

Caught-in/between Injuries and Prevention in the Construction Industry

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Caught-in/between hazards, along with falls, struck-by, and electrocution, are the Focus Four hazards identified by the U.S. Occupational Safety and Health Administration as leading causes of fatalities in construction (OSHA, 2011). To prevent construction workers from caught-in/between injuries, specific hazards and working environments should be taken into account for safety and health intervention programs. This Quarterly Data Report provides updated data on deaths and injuries from being caught or crushed in collapsing materials or being caught or compressed by objects and equipment. Primary sources of caught-in/between injuries and vulnerable worker groups for such injuries were also analyzed and are presented in the report. Numbers of fatal and nonfatal injuries were obtained from the Census of Fatal Occupational Injuries (CFOI) and the Survey of Occupational Injuries and Illnesses (SOII), respectively. Both the CFOI and SOII are data collections of the U.S. Bureau of Labor Statistics (BLS). In addition to the BLS data, this report introduces solutions to prevent caught-in/between injuries selected from a variety of sources, including OSHA, the National Institute for Occupational Safety and Health (NIOSH), and CPWR.



KEY FINDINGS

- From 2011 to 2015, 275 construction workers died from caught-in/between injuries, more than any other major industry.
- In 2015, 68 construction workers were killed due to caught-in/between injuries, a 33% increase from 2011, higher than the 26% increase in overall fatalities in construction during this period.
- More than two in three of caught-in/between fatalities from 2011 to 2015 were due to being caught or crushed in collapsing materials, while about 93% of all nonfatal caught-in/between injuries were caused by equipment or objects.
- Ironworkers had the highest rate of caught-in/between fatalities, while helpers had the highest rate of nonfatal caught-in/between injuries.
- In general, older construction workers had an elevated risk of caught-in/between fatalities, and workers under 20 years old had an elevated risk of both fatal and nonfatal caught-in/between injuries.

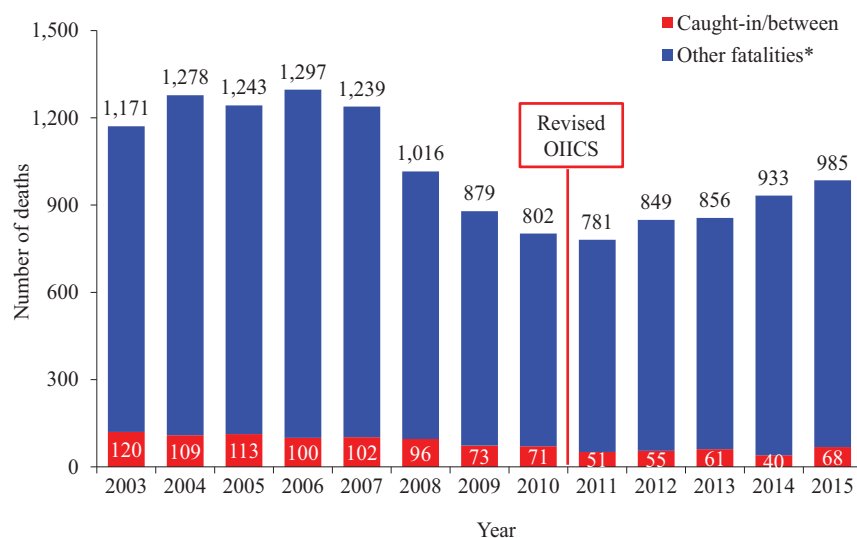
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SECTION 1: Trends of Fatal Caught-in/between Injuries in Construction (All employment)

The number of caught-in/between fatalities¹ in construction declined during the recession and increased afterwards, coinciding with the overall fatality trend in this industry (Dong et al, 2017). In 2015, 68 construction workers died from caught-in/between injuries, a 33.3% increase from 2011,² surpassing the growth rate of overall fatalities (26.1%) in construction (chart 1). Between 2003 and 2015, caught-in/between injuries claimed 1,059 construction workers' lives, accounting for about 8% of construction fatalities during this period.

1. Number of fatalities in construction, caught-in/between and other fatalities*, 2003-2015



¹ Caught-in/between fatalities in this study include caught in or compressed by equipment or objects (Event codes 64xxxx in OIICS 2.01 and Event codes 03xxxx in OIICS 1.01) and caught in or crushed in collapsing materials (Event codes 65xxxx in OIICS 2.01 and Event codes 04xxxx in OIICS 1.01).

² In 2011, the Census of Fatal Occupational Injuries (CFOI) switched from OIICS version 1.01 to version 2.01, therefore the number of caught-in/between fatalities are not directly comparable before and after 2011.

Note: * Other fatalities are fatalities from all causes except caught-in/between.

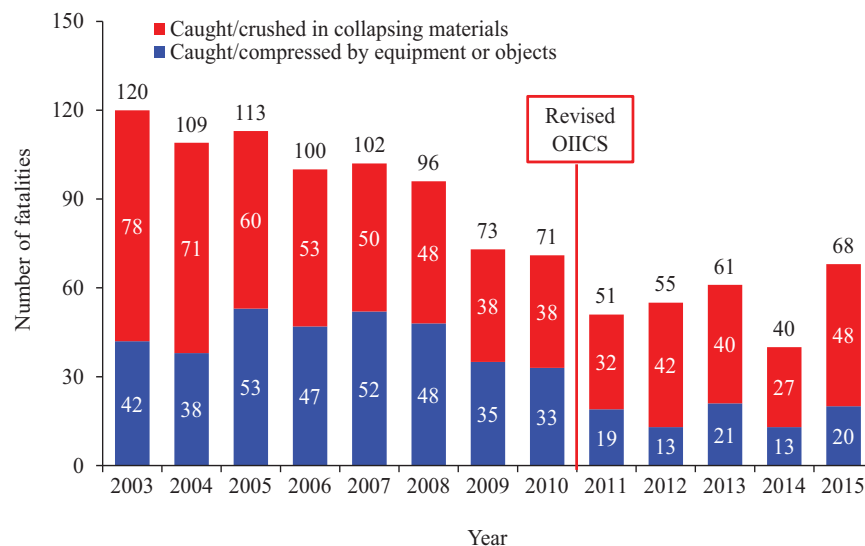
Source: Fatal injury data were generated by the CPWR Data Center with restricted access to BLS CFOI micro data. The views expressed here do not necessarily reflect the views of the BLS.

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When stratified into more detailed categories, more than two in three (68.6%) of caught-in/between fatalities that occurred from 2011 to 2015 were due to being caught or crushed in collapsing materials (chart 2). The number of such deaths increased 50%, from 32 in 2011 to 48 in 2015², while deaths due to being caught or compressed by equipment or objects stayed relatively stable during the same period.

2. Number of fatal caught-in/between injuries in construction, 2003-2015



² In 2011, the Census of Fatal Occupational Injuries (CFOI) switched from OIICS version 1.01 to version 2.01, therefore the number of caught-in/between fatalities are not directly comparable before and after 2011.

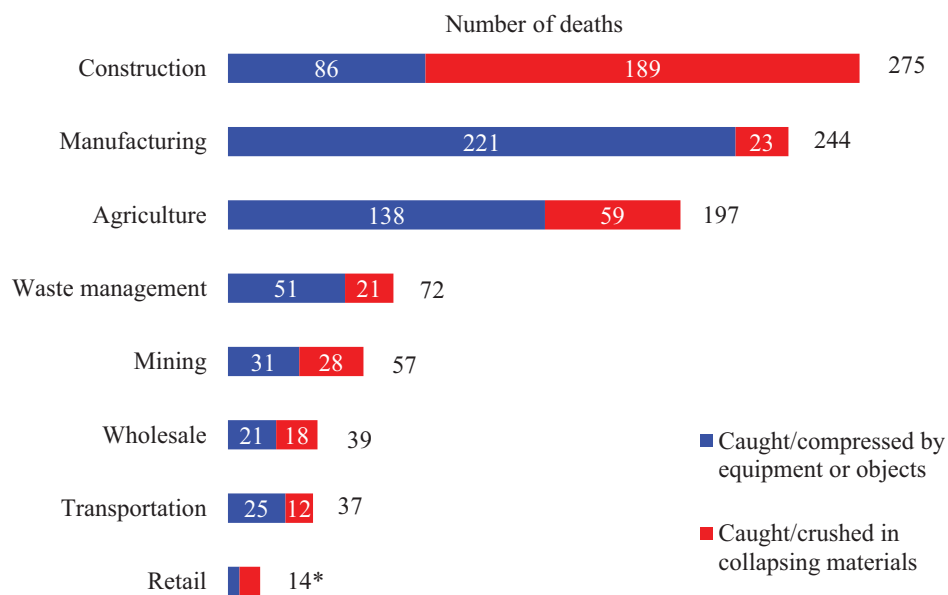
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From 2011 to 2015, 275 construction workers died from caught-in/between injuries, more than any other major industry (chart 3). Specifically, the construction industry had the highest number of fatalities due to being caught or crushed in collapsing materials and the third highest number of deaths due to being caught or compressed by equipment or objects among all major industries.

3. Number of fatal caught-in/between injuries, by major industry, sum of 2011-2015



*Five deaths from being caught/compressed by equipment or objects, and nine deaths from being caught/crushed in collapsing materials.

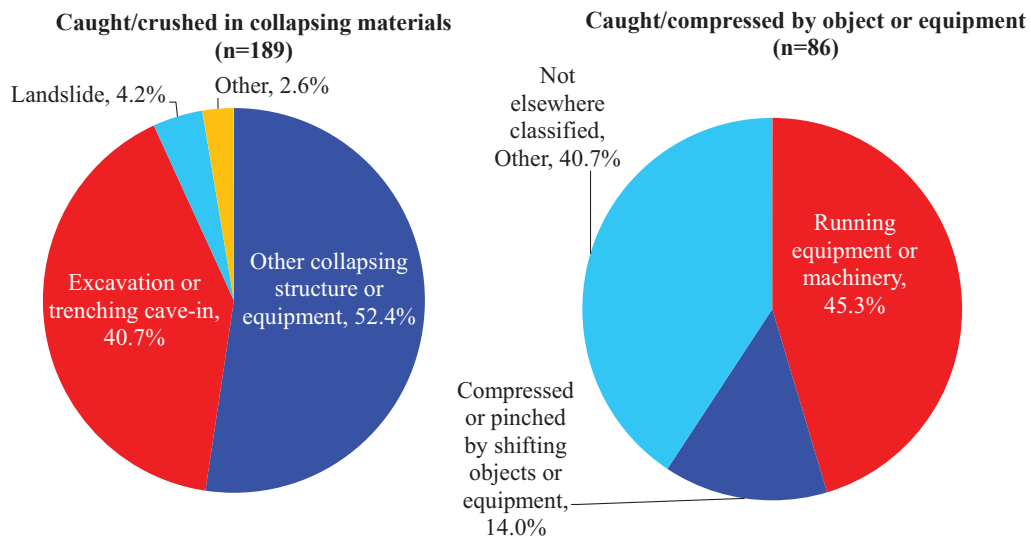
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Among 189 construction workers who died from being caught or crushed in collapsing materials, more than half (52.4% or 99) were killed by collapsing structures or equipment such as walls or cranes, and another 40.7% (77) of deaths were caused by excavation or trench cave-ins (chart 4). The leading cause of caught/compressed by equipment or objects deaths was due to running equipment or machinery (45.3% or 39 deaths), followed by being compressed or pinched by shifting objects or equipment.

4. Fatal caught-in/between injuries in construction, by event or exposure, sum of 2011-2015



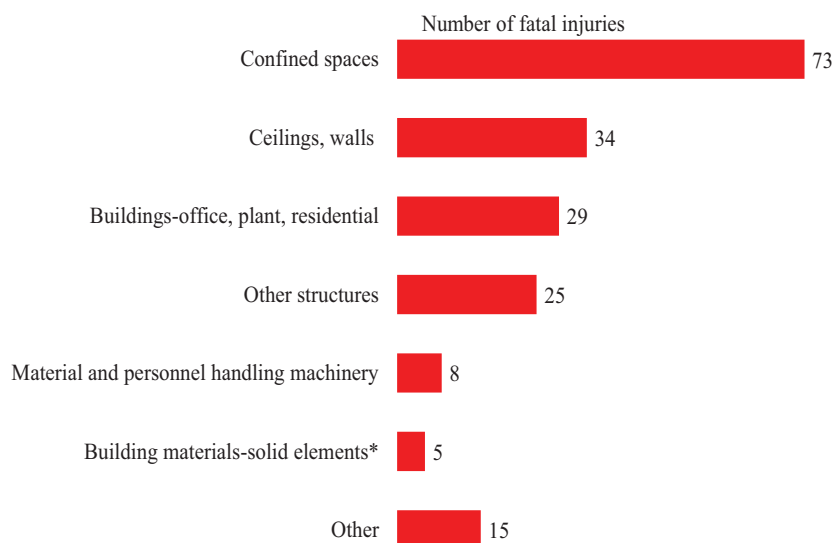
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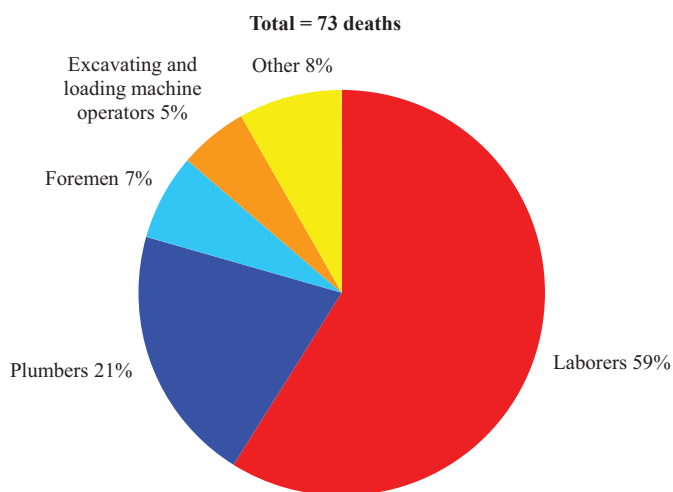
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From 2011 to 2015, among construction worker fatalities due to being caught or crushed in collapsing materials, 73 (38.6%) occurred in confined spaces (such as ditches, channels, trenches, or underground vaults), and another 34 (18.0%) happened when workers were caught or crushed by ceilings or walls (chart 5a). Among workers who died of being caught or crushed in confined spaces, nearly 60% (43) were laborers, followed by plumbers (chart 5b).

5a. Number of fatal injuries from being caught or crushed in collapsing materials in construction, by primary source, sum of 2011-2015



5b. Number of fatal injuries due to being caught or crushed in confined spaces, by occupation in construction, sum of 2011-2015



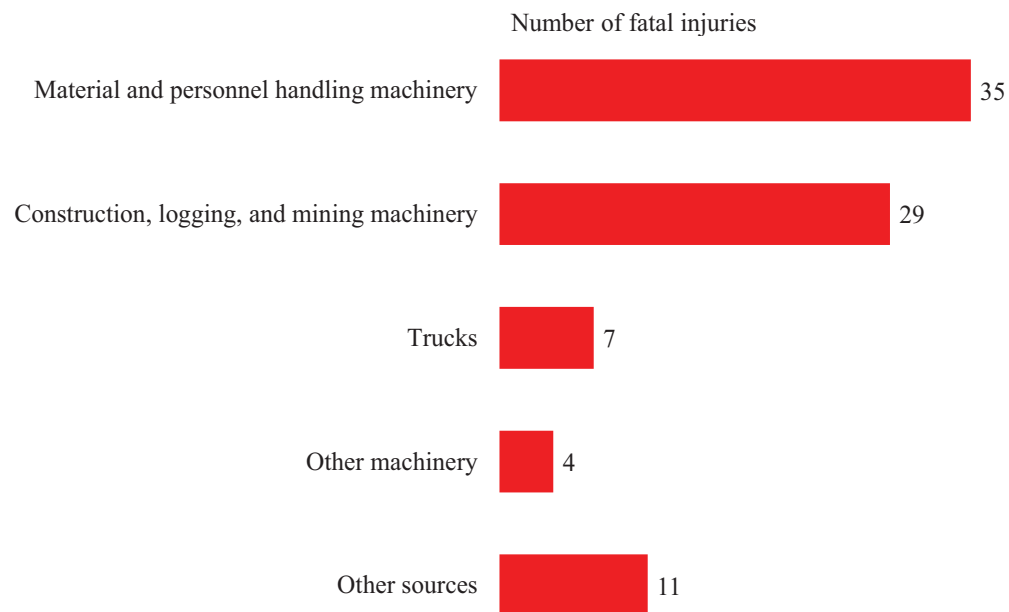
Note: Solid elements include bricks, blocks, structural stone, pipes, ducts, tubing, etc.
Source: Fatal injury data were generated by the CPWR Data Center with restricted access to BLS CFOI micro data. The views expressed here do not necessarily reflect the views of the BLS.

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Among workers who died of being caught or compressed by equipment or objects, 35 (40.7%) were caught by material and personnel handling machinery (such as cranes, elevators, and conveyors), and another 29 (33.7%) were by construction, logging, and mining machinery (chart 6).

6. Number of fatal injuries in construction from being caught or compressed by object or equipment, selected primary source, sum of 2011-2015

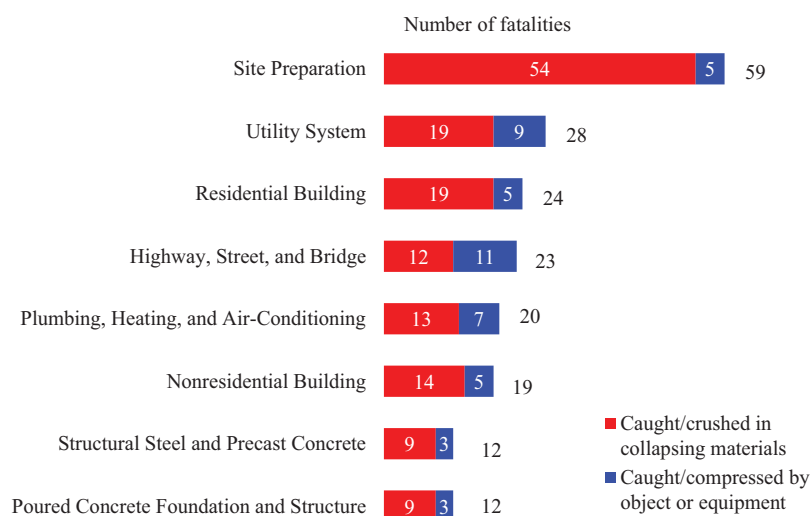


Source: Fatal injury data were generated by the CPWR Data Center with restricted access to BLS CFOI micro data. The views expressed here do not necessarily reflect the views of the BLS.

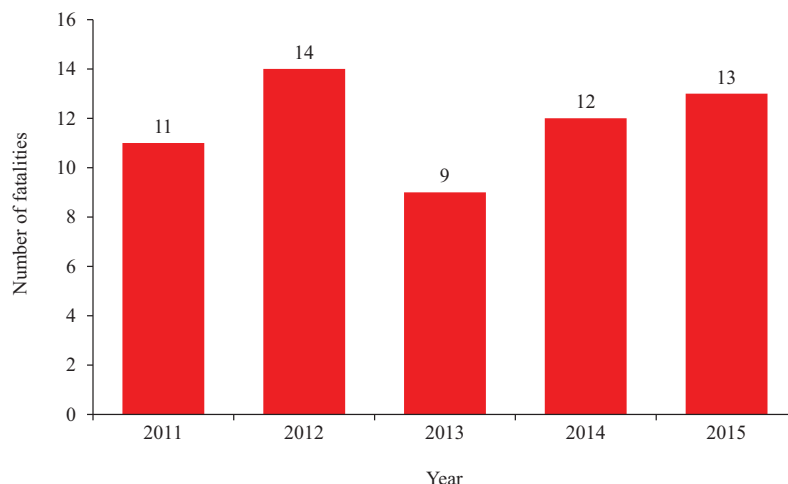
SECTION 2: Fatal Caught-in/between Injuries among Construction Subgroups (All employment)

Of the construction subsectors, the Site Preparation sector (NAICS 23891) had the highest number of caught-in/between fatalities from 2011 to 2015; the majority (91.5%) of these fatalities were due to being caught or crushed in collapsing materials (chart 7). However, equipment or objects led to more caught-in/between deaths in Highway, Street, and Bridge (NAICS 2373x) than in other construction subsectors. Examining fatalities in the Site Preparation subsector year to year, the number of caught-in/between deaths fluctuated over time, with an average of 12 deaths annually between 2011 and 2015 (chart 8).

7. Number of fatal caught-in/between injuries, selected construction subsectors, sum of 2011-2015



8. Number of fatal caught-in/between injuries in Site Preparation subsector, 2011-2015



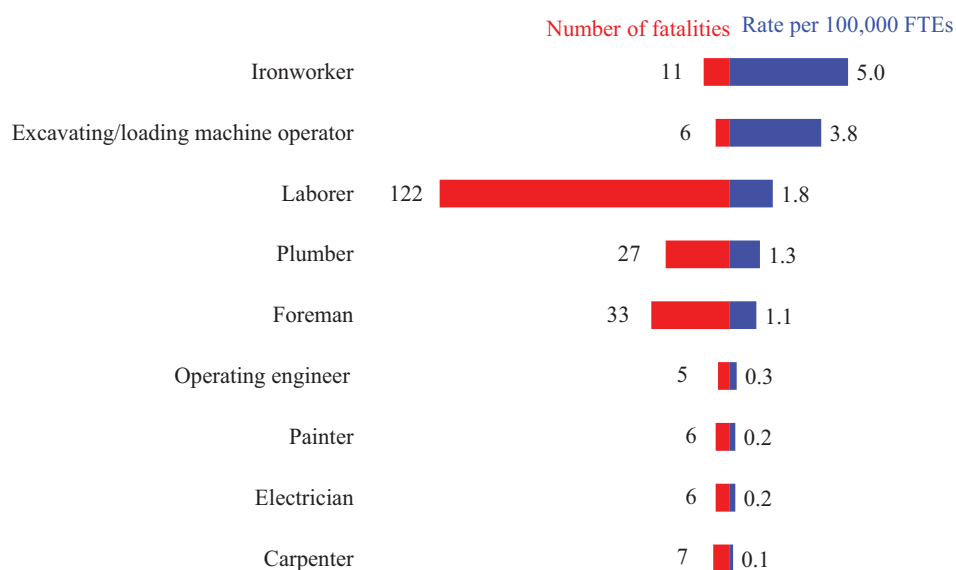
Source: Fatal injury data were generated by the CPWR Data Center with restricted access to BLS CFOI micro data. The views expressed here do not necessarily reflect the views of the BLS.

Section 2: Fatal Caught-in/between Injuries among Construction
Subgroups (All employment)

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By occupation, construction laborers, the largest trade in construction, had the highest number of fatal caught-in/between injuries among all construction occupations between 2011 and 2015 (122 deaths; chart 9). However, ironworkers had the highest rate of fatalities due to caught-in/between injuries, with 5 deaths per 100,000 *full-time equivalent workers* (FTEs). Excavating/loading machine operators had the second highest risk, with 3.8 deaths per 100,000 FTEs.

9. Number and rate of fatal caught-in/between injuries in construction, selected occupations, sum of 2011-2015



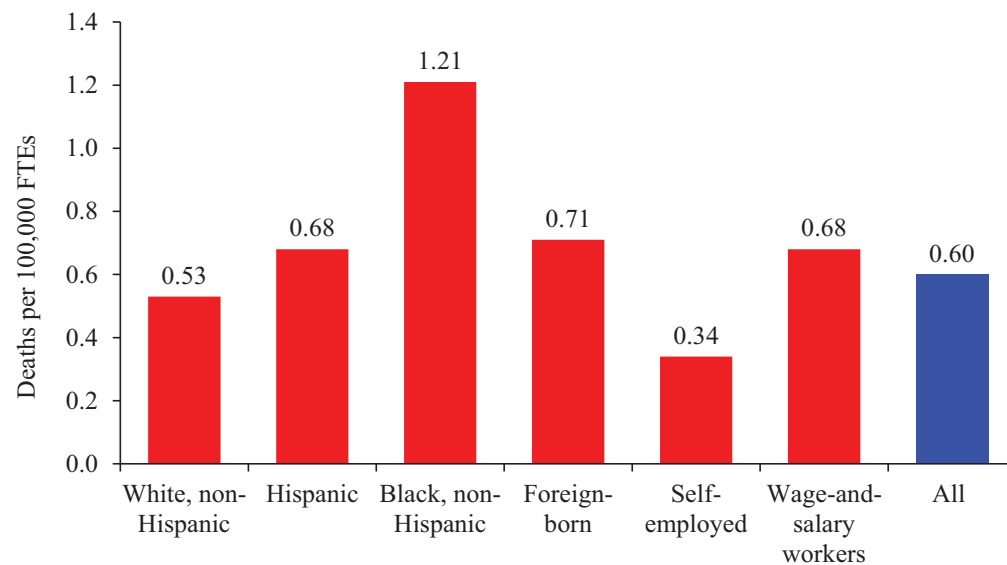
Source: Fatal injury data were generated by the CPWR Data Center with restricted access to BLS CFOI micro data. Numbers of FTEs were estimated using the Current Population Survey. Calculations by the authors. The views expressed here do not necessarily reflect the views of the BLS.

Section 2: Fatal Caught-in/between Injuries among Construction Subgroups (All employment)

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The rate of fatal caught-in/between injuries in construction varies by worker characteristics. On average from 2011 to 2015, black non-Hispanic workers experienced a much higher rate of fatal caught-in/between injuries (1.21 deaths per 100,000 FTEs; chart 10) than any other worker group. Self-employed construction workers had a lower rate of such fatalities (0.34 deaths per 100,000 FTEs).

10. Rate of fatal caught-in/between injuries in construction, selected worker characteristics, average of 2011-2015



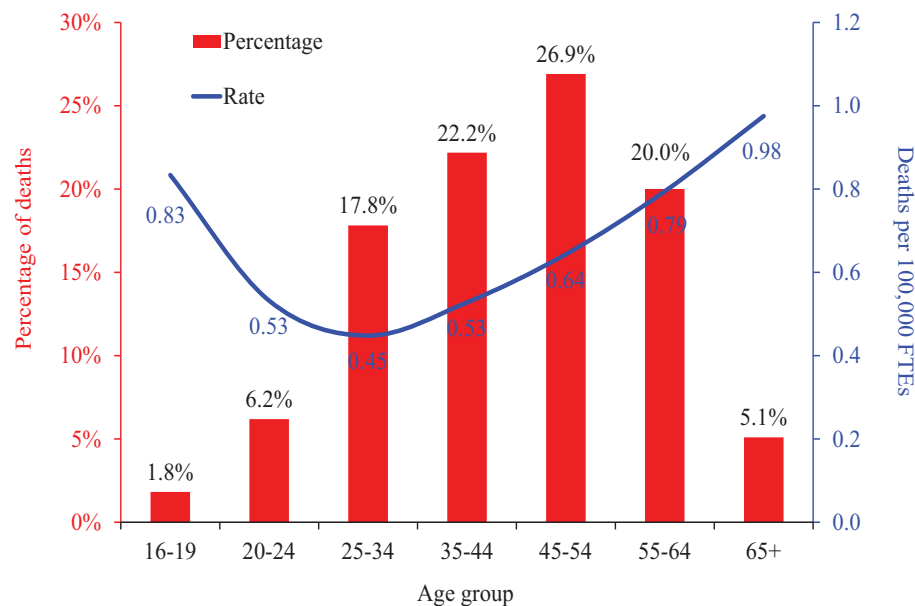
Source: Fatal injury data were generated by the CPWR Data Center with restricted access to BLS CFOI micro data. Numbers of FTEs were estimated using the Current Population Survey. Calculations by the authors. The views expressed here do not necessarily reflect the views of the BLS.

Section 2: Fatal Caught-in/between Injuries among Construction Subgroups (All employment)

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By age, more than a quarter (26.9%) of construction workers who died from caught-in/between injuries were 45 to 54 years old, the largest proportion among all age groups (chart 11). While workers aged 65 years and older only accounted for 5% of such deaths, they had the highest rate of such fatalities of any age bracket, at nearly one death per 100,000 FTEs, more than twice the rate for those aged 25-34. In addition, the youngest age group had an elevated risk of caught-in/between fatalities.

11. Percentage and rate of fatal caught-in/between injuries in construction, by age group, average of 2011-2015

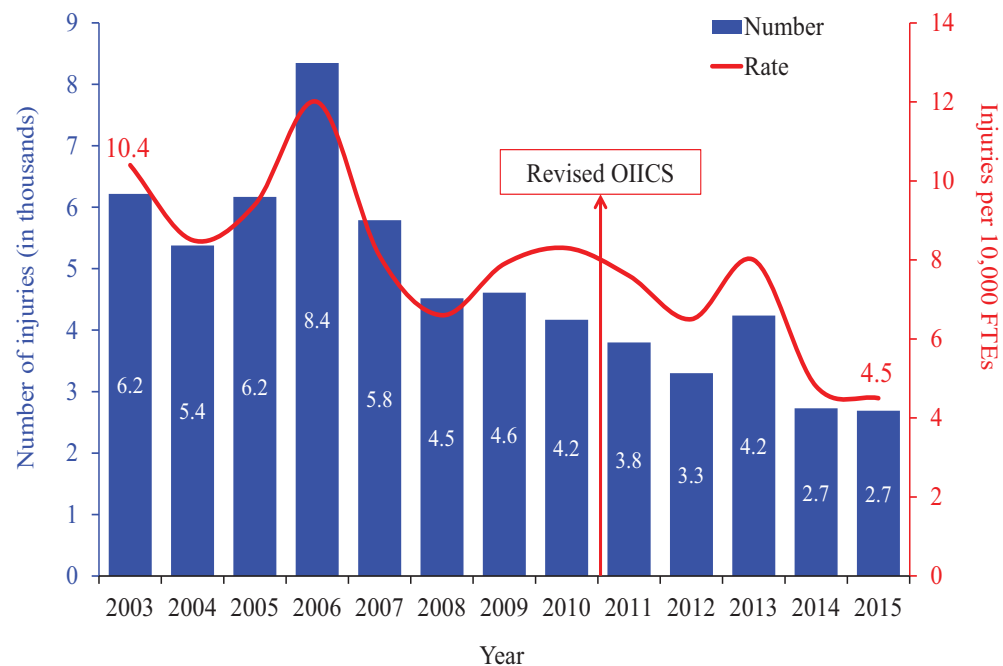


Source: Fatal injury data were generated by the CPWR Data Center with restricted access to BLS CFOI micro data. Numbers of FTEs were estimated using the Current Population Survey. Calculations by the authors. The views expressed here do not necessarily reflect the views of the BLS.

SECTION 3: Trends of Nonfatal Caught-in/between Injuries in Construction (Private wage-and-salary workers)

Coinciding with the overall nonfatal injury trend, both the number and rate of caught-in/between injuries resulting in days away from work (DAFW) in construction declined between 2003 and 2015. In 2015, 2,690 caught-in/between injuries occurred in construction,³ about a 30% decrease from 2011 (chart 12). The injury rate declined even more, falling 41% from 7.6 to 4.5 injuries per 10,000 FTEs during the same period.

12. Number and rate of nonfatal caught-in/between injuries resulting in days away from work in construction, 2003-2015



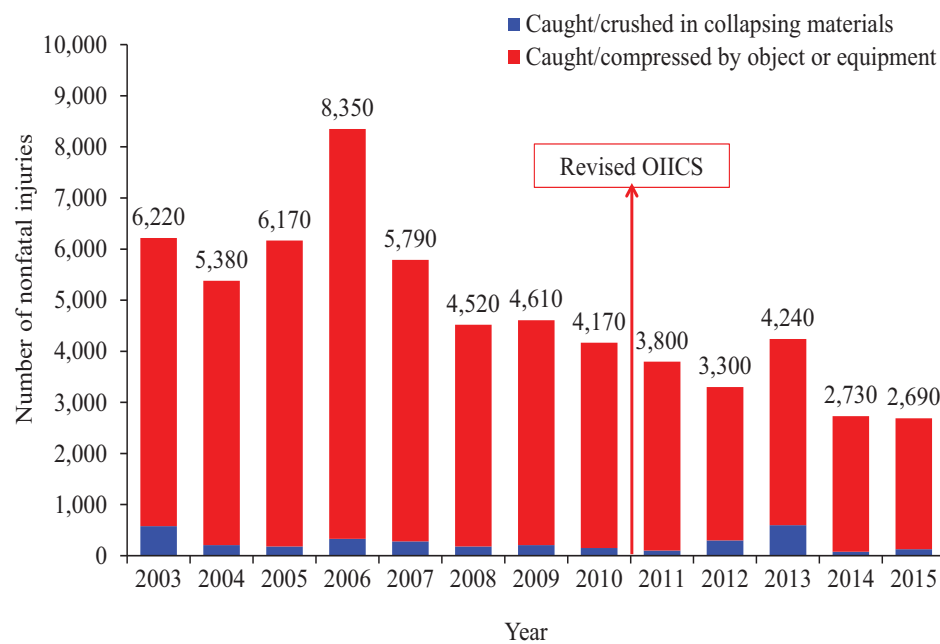
³In 2011, the Survey of Occupational Injuries and Illnesses (SOI) switched from OIICS version 1.01 to version 2.01, therefore the number of caught-in/between injuries are not directly comparable before and after 2011.
 Source: 2003-2015 Survey of Occupational Injuries and Illnesses.

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By more detailed categories, about 93% of all nonfatal caught-in/between injuries in construction from 2011 to 2015 were caused by equipment or objects (chart 13). The decrease (1,140 fewer injuries) between 2011 and 2015 can be attributed to a decrease in equipment and object injuries.

13. Number of nonfatal caught-in/between injuries in construction, by collapsing materials versus by object or equipment, 2003-2015



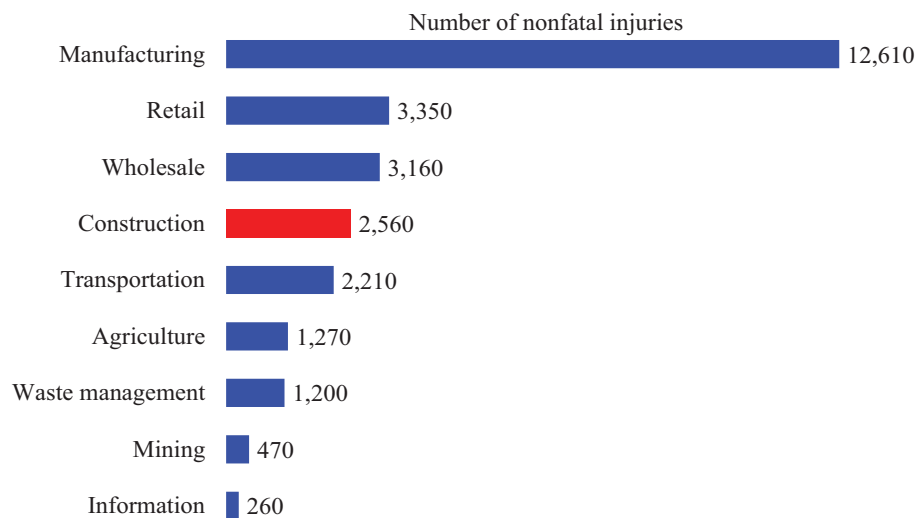
Note: In 2011, the SOII switched to OIICS version 2.01, therefore the numbers before and after 2011 are not comparable.
 Source: 2003-2015 Survey of Occupational Injuries and Illnesses.

Section 3: Trends of Nonfatal Caught-in/between Injuries in Construction (Private wage-and-salary workers)

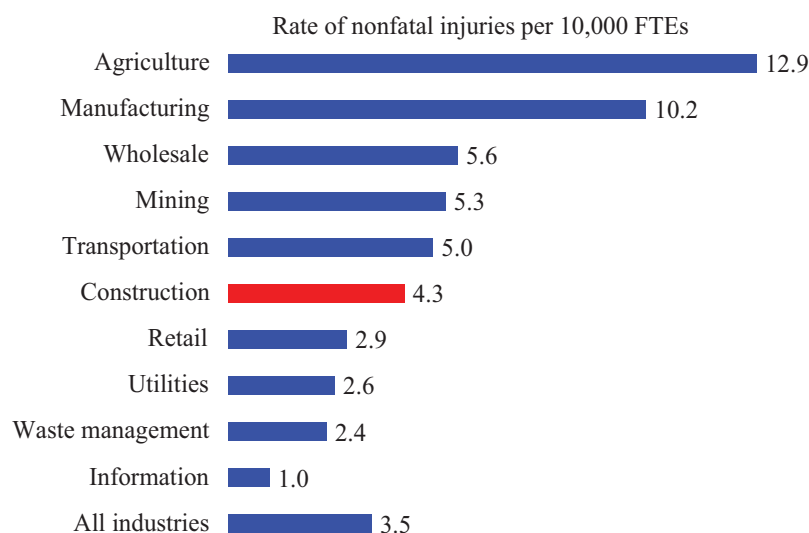
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Compared to other major industry sectors, construction had the fourth-highest number of nonfatal caught/compressed by object or equipment injuries (chart 14a). However, in terms of risk, construction workers were more likely than the average worker to sustain caught/compressed by injuries, with 4.3 injuries per 10,000 FTES in construction, 23% higher than the risk of all industries combined in 2015 (chart 14b).

14a. Number of nonfatal injuries from being caught or compressed by object or equipment, by major industry, 2015



14b. Rate of nonfatal injuries from being caught or compressed by object or equipment, by major industry, 2015



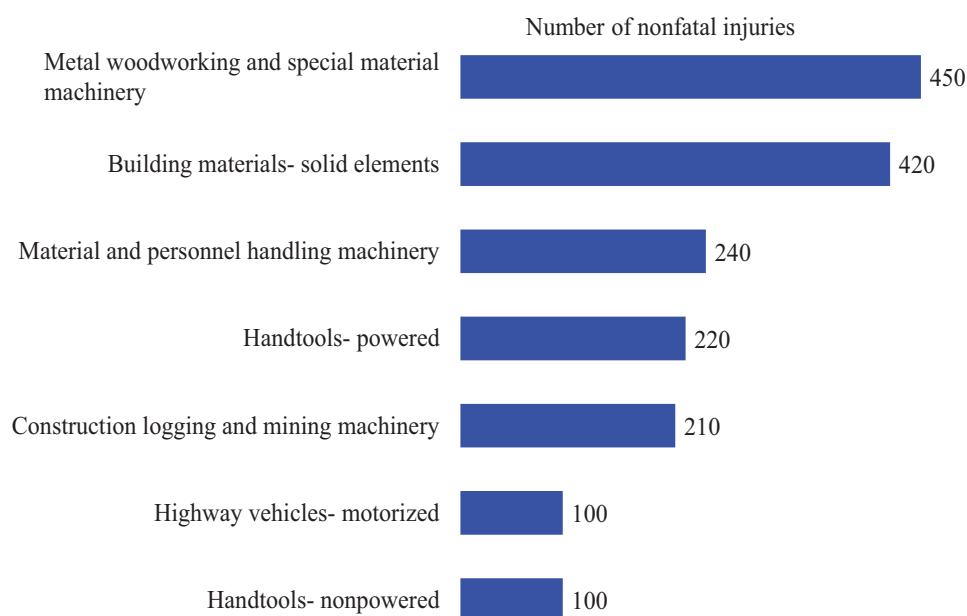
Source: 2015 Survey of Occupational Injuries and Illnesses.

Section 3: Trends of Nonfatal Caught-in/between Injuries in Construction (Private wage-and-salary workers)

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In 2015, among nonfatal injuries due to being caught/compressed by objects or equipment, metal woodworking and special material machinery was the leading source, responsible for about 450 injuries (chart 15). Another common source was building materials (solid elements). Together these two sources caused 34% of nonfatal caught/compressed by object or equipment injuries.

15. Nonfatal injuries in construction from being caught or compressed by object or equipment, selected primary sources, 2015



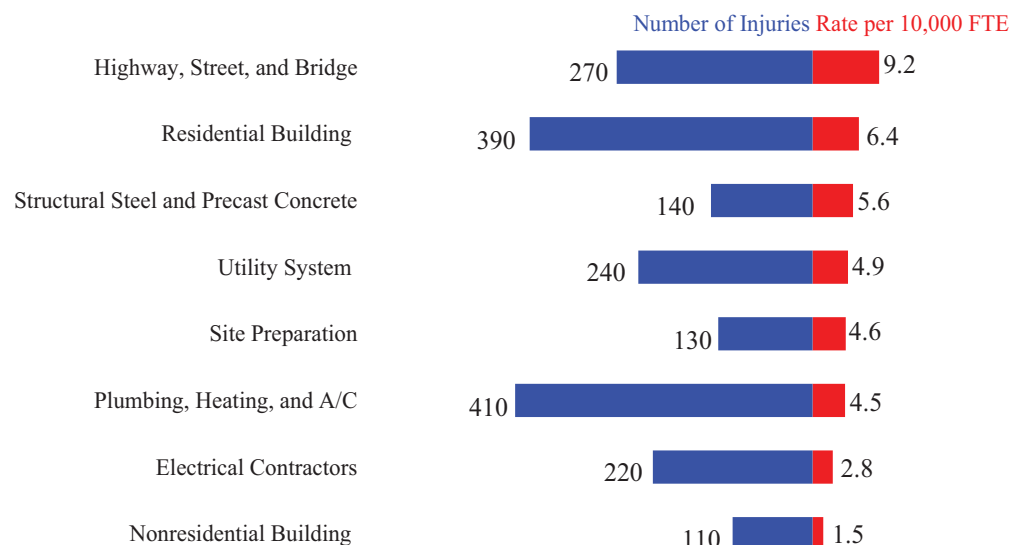
Source: Numbers were obtained from the BLS through special requests. The views expressed here do not necessarily reflect the views of the BLS.

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SECTION 4: Nonfatal Caught-in/between Injuries among Construction Subgroups (Private wage-and-salary workers)

The Plumbing, Heating, and Air Conditioning (NAICS 23822) subsector had a higher number of caught/compressed by object or equipment injuries than other subsectors, with 410 workers suffering such injuries in 2015 (chart 16). However, the Highway, Street, and Bridge subsector experienced the highest rate of such injuries, with 9.2 injuries per 10,000 FTEs in 2015. The Residential Building Subsector (NAICS 23611) experienced the second highest number of such injuries and the second highest rate.

16. Number and rate of nonfatal injuries from being caught or compressed by object or equipment, selected construction subsectors, 2015



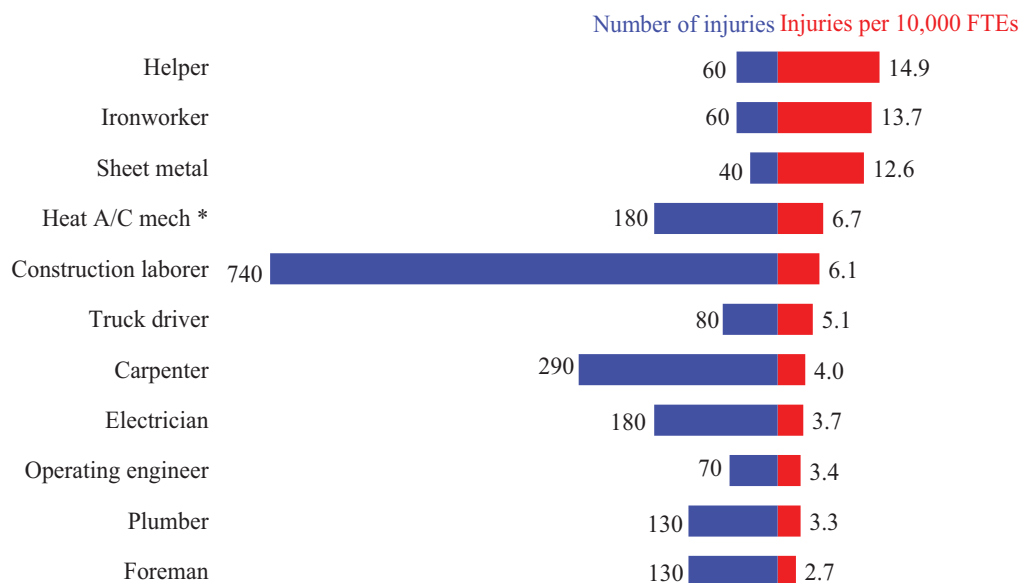
Source: 2015 Survey of Occupational Injuries and Illnesses.

Section 4: Nonfatal Caught-in/between Injuries among Construction Subgroups (Private wage-and-salary workers)

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By occupation, construction laborers had more DAFW injuries due to being caught/compressed by an object or equipment than other occupations, with 740 laborers taking work off due to such injuries in 2015 (chart 17). Carpenters, the second largest trade in construction, had the second-highest number of nonfatal caught/compressed by object or equipment injuries in construction (290 injuries). Construction helpers⁴ had the highest rate of such injuries (14.9 injuries per 10,000 FTEs), followed by ironworkers and sheet metal workers.

17. Number and rate of nonfatal caught or compressed by object or equipment injuries resulting in days away from work, selected construction occupations, 2015



⁴“Construction helpers” refer to “helpers, construction trades”, coded as 6600 by the 2010 Census Occupational Classification, and as 47-3010 by the 2010 Standard Occupational Classification (SOC).

<https://www.bls.gov/cps/cenocc2010.htm>. Helpers assist construction craft workers, such as electricians, carpenters, and cement masons, with a variety of tasks.

Note: *refers to the Heating and Air Conditioning Mechanics occupation.

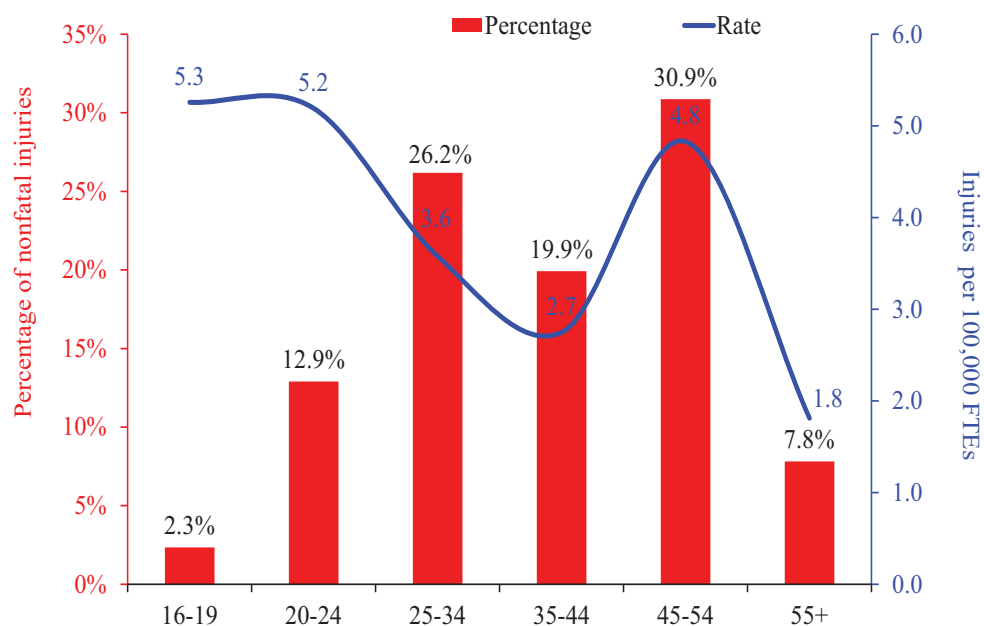
Source: Number of nonfatal injuries were obtained from the BLS through special requests. Numbers of FTEs were estimated using the Current Population Survey. Calculations by the authors.

Section 4: Nonfatal Caught-in/between Injuries among Construction Subgroups (Private wage-and-salary workers)

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Unlike fatal caught-in/between injuries (*see* chart 11),⁵ older construction workers had a lower risk of nonfatal caught/compressed by object or equipment injuries than their younger counterparts. Construction workers under 20 years old had the highest rate of nonfatal caught/compressed by injuries, with 5.3 injuries per 10,000 FTEs, while workers aged 55 years and older had the lowest rate of such injuries (chart 18). Construction workers aged 45 to 54 years old had the largest proportion of caught/compressed by injuries (30.9%). This age group had a higher injury rate than older ones and shared a larger proportion of construction employment as well.

18. Percentage and rate of nonfatal injuries from being caught or compressed by object or equipment in construction, by age group, 2015



⁵Since 93% of nonfatal caught in/between injuries are due to objects or equipment, these categories are roughly comparable.

Source: Numbers were obtained from the BLS through special requests. Numbers of FTEs were estimated using the Current Population Survey. Calculations by the authors. The views expressed here do not necessarily reflect the views of the BLS.

SECTION 5: Caught-in/between Prevention in Construction

Caught-in/between injuries and deaths are preventable. Training (OSHA, 2011), engineering controls, safety protocols, personal protective equipment, and other solutions may be implemented to prevent caught-in/between injuries among construction workers.

Table 1: Solutions to Prevent Caught-in/between Injuries

Event	Hazard	Solution
Caught in or compressed by object or equipment	Hand or other body part pinched or squeezed in between parts of machine	<ul style="list-style-type: none"> • Train all workers in use of safety equipment such as emergency shut-off devices before use¹ • Ensure adequate machine guarding is in place and properly secured on all moving parts before starting work¹ • Use proper lockout and tagout procedures to ensure that equipment is not accidentally energized during maintenance or repair.^{1,2a} • Use machines where moving components are internalized^{2b} • Keep hands and body away from moving parts¹ • Wear appropriate work boots³
	Hair, clothing, or jewelry caught in between parts of equipment	<ul style="list-style-type: none"> • Wear closefitting clothing and secure loose sections of cloth⁴ • Do not wear jewelry at work, tie back long hair, and keep facial hair short or secured⁴
	Pinned between equipment and wall or other immovable object	<ul style="list-style-type: none"> • Never stand between moving materials and an immovable structure⁵ • Never work in swing radius of rotating equipment⁵ • Wear a seatbelt when operating vehicles to avoid being thrown from the vehicle and subsequently crushed⁶ • Always wear high visibility apparel that is appropriate for the job task and work environment⁶ • Keep vehicle foot controls free of mud, ice, snow, and debris⁷ • Regularly inspect and maintain side screens, restraint bars, and other safety devices⁷ • Use audible back-up alarms for heavy equipment^{2c}
Caught in or crushed in collapsing materials	Materials handling; crushed by collapsing structure or tip overs; crushed by walls that collapse during demolition	<ul style="list-style-type: none"> • Inspect crane operations before use and ensure supporting surface can support load³ • Use caution when handling materials³ • Stack and store materials properly to reduce collapse hazards³ • Never exceed load capacity of equipment³ • Secure vertically stacked drywall panels with stabilization clip^{2d} • Inspect and illuminate all stairways and passageways; inspect all ladders⁸ • Laterally brace all stand-alone walls higher than one story⁸ • Never stand between load and ground or other structure^{5,8}
	Trenches and excavations; cave ins	<ul style="list-style-type: none"> • Use shoring equipment, trench box, or shield in all excavations 5 feet deep or more, and remain inside protection system at all times^{2e,2f,9} • Keep exit ladder or ramp within 25 feet of worker at all times⁶ • Use sloping, benching, shoring, or shielding techniques⁹ • Secure any nearby equipment, soil, or other materials that could fall or roll into excavations and keep at least 2 feet from trench edge⁹ • Inspect trenches after water intrusion or rain⁹ • For excavations more than 20 feet deep, a professional engineer must design the system to protect workers⁹

Source: For sources cited in the table, please see the attached supplement.

Conclusion

Caught-in/between hazards are one of the major causes of fatal and nonfatal injuries in construction. During the period of 2011 to 2015, 275 construction workers died from caught-in/between injuries, more than any other major industry. Construction also had an elevated risk of nonfatal caught or compressed by injuries among all industries.

Hazards leading to fatal and nonfatal caught-in/between injuries in construction were quite different. More than two in three (68.6%) of caught-in/between fatalities occurred when workers were caught or crushed in collapsing materials, while about 93% of nonfatal caught-in/between injuries were a result of workers being caught or compressed by objects or equipment. The risk of caught-in/between injuries varied by occupation. Ironworkers and excavating or loading machine operators were the most dangerous occupations in terms of caught-in/between fatalities, whereas helpers, ironworkers, and sheet metal workers had the highest risk of nonfatal caught-in/between injuries. In general, older construction workers had an elevated risk of caught-in/between fatalities, and workers under 20 years old had an elevated risk of both fatal and nonfatal caught-in/between injuries.

Caught-in/between injuries and fatalities are preventable. Related information and solutions are available at [OSHA](#), [NIOSH](#), and [CPWR](#) websites.

References

- Dong XS, Wang X, Katz R, West G, Bunting J. 2017. Fall Injuries and Prevention in the Construction Industry <http://www.cpwr.com/sites/default/files/publications/Quarter1-QDR-2017.pdf> (Accessed Nov 2017).
- OSHA. 2011. Construction Focus Four: Outreach Training Packet https://www.osha.gov/dte/outreach/construction/focus_four/constrfocusfour_introduction.pdf (Accessed Nov 2017).

Data Sources

- Bureau of Labor Statistics, 2003-2015 Census of Fatal Occupational Injuries
- Bureau of Labor Statistics, 2003-2015 Survey of Occupational Injuries and Illnesses
- Bureau of Labor Statistics, 2011-2015 Current Population Survey

Supplement: Sources of Table 1 (accessed November 2017)

1. OSHA. [Machine Guarding eTool](#).
2. CPWR- The Center for Construction Research and Training. [CPWR Solutions Database](#).
 - a. [Lock Out Tag Out](#)
 - b. [Split Frame Lathe With Minimal External Components](#)
 - c. [Self-Adjusting and Directional Backup Alarms](#)
 - d. [Installing Drywall Stabilizing Clip](#)
 - e. [Shoring Equipment for Trenching](#)
 - f. [Trench Boxes](#)
3. OSHA. [Materials Handling and Storage](#).
4. OSHA. [Safeguarding Equipment and Protecting Employees from Amputations](#).
5. OSHA. [Cranes and Derricks in Construction](#).
6. OSHA. [Struck by Hazards](#).
7. NIOSH. 2010. [Preventing Injuries and Deaths from Skid-Steer Loaders](#).
8. OSHA. [Demolition](#).
9. OSHA. [Trench and Excavation Safety](#).

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The CPWR Data Center is part of CPWR – The Center for Construction Research and Training. CPWR is a 501(c)(3) nonprofit research and training institution created by NABTU, and serves as its research arm. CPWR has focused on construction safety and health research since 1990. The Quarterly Data Reports – a series of publications analyzing construction-related data, is part of our ongoing surveillance project funded by the National Institute for Occupational Safety and Health (NIOSH).

Please visit CPWR's other resources to help reduce construction safety and health hazards:

Construction Solutions <http://www.cpwrconstructionsolutions.org/>

Construction Solutions ROI Calculator <http://www.safecalc.org/>

The Electronic Library of Construction OSH <http://www.elcosh.org/index.php>

Falls Campaign <http://stopconstructionfalls.com/>

Hand Safety <http://choosehandsafety.org/>

Work Safely with Silica <http://www.silica-safe.org/>

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