

FIRE GROWTH

Effects on Fire Development

The time advantages gained by larger engine crew sizes and/or by using elevators impacted the interior conditions on the fire floor (i.e., temperature, visibility, toxicity, etc.). For medium growth rate fires, entering firefighters encountered fires between 5 MW to 11 MW in size, depending on crew configuration and ascent method. This range in fire size can be visualized as the equivalent of two

cubicles on fire for a 6-person crew versus five cubicles on fire for a 3-person crew, as demonstrated in Figure 91. For a fast fire, the fire size in terms of cubicles on fire increased from two for 6-person crews to eight for 3-person crews (13 MW to 20 MW). For a slow growth fire, all crew sizes got water on the fire before the fire grew past two cubicles (2.5 MW to 5 MW).

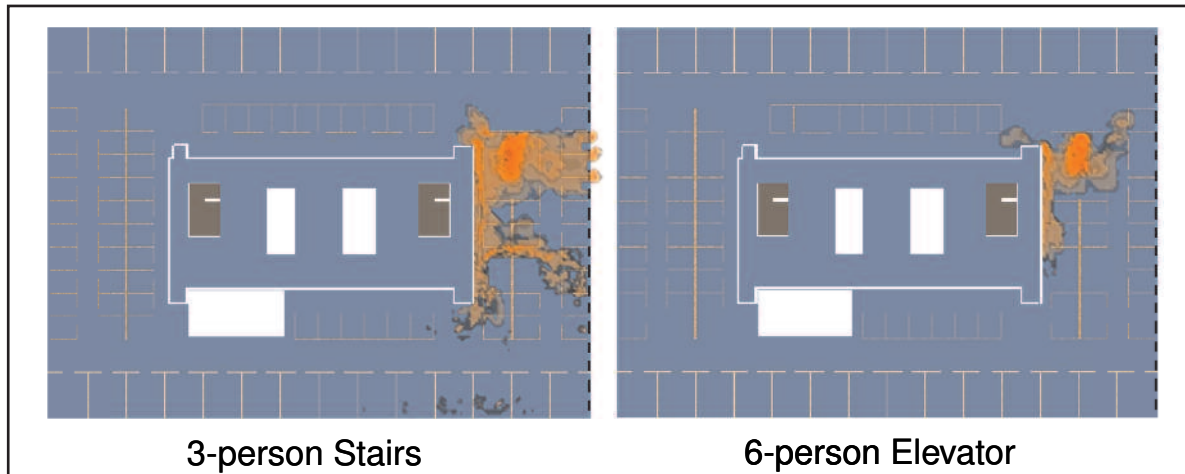


Figure 1: Visualization of HRR for a medium growth fire for a 3-person crew using the stairs (left) and a 6-person crew using the elevators (right) at the time firefighters make entry to the floor.

Due to the length of time for which these fires burn (between 12 min and 28 min on average), the number of cubicles burning at any given time can vary. Depending on the growth rate, some cubicles may be in the growth phase, some in the steady burning phase, and some in the decay phase. As a result, the instantaneous HRR value may be higher at an earlier time, even though the conditions on the fire floor may be worse as more total heat has been released.

The study confirmed that properly engineered and operational fire sprinkler systems drastically reduce the risk exposure for both the building occupants and firefighters. While information has been well understood for many years and most new high-rises are constructed with fire sprinkler protection, NFPA estimates that 41 % of U.S. high-rise office buildings, 45 % of high-rise hotels and 54 % of high-rise apartment buildings are not equipped with sprinklers. Further, sprinkler systems fail in about one in 14 fires. Thus, fire departments should be prepared to manage the risks associated with unsprinklered high-rise building fires.

Fire Growth Rate	Sprinkler Activation Time (MM:SS)	Peak HRR Value (MW)
Slow	4:54	0.41
Medium	2:45	0.64
Fast	2:15	1.69

The values shown in the table are sorted by the amount of heat released at the time of entry to the fire floor, which illustrates the impact of getting to the fire faster. Moving up and down a column of this table shows the impact of crew configuration and ascent method on total heat release. Moving left to right shows the impact of varying the fire growth rate holding configuration and ascent method constant. Referring back to the table, a 6-person crew taking the elevator gets water on the fire 6 min 38 s faster than a 3-person crew taking the stairs. This time difference results in the 3-person crew facing interior conditions with total heat release from 2 to 3 times greater than that faced by the 6-person crew, depending on the fire growth rate.

Crew Size	Ascent Method	Total Heat Release by Fire Growth Rate (GJ)		
		Slow	Medium	Fast
3	Stairs	3.0	7.1	13.7
4	Stairs	2.4	5.9	11.7
3	Elevator	2.1	5.2	10.8
5	Stairs	1.9	4.7	9.9
6	Stairs	1.8	4.4	9.4
4	Elevator	1.7	4.2	9.0
5	Elevator	1.6	4.0	8.8
6	Elevator	1.0	3.0	6.6