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Fire Resistance Tests on Cellulose and Glass Fiber Insulated Wood Stud Shear Walls

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FIRE RESISTANCE TESTS ON CELLULOSE AND GLASS FIBER INSULATED WOOD STUD SHEAR WALLS

V. K. R. Kodur, M. A. Sultan, J.C.Latour, P. Leroux and R.C.Monette

ABSTRACT

This report presents the results of 2 full-scale fire resistance tests conducted on load-bearing gypsum board protected, wood stud shear wall assemblies. The wall assembly had an asymmetrical installation (1x2) with a layer of gypsum board on both exposed and unexposed sides and a shear membrane as a base layer on the unexposed side of the wood stud frame. The gypsum board used was 12.7 mm thick Type X and the shear membranes used were of 12.7 mm and 8.5 mm thick plywood. The insulation used were of cellulose and glass fibre type.

These two tests were conducted to determine the effect of insulation and of shear membrane thickness on the fire resistance of gypsum board protected, wood stud shear wall assemblies. A discussion of these results in relation to other similar tests that were conducted previously, are presented in the paper.

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Canadian Wood Council
Canadian Home Builders Association
Canadian Sheet Steel Building Institute
Forintek Canada Corp.
Gypsum Manufacturers of Canada
Owens-Corning Canada
Roxul Inc.
Cellulose Insulation Manufacturers Association of Canada
Institute for Research in Construction

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INTRODUCTION

General

In 1994, the National Research Council of Canada's (NRC), Institute for Research in Construction (IRC), in partnership with a number of industry and government partners, completed a research study to quantify the sound transmission class and fire resistance ratings for gypsum board protected, wood stud and steel stud wall assemblies. The results of that study provided the basis for updating the fire resistance and sound insulation ratings in the 1995 edition of the National Building Code of Canada (NBCC), Table A-9.10.3.1. [1].

Table A-9.10.3.1 contains little or no information on certain wall assemblies, such as load-bearing steel stud walls and walls with shear bracing, given that these were not part of the earlier study. Several parties suggested that the earlier research project be extended to include such wall assemblies. As a result, this current project (Walls-II) was intiated with the objective of determining the fire resistance and sound transmission performance of gypsum board protected, wood and steel stud load-bearing wall assemblies and focused on three main areas:

1. The fire and sound resistance of gypsum board protected, loadbearing, steel stud wall assemblies.
2. The impact of using shear panels, or bracing, in combination with gypsum board, on the fire resistance and sound transmission performance of load bearing, wood and steel stud walls.
3. The fire resistance and sound transmission performance of new products that were not part of the earlier study.

A total of 12 fire resistance tests were carried out to study the impact of using shear panels, or bracing's, in combination with gypsum board on the fire resistance of load-bearing, wood stud walls. Detailed results from the ten fire resistance tests are reported in Reference 2. The results of the remaining two fire resistance tests on wood stud shear walls are presented in this report.

Background

As a result of a number of recent earthquakes and windstorms in North America, Japan and other parts of the world, there has been an increased focus on the design of buildings to resist lateral movement when exposed to high winds or earthquakes. In the

case of buildings using wood frame construction, shear walls are often incorporated into the building design to resist these loads.

In residential buildings, these shear walls also typically form the critical boundaries between suites or between suites and corridors. Consequently, they are also required to meet fire resistance and sound transmission performance requirements. In the first NRC partnership project, shear wall systems, which incorporated wood-based panels in combination with gypsum board, were tested for sound transmission only. Information on the fire performance of such assemblies was not generated. As a result, there are limited references to shear wall designs in the 1995 NBCC tabulated data on fire and sound ratings for wood stud walls.

The intent of the present study is to determine the impact of using wood-based structural panels, in combination with gypsum board, on the fire resistance rating and sound transmission rating of walls. Systems tested would be replicates of wall assemblies tested under the first phase of the project [3] but, would include plywood and oriented strand board (OSB) sheathing in addition to gypsum board.

To develop the fire resistance information ten fire resistance tests were carried out to study the impact of using shear panels, or bracing in combination with gypsum board, on the fire resistance of load-bearing, wood stud walls. Results from these tests, including the temperature distribution and the deflections, are reported in Reference 11.

Detailed analysis of the results from the ten fire tests have indicated that the thickness of the shear membrane and the type of insulation might influence the fire resistance of load-bearing wood-stud shear walls [4]. Two additional fire tests on wood-stud shear walls were conducted to quantify the effect of these two parameters. Detailed results from these two tests, including the average temperature distribution and the deflections for the loaded wall assemblies, are presented in this report.

DESCRIPTION OF TEST ASSEMBLIES

Two full-scale wood stud shear wall assemblies, designated as F32 and F33, were tested in a specially built furnace for conducting full-scale loaded/unloaded wall fire tests. The full-scale test furnace is shown in Figure 1. The details of the assemblies are given in Table 1.

Dimensions

The wood stud shear wall assemblies were 3048 mm high by 3658 mm wide with various depths depending on the number of layers of gypsum board/shear wall material. The specific dimensions of each assembly are given in Figures 2 to 5.

Materials

The materials used in the wall assemblies are described in the following sections.

Gypsum Board

Type X gypsum board (Westroc "Fireboard" C/Type X), conforming to the requirements of CAN/CSA-A82.27-M91 [5] was used. The thickness of this Type X gypsum board was 12.7 mm.

Framing Materials

The wood studs used were nominal 2x4's (SPF No. 2, S-Dry, 38 mm thick by 89 mm deep) and conformed to CSA 0141-1970 [6]. The wood studs were supplied by Forintek Canada Corp.

Shear Wall

The shear wall panel used was Plywood (CSP Weldwood, COFI Exterior sheathing with an average mass per unit area of 5.96 kg/m^2). The shear panel in wall assembly F32 was of 12.7 mm thick and in assembly F33 it was 8.5 mm thick. The shear wall panels were supplied by Forintek Canada Corp.

Insulation

Two types of insulation, both meeting the requirements of CAN/CSA-A101 CSA-A101 [7] were used in this test series, namely, Glass Fibre-R12 (with bulk density of 10 kg/m^3), for Assembly F33 and dry blown cellulose (47 kg/m^3) for assembly F32. Glass Fibre-R12 was supplied by Owens-Corning Canada, Willowdale, Ontario and Cellulose fibre was supplied by Cellulose Insulation Manufacturers Association of Canada.

Fabrication

The full-scale assemblies were constructed in accordance with CAN/CSA-A82.31-M91 [5]. Details on the assemblies are presented in Table 1.

Wood Stud Assemblies

The wood studs were spaced at 406 mm O.C. for all assemblies. Prior to the assembly being constructed, the wood studs were conditioned at room temperature (22°C) with a relative humidity of 50%. Studs were removed from the conditioning room only when ready to be used in construction. The average moisture content of the wood studs was 12%.

The configurations of wall assemblies F32 and F33 were similar to wall assembly F21 reported in Reference 2. In these asymmetrical (1x2) wall assemblies, the exposed side had a gypsum board layer and the unexposed side had a gypsum board layer as a face layer as well as the shear wall panels (CSP) as the base layer. The shear panel in wall assembly F32 was 12.7 mm thick while in assembly F33 it was 8.5 mm thick.

The base layer shear panels on the unexposed side were attached to the wood studs with 76.2 mm non-galvanised common nails spaced at 152 mm O.C. on the panel edges and 305 mm O.C. in the field of the panels (Figure 6). The face layer gypsum board on the unexposed side was then attached to the shear wall panels and the studs

with 41 mm long Type S drywall screws spaced at 406 mm O.C. along the edges and in the field of the gypsum board. Gypsum board placement and screw locations are shown in Figures 7 and 8, respectively. Screw heads on both the exposed and unexposed faces were covered with joint compound. Gypsum board joints were also taped and covered with joint compound.

On the fire exposed side, a layer of 12.7 mm thick Type X gypsum board was attached vertically to the wood studs with Type S drywall screws, 41 mm long, and spaced at 406 mm O.C. along the edges and in the field of the board. Gypsum board joints and screw locations are shown in Figures 7 and 8, respectively. The screw heads on both the exposed and unexposed faces were covered with joint compound. The gypsum board joints were finished with fibre tape and covered with joint compound.

Insulation

Glass fibre batts, 89 mm thick by 381 mm wide and 1194 mm long, were placed between the studs of wall assembly F33. The cellulose insulation was dry-blown into the wall cavity of specimen F32. For the purpose of cellulose insulation placement, a cavity was formed after the installation of the shear membrane and gypsum board on the unexposed side of the wall by attaching a polypropylene mesh to the wood studs on the fire-exposed side of the wood stud frame (the mesh formed a vertical plane).

Instrumentation

Type K (20 gauge) 0.91-mm thick chromel-alumel thermocouples were used for measuring temperatures at a number of locations throughout an assembly. Inside the cavities, the thermocouples were attached to 6 wire hangers installed midway between the studs and at mid-depth of the studs at distances of 1/4 and 3/4 of the height of the wall. By providing tension to the hanger wire, the thermocouples were positioned flush with the surface of the gypsum board and shear membrane base layer.

Thermocouples located on the stud/base layer faces and those located between the base and face layers were taped into position and then the gypsum board or shear panel was screwed to the stud or the face gypsum board layer. Seventy-nine (79) thermocouples were installed at various locations within the wall assembly.

A number of small holes, 12.7 mm in diameter, were drilled through the wood stud assemblies at the bottom to allow the thermocouple wiring to exit the assembly.

Thermocouple locations for wall assemblies are shown in Figure 9. Thermocouple locations on the unexposed surface of the wall assemblies are shown in Figure 10.

The deflection at the unexposed surface was measured at different locations as shown in Figure 11 using the electro-mechanical method described in Reference 9.

Loading System

The loading device used in this study is illustrated in Figure 1. Details on this device are presented in Reference 10. The components of this device are a strong steel frame, in which the wall assembly is placed, and 8 hydraulic jacks fitted at the top to simulate vertical structural loads. The applied loading on the wall assemblies used in this study is presented in Table 1. The load calculations were prepared by the Canadian Wood Council [11].

TEST CONDITIONS AND PROCEDURES

Test Procedure

The tests were carried out by exposing the assemblies to heat in a propane-fired vertical furnace as shown in Figure 1. The assemblies were sealed at the edges against the furnace using ceramic fibre blankets. The furnace temperature was measured by nine (20 gauge) shielded thermocouples in accordance with CAN/ULC-S101-M89 [12]. The average temperature of the nine thermocouples was used to control the furnace temperature.

Fire Exposure

The ambient temperature at the start of each test was approximately 22°C. During the test, the wall assembly was exposed to heating on the exposed side in such a way that the average temperature in the furnace followed, as closely as possible, the CAN/ULC-S101 [12] Standard temperature-time curve.

Failure Criteria

The failure criteria were derived from CAN/ULC-S101-M89 [12]. The assembly was considered to have failed if: a single point thermocouple temperature reading on the unexposed face rose 180°C above ambient, or the average temperature of the 9 thermocouple readings under the insulated pads on the unexposed face (Figure 14) rose 140°C above the ambient temperature, or there was passage of flame or gases hot enough to ignite cotton waste.

Also, test assembly was also deemed to have structurally failed if there was excessive (>150 mm) deflection. This criterion, though not specifically defined in the CAN/ULC-S101-M89, was used since the excessive deflection leads to failure of a load bearing wall assembly.

Recording of Results

The furnace and wall assembly temperatures, as well as the deflections, were recorded at 1 minute intervals using Labtech Notebook data acquisition software and a Fluke Helios-I data acquisition system. The gauge pressure of the loading system was also recorded at 1-minute intervals.

RESULTS AND DISCUSSION

The results of the two full-scale fire resistance tests are summarized in Table 1a in which the failure times and mode of failure are given for each assembly. Also, results from ten previous tests are tabulated in Table 1b as some of these results are used to illustrate the influence of various parameters on fire resistance [2].

Both wall assemblies failed structurally through excessive deflection. The unexposed surface temperature at the time of structural failure was below the temperature failure criteria for wall assemblies F32 and F33. Figures 16 and 17 show photographs of wall assemblies after the completion of fire resistance tests.

The temperature distribution at the various locations in the assemblies, as well as on the unexposed surfaces, is plotted in Figures 12 and 13, while the measured deflections are plotted in Figures 14 to 15. In addition, the measured temperatures and deflections at 1-minute intervals, as well as computed average temperatures at critical locations, are tabulated in Tables 2-7 for wall assemblies F32 and F33. The exact location of the thermocouples and deflection gauges can be found in Figures 9 and 11, respectively.

The influence of various parameters, such as the addition of a shear membrane, type of shear membrane, location of shear membrane, insulation type, load intensity, and presence of resilient channels, on the fire resistance of load-bearing gypsum board protected wood stud shear wall assemblies are discussed in References 2 and 4. The effect of shear membrane thickness and insulation type is discussed in the following section.

Effect of Shear Membrane Thickness

Results from fire tests F21 and F33 can be used to indicate the influence of shear membrane thickness on the fire resistance rating of load-bearing wood stud shear wall assemblies. These two assemblies were of similar configuration except for the thickness of the shear membrane. The structural failure criterion was reached at 42 and 46 minutes for Assemblies F21 and F33, which had 12.7 and 8.5-mm thick shear membranes respectively (Figure 17). The results show that the wall with a thinner shear membrane provided higher fire resistance. This could be attributed to the positive benefit obtained from the enhancement of eccentricity (of load), resulting from the shifting of centre of gravity, which occurs due to the loss of cross sectional area of the stud. Further research is needed to determine the exact mechanism and to quantify the benefit of this effect.

Effect of Insulation Type

Results from fire tests F21, F21A, F22A and F32 can be used to indicate the effect of insulation types on the fire resistance of load-bearing wood stud shear walls (see Figure 16). The failure of the glass fibre insulated wall assembly (F21 and F21A) occurred at 42 and 43 minutes respectively, while the failure of the rock fibre and cellulose insulated wall assemblies occurred at 54 and 51 minutes respectively. As shown in Figure 18, these results suggest that the use of cellulose fibre insulation provides a higher fire resistance compared to glass fibre insulation, but a lower fire resistance compared to rock fibre insulation. It should be noted that the lower fire

resistance in Roxul insulated wall assembly (F22), as compared to wall assembly (F22A), is due to a higher load intensity and full details are provided in Ref. (2).

CONCLUSIONS

The following points summarise the information presented in this report:

1. In load-bearing gypsum board protected wood stud wall assemblies, provision of a 8.5 mm shear membrane resulted in a higher fire resistance compared to a similarly-constructed wood stud wall assembly with a 12.5 mm thick shear membrane.
2. For load-bearing wood stud shear walls, the assembly with cellulose fibre insulation provided a better fire resistance compared to a similar assembly with glass fibre insulation, but a lower fire resistance compared to rock fibre insulation.

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Table 1. Wood Stud Wall Assembly Parameters and Fire Resistance Test Results

(a) Wall Assemblies F-32 and -F33

Assembly Number	Stud Type	Stud Size (mm)	Stud Rows	Shear Bracing	Stud Spacing (mm)	Gyp. Brd./Shr. Pn. Layer (Exp/Unexp.)	Gypsum Board/ Thickness (mm)	Gypsum Board Type	Insulation Type	Insulation Thickness (mm)	Resilient Channel	Load (kN)	Fire Rating (min)	Mode Of Failure
F-32	Wood	89	1	$Y^{1\ Unexp.}$	400	1x2	12.7	X	CI	89	N	76	51	S/F
F-33	Wood	89	1	$Y^{3\ Unexp.}$	400	1x2	12.7	X	GFI	89	N	76	46	S/F

(b) Wall Assemblies F-19 to F-24 [11]

Assembly Number	Stud Type	Stud Size (mm)	Stud Rows	Shear Bracing	Stud Spacing (mm)	Gyp. Brd./Shr. Pn. Layer (Exp/Unexp.)	Gypsum Board/ Thickness (mm)	Gypsum Board Type	Insulation Type	Insulation Thickness (mm)	Resilient Channel	Load (kN)	Fire Rating (min)	Mode Of Failure
F-19	Wood	89	1	$Y^{1\ Exp.}$	400	2x1	12.7	X	GFI	89	N	76	48	S/F
F-20	Wood	89	1	$Y^{2\ Exp.}$	400	2x1	12.7	X	GFI	89	N	76	47	S/F
F-21	Wood	89	1	$Y^{1\ Unexp.}$	400	1x2	12.7	X	GFI	89	N	76	42	S/F
F-21A	Wood	89	1	$Y^{1\ Unexp.}$	400	1x2	12.7	X	GFI	89	N	76	43	S/F
F-22	Wood	89	1	$Y^{1\ Unexp.}$	400	1x2	12.7	X	MFI	89	N	76*	43	S/F
F-22A	Wood	89	1	$Y^{1\ Unexp.}$	400	1x2	12.7	X	MFI	89	N	76	54	S/F
F-23	Wood	89	1	N	400	1x1	12.7	X	GFI	89	N	76*	29	S/F
F-23A	Wood	89	1	N	400	1x1	12.7	X	GFI	89	N	76	34	S/F
F-23B	Wood	89	1	N	400	1x1	12.7	X	GFI	89	N	76	36	S/F
F-24	Wood	89	1	$Y^{1\ Unexp.}$	400	1x2	12.7	X	GFI	89	$Y^{Exp.}$	76	37	S/F

Y - Yes
N - No
Y^1 - 12.7 mm Plywood (COFI)
Y^2- 12.7 mm OSB
Y^3 - 8.5 mm Plywood (COFI)
X - Type X Gypsum Board
GFI - R12, Glass Fibre Insulation
MFI - R13 Mineral Fibre Insulation
CI - Cellulose Insulation - dry blown
Exp. - Exposed Side Unexp. - Unexposed Side
S/F - Structural Failure
* Actual loads were 15-20% higher

Table 2. Measured Temperatures in Wood Stud Wall Assembly F-32

Time	T(Furn. Temp.)	**Temperatures at Thermocouple Number** (see Figures 9 and 10 for thermocouple locations)																	
(min)	(°C)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
0	27	23	25	24	24	25	25	24	24	25	25	25	24	26	25	25	25	24	25
1	40	24	25	24	24	25	25	24	24	25	25	25	25	26	25	25	25	24	25
2	132	24	25	24	24	25	25	24	24	25	25	25	24	26	25	25	25	24	25
3	473	23	25	24	24	25	25	24	24	25	25	25	24	26	25	25	25	24	25
4	508	23	25	24	24	25	25	24	24	25	25	25	24	26	25	25	29	30	26
5	477	23	25	24	24	25	25	24	24	25	25	25	25	26	25	25	40	45	34
6	596	23	25	24	24	25	25	24	24	25	25	25	24	26	25	25	47	56	42
7	575	24	25	24	24	25	25	24	24	25	25	25	25	26	25	25	59	73	54
8	639	23	25	24	24	25	25	24	24	25	25	25	25	26	25	25	67	80	63
9	657	23	25	24	24	25	25	24	24	25	25	25	25	26	25	25	79	88	75
10	695	23	25	24	24	25	25	25	24	25	25	25	25	26	25	25	85	90	82
11	715	23	25	24	24	25	25	25	24	25	25	26	25	26	25	25	91	92	88
12	724	23	25	24	24	25	25	25	24	25	25	26	25	26	25	25	93	93	90
13	746	23	25	25	24	25	25	25	24	25	25	26	25	26	25	25	95	93	91
14	733	23	25	25	25	25	25	26	24	25	26	27	25	26	25	26	95	93	91
15	764	23	25	25	25	26	26	26	25	25	26	27	25	26	25	26	94	91	90
16	772	23	26	26	25	26	26	27	25	25	27	28	25	26	25	26	93	89	89
17	762	23	26	27	25	26	26	28	25	25	29	28	25	27	26	27	90	87	88
18	774	23	27	27	26	27	27	29	26	26	30	29	26	27	26	27	87	85	86
19	797	24	27	28	26	28	28	30	26	26	32	30	26	27	27	28	85	85	84
20	799	24	28	29	27	28	28	30	27	26	35	30	26	28	27	28	85	85	83
21	798	23	29	30	28	29	29	31	27	27	36	30	27	29	27	29	85	86	83
22	803	24	29	31	29	31	30	32	28	27	38	31	27	29	28	29	86	87	83
23	814	23	30	32	29	32	31	33	29	28	39	31	27	30	28	30	87	87	84
24	821	23	31	33	30	34	32	34	30	28	39	31	28	31	29	31	88	88	84
25	815	23	31	33	31	36	33	35	30	29	39	32	28	31	29	31	89	89	84
26	810	23	32	34	31	37	34	36	31	29	39	32	28	32	30	32	90	89	84
27	827	23	33	35	32	39	35	36	32	30	39	32	28	32	30	32	91	89	85
28	842	23	34	36	33	40	36	37	33	30	39	32	29	33	31	33	91	89	85
29	837	23	34	37	34	41	37	38	33	31	39	32	29	33	31	33	93	89	86
30	831	23	35	37	34	42	38	39	34	32	39	33	30	34	32	34	98	90	86
31	839	23	36	38	35	43	38	39	35	32	39	33	30	34	32	34	112	92	87
32	857	23	37	39	36	44	39	40	36	33	38	33	30	35	32	35	148	98	87
33	859	23	38	40	37	44	40	41	37	34	39	33	30	35	33	35	228	117	87
34	851	23	38	40	37	45	41	42	38	34	38	33	30	36	33	36	342	157	88
35	850	23	39	41	38	46	42	42	38	35	38	33	31	36	34	36	440	224	89
36	866	23	40	42	39	46	43	43	39	36	38	34	31	37	34	37	512	297	90
37	877	23	41	43	39	47	44	44	40	36	38	34	31	37	34	37	568	362	104
38	869	23	41	43	40	47	44	44	41	37	38	34	32	37	35	37	615	411	155
39	862	23	42	44	41	48	45	45	42	38	38	34	32	38	35	38	647	451	237
40	872	23	43	45	41	48	46	46	42	38	38	34	32	38	35	39	670	483	374
41	888	23	44	46	42	49	47	47	43	39	38	35	32	38	35	39	690	513	513

Table 2. Measured Temperatures in Wood Stud Wall Assembly F-32 (Cont'd)

Time	T(Furn. Temp.)	**Temperatures at Thermocouple Number** (see Figures 9 and 10 for thermocouple locations)																
(min)	(°C)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
42	887	23	44	46	43	49	47	47	44	40	38	35	32	39	35	39	707	524	577
43	879	23	45	47	43	50	48	48	45	41	38	35	32	39	36	40	719	539	625
44	879	23	46	48	44	50	49	50	45	41	39	35	33	39	36	40	727	555	667
45	893	23	46	48	44	51	49	51	46	42	39	36	34	40	36	41	736	570	713
46	903	23	47	49	45	51	50	53	47	43	38	36	34	40	36	41	745	587	756
47	896	23	48	50	46	51	50	54	47	44	38	36	34	40	37	41	753	586	801
48	889	23	49	50	46	52	51	56	48	45	38	36	34	41	37	42	763	607	840
49	894	23	49	51	47	52	52	57	48	45	39	37	34	41	37	42	775	626	864
50	910	23	50	52	48	53	52	59	49	46	39	37	34	41	38	43	789	650	888
51	913	23	51	52	48	53	53	60	50	47	39	37	35	41	38	43	804	686	878
52	876	25	51	53	49	53	53	60	50	47	39	38	36	41	38	43	784	731	700

Table 2. Measured Temperatures in Wood Stud Wall Assembly F-32 (Cont'd)

Time	T(Furn. Temp.)	**Temperatures at Thermocouple Number** (see Figures 9 and 10 for thermocouple locations)																	
(min)	(°C)	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
0	27	24	24	23	24	23	25	24	25	24	25	24	25	24	25	24	25	24	25
1	40	24	24	23	24	23	26	24	26	25	26	25	25	24	25	24	25	24	25
2	132	24	24	23	24	23	43	28	39	35	37	32	25	24	25	24	25	24	25
3	473	24	24	24	24	23	97	90	90	83	82	72	25	24	25	24	25	24	25
4	508	31	25	40	27	27	93	93	87	82	81	78	25	24	25	24	25	24	25
5	477	46	30	50	35	34	89	90	81	77	76	74	25	24	25	24	25	24	25
6	596	58	35	59	41	40	98	98	90	88	89	86	25	24	25	24	25	24	25
7	575	75	43	73	49	50	96	96	89	86	88	86	25	24	25	24	25	26	25
8	639	82	51	78	56	57	97	97	95	89	91	90	26	24	25	25	25	29	26
9	657	89	65	86	66	67	98	97	98	91	93	93	27	25	25	25	25	36	27
10	695	91	75	87	74	74	98	96	102	94	94	95	29	25	26	25	26	46	30
11	715	93	84	90	84	79	102	97	106	97	96	97	35	26	27	26	28	57	34
12	724	93	87	89	89	82	106	97	109	100	96	99	46	28	28	26	33	64	39
13	746	94	88	90	91	84	110	100	112	103	97	101	59	30	30	26	45	70	44
14	733	94	88	90	92	86	115	104	115	106	99	103	66	32	32	27	61	74	49
15	764	92	88	87	91	86	124	110	119	109	101	105	67	35	33	27	67	76	54
16	772	90	86	83	91	85	134	115	127	114	103	108	61	41	33	28	68	77	58
17	762	89	85	87	88	86	145	123	138	120	108	114	67	43	34	29	72	78	61
18	774	87	84	87	88	85	168	137	168	128	115	121	66	45	34	29	73	79	63
19	797	85	84	89	90	86	191	155	202	141	131	141	60	47	35	30	74	80	65
20	799	84	85	91	92	89	215	181	237	159	156	159	58	48	36	31	76	82	67
21	798	85	86	91	93	90	248	209	279	183	182	176	57	49	38	32	78	83	69
22	803	86	86	91	92	91	287	228	339	214	208	195	56	50	39	33	79	84	72
23	814	86	86	91	92	91	329	254	399	255	231	219	55	51	40	34	79	84	74
24	821	86	86	91	92	91	370	287	449	319	260	243	54	52	41	35	79	84	76
25	815	86	86	91	92	91	401	325	499	390	295	276	54	53	42	36	79	83	78
26	810	87	87	91	92	92	430	384	535	441	334	325	54	55	43	38	79	83	80
27	827	88	88	92	92	92	453	429	560	492	363	377	54	56	44	39	79	82	81
28	842	88	89	93	92	92	476	474	576	542	389	417	55	56	45	40	79	82	82
29	837	88	91	96	93	92	503	527	594	580	419	463	56	57	46	41	79	81	83
30	831	89	95	105	93	92	530	577	607	609	452	507	57	58	47	43	79	80	84
31	839	90	101	123	93	93	556	626	616	629	484	551	58	59	48	44	79	79	85
32	857	91	109	156	93	93	584	673	624	647	514	583	60	59	49	45	79	79	86
33	859	92	124	210	93	93	611	701	634	664	539	612	62	60	50	47	79	78	86
34	851	93	148	282	94	93	638	721	642	679	560	640	65	62	51	48	79	78	87
35	850	95	183	357	94	94	668	743	648	691	578	665	66	63	52	49	79	78	87
36	866	100	231	428	95	95	699	768	656	701	593	685	67	64	54	51	79	77	88
37	877	111	297	494	95	95	718	773	663	713	601	705	68	65	55	53	79	77	88
38	869	125	380	554	96	97	734	774	673	723	617	722	69	66	56	54	80	77	89
39	862	145	464	601	97	100	747	785	680	730	629	733	69	67	58	56	80	77	89
40	872	169	536	635	98	104	783	806	685	735	639	738	70	68	61	58	80	78	90
41	888	196	598	664	102	110	790	816	692	741	651	742	73	68	67	60	81	78	90

Table 2. Measured Temperatures in Wood Stud Wall Assembly F-32 (Cont'd)

Time	T(Furn. Temp.)	**Temperatures at Thermocouple Number** (see Figures 9 and 10 for thermocouple locations)																	
(min)	(°C)	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
42	887	227	653	691	109	116	782	809	701	748	663	751	81	69	76	62	82	80	90
43	879	263	691	712	117	125	774	805	708	751	676	756	102	70	90	63	83	82	91
44	879	260	714	727	128	143	772	816	713	753	687	757	143	71	105	65	95	86	91
45	893	228	731	738	142	525	759	820	718	756	696	758	232	73	122	66	100	91	91
46	903	202	744	750	157	670	758	817	729	761	706	760	384	74	143	68	100	99	91
47	896	180	756	761	176	690	780	817	740	764	717	767	596	75	176	70	100	100	92
48	889	196	763	768	200	700	827	803	748	772	726	768	785	76	228	71	100	100	92
49	894	308	768	771	229	702	880	789	754	780	733	766	872	78	322	74	100	102	92
50	910	430	773	775	256	708	909	789	761	790	742	766	909	84	493	77	100	106	92
51	913	593	781	784	287	724	926	808	786	803	757	775	921	131	664	83	100	114	92
52	876	630	814	766	338	756	760	759	685	735	737	760	729	157	705	140	100	185	90

Table 2. Measured Temperatures in Wood Stud Wall Assembly F-32 (Cont'd)

Time	T(Furn. Temp.)	**Temperatures at Thermocouple Number** (see Figures 9 and 10 for thermocouple locations)																	
(min)	(°C)	37	38	39	40	41	42	43	44	45	46	47	60	61	62	63	64	65	66
0	27	24	25	24	25	24	25	25	25	24	25	24	25	25	25	25	25	25	25
1	40	24	25	24	25	24	27	26	27	26	26	25	25	25	25	25	25	25	25
2	132	24	25	24	25	24	44	45	43	39	41	36	25	25	25	25	25	25	25
3	473	24	25	24	25	24	88	87	87	87	75	84	25	25	25	25	25	25	25
4	508	24	25	25	25	24	85	85	83	81	78	81	25	25	25	25	25	25	25
5	477	24	25	25	25	24	84	84	84	83	79	81	25	25	25	25	25	25	25
6	596	25	25	25	25	25	96	98	96	95	92	92	25	25	25	25	25	25	25
7	575	26	25	26	26	26	101	106	101	100	93	97	25	25	25	25	25	25	25
8	639	29	26	29	27	29	108	115	108	107	92	102	25	25	25	25	25	25	25
9	657	35	27	34	29	35	115	121	114	112	94	108	25	25	26	25	25	25	25
10	695	43	29	40	33	43	119	125	118	116	96	111	25	25	27	25	25	25	25
11	715	50	32	46	39	50	123	129	122	120	98	114	25	25	32	25	25	25	25
12	724	58	37	51	46	57	126	132	124	123	98	117	25	26	48	25	26	25	26
13	746	64	43	55	53	64	130	137	128	128	98	120	26	27	65	25	26	25	26
14	733	69	48	59	58	70	138	150	137	141	98	126	26	28	70	26	27	25	27
15	764	72	53	62	62	76	149	168	151	165	106	134	27	30	70	26	29	25	27
16	772	73	57	63	65	76	184	237	183	211	133	204	28	31	69	27	30	25	28
17	762	74	60	63	66	75	257	323	220	287	165	299	28	33	73	28	31	25	29
18	774	74	62	65	67	75	333	393	268	362	211	351	29	34	75	29	32	26	31
19	797	75	65	68	68	75	389	444	322	447	250	396	30	36	76	30	34	26	32
20	799	76	68	71	70	76	442	488	409	487	277	438	31	37	78	31	34	26	33
21	798	77	70	74	71	77	479	521	465	528	287	478	32	38	79	32	35	26	35
22	803	79	72	77	73	78	509	551	501	555	331	513	33	40	79	33	36	27	36
23	814	80	73	79	74	79	532	570	535	580	350	539	34	41	78	33	36	27	37
24	821	82	75	81	76	81	549	589	560	601	380	567	35	42	77	34	37	28	39
25	815	83	76	82	77	82	568	611	588	622	426	593	37	43	76	35	37	28	40
26	810	84	78	84	79	83	587	631	611	639	455	615	38	44	75	35	38	29	41
27	827	85	79	85	80	84	598	645	629	653	458	635	39	45	74	36	38	29	43
28	842	86	83	86	82	85	614	661	650	668	457	655	40	46	72	37	38	30	44
29	837	86	91	87	83	86	630	678	670	684	475	672	36	47	71	37	39	30	45
30	831	87	113	88	84	86	641	692	686	697	453	686	41	48	69	38	39	31	46
31	839	88	169	89	85	87	652	704	698	707	471	699	40	49	68	39	40	32	47
32	857	89	270	90	86	88	663	716	711	717	473	713	44	50	67	39	41	32	48
33	859	89	399	90	86	88	674	730	726	727	399	726	46	51	66	40	41	33	49
34	851	90	523	90	87	89	683	740	739	733	418	737	48	52	65	40	42	34	50
35	850	90	608	91	88	89	690	745	747	734	470	743	49	53	64	41	43	35	51
36	866	91	658	91	88	90	697	750	753	733	469	749	48	53	63	42	43	35	52
37	877	91	693	92	89	90	706	756	763	736	473	755	51	54	63	42	44	36	53
38	869	91	719	92	89	90	715	760	769	738	484	758	53	55	62	43	45	37	54
39	862	92	736	92	90	91	720	761	774	738	473	759	54	56	62	44	45	38	55
40	872	92	744	92	90	91	725	758	778	736	483	759	55	56	62	44	46	39	55
41	888	93	752	93	91	91	732	757	786	737	516	760	56	57	62	45	47	40	56

Table 2. Measured Temperatures in Wood Stud Wall Assembly F-32 (Cont'd)

Time	T(Furn. Temp.)	**Temperatures at Thermocouple Number** (see Figures 9 and 10 for thermocouple locations)																	
(min)	(°C)	37	38	39	40	41	42	43	44	45	46	47	60	61	62	63	64	65	66
42	887	93	760	93	91	91	739	759	798	741	552	763	57	57	61	45	47	41	57
43	879	93	766	93	92	92	746	760	802	743	567	762	58	58	61	46	48	42	57
44	879	94	767	94	92	92	751	757	802	742	574	761	58	59	61	47	48	42	58
45	893	94	768	95	92	92	755	756	805	741	550	760	59	59	62	47	49	43	59
46	903	94	771	97	93	92	760	757	808	743	562	762	60	60	62	48	49	44	59
47	896	94	775	100	93	92	764	762	810	745	579	770	60	60	62	49	50	46	60
48	889	95	776	105	94	92	766	765	811	745	586	769	61	60	63	49	50	46	60
49	894	95	775	114	94	93	768	770	811	747	594	766	62	61	64	50	51	46	61
50	910	97	776	127	94	93	770	783	811	752	607	765	62	61	64	51	51	47	61
51	913	100	784	144	94	93	880	800	824	769	618	780	48	62	65	51	51	47	61
52	876	101	765	157	96	167	525	743	777	756	617	767	48	62	63	52	52	47	62

Table 2. Measured Temperatures in Wood Stud Wall Assembly F-32 (Cont'd)

Time	T(Furn. Temp.)	**Temperatures at Thermocouple Number** (see Figures 9 and 10 for thermocouple locations)												
(min)	(°C)	67	68	69	70	71	72	73	74	75	76	77	78	79
0	27	25	25	24	25	25	25	25	24	24	24	24	23	23
1	40	25	25	24	25	25	25	25	24	24	24	24	23	23
2	132	25	25	24	25	25	25	25	24	24	24	24	23	23
3	473	25	25	25	25	25	25	25	24	24	24	24	23	23
4	508	25	25	25	25	25	25	25	25	24	24	24	24	23
5	477	25	25	25	25	25	26	25	26	25	24	24	25	24
6	596	25	25	25	25	25	26	25	27	26	25	25	26	25
7	575	25	25	25	25	25	28	26	28	28	26	26	29	27
8	639	25	25	27	25	25	29	28	30	30	27	28	32	29
9	657	25	25	31	25	25	32	29	33	33	29	30	36	33
10	695	25	25	36	25	25	34	32	36	35	31	32	41	37
11	715	25	26	50	26	25	37	35	39	38	34	35	47	41
12	724	26	26	62	26	26	40	38	42	41	36	38	51	46
13	746	27	27	70	28	26	43	42	44	44	40	41	54	49
14	733	28	28	72	29	26	46	45	47	47	42	44	57	52
15	764	29	29	71	31	27	49	48	49	50	45	47	59	54
16	772	30	30	69	32	28	52	51	51	52	48	49	61	56
17	762	32	32	70	34	29	54	54	53	54	50	50	62	57
18	774	33	33	72	36	30	56	56	55	56	52	51	64	59
19	797	35	34	72	38	32	58	58	57	57	54	53	65	61
20	799	36	36	73	39	33	61	60	58	59	56	54	67	62
21	798	38	37	73	40	34	63	62	60	61	58	56	69	64
22	803	39	38	73	41	36	65	64	62	63	59	58	70	65
23	814	41	39	73	43	37	67	66	63	64	61	59	71	67
24	821	42	40	72	44	38	68	67	65	66	63	61	72	68
25	815	43	41	71	45	40	70	69	67	68	65	63	73	69
26	810	45	42	70	46	41	71	70	71	69	66	64	74	70
27	827	46	44	68	47	42	73	72	77	71	68	66	75	71
28	842	47	45	67	48	44	74	73	91	73	69	68	76	72
29	837	48	46	66	49	45	76	74	123	74	71	69	77	74
30	831	49	47	65	50	46	78	76	181	76	72	71	78	75
31	839	50	48	64	51	47	80	77	263	78	74	72	79	76
32	857	51	49	63	51	48	84	78	363	81	75	74	80	78
33	859	52	50	62	52	49	90	80	476	87	77	76	81	79
34	851	53	51	61	53	50	100	81	572	99	80	78	82	81
35	850	53	52	60	54	51	116	82	633	102	84	81	84	83
36	866	54	53	60	55	52	139	84	668	104	89	84	85	85
37	877	55	53	59	55	53	172	85	694	106	96	87	87	88
38	869	56	54	59	56	54	221	86	713	108	103	92	90	94
39	862	56	55	58	57	55	280	87	722	110	112	96	93	98
40	872	57	56	58	57	55	342	89	725	111	120	101	97	99
41	888	57	57	58	58	56	407	90	731	113	128	106	78	100

Table 2. Measured Temperatures in Wood Stud Wall Assembly F-32 (Cont'd)

Time	T(Furn. Temp.)	**Temperatures at Thermocouple Number** (see Figures 9 and 10 for thermocouple locations)												
(min)	(°C)	67	68	69	70	71	72	73	74	75	76	77	78	79
42	887	58	57	57	59	57	474	92	742	114	137	110	63	100
43	879	58	58	57	59	57	537	94	749	116	146	115	72	100
44	879	59	58	57	60	58	588	96	750	121	157	121	63	100
45	893	59	59	57	60	58	629	97	754	127	171	128	56	73
46	903	60	60	57	61	59	664	99	760	137	191	132	58	64
47	896	60	60	58	61	60	694	101	766	151	224	136	61	50
48	889	61	61	58	62	60	716	103	770	171	295	148	56	47
49	894	61	61	58	62	61	730	106	773	200	408	162	70	47
50	910	61	62	59	62	61	744	112	779	241	560	182	76	57
51	913	62	62	58	63	61	853	128	794	301	649	225	196	110
52	876	49	63	58	63	61	724	206	765	425	640	264	212	141

Table 3. Average of Measured Temperatures in Wood Stud Assembly F-32

Time (min)	T(Furn Temp) (°C)	BL/Cav (Exp) Avg (36-41)	BL/WStd (Exp) Avg (24-29)	Surf/WStd Avg (16-23)	Ctr/WStd Avg (72-79)	BL/Cav (Unexp) Avg (42-47)	BL/WStd (Unexp) Avg (30-35)	BL/FL (Unexp) Avg (60-71)	Unexposed Avg (1-9)
0	27	25	24	24	24	25	24	25	22
1	40	25	25	24	24	26	24	25	24
2	132	25	36	24	24	41	24	25	37
3	473	25	86	24	24	85	24	25	85
4	508	25	86	30	24	82	24	25	90
5	477	25	81	39	25	82	24	25	87
6	596	25	92	47	26	95	25	25	104
7	575	26	90	59	27	100	25	25	104
8	639	28	93	67	29	105	26	25	113
9	657	31	95	77	32	111	27	25	118
10	695	36	97	82	35	114	30	26	125
11	715	42	99	88	38	118	33	28	130
12	724	48	101	89	41	120	37	30	134
13	746	54	104	91	45	124	43	33	139
14	733	59	107	91	48	132	48	34	141
15	764	63	111	90	50	145	51	35	147
16	772	65	117	88	52	192	51	36	154
17	762	67	125	88	54	258	54	37	162
18	774	68	139	86	56	320	54	38	173
19	797	69	160	86	58	375	54	39	184
20	799	71	185	87	60	423	55	41	193
21	798	73	213	87	61	460	56	42	201
22	803	75	245	88	63	493	57	42	210
23	814	77	281	88	65	518	57	43	218
24	821	78	321	88	66	541	57	44	227
25	815	80	364	89	68	568	58	45	235
26	810	81	408	89	70	589	58	45	242
27	827	82	446	89	72	603	59	46	250
28	842	84	479	90	74	618	59	46	258
29	837	86	514	91	80	635	60	47	264
30	831	91	547	93	88	643	61	47	270
31	839	101	577	99	100	655	61	48	279
32	857	118	604	109	114	665	62	49	290
33	859	140	627	131	131	664	63	49	300
34	851	161	647	162	147	675	64	50	310
35	850	176	666	197	158	688	65	50	320
36	866	184	683	231	167	692	65	51	331
37	877	190	695	266	177	698	66	52	340
38	869	195	707	304	188	704	67	52	347
39	862	198	717	343	200	704	68	53	354
40	872	200	731	384	210	706	69	53	363
41	888	201	739	423	219	715	71	54	372

Table 3. Average of Measured Temperatures in Wood Stud Assembly F-32 (Cont'd)

Time (min)	T(Furn Temp) (°C)	BL/Cav (Exp) Avg (36-41)	BL/WStd (Exp) Avg (24-29)	Surf/WStd Avg (16-23)	Ctr/WStd Avg (72-79)	BL/Cav (Unexp) Avg (42-47)	BL/WStd (Unexp) Avg (30-35)	BL/FL (Unexp) Avg (60-71)	Unexposed Avg (1-9)
42	887	203	742	450	229	725	75	54	275
43	879	204	745	474	241	730	82	55	281
44	879	205	750	490	249	731	94	55	286
45	893	206	751	548	254	728	114	56	295
46	903	206	755	576	263	732	145	56	304
47	896	208	764	588	273	738	186	57	313
48	889	209	774	605	288	740	227	58	322
49	894	211	783	630	312	743	258	58	333
50	910	213	793	659	344	748	295	58	345
51	913	218	809	692	407	779	336	58	366
52	876	230	739	690	422	698	336	57	352

BL - Base Layer
FL - Face Layer
Cav - Cavity
WStd - Wood Stud
Surf - Surface
Ctr - Center
Exp - Exposed
Unexp - Unexposed

Table 4. Measured Temperatures in Wood Stud Wall Assembly F-33

Time	T(Furn Avg)	**Temperatures at Thermocouple Number** (see Figures 9 and 10 for thermocouple locations)																	
(min)	(°C)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
0	25	22	22	22	22	22	22	22	22	22	22	23	22	23	22	22	23	22	23
1	38	22	22	22	22	22	22	22	22	22	22	23	22	23	22	22	23	22	23
2	121	22	22	22	22	22	22	22	22	22	22	23	22	23	22	22	23	23	23
3	443	22	22	22	22	22	22	22	22	22	22	23	22	23	22	22	41	36	31
4	505	22	22	22	22	22	22	22	22	22	22	23	22	23	22	22	61	57	49
5	493	22	22	22	22	22	22	22	22	22	22	23	22	23	22	22	61	56	51
6	596	22	22	22	22	22	23	22	22	22	22	23	22	23	22	23	70	67	55
7	582	22	23	22	23	23	23	22	22	22	23	23	22	23	23	23	77	71	62
8	648	22	23	23	23	23	23	22	22	23	23	23	23	23	23	23	80	74	65
9	664	22	23	23	24	23	24	23	23	23	23	23	23	23	23	23	85	80	69
10	701	22	23	24	25	24	24	23	23	24	23	23	23	24	24	24	87	81	73
11	725	22	24	25	26	24	25	23	24	24	24	23	23	24	24	25	90	86	76
12	726	22	24	25	27	25	26	24	24	25	24	24	24	25	25	25	90	86	78
13	745	22	25	27	28	26	27	24	25	26	25	24	24	26	26	26	90	87	80
14	739	22	26	28	30	27	28	25	26	27	25	25	25	27	26	27	90	86	80
15	767	22	26	29	31	28	30	25	27	28	26	25	25	27	27	28	86	85	83
16	764	22	27	30	32	29	31	26	27	29	26	26	26	28	27	29	83	83	80
17	767	22	28	31	33	30	32	26	28	30	27	27	27	29	28	30	81	76	75
18	788	22	29	32	35	31	33	27	29	32	27	28	27	29	29	30	81	73	77
19	786	22	30	34	36	32	35	28	30	33	28	28	28	30	29	31	81	76	80
20	785	22	31	35	37	34	36	28	31	34	29	29	29	31	30	32	81	78	81
21	804	22	32	36	38	35	37	29	32	35	29	30	29	31	30	32	85	80	83
22	813	22	33	36	39	36	38	30	33	36	30	31	30	31	30	33	86	82	88
23	806	22	34	37	39	37	39	30	34	37	30	31	31	32	31	33	88	83	98
24	806	22	35	38	40	38	40	31	34	38	31	32	31	32	31	34	90	86	117
25	824	22	36	39	41	39	42	32	35	39	31	33	32	32	31	34	103	89	128
26	833	22	37	40	42	39	43	33	36	39	32	33	32	33	32	35	121	92	136
27	823	22	38	41	43	40	45	34	37	40	32	33	33	34	33	35	135	97	145
28	831	22	39	42	43	41	47	35	38	41	32	34	33	34	33	36	147	102	155
29	846	22	41	43	44	42	49	36	39	42	33	35	34	35	34	36	156	108	164
30	836	22	42	44	45	43	51	37	40	43	34	35	34	36	34	37	165	114	175
31	844	22	44	45	47	45	52	39	41	44	34	36	35	36	35	38	174	119	187
32	857	22	45	46	48	46	54	40	42	45	35	37	35	38	36	39	182	124	199
33	846	22	47	47	49	47	56	41	44	46	36	37	36	39	37	39	191	129	213
34	857	22	49	48	51	48	58	42	45	47	36	38	37	39	38	40	200	135	227
35	867	22	51	49	53	50	60	44	47	48	37	39	37	40	39	41	209	141	241
36	858	23	53	51	54	51	62	45	48	49	38	39	38	41	40	42	219	147	255
37	861	23	54	52	56	53	64	46	50	50	39	40	38	42	40	42	231	154	269
38	878	23	56	53	57	54	66	47	51	52	39	40	39	42	42	44	246	160	282
39	878	23	58	55	58	55	68	48	52	53	40	41	40	44	43	44	259	167	295
40	872	23	60	56	60	57	71	49	54	54	41	41	40	44	43	45	274	175	309
41	871	23	61	57	61	58	73	50	55	55	42	42	41	44	44	46	290	182	322

Table 4. Measured Temperatures in Wood Stud Wall Assembly F33, (Cont'd)

Time	T(Furn Avg)	**Temperatures at Thermocouple Number** (see Figures 9 and 10 for thermocouple locations)																	
(min)	(°C)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
42	883	23	63	58	63	60	75	51	57	56	42	43	41	46	44	47	307	192	336
43	898	23	65	60	64	61	78	53	58	57	43	43	42	47	45	48	324	202	351
44	894	23	67	61	65	62	80	54	60	59	43	43	43	48	46	48	335	216	368
45	902	23	71	63	67	64	83	56	62	60	44	44	43	48	47	51	354	231	386
46	888	23	74	69	68	65	86	63	63	61	44	44	43	48	47	57	366	245	399

Table 4. Measured Temperatures in Wood Stud Wall Assembly F33, (Cont'd)

Time	T(Furn Avg)	**Temperatures at Thermocouple Number** (see Figures 9 and 10 for thermocouple locations)																	
(min)	(°C)	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
0	25	23	23	22	23	22	24	23	24	23	24	23	22	22	22	22	22	22	24
1	38	23	23	22	23	22	26	24	28	25	26	26	22	22	22	22	22	22	26
2	121	23	23	23	23	22	37	27	61	39	54	47	22	22	22	22	22	22	54
3	443	26	59	41	26	23	89	68	89	89	84	72	23	22	23	23	22	23	90
4	505	50	66	52	42	25	91	92	85	83	83	77	23	22	24	24	23	24	86
5	493	54	63	53	47	31	86	86	80	79	79	74	23	23	24	24	23	24	81
6	596	62	73	60	50	34	94	96	91	88	87	77	24	24	27	29	23	27	90
7	582	68	75	62	56	37	94	94	90	86	88	80	25	26	29	32	23	29	92
8	648	70	77	65	57	40	95	98	94	89	91	82	27	28	32	37	24	31	100
9	664	76	82	69	60	44	96	97	98	91	94	86	31	30	38	44	24	36	108
10	701	78	83	71	63	49	97	98	100	92	96	89	38	34	45	50	25	41	113
11	725	83	85	74	67	55	100	99	105	94	102	93	44	38	52	55	27	47	117
12	726	84	86	75	71	59	106	99	111	95	106	97	50	44	57	58	28	50	120
13	745	85	86	77	75	63	110	104	115	96	111	101	56	50	63	61	30	55	124
14	739	85	84	75	86	75	116	110	121	101	117	106	57	54	61	57	31	49	131
15	767	85	79	73	84	80	123	118	127	106	125	113	54	51	71	57	33	50	141
16	764	85	77	72	79	72	133	128	136	112	143	122	60	50	66	59	36	51	174
17	767	77	81	76	79	69	153	159	155	144	181	143	68	60	70	68	38	60	233
18	788	75	80	78	79	71	186	196	200	167	214	177	64	62	67	67	40	60	294
19	786	76	81	78	79	71	228	222	243	188	249	213	62	62	66	64	42	60	351
20	785	79	85	80	80	71	270	239	282	213	283	251	61	60	68	64	43	61	402
21	804	80	87	80	82	73	312	261	316	237	311	286	59	61	70	64	45	62	437
22	813	82	92	81	87	78	350	286	350	262	341	324	60	61	69	62	46	60	473
23	806	84	109	85	94	85	385	312	391	295	380	375	59	60	68	67	47	66	512
24	806	87	125	100	121	87	414	334	423	333	420	409	61	60	76	73	49	73	543
25	824	89	137	125	142	90	442	363	455	354	457	435	72	60	78	76	50	76	549
26	833	90	148	139	157	92	469	401	489	384	491	465	81	67	78	76	52	76	540
27	823	89	159	150	169	95	495	458	518	418	515	475	84	75	76	75	53	76	549
28	831	87	169	160	180	100	520	503	540	450	535	504	84	79	75	74	55	75	560
29	846	87	179	169	188	110	542	539	559	476	552	524	84	82	75	73	56	73	576
30	836	87	190	179	197	117	563	568	577	504	568	545	84	83	75	75	58	72	595
31	844	87	203	189	205	121	586	600	591	518	582	558	85	84	75	78	59	71	607
32	857	89	215	201	214	125	607	627	604	523	597	575	86	84	75	82	60	70	622
33	846	94	229	216	223	129	627	660	618	541	611	593	86	85	76	84	62	69	637
34	857	113	243	233	232	132	657	675	629	556	624	607	86	86	77	85	63	68	646
35	867	130	256	251	241	137	679	691	640	570	634	620	86	86	77	85	65	68	652
36	858	138	271	270	251	141	697	702	650	589	646	633	86	87	79	86	67	69	658
37	861	142	286	290	261	146	727	713	658	608	657	643	90	87	80	86	69	71	665
38	878	148	303	310	272	151	751	729	667	625	667	651	95	87	81	86	71	74	668
39	878	155	323	331	283	155	758	743	678	638	679	661	107	87	82	87	73	87	669
40	872	161	346	352	296	160	765	756	689	653	688	675	119	87	84	87	77	98	672
41	871	170	374	372	310	165	776	769	698	662	698	690	137	87	85	87	79	99	674

Table 4. Measured Temperatures in Wood Stud Wall Assembly F33, (Cont'd)

Time	T(Furn Avg)	**Temperatures at Thermocouple Number** (see Figures 9 and 10 for thermocouple locations)																	
(min)	(°C)	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
42	883	181	404	390	324	169	792	785	708	673	705	704	148	87	87	87	87	98	677
43	898	195	441	407	317	173	800	804	718	684	715	716	144	86	88	88	91	97	682
44	894	219	484	423	333	178	796	858	733	730	739	729	181	87	89	88	96	97	691
45	902	274	538	442	353	185	807	831	741	720	735	741	307	88	90	89	103	99	692
46	888	321	592	457	376	189	789	825	748	741	781	750	755	89	91	90	122	99	707

Table 4. Measured Temperatures in Wood Stud Wall Assembly F33, (Cont'd)

Note: * Denotes faulty thermocouple

Time	T(Furn Avg)	**Temperatures at Thermocouple Number** (see Figures 9 and 10 for thermocouple locations)																	
(min)	(°C)	37	38	39	40	41	42	43	44	45	46	47	60	61	62	63	64	65	66
0	25	24	24	24	24	23	22	*	22	22	22	22	22	22	22	22	22	22	22
1	38	25	26	25	26	25	22	*	22	22	22	22	22	22	22	22	22	22	22
2	121	45	58	49	67	52	22	*	22	22	22	22	22	22	22	22	22	22	22
3	443	87	86	89	90	89	25	*	27	26	24	23	22	22	22	22	22	22	22
4	505	87	85	86	87	87	41	*	44	38	35	40	23	23	22	22	22	22	23
5	493	83	81	83	83	84	45	*	48	43	41	49	24	25	23	22	23	22	25
6	596	92	88	89	91	90	48	*	52	47	43	55	26	27	23	22	23	23	27
7	582	98	92	96	92	98	54	*	58	51	47	62	28	29	23	23	23	23	30
8	648	108	100	106	96	108	56	*	60	53	49	65	31	32	24	23	24	24	32
9	664	117	105	114	100	116	60	*	65	57	53	69	33	34	25	24	25	25	35
10	701	121	108	119	101	121	64	*	69	60	58	72	35	37	26	25	26	27	37
11	725	125	111	122	104	125	68	*	72	63	64	75	38	39	27	26	28	29	40
12	726	127	114	125	105	130	72	*	74	66	67	77	40	41	29	27	30	31	42
13	745	130	119	131	109	138	74	*	75	68	68	78	42	43	31	29	32	33	44
14	739	135	127	141	110	152	76	*	72	72	65	77	45	44	33	31	34	34	46
15	767	145	139	158	125	207	77	*	71	74	65	75	47	46	34	32	36	36	48
16	764	164	183	217	183	295	76	*	70	67	66	71	49	47	36	33	38	37	50
17	767	222	238	299	251	388	74	*	72	65	66	73	50	49	37	34	40	39	50
18	788	283	284	377	342	474	75	*	71	68	64	72	51	50	38	36	42	40	51
19	786	362	331	461	427	533	75	*	70	67	64	71	51	50	39	38	43	42	52
20	785	449	373	518	478	581	76	*	72	68	69	73	52	50	40	39	44	43	52
21	804	505	406	561	513	617	81	*	76	71	75	78	53	51	40	40	45	43	53
22	813	549	447	600	510	643	99	*	76	77	87	89	53	52	41	41	46	44	54
23	806	590	484	638	516	655	113	*	78	83	106	106	54	53	42	42	47	44	55
24	806	622	520	662	541	663	123	*	86	87	115	129	55	54	43	42	48	46	57
25	824	642	539	679	547	671	135	*	106	106	121	139	56	55	43	43	49	47	59
26	833	658	544	696	568	682	145	*	121	120	125	145	58	57	44	44	50	49	62
27	823	670	556	711	592	693	153	*	130	133	129	150	60	60	45	45	52	50	65
28	831	680	570	717	611	700	159	*	136	144	134	156	63	63	47	47	53	51	68
29	846	689	589	723	631	708	164	*	140	153	140	163	65	66	49	49	54	52	70
30	836	699	604	732	652	719	169	*	144	161	144	169	68	70	50	51	54	53	72
31	844	701	615	731	665	725	174	*	148	169	148	176	71	74	51	53	55	54	74
32	857	707	627	734	676	734	180	*	152	176	151	182	73	77	52	54	56	55	76
33	846	714	639	742	687	744	185	*	155	179	153	188	75	79	53	55	56	56	79
34	857	714	646	747	686	749	189	*	159	181	156	193	77	81	54	57	57	57	81
35	867	719	656	755	687	757	195	*	164	186	159	199	78	82	55	58	58	58	84
36	858	725	665	763	698	768	201	*	168	192	162	205	80	84	55	59	59	59	87
37	861	727	671	765	706	783	207	*	173	198	165	213	82	85	56	59	60	60	89
38	878	729	677	769	714	796	211	*	178	206	168	221	85	87	57	60	61	61	92
39	878	736	686	775	725	810	218	*	183	213	171	230	87	89	57	61	62	62	96
40	872	741	694	774	737	814	223	*	189	222	173	242	90	91	58	62	63	62	99
41	871	744	700	772	758	820	228	*	198	231	176	254	92	93	59	62	64	63	103

Table 4. Measured Temperatures in Wood Stud Wall Assembly F33, (Cont'd)

Note: * Denotes faulty thermocouple

Time	T(Furn Avg)	**Temperatures at Thermocouple Number** (see Figures 9 and 10 for thermocouple locations)																	
(min)	(°C)	37	38	39	40	41	42	43	44	45	46	47	60	61	62	63	64	65	66
42	883	747	705	771	966	837	232	*	205	239	179	268	94	95	60	63	65	64	106
43	898	755	712	776	994	967	236	*	212	247	270	298	97	98	61	64	66	64	110
44	894	780	728	770	838	877	241	*	222	259	870	792	99	101	62	65	67	65	115
45	902	773	721	782	883	946	247	*	229	264	862	930	102	104	63	66	69	66	122
46	888	781	724	788	910	948	253	*	238	273	888	910	106	110	64	67	70	66	130

Table 4. Measured Temperatures in Wood Stud Wall Assembly F33, (Cont'd)

Note: * Denotes faulty thermocouple

Time	T(Furn Avg)	**Temperatures at Thermocouple Number** (see Figures 9 and 10 for thermocouple locations)												
(min)	(°C)	67	68	69	70	71	72	73	74	75	76	77	78	79
0	25	22	*	22	22	22	23	23	23	23	22	22	22	22
1	38	22	*	22	22	22	23	23	23	23	22	22	22	22
2	121	22	*	22	22	22	23	23	23	23	22	22	22	22
3	443	22	*	22	22	22	23	23	23	23	23	23	23	22
4	505	22	*	22	23	22	24	24	24	24	25	26	28	24
5	493	23	*	22	24	23	25	26	25	26	27	30	31	26
6	596	24	*	22	25	25	27	28	26	29	29	34	33	27
7	582	26	*	23	27	28	28	30	28	31	31	39	37	30
8	648	27	*	23	29	30	*	32	30	33	34	44	39	32
9	664	29	*	23	31	32	*	35	32	36	37	49	42	34
10	701	31	*	23	33	35	33	37	34	38	39	52	45	36
11	725	32	*	24	35	37	36	40	36	41	42	56	48	39
12	726	34	*	25	37	40	38	42	39	44	44	58	51	41
13	745	36	*	26	39	42	28	44	41	47	46	59	53	43
14	739	37	*	27	41	44	*	47	43	49	47	59	55	46
15	767	39	*	28	43	46	43	49	46	51	48	59	56	48
16	764	41	*	29	44	47	46	51	48	53	49	59	57	49
17	767	42	*	31	46	48	48	52	49	55	50	59	59	51
18	788	43	*	32	46	48	49	53	50	57	52	60	59	53
19	786	44	*	34	47	49	51	55	52	59	53	61	60	55
20	785	45	*	35	48	49	52	56	54	60	54	62	61	57
21	804	45	*	37	49	50	54	58	55	62	56	63	63	59
22	813	46	*	38	50	51	55	59	57	64	58	65	65	63
23	806	48	*	39	52	52	57	61	59	66	59	66	67	69
24	806	49	*	40	54	54	59	63	61	68	61	68	70	76
25	824	51	*	41	56	56	61	65	63	71	63	70	74	89
26	833	53	*	42	59	58	62	68	66	74	66	72	79	96
27	823	56	*	43	62	60	64	71	69	78	69	73	83	100
28	831	58	*	44	65	63	66	75	73	83	72	76	89	101
29	846	62	*	45	69	66	68	80	76	88	76	78	96	101
30	836	66	*	47	72	68	71	85	81	92	80	81	98	102
31	844	70	*	48	74	71	74	91	85	97	85	84	100	102
32	857	72	*	49	77	73	78	96	90	102	90	87	101	102
33	846	75	*	50	79	75	82	100	94	107	95	91	105	103
34	857	76	*	51	82	77	86	101	98	111	99	96	109	104
35	867	78	*	52	84	79	90	105	102	115	104	100	113	109
36	858	79	*	53	87	81	94	109	104	119	109	105	118	119
37	861	81	*	54	89	83	97	113	107	123	115	107	124	126
38	878	83	*	57	91	86	101	115	109	128	129	110	130	133
39	878	85	*	62	94	88	104	118	113	134	204	114	136	141
40	872	87	*	69	96	91	106	121	116	140	504	133	142	149
41	871	89	*	75	98	94	108	125	120	147	764	412	149	156

Table 4. Measured Temperatures in Wood Stud Wall Assembly F33, (Cont'd)

Note: * Denotes faulty thermocouple

Time	T(Furn Avg)	**Temperatures at Thermocouple Number** (see Figures 9 and 10 for thermocouple locations)												
(min)	(°C)	67	68	69	70	71	72	73	74	75	76	77	78	79
42	883	92	*	80	102	97	110	129	124	158	874	716	156	164
43	898	96	*	89	105	101	*	133	129	173	906	825	165	174
44	894	99	*	93	117	109	117	138	135	193	845	715	174	185
45	902	103	*	95	213	146	*	142	142	214	879	905	185	198
46	888	110	*	90	578	251	276	147	156	236	884	932	198	210

Table 5. Average of Measured Temperatures in Wood Wall Assembly F-33

Time (min)	T(Furn Temp) (°C)	BL/Cav (Exp) Avg (36-41)	BL/WStd (Exp) Avg (24-29)	Surf/WStd Avg (16-23)	Ctr/WStd Avg (72-79)	BL/Cav (Unexp) Avg (42-47)	BL/WStd (Unexp) Avg (30-35)	BL/FL (Unexp) Avg (60-71)	Unexposed Avg (1-9)
0	25	24	24	23	22	22	22	22	22
1	38	26	26	23	22	22	22	22	22
2	121	54	44	23	22	22	22	22	22
3	443	89	82	35	23	25	23	22	22
4	505	86	85	50	25	40	23	22	22
5	493	82	81	52	27	45	23	23	22
6	596	90	89	59	29	49	26	24	22
7	582	95	89	63	32	54	27	26	22
8	648	103	91	66	35	57	30	27	23
9	664	110	94	71	38	61	34	29	23
10	701	114	95	73	40	65	39	30	24
11	725	117	99	77	42	69	44	32	24
12	726	120	102	79	45	71	48	34	25
13	745	125	106	80	45	73	52	36	26
14	739	133	112	83	49	72	52	38	26
15	767	153	119	82	50	72	53	40	27
16	764	203	129	79	51	70	53	41	28
17	767	272	156	77	53	70	61	42	29
18	788	342	190	77	54	70	60	43	30
19	786	411	224	78	56	70	59	44	31
20	785	467	256	79	57	72	60	45	32
21	804	507	287	81	59	76	60	46	33
22	813	537	319	84	61	86	60	47	34
23	806	566	356	91	63	97	61	48	34
24	806	592	389	102	66	108	65	49	35
25	824	605	418	113	70	121	69	51	36
26	833	615	450	122	73	131	72	52	37
27	823	628	480	130	76	139	73	54	38
28	831	640	508	137	79	146	74	57	39
29	846	652	532	145	83	152	74	59	40
30	836	667	554	153	86	157	74	61	41
31	844	674	572	161	90	163	75	63	42
32	857	683	589	169	93	168	76	65	43
33	846	694	608	178	97	172	77	67	44
34	857	698	625	189	101	176	77	68	46
35	867	704	639	201	105	181	78	70	47
36	858	713	653	211	110	186	79	71	48
37	861	719	668	222	114	191	80	73	50
38	878	725	682	234	119	197	82	74	51
39	878	733	693	246	133	203	87	76	52
40	872	738	704	259	176	210	92	79	54
41	871	745	715	273	248	217	96	81	55

Table 5. Average Temperatures Measured in Full ScaleAssembly F33 (Cont'd)

Time (min)	T(Fav) (°C)	BL/Cav (Exp) Avg (36-41)	BL/WStd (Exp) Avg (24-29)	Surf/WStd Avg (16-23)	Ctr/WStd Avg (72-79)	BL/Cav (Unexp) Avg (42-47)	BL/WStd (Unexp) Avg (30-35)	BL/FL (Unexp) Avg (60-71)	Unexposed Avg (1-9)
42	883	784	728	288	304	224	99	83	56
43	898	814	739	301	358	253	99	86	58
44	894	781	764	319	313	477	106	90	59
45	902	800	763	345	381	506	129	104	61
46	888	810	772	368	380	512	208	149	64
47	821	818	822	405	315	467	328	165	68

BL - Base Layer
FL - Face Layer
Cav - Cavity
WStd - Wood Stud
Surf - Surface
Ctr - Center
Exp - Exposed
Unexp - Unexposed

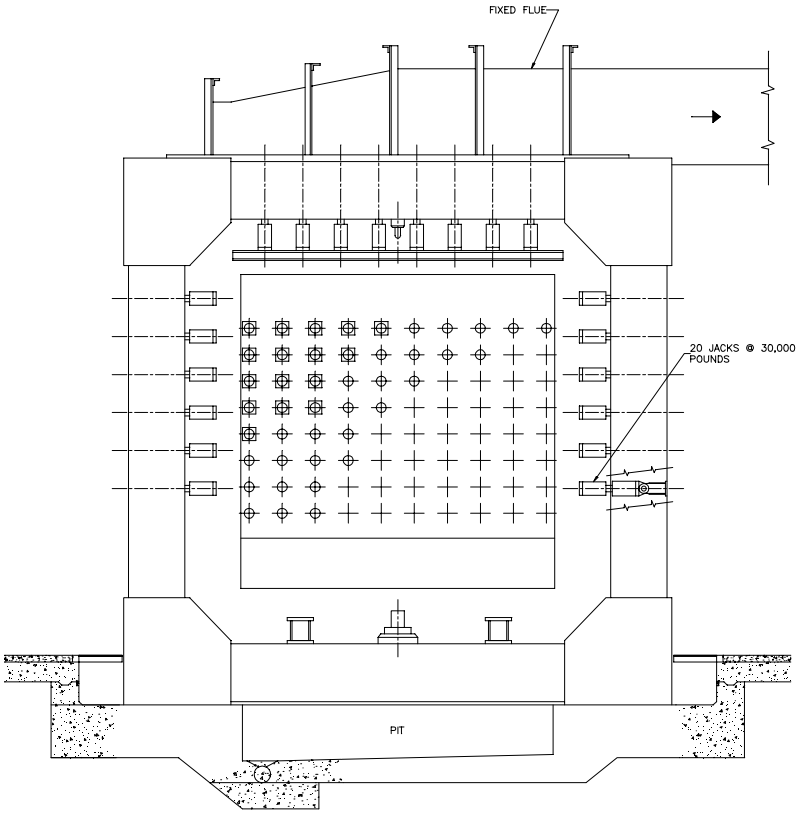
Table 6. Measured Deflections in Wood Stud Wall Assembly F-32

Note: * Denotes faulty reading

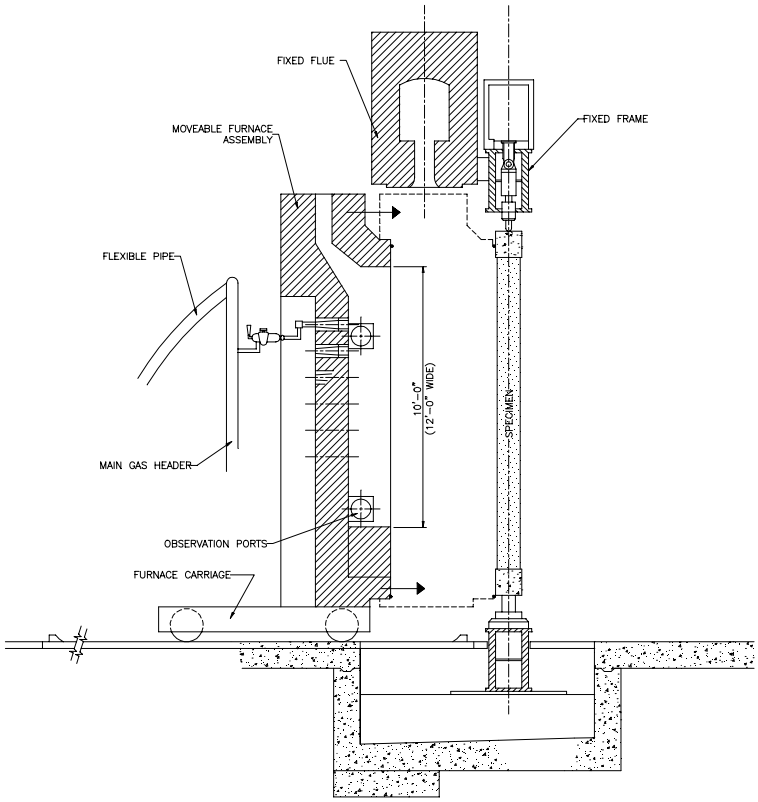
Time (min)	DELFN-1 (cm)	DELFN-2 (cm)	DELFN-3 (cm)	DELFN-4 (cm)	DELFN-5 (cm)	DELFN-6 (cm)	DELFN-7 (cm)	DELFN-8 (cm)	DELFN-9 (cm)
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1
2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
3	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.0	0.1
4	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1
5	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1
6	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1
7	0.2	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1
8	0.2	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.2
9	0.2	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1
10	0.2	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.2
11	0.2	0.1	0.1	0.3	0.2	0.2	0.2	0.1	0.2
12	0.2	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.2
13	0.2	0.1	0.1	0.2	0.2	0.1	0.2	0.1	0.1
14	0.2	0.1	0.0	0.2	0.2	0.1	0.2	0.1	0.1
15	0.2	0.1	0.0	0.2	0.1	0.1	0.2	0.1	0.1
16	0.2	0.1	0.0	0.2	0.1	0.1	0.2	0.0	0.1
17	0.2	0.0	0.0	0.2	0.1	0.1	0.2	0.0	0.1
18	0.1	0.0	0.0	0.2	0.1	0.1	0.2	0.0	0.1
19	0.1	0.0	0.0	0.2	0.0	0.1	0.2	-0.1	0.1
20	0.1	-0.1	-0.1	0.2	0.0	0.0	0.2	-0.1	0.0
21	0.1	-0.1	-0.1	0.1	-0.1	0.0	0.1	-0.2	0.0
22	0.0	-0.2	-0.1	0.1	-0.2	-0.1	0.1	-0.2	0.0
23	0.0	-0.2	-0.1	0.0	-0.2	-0.1	0.1	-0.3	0.0
24	0.0	-0.3	-0.2	0.0	-0.3	-0.1	0.1	-0.3	-0.1
25	-0.1	-0.3	-0.2	0.0	-0.3	-0.2	0.1	-0.3	-0.1
26	-0.1	-0.3	-0.2	0.0	-0.4	-0.2	0.0	-0.4	-0.2
27	-0.1	-0.4	-0.3	-0.1	-0.5	-0.3	0.0	-0.4	-0.2
28	-0.2	-0.5	-0.3	-0.1	-0.5	-0.4	0.0	-0.5	-0.2
29	-0.2	-0.5	-0.3	-0.2	-0.6	-0.4	-0.1	-0.6	-0.3
30	-0.2	-0.6	-0.4	-0.2	-0.7	-0.5	-0.1	-0.6	-0.3
31	-0.3	-0.7	-0.4	-0.3	-0.8	-0.5	-0.1	-0.7	-0.4
32	-0.3	-0.7	-0.4	-0.3	-0.8	-0.6	-0.1	-0.7	-0.4
33	-0.4	-0.8	-0.5	-0.4	-0.9	-0.7	-0.2	-0.8	-0.5
34	-0.4	-0.9	-0.5	-0.5	-1.0	-0.7	-0.2	-0.9	-0.5
35	-0.5	-1.0	-0.6	-0.6	-1.2	-0.8	-0.3	-1.0	-0.6
36	-0.5	-1.1	-0.7	-0.7	-1.3	-0.9	-0.4	-1.1	-0.7
37	-0.6	-1.2	-0.7	-0.8	-1.5	-1.0	-0.4	-1.2	-0.8
38	-0.7	-1.3	-0.8	-0.9	-1.6	-1.2	-0.5	-1.4	-0.9
39	-0.8	-1.5	-0.9	-1.0	-1.8	-1.3	-0.6	-1.5	-1.0
40	-0.9	-1.6	-1.0	-1.2	-2.0	-1.5	-0.7	-1.7	-1.1
41	-1.1	-1.9	-1.1	-1.4	-2.3	-1.7	-0.9	-1.9	-1.3
42	-1.3	-2.0	-1.2	-1.6	-2.6	-1.9	-1.0	-2.0	-1.5
43	-1.4	-2.3	-1.4	-1.9	-2.9	-2.1	-1.2	-2.3	-1.7
44	-1.6	-2.5	-1.5	-2.2	-3.1	-2.3	-1.4	-2.5	-1.8
45	-1.9	-2.8	-1.8	-2.6	-3.5	-2.6	-1.7	-2.7	-2.1
46	-2.2	-3.0	-1.9	-3.0	-3.9	-2.9	-1.9	-3.0	-2.3
47	-2.5	-3.4	-2.1	-3.5	-4.3	-3.3	-2.3	-3.3	-2.6
48	*	*	*	*	*	*	*	*	*
49	-3.3	-4.1	-2.7	-4.7	-5.2	-4.1	-3.1	-3.9	-3.2
50	-3.9	-4.6	-3.2	-5.6	-6.0	-4.6	-3.7	-4.4	-3.5
51	-7.7	-7.9	-5.4	-12.1	-10.8	-7.7	-8.8	-7.7	-5.5

Table 7. Measured Deflections in Wood Stud Wall Assembly F-33

Time (min)	DELFN-1 (cm)	DELFN-2 (cm)	DELFN-3 (cm)	DELFN-4 (cm)	DELFN-5 (cm)	DELFN-6 (cm)	DELFN-7 (cm)	DELFN-8 (cm)	DELFN-9 (cm)
0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.1	-0.1
3	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.0
4	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	-0.1
5	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	-0.1
6	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.1	-0.1
7	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	-0.1
8	0.1	0.0	0.0	0.1	0.1	0.0	0.1	0.1	-0.1
9	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	-0.1
10	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	-0.1
11	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	-0.1
12	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	-0.1
13	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	-0.1
14	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.1	-0.1
15	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.1	-0.1
16	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.1	-0.1
17	0.1	0.0	0.0	0.0	0.1	-0.1	0.0	0.1	-0.1
18	0.1	0.0	0.0	0.0	0.1	-0.1	0.0	0.0	-0.1
19	0.1	0.0	0.0	0.0	0.0	-0.1	0.1	0.0	-0.2
20	0.1	0.0	-0.1	0.0	0.0	-0.2	0.0	0.0	-0.2
21	0.0	0.0	-0.1	0.0	0.0	-0.2	0.0	0.0	-0.2
22	0.0	0.0	-0.1	-0.1	-0.1	-0.3	0.0	-0.1	-0.3
23	0.0	-0.1	-0.2	-0.1	-0.2	-0.4	0.0	-0.2	-0.4
24	-0.1	-0.2	-0.2	-0.1	-0.3	-0.5	-0.1	-0.2	-0.4
25	-0.1	-0.3	-0.3	-0.2	-0.3	-0.5	-0.1	-0.3	-0.5
26	-0.1	-0.3	-0.3	-0.2	-0.4	-0.6	-0.1	-0.3	-0.5
27	-0.1	-0.4	-0.4	-0.3	-0.5	-0.7	-0.2	-0.4	-0.6
28	-0.2	-0.4	-0.4	-0.3	-0.6	-0.8	-0.2	-0.5	-0.7
29	-0.2	-0.5	-0.5	-0.4	-0.7	-0.9	-0.3	-0.6	-0.8
30	-0.3	-0.6	-0.6	-0.5	-0.8	-1.0	-0.3	-0.7	-0.9
31	-0.3	-0.7	-0.7	-0.6	-1.0	-1.2	-0.4	-0.8	-1.0
32	-0.4	-0.8	-0.8	-0.6	-1.1	-1.3	-0.4	-0.9	-1.1
33	-0.5	-0.9	-0.9	-0.7	-1.3	-1.5	-0.5	-1.1	-1.2
34	-0.6	-1.1	-1.0	-0.8	-1.6	-1.7	-0.6	-1.3	-1.4
35	-0.7	-1.2	-1.2	-1.0	-1.8	-1.9	-0.7	-1.4	-1.5
36	-0.8	-1.5	-1.3	-1.2	-2.1	-2.2	-0.8	-1.7	-1.7
37	-1.0	-1.7	-1.5	-1.4	-2.5	-2.5	-1.0	-1.9	-1.9
38	-1.2	-2.0	-1.7	-1.6	-2.9	-2.8	-1.2	-2.2	-2.2
39	-1.4	-2.4	-2.0	-2.0	-3.5	-3.2	-1.4	-2.6	-2.4
40	-1.7	-2.7	-2.3	-2.4	-4.0	-3.6	-1.7	-2.9	-2.7
41	-2.1	-3.1	-2.6	-2.8	-4.5	-4.1	-1.9	-3.3	-3.0
42	-2.5	-3.6	-3.0	-3.4	-5.2	-4.6	-2.3	-3.7	-3.5
43	-3.0	-4.1	-3.4	-3.9	-5.8	-5.3	-2.6	-4.2	-3.9
44	-3.5	-4.6	-3.9	-4.6	-6.7	-6.2	-3.1	-4.7	-4.5
45	-4.7	-6.0	-5.2	-6.1	-8.7	-8.6	-4.1	-6.0	-6.4
46	-7.0	-8.4	-7.8	-8.8	-12.2	-9.2	-5.7	-8.4	-9.7



FRONT ELEVATION WITH TEST SPECIMEN REMOVED



SECTION VIEW

Figure 1. Full-Scale Wall Furnace Test Facility

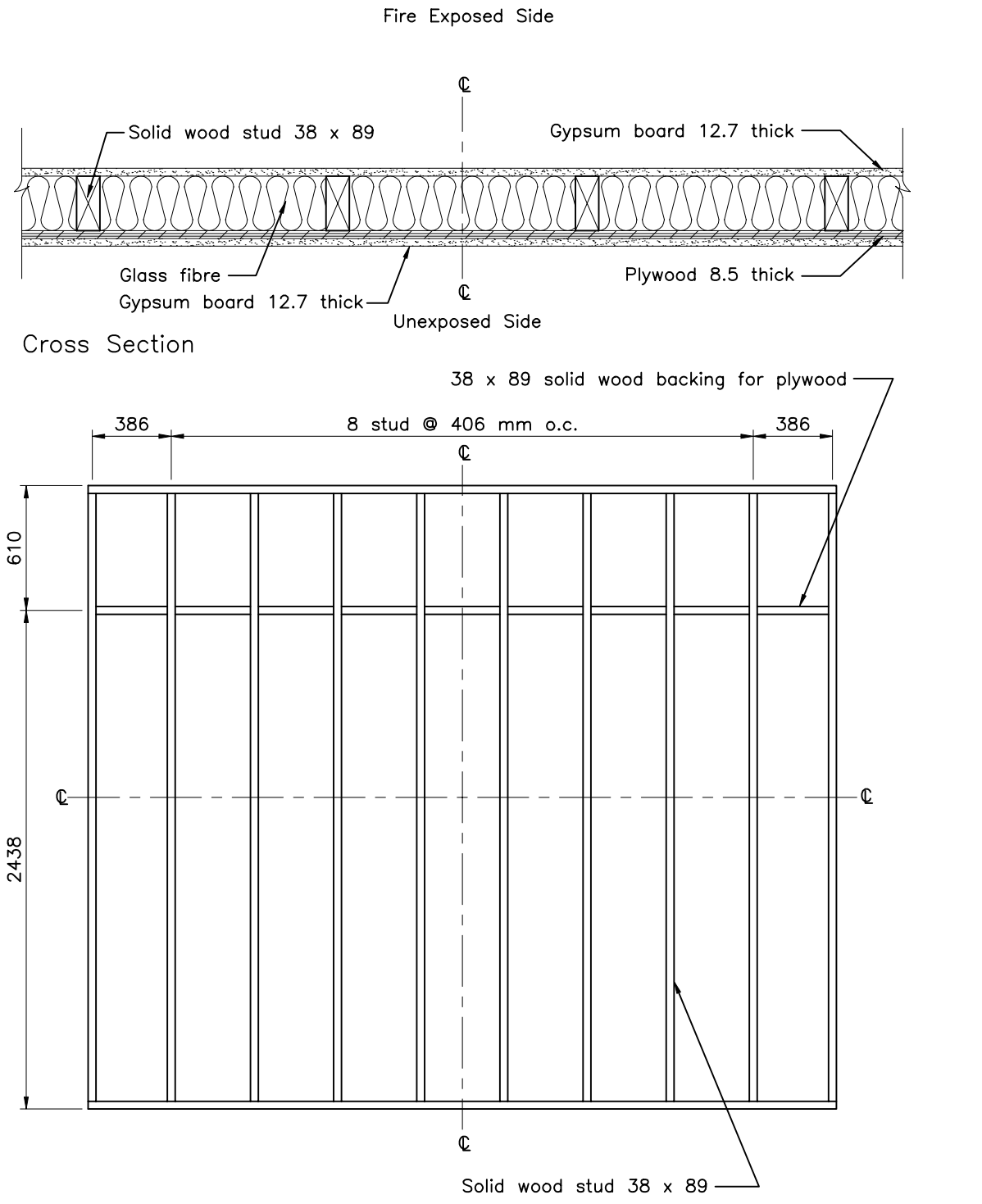


Figure 2. Wood Stud Layout and Cross Sectional Details for Wall Assembly F–33

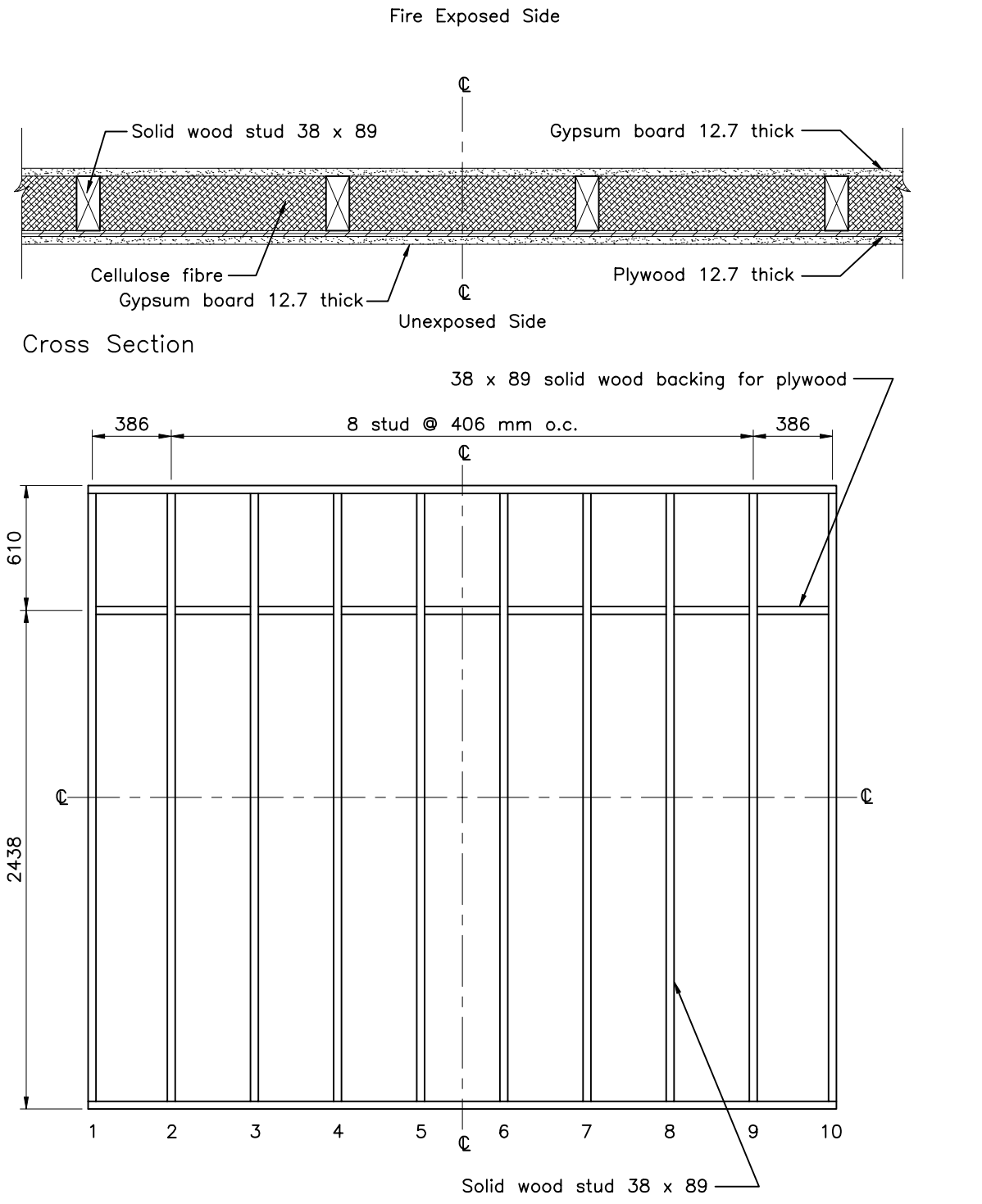
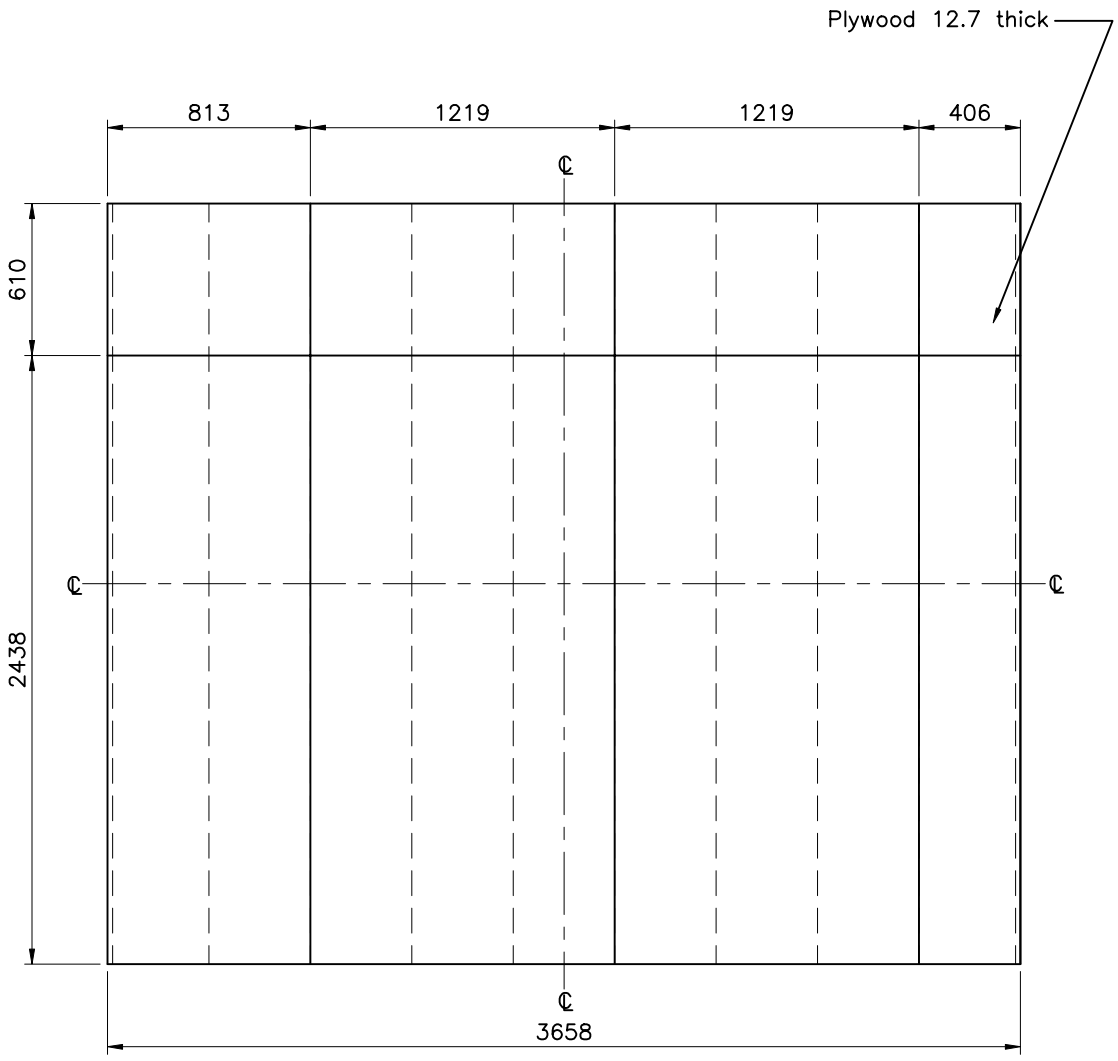
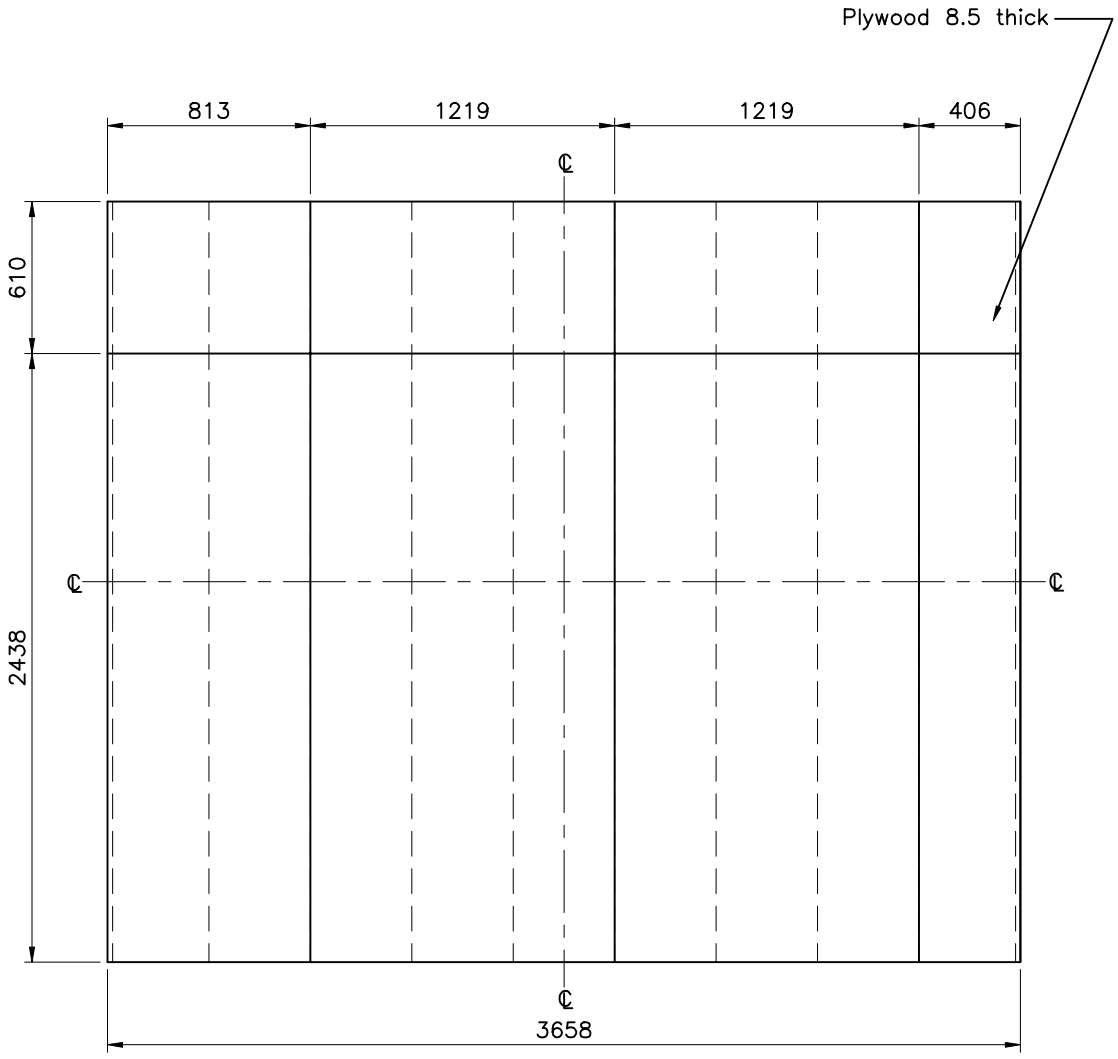


Figure 3. Wood Stud Layout and Cross Sectional Details for Wall Assembly F–32



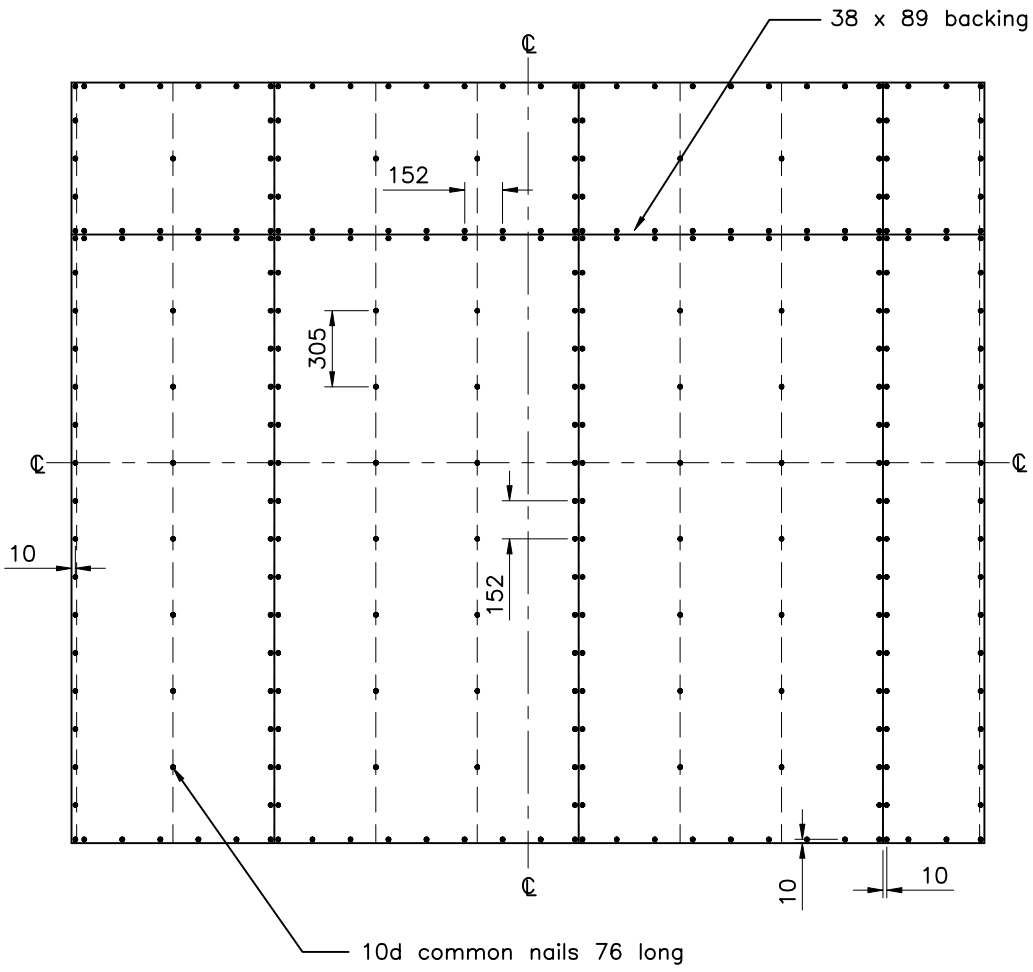
(Dimensions are in millimetres)

Figure 4. Shear Bracing Layout (Unexposed Side) for Wall Assembly F–32



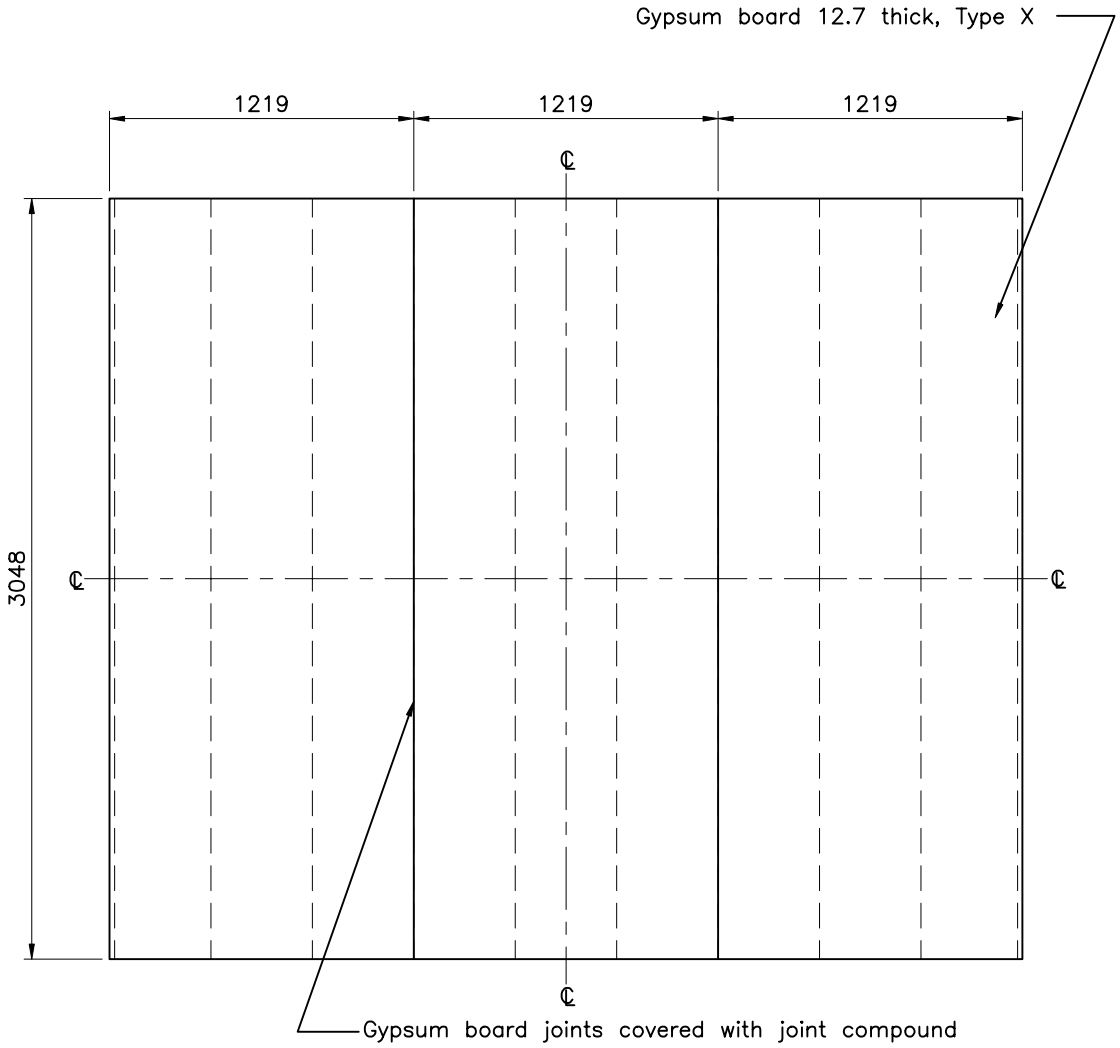
(Dimensions are in millimetres)

Figure 5. Shear Bracing Layout (Unexposed Side) for Wall Assembly F–33



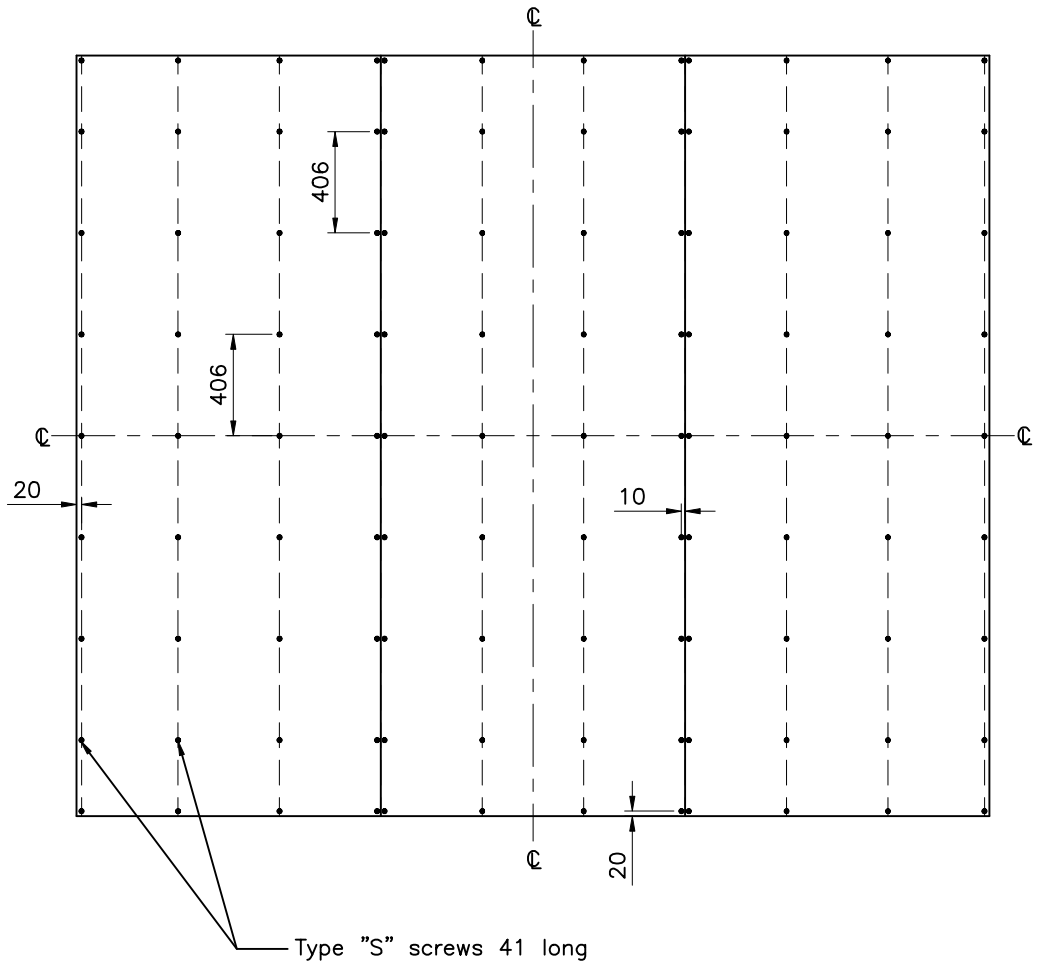
(Dimensions are in millimetres)

Figure 6. Nail Pattern for the Attachment of the Shear Bracing (Unexposed Side) to Wall Assemblies F–32 and F–33



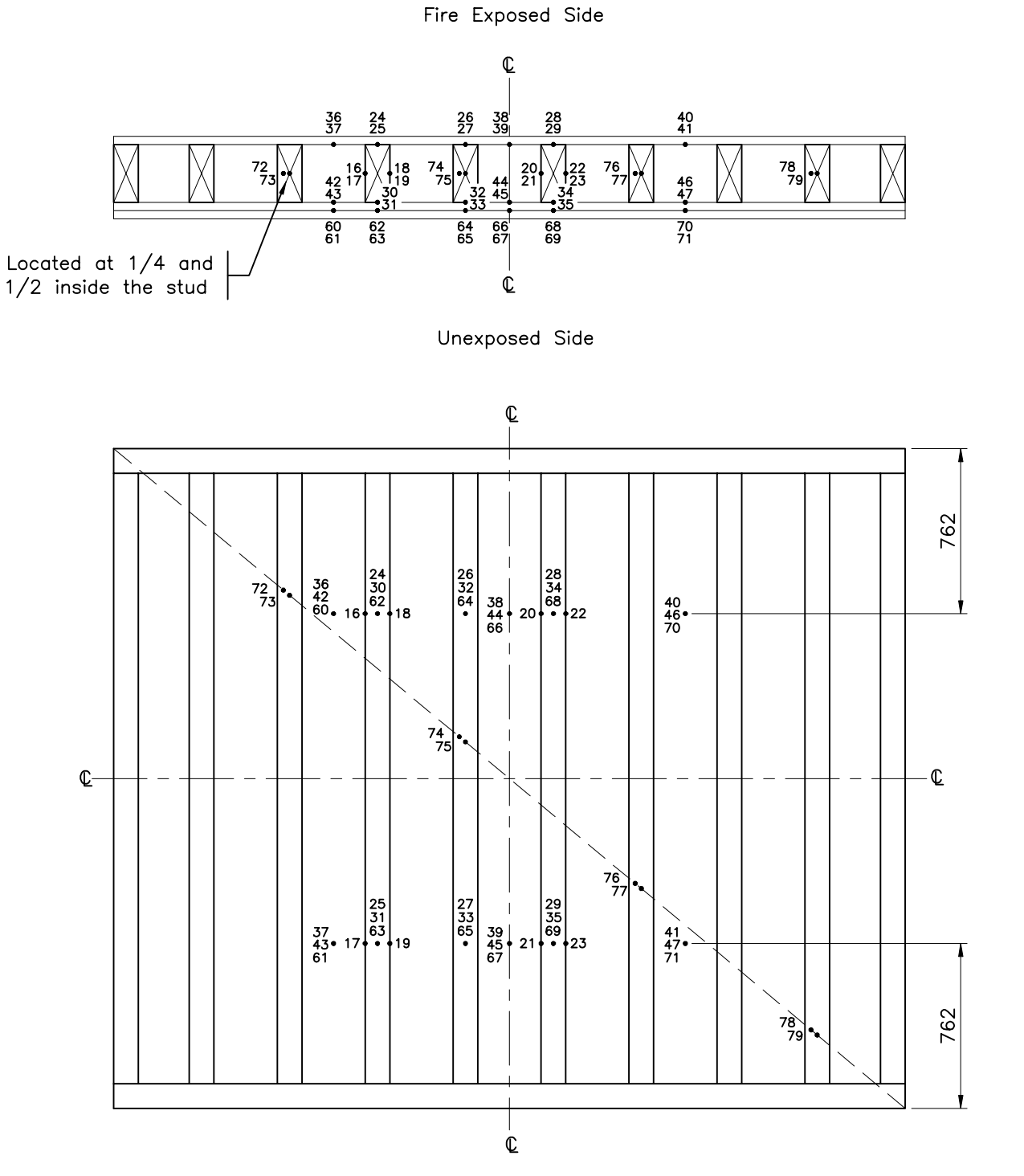
(Dimensions are in millimetres)

Figure 7. Gypsum Board Layout on Exposed and Unexposed side of Wall Assemblies F–32 and F–33



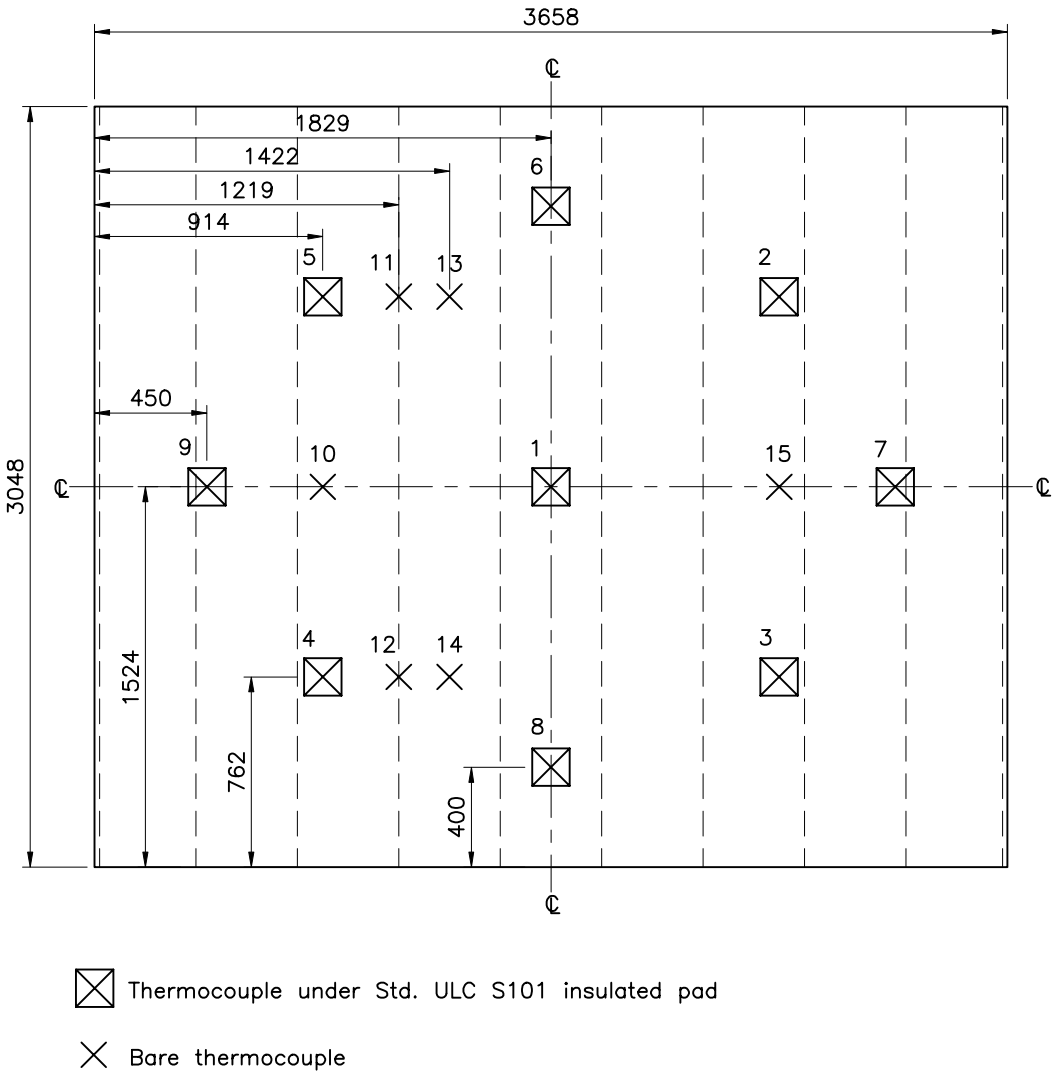
(Dimensions are in millimetres)

Figure 8. Screw Pattern for the Attachment of the Gypsum Board (Exposed and Unexposed Side) to Wall Assemblies F–32 and F–33



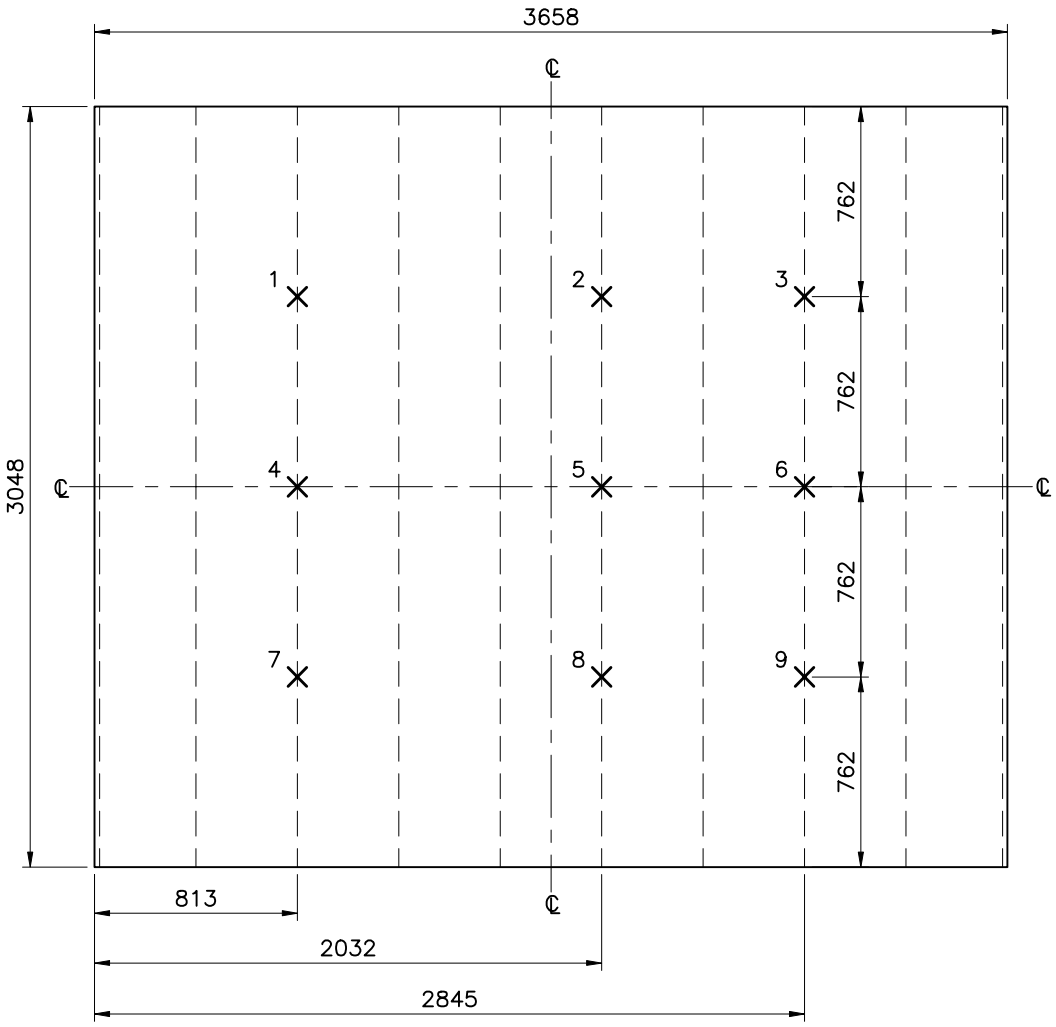
(Dimensions are in millimetres)

Figure 9. Thermocouple Locations in Wall Assemblies F–32 and F–33



(Dimensions are in millimetres)

Figure 10. Thermocouple Locations on Unexposed Surface of Wall Assemblies F–32 and F–33



(Dimensions are in millimetres)

Figure 11. Deflection Measurement Locations in Wall Assemblies F–32 and F–33

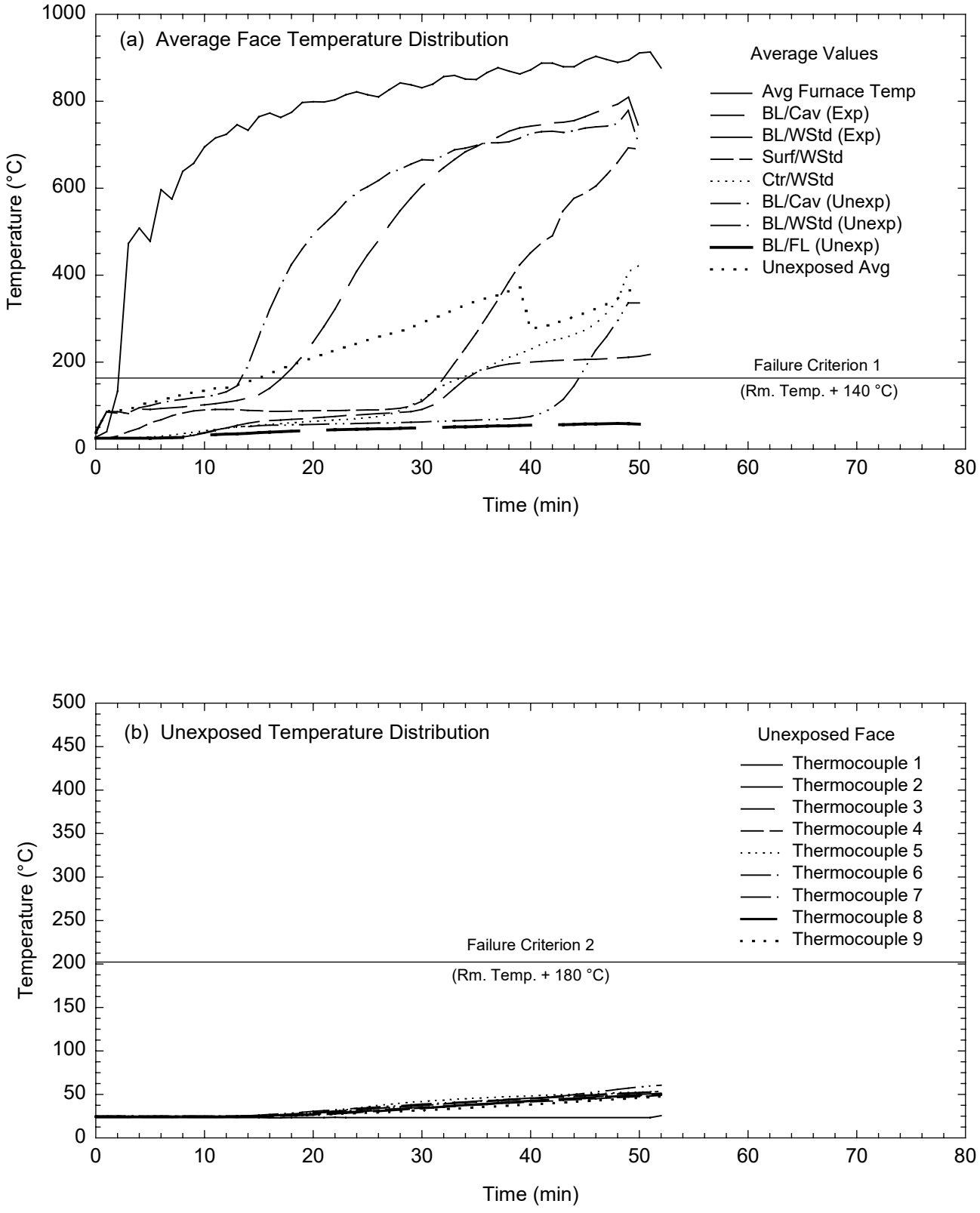
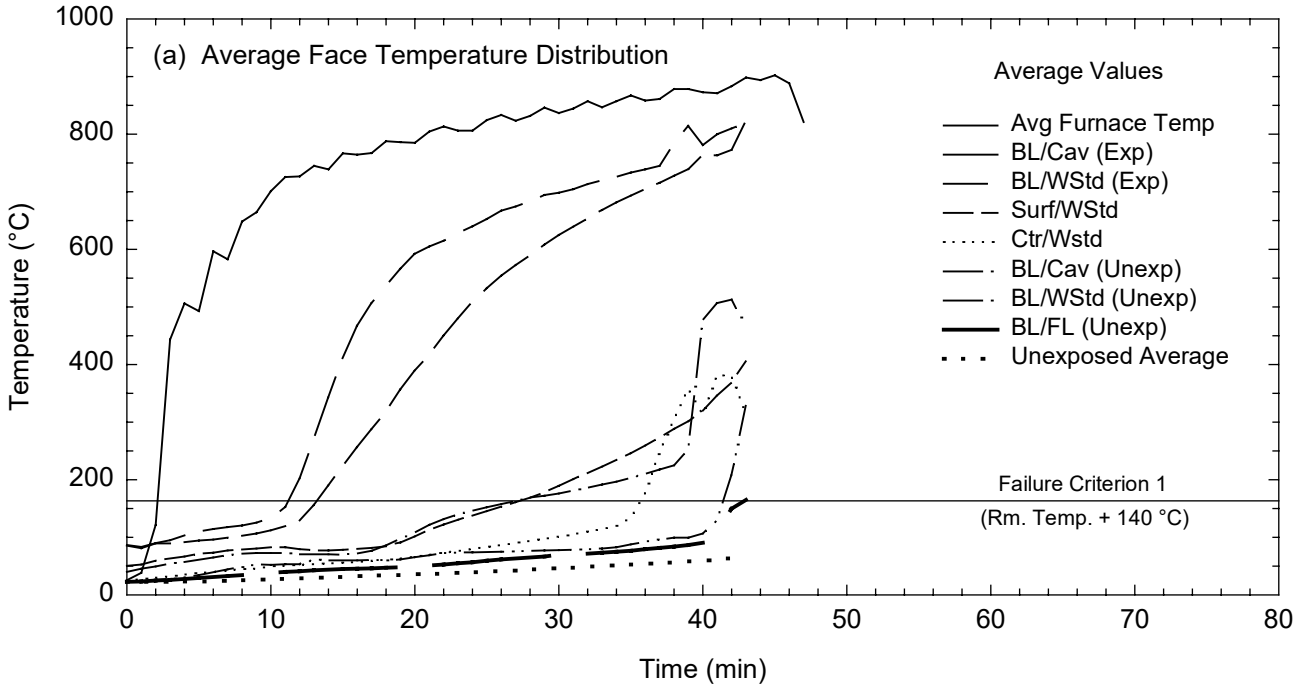


Figure 12. Temperature Distributions in Wood Stud Shear Wall Assembly F32



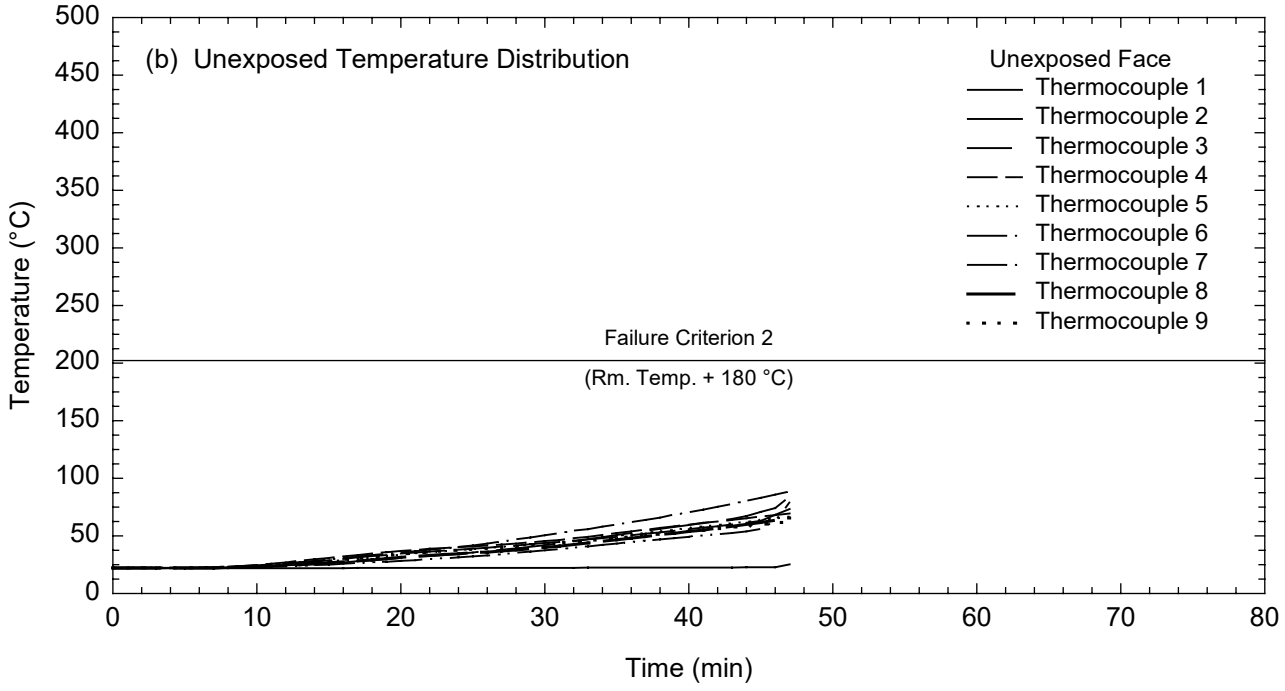


Figure 13. Temperature Distributions in Wood Stud Shear Wall Assembly F33

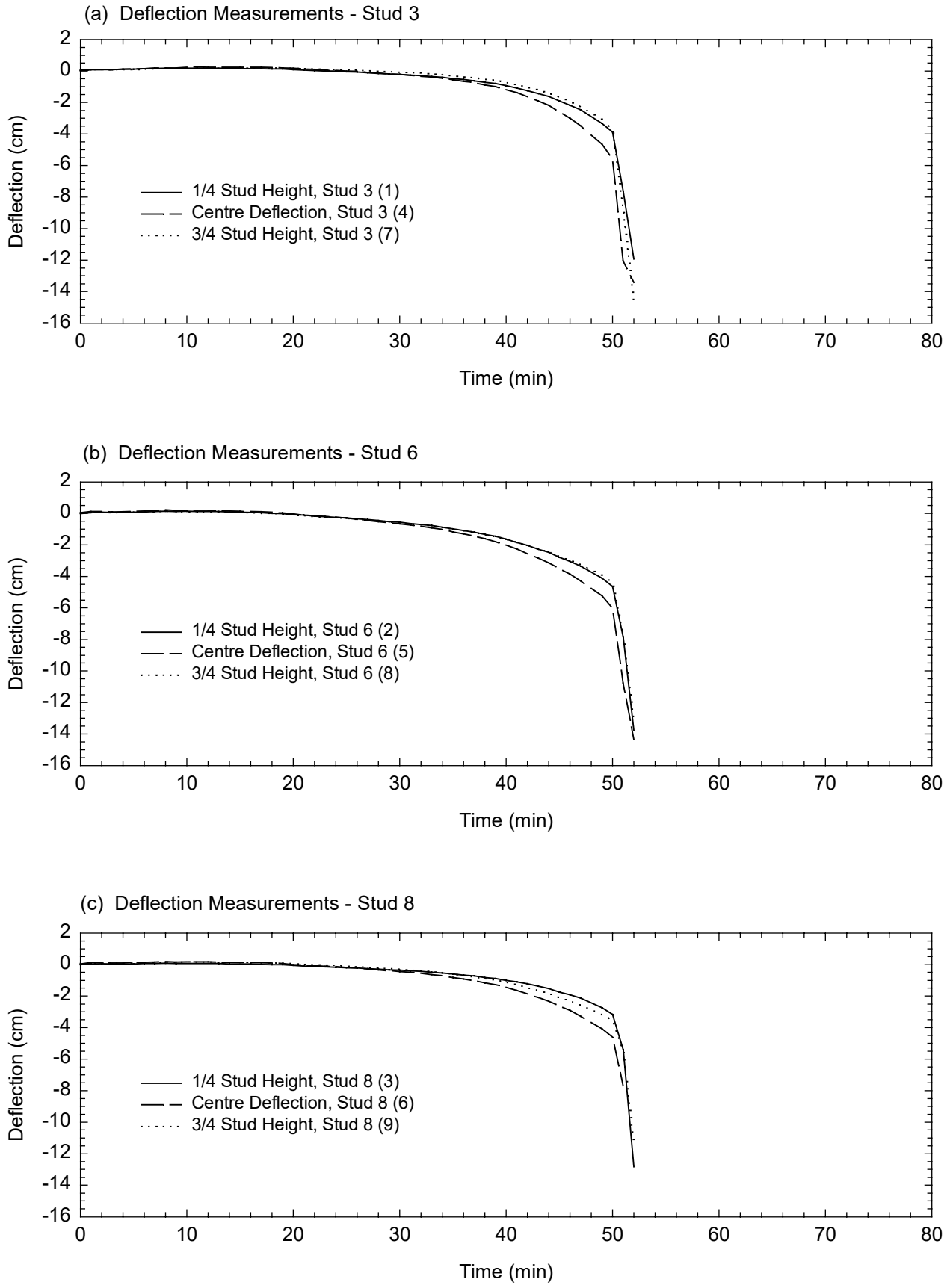


Figure 14. Measured Deflections in Wood Stud Wall Assembly F32

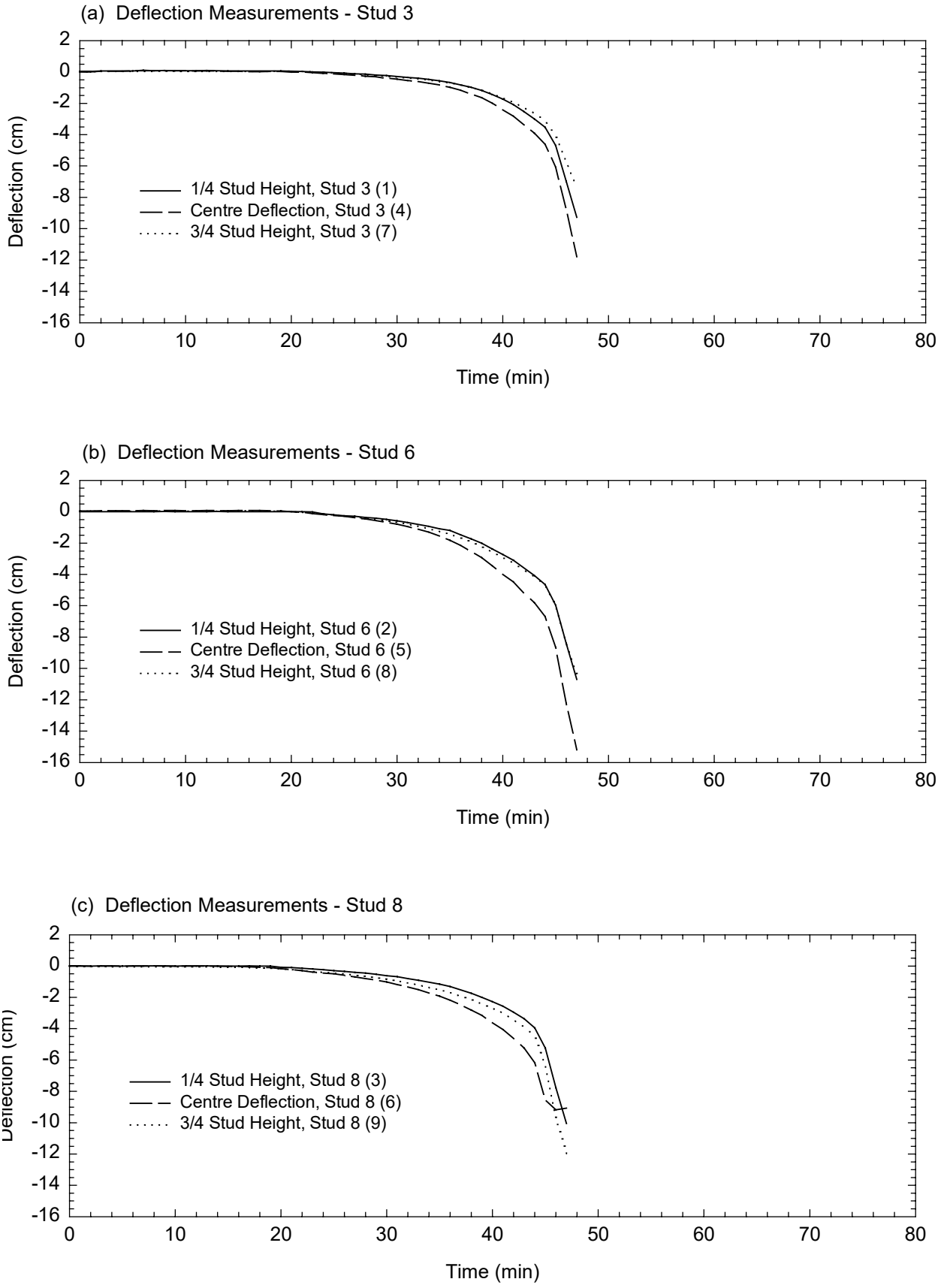


Figure 15. Measured Deflections in Wood Stud Wall Assembly F33