STANDARD ON THE DESIGN AND CONSTRUCTION OF LOG STRUCTURES

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American National Standard

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INTERNATIONAL CODE COUNCIL®

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·ft²·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/ft² (98 kg/m²) of exterior wall area shall be deemed to have heat capacities equal to or exceeding 6 Btu/ft² [KJ(m²+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/ft²×°F [kJ/(m²×K)] of exterior wall area.

w = Mass of the exterior wall, lb/ft² (kg/m²) of exterior wall area is the density of the exterior wall material, lb/ft³ (kg/m³) 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)