

Impact of Modern Construction Practices on  
Fire Fighter Line of Duty Deaths:

An analytical review of NIOSH LODD reports 1997-2009



International Society of Fire Service Instructors  
And  
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## Introduction

The purpose of the research in this document was to examine Firefighter Line-of-Duty-Death (LODD) reports produced by the National Institute of Occupational Safety & Health (NIOSH), searching for any correlation or issues that needed to be resolved between firefighters, fire suppression tactics and light frame construction.

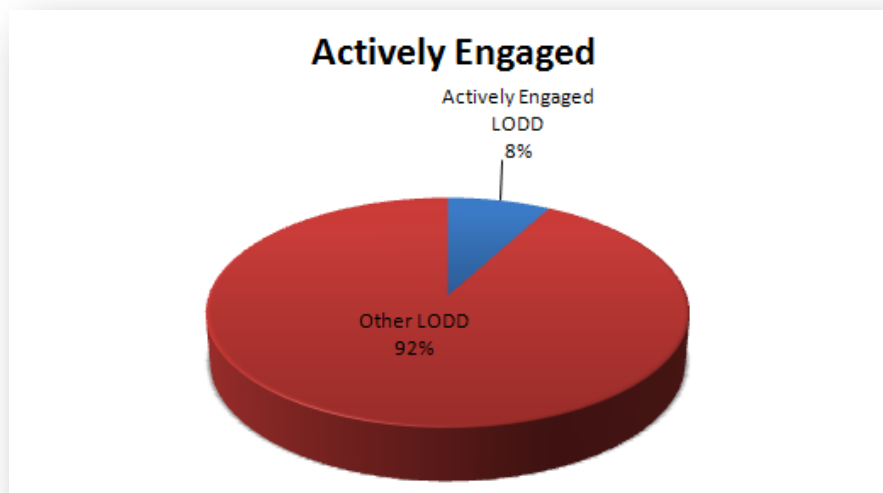
In a review of NIOSH LODD Reports from 1996-2009, 12 reports were found to involve firefighters engaged in firefighting operations within a structure with engineered components. For the purposes of this document, being engaged in “active firefighting operations” refers to those that meet one or more of the following criteria:

- Interior operations related to suppression activities
- Interior operations related to search & rescue activities
- Exterior operations that rendered the firefighter dependant on building construction features (on the roof, cutting a hole for ventilation, as an example)

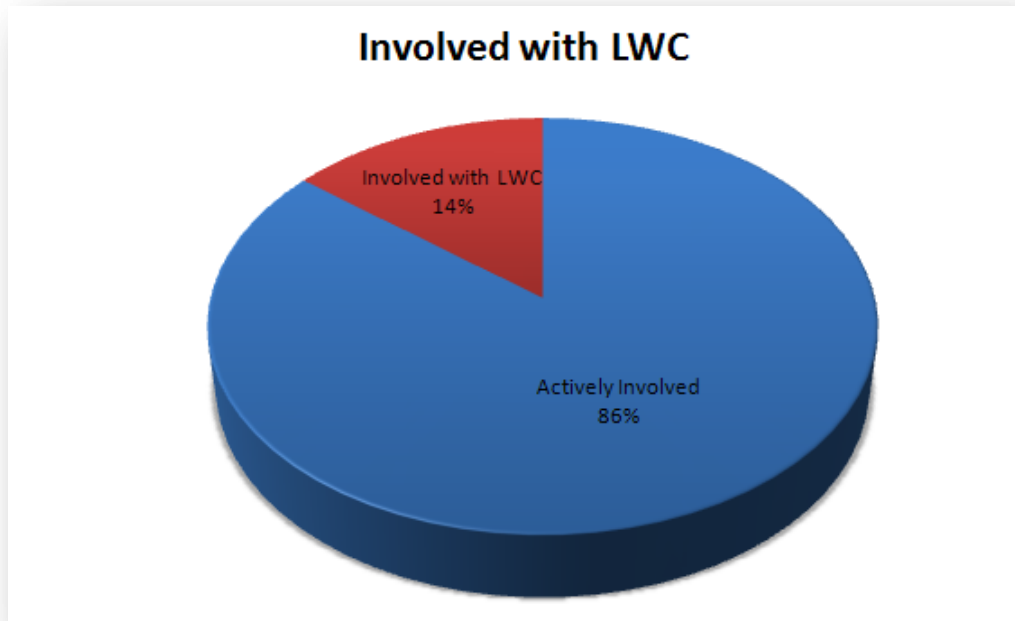
This report is part of ongoing research, which will expand beyond what is typically provided in NIOSH documents. A final report is expected to be published in the near future.

## Research

The database of NIOSH LODD reports (<http://www.cdc.gov/niosh/fire/>) was searched for firefighters that were killed actively engaged in interior fire suppression operations.



Through analysis of the structure type, report photos, etc., events that involved structures built with lightweight components were further analyzed. This analysis found that 12 incidents (17 deaths, or 14% of those involving “active firefighting”) occurred in structures with lightweight construction.

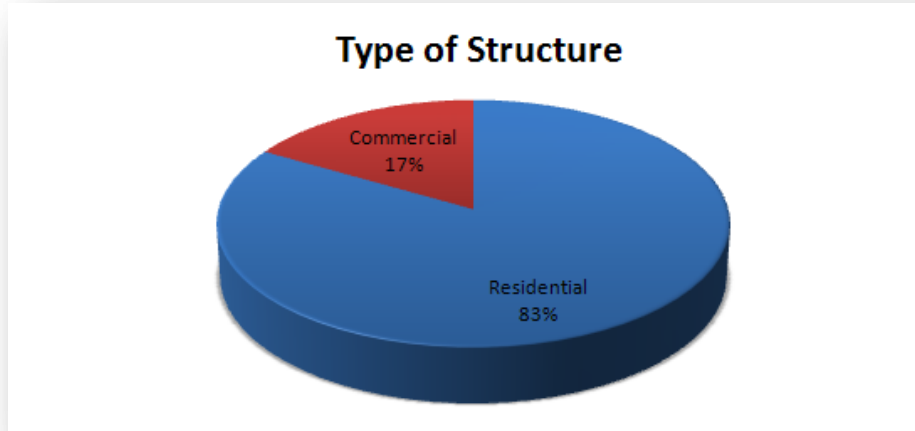


Of the 12 reports that were ultimately found to meet the criteria for “active firefighting” and the presence of lightweight components:

- 5 involved a floor collapse (light weight construction)  
~F2001-16, F2002-11, F2006-24, F2006-26, F2007-07
- 5 involved light frame components on fire, but victims were disoriented by the intense heat and smoke, or a hostile fire event occurred from a vent opening or a correlation with PPV.  
~F1998-06, F1999-21, F2001-27, F2004-10, F2005-13
- 1 collapse blocked an exit for victim  
~F2002-06
- 1 commercial w/light frame construction  
~F2000-13

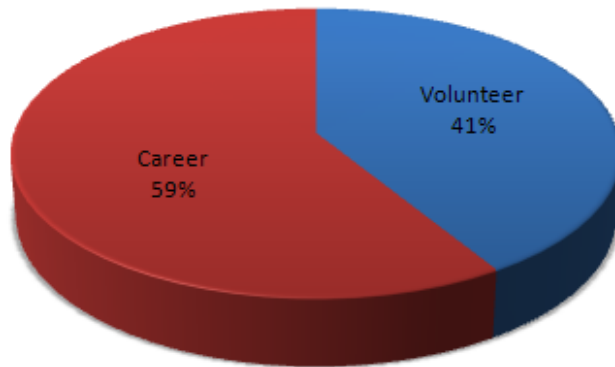
## Research Findings

- For the 78 incidents (1996 – 2009) involving “active firefighting” fatalities, there were a total of 117 deaths.
- Of the 78 incidents involving “active firefighting” fatalities, 12 involved structures with lightweight components
- Those 12 incidents resulted in 17 firefighter fatalities
- Of those 12 deaths, 17% (2) occurred in commercial structures, with 83% (10) occurring in residential structures.



*Image from the January 26, 2007, fire that claimed Volunteer Firefighter Shane Daughtee (NIOSH Report 2007-07)*

## Career vs. Volunteer



- Volunteers accounted for 7 fatalities in the reports above, totaling 41 years of experience total for volunteer victims (5.85 years of experience per victim).
- Career firefighters accounted for 10 fatalities, totaling 106 years of experience (10.6 years of experience per victim).
- The average size of the involved commercial structures is 44,443 square-feet
- The average size of the involved residential structures is 2,375 square-feet
- Average experience level for all victims is 8.15 years.
- These 17 fatalities accounted for 1.1% of all LODD's between 1996 and 2009.
- The average firefighter age for these 17 victims is 32.9 years.
- The year of construction for the involved structure was identified in 10 of the 12 cases, placing the average age of the structure at the time of the fire at 12.1 years.



*Image of the hole into which a firefighter fell, claiming his life, following the failure of engineered wood I-joists. (NIOSH Report 2006-24)*

Not only do LODD's cost departments, insurance companies, taxpayers, firefighters and other entities countless dollars each year, but injuries do as well. According to the NIST study titled *The Economic Consequences of Firefighter Injuries and Their Prevention* in 2002 firefighter injuries cost between \$74,000 and \$97,000 per injury. This total came to between \$6.0 billion and \$7.8 billion in 2002.

The review of the LODD reports resulted in the observations listed above, but also a review of each of the listed reports "Fire Department Recommendations" section yielded useful information and showed a trend as to what our problems were on scene of such structures.

**Fire departments should implement an incident command system with written operating procedures for all firefighters**

(9 reports)

Disorganization and inefficiency in operations results in wasted time and effort on the fire ground. An established on-scene command structure with personnel arriving with known assignments would minimize communication on assigning the very specific tasks and what tool to use, as well as allowing for self-study of operational procedures. Having these procedures written down and reviewed in training or in a self-study setting would greatly increase organization and efficiency of personnel on scene.

**Fire departments should ensure that Incident Command continually evaluates the risk versus gain during operations at an incident**

(8 reports)

The importance of knowing what type of building construction is involved with the fire and understanding the type of construction and its behavior when affected by fire is paramount. If structural stability of the structure is a concern, then the survivability of any occupants is in question, and a defensive mode should be considered.

**Fire departments should ensure a back-up radio dispatch system is in place and available when needed**

(7 reports)

On the fire ground, properly working radio communication can affect the outcome of the operation greatly. There are back up personnel, extra apparatus and equipment, but is there a back-up radio system should something happen? Within the recommendations of 7 of the reports, NFPA 1221 Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems is discussed, this standard requires a back-up system to ensure that communications can continue if the primary system fails.

### **Fire departments should ensure that adequate numbers of staff are available to operate safely and effectively**

(7 reports)

Further reinforced by a recent report released by the National Institute of Standards and Technology (NIST) (<http://www.nist.gov>), having adequate personnel on scene to handle the multitude of tasks is critical in efficiency, loss prevention and safety. If there is a single company or two, operations are to be done as if there are only two companies. The incident commander must operate on scene with what they have available on the scene, not with what's "on the way". They must be skilled in doing what they need to do with what the resources they have. If it means water being applied from the safety of an exterior window, because there's not enough personnel on scene for "2 in, 2 out" and for RIT to be established, so be it. Light frame construction affected by fire is not concerned with proper staffing, and will probably fail by the time the proper staffing is on scene and the IC is interested in making an interior attack.

### **Fire departments should establish SOPs regarding TIC use during interior operations**

(5 reports)

Firefighters must have a TIC available for use, have SOPs in place to organize their specific use, and also be trained in how to use a TIC as a tool or aid. TICs should not be used as a firefighter's primary means finding entry and egress, batteries go bad, tunnel vision occurs and firefighters get lost. Having just SOPs won't prevent this recommendation from coming up again, but knowing and understanding the SOPs and practicing what its intent is, will make the firefighters use of a TIC successful.

### **Ventilation should be closely coordinated with the fire attack**

(5 reports)

When tactical ventilation is not coordinated with fire attack, especially when using PPV, the resulting assistance of the "ventilation" to the fire spread can be dangerous, and counterproductive. Through training, and communication PPV can be a very effective and safe tactic.

### **Fire departments should ensure that fire fighters performing fire fighting operations under or above trusses are evacuated as soon as it is determined that the trusses are exposed to fire**

(5 reports)

Firefighters and command staff having a knowledge of fire behavior is critical, but also knowledge and understanding of the effects of flame impingement on light weight construction components is important. Based on this knowledge, Officers will have a better understanding of when to stay and fight and when to evacuate.

## Summary Statement

In recent years, UL and various partners were awarded funds through the Assistance to Firefighters Grant program to research floor and roof assemblies and their behavior when affected by fire. The tests performed showed that floor collapse can occur in about 6 minutes. These findings among the many others (see “Battling the Hidden Danger”, (Dalton, et. al. , Fire Rescue, Feb. 2010, p.72) further make the case for making identification of these structures a top priority for the Incident Commander, and for the Incident Commander to determine operations relative to the likelihood of a collapse.

With the review of NIOSH reports for this project, along with the fire research done by UL and its partners, the importance of company level training and understanding of tactics and behavior of lightweight components with flame impingement is paramount.

Firefighters and officers should routinely review NIOSH reports, paying particular attention to the circumstances surrounding the incident and the operations of the department. This provides the opportunity to identify trends or factors that may be present in your department, and take corrective actions before a tragic event occurs.

Additionally, there are valuable lessons to be learned from the “Fire Department Recommendations” sections of these reports. Regardless of the construction type, there are recurring recommendations that appear. The fire service must understand that, regardless of construction type, there are factors that must be addressed to safely operate at any working fire:

- Effective incident command is paramount, which extends to incidents beyond fire suppression
- No fire will go as planned if the ability to communicate is impaired
- We must learn to operate within the limitations of the staffing that is on-scene
- A risk/benefit analysis must be completed on every response

Further analysis of these incidents and the factors that contribute to them is part of ongoing research. The information reported in this document will be combined with further research in another report which will be published. This research will examine more specific aspects of the incidents and allow for more information regarding operations involving lightweight components.

As the buildings change that we respond to, so must our tactics and knowledge. The research and training materials are available to prevent a fatality and injuries from light frame construction. The leadership and commitment to train and take the knowledge and skills to the fire ground is what is needed now.