



# RESEARCH



## Fires in Structures Under Construction

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## Fires in structures under construction

From 2017 to 2021, local fire departments responded to an estimated average of 4,440 fires in structures under construction per year. These fires caused an annual average of five civilian deaths, 59 civilian injuries, and \$370 million in direct property damage. Only 1 percent of all the reported structure fires were in structures under construction, but these fires accounted for 3 percent of the direct property damage in structure fires.

- The estimated number of fires in structures under construction has increased since 2014 after declining between 2006 and 2010.
- Three of every four fires (76 percent) in structures under construction involved residential properties.
- Cooking equipment was the leading cause of fires on construction sites, but these fires tended to be minor.
- Fires that were intentionally set caused fewer than one in 10 fires (8 percent) but 45 percent of the direct property damage.
- Fires in structures under construction were highest in January and lowest in October.
- Fires in structures under construction were most common in the afternoon and evening; however, fires that occurred between midnight and 6 a.m. accounted for just over half (51 percent) of the direct property damage.
- The leading factors contributing to the ignition of fires in structures under construction included heat sources that were too close to combustible materials, abandoned or discarded materials or products, and electrical failures or malfunctions.

## Property Use

The vast majority of the fires in structures under construction involved residential properties (76 percent) and accounted for the largest shares of deaths, injuries, and direct property damage (see Table A). Another 6 percent of fires involved mercantile or business properties, while fires in outside or special properties accounted for 5 percent but caused 11 percent of the direct property damage.

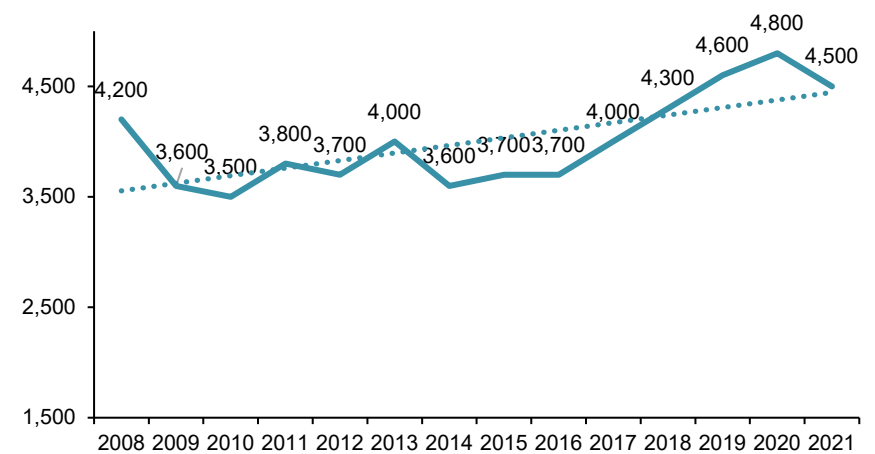
**Table A. Fires in Structures Under Construction by Property Use:  
2017–2021 Annual Averages**

Property Use	Fires	Civilian Injuries	Direct Property Damage
Residential	76%	76%	79%
Mercantile or business	6%	5%	3%
Outside or special property	5%	4%	11%
Assembly	3%	5%	2%
Storage	3%	2%	1%
Health care, detention, correction	2%	7%	2%

## Recent trends in fires in structures under construction

Figure 1 shows the estimated number of fires in structures under construction from 2008 to 2021. As the trend line shows, there has been an increase in the number of these fires over this period, particularly in the years since 2015, after declining between 2008 and 2010.

**Figure 1. Fires in Structures Under Construction: 2008–2021**



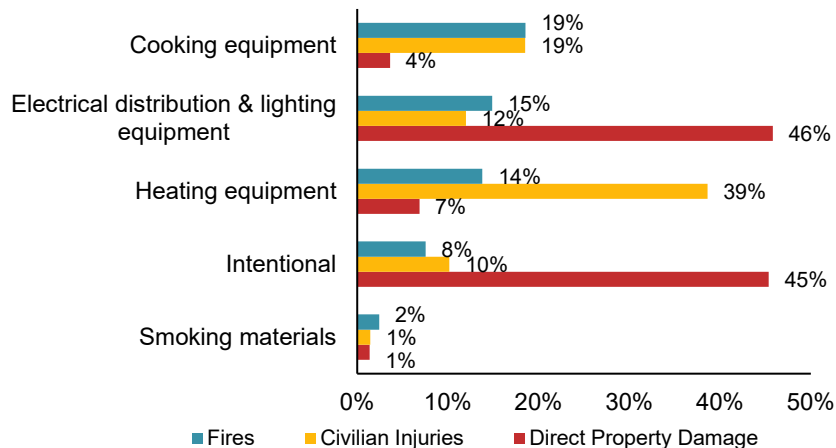


## Leading causes of fire in structures under construction

Figure 2 shows that cooking equipment was the leading cause of fires on construction sites. While these fires were usually minor, they accounted for one-fifth (19 percent) of the reported injuries. Electrical distribution and lighting equipment accounted for 15 percent of the fires but nearly half (46 percent) of the direct property damage. Another 14 percent of the fires were caused by heating equipment. Fires that were intentionally set caused 8 percent of the fires but 45 percent of the direct property damage. Smoking materials accounted for 2 percent of the fires and 1 percent of the direct property damage.

It is important at construction sites—where combustible and flammable materials are present—for equipment to be used for its intended purpose. It is also important for temporary heaters to be selected and used with fire safety in mind. The areas around temporary heaters must also be kept clear of combustible materials.

**Figure 2. Fires in Structures Under Construction by Leading Cause: 2017–2021 Annual Averages**

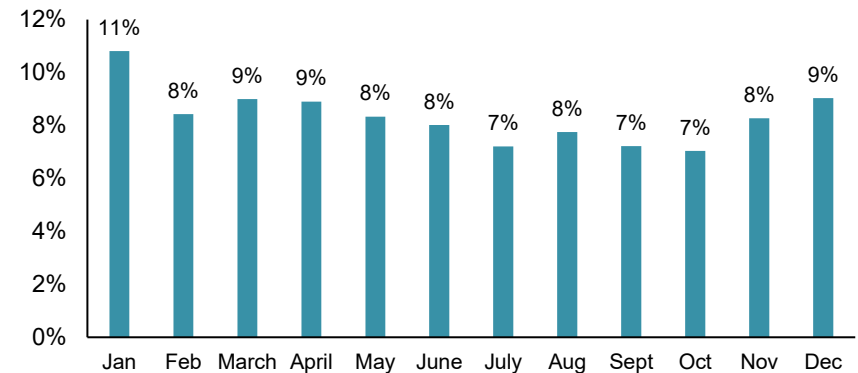


## Timing of fires in structures under construction

Figure 3 shows that the number of fires in structures under construction was highest in January (11 percent of the yearly total) and was generally

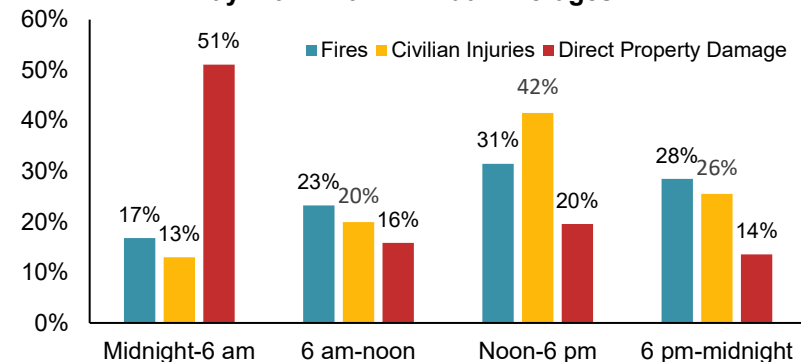
higher in cold weather months (December, January, and March). The lowest shares of fires occurred in July, September, and October (each of which accounted for 7 percent of the fires). Fires in the remaining months accounted for either 8 or 9 percent of the annual average.

**Figure 3. Fires in Structures Under Construction by Month: 2017–2021 Annual Averages**



The peak periods for fires in structures under construction were the hours between noon and 9 p.m. and between 4 p.m. and 8 p.m. (Figure 4). Although approximately one-fifth of the fires (18 percent) occurred between midnight and 6 a.m., these fires accounted for more than half (51 percent) of the direct property damage. Fires may spread more easily undetected during overnight hours when workers are less likely to be at the construction site.

**Figure 4. Fires in Structures Under Construction by Time of Day: 2017–2021 Annual Averages**

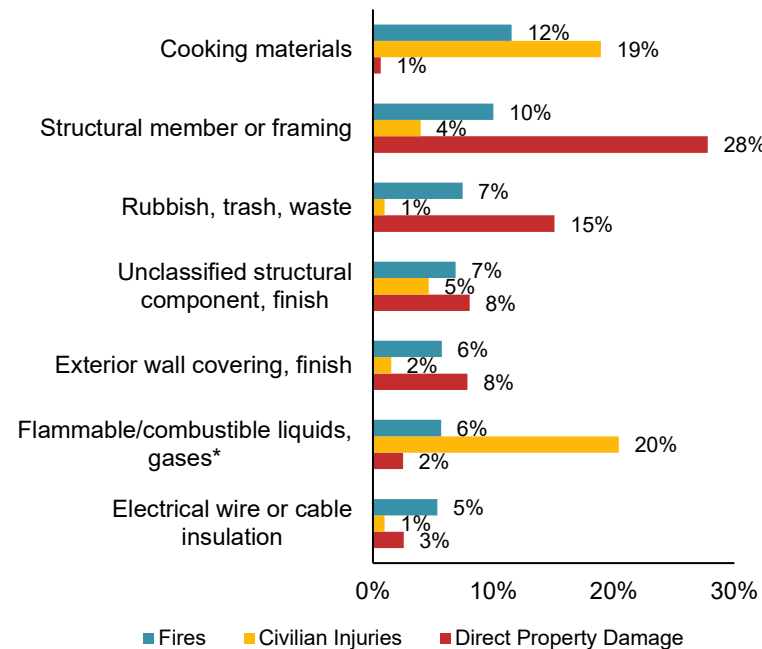


## Leading items first ignited in structure fires under construction

Most often, cooking materials were the first items ignited in fires in structures under construction. However, almost one-quarter of the fires involved the ignition of structural elements, including structural members or framing (10 percent), unclassified structural components (7 percent), or exterior wall coverings or finishes (6 percent), as indicated in Figure 5.

Waste materials were first ignited in 7 percent of the fires, but these fires accounted for 15 percent of the direct property damage. The ignition of flammable or combustible liquids or gases, piping, or filters accounted for 6 percent of the fires but one-fifth (20 percent) of the injuries.

**Figure 5. Leading Items First Ignited in Structure Fires Under Construction: 2017–2021 Annual Averages**



\*Flammable or combustible liquid or gas, piping, or filter.

## Equipment involved in ignition

Fires in structures under construction most often involved cooking equipment, electrical distribution and lighting equipment, or heating equipment. Electrical distribution and lighting equipment accounted for a disproportionately large share of the direct property damage. Cooking equipment and heating equipment each accounted for the largest shares of injuries (see Table B).

Temporary electrical wiring or lighting can emit heat or sparks if not properly installed or maintained and should be regularly reviewed by qualified personnel to ensure safety.

Torches, burners, or soldering irons were involved in 7 percent of the fires, but these fires accounted for 13 percent of the direct property damage. Hot work activities pose a variety of combustion hazards and should be carried out under a stringent permitting system. For more information on hot work safety, see [nfpa.org/Training-and-Events/By-topic/Hot-Work](https://www.nfpa.org/Training-and-Events/By-topic/Hot-Work).

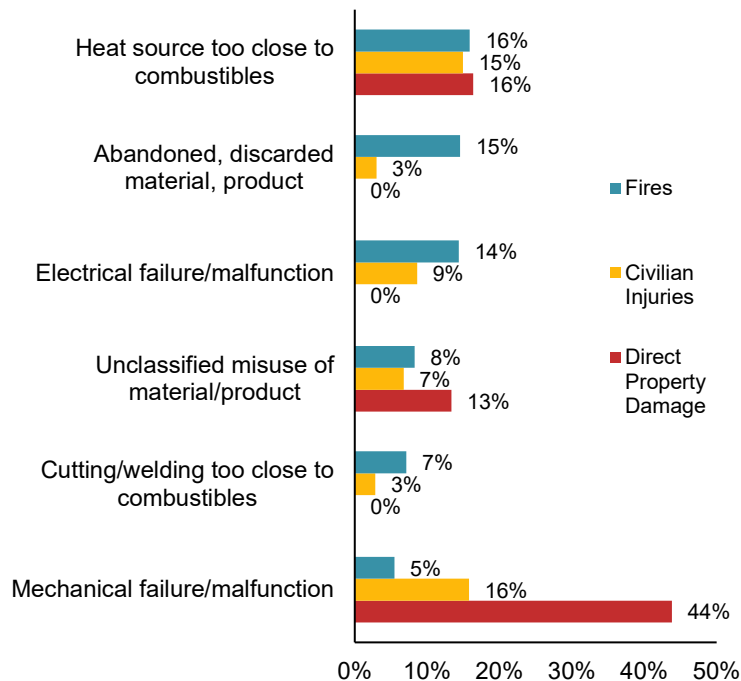
**Table B. Fires in Structures Under Construction by Equipment Involved in Ignition: 2017–2021 Annual Averages**

Equipment Involved	Fires	Civilian Injuries	Direct Property Damage
Cooking equipment	19%	19%	4%
Electrical distribution and lighting equipment	15%	12%	46%
Wiring and related equipment	10%	10%	13%
Heating equipment	14%	39%	7%
Fixed or portable space heater	6%	29%	4%
Torch, burner, or soldering iron	7%	9%	13%

## Factor contributing to ignition

The leading factors contributing to the ignition of fires in structures under construction included heat sources being too close to combustible materials, abandoned or discarded materials or products, and electrical failures or malfunctions, as shown in Figure 6. Other factors contributing to construction fires included cutting or welding too close to combustible materials, unclassified misuse of materials or products, and mechanical failures or malfunctions. Good worksite practices should include regular maintenance for the equipment. Fire safety procedures for the use of powered equipment and combustible materials should also be established.

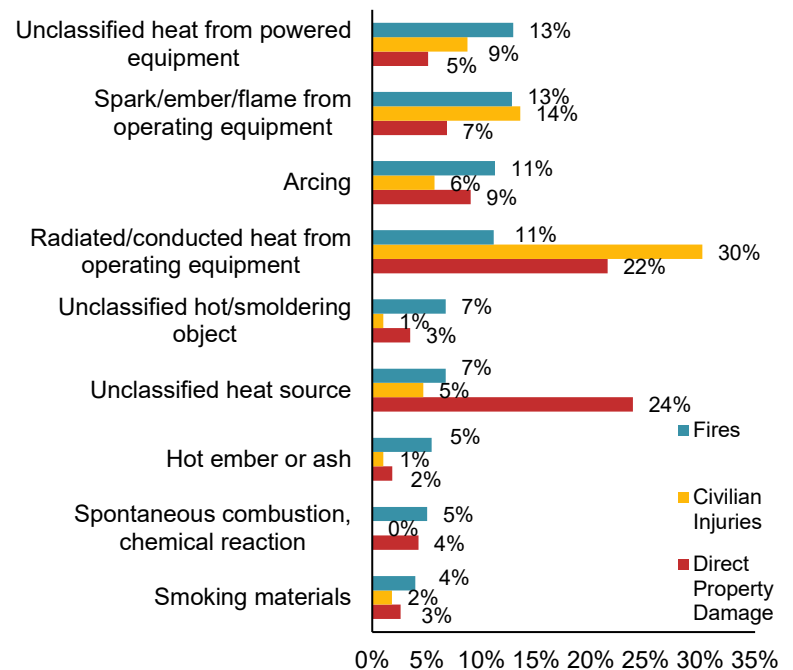
**Figure 6. Fires in Structures Under Construction by Factors Contributing to Ignition: 2017–2021 Annual Averages**



## Heat source

The leading heat sources for fires in structures under construction involved either heat from powered equipment or sparks, embers, or flame from operating equipment, which together accounted for one-quarter (26 percent) of the fires (Figure 7). Arcing and radiated or conducted heat from operating equipment each provided the heat source for 11 percent of the fires, with the latter also accounting for three in ten injuries and 22 percent of the direct property damage. Unclassified hot or smoldering objects accounted for 7 percent of the fires, followed by hot embers or ash (5 percent), spontaneous combustion or chemical reaction (5 percent), and smoking materials (4 percent).

**Figure 7. Fires in Structures Under Construction by Heat Source: 2017–2021 Annual Averages**

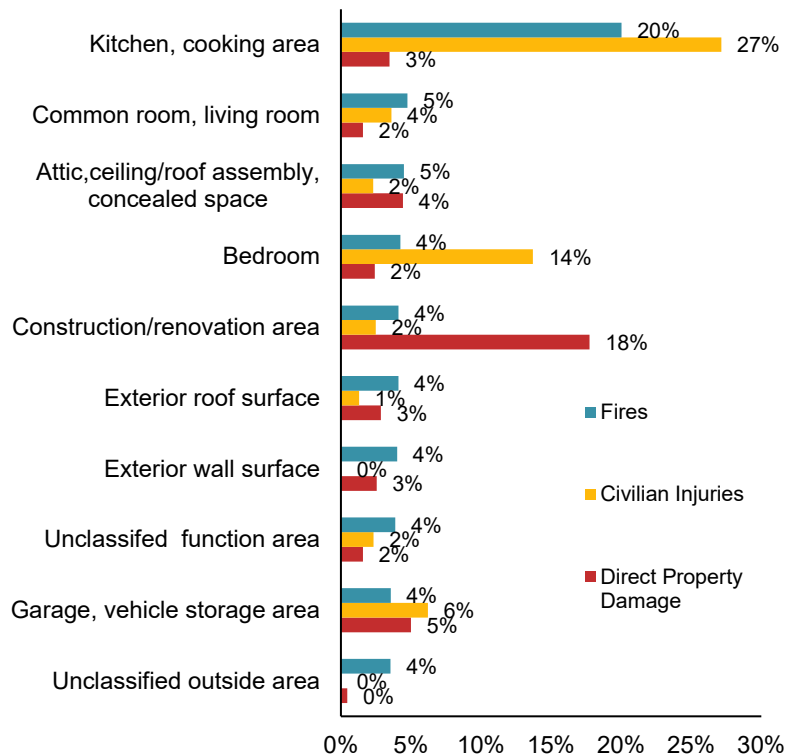


## Area of origin

The leading area of origin for fires in structures under construction was a kitchen or cooking area, which accounted for one-fifth (20 percent) of the fires.

Fires that originated in a common or living room and an attic or ceiling/roof assembly or concealed space each accounted for five percent of the fires, while fires originating in a bedroom, construction or renovation area, exterior roof surface, function area, garage or vehicle storage area, and unclassified outdoor area each accounted for four percent of the fires. The fires that originated in a construction or renovation area accounted for nearly one-fifth (18 percent) of the direct property damage.

**Figure 8. Fires in Structures Under Construction by Area of Origin: 2017–2021 Annual Averages**



Just over one quarter (27 percent) of the civilian injuries occurred in fires that originated in a kitchen or cooking area. Fires that originated in a bedroom accounted for 14 percent of the civilian injuries. See Table 11 in the supporting tables document for details.

## Discussion

On average, firefighters responded to nearly 12 fires in structures under construction each day between 2017 and 2021. Fires at such construction sites are a longstanding problem, but their major causes are generally well-established—a good indication that they can be prevented through greater attention to fire hazards.

The most common causes of under construction fires in the most recent five-year period, as well as historically, are electrical distribution and lighting equipment; heating equipment; cooking equipment; a torch, burner, or soldering iron; or an intentional cause. For each of these causes, there are safety protocols that can be utilized to reduce the risk of fire.

The safety protocols can include the following:

- Ensure that the temporary electrical service lighting follows the installation requirements set forth in *NFPA 70®*, *National Electrical Code®*; electrical equipment is maintained and regularly inspected; use of extension wiring is kept to a minimum; and machinery and equipment do not overload available circuits.
- Prohibit the use of temporary cooking equipment (such as hot plates or grills) or the use of improvised heating devices for warming food at the construction site.
- Ensure that unauthorized temporary heaters are restricted from the worksite and that the heaters permitted on the worksite are placed at safe distances from combustible and flammable materials; are used in conformity with their listing and manufacturer instructions; and are regularly checked to ensure that they are being safely operated and do not constitute a hazard (such as being overturned).

- Require a permit system for hot work activities and enforce a thirty-minute (or longer) cool-down interval after torches, burners, or soldering irons have been used.
- Reduce the risk of arson by safeguarding construction sites with fencing or other controls; these controls can include lighting or after-hours security personnel, as needed.
- Have an approved fire prevention program (also known as a fire safety plan) for the construction site.
- Ensure there is a fire prevention program manager to administer the fire safety plan to completion.

Guidance for preventing fires at structures under construction or undergoing renovation is available in [NFPA 241](#), *Standard for Safeguarding Construction, Alteration, and Demolition Operations*.

## Acknowledgments

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We are also grateful to the US Fire Administration for its work in developing, coordinating, and maintaining NFIRS.

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