Hot Issues in Fire Engineering

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Cabin Design for Big Halls : An Enclosed Compartment or Not?

W.K. Chow
Fellow Elected, Hong Kong Academy of Engineering Sciences
Research Centre for Fire Engineering, Department of Building Services Engineering
The Hong Kong Polytechnic University, Hong Kong, China

The "cabin" concept [1] has been widely used in fire safety protection of big halls in Southeast Asia, including the airport terminal [e.g. 2] of Hong Kong (now the Hong Kong Special Administrative Region HKSAR of China). Generally speaking, the 'cabin' concept might offer protection to areas of high fire load in big halls; it also allows better space allocation if fire can be controlled at the design value. The ideal design is to enclose the cabin as a submarine compartment in case of fire. Otherwise, safety in the 'open cabin' has to be ensured by appropriate hardware fire engineering systems, such as a functioning fire suppressions system which has an adequate smoke extraction rate. Software fire safety management has to be implemented by limiting fire load density and forbidding combustibles in the cabin.

As raised before in a previous Hot Issue in Fire engineering [3], the capabilities of the sprinkler system to control fires at low values such as 2 MW [4] in the cabin of retail areas is a concern. The concept is also extensively applied in big halls in China. However, there are assumptions that the cabin design which has been used in the past 20 years would take the cabin as a submarine compartment. Such presumption should be carefully reviewed as it is difficult to create a completely enclosed cabin design. In fact, 'open cabin' appears in the market for convenience. As observed in preliminary full-scale burning tests [5], smoke would spread out readily from the 'open cabin' which was not totally sealed in case of fire. Water discharged from sprinkler would even drive hot steam out.

As cabin roof confines heat and smoke, flashover [2,6,7] will occur if the sprinkler and smoke extraction systems fail to work. Smoke will come out of the 'open cabin' if the smoke extraction rate is not high enough, or the extraction points and make-up air locations are not installed at the right positions. It should be noted that the objective of installing a sprinkler system is to control the fire at a certain value, not to extinguish the fire. This was clearly observed in a recent experiment which evaluated the performance of domestic sprinkler [8,9].

Adequate fire services provisions, at least a functioning fire suppression system and a smoke management system, must be installed and designed properly in the cabin without being sealed completely under agreed design fires. In case of sprinkler and smoke management system failure, a cabin, particularly an 'open cabin', would become a big burning object, inducing a high air entrainment rate and very high smoke production rate. Smoke would then spread quickly in the big hall and the adjacent areas.

The analysis of flashover criteria [6] for a cabin fire [10], smoke filling process in an atrium and smoke extraction system performance [11] and others [7] has highlighted all the aforementioned concerns. However, systematic experiments have not been carried out, hence the lack of reliable data in the literature to demonstrate that real fires of high heat release rate can be controlled by cabin design. Consequently, firemen have to spend more effort in big fires. It was clearly demonstrated that even a small fire was very difficult to locate in the big airport terminal hall in 1998 [12].

Firefighters are now working out contingency plan in all places where they might encounter new types of fire hazards. Appropriate fire safety management scheme should be implemented on upgrading the fire action plan with more serious inspection.

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