



The National Institute for Occupational Safety and Health (NIOSH)

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Laborer Dies After Being Struck by Overturning Crane—Virginia

FACE 9419

SUMMARY

On August 8, 1994, a 24-year-old male construction laborer (the victim) was fatally injured when a crane being used to lower a bucket of gravel from the shoulder of an interstate highway into a drainage ditch tipped over. The victim and co-workers were engaged in spreading a gravel base preparatory to pouring concrete in the ditch. As the crane operator was lowering the gravel bucket to the victim, the crane's outriggers slipped off the blocking, or the blocking rolled out from under the outrigger floats, and the crane tipped toward the ditch. The end of the crane's boom struck the victim, fracturing his skull and amputating his right arm. A local EMS responded to the site 10 minutes after notification by the co-workers and pronounced the victim dead.

NIOSH investigators concluded that, to prevent similar occurrences, employers should:

- ensure that each time a crane is set up, it is level and the outrigger floats are supported by firm stable footing
- ensure that equipment manufacturer's recommended safe operating procedures for crane set-up and lift configurations are followed
- ensure that all crane components are properly rigged while lifting operations are being conducted.

INTRODUCTION

On August 8, 1994, a 24-year-old male construction laborer (the victim) was fatally injured when he was struck by the end of a crane boom as the crane tipped over. On August 11, 1994, officials of the Virginia Occupational Safety and Health Administration (VAOSHA) notified the Division of Safety Research (DSR) of the incident and requested technical assistance. On September 28, 1994, a safety engineer and a statistician from DSR interviewed the company vice-president and visited the site. The incident was reviewed with the VAOSHA compliance officer assigned to the case and photographs of the crane and incident site were taken.

The employer in this incident was a concrete contractor who had been in business for 14 years and employed 25 workers. The company had been contracted to pave drainage ditches and headwalls along an 84-mile section of interstate highway. The victim had worked as a laborer for the company for 1 year and 8 months and had received on-the-job training in the task being performed at the time of the incident. The company had general written safety policies. Task-specific safety

procedures were unwritten but were communicated verbally to the workers on the job. This was the company's first fatality. On July 13, 1994, the crane involved in this incident had tipped over under similar circumstances to those present on August 8, 1994, but without injury to any workers.

INVESTIGATION

On August 8, 1994, the construction crew consisting of a crane operator/foreman, two concrete finishers, and three laborers, one of whom was the victim, began work at 7 a.m. The crew positioned a 22-ton capacity, rough terrain, hydraulic crane on the shoulder along the highway to lower buckets of gravel and concrete down to the ditch line, about 20 feet below the shoulder's edge. The crane was set up on fully extended outriggers, with the left side outrigger floats placed on stacked wooden blocks, which provided additional bearing surface on the shoulder's newly placed fill material. The blocks also tipped the crane slightly toward the highway for additional resistance to the load. This procedure had been followed by the crew members since the tipping incident of July 13, 1994. Concrete was placed in the ditch by loading from a concrete truck located on the road shoulder into a concrete/gravel bucket attached to the crane's load line. The bucket had a capacity of 2 cubic yard. Once loaded, the bucket was swung over and lowered to the ditch below. The victim's task was to trip the bucket's discharge mechanism and pour the concrete, which was then spread by the laborers, and finished by the concrete finishers. The crew had successfully deposited 8 cubic yards of concrete between 7 and 10:30 a.m., when they took a break. They then repositioned the crane along the shoulder to access the unfinished area of the ditch and prepared for continuing concrete placement. While part of the crew set forms in the ditch, the victim, one laborer, and the crane operator began depositing and spreading gravel. At approximately 10:45 a.m., the crane operator was lowering a load of gravel (approximately 3 cubic yard) to the victim when the ditch side outrigger floats slipped off the timbers, allowing the crane to slide and tip over toward the ditch. As the crane tipped, the head sheave of the boom contacted the victim, fracturing his skull and amputating his right arm above the elbow.

One of the crew members immediately called the local emergency medical service (EMS). The crane operator righted the crane by extending the boom, left the operator's cab, and joined other members of the crew in the ditch where the victim was lying face down. The co-workers rolled the victim face up because they feared he would suffocate. Ten minutes after notification, the EMS arrived on site and pronounced the victim dead.

CAUSE OF DEATH

The medical examiner determined the cause of death to be skull fracture.

RECOMMENDATIONS

Recommendation #1: Employers should ensure that each time a crane is set up, it is level and the outrigger floats are supported by firm stable footing.

Discussion: When positioned along the road shoulder, the right side crane outrigger floats rested on the paved portion of the shoulder. The left side floats were placed on the edge of a gravel undercourse which had been spread and compacted, by rolling, 2 weeks before the incident. To increase the bearing area for the 16- by 16-inch outrigger floats, the left side floats had been positioned on wooden blocks, stacked three blocks high, which were resting on the sloped edge of the gravel undercourse. The set-up also tilted the crane toward the highway, presumably to provide additional resistance to tipping toward the ditch, as had occurred 3 weeks earlier. This set-up could have affected the crane's stability in several ways.

- Normal operating movement of the crane may have further compacted the new fill under the left side outrigger floats, allowing the blocks to sink to the extent that the outrigger floats slipped off them.
- Since the blocks were set on the slope of the fill, normal operating movement may have caused the blocks to slide down-slope and out from under the outrigger floats.
- Since the blocks were stacked three high and the crane set-up was not level, normal operating movement may have dislodged the blocks from under the outrigger floats.

- A combination of these conditions may have occurred.

The manufacturer's operating manual for the crane specifies that the crane should be leveled on a firm supporting surface and that it may be necessary to add supports under the outrigger floats or tires to spread the load to a larger bearing surface. When necessary to perform lifts near edges of slopes, consideration should be given to positioning the crane a sufficient distance away from the slope so that the outrigger floats will be resting on firm, level ground. When this is not possible, blocking used to increase bearing surface should be secured to prevent dislodgement. It may have been possible for example, to secure the blocks by pinning them to the ground with steel rods.

Recommendation #2: Employers should ensure that the equipment manufacturer's recommended safe operating procedures for crane set-up and lift configurations are followed.

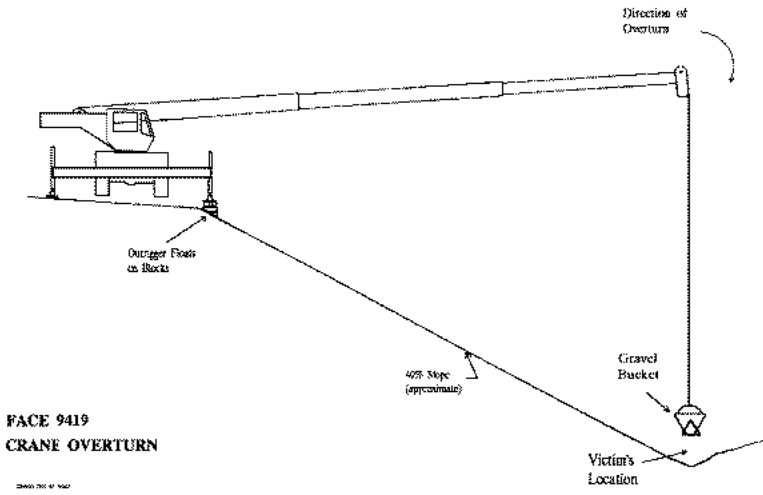
Discussion: 29 CFR, 1926.550 (a) general requirements for Cranes and Derricks, requires that the manufacturer's specifications and limitations applicable to the operation of any and all cranes and derricks should be followed. The manufacturer of the crane in this incident recommends that the crane be leveled on a firm supporting surface. Depending on the nature of the supporting surface, it may be necessary to have structural supports of sufficient strength under the outrigger floats or tires to spread the load to a larger bearing surface. Additionally, the the crane set-up may have contributed to its instability. To access the ditch from the highway shoulder would require an operating radius of about 50 feet. The distance along the slope from the victim's location in the ditch to the crane's center of rotation measured 54 feet and the angle of the slope measured 24 degrees. After the incident, the crane operator indicated that the boom angle of elevation had been between 5 and 20 degrees. The boom angle of rotation was about 85 degrees from the center line of the highway. The exact length to which the boom was extended is not known; however, it extended a sufficient distance (between 50 and 60 feet) to reach the victim in the ditch when it overturned. According to the range diagram included in the crane's operating manual, at 5 degrees boom angle it is necessary to extend the boom of an unladen (i.e., no load) crane to about 55 feet to obtain a 50-foot operating radius. To obtain a 50-foot operating radius at a 20-degree boom angle, the boom would be extended 60 feet. The operating manual also includes a load capacity rating chart for use when lifting with outriggers fully extended. This chart lists recommended operating loads based on the stability and structural strength of the crane for various lift configurations. The load being lifted was estimated to be about 1,000 pounds. At an operating radius of 50 feet, the chart listed a recommended maximum lifting capacity of 4,410 pounds with the boom elevated at 23.5 degrees and extended to 60 feet. For angles and boom lengths below 60 feet, no recommended load capacity is listed. The operating manual cautions against operation of the crane for configurations not listed in the capacity chart, warning that operation at a radius and boom length where capacities are not listed, may cause the crane to overturn without any load being on the hook. Depending on the actual boom angle of elevation in this incident, the crane's lift configuration may have been unstable. Further, the manufacturer cautions that when a crane is set up in an out-of-level condition, there is no allowable lifting capacity.

Recommendation #3: Employers should ensure that all crane components are properly rigged while lifting operations are being conducted.

Discussion: During normal crane operation, the weight of the crane is supported by four outriggers fitted with 16- by 16-inch floats. Distribution of the weight on the outriggers is not uniform because crane rotation and reaction to lifting forces may cause an outrigger float to lift. The floats are equipped by the manufacturer with spring loaded latching mechanisms designed to prevent the foot from disengaging from the float collar if the outrigger raises. After the incident, it was found that the latch mechanisms on the ditch side floats were defective. One of the jacks could have lifted during operation and disengaged from the float. When continued operation shifted the load back to the jack, the bearing surface offered by the jack's foot may have been insufficient to support the crane's weight, resulting in or aggravating the crane's instability.

REFERENCE

29 CFR, 1926.550 (a) Code of Federal Regulations, U.S. Government Printing Office, Office of Federal Register, General Requirements for Cranes and Derricks, Page 203, July 1, 1990.



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