

AN ANALYSIS OF FATAL EVENTS IN THE CONSTRUCTION INDUSTRY 2004

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This report is based upon OSHA-inspected fatal events in construction during calendar 2004. The data analyzed were provided by Dr. Joseph Dubois, Director, Office of Statistics, Occupational Safety and Health Administration. William R. Schriver, Ph.D., Research Director, Thomas E. Cressler II, M.S., Associate Director and James E. Beavers, P.E., Ph.D., Director, conducted the study and prepared this report; they alone are responsible for all interpretations, conclusions and any errors found in the report.

Executive Summary

OSHA inspected 785 fatal construction incidents (excluding non-work related causes), involving 806 fatalities, in calendar year 2004. Five of the 30 proximal causes classified in this report accounted for 345 (43.9 percent) of the fatal events investigated. They were: (1) *Falls from/through Roofs*: 108 events (13.8 percent); (2) *Crushed/Runover of Non-Operator of Construction Equipment*: 75 events (9.6 percent); (3) *Falls from/with Structures*: 63 events (8.0 percent); (4) *Lifting Operations*: 51 events (6.5 percent); and (5) *Electrocution from Equipment Installation/Tool Use*: 48 events (6.1 percent).

A comparison of the year-to-year ranks of the proximal causes during the 1991-2004 period shows that they are highly and significantly correlated, i.e., the individual ranks of the causes vary very little from year-to-year.

Most of the fatal events involved a single victim, but 17 (2.2 percent) of the events were multi-fatality events which accounted for 38 (4.7 percent) of the fatalities.

Other findings were: (1) in 429 (54.6 percent) of the fatal events the victim was judged to be the primary initiator of the cause; in 107 events (13.6 percent) another employee was judged to be the primary initiator of the cause; in 212 events (27.0 percent) the victim was judged to be simply in the wrong place at the wrong time; and the remaining 37 events (4.7 percent) could not be classified; (2) in 578 of the events (73.6 percent) the victim was judged to be performing work at the task site when injured; in 114 events (14.5 percent) the victim was relocating between work stations; in 21 events (2.7 percent) the victim was judged to be entering, leaving or away from their task site when injured; and in 72 events (9.2 percent) no classification was possible; and (3) most fatal events happened on Tuesday with 160 (20.4 percent) events occurring that day of the week, followed by Mondays with 152 (19.4 percent) occurring that day; and most fatal events happened between the 10:00 and 11:00 hours (10:00 am and 11:00 am) with 111 (14.1 percent) events occurring during this time interval, followed by 11:00 to 12:00 with 91 (11.6 percent) events occurring in each of these periods.

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I. Introduction

This paper reports on the direct causes of fatal events in the construction industry which occurred in calendar year 2004. Eleven earlier studies¹ by the Construction Industry Research and Policy Center (CIRPC) analyzed the causes of fatal events in this industry in 1991-1992, 1993-1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002 and 2003.

II. Data

The data analyzed in this report, provided by OSHA from Form 170's, consist of narrative descriptions of the 785 fatal events inspected by OSHA resulting from accidents which occurred in construction during calendar year 2004. The Occupational Safety and Health Act of 1970 provides States with the option of administering the Act themselves or accepting Federal administration of the Act. Twenty-nine States and the District of Columbia chose administration under the Federal System, and the remaining 21 States and two Territories chose self-administration under State Plans².

In this report, as in earlier reports, analysis includes all OSHA-inspected fatal construction events regardless of Federal or State administration.

Also, as in the earlier studies, non-accidental fatalities on construction sites or contractor yards (such as deaths from non-work related heart attacks, strokes, seizures, etc.) and fatalities of construction workers killed off-site in traffic accidents were excluded from the analysis; these

¹ An Analysis of Fatal Events in the Construction Industry, 1991-1992 (1993), An Analysis of Fatal Events in the Construction Industry, 1993-1994 (1995), An Analysis of Fatal Events in the Construction Industry, 1995 (1996), An Analysis of Fatal Events in the Construction Industry, 1996 (1997), An Analysis of Fatal Events in the Construction Industry, 1997 (1999), An Analysis of Fatal Events in the Construction Industry, 1998 (2000), An Analysis of Fatal Events in the Construction Industry, 1999 (2001), An Analysis of Fatal Events in the Construction Industry, 2000 (2002), An Analysis of Fatal Events in the Construction Industry, 2001 (2003), An Analysis of Fatal Events in the Construction Industry, 2002 (2004) and An Analysis of Fatal Events in the Construction Industry, 2003, (2005). Construction Industry Research and Policy Center, University of Tennessee, Knoxville.

² States in the Federal System are: AL, AR, CO, CT, DE, DC, FL, GA, ID, IL, KS, LA, ME, MA, MS, MO, MT, NE, NH, NJ, NY, ND, OH, OK, PA, RI, SD, TX, WV and WI. States and Territories under State Plans are: AK, AZ, CA, HI, IN, IA, KY, MD, MI, MN, NV, NM, NC, OR, PR, SC, TN, UT, VT, VI, VA, WA and WY.

fatalities accounted for about 3 percent of OSHA-inspected fatal construction events in 1991-2003 but about 5 percent in 2004. Although the Occupational Safety and Health Act of 1970 requires employers to report fatalities to OSHA within eight hours of the occurrence of the event, all fatalities on construction sites are not inspected by OSHA; for example, OSHA does not inspect fatal construction events involving independent contractors with no employees. Therefore, the results reported upon here do not provide a year-to-year analysis of changes in the absolute number of fatal events or individuals killed on construction sites.

Each narrative record typically consists of a brief description of the event leading to the fatality, although this is not always the case. Where the narrative description was omitted, inconclusive or completely unclear the event cause was coded “unknown cause or other”; otherwise each narrative was analyzed and classified into one of 31 cause categories, although a great deal of collective judgment was often required to classify the cause of many of the accidents.

This report also includes the following classification of each fatal event according to coding by the OSHA compliance officer who investigated the accident: (1) type of construction (new or addition, alteration or rehabilitation, maintenance or repair, demolition, other); (2) estimate of total project value (seven dollar-value categories beginning with “under \$50,000” and ending with “\$20,000,000 and over”); (3) 17 end-use categories, such as “single-family housing,” “multi-family building,” “commercial building,” “street or highway,” etc.; and (4) the construction operation being performed that caused the fatal event (selected from a list of construction operations such as “backfilling and compacting,” “cutting concrete pavement,” “erecting structural steel,” “installing equipment (HVAC and other,” etc.). However, CIRPC’s review of over 1200 case files of fatal construction events occurring in 1997, 1998 and 1999

revealed that coded data for an event were sometimes internally inconsistent or did not comport with corresponding narrative descriptions. Consequently, the data analyzed in this report are restricted to the direct causes of the fatal events where the authors were able, in most cases, to classify the events with relative certainty according to 31 types of causes, essentially the same types as were used in CIRPC's previous fatality studies. However, coded data are included in Appendix C for the following: (1) end-use of structure; (2) type of construction; (3) occupation of the victim(s); (4) contract value of the construction project; and (5) construction operation associated with the fatality.

In classifying the events a rule of primacy was followed for multiple-cause fatalities (representing less than 1 percent of the fatality events in this study and the earlier studies cited): the first cause in the chain of causes was recorded as the cause of the fatal event. Definitions of the causes are shown in Appendix A.

III. Analysis of Fatal Events by Cause

A. Distribution of Fatal Events by Cause

Table 1 shows the cause classification system, the number of times each cause represented a fatal event in 2004, the relative frequency of each cause and the number of victims killed.³ It can be seen that "fall from/through roof" led all other causes in number of fatal events (108 or 13.8 percent of total fatal events), followed by "crushed/run-over of non-operator by operating construction equipment" (75 or 9.6 percent). The third leading cause was "fall from/with structure" (63 or 8.0 percent); the fourth leading cause was "lifting operations" (51 or 6.5 percent); the fifth leading cause was "electrocution from equipment installation/tool use" (48

³ Each event included at least one person killed and in several events additional workers were killed or injured.

Table 1. Construction Fatality Event Causes, 2004

Event Causes	Description	Number of Events and Victims		Percent of Events
		Events	Victims	
1.	asphyxiation/inhalation of toxic vapor	15	18	1.9
2.	caught in/struck by stationary equipment	5	6	0.6
3.	crushed from collapse of structure	32	36	4.1
4.	crushed/run-over of non-operator by operating construction equipment	75	75	9.6
5.	crushed/run-over/trapped of operator by operating construction equipment	34	34	4.3
6.	crushed/run-over by construction equipment during maintenance/modification	18	18	2.3
7.	crushed/run-over by highway vehicle	19	19	2.4
8.	drown, non-lethal fall	6	6	0.8
9.	electric shock by touching exposed wire	15	15	1.9
10.	electric shock by equipment contacting power source	34	36	4.3
		<u>Event</u>	<u>Percent</u>	
a.	ladder	11	1.4	
b.	scaffold	0	0.0	
c.	crane/lifting equipment/boom/dump truck	15	1.9	
d.	contact while handling materials such as gutters, iron rods, etc.	8	1.0	
11.	electric shock from equipment installation/tool use	48	48	6.1
12.	electric shock, other	3	3	0.4
13.	elevator (struck/crushed by elevator or counter weights)	2	2	0.3
14.	fall from/with ladder: includes collapse/fall of ladder	41	41	5.2
15.	fall from/through roof	108	109	13.8
		<u>Event</u>	<u>Percent</u>	
a.	fall off of roof	57	7.3	
b.	fall through roof other than skylight	22	2.8	
c.	fall through skylight or other opening	29	3.7	
16.	fall from highway vehicle/construction equipment	2	2	0.3
17.	fall from/with scaffold	24	24	3.1
18.	fall from/with bucket (aerial lift/basket)	15	15	1.9
19.	fall from/with structure (other than roof)	63	63	8.0
		<u>Event</u>	<u>Percent</u>	
a.	fall with collapse of structure	9	1.1	
20.	fall from/with platform or catwalk	18	20	2.3
21.	fall through opening (other than roof)	26	26	3.3

22.	fall, other or unknown	3	3	0.4
23.	fire/explosion/scalding	13	17	1.7
24.	hyperthermia/hypothermia	3	3	0.4
25.	hit, crushed, fall during lifting operations	51	53	6.5
26.	struck by falling object/projectile (including tip-overs)	37	37	4.7
27.	crushed/suffocation from trench collapse	37	39	4.7
28.	crushed while unloading-loading equipment/material (except by crane)	20	20	2.5
29.	shock/burn from lightning	3	3	0.4
30.	crushed other	1	1	0.1
31.	unknown cause or other	14	14	1.8

		<u>Event</u>	<u>Percent</u>
a.	Other	3	0.4

Total		<u>785</u>	<u>806</u>	<u>100.00</u>
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or 6.1 percent); and the sixth leading cause was “fall from/with ladder” (41 or 5.2 percent). The number and relative frequencies of the remaining causes of the 785 fatal events analyzed may be read directly from Table 1. (Comparative frequencies for earlier years are shown in Figures B1 through B4 in Appendix B.)

At the risk of misleading the reader by over generalizing, it may be informative to describe frequently occurring specific examples of situations leading to the 10 most frequent causes of fatal events listed in Table 1.

Falls from /with/through Roofs. An inattentive roofer or laborer without fall protection walks backward and off the roof or steps into a skylight opening or on to a covered skylight opening.

Crushed, Run-over, Non-operator. A laborer guiding trucks while backing up, a grade checker or a laborer performing site clean-up in proximity of excavating machinery is run-over after getting out of the line-of-sight of an operator/driver.

Falls from/with Structures. An ironworker without fall protection slips or loses balance while erecting steel frame and falls or a carpenter or an ironworker falls as a result of a collapsing structure or structural component (14.3 percent of falls from/with structures were caused by collapses.)

Lifting Operations. A boom is moved before the disconnect is completed causing the load to fall on a worker. A lifting sling is improperly set causing the sling to break or the load to shift and fall on a worker.

Electrocution from Equipment Installation. An electrician, helper or lineman working “hot” inadvertently contacts an energized source by body, uninsulated tool or jumper.

Fall from/with Ladder. The most common causes were failure to secure the ladder allowing it to slip at the base or to the side when the worker used the ladder or the worker simply lost his/her balance.

Struck by Falling Object/Projectile. There were a wide variety of situations in which this type of event occurred, and no typical pattern was evident. Examples of situations were: struck by nails from nail guns, struck by cap on a pressurized line, debris falling during demolition, equipment falling from roof and falling trees.

Trench Collapse. A laborer or pipelayer is working in an unprotected trench (without sloping, shoring or trench box) and a trench wall collapses, killing the worker.

Crushed/Run-over...Operator. Mobile construction equipment, such as dozers and fork lifts, goes over an embankment and rolls over or rolls over when encountering uneven terrain, resulting in the crushing of the operator. (The operator may be crushed inside the equipment or crushed by the equipment while trying to escape.)

Equipment Contacting Electric Line. Lifting equipment, such as a crane or lull, or a ladder is positioned into an overhead electric line resulting in the electrocution of the worker who becomes a ground.

The number of victims killed by each cause is also shown in Table 1 where it can be seen that in most events only one worker was killed per event. There were 21 fatality causes where no event had multiple fatalities; only 9 fatality causes included events with multiple fatalities.

“Fire/explosion/scalding” was the fatality cause which had the most victims killed per event, i.e., 13 events and 17 victims or 1.3 victims per event.

The Bureau of Labor Statistics (BLS) reported that during 1995-1999, 4 percent of all fatal work-related events involved multiple fatalities, and these multiple-fatality events accounted for 10 percent of the workers killed during the period. They averaged three fatalities per incident.⁴

The OSHA data for construction fatalities in 2004 show that 2.2 percent of the fatal events had multiple fatalities, and they accounted for 4.7 percent of the individuals killed. The multiple-fatality construction incidents averaged 2.2 fatalities per incident. It should be noted that the BLS data included homicides, and they accounted for 19 percent of their multi-fatality incidents. Homicides were excluded from the analysis of OSHA data, but they were all single-fatality events.

⁴ Drudi, Dino and Mark Zak, “Work-Related Multi-Fatality Incidents,” Monthly Labor Review, Vol. 127, No. 10, October 2004.

Table 2 shows a comparison of the ranks of the causes in 2004 with the average rank of the causes of fatal events during the period 1991 - 2003. It can be seen that the overall rank pattern of the causes in 2004 is very similar to the rank pattern in 1991 – 2003. An overall statistical comparison of the correlation of the rank in 2004 with the average rank in 1991-2003 was calculated using a Spearman rank correlation procedure.⁵ The correlation obtained was + .94, $p < .001$, indicating that the ranks of the causes in the two time periods are highly and positively correlated, i.e., did not change significantly between 1991 – 2003 and 2004⁶. Since averaging the 1991 – 2003 ranks removed inter-year variance; a somewhat lower correlation would be expected between 2003 and 2004 ranks of causes, i.e., a measure of the short-term cycle as opposed to a longer-term trend. The Spearman rank-order correlation between 2003 and 2004 causes was calculated and found to be + .93, $p < .001$, indicating that the 1991-2002 pattern changed very little between 2003 and 2004.

The correlation result is not surprising given that the general composition of construction output, and therefore the mix of construction operations required to produce the output, was probably very similar during the time periods examined. This interpretation implies that the rank of a cause is a function of the magnitude of exposure to the cause and/or the inherent danger associated with the cause.

⁵ Sidney Siegel, Nonparametric Statistics for the Behavioral Sciences (New York: McGraw-Hill Book Co., Inc., 1956), p. 219.

⁶Five of the 719 fatal events in 2002 and 17 of 719 fatal events in 2001 had either no narrative or a narrative too incomplete to classify the cause of fatality. These records were coded as “unknown” cause; this was not done in prior years. They were omitted from the calculation of the Spearman Rank correlation in order to avoid data distortion.

Table 2. Comparison of Ranks of Causes of Fatal Events in 1991 - 2003 with 2004

<u>Event</u>	<u>1991 - 2003 Average</u>			<u>2004</u>		
	<u>Number</u>	<u>Percent</u>	<u>Rank</u>	<u>Number</u>	<u>Percent</u>	<u>Rank</u>
1. asphyxiation/inhalation of toxic vapor	7.5	1.2	22	15	1.9	20
2. caught in/struck by stationary equipment	6.0	1.0	23	5	0.6	24
3. crushed from collapse of structure	25.8	4.1	9	32	4.1	11
4. crushed/run-over of non-operator by operating construction equipment	48.4	7.7	3	75	9.6	2
5. crushed/run-over/trapped of operator by operating construction equipment	32.8	5.2	6	34	4.3	9
6. crushed/run-over by construction equipment during maintenance/modification	12.2	1.9	21	18	2.3	17
7. crushed/run-over by highway vehicle	24.3	3.9	13	19	2.4	15
8. drown, non-lethal fall	5.5	0.9	24	6	0.8	23
9. electric shock by touching exposed wire	24.4	3.9	12	15	1.9	20
10. electric shock by equipment contacting power source	45.9	7.3	4	34	4.3	9
11. electric shock from equipment installation/tool use	30.6	4.9	7	48	6.1	5
12. electric shock, other	4.2	0.7	28	3	0.4	26
13. elevator (struck/crushed by elevator or counter weights)	2.8	0.4	29	2	0.3	28
14. fall from/with ladder: includes collapse/fall of ladder	25.8	4.1	10	41	5.2	6
15. fall from/through roof	71.3	11.3	1	108	13.8	1
16. fall from highway vehicle/construction equipment	5.4	0.9	25	2	0.3	28
17. fall from/with scaffold	21.2	3.4	14	24	3.1	13
18. fall from/with bucket (aerial lift/basket)	13.2	2.1	19	15	1.9	20
19. fall from/with structure (other than roof)	52.8	8.4	2	63	8.0	3

Table 2. (continued)

<u>Event</u>	<u>1991 - 2003 Average</u>			<u>2004</u>		
	<u>Number</u>	<u>Percent</u>	<u>Rank</u>	<u>Number</u>	<u>Percent</u>	<u>Rank</u>
20. fall from/with platform or catwalk	14.4	2.3	17	18	2.3	17
21. fall through opening (other than roof)	16.6	2.6	15	26	3.3	12
22. fall, other or unknown	4.7	0.7	26	3	0.4	26
23. fire/explosion/scalding	13.8	2.2	18	13	1.7	22
24. hyperthermia/hypothermia	4.3	0.7	27	3	0.4	26
25. hit, crushed, fall during lifting operations	33.4	5.3	5	51	6.5	4
26. struck by falling object/projectile (including tip-overs)	25.3	4.0	11	37	4.7	7
27. crushed/suffocation from trench collapse	29.9	4.8	8	37	4.7	7
28. crushed while unloading-loading equipment/material (except by crane)	12.4	2.0	20	20	2.5	14
29. shock/burn from lightning, other	14.7	2.3	16	18	2.3	17
TOTAL	<u>629.7</u>	<u>100.0</u>		<u>785</u>	<u>100.0</u>	

While the number of OSHA-inspected fatal construction events have had an upward trend since 1991, employment in construction establishments has also increased.⁷ The trend of these fatal events per 100,000 construction establishment employees is as follows: 1991 – 1992: 13.1; 1993 – 1994: 11.8; 1995: 11.4; 1996: 10.5; 1997: 10.6; 1998: 10.4; 1999: 11.0; 2000: 9.5; 2001: 10.8; 2002: 10.7; 2003: 10.5; and 2004: 11.4.

IV. Analysis by Victim’s Situation

An analysis was performed to classify the fatal events by four general categories: (1) victim(s) was primary, immediate contributor to the event; (2) person(s) other than victim(s) was primary, immediate contributor to the event; (3) no individual directly contributed to the event, the victim(s) being “at the wrong place at the wrong time”; and (4) unknown.

The first category includes, for example, most falls, crushing/runover of operators, electrocutions other than those occurring during lifting operations, asphyxiations and hypothermia. The second category includes, for example, most crushing/runover of nonoperators, lifting operations, loading/unloading of equipment/materials, struck by highway vehicles, falls from/with aerial lifts, and electrocutions from crane boom/tackle contacting overhead powerlines. The third category includes, for example, most structure and trench collapses, struck by projectile/falling objects, and lightning.

Although the classifications were often subjective due to a lack of precise information or conflicting information, following are the results for the 785 events: (1) victim primary initiator of event: 429 events (54.6) percent; (2) person other than victim was primary initiator: 107 events (13.6 percent); (3) “wrong place at wrong time”: 212 events (27.0 percent); and (4) unknown: 37 events (4.7 percent).

⁷ Bureau of Labor Statistics, National Employment, Hours, and Earnings.

An additional classification of the 785 fatal events was also performed to estimate the distribution of events by work status of the victim: (1) victim(s) was performing his task (as opposed to going to/from task station); (2) victim was relocating between task stations; (3) leaving/returning for breaks, lunch, etc., or beginning/ending work day; and (4) unknown.

The first category includes, for example, many roofing fatalities, fatalities resulting from structure and trench collapses, events involving crushing/runover of operators, electrocutions while installing electrical equipment, workers caught in stationary equipment and workers falling from/with aerial lifts and scaffolds.

The second category includes, for example, some nonoperators crushed/runover by construction equipment, foremen/supervisors, ladder falls, laborers/riggers awaiting completion of lifts and workers climbing/relocating during building steel erection and communication tower erection/alteration.

As with the previously discussed classification of who initiated the event, the work status classifications were also subjective – perhaps even more so. Never-the-less, it may be useful in understanding in a general sense the situations in which construction fatalities occur. It was found that: (1) 578 (73.6 percent) of the fatal events involved workers performing work at their task site; (2) 114 (14.5 percent) of the events involved workers relocating between task stations; (3) 21 (2.7 percent) of the events involved workers entering, leaving or away from their task site; and (4) 72 (9.2 percent) of the events could not be classified.

V. Analysis of Fatal Events by Day of Week and Time

The fatality data reported on OSHA Form 170 includes the date and time of day of most fatal events. Table 3 shows the distribution of fatal events by day of the week. Contrary to the popular conception that most fatalities occur on Mondays and Fridays, it can be seen that

Tuesday had the largest number of events, 160, followed by Monday and Wednesday with 152 and 141 events respectively, and Friday had the fewest number of fatal events, 119, when weekends are excluded. However, without knowing the total number of construction hours worked each day, it is not possible to conclude that any one day is more or less hazardous than another.

Table 3. Distribution of Fatal Construction Events by Day of Week

<u>Day</u>	<u>Number of Events</u>	<u>Percent</u>
Monday	152	19.4
Tuesday	160	20.4
Wednesday	141	18.0
Thursday	132	16.8
Friday	119	15.2
Saturday	63	8.0
Sunday	<u>18</u>	<u>2.3</u>
Total	785	100.0

Table 4 shows the distribution of fatal events by hour (military) of the day. It can be seen that the two-hour periods (10 – 11) and (11 – 12) before the noon period hour contained the most fatal events, 111 and 91, respectively. As pointed out previously, without knowing the total hours worked in construction each hour, it is not possible to calculate hourly event rates. However, it may be reasonably assumed that the total construction hours worked each hour during the 8-12 hour period and the 13-16 hour period are approximately equal. Even if this were true, the hourly differences would not be statistically significant.

Table 4. Distribution of Fatal Construction Events by Hour

<u>Hour</u>	<u>Number of Events</u>	<u>Percent</u>
0-1	6	0.8
1-2	4	0.5
2-3	1	0.1
3-4	3	0.4
4-5	4	0.5
5-6	3	0.4
6-7	7	0.9
7-8	37	4.7
8-9	48	6.1
9-10	80	10.2
10-11	111	14.1
11-12	91	11.6
12-13	62	7.9
13-14	59	7.5
14-15	84	10.7
15-16	61	7.8
16-17	53	6.8
17-18	25	3.2
18-19	19	2.4
19-20	7	0.9
20-21	9	1.1
21-22	5	0.6
22-23	3	0.4
23-24	3	0.4
<i>Total</i>	<u>785</u>	<u>100.0</u>

APPENDIX A

Definitions of Fatality Causes

1. asphyxiation/inhalation of toxic vapor: lack of oxygen and/or inhalation of toxic gas, (excluding asphyxiation resulting from fire/explosion).
2. caught in/struck by stationary equipment: body or clothing caught pulling worker into equipment.
3. collapse of structure: building or other structure falling on worker, not including falling ladder, scaffold, aerial lift/ basket, platform, with a structure, trench collapse, or wall (earthen) collapse.
4. crushed/run-over of non-operator by operating construction equipment: non-operator run-over or crushed between equipment and ground or another object by an operator controlled piece of construction equipment.
5. crushed/run-over/trapped of operator by operating construction equipment: includes rollover and catching of body in equipment or between equipment and ground or other object while operating the equipment.*
6. crushed/run-over by construction equipment during maintenance/ modification: includes equipment/parts falling on worker while assembling or disassembling equipment.
7. crushed/run-over by highway vehicle: any run-over by non-construction equipment, including trains.
8. drown, non-lethal fall: non-lethal falls into water and flooding of container, trenches, etc.
9. electrocution by touching exposed wire/source: body part contacting the wire/source except when installing equipment or using a tool.
10. electrocution by equipment contacting wire
 - a. ladder
 - b. scaffold
 - c. crane/lifting equipment/boom/dump truck:
 - d. other: contact while handling materials, e.g. gutters, iron rods, painting equipment, etc.
11. electrocution from equipment installation/tool use: includes failure to de-energize equipment, inappropriate energizing, contacting energized part with tool or body, and inadequately grounded tools or exposed tool wires.
12. electric shock, other and unknown cause
13. elevator (struck/crushed by elevator or counter-weights):
14. fall from/with ladder: includes collapse/fall of ladder.

*Includes fatalities resulting from asphyxiation/fire/explosion/drowning of trapped operators.

15. fall from roof; fall through roof: skylight or other opening.
 - a. fall off of roof
 - b. fall through roof other than skylight
 - c. fall through skylight or other opening
16. fall from vehicle (vehicle/construction equipment): falls from vehicle or equipment while in motion or at rest.
17. fall from/with scaffold: includes collapse/fall of scaffold.
18. fall from/with bucket (aerial lift/basket): includes collapse/fall of bucket.
19. fall from/with structure (other than roof): fall through opening in the side or through the floor (not opening in the floor) and with the structure in a collapse.
 - a. fall with collapse of structure
20. fall from/with platform or catwalk (attached to structure: includes collapse/fall of platform).
21. fall through opening (other than roof): falls through stairwells, equipment openings, or other openings in a floor.
22. fall, other or unknown
23. fire/explosion/scalding, excluding electrical burns/explosions
24. heat/hypothermia
25. lifting operations: failure of equipment, inappropriate lifting, and all loading and unloading by crane operations except electrocution. (Includes objects falling and striking victim during lifting operation).
26. struck by falling object/projectile (including tip-overs): does not include collapse of structure, trench, earthen wall, or lifting operations.
27. trench collapse: includes earthen wall
28. unloading-loading equipment/material (except by crane): includes slipping and tipping over of construction equipment/material while loading and unloading.
29. lightning
30. crushed
31. unknown cause or other
 - a. other

APPENDIX B

Figure B1. Comparison of Construction Fatality Events (1995-2003 with 2004)

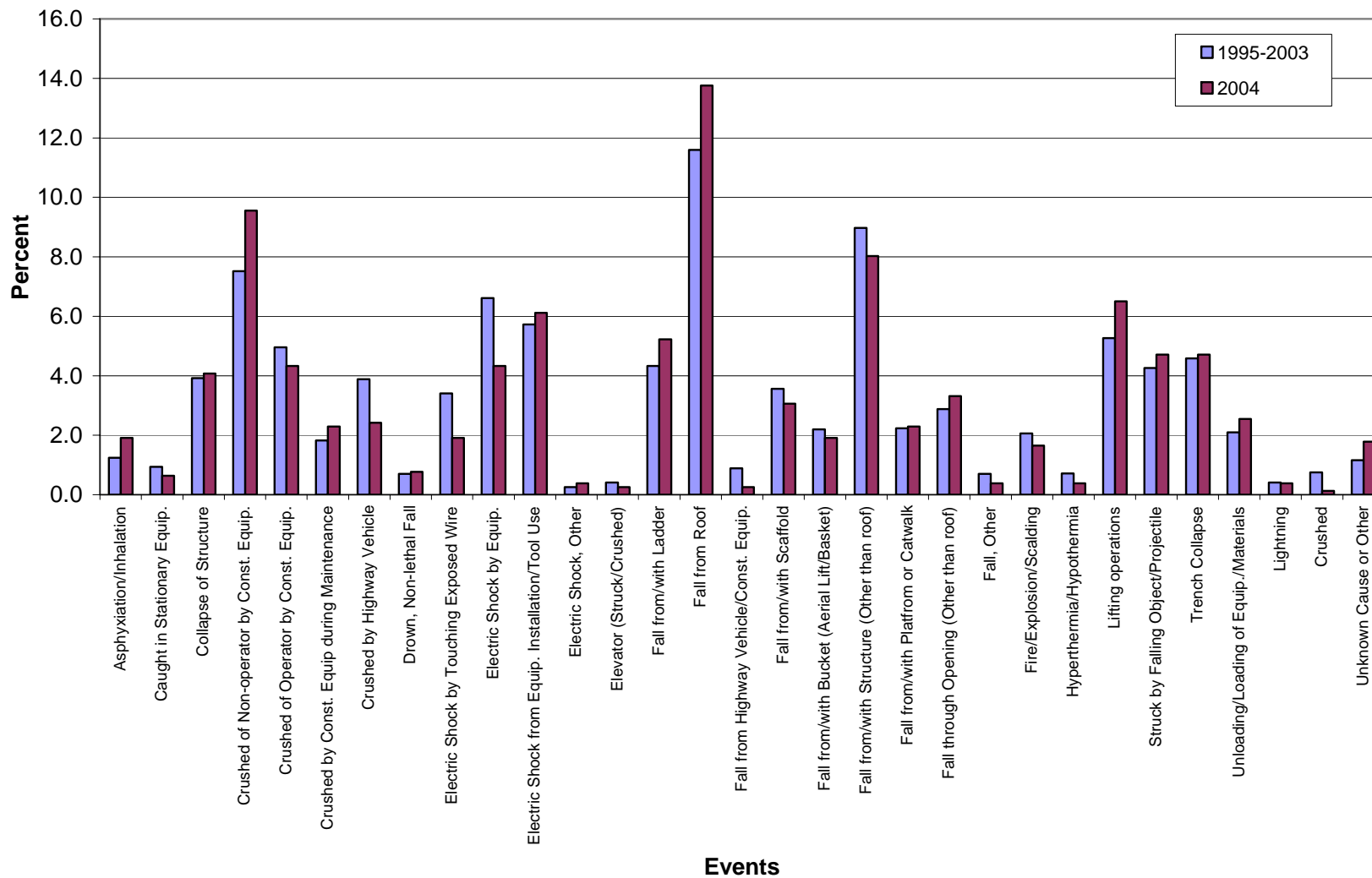


Figure B2. Comparison of Construction Fatality Events (2004)

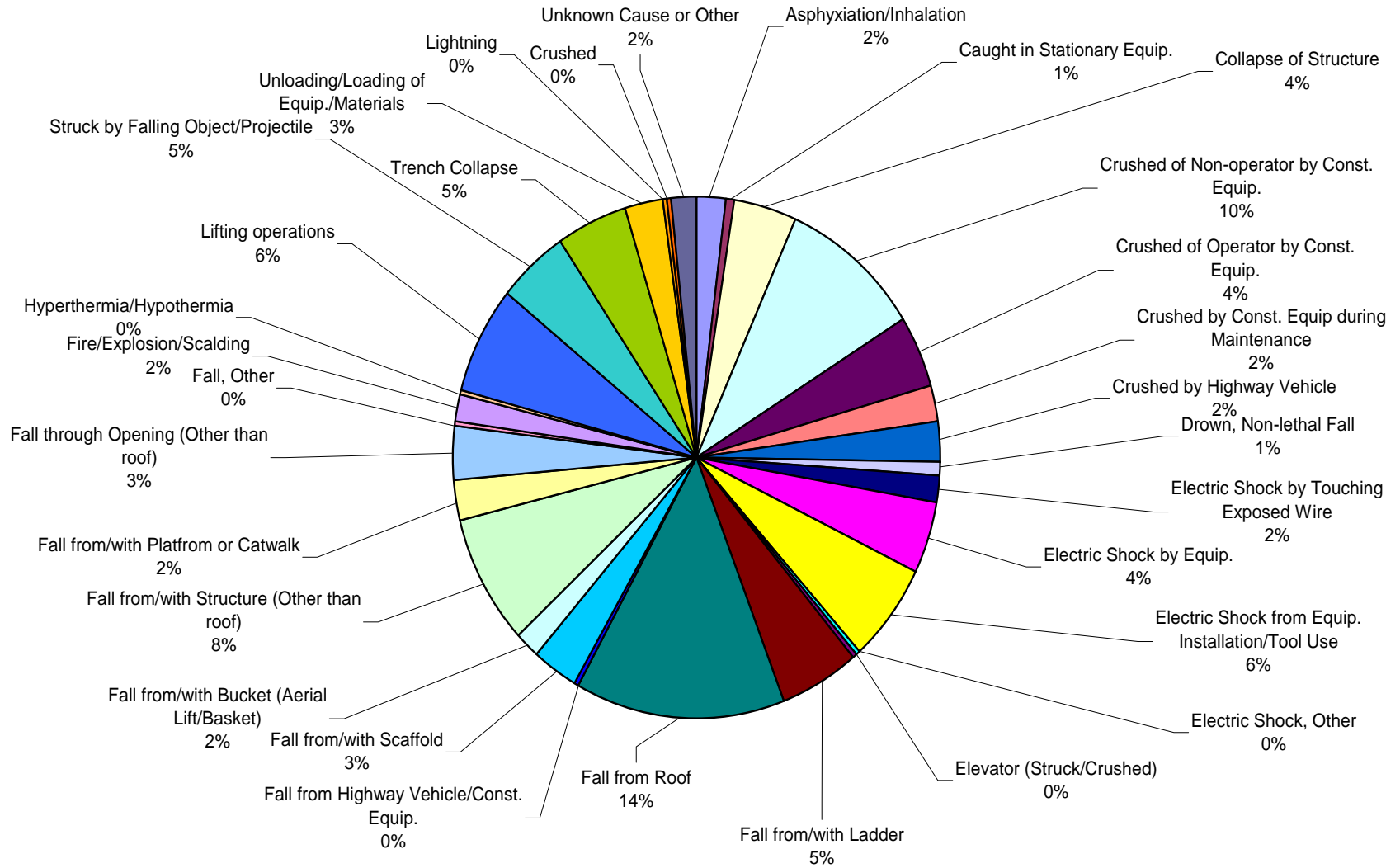


Figure B3. Comparison of Construction Fatality Events (1995-2003)

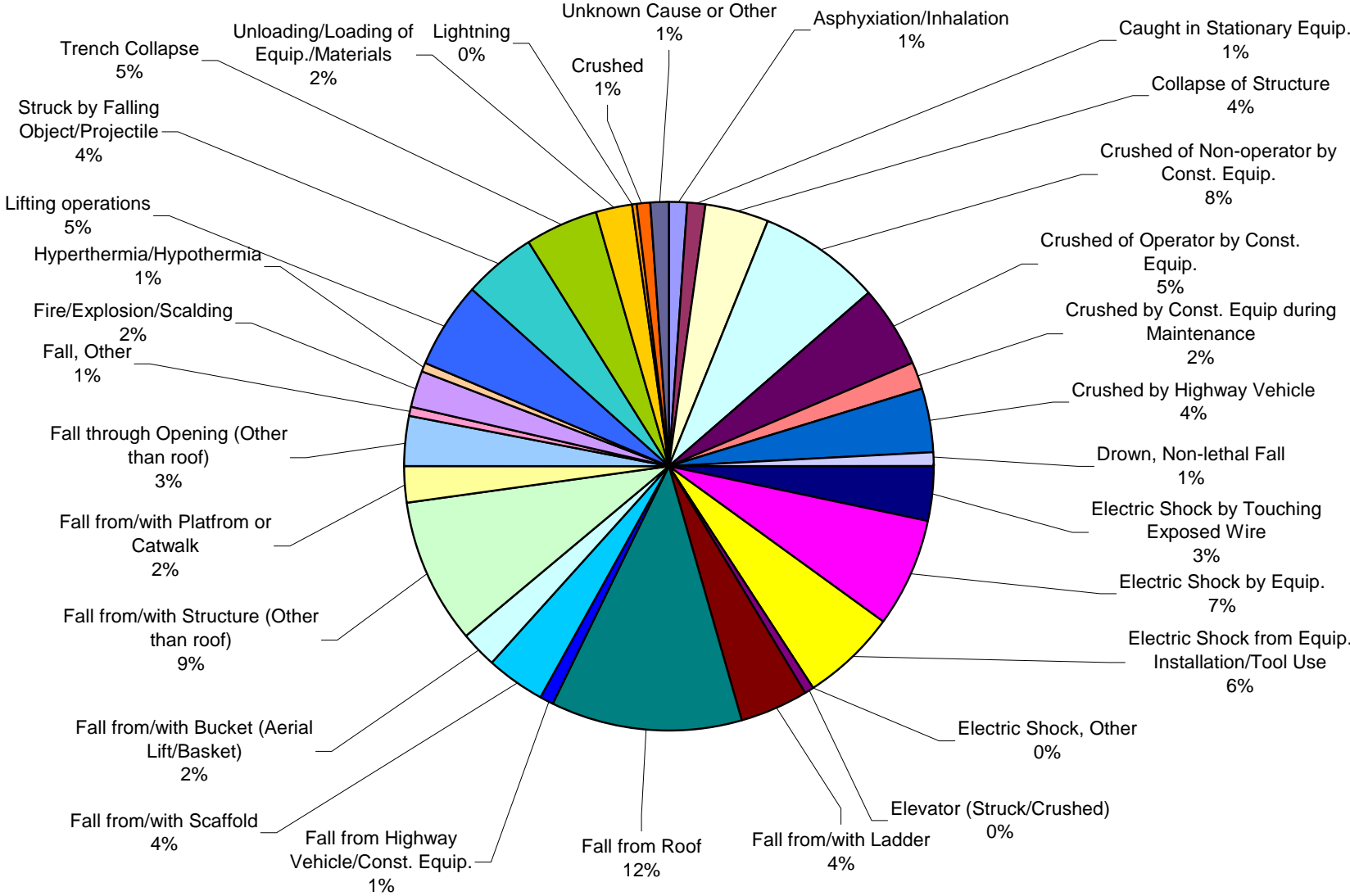
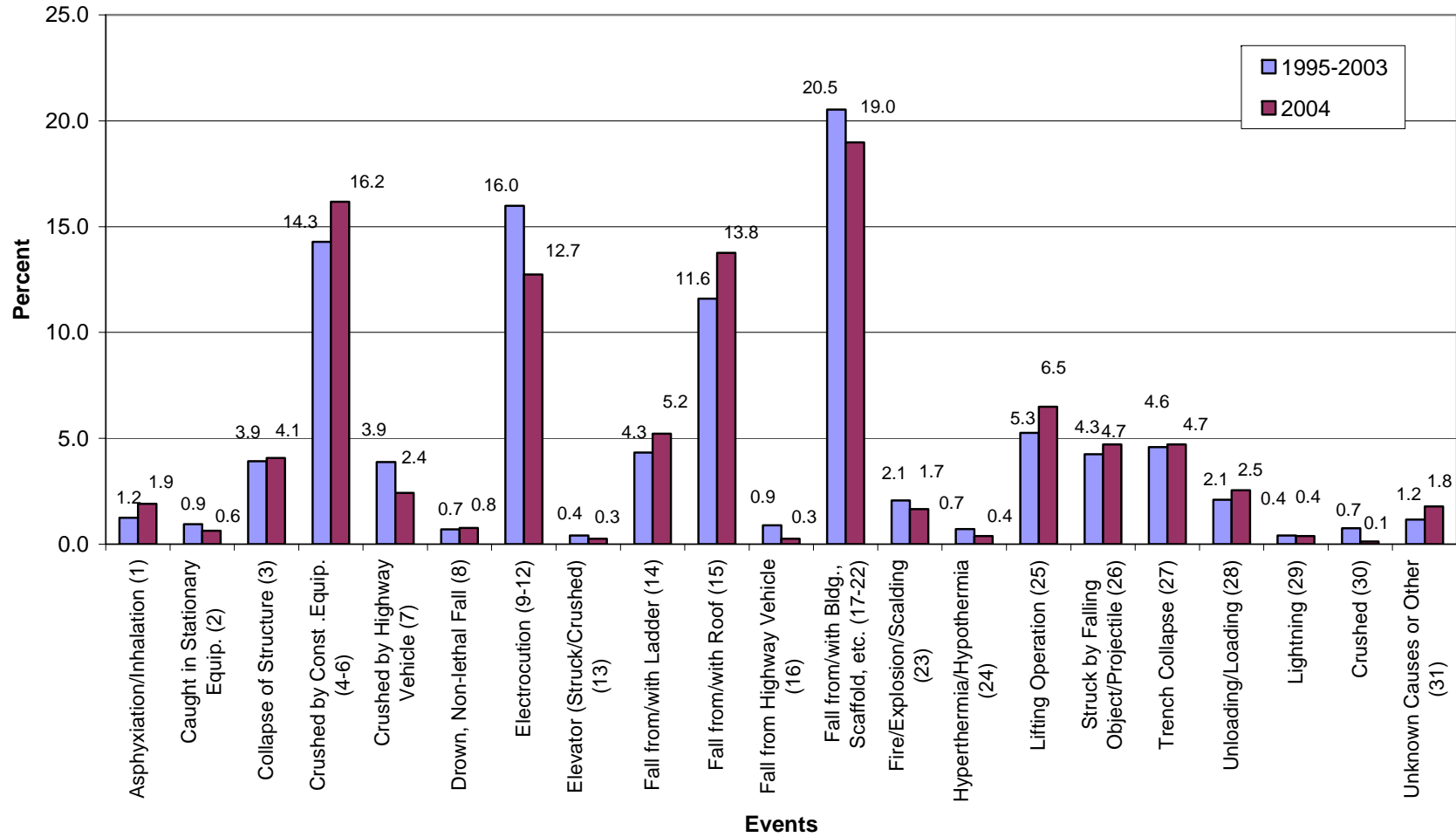


Figure B4. Comparison of Construction Fatality Events (1995-2003 and 2004)



APPENDIX C

Table C1. Construction Fatal Events by End-Use Type, 2004

End Use Type	Description	Number of Frequency	Percent	Cumulative Percent
1	Bridge	24	3.06	3.06
2	Commercial Building	162	20.64	23.69
3	Contractor's Yard/Facility	11	1.40	25.10
4	Excavation, Landfill	14	1.78	26.88
5	Highway, Road, Street	86	10.96	37.83
6	Manufacturing Plant	17	2.17	40.00
7	Multi-Family Dwelling	62	7.90	47.90
8	Other Building	122	15.54	63.44
9	Other Heavy Construction	17	2.17	65.61
10	Pipeline	20	2.55	68.15
11	Powerline, Transmission Line	17	2.17	70.32
12	Powerplant	12	1.53	71.85
13	Refinery	3	0.38	72.23
14	Sewer/Water Treatment Plant	22	2.80	75.03
15	Shoreline Development, Dam, Reservoir	1	0.13	75.16
16	Single Family or Duplex Dwelling	170	21.66	96.82
17	Tower, Tank, Storage Elevator	20	2.55	99.36
18	Missing	<u>5</u>	<u>0.64</u>	100.00
		785	100.00	

Table C2. Construction Fatal Events by Type of Project, 2004

Project Type	Description	Number of Frequency	Percent	Cumulative Frequency
1	New, Addition and Alteration Construction	553	70.45	70.45
2	Maintenance, Repair and Demolition	181	23.06	93.50
3	Other	46	5.86	99.36
X	Missing	<u>5</u>	0.64	100.00
		785		

The coding for these data could not be verified.

Table C3. Construction Fatal Events by Four-Digit SIC, 2004

Description	SIC	Number of Frequency	Percent	Cumulative Percent
General Contractors - Single Family Houses	1521	23	2.93	2.93
General Contractors - Residential Buildings Other than Single Family	1522	13	1.66	4.59
Operative Builders	1531	2	0.25	4.84
General Contractors - Industrial Building and Warehouses	1541	15	1.91	6.75
General Contractors - Non-residential Buildings, other than Industrial and Warehouse	1542	40	5.10	11.85
Highway and Street Construction, Except Elevated Highways	1611	61	7.77	19.62
Bridge, Tunnel, and Elevated Highway Construction	1622	12	1.53	21.15
Water, Sewer, Pipeline, and Communications and Power Line Construction	1623	61	7.77	28.92
Heavy Construction, Not Elsewhere Classified	1629	39	4.97	33.89
Plumbing, Heating and Air-Conditioning	1711	37	4.71	38.60
Painting and Paper Hanging	1721	31	3.95	42.55
Electrical Work	1731	65	8.28	50.83
Masonry, Stone Setting, and Other Stone Work	1741	33	4.20	55.03
Plastering, Drywall, Acoustical, and Insulation Work	1742	10	1.27	56.31
Terrazzo, Tile, Marble, and Mosaic Work	1743	1	0.13	56.43
Carpentry Work	1751	46	5.86	62.29
Floor Laying and Other Floor Work, Not Elsewhere Classified	1752	3	0.38	62.68
Roofing, Siding, and Sheet Metal Work	1761	86	10.96	73.63
Concrete Work	1771	29	3.69	77.32
Water Well Drilling	1781	3	0.38	77.71
Structural Steel Erection	1791	39	4.97	82.68
Glass and Glazing Work	1793	8	1.02	83.69
Excavation Work	1794	38	4.84	88.54
Wrecking and Demolition Work	1795	17	2.17	90.70
Installation or Erection of Building Equipment, Not Elsewhere Classified	1796	8	1.02	91.72
Special Trade Contractors, Not Elsewhere Classified	1799	<u>65</u> 785	<u>8.28</u> 100.00	100.00

Table C4. Construction Fatal Events by Project Value, 2004

Project Value Code	Description	Number of Frequency	Percent	Cumulative Percent
1	Under \$50,000	245	31.21	31.21
2	\$50,000-\$250,000	150	19.11	50.32
3	\$250,000-\$500,000	78	9.94	60.25
4	\$500,000-\$1,000,000	72	9.17	69.43
5	\$1,000,000-\$5,000,000	111	14.14	83.57
6	\$5,000,000-\$20,000,000	71	9.04	92.61
7	\$20,000,000 and over	53	6.75	99.36
8	Missing	<u>5</u>	<u>0.64</u>	100.00
		785	100.00	

The coding for these data could not be verified.

Table C5. Construction Fatalities by Construction Operation, 2003

Code	Description	Frequency	Percent of Events
01	Backfilling and compacting	17	2.1
02	Bituminous concrete placement	7	0.9
03	Construction of playing fields, tennis courts	1	0.1
04	Cutting concrete pavement	5	0.6
05	Demolition	43	5.3
06	Dredging	2	0.2
07	Elevator, escalator installation	5	0.6
08	Dredging	6	0.7
09	Erecting structural steel	23	2.9
11	Excavation	37	4.6
12	Exterior masonry	29	3.6
13	Exterior cladding	6	0.7
14	Exterior carpentry	46	5.7
15	Exterior painting	29	3.6
16	Fencing, installing lights, signs, etc.	18	2.2
18	Forming	12	1.5
19	Forming for piers or pylons	4	0.5
20	Installing interior walls, ceilings, doors	11	1.4
21	Installing metal siding	7	0.9
22	Installing windows and doors, glazing	9	1.1
23	Installing culverts and incidental drainage	8	1.0
24	Installing equipment (HVAC and other)	36	4.5
25	Installing plumbing, lighting fixtures	15	1.9
26	Installing underground plumbing conduit	16	2.0
27	Interior tile work (ceramic, vinyl, acoustic)	2	0.2
28	Interior masonry	4	0.5
29	Interior plumbing, ducting, electrical work	21	2.6
30	Interior carpentry	14	1.7
31	Interior painting and decorating	3	0.4
32	Landscaping	6	0.7
34	Paving	21	2.6
35	Pile driving	3	0.4
36	Placing bridge deck	2	0.2
37	Placing bridge girders and beams	5	0.6
38	Plastering	4	0.5
39	Pouring or installing floor decks	7	0.9
40	Pouring concrete floor at grade	1	0.1
42	Pouring concrete foundations and walls	6	0.7
43	Roofing	91	11.3

45	Site clearing and grubbing	11	1.4
46	Ships	20	2.5
47	Stripping and curing concrete	6	0.7
48	Surveying	5	0.6
49	Swimming Pool Construction	1	0.1
50	Temporary work (buildings, facilities)	26	3.2
51	Traffic protection	7	0.9
52	Trenching, installing pipe	37	4.6
53	Waterproofing	5	0.6
54	Steel Erection of Solid Web-Connecting	2	0.2
55	Steel Erection Of Solid Web-Bolting-Up/Detail Work	1	0.1
57	Steel Erection of Solid Web – Plumbing-Up	1	0.1
58	Steel Erection of Solid Web-Moving Point To Point	1	0.1
60	Steel Erection Of Open Web Steel Joists-Connecting	1	0.1
65	Steel Erection of Open Web Steel Joists – Landing Materials (Hoisting)	1	0.1
66	Installation Of Decking-Initial Laying Deck (Including Layout & Safety)	8	1.0
67	Installation Of Decking-Final Attachment Deck (Welding/Shear Studs/Etc	2	0.2
69	Installation Of Decking-Hoisting Bundles	1	0.1
70	Other Activities-Installing Ornamental And Architectural Steel	6	0.7
71	Other Activities-Post Decking Detail Work	8	1.0
00	Missing	<u>74</u>	<u>9.2</u>
		806	100.00
