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02.13.2018

# Engineering Judgement Report

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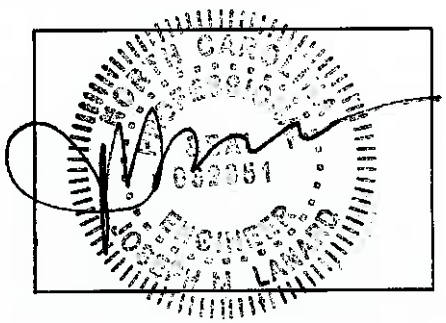
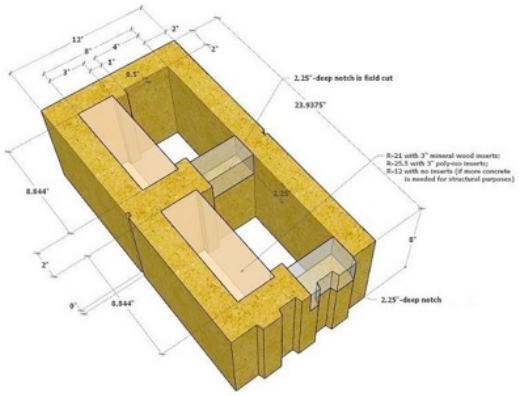
| PROJECT NUMBER: | 31815.00 |
| SUBJECT: | Faswall Engineering Judgement |
| ADDRESS: | Chapel Hill, NC |
| AREA(S) AFFECTED: | Building Foundation |
| APPLICABLE CODES AND REFERENCE STANDARDS: | • 2012 North Carolina Residential Code (NCRC)<br>• 1988 ASTM E 119<br>• 2007 ASTM E 119 |
| PREPARED FOR: | Paul Wood<br>ShelterWorks Ltd. |
| PREPARED BY: | Joseph M. Lanaro, P.E.<br>Chazen Engineering, Land Surveying & Landscape Architecture Co., D.P.C.<br>547 River Street<br>Troy, New York 12180<br>(518) 273-0055 |



## PURPOSE:

ShelterWorks is constructing a new residence in Chapel Hill, North Carolina. The proposed building construction will include FasWall, an insulated concrete form block created and manufactured by ShelterWorks. This professional analysis has been performed to determine if the requirements of the ASTM E 119 test standard applicable to the most current North Carolina Residential Code are met by a non-loadbearing assembly (FasWall) tested according to the 1988 ASTM E 119.




## SUMMARY:

The current North Carolina Residential Code requires that exterior walls must be rated per Table R302.1, which references the 2007 version of the Standard Test methods for Fire Tests of Building Construction Materials (ASTM E 119). The existing lab report for FasWall references the 1988 E 119 test standards. The approach to this engineering judgement is to compare the 1988 to the 2007 version of the ASTM E 119 to determine any non-editorial methodological or parameter changes.

The analysis will also verify any additional testing requirements for a load bearing 2007 E 119 test above and beyond the 1988 E 119 non-load bearing assembly lab report. This approach will provide a clear methodology to determine if the wall assembly meets the requirements of the 2007 E 119.

## COMPREHENSIVE REVIEW:

The experimental methodology and fire testing procedures of the 1988 and 2007 edition of the 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.

A comparison of the experimental methodology is detailed in Table 1. The fire test requirements were also compared and can be found in Table 2. The analysis to determine the differences between the non-loadbearing testing procedures and the current load-bearing procedures is shown in Table 3.

**Table 1. Comparison of ASTM E 119 1988/2007 Methodologies.**

| Methodology | ASTM E 119 1988 | ASTM E 119 2007 | Conducted Test of FasWall |
|---|---|---|---|
| Time-Temperature Curve | Standard temperature time curve given for testing exposure. | Editorial changes only. | Followed exactly.<br>**Meets 1988/2007 Requirements** |
| Furnace Temperatures | Specifications regarding nine thermocouples measuring the furnace temperature; clearly defines spacing and accuracy requirements for floor, column, wall and partition assemblies. | Editorial changes only. | Three additional thermocouples were attached, making the test more accurate.<br>**Meets 1988/2007 Requirements** |
| Temperatures of Unexposed Surfaces of Floors, Roofs, Walls and Partitions | Specifications regarding nine thermocouples or thermometers measuring the unexposed surface; defines placement, frequency of sampling, and determination of fire endurance end point. | Editorial changes only. | *"No ignition of hot gases or cotton waste"*<br>**Meets 1988/2007 Requirements** |

**Table 2. Comparison of ASTM E 119 1988/2007 Conduct of Fire Tests Requirements.**

| Conduct of Fire Tests | ASTM E 119 1988 | ASTM E 119 2007 | Conducted Test on FasWall |
|---|---|---|---|
| Fire Endurance Test | Fire endurance test continues until failure or until the specimen has withstood test conditions for the specified period of time; test can be continued beyond this point 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."*<br>**Meets 1988/2007 Requirements** |
| Hose Stream Test | Test involves specified fire hose pressure and duration. Details requirements for hose discharge and requires | Editorial changes.<br>Requirement for 20 ft. nozzle distance parameter and hose discharge removed and replaced | *"Hose Stream test made on the specimen subjected to the fire endurance test and immediately following* |

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| | nozzle to be 20 ft. from wall. | with reference to ASTM E-2226 *Practice for Application of the Hose Stream, which* offers added nozzle requirements for fire hose used in the test. | *the expiration of the fire endurance test."*<br>**Meets 1988/2007 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%"*<br>**Meets 1988/2007 Requirements** |

**Table 3. Comparison of ASTM E 119 Testing Requirements Standards for 1988 Non- loadbearing and 2007 Loadbearing Wall.**

| | Non-Load Bearing | Load Bearing | Conducted Test |
|---|---|---|---|
| Size of Sample | Not less than 100 sf with neither dimension < 9 ft | No change. | **Meets 1988/2007 Load Bearing Requirements** |
| Loading | None required | *Maximum load defined by nationally recognized structural design criteria.* | No load applied<br>**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<br>**See Analysis Below** |
| Loading 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 concrete, was used as a conservative value.

The rebar reached a peak temperature of 179°C (354°F), based on the conducted FasWall test results. Based on Figure 9.14 from *Structural Design for Fire Safety* by Andrew H. Buchanan, shown below for reference, 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.

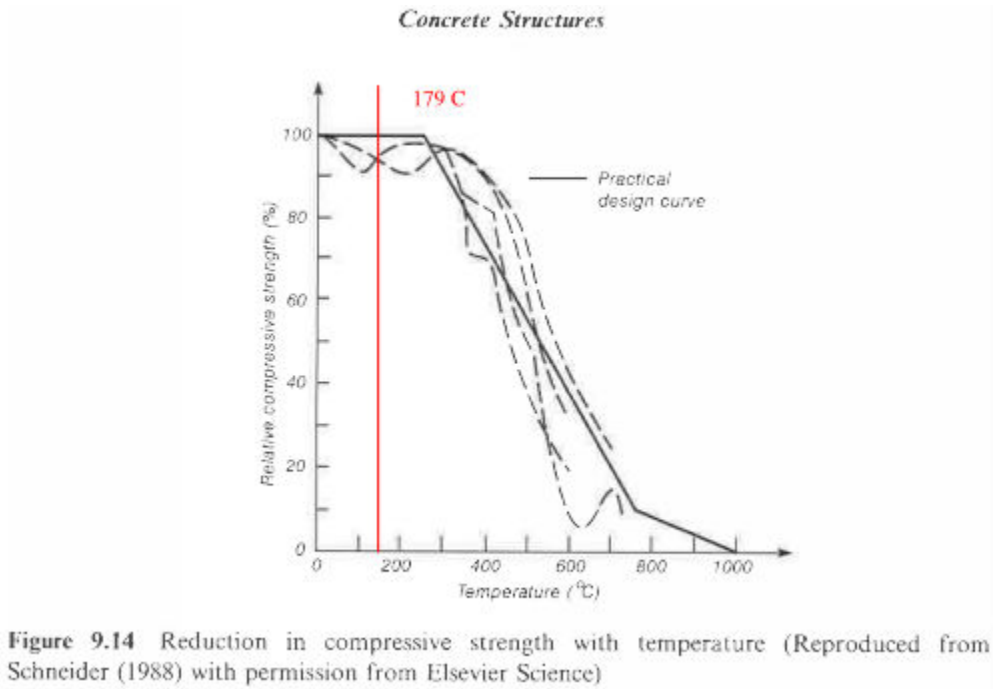


**Figure 9.14** Reduction in compressive strength with temperature (Reproduced from Schneider (1988) with permission from Elsevier Science)

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 2007 loadbearing versions of the E 119, 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 edition of ASTM E 119 to the 2007 edition of the ASTM E 119 referenced by the current North Carolina Residential Code, 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 2007 version of ASTM E 119 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.