

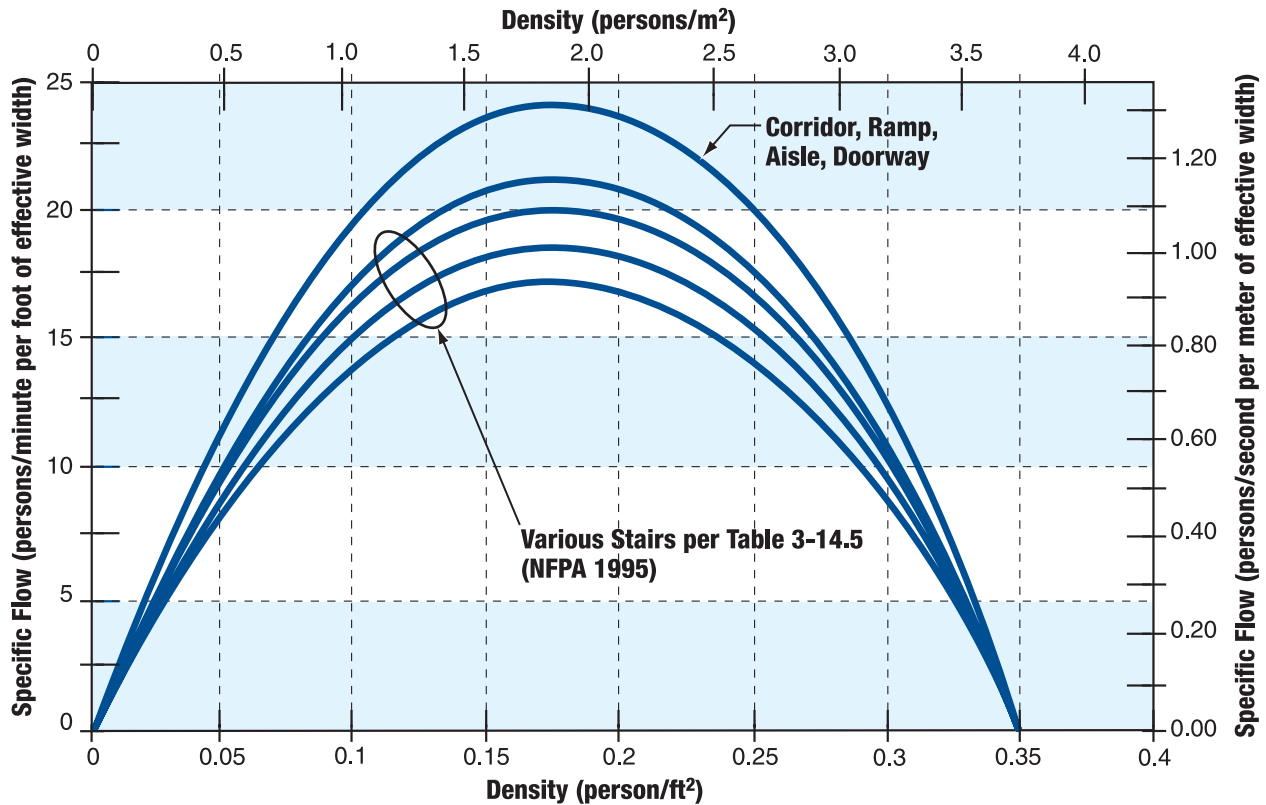


Figure A-14 Specific flow rate as a function of density (SFPE Handbook of Fire Protection Engineering).

Given these assumptions, the results presented in Figure A-15 relate to a lower limit of the time expected to evacuate the WTC towers. There were three exit stairways serving most floors of the WTC towers. Below the impact area, all stairways appeared to be available. The number of people in each building on the morning of September 11, 2001, is not known. Therefore, a range of occupant loads is included in Figure A-15.

By all indications, it was instantly apparent to the building occupants that evacuation was necessary, so very little time was likely to have transpired in pre-movement activities. The time for the leading edge of the evacuees to reach the stairs and to descend from the lowest occupied floor (7) to the discharge doors on floors 1 and 2 is estimated to have taken about 3 minutes until the steady human flow reached its capacity. The sense of urgency in the evacuees is estimated to have maintained the egress flow at or near the theoretical maximum for stair exit flow (i.e., 24 persons/minute per foot).

The two end stairs were 44 inches wide and the center stair was 56 inches wide. Each stair had a single 36-inch-wide exit door at its discharge level. As such, the effective width for each stair door was 24 inches (2 feet). The expected steady flow rate from the stair doorways was 48 persons/minute. Based on an available egress time of 90 minutes in WTC 1 and 50 minutes in WTC 2, the number of persons who could have exited through the stairs is estimated to be up to 13,000 for WTC 1 and up to 7,200 for WTC 2. These estimates do not include any persons who used elevators, were on the 2nd (Plaza) level or lower in the buildings at the time, or initiated evacuation in WTC 2 immediately after the impact of WTC 1.