SPRINKLERS AND ROOF VENTS?

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The question of whether or not it is appropriate or necessary to install automatic roof vents in storage and industrial buildings which are protected by sprinklers has been an issue which the fire protection community has "wrestled with" for more than 20 years. Two of the four model fire prevention codes presently used in the United States, the Uniform Fire Code and the Standard Fire Prevention Code, require that automatic roof vents (or a mechanical smoke removal system) be installed in buildings which contain high-piled storage, while the other two model fire prevention codes, the BOCA National Fire Prevention Code and NFPA 1, the fire prevention code published by the National Fire Protection Association (NFPA), do not contain specific provisions which mandate the installation of roof vents (or a mechanical smoke removal system) in buildings which contain high-piled storage.

The newest model fire prevention code published, the 2000 edition of the International Fire Code, includes provisions regarding the protection of buildings which contain high-piled storage similar to the provisions contained in the Uniform Fire Code and the Standard Fire Prevention Code. While the fact that the International Fire Code requires roof vents (or a mechanical smoke removal system) in sprinklered buildings which contain high-piled storage would seem to settle the question whether or not roof vents should be installed in sprinklered storage buildings, the debate on this issue is far from over. In fact, the 1999 code change cycle for the International Fire Code included a proposal by a representative of Factory Mutual to delete the requirement for roof vents. Similarly, the 2000 code change cycle includes two separate proposals, one by Schirmer Engineering Corporation and another by Schulte & Associates, to delete the requirement for roof vents in sprinklered storage buildings.

Given the above, perhaps the "jury is still out" on whether or not installing automatic roof vents in sprinklered buildings represents good engineering practice. A review of some of the literature pertaining to the installation of roof vents in sprinklered buildings might well be instructive.

NFPA 13E

The 1995 edition of NFPA 13E, the Guide for Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems, states the following with regard to ventilation of sprinklered storage buildings:

"Occupancies with a wide variety of configurations and a wide range of storage commodities might need special procedures, particularly where storage heights are in excess of 15 feet. Is some cases, routine ventilation procedures in the early stages of a fire can hinder effective sprinkler operation. It is desirable for the fire department to discuss its pre-fire plan for warehouse occupancies with the occupant, sprinkler designer, and insurance carrier to determine if a modification in procedures is appropriate."

NFPA 13E also states the following:

"For those cases where search and rescue operations have been completed prior to ventilation work being performed by the fire department, it might be appropriate to allow the automatic sprinklers to continue to operate without further ventilation to enable them to achieve full control of the fire. This might take 20 to 30 min[utes] or more."

NFPA 231

The issue of providing ventilation during fire fighting operations is also addressed in Appendix A of the 1998 edition of NFPA 231. NFPA 231 indicates the following:

"Smoke removal is important to manual fire fighting and overhaul. Since most fire tests were conducted without smoke and heat venting, the protection specified in Sections 5-1, 6-1 and 7-1 was developed without the use of such venting. However, venting through eaveline windows, doors, monitors, or gravity vents or mechanical exhaust systems is essential to smoke removal after control of the fire is achieved. (See NFPA 204, Guide for Smoke and Heat Venting.)"

NFPA 231C

The 1998 edition of NFPA 231C, the Standard for Rack Storage of Materials, also addresses the installation of roof vents (and draft curtains) in warehouses which contain high-piled storage stored in racks. NFPA 231C indicates the following:

"Design curves [contained in NFPA 231C] are based on the assumption that roof vents and draft curtains are not being used."

NFPA 231C also indicates the following regarding the effectiveness of sprinkler protection for warehouses containing rack storage:

"Sprinkler protection installed as required in this standard is expected to protect the building occupancy without supplemental fire department activity."

"During the testing program, the installed automatic extinguishing system was capable of controlling the fire and reducing all temperatures to ambient within 30 minutes of ignition."

Regarding the installation of smoke removal equipment, NFPA 231C states the following:

"Smoke removal capability should be provided. Examples of smoke removal equipment include:

- Mechanical air-handling equipment
- Powered exhaust fans
- Roof-mounted gravity vents
- Perimeter gravity vents

Whichever system is selected, it should be designed for manual actuation by the fire department, thus allowing personnel to coordinate the smoke removal (ventilation) with mop-up operations."

NFPA 204

The 1998 edition of NFPA 204, the Guide for Smoke and Heat Venting, states the following regarding the installation of roof vents in sprinklered buildings:

"A broadly accepted equivalent design basis for using both sprinklers and vents together for hazard control (e.g. property protection, life safety, water usage, obscuration, etc.) has not been universally recognized."

"For occupancies that present a high challenge to sprinkler systems, concern has been raised that inclusion of automatic roof venting may be detrimental to the performance of automatic sprinklers."

NFPA 204 also addresses the installation of curtain boards and states the following regarding curtain boards:

"Large-scale tests [Troup 1994] indicate that the presence of curtain boards can cause increases in sprinkler operation, smoke production, and fire damage (i.e. sprinklers opened well away from the fire)."

FM Data Sheet 8-33

Data Sheet 8-33 issued by Factory Mutual in January, 1984 addresses the issue of the installation of roof vents in sprinklered buildings as follows:

> "Factory Mutual recommended protection is based on roof vents and draft curtains not being provided. Fire tests have not shown automatic vents to be cost effective and they may even increase sprinkler water demand. Hence, permanent heat and smoke vents, if any, should be arranged for manual operation. Smoke removal during mop-up operations can frequently be achieved through eave-line windows, doors, monitors, non-automatic exhaust systems (gravity or mechanical), or manually operated heat and smoke vents. Fire departments can cut holes in steel or wood roofs and also use their smoke exhausters."

AAMA Smoke Vent Task Group Research

In a memorandum dated September 10, 1999, the American Architectural Manufacturers Association (AAMA) Smoke Vent Task Group announced a research project to "study the interaction between sprinklers, smoke/heat vents and draft curtains. This memorandum stated that the purpose of the study is "to develop scientifically based engineering design criteria for the installation of draft curtains and vents."

Interaction of Sprinklers and Smoke and Heat Vents

In a paper dated February, 1999, Craig Beyler and Leonard Cooper of Hughes Associates, Inc. discuss various research projects on the interaction of sprinklers and roof vents. This paper contains the following statement regarding the interaction between sprinklers and roof vents:

> "The experimental studies have shown that early vent activation has no detrimental effects on sprinkler performance and have also shown that current design practices are likely to limit the number of vents operated to one and vents may in fact not operate at all in very successful sprinkler operations."

Conclusions

Proponents of the installation of roof vents and draft curtains in sprinklered storage buildings claim that the combination of roof vents and curtain boards perform the following functions (under fire conditions):

- Improve the visibility in the building.
- Reduce the temperatures within the building.

- Limit the damage in the building.
- Reduce the need for manual venting of the roof.
- Provide protection for the building in the event of failure of the sprinkler system.

Now just a few questions to ask yourself:

- If the operation of the sprinkler system is capable of reducing temperatures to ambient within 30 minutes of the operation of sprinklers, why is it necessary to install roof vents to reduce the temperatures within the building?
- If the operation of the sprinkler system is capable of controlling the fire without supplemental fire department activity, why is it necessary to improve the visibility within the building so that fire fighters can attack the fire? Why not just let the sprinkler system control the fire without fire department intervention and then ventilate the building manually (by opening doors or other openings) after the fire has been controlled?
- If roof vents are capable of reducing fire and smoke damage to the contents of storage building, why is it that property insurers, including the Industrial Risk Insurers (IRI), do not recommend or require the installation of roof vents in sprinklered storage buildings?
- How do roof vents and curtain boards reduce damage to the contents of a building if research shows that roof vents won't operate in buildings where the sprinkler system promptly controls the fire?
- If one of the reasons for installing roof vents and draft curtains is because the sprinkler system may fail, why not spend the money it would cost to install the roof vents and draft curtains on making sure that the sprinkler system in the building is properly designed and installed and is properly maintained?

Finally, the September 10, 1999 AAMA memorandum which announces the sprinkler/vent interaction research project states that the purpose of the research project is to develop "scientifically based. . . . .design criteria for the installation of draft curtains and vents." This is tantamount to an admission that the present design criteria for roof vents and draft curtains contained in the model fire prevention codes and the new International Fire Code is not "scientifically based". If there is presently no scientific basis for the design of roof vents and draft curtains in sprinklered buildings, then only one question remains to be answered-how did requirements for roof vents and draft curtains ever get in the code?

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