FASWALL

Fire Rated Assembly Analysis

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REPORT

Project Overview

Liberty Natural Products is constructing a new production facility in Clackamas County Oregon. The facility is a one story, 10,000 SF, fully sprinklered Type VB building.

Code Unlimited was consulted to offer professional analysis to determine if the requirements of the current ASTM E119 test standard are met by a non-loadbearing assembly (FasWall) tested according to the 1998 ASTM E119.

Applicable Code

- 2014 Oregon Structural Specialty Code (OSSC)
- 2014 Oregon Fire Code (OFC)
- 1988 ASTM E-119
- 2008a ASTM E-119

Approach

The approach is to compare the 1988 and current version of the ASTM E119 standards to determine any methodological or parameter changes. The FasWall lab report from a 1988 E119 test will be compared to the current standard and any non-editorial changes.

An analysis will be undertaken to verify any additional testing requirements for a load bearing current E119 test above and beyond the 1998 E119 non-load bearing assembly lab report. An analysis will be made to determine if the wall assembly meets the requirements of the current E119 test requirements.

Analysis

The experimental methodology and fire testing procedures of the 1998 and the current edition of *Standard Test Methods for Fire Tests of Building Construction Materials* (ASTM E 119) were compared to determine any changes that have taken place. While the language of the standard has changed, the experimental procedures have not. All changes were editorial or organizational in nature.

Each experimental methodology was compared and are detailed in the Table 1 below. The fire test requirements were also compared and can be found in Table 2 below.

The analysis to determine the differences between the non-loadbearing testing procedures and the current load-bearing procedures is shown below in Table 3.

Table 1. Comparison of ASTM E119 1998/2008a Methodologies.

Methodology	ASTM E119 1988	ASTM E119 2008a	Conducted Test
Time-Temperature Curve	Standard temperature time curve given for testing exposure.	Editorial changes only	Followed exactly **Meets 1998/Current Requirements**
Furnace Temperatures	Nine thermocouples used with clearly defined spacing and accuracy requirements for floor, column, wall and partition assemblies.	Editorial changes only	Three additional thermocouples were attached making the test more accurate. **Meets 1998/Current Requirements**
Temperatures of Unexposed Surfaces of Floors, Roofs, Walls and Partitions	More specifications regarding thermocouple temperature readings for areas with no thermocouple in immediate area.	Editorial changes only	*"No ignition of hot gases or cotton waste"* **Meets 1998/Current Requirements**

Table 2. Comparison of ASTM E119 1998/2008a Conduct of Fire Tests Requirements.

Conduct of Fire Tests	ASTM E119 1988	ASTM E119 2008a	Conducted Test
Fire Endurance Test	Continue the test until failure occurs it can be continued beyond the standard time to obtain additional performance data.	Editorial changes only	*"The assembly maintained its structural integrity throughout the test period… it is concluded that the wall assembly… has a Fire Resistance Rating of 4 hours."* **Meets 1998/Current Requirements**
Hose Stream Test	Test involves specified fire hose pressure and duration. Requires 20 ft. nozzle distance from wall.	Editorial changes and 20 ft. nozzle distance parameter removed. ASTM E 2226 *Practice for Application of the Hose Stream* offers added nozzle requirements for fire hose used in the test.	*"Hose Stream test made on the specimen subjected to the fire endurance test and immediately following the expiration of the fire endurance test."* **Meets 1998/Current Requirements**
Protection and Conditioning of Test Specimen	Involves parameters for ensuring the quality of the test specimen with regards to drying and moisture content.	Editorial changes with some exacting statements to prevent poor drying methods.	*"Three days prior to the test, a 1.50-inch diameter core sample was taken at mid-depth from the wall assembly. The moisture content, determined by the oven dry method… was 3.94%"* **Meets 1998/Current Requirements**

Table 3. Comparison of ASTM E119 Testing Requirements Standards for 1988 Non- loadbearing and 2008a Loadbearing Wall.

	Non-Load Bearing	Load Bearing	Conducted Test
Size of Sample	Not less than 100 sq ft neither dimension < 9 ft	No change	**Meets Current Load Bearing Requirements**
Loading	None required	*Maximum load defined by nationally recognized structural design criteria*	No load applied **See Analysis Below**
Loading Condition of Acceptance	None required	*"The wall or partition shall have sustained the applied load during the fire endurance test without passage of flame or gases hot enough to ignite cotton waste"*	No load applied **See Analysis Below**
Hose Stream Condition of Acceptance	None required	*"Wall or partition shall have sustained the applied load during the fire and hose stream test."*	**See Analysis Below**

The FasWall assembly is designed to meet the structural design criteria for the maximum typical bearing load under non-event conditions. In order to assess the load bearing capacity of the Faswall during event conditions, the reinforced concrete core, which provides the entire bearing capacity, was examined. The rebar within the concrete core exhibited the highest recorded temperature of the tested assembly during the 4-hour test. This temperature, higher than that of the concrete, was used as a conservative value.

The rebar reached a peak temperature of 354°F or 179°C, based on the conducted FasWall test results. Based on Figure 9.14 from *Structural Design for Fire Safety* by Andrew H. Buchanan, the relative compressive strength of concrete will remain at 100% at the tested temperature of 179°C. Based on the sustained compressive strength under heating, the structural loading of the FasWall will not be compromised.

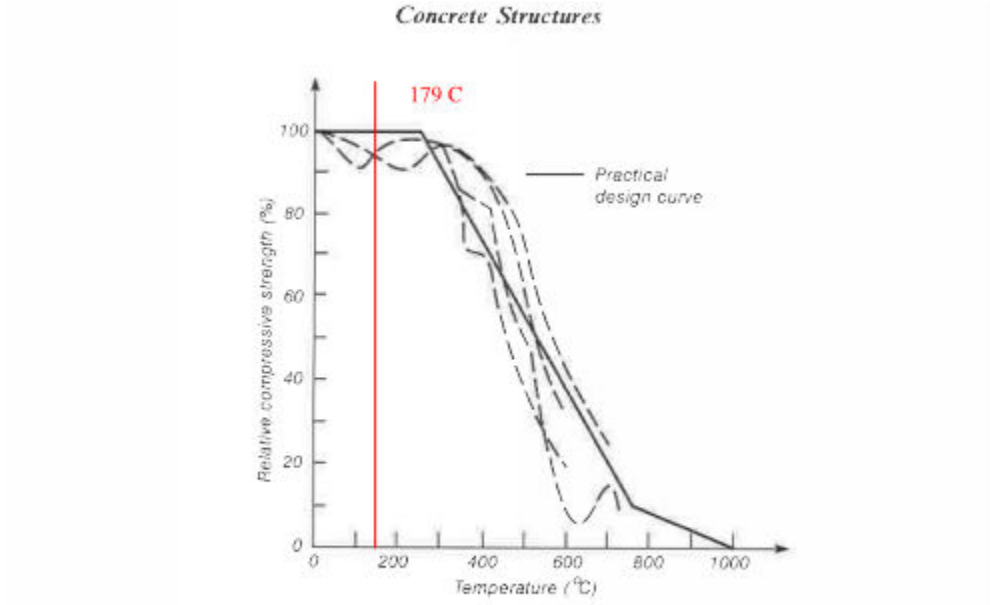

Figure 9.14 Reduction in compressive strength with temperature (Reproduced from Schneider (1988) with permission from Elsevier Science)

The purpose of the hose stream test is twofold: put a lateral force on the wall and expose the wall to thermal shock. As shown above, there is no expected loss in strength in the concrete core. The relatively low lateral forces placed on the wall by the hose stream are minimal in comparison to the compressive loads. The FasWall assembly will be able to withstand the laterals forces applied by the hose stream.

During the original testing, a hose stream test was conducted on the non-loadbearing wall. The FasWall test results state that the assembly withstood the hose stream test and thus withstood the thermal shock. Since the time-temperature curve is the same for both the 1988 non-loadbearing and the 2008a loadbearing versions of the E119, similar temperatures will be exhibited within a loadbearing assembly and would undergo similar thermal shock. It is our analysis that a loadbearing FasWall assembly tested to the current standard would pass the thermal shock of a hose stream test.

Conclusion

After comparing the 1988 to the current edition of the ASTM E119 there are no revisions to the standard that alter the testing methodology. Additionally, the observed temperatures will not compromise the compressive strength, lateral strength, or the ability to withstand thermal shock of the FasWall assembly. To conclude, our opinion is that the FasWall assembly meets all the requirements of the current version of ASTM E119 and may be regarded as a 4-hour load-bearing assembly. Our evaluation of the testing supports utilizing the material in this load bearing application.

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