



BUILDING IN ALASKA

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Thermal Coefficients of Typical Sections

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This publication gives a comparative evaluation of how stud spacing affects wall and roof insulation values, and heat loss. It is intended as an aid in deciding which wall design achieves the desired insulation level sought.

The insulation value of a floor, wall or roof section may be rated as conductance of heat or resistance to heat flow. Conductance (U) of heat is measured in British Thermal Units (BTU) per hour per square foot per degree Fahrenheit. Resistance (R) to heat flow is simply the reciprocal of conductance, such that $R=1/U$. The larger the R-value or smaller the U-value, the lower the heat loss or heating cost becomes. Various section insulation values for wall, floor and truss roof sections are given in the following pages of this publication.

Normally, framing members are not included in the heat loss calculations. For example, a 2×6 stud wall insulated with 6

inches of fiberglass has a theoretical insulation R-value of 21.08 ($U=0.0765$), if framing members are excluded, Table 7. If studs are included, the wall would have an average R-value of 18.43 ($U=0.0543$) at a stud spacing of 24 inches or an R-value of 17.80 ($U=0.0562$) at a 16-inch stud spacing. However, in counting double studs around windows, doors, etc., the average stud spacing becomes 10 inches, resulting in an average R-value of 16.77 ($U=0.596$) or less.

Many builders today are considering double 2×4 stud walls with two 3½ inch fiberglass batts for an average R-value of 19.95 ($U=0.0501$) at an average stud spacing of 10 inches, Table 6.

A 2×4 stud wall insulated with 3½ inches of fiberglass at average spacing 10 inches and 2×4 horizontal nailers at 16-inch centers insulated with 1½ inches of fiberglass would have an average R-value of 15.42 ($U=0.0649$), Tables 4a and 4c.

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Abbreviations Used in Tables

BTUHF = BTU/HR/°F, an abbreviation of the transfer rate for heat

DStud = Depth of stud, (widest dimension) in inches

FG = Fiberglass

GYP BD = Gypsum board, more commonly know as "sheet rock"

GYP = Same as above

HWall = Height of wall in inches

PLY = Plywood

Rinsulation = R-value of insulation of example wall section described in each table

RSkin = R-value of exterior and interior sheathings and film resistance values, all combined

RWood = R-Value of wood per inch

WStud = Width of stud, usually 1.50, or 1.5 inches

WWall = Width of wall in inches

Table 1. Floor, 2 X 10, 9¹/₂ FG, ³/₈ & ³/₄ PLY

Spacing Inches	Members	Frame Sq Ft	Insulation Sq Ft	BTUHF Insulation	BTUHF Frame	BTUHF Total	Average U-Value	Average R-Value
1.5	64.0	64.00	0.	0.	4.53	4.53	0.0707	14.135
2.0	48.0	48.00	16.00	0.50	3.40	3.89	0.0608	16.445
4.0	24.0	24.00	40.00	1.24	1.70	2.94	0.0459	21.785
6.0	16.0	16.00	48.00	1.49	1.13	2.62	0.0409	24.429
8.0	12.0	12.00	52.00	1.61	0.85	2.46	0.0385	26.007
10.0	9.6	9.60	54.40	1.69	0.68	2.37	0.0370	27.056
12.0	8.0	8.00	56.00	1.74	0.57	2.30	0.0360	27.804
14.0	6.9	6.86	57.14	1.77	0.49	2.26	0.0353	28.363
16.0	6.0	6.00	58.00	1.80	0.42	2.22	0.0347	28.798
18.0	5.3	5.33	58.67	1.82	0.38	2.20	0.0343	29.146
20.0	4.8	4.80	59.20	1.84	0.34	2.17	0.0340	29.430
22.0	4.4	4.36	59.64	1.85	0.31	2.16	0.0337	29.666
24.0	4.0	4.00	60.00	1.86	0.28	2.14	0.0335	29.866
0.	0.	0.	64.00	1.98	0.	1.98	0.0310	32.260
RWood	Rinsulation	HWall	WWall	DStud	WStud	Plate	Extra	RSkin
1.25	30.00	96.00	96.00	9.50	1.50	0.	0.	2.26

Table 2. Floor, 2 X 12, 12 FG, 3/8 & 3/4 PLY

Spacing Inches	Members	Frame Sq Ft	Insulation Sq Ft	BTUHF Insulation	BTUHF Frame	BTUHF Total	Average U-Value	Average R-Value
1.5	64.0	64.00	0.	0.	3.85	3.85	0.0601	16.635
2.0	48.0	48.00	16.00	0.40	2.89	3.28	0.0513	19.495
4.0	24.0	24.00	40.00	0.99	1.44	2.44	0.0381	26.270
6.0	16.0	16.00	48.00	1.19	0.96	2.15	0.0337	29.711
8.0	12.0	12.00	52.00	1.29	0.72	2.01	0.0315	31.794
10.0	9.6	9.60	54.40	1.35	0.58	1.93	0.0301	33.190
12.0	8.0	8.00	56.00	1.39	0.48	1.87	0.0292	34.190
14.0	6.9	6.86	57.14	1.42	0.41	1.83	0.0286	34.943
16.0	6.0	6.00	58.00	1.44	0.36	1.80	0.0281	35.529
18.0	5.3	5.33	58.67	1.46	0.32	1.78	0.0278	35.999
20.0	4.8	4.80	59.20	1.47	0.29	1.76	0.0275	36.385
22.0	4.4	4.36	59.64	1.48	0.26	1.74	0.0272	36.706
24.0	4.0	4.00	60.00	1.49	0.24	1.73	0.0270	36.978
0.	0.	0.	64.00	1.59	0.	1.59	0.0248	40.260
RWood	RInsulation	HWall	WWall	DStud	WStud	Plate	Extra	RSkin
1.25	38.00	96.00	96.00	11.50	1.50	0.	0.	2.26

Table 3. Wall, 2 X 4, 3 1/2 FG, 1/2 GYP BD, 5/8 PLY

Spacing Inches	Members	Frame Sq Ft	Insulation Sq Ft	BTUHF Insulation	BTUHF Frame	BTUHF Total	Average U-Value	Average R-Value
1.5	64.0	64.00	0.	0.	9.91	9.91	0.1549	6.455
2.0	48.0	48.75	15.25	1.17	7.55	8.72	0.1362	7.341
4.0	24.0	25.88	38.13	2.91	4.01	6.92	0.1082	9.244
6.0	16.0	18.25	45.75	3.50	2.83	6.32	0.0988	10.119
8.0	12.0	14.44	49.56	3.79	2.24	6.03	0.0942	10.621
10.0	9.6	12.15	51.85	3.96	1.88	5.85	0.0913	10.947
12.0	8.0	10.63	53.38	4.08	1.65	5.73	0.0895	11.176
14.0	6.9	9.54	54.46	4.16	1.48	5.64	0.0881	11.345
16.0	6.0	8.72	55.28	4.23	1.35	5.58	0.0871	11.476
18.0	5.3	8.08	55.92	4.27	1.25	5.53	0.0864	11.579
20.0	4.8	7.57	56.43	4.31	1.17	5.49	0.0857	11.663
22.0	4.4	7.16	56.84	4.35	1.11	5.45	0.0852	11.733
24.0	4.0	6.81	57.19	4.37	1.06	5.43	0.0848	11.792
0.	0.	0.	64.00	4.89	0.	4.89	0.0765	13.080
RWood	RInsulation	HWall	WWall	DStud	WStud	Plate	Extra	RSkin
1.25	11.00	96.00	96.00	3.50	1.50	3.00	0.	2.08

Table 4a. Wall, 2 X 4, 3½ FG, 5/8 PLY (Add Nailers)

Spacing Inches	Members	Frame Sq Ft	Insulation Sq Ft	BTUHF Insulation	BTUHF Frame	BTUHF Total	Average U-Value	Average R-Value
1.5	64.0	64.00	0.	0.	10.66	10.66	0.1665	6.005
2.0	48.0	48.75	15.25	1.21	8.12	9.33	0.1457	6.863
4.0	24.0	25.88	38.13	3.02	4.31	7.33	0.1145	8.734
6.0	16.0	18.25	45.75	3.62	3.04	6.66	0.1041	9.608
8.0	12.0	14.44	49.56	3.92	2.40	6.33	0.0989	10.113
10.0	9.6	12.15	51.85	4.11	2.02	6.13	0.0958	10.443
12.0	8.0	10.63	53.38	4.23	1.77	6.00	0.0937	10.675
14.0	6.9	9.54	54.46	4.31	1.59	5.90	0.0922	10.847
16.0	6.0	8.72	55.28	4.38	1.45	5.83	0.0911	10.980
18.0	5.3	8.08	55.92	4.43	1.35	5.77	0.0902	11.085
20.0	4.8	7.57	56.43	4.47	1.26	5.73	0.0895	11.171
22.0	4.4	7.16	56.84	4.50	1.19	5.69	0.0889	11.243
24.0	4.0	6.81	57.19	4.53	1.13	5.66	0.0885	11.303
0.	0.	0.	64.00	5.07	0.	5.07	0.0792	12.630
RWood	RInsulation	HWall	WWall	DStud	WStud	Plate	Extra	RSkin
1.25	11.00	96.00	96.00	3.50	1.50	3.00	0.	1.63

Table 4b. Nailers, 2 X 2, No Insulation, ½ GYP

Spacing Inches	Members	Frame Sq Ft	Insulation Sq Ft	BTUHF Insulation	BTUHF Frame	BTUHF Total	Average U-Value	Average R-Value
1.5	64.0	64.00	0.	0.	27.53	27.53	0.4301	2.325
2.0	48.0	48.75	15.25	11.21	20.97	32.18	0.5028	1.989
4.0	24.0	25.88	38.13	28.03	11.13	39.16	0.6119	1.634
6.0	16.0	18.25	45.75	33.64	7.85	41.49	0.6483	1.543
8.0	12.0	14.44	49.56	36.44	6.21	42.65	0.6664	1.500
10.0	9.6	12.15	51.85	38.13	5.23	43.35	0.6774	1.476
12.0	8.0	10.63	53.38	39.25	4.57	43.82	0.6846	1.461
14.0	6.9	9.54	54.46	40.05	4.10	44.15	0.6898	1.450
16.0	6.0	8.72	55.28	40.65	3.75	44.40	0.6937	1.442
18.0	5.3	8.08	55.92	41.12	3.48	44.59	0.6967	1.435
20.0	4.8	7.57	56.43	41.49	3.26	44.75	0.6992	1.430
22.0	4.4	7.16	56.84	41.79	3.08	44.87	0.7012	1.426
24.0	4.0	6.81	57.19	42.05	2.93	44.98	0.7028	1.423
0.	0.	0.	64.00	47.06	0.	47.06	0.7353	1.360
RWood	RInsulation	HWall	WWall	DStud	WStud	Plate	Extra	RSkin
1.25	0.91	96.00	96.00	1.50	1.50	3.00	0.	0.45

Table 4c. Nailers, 2 X 2, 1½ FG, ½ GYP

Spacing Inches	Members	Frame Sq Ft	Insulation Sq Ft	BTUHF Insulation	BTUHF Frame	BTUHF Total	Average U-Value	Average R-Value
1.5	64.0	64.00	0.	0.	27.53	27.53	0.4301	2.325
2.0	48.0	48.75	15.25	2.54	20.97	23.51	0.3673	2.722
4.0	24.0	25.88	38.13	6.35	11.13	17.48	0.2732	3.661
6.0	16.0	18.25	45.75	7.62	7.85	15.47	0.2418	4.136
8.0	12.0	14.44	49.56	8.26	6.21	14.47	0.2261	4.423
10.0	9.6	12.15	51.85	8.64	5.23	13.87	0.2167	4.615
12.0	8.0	10.63	53.38	8.90	4.57	13.47	0.2104	4.753
14.0	6.9	9.54	54.46	9.08	4.10	13.18	0.2059	4.856
16.0	6.0	8.72	55.28	9.21	3.75	12.96	0.2026	4.937
18.0	5.3	8.08	55.92	9.32	3.48	12.80	0.1999	5.002
20.0	4.8	7.57	56.43	9.40	3.26	12.66	0.1978	5.054
22.0	4.4	7.16	56.84	9.47	3.08	12.55	0.1961	5.099
24.0	4.0	6.81	57.19	9.53	2.93	12.46	0.1947	5.136
0.	0.	0.	64.00	10.67	0.	10.67	0.1667	6.000
RWood	RInsulation	HWall	WWall	DStud	WStud	Plate	Extra	RSkin
1.25	5.55	96.00	96.00	1.50	1.50	3.00	0.	0.45

Table 5. Wall, Double, 2 X 4, 7 FG, ½ GYP, 5/8 PLY

Spacing Inches	Members	Frame Sq Ft	Insulation Sq Ft	BTUHF Insulation	BTUHF Frame	BTUHF Total	Average U-Value	Average R-Value
1.5	64.0	64.00	0.	0.	5.91	5.91	0.0923	10.830
2.0	48.0	48.75	15.25	0.63	4.50	5.13	0.0802	12.464
4.0	24.0	25.88	38.13	1.58	2.39	3.97	0.0621	16.111
6.0	16.0	18.25	45.75	1.90	1.69	3.59	0.0560	17.852
8.0	12.0	14.44	49.56	2.06	1.33	3.39	0.0530	18.872
10.0	9.6	12.15	51.85	2.15	1.12	3.28	0.0512	19.541
12.0	8.0	10.63	53.38	2.22	0.98	3.20	0.0500	20.015
14.0	6.9	9.54	54.46	2.26	0.88	3.14	0.0491	20.367
16.0	6.0	8.72	55.28	2.30	0.81	3.10	0.0484	20.640
18.0	5.3	8.08	55.92	2.32	0.75	3.07	0.0479	20.857
20.0	4.8	7.57	56.43	2.34	0.70	3.04	0.0475	21.034
22.0	4.4	7.16	56.84	2.36	0.66	3.02	0.0472	21.181
24.0	4.0	6.81	57.19	2.37	0.63	3.00	0.0469	21.305
0.	0.	0.	64.00	2.66	0.	2.66	0.0415	24.080
RWood	RInsulation	HWall	WWall	DStud	WStud	Plate	Extra	RSkin
1.25	22.00	96.00	96.00	7.00	1.50	3.00	0.	2.08

Table 6. Wall, 2 X 4, 3½ FG, ⅝ PLY, ½ GYP, Interior Shell.

Spacing Inches	Members	Frame Sq Ft	Insulation Sq Ft	BTUHF Insulation	BTUHF Frame	BTUHF Total	Average U-Value	Average R-Value
1.5	64.0	64.00	0.	0.	11.63	11.63	0.1817	5.505
2.0	48.0	48.75	15.25	1.26	8.86	10.11	0.1580	6.329
4.0	24.0	25.88	38.13	3.14	4.70	7.84	0.1226	8.160
6.0	16.0	18.25	45.75	3.77	3.32	7.09	0.1107	9.031
8.0	12.0	14.44	49.56	4.09	2.62	6.71	0.1048	9.540
10.0	9.6	12.15	51.85	4.27	2.21	6.48	0.1013	9.874
12.0	8.0	10.63	53.38	4.40	1.93	6.33	0.0989	10.110
14.0	6.9	9.54	54.46	4.49	1.73	6.22	0.0972	10.286
16.0	6.0	8.72	55.28	4.56	1.58	6.14	0.0960	10.421
18.0	5.3	8.08	55.92	4.61	1.47	6.08	0.0950	10.530
20.0	4.8	7.57	56.43	4.65	1.38	6.03	0.0942	10.618
22.0	4.4	7.16	56.84	4.69	1.30	5.99	0.0935	10.691
24.0	4.0	6.81	57.19	4.71	1.24	5.95	0.0930	10.753
0.	0.	0.	64.00	5.28	0.	5.28	0.0824	12.130
RWood	RInsulation	HWall	WWall	DStud	WStud	Plate	Extra	RSkin
1.25	11.00	96.00	96.00	3.50	1.50	3.00	0.	1.13

Table 7. Wall, 2 X 6, ½ GYP, 5½ FG, ⅝ PLY

Spacing Inches	Members	Frame Sq Ft	Insulation Sq Ft	BTUHF Insulation	BTUHF Frame	BTUHF Total	Average U-Value	Average R-Value
1.5	64.0	64.00	0.	0.	7.15	7.15	0.1117	8.955
2.0	48.0	48.75	15.25	0.72	5.44	6.17	0.0964	10.377
4.0	24.0	25.88	38.13	1.81	2.89	4.70	0.0734	13.623
6.0	16.0	18.25	45.75	2.17	2.04	4.21	0.0658	15.208
8.0	12.0	14.44	49.56	2.35	1.61	3.96	0.0619	16.148
10.0	9.6	12.15	51.85	2.46	1.36	3.82	0.0596	16.769
12.0	8.0	10.63	53.38	2.53	1.19	3.72	0.0581	17.211
14.0	6.9	9.54	54.46	2.58	1.06	3.65	0.0570	17.541
16.0	6.0	8.72	55.28	2.62	0.97	3.60	0.0562	17.797
18.0	5.3	8.08	55.92	2.65	0.90	3.56	0.0556	18.002
20.0	4.8	7.57	56.43	2.68	0.85	3.52	0.0550	18.168
22.0	4.4	7.16	56.84	2.70	0.80	3.50	0.0546	18.307
24.0	4.0	6.81	57.19	2.71	0.76	3.47	0.0543	18.425
0.	0.	0.	64.00	3.04	0.	3.04	0.0474	21.080
RWood	RInsulation	HWall	WWall	DStud	WStud	Plate	Extra	RSkin
1.25	19.00	96.00	96.00	5.50	1.50	3.00	0.	2.08

Table 8. Truss Roof, 6 FG, 1/2 GYP

Spacing Inches	Members	Frame Sq Ft	Insulation Sq Ft	BTUHF Insulation	BTUHF Frame	BTUHF Total	Average U-Value	Average R-Value
1.5	64.0	64.00	0.	0.	7.49	7.49	0.1170	8.545
2.0	48.0	48.00	16.00	0.77	5.62	6.39	0.0999	10.013
4.0	24.0	24.00	40.00	1.94	2.81	4.74	0.0741	13.491
6.0	16.0	16.00	48.00	2.32	1.87	4.19	0.0655	15.258
8.0	12.0	12.00	52.00	2.52	1.40	3.92	0.0613	16.326
10.0	9.6	9.60	54.40	2.63	1.12	3.76	0.0587	17.043
12.0	8.0	8.00	56.00	2.71	0.94	3.65	0.0570	17.556
14.0	6.9	6.86	57.14	2.76	0.80	3.57	0.0557	17.942
16.0	6.0	6.00	58.00	2.81	0.70	3.51	0.0548	18.243
18.0	5.3	5.33	58.67	2.84	0.62	3.46	0.0541	18.484
20.0	4.8	4.80	59.20	2.86	0.56	3.43	0.0535	18.682
22.0	4.4	4.36	59.64	2.89	0.51	3.40	0.0531	18.847
24.0	4.0	4.00	60.00	2.90	0.47	3.37	0.0527	18.986
0.	0.	0.	64.00	3.10	0.	3.10	0.0484	20.670
RWood	RInsulation	HWall	WWall	DStud	WStud	Plate	Extra	RSkin
1.25	19.00	96.00	96.00	5.50	1.50	0.	0.	1.67

Table 9. Truss Roof, 9 1/2 FG, 1/2 GYP

Spacing Inches	Members	Frame Sq Ft	Insulation Sq Ft	BTUHF Insulation	BTUHF Frame	BTUHF Total	Average U-Value	Average R-Value
1.5	64.0	64.00	0.	0.	3.27	3.27	0.0512	19.545
2.0	48.0	48.00	16.00	0.51	2.46	2.96	0.0463	21.614
4.0	24.0	24.00	40.00	1.26	1.23	2.49	0.0389	25.693
6.0	16.0	16.00	48.00	1.52	0.82	2.33	0.0365	27.418
8.0	12.0	12.00	52.00	1.64	0.61	2.26	0.0352	28.370
10.0	9.6	9.60	54.40	1.72	0.49	2.21	0.0345	28.974
12.0	8.0	8.00	56.00	1.77	0.41	2.18	0.0340	29.391
14.0	6.9	6.86	57.14	1.80	0.35	2.16	0.0337	29.696
16.0	6.0	6.00	58.00	1.83	0.31	2.14	0.0334	29.929
18.0	5.3	5.33	58.67	1.85	0.27	2.13	0.0332	30.113
20.0	4.8	4.80	59.20	1.87	0.25	2.11	0.0330	30.262
22.0	4.4	4.36	59.64	1.88	0.22	2.11	0.0329	30.385
24.0	4.0	4.00	60.00	1.89	0.20	2.10	0.0328	30.488
0.	0.	0.	64.00	2.02	0.	2.02	0.0316	31.670
RWood	RInsulation	HWall	WWall	DStud	WStud	Plate	Extra	RSkin
1.25	19.00	96.00	96.00	5.50	1.50	0.	0.	12.67