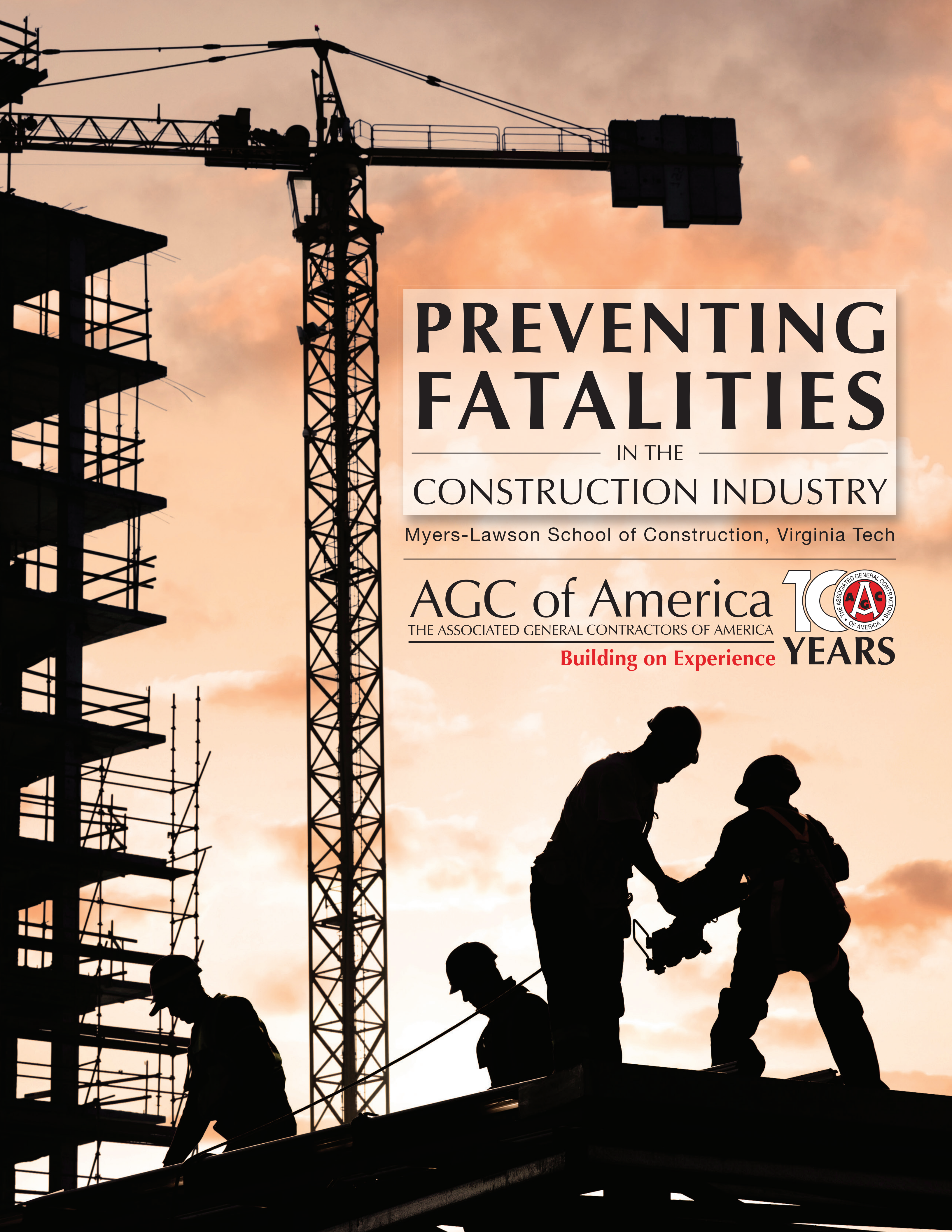

PREVENTING FATALITIES

IN THE CONSTRUCTION INDUSTRY

Myers-Lawson School of Construction, Virginia Tech

AGC of America
THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA
Building on Experience
100 YEARS

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Executive Summary

The Associated General Contractors (AGC) of America commissioned this study with the goal of taking a deeper dive into existing information on fatalities with an eye towards learning new methods of preventing worker fatalities in the construction industry. The study, conducted by the Myers-Lawson School of Construction at Virginia Tech, involved analyzing detailed, confidential fatality reports from 2010-2012 because the industry wants to develop employer-employee strategies to reduce the risk of workers being injured.

The data used in this study are from the U.S. Bureau of Labor Statistics (BLS). The BLS's Injuries, Illnesses, and Fatalities (IIF) program provides annual information on the rate and number of work-related injuries, illnesses, and fatal injuries, and how these statistics vary by incident, industry, geography, occupation, and other variables. These data are collected through the Survey of Occupational Injuries and Illnesses (SOII) and the Census of Fatal Occupational Injuries (CFOI).

This study is unique and innovative in many aspects. First, the data investigated is current and the findings reflect the most recent trends in injuries in the construction industry. Second, unlike previous studies of BLS data that only considered factors at a high level of categorized data, this study drilled down deeper to capture specifics and the analysis resulted in more detailed and actionable information. Third, advanced analytic techniques were adopted. Compared to traditional statistical analysis, the methods used in this study can handle a greater number of cases with increased accuracy. Fourth, unlike previous studies, the analysis included an emphasis on work zone-related accidents. Regional differences were also investigated for every factor with an attempt to provide more targeted interventions while considering geographic variances. Finally, unlike other portrayals of BLS data, this study provides concrete and actionable recommendations for intervention.

New Findings

- Most fatalities occurred between 10 a.m. and 3 p.m., with a peak at noon. Previous studies found that occurrence of fatalities was most dominant between the hours of 9 a.m. and 1 p.m., and bottomed around noon.
- Fatalities due to Transportation and Violence and other injuries by persons or animals increased, while fatalities due to Exposure to harmful substances and Fire and explosions decreased.
- Small construction establishments with 1-9 employees accounted for 47% of fatalities and the highest fatality rate at 26 fatalities per 100,000 workers annually. Most previous studies ignored the smallest establishments.
- Most highway and road work zone fatalities involved vehicular operations.
- Hispanic workers made up 24% of the workforce and accounted for 20% of highway and road work zone fatalities in 2010-2012. This conflicts with the widespread perception that Hispanics are disproportionately victims of construction fatalities.

Findings Consistent with Existing Literature

- The Specialty Trades had significantly more fatalities than any other sector, accounting for 56% of deaths. However, the Heavy & Civil sector had the highest annual fatality rate with 24 fatalities per 100,000 workers.
- Overall, most fatalities occurred in the South region[1] (46%) with the highest annual fatality rate (17 deaths per 100,000 workers). This region is also largest in terms of the population of the employed.

[1] DC, MD, VA, DE, WV, NC, SC, KY, TN, GA, FL, AL, MS, AR, OR, LA, and TX.

- Fatalities increased during the spring and summer months, peaked in August (12%), and decreased until reaching a minimum in winter (February: 5%).[2] The ratios of fatalities to employment followed a similar pattern.
- Almost 75% of all deaths occurred Monday through Thursday, with similar totals on each of those days. Fatalities decreased on Friday and during the weekend, reaching a minimum on Sunday (4.7%).
- Industrial project locations experienced the highest number of fatalities at 35%. Residential and Heavy project locations accounted for 25% and 29%, respectively. The remainder of fatalities occurred at Commercial (5%) and other (6%) locations.
- Constructing activities accounted for 49% of fatalities, followed by vehicular and transportation operations (27%).
- Falls remain the leading cause (33%) of deaths in construction, accounting for one-third of all fatalities. Transportation incidents accounted for 29% of fatalities. Falls were commonly from buildings, other structural elements, and ladders. Transportation fatalities typically involved trucks (36%) and multi-purpose highway vehicles (31%), for example, pickups.
- Wage and Salary[3] workers accounted for 79% of fatalities. The remainder were mainly self-employed (19%), with small numbers of family workers, volunteers or unknown employment status.
- Workers 35-54 years of age accounted for 50% of fatalities. Ratios suggest a steady increase in the fatality rate from age 35, with the peak among workers age 65 or more (19 deaths per 100,000 workers per year).
- Hispanic workers accounted for 25% of all fatalities, which is equivalent to the Hispanic employment proportion (24%) in the construction industry. As noted under "New Findings," Hispanics accounted for only 20% of highway and road work zone fatalities; at other work sites, Hispanics accounted for 27% of fatalities.
- Consistent with the overall findings, most highway and road work zone fatalities occurred in the summer (30%) and the number of fatalities peaked in August (11%).
- Most highway and road work zone victims were wage and salary workers (89%).

[2] Spring: March, April, and May; Summer: June, July, and August; Fall: September, October, and November; Winter: December, January, and February.

[3] Workers who receive wages, salaries, commissions, tips, payment in kind, or piece rates. The group includes employees in both the private and public sectors. (BLS, 2016)

Introduction

The construction industry is vital to the U.S. economy and national security. Per the most recent economic census in 2012, the U.S. construction industry had 598,065 establishments. The industry had total revenue of $1.4 trillion. In terms of employment, the construction industry employed 5,669,623 workers and provided $273 billion in annual payroll. In 2012, Hispanic employment in construction accounted for 24% of all construction workers.

The fatality data used in the report are from the U.S. Bureau of Labor Statistics (BLS) under a Virginia Tech/BLS agreement. The BLS's Injuries, Illnesses, and Fatalities (IIF) program provides annual information on the rate and number of work-related injuries, illnesses, and fatal injuries, and how these statistics vary by incident, industry, geography, occupation, and other variables. These data are collected through the Survey of Occupational Injuries and Illnesses (SOII) and the Census of Fatal Occupational Injuries (CFOI).

Fatality trending has been historically challenging because of the relatively small number of data points. By investigating three years of national data, patterns emerged. The data used in this project include all 2,338 (i.e. 17%) construction-related deaths out of an overall 14,011 fatal injuries across all industries. The data range was the three years from 2010 to 2012. Near the end of the project, 2013 data became available. A quick review suggested no major changes were realized.

The fatal injury distribution by year was as follows:
2010: 790 cases (34%)
2011: 741 cases (32%, a 6% annual decrease)
2012: 807 cases (35%, a 9% annual increase)

The employment data used for rate calculations are based on the number of workers rather than hours of work (or full-time equivalents). This method is used by the Centers for Disease Control and Prevention (CDC)/National Institute for Occupational Safety and Health (NIOSH) in fatal injury rate calculations.

Since the number of fatalities could be related to metrics such as the number of workers, ratios (e.g. fatality rates) were included in the report. This helps the reader answer the question of whether there are more fatalities in August simply because there is more construction in August. Therefore, ratios such as fatalities/employment are reported. The data on the number of construction workers employed, and the number of construction establishments were extracted from a national census dataset.

Data Mining Methods

The analytical methods included several advanced data mining techniques such as Exploratory Data Analysis (EDA) and Narrative Text Analysis (NTA). EDA applies inductive reasoning to statistical techniques and thus becomes different from conventional statistics. EDA does not rely on preconceived notions about fatal incidents, but rather, starts from specific observations and measures. The technique then detects patterns, and regularities, and finally allows the generation of general conclusions. Specific statistical techniques and tests such as frequency analysis, t-test, and chi-square tests were performed.

Narrative Text Analysis (NTA) enables the extraction and exploration of useful, hidden information from text and helps to elaborate and interpret accident and suggest prevention measures. NTA techniques include information retrieval, lexical analysis, pattern recognition, tagging/annotation, information extraction, text mining, visualization and predictive analytics. NTA allows for distilling valuable information to supplement traditional safety analysis and is a proven method for occupational safety and health research in the architecture, engineering, and construction (AEC) industry.

Note to the Reader

The construction safety and health professional and management can use these findings for comparative purposes. Given the relatively small number of fatalities for a given company, it might be instructive to compare more measurable metrics such as reportables, and near misses against the fatality results. For example, if a given day of the week, on average, had significantly more fatalities than on other days, is this consistent with near-miss data? These types of comparisons can stimulate rich discussion that focuses on "why" or "why not" a given company follows the aggregated fatality patterns.

The data are what the data are. In some cases, findings disrupted general preconceived perceptions. Be prepared to be challenged.

Finally, it is important, especially when comparing company data to the data reported in this report that readers understand that benchmarking is about understanding, based upon metrics, who the best performers are, but then acting by adapting or adopting best practices. This report does not focus on the best performance since any preventable fatality corresponds to poor performance. Once the safety and health professional and management decide where the company needs to improve, it is then appropriate to benchmark others who excel. In true benchmarking, this means potentially looking outside the construction industry, and potentially outside of the USA where the number of fatalities per 100,000 workers are lower than in the USA.

Organization of the Report

It is useful to conceptualize construction in systems terms [Figure 1]. "Workers" perform through "means and methods", using machinery, equipment, tools, and by following procedures defined by "management." Work, workers, general contractors, and sub-contractors are organized as a "project". The "context" of the project is to operate within a larger organizational (corporate), legal, political, economic, and social environment. From a safety and health standpoint, breakdowns often occur, within a given component, and especially at the interfaces between components. The report is organized by these components of a construction work system.

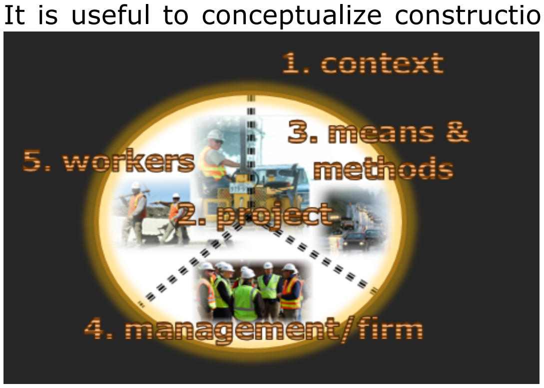


Figure 1. Construction Conceptualized in Systems Terms

Context

Region

Findings

A total of 2,338 (17%) workers died from construction-related injuries between 2010 and 2012, out of an overall 14,011 fatalities across all industries. Although no significant trend was observed across the three years [Figure 2], the difference among census regions was significant [Figures 3 and 4]. Southern states accounted for 1,081 (46%) of those fatalities, more than twice that of any other region. When employment was factored in, the South still led the regions with 17 fatalities per 100,000 employees per year [Figure 5]. It was followed closely by the Midwest with 16 fatalities per 100,000 employees. For more information on regional trends, refer to page 24.

Figure 2. Number of Fatalities, 2010-2012

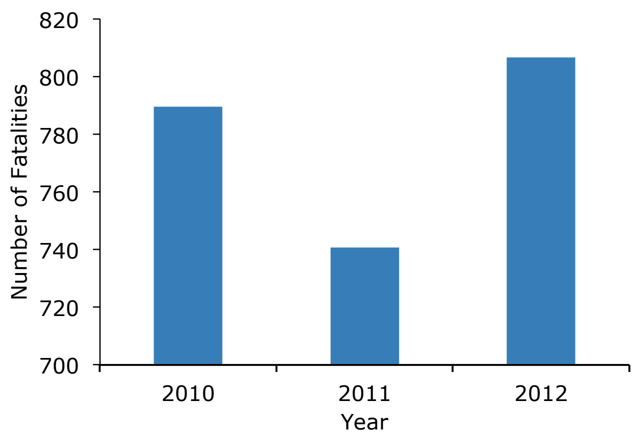


Figure 3. Census Regions (BLS, 2014)

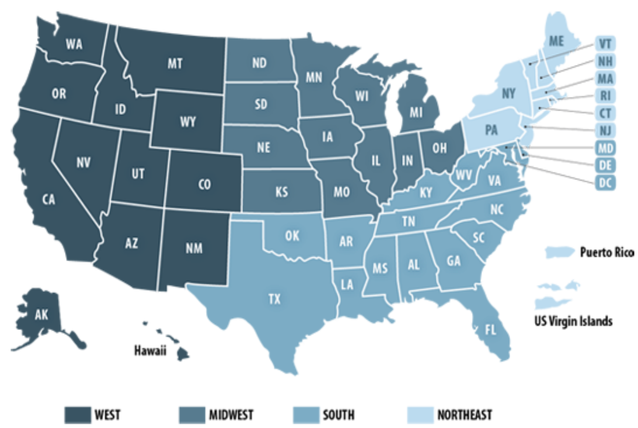


Figure 4. Number and Percentage of Fatalities, by Region, 2010-2012

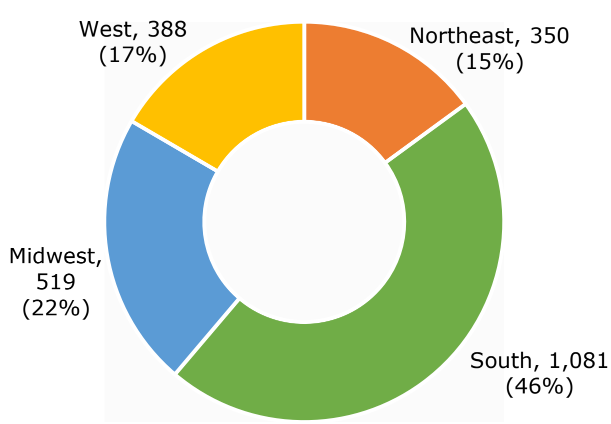
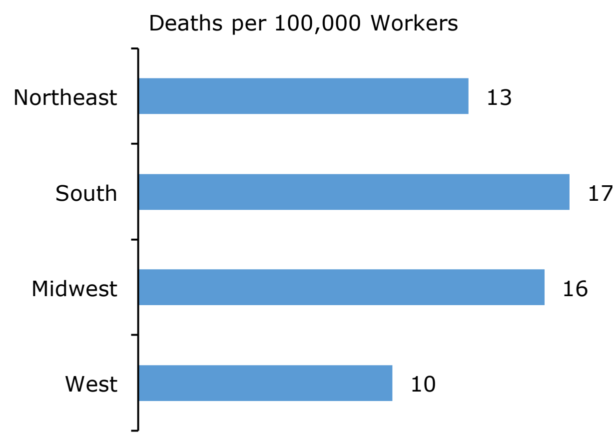


Figure 5. Annual Fatality Rates, by Region, 2010-2012



Potential Actions

1. For contractors performing work in the South, communications and training can include a discussion on why the South accounts for more than twice the number of fatalities than the other regions.

SECTOR

FINDINGS

The Specialty Trades suffered 1,302 (56%) fatalities, the highest among the construction sectors [Figure 6]. The Heavy & Civil and Building Construction sectors had less than half of that amount, with 576 (25%) and 399 (17%) fatalities, respectively. Taking employment into consideration, Heavy & Civil had the highest annual fatality rate among the sectors at 24 deaths per 100,000 workers [Figure 7].

Figure 6. Number and Percentage of Fatalities, by Sector, 2010-2012

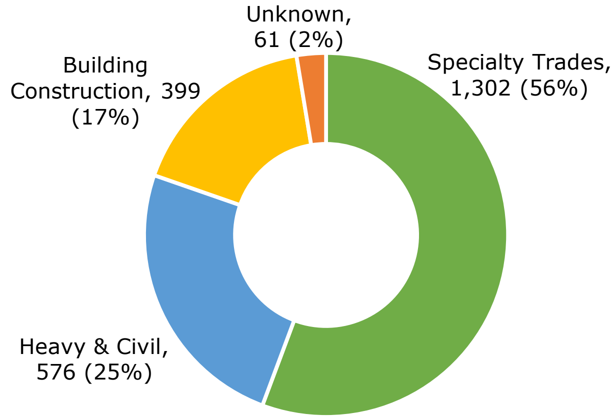
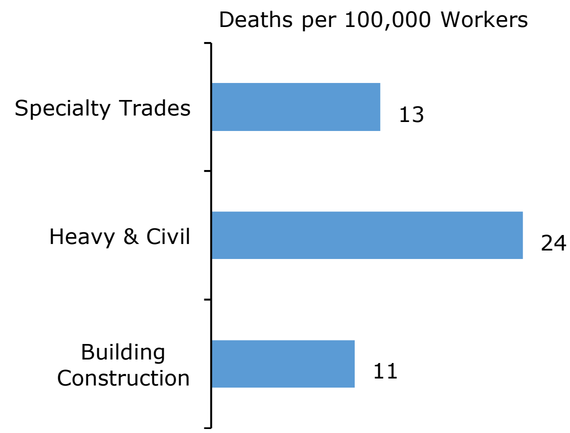


Figure 7. Annual Fatality Rates, by Sector, 2010-2012[4]



POTENTIAL ACTIONS

1. The risks associated with specialty sub-contractors should be conveyed in company communication and training.
2. Contractors should work with their specialty sub-contractors to ensure that safety policies and procedures are in place and enforced.
3. Specialty trades are typically small establishments with 1 to 9 employees. Small establishments accounted for almost 50% of fatalities between 2010 and 2012. General contractors should consider transferring their controls and corporate safety culture to specialty trade sub-contractors.

4 Number of construction workers in each industry sector, according to BLS data for 2010 to 2012: Specialty Trades – 3,457,400; Heavy & Civil – 841,500; Building Construction – 1,233,200.

Season

Findings

Fatalities increased steadily during the spring (March, April, and May) and summer (June, July, and August) months and declined in the autumn (September, October, and November) and winter months (December, January, and February) [Figure 8]. Overall, the highest number of fatalities occurred in summer (32%) and the lowest in winter (19%). In addition, fatalities peaked in August (12%) and bottomed-out in February (5%). Fatality rates from 2010-2012 followed a similar trend, suggesting that more deaths are not occurring over the summer simply because there is increased employment [Figure 9]. The findings did not indicate that new hires are more likely to be involved in incidents resulting in death, suggesting that they should not be disproportionately considered.

These findings are consistent with existing literature, which suggests that the largest proportion of injuries in construction occurs during the summer months. Huang and Hinze (2003) found that slip-and-fall injuries peaked during the summer months and decreased during the winter months. Hinze et al. (2005) observed that accident occurrence was highest during March, April, the summer, and October for struck-by accidents. Zhao et al. (2014) identified that electrical fatalities peaked in August and slumped in January.

Figure 8. Number and Percentage of Fatalities, by Month of the Year, 2010-2012

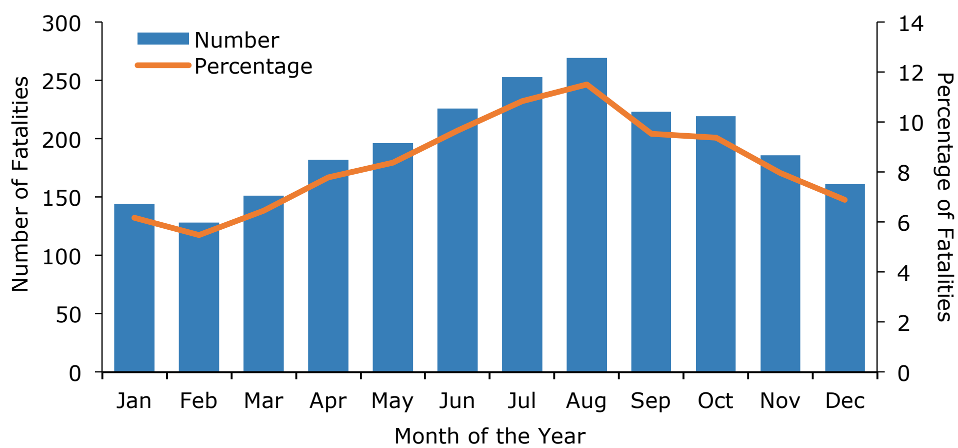
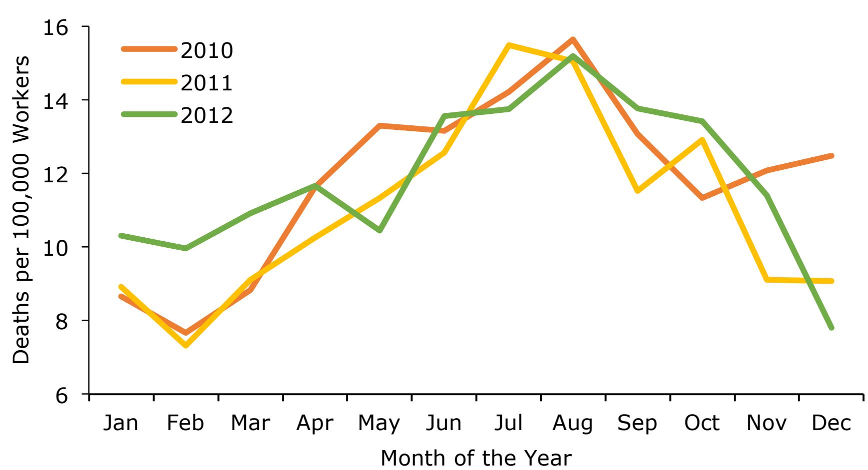


Figure 9. Fatality Rates, by Month of the Year, 2010-2012



POTENTIAL ACTIONS

Since summer is the riskiest season for construction workers:

1. Raise awareness about the summer seasonality of safety and health hazards, including adopting or adapting OSHA's "Water. Rest. Shade." guidance.
2. Share these statistics within training courses and encourage trainees to share what they believe are the causes:
    a. Health effects (e.g. fatigue, dizziness), associated with hot conditions.
    b. Health conditions most likely to occur in summer:
        i. Dehydration
        ii. Sunburn
        iii. Lightning strikes
        iv. Burns and falls from heights (i.e. rooftop utilities get hot).
        v. Etc.
3. Consider adding a seasonal component to safety and health policies and procedures. For example:
    a. Make accessible and recommend workers drink 4 cups water/hour.
    b. Wear gloves and sunglasses while working on roofs in summer.
4. Since there are more workers in summer, require a buddy system for risky tasks.
5. Contractors are encouraged to benchmark their company data against these national statistics and explore how and why their results are similar or different.

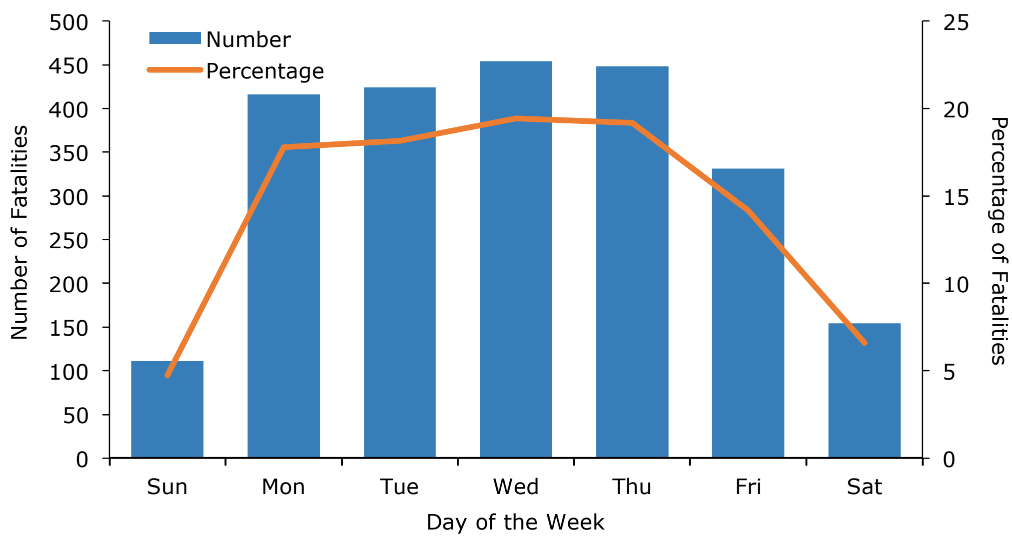
PROJECT

DAY

FINDINGS

Monday through Thursday accounted for almost 75% of total fatalities [Figure 10]. Fatalities reached a minimum over the weekend (11%), with 6% on Saturday and 5% on Sunday. These findings are consistent with existing literature, which suggests that the ratio of fatalities between weekdays and weekends is approximately 7:1. Zhao et al. (2014) found that 87% of fatalities in construction occurred during weekdays and 13% occurred during the weekend. In addition, BLS does not collect data on the daily number of construction workers, and thus this report did not track daily fatality ratios.

Figure 10. Number and Percentage of Fatalities, by Day of the Week, 2010-2012



POTENTIAL ACTIONS

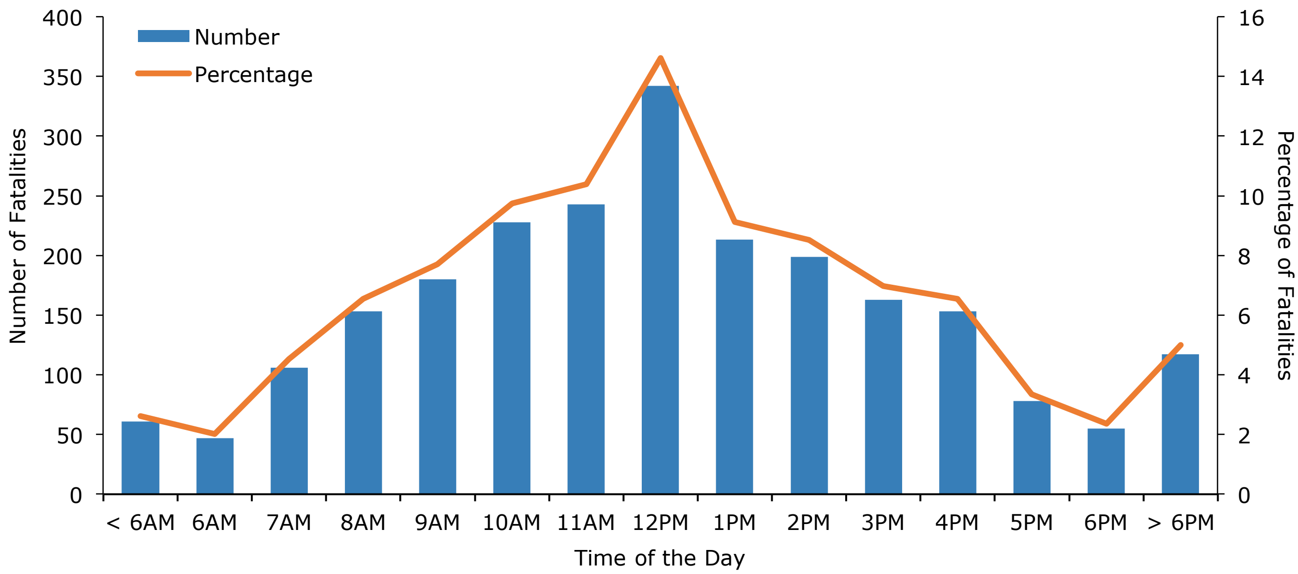
1. Review company data to determine whether there are fewer workers on Fridays, yielding fewer fatalities, or if Fridays are, in fact, "safer".
2. Make workers aware of the daily risk of injury or death. Use communication media to dispel the myth that certain weekdays are safer than others. Workers need to be vigilant every day because the risk of dying on the job is approximately the same during the week (before Friday).
3. Contractors are encouraged to benchmark their company data against these national statistics and explore how and why their results are similar or different.

Time of Day

Findings

The highest number of fatalities occurred around noon (15%) and 52% of all fatalities occurred between 10 a.m. and 3 p.m. [Figure 11]. This finding, which suggests that most deaths occur around midday, differs from existing literature. Analysis of hourly fatality data from 1997 to 2000 revealed that fatal incident occurrence was dominant around the hours of 9 a.m. and 1 p.m., and declined around noon (Huang and Hinze 2003). Another study found that most accidents occurred between 10 a.m. and 11 a.m. in the morning and between 1 p.m. and 2 p.m. in the afternoon, while the least number of accidents happened between noon and 1 p.m. (Hinze et al. 2005). Additionally, BLS does not collect data on the hourly number of construction workers, and thus, this report did not track hourly fatality ratios.

Figure 11. Number and Percentage of Fatalities, by Time of Day, 2010-2012



Potential Actions

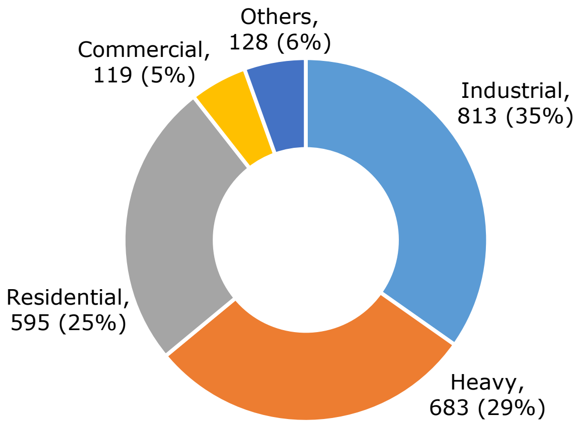
1. Distribute an urgent all-points-bulletin to workers that the most recent analysis of time-of-day data indicates the "lunch hour" is the most prone to fatalities.
2. Consider scheduling additional toolbox talks or safety meetings around noon, and particularly on Wednesdays or Thursdays.
3. In training, probe workers about the causes of midday added risk.
4. Contractors are encouraged to benchmark their company data against these national statistics and explore how and why their results are similar or different.

Project Location

Findings

"Project location" indicates where the fatal incident occurred. The BLS definition of project location includes the specialty trades. Industrial, Heavy, and Residential project locations, combined, accounted for roughly 90% of all fatalities [Figure 12]. Industrial project locations experienced the highest number of fatalities with 813 deaths (35%), followed by Heavy (29%) and Residential (25%) project locations. Commercial project locations had the least fatalities (5%).

Figure 12. Number and Percentage of Fatalities, by Project Location, 2010-2012



Residential: homes, apartments, residential institution, etc.

Heavy: street, highway, freeway, interstate, road, mines and quarries, etc.

Industrial: industrial places and premises, dockyard, loading platform, factory, warehouse, railway yard, etc.

Commercial: recreation, sport, recreation, bank, office, restaurant, café, school, hotel, store, etc.

Potential Actions

1. The risk associated with specialty trades and small establishments should be discussed in the context of these project location findings.
2. As part of any worksite training, ask workers to discuss which project locations they believe are safer than others and why. Then, follow with the statistical truths.
3. Contractors are encouraged to benchmark their company data against these national statistics and explore how and why their results are similar or different.

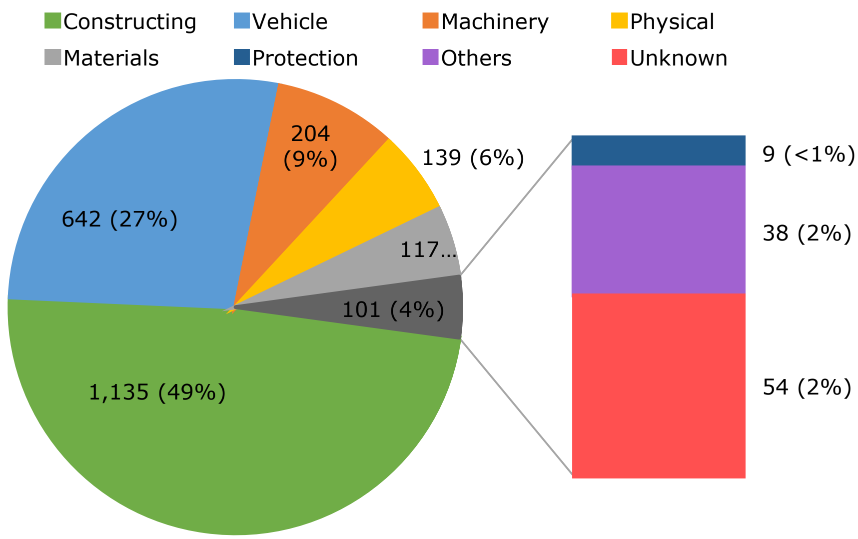
Means and Methods

Worker Activity

Findings

"Worker activity" describes what the victim was doing at the time the fatality occurred. Constructing accounted for 49% of fatalities, the highest among the worker activities [Figure 13]. The second highest, vehicular and transportation operations, accounted for 27% of fatalities. 78% of vehicle-related fatalities occurred in a location of heavy construction projects. These findings are consistent with existing literature.

Figure 13. Number and Percentage of Fatalities, by Worker Activity, 2010-2012



Constructing: Building, repairing, cleaning, assembling, installing, repairing, painting, removing, etc.

Vehicle: Vehicular and transportation operations (driving, riding, boarding, etc.)

Machinery: Using or operating tools, machinery (operating crane, cutting, using tools, reading gauge, valves, welding, trimming, etc.)

Physical: Physical activities (climbing, entering, exiting, sitting, standing, walking, jumping, etc.)

Materials: Materials handling operations (lifting, carrying, holding, loading, packing, etc.)

Protection: Protective service activities (fighting a fire, teaching, training, rescuing, etc.)

Potential Actions

1. Vehicular occupational fatalities are a particular concern in heavy construction. This coupled with a prevalence of fatalities of motorists passing through work zones, suggests special attention to struck-by risk is needed in communication and training.
2. The following controls should be considered in heavy work zones:
    a. Placement of truck mounted attenuators;
    b. Proper buffer spaces;
    c. Automated flaggers;
    d. Transition length; and
    e. Cones and barrels spacing.

EVENT OR EXPOSURE

FINDINGS

Falls remain the most common cause of deaths in construction. One-third of all fatalities was a result of Falls, Slips, & Trips [Figure 14]. This finding is consistent with studies by CPRW (2013) and Jeong (1998), which found that falls accounted for 33% of construction fatalities. Transportation incidents, specifically contact/collision with vehicles, were responsible for 29% of all fatalities. The data showed that fatalities increased due to Transportation and due to Violence and other injuries by persons or animals, while decreased due to Exposure to harmful substances and Fire and explosions [Figure 15]. This finding is consistent with CPWR (2013) which found that deaths due to transportation increased from 26% in 2010 to 29% in 2012.

Figure 14. **Number and Percentage of Fatalities, by Event or Exposure, 2010-2012**

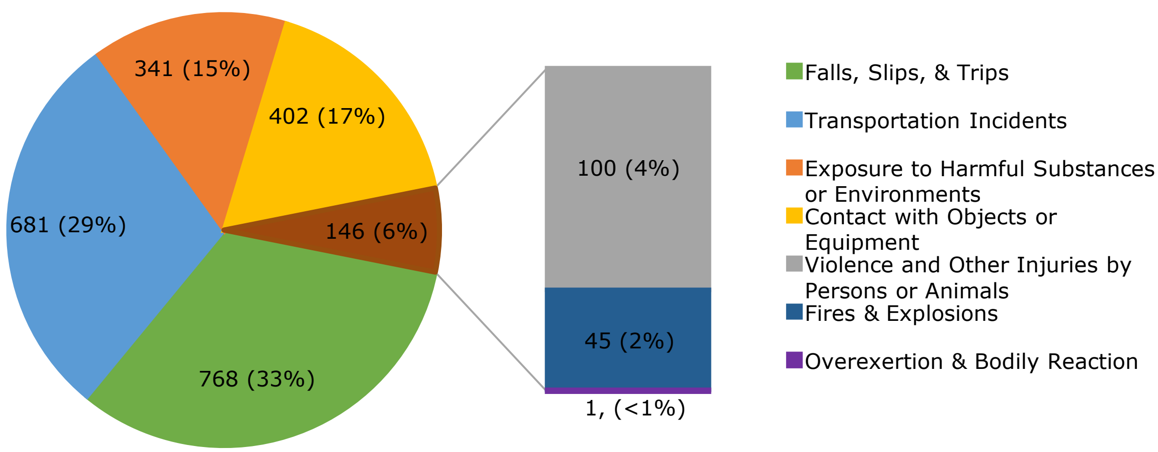
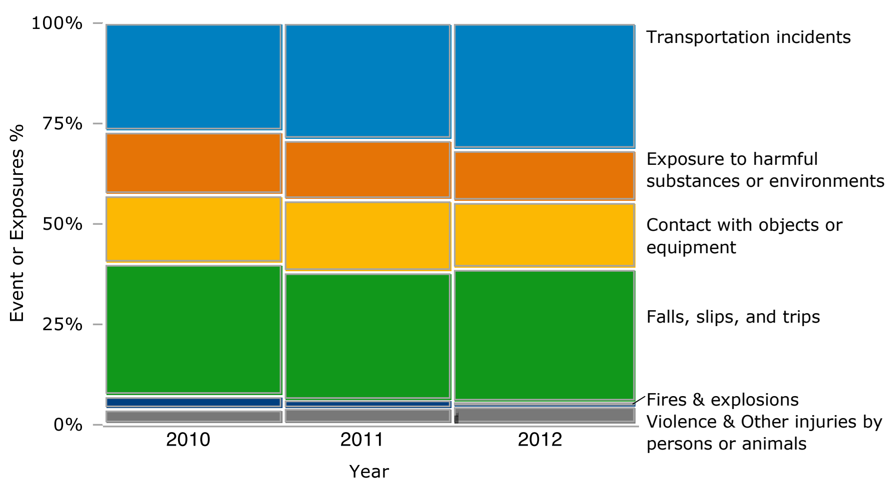


Figure 15. **Change in the Percentage of Events or Exposures over Time, 2010-2012**



POTENTIAL ACTIONS

1. Although awareness campaigns regarding fall prevention continue, so do the fatality statistics. Focus efforts on prevention through design, i.e. separating workers from the possibility that a fall can occur through alternative design, means and methods.
2. Contractors are encouraged to reevaluate their site transportation practices at multiple times during the day.
3. Consider deploying sensor-based and other related collision avoidance technologies.

Source

Findings

The major sources of construction deaths were Structures & surfaces and Vehicles. Together, they accounted for 58% of fatalities [Figure 16]. This finding is consistent with Falls, Slips, & Trips, and Transportation Incidents being the events/exposures with the highest fatalities. Each event/exposure has its own, unique set of sources. In most cases, there are two or three most prevalent sources [Table 1].

Figure 16. **Number and Percentage of Fatalities, by Source, 2010-2012**

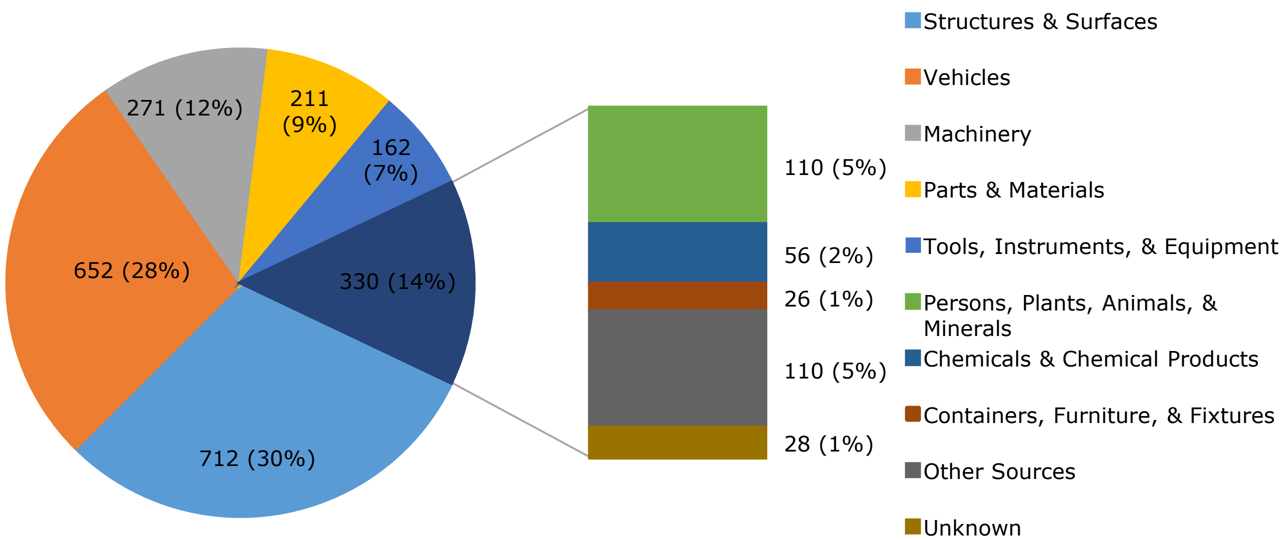


Table 1. **Percentage of Fatalities, by Highly Ranked Source, 2010-2012**

Percentage of Fatalities (%)	Highly Ranked Source, by Event or Exposure
	Falls, Slips, & Trips
31	Buildings (e.g., residential, commercial, industrial, and public buildings)
28	Other structural elements (e.g., doors, fences, gates, roofs, trusses, skylights, ceilings, walls, windows, elevator shafts)
15	Ladders (e.g., fixed, movable ladders)
	Transportation Incidents
36	Trucks (e.g. delivery trucks, dump trucks, semi-trailers)
31	Multi-purpose highway vehicles (e.g. Pickups)
16	Passenger Vehicles (e.g. automobiles, buses, passenger vans, motorcycles)
14	Construction, logging, and mining machinery
	Contact with Objects or Equipment
35	Material and personnel handling machinery (e.g., cranes, overhead hoists, lifts, and conveyors)
17	Construction, logging, and mining machinery
13	Building materials (e.g., bricks, ducts, pipes, concrete blocks, tiles, lumbers, beams, bars)
9	Buildings
6	Confined spaces (e.g., trenches, excavations, caves, tunnels, sewers, underground mines, wells, tanks, bins)
6	Other structural elements (e.g., entrance, exits, fences)
	Exposure to Harmful Substances or Environments

30	Machine, tool, and electric parts (e.g., electric parts, appliance parts,)
11	Environmental and elemental conditions (e.g., air pressure, flame, smoke, flooding, temperature extremes)
7	Other chemicals (e.g., carbon dioxide, gases, cryogenic gases)
6	Ladders (e.g., fixed, movable ladders)
6	Paper, books, magazines
4	Chemical products - general (e.g., adhesives, alcohol, drugs)
	Violence and Other Injuries by Persons or Animals
50	Person - injured or ill worker (e.g., bodily motion, fainting, heart attack)
17	Person - other than injured or ill worker (e.g., co-worker, assailant)
14	Apparel and textiles
	Fires and Explosions
28	Paper, books, magazines
13	Coal, natural gas, petroleum fuels and products
13	Containers (e.g., boxes, bags, bottles, cans, tanks, pots)

POTENTIAL ACTIONS

1. By drilling down to the sources of events/exposures, a more actionable plan can be developed.
2. Contractors should track and compare their own causes of incidents and near misses. Interventions should start with the most common causes, but should not ignore others. For example, falls from buildings remains the greatest concern for slips, trips and falls (31%), but ladder safety cannot be ignored (15%), for example, ladder contact with overhead powerlines.

MANAGEMENT

ESTABLISHMENT SIZE AND EMPLOYEE STATUS

FINDINGS

According to data from the 2012 Economic Census, roughly 80% of construction establishments[5] are small, employing less than 10 people. Between 2010 and 2012, small construction establishments (1-9 employees) employed 25% of total construction workers and experienced 47% of fatalities, resulting in the highest fatality rate at 26 deaths per 100,000 workers. Construction establishments with 10-49 employees employed 34% of construction workers and suffered 18% of fatalities, resulting in a fatality rate of 7 deaths per 100,000 workers. Mid-sized establishments with 50-99 employees, had 13% of construction workers and suffered 6% of fatalities, leading to a fatality rate of 6 deaths per 100,000 workers. Large establishments with over 100 employees hired 28% of construction workers and had 12% of fatalities, resulting in a rate of 6 deaths per workers as well [Figure 17].

With respect to employment status, the majority of victims were payroll, or wage-and-salary, employees (79%) [Figure 18]. Self-employed workers accounted for 19% of fatalities. These findings are consistent with existing literature.

Figure 17. Number and Annual Rate of Fatalities, by Establishment Size, 2010-2012

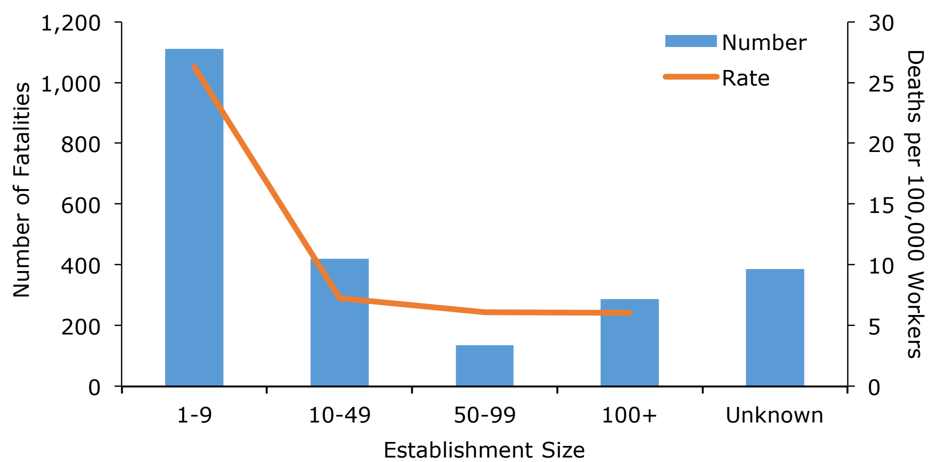
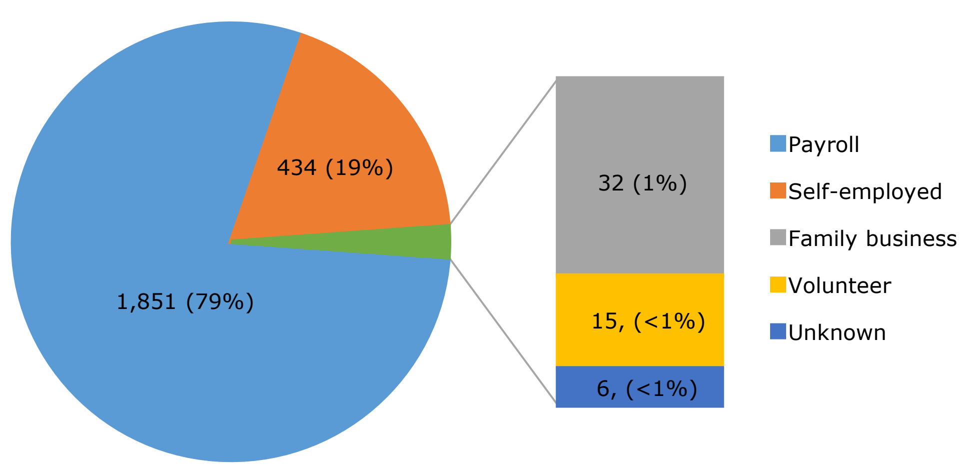


Figure 18. Number and Percentage of Fatalities, by Employee Status, 2010-2012



[5] The U.S. Census Bureau identifies an "establishment" as a single business organization operating in the same state and industry, and under one firm for census purposes. In other words, one construction firm can have multiple establishments.

POTENTIAL ACTIONS

1. Previous studies and analyses have excluded extremely small firms (i.e. 1-9 employees). This study analyzed these and discovered they are at risk. Therefore, it is important to communicate the added risk for establishments under 10 employees.
2. Consider transferring culture, policies, and procedures to smaller contractors/sub-contractors.
3. Using a benchmarking process, explore and identify the best practices associated with larger establishments that which can be adopted or adapted by smaller establishments (Saunders, McCoy, Kleiner, Mills, Cooke, Lingard, Blismas, and Wakefield, 2016).

WORKERS

AGE AND ETHNICITY

FINDINGS

Construction workers aged 35-54 accounted for 50% of fatalities [Figure 19]. Younger and older workers, under 25 and 65 or over, represented relatively small proportions of fatalities, with 8% and 7%, respectively. When employment numbers were factored in, fatalities rates showed a steady increase from age 35. The 65+ age group had the highest fatality rate (19 fatalities per 100,000 workers) while experiencing only 7% of fatalities, suggesting that this group has a higher risk of death.

These findings are consistent with the existing literature. It can be assumed that middle-aged workers have comparatively more working experience, while experiencing the greatest proportion of fatalities. Historically, the proportions of fatalities among construction workers age 45 and older were 34% in 1992, 44% in 2005, and 52% in 2012. This trend mirrors the increase in the number of older construction workers in the Industry (CPWR, 2013).

Most fatalities occurred among Non-Hispanics (75%) [Figure 20]. Hispanics, who make up 24% of the construction workforce (including self-employed), accounted for the remaining 25% of fatalities.

Figure 19. Number of Fatalities and Annual Fatality Rate, by Age Group, 2010-2012

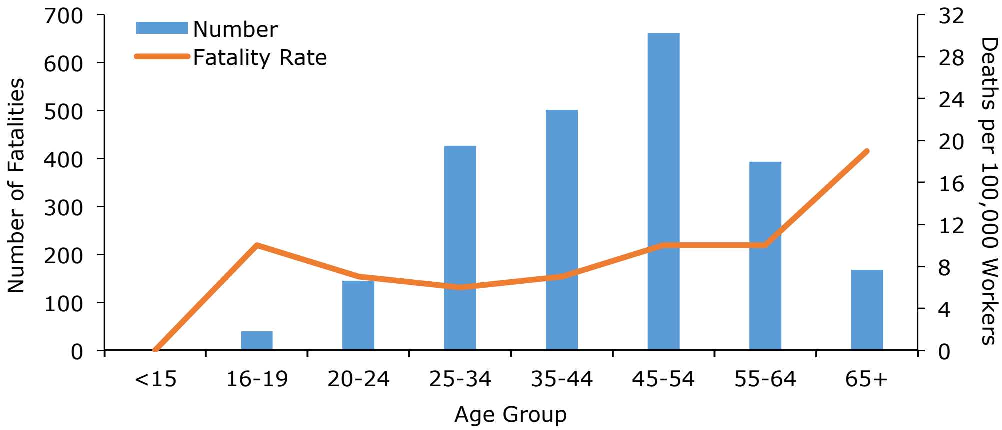
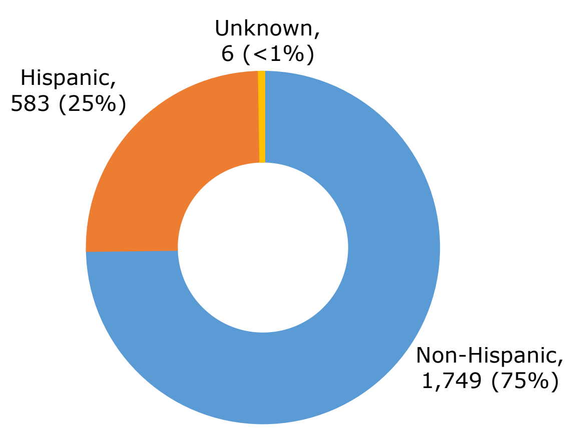


Figure 20. Number and Percentage of Fatalities, by Ethnicity, 2010-2012



POTENTIAL ACTIONS

1. Create awareness about the increased safety concerns related to an aging workforce.
2. For workers aged 65+, reconsider employment practices for field work assignments.
3. Emphasize in communication and training that gaining more experience as one ages, does not necessarily decrease the risk of fatalities. Therefore, there is a need to be vigilant about safety, every day.

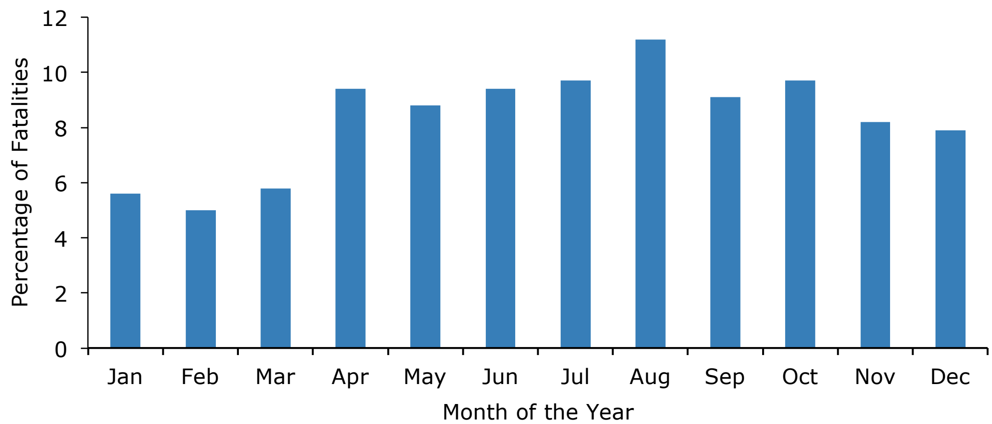
Highway and Road Work Zone Trends

Findings

Sector
As expected, most highway and road work zone construction worker fatalities (673 in 2010-2012) occurred in the industrial sectors of heavy (50%) and specialty trades (39%).

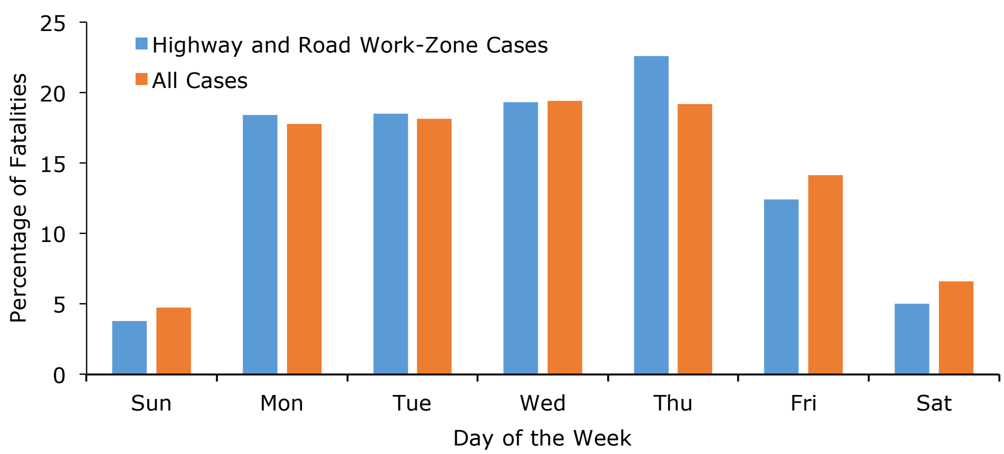
Season
Consistent with overall findings, most highway and road work zone deaths occurred in the summer (30%) and the number of fatalities peaked in August (11%) [Figure 21].

Figure 21. Percentage of Work Zone Fatalities, by Month of the Year, 2010-2012



Day of the Week
Highway and road work zone deaths trended in a similar fashion to overall fatalities [Figure 22].

Figure 22. Percentage of Highway and Road Work Zone Fatalities, by Day of the Week, 2010-2012



Worker Activties
Most highway and road work zone fatalities involved vehicular operations (69%). Vehicular activities can be related to either construction operators or other drivers.

Employee Status
As expected, most victims were wage and salary workers (89%).

Ethnicity
Most victims were non-Hispanic workers (80%). Hispanics comprise 24% of the total construction workforce. The proportion of Hispanic worker fatalities in work zones (20%) is smaller than that of non-work zone fatalities (27%).

Gender
As expected, most victims were Male (98%).

POTENTIAL ACTIONS

1. Since most highway and road work zone fatalities occurred in summer, establishments should consider working with appropriate organizations to raise awareness about work zones during summer. This may include AAA and State transportation authorities.
2. Most work zone fatalities occur between Monday and Thursday, likely the days on which most construction is performed. Communications and training should focus on vigilance and administrative controls on these days.
3. Although not reported in these occupational data, public deaths related to work zone incursions far exceed worker fatalities; communications through AAA and DOTs should include this fact.

Regional Trends

The South led the regions in fatalities across almost all categories [Figures 23 through 37]. It was typically followed by the Midwest, West, and then the Northeast. Washington, DC, and the states of MD, VA, DE, WV, NC, SC, KY, TN, GA, FL, AL, MS, AR, OR, LA, and TX comprise the south region.

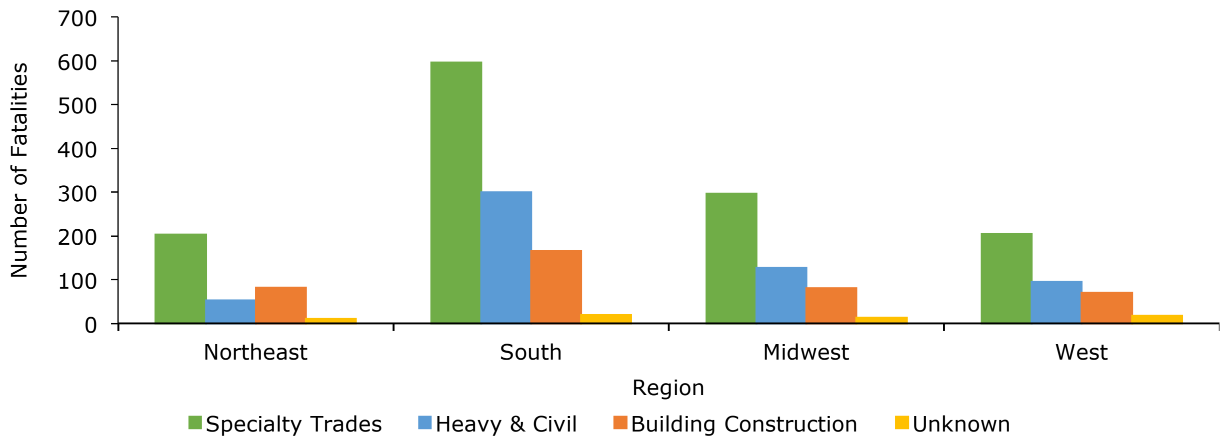
Before drawing conclusions about regional differences, it is important to note that in terms of population and employment, regions have different sizes. As a percentage of total employment, the regions differ approximately as follows: South, 36.7%; Midwest, 21.8%; Northeast, 17.8%, and West, 23.7%.

Findings

Sector

The South experienced more fatalities than the other regions across all sectors of construction [Figure 23]. There were 597 fatalities in the specialty trades in the South.

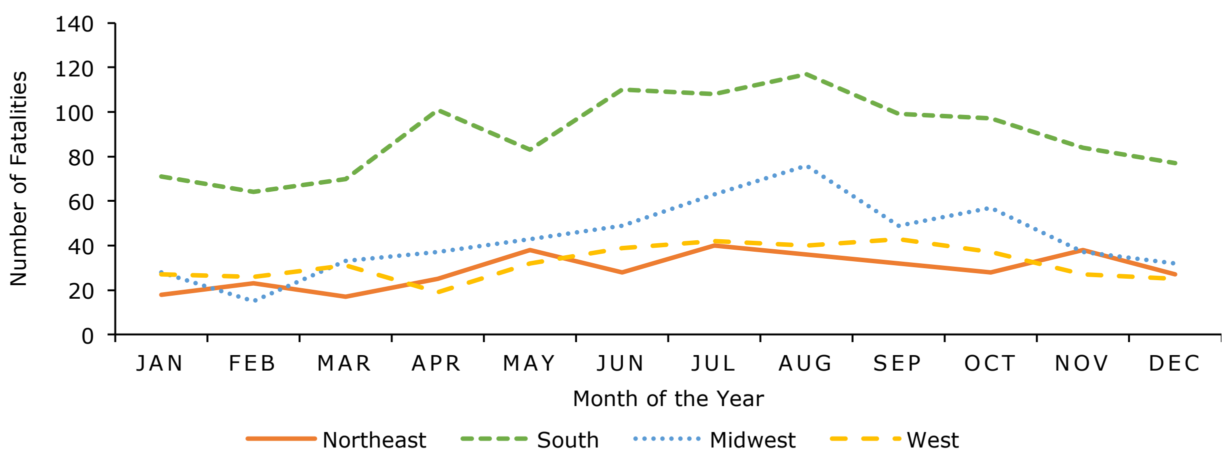
Figure 23. Regional Distribution of Fatalities, by Sector, 2010-2012



Season

The South experienced more fatalities in every month compared to other regions [Figure 24]. The August peak is experienced by the South and Midwest.

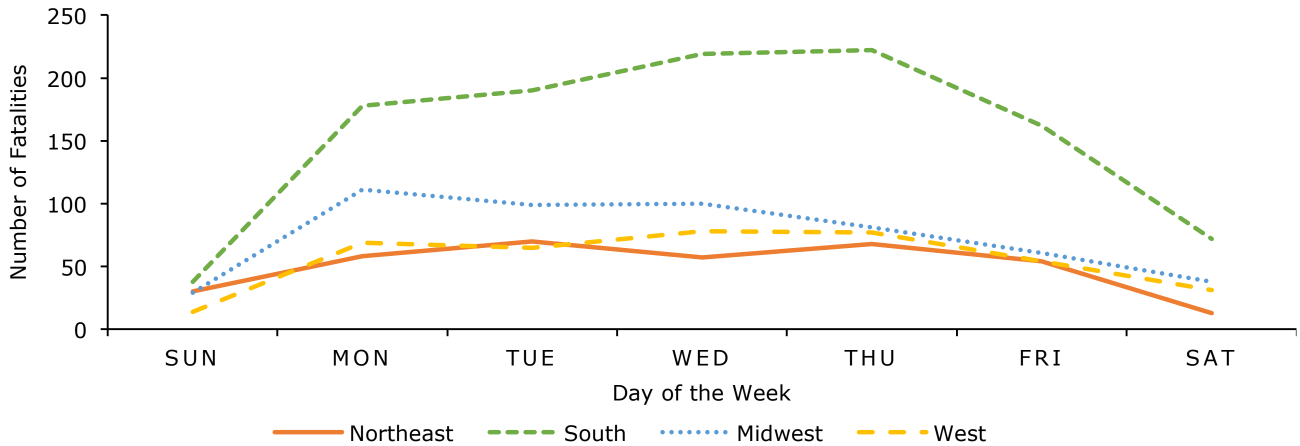
Figure 24. Regional Distribution of Fatalities, by Month of the Year, 2010-2012



Day of the Week

Fatalities by day of the week are illustrated in Figure 25. All regions experience the most fatalities Monday-Thursday.

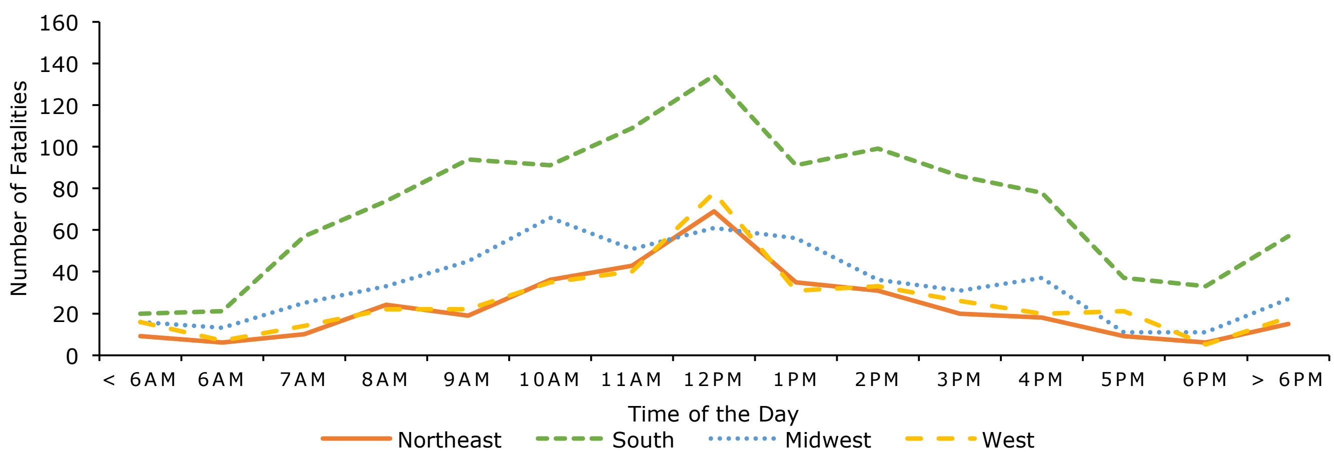
Figure 25. Regional Distribution of Fatalities, by Day of the Week, 2010-2012



Time of Day

All regions except for the Midwest experienced the most fatalities at the noon hour [Figure 26]. In the Midwest, the peak is 10:00 AM.

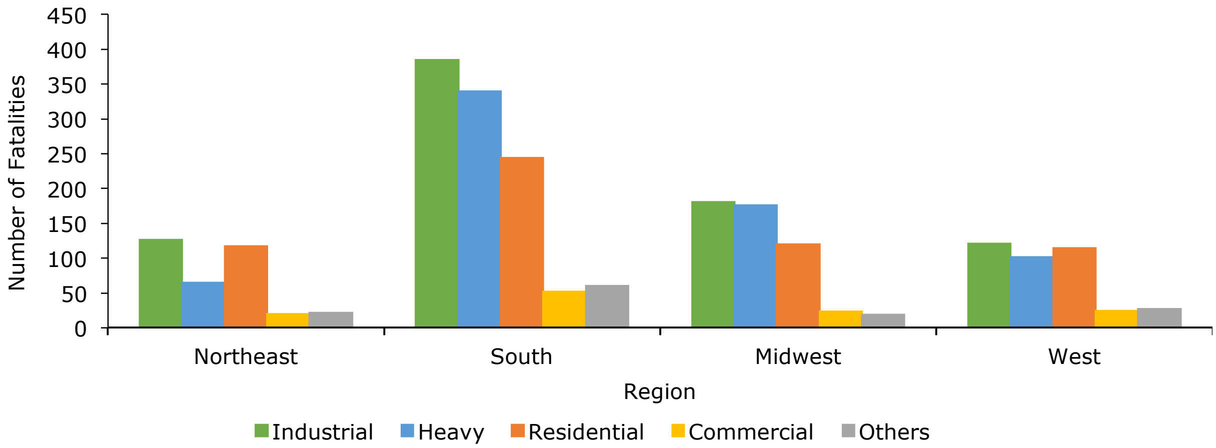
Figure 26. Regional Distribution of Fatalities, by Time of the Day, 2010-2012



Project Location

Each region has a unique distribution of fatalities across project location [Figure 27].

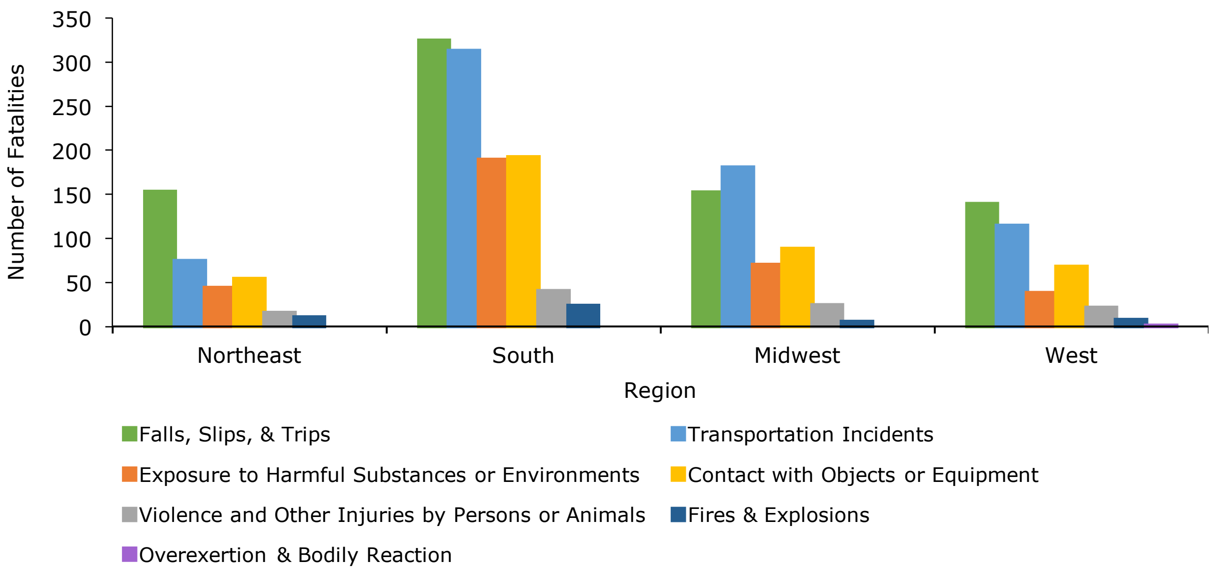
Figure 27. Regional Distribution of Fatalities, by Project Location, 2010-2012



Event or Exposure

Each region has a unique distribution of fatalities across events or exposures [Figure 28].

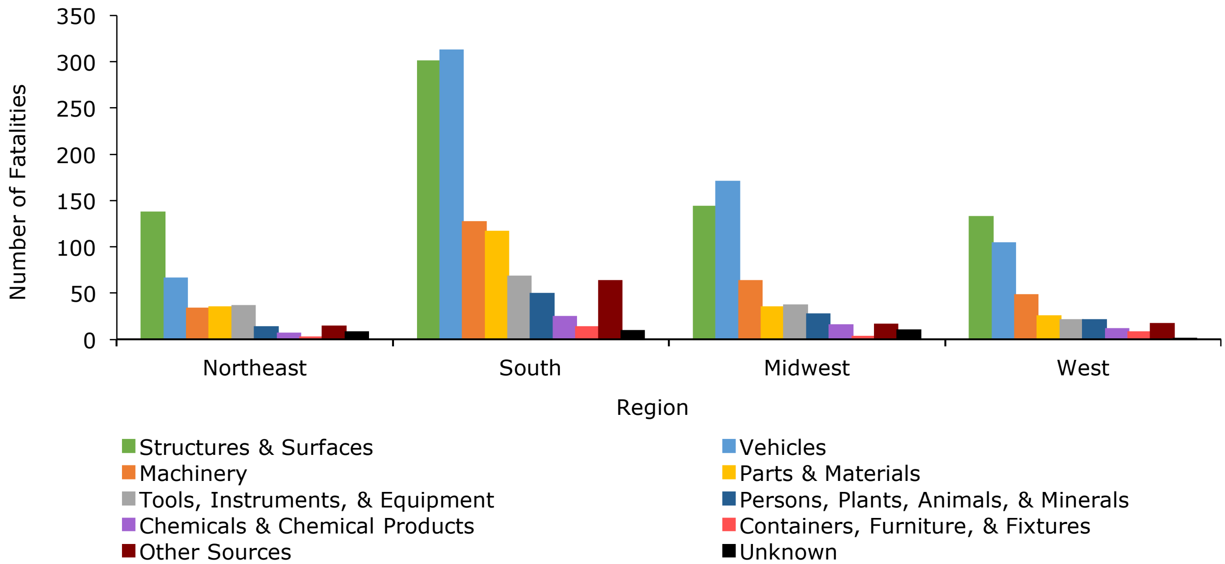
Figure 28. Regional Distribution of Fatalities, by Event or Exposure, 2010-2012



Event or Exposure

Each region has a unique distribution of fatalities across sources [Figure 29].

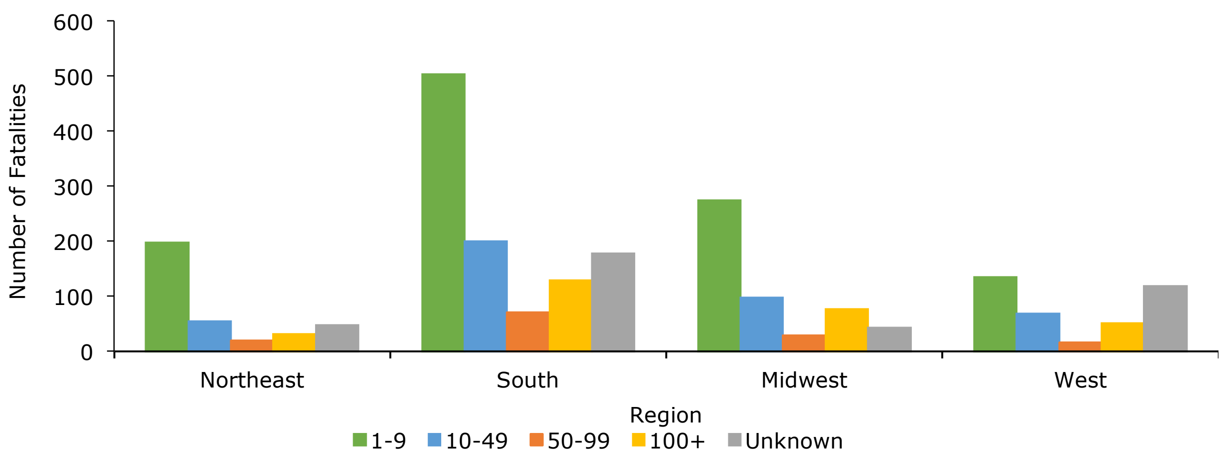
Figure 29. Regional Distribution of Fatalities, by Source, 2010-2012



Size

All regions experience the most fatalities in the smallest of establishments (1-9), followed by 10-49 employees [Figure 30].

Figure 30. Regional Distribution of Fatalities, by Establishment Size, 2010-2012



Employment Status

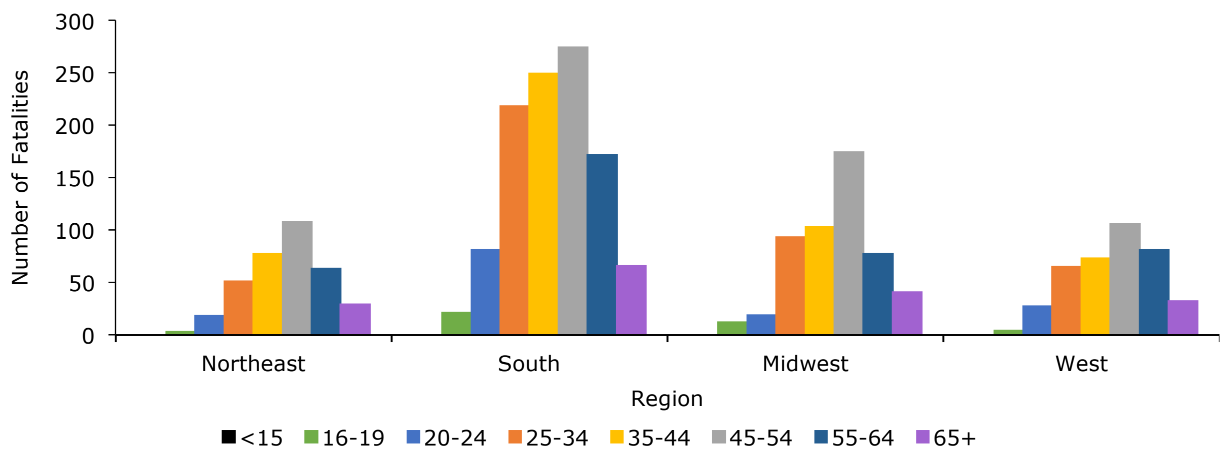
All regions are characterized by the same pattern of employee status, with payrolled employees experiencing the most fatalities [Figure 31].

Figure 31. Regional Distribution of Fatalities, by Employee Status, 2010-2012

Age

The 45-55 age group had the most fatalities in each region, and the overall relative distribution within each region was similar across the regions [Figure 32].

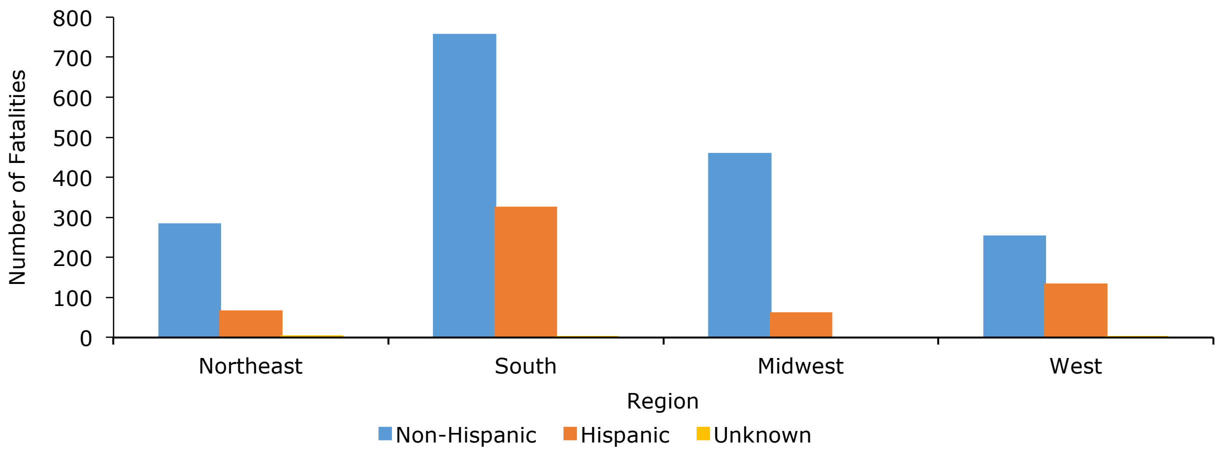
Figure 32. Regional Distribution of Fatalities, by Age Group, 2010-2012



Ethnicity

The West had the highest proportion of Hispanics, followed by the South [Figure 33].

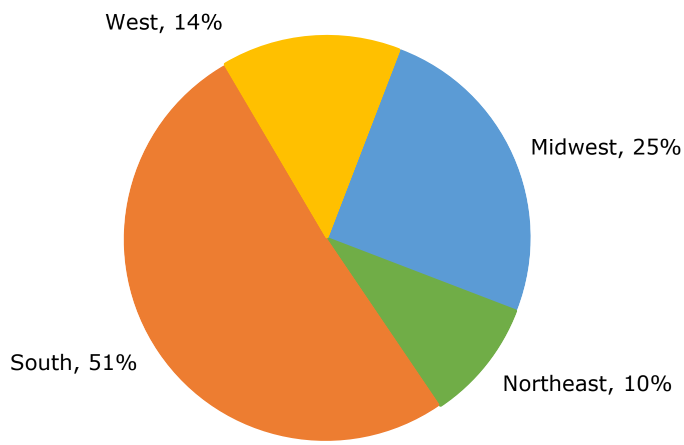
Figure 33. Regional Distribution of Fatalities, by Ethnicity, 2010-2012



Work zones

The South experienced more work zone fatalities than the other regions [Figure 34]. Normalizing for employment, the Midwest had a disproportionate share of work zone fatalities as compared to the West.

Figure 34. Regional Distribution of Highway and Road Work Zone Fatalities, 2010-2012



Potential Actions

1. Emphasize in communication and training, that regions differ in terms of population and employment.
2. In the context of the relative sizes of regions in terms of employment (largest to smallest: South, West, Midwest, Northeast), training discussion can focus on expected rank orders versus actual. For example, why does the West have fewer fatalities in establishments of 1-9 than the Midwest and Northeast (Figure 30)?
3. Training courses should include discussion about regional factors that could affect construction safety, including weather, worker demographics, unionization, etc.

References

Center for Construction Research and Training [CPWR] (2013). *The construction chart book: The U.S. Construction industry and its workers*, CPWR, Silver Spring, MD.

Hinze, J., Huang, X., and Terry, L. (2005). The nature of struck-by accidents. *Journal of Construction Engineering and Management*, 131(2), 262-268.

Huang, X., and Hinze, J. (2003). Analysis of construction worker fall accidents. *Journal of Construction Engineering and Management*, 129(3), 262-271.

Hunting, K. L., Murawski, J. A., and Welch, L. S. (2004). Occupational injuries among construction workers treated at the George Washington University Emergency Department, 1990-97. Silver Spring, MD.

Jeong, B. Y. (1998). Occupational deaths and injuries in the construction industry. *Applied Ergonomics*, 29(5), 355-360.

Saunders, L.W., McCoy, A.P., Kleiner, B.M., Cooke, T., Lingard, H., Blismas, N., Mills, T. and Wakefield, R. (2016). International benchmarking for performance improvement in construction safety and health. *Benchmarking: An International Journal*, Volume 23, Issue 2.

U.S. Bureau of Labor Statistics (2014). Geographic information by census region. Available at https//www.bls.gov/regions/home.htm

U.S. Bureau of Labor Statistics (2016). Glossary. Available at https://www.bls.gov/bls/glossary.htm

Zhao, D., Thabet, W., McCoy, A., and Kleiner, B. (2014). Electrical deaths in the U.S. Construction: An analysis of fatality investigations. *International Journal of Injury Control and Safety Promotion*, 21(3), 278-288.