

The Iroquois Theatre after the fire of December 30, 1903. The fire safety curtain had to be closed manually, and it got stuck. Other failures contributed to the high death toll.

Fire safety curtain systems: New knowledge drives new standards

BY DAN CULHANE

THERE HAVE BEEN MASSIVE EVOLUTIONARY CHANGES in technology, some of which have impacted fire safety curtains. Many of our past assumptions about the curtains are now proven wrong, and the new standards reflect these changes.

There are periodic reviews and revisions of all standards. PLASA standards are reviewed no less frequently than every five years, while National Fire Protection Association (NFPA) standards are subject to these reviews on a fixed three-year cycle. *PLASA E1.22, Entertainment Technology – Fire Safety Curtain Systems* is currently going through this revision process as I write this article. The 2016

version of the *NFPA 80, Standard for Fire Doors and Other Opening Protectives*, has just been published. The next revision for this document will be in 2019.

The most significant changes in the evolution of fire safety curtain technology has primarily been in the form of a research paper from the architect/engineering firm Ove Arup & Partners PC in conjunction with The Fire Protection Research Foundation. Together they published a report entitled “Fire Safety in Theatres – A New Design Approach.” This paper is available for your perusal from the NFPA at <http://tinyurl.com/oaq3zt3>. The second

significant change comes from the Entertainment Technology Certification Program (ETCP), brought to you by PLASA.

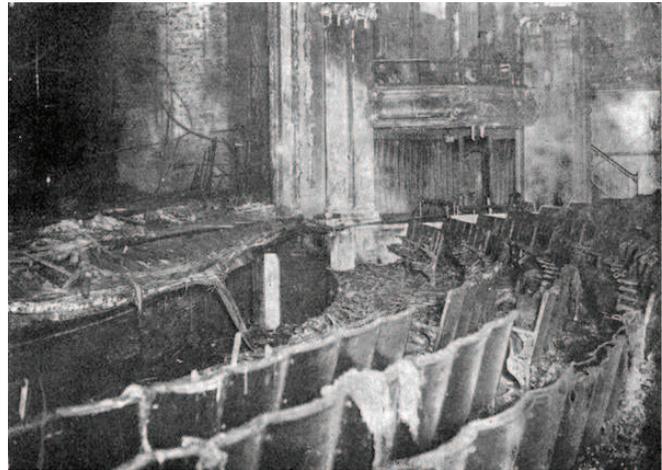
The research outlined in the “Fire Safety in Theatres” paper calls into question current established fire safety curtain assumptions that have been in place, with few changes, for the past 100 years. The research behind these proposed changes relied on computational fluid dynamics (CFD) to examine and assess fire conditions, and the effectiveness of the fire protection systems used in the stage. The research showed that, while many of the fire curtain practices in place are effective, a few of them are ineffective and unnecessary, which is the basis for most of the changes in both the *NFPA 80* and *PLASA E1.22* standards.

CFD modeling has shown that rate-of-rise heat detectors, particularly those considered “ultra-fast,” will most likely activate before both fusible links and sprinklers. This is to be desired, as it is preferable for the fire safety curtain to close prior to sprinkler activation. Once the sprinklers are activated, the water droplets will cool the surrounding air and inhibit the activation of heat detectors or fusible links associated with the fire safety curtain. After sprinkler activation, only the manual release of the fire curtain will cause it to close. The CFD further showed that ceiling mounted rate-of-rise detectors are better at detecting a fire than the traditional wall-mounted rate-of-rise detectors mounted on the proscenium wall above the fire safety curtain.

The research showed that in addition to the slow response time of the fusible links in the fire safety curtain release line, the activation of the fire curtain is unlikely to happen before activation of either the rate-of-rise detectors or sprinklers. Once the sprinklers are



After 112 years, the Iroquois Theatre fire with the loss of 602 people, remains the second largest loss of life due to fire or explosions in the US and is only eclipsed by The World Trade Center.



The audience and fore stage area of the Iroquois Theatre.



The stage area of the Iroquois Theatre after the fire.

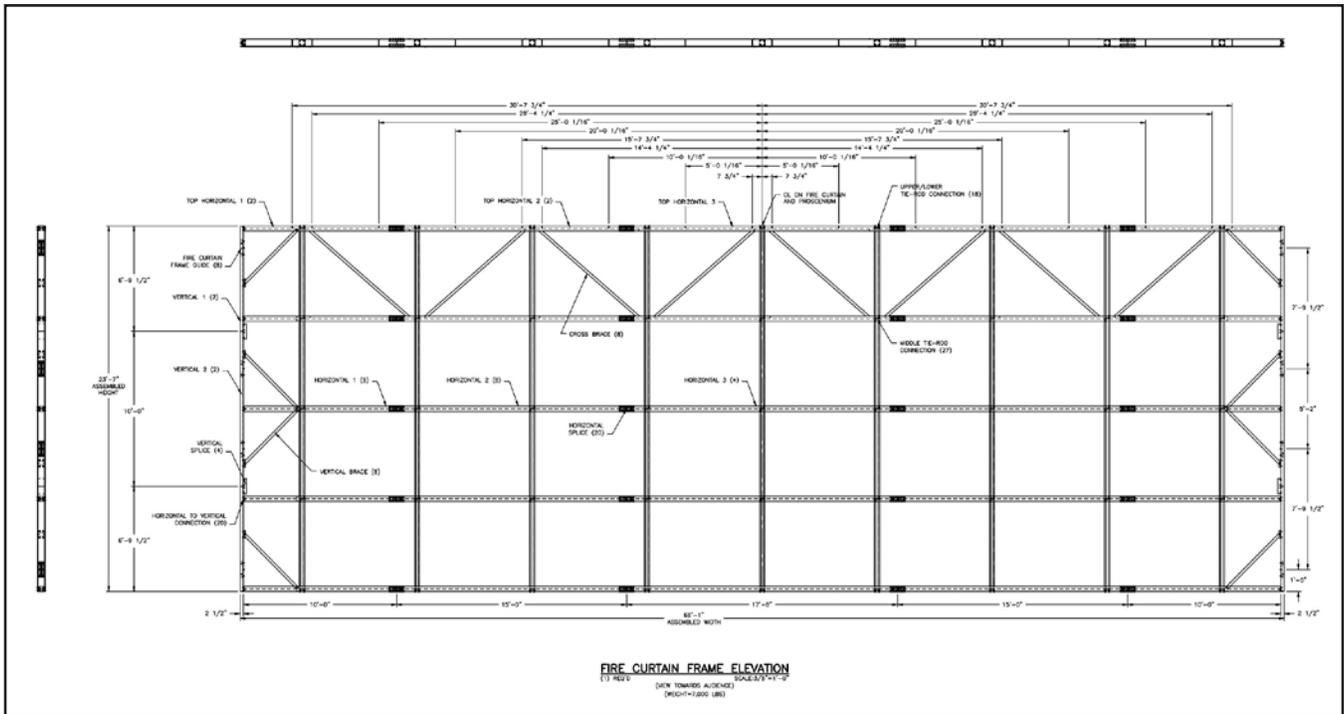
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activated, there is little chance that the fusible links will ever melt and release.

The PLASA Technical Standards Program’s Rigging Working Group, in conjunction with public review comments, is in the process of revising the standards to reflect the most up to date research and certifications available. The NFPA Technical Committee has already revised *NFPA 80* to reflect this information, and has published the 2016 edition.

One important note regarding the rate-of-rise system required on all fire curtains: *NFPA 80* requires the rate-of-rise detectors to be installed per *NFPA 72, The National Fire Alarm and Signaling Code*. This is significant, as this code states: “The purpose of fire alarm and signaling systems shall be primarily to provide notification of

alarm, supervisory, and trouble conditions; to alert the occupants; to summon aid; and to oversee emergency control functions.” The code goes on to stipulate who can design such a system. “Fire alarm system and emergency communications system plans and specifications shall be developed in accordance with this *Code* by persons who are experienced in the proper design, application, installation, and testing of the systems.” “State or local licensure regulations shall be followed to determine qualified personnel.” The code is very specific as to who is allowed to install these systems. “Fire alarm systems and emergency communications systems installation personnel shall, at the least, be qualified or shall be supervised by persons who have met the standards of qualification in the installation, inspection, and testing of the systems.” “State and



local licensure regulations shall be followed to determine qualified personnel.” The importance of this requirement is to ultimately determine that a theatre rigging contractor, who is qualified only as a rigging contractor, is not qualified to design, select, or install any part of the rate-of-rise system, including the equipment, wiring, and the rate-of-rise detectors. Additionally, all of this equipment must be tied into the building’s fire alarm system.

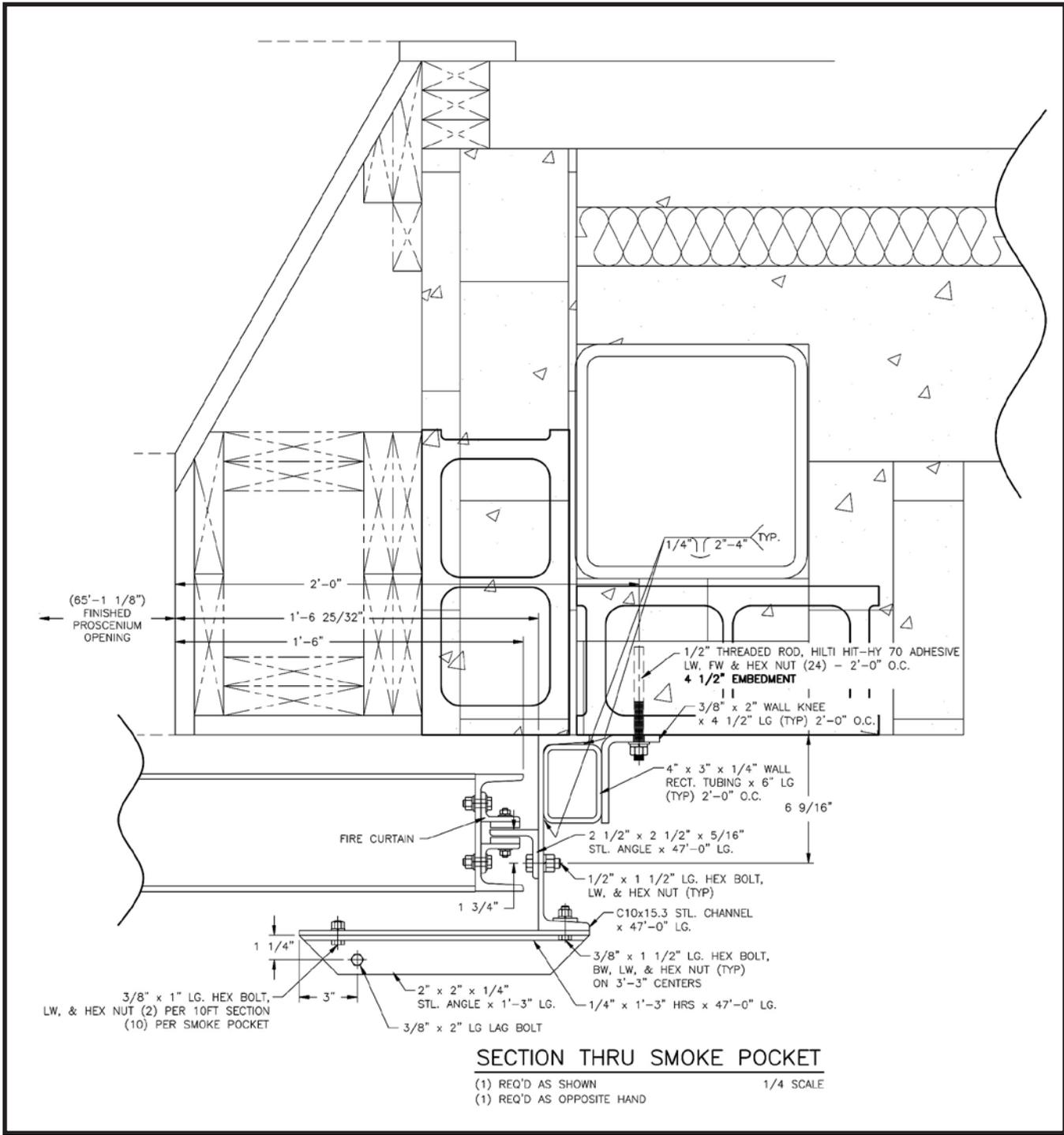
NFPA 80 requires the rate-of-rise detectors to be installed per NFPA 72, The National Fire Alarm and Signaling Code.

Fusible links are now totally removed from *E1.22*. *NFPA 80* has eliminated all but one reference to the term “fusible link,” which is used in conjunction with the fire curtain release line. However, all references to locations and spacing have been removed from the standard. Additionally, it is expected that the 2019 version of the standard will have eradicated that final legacy sentence. Given that the fire safety curtain release line no longer needs fusible links, it can

be installed anyplace above the fire safety curtain, as long as it does not interfere with the operation and need not be located within 12” of the roof or roof support structure as once mandated. Rate-of-rise systems are still required, as are the manual release stations on the back of the proscenium wall at either side of the proscenium opening.

Beginning in 2009, the *International Building Code (IBC)* began referencing *NFPA 80* for fire safety curtains in new construction. This reference was brought forward in the latest 2012 edition. The *IBC* reference to *NFPA 80* is without a specific year which means that the most current version of *NFPA 80* should be referenced. While this gives *NFPA 80* more prominence in the code world, *E1.22* has the distinction of allowing fire safety curtains to be constructed from materials other than the standard fabric membrane fire safety curtain. Both *E1.22* and *NFPA 80* each have a place in new building construction.

With the *IBC 2009* reference of *NFPA 80*, *IBC* no longer describes how a fire safety curtain needs to operate. The old requirement that the fire curtain must close in 30 seconds with the last 8’ taking no less than five seconds is now obsolete. Fire safety curtain closing times are now more in line with that of the roll-up door industry. In an emergency, the closing times now have an “average closing speed of not less than 6”/sec (152 mm/sec) and not more than 24”/sec (610 mm/sec).” This accomplishes a couple of things. First, the AHJ only has to remember one emergency closing speed, and secondly, the rigging company now has a wider and more realistic closing time for



the fire safety curtain. No longer will it be necessary to attempt to close a 40,000 lb. fire curtain that has to travel 40' at speeds that rival a free fall, only to have to arrest the last 8' so that it close in not less than 5 seconds.

For E1.22, the average closing speed is not less than 1' per second, with the last 8' of travel requiring a minimum of five seconds. While

this may seem counter-intuitive, bear in mind that the first part of 1' per second is based upon average closing speed.

Past standards, such as the old *UBC 4.1-1997* fire curtain standard is now almost completely non-referenced in codes and specifications. Over time, references to older standards will disappear as the newer standards become more widely accepted.



The decorative fire curtain for the Alabama Theatre built in 1927.

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The next area of fire safety improvement lies in related systems within theatres. A few people, such as Bill Conner, are working on improving standards, such as *NFPA 101*, the *Life Safety Code*, to ensure that smoke vents are released early, in the event of a fire on stage (See the Summer 2013 issue of *Protocol* for Bill Conner's "Stage Ventilation: Clearing the Heat and Smoke"). Conner is working on requiring lower temperature fusible links to be installed in smoke vents.

Smoke vents are arguably the most

important single piece of life safety equipment, as smoke inhalation during fires has injured or killed more people than has the heat from the fire. Most smoke vents in use today are operated by a 165° F fusible link and also have a manual release pull handle. The fusible link is the same previously discussed fusible link which has been shown to have very slow response time, resulting in the activation of every other system before the fusible link melts. This means that the likelihood of the smoke vent opening automatically is greatly diminished. Having a lower temperature fusible link in the system will allow for early activation of the smoke vent before other systems activate.

Most smoke vents have a manual release, but it is often located at the grid level. I have inspected theatres without walking grids that have had the manual release handles hanging 40' above the stage. In the event of a fire on stage with a walking grid, no one from the fire department would attempt

to traverse a dark, unfamiliar grid in order to manually release the smoke vents. It is necessary for the smoke vent to be operated from the stage floor, and the latest edition of the *Life Safety Code* requires this (clauses 12.4.6.5.2.3 and 13.4.6.5.2.3).

PLASA, through the ETCP certification program, has provided an important element not previously available to the local Fire Marshall or Authority Having Jurisdiction (AHJ), who has the ultimate responsibility for the safety of the public in that facility; a third party certification is now required to ensure that the people designing and supervising the installations of the fire safety curtain have a suitable background for that which they are designing and installing. Prior to this version of the PLASA and NFPA standards, anyone could design and supervise the installation and testing of a fire safety curtain system, the only criteria being that the person claimed knowledge and skill in fire safety curtain systems. The Fire Marshall

or AHJ had little choice but to accept the fire safety curtain designer and installer on their word.

As stated above, both standards will now require a third party certification for the designer and installation supervisor, certifying some knowledge of design, installation, application, and testing of fire safety curtain systems. ETCP provides that certification in the form of a Certified Rigger – Theatre. With this certification, the AHJ can rely upon another organization to insure that the designers and installation supervision is vetted and will meet a minimum standard.

While both the NFPA and PLASA standards address different aspects of fire safety curtains, they do have a significant overlap in scope. To this end, small adjustments to the *E1.22* standard are designed to help unify the design, installation, inspection, and testing of the fire safety curtain to those of the NFPA requirements. A fire safety curtain built to one fire curtain standard will usually need to comply with the other standard, too. Having the requirements for both standards being close to each other helps to eliminate costly errors when building, installing, inspecting, and testing of fire curtains. ■



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Year Award. Dan recently wrote the chapter on “The Mechanics of Stage Automation” in the book *Entertainment Rigging for the 21st Century*, edited by Bill Sapsis. He has an MFA in Theatre Technology from the University of Wisconsin, Madison and a BA in Theatre from Southern Illinois University – Carbondale. Dan serves on the PLASA Technical Standards Program Rigging Working Group, is the chair of the task group revising the standard for fire safety curtains, and co-chair of the Stage Lift Working Group. Dan is a member of the UL Standards Technical Panel for Fire Doors (STP 10), and serves as an alternate committee member to the NFPA Technical Committee on Fire Doors and Windows.