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CHEMISTRY AND CHEMICAL ENGINEERING DIVISION
FIRE TECHNOLOGY DEPARTMENT
WWW.FIRE.SWRI.ORG
FAX (210) 522-3377

FIRE PERFORMANCE EVALUATION OF M N CHAI CORPORATION CO., LTD.'S, *AATIS/FR 4-MM THICK ALUMINUM CLAD PANEL,* TESTED IN ACCORDANCE WITH UBC 26-9, *METHOD OF TEST FOR THE EVALUATION OF FLAMMABILITY CHARACTERISTICS OF EXTERIOR, NONLOAD-BEARING WALL ASSEMBLIES CONTAINING COMBUSTIBLE COMPONENTS USING THE INTERMEDIATE-SCALE, MULTISTORY TEST APPARATUS,* 1997 EDITION

FINAL REPORT
Consisting of 35 Pages

SwRI® Project No. 01.15677.01.002
Test Date: August 26, 2010
Report Date: September 23, 2010

Prepared for:

M N Chai Corporation Co., Ltd.
95/397-8 Rama 3 Road, Soi 52
Chongnonsee, Yannawa
Bangkok, 10120
THAILAND

Prepared by:

for

Barry L. Badders Jr., P.E.
Manager
Fire Resistance Section

Approved by:

Matthew S. Blais, Ph.D.
Acting Director
Fire Technology Department

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ABSTRACT

Southwest Research Institute's (SwRI) Fire Technology Department, located in San Antonio, TX, conducted an Intermediate-Scale Multistory Test Apparatus (ISMA) fire performance evaluation test for M N Chai Corporation Co., Ltd., located in Bangkok, Thailand. Testing was conducted on August 26, 2010, on a wall assembly utilizing M N Chai Corporation Co., Ltd.'s, *AATIS/FR 4-mm Thick Aluminum Clad Panel.*

Testing was performed in accordance with the Uniform Building Code Standard 26-9, *Method of Test for the Evaluation of Flammability Characteristics of Exterior Nonload-Bearing Wall Assemblies Containing Combustible Components Using the Intermediate-Scale, Multistory Test Apparatus,* 1997 Edition. The wall assembly **met** the acceptance criteria stated in the standard.

This report contains a description of the test procedure followed, assembly tested, and the results obtained. The results apply specifically to the specimens tested, in the manner tested, and not to similar materials, nor to the performance when used in combination with other materials.

1.0 INTRODUCTION

Southwest Research Institute's (SwRI) Fire Technology Department, located in San Antonio, TX, conducted an Intermediate-Scale Multistory Test Apparatus (ISMA) fire performance evaluation test for M N Chai Corporation Co., Ltd., on a wall assembly utilizing M N Chai Corporation Co., Ltd.'s, *AATIS/FR 4-mm Thick Aluminum Clad Panel*. The test was conducted on August 26, 2010, in accordance with the procedures described in the Uniform Building Code Standard 26-9, *Method of Test for the Evaluation of Flammability Characteristics of Exterior Nonload-Bearing Wall Assemblies Containing Combustible Components Using the Intermediate-Scale, Multistory Test Apparatus*, 1997 Edition. The wall assembly **met** the acceptance criteria as stated in the UBC 26-9 test standard.

This report contains a description of the test procedure followed, assembly tested, and the results obtained. The results apply specifically to the specimens tested, in the manner tested, and not to similar materials, nor to the performance when used in combination with other materials.

2.0 SCOPE

UBC 26-9 provides a method of determining the flammability characteristics of exterior, nonload bearing wall assemblies, which contain combustible components.

The test method is intended to simulate the "full-scale" fire performance of the wall assembly being evaluated. The primary performance characteristics evaluated in this test are the capability of the test wall assembly to resist the following:

1. Flame propagation over the exterior face of the system,
2. Vertical flame spread within the combustible core components from one story to the next,
3. Vertical flame spread over the interior (room side) surface of the panels from one story to the next, and
4. Lateral flame spread from the compartment of fire origin to adjacent spaces.

The above are assessed through visual observations and temperature data obtained during the test.

3.0 TEST ASSEMBLY

SwRI received the sample from M N Chai Corporation Co., Ltd., on August 19, 2010. The system was preassembled in two sections. The test sample was constructed with 3 × 1-9/16 × 3/16-in. (76 × 40 × 5-mm) C-channel. Attached to each side of the channel was 5/8-in. (16-mm), Type "X", gypsum wallboard. The cavity between the gypsum wall board was filled with 1-in. (25-mm) thick, 2-lb/ft^3 (32-kg/m^3) fiberglass insulation and 2-in. (51-mm) thick, 8-lb/ft^3 (128-kg/m^3) mineral wool insulation. The fiberglass insulation was on the fire exposed (interior) side. The exterior of the wall

as finished with M N Chai Corporation Co., Ltd.'s, *AATIS/FR 4-mm Thick Aluminum Clad Panel*, that included a 1-in. (25-mm) air gap between the gypsum wall board and the panel system. The *AATIS/FR 4-mm Thick Aluminum Clad Panel* consisted of 0.02-in. (0.5-mm) aluminum skins with a 0.12-in. (3-mm) magnesium hydroxide polyethylene core. The window sill, jambs, and header were finished with one layer of 5/8-in. (16-mm), Type "X", gypsum wallboard. Detailed drawings of the test sample are located in Appendix A.

SwRI personnel assembled the two panels into a test frame and attached the provided gypsum wallboard to the interior surface of the wall. The test wall assembly for the ISMA test was built into a movable frame system that was installed and secured to the test apparatus.

4.0 CALIBRATION

UBC 26-9, Section 26.907, requires the apparatus to be calibrated (a) initially, prior to the first wall assembly test, (b) when significant changes to the gas flow system are made, (c) within 1 year prior to the test on an actual product wall assembly, or (d) whenever ceramic blanket covering more than 50% of the wall or ceiling surface in the burn room is replaced.

SwRI conducted an ISMA calibration test on February 4, 2010, with the burner regime shown in Table 1. This calibration confirmed the burner regime necessary to reach the required temperatures and heat flux levels.

Table 1. Burner Regime.

Time Interval (min)	Room Burner SCFM	Room Burner kW (Btu/min)	Window Burner SCFM	Window Burner kW (Btu/min)
00:00 – 05:00	40.05	704 (40,045)	0.0	0 (0)
05:00 – 10:00	41.42	728 (41,422)	2.96	52 (2,960)
10:00 – 15:00	43.52	765 (43,523)	6.92	122 (6,918)
15:00 – 20:00	47.68	838 (47,676)	7.39	130 (7,394)
20:00 – 25:00	48.55	853 (48,546)	8.02	141 (8,016)
25:00 – 30:00	48.37	850 (48,374)	8.94	157 (8,938)

Table 2 compares the average heat flux data obtained during the calibration test with the allowable heat flux ranges specified in Table 29-9-B of UBC 26-9 for the indicated time period.

Table 2. Heat Flux Values for ISMA Calibration.
(Average Values for Time Period Indicated)

Time (min)		0–5	5–10	10—15	15–20	20–25	25–30
Calorimeter 1 (2 ft Above Window, W/cm²)	Range	0.7–1.1	1.5–2.3	2.0–3.0	2.3–3.5	2.7–4.1	3.0–4.6
	Actual	1.1	***2.5***	2.9	3.3	3.7	4.0
Calorimeter 2 (3 ft Above Window, W/cm²)	Range	0.8–1.2	1.6–2.4	2.1–3.1	2.6–3.8	3.0–4.4	3.2–4.8
	Actual	1.1	***2.6***	3.0	3.5	3.7	4.2
Calorimeter 3 (4 ft Above Window, W/cm²)	Range	0.6–1.0	1.2–1.8	1.6–2.4	2.0–3.0	2.4–3.6	2.7–4.1
	Actual	0.8	***2.0***	2.3	2.7	2.9	3.1

Notes: Window Burner placed 1-in. away from face of wall assembly. The values obtained 5 to 10 min into the calibration were slightly above the limit. These values represent a more severe test scenario, and therefore, are considered acceptable.

Table 3 compares the average temperature data obtained during the calibration test with the allowable temperature ranges specified in Table 29-9-B of UBC 26-9 for the indicated period. The allowable temperature range is ± 10% of the temperature values specified in Table 29-9-B.

Table 3. Average Temperature Values for ISMA Calibration.
(Average Values for Time Period Indicated)

Time (min)		0–5	5–10	10–15	15–20	20–25	25–30
Burner Room Average of 5 TCs (ºF)	Range	1036–1266	1211–1481	1334–1630	1440–1760	1437–1757	1483–1813
	Actual	1116	1326	1418	1519	1571	1595
Interior Wall Surface Average of 3 TCs (ºF)	Range	959–1172	1168–1428	1290–1576	1420–1736	1418–1734	1490–1821
	Actual	1097	1324	1412	1521	1581	1612
1 ft Above Window (ºF)	Range	542–662	782–957	857–1047	893–1091	941–1151	970–1186
	Actual	563	917	990	1049	1086	1115
2 ft Above Window (ºF)	Range	611–747	914–1117	1009–1233	1065–1301	1121–1370	1166–1426
	Actual	635	1058	1139	1213	1257	1306
3 ft Above Window (ºF)	Range	581–711	874–1068	986–1206	1057–1291	1121–1370	1183–1445
	Actual	587	1029	1107	1201	1243	1306
4 ft Above Window (ºF)	Range	519–635	772–944	884–1080	957–1169	1022–1249	1102–1346
	Actual	***500***	884	946	1057	1092	1149
5 ft Above Window (ºF)	Range	469–573	689–842	788–963	854–1044	906–1108	995–1217
	Actual	***431***	761	819	941	975	1024
6 ft Above Window (ºF)	Range	425–519	621–759	708–866	770–942	822–1004	909–1111
	Actual	***402***	690	737	861	884	922

Notes: Window Burner placed 1-in. away from face of wall assembly. Some early values are out of range. These values are the result of a compromise made to keep the heat flux values in Table 2 in range, as heat flux is the boundary condition.

In summary, the calibration test provides documented evidence that SwRI's ISMA successfully demonstrated the ability to achieve the fire exposure conditions specified in UBC 26-9, and that the facility can perform the fire evaluation described in UBC 26-9.

5.0 INSTRUMENTATION

The instrumentation for this test consisted of thermocouples (TCs) at the following locations:

- Exterior and interior face of test wall assembly as shown in Figures A-2 and A-3, respectively.
- Burn room ceiling area as shown in Figure A-4.
- Within the combustible core, air cavity, and/or insulation as shown in Figure A-5.

The temperature measurements were made using 18-ga, Type "K" TCs in the burn room and 20-ga, Type "K" TCs in all other locations. All data was recorded at intervals not exceeding 15 s. Flow rate of natural gas to each of the burners was monitored and recorded using calibrated turbine meters and frequency converters.

6.0 TEST PROCEDURE

Testing was conducted on August 26, 2010, in accordance with UBC 26-9. Instrumentation connections were verified, and the window burner was positioned inside the room such that the vertical centerline of the window burner was offset 1 in. from the exterior face of the test wall assembly. The test conditions were recorded as an ambient temperature of 85 °F and a relative humidity of 54% on August 26, 2010. The airflow across the exterior face of the test assembly was less than 4 ft/s as determined by an anemometer placed at right angles to the exterior face.

Documentation for the test consisted of digital photographs taken of the test wall assembly during the test, and during post-test to include dissection of the test assembly. Color video of the exterior face of the test wall assembly was taken prior to, during, and post-test. Color video of the test wall/floor intersection in the second-floor level was taken during the test period. Information from the second-floor video is used to assist in determination of flame penetration and/or smoke development.

7.0 TEST RESULTS

The ISMA performance evaluation test for M N Chai Corporation Co., Ltd.'s, *AATIS/FR 4-mm Thick Aluminum Clad Panel,* was conducted on August 26, 2010. Visual observations made during the test appear in Table 4. Flame propagation observations are based on sustained flames on the surface of the wall. Intermittent flaming above the sustained flames is not considered for estimating the extent of flame propagation. The following sections outline the performance of the wall assembly with respect to the conditions of acceptance detailed in UBC 26-9.

Table 4. Test Observations of Front Wall.

TIME (min:s)	VISUAL OBSERVATIONS OF FRONT WALL
00:00	Start of test.
02:00	Flame out of window is visible.
02:30	Buckling of the panels is visible.
05:00	Window burner added.
06:00	Buckling of the panels is visible to the 14-ft demarcation.
08:00	No activity in the 2nd floor room.
09:00	Heavy deflection of the panels just above the window. No aluminum melting.
10:00	Discoloration of aluminum up to 6 or 7 ft.
10:30	Aluminum skin is blistering.
10:45	Paint on aluminum is peeling off.
13:00	Light smoking from top of wall.
15:00	Discoloration to 9 ft.
17:30	Aluminum still intact.
20:00	No notable change.
23:00	Discoloration and paint peeling just past 10 ft.
26:30	Small flame attached just above window.
28:30	Light smoke in 2nd floor room.
30:00	End of test. Observation period begins.
40:00	Observation period terminated.

Section 26.908, Part 1 - Flame Propagation Shall Not Occur beyond the Area of Flame Plume Impingement on the Exterior Face of the Wall Assembly:

1. TCs 11 and 14–17 did not exceed 1000 °F at any time during the test.
2. Flames emitting from the surface of the exterior face did not reach a vertical elevation of 10 ft above the top of the window opening at any time during the test.
3. Flames emitting from the surface of the exterior face did not reach a lateral distance of 5 ft from the vertical centerline of the window opening any time during the test.

Section 26.908, Part 2 - Flame Propagation Shall Not Occur Either Vertically or Laterally through the Core Components:

1. TCs 28 and 31–40 did not exceed 750 °F above their temperature as measured at the start of the test at any time during the test.

Section 26.908, Part 3 - Flame Propagation Shall Not Occur Laterally through the Core Components in the First-Floor Area:

1. Flames did not occur over the surface of the exterior face beyond the concrete block walls or beyond the intersection of the test wall assembly, and the concrete block fixture walls.
2. TCs 18 and 19 did not exceed 750 °F above their temperature as measured at the start of the test at any time during the test.

Section 26.908, Part 4 - Excessive Temperature 1 in. from the Interior Surface of the Test Wall Assembly within the Second-Floor Area Shall Not Exceed 500 °F above the Initial Ambient Temperature:

1. TCs 49–54 did not exceed 500 °F above the ambient temperature as measured at the start of the test at any time during the test.

Section 26.908, Part 5 - Flame Propagation Shall Not Occur within the Second-Floor Room:

1. Review of the pertinent TC data, second-floor videotape, and post-test inspection indicated that flame propagation did not occur in the second floor at any time during the test.

Appendix A contains descriptions of the wall assembly and Client-provided drawings. See Appendix B for photographic documentation of the test and post-test inspection. Graphical temperature data can be located in Appendix C.

8.0 CONCLUSION

SwRI's Fire Technology Department, conducted an ISMA fire performance evaluation test for M N Chai Corporation Co., Ltd., on August 26, 2010. Testing was conducted on a wall assembly utilizing M N Chai Corporation Co., Ltd.'s, *AATIS/FR 4-mm Thick Aluminum Clad Panel*. The test results indicate that the wall assembly **met** the acceptance criteria stated in the UBC 26-9 standard.

APPENDIX A

TEST ASSEMBLY DRAWINGS AND CLIENT-PROVIDED DRAWINGS

(CONSISTING OF 15 PAGES)

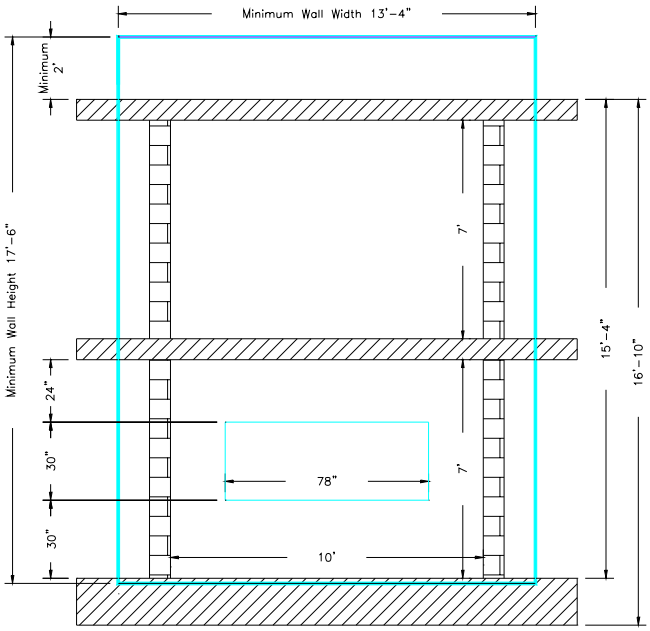

Figure A-1. Front View of Wall System in Place on Test Structure.

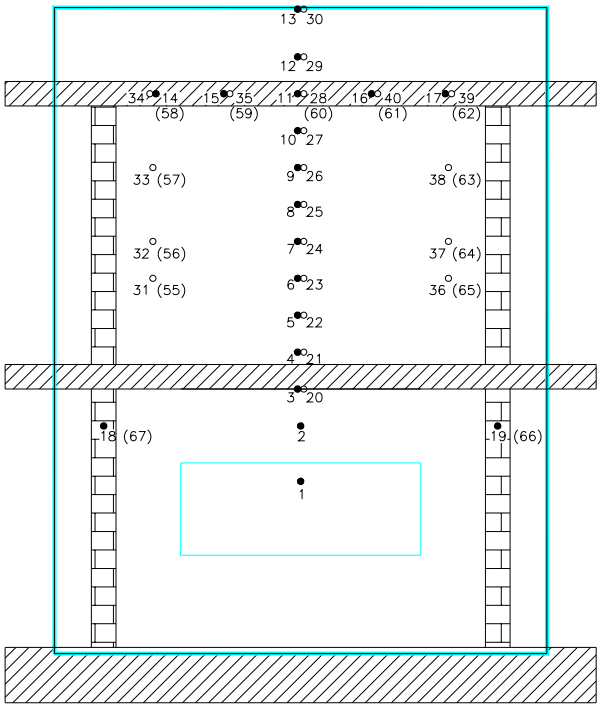

Figure A-2. Instrumentation Arrangement--Part I (Exterior Face).

• Surface TCs
o Cavity TCs

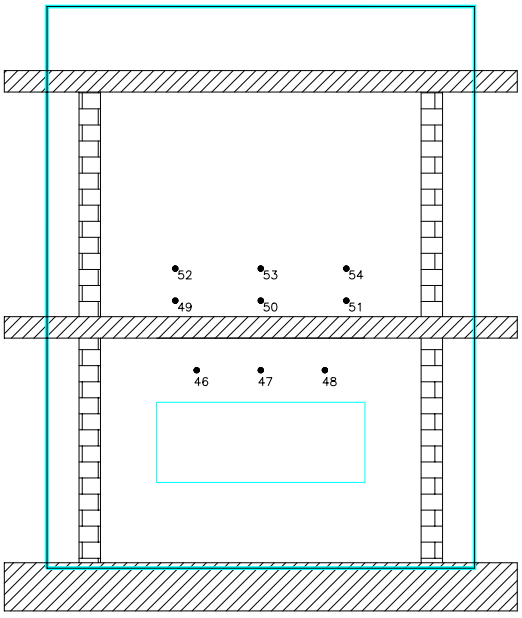

Figure A-3. Instrumentation Arrangement--Part II (Interior Face).

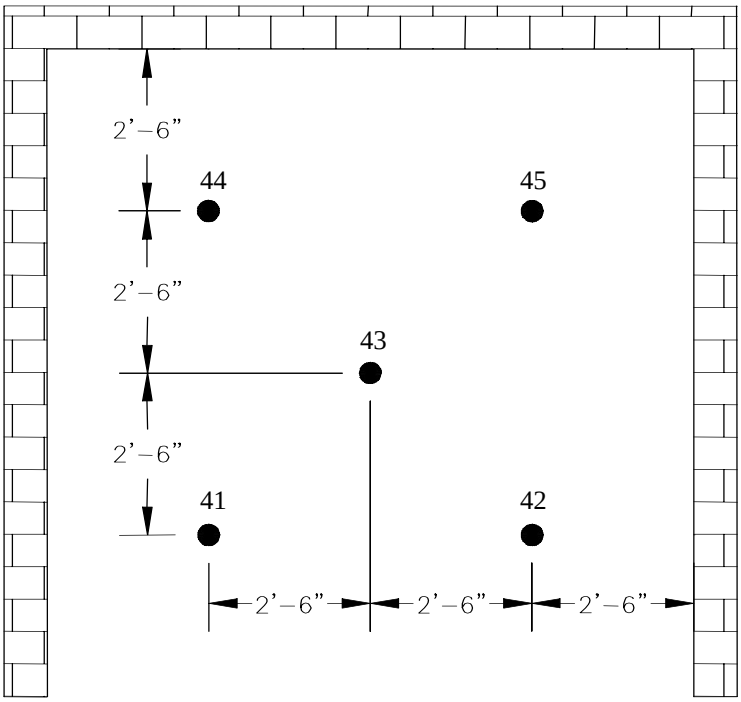

Figure A-4. Instrumentation Arrangement--Part III (Burn Roof Ceiling).

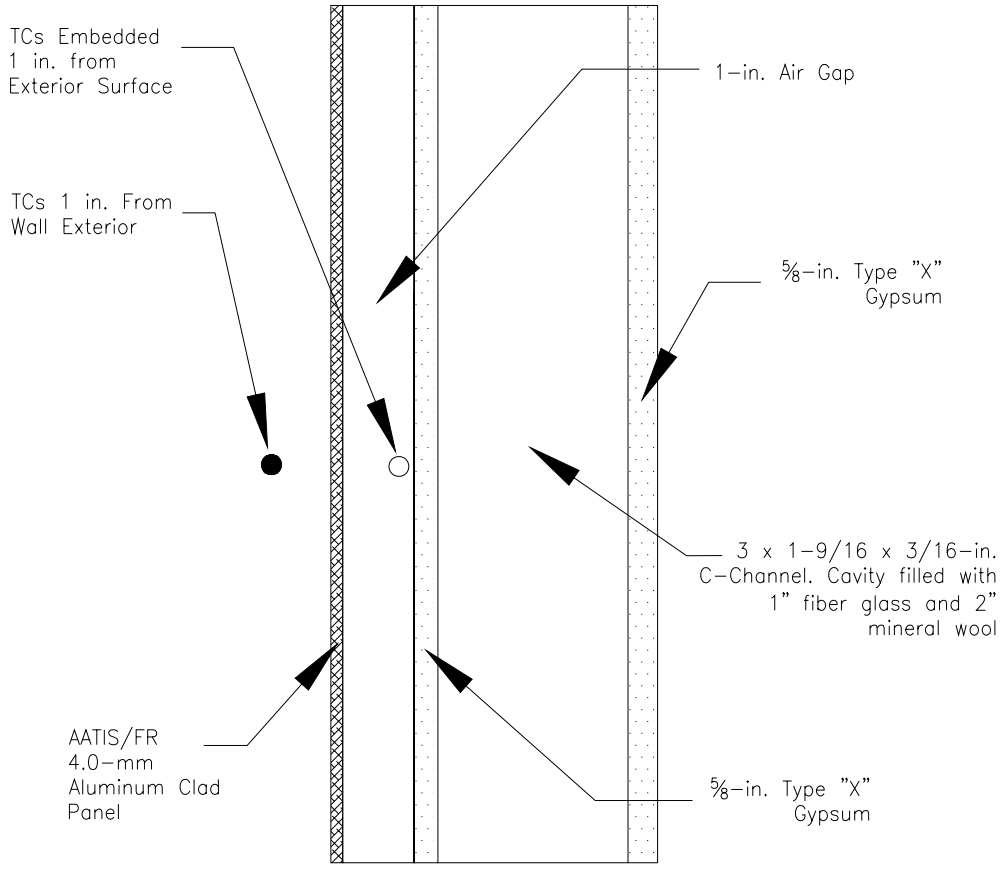

Figure A-5. Instrumentation Arrangement--Part IV.
(Combustible Core, Air Cavity, and/or Insulation)

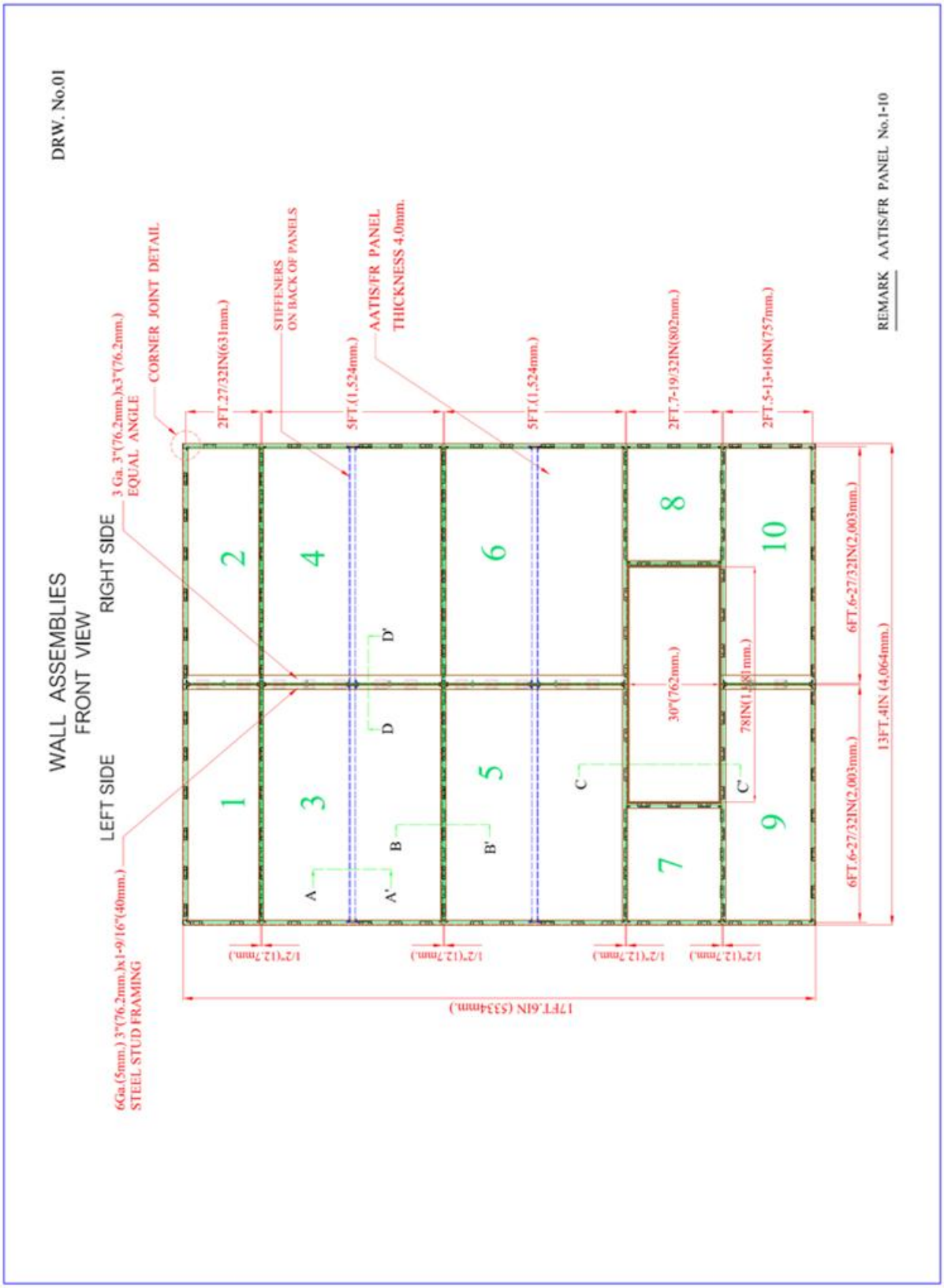

Figure A-6. Client-Provided Drawing.

Figure A-7. Client-Provided Drawing.

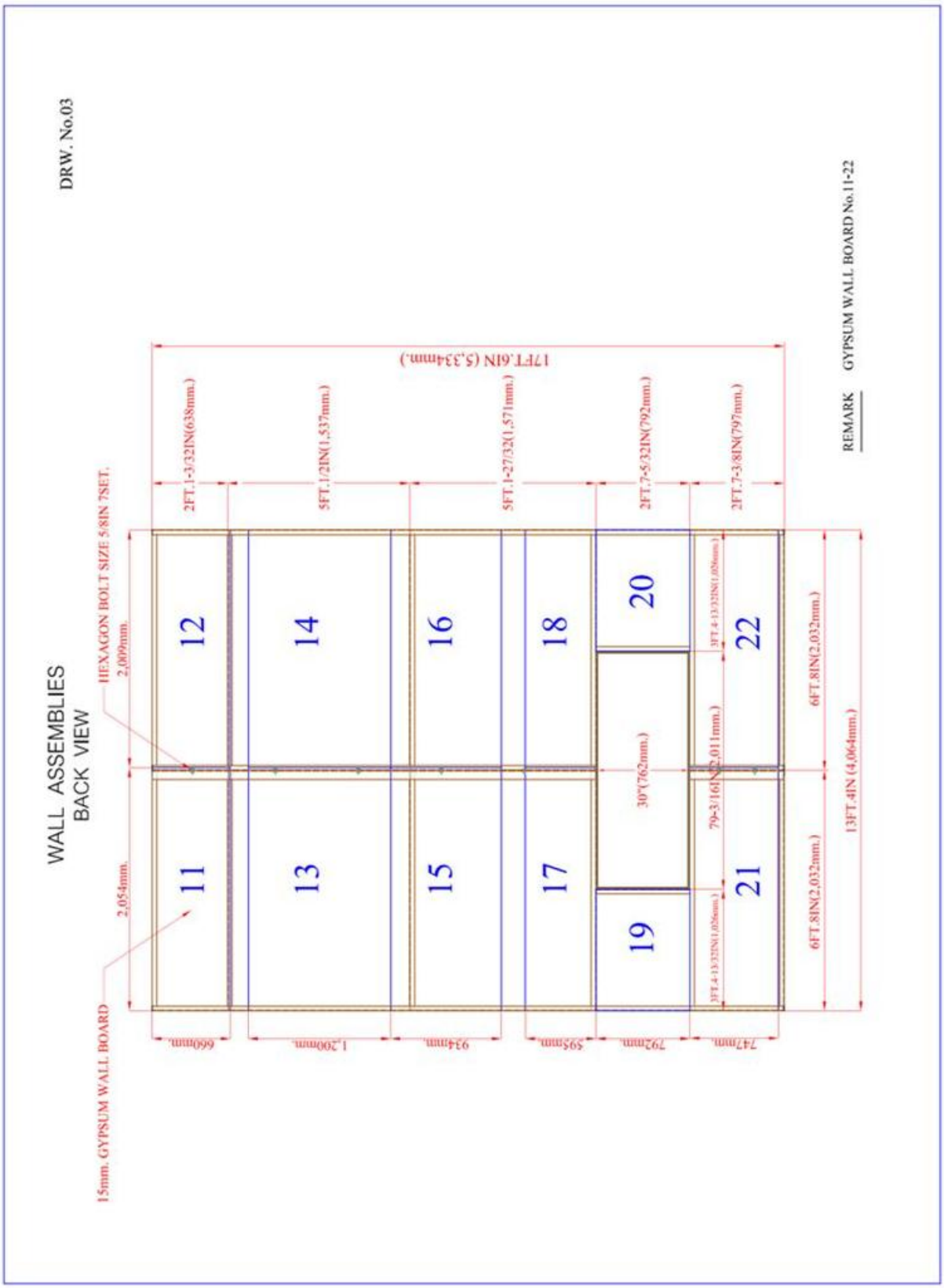

Figure A-8. Client-Provided Drawing.

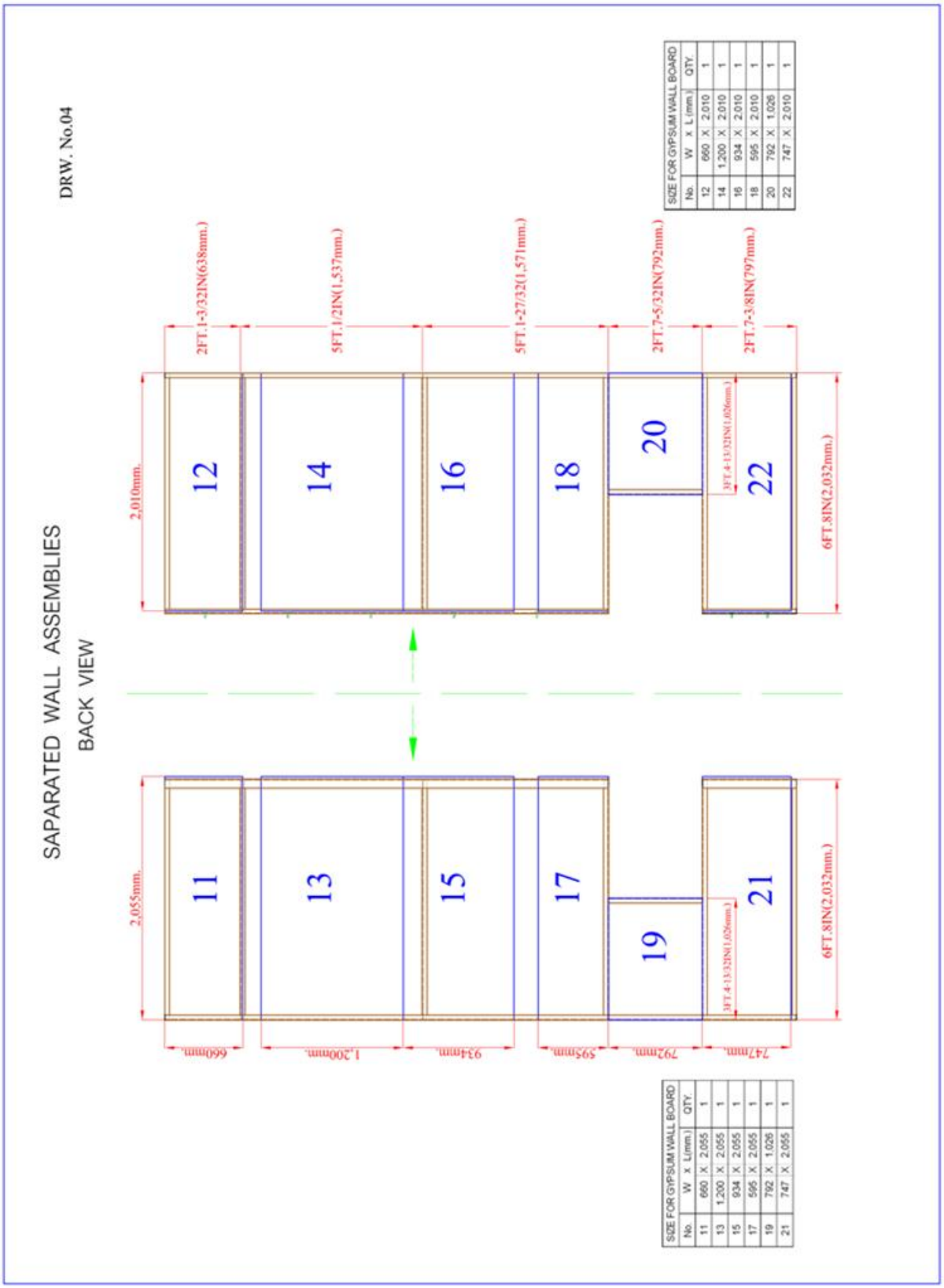

Figure A-9. Client-Provided Drawing.

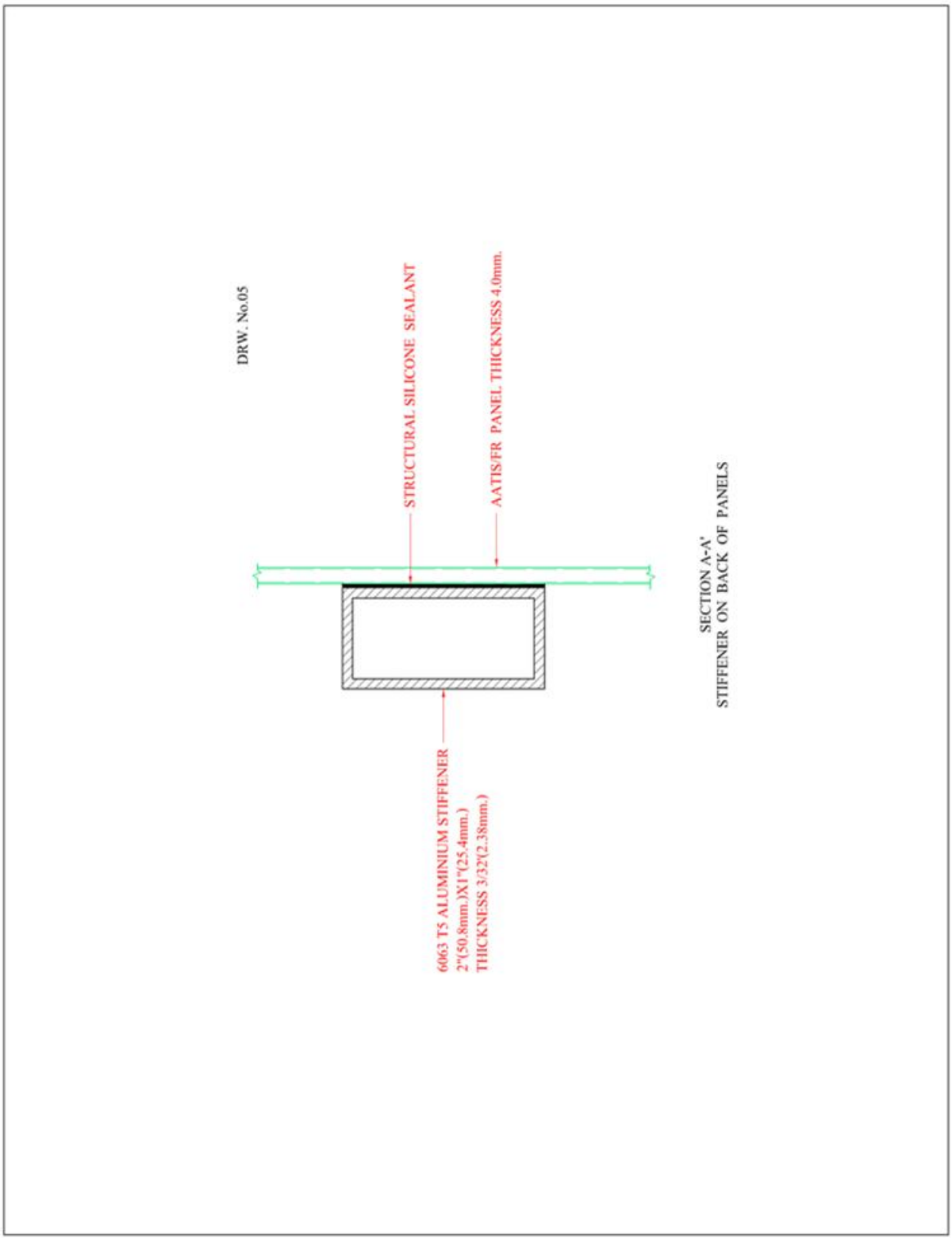

Figure A-10. Client-Provided Drawing.

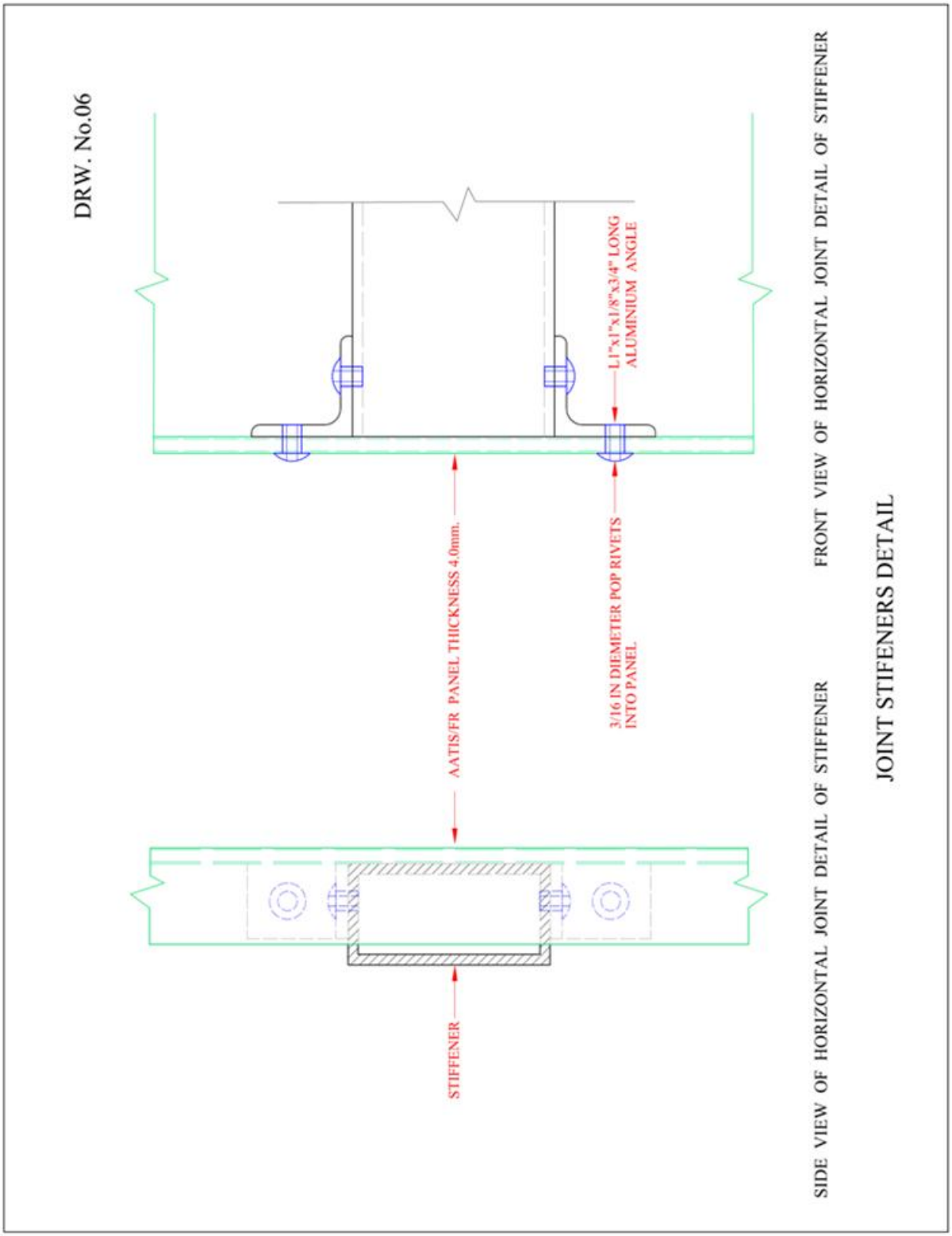

Figure A-11. Client-Provided Drawing.

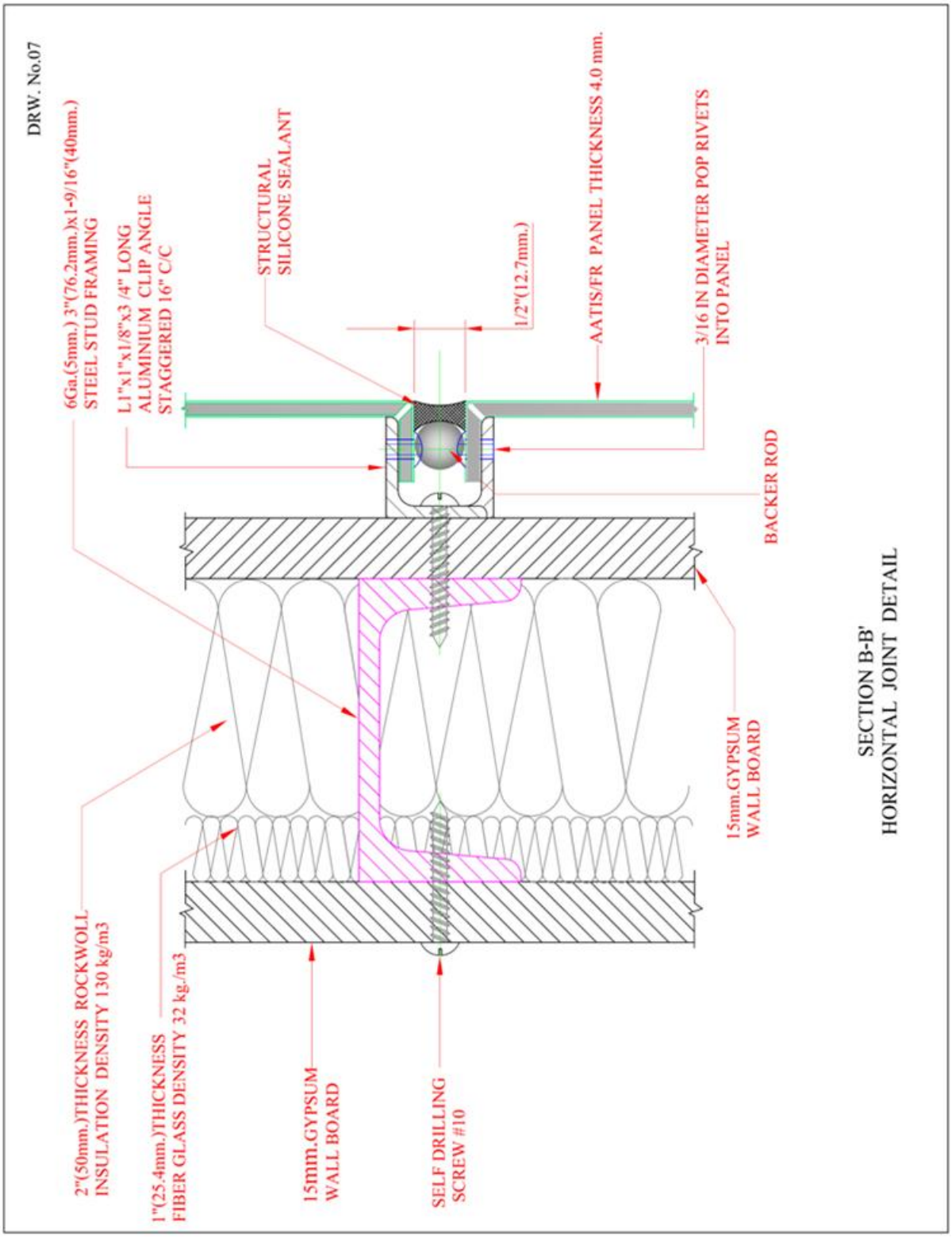

Figure A-12. Client-Provided Drawing.

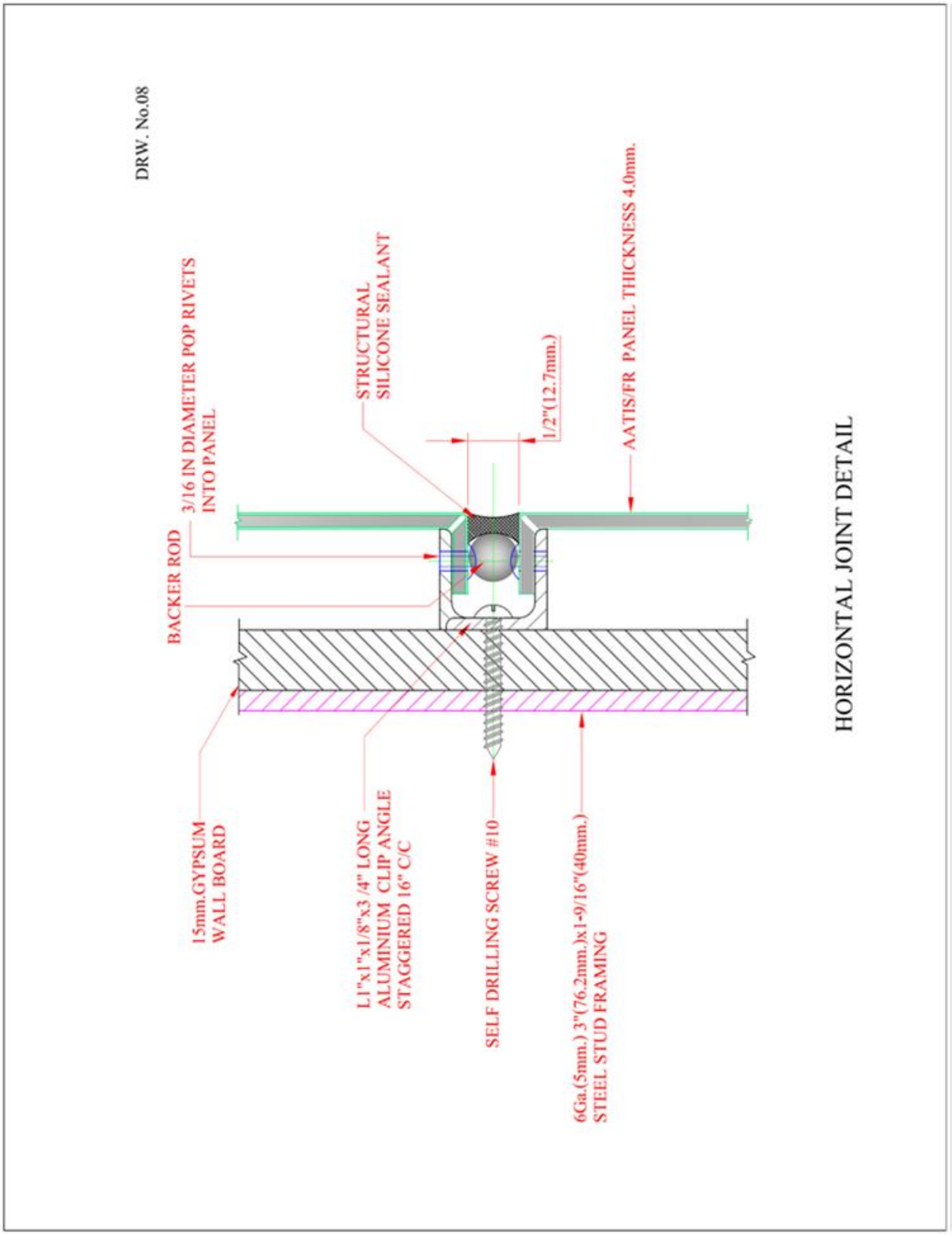

Figure A-13. Client-Provided Drawing.

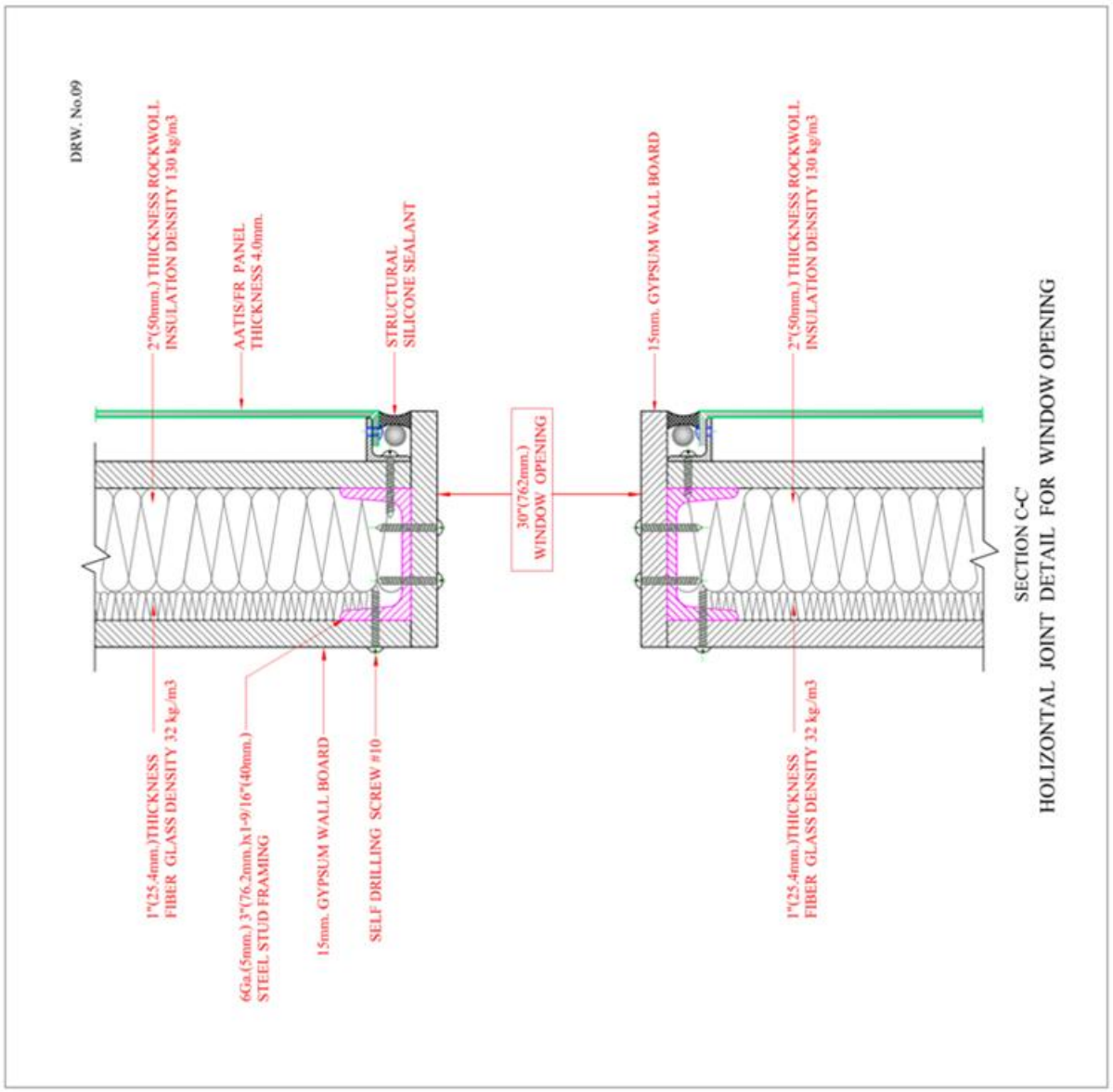

Figure A-14. Client-Provided Drawing.

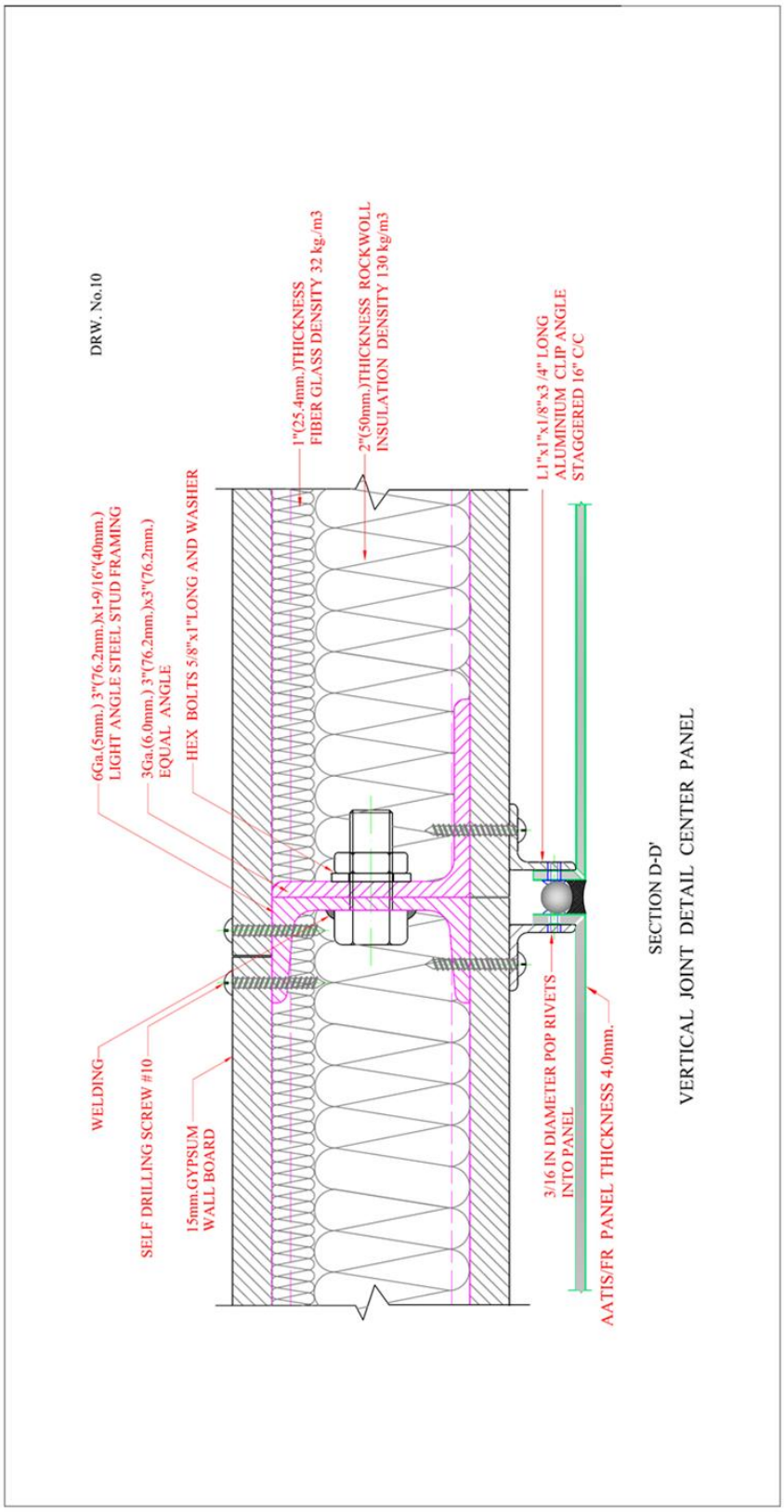

Figure A-15. Client-Provided Drawing.

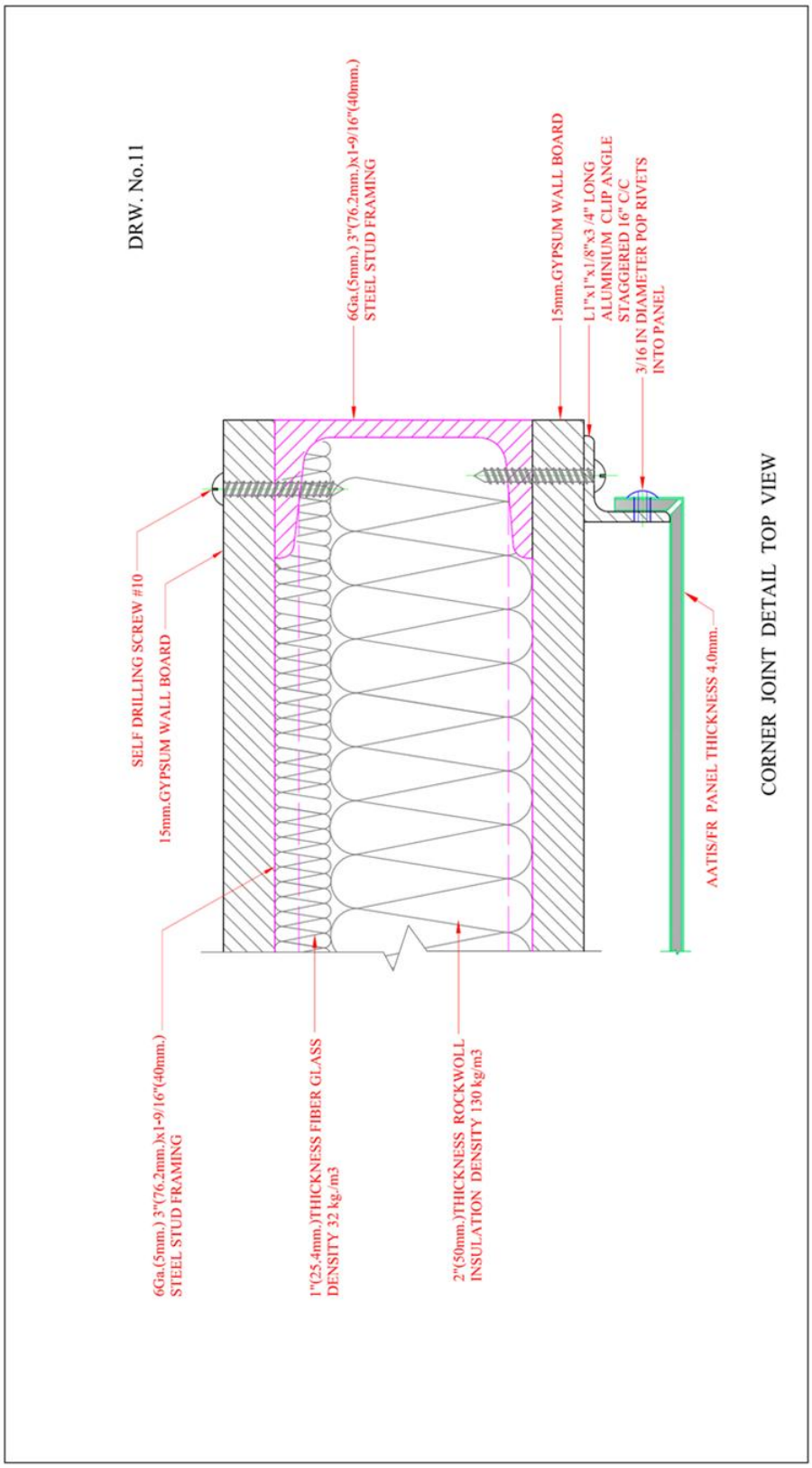

Figure A-16. Client-Provided Drawing.

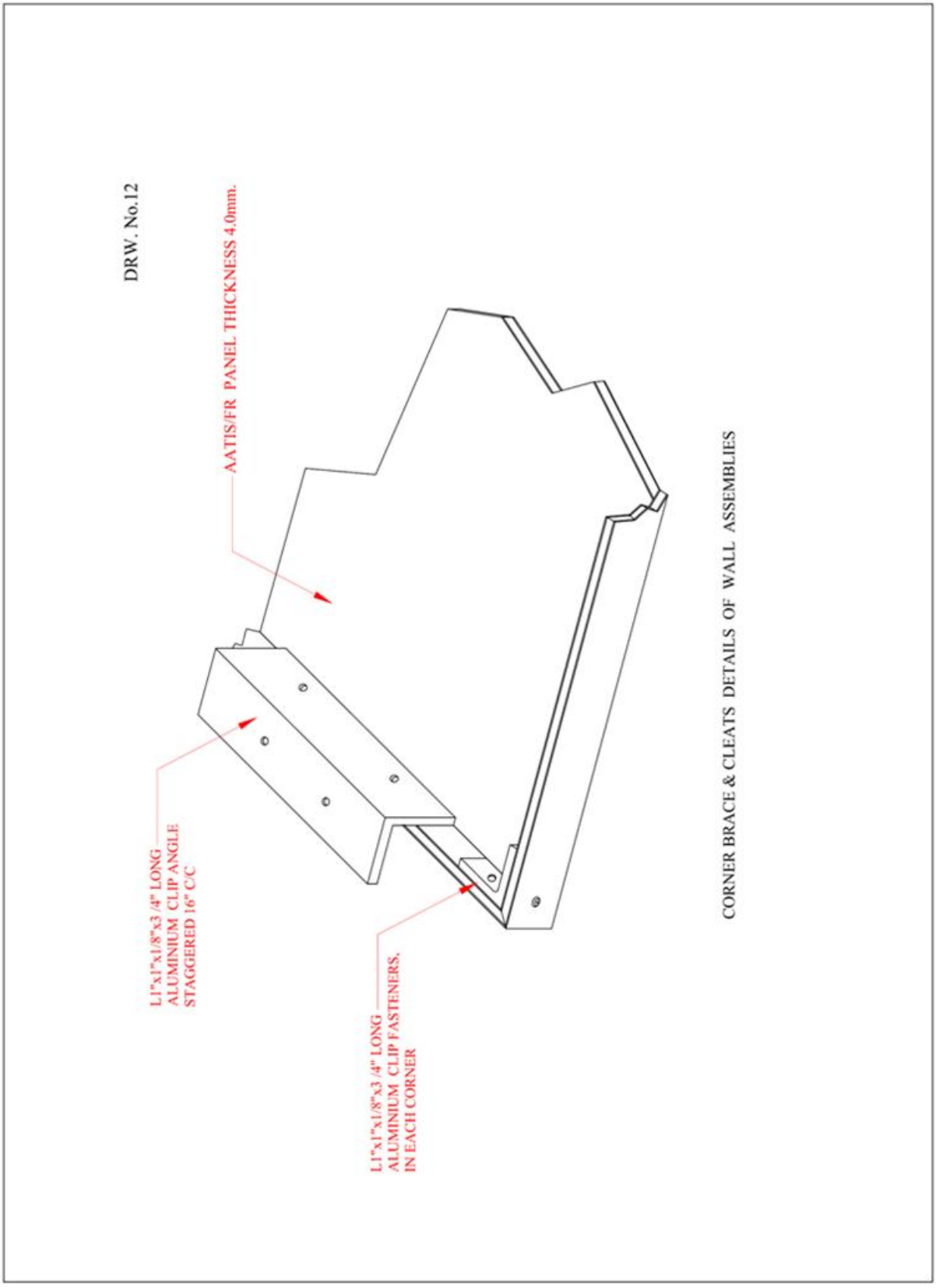

Figure A-17. Client-Provided Drawing.

APPENDIX B

PHOTOGRAPHIC DOCUMENTATION

(CONSISTING OF 3 PAGES)

Figure B-1. Wall Assembly prior to start of Test.

Figure B-2. Initial Deflection above Window.

Figure B-3. Application of Window Burner.

Figure B-4. 20 min into Test.

Figure B-5. End of Test.

Figure B-6. Backside of Panel Following the Test.

APPENDIX C

GRAPHICAL TEMPERATURE DATA

(CONSISTING OF 6 PAGES)

MN Chai Corporation
SwRI Project No. 01.15677.01.002
Test Date: 26 August 2010
Test ID: 10-238MN

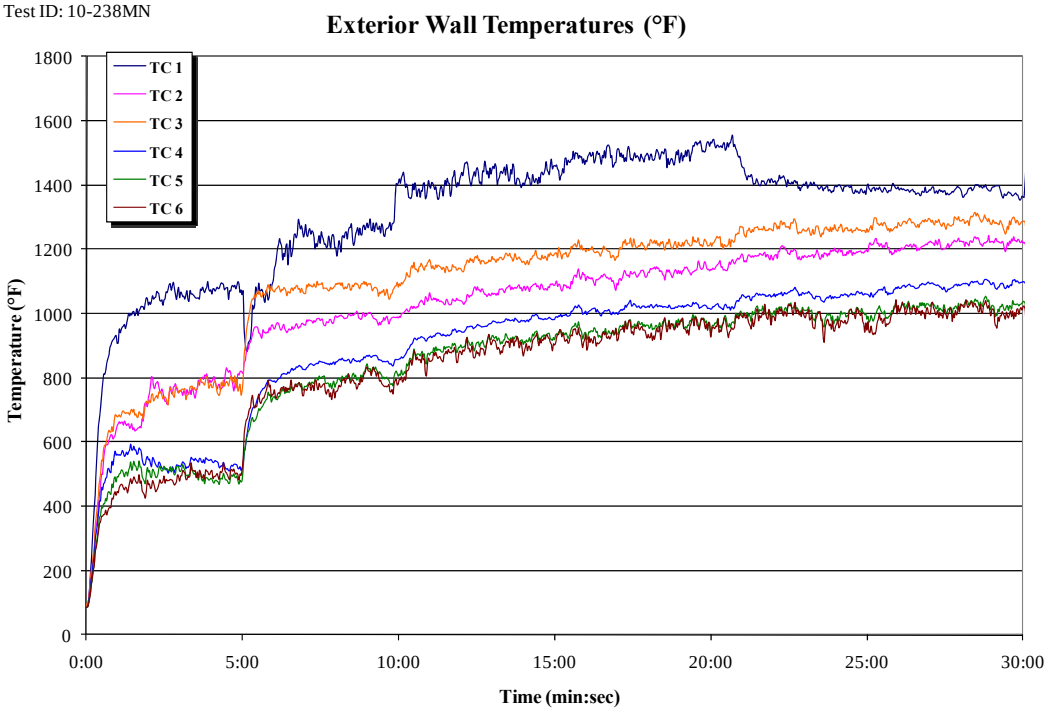

Figure C-1. Exterior Wall Temperatures (TCs 1-6).

MN Chai Corporation
SwRI Project No. 01.15677.01.002
Test Date: 26 August 2010
Test ID: 10-238MN

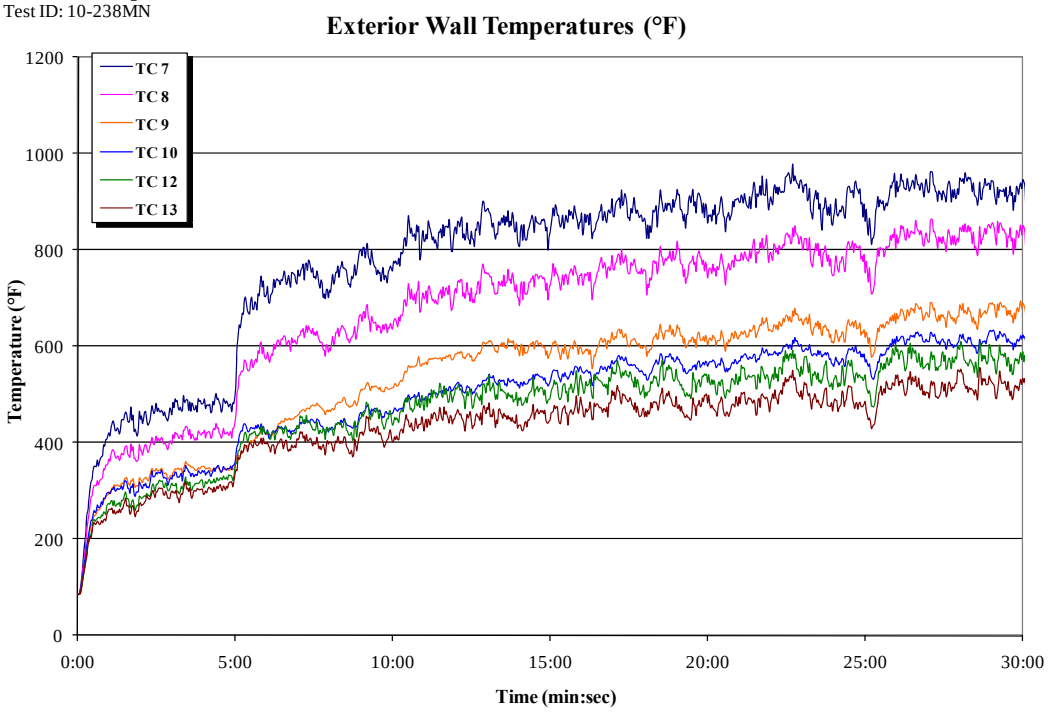

Figure C-2. Exterior Wall Temperatures (TCs 7-10, 12, and 13).

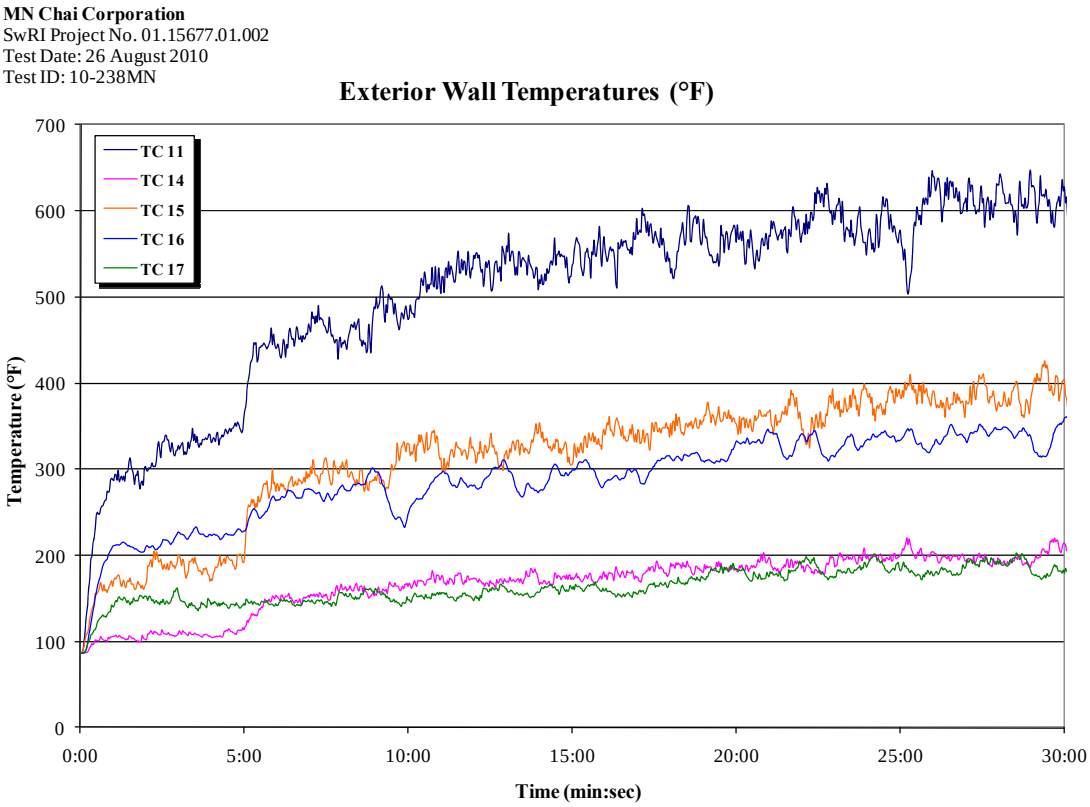

Figure C-3. Exterior Wall Temperatures (TCs 11, and 14-17).

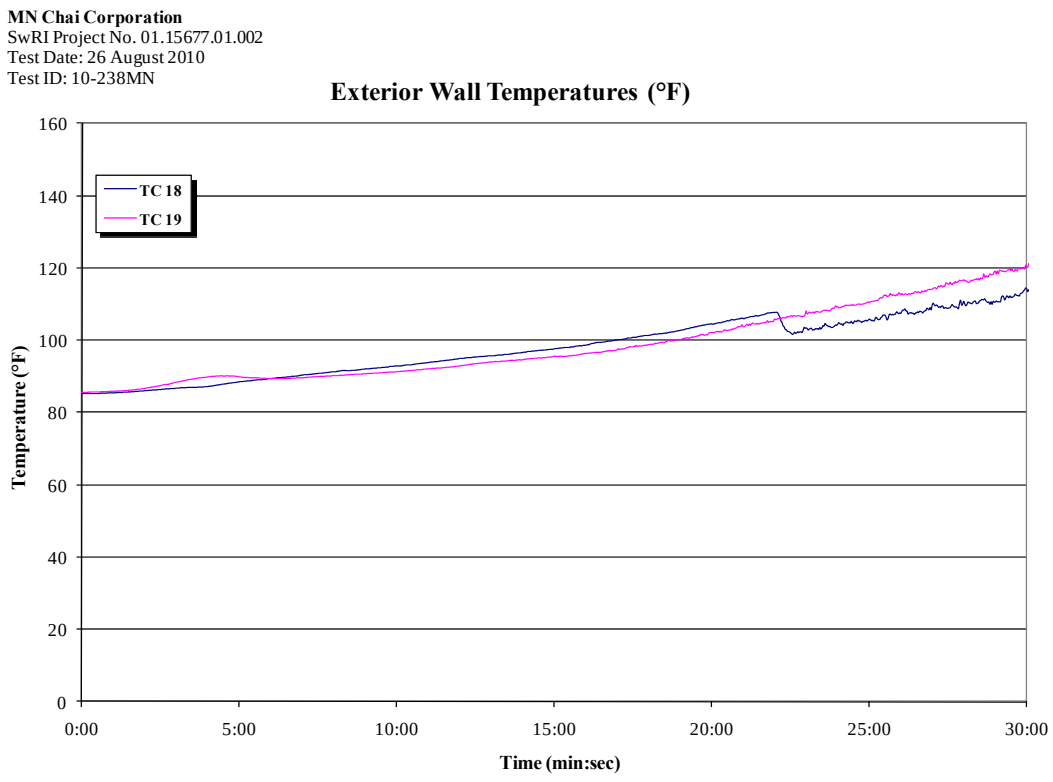

Figure C-4. Exterior Wall Temperatures (TCs 18 and 19).

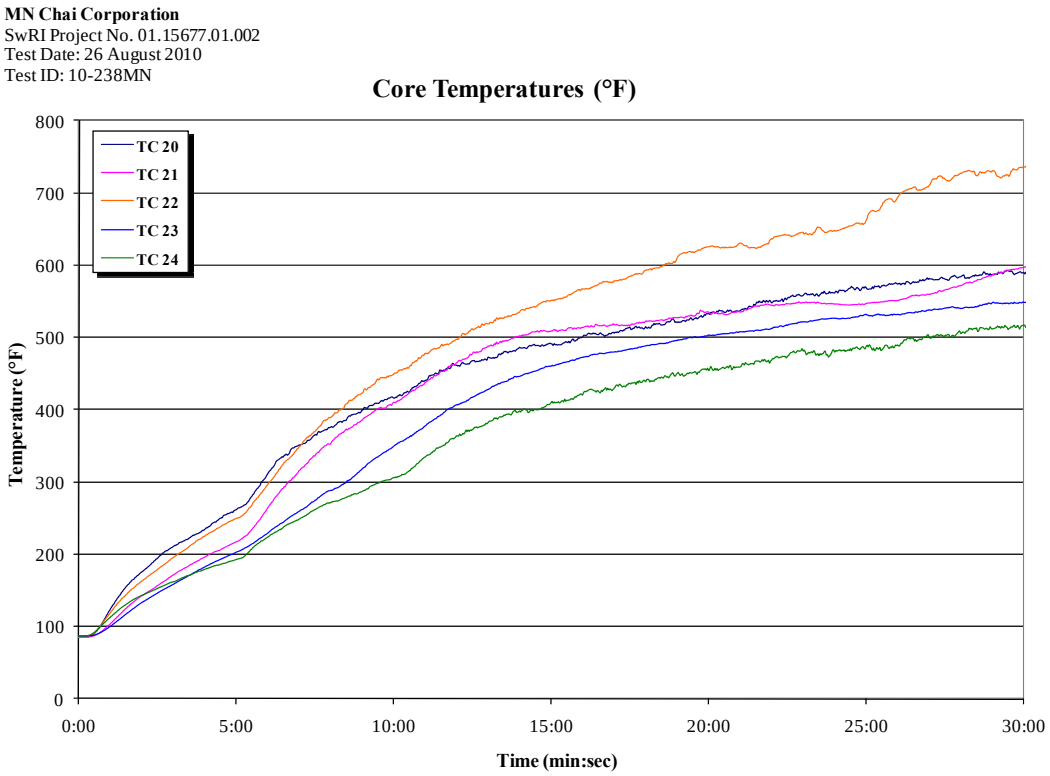

Figure C-5. Core Temperatures (TCs 20-24).

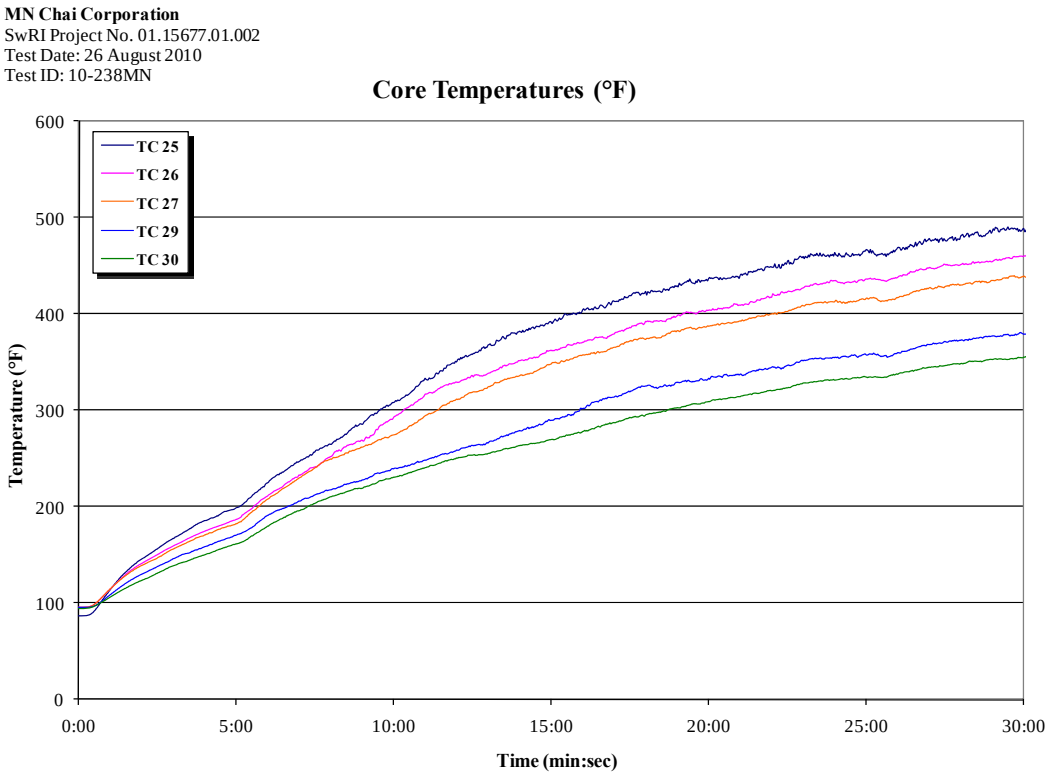

Figure C-6. Core Temperatures (TCs 25-30).

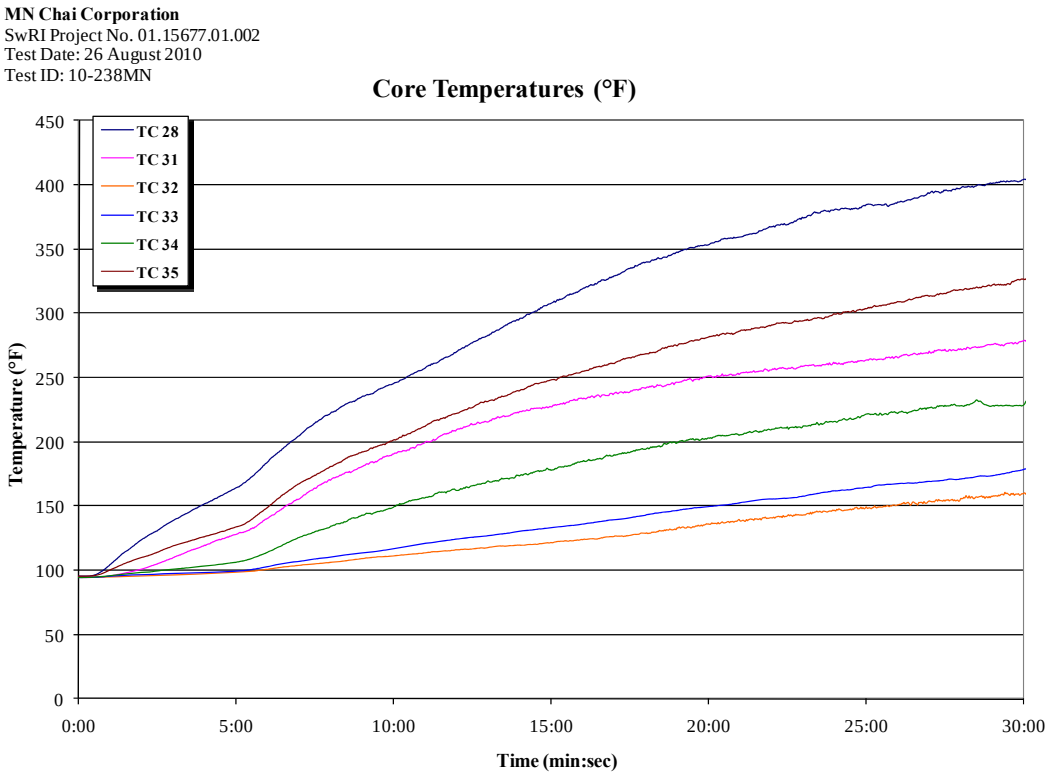

Figure C-7. Core Temperatures (TCs 28, and 31-35).

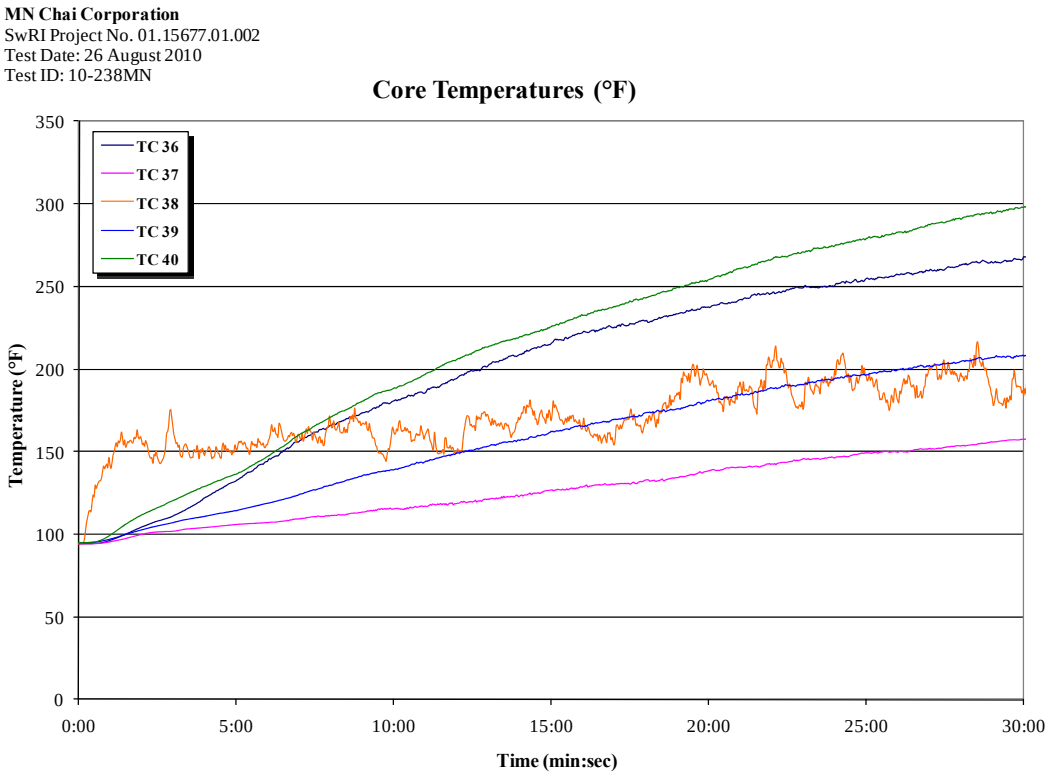

Figure C-8. Core Temperatures (TCs 36-40).

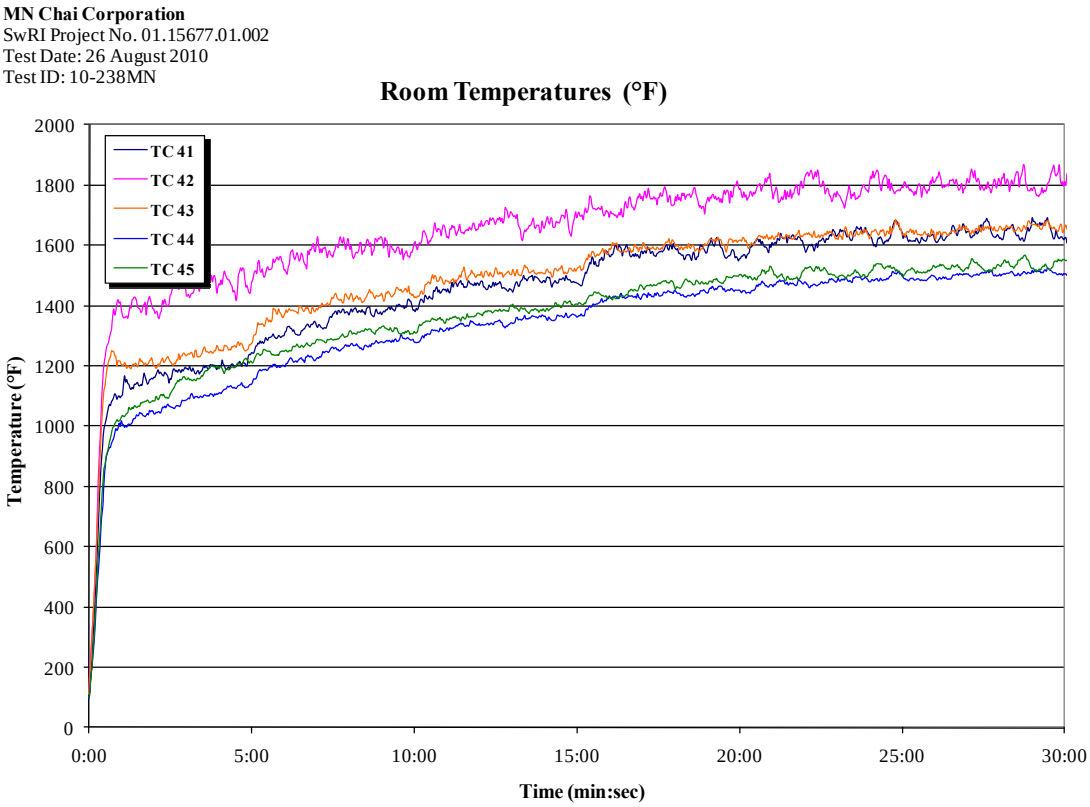

Figure C-9. Room Temperatures (TCs 41-45).

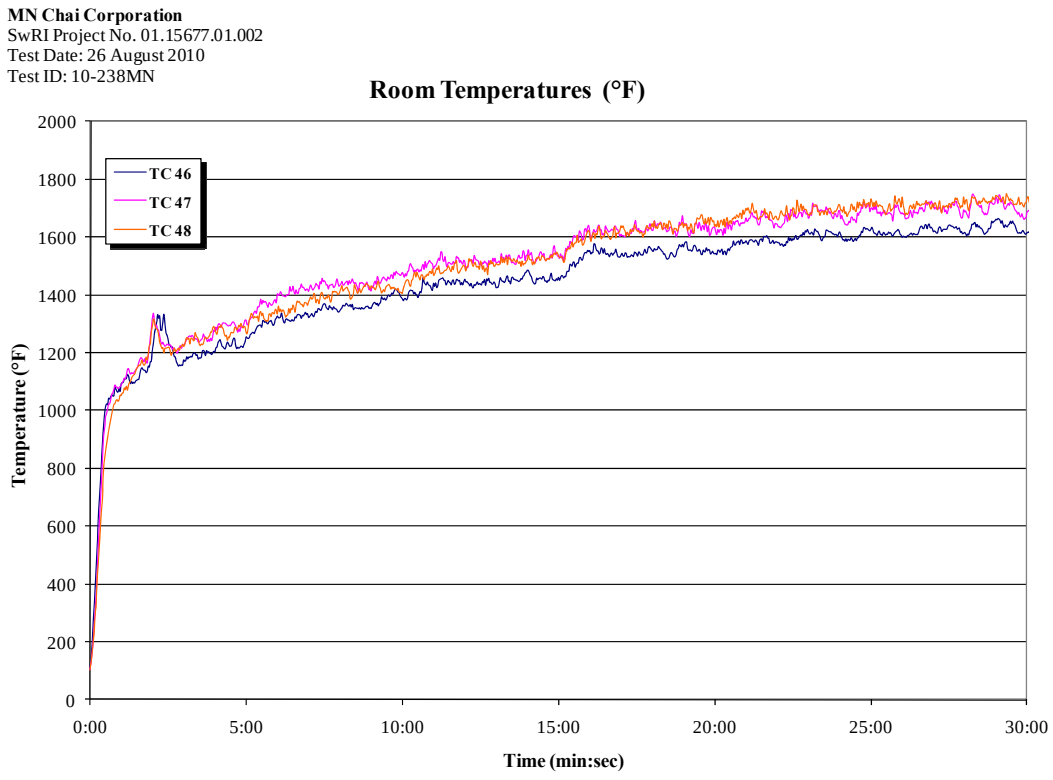

Figure C-10. Room Temperatures (TCs 46-48).

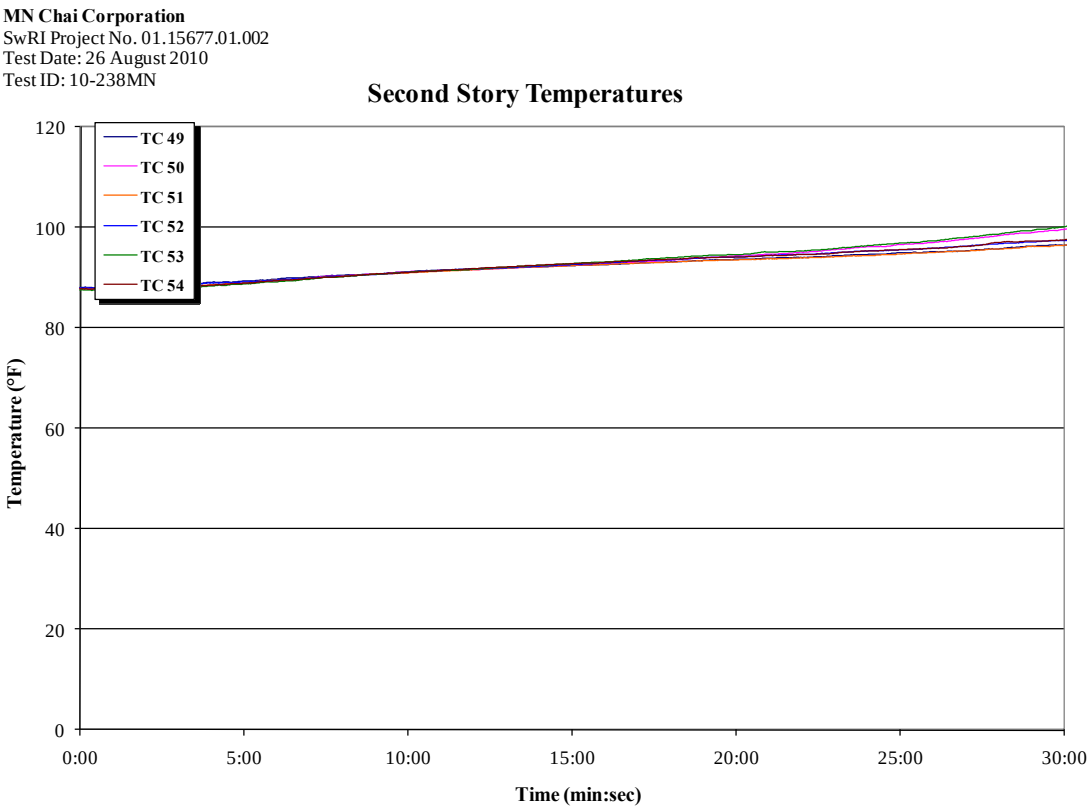

Figure C-11. Second Story Temperatures (TCs 49-54).