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REPORT

on

FIRE TEST INVESTIGATION OF A STEEL STUD BEARING WALL ASSEMBLY CONSISTING OF GYP-FAST FASTENERS

ITW Buildex
Itasca, IL

DESCRIPTION

MATERIALS:

The materials used in the construction of the wall assembly are described below.

Floor and Ceiling Runner - The channel-shaped steel tracks used to support the wall assembly along the lintel and sill of the test frame were fabricated from No. 18 MSG (0.045 in. thick) galvanized steel and measured 3-3/4 in. wide with 1-1/4 in. wide flanges. The runners were supplied in 10 ft. lengths.

Steel Studs - The C-shaped studs were fabricated from No. 18 MSG (0.045 in. thick) galvanized steel and measured 3-5/8 in. deep with 1-23/32 in. long flanges and 1/2 in. long returns. The studs bore the marking "MBA Building Supplies 3-5/8 CSJ18GA." Oval cutouts spaced 24 in. OC, were punched lengthwise on the studs. The cutout area was 4 in. long by 1-1/2 in. wide. The studs were supplied in 10 ft. lengths.

Steel Bracing – The flat steel strapping was fabricated from No. 20 MSG (0.0365 in. thick) galvanized steel and measured 2 in. wide.

Batts and Blankets – The nominal 3-1/2 in. thick mineral wool batt insulation was supplied in boards measuring nominal 2 by 4 ft. before cutting into the desired sizes. The average density of the boards was 3.56 pcf. The boards were designated Delta-4 Board and manufactured by Rock Wool Manufacturing Company. The outer packaging bore the Classification Marking of Underwriters Laboratories Inc.

Gypsum Wallboard - The 5/8 in. thick UL Classified gypsum board designated Type 9 was manufactured by Georgia Pacific. The panels were supplied in 4 by 10 ft before being cut into the desired sizes.

Gypsum Sheathing - The 5/8 in. thick UL Classified gypsum sheathing designated Type DGG was manufactured by Georgia Pacific. The panels were supplied in 4 by 8 ft before being cut into the desired sizes.

Wall and Partition Facings and Accessories – The steel fasteners were 1-1/2 in. long, with a knurled shaft, designated Type Gyp-Fast Fasteners, and were manufactured by ITW Buildex.

Joint Tape and Compound - The wallboard joints on the exposed side of the assembly were covered with 2 in. wide paper tape and both the joints and the screwheads were covered with joint compound.

Steel Fasteners - The various types and sizes of other fasteners used in the construction of the wall assembly are described in the order of use under the heading "Erection of Test Assembly."

ERECTION OF TEST ASSEMBLY:

The wall assembly was constructed in accordance with methods indicated by the submitter, by workmen employed by the submitter, under the observation of members of the Laboratories' Staff.

The floor and ceiling runner channels were attached to the test frame using 1 in. long by 1/4 in. diameter, No. 20 bolts.

The steel studs were installed in the test frame as shown in ILLS. 1 and 2. The steel studs were cut to 9 ft. 11-15/16 in. long. The studs were spaced 24 in. OC and screwed to the floor and ceiling runner channels with 1/2 in. pan head steel screws.

Per the stud manufacturer's recommendations, the two end stud cavities were braced at midheight with floor runner channels approximately 28-7/8 in. long that were cut 4 in. from each end and bent. The channel pieces were secured to the studs with No. 7 by 7/16 in. long low-profile, self-drilling steel screws as shown in ILL. 3. One row of flat steel strapping was installed at midheight on both sides of the assembly and secured to the floor runner channels and steel studs with No. 7 by 7/16 in. long low-profile, self-drilling steel screws as shown in ILL. 4.

On the unexposed side of the assembly, the Type DGG gypsum sheathing board was attached vertically to the steel studs as shown in ILL. 5. Vertical joints were located 2 ft. and 6 ft. from the north end of the assembly. Horizontal joints were located at 2 ft. from the bottom, top, and bottom of the north, center and south sheets, respectively. The boards were secured to the steel studs with the Type Gyp-Fast fasteners spaced 8 in. OC at the perimeter and 12 in. OC in the field of the boards. The horizontal joints of the gypsum sheathing boards were not backed.

The mineral wool insulation was friction-fitted into the stud cavities, with butt joints located at 4 ft. and 8 ft. from the bottom of the assembly, as shown in ILL. 6.

On the exposed side of the assembly, the Type 9 gypsum board was attached vertically to the steel studs as shown in ILL. 7. Vertical joints were located 4 ft. and 8 ft. from the north end of the assembly. There were no horizontal joints. The boards were secured to the steel studs with No. 6 by 1-1/4 in. long screws spaced 8 in. OC at the perimeter and 12 in. OC in the field of the boards. The screws on opposite sides of the vertical joints were offset 1/2 in.

All joints on the exposed surface of the assembly were covered with paper tape and two coats of joint compound. The screw heads on the exposed surface of the assembly were covered with joint compound. The joints and screwheads on the unexposed surface were left untreated.

The appearance of the exposed and unexposed surfaces of the assembly before the fire endurance test is shown on ILLS. 8 and 9, respectively.

TEST RECORD GENERAL

Test results relate only to items tested.

FIRE ENDURANCE TEST:

The fire endurance test was conducted in accordance with the Standard, Fire Tests of Building Construction and Materials, UL 263 (ASTM E119, NFPA 251), 13th Edition dated April 4, 2003.

SAMPLE

The test assembly measured 10 ft wide by 10 ft high and was constructed in the test frame as described in the Section of this Report entitled "Erection of Test Assembly," and as shown in ILLS. 1 through 9.

METHOD

The furnace temperatures were measured with 12 thermocouples symmetrically located in the furnace chamber, positioned 6 in. from the exposed face of the assembly as required by the Standard.

The temperatures of the unexposed surface were measured by 10 thermocouples. Each unexposed surface thermocouple was covered with a dry ceramic fiber pad. Nine additional thermocouples were installed on the steel studs of the assembly. The unexposed surface thermocouples and the stud thermocouples are shown in ILLS. 10 and 11, respectively. Thermocouple Nos. 2, 5 and 8 were moved 5 in. up from the location shown to avoid contact with the strapping.

A roving thermocouple, constructed essentially in accordance with Section 4.3.4 of Standard ULC-S101-04, was available to take measurements of the wall assembly as required by Section 5.3.1.1 of the same Standard.

A vertical load totaling 13,239 lb was applied to the 10 by 10 ft specimen installed in the test frame. The load application was provided by hydraulic equipment through six rams, equally spaced below the concrete sill. The ram loads pushing the concrete sill upward resulted in applying a net total vertical load of 15,065 lb, uniformly distributed along the 10 ft bottom of the specimen, after counteracting the dead load of the sill (1,826 lb). The above load was applied 3 min before conducting the test and was maintained throughout the test duration. The above loading maintained an axial load of 2648 lb per stud. This load was calculated to develop 100 percent of the maximum allowable design load on the 10 ft long steel studs.

The deflection of the wall was determined by the measurements of the centerline of the unexposed surface (horizontal). The reference line was a fine, taut steel wire with one end fastened to the brickwork at one side of the test frame and the other end carried over a pull mounted in the brickwork on the opposite side and weighted. In addition, vertical deflections were measured by two dial micrometers located along the sill of the assembly at the approximate quarter points.

The pressures within the furnace chamber with respect to the laboratory were measured with stainless steel pressure probes located approximately 3 ft. from the top, at the center and approximately 3 ft. from the bottom of the wall height near the center of the wall assembly.

Throughout the test, observations were made to note the character of the fire and its control, the condition of the exposed and unexposed surfaces, and the development pertinent to the performance of the assembly with reference to the stability, heat, insulation, integrity, passage of flame, the deformation of the assembly and generation of smoke.

TEST RECORD NO. 1

RESULTS

Character and Distribution of Fire - The fire was luminous and well distributed, and the furnace temperatures followed the standard time-temperature curve as outlined in the Standard as shown in graphical form on ILL. 12 and in tabulated form in Appendix A.

Pressures Within the Furnace Chamber – The furnace pressures are shown in tabular form in Appendix B.

Observations During Fire Test - Table I contains a chronological description of the observations made during the fire test on the exposed and unexposed surfaces of the test assembly. All references to dimensions are approximate.

Table I

Test Time, hr:min	Test Observations
0:00	Gas on.
0:04	The gypsum board had turned dark in color and the paper began to smolder.
0:07	The gypsum board paper had stopped smoldering. The paper had scaled and began to peel off.
0:09	The screwheads began to show through the joint compound. The vertical joints began to darken.
0:13	The gypsum board had turned light in color.
0:20	No noticeable changes had occurred.
0:23	Flaming occurred at the vertical gypsum board joints.
0:27	The vertical gypsum board joints had opened approx 1/4 in.
0:32	The south stud had buckled slightly approx 2 ft. up from the bottom of the assembly. The vertical gypsum board joints had opened approx 1 in.
0:35	The north sheet of gypsum board had horizontal and vertical cracks. The horizontal cracks were located at midheight of the assembly.
0:36	The south 2 ft. wide sheet had major separation at both vertical joints. On the unexposed side at the south end, the bottom horizontal joint had separated and the upper sheet had bowed outwards. The upper sheet had a vertical crack at the vertical centerpoint.
0:38	The south sheet on the exposed side had all but fallen in the bottom half. The center sheet had a major horizontal crack at the center point.
0:41	The 2nd stud from the north end was entirely exposed. The 2nd 2 ft. wide piece of gypsum board from the north end was entirely gone. On the unexposed side, the bottom south piece did not deflect with the rest of the wall assembly, thus it was separated at the upper right corner and at the top center. See ILL. 13.

(Table Cont'd)

Test Time, hr:min	Test Observations
0:44	At the 2nd stud cavity on the exposed side all of the gypsum board had completely fallen off from top to bottom. In the next three cavities the gypsum board had fallen off the bottom half of the assembly.
0:47	The gypsum board in the center cavity had completely fallen off the assembly.
0:51:30	The vertical deflection meters were turning counter-clockwise fairly rapidly, indicating rapid upward movement. The wall assembly failed to maintain the applied load. On the unexposed side, the gypsum sheathing had cracked outwards in the north section approx 1 ft. from the bottom.
0:52	Gas off.

Deflection - The horizontal and vertical deflections of the wall assembly which were measured during the fire test are shown in Table II:

Table II

Test Time, Min	Horizontal Deflection of Unexposed Surface (In.)			Vertical Deflection (In.)	
	South QP	Center	North QP	South QP	North QP
Preload	0	0	0	0.000	0.000
Load	- 1/16	0	0	0.058	0.056
0	- 1/16	0	0	0.058	0.056
5	- 1/4	- 3/8	- 1/4	0.033	0.036
10	- 1/16	- 3/16	- 1/16	0.022	0.017
15	- 1/16	- 1/8	- 1/16	0.020	0.016
20	- 1/8	- 3/16	- 1/16	0.013	0.005
25	- 3/4	-1 3/16	- 7/8	**	**
30	- 1/8	-1 3/4	-1 1/4		
35	5/16	-2 9/16	-1 5/8		
40	1/8	-3 1/16	-2 1/8		
45	1 3/16	-3 1/8	-2 1/2		
50	1 1/4	-3 3/8	-2 5/8		

QP - Quarter point.
** - Readings taken after this point were incorrectly read off the deflection meter.
Horizontal Movement - Away from fire unless denoted by "-".
Vertical Movement - Upward unless denoted by "-".

Temperatures of the Wall Assembly - The temperatures recorded within the stud cavity and on the unexposed surface of the assembly are shown in tabular form in Appendix C.

The initial average temperature of the unexposed surface was 72.5°F. Therefore, based on an average temperature rise of 250°F above ambient and a maximum individual rise of 325°F above ambient, the average limiting temperature was 322.5°F and the limiting individual temperature was 397.5°F.

Neither the average nor individual limiting temperature was reached at the end of the test. The average temperature at 51 minutes was 184.2°F, and the maximum individual temperature was 258.3°F at Thermocouple No. 15. A plot of the average and maximum unexposed surface temperatures is shown in ILL. 14.

A plot of the average and maximum steel stud temperatures is shown in ILL. 15.

No suspected hot spots developed on the wall assembly during the test duration which would warrant the use of the roving thermocouple as required by Section 5.3.1.1 of the Standard ULC-S101-04.

OBSERVATIONS AFTER THE FIRE ENDURANCE TEST:

The appearance of the exposed and unexposed surfaces after the endurance test is shown in ILLS. 16 and 17, respectively.

CONCLUSION

The following conclusions represent the judgment of Underwriters Laboratories Inc. based on the examination and tests presented in this Report, as they relate to established principles and previously recorded data.

FIRE RESISTANCE PROPERTIES:

It is judged that the load bearing wall assembly constructed of the materials and in the manner described herein will afford 45 min protection against the passage of flame and dangerous transmission of heat when exposed to fire from either direction.

Limiting temperatures on the unexposed surface (250°F average or 325°F individual temperature rise above the initial temperature) were not reached during the Classification period. The assembly performed, during the Classification period, without developing unexposed surface conditions which would ignite cotton waste. The hose stream test is not required for wall assemblies with rating periods less than 1 h.

The above Classification is based on the "Conditions of Acceptance" for tests of load bearing walls and partitions, as specified in ANSI/UL 263 (ASTM E119, NFPA No. 251).

PRACTICABILITY:

The materials used in the test assembly were readily installed by qualified workers, with tools and methods commonly used for construction of this nature.

Materials and installation procedures were in accordance with those described in this Report and are significant factors in the fire resistance of the construction.

CONFORMITY:

This construction was tested in accordance with the Standard, "Fire Tests of Building Construction and Materials," ANSI/UL 263 (ASTM E119, NFPA 251), Thirteenth Edition, dated April 4, 2003.

FOLLOW-UP PROGRAM:

The Wall and Partition Facings and Accessories (Gyp-Fast steel fasteners), as described herein, are judged to be eligible for Classification and Follow-Up Service of Underwriters Laboratories Inc. Under the Follow-Up Services Program, the manufacturer is authorized to use Underwriters Laboratories' Classification Marking on those products which comply with the Follow-Up Services Procedure, and any other applicable requirements of Underwriters Laboratories Inc. Only those products which properly bear Underwriters Laboratories' Classification Marking are considered as Classified by Underwriters Laboratories Inc.

The Classification Marking to be used on the Wall and Partition Facings and Accessories, is illustrated below:

WALL AND PARTITION FACINGS AND ACCESSORIES
AS TO FIRE RESISTANCE ONLY
SEE UL FIRE RESISTANCE DIRECTORY
<control number>

Report by:

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