



The National Institute for Occupational Safety and Health (NIOSH)

Promoting productive workplaces
through safety and health research / **NIOSH**

Laborer Dies from 80-Foot Fall through a Bridge

FACE 8931

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On April 12, 1989 a 31-year-old male laborer was killed when he fell 80 feet through a section of bridge road surface that broke under him.

CONTACTS/ACTIVITIES

State officials notified DSR of this fatality and requested technical assistance. On May 3 and 4, 1989, a safety engineer discussed the incident with company representatives and a state compliance officer. The incident site was photographed.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The employer is a general construction firm that has been in business for 40 years. The firm employs about 350 people, including 120 laborers. The company has written safety policies and procedures, but has no formal safety training program. The company employs union members generally hired from union halls, and recognizes that the amount of safety training these workers have received can vary widely.

The company has a safety officer in the main office who performs regular inspections of the various jobsites. He also provides safety information for use by field supervisors. In addition, the company's insurance carrier inspects each jobsite and furnishes written reports of the findings to the company. The company has safety incentive programs for the workers and for jobsite supervisors.

The site supervisor is responsible for on-site safety, and the supervisor and foremen conduct some on-the-job safety training. Each site supervisor conducts a weekly safety meeting of about 5 minutes. Three safety meetings had been conducted since work at the site started in mid-March. These meetings addressed fall hazards and the use of personal fall-protection equipment.

SYNOPSIS OF EVENTS

The victim was part of a ten-man crew removing the decking from a 50-year-old bridge so that a new roadway could be installed. The decking was composed of a steel, concrete, and asphalt composite. Workers used concrete saws to cut the decking into 16-foot-long by 5 1/2-foot-wide pieces. For each piece to be removed, lengthwise cuts through the asphalt and concrete layers were made parallel to, and about 4 inches to the outside edge of steel support beams underneath the decking. The workers removed the material from between the cuts, leaving some structural gridwork steel in place to hold the slab in position. The slab then had four holes drilled through it with pins being inserted for lifting. A cut was made along the width of the slab shortly before removing it from the bridge deck. When the slab was ready to be picked up, two laborers would cut the steel pieces joining the slab to the adjacent decking. The slab would then be picked up by a hydraulic crane and placed on a flatbed truck for removal from the bridge.

The victim had cut the steel along the length of the slab. He was wearing a safety belt and a 6-foot lanyard that was attached to an eyebolt on an 8-foot spreader beam which was used to lift the slabs. (A spreader beam is an I-beam suspended from a crane hook with cables attached at different locations along the beam. The cables are spaced so that weight is evenly distributed to allow the piece to be picked up and moved in a level position. Use of a spreader beam also reduces the risk that the piece will break during lifting.) After the victim had made his cuts, he reached up and disconnected his lanyard from the spreader beam so that he could step clear while the slab was being lifted. The victim had one foot on one of the main support beams and one foot on the slab. Before he could step off the slab, it broke in two, opening like a trap door. The victim fell through the slab to the debris-covered ground 80 feet below.

The superintendent immediately sent a worker to call for emergency help while he and another co-worker climbed down the bridge to the victim. They got to the victim within 2 minutes and checked him for vital signs but found none.

The victim had landed facedown on broken concrete and hard packed ground. The rescue squad transported the victim to a nearby hospital where he was pronounced dead on arrival by the emergency room physician.

The slab that failed was examined after the incident. It was discovered that at the areas where the slab had separated, a repair had been made in the past (time unknown). Apparently the deck pan, reinforcing bar, and deck grid had deteriorated at some point in time, allowing the concrete to fall out. The concrete had been replaced using a cardboard form to hold a cement mixture in place. No reinforcing steel was installed in this repaired area that could be seen during inspection of the failed section. The bridge deck was covered with an asphalt layer, which hid the patch from the view of the workers. (The repair may not have been noticeable due to wear on the road surface over time.)

It is suspected that when the reinforcing steel that connected the slab with adjacent sections of the bridge was cut, the weight transferred to the four points of suspension on the slab. The weight of the slab caused separation to occur at the repaired section. When the victim put his weight on the slab to disconnect his lanyard, he provided additional force which helped the failure to occur. Any noises of the slab failing may have been masked by the noise from work going on in other areas of the bridge. The lack of reinforcing steel in the patched area caused that area to have poor tensile properties, allowing the slab to break under its own weight.

CAUSE OF DEATH

The coroner's report listed the cause of death as multiple traumatic injuries sustained as a result of the fall.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Workers should be able to secure and disconnect fall protection systems from a safe location.

Discussion: The procedure being used had the worker secure his lanyard to the spreader beam and then disconnect it when the work was done. This required the worker to step on the slab that was suspended from the spreader beam. If the slab had deteriorated sufficiently, it could fail at any time during the later removal stages. A possible solution to this problem, and one since adopted by the company, is to install a 5-foot extension onto the spreader beam. A cable is secured to the

spreader beam and the extension, permitting the worker to slide the lanyard hook along the cable so that he can walk beyond the slab and disconnect when he is clear of the slab. Another possible solution would be to install a lanyard with a retractor reel on the spreader beam. The worker could pull the line out of the reel and connect it to his safety belt. When he finished the work in that area the worker could then move away to a safe area and disconnect the line from his belt.

Recommendation #2: Alternative methods of supporting the slab while lifting it from the bridge floor to the truck should be considered.

Discussion: Drilling holes through a slab and driving in pins may cause further deterioration of a weakened slab and cause it to fail while it is being lifted from the bridge floor. Since this incident, the company has changed the method of securing a slab for removal. Currently, six "C"-shaped holders are slipped onto the slab. The present configuration has two holders at each end and one in the middle of each side. A configuration that might provide even more security during lifting would have one holder placed in the center of each end and two holders on each side about 1/3 of the length from each end. This would provide more support for the slab along its length, where it is most likely to fail.

Recommendation #3: Specific maintenance and repair tasks on bridges and similar structures should be designed to match or exceed original design specifications, should be inspected, and should be documented.

Discussion: Organizations responsible for maintaining bridges or similar structures must ensure that each repair restores full structural integrity to the affected area. An engineer should set the repair specifications such that the repaired area is, at minimum, as sound as, and fully integrated into, the surrounding structure. An engineer or a qualified or certified inspector should inspect the repaired area to verify that the repairs have been done according to specifications. Accurate records of all repairs should be maintained for the life of the structure.

In this case, the company removing the bridge roadway surface was not provided information regarding previously repaired areas of the bridge until after this fatal incident. In fact, the organization responsible for maintaining this bridge had no record of the specific repair that led to the fatality.

Had the original repair on the area which ultimately failed been effective, or had the inadequacy of the repair been detected through inspection by the maintenance organization or the construction company dismantling the road surface, this fatality may have been prevented.

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Last Reviewed: November 18, 2015

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