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Campus Fire Safety e-NewZone Monthly Newsletter ... May 2014, Volume 4, Issue 5

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The Center will be exhibiting at the NFPA Conference in Las Vegas, June 9 - 12. Drop by our booth (# 2207) to visit.

From The President

Campuses today are continually searching for cutting-edge techniques to decrease risk exposure for their students and faculty. However, campus administrators must understand that adopting new policies and procedures or installing the most technologically advanced fire and life safety equipment can, and will, only go so far toward advancing the institution’s overall fire safety ... **MORE**

About The Center for Campus Fire Safety

The Center is the Voice of over 4000 colleges and universities. As nationwide non-profit, membership based, organization devoted to reducing the loss of life from fire at our nation's campuses, we offer an abundance of free resources to help fire and life safety officials working on college campuses and fire departments with responsibility for a college campus/university.

Welcome to all of our New Center Members (month to date)

Vivekanand, Laurie, Hudson Valley Community College (NY)
Zwiebel, Terry, Norfolk Fire Division (NE)
Giardino, Theresa, Montclair State University (NJ)
Shedlock, Michele, Chubb Loss Control University
Post, Allen, Winter Park Fire Dept (FLA)
Mitchell, Edward, City of Winter Park (FLA)
Mohamad Abou Chakra, DAR Group of International Business Consultants, Beirut, Lebanon

Our Off Campus Fire & Life Safety Alliance is growing. If you are a member and did NOT receive your invitation to join, contact: **supporteam@campusfiresafety.org** or **click to learn more**

The Inspector, by Phil Chandler

Trash & Dumpster Fires

At last, the students are gone—and on some campuses, none too soon. From where I sit, when not tearing up shoe leather doing inspections, I am able to monitor the steady stream of incoming campus fire reports from around the state. One thing that has really got my attention as of late, are the inordinate reports of trash and dumpster fires. Some choose to categorize them as "nuisance fires," which I believe to be a mistake. ... **MORE**

Off-Campus, by Tim Knisely

False or Unwanted Alarms: Smoke Detectors and Sequence of Operation (Part 2)

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Codes, Standards & More

Student Fire and EMS Squads: Learning and Giving Back

... By Ken Holland, FF/NREMT-P, Senior Emergency Services Specialist, NFPA

While in my second year of college, I attended the University of New Hampshire in Durham, New Hampshire, my resident assistant (RA) was a member of a volunteer ambulance service that provided service to the university and the towns of Durham, Lee, and Marbury. After several conversations with her she convinced me to head on down to the station and see what it was all about and maybe volunteer my time to

909 Smoke Control Systems

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acceptance testing of smoke control systems that are intended to provide a tenable environment for the evacuation or relocation of occupants. These provisions are ... **MORE**

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MAJOR FIRE NEWS

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Fatalities Defined | Fatality Statistics

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(... more coming soon!)

- **Library** ... best practices, white papers, technology, codes,++
- **Data Collection** ... help us collect fire incident data here!
- **Membership** ... become a member or visit our member website!
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All Center Activities

Center Honory Lifetime Members ... (Shawn & Al)

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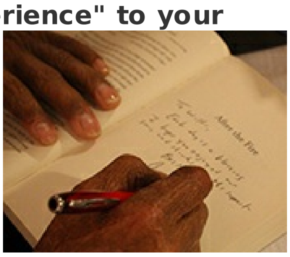

Shawn and Al, Seton Hall burn survivors, are lifetime members ofThe Center for Campus Fire Safety and have been with us for several years now. Many of you have met them at our annual Forum(s). Learn more about their experience and their willingness to speak at your campus.

MEET SHAWN & AL | PURCHASE AFTER THE FIRE VIDEO

Thanks to our Annual Sponsors for their support and dedication to campus fire and life safety.

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US

FROM THE PRESIDENT

By Paul D. Martin

May 2014

Campuses today are continually searching for cutting-edge techniques to decrease risk exposure for their students and faculty. However, campus administrators must understand that adopting new policies and procedures or installing the most technologically advanced fire and life safety equipment can, and will, only go so far toward advancing the institution's overall fire safety.

The single most influential element of a highly successful fire and life safety program is personal behavior. I use the following statement in my training programs -- "We have the safest, best designed building in the world – until you let the people in." Now I realize that this is somewhat an exaggeration, but it does serve the purpose to make folks think, if only for a moment, about the role each person has in fire and life safety.

We all understand that a commitment to fire and life safety is critical to improving the institution's overall safety performance, but less obvious is the level of commitment at the individual level. Although a strong fire and life safety performance begins with the institution, it is actually carried out by the collective behaviors of everyone on campus. Thus, everyone's personal safety commitment can dramatically affect the fire safety outcomes and carry consequences not only for themselves, but their friends, coworkers and the public at large as well.

Simply put: Everyone has a personal responsibility for fire and life safety.

But the truth is we see evidence every day that a growing lack of personal responsibility isn't just urban legend – and isn't just how "other people" are failing to hold up their part. The sad truth is that many, many people in our society believe they should not be held responsible for the choices they make or the consequences of those choices. We see it on a personal level with the decisions we make in our daily lives. We see it on a professional level with lapses in ethics by corporate and public that dominate the news. And sadly in our business –fire and life safety – we all too often deal with the tragic results.

If it seems like responsibility-shirking is on the rise, it may not be your imagination. Narcissism has risen 30% among college students since 1979, and studies show their self-confidence is at an all-time high. Unfortunately this artificial confidence also carries over into their belief that fire won't happen to them and that it is solely the schools' responsibility to protect them. The majority of college students think they are above average when it comes to social and intellectual confidence, leadership qualities, and the drive to succeed, even though this is statistically impossible, and belied by the facts.

FROM THE PRESIDENT

By Paul D. Martin

May 2014

Apathy to fire and life safety isn't unique to the students. Truth be told, faculty and staff also display a cavalier attitude almost as much. And it is their poor behavior that has even greater consequences – for they are the role models – whether by design or not.

Make no mistake: the "Not Me-ism" in our society is a huge problem. "They" are always at fault. In all my years, I have never met "they" but "they" are certainly a convenient group to have around so that the fault never lies with "us" or "me."

I cannot think of a more appropriate statement to illustrate the importance personal responsibility has in assuring one's safety than that of Robert Brault, when he said "The ultimate folly is to think that something crucial to your welfare is being taken care of for you."

So the question is – how do we get people to take a greater personal responsibility? I wish I had a guaranteed, fool proof method. But I don't. What I can share with you are a couple of management tips that I have used over the years to help people take more responsibility for their work.

Provide folks with the skills and resources to actually do their job. Then set up an environment that makes it easy for them to change, and help them take responsibility for their decisions and actions.

Sometimes, people don't take responsibility because they feel apathetic about their work. They can't see how their efforts tie into the "bigger picture." So, make sure that they understand how their behavior ties into the larger goals of the organization. Highlight the importance of what they're doing, and also paint a picture that details the unpleasant direct and indirect consequences that happen when they don't do their work properly (IE: safely).

The organization should encourage employee (and student) involvement in their fire safety programs. However, people must be internally motivated to create the safest environment possible, or the organization's efforts will be fruitless.

Personal responsibility requires a willingness to do whatever is necessary, whether you want to or not. Complying with fire and life safety codes and standards is a key element of practicing personal responsibility. Unfortunately, *"Most of us can read the writing on the wall; we just assume it's addressed to someone else"* ~ Ivern Ball.

This is a problem that I hope you – as our nation's campus fire safety leaders – will make a priority to turn around. I know that all of us at The Center are committed to do so.

Paul

Paul Martin, President

FROM THE PRESIDENT

By Paul D. Martin

May 2014

Paul D. Martin is Chief of Inspections and Investigations for the New York State Office of Fire Prevention and Control where he served as a principle architect of New York State's nationally acclaimed Campus Fire Safety Program.

Under Paul's leadership, the staff of the Inspections and Investigations Branch is responsible for: fire and life safety inspections in a very diverse collection of facilities throughout New York State, including all colleges and universities; performing fire investigations statewide of fatal, large loss or other significant fires; providing fire safety education and information dissemination intended to elevate the public's understanding of the danger of fire; and enforcement of the laws and regulations of the state regarding fire safety, including the world's first standard for reduce ignition propensity cigarettes.

Paul is active in the National Association of State Fire Marshals, where he serves as Vice-Chair of their Model Codes Committee and works on issues associated with fire and life safety for special needs occupancies. Additionally, he serves as co-chair of Prevention, Advocacy, Resource and Data Exchange (PARADE), a program of the United States Fire Administration designed to foster the exchange of fire-related prevention/ protection information and resources among Federal, State, and local levels of government.

He serves on the International Building Code - Means of Egress Committee for the International Code Council, where he is active in the development of the Codes promulgated under the auspices of the ICC. Additionally he is a principle member of the NFPA technical committee currently drafting a new standard on Fire Prevention Unit Organization and Deployment.

Paul holds an associate degree in fire science, a bachelor of science in public administration and has an extensive portfolio of professional development education. During his fire service career spanning more than thirty years, Paul has served in multiple line and administration positions and has received several awards of valor, including the 2000 Firehouse Magazine® national grand prize for heroism.

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THE INSPECTOR

By Phil Chandler

May 2014

At last, the students are gone—and on some campuses, none too soon. From where I sit, when not tearing up shoe leather doing inspections, I am able to monitor the steady stream of incoming campus fire reports from around the state. One thing that has really got my attention as of late, are the inordinate reports of trash and dumpster fires. Some choose to categorize them as "nuisance fires," which I believe to be a mistake. Seeing them as a mere nuisance suggests that there is little that we can do to prevent them and represents an acquiesence to their inevitability.

Trash fires anywhere on the campus present an inestimable life hazard. The most pernicious of these fires are those intentionally set. Dumpsters are frequent targeted by those displaying excess exuberance at year end. More disconcerting than the fires themselves, is the terryfying thought that an individual to whom the unleashing of a fire seems like a good idea is on the loose on campus. It is often just luck or circumstance that the fire this time was in the parking lot, away from buidings, as if dumpster fires aren't potentially deadly in their own right. Who knows what's in there? Propane tanks? Aresol cans? More importantly, who's to say that the same knuclehead won't flick his Bic inside a structutre, next time?

Knowing that such dangerous cretans are out and about on every campus—the same ones that singe the bottom of hall posters and melt the ceiling light lense in the elevator cars—compels the inspector to look at other attractive targets of opportunity during routine inspections. An overloaded dumpster in a dimly lit corridor or a trash gondola left at the bottom of a stairwell strikes me as a fire waiting to happen. We of course must be vigilant at all times for storage of combustible waste in the building. However, as dilligent as we are, trash receptacles of all size get placed everywhere they don't belong. Why tempt fate?

There is much that we can do to prevent trash fires. First and foremost, we need to treat intentionally set fires as the crime that they are—"not boys being boys," not maliscious mischief—but arson! In New York setting a fire in a building, regardless of how small, is a felony! Yet often times these fires are not investigated at all, if even reported.

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We can also make sure that our trash gondlas and large receptacles, regardless of where they are placed, are themselves covered at all times and the covers along with the containers are both made of noncombustible material or material that at least meets minimum standards for peak rate of heat release (IFC 2012 304.3.2). Simply having a cover may be enough of a deterrent for a first-time arsonist, to say nothing of being aesthetically more pleasing.

Of course, not all of our trash fires are intentionally set. Many are the result of just plain old carelessness. Oily rags in tightly wrapped plastic garbage bags that spontaneously ignite comes to mind. So does carelessly discarded smoking material, a frequent occurrence on every campus I visit. Nothing scares me more than the thought of students cleaning up after an all night party—emptying the ashtrays into a plastic bin and then retiirng for the night, with hot embers still smouldering. A proverbial ticking time bomb!

Here too, having a securely fitting noncombustible lid will, at the very least, hold down the growth of such a fire long enough, hopefully, to allow occupants to escape. It may also smother the fire altogether by limiting the supply of oxygen, a necessary component of combustion.

Having noncombustible containers is equally important. Unfortunately, most trash receptacles, especially the larger ones ranging in size from 40 gallons to those a yard or more in capacity, are made of polyethylene plastic, a material that has a fuel value more than double that of newsprint! What's more, this material readily melts, ignites at a relatively low temperature, and then becomes a flowing, burning liquid. Not something I want to encounter! As the Commentary to the 2012 International Fire Code emphatically states: "To contain combustible waste in another combustible material that has twice the fuel potential makes little sense."

As is often the case, code compliance can be costly. As we discussed last month, maintaining opening protectives appropriately is a budget buster for some colleges. Having to replace all large waste receptacles on campus with those that meet the requirements of IFC 304.3.2 also comes with a hefty price tag. Yet here too, just as the case with maintaining fire doors, the cost is easily justified when compared with the potential risk posed by non-compliance. The loss of life is a very real possibility as a

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burning plastic inferno fills a residential corridor or stairwell with thick, black, toxic smoke.

Even if one wishes to dismiss the worst-case scenario as far-fetched (what a mistake!), every day garden-variety fires (also, a dangerous term) in trash receptacles can cause untold cleanup expenses, especially if triggering sprinkler activation.

From a common sense perspective, it's a no-brainer. Consider the above image. Which makes more sense to you—an overflowing gondola providing a ready target for any nut case with a lighter, a filthy mess attracting rodents and insects, an accident waiting to happen? Or would you prefer a noncombustible container with a hinged lid that deters mischief, closes if a fire should occur and practically extinguishes a fire by itself before the fire department arrives and before the sprinkler activates? This is a classic case of "pay me now or pay me later."

Philip Chandler is a long time firefighter and a fulltime government fire marshal working extensively in the college environment – from large public university centers to small private colleges.

His primary responsibilities include code enforcement and education. Phil welcomes your comments, thoughts and opinions (whether in agreement or opposition) to his viewpoints. He may be reached at: mailto:theinspector@campusfiresafety.org

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OFF-CAMPUS

By Tim Knisely

May 2014

False or Unwanted Alarms – Part 2:

Smoke Detectors and Sequence of Operation

We all have heard the old adage that "more is better." That may be true in some products or services that relate to safety, but this is not always the case for fire protection systems.

Building codes are a minimum standard so it is often times refreshing to see a designer exceed these minimums, or try to get a grade better than a "C". This is also where it can create a dilemma for the AHJ. My colleagues and I often debate if it is the plans examiners duty to inform a design professional that their proposed design exceeds the code. More times than not, the examiner is noting deficiencies in the plan and where it needs to be improved.
Typically, the examiner will not offer advice about this enhancement because it is meets the minimum code and standard, plus the owner may have requested this change.

However, this can create problems in the fire protection arena. All codes and standards include the "shall" and "should" considerations in just about every application. In many fire protection systems the standards are pretty clear in where, or where not to install a particular product. The standards even have rules on not placing products too close together, such as sprinklers. Often times there aren't enough "shalls" to prevent some of the excess that we see in other systems, such as fire alarms with smoke detectors in particular. Let's take a look at how more can be worse.

Smoke Detectors:

The first indication that there are too many or improperly installed smoke detectors is when the fire department responds to a property frequently for unnecessary or unwanted alarms. It's too bad that we couldn't have caught these installations at the design stage or the approval stage to prevent this. But, not all fire protection systems go through an approval process depending on where you are located in the country. It you find yourself in this situation it can be challenging to correct.

OFF-CAMPUS

By Tim Knisely

May 2014

Smoke detectors are the most common culprit because these are often the device of choice in detecting a fire and protecting a building. Smoke detectors may be found in the most unusual places, such as the commercial kitchen where smoke and steam are prevalent. Inside the janitor's closet where we may also find steam you are likely to find a smoke detector. Other areas with steam or damp locations include the areas immediately outside the bathrooms and in dish rooms, laundry rooms, furnace rooms and attics.

The smoke detector installed in the restaurant dish room that generated numerous unwanted alarms.

If you need to provide alternative detection here a heat detector is probably your best option. If the building is protected with sprinklers, the sprinkler can be considered the heat detector in most codes and standards if the sprinkler causes the alarm to sound upon activation.

A smoke detector was installed in this kitchen. At the final inspection it was replaced to prevent unwanted alarms.

Sequencing of Alarms:

While not related to the proper installation of the devices alarms we really need to look at the sequencing of alarm signals, and what happens in a building when an alarm sounds.

In some buildings it may be wise for all of the occupants to be alerted to a fire alarm signal immediately, but not always. This is especially true in a residential building (apartment or a residence hall) where microwave cooking is present. In some settings, the dwelling rooms or sleeping rooms are protected with 110-volt or battery operated smoke alarms. If these alarms sound from smoke or steam, it only sounds within these areas. The building alarm will not sound until the smoke reaches the common area / corridor smoke detector that is part of the fire alarm system. In newer or more modern installations the dwelling/sleeping unit smoke detection can be provided by a smoke detector with a sounder base or horn that is part of the building alarm system. This is a great option to consider in new or renovated buildings, but be careful. When the detectors in the dwelling/sleeping unit sound the alarm processes or sequence of operation does not need to be different than110-voltbsystem. Instead, we're finding that these alarms are programmed to sound the entire building upon activation of one smoke detector in a living space, as well as notify the fire department. So, if someone burns popcorn in the microwave within their kitchen or room (kitchenette) the smoke detector/sounder base in this room sounds and so does the notification appliances for the entire building. Maybe all four, six or eight floors are now in alarm alerting every occupant in the building because someone burnt popcorn and the fire department is on the way. This doesn't need to occur – the best arrangement in these situations is for the detector and sounder base to activate and alert the occupants of the dwelling. The fire alarm system can notify the supervising station or campus security of the alarm activation and the appropriate staff is notified to respond.

Depending on the jurisdiction this may be the fire department or it may be the on-call maintenance staff. However, if additional or different devices activate then the building alarm must be activated and the fire department needs to be notified.

Special Considerations:

Fire alarm systems, combined with sprinklers and fire rated features in the building help to provide early warning of a fire, prevent the fire from spreading and help to contain the smoke and heat. These systems work well together as long as they are properly designed, installed and maintained. The building staff and tenants need to be educated about the systems, what they do, how they work and what they sound like.

Another consideration is for your choice of fire protection contractor. Fire protection systems are specialized systems and the installers need specialized training. Sprinkler systems are not plumbing systems and fire alarm systems are not electrical systems. If you specify fire protection systems for your campus, or if you approve these installations in your community make sure you make the extra effort to make sure that the installation contractor is qualified to do this work in accordance with the code or standard.

Tim Knisely

Tim Knisely is on the Board of Directors for The Center and the Senior Fire Inspector for the Centre Region Code Administration in State College, PA. In this position he manages the Existing Structures Division that administers the fire and property maintenance code in all existing commercial and residential rental properties, and coordinates the life safety education for the community including off-campus and Greek housing.

Tim has been active with The Center for Campus Fire Safety since its inception and served as treasurer from 2007 to 2010.

He is a frequent presenter at Campus Fire Forum, an instructor for the Fire-Smart Campus program and served as project manager for Campus Fire Data.

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CAMPUS FIRE SAFETY CODE TALK

Campus Fire Safety e-NewZone

Student Fire and EMS Squads: Learning and Giving Back

By Ken Holland, FF/NREMT-P, Senior Emergency Services Specialist, NFPA

While in my second year of college, I attended the University of New Hampshire in Durham, New Hampshire, my resident assistant (RA) was a member of a volunteer ambulance service that provided service to the university and the towns of Durham, Lee, and Marbury. After several conversations with her she convinced me to head on down to the station and see what it was all about and maybe volunteer my time to the organization. One of my concerns was that I had no formal training as an EMS provider and wondered what I could possibly offer the organization and the community in which they serve. She said that they would train me in whatever they could and point me to where I could get formal training, if I was interested. The trip down to the station changed my life as it propelled me into what has been a 22 span in EMS.

When I first went to college I had no idea that there was even a volunteer ambulance service in town as I thought it was run by the fire department. I also didn't know that there are so many student run fire and EMS squads throughout the country.

CAMPUS FIRE SAFETY CODE TALK

Most of the fire and EMS squads are volunteer while some are not, but in either case it is the students that are providing a majority of the services.

While doing some research for this article, so as to not just have my own personal experience to write from, I was amazed at just how many student fire and EMS squads there are at colleges throughout the country. As was my experience, many of these organizations and educational institutions offer free training and certification to members so that they can in turn use those skills learned to give back to the community in which they serve. Some educational institutions even offer scholarships to students who want to become a part of a fire and EMS squad that is part of the college.

In many cases the involvement in a student fire and EMS squad can be used or seen as a stepping stone to what may be a full time career for some once they have completed college. It could maybe a stepping stone into a life of volunteering and community networking, or just an experience of personal enrichment. In any event, the act of becoming a part of a student fire and EMS squad can have so many positive attributes that can be lifelong in nature. Depending on how involved one wants to get, there is the opportunity to learn about the operations of the organization. This could include maintaining the proper certifications needed for the providers and the organizations to continue to provide a particular level of service. This could also include how to maintain staffing levels for the fire and EMS squad to ensure they can provide a consistent level of service. One might also be interested in learning about vehicle maintenance, which could include the purchasing of new vehicles, retirement of older vehicles, or the refurbishment of existing vehicles. I would be remiss if I didn't point out that the National Fire Protection Association (NFPA) has standards that cover many of these areas already, which is something else the student could bet involved in. The point being is that there is much more than just providing the fire and EMS to the community, it is really up to the student to determine how involved they want to be.

So I would encourage the parents who will be sending their children off to college next fall to look into whether or not there is a student fire and EMS squad that they can become a part of. When we send out children off to college we want them to get the best education and learning experience that they can, experience a new chapter in their life as an adult, to grow as a person, and to also find a way to give back. What better way to experience all of that, and more, when there is the opportunity to be a part of a student fire and EMS squad? The learning experience and life experience that one will get from this, in my opinion and from my experience, will last a life time. The significance and simple act of volunteering and giving back to the community as a college student, especially as it relates to student fire and EMS squads, will plant the seed for a lifelong desire to stay connected and committed to the community in which they live in.

Ken is a Senior Emergency Services Specialist with the National Fire Protection Association (NFPA) and he is involved in working with several technical committees that develop and maintain various safety standards revolving around Fire Service Occupational Safety and Health (FSOSH), the EMS community, Aircraft Rescue and Fire Fighting (ARFF), and the new NFPA 1917, Standard for Automotive Ambulances. Ken has 22 years in EMS, of which 18 years he has devoted his time to being a paramedic. Before the NFPA, Ken was a member of the Bridgewater, Massachusetts Fire Department as a fire fighter/paramedic and the ALS coordinator for the department. Ken has his BA in Political Science and an MBA in Public Administration.

ICC CODE CORNER
2012 IFC Code & Commentary

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SECTION 909

SMOKE CONTROL SYSTEMS

909.1 Scope and purpose. This section applies to mechanical or passive smoke control systems when they are required for new buildings or portions thereof by provisions of the International Building Code or this code. The purpose of this section is to establish minimum requirements for the design, installation and acceptance testing of smoke control systems that are intended to provide a tenable environment for the evacuation or relocation of occupants. These provisions are not intended for the preservation of contents, the timely restoration of operations, or for assistance in fire suppression or overhaul activities. Smoke control systems regulated by this section serve a different purpose than the smoke- and heatventing provisions found in Section 910.

Mechanical smoke control systems shall not be considered exhaust systems under Chapter 5 of the International Mechanical Code .

♦This section is clarifying the intent of smoke control provisions, which is to provide a tenable environment to occupants during evacuation and relocation and not to protect the contents, enable timely restoration of operations or facilitate fire suppression and overhaul activities. There are provisions for high rise buildings in Section 403.4.6 of the IBC that are focused upon the removal of smoke for post fire and over-haul operations which is very different than the smoke control provisions in Section 909. Another element addressed in this section is that smoke control systems serve a different purpose than smoke and heat vents (see Section 910). This eliminates any confusion that smoke and heat vents can be used as a substitution for smoke control. Additionally, a clarification is provided to note that smoke control systems are not considered an exhaust system in accordance with Chapter 5 of the IMC. This is due to the fact that such systems are unique in their operation and are not necessarily designed to exhaust smoke but are focused upon tenability for occupants during egress.

It should be noted that the smoke control provisions are duplicated

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in Chapter 5 of the IMC.

It is important to note that these provisions only apply when smoke control is required by other sections of the code. The code requires smoke management within atrium spaces (see Section 404.5 of the IBC) and underground buildings (see Section 405.5 of the IBC). High-rise facilities require smokeproof exit enclosures in accordance with Sections 909.20 of the IBC and 1019.1.8 (see Section 403.5.4 of the IBC). Also, covered mall buildings that contain atriums that connect more than two stories require smoke control (see Section 402.10 of the IBC).

Section 909 focuses primarily on mechanical smoke control systems but there are many instances within the code were smoke is required to be managed in a passive way through the use of concepts such as smoke compartments. Smoke compartments are formed through the use of smoke barriers in accordance with Section 709 of the IBC. Smoke barriers can be used simply as a passive smoke management system or can be a design component of a mechanical smoke control system in accordance with Section 909. Some examples of occupancies requiring passive systems include hospitals, nursing and similar facilities (Group I-2 occupancies) and detention facilities (Group I-3 occupancies) (see Sections 407.4 and 408.6 of the IBC).

In some cases, mechanical smoke control in accordance with Section 909 is allowed as an option for compliance. More specifically if a Group I-3 contains windowless areas of the facility natural or mechanical smoke management is required (see Section 408.9 of the IBC).

In the last several years, smoke control provisions have become more complex. The reason is related to the fact that smoke is a complex problem, while a generic solution of six air changes has repeatedly and scientifically been shown to be inadequate. Six air changes per hour does not take into account factors such as buoyancy; expansion of gases; wind; the geometry of the space and of communicating spaces; the dynamics of the fire, including heat release rate; the production and distribution of smoke and the interaction of the building systems.

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Smoke control systems can be either passive or active. Active systems are sometimes referred to as mechanical. Passive smoke control systems take advantage of smoke barriers surrounding the zone in which the fire event occurs or high bay areas that act as reservoirs to control the movement of smoke to other areas of the building. Active systems utilize pressure differences to contain smoke within the event zone or exhaust flow rates sufficient to slow the descent of the upper-level smoke accumulation to some predetermined position above necessary exit paths through the event zone. On rare occasions, there is also a possibility of controlling the movement of smoke horizontally by opposed airflow, but this method requires a specific architectural geometry to function properly that does not create an even greater hazard.

Essentially, there are three methods of mechanical or active smoke control that can be used separately or in combination within a design: pressurization, exhaust and, in rare and very special circumstances, opposed airflow.

Of course, all of these active approaches can be used in combination with the passive method.

Typically, the mechanical pressurization method is used in high-rise buildings when pressurizing stairways and for zoned smoke control. Pressurization is not practical in large open spaces such as atriums or malls, since it is difficult to develop the required pressure differences due to the large volume of the space.

The exhaust method is typically used in large open spaces such as atriums and malls. As noted, the pressurization method would not be practical within large spaces. The opposed airflow method, which basically uses a velocity of air horizontally to slow the movement of smoke, is typically applied in combination with either a pressurization method or exhaust method within hallways or openings into atriums and malls.

The application of each of these methods will be dependent on the specifics of the building design.

Smoke control within a building is fundamentally an architecturally driven problem. Different architectural geometries first dictate the need or lack thereof for smoke control, and then define the bounds of available solutions to the problem.

909.2 General design requirements. Buildings, structures, or parts thereof required by the International Building Code or this code to have a smoke control system or systems shall have such systems designed in accordance with the applicable requirements of Section 909 and the generally accepted and well-established principles of engineering relevant to the design. The construction documents shall include sufficient information and detail to describe adequately the elements of the design necessary for the proper implementation of the smoke control systems. These documents shall be accompanied with sufficient information and analysis to demonstrate compliance with these provisions.

♦This section simply states that when smoke control systems are required by the code, the design is required to be in accordance with the provisions of this section. As noted in the commentary to Section 909.1, there are instances within the code that have smoke management systems that are purely passive in nature and do not reference Section 909.

This section stresses that such designs need to follow "generally accepted and well-established principles of engineering relevant to the design," essentially requiring a certain level of qualifications in the applicable areas of engineering to prepare such designs. The primary engineering disciplines tend to be fire engineering and mechanical engineering. It should be noted that each state in the U.S. typically requires minimum qualifications to undertake engineering design. Two important resources when designing smoke control systems are the International Code Council's (ICC) Guide to Smoke Control in the 2006 IBC and American Society of Heating, Refrigerating and Air-Conditioning Engineers' (ASHRAE) Design of Smoke Management Systems.

Additionally, Section 909.8 requires the use of NFPA 92B for the design of smoke control systems using the exhaust method. This standard has many relevant aspects beyond the design that are beneficial. In particular, Annex B provides resources in terms of determination of fire size for design. ICC's Guide to Smoke Control in the 2006

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IBC also provides guidance on design fires.

A key element covered in this section is the need for detailed and clear construction documents so that the system is installed correctly. In most complex designs, the key to success is appropriate communication to the contractors as to what needs to be installed. The more complex a design becomes, the more likely there is to be construction errors. Most smoke control systems are complex, which is why special inspections in accordance with Section 909.3 and Chapter 17 of the IBC are critical for smoke control systems. Additionally, in order for the design to be accepted, analyses and justifications need to be provided in enough detail to evaluate for compliance.

Adequate documentation is critical to the commissioning, inspection, testing and maintenance of smoke control systems and significantly contributes to the overall reliability and effectiveness of such systems.

909.3 Special inspection and test requirements. In addition to the ordinary inspection and test requirements which buildings, structures and parts thereof are required to undergo, smoke control systems subject to the provisions of Section 909 shall undergo special inspections and tests sufficient to verify the proper commissioning of the smoke control design in its final installed condition. The design submission accompanying the construction documents shall clearly detail procedures and methods to be used and the items subject to such inspections and tests. Such commissioning shall be in accordance with generally accepted engineering practice and, where possible, based on published standards for the particular testing involved. The special inspections and tests required by this section shall be conducted under the same terms as in Section 1704 of the International Building Code.

♦Due to the complexity and uniqueness of each design, special inspection and testing must be conducted.

The designer needs to provide specific recommendations for special inspection and testing within his or her documentation. In fact, the code specifies in Chapter 17 of the IBC that special inspection

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agencies for smoke control have expertise in fire protection engineering, mechanical engineering and certification as air balancers. Since the designs are unique to each building, there probably will not be a generic approach available to inspect and test such systems. The designer can and should, however, use any available published standards or guides when developing the special inspection and testing requirements for that particular design. ICC's Guide to Smoke Control in the 2006 IBC provides some background on such inspections, Also, ASHRAE Guideline 5 is a good starting place but only as a general outline. In addition, NFPA 92A and NFPA 92B also have extensive testing, documentation and maintenance requirements that may be a good resource.

NFPA 92B is referenced in Section 909.8 for the design of smoke control systems using the exhaust method. Each system will require a unique commissioning plan that can be developed only after careful and thoughtful examination of the final design and all of its components and interrelationships. Generally, these provisions may be included in design standards or engineering guides.

909.4 Analysis. A rational analysis supporting the types of smoke control systems to be employed, the methods of their operations, the systems supporting them, and the methods of construction to be utilized shall accompany the construction documents submission and include, but not be limited to, the items indicated in sections 909.4.1 through 909.4.6.

♦This section indicates that simply determining airflow, exhaust rates and pressures to maintain tenable conditions is not adequate. There are many factors that could alter the effectiveness of a smoke control system, including stack effect, temperature effect of fire, wind effect, heating, ventilating and air-conditioning (HVAC) system interaction and climate, as well as the placement, quantity of inlets/outlets and velocity of supply and exhaust air. These factors are addressed in the sections that follow. Additionally, the duration of operation of any smoke control system is mandated at a minimum of 20 minutes or 1.5 times the egress time, whichever is less. The

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code cannot reasonably anticipate every conceivable building arrangement and condition the building may be subject to over its life and must depend on such factors being addressed through a rational analysis.

909.4.1 Stack effect. The system shall be designed such that the maximum probable normal or reverse stack effect will not adversely interfere with the system's capabilities. In determining the maximum probable stack effect, altitude, elevation, weather history and interior temperatures shall be used.

♦ Stack effect is the tendency for air to rise within a heated building when the temperature is colder on the exterior of the building. Reverse stack effect is the tendency for air to flow downward within a building when the interior is cooler than the exterior of the building. This air movement can affect the intended operation of a smoke control system. If stack effect is great enough, it may overcome the pressures determined during the design analyses and allow smoke to enter areas outside the zone of origin (see Figure 909.4.1).

909.4.2 Temperature effect of fire. Buoyancy and expansion caused by the design fire in accordance with Section 909.9 shall be analyzed. The system shall be designed such that these effects do not adversely interfere with the system's capabilities.

♦ This section requires that the design account for the effect temperature may have on the success of the system. When air or any gases are heated, they will expand. This expansion makes the gases lighter and, therefore, more buoyant. The buoyancy of hot gases is important when the design is to exhaust such gases from a location in or close to the ceiling; therefore, if sprinklers are part of the design, as required by Section 909, the gases may be significantly cooler than an unsprinklered fire, making it more difficult to remove the smoke and alter the plume dynamics.

The fact that air expands when heated needs to be accounted for in the design.

When using the pressurization method, the expansion of hot gases needs to be accounted for, since it will take a larger volume of air to create the necessary

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pressure differences to maintain the area of fire origin in negative pressure. The expansion of the gases has the effect of pushing the hot gases out of the area of fire origin. Since sprinklers will tend to cool the gases, the effect of expansion is lower. The pressure differences required in Section 909.6.1 are specifically based on a sprinklered building. If the building is nonsprinklered, higher pressure differences may be required. The minimum pressure difference for certain unsprinklered ceiling height buildings is as follows:

Ceiling height Minimum pressure difference (feet) (inch water gage)

9 0.10

15 0.14

21 0.18

This is a very complex issue that needs to be part of the design analysis. It needs to address the type and reaction of the fire protection systems, ceiling heights and the size of the design fire.

909.4.3 Wind effect. The design shall consider the adverse effects of wind. Such consideration shall be consistent with the wind-loading provisions of the International Building Code.

♦The effect of wind on a smoke control system within a building is very complex. It is generally known that wind exerts a load upon a building. The loads are looked at as windward (positive pressure) and leeward (negative pressure). The velocity of winds will vary based on the terrain and the height above grade; therefore, the height of the building and surrounding obstructions will have an effect on these velocities.

These pressures alter the operation of fans, especially propeller fans, thus altering the pressure differences and airflow direction in the building. There is not an easy solution to dealing with these effects. In fact, little research has been done in this area.

It should be noted that in larger buildings a wind study is normally undertaken for the structural design.

The data from those studies can be used in the analysis of the effects on the pressures and airflow within the building with regard to the performance of the smoke control system.

909.4.4 Systems. The design shall consider the

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effects of the heating, ventilating and air-conditioning (HVAC) systems on both smoke and fire transport. The analysis shall include all permutations of systems status. The design shall consider the effects of the fire on the heating, ventilating and air-conditioning systems.

♦If not properly configured to shut down or included as part of the design, the HVAC system can alter the smoke control design. More specifically, if dampers are not provided between smoke zones within the HVAC system ducts, smoke could be transported from one zone to another. Additionally, if the HVAC system places more supply air than assumed for the smoke control system design, the velocity of the air may adversely affect the fire plume or a positive pressure may be created. Generally, an analysis of the smoke control design and the HVAC system in all potential modes should occur and be noted within the design documentation as well as incorporated into inspection, testing and maintenance procedures. This is critical as these systems need to be maintained and tested to help ensure that they operate and shut down systems as required.

909.4.5 Climate. The design shall consider the effects of low temperatures on systems, property and occupants. Air inlets and exhausts shall be located so as to prevent snow or ice blockage.

♦This section is focused on properly protecting equipment from weather conditions that may affect the reliability of the design. For instance, extremely cold or hot air may damage critical equipment within the system when pulled directly from the outside. Some listings of duct smoke detectors are for specific temperature ranges; therefore, placing such detectors within areas exposed to extreme temperatures may void the listing. Also, the equipment and air inlets and outlets should be designed and located so as to not collect snow and ice that could block air from entering or exiting the building.

909.4.6 Duration of operation. All portions of active or passive smoke control systems shall be capable of continued operation after detection of the fire event for a period of not less than either 20 minutes or 1.5 times the calculated egress time, whichever is less.

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♦The intent of the smoke control provisions is to provide a tenable environment for occupants to either evacuate or relocate to a safe place. Evacuation and relocation activities include notifying occupants, possible investigation time for the occupants, decision time and the actual travel time. In order to achieve this goal, the code has established 20 minutes or 1.5 times the calculated egress time, whichever is less, as a minimum time for evacuation or relocation. Basically this allows a designer to undertake an egress analysis to more closely determine the necessary time for egress. The code provides a safety factor of 1.5 times the egress time to account for uncertainty related to human behavior. It is stressed that the 20-minute duration as well as the calculated egress time, whichever approach is chosen, begins after the detection of the fire event and notification to the building occupants to evacuate has occurred, since occupants need to be alerted before evacuation can occur. The calculation of evacuation time needs to include delays with notification and the start of evacuation (i.e. pre-movement time, etc.) It is stressed that the code states 20 minutes or 1.5 times the egress time, whichever is less (i.e., 20 minutes is a maximum).

Egress of occupants can be addressed through hand calculations or through the use of computerized egress models. Some of the more advanced models can address a variety of factors, including the building layout, different sizes of people, different movement speeds and different egress paths available. With these types of programs the actual time can be even more precisely calculated. Of course it is cautioned that in many cases these models provide the optimal time for egress. The safety factor of 1.5 within the code is intended to address many of these uncertainties.

Note that this section applies to all types of smoke control designed in accordance with Section 909.

Also, most smoke control systems will typically have the ability to run for longer than the 20-minute maximum as they are on standby power and may be able to continue to achieve the tenability goals. In some cases even if the system runs longer than 20 minutes the tenability may not be able to continue. It simply depends on the system design and the fire hazards within the building.

System response as required in Section 909.17 needs to be accounted for when determining the ability of the smoke control system to keep the smoke layer interface at the appropriate level (see commentary, Section 909.17).

909.5 Smoke barrier construction. Smoke barriers shall comply with the International Building Code. Smoke barriers shall be constructed and sealed to limit leakage areas exclusive of protected openings. The maximum allowable leakage area shall be the aggregate area calculated using the following leakage area ratios:

1. Walls: A/Aw = 0.00100

2. Interior exit stairways and ramps and exit passageways:

A/Aw = 0.00035

3. Enclosed exit access stairways and ramps and all other shafts: A/Aw = 0.00150

4. Floors and roofs: A/AF = 0.00050 where:

A = Total leakage area, square feet (m2).

AF = Unit floor or roof area of barrier, square feet (m2).

Aw = Unit wall area of barrier, square feet (m2).

The leakage area ratios shown do not include openings due to doors, operable windows or similar gaps. These shall be included in calculating the total leakage area.

♦Part of the strategy of smoke control systems, particularly smoke control systems using the pressurization method (often termed zoned smoke control) is the use of smoke barriers to divide a building into separate smoke zones (or compartments). This strategy is used in both passive and mechanical systems. It should be noted that not all walls, ceilings or floors would be considered smoke barriers. Only walls that designate separate smoke zones within a building need to be constructed as smoke barriers. This section is simply providing requirements for walls, floors and ceilings that are used as smoke barriers. It should be noted that it is possible that a smoke control system utilizing the exhaust method may not need to utilize a smoke barrier to divide the building into separate smoke zones; therefore, the evaluation of barrier construction and leakage

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area may not be necessary and as noted are primarily focused upon designs using the pressurization method.

In order for smoke to not travel from one smoke zone to another, specific construction requirements are necessary in accordance with the code. It should be noted that openings such as doors and windows are dealt with separately within Section 909.5.2 from openings such as cracks or penetrations.

909.5.1 Leakage area. Total leakage area of the barrier is the product of the smoke barrier gross area multiplied by the allowable leakage area ratio, plus the area of other openings such as gaps and operable windows. Compliance shall be determined by achieving the minimum air pressure difference across the barrier with the system in the smoke control mode for mechanical smoke control systems. Passive smoke control systems tested using other approved means, such as door fan testing, shall be as approved by the fire code official.

♦It is impossible for walls and floors to be constructed that are completely free from openings that may allow the migration of smoke; therefore, leakage needs to be compensated for within the design by calculating the leakage area of walls, ceilings and floors. The factors provided in Section 909.5, which originate from ASHRAE's provisions on leaky buildings, are used to calculate the total leakage area. The total leakage area is then used in the design process to determine the proper amount of air to create the required pressure differences across these surfaces that form smoke zones. These pressure differences then need to be verified when the system is in smoke control mode.

Additionally, Section 909.5 provides ratios to determine the maximum allowable leakage in walls, interior exit stairways, shafts, floors and roofs. These leakage areas are critical in determining whether the proper pressure differences are provided when utilizing the pressurization method of smoke control. Pressure differences will decrease as the openings get larger.

909.5.2 Opening protection. Openings in smoke barriers shall be protected by automatic-closing devices actuated

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by the required controls for the mechanical smoke control system.

Door openings shall be protected by fire door assemblies complying with Section 716.5.3 of the International Building Code.

Exceptions:

1. Passive smoke control systems with automatic-closing devices actuated by spot-type smoke detectors listed for releasing service installed in accordance with Section 907.10.

2. Fixed openings between smoke zones that are protected utilizing the airflow method.

3. In Group I-2, where such doors are installed across corridors, a pair of opposite-swinging doors without a center mullion shall be installed having vision panels with fire protection-rated glazing materials in fire protection-rated frames, the area of which shall not exceed that tested. The doors shall be close-fitting within operational tolerances and shall not have undercuts, louvers or grilles. The doors shall have head and jamb stops, astragals or rabbets at meeting edges and shall be automatic-closing by smoke detection in accordance with Section 716.5.9.3 of the International Building Code . Positive-latching devices are not required.

4. Group I-3.

5. Openings between smoke zones with clear ceiling heights of 14 feet (4267 mm) or greater and bankdown capacity of greater than 20 minutes as determined by the design fire size.

♦Similar to concerns of smoke leakage between smoke zones, openings may compromise the necessary pressure differences between smoke zones.

Openings in smoke barriers, such as doors and windows, must be either constantly or automatically closed when the smoke control system is operating.

This section requires that doors be automatically closed through the activation of an automatic closing device linked to the smoke control system. Essentially, when the smoke control system is activated, all openings are automatically closed. This most likely would mean that the mechanism that activates the smoke control system would also automatically close all openings. The smoke control system will be activated by a specifically zoned smoke detection or sprinkler system as

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required by Sections 909.12.2 and 909.12.3.

In terms of actual opening protection, Section 909.5.2 is simply referring the user to Section 716.4.3 of the IBC for specific construction requirements for doors located in smoke barriers. Note that smoke barriers are different from fire barriers, since the intended measure of performance is different. One is focused on fire spread from the perspective of heat, the other from the perspective of smoke passage.

Smoke barriers do require a 1-hour fire-resistance rating.

There are several exceptions to this particular section.

Exception 1 is specifically for passive systems.

Passive systems, as noted, are systems in which there is no use of mechanical systems. Instead, the system operates primarily upon the configuration of barriers and layout of the building to provide smoke control. Passive systems can use spot-type detectors to close doors that constitute portions of a smoke barrier.

Essentially, this means a full fire alarm system would not be required. Instead, single station detectors would be allowed to close the doors. Such doors would need to fail in the closed position if power is lost. The specifics as to approved devices would be found in NFPA 72.

Exception 2 is based on the fact that some systems take advantage of the opposed airflow method such that smoke is prevented from migrating past the doors. Therefore, since the design already accounts for potential smoke migration at these openings through the use of air movement, it is unnecessary to require the barrier to be closed.

Exception 3 is specifically related to the unique requirements for Group I-2 occupancies. Essentially, a very specific alternative, which meets the functional needs of Group I-2 occupancies, is provided. One aspect of the alternative approach is that doors have vision panels with approved fire protection-rated glazing in fire protection-rated frames of a size that does not exceed the type tested.

Exception 4 allows an exemption from the automatic- closing requirements for all Group I-3 occupancies.

This is related to the fact

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that facilities that have occupants under restraint or with specific security restrictions have unique requirements in accordance with Section 408 of the code. These requirements accomplish the intent of providing reliable barriers between each smoke zone since, for the most part, such facilities will have a majority of doors closed and in a locked position due to the nature of the facility.

The staff very closely controls these types of facilities.

Exception 5 relates to the behavior of smoke. The assumption is that smoke rises due to the buoyancy of hot gases, and if the ceiling is sufficiently high, the smoke layer will be contained for a longer period of time before it begins to move into the next smoke zone. Therefore, it is not as critical that the doors automatically close. This allowance is dependent on the specific design fire for a building. See Section 909.9 for more information on design fire determination.

Different size design fires create different amounts of smoke that, depending on the layout of the building, may migrate in different ways throughout the building. This section mandates that smoke cannot begin to migrate into the next smoke zone for at least 20 minutes. This is consistent with the 20-minute maximum duration of operation of smoke control systems required in Section 909.4.6. It should be noted that a minimum of 14-foot (4267 mm) ceilings are required to take advantage of this exception. This exception would require an engineering analysis.

909.5.2.1 Ducts and air transfer openings. Ducts and air transfer openings are required to be protected with a minimum Class II, 250°F (121°C) smoke damper complying with Section 717 of the International Building Code.

♦Another factor that adds to the reliability of smoke barriers is the protection of ducts and air transfer openings within smoke barriers. Left open, these openings may allow the transfer of smoke between smoke zones. These ducts and air transfer openings most often are part of the HVAC system. Damper operation and the reaction with the smoke control system will be evaluated during acceptance testing. It should be noted that there are duct systems

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used within a smoke control design that are controlled by the smoke control system and should not automatically close upon detection of smoke via a smoke damper.

It should be noted that a smoke damper works differently than a fire damper. Fire dampers react to heat via a fusible link, while smoke dampers activate upon the detection of smoke. The smoke dampers used should be rated as Class II, 250°F (121°C). The class of the smoke damper refers to its level of performance relative to leakage. The temperature rating is related to its ability to withstand the heat of smoke resulting from a fire. It should be noted that although smoke barriers are only required to utilize smoke dampers, there may be many instances where a fire damper is also required. For instance, the smoke barrier may also be used as a fire barrier. Also, Section 717.5.3 of the IBC would require penetration of shafts to contain both a smoke and fire damper. Therefore, in some cases both a smoke damper and fire damper would be required. There are listings specific to combination smoke and fire dampers.

More specific requirements about dampers can be found in Chapter 7 of the IBC and Chapter 6 of the IMC.

909.6 Pressurization method. The primary mechanical means of controlling smoke shall be by pressure differences across smoke barriers. Maintenance of a tenable environment is not required in the smoke-control zone of fire origin.

♦There are several methods or strategies that may be used to control smoke movement. One of these methods is pressurization, wherein the system primarily utilizes pressure differences across smoke barriers to control the movement of smoke. Basically, if the area of fire origin maintains a negative pressure, then the smoke will be contained to that smoke zone. A typical approach used to obtain a negative pressure is to exhaust the fire floor. This is a fairly common practice in high-rise buildings. Interior exit stairways also utilize the concept of pressurization by keeping the interior exit stairways under positive pressure. The pressurization method in large open spaces, such as malls and atria, is impractical since it would take a large quantity of supply air to create the necessary pressure

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differences. It should be noted that pressurization is mandated as the primary method for mechanical smoke control design but this is related to the primary methods historically used for smoke control in high rise buildings. Currently highrise buildings do not require smoke control. Airflow and exhaust methods are only allowed when appropriate.

The exhaust method is the most commonly applied method due to the use of the atrium provisions in Section 404.5 of the IBC.

The pressurization method does not require that tenable conditions be maintained in the smoke zone where the fire originates. Maintaining this area tenable would be impossible, based on the fact that pressures from the surrounding smoke zones would be placing a negative pressure within the zone of origin to keep the smoke from migrating.

Pressurization is used often with interior exit stairways. This method provides a positive pressure within the interior exit stairways to resist the passage of smoke. Stair pressurization is one method of compliance for stairways in high-rise or underground buildings where the floor surface is located more than 75 feet (22 860 mm) above the lowest level of fire department vehicle access or more than 30 feet (9144 mm) below the floor surface of the lowest level of exit discharge. It should be noted that there are two methods found in the code that address smoke movement—smokeproof enclosures or pressurized stairs. A smokeproof enclosure requires a certain fire resistance rating along with access through a ventilated vestibule or an exterior balcony. The vestibule can be ventilated in two ways: using natural ventilation or mechanical ventilation as outlined in Sections 909.20.3 and 909.20.4 of the IBC. The pressurization method requires a sprinklered building and a minimum pressure difference of 0.15 inch (37 Pa) of water and a maximum of 0.35 inch (87 Pa) of water.

These pressure differences are to be available with all doors closed under maximum stack pressures (see Sections 909.20 of the IBC and 1022.9 of the code for more details).

As noted, the pressurization method utilizes pressure differences across smoke barriers to achieve control of smoke. Sections 909.6.1 and 909.6.2 provide the criteria for smoke control design in terms of minimum and maximum pressure differences.

In summary, the pressurization method is used in two ways. The first is through the use of smoke zones where the zone of origin is exhausted, creating a negative pressure. The second is stair pressurization that creates a positive pressure within the stair to avoid the penetration of smoke. Note that the code allows the use of a smokeproof enclosure instead of pressurization.

909.6.1 Minimum pressure difference. The minimum pressure difference across a smoke barrier shall be 0.05-inch water gage (0.0124 kPa) in fully sprinklered buildings.

In buildings allowed to be other than fully sprinklered, the smoke control system shall be designed to achieve pressure differences at least two times the maximum calculated pressure difference produced by the design fire.

♦The minimum pressure difference is established as 0.05-inch water gage (12 Pa) in fully sprinklered buildings. This particular criterion is related to the pressures needed to overcome buoyancy and the pressures generated by the fire, which include expansion.

This particular criterion is based upon a sprinklered building. The pressure difference would need to be higher in a building that is not sprinklered. Additionally, the pressure difference needs to be provided based upon the possible stack and wind effects present.

909.6.2 Maximum pressure difference. The maximum air pressure difference across a smoke barrier shall be determined by required door-opening or closing forces. The actual force required to open exit doors when the system is in the smoke control mode shall be in accordance with Section

1008.1.3. Opening and closing forces for other doors shall be determined by standard engineering methods for the resolution of forces and reactions. The calculated force to set a sidehinged, swinging door in motion shall be determined by:

$F = F_{dc} + K(WA\Delta P)/2(W - d)$ (Equation 9-1) where:

A = Door area, square feet (m2).

d = Distance from door

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handle to latch edge of door, feet (m).

F = Total door opening force, pounds (N).

Fdc = Force required to overcome closing device, pounds (N).

K = Coefficient 5.2 (1.0).

W = Door width, feet (m).

ΔP = Design pressure difference, inches of water (Pa).

♦The maximum pressure difference is based primarily upon the force needed to open and close doors. The code establishes maximum opening forces for doors.

This maximum opening force cannot be exceeded, taking into account the pressure differences across a doorway in a pressurized environment. Essentially, based on the opening force requirements of Section 1008.1.3, the maximum pressure difference can be calculated in accordance with Equation 9-1. In accordance with Chapter 10, the maximum opening force of a door has three components, including:

• Door latch release:

Maximum of 15 pounds (67 N)

• Set door in motion:

Maximum of 30 pounds (134 N)

• Swing to full open position:

Maximum of 15 pounds (67 N) Equation 9-1 is used to calculate the total force to set the door into motion when in the smoke control mode; therefore, the limiting criteria would be 30 pounds (134 N). It should be noted that although the accessibility requirements related to door opening force are more restrictive in Section 404.2.8 of ICC A117.1 fire doors do not require compliance with these requirements.

Next Month

909.7 Airflow design method. (Page 414)

ICC CODE CORNER
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