

Are Architects, Engineers and Code-Writing Officials Friends of the Firefighter?

By Vincent Dunn, Deputy Chief FDNY (ret.)

Following a lecture I gave at the Fire Department of New York (FDNY) Division of Training on why the World Trade Center collapsed, a fire chief, who is also an engineer came to me and said, "Chief, you were rough on architects and engineers." That night, I thought of what he had said and realized that since the World Trade Center tragedy, there is an edge in my voice when I talk about architects, engineers, and even code officials. Perhaps he was right.

But then I started thinking about architects, engineers and building codes officials, and the building construction changes I have seen over the past three decades. I asked myself, "Are architects, engineers and those who write building codes friends of the firefighter?" I had no answer.

As I continued giving lectures to groups of firefighters around the country, I began asking my audiences that question. The answer I received most often was, "No, architects, engineers, and codes officials are not friends of the firefighter." Some firefighters answered, "I don't know." But very rarely did anyone defend the architects, engineers and building code officials.

The responses I received indicate to me a small rift between the architectural, engineering and codes-writing communities on the one side and the fire services community on the other side. This sentiment seems to be related to building construction methods and materials, and building codes changes incorporated into structures today.

Across the country engineering schools (not architects or building code officials) often team up with their local fire departments. For example, Polytechnic University in New York City, an engineering school, for many years, has teamed up with the Fire Department of New York (FDNY) to create and support a Center for Fire Safety Engineering. In the 1970s, Polytechnic helped the FDNY conduct full-scale tests of high-rise buildings and row-frame houses. Polytechnic engineers worked with us when writing building code changes for high-rise office buildings and today they are helping the FDNY prepare for the future. Also, fire protection engineers Glenn Corbett and Charles Jennings teach at John Jay College, the fire science institute, and nearly single-handedly led the way for an investigation of the World Trade Center collapse.

Twenty years ago, I was invited to teach a course on fire protection design by Manhattan College's civil engineering department. This was in response to the MGM-Grand Hotel fire in Nevada. Worcester Polytechnic Institute in Massachusetts is the premier fire protection engineering school in the nation. The National Fire Protection Association (NFPA), whose membership consists largely of architects and engineers, provides most of the fire protection literature and technical information to the fire service.

With all this interaction, how could there be a misunderstanding between the firefighters and the architects, engineers, and code officials of this country? What could

possibly be bothering the fire service? Why is there an edge in my voice when I speak about safety and survival on the fire ground?

- **Lightweight construction.** One of the reasons for this rift involves lightweight construction. One firefighter dies every eighteen months in the collapse of a burning building constructed with lightweight wood construction. The widespread use of lightweight wood truss construction and, especially the connector used to fasten members of this light truss together, are concerns to the firefighter. Instead of using standard-size nails or bolts to connect the trusses, so-called "sheet metal surface fasteners" of random sizes and shapes are used. The sheet metal surface fastener penetrates the wood surface only one-quarter to one-half inch. Architects, engineers, and codes officials are looked on by some firefighters as promoting this deadly construction. At least very few architects engineers or code officials have spoken out against it.

- **NFPA misunderstanding.** There are architects and engineers from an organization called the "NFPA" who go around the country lecturing on the fire departments' misconceptions and exaggerations of the dangers of lightweight truss construction. Firefighters, including myself, mistakenly assume the initials NFPA stand for the National Fire Protection Association. However, an official who does represent the National Fire Protection Association informed me in no uncertain terms that the people who are contradicting firefighters on this issue are NOT affiliated with their organization. In fact, the NFPA representatives who sometimes follow Frank Brannigan and myself around the country, claiming that we exaggerate the dangers of trusses, actually belong to the "National Forest Products Association." Hence, the initials "NFPA."

- **Wooden I-beams.** Another new design in building construction is the wooden I-beam. This lightweight beam is composition wood. Two inch by four-inch boards serves as a top and bottom flange. They are attached to a piece of particleboard, which acts as a web member. This composition floor and roof support is shaped as an I-beam and is promoted as "the silent floor beam". A so-called "silent floor beam" supported a structure where two firefighters were recently killed when the floor collapsed.

- **Steel bar joist-truss construction.** Lightweight steel bar joists were used to support floors in the World Trade Center. These floor supports are another form of lightweight floor and roof construction used throughout the country that have the fire service alarmed. When unprotected, lightweight bar-joist beams can fail within five-to-ten minutes of fire exposure. The World Trade Center, constructed by the Port Authority, was the only high-rise office building in New York City to use lightweight bar-joist construction in high-rise office building construction.

- **Sheet metal C-beams.** Another type of lightweight construction is the C-beam. This floor and roof beam is a thin piece of sheet metal bent in the shape of a long, thin "C". It uses a bent shape to give it an increase in load bearing capability while reducing the actual amount of steel used in the steel member. Firefighters are holding their breath waiting to see how this new structure reacts to fire and collapse.

- **Fire protection of steel.** Since the 1960s, builders have used "fluffy" spray-on fire protection covering steel. Instead of the heavy concrete encasement used in pre- World

War II fire-resistive buildings, a lightweight mineral fiber is sprayed on steel to protect it from fire. The transition to the use of spray-on fire protection for steel has been fought by the fire services since its introduction in the New York City building codes. FDNY Chief John O'Hagan in 1976 outlined the problems in his 1976 book *High Rise Fire and Life Safety* with the following points:

1. The spray-on slurry is often not mixed properly.
2. The steel is not prepared properly to allow the spray-on material to adhere to the steel.
3. Workers do not apply the spray-on material evenly.
4. During other subsequent work the critically important fire protection is easily removed.

It would be unfair to totally blame architects, engineers and building codes officials for this inadequate fire protection.

Builders Or Designers?

Several months ago, I wrote an article about the fire-vulnerability of lightweight building materials. I stated that responsibility for use of this type of construction belonged to builders. A contractor called me and said I should not blame builders. Builders have to erect a structure the way the architect and or engineer directs. Architects and engineers state they are not responsible because they must build the structure the way the owner and building codes direct. The term they use to describe their choices is "client driven."

Architects, engineers and code officials are not solely responsible for this revolution in construction methods and materials. There also are building owners, designers, manufacturers, and product sales representatives who introduce products that are deadly for firefighters and occupants in a burning building.

Other building codes changes that have firefighters questioning the fire safety concerns of design professionals include:

- **Fire-resistive construction.** The idea behind the concept of a fire-resistive building has been allowed to slip away. At one time, a fire-resistive building was a structure that ... barring a collapse or explosion ... would confine a fire to one floor. This is no longer true. In the 1970s, New York had a two-floor fire in One New York Plaza. In the 1980s, Los Angeles had a five-floor fire in the First Interstate Bank building. In the 1990s, the One Meridian Plaza building in Philadelphia suffered a nine-floor fire. Today we no longer have fire-resistive buildings because the building industry has selectively neglected the concept of containment! If sprinklers or firefighters do not extinguish a fire, the buildings will not confine it.

- **Evacuation of occupants.** Stair design and capacity still is based on the concept of a fire resistive building where fire will be confined to one floor. Under this theory, stairs

need not have the capacity to hold all the people of the building. In fact, stairs are designed to allow only a limited number of people to leave a building. Remember the Titanic and the limited number of lifeboats? Similarly, the rest of the people must stay in place during the fire. This is a so-called "defend-in-place" firefighting strategy, and it is based on the idea that buildings will be fire-resistive. Sadly, we in the fire services know that is not true.

- **Large open-floor-area design.** "Client-driven" architects and engineers have constructed buildings so large that they are beyond the control of firefighters using hose streams. These buildings contain 30,000 to 40,000 square feet of open floor space. Either the designers did not know or did not care that a typical fire company can extinguish only about 2,500 square feet of fire. If these buildings are not protected with functioning automatic sprinklers, firefighters cannot extinguish a fire inside such large-area structures. Effective control of fires requires structures to be built with passive containment systems.

- **Floor construction.** The use of four-inch concrete floors over corrugated steel I-beams has failed at **every** serious high-rise office building fire in New York City. Floor steel-beam supports sag, warp and twist. The four-inch concrete floor sags with the steel and cracks and heaves. Smoke and flames spread to the floor above. Floor beams and concrete floor surface must be replaced after every serious fire. This started at the 1970s fire in One New York Plaza, where 130 steel floor beams were replaced and 20,000 square feet of concrete floor were removed. It continues to happen today. For example, in a fire in 1993 at the Bankers Trust building on Park Avenue, floors were seriously damaged requiring they be "shored up" before firefighters could enter, perform salvage and overhaul the smoldering offices.

- **Scissor stairs.** Scissor stairs are another design innovation recently incorporated in the building codes. The enclosing of two stairs in one building is a cost savings that firefighters are concerned about, especially since the stair enclosures can now be constructed of two layers of sheetrock instead of masonry. Now, since the second terrorist attack on the World Trade Center, engineers say they want to "harden" the construction of high-rise buildings. Perhaps they should ask who was responsible for softening our buildings over the past fifty years! The Federal Emergency Management Agency (FEMA), in its investigation, stated that the stairways of the World Trade Center buildings were clustered together in the core area. In pre-World War II buildings, stairways were required by law to be located on remote portions of a large floor area. This way, if fire blocked one exit, occupants find another exit at a remote area of the floor. Exit stairways also used to be at each end of a floor area. The New York City building codes, written in 1968, defined the meaning of the term "remote" when applied to exit stairs. The building code defined exits "remote" if they were over *15 feet* away from each other!

- **Controlled inspections.** Another innovation in the 1968 building codes was the "controlled inspection." Under this concept, building or fire officials need not always go to a construction site to inspect a process or material. Rather, a so-called "controlled inspection" is allowed. This is accomplished when an architect or engineer sends a written affidavit to the building department that the material or process has been

inspected and meets the building code requirements. The "controlled inspection" might cut down on the chance of bribery, but some say it is the proverbial fox guarding the hen house.

- **Shortcuts in construction.** I was recently talking to a reporter about some of the construction techniques that concern firefighters. With alarm in her voice, she interrupted asking, "Are you talking about illegal shortcuts in construction?" I laughed and said, "Heck, no. They are legal! Such techniques are associated with terms like 'the bottom line,' 'fast track,' 'client driven' and 'affordable housing.' They do not violate any building codes. They are perfectly legal. They live up the 'letter of the law.'"

The Voice Of The Fire Service

At a lecture, a firefighter asked, "Who speaks for the fire service? Where does the official voice for the firefighter come from?" He said that when there is a large-scale fire and collapse, the architect could look to the American Institute of Architects (AIA) for an official explanation as to what happened. The engineer can consult the American Society of Civil Engineers (ASCE) to obtain an official engineering explanation. Codes officials, I am sure, have associations that provide an official view of a building disaster.

But to whom do firefighters look for an explanation of a disaster? Where does the fire protection point-of-view come from? Someone suggested the fire protection point of view comes from the National Fire Protection Association. Another firefighter said, "No, they only repeat the view held by architects and engineers. They do not speak for firefighters."

Finally, one firefighter said it all. He said, "Chief, I know where the firefighter goes for an official explanation. When firefighters are killed, we go to their widows. **The families of dead firefighters are the voice of the fire service.** "

###