

Fall Injuries and Prevention in the Construction Industry

Xiuwen Sue Dong, DrPH*, Xuanwen Wang, PhD, Rebecca Katz, MPH, Gavin West, MPH, Jessica Bunting, MPH

Falls are a common cause of fatal and nonfatal injuries in the construction industry. In response to the staggering number of fall-related injuries and fatalities, the National Occupational Research Agenda (NORA) Construction Sector Council, CPWR – The Center for Construction Research and Training, the National Institute for Occupational Safety and Health (NIOSH), and the Occupational Safety and Health Administration (OSHA), launched the National Fall Prevention Campaign on Workers’ Memorial Day in April of 2012. The campaign is now entering its sixth year. To support the national campaign and increase public awareness of the risk of falls in construction, this Quarterly Data Report provides updated data on fatal and nonfatal fall injuries among construction workers, focusing on the recent economic recovery and high-risk worker groups. In addition to data obtained from the U.S. Bureau of Labor Statistics (BLS), this report contains data illustrated in the Construction Fatality Map (CFM) maintained by CPWR — an accompanying product from the national campaign. While the BLS data show the overall trends of fall injuries at the national level, the numbers from the CFM present geographic variations. New findings from the National Safety Stand-Down, the major annual event associated with the fall prevention campaign, are also included, which confirm that the campaign is reaching all construction subsectors, including small residential construction companies nationwide.

KEY FINDINGS

- Between 2011 and 2015, the annual number of fall fatalities in construction increased by 36%, exceeding the growth in employment and total fatalities in this industry.
- More than half (55%) of fall fatalities in construction occurred at a height of 20 feet or less.
- Falls from roofs comprised one-third of fall deaths, followed by falls from ladders (24%).
- Fall fatalities in residential construction increased from 26 deaths in 2011 to 61 deaths in 2015, more than double.
- Roofers had the highest rate of fall fatalities in construction; however, the number and rate of fatal falls in this occupation decreased in 2015.
- Hispanic workers, foreign-born workers, and workers aged 55 or older had an elevated risk of fatal falls.
- From 2014 to 2016, the National Safety Stand-Down events reached more than 5 million workers across the nation.



Construction Fatalities

About the Campaign



Join the 4th Annual National Safety Stand-Down

May 8 – 12, 2017

The Stand-Down provides an opportunity for employers to talk directly to employees about the risk of falls, protective methods, and the company's safety policies, goals and expectations. Companies can participate by stopping work and providing a focused toolbox talk on fall prevention, conducting equipment inspections, demonstrating fall protection and procedures, or any number of other activities that educate workers on fall hazards and solutions. Visit [About the Stand-Down](#) to learn more about the history of this event and how to participate.

Training and Other Resources



Click on the following to find materials that can help contractors, workers, and safety professionals prevent falls from scaffolds, ladders, and roofs:

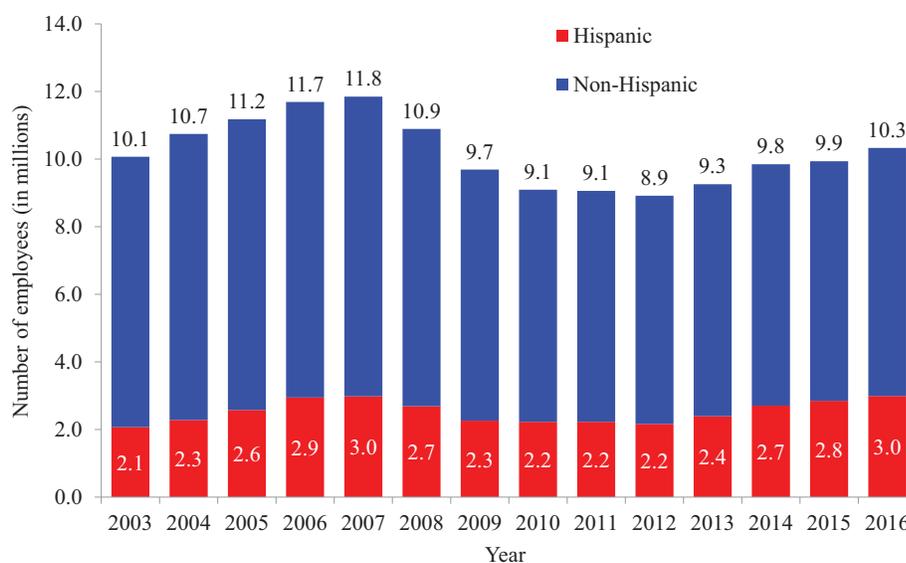
- Ladders
- Scaffolds
- Roofs

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SECTION 1: TRENDS OF FATAL FALLS IN CONSTRUCTION

The U.S. construction industry is showing strong signs of recovery after being hit hard by the latest economic recession. In 2016, 10.3 million U.S. workers were employed in construction, a 16% increase after construction employment bottomed out in 2012 (chart 1). Although overall construction employment is still lower than the pre-recession level, the number of Hispanic construction workers reached 3 million in 2016, slightly surpassing its peak level in 2007 (2.98 million). Hispanic employment experienced more volatility than the overall construction workforce. Hispanic employment increased 43.9% between 2003 and 2007, plunged 37.9% during the recession, and then gained 38.5% during the recovery. In 2016, nearly 30% of construction workers identified themselves as Hispanic—a historic high.

1. Construction employment in the United States, 2003-2016 (All employment)

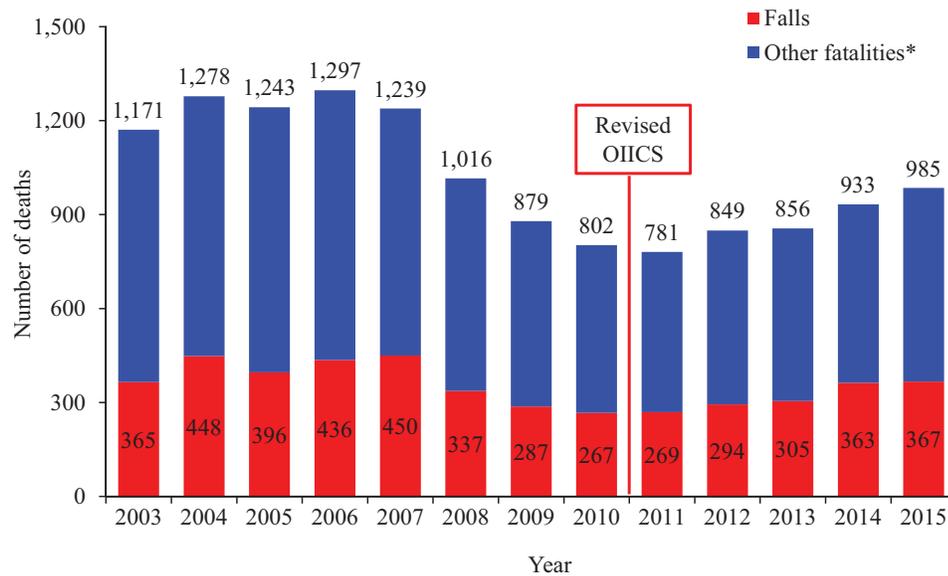


Section 1: Trends of Fatal Falls in Construction

First Quarter 2017

Coinciding with the employment trend, the number of fatalities among construction workers climbed to 985 in 2015 after dipping to 781 in 2011, a 26% increase over four years, outpacing the employment growth during the same period (chart 2). Falls remain the leading cause of work-related fatalities in construction, accounting for around one-third of the total number of fatalities in this industry.¹ Although fatal falls followed the overall injury trends, fall deaths rose faster than overall deaths in construction during the economic recovery. Between 2011 and 2015, the number of fall fatalities in construction increased by 36.4% from 269 to 367, compared to a 26.1% increase in overall fatalities.

2. Number of fatalities in construction, falls and other fatalities*, 2003-2015



¹In 2011, the definition of falls was revised in the Census of Fatal Occupational Injuries (CFOI) to include slips and trips, therefore the number of fall fatalities are not directly comparable before and after 2010.

Note: * Other fatalities are fatalities from all causes except falls.

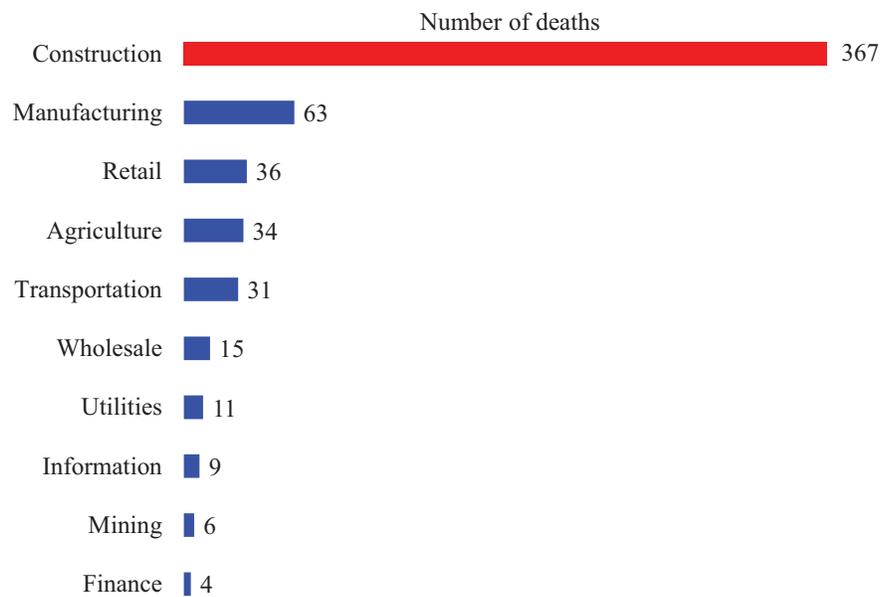
Source: U.S. Bureau of Labor Statistics, 2003-2015 Census of Fatal Occupational Injuries. Numbers were from the online CFOI database.

Section 1: Trends of Fatal Falls in Construction

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Fall deaths in construction are more prevalent than in other major industries (chart 3). In 2015, 367 construction workers died from falls, accounting for 45.9% of the total (800) occupational fall fatalities in all industries. There were nearly six times (367 versus 63) as many fall fatalities in construction than manufacturing, the industry with the second highest number of deaths from falls.

3. Number of fatal fall injuries by major industry, 2015 (All employment)



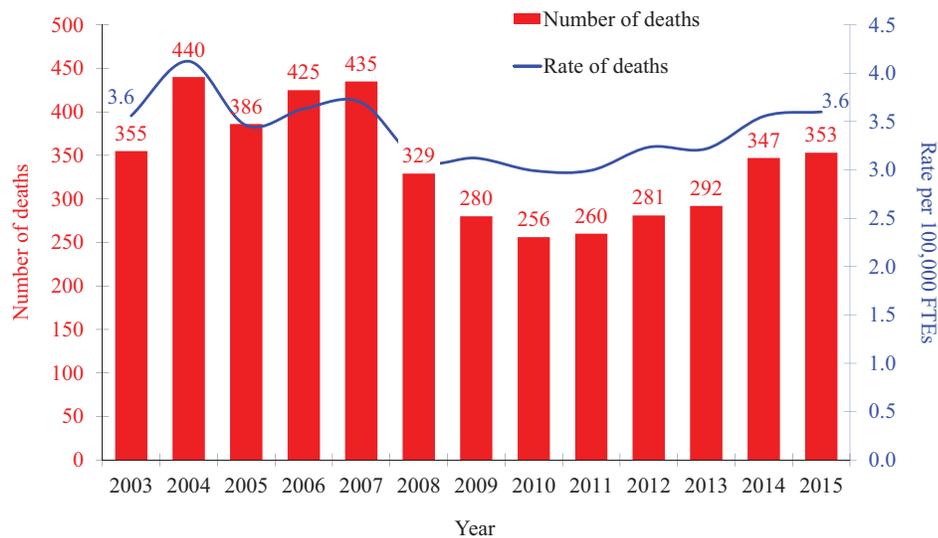
Source: U.S. Bureau of Labor Statistics, 2015 Census of Fatal Occupational Injuries. Numbers were from the online CFOI database.

Section 1: Trends of Fatal Falls in Construction

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Between 2003 and 2015, 4,439 construction workers died from falling to a lower level, accounting for 97% of fall fatalities in construction (chart 4). Both the number and rate of fatal falls to a lower level dropped during the recession. In 2010, the rate of falls to a lower level dipped to 3 deaths per 100,000 FTEs (full-time equivalents), a historic low. By 2015, both the rate and number of fall deaths had increased, with 353 fall deaths at a rate of 3.6 fall fatalities per 100,000 FTEs. This increase may be partially explained by construction rebounding with the recent economic recovery.

4. Number and rate of fatal falls to a lower level in construction, 2003-2015 (All employment)



Note: In 2011, the CFOI switched to OIICS version 2.01 which categorizes slips, trips, and falls together. In previous years, slips and trips were categorized elsewhere.

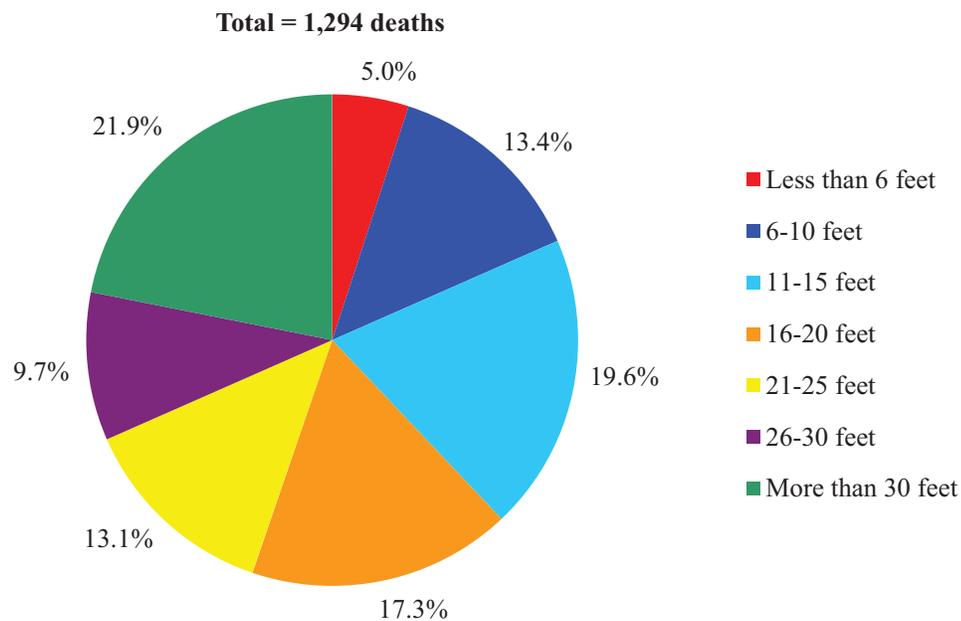
Source: U.S. Bureau of Labor Statistics, 2003-2015 Census of Fatal Occupational Injuries. Numbers were from the online CFOI database. Employment data were from the Current Population Survey. Calculations by the authors.

Section 1: Trends of Fatal Falls in Construction

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The Census of Fatal Occupational Injuries (CFOI) began collecting information on the height of falls in 2011. Between 2011 and 2015, nearly a quarter (21.9%) of fatal falls to a lower level occurred from a height of more than 30 feet (chart 5). However, more than half of the fatal falls (55.3%) were from 20 feet or less, including over a third (38.0%) of fatal falls from 15 feet or less.

5. Fatal falls to a lower level in construction, by height of fall, sum of 2011-2015



Note: 239 deaths without height information were excluded.

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

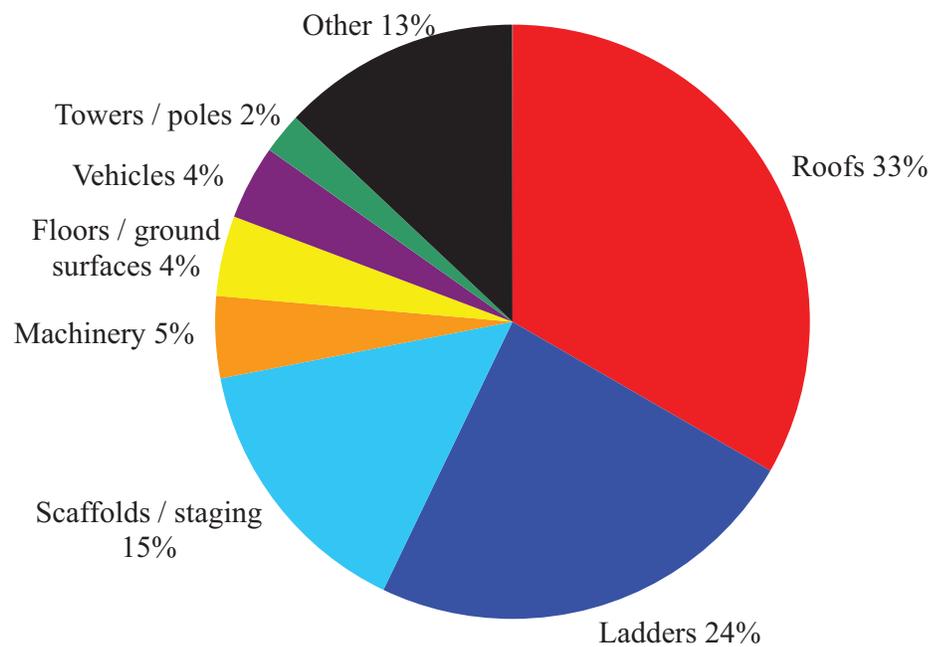
Section 1: Trends of Fatal Falls in Construction

First Quarter 2017

When stratified by the primary source of fall fatalities, falls from roofs ranked first among all major sources, comprising one-third (33%) of all fall deaths in construction from 2011 to 2015, followed by falls from ladders (24%; chart 6). Overall, falls from roofs, ladders, and *scaffolds and staging*² amounted to nearly three quarters of all fall fatalities (72%).

6. Fatal falls to a lower level in construction by primary source, sum of 2011-2015

Total = 1,533 deaths



²This category includes all types of scaffolds and staging used inside or outside buildings, stadiums, or amphitheaters.

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

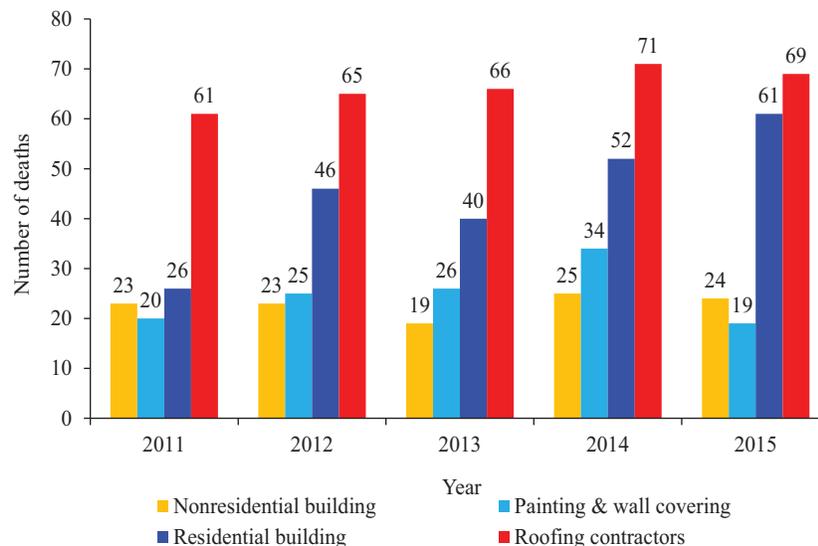
SECTION 2: FATAL FALLS AMONG CONSTRUCTION SUBGROUPS

The risk of fatal falls varied significantly among construction subgroups. By industry, 332 fall fatalities occurred in roofing contractors (NAICS 23816) from 2011 to 2015, marking this subsector with the highest number of fatal falls in the construction industry (chart 7). Residential building construction (NAICS 23611) experienced the next highest number of fatal falls at 225 during the five years. Although roofing contractors had the highest number of fall fatalities among all construction subsectors, the number remained relatively flat with an average of 66 fall deaths per year (chart 8). By contrast, the number of fatal falls in residential building construction reached 61 in 2015, nearly 2.5 times as high as the number of 26 in 2011.

7. Number of fatal falls to a lower level, selected construction subsectors, sum of 2011-2015



8. Number of fatal falls to a lower level, selected construction subsectors, 2011-2015 (All employment)



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

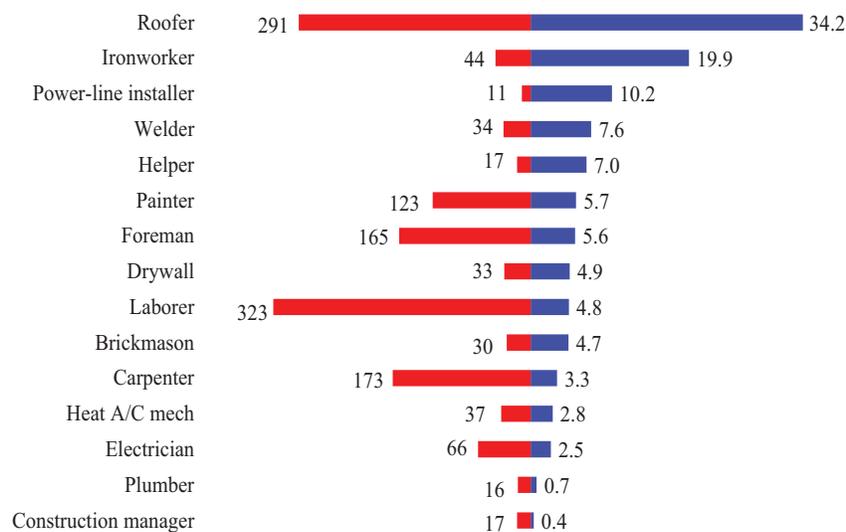
Section 2: Fatal Falls Among Construction Subgroup

First Quarter 2017

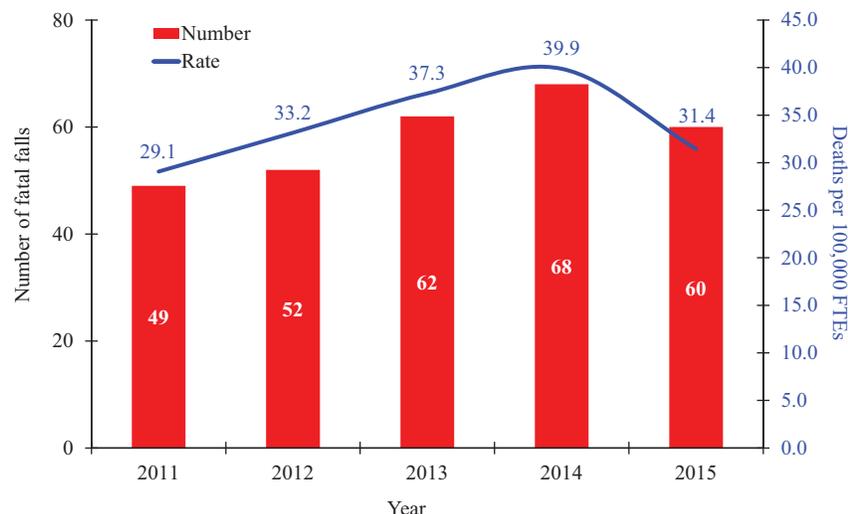
By occupation, a total of 323 laborers died from fall injuries from 2011 to 2015, the largest number among all construction trades (chart 9). However, roofers had the highest risk of fatal falls, with 34.2 deaths per 100,000 full-time equivalents (FTEs), more than 10 times the rate of all construction occupations combined (3.3 deaths per 100,000 FTEs, see chart 13). Other occupations at risk included ironworkers and power-line installers.

Similar to the trend found in roofing contractors (as an industry subsector based on NAICS), both the number and rate of fatal falls among roofers (based on occupational classifications) show signs of reduction in 2015. The number of fatal falls to a lower level among roofers decreased from 68 in 2014 to 60 in 2015, while the rate dropped from 39.9 to 31.4 deaths per 100,000 FTEs during the same time period, a 21% decrease within one year (chart 10).

9. Number and rate of work-related fatalities from falls to a lower level in construction, selected occupations, sum of 2011-2015



10. Number and rate of fatal falls to a lower level among roofers, 2011-2015



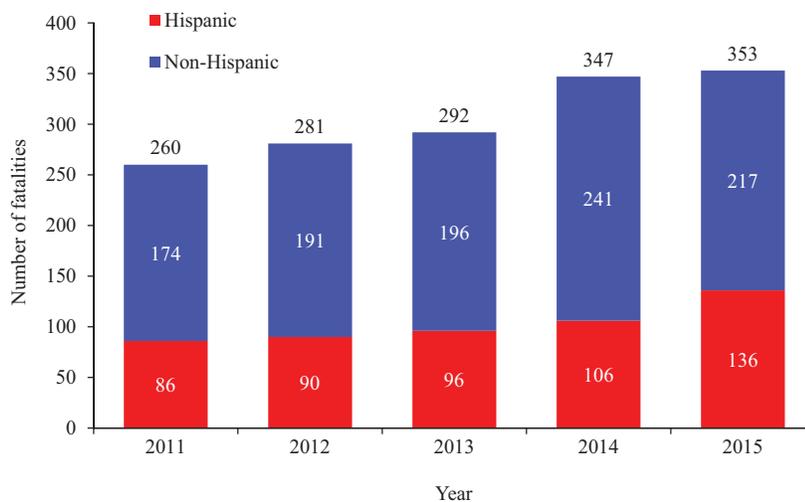
Source: Numbers were obtained from the BLS through special requests. Numbers of FTEs were estimated using the Current Population Survey. Calculations by the authors. The views expressed here do not necessarily reflect the views of the BLS.

Section 2: Fatal Falls Among Construction Subgroup

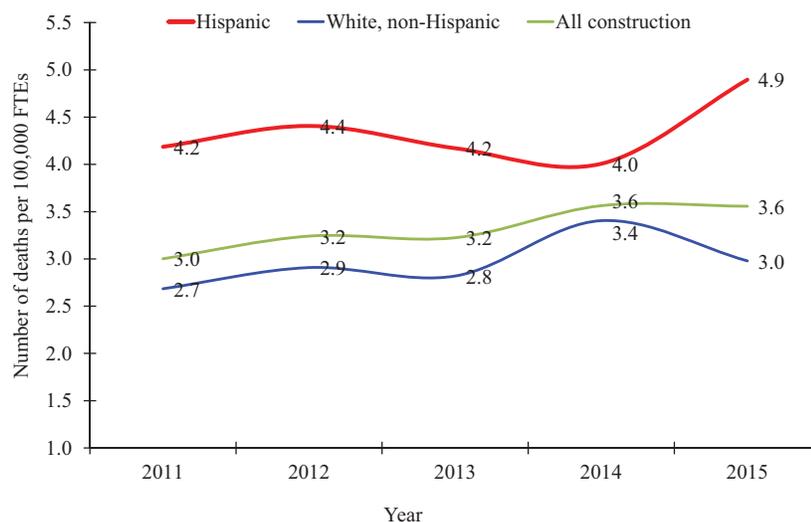
First Quarter 2017

Fatal falls to a lower level increased among all construction workers from 2011 to 2015. However, fall fatalities increased at a faster pace among Hispanic workers compared to non-Hispanic workers (chart 11). The number of fall deaths among Hispanic construction workers jumped from 106 in 2014 to 136 in 2015, a 28.3% increase. In contrast, the number of fall deaths among non-Hispanic construction workers dropped to 217 in 2015, a 10% decrease from 241 in 2014. Hispanic construction workers also had consistently higher rates of fatal falls than their white, non-Hispanic counterparts. Specifically, the rate of fatal falls among Hispanic workers increased from 4.0 to 4.9 deaths per 100,000 FTEs between 2014 and 2015, a more than 20% increase within one year (chart 12). However, the rate among white, non-Hispanic workers dropped from 3.4 to 3.0 deaths per 100,000 FTEs during the same time period.

11. Number of fatal falls to a lower level in construction, Hispanic versus non-Hispanic, 2011-2015



12. Rate of fatal falls to a lower level, Hispanic versus white, non-Hispanic, 2011-2015



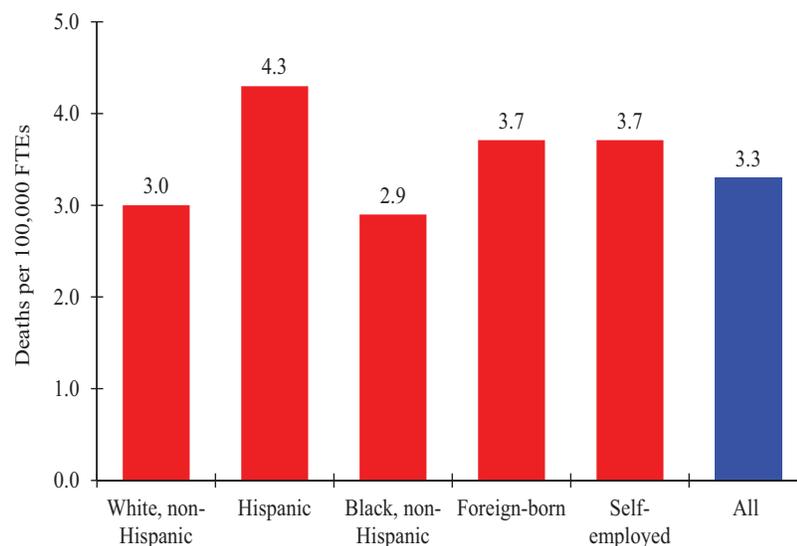
Source: Numbers of fatal and nonfatal injuries were obtained from the BLS through special requests. Numbers of FTEs for rate estimates were using the Current Population Survey. Calculations by the authors. The reviews expressed here do not necessarily reflect the views of the BLS.

Section 2: Fatal Falls Among Construction Subgroup

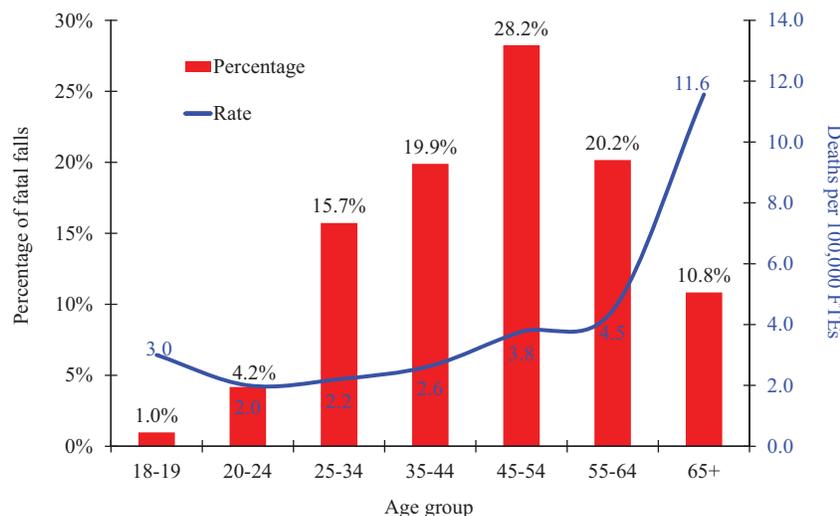
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In addition to Hispanic workers, foreign-born workers and workers who were self-employed in construction had an elevated risk of fatal falls compared to average rates of construction workers; each had a rate of 3.7 deaths per 100,000 FTEs (chart 13).³ By age, 28.2% of construction workers who died from falls to a lower level were between the ages of 45 and 54 years, the largest proportion among all age groups (chart 14). Conversely, while only 10.8% of fall fatalities were among workers 65 years or older, the rate of fatal falls for this age group was higher than for any other age group, with 11.6 deaths per 100,000 FTEs.

13. Rate of fatal falls to a lower level in construction, selected characteristics, average of 2011-2015



14. Percentage and rate of fatal falls to a lower level in construction, by age group, average of 2011-2015



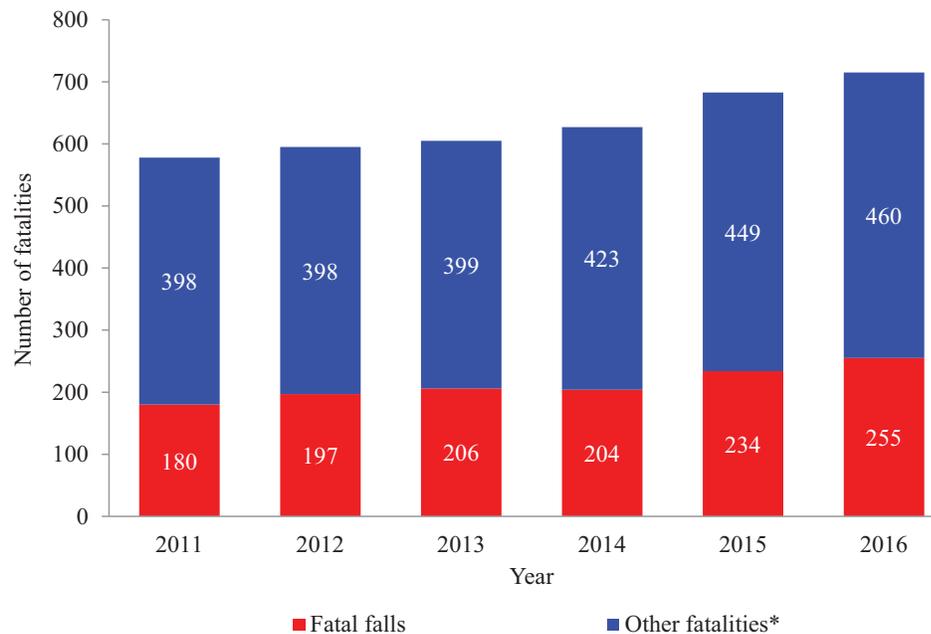
³From 2011 to 2015, the average annual number of fatal falls to lower level among white, non-Hispanics, Hispanics, black, non-Hispanics, foreign-born workers, and self-employed workers were 181, 103, 13, 106, and 81, respectively.

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 3: FATAL FALLS ILLUSTRATED IN CPWR CONSTRUCTION FATALITY MAPS

CPWR gathered public information from OSHA investigations and news reports for 1,276 work-related fatal falls that occurred in construction from 2011 to 2016. This information was disseminated via online interactive maps and downloadable datasets (<http://stopconstructionfalls.com/>) to increase public awareness of these deaths, and to increase access to construction fatality data for prevention purposes. These maps captured approximately three-quarters of all fatalities and two-thirds of fatal falls in the construction industry. The number of construction fatalities and fatal falls illustrated in the maps has increased since the beginning of the project (chart 15).

15. Number of work-related fatal injuries in construction featured in the CPWR fatality maps, 2011-2016



Source: CPWR Construction Fatality Map; Public fatality data from news reports and OSHA investigations. Calculations by the authors.

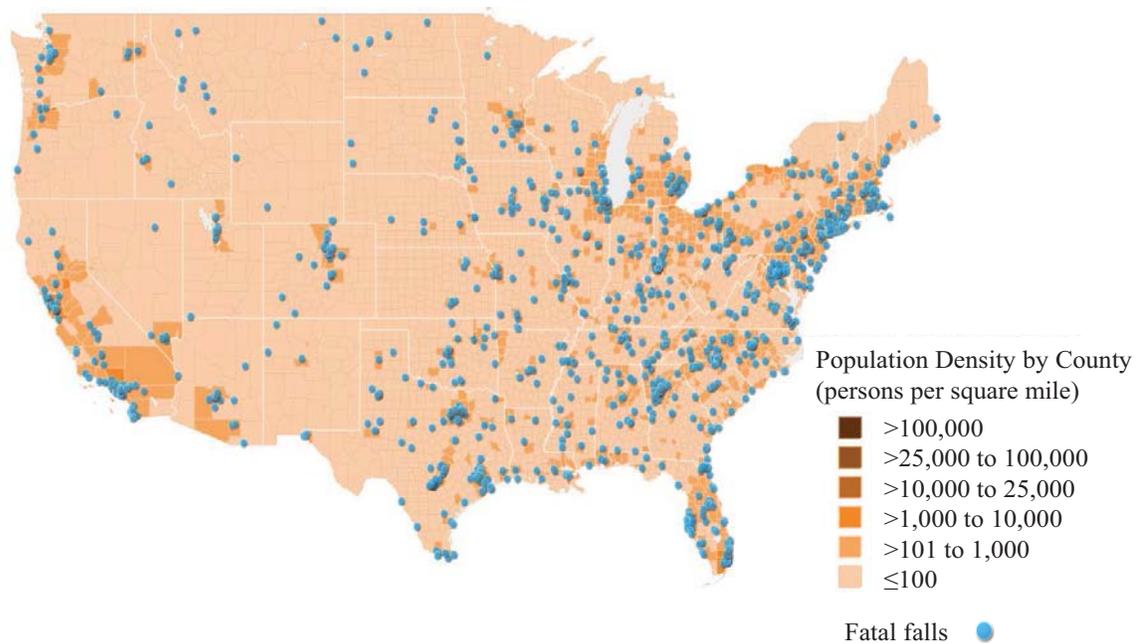
*Fatalities from all causes, except falls

Section 3: Fatal Falls Illustrated in CPWR Construction Fatality Maps

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Geographically, fatal falls occurred across the entire United States with clustering in and around densely populated cities, such as New York, Los Angeles, Houston, and Chicago (chart 16). Two explanations are likely to account for the observed clustering. Since some data for the fatality maps are obtained from news reports, it is possible that fatal falls in urban areas are more likely to attract media attention. Moreover, there is more construction activity in urban areas than rural areas, putting a greater number of workers in large cities at risk.

16. Fatal falls in construction shown on the CPWR construction fatality map, sum of 2011-2016, by county-level population density



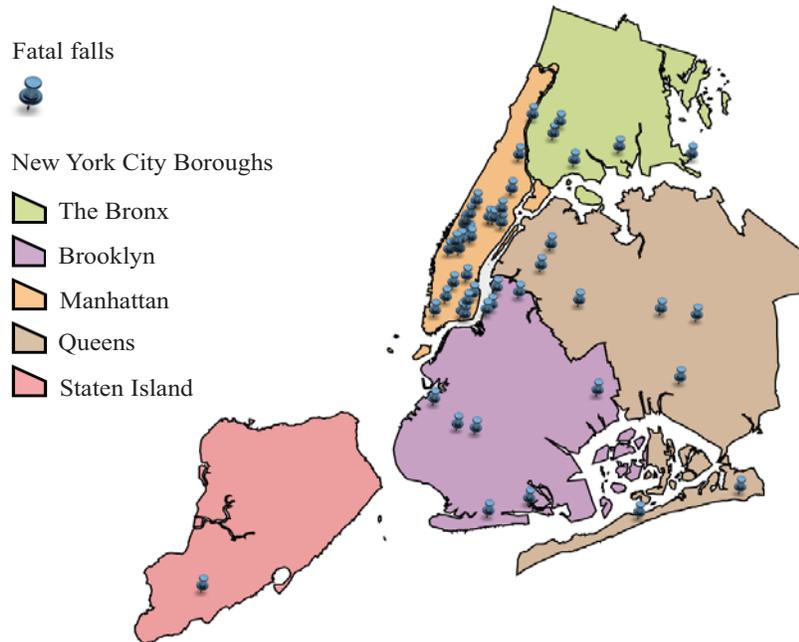
Sources: 1. CPWR Construction Fatality Map; Public fatality data from news reports and OSHA investigations.
2. Population density using Census 2010 geographies from ©2013 Esri.

Section 3: Fatal Falls Illustrated in CPWR Construction Fatality Maps

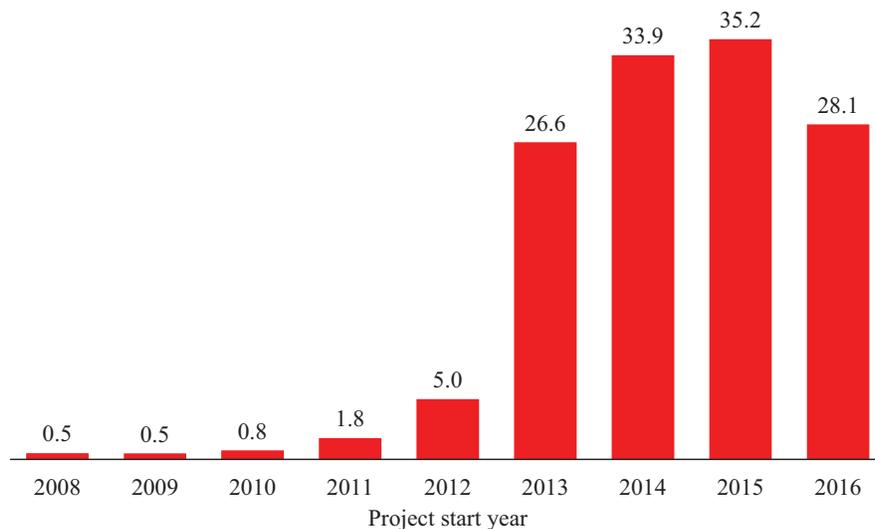
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In New York City, the number of fatal falls over the past six years (chart 17a) corresponds to the recent surge in residential construction activity in this city, particularly in the borough of Manhattan (chart 17b).

17a. Fatal falls in New York City shown on the CPWR construction fatality map, sum of 2011-2016 (52 deaths)



17b. New York City Department of Buildings residential work permits issued in Manhattan, 2008-2016 (Number in thousands)



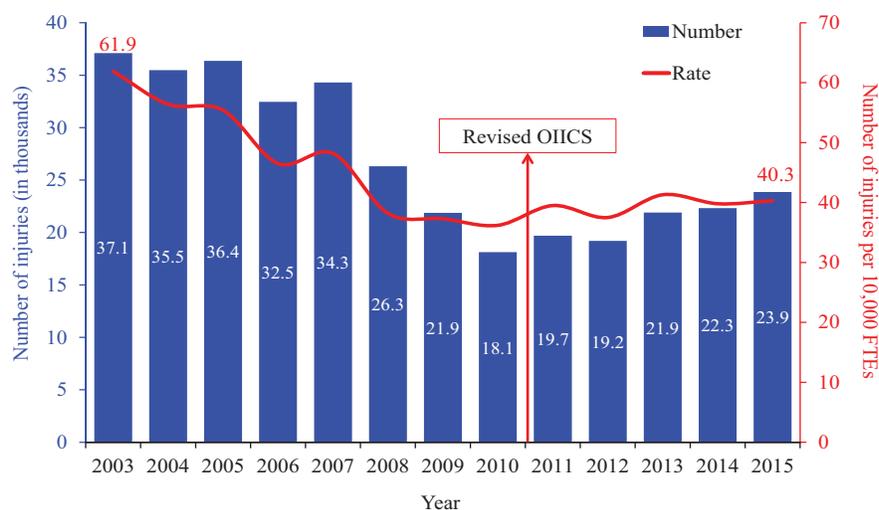
Source: Chart 17a - 1. CPWR Construction Fatality Map; Public fatality data from news reports and OSHA investigations. 2. Population density using Census 2010 geographies from ©2013 Esri.

Chart 17b - NYC OpenData DOB Permit Issuance Dataset. Retrieved from <https://data.cityofnewyork.us/Housing-Development/DOB-Permit-Issuance/ipu4-2q9a>. Updated March 17, 2017. Accessed March 17, 2017. Calculations by the authors.

SECTION 4: NONFATAL FALL INJURIES IN CONSTRUCTION

The trend of nonfatal fall injuries resulting in days away from work (DAFW) among construction workers mirrored employment and fall fatality trends in this industry. The number of fall injuries with DAFW increased by 21% from 2011 to 2015, after the lowest level of 18,100 in 2010 (chart 18). The rate of nonfatal falls also rose from 36.2 injuries to 40.3 injuries per 10,000 FTEs during this time period. In 2015, 23,860 nonfatal fall injuries occurred in construction, second only to retail among the major industries (chart 19).

18. Number and rate of fall injuries resulting in days away from work in construction, 2003-2015



19. Number of nonfatal fall injuries by major industry, 2015



Note: Chart 18 - In 2011, the SOII switched to OIICS version 2.01 which categorizes slips, trips, and falls together. In previous years, slips and trips were categorized elsewhere. Data cover private wage-and-salary workers.

Source: Chart 18 - 2003-2015 Survey of Occupational Injuries and Illnesses.

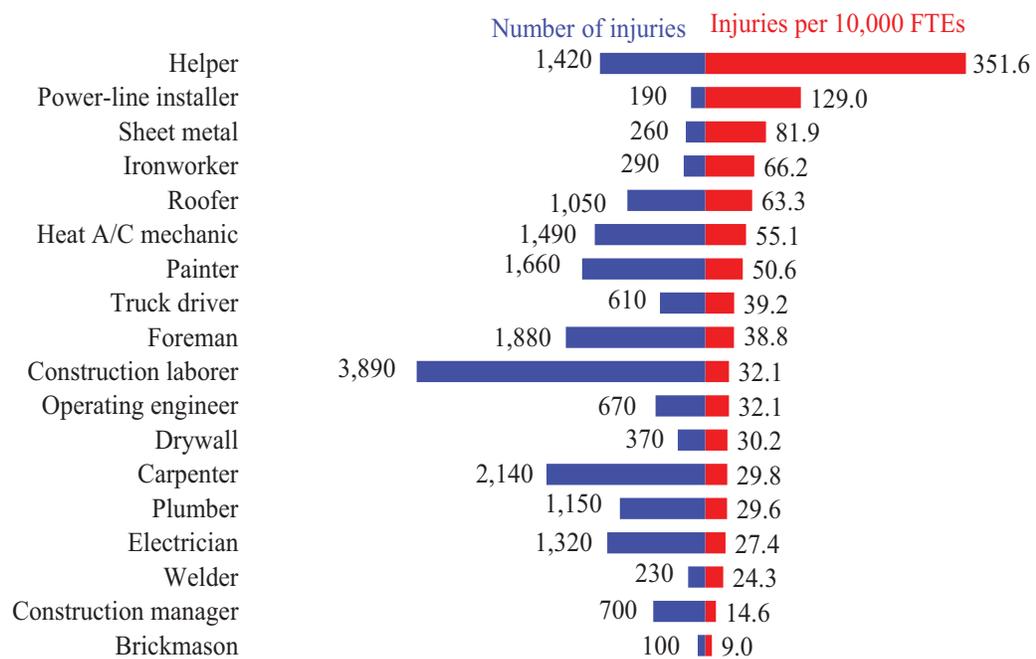
Chart 19 - U.S. Bureau of Labor Statistics, 2015 Survey of Occupational Injuries and Illnesses.

Section 4: Nonfatal Fall Injuries in Construction

First Quarter 2017

In 2015, construction laborers and carpenters, the two largest trades in construction, experienced higher numbers of nonfatal injuries from slips, trips, and falls resulting in DAFW than any other construction occupation (chart 20). However, helpers and power-line installers had exceedingly higher rates of nonfatal falls (351.6 and 129.0 per 10,000 FTEs, respectively) than other construction occupations.

20. Number and rate of nonfatal injuries from falls resulting in days away from work, selected construction occupations, 2015 (Private wage-and-salary workers)



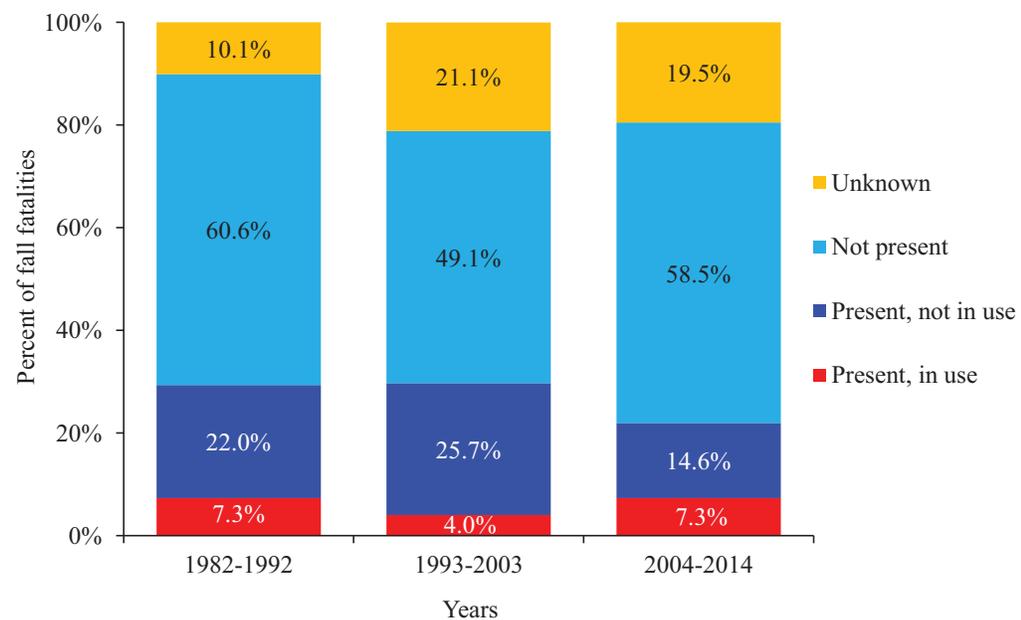
Note: Falls include injuries from slips and trips.

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

SECTION 5: FALL PREVENTION IN CONSTRUCTION

Effective fall protection is crucial in the reduction of fall injuries and death rates. OSHA requires employers to provide and install fall protection systems for an employee before that employee begins any work that necessitates the use of fall protection (OSHA, 1995). OSHA also provides criteria for Personal Fall Arrest Systems (PFAS) and their use (OSHA, 1998). However, a study based on the NIOSH Fatality Assessment and Control Evaluation (FACE) program indicates that a large number of workers killed by falls in construction did not have access to PFAS when the incident occurred (Dong et al., 2017). Among the fatal falls in construction investigated by FACE programs between 2004 and 2014, 58.5% of the decedents had no PFAS present; 14.6% had PFAS, but did not use; and another 7.3% used PFAS, but the PFAS failed (chart 21).

21. NIOSH FACE reports, fatal falls in construction, by Personal Fall Arrest System (PFAS) status, 1982-2014



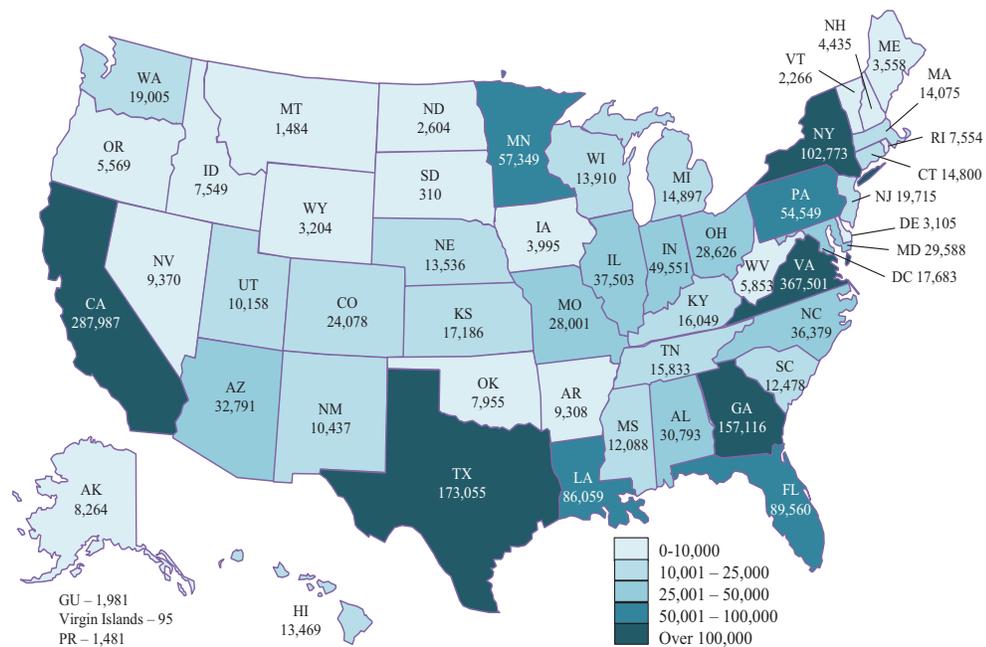
Source: Dong XS, Largay JA, Choi SD, Wang X, Cain CT, Romano N. 2017. Fatal falls and PFAS use in the construction industry: Findings from the NIOSH FACE reports. *Accident Analysis & Prevention*, 102:136-143.

Section 5: Fall Prevention in Construction

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As part of the National Fall Prevention campaign, the annual Safety Stand-Down brings together employers, workers, and safety associations across the country to pause work on the jobsite and focus on preventing falls through talks, demonstrations, trainings, and other activities that focus on safety (Bunting et al., 2017). From 2014 to 2016, the National Safety Stand-Down events reached over 100,000 workers in each state of California, Texas, Georgia, Virginia, and New York (chart 22). Overall, companies receiving a certificate⁴ reported having over 2.2 million Stand-Down participants. Including participants without certificates, it is estimated that the Safety Stand-Down events reached more than 5 million workers.

22. Number of workers reached through the National Safety Stand-Downs, by state, sum of 2014-2016



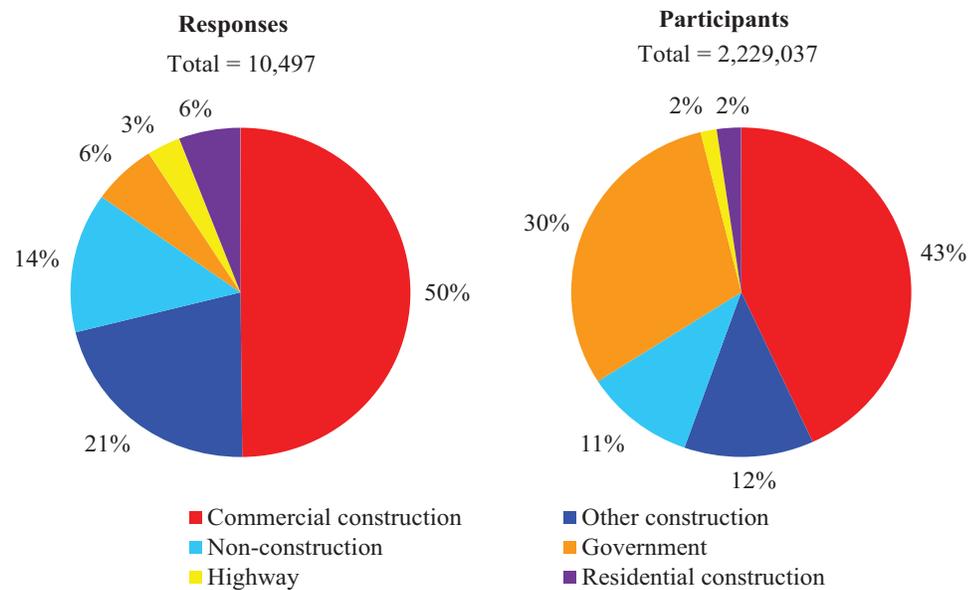
⁴ Some of the companies who participated in the event reported to OSHA on the number of workers reached in order to receive a certificate of participation.
 Source: OSHA Safety Stand-Down Certificate of Participation Database. Calculations by the authors.

Section 5: Fall Prevention in Construction

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Although a large number of Safety Stand-Down *responses*⁵ (5,230) and *participants*⁶ (960,535) were in commercial construction, workers from small residential construction companies also participated in the Stand-Down events. Moreover, the campaign reached workers beyond the construction industry. Between 2014 and 2016, 14% of responses and 11% of participants in the Stand-Down events were from non-construction industries (chart 23).

23. National Safety Stand-Down responses and participants, by type of construction, sum of 2014-2016



⁵Responses are unique entries in OSHA's certificate of participation database, which can be from a company or an individual.

⁶If a response comes from an individual, it is counted as one participant. If the response comes from a company with multiple participants, the number of participants is counted.

Source: OSHA Safety Stand-Down Certificate of Participation Database. Calculations by the authors.

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Conclusion

Fall injuries and fatalities increased as construction rebounded with the economic recovery. In 2015, 367 construction workers died from falls, a 36% increase from 2011, surpassing the growth in employment and overall fatalities in this industry. The clusters of fall fatalities shown on the CPWR Fatality Maps were consistent with the BLS data, illustrating the positive correlation of fall injuries with population density and construction activity.

The increase in fall fatalities was more pronounced in residential building construction and among Hispanic workers than for the overall construction industry. This report also confirmed that fall risk exists at low heights, demonstrated by the fact that more than half of all fall fatalities (55%) between 2011 and 2015 occurred from a height of 20 feet or less. Moreover, roofers, older workers, Hispanic workers, foreign-born workers, and self-employed workers had a higher risk of fatal falls than the average among all construction workers. Nevertheless, fatal falls among roofers showed signs of decrease in recent years. Fall protection efforts may have contributed to this reduction.

The findings in this report emphasize the need to reduce falls and the importance of the ongoing National Fall Prevention campaign. It is estimated that the Safety Stand-Down events have reached more than 5 million workers (including those without certificates) across the nation in a three-year period, vitally raising public awareness of the risk of falls and importance of fall prevention in the construction industry. The campaign encourages construction contractors to PLAN ahead to get the job done safely, PROVIDE the right equipment to workers, and TRAIN workers to use the equipment safely.

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- OSHA. 1995. Subpart M - Fall Protection: Duty to have fall protection. https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10757&p_table=STANDARDS (Accessed March 2017).
- OSHA. 1998. Subpart I - Personal Protective Equipment: Personal fall arrest systems (PFAS). https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10275 (Accessed March 2017).

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Data Sources:

Health insurance coverage

- 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, 2003-2016 Current Population Survey.
- CPWR Construction Fatality Map, 2011-2016.
- OSHA Safety Stand-Down Certificate of Participation Database, 2014-2016.

About the CPWR Data Center

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 North America’s Building Trades Unions, 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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