

Engineering Judgment

by Dean K. Wilson, P.E.

Our fire alarm system installation firm has obtained a huge contract to provide protection for what amounts to a prison for children. I know that sounds very distasteful. Naturally, the corporation that builds and operates such facilities do not call them “prisons.” But, that is what they are: prisons for children who have displayed horrible behavior at such an early stage of their lives that they have been removed from the custody of their parents and incarcerated. In any case, this job is enormous—lots and lots of smoke detectors. Many of the rooms have unusual ceiling shapes and heights. Many of the rooms have unusual geometry. In reading NFPA 72-2002, *National Fire Alarm Code*, we have hit a wall in trying to understand how to locate detectors in these unusual configurations. Can you help us?

I will try to help you. Quite frankly you have come up against one of the dirty little secrets in the fire protection industry: locating smoke detectors requires “engineering judgment.”

“Wait just a minute,” you may respond. “I’m not an engineer. I just install these things.”

Okay. I understand your response. That reason alone may lead you to seek out a licensed professional fire protection engineer to assist you when you get involved in a project that goes beyond normal ceiling configurations, ceiling heights, and room geometries, or when the hazard

you must protect strays from the common hazards found in ordinary occupancies. You should feel no shame in seeking help from someone qualified to respond to the requirements of the *Code*.

NFPA 72-2002 states the following in the sections noted:

5.7.1.4 The prescriptive requirements in this section shall be applied only where detectors are installed in ordinary indoor locations.

5.7.1.7 The selection and placement of smoke detectors shall take into account both the performance characteristics of the detector and the areas into which the detectors are to be installed to prevent nuisance alarms or improper operation after installation.

5.7.1.9* The location of smoke detectors shall be based on an evaluation of potential ambient sources of smoke, moisture, dust, or fumes, and electrical or mechanical influences to minimize nuisance alarms.

5.7.3.1.1 The location and spacing of smoke detectors shall be based upon the anticipated smoke flows due to the plume and ceiling jet produced by the anticipated fire as well as any pre-existing ambient air flows that could exist in the protected compartment.

5.7.3.1.2 The design shall account for the contribution of the following factors in predicting detector response to the anticipated fires to which the system is intended to respond:

- (1) Ceiling shape and surface
- (2) Ceiling height
- (3) Configuration of contents in the protected area
- (4) Combustion characteristics and probable equivalence ratio of the anticipated fires involving the fuel loads within the protected area
- (5) Compartment ventilation
- (6) Ambient temperature, pressure, altitude, humidity, and atmosphere

As you can see from these requirements, you have many factors which you must consider in order to properly locate smoke detectors in unusual configurations. Immediately you should note that section 5.7.1.4 limits the use of any of the prescriptive requirements of the *Code* to “ordinary indoor locations.” While this phrase has no specific definition, common sense must dictate which locations may reasonably bear the description “ordinary.”

In section 5.7.3.1.1, location of smoke detectors must consider “smoke flows due to the plume and ceiling jet produced by the anticipated fire as well as any pre-existing ambient air flows that could exist in the protected compartment.” To do this, you must have a solid grasp of plume theory and its application to real environments. You can get an idea of what this may involve by reading some of the commentary regarding smoke detectors in Appendix B of the *Code*, “Engineering Guide for Automatic Fire Detector Spacing.”

Some installation contractors take the approach that they will treat every compartment of a building the same, whether it has a unique configuration or not. This approach may even satisfy some Authorities Having Jurisdiction who may not know about the specific requirements of the *Code*.

However, if a fire occurs, such a contractor will find himself or herself doomed in court. In our currently litigious society, there *will be* a lawsuit following a fire. The contractor *will* be named in the suit. And, some expert licensed professional fire protection engineer will be hired by the plaintiff to analyze the location of the smoke detectors and soundly criticize the locations chosen by the contractor. In such a case, juries will usually rule against the contractor and shake their heads at how such ignorance could have been allowed to promote such an inappropriate installation.

As a contractor, can you learn what you need to learn to be able to properly located smoke detectors in unusual configurations? Of course you can. But, it won't be easy. You will need to do some real study. You will need to find someone to mentor you who truly understands the factors involved in detector location. You will need to spend far more time than you may be able to justify

to bring yourself up to the place where you can respond appropriately with confidence to various compartment configurations.

In the end, you may decide you have better uses for your time. The solution? Hire a qualified licensed professional fire protection engineer who has solid experience in dealing with this complex subject. You will be glad you did and your customer will also be glad you did.

And, for those of you reading this who serve as Authorities Having Jurisdiction, you also need to learn from this example. When faced with a complex project, require the owner submitting plans for your review to hire a licensed professional fire protection engineer to work on behalf of the jurisdiction you represent. For unless you have a licensed professional fire protection engineer on your staff, who has the knowledge and experience to properly review smoke detector locations in unusual compartment configurations, you will be “flying blind” trying to review any submittal.

Never be ashamed to ask for help. Asking for help is a sign of strength, not a sign of weakness.

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