ELEVATOR FIRE SAFETY

by William A. Webb, P.E.

INTRODUCTION

The information advertising this Symposium aptly stated that, "...there have been a number of issues related to elevators and fire which have caused controversy and confusion." This is evidenced by the complicated approaches some authorities and designers have developed to meet the seemingly simple provision to allow automatic sprinkler protection in elevator hoistways, machine rooms or machinery spaces. That provision is in Rule 102.2 which states in part, "A means shall be provided to automatically disconnect the main line power supply to the affected elevator prior to the application of water."

Another issue which has focused attention on the continual controversy of using elevators for egress in fire emergencies, is the need to provide egress during a fire for the mobility impaired. Codes have begun to allow such use of elevators even though the means to properly protect elevators during a fire emergency has not been resolved according to some authorities.

In this paper, I shall touch on three of the four topics of the Symposium. The three topics which I shall discuss are:

(1) Emergency operation of elevators during a fire.

(2) Sprinklers in elevator hoistways and machine rooms.

(3) Handicapped use of elevators

EMERGENCY OPERATION OF ELEVATORS DURING A FIRE

Most building codes require Phase I elevator recall to be initiated by smoke detectors in elevator lobbies and machine rooms. Some also require smoke detectors in hoistways. A notable exception to the smoke detector requirement is the New York City Building Code which allows automatic sprinkler waterflow to initiate automatic elevator sprinkler systems. As a matter of fact, the 1978 edition of A17.1 allowed elevator lobby smoke detectors to be omitted in buildings completely protected by automatic sprinklers. To satisfy the New York City Building Code requirements, the sprinkler waterflow must perform all of the functions which smoke detectors would otherwise perform.

Advantages

There are advantages to such an arrangement. Among them is a reduced likelihood of premature recall. Such premature recall could be caused by unwanted alarms from smoke detectors. Another way to describe this situation is that it is more likely that recall will occur only during a fire. Smoke detectors, being sensitive devices, can respond to conditions which they interpret as a fire but which are not threatening to the building or to the elevators. Even with cross-zoning or alarm verification features, the likelihood of premature recall by smoke detectors is greater than for recall by sprinkle waterflow specifically because smoke detectors are intended to respond more quickly than automatic sprinklers. Because the purpose of this paper concerns elevators, I refer the interested reader to the literature for the characteristics of smoke detectors.

Another advantage of using sprinkler waterflow in lieu of smoke detectors, at least in the elevator lobby for automatic elevator recall, is lower cost.

Disadvantages

Among the disadvantages are that although it is more likely that the elevator will be recalled only when there is a fire, it is also more likely that it will be recalled without any immediate threat to the elevator. Typically, any automatic sprinkler waterflow on a floor served by the elevator causes the elevator to be recalled, unless the elevator is in a separate fire zone. Consequently, sprinklers

respects, this is an advantage because it would take the elevator out of occupant service sooner than with smoke detectors in the elevator lobby, thereby assuring that occupants will use the intended exits rather than the elevator. It also makes it more likely that the elevators will be available for the fire department when they arrive.

Another disadvantage is that the time to initiate elevator recall for a fire near the elevator shaft will likely be greater if recall is initiated by automatic sprinkler protection rather than if by elevator lobby smoke detectors. I do not consider this to be a major disadvantage because although the sprinklers may take longer to initiate elevator recall, they should begin controlling the fire once they operate. It is also likely that the difference in response time in so far as the threat to the elevators is not significant.

The response time of the automatic sprinkler system could be reduced by using quick response automatic sprinklers. As I mentioned for the smoke detectors, the difference in response time would I expect not be significant in so far as the threat to the elevators is concerned.

Alternate Floor Recall

Many codes now require alternate floor recall if a fire signal is initiated from the base recall floor. This generally applies whether or not the building is protected by automatic sprinklers. I suggest that such an arrangement is not always necessary. If automatic elevator recall is initiated by elevator lobby smoke detectors on a base floor with a typical office building ceiling height of 10 or 12 feet and the elevator lobby is relatively narrow, alternate floor recall would be prudent. My rationale is that it is likely that if the elevator lobby smoke detector is responding to a fire on the base floor, persons in the elevator will have difficulty escaping from the elevator through the elevator lobby. On the other hand, if the elevator lobby ceiling height is great, say 20 feet or more, if the elevator lobby is furnished with hard surfaces and if it is a large space, it is likely that occupants of the recalled elevator will be able to escape without significant danger. I believe this approach could be used whether or not the building is protected by automatic sprinklers. One could also apply the same logic if recall were initiated by sprinkler waterflow. I recognize, however, that it is difficult to codify this judgement process.

An advantage of alternate floor recall is that the elevator shaft doors will remain closed on the initiating floor, thereby helping to prevent the smoke from entering the elevator shaft and possibly contaminating remote floors. A disadvantage is that occupants may be discharged at great distance away from the ground floor, perhaps high up in the building. This could cause anxiety. The elevator and building emergency communication system should be used to inform occupants that the elevator is responding as intended.

SPRINKLER IN ELEVATOR HOISTWAYS AND MACHINE ROOM

Hoistway Sprinklers

Although some codes require automatic sprinkler protection in hoistways in order to permit the building to be considered fully sprinklered, the logic of such protection is, in my opinion, suspect. I will recognize that there have been some instances of fires in elevator cars, that have occurred because fire from the floor penetrated into the shaft or were from the fire in the car, often deliberately set. In each case, automatic sprinkler protection in the hoistway would have little effect. In other former cases which occurred, the building was not protected by automatic sprinklers. When such protection is provided, it is unlikely that a fire will penetrate into the shaft. In the case where fires have occurred in the car, the fire must reach substantial proportions before it can operate sprinklers in the hoistway. In my opinion, it is not very likely that the hoistway sprinklers would be effective to any substantial degree in reducing the size of the fire in the elevator car. Conversely, the elevator shaft construction and the elevator shaft doors and the automatic sprinkler protection on the floors should prevent fire spread from the elevator car from entering the floors.

Machine Room Sprinklers

The concern expressed for automatic sprinklers in elevator machine rooms, which apparently has been substantiated by actual experience, is that water discharge could affect elevator controls. Another concern is that water discharge could affect the elevator brakes. For these reasons, the elevator code requires power to be disconnected form the elevators before the water is applied. While this is simple to state, it is not so simple to accomplish. A reasonable solution is that described in interpretation ANSI/ASME A17.1 Inquiry 86-56 which requires heat detectors at each sprinkler in the elevator machine room. The heat detectors are to have a lower temperature rating that the sprinklers. Operation of the heat detectors cuts the power which should occur before automatic sprinkler operation. Smoke detectors in

the machine room cause elevator recall. One needs to place sufficient smoke detectors in the elevator machine room to see that the smoke detectors respond before the heat detectors.

Another solution, which is more complicated in may opinion and therefore less reliable, is to use preaction automatic sprinklers with a time delay. Smoke detectors would recall the elevators and start a timer. The timer would be set so as to allow sufficient time for the elevators to be recalled. Heat detectors would release the preaction valve to admit water to the sprinklers only after the preset time.

A still more complicated solution is to use a double-interlocked combination dry-pipe preaction system. With this arrangement, both the heat detector and the sprinkler must operate by discharging air from the sprinkler system, before water would be discharged. The smoke detector would cause the elevator recall; the heat detector would actuate the preaction valve. The actuation of the dry-pipe valve would interrupt the power supply to the elevators. Further safety intended to see that the cars have been "homed" before power was interrupted would be to interlock the elevator doors on the home floor to be sure they are open before the power is interrupted. This arrangement introduces a further complication and therefore a greater likelihood of failure.

HANDICAPPED USE OF ELEVATORS DURING FIRE EMERGENCIES

As I mentioned in the introduction, the model building codes already have or are considering proposals to allow the use of elevators on Phase II firefighter service for evacuating the mobility impaired in a fire emergency. This is in spite of strongly held industry opinions that "Presently, Elevators Are Not Safe In Fire Emergencies." This is the title of a paper presented by E. H. Sumka of Westinghouse Elevator Company and published in ASHRAE Transactions 1987. G. T. Tamura and J. H. Klote of the National Research Council of Canada and the National Institute for Standards and Technology, respectively, have tested means to provide smoke control for elevators. The system includes pressurization of the elevator shaft and elevator lobbies. In a paper entitled "An Overview of Smoke Control Technology" published by NIST September, 1987, Klote states, "Before elevator smoke control can become a reality, the information developed about elevator smoke control by the NBS [NIST]/NRCC joint project needs to be put in a form readily usable to our design engineers." To date, this has not been done. For this reason and because guidelines for emergency evacuation procedures for the mobility impaired need to be developed, I believe elevator use should be restricted to buildings protected by automatic sprinklers and for those buildings having areas of refuge at the elevators to restrict smoke spread through the elevator shaft. Their use should further restricted to evacuating the fire floor. This is because it is possible that smoke will infiltrate into the elevator shaft, because vestibule doors might not close properly. This has occurred and was reported at the First Interstate Bank fire in Los Angeles. Although the likelihood of such smoke infiltration, even with doors propped open is low in a sprinklered building, the risk of exposing persons to smoke in the elevator shaft is probably unwarranted. Occupants are likely to be safer in an area of refuge where they can wait for emergency assistance from firefighters.

SUMMARY

This paper is intended to achieve simple, reasonable and adequate solutions to achieving proper response of elevators during fire emergencies. My intention was to describe an engineering approach and the basis for applying engineering judgement to those solutions.

William A. Webb, P.E. Senior Vice President of Rolf Jensen & Associates, Inc. and serves as a Technical Officer for the firm. He is experienced in fire protection systems design, and building code consulting and negotiation. He has a B.S. degree in Fire Protection and Safety Engineering from Illinois Institute of Technology and has done graduate work in business, law, computer programming, statistics, and business administration. He is a member of the Society of Fire Protection Engineers, the National Society of Professional Engineers, and the American Society of Heating, Refrigeration and Air Conditioning Engineers. Mr Webb is Vice Chairman of ASHRAE's technical committee on Fire and Smoke Control and Chairman of the Guideline Project Committee for Commissioning Smoke Management Systems. As a member of NFPA, he also serves on several of their standards writing committees.