



# Target Hazards: Restaurant Fires

500-0188

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## I. SYNOPSIS

Of the innumerable hazards we face as fire-fighters, practically nothing has the potential for hidden dangers so much as the restaurant fire. From the internal layout being strewn with obstacles to both search and fire attack and the roof loaded with numerous dead loads that can fall on us to the unknown chemicals stored within the building and the lightweight construction used to support the roof, we should remember to exercise due caution when approaching a fire in a restaurant.

## II. OBJECTIVES

Upon completion of this lesson:

1. The firefighter should be able to list and describe the hazards associated with lightweight truss construction when fighting a fire in a restaurant. [NFPA 921-5.3.1.1, 5.3.1.7, NFPA 1001-4-5.1]
2. The firefighter should be able to list hazards to movement when searching and conducting fire suppression operations within the restaurant and describe how these hazards affect operations. [NFPA 1521-A-2-4.4, NFPA 1620-3-2.2.3, NFPA 1001-3-3.7, 3-3.8, 3-3.9, 3-3.11]
3. The firefighter should be able to describe fire suppression elements associated with restaurants. [NFPA 1001-3-3.13, 4-5.1]

## III. INTRODUCTION

"We had a restaurant fire my rookie year. It was a combination restaurant and bar, and the place was fully involved. So I go a two-and-a-half inch hose line. That's a pretty big line, and I'm solo on this thing, and I'm hitting the hell out of these flames. My officer comes over. He says "What the hell are you doing? The fire's out!". I say, "Look inside here. Look at all the fire I've been hitting". It was night, the lights in this place were flickering like crazy. What I had done was put about one hundred thousand gallons into a red bathroom. With all the lights blinking and everything, I thought it was fire."

Excerpt from "The Fire Inside – Firefighters Talk About Their Lives" by Steve Delsohn, Copyright 1996, HarperCollins Publishers, Inc., 10 East 53rd Street, New York, NY 10022, ISBN 0-06-0177665-2

Fires are not always what they seem to be and when the risks to firefighting personnel are underestimated the results can sometimes be disastrous. Restaurant fires can be particularly deceptive due to the cluttered internal arrangement and substantial loads placed on the ceiling and roof supports.

## IV. KEY POINTS

- A. Lightweight truss roofs are more susceptible to early failure when involved in a fire
- B. The internal arrangement of restaurants can be very disorienting in three dimensions
- C. Fire protection systems are usually present but often limited to only specific areas of operation

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## V. OUTLINE

A. Lightweight Truss Roofs are inherently less capable of maintaining structural stability in the face of fire impingement.

1. Lightweight truss roofs are more susceptible to early failure when involved in a fire

For example, lightweight floor and roof construction, including panelized roofs, tubular metal truss, plywood truss, and metal gusset truss, all present the potential for early building collapse.

2. Platform Frame Construction

a. Description of Platform Construction

Platform frame construction is the most common construction method currently used for residential and lightweight commercial construction. In this method of construction, separate platforms or floors are developed as the structure is built. The foundation wall is built; joists are placed on the foundation wall; then a sub-floor is placed. The walls for the first floor are then constructed, with the ceiling joists placed on the walls. The rafter, ridgepole, or truss construction methods are used for the roof assembly. An important fire concern other than the fact that combustible materials are used in construction is that

there are concealed spaces in soffits and other areas for fire to spread without detection.

b. Platform construction provides some barriers to vertical fire spread if not perforated

Platform construction inherently provides fire barriers to vertical fire travel as a result of the configuration of the stud channels. However, these barriers in wood frame construction are combustible and may be breached over the course of the fire allowing the fire to spread to other spaces. Vertical fire spread may also occur in platform construction through utility paths, such as electrical, plumbing, and HVAC. Openings for utilities in wall stud spaces may allow easy passage of the fire from floor to floor.

3. Wood trusses are often connected with gusset plates which can lead to early failure

Wood trusses are similar to trusses of other materials in their general design and construction. The truss members are often fastened using nail or gusset plates. The gussets can lead to earlier failure than burn-through of the members. This failure occurs because the metal gussets conduct heat rapidly into the wood, causing charring, and because the actual fastening penetrating tines are short.

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The charring causes the wood to "release" the gusset, leading to collapse of the truss. Failure of one truss will induce loads on adjacent trusses that may lead to a rapid collapse.

#### 4. The roof of a restaurant often contains substantial dead loads

At a fire in a large city, fire fighters were overhauling a fire in a restaurant, seeking hidden pockets of fire in the overhead. They attacked the fire-weakened supports of the building. Above them, added-on air-conditioning units fell, causing several fatalities.

At a fire on New Year's Day, a company was operating a nozzle at the scene of the fire when the ceiling of a restaurant collapsed and a flashover occurred. Two firefighters were able to escape on their own; a third was rescued after additional crews were able to cool the area where the firefighters were trapped. A fourth firefighter was removed and given emergency medical care. He arrested en route to the hospital and subsequently died. He had burns over 70% of his body.

Two firefighters were trapped and killed when the roof of the restaurant under which they were operating collapsed. One victim was found close to the location where they were last known to have been operating a nozzle. The other victim was found near the rear door of the structure

a) Restaurants can have additional air-conditioning units added or refrigeration units as well as exhaust systems.

Often these add-ons are made with little consideration to the load for which the roof was originally engineered.

b) Signage is also often attached to the roof, particularly the parapet wall

#### B. The internal arrangement of restaurants can be very disorienting in three dimensions

##### 1. Restaurants usually try to accommodate the most patrons possible

We've all been in restaurants where the space between tables barely accommodates the patrons, let alone the waitperson with a heavily loaded tray. When we have to negotiate these tables performing a primary search or dragging a hose line to the fire, it is easy to get disoriented or hung up.

##### 2. Restaurants often decorate the walls and ceilings with additional materials.

Particularly troubling are specialty restaurants that decorate according to either a theme or contain an eclectic scattering of items and materials on the walls and ceilings. Even when these items meet building and life safety code requirements for flame spread, they can still add to the dead load and present an entanglement hazard.

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### C. Fire Protection Systems

#### 1. Systems for protection from specific hazards

Most restaurants have automatic fire suppression systems designed for the protection of cooking equipment and cooking areas.

Fires in these areas are not only dangerous for the obvious reasons but because the cooking areas generally have ventilation systems above the cooking area that, if not fully suppressed, can act to promote fire spread throughout the ceiling/attic space.

At the time that these tests were developed, rendered animal fat (lard) was typically used in commercial kitchens to fry various foods. Commercial cooking operations, appliances and supplies have changed greatly since the 1960's. Health concerns have reduced the use of lard. Efforts to cook faster have caused the use of insulated "high efficiency" fryers that heat faster and cool slower. Restaurant suppliers estimate that 70-75% of commercial kitchens use vegetable oils for frying in high-efficiency fryers.

These changes have significantly altered the fire hazard in cooking areas. Lard has a large percentage of saturated fat whereas vegetable oils have a very low percent of such fatty acids. The auto-ignition temperature of most animal fats in the 550-600 degree F. range compared to the auto-igni-

tion temperature of most vegetable oils which is at 685F-degree and higher.

The extinguishing agent employed in pre-engineered restaurant systems is an alkaline base. Fatty acids combine with alkalines to produce a soapy solution in process known as saponification. Thus, when a suppression system is discharged on a burning deep fat fryer containing rendered animal fat, a soap blanket is formed cutting off the oxygen supply and containing the fire until the fuel (animal fat) is cooled below its auto-ignition temperature.

A similar fire involving vegetable oils creates a different set of circumstances. With only a limited amount of fatty acids saponification is greatly reduced and the higher temperature of such fires, enhanced by the insulation in a high efficiency fryer, causes the soap blanket to break down. Thus the extinguishing capability of the fire suppression system is reduced.

Newer dry and wet chemical systems are designed to address this problem but not all systems have been converted.

The problem of fires in cooking appliances is so significant that a relative new class of extinguishers, Class K, was established. Class K fires are those which involve cooking appliances and combustible cooking media such as vegetable oil and animal fats.

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### 2. Systems for the general protection of the occupancy

Some restaurants are small enough or old enough to avoid the requirement for sprinkler systems in the patron areas of the restaurant. The absence of these systems can contribute to fire spread. Furthermore, the fire can spread in the overhead void space above the false ceiling and the sprinkler heads, further weakening the trusses.

We need to clearly evaluate the risk we take with pursuing an aggressive interior attack on such fires against the potential gain

### D. Summary

"Any ceiling below a truss void should be pulled and examined by disciplined fire fighters under control, standing near a doorway for rapid escape."

We should be very aware of the fire situation that exists not only when we arrive but what damage has been done to the structure before our arrival.

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## GLOSSARY

Saponification

Breakdown of fat by a base into glycerol and fatty acid salts (soap)

Class K

Fires in cooking appliances involving combustible vegetable oils and animal fats and/or oils

Dead Load

Weight of the building itself and any permanently affixed equipment attached to the structure

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