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THE BENEFITS OF SMOKE/HEAT VENTS?

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In a paper titled "*Smoke and Heat Vents: A review of the technology and the way forward to the next generation*", written by Dr. Craig Beyler of Hughes Associates, Inc. (HAI) and distributed at a meeting of the International Code Council's (ICC) Code Technology Committee (CTC) meeting held in Kansas City in October 2006, Beyler lists the potential benefits of providing smoke and heat vents in single story buildings. The following are excerpts from Beyler's paper:

> "*The primary means of controlling the production of smoke and heat is to suppress the fire by automatic means or by manual firefighting. Even when automatic suppression systems are employed, manual firefighting by the fire department is an integral part of the process of fire suppression.*"
>
> "*The specific benefits of smoke and heat venting include:*
>
> 1. *Facilitate safe egress of building occupants by restricting spread of smoke and hot gases into escape routes*
>
> 2. *Facilitate firefighting operations by enabling firefighters to enter the building and to see the seat of the fire without the delay and hazards of manual roof venting*
>
> 3. *Limit damage to the building and contents due to smoke and heat by removing smoke and heat from the building*
>
> *Each of these is achieved by preventing smoke logging of the building down to occupied levels of the building where people require adequate visibility to escape and where adequate visibility facilitates the firefighters finding and extinguishing the fire. Limiting smoke damage to the building and contents is achieved by removing the smoke. This limits the exposure of the building interior and contents to smoke deposition.*"

The benefits of smoke and heat vents listed above appear to be rationale and logical effects of venting with but one unstated caveat-the vents must actually open. In other forums, however, Dr. Beyler clearly admits that this caveat is a problem where automatic vents are provided in buildings which are protected by (standard spray) sprinklers.

In a proposal to amend the 2002 edition of NFPA 204, Beyler (and Paul Compton, Colt International Ltd.) proposes that the following text be included in the Appendix of NFPA 204:

> "*In tests where the vents were opened by fusible link*[,] *a number of the vents failed to open, attributed to either the cooling effects of the sprinklers on the smoke layer or direct spray cooling of the fusible links.*"
>
> "*. . . .The effect of sprinkler cooling may limit the number of vents opening if control is only by fusible link or if drop out panels are used. If the fusible link or drop out panel operating temperature is equal to or higher than the sprinkler bulb operating temperature then vents outside the outer ring of operating sprinklers are unlikely to open. This could significantly limit the effectiveness of the smoke vent system. . . .*"

It's difficult to disagree with Dr. Beyler's statement that, if automatic roof vents don't open due to the interaction of sprinklers and the vents, "*this could significantly limit the effectiveness of the smoke vent system*". Of course, if automatic roof vents don't open in a fire due to sprinkler operation, then none of the benefits of providing roof vents listed above will actually occur either. That statement seems rather obvious, but neither Beyler nor Jesse Beitel, also with HAI, have conceded this point at ICC code development meetings held in Cincinnati (2005), Lake Buena Vista (2006) or Palm Springs (2008) or in the CTC roof vent study group teleconferences (2007). Both Beyler and Beitel continue to state that "[automatic roof] vents work", while conveniently neglecting to indicate that this statement is only accurate in buildings which are not protected by sprinklers or in buildings protected by a sprinkler system which fails to discharge water spray due to a closed valve, damaged supply piping or a pump which fails to start.

Well, if roof vents don't operate in sprinklered buildings as indicated by Beyler in his NFPA 204 proposal, then perhaps the statements made by Beyler regarding the potential benefits of automatic vents may also be erroneous. Let's analyze Beyler's list of the potential benefits of vents.

The first item in Beyler's list of benefits indicates that roof vents assist occupants in making safe egress from buildings provided with vents. While this statement may be true in buildings which are not protected by a sprinkler system, this most surely is not the case in sprinklered buildings provided with vents. The tests of sprinkler and vent interaction sponsored by the National Fire Protection Research Foundation (NFPRF) in 1997/1998 demonstrated that if vents operate at all in sprinklered buildings, the vent operation will be significantly delayed by sprinkler operation.

For instance, in Test P-2 of the large scale test series in the NFPRF-sponsored research, one roof vent did actually open, however, the vent operated 6 minutes and 4 seconds after the fire was ignited. By the time the roof vent operated, it would be expected that most, if not all single-story buildings, would have already been evacuated. (It is worth noting that, in this test, a roof vent located directly over the fire failed to operate. The vent which operated was located roughly 20 feet from the ignition point of the fire. If the vents were spaced farther apart, it is likely that this vent would also have failed to operate.)

In Test P-3 of the NFPRF-sponsored large scale test series, a vent located approximately 10 feet from the ignition point operated 4 minutes and 11 seconds after the fire was ignited. (In this case, the operation of the vent was aided by the installation of draft curtains located 10 feet from the center of the vent. It is likely that the operation of the vent would have been further delayed had the vent not been located in close proximity to the draft curtain. It should be noted that the International Building Code/International Fire Code do not require that draft curtains be provided.) Once again, it would be expected that most, if not all single-story buildings, would be evacuated prior to the operation of the vent. Even if building evacuation had not been completed within 4 minutes, it would be expected that the operation of a single vent with typical dimensions of either 4 feet by 4 feet or 4 feet by 8 feet would have little impact on the conditions at the floor prior to egress being completed, particularly if draft curtains are not provided in the building.

Another claimed benefit of providing automatic roof vents in a sprinklered building is that the vents will allow firefighters to enter the building, quickly determine where the seat of the fire is located and to immediately begin manual firefighting operations. Of course, this claimed benefits depends upon whether or not the vents actually operate and, if vents do operate, the size and number of vents which open, as well as the time at which the vents operate.

A fire which occurred in a building utilized for bulk merchandising on March 19, 1998 in Tempe, Arizona casts considerable doubt on this claim. The building in Tempe was provided with both roof vents and draft curtains installed per the Uniform Fire Code. In this fire, a total of three roof vents and one skylight opened prior to the arrival of the fire department at the building. Despite the fact that more roof vents operated than is typical in a building protected by a sprinkler system, firefighters reported zero visibility at the floor throughout the building at the time of their arrival at the fire. In this case, firefighters were ordered to the roof to manually open all of the vents provided.

Although firefighters were able to save the building by manually opening the roof vents and then attacking the fire, sending firefighters to the roof was an extremely risky operation because the sprinkler system was failing to control the fire. (The sprinkler failure was due at least in part because draft curtains interfered with "pre-wetting" and allowed the fire to jump an aisle which was 10 feet in width.) Thankfully, the operation of the sprinklers was at least able to maintain the stability of the roof during the vent opening operation.

While the fire department responding to the fire in Tempe had sufficient manpower capabilities to conduct the vent opening operation, followed by manual interior firefighting operations, an excerpt from a US Fire Administration (USFA) study titled "Four Years Later-A Second Needs Assessment of the U.S. Fire Service" dated October 2006 includes the following passages:

> "*In communities with less than 2,500 population, 21% of fire departments, nearly all of them all- or mostly-volunteer departments, deliver an average of 4 or fewer volunteer firefighters to a mid-day house fire. Because these departments average only one career firefighter per department, it is likely that most of these departments often fail to deliver the minimum of 4 firefighters recognized by national standards as the necessary minimum for interior fire attack.*"

> "*An estimated 79,000 firefighters serve in fire departments that protect communities of at least 50,000 population and have fewer than 4 career firefighters assigned to first-due engine companies. It is likely that, for many of these departments, the first arriving complement of firefighters often falls short of the minimum of 4 firefighters needed to initiate an interior attack on a structure fire, thereby requiring the first-arriving firefighters to wait until the rest of the first-alarm responders arrive*."

Certainly, given the information about fire department manpower, it can be concluded that many fire departments in the United States do not have sufficient manpower to manually open vents on the roof and, then conduct an interior manual firefighting operation in a large single story building where the sprinkler system is failing. Due to the lack of manpower, many fire departments in the United States will simply be unable to effectively utilize any additional time venting provides for interior manual firefighting.

Even with effective venting, it should be noted that zero visibility at the floor of a single-story building will only be delayed for a short period of time. Hence, having sufficient firefighting manpower at the fire within the first ten minutes of the fire is absolutely essential for being able to take advantage of the delay in the loss of visibility that vents actually provide. It should also be noted that the delay in the loss of visibility will depend upon the size of the fire, the size and number of roof vents which actually operate, whether or not draft curtains are provided and, of course, the size and roof height of the building. Given all the different variables, the delay in the loss of visibility at the floor of a building provided by automatic roof vents will vary at every fire.

The third benefit that Beyler claims for automatic roof vents is a reduction in damage to both the building and the contents. While it is intuitively logical that this would likely be the case, Beyler cannot ~~to~~ point to any study that actually confirms that this is the case. Most would think that, if the installation of automatic roof vents significantly reduces property damage, the smoke/heat vent manufacturers would have long ago conducted a study to confirm this claim. In my opinion, the reason that the vent manufacturers have not conducted such a study is that the reduction in damage due to the installation of automatic roof vents is so insignificant that it's simply not worth talking about.

The fire in Tempe, Arizona on March 19, 1988 is a good example of why automatic roof vents may not actually reduce or limit property damage. Although firefighters were able to ultimately control the fire and save the building shell due to roof vents, manually opening vents on the roof of a building with a failing sprinkler system was an extremely risky operation. Firefighters were only able to save the building shell due to the fact that adequate manpower was available at the fire scene and because the fire incident commander made the decision to attempt the risky operation of manually opening the vents.

If the incident commander had decided that manually opening the roof vents was too risky to be attempted, the building would in all probability have been destroyed. Hence, the installation of roof vents only saved the building shell because the fire commander made the decision to risk the lives of firefighters on the roof. In today's fire service, fewer fire commanders are willing to take that risk. The lives of our firefighters are simply not worth saving a building shell.

Of course, if roof vents actually reduced property damage, you would expect that property insurers would require that roof vents be installed in sprinklered buildings. Can you name any US property insurer that requires that roof vents be installed in large warehouses and industrial buildings protected by sprinklers? I can't (and neither can Beyler). Given this, it is also intuitively logical to conclude that property insurers disagree with Beyler's claim regarding a reduction in fire and smoke damage.

The above casts significant doubt about all three of Beyler's claims of benefits when roof vents and draft curtains are provided in large single story industrial and storage buildings protected by sprinklers. Why then would any building owner install smoke/heat vents in a building protected by a sprinkler system? The answer to that question is rather simple- the International Building Code/International Fire Code require that smoke/heat vents be provided in sprinklered buildings and code changes to delete the requirements for vents in sprinklered buildings have been defeated because the fire service actually believes that automatic vents work. Sooner or later, the fire service will figure it out. In the interim, billions of dollars will be wasted on providing roof vents and the smoke/heat vent manufacturers will reap the benefits of selling a fire protection technology which simply doesn't work well, if at all, in sprinklered buildings.

It's rather unfortunate that those billions of dollars wasted on roof vents (and draft curtains) could have been put to far better use subsidizing the installation of sprinklers in single-family dwellings. Imagine a country where all new homes are protected by sprinklers, but where there are no roof vents and draft curtains provided in large single-story industrial and storage buildings. From a fire safety viewpoint, both our citizens and our firefighters would be far safer if this were the case.

Not to change the subject, but there is no argument that the three benefits that Beyler claims for roof vents are actually provided by the installation of sprinklers in homes, as well as by the installation of sprinklers in large single-story industrial and storage buildings.

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