De-Mystifying Building Life Safety Codes


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The National Fire Protection Association's "Life Safety Code" (known as NFPA 101) has been around in some form for over 50 years. For most of that time, NFPA 101 was a code standard applied by State Health Departments to regulate the construction and alteration of health care and health related facilities.

Over the past decade, building codes across the country have moved towards standardization through local adoption of the International Building Code or IBC. Although many jurisdictions create local code supplements, the core of the IBC is now, for the most part, a national code.

The IBC in turn, adopts the NFPA "Family of Codes" as reference standards. Foremost of these is NFPA 101. So now, whether you own or operate a hotel, a school, nursing home, a community health center or any number of other occupancies, your building is being regulated in some part by NFPA 101.

In this article, I will try to distill 35 years of Life Safety Code experience into a few paragraphs by focusing on several key concepts that are the foundation of all building codes.

Building/Life Safety codes are all about controlling the degree of hazard. Common sense tells us that the more hazardous a building is the more restrictive "The Code" should be in trying to mitigate and offset those hazards.

So what defines hazard? There are four main variables that determine the degree of hazard in any building and just like an excel spreadsheet, if you change any code variable, you get a different answer (or in our case, degree of hazard).

Variable #1: Occupancy

Sub-Variable 1a: Persons and Activities

This variable centers on a person's ability to self-evacuate during an emergency. Obviously a pre-school child or an elderly nursing home patient cannot evacuate from a building without assistance. Therefore, logic (and Codes) would hold that schools and nursing homes have a higher degree of hazard than say, an office building.


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Sub-Variable 1b: Contents

It's pretty obvious that a warehouse or factory where large quantities of paper goods, paints & solvents are manufactured or stored is more hazardous than say, a typical doctor's office.

Variable #2: Construction Systems & Materials

This variable is about the relative degree of a building's major structural materials to support a fire. Codes organize these structural systems into "Construction Classes". "The Code" creates two major sub-classifications; combustible and non-combustible. It's pretty clear that concrete beams and columns do not burn (non-combustible) and that wood stud walls do (combustible). Each sub-classification in turn is assigned a degree of hazard based on how "well protected" from a fire a given structural element is. For example, a steel beam or column wrapped with two layers of sheetrock can usually resist a fire for one hour. The New York City Building Code (IBC) for example, would classify this structural system as IC (I = Non-Combustible, C = its relative degree of combustibility compared to say a 2 hour fire resistance = IB).

Variable #3: Size and Height (Known as Tabular Limits)

Common sense again tells us that the taller a building is, the higher its degree of hazard. The same applies to its floor plan. A building with 100,000 square feet on a floor is deemed to be more hazardous than one with only 15,000 square feet per floor. The larger floor plan accommodates more people making it inherently more hazardous.

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Variable #4: Sprinkler System

It goes without saying that a building is less hazardous if it has a sprinkler system.

So we now have 4 major Life Safety variables, let's plug them into our theoretical code spreadsheet and see what happens:

Example 1: Tabular limits. All codes have 2 major "construction/risk" tables. One defines the details of construction classes (whether a beam or column has a 1, 2 or 3 hour fire resistance). The other table limits building size (height & floor plan) based on its occupancy and construction class. Let's say you want to build a 5 story warehouse, partially of wood with 15,000 square feet per floor and your building will not be sprinklered:

Proposed Scenario (Based on New York City (IBC) Building Code Designations)		Maximum Code Allowance
Occupancy Group:	S-2 Storage (Moderate Hazard)	S-2
Construction Class:	IIC = Combustible	IIC
Floor Plan Size	15,000 Sq. Ft.	5,000 Sq. Ft.
Building Height:	5 Stories, 60 Feet	3 Stories, 40 Feet
Sprinklered:	No	No

As you can see, "The Code" is only allowing an unsprinklered 3 story warehouse with a maximum of 5,000 Sq. Ft. per floor because this specific combination of elements is deemed to be "Too Hazardous". However, if we change a few variables to reduce the degree of hazard the picture changes too.

Proposed Scenario (* Change from Previous Scenario)		Code Allowance
Occupancy Group:	S-2 Storage (Moderate Hazard)	S-2
* Construction Class:	ID = Non-Combustible	ID
Floor Plan Size:	15,000 Sq. Ft.	No Limit
Building Height:	5 Stories, 60 Feet	7 Stories, 85 Feet
* Sprinklered:	Yes	Yes

* Indicates new variables.

By changing to a Non-Combustible Class (ID) and by sprinklering the building, we can build a 5 story warehouse with unlimited floor area. We changed the "Hazard Variables" (made the building safer) and our "Code Spreadsheet" produced a different answer.

Egress

Another key ingredient to building Life Safety is Egress (Exiting). You can look at Egress as the "Fifth Variable" in our Code Spreadsheet. However, Egress does not impact the other 4 Variables, but is impacted by them.

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For example, when a building is sprinklered, it's safer, therefore the exits can be further apart. In a hospital or nursing home, exit corridors must be 8 foot wide to allow for the movement of bed-bound occupants. In a theater or auditorium occupancy, the high volume of persons dictates that there be more exits easily reachable from even the most remote areas of the space.

Other Factors

Once you understand the interrelationship between the four "Hazard Variables" you have a core understanding of how Life Safety Building Codes work. Drilling down further will reveal concepts and details that support and refine these core concepts. This short-form article does not allow for a much more detailed explanation, but a few key areas should be mentioned.

Finishes:


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Finishes are assigned classifications based on their ability to burn and generate smoke. Wall finishes are assigned Alphabetical Classifications "A", "B" & "C" based on their tested "Flame Spread" and "Smoke Developed" ratings. Floor materials are given a Type I or II designation. Codes will limit where finishes of a certain designation are permitted. For example, exit stairs and corridors might only be permitted to have Class "A" wall finishes which have the lowest likelihood of burning and generating smoke.

Opening Protectives:

In our discussion of construction classes, we learned that walls, floor systems and roof systems may have fire resistance ratings (1, 2 or 3 hours). In order to maintain those ratings, openings in those systems must be protected. For example, a door in a fire rated wall must have a latch and a closer so it will remain securely in place during a fire. The door must be tested by a code accepted agency (such as Underwriters Laboratories = UL) to achieve the required fire rating. The door receives a metal tag or "label" certifying compliance.

Other large penetrations through fire rated construction such as HVAC ducts must also be protected. Ducts are most commonly protected with fusible link fire dampers (doors inside the duct). These dampers are normally held in the open position by a spring and fusible link, until the fusible link is "broken" by high temperatures, allowing the spring to slam the damper shut.


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Smaller penetrations such as pipes and conduits must be fire stopped and smoke stopped to prevent the spread of flame and gases. Fire stopping materials include mineral wool and non-combustible solid blocking. Smoke stopping is achieved through the use of approved type sealants applied over and around fire stopping to completely seal the penetration tightly.

Alternative Methods of Compliance

NFPA 101 has a Sister Code, NFPA 101A "Alternative Methods of Life Safety". This code "comes in handy" for older buildings with grandfathered non-compliances that have become active violations due to code changes or updates.

NFPA 101A essentially takes a "Whole Building Approach" to Life Safety and assigns a weighted system of positive (+) and Negative (-) points to existing conditions. The conditions evaluated can vary from building height to staffing to the combustibility of furnishings. Once all the points are assigned, if the summation produces a number of zero or higher, the building is deemed to have achieved the required overall level of fire safety, even though it may be deficient in specific areas.

Not all jurisdictions allow the use of NFPA 101A, so it is best to check with your local code official or your Architect.


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