Determining the fire flow requirement

The Kimball rule of thumb

In 1966, the National Fire Protection Association published Fire Attack 1: Command Decisions and Company Operations by Warren Y. Kimball, the NFPA Fire Service Department manager. Like Layman’s book a decade earlier, Kimball’s book serves a wide fire service audience. Kimball provided a rough rule of thumb in estimating required fire flow at 3 gallons per minute per 100 cubic feet. The volume of the building is determined by length multiplied by width multiplied by height.

Using this formula, a three story building (ten feet per floor) that is 50’ wide and 100’ long would be a 150,000 cubic foot building. Multiplying 150,000 square feet by .03 (3 gpm for each 100 cubic feet) means that this building requires 4500 gallons per minute. That is the Los Angeles City threshold for a Category B dispatch of not less than six fire companies with not less than two truck companies. Kimball’s calculations were for the entire building, a consideration reinforced by Francis Brannigan when evaluating multiple family dwellings and other Type V buildings.. Brannigan is emphatic that the company officer must assume the entire building is on fire when one room is burning.

Iowa State University Rate of Flow Formula

The Iowa State University Rate-of-Flow Formula was developed to determine the fire flow needed to knock down a fully involved structure or compartment in a structure. The knockdown flow is determined by dividing the cubic size of the compartment or building by 100. Using Kimball’s 150,000 cubic foot building, the Iowa Rate-of-Flow formula would require a thirty second flow of 1500 gallons per minute to achieve knockdown.

National Fire Academy Fire Flow Formula

The National Fire Academy Fire Flow Formula is used in the strategy and tactics classes. It is a more complex version of the Iowa Rate-of-Flow formula. It requires a three-part calculation:

\* For each floor, estimate the length and width of the building and divide by three. NFF = (Length x Width)/3 Using Kimball’s example, one floor is 50 ‘ by 100’. The equation will be (50 x 100)/3 or 1700 gpm for one floor. The answer is rounded to the nearest 100. If all three floors are fully involved, you will need 5000 gallons per minute.

\* Determine the percentage of fire involvement on the floor. If one fourth of the floor is involved, reduce the fire flow by 75%. NFF = [(Length x Width)/3] x % involvement.

\* Exposures come in two flavors, interior and exterior. For interior exposures, add 25% of your fire flow to each floor above the fire, not to exceed five floors. Using the Kimball example, let’s assume the first floor is fully involved. That requires a 1700 gpm flow. The second floor exposure requires 25% of that flow, or 400 gpm. So does the third floor.

The fire flow for the Kimball example, with the first floor fully involved,

will be 1700 + 400 + 400 = 2500 gpm.

o For exterior exposures, you will add 25% of the required fire flow for each side of a building that has another building exposed to the fire. In the Kimball example, there are exposed buildings on the B and D sides of the building. The original fire flow for the 50’ by 100’ by three story (30’) building was determined to by 1700 gpm if the first floor was fully involved. Each exposure will require 25% of that flow, or 400 gpm, to cover the exposure. So, the final fire flow for the Kimball example, with a fully involved first floor and exposures on sides B and D is:

+ First floor = 1700 gpm

+ Second floor exposure = 400 gpm

+ Third floor exposure = 400 gpm

+ Side B exposure = 400 gpm

+ Side D exposure = 400 gpm

+ The exposures total 1600 gpm, and are called EC in the NFA equation

+ Total required fire flow is 3300 gpm.

\* Final NFA formula is NFF gallons per minute = ([(length x width)/3] + EC) x % involvement

For grins, lets see what you need if the entire Kimball building is involved on your arrival:

\* First floor = 1700 gpm

\* Second floor = 1700 gpm

\* Third floor = 1700 gpm

\* Fire building requires 5100 gpm fire flow. Remember that the Kimball rule of thumb said you needed 4500 gpm.

\* No interior exposures, but Side B requires 25% of 5100 gpm, or 1300 gpm. So does the Side D exposure.

So, if the Kimball building is fully involved with two exposures you will need 7700 gpm to handle the event.