

## Fatal occupational injuries at road construction sites

Stephen Pegula

During the 1995 to 2002 period, 844 workers were killed while working at a road construction site.<sup>1</sup> More than half of these fatalities were attributable to a worker being struck by a vehicle or mobile equipment. The range of these fatal occupational injuries was a low of 93 in 1996 and a high of 124 in 1999, as shown below:

1995 .....	94	1999 .....	124
1996 .....	93	2000 .....	106
1997 .....	94	2001 .....	118
1998 .....	113	2002 .....	102

Fatal workplace injuries at road construction sites were first identified as a separate category in the Bureau of Labor Statistics Census of Fatal Occupational Injuries (CFOI) in 1995. Since that time, overall workplace fatalities have generally declined, but fatalities at road construction sites have fluctuated, staying in the low 100's since 1998. Workplace fatalities that occur at a road construction site typically account for 1.5 percent to 2.0 percent of all workplace fatalities annually.

A number of safety measures exist for road construction sites. For instance, the Federal Highway Administration's *Manual on Uniform Traffic Control Devices* provides guidance ranging from the types of signs to use at a road construction site to the proper use of rumble strips.<sup>2</sup> In addition, the Federal Highway Administration offers tips for motorists on traveling safely through road construction sites.<sup>3</sup> As fatal work injuries at road construction sites continue to account annually for a large number of fatal occupational inju-

ries, it becomes even more important to determine the types of workers involved in road construction site fatalities and the events that precipitate the fatalities.<sup>4</sup>

### What is a road construction site?

There are various definitions of what constitutes a road construction site. According to the BLS Census of Fatal Occupational Injuries, a road construction site includes, "...road construction workers and vehicle occupants fatally injured in work zones. Work zones include construction, maintenance, and utility work on a road, street, or highway." The Federal Highway Administration's *Manual on Uniform Traffic Control Devices* gives this definition, "A work zone is an area of a highway with construction, maintenance, or utility work activities. A work zone is typically marked by signs, channelizing devices, barriers, pavement markings, and/or work vehicles. It extends from the first warning sign or high-intensity rotating, flashing, oscillating, or strobe lights on a vehicle to the END ROAD WORK sign or the last TTC [temporary traffic control] device."<sup>5</sup>

In this report, only fatal work injuries that occurred at road construction sites as defined by CFOI are included in the analysis. Fatal work injuries at road construction sites were identified in two ways. First, all occupational fatalities that were coded as having occurred at a road construction site were included.<sup>6</sup> Next, the remaining CFOI record set was searched for key variables that might indicate that a fatal work injury did indeed occur at a road construction site, but was not coded as such. These variables include:

- **Keywords.** Records with narratives containing variations on the following words were examined—zone, construction site, worksite, pedestrian, road construction, road site, flag, cone, road crew, highway construction, street construction, barrel, manhole, road repair,

painting line, pothole, and sewer.

- **Industry.** All records in which the decedent was employed in Standard Industrial Classification (SIC) 1611—Highway and Street Construction; or SIC 1622—Bridge, Tunnel, and Elevated Highway Construction; and where the fatality occurred on a roadway were examined.
- **Occupation.** All records in which the decedent was employed, per the U.S. Census Bureau Occupation Codes, as a construction laborer (869), operating engineer (844), or paving, surfacing, and tamping equipment operator (594), and where the fatality occurred on a roadway were examined.
- **Worker activity.** All records in which the decedent was, as classified by the CFOI worker activity codes, directing or flagging traffic (150); walking behind a vehicle (162); or resurfacing, black-topping, etc. (140); and where the fatality occurred on a roadway were examined.
- **Source and secondary source.** All records in which the source or secondary source of the fatal work injury, as classified by the Occupational Injury and Illnesses Classification System, was construction, logging, and mining machinery (codes 3200 to 3299) and where the fatality occurred on a roadway were examined.
- **Event.** All records in which the decedent was killed, as classified in the Occupational Injury and Illnesses Classification System, by being struck by a vehicle or mobile equipment and where the fatality occurred on a roadway were examined.

Records found through this key variable search deemed to have occurred at a road construction site (per the CFOI definition), but not coded as road construction, were recoded for this report.<sup>7</sup>

Stephen Pegula is an economist in the Office of Safety, Health, and Working Conditions, Bureau of Labor Statistics.

*Limitations of the data.* The consistency of the application of the road construction site location code in CFOI could affect the data used for this analysis. An examination of the CFOI narratives shows that the road construction site location code was applied more rigorously later in the study period.<sup>8</sup> More cases in need of recoding were found in the early years of the study than in the latter years. These different applications of the code may skew the data; that is, the increase in fatal work injuries at road construction sites over time may be partly due to the more rigorous application of the location code in the latter years of the study period.

### Dangers at road construction sites

Few work environments present the multitude of risks as do road construction sites. For example, vehicles may pass by at high speeds, and the work conditions are constantly changing. Data from the National Highway Traffic Safety Administration show that injuries at road construction sites are a major concern. In 2001, 1,079 people were killed at a road construction site.<sup>9</sup> This figure includes people who were not at work at the time of their death, such as occupants of vehicles passing through road construction sites for nonwork-related reasons.

Highway traffic is a concern for workers at a road construction site, but workers also face a similar danger from vehicles and mobile equipment being used at such sites. As shown later, fatally injured workers at road construction sites were more likely to be struck and killed by construction vehicles and equipment than by automobiles.

To improve the country's roads, Congress passed the Transportation Equity Act for the 21st Century (TEA-21) in 1998. This act provided more than \$200 billion dollars for transportation-related programs.<sup>10</sup> This legislation is in the process of being renewed.<sup>11</sup> Improving the

country's roads will mean that more road construction sites will be needed. To better protect workers, the Federal Government has taken steps to improve safety in work zones. For example, in 2001, the National Institute for Occupational Safety and Health (NIOSH) published "Building Safer Highway Workzones: Measures to Prevent Worker Injuries From Vehicles and Equipment."<sup>12</sup> In addition, the National Work Zone Safety Information Clearinghouse was created in February of 1998 to improve safety in highway work zones.<sup>13</sup> This clearinghouse provides access to data, training, and safety information for workers at road construction sites.

### Data analysis

*Demographics.* As mentioned earlier, over the 1995–2002 period, 844 workers lost their lives due to fatal work injuries incurred at a road construction site. (See table 1.) The workplace fatality demographic breakdown for this group was very similar to the workplace fatality demographic breakdown for workers in general. Males accounted for 93 percent (787) of the workplace fatalities at a road construction site, compared with 92 percent for all workplace fatalities. White workers accounted for 73 percent (613) of the road construction site workplace fatalities and 73 percent of fatally injured workers overall. Black workers and Hispanic workers represented 10 percent and 14 percent, respectively, of workplace fatalities occurring at road construction

sites, and 10 percent and 12 percent of workplace fatalities to all workers.

In terms of age, approximately 70 percent (594) of the decedents were between the ages of 25 and 54. Workers under age 25 made up 10 percent of fatal work injuries incurred at a road construction site and 11 percent of fatal work injuries overall. Workers age 55 and older accounted for 20 percent of the fatal work injuries incurred at a road construction site and 22 percent of workplace fatalities overall. Workers killed at a road construction site were largely working for wage and salary; approximately 96 percent (811) of the decedents were wage/salary workers, while only 4 percent were self-employed. For overall workplace fatalities from 1995 to 2002, 80 percent of the decedents were wage/salary workers and 20 percent were self-employed.

**Table 1.** Worker fatalities at road construction sites over the 1995–2002 period, by selected demographic characteristics

Characteristics	Number of fatalities
Total .....	844
Employee status:	
Wage and salary workers <sup>1</sup> .....	811
Self-employed <sup>2</sup> .....	33
Gender:	
Male .....	787
Female .....	57
Age:	
18 to 19 years .....	17
20 to 24 years .....	63
25 to 34 years .....	185
35 to 44 years .....	213
45 to 54 years .....	196
55 to 64 years .....	130
65 years and older .....	36
Race or ethnic origin: <sup>3</sup>	
White .....	613
Black or African American .....	86
Hispanic or Latino <sup>4</sup> .....	118

<sup>1</sup> May include volunteers and other workers receiving compensation.

<sup>2</sup> Includes paid and unpaid family workers, and may include owners of incorporated businesses, or members of partnerships.

<sup>3</sup> The categories "White" and "Black or African American" do not include "Hispanic or Latino" persons.

<sup>4</sup> Persons identified as Hispanic may be of any race.

NOTE: Totals for 2001 exclude fatalities resulting from the September 11 terrorist attacks. Totals for major categories may include subcategories not shown separately.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, in cooperation with State, New York City, District of Columbia, and Federal agencies, Census of Fatal Occupational Injuries.

**Table 2. Worker fatalities at road construction sites over the 1995–2002 period, by State of incident**

State of incident	Number of fatalities
Texas .....	71
California .....	51
Florida .....	46
Ohio .....	46
Pennsylvania .....	44
New York .....	40
Indiana .....	38
Illinois .....	36
Virginia .....	36
Georgia .....	32

NOTE: Totals for 2001 exclude fatalities resulting from the September 11 terrorist attacks.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, in cooperation with State, New York City, District of Columbia, and Federal agencies, Census of Fatal Occupational Injuries.

**Table 3. Worker fatalities at road construction sites over the 1995–2002 period, by event or exposure**

Event or exposure	Number of fatalities
Transportation incidents .....	693
Highway .....	137
Collision between vehicles, mobile equipment .....	83
Moving in the same direction .....	29
Moving and standing vehicle, mobile equipment in roadway .....	29
Noncollision .....	36
Jack-knifed or overturned–no collision .....	27
Nonhighway .....	43
Noncollision accident .....	41
Overturned .....	27
Worker struck by vehicle, mobile equipment .....	509
Worker struck by vehicle, mobile equipment in roadway .....	363
Worker struck by vehicle, mobile equipment on side of road .....	119
Contact with objects and equipment .....	85
Struck by object .....	44
Falls .....	28
Exposure to harmful substances and environments .....	33
Contact with electric current .....	23
Contact with overhead power lines .....	20

NOTE: Totals for 2001 exclude fatalities resulting from the September 11 terrorist attacks. Totals for major categories may include subcategories not shown separately.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, in cooperation with State, New York City, District of Columbia, and Federal agencies, Census of Fatal Occupational Injuries.

**Table 4. Worker fatalities at road construction sites over the 1995–2002 period, by industry and occupation**

Characteristics	Number of fatalities
Industry:	
Private industry .....	688
Construction .....	566
Heavy construction, except building .....	467
Highway and street construction .....	340
Heavy construction, except highway .....	125
Bridge, tunnel, and elevated highway .....	70
Water, sewer, and utility lines .....	34
Special trade contractors .....	90
Transportation and public utilities .....	52
Trucking and warehousing .....	44
Trucking and courier services, except air .....	44
Trucking, except local .....	34
Services .....	34
Government <sup>1</sup> .....	156
State government .....	83
Construction .....	57
Heavy construction, except building .....	56
Highway and street construction .....	55
Public administration .....	24
Local government .....	70
Construction .....	38
Heavy construction, except building .....	38
Highway and street construction .....	37
Public administration .....	29
Occupation:	
Managerial and professional specialty .....	52
Precision production, craft, and repair .....	183
Construction trades .....	170
Supervisors, construction occupations .....	55
Construction trades, except supervisors .....	115
Paving, surfacing, and tamping equipment operators .....	27
Operators, fabricators, and laborers .....	558
Transportation and material moving occupations .....	186
Motor vehicle operators .....	85
Truck drivers .....	83
Material moving equipment operators .....	101
Operating engineers .....	54
Grader, dozer, and scraper operators .....	27
Handlers, equipment cleaners, operators, and laborers .....	359
Construction laborers .....	335

<sup>1</sup> Includes fatalities to workers employed in governmental organizations regardless of industry.

NOTE: Totals for 2001 exclude fatalities resulting from the September 11 terrorist attacks. Totals for major categories may include subcategories not shown separately.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, in cooperation with State, New York City, District of Columbia, and Federal agencies, Census of Fatal Occupational Injuries.

Texas had the largest number of workplace fatalities at road construction sites; 8 percent (71) of the workplace fatalities occurred in this State. (See table 2, page 45.) Other States with a large number of these types of occupational fatalities included California (6 percent), Florida (5 percent), Ohio (5 percent), Pennsylvania (5 percent), and New York (5 percent).

*Event or exposure.* More than four-fifths (693) of occupational fatalities that occur at a road construction site were caused by transportation incidents. Most prevalent were workers who were struck by a vehicle or mobile equipment, who accounted for approximately 60 percent (509) of all fatal work injuries that occurred at a road construction site. (See table 3, page 45.) Other fatal events of note included highway collisions between vehicles or mobile equipment (10 percent of all fatal work injuries at a road construction site), being struck by an object (5 percent), and falls (3 percent).

*Industry and occupation.* In the private sector, 82 percent (566) of the road construction site decedents worked in construction. (See table 4, page 45.) Most of these construction fatalities (60 percent) were incurred by workers in highway and street construction. No other major industry group in the private sector accounted for more than 8 percent of the fatalities. Government workers accounted for 18 percent (156) of the workplace fatalities that occurred at a road construction site. These fatalities were incurred primarily by State and local government workers. As in the private sector, decedents working for a government entity were most likely to be working in highway and street construction.

Among occupations, 40 percent (335) of the decedents worked as construction laborers. (See table 4, page 45.) The remaining decedents were employed in the construction trades (20 percent), as material moving equipment

operators (12 percent), and as truck drivers (10 percent), among other occupations.<sup>14</sup>

*Struck by vehicle or mobile equipment incidents.* Approximately 60 percent (509 fatalities) of the occupational fatalities that occurred at road construction sites were the result of workers being struck by vehicles or mobile equipment. Construction laborers incurred 49 percent (247) of these fatalities. In addition, 48 percent (242) of the decedents were working in the private highway and street construction industry. Geographically, these incidents were most likely to occur in Texas (9 percent, or 46 fatalities, of all struck by vehicle or mobile equipment workplace fatalities at road construction sites), Florida (7 percent), California (6 percent), Pennsylvania (6 percent) and Ohio (6 percent). (See table 5.)

For fatalities for which the time of incident was available, 29 percent of the decedents who were struck by vehicles or mobile equipment at a road construction site were struck between the hours of 9:00 a.m. and 11:59 a.m., and 17 percent were struck between 6:00 a.m. and 8:59 a.m. These percentages were larger than those for all fatal occupational injuries, where 23 percent occurred between 9:00 a.m. and 11:59 a.m., and 13 percent occurred between 6:00 a.m. and 8:59 a.m. Fatalities at road construction sites from being struck by a vehicle or mobile equipment also tend to be more clustered in the daylight hours (6:00 a.m. to 5:59 p.m.) than fatalities in general. Approximately 83 percent of the fatal work injuries incurred by workers at road construction sites from being struck by a vehicle or mobile equipment occurred in daylight hours, while 75 percent of all fatal work injuries occurred during these hours.

In struck by vehicle or mobile equipment cases, the vehicle or mobile equipment that struck the worker is the source of the fatal injury. In 54 percent (274) of the cases, a truck struck the worker. Of these trucks, 36 percent were dump

trucks, 21 percent were pickup trucks, and 19 percent were semitrailer, tractor trailer, or trailer trucks. Automobiles were the source in 28 percent (143) of all cases of struck by vehicle or mobile equipment at road construction sites. Finally, construction machinery, which includes backhoes, levelers, planers, scrapers, steamrollers, and road pavers, accounted for 11 percent (56) of the struck by vehicle or mobile equipment fatalities. (See table 6.)

Note that workers at a road construction site faced a greater likelihood of being struck by a construction vehicle or construction equipment than of being struck by a car. While 28 percent of the workers who were killed in struck by vehicle or mobile equipment incidents at a road construction site were struck by automobiles, 31 percent were struck by dump trucks or construction machinery.

With respect to the activity the decedent was performing when he or she was struck by a vehicle or mobile equipment, 29 percent (147) were constructing, repairing, or cleaning. Approximately 28 percent were walking in or near a roadway when they were struck,

**Table 5.** Worker fatalities at road construction sites over the 1995–2002 period, resulting from being struck by a vehicle or mobile equipment, by State of incident

State of incident	Number of fatalities
Texas .....	46
Florida .....	37
California .....	33
Pennsylvania .....	30
Ohio .....	29
Illinois .....	23
Georgia .....	22
New York .....	20
Virginia .....	18
North Carolina .....	17

NOTE: Totals for 2001 exclude fatalities resulting from the September 11 terrorist attacks.  
 SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, in cooperation with State, New York City, District of Columbia, and Federal agencies, Census of Fatal Occupational Injuries.

**Table 6.** Worker fatalities at road construction sites over the 1995–2000 period, resulting from being struck by a vehicle or mobile equipment, by source of the fatality

Source	Fatalities	
	Number	Percent
All struck by vehicle or mobile equipment fatalities <sup>1</sup> .....	509	100
Vehicles .....	446	88
Highway vehicle-motorized .....	441	87
Automobile .....	143	28
Truck .....	274	54
Dump truck .....	100	20
Pickup truck .....	57	11
Semi-trailer, tractor trailer, or trailer truck .....	53	10
Van .....	14	3
Machinery .....	63	12
Construction, logging, and mining machinery .....	56	11
Excavating machinery .....	21	4
Backhoes .....	9	2
Bulldozers .....	6	1
Road grading and surfacing machinery .....	30	6
Graders, levelers, planers, and scrapers .....	20	4
Steam rollers and road pavers .....	6	1

<sup>1</sup> In struck by vehicle or mobile equipment fatalities, the source of the fatality is the vehicle or mobile equipment that struck the decedent.

NOTE: Totals for 2001 exclude fatalities resulting from the September 11 terrorist attacks. Totals for major categories may include subcategories not shown separately.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, in cooperation with State, New York City, District of Columbia, and Federal agencies, Census of Fatal Occupational Injuries.

**Table 7.** Worker fatalities at road construction sites over the 1995–2002 period, resulting from being struck by a vehicle or mobile equipment, by worker activity

Worker activity	Fatalities	
	Number	Percent
All struck by vehicle or mobile equipment fatalities .....	509	100
Vehicular and transportation operation .....	278	55
Resurfacing and blacktopping .....	38	7
Directing or flagging traffic .....	93	18
Walking in or near roadway .....	141	28
Using or operating tools or machinery .....	17	3
Constructing, repairing, or cleaning .....	147	29
Construction, assembling, or dismantling .....	66	13
Constructing or assembling .....	10	2
Installing .....	14	3
Dismantling or removing .....	8	2
Repairs or maintenance .....	30	6
Repairing .....	17	3
Maintenance .....	9	2
Inspecting or checking .....	18	4
Painting, etc. ....	11	2
Material handling operations .....	12	2
Physical activity, not elsewhere classified <sup>1</sup> ..	46	9

<sup>1</sup> Includes walking, sitting, running, and climbing ladders or stairs.

NOTE: Totals for 2001 exclude fatalities resulting from the September 11 terrorist attacks. Totals for major categories may include subcategories not shown separately.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, in cooperation with State, New York City, District of Columbia, and Federal agencies, Census of Fatal Occupational Injuries.

slightly more than 18 percent were directing or flagging traffic, and 7 percent were resurfacing or blacktopping. (See table 7.)

## Notes

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<sup>1</sup> Preliminary data for 2002 are used in this analysis.

<sup>2</sup> For more information on the Manual on Uniform Traffic Control Devices, see <http://mutcd.fhwa.dot.gov/>

<sup>3</sup> See <http://safety.fhwa.dot.gov/roaduser/wzs.htm>

<sup>4</sup> For an examination of worker fatalities in highway work zones from 1992 to 1998, see pages 5 and 6 of *Building Safer Highway Work Zones: Measures to Prevent Worker Injuries from Vehicles and Equipment*, on the Internet at: <http://www.cdc.gov/niosh/pdfs/01-128.pdf>

<sup>5</sup> See <http://mutcd.fhwa.dot.gov/pdfs/2003r1/Ch6A-E.pdf>, page 6C–2.

<sup>6</sup> CFOI uses a location code of 65 to designate fatal work injuries that occur at road construction sites.

<sup>7</sup> Ascertaining whether a record should be recoded as a road construction fatality was sometimes complicated by vague and/or incomplete narratives. For the borderline cases, the determination as to whether a fatality occurred at a road construction site was made by examining the combination of the narrative, industry, occupation, and worker activity. Because there are various definitions of what constitutes a road construction site, different people may make different determinations as to whether a fatal work injury occurred at a road construction site. For this analysis, the reclassifications were made by the author with input from CFOI staff. These reclassifications were based on a consistent set of requirements formulated by the author and CFOI staff.

<sup>8</sup> The examination of the narratives should mitigate the problems arising from the application of the location code. The breakdown for added records is as follows:

Years	Records added	Years	Records added
1995 .....	63	1999 .....	53
1996 .....	47	2000 .....	43
1997 .....	36	2001 .....	45
1998 .....	37	2002 .....	24

In total, 496 records were included because the location code was 65-road construction. An additional 348 were added after examining records.

<sup>9</sup> See Table 61 in <http://www.nrd.nhtsa.dot.gov/pdf/nrd-30/NCSA/TSEAnn/TSE2001.pdf>

<sup>10</sup> Camille Villanova, "Looking for Safety Zones," *Job Safety and Health Quarterly*, Vol. 11, No. 3, p. 19. For more information on TEA–21, see <http://www.fhwa.dot.gov/tea21/>

<sup>11</sup> For more information on the reauthorization on TEA–21, see <http://www.fhwa.dot.gov/reauthorization/index.htm>

<sup>12</sup> See <http://www.cdc.gov/niosh/pdfs/01-128.pdf>

<sup>13</sup> The National Work Zone Safety Information Clearinghouse was the product of collaboration between the American Road & Transportation Builders Association (ARTBA) and the Federal Highway Administration. Now, it is run jointly by ARTBA and the Texas Transportation Institute. For more information, access <http://wzsafety.tamu.edu> and <http://wzsafety.tamu.edu/files/brochure.stm>

<sup>14</sup> Material moving equipment operators include occupations such as operating engineers; excavating and loading machine operators; and grader, dozer, and scraper operators.