A COMPARISON OF OLD AND NEW OSHA REGULATIONS ON CRANES AND DERRICKS USING COMPREHENSIVE GAP ANALYSIS

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ABSTRACT: Aiming at reducing deaths and injuries involving construction crane operations, OSHA has recently updated its 40-year-old crane safety standards with new rules addressing the use of cranes and derricks in construction. The goal of this change in rule is to deal with the leading causes of fatalities related to crane and derrick operations. Employers in the construction industry are mandated to ensure that employees in the work zone are trained to recognize hazards associated with the use of the equipment and any related duties that they are assigned to perform. However, those responsible at construction sites for the supervision and management of safe crane operations often lack the integrated knowledge of the standards, regulations and best practices for conducting or supervising daily, monthly, or quarterly inspection of cranes. As such, proper planning, management and implementation of crane operations, including inspections are just as paramount to reducing accidents on the construction site. It is important that engineers responsible for the management and planning of crane operations understand the latest OSHA crane and hoisting standards to ensure a safer work environment is maintained. Many on site engineers overseeing crane operations do not have adequate training, experience, and knowledge of the inspection requirements to assess safe crane operation and too often rely on the crane operator's judgement. This paper highlights recent research effort in defining significant changes in new crane and hoisting standards and provides basis for safety construction operations.

Keywords: crane and derricks; safety; OSHA; gap analysis

1. INTRODUCTION

Cranes, derricks, hoists, and slings are examples of lifting equipment frequently used in construction operations. Available in different types and configurations, cranes are designed to make various lifts and are an absolute necessity in construction projects. However, cranes also share the potential for disaster when operations are not managed safely. Cranes are more commonly the cause of on-the-job accidents than any other heavy equipment as they account for more than 20 percent of all deaths associated with construction jobs (Hodgison, 2010). Moreover, crane accidents are often the most costly of construction accidents when measured in lives as the statistics from the Bureau of Labor Statistics (BLS) show that the number of deaths due to crane accidents average around 78 a year (BLS, 2008).

As such, the need to ensure safety at construction sites while using cranes and derricks have become extremely important due to many accidents and fatalities recorded in the United States and across the world (Peraza, 2009). More specifically, the Center for Construction Research and Training (CCRT) reported that between 1992 and 2006, data from the BLS documented 632 construction worker deaths resulting from crane accidents (Peraza, 2009). Death caused by electrocution from power lines and crane collapse accounted for approximately 158 deaths or 25 percent and 89 fatalities or 14 percent respectively.

Aiming at reducing deaths and injuries involving construction crane operations, OSHA (Occupational Health and Safety Administration) has recently updated its 40-year-old crane safety standards with new rules addressing the use of cranes and derricks in construction. The goal of this change in rule is to deal with the leading causes of fatalities related to crane and derrick operations, including electrocution, crushed-by/struck-by hazards during assembly/disassembly, collapse and overturn, among other types of fatal injuries. According to the OSHA estimation, 22 fatalities and 175 non-fatal injuries per year are expected to be prevented by the new regulation.

Highlights of the significant requirements in this change include: certification or qualification of crane operators, signalers, and riggers; a pre-erection inspection of tower crane parts; assessment of ground conditions; and procedures for working in the vicinity of power lines, among others (OSHA Fact Sheet). In order to clarify the scope of the regulation, OSHA has provided both functional description and a list of examples for the equipment that is covered. Employers in the construction industry are mandated to ensure that employees in the work zone are trained to recognize hazards associated with the use of the equipment and any related duties that

they are assigned to perform.

However, those responsible at construction sites for the supervision and management of crane operations lack the integrated knowledge of these modified standards for cranes and consequently lack the abilities to implement safe crane operations. Therefore, proper planning, management and oversight of crane operations are just as paramount to reducing accidents on the construction site. It is important that engineers responsible for the management and planning of crane operations understand the latest OSHA standards to ensure a safer work environment. Many on site engineers overseeing crane operations do not have adequate training, experience, and knowledge to assess the safety of a crane operation and oftentimes rely on the operator's judgment. Based on comprehensive gap analysis, this paper reviews significant changes in standards and regulations that govern crane and derrick operations and suggests best practice in implementation of these revised regulations.

2. BACKGROUND

2.1 Major Causes of Crane Accidents

Some of the major crane fatalities include, collapse due poor ground conditions, overloading, or shifting of the load resulting in crane collapse crushed-by or struck-by hazards during assembly/disassembly, electrocution among others. A review of trade and news media in 2008 by the Center for Construction Research and Training (CCRT) showed 54 construction worker fatalities related to crane accidents representing an approximately 30% increase over the annual fatalities average between 1992 and 2006 (Peraza, 2009). Figure 1 below shows crane related deaths of workers between 1992 and 2006.

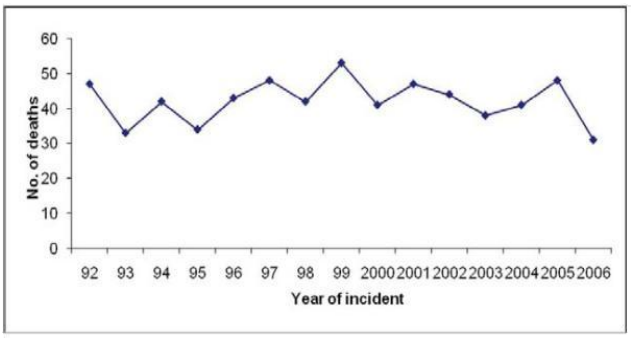

Figure 1. Crane-Related Deaths of Workers, 1992-2006. Based on US Bureau of Labor Statistics, Census of Fatal Occupation Injuries Research File. Graphic from the Center for Construction Research and Training (Pareza 2009)

Beaver et al (2006), examined the major causes of crane related fatalities between 1997 and 2003 from OSHA's Integrated Management Information Systems (IMIS) data base. A total of 125 cases involving crane and derricks accidents were identified during the examination. The causes of fatalities during the hoisting activities are summarized in the table below.

Table 1. Causes of Fatalities during the Performance of Hoisting Activities (Federal Register/Vol. 75. 152, 2010)

Activities	% of Fatalities
Struck by load (other than failure of boom/cable)	32
Electrocution	27
Crushed during assembly/disassembly	21
Failure of boom/cable	12
Crane tip-over	11
Struck by cab/counterweight	3
Falls	2

Suruda et al. (1999) similarly examined major causes of accident between 1984 and 1994 from the OSHA IMIS database involving cranes in the construction industry. During the 11 year period, OSHA recorded 502 deaths in 479 incidents involving cranes in the construction industry. Table 2 below summarizes the causes and related number of incidents.

Table 2. Causes of Crane Incidents (Federal Register/Vol. 75, No. 152, 2010)

Incident Caused by	No. of Incidents	% of Incidents
Electrocution	198	39
Crane assembly/disassembly	58	12
Boom buckling/collapse	41	8
Crane upset/overturn	37	7
Rigging failure	36	7
Overloading	22	4
Struck by moving load	22	4
Accidents related to manlifts	21	4
Working within swing radius of counterweight	17	3
Two-blocking	11	2
Hoist limitations	7	1
Other causes	32	6

3. PROJECT INITIATION

Many on site engineers overseeing crane operations do not have adequate training, experience and knowledge of the inspection requirements to assess safe crane operation and too often rely on the crane operator's judgment. It is therefore imperative that engineers responsible for the management and planning of crane operations understand the latest OSHA crane and hoisting standards to ensure a safer working environment is maintained.

4. RESEARCH OBJECTIVES

In partnership with the Crane Safety Committee (CSC) of the Construction Institute (CI), the University of North Carolina at Charlotte is carrying out the following:

- Gap analysis to thoroughly analyze the new OSHA crane standards (29 CFR 1926 Subpart CC) in comparison to old OSHA standards (29 CFR 1926.500 Subpart N)
- Update crane Inspection guidelines for OSHA Compliance Officers standard and identify any

significant impact of the modification of the standard have on crane inspections

5. ANALYSIS (in progress)

OSHA Act of 1970 instituted regulation 29 CFR 1926 to reduce injuries and illnesses in American work place. Under this regulation, the subpart N of 29 CFR 1926 was associated with cranes, derricks, hoists, elevators and conveyors. Hence the introduction of 29 CFR 1926.550 was the standard for Cranes and Derricks. In 1988 the 29 CFR 1926.550 was amended to include conditions under which employees on personnel platforms should be hoisted by cranes and derricks.

In 1993 the 29 CFR 1926.550 was amended to require that all employees be kept clear off lifted and suspended loads. In 2010, OSHA released new standard 29 CFR 1926 subpart CC for crane and derricks. Extensive gap analysis was conducted to identify major changes between the two standards (Subparts N & CC) governing the crane and lifting operations. Table 3 below highlights the significant changes as a result of the gap analysis.

Table 3. Gap Analysis – Comparing Old and New Crane Standards

	Description	**1926.550 N (old)**	**1926 CC (new)**
1	Ground conditions	No	Yes
2	Assembly/Disassembly	No	Yes
3	Power Lines	Limited	Yes
4	Inspections	Yes	Yes
5	Crane Signaling	Limited	Yes
6	Operator Qualifications	No	Yes
7	Wire Rope	Yes	Yes
8	Floating Cranes	Limited	Yes
9	Personnel Platform	Yes	Yes
10	Authority to Stop Operation	No	Yes
11	Training	No	Yes

In Table 3, "No" indicates that the particular topic is not covered in OSHA standard whereas, "Yes" indicates that the topic is significantly covered in OSHA standard. Finally, "Limited" means the topic is partially covered.

Each of the 11 topical areas was thoroughly reviewed to better understand the significant gap between the two standards. The result of this analysis is summarized in subsequent tables below.

Table 4. Gap Analysis – Ground Conditions

New OSHA Standards	**Old OSHA Standard**
Ground Conditions 1926. 1402 ▪ Ability of the ground to support the Crane equipment ▪ A/D director or the operator must assess ground condition. ▪ Controlling Entity or Employer to remedy unsuitable ground prior to hoisting	Not Covered

Table 5. Gap Analysis – Assembly/Disassembly

New OSHA Standards	**Old OSHA Standard**
Assembly/Disassembly 1 926.1403 ▪ Employer must comply manufacturer procedure and prohibition ▪ A competent person and a qualified person to supervise Assembly/disassembly. ▪ Crew member must inform the operator when going to location where operator's view is obstructed ▪ During assembly/disassembly, rated capacity limits for loads must not be exceeded ▪ Employer procedures must be developed by a qualified person	1926.550(a) employer s hall comply with the m anufacturer's specificati ons and limitations 1926.550(a)(2) ▪ Rated load capacities, and recommended operating speeds shall be visible to the operator at his control. ▪ Attachments used with cranes shall not exceed manufacture's recommendation

Table 6. Gap Analysis – Power Line Safety

New OSHA Standards	**Old OSHA Standard**
Power line safety 1926.1407 If any part of the equipment or load could get closer than 20 feet to a power line, the employer must satisfy any of the following: ▪ Option (1) Deenergize and ground ▪ Option (2) Maintain 20 foot clearance or ▪ Option (3) follow Table A clearance ▪ If the operator is unable to see the elevated warning line, a dedicated spotter must be used ▪ A proximity alarm set alert operator of encroachment ▪ If employer requests voltage information power line has two days to provide it ▪ The employer must train each operator and crew member on procedures and dangers of power lines	**1926.550(a)(15)(vi)** ▪ Any overhead wire is deemed energized line until electrical utility authorities indicate otherwise and it has been visibly grounded ▪ Equipment clearance shall be a minimum of 4ft for voltage less than 50 kV., 10ft for voltage over 50 kV up to 345kV, and 16 ft for voltage up 750 kV

Table 7. Gap Analysis – Inspection

New OSHA Standards	Old OSHA Standard
Inspection 1926.1412 ▪ Equipment that has had modifications must be inspected by a qualified person ▪ Equipment that has had a repair or adjustment must be inspected by a qualified person ▪ Upon completion of assembly, the equipment must be inspected by a qualified person ▪ A competent person must begin a visual inspection prior to each shift the equipment will be used ▪ Each month the equipment is in service it must be inspected a competent person ▪ At least every 12 months the equipment must be inspected by a qualified person	**126.550(a)(6)** ▪ A thorough, annual inspection of the hoisting machinery shall be made by a competent person ▪ The employer shall maintain a record of the dates and results of inspection

Table 8. Gap Analysis – Crane Signaling

New OSHA Standards	Old OSHA Standard
Crane Signaling **1926.1404(q)(4)** Each outrigger or stabilizer must be visible to the operator or to a signal person during extension and setting **1926.1441(f)** *Signal person qualifications*. The employer must train each signal person in the proper use of signals applicable to the use of the equipment **1926.1404(q)(4)** Each outrigger or stabilizer must be visible to the operator or to a signal person during extension and setting **1926.1441(f)** *Signal person qualifications*. The employer must properly train each signal person **1926.1419(a)** A signal person must be provided in each of the following situations: ▪ The point of operation, meaning the load travel or the area near or at load placement, is not in full view of the operator ▪ When the equipment is traveling in the direction of obstructed view ▪ Due to site specific safety concerns, either the operator or the person handling the load determines that it is necessary **1926.1419(b)** *Types of signals*. Signals to operators must be by hand, voice, audible, or new signals	**1926.550*a)(4)** ▪ Hand signals to crane and derrick operators shall be per ANSI standard ▪ An illustration of the signals shall be posted at the job site ▪ 1926.550(d)(3) Crane with power travel mechanism shall have an effective audible warning signal 4.8A(17)P17 ▪ Outriggers must be visible to the operator or a signal person during extension or setting ▪ 4.8C(cab) Functioning Horn (warning signal) ▪ 4.8C(Engine House) Hand Signal Illustration

Table 9. Gap Analysis – Operator Qualification

New OSHA Standards	Old OSHA Standard
Operator Qualification **1926.1427(a)** ▪ The employer must ensure that, prior to operating any equipment the operator is qualified or certified to operate the equipment ▪ Exceptions: Operator qualification or certification is not required when manufacturer-rated hoisting/lifting capacity is 2,000 pounds or less ▪ The employer must provide the qualification or certification at no cost to operators employed on November 8, 2010 **Operator Qualification Options** ▪ Option (1): Certification by an accredited crane operator testing organization ▪ Option (2): Qualification by an audited employer program ▪ Option (3): Qualification by the U.S. military ▪ Option (4): Licensing by a government entity	

Table 10. Gap Analysis – Wire Rope

New OSHA Standards	Old OSHA Standard
Wire Rope 1926.1413 ▪ Wire rope must be inspected before each shift by a competent person ▪ Deficiency of wire rope must be examined by a competent person and removed if it's a safety hazard ▪ Monthly and annual comprehensive inspection of wire ropes by qualified person	1926.550(a)(7) Wire rope shall be taken out of service if: ▪ Broken ▪ Won or distorted ▪ Reduced diameter

Table 11. Gap Analysis – Floating Cranes

New OSHA Standards	Old OSHA Standard
Floating Cranes 1926.1437 The requirements for floating cranes include: ▪ Employer must ensure erected hazard safety boundaries ▪ A competent person must determine wind conditions ▪ Inspections should be conducted during each shift, monthly, annually and every four years by a competent person ▪ Equipment to secure floating crane must be in good condition	**1926.550(f)(2)(iii)** Floating cranes and floating derricks in use shall meet manufacturer's requirement for design, construction, installation, testing, maintenance, inspection and operation

Table 12. Gap Analysis – Personnel Platform

New OSHA Standards	Old OSHA Standard
Personnel Platform 1926.1431 ▪ Hoist of employees on personnel platform is prohibited except when personnel hoist, ladder, etc. are more hazardous, or is not possible. Platform must meet the following: ▪ Uniformly level ▪ Outriggers extended and locked ▪ The total load must not exceed 50% of design load capacity ▪ Equipment must have functional safety devices ▪ A trial lift with the unoccupied personnel platform required	**1926.550(g)** ▪ Hoist of employees on personnel platform is prohibited except when personnel hoist, ladder, etc. are more hazardous, or is not possible ▪ Hoisting of the personnel platform shall be a slow controlled activity

Table 13. Gap Analysis – Authority to Stop Operation

New OSHA Standards	Old OSHA Standard
Authority to stop operation 1926.1418 Whenever there is a concern as to safety, the operator must have the authority to stop and refuse to handle loads until a qualified person has determined that safety has been assured	Not covered

Table 14. Gap Analysis – Training

New OSHA Standards	Old OSHA Standard
Training 1926.1430 The employer must provide training as follows: ▪ Workers near overhead powerlines ▪ Each operator ▪ Each assigned signal person ▪ Each competent person and each qualified person ▪ Each operator and employee authorized to start/energize equipment ▪ Refresher training ▪ Training at no cost to the employee	Not covered

8. CONCLUSIONS

The comprehensive gap analysis conducted to compare old and new OSHA standards on crane and derricks revealed significant change that will impact daily construction operation. As this change in rule is imperative to dealing with the leading causes of fatalities related to crane and derrick operations and to maximizing safe working environment, those responsible at construction sites for the supervision and management of safe crane operations should possess the integrated knowledge of the standards, regulations and best practices for safely conducting or supervising crane and derrick operations. This study and the preliminary findings based on extensive gap analysis will serve as a guideline in understanding the latest OSHA craned and hoisting standards to ensure a safer work environment is maintained.

REFERENCES

[1] Beavers, J., Moore, J., Rinehart, R., and Schriver, W., "Crane-Related Fatalities in the Construction Industry", *Journal of Construction Engineering and Management*, 132(9), 901-910, 2006.

[2] Bernold, Lorenc, S., and Luces, "On-Line Assistance for Crane Operators", *Journal of Computing in Civil Engineering*, 11(4), 248-259, 1997.

[3] Parfitt, M., "Cranes, Structures under Construction, and Temporary Facilities: Are We Doing Enough to Ensure They Are Safe?", *Journal of Architectural Engineering*, 15(1), 1-2, 2009.
[4] Peraza, D. B., and Travis, J. A., "Crane Safety—An Industry in Flux", *Forensic Engineering*, 556-566, 2009.
[5] Suruda, A., Liu, D., Egger, M., and Lillquist, D., "Fatal injuries in the United States construction industry involving cranes 1984-1994", *Journal Of Occupational And Environmental Medicine/American College Of Occupational And Environmental Medicine*, 41(12), 1052-1058, 1999.
[6] Federal Register/Vol. 75, No. 152/Monday, August 9, 2010/Rules and Regulations, P 47910
[7]http://aemp.org/education/meetings/11ams_Leadership Perspectives on the OSHA rule-Ryan.pdf, 10/28/2012, 6:05pm