

Revision: Crane-Related Deaths in Construction and Recommendations for Their Prevention

Introduction

The deaths of six construction workers and a bystander, along with injuries to 24 construction workers and first responders in a New York City crane collapse March 15, 2008, set off an alarm within the construction community and city dwellers living in the shadow of large scale projects. Just 10 days later, a 20-foot crane section in Miami fell 30 stories, killing two construction workers and injuring five. New Yorkers, already jittery from the first crane collapse, saw another crane fall in their city May 30, which killed two construction workers and injured one worker and one bystander.

The first New York crane collapse garnered much media attention because of the scale of the event – a high death toll among workers and a visitor killed when the crane’s boom crushed a residential building. But injury and death to bystanders is not a first-time occurrence. Selected examples of crane-related bystander deaths collected from news reports are included in Table 1.

In 2003, OSHA formed a Crane and Derrick Negotiated Rulemaking Advisory Committee (C-DAC) of representatives from industry, labor and government to develop a new safety standard for the construction industry to aid in reducing the number of fatalities. The committee first met in July 2003, and reached a consensus on regulatory language for the new standard on July 9, 2004. On September 16, 2008, OSHA published the proposed crane and derrick rule for public comment in the Federal Register, with a deadline for public comment of December 8, 2008.

In light of the large number of recent fatalities, CPWR first examined the data from the Bureau of Labor Statistics (BLS) in June, 2008 to evaluate trends over time and propose recommendations to prevent future injury and death. Recently, we re-examined the data when further studies showed that many construction workers struck by crane loads were not being counted under the CFOI Source code for cranes. In addition, we gathered data on construction crane injuries and deaths from the Internet from January to August, 2008.

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Methods

Construction industry fatality data for the 2-digit BLS Standardized Industrial Classification (SIC) Codes 15, 16 and 17 for 1992 through 2002 were identified in the Census of Fatal Occupational Injuries (CFOI) database. For 2003-2007, the 2002 North American Industry Code System (NAICS) codes 236-238 were used. The resulting data were entered into a Microsoft Excel 2003 database for analysis.

Construction worker deaths related to cranes were identified by selecting all records with the Source and Secondary Source code 34* (Cranes). In addition, the construction record narratives were searched for the word “crane”. Records involving aerial lifts, and scissor lifts were excluded, but crane man baskets were included.

The CFOI narratives including event, occupation and establishment codes of the crane-related deaths were used to classify deaths by cause, occupation and establishment size. This report identifies the main causes of death, the types of cranes involved in fatal incidents, the trades of those who died, and the size of the employer experiencing the greatest number of fatalities.

Information on construction crane injuries and deaths from January through October, 2008 were gathered from the following Internet sources: CraneAccidents.com, Washington State Department of Labor and Industries, Google, Internet newews articles, OSHA Underground, Cranes Today, and The Weekly Toll.

Results

1992-2006 CFOI Study

The revised study found a total of 632 crane-related construction worker deaths involving 610 crane incidents from 1992-2006, compared to a total of 323 deaths in 307 incidents in the previous study. The revised average is 42 deaths per year, with 18 multiple death incidents involving 40 deaths.

Four main types of cranes have been associated with crane-related fatalities. Of the 610 fatal crane incidents, only 375 could be identified from the record as to type of crane. Of these, 292 (78%) involved mobile or truck cranes. Forty-five of the fatal incidents involved overhead or gantry cranes (12%), 18 involved tower cranes (5%), and 11 involved floating or barge cranes (3%). The remaining 9 reports do not meet BLS publication requirements.

Causes of death

Of the total 632 crane-related deaths, 157 were caused by overhead power line electrocutions (25%), 132 deaths were associated with workers being struck by crane loads, 125 deaths involved being struck by cranes, crane booms/jibs or other crane parts

(20%), 89 deaths involved crane collapses (14%), 56 deaths involved falls (9%), and 30 deaths involved being caught in/between crane parts (5%). (See Table 2.)

Over half of all electrocutions (53%) were associated with the crane boom, cable or load/load line contacting an overhead power line. The rest involved contact of an overhead power line with unspecified parts of the crane. Table 3 describes worker activities leading to electrocutions. Those activities involved workers on foot touching or guiding the crane load or cables, workers operating the crane – including several operators who were electrocuted after jumping from the crane, and workers on foot touching the crane.

Being struck by crane loads was the second leading cause of death. Of the 132 crane load deaths, 42 occurred while loading/unloading (32%), 19 while flagging/directing/guiding the crane load (14%), 9 while operating the crane (7%), and 20 involving other crane-related work (15%). Forty-two deaths involved workers not involved with crane work (32%).

Struck by crane or crane parts was the third leading cause of death. Of the 125 deaths, 64 involved being struck by falling crane booms/jibs. Of these, 36 deaths involved dismantling the boom (56%), 6 involved lengthening the boom (9%), 8 involved breaking of the boom or boom cable (13%), and 14 involved other causes (22%).

Crane collapses were the fourth leading cause of death. An unstable, uneven or icy surface on which the crane was sitting accounted for 12 fatalities (15%). Overloading the crane accounted for another 10 deaths (12%). In 7 cases (9%), the crane load or boom shifted. In 56% percent of the reported cases, there was no information provided as to the cause in the CFOI narrative. Of the 81 crane collapses, 34 involved mobile cranes.

Trades Involved

Construction laborers experienced 191 crane-related deaths between 1992 and 2006 (30%), followed by 101 deaths of heavy equipment operators (16%), which included 62 crane and tower operators. In addition, 86 supervisors/managers/administrators died in crane-related incidents (14%), as did 42 ironworkers (7%), and 41 carpenters (6%). Other trades with fewer numbers of deaths included welders and cutters, electrical workers, mechanics, sheet metal workers, and truck drivers (totaling 27%).

Overall, 188 of the 632 construction workers (30%) were employed by subcontractors with fewer than 10 employees. One hundred and eight individuals (17%) worked for employers with over 100 employees. Twenty-nine of the construction workers who died on the job were self-employed (5%).

January to October, 2008 Construction Crane Injuries and Deaths

An Internet search from January to October, 2008 revealed a total of 83 construction crane incidents involving injuries and deaths. There were a total of 52 deaths and 93 injuries of construction workers deaths, and 4 deaths and 21 injuries of non-construction workers (10 bystanders and 11 rescue workers). These incidents involved 74 mobile cranes, 7 tower cranes, and 2 other cranes.

The causes of 79 incidents involving construction worker deaths and injuries were:

- 26 crane collapses (33%), involving 24 deaths and 54 injuries
- 13 struck by crane load incidents (16%), involving 6 deaths and 10 injuries
- 12 overhead power line contacts (15%), involving 10 deaths and 8 injuries
- 8 struck by other crane part incidents (10%), involving 6 deaths and 6 injuries
- 19 other causes (23%) – including 6 highway incidents, 4 falls, 3 caught in/between, 3 struck by non-crane falling objects, and 1 struck by lightning. These involved 6 deaths and 15 injuries

The causes of the 9 incidents involving bystander deaths and injuries were:

- 3 crane collapses, involving 3 deaths and 14 injuries (including 11 rescue workers)
- 3 highway collisions, involving 1 death and 3 injuries
- 2 work zone intrusions, involving 3 injuries
- 1 struck by falling crane boom, involving 1 injury.

In 2 of the crane collapses and 2 of the highway collisions, construction workers were also killed or injured.

There were construction crane incidents involving deaths and injuries in 33 states, with 24 states involving deaths. New York, Texas and Florida had 28 crane incidents involving 22 deaths and 52 injuries of construction workers, and 1 death and 4 injuries of bystanders, and 11 injuries of rescue workers (in the March 15 NYC tower crane collapse).

Conclusions and Recommendations

The findings of these analyses indicate the number of crane-related deaths and injuries is significant, and do not only involve construction workers but can involve bystanders. The main causes of worker deaths were electrocution, collapse, or struck by crane parts or crane loads. More than half of the deaths were among construction laborers and heavy equipment operators. Employees working for small contractors represent a large portion (about one-third) of the total number of deaths. Most crane-related deaths involved mobile cranes.

Possible explanations for these findings are a lack of worker and supervisor training, lack of jobsite safety plans, lack of adequate crane inspections, and lack of proper investigation and reporting of crane accidents and fatalities.

Specific recommendations to reduce and prevent future injuries and fatalities are as follows:

First, crane operators should be certified by a nationally accredited crane operator testing organization, such as the National Commission for the Certification of Crane Operators (NCCCO)*. Presently only 15 states and a few cities[§] (including New York City) require certification or licensing of crane operators, and some have their own certification program. We recommend that states and cities should require certification by a national certification organization for reasons of standardization of qualifications and to promote the transfer of credentials between states.

Second, riggers who attach the load to the crane and signalpersons who visibly or audibly direct the crane operator on where to place the load should be adequately trained and tested. NCCCO will in the future offer certifications for these types of workers.

Third, crane inspectors should be certified. OSHA requires that employers designate a competent person[¶] to inspect machinery and equipment prior to each use, and during use, to make sure it is in safe operating condition [29 CFR 1926.550(a)(5)]. OSHA also requires annual inspections. For some work activities, such as use of cranes for maritime activities and work at nuclear plants, OSHA may require a higher degree of inspection. However, since inadequate inspections have been implicated in work-related crane deaths, we recommend that crane inspectors should have the same degree of qualification as crane operators.

Fourth, in addition to other mandated inspections, cranes must be inspected thoroughly by a certified crane inspector after being assembled or modified, such as the “jumping” of a tower crane.

Fifth, according to the proposed OSHA consensus standards on cranes, only trained workers should assemble, modify or disassemble cranes, and they should always be under the supervision of a person meeting both the definition of qualified person** and competent person specified in the standard. In many instances, especially with rented cranes, there are no trained personnel present when cranes are set up and dismantled. This issue must also be addressed.

Sixth, crane loads should not be allowed to pass over street traffic. If rerouting is not possible, then streets should be closed off when loads pass over streets and pedestrian walkways. Presently crane loads are not allowed to pass over construction workers.

Seventh, more complete reporting of data, particularly after a crane collapse, is necessary. OSHA and the industry should conduct more thorough investigations of crane-related fatalities and capture more complete data in its reporting system.

* Such certification organizations should be accredited by a nationally recognized accrediting organization such as the American National Standards Institute (ANSI), should administer written and practical tests to determine the knowledge and skills of the applicant, and meet other standard accreditation criteria.

^ε California, Hawaii, Minnesota, Montana, Nevada, New Jersey, New Mexico, Utah, Washington (as of 2010), and West Virginia require or recognize NCCCO certification of crane operators as part of their state licensing program. Connecticut, Massachusetts, New York, Oregon, and Rhode Island have their own licensing programs. Among cities, New Orleans, New York, and Omaha require or recognize NCCCO certification of crane operators; Chicago, Los Angeles, and Washington, D.C. have their own licensing program.

[∇] A competent person, according to OSHA, is one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous or dangerous to employees, and *who has authority to take prompt corrective measures* [italics added for emphasis] to eliminate them. [29 CFR 1926.32(f)]

** A qualified person means a person who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training and experience, has successfully demonstrated the ability to solve/resolve problems relating to the subject matter, the work, or the project.

References

Jamieson, R. [2006] “The Fall and Rise of a Crane Operator.” *Seattle Post-Intelligencer*, Dec. 14.

Kates, B. [2008]. “Pain of the Cranes.” *New York Daily News*, March 24.

Kilborn, P. [1989]. “San Francisco Crane Collapse was no Fluke.” *New York Times*, Dec.17.

LaBar, G. [1999]. “Three Workers Die When ‘Big Blue’ Falls at Stadium.” *Occupational Hazards*, July 15.

MSNBC staff. [2008] “Crane Collapse Kills Two and Unsettles New Yorkers,” May 31. www.msnbc.msn.com/id/24889155/print/1/displaymode/1098/ (Accessed May 30, 2008.)

OSHA [1990]. *Analysis of Construction Fatalities – the OSHA Database 1985-1989*. Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration.

Walter, L. [2008]. “Miami Crane Collapse Kills 2, Injures 5.” *Occupational Hazards*, March 6.

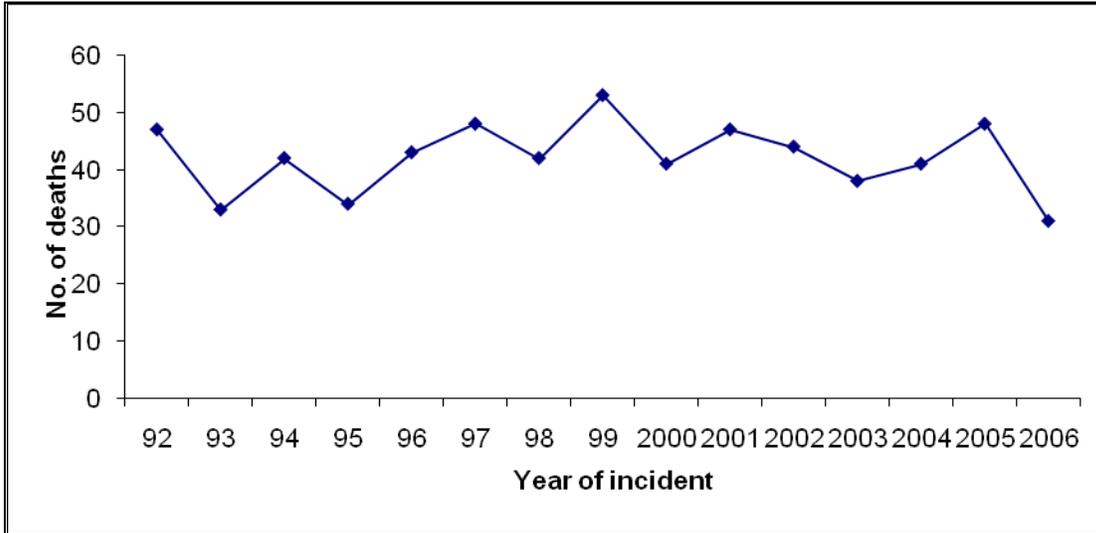
Ward, K. [2008]. “‘It Was Gone’: String of Problems Led to 51 Deaths at Willow Island.” *The Charleston Gazette*, April 27.

Ware, P. [2008]. “OSHA Begins Investigating Crane Collapse in New York that Killed Seven, Injured 24.” *BNA OSH News*, March 20.

Table 1. Examples of Fatal Crane Incidents

<u>Date</u>	<u>Location</u>	<u>Description</u>
4/27/78	Willow Island, WV	Crane lifting bucket of cement collapsed onto scaffold inside cooling tower. Construction workers: 51 dead Source: [Ward, 2008]
11/29/89	San Francisco, CA	Tower crane fell 16 stories while being jumped. Construction workers: 4 dead Bystanders: 1 dead; 22 injured Source: [Kilborn, 1989]
11/14/99	Milwaukee, WI	“Big Blue” tower crane collapsed at stadium and struck three workers in a crane basket. Winds 25-30 mph. Construction workers: 3 dead Source: [LaBar, 1999]
9/29/06	New York, NY	4-ton chunk of steel fell from crane crushing a taxi. Bystanders: 5 injured Source: [Kates, 2008]
11/16/06	Bellevue, WA	Crane collapsed on a condo. Construction workers: 1 injured Bystanders: 1 dead Source: [Jamieson, 2006].
3/15/08	New York, NY	Tower crane collapsed while being jumped, damaging several buildings. Construction workers: 6 dead, 13 injured Bystanders: 1 dead, 11 first responders injured Source: [Ware, 2008]
3/25/08	Miami, FL	20-foot section crane fell 30 stories while jumping the crane. Construction workers: 2 dead, 5 injured Source: [Walter, 2008]
5/30/08	New York, NY	Crane cab, boom, and machine deck separated from the tower mast and collapsed onto the street Construction workers: 2 dead, 1 injured Bystanders: 1 injured Source: [MSNBC staff, 2008]

Figure 1. Crane-Related Deaths in Construction by Year, 1992-2006*



* Data from 2006 are preliminary; data from 1992-2005 are revised and final.
 Source: U.S. Bureau of Labor Statistics Census of Fatal Occupational Injuries Research File

Table 2. Causes of crane-related deaths in construction, 1992-2006

<i>Cause of death</i>	<i># deaths</i>	<i>%</i>
Overhead power line electrocutions	157	25%
Struck by crane loads	132	21%
Struck by crane or crane parts*	125	20%
Crane collapses	89	14%
Falls**	56	9%
Caught in/between	30	5%
Other causes***	43	7%
Total	632	****

* Involved 18 cranes (including 13 run-over by mobile crane), 78 crane booms/jibs (64 due to falling booms/jibs), and 29 other crane parts

** Includes 21 falls from crane bodies, 9 from crane baskets, 8 from crane loads and 18 other falls.

*** Other causes include 12 highway incidents and 11 struck by objects other than crane loads or parts.

****Does not add to 100 due to rounding.

Source: U.S. Bureau of Labor Statistics Census of Fatal Occupational Injuries Research File

Table 3. Activity of construction workers electrocuted by overhead power lines, 1992-2006

<i>Contact with overhead power lines</i>	#	%
Worker on foot touching/guiding load or cables	81	52%
Operating crane*	40	25%
Worker on foot touching crane	20	13%
Other**	16	10%
Total	157	***

* Includes 7 deaths of operators who jumped from crane

** Includes 6 deaths of workers on foot near but not touching crane

*** Does not add to 100% due to rounding.

Source: U.S. Bureau of Labor Statistics Census of Fatal Occupational Injuries Research File

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