Smoke Control

Heated Debate

Interaction between Sprinklers and Smoke Ventilators

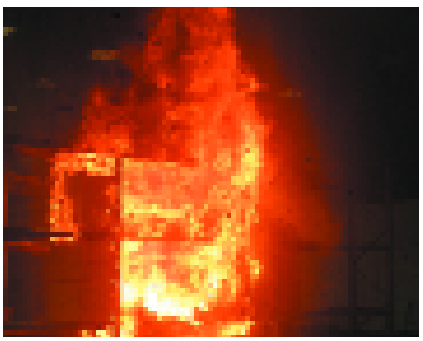
Introduction

INTRODUCTION

In the event of a fire, both sprinkler systems and smoke ventilators have a role to play in protecting life and property. However, controversy has surrounded their joint application. Paul Compton, Technical Director of Colt International, discusses their interaction.

Sprinkler and smoke ventilation systems have different and complementary purposes.

A sprinkler system is intended to control a fire, prevent its growth and ideally extinguish it. A smoke ventilation system is not intended to have any effect on the fire itself but to control the smoke and heat generated by it, removing them from the building to minimise smoke and heat damage and risk of structural collapse. Allowing visibility for evacuation and subsequent fire fighting operations is also achieved by a smoke control system. A combination of sprinklers and smoke ventilators should therefore be a "dream team".



CONTROVERSY

Unfortunately, there has been technical controversy for many years regarding the interaction of sprinklers and smoke ventilators and, despite significant research and testing, there is still no universally accepted criteria for combining these systems.

The main arguments against the combined use of sprinklers and smoke ventilators have been that the removal of heat and smoke by ventilators could delay the operation of sprinkler heads and that by maintaining the oxygen content of the building, the ventilation system could allow the fire to burn more fiercely.

Proponents of smoke ventilation have argued in turn that the smoke logging which occurs in an unventilated building poses a greater threat to life and property than any potential delay in sprinkler operation and that, in the relatively large spaces in which smoke ventilation is used, depletion of oxygen will not have any significant effect on fire growth until well after the building is smoke logged. In the absence of definitive information, some organisations have currently determined that the operation of smoke ventilators should be delayed until after the first sprinklers have operated. Is such an approach valid?

FACT

Over thirty years ago, it used to be suggested that there should be no ventilation in buildings where sprinklers were installed, in case the ventilation hindered their operation. However, in successive fires, smoke and steam logging complicated escape and made it difficult for fire fighters to finish the work that the sprinklers had started. Perhaps the venting of heat could still allow sprinklers over the seat of a fire to concentrate water where it was needed while smoke and steam removal would limit unnecessary damage and assist fire fighters in doing their job.

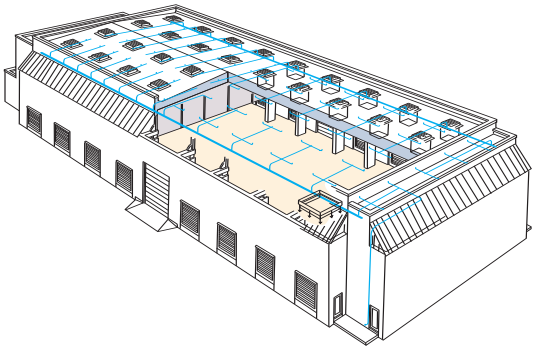
In time, and with the benefit of experience, the suggestion was modified so that trigger mechanisms brought vents into operation after the first sprinklers. Insurers were especially cautious at the time because there was little experience on which to assess the use of automatic smoke ventilation. But the delay in operating smoke ventilators meant that smoke and water damage continued to be higher than necessary. Nevertheless, insurers still largely put their faith in compartmentation and sprinklers whilst discouraging the early use of smoke ventilation, just in case it affected sprinkler operation.

"A combination of sprinklers and smoke ventilators should always be considered"

TODAY'S SYSTEMS

Nowadays it is generally accepted that, with few exceptions, where smoke ventilators are installed, they should operate automatically and as early as possible, regardless of the sprinklers system configuration in order to enable people to escape in safety.

The latest research has been two series of full-scale experiments. The first, in 1992, was conducted by Colt International and the Fire Research Station in a purpose built multi-functional test building in Ghent, Belgium (see below).



The second, in 1998, was conducted by the NFPRF and NIST in the UL fire test building in the USA. Both largely confirmed that when fire breaks out, there should be no unnecessary delay to the operation of any fire protection system. The earlier that ventilators open, the greater is the chance of preventing the smoke from mixing into the layer of cool air near the floor. It is more difficult to subsequently clear such smoke logging than to prevent it.

CONCLUSION

The experiments showed that ventilation did not significantly delay the operation of the first sprinklers, but could reduce the number of sprinklers operating unnecessarily away from the seat of the fire.

The effects of ventilation on sprinkler operation were secondary to factors like the rate of fire growth, the nominal operating temperature of the sprinklers and, with rapidly growing fires, the time constant of the sprinklers.

The effects of ventilation on operation of the first sprinklers are least with fires of high heat output which are growing rapidly, particularly vertically. These are the fires for which rapid sprinkler operation is most likely to be required if the fire is to be controlled. With slowly growing fires of low heat output, a slight delay in the opening of sprinklers, such as might be caused by ventilation, would not be serious. The more slowly the fire grows, the smaller it will be at the time of sprinkler operation.

Except in very small areas, there would now appear to be little justification for the suggestion that vents should not be open before sprinkler operation.

Smoke can travel at a speed of over 2m/s (5 mph). This is faster than the probable escape speed of an occupant.

This fire exit shows the effects of smoke within just a few minutes of a fire breaking out.