5/8	1.07	17	13	0.99
9	7-3/8	1.06	18	13-11/16	0.99
10	8-1/16	1.05	20	15-1/8	0.97
11	8-3/4	1.04	24	17-15/16	0.96
12	9-1/2	1.03	28	20-13/16	0.94

For SI: 1 inch = 25.4 mm.

TABLE 302.2(5)
BASE DESIGN VALUES FOR WALL LOGS

Species and commercial grade[d]	Wall-Log Design values in pounds per square inch (lbf/in^2)[b,c]						Source Agency[a]
	Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain $F_{c\|\|}$	Modulus of Elasticity E*10[6]	
Appalachian Softwoods							
Premium	975	650	125	350	675	1.1	TP
Select	875	575	125	350	600	1.1	
Rustic	750	500	125	350	525	1	
Wall Log 40	575	375	125	350	400	0.8	
Wall Log 30	425	275	125	350	300	0.8	
Aspen G=0.37 unseasoned condition							
Beam	1150	750	125	310	800	1	LHC
Header	925	625	125	310	675	1	
Wall	600	400	125	310	500	0.8	
Utility	400	275	125	310	450	0.8	
Premium	1000	675	115	245	600	0.9	TP
Select	900	600	115	245	525	0.9	
Rustic	775	525	115	245	450	0.8	
Wall Log 40	600	400	115	245	350	0.7	
Wall Log 30	450	300	115	245	250	0.7	
Bald Cypress (CYP) G=0.43 unseasoned condition							
Beam	1400	950	150	615	1250	1.3	LHC
Header	1150	775	150	615	1100	1.3	
Wall	775	525	150	615	825	1	
Utility	525	350	150	615	725	1	
Premium	1300	875	145	615	1000	1.3	TP
Select	1150	775	145	615	900	1.3	
Rustic	1000	675	145	615	775	1.1	
Wall Log 40	775	500	145	615	575	1	
Wall Log 30	575	375	145	615	425	1	

(continued)

TABLE 302.2(5)—continued
BASE DESIGN VALUES FOR WALL LOGS

Species and commercial grade[d]	Wall-Log Design values in pounds per square inch (lbf/in^2)[b,c]						Source Agency[a]
	Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain $F_{c\|}$	Modulus of Elasticity $E*10^6$	
Cedar: Incense (IC) G=0.35 unseasoned condition							
Beam	1300	900	155	565	1100	0.9	LHC
Header	1100	725	155	565	950	0.9	
Wall	725	475	155	565	725	0.7	
Utility	475	325	155	565	650	0.7	
Premium	1250	825	155	565	875	0.9	TP
Select	1100	725	155	565	775	0.9	
Rustic	950	625	155	565	675	0.8	
Wall Log 40	725	475	155	565	525	0.7	
Wall Log 30	525	350	155	565	375	0.7	
Cedar: Northern White							
Premium	850	575	115	370	550	0.7	TP
Select	750	500	115	370	500	0.7	
Rustic	650	425	115	370	425	0.6	
Wall Log 40	500	325	115	370	325	0.5	
Wall Log 30	375	250	115	370	250	0.5	
Cedar, Red (Western, RC) G=0.31 unseasoned condition							
Beam	1150	775	130	440	1000	1	LHC
Header	950	625	130	440	850	1	
Wall	625	425	130	440	650	0.8	
Utility	425	275	130	440	575	0.8	
Cedar: Western red (WRC) G=0.31 unseasoned condition							
Beam	1150	750	140	385	1000	1	LHC
Header	925	625	140	385	850	1	
Wall	625	400	140	385	625	0.8	
Utility	425	275	140	385	575	0.8	
Premium	1050	700	135	385	775	1	TP
Select	925	625	135	385	700	1	
Rustic	825	550	135	385	600	0.9	
Wall Log 40	625	400	135	385	450	0.8	
Wall Log 30	450	300	135	385	350	0.8	

(continued)

TABLE 302.2(5)—continued
BASE DESIGN VALUES FOR WALL LOGS

Species and commercial grade[d]	Wall-Log Design values in pounds per square inch (lbf/in²)[b,c] Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain $F_{c\|}$	Modulus of Elasticity E*10⁶	Source Agency[a]
Cedar: Western red-Canadian (WRC-N) G=0.31 unseasoned condition							
Beam	1150	750	130	435	975	1.1	LHC
Header	925	625	130	435	850	1.1	
Wall	600	400	130	435	625	0.9	
Utility	400	275	130	435	575	0.9	
Cedar, White (WC) G=0.30 unseasoned condition							
Beam	850	575	115	340	675	0.6	LHC
Header	700	475	115	340	575	0.6	
Wall	450	300	115	340	450	0.5	
Utility	300	200	115	340	400	0.5	
Cedar, Yellow (Western, YC) G=0.42 unseasoned condition							
Beam	1400	950	155	535	1150	1.3	LHC
Header	1150	775	155	535	950	1.3	
Wall	775	525	155	535	725	1.1	
Utility	525	350	155	535	650	1.1	
Douglas Fir							
Premium	1500	1000	165	630	1050	1.6	TP
Select	1300	875	165	630	900	1.6	
Rustic	1150	775	165	630	800	1.4	
Wall Log 40	850	575	165	630	600	1.3	
Wall Log 30	650	425	165	630	450	1.3	
Douglas Fir (N)							
Premium	1500	1000	175	600	1000	1.5	TP
Select	1300	875	175	600	875	1.5	
Rustic	1150	775	175	600	750	1.3	
Wall Log 40	850	575	175	600	575	1.2	
Wall Log 30	650	425	175	600	425	1.2	
Douglas Fir (S)							
Premium	1400	950	165	520	925	1.2	TP
Select	1250	850	165	520	825	1.2	
Rustic	1100	725	165	520	700	1.1	
Wall Log 40	825	550	165	520	525	1	
Wall Log 30	625	425	165	520	400	1	

(continued)

TABLE 302.2(5)—continued
BASE DESIGN VALUES FOR WALL LOGS

Species and commercial grade[d]	Wall-Log Design values in pounds per square inch (lbf/in^2)[b,c]						Source Agency[a]
	Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain $F_{c\|}$	Modulus of Elasticity $E*10^6$	
Douglas Fir-Larch (DFL) G=0.45 unseasoned condition							
Beam Dense	1900	1250	170	720	1500	1.5	LHC
Beam	1600	1100	170	640	1300	1.4	
Header Dense	1550	1050	170	720	1300	1.5	
Header	1300	875	170	640	1100	1.4	
Wall	875	575	170	640	825	1.1	
Utility	575	400	170	640	750	1.1	
Premium	1500	1000	175	600	1000	1.5	TP
Select	1300	875	175	600	875	1.5	
Rustic	1150	775	175	600	750	1.3	
Wall Log 40	850	575	175	600	575	1.2	
Wall Log 30	650	425	175	600	425	1.2	
E. Spruce-Pine-Fir (ESPF) G=0.38 unseasoned condition							
Beam	1050	725	125	430	850	1.2	LHC
Header	875	600	125	430	725	1.2	
Wall	575	375	125	430	550	1	
Utility	400	250	125	430	500	1	
Eastern Softwoods (ESW) G=0.38 unseasoned condition							
Beam	1050	725	120	430	850	1.2	LHC
Header	875	600	120	430	725	1.2	
Wall	575	375	120	430	550	0.9	
Utility	400	250	120	430	500	0.9	
Premium	975	650	125	350	675	1.1	TP
Select	875	575	125	350	600	1.1	
Rustic	750	500	125	350	525	1	
Wall Log 40	575	375	125	350	400	0.8	
Wall Log 30	425	275	125	350	300	0.8	

(continued)

TABLE 302.2(5)—continued
BASE DESIGN VALUES FOR WALL LOGS

Species and commercial grade[d]	Wall-Log Design values in pounds per square inch (lbf/in²)[b,c]						Source Agency[a]
	Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain $F_{c\parallel}$	Modulus of Elasticity E*10[6]	
Eastern Woods							
Premium	975	650	125	350	675	1.1	TP
Select	875	575	125	350	600	1.1	
Rustic	750	500	125	350	525	1	
Wall Log 40	575	375	125	350	400	0.8	
Wall Log 30	425	275	125	350	300	0.8	
Fir: Alpine							
Premium	1000	675	125	405	700	1.3	TP
Select	900	600	125	405	625	1.3	
Rustic	775	525	125	405	550	1.2	
Wall Log 40	600	400	125	405	400	1.1	
Wall Log 30	450	300	125	405	300	1.1	
Fir: Balsam							
Premium	1300	875	145	615	1000	1.3	TP
Select	1150	775	145	615	900	1.3	
Rustic	1000	675	145	615	775	1.1	
Wall Log 40	775	500	145	615	575	1	
Wall Log 30	575	375	145	615	425	1	
Fir: White (WF) G=0.37 unseasoned condition							
Beam	1250	825	150	440	1000	1.2	LHC
Header	1000	675	150	440	875	1.2	
Wall	675	450	150	440	650	1	
Utility	450	300	150	440	600	1	
Hem-Fir (HF) G=0.39 unseasoned condition							
Beam	1200	800	135	480	1000	1.4	LHC
Header	1000	675	135	480	875	1.4	
Wall	650	450	135	480	650	1.1	
Utility	450	300	135	480	600	1.1	
Premium	1150	775	135	370	800	1.2	TP
Select	1050	700	135	370	700	1.2	
Rustic	900	600	135	370	625	1.1	
Wall Log 40	675	450	135	370	475	1	
Wall Log 30	500	350	135	370	350	1	

(continued)

TABLE 302.2(5)—continued
BASE DESIGN VALUES FOR WALL LOGS

Species and commercial grade[d]	Wall-Log Design values in pounds per square inch (lbf/in^2)[b,c]						Source Agency[a]
	Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain $F_{c\|}$	Modulus of Elasticity E*10[6]	
Eastern Hemlock - Tamarack							
Premium	1250	850	155	550	875	1.1	TP
Select	1150	750	155	550	775	1.1	
Rustic	975	650	155	550	675	1	
Wall Log 40	750	500	155	550	500	0.9	
Wall Log 30	550	375	155	550	375	0.9	
Hemlock: Western							
Premium	1300	875	165	410	950	1.4	TP
Select	1150	775	165	410	825	1.4	
Rustic	1000	675	165	410	725	1.3	
Wall Log 40	750	500	165	410	550	1.1	
Wall Log 30	575	375	165	410	400	1.1	
Larch: Western							
Premium	1600	1100	175	605	1150	1.6	TP
Select	1450	950	175	605	1000	1.6	
Rustic	1250	825	175	605	875	1.4	
Wall Log 40	925	625	175	605	650	1.2	
Wall Log 30	700	475	175	605	500	1.2	
Mixed Oak							
Premium	1250	850	155	795	775	1.2	TP
Select	1100	750	155	795	675	1.2	
Rustic	950	650	155	795	600	1	
Wall Log 40	725	475	155	795	450	0.9	
Wall Log 30	550	375	155	795	325	0.9	
Mixed Southern Pine (MSP) G=0.48 unseasoned condition							
Beam Dense	1500	1000	165	680	1150	1.2	LHC
Beam	1250	850	165	600	1000	1.2	
Header Dense	1200	825	165	680	1000	1.2	
Header	1050	700	165	600	850	1.2	
Wall	675	450	165	600	650	0.9	
Utility	450	300	165	600	575	0.9	
Premium	1450	975	165	595	950	1.3	TP
Select	1300	850	165	595	850	1.3	
Rustic	1100	750	165	595	750	1.2	
Wall Log 40	850	575	165	595	550	1	
Wall Log 30	625	425	165	595	425	1	

(continued)

TABLE 302.2(5)—continued
BASE DESIGN VALUES FOR WALL LOGS

Species and commercial grade[d]	Wall-Log Design values in pounds per square inch (lbf/in^2)[b,c]						Source Agency[a]
	Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain $F_{c\|}$	Modulus of Elasticity E*10^6	
Oak, Red (RO) G=0.57 unseasoned condition							
Beam	1400	925	160	985	1000	1.3	LHC
Header	1150	775	160	985	850	1.3	
Wall	750	500	160	985	650	1.1	
Utility	500	350	160	985	575	1.1	
Premium	1250	850	155	820	775	1.2	TP
Select	1100	750	155	820	675	1.2	
Rustic	950	650	155	820	600	1.1	
Wall Log 40	725	475	155	820	450	1	
Wall Log 30	550	375	155	820	325	1	
Oak, White (WO) G=0.62 unseasoned condition							
Beam	1450	975	210	1225	1100	1	LHC
Header	1200	800	210	1225	925	1	
Wall	775	525	210	1225	700	0.8	
Utility	525	350	210	1225	625	0.8	
Premium	1450	975	205	795	875	1.2	TP
Select	1300	850	205	795	775	1.2	
Rustic	1100	750	205	795	675	1	
Wall Log 40	850	575	205	795	525	0.9	
Wall Log 30	625	425	205	795	375	0.9	
Pine: Eastern white (EWP) G=0.35 unseasoned condition							
Beam	1050	700	125	350	875	1.1	LHC
Header	875	575	125	350	725	1.1	
Wall	575	375	125	350	550	0.8	
Utility	375	250	125	350	500	0.8	
Premium	975	650	125	350	675	1.1	TP
Select	875	575	125	350	600	1.1	
Rustic	750	500	125	350	525	1	
Wall Log 40	575	375	125	350	400	0.8	
Wall Log 30	425	275	125	350	300	0.8	

(continued)

TABLE 302.2(5)—continued
BASE DESIGN VALUES FOR WALL LOGS

Species and commercial grade[d]	Wall-Log Design values in pounds per square inch (lbf/in^2)[b,c]						Source Agency[a]
	Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain $F_{c\|}$	Modulus of Elasticity E*10^6	
Pine: Idaho White							
Premium	950	650	125	310	700	1.3	TP
Select	850	575	125	310	625	1.3	
Rustic	725	500	125	310	550	1.1	
Wall Log 40	550	375	125	310	400	1	
Wall Log 30	425	275	125	310	300	1	
Pine: Loblolly (LBP) G=0.47 unseasoned condition							
Beam	1550	1050	160	595	1250	1.5	LHC
Header	1250	850	160	595	1050	1.5	
Wall	825	550	160	595	800	1.2	
Utility	550	375	160	595	725	1.2	
Pine: Lodgepole (LPP) G=0.39 unseasoned condition							
Beam	1150	775	125	400	925	1.1	LHC
Header	975	650	125	400	775	1.1	
Wall	625	425	125	400	600	0.9	
Utility	425	275	125	400	525	0.9	
Premium	1100	725	125	395	725	1.1	TP
Select	975	650	125	395	650	1.1	
Rustic	825	550	125	395	575	1	
Wall Log 40	625	425	125	395	425	0.9	
Wall Log 30	475	325	125	395	325	0.9	
Pine: Longleaf (LLP) G=0.54 unseasoned condition							
Beam	1850	1250	200	720	1600	1.7	LHC
Header	1500	1000	200	720	1350	1.7	
Wall	1000	675	200	720	1000	1.3	
Utility	675	450	200	720	925	1.3	
Pine: Northern							
Premium	1150	775	125	405	775	1.1	TP
Select	1000	675	125	405	675	1.1	
Rustic	875	600	125	405	600	1	
Wall Log 40	675	450	125	405	450	0.9	
Wall Log 30	500	325	125	405	325	0.9	

(continued)

TABLE 302.2(5)—continued
BASE DESIGN VALUES FOR WALL LOGS

Species and commercial grade[d]	Wall-Log Design values in pounds per square inch (lbf/in²)[b,c]						Source Agency[a]
	Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain $F_{c\parallel}$	Modulus of Elasticity E*10[6]	
Pine: Ponderosa (PP) G=0.39 unseasoned condition							
Beam	1100	725	130	440	875	1.1	LHC
Header	900	600	130	440	750	1.1	
Wall	600	400	130	440	550	0.8	
Utility	400	275	130	440	500	0.8	
Premium	1000	675	125	440	700	1.1	TP
Select	900	600	125	440	600	1.1	
Rustic	775	525	125	440	525	1	
Wall Log 40	600	400	125	440	400	0.8	
Wall Log 30	450	300	125	440	300	0.8	
Ponderosa Pine – Lodgepole Pine (PP-LP)							
Premium	1000	675	125	395	700	1.1	TP
Select	900	600	125	395	600	1.1	
Rustic	775	525	125	395	525	1	
Wall Log 40	600	400	125	395	400	0.8	
Wall Log 30	450	300	125	395	300	0.8	
Ponderosa Pine – Sugar Pine (PP-SP)							
Premium	1000	675	125	345	700	1.1	TP
Select	900	600	125	345	600	1.1	
Rustic	775	525	125	345	525	1	
Wall Log 40	600	400	125	345	400	0.8	
Wall Log 30	450	300	125	345	300	0.8	
Pine: Red (RP) G=0.42 unseasoned condition							
Beam	1250	825	125	410	975	1.4	LHC
Header	1000	675	125	410	825	1.4	
Wall	675	450	125	410	625	1.1	
Utility	450	300	125	410	550	1.1	
Pine: Red-Canadian (RP-N) G=0.39 unseasoned condition							
Beam	1050	725	130	440	850	1.1	LHC
Header	875	600	130	440	725	1.1	
Wall	575	375	130	440	550	0.9	
Utility	400	250	130	440	475	0.9	

(continued)

TABLE 302.2(5)—continued
BASE DESIGN VALUES FOR WALL LOGS

Species and commercial grade[d]	Wall-Log Design values in pounds per square inch (lbf/in²)[b,c]						Source Agency[a]
	Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain $F_{c\|}$	Modulus of Elasticity E*10[6]	
Pine: Sugar (SUP) G=0.34 unseasoned condition							
Beam	1100	725	130	345	925	1.1	LHC
Header	900	600	130	345	775	1.1	
Wall	600	400	130	345	600	0.9	
Utility	400	275	130	345	525	0.9	
Premium	1000	675	125	345	725	1.1	TP
Select	900	600	125	345	650	1.1	
Rustic	775	525	125	345	550	1	
Wall Log 40	600	400	125	345	425	0.9	
Wall Log 30	450	300	125	345	325	0.9	
Pine: Western white (WWP) G=0.35 unseasoned condition							
Beam	1000	700	125	315	900	1.3	LHC
Header	850	575	125	315	750	1.3	
Wall	550	375	125	315	575	1	
Utility	375	250	125	315	500	1	
Redwood							
Premium	1150	800	145	420	875	1	TP
Select	1050	700	145	420	775	1	
Rustic	900	600	145	420	675	0.9	
Wall Log 40	675	450	145	420	500	0.8	
Wall Log 30	500	350	145	420	375	0.8	
Southern Pine (SP) G=0.48 unseasoned condition							
Beam Dense	1900	1300	170	680	1550	1.6	LHC
Beam	1650	1100	170	600	1350	1.5	
Header Dense	1550	1050	170	680	1300	1.6	
Header	1350	900	170	600	1150	1.5	
Wall	875	600	170	600	850	1.2	
Utility	600	400	170	600	775	1.2	
Premium	1450	950	165	515	1000	1.5	TP
Select	1250	850	165	515	875	1.5	
Rustic	1100	750	165	515	775	1.3	
Wall Log 40	825	550	165	515	575	1.2	
Wall Log 30	625	425	165	515	425	1.2	

(continued)

TABLE 302.2(5)—continued
BASE DESIGN VALUES FOR WALL LOGS

Species and commercial grade[d]	Wall-Log Design values in pounds per square inch (lbf/in²)[b,c]						Source Agency[a]
	Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain $F_{c\|}$	Modulus of Elasticity E*10[6]	
Spruce: Eastern (ES) G=0.38 unseasoned condition							
Beam	1050	725	125	430	850	1.3	LHC
Header	875	600	125	430	725	1.3	
Wall	575	375	125	430	550	1.1	
Utility	400	250	125	430	500	1.1	
Premium	1000	675	125	390	700	1.2	TP
Select	900	600	125	390	625	1.2	
Rustic	775	525	125	390	525	1.1	
Wall Log 40	575	400	125	390	400	1	
Wall Log 30	450	300	125	390	300	1	
Spruce: Engelmann G=0.33 unseasoned condition							
Premium	950	650	125	320	600	1.1	TP
Select	850	575	125	320	525	1.1	
Rustic	725	500	125	320	450	1	
Wall Log 40	550	375	125	320	350	0.9	
Wall Log 30	425	275	125	320	250	0.9	
Engelmann Spruce – Alpine Fir (ES-AF)							
Premium	950	650	125	320	600	1.1	TP
Select	850	575	125	320	525	1.1	
Rustic	725	500	125	320	450	1	
Wall Log 40	550	375	125	320	350	0.9	
Wall Log 30	425	275	125	320	250	0.9	
Engelmann Spruce – Lodgepole Pine (ES-LP)							
Premium	950	650	125	320	600	1.1	TP
Select	850	575	125	320	525	1.1	
Rustic	725	500	125	320	450	1	
Wall Log 40	550	375	125	320	350	0.9	
Wall Log 30	425	275	125	320	250	0.9	
Engelmann Spruce – Alpine Fir – Lodgepole Pine (ES-AF-LP)							
Premium	950	650	125	320	600	1.1	TP
Select	850	575	125	320	525	1.1	
Rustic	725	500	125	320	450	1	
Wall Log 40	550	375	125	320	350	0.9	
Wall Log 30	425	275	125	320	250	0.9	
Spruce – Pine – Fir							
Premium	950	650	125	305	600	1.1	TP
Select	850	575	125	305	525	1.1	
Rustic	725	500	125	305	450	1	
Wall Log 40	550	375	125	305	350	0.9	
Wall Log 30	425	275	125	305	250	0.9	

(continued)

TABLE 302.2(5)—continued
BASE DESIGN VALUES FOR WALL LOGS

Species and commercial grade[d]	Wall-Log Design values in pounds per square inch (lbf/in^2)[b,c]						Source Agency[a]
	Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain $F_{c\|}$	Modulus of Elasticity E*10[6]	
Tamarack							
Premium	1400	950	155	595	975	1.3	TP
Select	1250	850	155	595	875	1.3	
Rustic	1100	725	155	595	750	1.2	
Wall Log 40	825	550	155	595	575	1.1	
Wall Log 30	625	425	155	595	425	1.1	
W. Spruce-Pine-Fir (WSPF) G=0.37 unseasoned condition							
Beam	1050	725	120	410	775	1.2	LHC
Header	875	600	120	410	675	1.2	
Wall	575	375	120	410	500	1	
Utility	400	250	120	410	450	1	
Western Softwoods (WS) G=0.38 unseasoned condition							
Beam	1050	700	120	410	775	1.2	LHC
Header	875	575	120	410	675	1.2	
Wall	575	375	120	410	500	0.9	
Utility	375	250	120	410	450	0.9	
Western Woods							
Premium	950	625	125	310	600	1	TP
Select	850	575	125	310	525	1	
Rustic	725	500	125	310	450	0.9	
Wall Log 40	550	375	125	310	350	0.8	
Wall Log 30	425	275	125	310	250	0.8	
White Woods							
Premium	950	625	125	310	600	1	TP
Select	850	575	125	310	525	1	
Rustic	725	500	125	310	450	0.9	
Wall Log 40	550	375	125	310	350	0.8	
Wall Log 30	425	275	125	310	250	0.8	
Yellow Poplar							
Premium	1100	725	135	420	675	1.3	TP
Select	950	650	135	420	600	1.3	
Rustic	825	550	135	420	525	1.3	
Wall Log 40	625	425	135	420	400	1	
Wall Log 30	475	325	135	420	300	1	

For SI: 1 lbf/in^2 = 6.89 kPa

a. Source Agencies:
  1. LHC: Log Home Council, National Association of Home Builders
  2. TP: Timber Products Inspection, Inc.

b. All appropriate adjustment factors shall be applied in accordance with Tables 302.2(4) and 302.2(6).

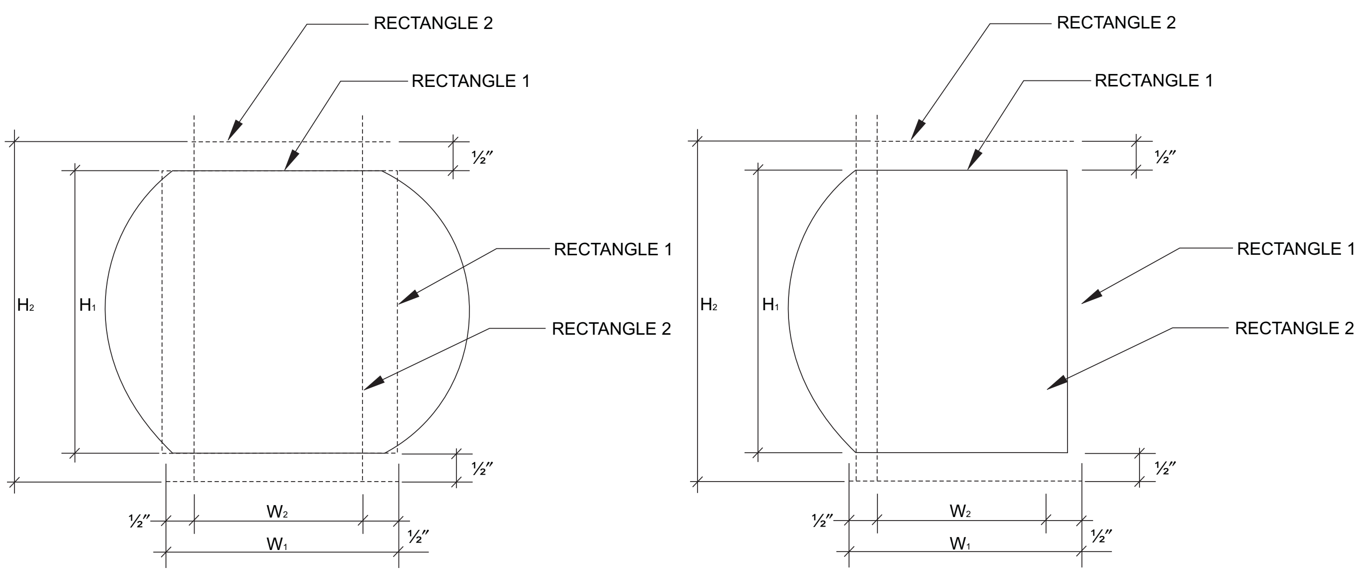
c. Compression parallel to the grain values have been increased by 10 percent to account for seasoning. For logs that are unseasoned, the design value for compression parallel to the grain shall be multiplied by 0.91.

d. Values listed represent the typical species or species combination design values. Other species combinations published by accredited grading agencies are permissible.

TABLE 302.2(6)
APPLICABILITY OF ADJUSTMENT FACTORS FOR WALL LOGS AND SRTBs

	Load Duration Factor[a]	Wet Service Factor[b]	Temperature Factor[c]	Beam Stability Factor[d]	Size Factor[e,f]	Flat Use Factor[g]	Incising Factor[h]	Repetitive Member Factor[i]	Column Stability Factor[k]	Buckling Stiffness Factor[j]
$F_b' = F_b x$	C_D	C_M	C_t	C_L	C_F	C_{fu}	C_i	C_r	—	—
$F_t' = F_t x$	C_D	C_M	C_t	—	C_F	—	C_i	—	—	—
$F_v' = F_v x$	C_D	C_M	C_t	—	—	—	C_i	—	—	—
$F_{c\perp}' = F_{c\perp} x$	—	C_M	C_t	—	—	—	C_i	—	—	—
$F_c' = F_c x$	C_D	C_M	C_t	—	C_F	—	C_i	—	C_P	—
$E' = E x$	—	C_M	C_t	—	—	—	C_i	—	—	C_T

a. *Load Duration Factor:* Values shown within Tables 302.2(3) and (5) are based upon normal load durations.
b. *Wet Service Factor:* Logs are to be installed and protected against moisture so as to achieve equilibrium moisture content in-service. Therefore, the Wet Service Factor shall not apply.
c. *Temperature Factor:* Per AF&PA NDS.
d. *Beam Stability Factor:* Per AF&PA NDS.
e. *Size Factor (SRTB and USRTB):* Bending design values, F_b, shown within Table 302.2(5) are calculated for an inscribed member width of 12 inches (305 mm). For gravity loads, the vertical dimension of the wall log is the width. For lateral loads, the horizontal dimension of the wall log is the width. The bending design value, F_b, shown with table 302.2(5) shall be multiplied by the size factor,
$C_{F} = (12/d)^{1/9} < 1.0$,
Where: d = the width of the inscribed rectangle of the wall log relative to the direction of the imposed load being analyzed.
f. *Size Factor (wall logs):* Bending design values, F_b, shown within Table 302.2(3) are calculated for a 2" × 2" (51 mm × 51 mm). Currently ASTM D 3957 does not explicitly require a size reduction for SRTB values. However, this is commonly performed within the industry and the applicability of this factor is at the designer's discretion. Should a size reduction be necessary, the bending design value, F_b, show within Table 302.2(3) shall be multiplied by the size factor,
$C_F = (2.2568/d)^{1/9}$
Where: d = log diameter
g. *Flat Use Factor:* Not applicable for any use of wall logs or sawn round timbers.
h. *Incising Factor:* Per AF&PA NDS.
i. *Repetitive Member Factor:* Not applicable for any use of wall logs or sawn round timbers.
j. *Buckling Stiffness Factor:* Not applicable for any use of wall logs or sawn round timbers.
k. *Column Stability Factor:* Per AF&PA NDS.



For SI: 1 inch = 25.4 mm.

FIGURE 302.2.3.6
LOG THICKNESS

302.2.3.3.4 Test procedure. Specific gravity shall be determined in accordance with ASTM D 2395.

302.2.3.4 Section properties. Section properties for Sawn Round and Unsawn Round Timber Beams shall be in accordance with Table 302.2(2). Section properties for wall logs shall be determined using the log height and width dimensions of the largest rectangle that can be inscribed within the profile in accordance with Sections 302.2.3.5 and 302.2.3.6.

Exception: When a square is inscribed within the profile of a round log, the section properties of the inscribed square may be increased by the factors shown in Table 302.2(4).

302.2.3.5 Log stack height. For calculation purposes, the log stack height in inches (H_L) shall equal the average vertical dimension of the log at time of manufacture as described in Figure 302.2.3.6 as follows:

1. For logs profiled with horizontal bearing surfaces, H_L is the dimension between bearing surfaces.
2. For all other log profiles, the manufacturer shall provide the dimension for H_L.

302.2.3.6 Log thickness. For calculation purposes, the log thickness (W_L) shall equal the average cross sectional area divided by the stack height.

302.2.3.7 Log density. The density of the log shall be calculated as follows:

Density (lb/ft^3) = $62.4 \times \{G/[1+(0.009 \times G \times MC_D)]\} \times (1+MC_D/100)$

where:

G = Specific gravity.

MC_D = Design moisture content.

302.2.3.8 Log weight. Log weights shall be calculated as follows:

1. The weight of the log wall in pounds per square foot (psf) shall be calculated by multiplying the density times $W_L/12$.
2. The weight of the log wall in pounds per lineal foot (plf) shall be calculated by multiplying the weight of the wall (psf) times the overall log wall height (in feet).
3. The weight of an individual log in pounds per lineal foot (plf) shall be calculated by multiplying density times $(W_L/12)(H_L/12)$.

302.2.4 Notching and boring. Notching and boring of logs used in structural applications shall be in accordance with this section and Figure 302.2.4.

Exception: When specific engineering analysis is provided by a registered design professional.

302.2.4.1 Wall logs. Wall logs that are fully supported throughout their length shall be permitted to have up to two-thirds the cross-section removed to accommodate joints, corners, and intersecting walls.

302.2.4.2 Interlocking log notches. Interlocking log notches shall resist the separation of the two log members it joins, or shall have mechanical fasteners that resist separation.

302.2.4.3 Kerfing. Where kerfing is provided in logs used in walls the depth of the kerf shall be no deeper than $H_L/2$. The sum of the depths of the kerf and cope shall not exceed $H_L/2$. Where beams are kerfed, the net section shall be used to determine the section capacity.

302.2.4.4 Notches. Notches on the edges of bending members shall not be located in the middle one-third of the span. Notches in the outer thirds of the span shall not exceed one-sixth of the actual member depth and shall not be longer than one-third of the depth of the member. Where notches are made at the supports, they shall not exceed one-fourth the actual log depth.

302.2.4.5 Round holes. Round holes in bending members shall be limited in diameter to one-third the minimum log dimension at the location of the hole. The edge of the round hole shall not be closer than 2 inches (51 mm) to the edge of the log. Edges of round holes shall not be located closer than 2 inches (51 mm) to the edge of a notch.

302.2.4.6 Rectangular holes. Depth of rectangular holes in bending members located in the outer thirds of the span shall not exceed one-fourth the member depth at the location of the hole. Depth of rectangular holes located in the middle one-third of the span shall not exceed one-third the member depth at the location of the hole. Width of rectangular holes in the outer thirds of the span shall not exceed one-third the member depth at the location of the hole. Width of rectangular holes in the middle third of the span shall not exceed one-half the member depth at the location of the hole. The edge of the rectangular hole shall not be closer than 2 inches (51 mm) to the edge of the log. Edges of rectangular holes shall not be located closer than 2 inches (51 mm) to the edge of a notch.

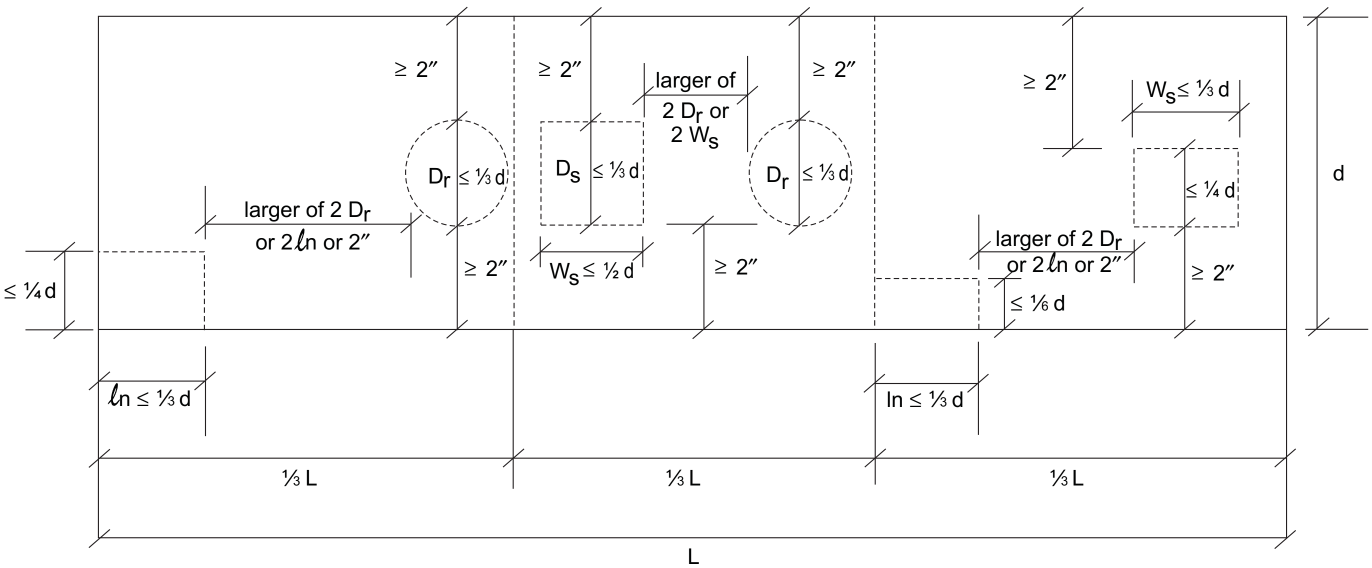
302.2.4.7 Spacing of notches and holes. Spacing between notches and holes in bending members shall be limited to the greater of at least twice the hole diameter or twice the notch width, using the larger diameter or width of the two.

Exception: Wall logs, or sections of wall logs, when they are fully supported along their length.

302.2.4.8 Shear design. For bending members with circular cross-section and notched on the tension face in accordance with the limits of this section, the allowable design shear shall be calculated in accordance with the AF&PA NDS.

302.2.4.9 Net section. The net section area shall be used in calculating the load carrying capacity of a structural member. The net section area is obtained by deducting from the gross section area the projected area of all material removed by boring, notching, or other means.

d = depth of log at location of notch or hole measured perpendicular to the direction of the hole or notch.
ℓn = length of notch
D_r = diameter of round hole
D_s = depth of rectangular hole
W_s = width of rectangular hole
L = clear span of bending member



For SI: 1 inch = 25.4 mm.

FIGURE 302.2.4
NOTCHING AND BORING

TABLE 304.2(1)
MOISTURE CONTENT OF SELECTED WOOD SPECIES AT FIBER SATURATION (MCFS)

Wood Species/Groups	Average moisture present at fiber saturation (MCFS)
Yellow Poplar	31
Engelmann Spruce Red Oak	30
Alaska Cedar Douglas Fir-Larch Western Hemlock	28
Southern Pine	26
Redwood	22
Cypress	30
Western Red Cedar	18
Sitka Spruce	28
All other species	30

TABLE 304.2(2)
SHRINKAGE COEFFICIENTS

Species	Shrinkage* (%) from green to ovendry moisture content: Radial	Tangential
Hardwoods		
Alder, red	4.4	7.3
Ash		
Black	5.0	7.8
Green	4.6	7.1
White	4.9	7.8
Aspen		
Bigtooth	3.3	7.9
Quaking	3.5	6.7
Basswood, American	6.6	9.3
Beech, American	5.5	11.9
Birch		
Paper	6.3	8.6
Sweet	6.5	9.0
Yellow	7.3	9.5
Butternut	3.4	6.4
Cherry, black	3.7	7.1
Cottonwood		
Black	3.6	8.6
Eastern	3.9	9.2
Elm		
American	4.2	9.5
Rock	4.8	8.1
Hackberry	4.8	8.9
Hickory	7.4	11.4
Magnolia, southern	5.4	6.6
Maple		
Bigleaf	3.7	7.1
Red	4.0	8.2
Silver	3.0	7.2
Sugar	4.8	9.9
Oak		
Northern red	4.0	8.6
Northern white	5.6	10.6
Southern red	4.7	11.3
Southern white (chestnut)	5.3	10.8
Pecan	4.9	8.9
Sweetgum	5.3	10.2
Sycamore, American	5.0	8.4
Tanoak	4.9	11.7
Tupelo		
Black	5.1	8.7
Water	4.2	7.6
Walnut, black	5.5	7.8
Willow, black	3.3	8.7
Yellow-poplar	4.6	8.2

Species	Shrinkage* (%) from green to ovendry moisture content: Radial	Tangential
Softwoods		
Baldcypress	3.8	6.2
Cedar		
Alaska	2.8	6.0
Atlantic white	2.9	5.4
Eastern redcedar	3.1	4.7
Incense	3.3	5.2
Northern white	2.2	4.9
Port-Orford	4.6	6.9
Western redcedar	2.4	5.0
Douglas-fir		
Coast[b]	4.8	7.6
Interior north[b]	3.8	6.9
Interior west[b]	4.8	7.5
Fir		
Balsam	2.9	6.9
California red	4.5	7.9
Grand	3.4	7.5
Nobel	4.3	8.3
Pacific silver	4.4	9.2
Subalpine	2.6	7.4
White	3.3	7.0
Hemlock		
Eastern	3.0	6.8
Western	4.2	7.8
Larch, western	4.5	9.1
Pine		
Eastern pine	2.1	6.1
Jack	3.7	6.6
Lodgepole	4.3	6.7
Ponderosa	3.9	6.2
Red		
Southern	3.8	7.2
Loblolly	4.8	7.4
Longleaf	5.1	7.5
Shortleaf	4.6	7.7
Slash	5.4	7.6
Sugar	2.9	5.6
Western white	4.1	7.4
Redwood		
Old growth	2.6	4.4
Young growth	2.2	4.9
Spruce		
Engelmann	3.8	7.1
Red	3.8	7.8
Sitka	4.3	7.5
White	4.7	8.2

*Expressed as a percentage of the green dimension.

TABLE 304.2(3)
PRESCRIBED SETTLING ALLOWANCE FOR NONHORIZONTAL BEARING SURFACES

Cope angle from horizontal (A)(degrees)	Notch-bearing width (NB), min. each side	Settling Allowance (per course)	C_{an}
Tan^{-1} (depth of cope/ 0.5BC])	NB = (BC/2)/CosA	NB ×SinA	—
0° to 10°	5/8"	1/8"	1.00
10° to 23.5°	11/16"	5/16"	1.10
23.5° to 38°	13/16"	9/16"	1.30
38° to 46.5°	15/16"	11/16"	1.50
47° to 52°	1-1/16"	7/8"	1.70
53° to 60°	1-1/4"	1-1/8 "	2.00

For SI: 1 inch = 25.4 mm, 1 degree = 0.0175 rad.

Notes:

1. BC = the greatest dimension between the points of the cope
2. For round bearing surfaces (e.g., cope), establish the angle from horizontal by connecting a line from the outer contact point to the top center point of the cope. Using the contact along the representative line, divide the actual contact area by the C_{AN} factor to determine the equivalent horizontal bearing area.
3. The settling allowance for compaction shown is based on a requirement for horizontal bearing of $1^{1}/_{4}$ inches (32 mm).

TABLE 304.2(4)
PRESCRIBED SETTLING ALLOWANCE DUE TO SHRINKAGE

Climate Zone[2]	Service Moisture Content (MCS)	Radial Shrinkage Coefficient = 2.5 for Cedar, Redwood			Radial Shrinkage Coefficient = 4 for White Woods			Radial Shrinkage Coefficient = 4.7 for Oak, Maple		
		MC_D = 19% *MC*	MC_D = 23% *MC*	MC_D = 30% *MC*	MC_D = 19% *MC*	MC_D = 23% *MC*	MC_D = 30% *MC*	MC_D = 19% *MC*	MC_D = 23% *MC*	MC_D = 30% *MC*
Dry	Ranging from 8% to 13%; averaging 10%	$^{3}/_{32}$-in. per ft. or 0.8% of involved height	$^{1}/_{8}$ -in. per ft. or 1% of involved height	$^{13}/_{64}$-in per ft. or 1.7% of involved height	$^{9}/_{64}$-in. per ft. or 1.2% of involved height	$^{13}/_{64}$-in. per ft. or 1.7% of involved height	$^{5}/_{16}$-in. per ft. or 2.6% of involved height	$^{11}/_{64}$-in.per ft. or 1.4% of involved height	$^{1}/_{4}$ -in. per ft. or 2.1% of involved height	$^{3}/_{8}$ -in. per ft. or 3.1% of involved height
Moist	Ranging from 12% to 15%; averaging 13%	$^{1}/_{16}$-in. per ft. or 0.5% of involved height	$^{3}/_{32}$-in. per ft. or 0.8% of involved height	$^{11}/_{64}$-in. per ft. or 1.4% of involved height	$^{3}/_{32}$-in. per ft. or 0.8% of involved height	$^{5}/_{32}$-in. per ft. or 1.3% of involved height	$^{17}/_{64}$-in. per ft. or 2.2% of involved height	$^{7}/_{64}$-in. per ft.nor 0.9% of involved height	$^{3}/_{16}$-in. per ft. or 1.6% of involved height	$^{5}/_{16}$-in. per ft. or 2.6% of involved height
Warm-H umid	Ranging from 13% to 15%; averaging 14%	$^{3}/_{64}$-in. per ft. or 0.4% of involved height	$^{3}/_{32}$-in. per ft. or 0.8% of involved height	$^{5}/_{32}$-in. per ft. or 1.3% of involved height	$^{5}/_{64}$-in. per ft. or 0.7% of involved height	$^{9}/_{64}$-in. per ft. or 1.2% of involved height	1/4 -in. per ft. or 2.1% of involved height	$^{3}/_{32}$-in. per ft. or 0.8% of involved height	$^{11}/_{64}$-in.per ft. or 1.4% of involved height	$^{19}/_{64}$-in. per ft. or 2.5% of involved height
Marine	Ranging from 13% to 17%; averaging 15%	$^{3}/_{64}$-in. per ft. or 0.4% of involved height	$^{5}/_{64}$-in. per ft. or 0.7% of involved height	$^{5}/_{32}$-in. per ft. or 1.3% of involved height	$^{1}/_{16}$-in. per ft. or 0.5% of involved height	$^{1}/_{8}$ -in. per ft. or 1% of involved height	$^{15}/_{64}$-in. per ft. or 2% of involved height	$^{5}/_{64}$-in. per ft. or 0.7% of involved height	$^{5}/_{32}$-in. per ft. or 1.3% of involved height	$^{9}/_{32}$-in. per ft. or 2.3% of involved height

For SI: 1 inch = 25.4 mm, 1 foot = 305 mm.

Notes to Table 304.2(4):

1. Tabulated settling due to shrinkage is based on the average MC_s for the climate zone.
2. Refer to Figure 304.2.2.3 Climate Zone Map to identify the appropriate climate zone. The climate zones are further defined below:

Marine (C) Definition - Locations meeting all four criteria:

1. Mean temperature of coldest month between –3ºC (27ºF) and 18ºC (65ºF).
2. Warmest month mean < 22ºC (72ºF).
3. At least four months with mean temperatures over 10ºC (5 0ºF).
4. Dry season in summer. The month with the heaviest precipitation in the cold season has at least three times as much precipitation as the month with the least precipitation in the rest of the year. The cold season is October through March in the Northern Hemisphere and April through September in the Southern Hemisphere.

Dry (B) Definition - Locations meeting the following criteria:

1. Not Marine and
2. $P_{in} < 0.44 \times (T_F - 19.5)$ [$P_{cm} < 2.0 \times (T_C + 7)$ in SI units] where:
   P = annual precipitation in inches (cm)
   T = annual mean temperature in ºF (ºC)

Moist (A) Definition - Locations that are not Marine and not Dry.

Warm Humid Definition - Locations shall be defined as locations where either of the following conditions occur:

1. 67ºF (19.4ºC) or higher wet-bulb temperature for 3,000 or more hours during the warmest six consecutive months of the year;
2. 73ºF (22.8ºC) or higher wet-bulb temperature for 1,500 or more hours during the warmest six consecutive months of the year.

302.2.5 Wood treatments. Use of wood treatments shall comply with the requirements of this section.

302.2.5.1 Tabulated design values. Tabulated design values apply to logs pressure treated by an approved process and preservative. Load duration factors greater than 1.6 shall not apply to structural members pressure-treated with water-borne preservatives.

302.2.5.2 Logs required to be preservative treated. Logs required by the applicable code to be preservative treated shall be treated using processes and preservatives in accordance with AWPA Standards and shall bear the quality mark or certificate of treatment issued by an accredited third party agency.

302.2.5.3 Design values and adjustment factors. Specific design values or applicable adjustment factors for logs pressure-treated with fire-retardant chemicals shall be determined in accordance with the applicable code or standard.

302.2.6 Handling and storage. Logs shall be handled and stored at the job site in accordance with the manufacturer's specifications and in a manner to protect the structural integrity of the logs.

302.3 Mechanical connections and fasteners. Mechanical connections and fasteners shall be designed and installed in accordance with AF&PA NDS specifications and shall conform to the standards specified in this section.

302.3.1 Bolts. Bolts shall comply with ANSI/ASME B 18.2.1 Square and Hex Bolts and Screws (Inch Series).

302.3.2 Lag screws. Lag screws or lag bolts shall comply with ANSI/ASME B18.2.1 Square and Hex Bolts and Screws (Inch Series).

302.3.3 Nails. Nails shall comply with ASTM F 1667, *Standard Specification for Driven Fasteners: Nails, Spikes and Staples.*

302.3.4 Screws. Screws shall comply with ANSI/ASME B18.6.1, *Wood Screws (Inch Series)*.

302.3.5 Metal connectors. Where metal plate or strapping size and gage are specified, minimum ASTM A 653, *Structural Quality*, Grade 33 steel shall be used.

302.3.6 Wood dowels. Wood dowels shall be permitted in connection design using NDS yield limit equations I, II, III, and IV. Bending yield strength, Fyb, for wood dowels shall be derived from the modulus of rupture (MOR, avg.) in Table 2 of ASTM D 2555. Listed MOR values shall be permitted to be adjusted to 12 percent moisture content using the ratios provided in Table X1.1 of ASTM D 2555. An additional yield mode V shall be determined as follows:

Allowable shear stress, F_{vp} in a wood dowel = $1{,}365 G_p^{0.926} G_t^{0.778}$

where:

G_t = Specific gravity for the timber.

G_p = Specific gravity for the dowel.

$G_p > G_t$

Allowable lateral design value (Z) for a doweled connection shall be the lesser of yield modes I, II, III, and IV from the NDS, and yield mode V determined as follows:

$Z_v = F_{vp}\,(pD2)/4$ Single Shear

$Z_v = F_{vp}\,(pD2)/2$ DoubleShear

where:

D = Diameter of a dowel; 1.5 inches (38 mm) ≥ D ≥ 0.75 inch (19 mm).

302.3.7 Other connectors. Other mechanical connections and fasteners shall demonstrate by analysis based on recognized theory, full scale or prototype loading tests, studies of model analogues, that the material, assembly, structure or design will perform satisfactorily in its intended end use.

SECTION 303
FIRE-RESISTANCE RATINGS OF LOGS AND LOG ASSEMBLIES

303.1 Fire resistance. Fire resistance of logs and log assemblies shall be in accordance with the provisions of this section.

303.2 Fire resistance ratings of log walls. Fire resistance ratings shall be in accordance with the requirements of this section.

303.2.1 Prescriptive rating. Log walls are equivalent to 1-hour fire-resistive-rated construction where the smallest horizontal dimension of each log is at least 6 inches (152 mm).

303.2.2 Calculated rating. Log wall fire resistance shall be calculated in accordance with the AF&PA *National Design Specification* (AF&PA AFPA NDS) *for Wood Construction*, Chapter 16.

303.2.3 Tested rating. Log wall fire resistance shall be tested in accordance with ASTM E 119 by an accredited laboratory.

303.3 Fire resistance of log columns and beams. Fire resistance of columns and beams shall be determined in accordance with the *International Building Code*.

303.4 Log thickness. For the purposes of Section 303, the log thickness shall be the smallest horizontal dimension from the outside face to the inside face of the log wall. Sealant systems shall not be included in determining the log thickness unless the sealant system is fire-resistive rated.

303.5 Sealing system. Sealant systems used to protect joints as part of the fire-resistive rated assembly shall be in accordance with the requirements of either ASTM E 1966 or UL 2079.

303.6 Fire blocking. Fire blocking shall be in accordance with the applicable code.

Exception: Fire blocking is not required within concealed horizontal spaces between successive courses of logs.

303.7 Fastener protection. Where minimum1-hour fire resistance is required, connectors and fasteners shall be protected from fire exposure by $1^1/_2$ inches (38 mm) of wood, or other approved covering or coating for a 1-hour rating.

303.8 Penetrations. Through penetrations of fire-resistance-rated log wall assemblies shall comply with this section. All other penetrations shall comply with the applicable code.

Exception: Where penetrating items are steel, ferrous or copper pipes or steel conduits, the annular space between the penetrating item and the fire-resistance-rated log wall assembly, the material used to fill the annular space shall prevent the passage of flame and gases sufficient to ignite cotton waste where subject to ASTM E 119 time-temperature fire conditions under a minimum positive pressure differential of 0.01 inch (2.49 Pa) of water at the location of the penetration for the time period equivalent to the fire-resistance rating of the construction penetrated.

303.8.1 Fire-resistance-rated assemblies. Penetrations shall be installed as tested in an approved fire-resistance-rated assembly.

303.8.2 Through-penetration fireblocking system. Through penetrations shall be protected by an approved penetration fireblocking system installed as tested in accordance with ASTM E 814 or UL 1479, with a minimum positive pressure differential of 0.01 inch (2.49 Pa) of water and shall have an F rating of not less than the required fire-resistance rating of the log wall assembly.

SECTION 304
PROVISIONS FOR SETTLING IN LOG STRUCTURES

304.1 Settling. Provisions for settling in log structures shall be designed and constructed in accordance with the provisions of this section.

304.2 Determining total settling. Total settling shall be determined by the provisions of either Section 304.2.1, 304.2.2, 304.2.3, 304.2.4 or 304.2.5.

304.2.1 Prescriptive requirement: Total settling shall be equal to or greater than 6 percent of the involved height.

304.2.2 Calculation procedure: Total settling shall be calculated using the following equation:

$$\Delta t = \Delta_{SL} + \Delta c + \Delta s$$

Where:

Δ_{SL} = Settling due to slumping.

Δc = Settling due to compaction.

Δs = Settling due to radial shrinkage.

304.2.2.1 Settling due to slumping. Settling due to slumping (Δ_{SL}) shall be in accordance with the requirements of this section.

304.2.2.1.1 Prescribed slumping. Prescribed slumping shall be $^{3}/_{16}$ inch (1.5 percent) per foot (4.8 mm per 304 mm) of involved log wall height.

304.2.2.1.2 Nonslumping conditions. $\Delta_{SL} = 0$ when one of the following conditions exists.

304.2.2.1.2.1 Continuous contact. Where Δc=0 in accordance with Section 304.2.2.2.2.

304.2.2.1.2.2 Coped wall systems. Settling due to slumping (Δ_{SL}) shall be permitted to be taken as 0 when either $\Delta c=0$ or when MC_D is less than or equal to MC_S

where:

MC_D = The design moisture content (see Section 302.2.2.1).

MC_S = The service moisture content (see Section 302.2.2.2).

or when a seasoning kerf is cut opposite of the cope and all four of the following conditions are met:

1. $MC_D > MC_S$

   where:

   MC_D = The design moisture content (see Section 302.2.2.1).

   MC_S = The service moisture content (see Section 302.2.2.2).

2. The kerf depth shall be greater than or equal to 0.125 ($^1/_8$) times H_L. For tapered round logs, the kerf depth shall be greater than 0.125 ($^1/_8$) times the diameter at all locations along the length of the log. In all conditions, kerf depth shall be less than $H_L/2$.

   where:

   H_L = The log stack height (see Section 302.2.3.5).

3. The wood separating the kerf from the cope shall be greater than or equal to the sum of the cope depth and the kerf depth.

4. The cope depth shall be less than or equal to 0.25 ($^1/_4$) times H_L.

   where:

   H_L = The log stack height (see Section 302.2.3.5).

304.2.2.1.2.3 Noncontact. Where logs are separated by bearing devices and joinery such that contact between logs is prevented.

304.2.2.1.3 Calculating slumping. Settling due to slumping shall be calculated using the following formula:

$$\Delta_{SL} = H_{CA} \times N \times C_{SL}$$

where:

H_{CA} = The height of the air space as measured from the apex of the cope to the top of the log beneath prior to installation.

N = The number of longitudinal seams occurring within the involved height.

C_{SL} = The slumping coefficient $= d/(p - W_C - \Delta_{ST})$.

where:

d = The log diameter.

p = The log circumference, $pd = 3.1416d$.

W_C = The width of the cope, measured across the points of the cope

Δ_{ST} = Tangential shrinkage = $[p \times (MC_D - MC_S)]/[(MC_{FSP} \times 100/S - MC_{FSP}) + MC_D]$

where:

MC_D = The design moisture content (see Section 302.2.2.3 and Section 302.2.2.1).

MC_S = The service moisture content (see Section 302.2.2.4 and Section 302.2.2.2).

MC_{FSP} = Moisture content at fiber saturation point; see Table 304.2(1). Neither MC_D nor MC_S shall exceed $MC_{FSP,}$ the moisture content value when shrinkage starts for most species.

S = The shrinkage coefficient (%) in tangential (S_T) direction, see Table 304.2(2).

C_{SL} can be assumed to be 0.5 when p =0.375d,

$MCD = MCFSP$,

MCS =12%, and S_T =8%.

304.2.2.2 Settling due to compaction. Settling due to compaction (Δc) shall be determined in accordance with the requirements of this section.

304.2.2.2.1 Prescribed. Prescribed compaction shall be $^1/_4$ inch (6.4 mm) per log course or 2 percent of involved settling height.

304.2.2.2.2 Noncompaction conditions. $\Delta c = 0$ when $B = B_r$.

where:

B_r = Required bearing width.

B = Actual bearing width of the log profile.

304.2.2.2.2.1 Bearing width. The bearing width B, is the width of the horizontal contact area, between two wall logs, that is continuous for the full length of the logs. The required bearing width B_r shall be calculated by the equation:

$B_r = [(W_F + W_R + W_W)/12] / F_{c\text{-}}$.

where:

W_F = Total loading (plf) applied to the wall by floors above the starter log (sill log or bottom plate log).

W_R = Total loading (plf) applied to the wall by roofs above the starter log (sill log or bottom plate log).

W_W = Total weight the wall (plf) above the starter log (sill log or bottom plate log).

$F_{c\text{-}}$ = The allowable design value for compression perpendicular to grain (psi).

304.2.2.2.2.2 Coped bearing surfaces. For angled or round bearing surfaces, divide the actual bearing width B, by the C_{AN} factor in Table 304.2(3) to determine the required bearing width, B_r.

304.2.2.2.3 Compaction conditions. When logs are profiled with a cope on their underside, the weight of the log and imposed loads is transferred along the two lines of contact unless the cope is contoured to match the shape of the top of the log beneath (e.g., cope radius = log radius).

304.2.2.3 Settling due to dimensional change. Settling of log walls due to shrinkage (dimensional change in cross-section, Δs) shall be determined in accordance with the provisions of this section.

304.2.2.3.1 Prescribed, Method A. Prescribed shrinkage (Δs) shall be $^3/_8$ inch (3 percent) per foot (9.5 mm per 305 mm) of involved log wall height.

304.2.2.3.2 Prescribed, Method B. Prescribed shrinkage (Δs) shall be 1 percent change in dimension per 4 percent change in moisture content (MC_S–MC_D) per foot of involved log wall height.

304.2.2.3.3 Prescribed, Method C. Select prescribed shrinkage (Δs) from Table 304.2(4) by climate zone, initial moisture content (M_I), and shrinkage coefficient. Refer to the Climate Zone Map included in Figure 304.2.2.3 (from the 2004 IECC Supplement) for a representation of geographic variation in outside equilibrium moisture content.

304.2.2.3.4 Calculated. Settling due to shrinkage shall be calculated using the equation:

Δs = $[H_D \times (MC_D - MC_S)]/[(MC_{FSP} \times 100/S - MC_{FSP}) + MC_D]$.

where:

H_D = The height of the wall section (involved height); for horizontal joint design, $H_D = H_L$ (see Section 302.2.3.5).

MC_D = The design moisture content (see Section 302.2.2.1).

MC_S = The service moisture content (see Section 302.2.2.2).

MC_{FSP} = Moisture content at fiber saturation point; see Table 304.2(1). Neither MC_D nor MC_S shall exceed MC_{FSP}, the moisture content value where shrinkage starts for most species.

S = The shrinkage coefficient (%) in radial (S_R) direction, see Table 304.2(2).

304.2.3 Engineering analysis. Total settling is permitted to be determined by engineering analysis.

304.2.4 Test method. Total settling is permitted to be determined by using empirical test data.

304.2.5 Field survey. Total settling is permitted to be determined by using data reported from actual case studies from

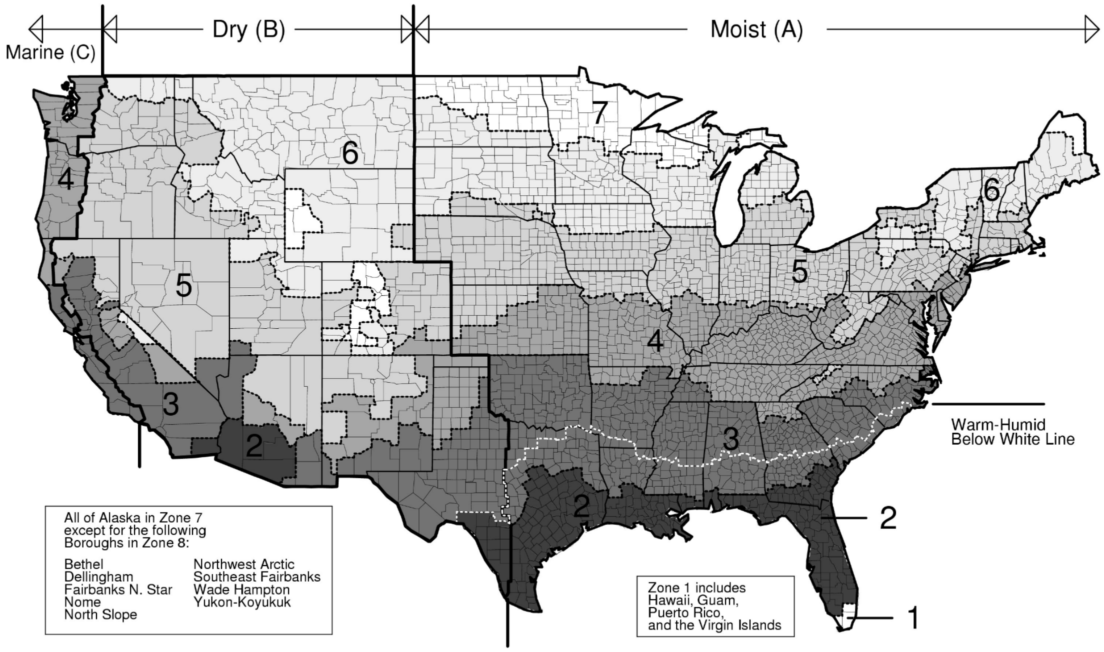


FIGURE 304.2.2.3
CLIMATE ZONE MAP

an inventory of same construction with identical measurements taken yearly for a minimum of five years.

304.3 Accommodating settling. Log structures shall accommodate calculated settling. Calculated settling accommodation shall be stated in the construction documents for each location of involved settling height.

Exception: Log wall systems where Δt is less than or equal to 0.5 percent of the involved settling height (H_D) to a maximum of $^1/_2$ inch (12.7 mm).

304.3.1 Settling gap. The settling gap must accommodate the involved settling height of materials as they settle. Trim or other measures used to conceal settling gaps in walls shall be treated as sliding joints.

304.3.2 Sliding joint. Vertical joints shall not restrict settling at log wall interface. Examples include but are not limited to the buck system installed at the sides of log wall openings, frame-wall intersections, cabinet installation, trim application, fireplaces and chimneys.

304.3.3 Settling devices. An adjustable and accessible device shall be used to accommodate the involved settling height at point loads. Examples include and are not limited to support posts and horizontal structural framing member to non-settling structures.

304.3.4 Staircases. Staircases shall be installed to accommodate adjustment for settling between floor levels and/or landings.

304.3.5 Counter-flashing. Counter-flashing shall be installed at all penetrations of the building exterior to allow appropriate movement due to settling.

304.3.6 Fasteners/connections. Installation of fasteners and connections shall conform to the requirements of this section.

304.3.6.1 Head of fasteners. Fasteners installed vertically shall be installed with the head a minimum of $^1/_{16}$ inch (1.6 mm) below the surface of the log. Where exposed to the outside, the connection shall be protected to prevent the collection of moisture.

304.3.6.2 Fasteners installed vertically. Where a fastener is installed vertically [plus or minus 5 degrees (0.0875 rad) from vertical] within the wall, it shall accommodate settling.

Exception: Wall systems fastened in such a way that the fastening system holds each log at or close to its original elevation in the wall as the logs dry to equilibrium moisture content.

304.3.6.3 Fasteners installed horizontally. Fasteners installed horizontally through a log wall that attach non-settling abutments to the log wall shall be installed with an oversized washer under the head of the fastener and located near the top of an oversized vertically slotted hole such that the involved settling at that location is accommodated. The washer shall be able to turn under the fastener head.

Exception: Wall systems fastened in such a way that the fastening system holds each log at or close to its original elevation in the wall as the logs dry to equilibrium moisture.

304.3.7 Electrical, mechanical, and plumbing systems. Installation of electrical, mechanical, and plumbing systems shall conform to the requirements of this section.

304.3.7.1 Flexible connections. Plumbing and ductwork running vertically through a floor, ceiling, or roof shall be equipped with flexible connections sufficient to accommodate the involved settling height. Wiring shall have sufficient slack or be provided with sufficient extra space to accommodate the involved settling height.

304.3.7.2 Pipes through log walls. A plumbing pipe shall only travel through a log wall perpendicular to the long horizontal axis of the logs, shall be level or nearly level, and shall be fitted with flexible connections at each end or be provided with a sufficient settling gap to accommodate the involved setting height.

SECTION 305 THERMAL ENVELOPE

305.1 Weather protection. Exterior walls shall comply with the applicable code and the provisions of this section.

305.1.1 Joint design. Joint design and applied sealants shall be capable of maintaining the weather seal between logs in exterior walls as individual logs reach equilibrium moisture content.

305.1.2 Moisture control and air leakage. The design shall resist air and moisture infiltration.

305.1.3 Extreme conditions. Where the effects of wind due to exposure (Exposure C or D) or topography (wind speed-up effect) exist, the exterior joint design shall be calculated on the lower extent of the MC_S range for the climate zone in accordance with Table 304.2.4.

305.1.4 Kerfs. Kerfs shall be protected from weather by being fully covered by the joint pattern of the log above (e.g., cope, tongue and groove), or by a notch or sealant.

305.1.5 Documentation. Assembly instructions for joints located on the exterior of a wall shall be detailed in the required construction documents.

305.1.6 Sealant. Sealant materials shall be applied in accordance with sealant manufacturer recommendations, and instructions. Sealant materials shall be compatible with all materials in contact with the sealant.

305.2 Procedural requirements. Compliance with the requirements of the *International Energy Conservation Code* or the energy provisions of the *International Residential Code* shall be determined in accordance with one of the following methods:

1. Section 304.3.1 and *International Energy Conservation Code* Chapter 5, including Table 602.1.1.1(1), Mass Wall Prescriptive Building Envelope Requirements for Exterior or Integral Insulation.
2. Energy compliance program.
3. Performance basis using a certified energy rating system.

305.3 Thermal properties of log walls. Thermal properties of log walls shall be determined in accordance with the methods provided in Section 305.3.1, 305.3.2 or 305.3.3.

305.3.1 Prescribed method. The R-value of the opaque log wall assembly shall be selected from Table 305.3.1.

305.3.2 Test method. Physical testing of thermal conductance shall be in accordance with ASTM C 177, ASTM C 236, or ASTM C 518.

305.3.3 Calculation method. Calculate the Coefficient of Transmission (u) of the log wall using the equation:

$U =$ 1/(inside air film + Ro + outside air film)

where:

Inside Air Film = An R-value of 0.68 for still air at a vertical surface and horizontal heat flow.

Outside Air Film = An R-value of 0.17 for a 15 mph (6.6 m/s) wind moving air in any direction during the winter.

$Ro =$ $[(A_L \times R_L) + (A_N \times R_N)]/A_T$ = The overall R-value of the wall assembly found by weighted average of areas of the assembly for respective variations in the cross-section of the wall. If the entire wall assembly consists only of logs, $Ro = R_L$.

where:

$A_L = L_T \times (IR_h\ C) / H_o =$ The percentage of the wall that consists of log.

$A_N = L_T \times (H_N\ C) / H_o =$ The percentage of the wall that is other than log.

where:

$L_T =$ The length of a wall using the dimension for the interior face of exposed wall.

$IR_h =$ The height of the inscribed rectangle.

$H_N =$ The height of the cross-section that is not log.

$C =$ The number of courses that constitute the vertical wall dimension.

$H_o =$ The overall height of the finished wall.

$A_T =$ The total wall area.

$R_L =$ W_L / k

where:

$W_L =$ The average thickness of the log at time of manufacture.

$k =$ Btu·in/(h·ft^2·F) = $G\ [B + C\ (MC_S)] + A$

TABLE 305.3.1
R-VALUE OF LOG WALL (R_o) BY AVERAGE WIDTH (W_L) AND SPECIFIC GRAVITY

Specific Gravity (SG)	Average Width 5 in.	6 in.	7 in.	8 in.	9 in.	10 in.	12 in.	14 in.	16 in.
0.29	8.98	10.61	12.23	13.86	15.48	17.11	20.36	23.61	26.86
0.3	8.76	10.35	11.93	13.51	15.1	16.68	19.84	23.01	26.17
0.31	8.56	10.1	11.64	13.19	14.73	16.27	19.35	22.44	25.52
0.32	8.37	9.87	11.37	12.87	14.38	15.88	18.89	21.89	24.9
0.33	8.18	9.65	11.11	12.58	14.04	15.51	18.44	21.38	24.31
0.34	8	9.44	10.87	12.3	13.73	15.16	18.02	20.88	23.75
0.35	7.84	9.23	10.63	12.03	13.43	14.82	17.62	20.41	23.21
0.36	7.68	9.04	10.41	11.77	13.14	14.5	17.24	19.97	22.7
0.38	7.38	8.68	9.99	11.3	12.6	13.91	16.52	19.13	21.74
0.39	7.24	8.52	9.79	11.07	12.35	13.63	16.18	18.74	21.29
0.41	6.98	8.2	9.43	10.65	11.88	13.1	15.55	18	20.45
0.42	6.85	8.05	9.25	10.45	11.66	12.86	15.26	17.66	20.06
0.44	6.62	7.77	8.93	10.08	11.24	12.39	14.7	17.01	19.32
0.47	6.3	7.4	8.49	9.58	10.67	11.76	13.94	16.12	18.3
0.5	6.02	7.05	8.09	9.12	10.16	11.19	13.26	15.33	17.4
0.51	5.93	6.95	7.97	8.98	10	11.02	13.05	15.08	17.11
0.52	5.85	6.85	7.85	8.85	9.85	10.84	12.84	14.84	16.84
0.53	5.77	6.75	7.73	8.71	9.7	10.68	12.65	14.61	16.58
0.54	5.69	6.65	7.62	8.59	9.55	10.52	12.45	14.39	16.32
0.55	5.61	6.56	7.51	8.46	9.41	10.37	12.27	14.17	16.08
0.59	5.32	6.22	7.11	8.01	8.9	9.8	11.58	13.37	15.16
0.6	5.26	6.14	7.02	7.9	8.78	9.66	11.43	13.19	14.95
0.7	4.69	5.46	6.23	6.99	7.76	8.53	10.07	11.6	13.14

For SI: 1 inch = 25.4 mm.

Notes to Table 305.3.1:

1. The tabulated values assume MC_S to be at 12 percent.
2. Above and left of the bold line, log criteria does not meet IECC requirements for heat capacity for thermal mass credit.
3. The tabulated R-values represent walls with log-to-log contact at all seams inclusive of air films. The u-value, required in energy conservation calculations, is the inverse of the R-value.

G = Specific gravity.

MC_S = The service moisture content.

A = 0.129, B = 1.34, and C = 0.028; the constants A, B, and C represent specific gravity greater than 0.30, design temperature at 75°F, (17°C) and moisture content less than 25 percent.

R_N = The sum of the R-values of the components that constitute the nonwood cross-section of the wall.

305.4 Thermal mass effect of log walls. Log walls having a mass greater than or equal to 20 lb/ft^2 (98 kg/m^2) of exterior wall area shall be deemed to have heat capacities equal to or exceeding 6 Btu/ft^2 [KJ(m^2+K)] The thermal mass benefit of log walls shall be determined in accordance with this section.

305.4.1 Establishing thermal mass. Thermal Mass shall be established using one of the methods described in the following sections.

305.4.1.1 Prescribed method. The thermal mass of the opaque log wall assembly shall be established from Table 305.4.1.3.

305.4.1.2 Test method. Physical testing of the thermal mass shall be in accordance with ASTM C 976.

305.4.1.3 Calculation method. Either calculate the weight of the wall in pounds per square foot (psf) using the density equation in Section 302.2.3.7 or determine the heat capacity for the thermal mass provision using the following.

$$HC = w \times c$$

where:

HC = Heat capacity of the exterior wall, Btu/ft^2×°F [kJ/(m^2×K)] of exterior wall area.

w = Mass of the exterior wall, lb/ft^2 (kg/m^2) of exterior wall area is the density of the exterior wall material, lb/ft^3 (kg/m^3) multiplied by the thickness of the exterior wall calculated in accordance with section 302.2.3.6.

c = Specific heat of the exterior wall material, Btu/lb×°F [kJ/(kg×K)] of exterior wall area as determined from Table 305.4.1.3. The moisture content references in Table 305.4.1.3 shall be selected to be less than or equal to MC_S.

305.4.2 Applying the thermal mass effect. When the wall assembly is determined to have sufficient thermal mass, the wall shall be deemed to comply with the code and is permitted to be further evaluated as a mass wall with integral insulation. The steps provided in this section are required for compliance with the *International Energy Conservation Code*.

305.4.2.1 Determine the required U_w. Using the gross wall calculation and the required U-values in accordance with the *International Energy Conservation Code*, determine the required U-value for the opaque wall area using the equation:

$$U_w = \frac{(A_o \times U_o) - [(U_g \times A_g)+(U_d \times A_d)]}{A_w}$$

where:

U_w = The thermal transmittance value for the compliant insulated frame wall.

A_o = Gross wall area.

U_o The allowable overall U for the gross wall.

A_g = Window area.

U_g = The actual value for windows.

A_d = Door area.

U_d = The actual value for doors.

A_w = The area of the opaque wall.

Where there are more than one door or window in the wall, the equation shall sum the UA for each window and door.

305.4.2.2 Determine the mass U_w. Referring to IECC Table 502.2.1.1.2(3), select the column by matching the U_w determined in Section 305.4.2.1 to those heading the columns. Select the row according to the design heating degree days. Where the column and row cross provides the U_w with thermal mass effect.

TABLE 305.4.1.3
HEAT CAPACITY OF SOLID WOOD

Temperature			Specific heat [(kJ/kg•K(Btu/lb•°F))]			
(K)	°C	°F	Ovendry	5% MC	12% MC	20% MC
280	7	45	1.2 (0.28)	1.3 (0.32)	1.5 (0.37)	1.7 (0.41)
290	17	75	1.2 (0.29)	1.4 (0.33)	1.6 (0.38)	1.8 (0.43)
300	27	80	1.3 (0.30)	1.4 (0.34)	1.7 (0.40)	1.9 (0.45)
320	47	116	1.3 (0.32)	1.5 (0.37)	1.8 (0.43)	2.0 (0.49)
340	67	152	1.4 (0.34)	1.6 (0.39)	1.9 (0.46)	2.2 (0.52)
360	87	188	1.5 (0.36)	1.7 (0.41)	2.0 (0.49)	2.3 (0.56)