

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. In May 2008, OSHA published its semiannual agenda and announced that the proposed crane standard will be published for public comment in the Federal Register in August 2008.

In light of the large number of recent fatalities, CPWR examined the data from the Bureau of Labor Statistics (BLS) to evaluate trends over time and propose recommendations to prevent future injury and death.

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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 code 34* (Cranes). (This does not include non-construction crane-related deaths from maritime, mining and general industry.) 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.

Results

A total of 323 construction worker deaths involving 307 crane incidents were identified from 1992-2006, an average of 22 construction worker deaths per year. Figure 1 shows the number of deaths by year. There were 12 multiple-death incidents in this time period, resulting in a total of 28 deaths.

Four main types of cranes have been associated with crane-related fatalities. Of the 307 fatal crane incidents, 216 (71%) involved mobile or truck cranes. Sixteen of the fatal incidents involved tower cranes (5%), 13 involved floating or barge cranes (4%), and 12 involved overhead cranes (4%). The remaining 66 reports were not sufficiently detailed to determine the type of crane involved or do not meet BLS publication requirements.

Causes of death

Of the total 323 crane-related deaths, 102 were caused by overhead power line electrocutions (32%), 68 deaths were associated with crane collapses (21%), and 59 deaths involved a construction worker being struck by a crane boom/jib (18%). (*See Table 2.*)

Half of all electrocutions, the leading cause of death, were associated with the crane boom or a crane cable contacting an overhead power line. The rest involved contact of an overhead power line with unspecified parts of the crane. Mobile cranes were involved in 80 of the 95 overhead power line fatal incidents. 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.

Crane collapses were the second leading cause of death. An unstable, uneven or icy surface on which the crane was sitting accounted for 12 fatalities (20%). Overloading the crane accounted for another 10 deaths (16%). In five cases (8%), 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 59 crane collapses, 37 involved mobile cranes.

The third leading cause of crane-related deaths is struck by the crane boom or jib. Fifty-two of the 59 struck-by crane booms or jib deaths were caused by a falling boom or jib. Almost half of these deaths (48%) occurred while workers were dismantling the boom. In most of these cases, the pins holding the boom sections together were removed without adequate support to prevent the sections from falling. In 12% of these cases, the deaths occurred while lengthening the boom. The remaining seven workers were struck by swinging booms in an unspecified manner. Of the 59 struck by boom/jib fatalities, a minimum of 35 deaths were caused by mobile cranes.

Trades Involved

Construction laborers experienced the greatest number of crane-related deaths between 1992 and 2006 (total of 96 or 30%), followed by heavy equipment operators (74 deaths or 23%), which included 50 crane and tower operators. In addition, 40 supervisors/managers/administrators died in crane-related incidents (12%), as did 18 ironworkers (6%), and 17 mechanics (5%). Other trades with fewer numbers of deaths included electrical workers, truck drivers, welders and carpenters (totaling 24%).

Overall, 103 of the 323 construction workers were employed by subcontractors with fewer than 10 employees. Fifty-one individuals worked for employers with over 100 employees. Twenty of the construction workers who died on the job were self-employed.

Conclusions and Recommendations

The findings of this analysis indicate the number of crane-related deaths reported by CFOI is significant. 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 certified. NCCCO will in the future offer certifications for these types of workers.

Third, crane inspectors should also 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.

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

Eighth, after OSHA publishes the proposed crane and derrick safety construction standard in August 2008 for public comment, all efforts should be made to speed up the adoption of the C-DAC consensus standard and the additional recommendations provided in this report.

* 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.

‡ 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 and Omaha require or recognize NCCCO certification of crane operators; Chicago, Los Angeles, New York City, 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.

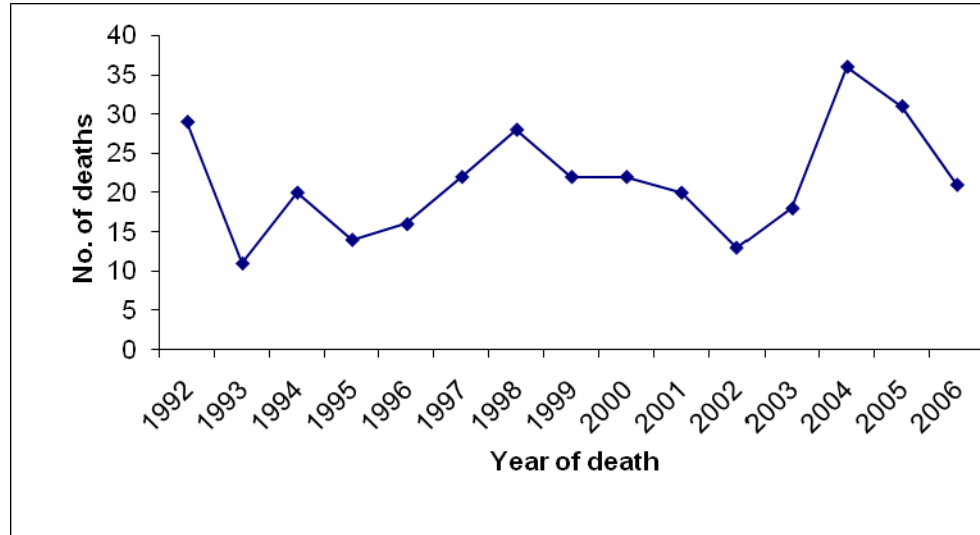
Ward, K. [2008]. “‘It Was Gone’: String of Problems Led to 51 Deaths at Willow Island.” *The Charleston Gazette*, April 27.

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

<u>Cause of death</u>	<u># deaths</u>	<u>%</u>
Overhead power line electrocutions	102	32%
Crane collapses	68	21%
Struck by crane booms/jibs*	59	18%
Struck by crane loads	24	7%
Caught in/between	21	7%
Struck by cranes**	18	6%
Other causes***	31	10%
Total	323	****

* 52 of 59 struck by crane booms/jibs were due to falling booms/jibs

** Includes 10 run over by mobile cranes

*** Other causes includes 14 struck by other crane parts and 9 highway incidents

****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	40	39%
Operating crane*	32	31%
Worker on foot touching crane	19	19%
Other**	11	11%
Total	102	100%

* Includes 7 deaths of operators who jumped from crane

** Includes 6 deaths of workers on foot near crane

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

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