

## A PRIMER ON ROOF VENTS IN SPRINKLERED BUILDINGS

By Richard Schulte

The International Building Code (IBC)/International Fire Code (IFC) require that fire areas with a floor area exceeding 12,000 square feet classified as industrial or moderate hazard storage occupancies be protected by a sprinkler system. Further, the IBC/IFC require that one-story industrial and moderate hazard storage buildings be provided with smoke/heat (roof) vents if the building contains an undivided area which exceeds 50,000 square feet. The IBC/IFC also require that one-story buildings which contain high-piled storage be provided with roof vents when the floor area of the high-piled storage exceeds 12,000 square feet. In other words, the IBC/IFC require that large one-story industrial and storage buildings protected by a sprinkler system also be provided with roof vents.

The installation of roof vents in buildings protected by sprinkler system has been controversial since the mid-1970's due to a concern that open roof vents may adversely affect the capability of a sprinkler system to control a fire. Despite this concern, the model building codes used in the United States, with the notable exception of the BOCA Code, have continued to require that roof vents be provided in large industrial and storage buildings protected by a sprinkler system for decades.

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While the model codes have required that roof vents be provided in large industrial and storage buildings for nearly 30 years, NFPA 204, the Standard for Smoke and Heat Venting, at this point in time, still does not contain specific design requirements for smoke/heat vent systems in buildings protected by a sprinkler system. Despite over 3 decades of research conducted by the manufacturers of vents and other organizations, we still don't know how to design roof vent systems for use in buildings provided with sprinkler protection.

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In 1994, research conducted by Factory Mutual Research Corporation (FMRC) determined that the installation of draft curtains in buildings protected by a sprinkler system will affect the sequence of operation of sprinklers, thereby potentially adversely affecting the capabilities of the sprinkler system. In 1997/1998, testing conducted at Underwriters Laboratories (UL) determined that the activation of standard spray sprinklers may prevent the opening of automatic roof vents.

Based upon the findings of the FMRC research on draft curtains and the research on vents and sprinklers at UL, several proposals to delete the requirements to provide roof vents in buildings protected by sprinklers have been proposed in code development cycles since the first editions of the IBC/IFC were published in 2000. To date, only one of these proposals has been approved by the voting membership of the International Code Council (ICC). The proposal which was approved exempts buildings protected by ESFR (early suppression fast response) sprinklers from the vent provisions.

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Given the controversy over the use of roof vents in sprinklered buildings and the number of code changes addressing the vent provisions in the IBC/IFC, the ICC Code Technology Committee (CTC) voted to form a study group on roof vents in October 2006. Based upon the study group's work, the CTC developed what is referred to as code change proposal F144-09/10. This code change proposal would eliminate the requirements for roof vents and instead substitute a requirement for a manually-controlled mechanical smoke removal system for sprinklered buildings presently required to be provided with vents.

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It seems obvious that the ability of automatic smoke/heat vents to perform their intended function is affected by the number of vents which open. The research conducted at UL which indicates that the operation of sprinklers delays or prevents the opening of (individually-activated) automatic roof vents clearly shows that the installation of vents in buildings protected by standard spray sprinklers is problematic at best. If no vents open, then not much heat/smoke will be vented through the vents.

In addition to the problem with the number of vents which open, there is another issue with the use of vents in sprinklered buildings. In order for open vents to perform their intended function, the temperature differential between the “smoke layer” which collects under the roof and the ambient temperature needs to be in excess of 200°F (110°C). (When the expected temperature differential will be less than 200°F, NFPA 204 recommends mechanical smoke removal.) Not only did the research at UL show that sprinkler activation delays or prevents the opening of roof vents, but the research also showed how effective operating standard spray sprinklers were in rapidly reducing the temperatures at the ceiling. Within minutes of sprinkler activation, the temperatures at the ceiling are reduced to below the 200°F temperature differential required for the vents to operate efficiently.

In response to the findings of the research conducted at UL, the chairman of the trade association representing the manufacturers of smoke/heat vents, the Smoke Vent Task Group, made a commitment to perform additional research on the interaction of sprinklers and vents. Although this commitment was made in September 1999, the trade association has yet to conduct further testing.

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In the summer of 2006, the trade association announced that a fire modeling study of the interaction between sprinklers and vents would be conducted. The results of this study were released in February 2008.

The modeling study, in effect, admitted that there was indeed a problem with the use of individually-activated automatic roof vents in buildings protected by standard spray sprinklers and the study recommended that the concept of the “ganged” operation of multiple vents be utilized. The modeling study proposed that multiple vents be opened 60 seconds after the water flow indicator in the sprinkler system was activated. In essence, the modeling study confirmed the obvious-in order for vents to perform their intended function, multiple vents must be opened early in the fire.

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While the concept of the “ganged” operation of vents was being advanced as the solution to the problem of interference of sprinkler activation with vent operation, the fire modeling study neglected to address the “validation” of the fire model for the purpose which the model was used. The capability of the fire model to reliably predict the activation times of sprinklers has never been “validated”. Without a reliable means of predicting sprinkler activation times, the modeling study could not establish that the simultaneous opening of multiple vents would not adversely affect the capability of the sprinkler system to perform its intended function. In other words, the trade association’s modeling study was discredited.

At the same time that the vent manufacturers' trade association was working on its modeling study, the NFPA 13 committee was also working on the issue of the use of roof vents in buildings protected by sprinklers. In 2007, the NFPA 13 committee considered a proposal which would have simply banned the use of draft curtains and roof vents in buildings protected by a sprinkler system. This proposal was modified to allow the use of roof vents in buildings protected by sprinklers provided that the vents were not automatic in operation. This modified proposal also permitted the installation of automatic roof vents provided that the activating device for the vents was such that the automatic operation of the vents would be prevented in the event that the sprinkler system worked as intended. This proposal was approved by the NFPA membership and is now included in the 2010 edition of NFPA 13.

Given the proposals to delete the requirements for roof vents in the IBC/IFC and the CTC's proposal to substitute a manually-activated mechanical smoke removal system for roof vents, the NFPA 204 committee has entered the fray and developed a proposal which would address some of the various issues surrounding the use of vents in sprinklered buildings. The NFPA 204 committee proposal would require that

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a performance-based design be utilized where vents are provided in a sprinklered building. As part of the performance-based analysis, the NFPA 204 committee proposal requires that the vents be designed such that the vents will not open until after the sprinkler system achieves control of the fire. The NFPA 204 committee proposal further recommends that the "ganged" operation of vents be considered.

While the NFPA 204 committee proposal acknowledges the purpose of the NFPA 13 requirements pertaining to the use of vents, the committee's proposal provides no guidance as to the methodology which is to be used to determine when the sprinkler system will achieve control of the fire. In fact, at present, no means by which we can reliably determine when multiple

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sprinklers will activate exists today. In other words, the NFPA 204 committee proposal relies on technology which has as yet to be perfected, at least at present.

The NFPA 204 committee's recommendation that the "ganged" operation of roof vents be considered is also rather interesting. In the proposal, the NFPA 204 committee admits that insufficient research into this concept has been conducted at present. It is difficult to understand why the committee would recommend a concept which has not been adequately researched and has not been proven to work. We have already been through this once before with the use of individually-activated automatic roof vents and found after years of using automatic roof vents that the vents do not work as we thought in sprinklered buildings. Why would we want to do this once again with the concept of the "ganged" operation of roof vents?

The NFPA 204 committee's proposal will likely be on the agenda at the technical meeting at the NFPA annual meeting in Boston in June 2011. A Notice of Intent to Make a Motion (NITMAM) has been filed requesting that the NFPA 204 Committee's technical report be returned to the Committee. If the NITMAM is approved, the 2011 edition of NFPA 204 will not be published and the amendment process for the document will be returned to the starting point.

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It is my opinion that smoke/heat vents are an archaic form of building fire protection. The basis for this opinion is the Sofa Super Store fire (and numerous other fires) where venting at an inappropriate time may have cost the lives of nine Charleston Fire Department fire fighters. Perhaps, it is time for the NFPA to consider withdrawing the NFPA 204 document as a technical standard.

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