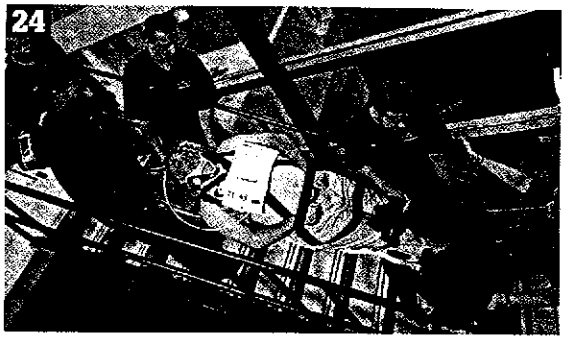
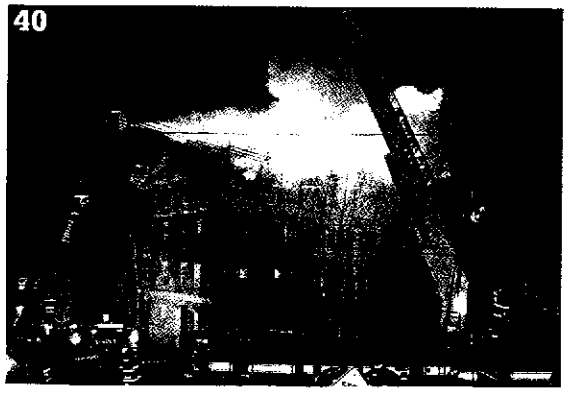
Fire Engineering®
TRAINING THE FIRE SERVICE FOR 139 YEARS

January 2016 | Volume 169, Number 1

FEATURES



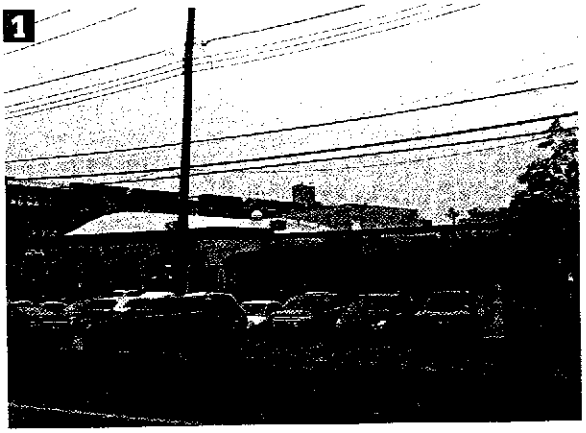


SPECIAL SECTION: FIRE ISSUES IN WOOD CONSTRUCTION

Redefining Hybrid Construction

BY BRIAN CRIMMINS

THE TERM "HYBRID CONSTRUCTION" IS used too often and inaccurately. Most fire departments classify building construction in accordance with National Fire Protection Association (NFPA) 220, *Standard on Types of Building Construction*, which sets forth the following classes: Type I (fire resistive), Type II (noncombustible), Type III (ordinary), Type IV (heavy timber), and Type V (wood frame). NFPA 220 does not, however, provide any official classification for hybrid buildings. In response, several authors have proposed creating an unofficial sixth construction type for all buildings that fall outside of the five traditional classes. This is insufficient because there are too many varieties of hybrid buildings and too many unique hazards in each of these buildings. I believe that hybrid buildings should actually be categorized into one of two subclasses, the "hybrid addition" and the "true hybrid," and better labeled with all relevant construction information in preincident plans.

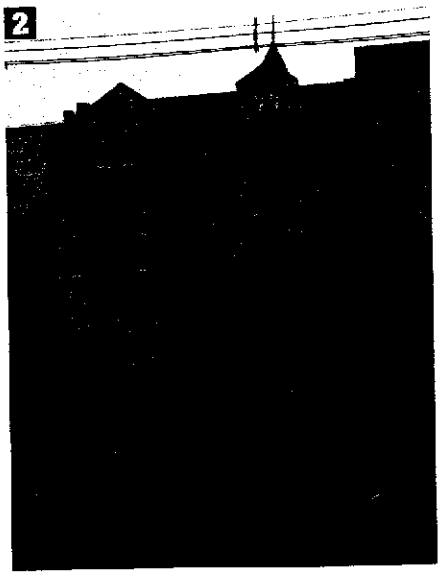


(1) Photos by author.

Previous Research

In *Brannigan's Building Construction for the Fire Service (Fifth Ed.)*, Glenn Corbett and Frank Brannigan state that hybrid buildings are those that do not fall into any of the five aforementioned construction types and "incorporate materials of more than one type, such as the use of wooden beams and steel columns."[1] In *The Art of Reading Buildings*, John Mittendorf and Dave Dodson cite building codes that allow "occupancy separation" or different types of construction for different occupancies within the same structure.[2] Gregory Havel describes hazards and safety precautions for fires in both newly constructed and older renovated hybrid buildings. Havel states that "building code officials ... classify [hybrid buildings] according to the most combustible components that are used."[3]

Given the wealth of research on this matter, we can make certain statements about hybrid buildings. First, the term "hybrid construction" is an unofficial designation that is not recognized by NFPA 220 or model building codes. Second, hybrid construction "combines various NFPA 220 construction types into one structure, or ... does not fit into any NFPA classification ...." (2) Third, building codes allow for the construction of hybrid buildings and may require fire separation barriers between different types of construction and the installation of automatic fire sprinklers.



Firefighter Risks

Hybrid buildings will not behave the way we expect them to under fire conditions. Expect hybrid buildings to have void spaces that will allow the fire to spread unseen throughout a structure, unprotected lightweight steel that will collapse with short-term exposure to heat and fire, and lightweight trusses or manufactured lumber that will also collapse early in fires. Further, we must anticipate poor construction practices such as inadequate firestopping and draftstopping between areas of a building that should have fire-rated separations. Also, any repairs and alterations may involve illegal noncompliant modifications to hybrid buildings that compromise the gypsum board, remove steel fireproofing, obstruct sprinklers, or otherwise diminish the fire protection. To be clear, fires in hybrid buildings will likely spread faster and result in collapse earlier than fires in traditional buildings.

Redefining Hybrid Construction and Preplanning

The term "hybrid construction" communicates very little about the actual hazards present in a building. Whereas Types I through V construction serve as categories for firefighting concerns (e.g., the building's ability to resist collapse in a fire, the combustibility of the load-bearing members, the presence of combustible voids, and the level of compartmentalization), the term "hybrid" does not provide this specific construction-related information. The term "hybrid construction" only serves as a catch-all phrase for nontraditional buildings.

Some of the uncertainties "hybrid construction" creates include the following:

- Do renovations that replace dimensional lumber with lightweight materials turn a traditional building into a hybrid?

- When one unprotected steel beam is added to a traditional Type III building for support, does that now make the structure a hybrid?
- If steel lintels are used above windows and doors on a Type III or a Type V structure, must the building be redefined as a hybrid?
- Do Type III buildings with steel lintels belong in the same construction category as a Type II building built over a Type I parking garage?

Clearly, this issue is complicated, and fire officers must decide how their department will address such questions. Without clarity on these issues and without detailed preincident plans, firefighters will respond to incidents unaware of the hazards they will face.

Begin by distinguishing between lightweight construction and hybrid construction. Lightweight construction poses a significant threat to firefighter safety because the engineered lumber, the lightweight trusses, and the unprotected steel are all susceptible to early collapse under fire conditions, often without warning. Hybrid construction, however, poses additional risks. Hybrid buildings combine the hazards and firefighting tactics of two or more construction types.

The next important distinction is to determine if a hybrid building belongs to a sub-class that I refer to as the "hybrid addition." This is when different construction types are present in different parts of the same building. This concept is similar to the phrase "occupancy separation" that Mittendorf and Dodson describe. The key here is that during a fire, the incident commander (IC) can divide the building into separate divisions (within the incident command system) for each distinct area. In this case, the IC can compartmentalize hazards and risks. For example, Type II buildings are occasionally built above Type I parking garages. Also, older Type III buildings often have a Type V addition added decades after construction. Finally, in my jurisdiction, an old Type IV factory was converted into a commercial building and modified by constructing both Type I and Type II additions in different parts of the structure.

Photo 1 shows a "hybrid addition." This Type III bowstring truss building was originally built as a bowling alley and was converted decades later into a strip mall. During the conversion, the original Type III building doubled in size, with the addition constructed of Type II noncombustible materials—masonry walls and an unprotected steel truss roof. Today, the original structure and the addition appear as a single unit. However, during a fire in this structure, the concerns, the hazards, and the operations in the Type III area will be different from those in the Type II area. The best practice to ensure firefighter safety is to label this structure as a "Type III (bowstring truss) with a Type II addition." In a fire at this location, the IC can potentially split operations in the building into two separate divisions and instruct crews on concerns relevant to their division.

Firefighters will have difficulty in determining the exact location of fire and the most appropriate firefighting tactics.

Another concern with the "hybrid addition" is further modification. Specifically, what happens when the occupant of the original Type III structure expands its business into part of the Type II structure? At this point, the occupant will likely attempt to open up areas that should have fire-rated separations. As a result, two distinct buildings will be fully combined into one. A fire in this modified structure will have significantly greater fire spread concerns and collapse hazards. Firefighters will also have a difficult task of determining the exact location of fire and the most appropriate firefighting tactics.

The other subcategory of hybrid buildings is the "true hybrid." This type of building also falls outside the traditional five construction types but in a different way. The true hybrid uses load-bearing materials consistently. There is no way to divide one style of construction from another. This building may have (as Corbett and Brannigan state) "wooden beams and steel columns," but they are present throughout the entire structure. Instead of unprotected steel beams added to one part of a Type III building, steel beams are installed throughout the building.

Photo 2 shows an example of a "true hybrid" building. The entire structure, built in 2014, is constructed of reinforced, cast-in-place concrete supported by unprotected steel trusses. Unlike a hybrid addition building, this structure cannot be separated into Type I and Type II divisions because the entire building is a "Type I/Type II true hybrid." Firefighting in this building would be unique from firefighting in the building in photo 1. The distinction is that in photo 2, the concerns, the hazards, and the operations are the same throughout the entire building, and the IC must inform all members of same.

...

The risk of overusing and misusing the term "hybrid construction" is that companies operating at a fire will be unfamiliar with the hazards and construction features of the building. To better understand and address the risks of hybrid buildings, fire officers must define what hybrid construction is and provide detailed preincident plans. Preincident plans should distinguish lightweight from hybrid structures and subcategorize hybrid buildings as either a "hybrid addition" or a "true hybrid," based on the style of construction. The "hybrid addition" is comprised of two or more unique NFPA 220 construction types under the same roof. The distinct construction types may be separated into different occupancies or combined into one. By contrast, the "true hybrid" uses a nontraditional mixture of construction materials throughout the entire building.

REFERENCES

1. Corbett, GP, and FL Brannigan. (2015). *Brannigan's Building Construction for the Fire Service (Fifth Ed.)*, Burlington, MA: Jones & Bartlett Learning.
2. Mittendorf, J and D Dodson. (2015). *The Art of Reading Buildings*, Tulsa, OK: PennWell Corporation.
3. Havel, G. (2013). "Construction Concerns: Construction Types and Fire Behavior." Fireengineering.com. http://www.fireengineering.com/content/dam/fe/online-articles/documents/2013/20130513havel_firebehavior.pdf.

BRIAN CRIMMINS is a battalion chief and hazardous materials technician with the Hoboken (NJ) Fire Department. He has a BA degree from Boston College and an MPA degree from John Jay College.