Thermal performance of wood frame walls
Sasaki, J. R.

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TECHNICAL NOTE

PREPARED BY J. R. Sasaki CHECKED BY D.G. Stephenson APPROVED BY AGW

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PREPARED FOR CMHC and Record Purposes

SUBJECT THERMAL PERFORMANCE OF WOOD FRAME WALLS

The over-all heat transmission coefficient (U-value) and inside surface temperature performance of idealized wood-stud frame walls were determined in a laboratory study using a number of types of glass fibre insulation and stud spacings of 16 and 24 in. In addition, inside surface temperatures were measured on walls with stud spacings in error by ± 1/2 in.

A typical test wall is shown in Figure 1. It consists of a frame of 2- by 4-in. wood studs and inner and outer facings of 1/2-in. plasterboard attached to the studs with steel screws. The inside surface temperatures were measured at the points shown in Figure 1. Glass fibre insulations investigated included: a semi-rigid friction-fit insulation with no paper backing; non-rigid friction-fit insulations with no paper backing and nominal thicknesses of 2 1/2 and 3 1/2 in.; and non-rigid paper-backed insulations with nominal thicknesses of 2 1/2 and 3 1/2 in.

The tests were conducted in the DBR/NRCL Wall Panel Testing Unit with a warm air temperature of 70°F and a cold air temperature of -20°F. The surface conductance at the warm face of the wall specimen was approximately 1.35 Btu/hr ft^2 °F; that at the cold face was approximately 4.5 Btu/hr ft^2 °F.

The U-values and surface temperatures measured in the tests are summarized in Table I. The inside surface temperatures measured on the wall with stud spacing of 16 in. (± 1/2 in.) and R7 friction-fit insulation are shown in Figure 2. The temperatures measured on the wall with stud spacing of 24 in. (± 1/2 in.) and R7 friction-fit insulation are shown in Figure 3. The temperatures measured on the wall with stud spacing of 24 in. and R10 friction-fit insulation are shown in Figure 4.

The results indicate that walls with friction-fit insulation compare favourably in thermal performance with walls having paper-backed insulation of the same thickness and density. The results also indicate that walls with a stud-spacing of 24 in. compare well with walls having a 16-in. spacing. None of the walls, even those with inexact stud spacings, experienced an excessively high U-value or excessively low inside surface temperatures.

The experience gained from this study suggests the following method of installing friction-fit insulation: install the lower batt of insulation first; rest the top batt on the edge of the lower batt and fold at the top. Excess insulation left at the top of the stud space will accommodate any sagging that may subsequently occur in the insulation.

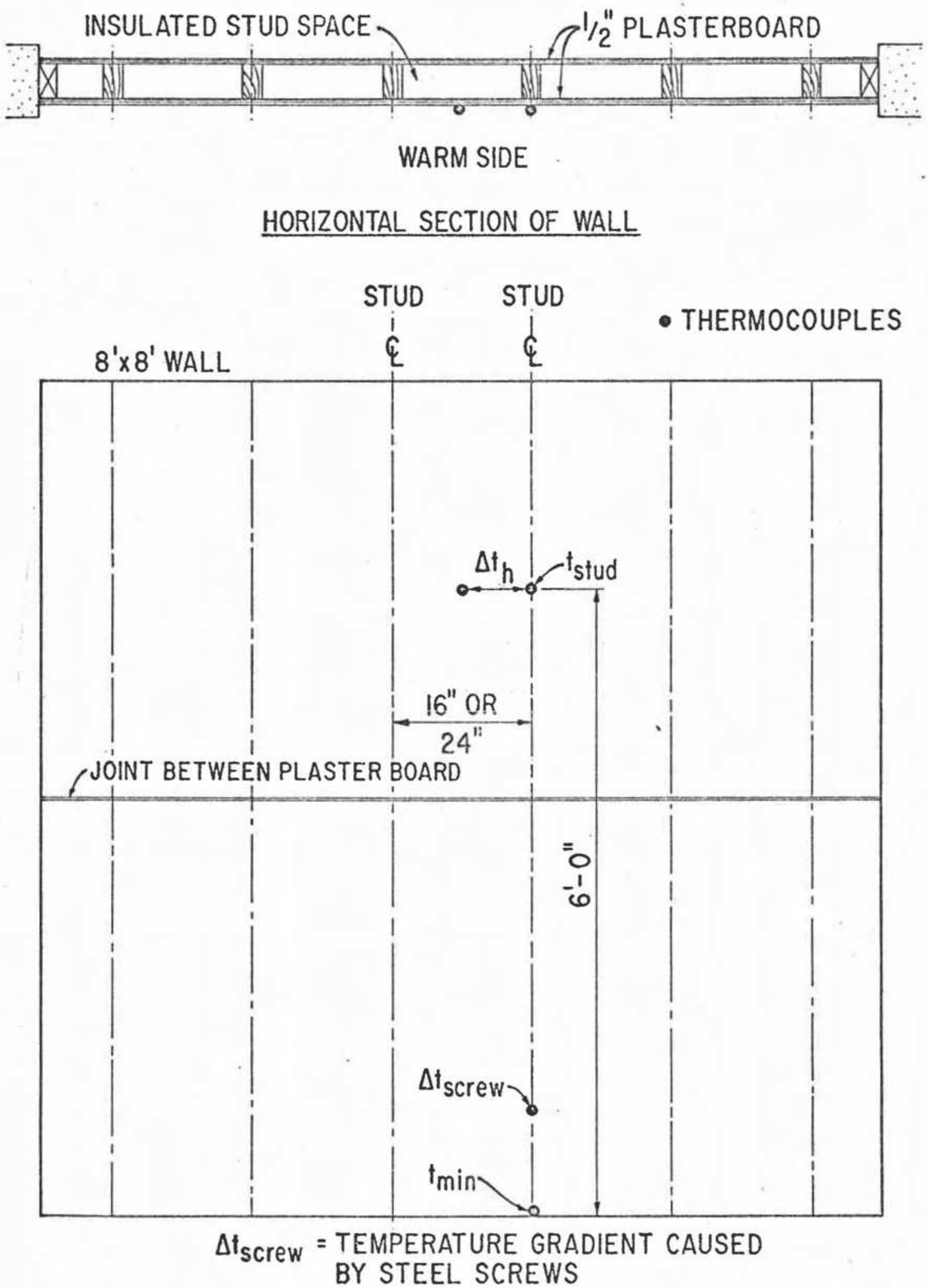
TABLE I

THERMAL PERFORMANCE OF WOOD-STUD FRAME WALLS WITH GLASS FIBRE INSULATION*

Glass Fibre Insulation - Type and Location	Stud Spacing (in.)	U	t_{stud}	Δt_h	Δt_{screw}	t_{min}
2-in. Friction fit (semi-rigid) to CS (R≈9)	16	.095	64	0.2	1.6	61
2-in. Friction fit (semi-rigid) to WS (R≈8)	16	.095	62	3.7	2.7	59
R7 Friction fit (2 1/2 in.) to CS	16	.111	64.5	1.7	1.8	60
	24	.091	63.5	1.5	-	58
R7 Paper backed (2 1/2 in.) to WS	16	.090	62.5	2.3	2.4	59
	24	.093	61.5	3.4	-	58.5
R10 Friction fit (3 1/2 in.)	16	.086	64	1.8	1.6	60.5
	24	.077	63.5	2.6	-	60
R10 Paper backed (3 1/2 in.)	16	.077	63	2.5	1.7	62
	24	.077	63	2.6	-	60.5

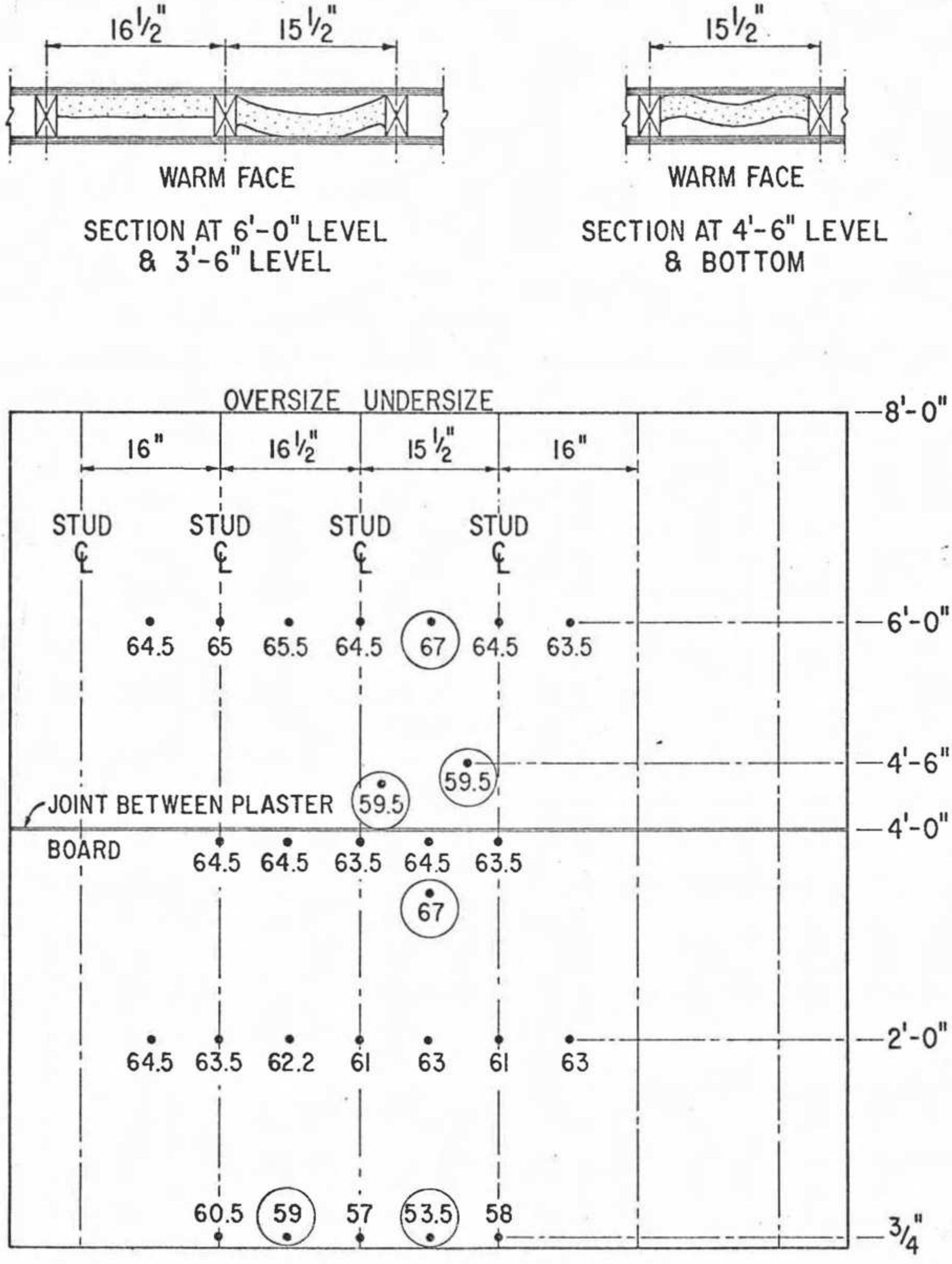
*CS = cold side sheathing board
WS = warm side wallboard
R = thermal resistance (hr ft² °F/Btu)
Δt_{screw} = (stud temperature off screw) - (stud temperature on screw)

Listed temperatures are for, warm air temperature = 70°F
cold air temperature = -20°F



WARM-SIDE WALL FACE

FIGURE 1 WOOD-STUD WALL CONFIGURATION

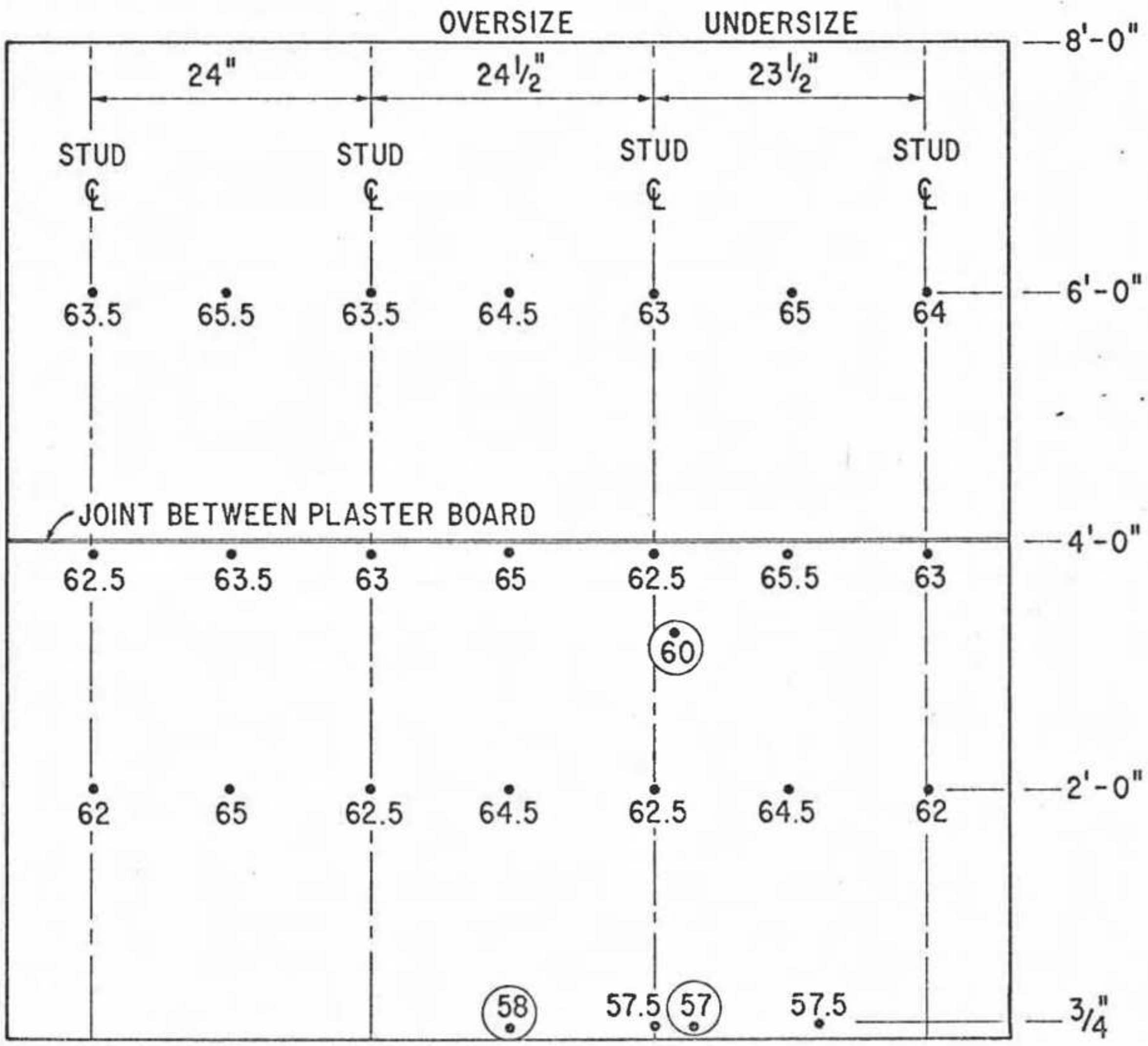


WARM-FACE SURFACE TEMPERATURES

COLD AIR TEMPERATURE = -20°F
WARM AIR TEMPERATURE = 70°F

○ HOT OR COLD SPOT

FIGURE 2 R7 FRICTION-FIT INSULATION
16-IN. (± ½ IN.) STUD SPACES

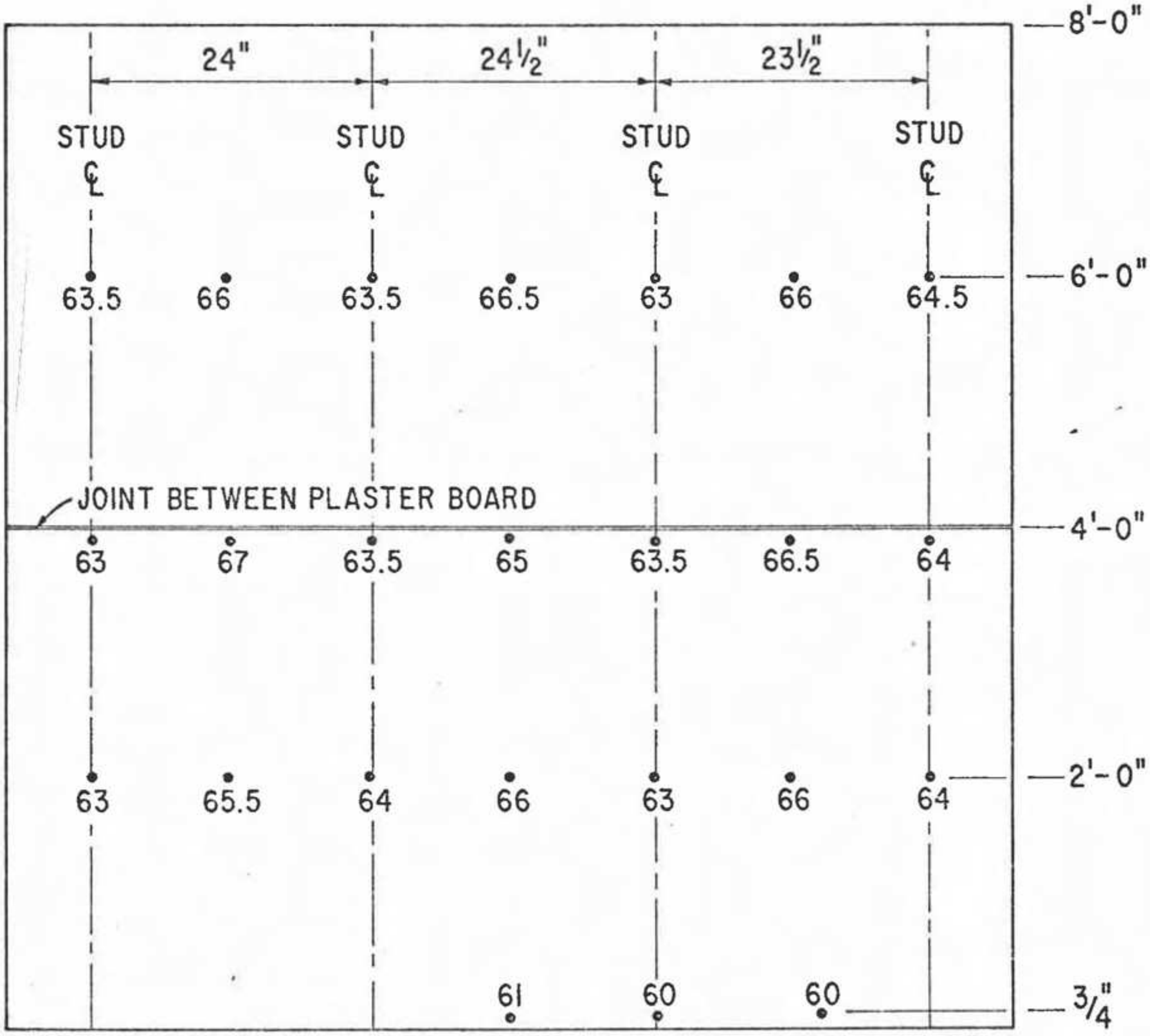


WARM-FACE SURFACE TEMPERATURES

COLD AIR TEMPERATURE = −20 °F
WARM AIR TEMPERATURE = 70 °F

◯ HOT OR COLD SPOT

FIGURE 3 R7 FRICTION-FIT INSULATION
24 - IN. (± ½ IN.) STUD SPACES



WARM-FACE SURFACE TEMPERATURES

COLD AIR TEMPERATURE = −20 °F
WARM AIR TEMPERATURE = 70 °F

FIGURE 4 R10 FRICTION-FIT INSULATION
24-IN. STUD SPACES