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WHAT IS THE DIFFERENCE BETWEEN FIRE RESISTANCE RATINGS FOR MASONRY ASSEMBLIES OBTAINED THROUGH IBC VERSUS A LISTING SERVICE SUCH AS UL OR FM?

In practical terms, there is little difference in the resulting fire resistance ratings for concrete masonry assemblies determined by each of the code-recognized methods. A concrete masonry assembly that is rated 2 hours, for example, using one method would be rated the same using any of the other permitted compliance options; within expected deviations associated with reproducibility of any test. The differences reside primarily in the procedures used by each process to determine the fire resistance rating, each affording their own unique advantages and disadvantages in application.

Because differences in the resulting fire resistance rating obtained through physical testing versus calculation, for example, are nominal, the *International Building Code* (IBC) permits the use of multiple compliance options as follows:

- Physical evaluation in accordance with ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials* or UL263, *Fire Tests of Building Construction and Materials*. While two distinct standards, the testing procedures outlined in ASTM E119 and UL263 are nearly identical, and as such produce very similar fire resistance ratings for concrete masonry assemblies.
- Calculated fire resistance determined in accordance with Section 721 of the IBC. The calculated fire resistance method is an adaptation of the standard ACI/TMS 216.1 [4], *Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies*. The calculated fire resistance is derived from hundreds of tests conducted on concrete masonry assemblies tested in accordance with ASTM E119.

- Prescriptive detailing requirements in accordance with Section 721 of the IBC. These include commonly used concrete masonry wall assemblies that are deemed-to-comply with a prescribed level of fire resistance based on historical testing in accordance with ASTM E119 or UL263.
- Alternative modeling or designs based upon engineering analyses or alternative sources of documentation, research, or testing.

Although not explicitly recognized by IBC, commercial listing services that publish reports of various concrete masonry assemblies that have undergone review or physical evaluation in accordance with established guidelines are also commonly used and accepted. The most commonly used listing service for concrete masonry assemblies is Underwriters Laboratory (UL), but others, including FM Global (FM), are also available.

Although this myriad of compliance options affords flexibility in applying the fire resistance requirements of the IBC, it can also be confusing to the end user. The following discussion offers a brief overview of the advantages and disadvantages associated with each compliance path.

Testing in Accordance with ASTM E119 or UL263

The fire resistance rating of virtually any concrete masonry assembly can be determined through physical testing using ASTM E119 or UL263, regardless of how unique the assembly's configuration is or the type of raw materials used to produce the concrete masonry units. The primary drawback to conducting large-scale testing is the costs associated with such evaluations, which can reach \$15,000 or more per specimen

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depending upon the variables evaluated. Due to these high costs, full-scale testing is often limited to one or two specimens and then computer modeling or other analytical technique is used to determine the fire resistance rating of other assembly variables, such as varying unit width or density.

Calculated Fire Resistance

The primary advantage of using the calculated fire resistance procedure outlined in Section 721 of the IBC and ACI/TMS 216.1 is its ease of use, low cost, and flexibility. The procedure determines the fire resistance rating of a given concrete masonry assembly based upon the type of aggregate used to manufacture the units and the equivalent thickness of the units. (The equivalent thickness is a numerical value based upon the amount of concrete material in the unit assuming the unit was 100 percent solid.) As such, the calculation procedure can be used on a near limitless combination of unit sizes, configurations, and densities. Also, the calculation method provides options to increase the fire resistance rating by considering the contribution of various types of finishes added to the concrete masonry assembly, further expanding its use and flexibility.

The disadvantage of using the calculation procedure is that the types of aggregate recognized by this method are limited. The calculation procedure of ACI/TMS 216.1 specifically lists the following four aggregate categories:

- Expanded slag or pumice
- Expanded clay, expanded shale, or expanded slate
- Limestone, cinders, or air-cooled slag
- Calcareous or siliceous gravel (other than limestone)

While the ACI/TMS 216.1 standard permits the above four aggregate types to be blended together during unit production and the corresponding fire resistance rating to be adjusted in proportion to the relative quantities of the specific aggregate types used during manufacturing, the use of aggregate types not listed in the calculation procedure is speculative without supporting information or analyses.

Prescriptive Detailing

As with the calculation procedure, the prescriptive deemed-to-comply options in the IBC for determining fire resistance ratings is straightforward and has no supplemental costs. Because the range of assemblies covered is limited, however, this approach is relatively inflexible.

Alternative Means and Methods

Alternative engineering analysis is by far the most flexible method of assessing the fire resistance rating of a concrete masonry assembly. Because the IBC is intentionally vague on the procedures to be used when determining the fire resistance rating using alternative means and methods, however, building code officials are not consistent in their interpretation of data or the documentation used to support a specific assembly's fire

resistance characteristics. As such, many building officials opt not to accept this method of compliance without considerable supporting information – often generated only at significant expense.

Listing Services

Many specifiers prefer to use the listing service option as it invokes an additional level of scrutiny through third-party verification. In addition to any expenses that may be required for physical evaluation, however, listing services also require monitoring of the materials and manufacturing procedures used in producing a concrete masonry unit used in a listed assembly. As such, concrete masonry units that are UL listed, for example, often have a cost premium associated with them. Further, listing services provide for little flexibility in their application as the units and assembly must be manufactured and constructed virtually exactly as tested. Often, there are supplemental requirements that must be met, such as UL618, *Concrete Masonry Units*, for UL listed assemblies.

For further information on the code approved calculated fire resistance procedure, see CMHA TEK 07-01D [5] *Fire Resistance Ratings of Concrete Masonry Assemblies* and CMHA TEK 07-06A [6] *Steel Column Fire Protection*.

REFERENCES

1. International Building Code (IBC) 2021, www.iccsafe.org
2. Standard Test Methods for Fire Tests of Building Construction and Materials, ASTM E 119 – 18c. ASTM International, 2018, www.astm.org.
3. Fire Tests of Building Construction and Materials, UL 263, www.ul.com
4. Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies, ACI/TMS 216.1, www.concrete.org, 2014.
5. Fire Resistance Ratings of Concrete Masonry Assemblies, CMHA TEK 07-01D, Concrete Masonry & Hardscapes Association, www.masonryandhardscapes.org.
6. Steel Column Fire Protection, CMHA TEK 07-06A, Concrete Masonry & Hardscapes Association, www.masonryandhardscapes.org.

ABOUT CMHA

The Concrete Masonry & Hardscapes Association (CMHA) represents a unification of the Interlocking Concrete Pavement Institute (ICPI) and National Concrete Masonry Association (NCMA). CMHA is a trade association representing US and Canadian producers and suppliers in the concrete masonry and hardscape industry, as well as contractors of interlocking concrete pavement and segmental retaining walls. CMHA is the authority for segmental concrete products and systems, which are the best value and preferred choice for resilient pavement, structures, and living spaces. CMHA is dedicated to the advancement of these building systems through research, promotion, education, and the development of manufacturing guides, design codes and resources, testing standards, and construction practices.

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