

Ready Mixed Concrete Truck Drivers: Work-Related Hazards and Recommendations for Controls

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Abbreviations

BLS	U.S. Bureau of Labor Statistics
NIOSH	National Institute for Occupational Safety and Health
PPE	Personal protective equipment

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• A truck discharges concrete at a construction site.	
• A driver uses a water hose to wash out a drum interior.	
Possible innovations:	
• The filling port on this water tank has been lowered.	
• The driver is washing the truck from an elevated platform equipped with guardrails.	
• A slump meter has been attached to the truck behind the cab.	

At the request of President James P. Hoffa of the International Brotherhood of Teamsters, the Center to Protect Workers' Rights contracted with the Center for Occupational and Environmental Medicine, Mount Sinai School of Medicine, in New York City, to conduct a hazard assessment of truck drivers in the ready mixed concrete industry. The project was to include the following:

- Review, analysis, and interpretation of OSHA Log 200 and inspection data and literature supplied by the Teamsters and the Center to Protect Workers' Rights.
- Development of a job description for ready mixed concrete truck drivers and a qualitative hazard assessment based on site observations and literature review
- A final report containing summary information on identified work-related hazards, OSHA Log 200 data, and recommendations for hazard abatement and areas for further study.

Because the data sources for this analysis are not a representative statistical sample for the ready mixed industry, the findings here do not necessarily exactly reflect the hazards in the industry; for instance, the types of injuries might occur in a different order than shown here if all injuries were counted. However, the data presented show the main safety and health problems encountered by the drivers.

Description of the Ready Mixed Concrete Industry

Concrete is a basic building material used in the construction of commercial and industrial buildings, bridges, roadways, sidewalks, houses, dams and other structures. It is a flexible and workable material yet it is strong and durable.

The ready mixed concrete industry employed more than 118,200 people in 1999 as managers, plant operators, laborers, maintenance mechanics, dispatchers, and truck drivers (BLS 2000).

Concrete is a mixture of cement, water, and aggregate. The hardened product is the result of a hydration reaction between the cement and water whereby the aggregate is bound together. To complete this reaction, the concrete mixture is cured by keeping it moist. Cement is produced at cement plants by grinding and mixing limestone and clay. The mixture is heated to a high temperature and treated with additives. Additives control special properties of cement, such as setting time and specific uses. Cement is then shipped to concrete plants and stored in silos or other storage containers until used.

Aggregate material is classified as fine or coarse. Silica sand is the most common fine aggregate; coarse aggregates include gravel, rock, and blast-furnace slag. At a concrete plant, fly ash may be added to supplement the cement. Admixtures, usually liquids, are also added to improve new and hardened concrete. Admixtures affect setting times, the amount of water needed, strength, and durability (National Ready Mixed Concrete Association 1995)

Although concrete can be produced at the site where it is to be used, the construction industry relies on ready mixed concrete, which is produced at a nearby facility and delivered to the site by truck. Concrete is plastic and moldable in its newly mixed form, and strong and durable in its hardened state. It is a perishable commodity whose value and quality depend on the timeliness and smoothness of delivery. Because of the short life of ready mixed concrete, the industry is necessarily dependent on local producers.

There are two types of ready mixed concrete plants: central plants (sometimes called “wet” plants) and dry-mix (traditional) plants. In central plants, a concrete batch is made up by an operator at the plant before it is loaded into the truck. At dry plants, the dry components of concrete are weighed and loaded separately into the truck mixer; water is then added and the final mix is made. Central plants offer producers more control over quality and consistency of the concrete mix, but require that a load be dropped in a shorter time, usually in 90 minutes or less.

Concrete formulations are dictated by the type of structure to be built. Weather conditions also have an impact on the proportion of water, admixtures, and water temperature used. (National Ready Mixed Concrete Association 1995)

Concrete plants are located in areas convenient for deliveries of raw materials (cement, sand, gravel, other aggregate), which are often brought to the plant by rail or barge. A typical plant consists of storage areas for the raw materials; tanks and conveyors for holding, mixing, and dispensing raw materials; a control room to weigh, mix, and load materials into trucks (these operations are often computerized); a dispatch room to schedule truck pickup and delivery; a yard area where trucks are washed off and parked when not in use; a maintenance garage; a driver shape-up room; and offices.

Ready mixed concrete trucks are the workhorses of the industry and vary in size and design. Basic truck features include driver cab, mixer drum and mechanical drive, dispenser chute with extensions, water tank, additive tanks, and fixed ladders. Fully loaded, a truck may weigh as much as 60,000 pounds and contain as much as 20 cubic yards of concrete (National Safety Council 1986).

Job Description: Ready Mixed Concrete Drivers

Truck drivers are key industry employees who are responsible for delivery of concrete to the work-site and maintaining of concrete quality during transfer from plant to site. For this report, driver operations were observed at two plants, one central and one dry-mix, in New York City in November 2000. Additional information regarding driver work tasks was taken from materials supplied by the Teamsters and the Center to Protect Workers’ Rights.

In the New York metropolitan area, as well as many other locations, union drivers are assigned daily work through a seniority-based shape up at the plant. Most drivers complete 3 to 4 loads per day and are guaranteed 8 hours of work each shift. Job duties can be divided into 3 operations, as follows:

Loading and Mixing Concrete at the Plant

Once a driver receives an assignment from a dispatcher, he/she mounts the truck and drives to the loading station where the concrete is filled into the truck drum in a wet or dry state. The driver operates the drum rotation speed in accordance with the concrete specifications and mixing instructions. After the concrete is loaded, the driver checks and fills the water and admixture tanks that are attached to the truck. During cold weather, water on the truck may be heated up to 160 F (operations are usually suspended when temperatures reach 10 F). Most admixtures are liquids and are transferred to tanks on the truck through hoses. When the truck is fully loaded, the driver hoses down the outside of the truck and then checks the concrete slump in the drum. The slump is a visible measure of the consistency of fresh concrete. The driver may adjust the slump by adding more water or admixtures. Several of these tasks require the driver to climb up onto the truck using fixed ladders and truck equipment for foot- and handholds.

Delivery to the Construction Site

During transit to the construction site, the drum is constantly rotated to mix the concrete and to maintain concrete quality. At the site, the driver maneuvers the truck to the point of discharge and readies the chute and dispensing mechanism. The driver checks the slump and may make adjustments to the mix by adding water or admixtures. The concrete may be discharged into pumping stations, buckets, or directly into place. It takes 15 to 20 minutes to fully discharge a truck. During this time, the driver stands by the controls, often perched on a truck ladder, and monitors the dispensing operation. When the mixer is completely discharged, the driver hoses down the inside and outside of the truck to prevent concrete splashes and spills from hardening.

Returning to the Plant and Cleaning Up

At the end of the day, when the driver returns to the plant, he/she hoses down the truck again. This operation requires the driver to climb onto the truck to reach different areas. Several times a year, drivers or laborers enter the mixer drum and remove hardened concrete inside the drum with pneumatic chippers. (The mixer drum is a confined space, which would present some serious hazards to workers, including loss of oxygen, and would thus be covered by OSHA permit-required confined space regulations.)

OSHA Data on Ready Mixed Concrete Truck Drivers

In 1999, the ready mixed concrete industry experienced 16 deaths, of which more than half were transportation related (Tubbs 1999). OSHA maintains injury and illness data and inspection data related to ready mixed concrete truck drivers.

OSHA Log 200 Injury and Illness Data

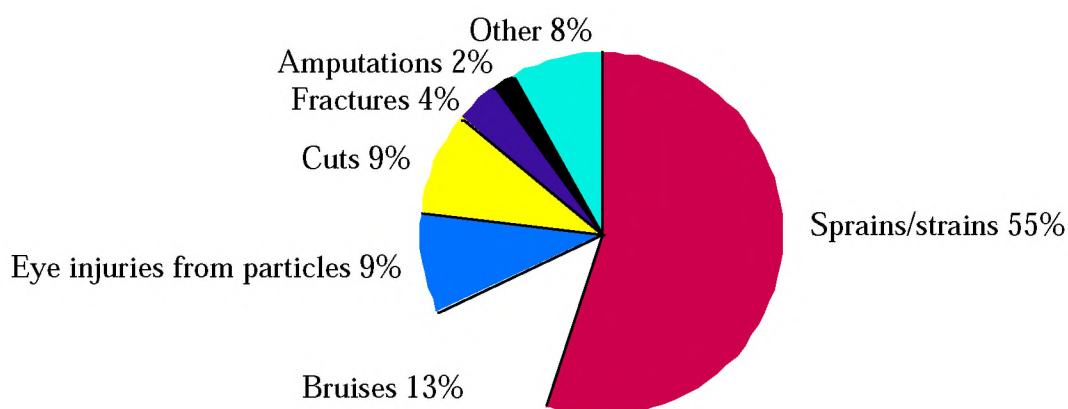
In 1999, the ready mixed concrete industry had an OSHA recordable rate of 10.2 nonfatal occupational injuries and illnesses per 100 full-time employees (BLS 2000). This rate is almost twice the average rate of 6.3 for general industry and is greater than the rate of 8.2 for construction. (Full time is 40 hours per week.)

To better understand the nature and types of nonfatal injuries to drivers in the ready mixed concrete industry, OSHA Log 200 forms, which record occupational injuries and illnesses, were analyzed. The Teamsters provided copies of OSHA Log 200 forms submitted by 23 ready mixed concrete plants throughout the United States for the three years 1997-99. Data were reviewed and only injuries and illnesses experienced by drivers were analyzed. Cases were eliminated from the data set if information was incomplete for type of injury, body part injured or whether the injury involved lost work time. Where one case showed more than one injury or injury to more than one body part for one driver, only the first injury/body part listed was counted. A total of 290 cases was analyzed for type of injury, body part injured and lost workdays. Except for 18 cases of hearing loss and one case of tendonitis, all cases were recorded as injuries. More than half of all the cases were sprains and strains (fig.1).

Of the 290 cases, 121 were lost time injuries, including time away from work and restricted work activity. As for all the cases, sprains and strains accounted for most lost-time cases (62%). Compared with the total cases, a higher percentage of fractures involved lost time (7% vs. 4%) and fewer cuts involved lost time (3%vs. 9%). The average number of lost days for the 121 injuries was 28 days. The OSHA Log 200 forms show that sprain-and-strain injuries had an average lost time of 31 days with a maximum of 279 days.

Backs and upper extremities each accounted for about one-third of the injuries and illnesses, and

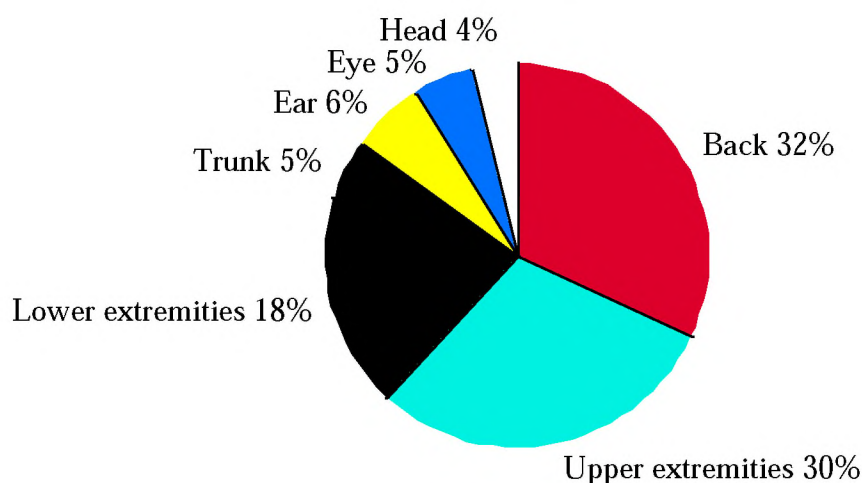
Figure 1. Injury and illness cases for drivers at 23 ready mixed concrete plants, 1997-99



Note: Total of 290 cases, with 19 illnesses (18 cases of hearing loss and one of tendonitis). Plants were located throughout the U.S. "Other" includes burns and hearing loss. Where more than one injury or illness was listed in one case for one driver, only the first injury or illness was counted.

Source: OSHA Log 200 reports

Figure 2. Injury and illness cases by body part for drivers at 23 ready mixed concrete plants, 1997-99



Note: Plants were located throughout the U.S. Total of 290 cases. Where more than one body part was affected in one case for one driver, only the first body part listed was counted.

Source: OSHA Log 200 reports.

lower extremities about one-fifth. Trunk (torso), head, ear, and eye made up the rest (fig. 2).

OSHA Inspection Data

In October 1999 through September 2000, OSHA conducted 96 inspections resulting in 586 citations for violations of OSHA standards in the ready mixed concrete industry (SIC 3273). Eighty-seven percent of the citations were for violations of 10 standards (table 1; BLS 2001).

Table 1. Ten most frequently cited standards in the ready mixed concrete industry, October 1999-September 2000

Standard	Title	# citations	% total
1910.146	Permit-Required Confined Spaces	157	27
1910.147	Control of Hazardous Energy, Lockout/Tagout	117	20
1910.134	Respiratory Protection	84	14
1910.1200	Hazard Communication	48	8
1910.23	Guarding Floor & Wall Openings & Holes	25	4
1910.95	Occupational exposure to noise	22	4
1910.132	Personal Protective Equipment	21	4
1904.02	Log & Summary of Occup. Injuries & Illnesses	19	3
1910.305	Electrical, Wiring Methods, Components & Equipmt	11	2
1910.27	Fixed ladders	8	1
	Total	512	87

In addition to the industrywide data, reports for six OSHA inspections in the ready mixed concrete industry, conducted in the year 2000, were reviewed. These reports, provided by the Teamsters Safety and Health Department, serve as examples of recent inspection activity and are not meant to be representative of OSHA inspection activity in this industry in that year. In these 6 reports, a total of 30 violations for OSHA standards were cited. Of these citations, 13 were for violations of 1910.146, permit-required confined space entry, 6 were for 1910.23, guarding floors and wall openings, 5 for 1910.147, control of hazardous energy (lockout/tagout — shutting off mechanical equipment before repairs or maintenance begin), and one for 1910.1200, hazard communication. The confined-space entry violations were for drum cleaning activities.

Occupational Hazards Faced by Ready Mixed Concrete Truck Drivers

Potential job safety and health hazards associated with operating ready mixed concrete trucks were identified through observations at work sites; discussions with drivers, company owners, and union representatives; an analysis of OSHA data; and a review of published literature. Potential hazards identified for ready mixed concrete truck drivers are listed below.

Slips, Trips, and Falls

Slips, trips, and falls from truck equipment, elevated work stations, and walking surfaces. According to the National Safety Council (1986), falls account for 50% of injuries to concrete truck drivers. Hazards include slippery surfaces, unsure footing, damaged ladders and walkways, and unsure hand- and footholds during climbing and descending truck cab and equipment. These hazards may occur at the plant or at the delivery site.

“Struck By” and Mechanical Hazards during Equipment Operations

Handling of the loadout chute can cause pinch point injuries to hands and fingers, struck by injuries

from swinging parts and falling materials and equipment. At both the plant and delivery site, falling objects and materials from overhead materials, tools, and equipment pose hazards.

Ergonomic Risk Factors

Concrete truck drivers show similar exposures to musculoskeletal risk factors as many other professional truck drivers and construction workers. This is shown from the literature review and from site visit videotapes and photographs (appendixes A-C). These exposures include whole-body vibration from driving the trucks, awkward and fixed postures (for instance, while hosing down the inside of the truck and holding the driving wheel of an empty truck over bumpy roads), forceful muscular activities (for instance, lifting heavy chutes, frequently lifting chutes, and activating a drum when discharging concrete), extremes in temperature (cold and hot), and repetitive twisting of the back and neck (for instance, when delivering concrete or looking out the back of a truck).

Other factors compound the problems. For instance, working for very long hours in extremes of temperature can induce stress. Work-related stress, which can impair work performance and cause numerous health problems (for instance, high blood pressure), has also been shown to be related to chronic work-related musculoskeletal disorders and increased periods of sick leave (Boshuizen, Bongers, and Hulshof 1990, 1992; Bongers and others 1990; Bovenzi 1996; Bovenzi and Hulshof 1999; Bovenzi and Zadini 1992; Griffin 1975; Magnusson, Pope, Wilder, and Areskoug 1996; Post 2000; and van den Heever 1996).

Noise

As with other construction and truck driving trades, ready mixed drivers are exposed to high noise levels during all phases of their work. The National Institute for Occupational Safety and Health (NIOSH) studied noise exposure among ready mixed truck drivers from one company and concluded that the drivers were at risk for noise-induced hearing loss. Almost all the personal noise measurements exceeded the OSHA General Industry action level of 85 decibels averaged over 8 hours, which requires a hearing conservation program; and all noise exposures exceeded the NIOSH recommended limit of 85 decibels (as measured using NIOSH criteria). Some loading and unloading operations reached peak levels in excess of 100 decibels. Audiometric testing is not common in the ready mixed concrete industry, although one company reported 17 cases of noise-induced hearing loss in one year (Lusk, Kerr, and Kauffman 1998; Neitzel, Seixas, Camp, and Yost 1999; Seshagiri 1998; and Tubbs 1999). (Conversation normally is at 70 decibels; hearing is measured on a logarithmic scale, which means 73 decibels is twice as loud as 70.)

Confined Spaces and Silica Dust

After several months, residual concrete inside the truck mixer drum hardens into a thick layer. This concrete must be removed periodically. Workers – drivers, laborers, or contract workers – enter the drum and use a pneumatic chipping hammer to break up the hardened concrete. This operation can result in excessive exposure to noise and silica dust from concrete-aggregate materials, like sand and gravel. Drivers may also be exposed to silica dust during drum loading operations at dry mix plants and from reentrainment of settled dust at the plant and at construction sites. Exposure to other confined space hazards, such as oxygen deficiency, accidental start-ups, heat stress, and mechanical hazards, should also be evaluated. (Goby 1995a, 1995b, 1995c, 1995d; Wilder, Pope, and Magnusson 1996; and Williams and Sam 1997).

Chemicals

Drivers may be exposed to dust containing silica, cement, and other aggregate materials during loading operations at the plant. At the plant and delivery site, drivers may have skin contact with mixed concrete and admixtures, which may contain irritant and sensitizing materials. Cement prod-

ucts are highly alkaline by nature and concrete contains hexavalent chromium, a powerful skin sensitizer. These materials can cause skin irritation and allergic reactions once sensitized. Drivers can also experience so-called bystander exposures of substances generated by activities at the delivery site (FOF Communications 1999).

Burns

During normal operations, truck equipment generates heat resulting in hot surfaces on equipment and truck components that pose contact hazards to drivers. During winter months, supplemental water used on the trucks is heated to temperatures as high as 160 F (National Ready Mixed concrete Association 1995; National Safety Council 1986) .

Eye Injuries

Flying particles and splashes of aggregate material, slurry water, and concrete expose drivers to serious hazards during loading and unloading operations. Eye-injury hazards may also be present at nearby operations at construction sites (ibid. - same as above).

Driving

Hazards to drivers during truck operations include collisions at the plant, on the road, and at the delivery site; being struck by vehicles backing up in the plant yard and at the delivery site; and rollovers while driving and unloading on unstable, uneven or steep ground at delivery sites (ibid. - same as above).

Recommendations for Prevention

Controlling hazards faced by ready mixed concrete truck drivers requires commitment by industry employers to implement comprehensive hazard identification and control programs based on occupational safety and health standards and best practices. Some employers and trade associations have already taken important steps in this direction (Illinois Ready Mixed Concrete Association 1997). Successful control strategies need to be disseminated to all industry employers. In some cases, such as ergonomic risk factors, additional research and technical assistance are needed to better characterize hazards and evaluate control effectiveness. Engineering controls, work practice controls, training, and personal protective equipment are needed to prevent work-related hazards and to protect drivers from injury and illness (*see* appendix B). These are some suggestions for employers:

- Implement a comprehensive safety and health program.** Employers should develop policies and procedures that demonstrate management commitment to worker safety and health at all levels of the company. Workers and their unions should participate actively in identifying and controlling hazards. Safety and health training should be provided to workers and managers when they begin work with a company and periodically after that.

- Reduce fall hazards.** Reconfigure water tanks and other truck equipment to eliminate the need to climb onto trucks and to minimize ladder use. Some companies have altered the location and position of water tanks so that drivers can reach equipment from the ground level. A guard at the top opening of the mixer drum can protect drivers from falling into drums during drum washing and checking slump. Use an elevated platform with stairways and guardrails to enable drivers to reach upper parts of trucks during washing and inspecting activities.

- Reduce machine and equipment hazards** by implementing programs for machine guarding and lockout/tagout.

- Use work practices to eliminate or reduce risk factors for back injuries.** Install equipment that helps drivers minimize twisting and turning while in the cab. For instance, automatically controlled mirrors can allow drivers to view rear work while maintaining more neutral postures. Reduce whole-body vibration in truck cabs by such methods as isolating cab from vibrations, using air-ride suspended seats, and using adjustable, well-padded seats and backrests. Implement frequent (hourly) rest breaks for drivers exposed to extensive whole-body vibration. Minimize lifting activities and awkward postures.
- Implement hearing conservation and noise control programs** that include sound-level measurements, audiometric testing, training, and noise reduction measures. Reduce noise sources in the trucks by installing noise transmission barriers and using preventive maintenance. Consider the use of flat attenuation hearing protection devices, which allow the wearer to hear warning signals and machine sounds.
- Implement confined-space entry programs** for all activities staged inside mixer drums such as periodic removal of hardened concrete with pneumatic chipping tools.
- Reduce silica exposure** during mixer drum cleanout with wet methods and ventilation. Use water spray attachments for chipping tools and wetting procedures. Supplement engineering and work practice controls with respirators, if needed.
- Implement hazard communication programs** for all substances used in ready mixed formulations.
- Implement a personal protective equipment (PPE) program** including hazard assessment, PPE selection and distribution, and PPE training — for instance for cleaning out mixer drums.

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Appendix A: Summary of Site Visits, New York City

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To: Michael McCann, PhD, CIH
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Date: 12-11-00

RE: Hazard Assessment of the Ready Mixed Concrete Industry: Summary of NYC Site Visits

Site visits at two concrete plants and one construction site were scheduled in New York City, November 16-17, 2000. The purpose of these site visits was twofold: 1) to orient research staff with the day to day operations of the ready mixed concrete industry and the specific tasks performed by ready mixed drivers; and 2) to observe potential workplace hazards encountered by ready mixed drivers.

The site visit team included: Michael McCann (CPWR), Azita Mashayekhi (IBT), Paul Luddine (BA, IBT LU282), Gene Boudon (BA, IBTLU282), Nancy Clark (Mount Sinai), and Jonathan Dropkin (Mount Sinai).

Empire Cement, Maspeth, NY

Empire Cement Company operates two concrete plants and 52 trucks at this site. Currently the company employs more than 40 Teamsters who are assigned daily work through a seniority-based shape up. At the plant, drivers are responsible for operating trucks during concrete fill-up, and filling water and chemical additive tanks; at construction locations, drivers dispense the concrete, add chemicals, and wash down truck. Each truck is equipped with water and additive tanks which are charged at the plant depending on the load requirements. The company has repositioned the filling ports on the water tanks so that drivers can add water from ground level thus eliminating the use of fixed ladders for this operation.

Most drivers complete 3-4 loads per day and are guaranteed 8 hours of work each shift. At the end of the day, drivers hose down the truck at the plant. Several times a year, laborers use pneumatic chippers to remove hardened concrete inside the drum. As ambient temperature decreases, the water used on the mixer trucks is heated up to 160F. Mixer operations are suspended when temperature drops to 10F.

Brooklyn Court House Construction Site: Unloading

Empire drivers drive their trucks into the construction site and dispense concrete into a pumping station where it is distributed to designated areas. Drivers positioned the concrete chute into the pumping station receptacle. Chutes are estimated to weigh about 50-60 pounds. At this site, one-hinged chutes were used. When access is limited, drivers may attach one or more extensions to increase the length of the chute. Drivers operate the controls to automatically feed additives from holding tanks on the truck into the mixer. Drivers monitor the mix and slump during unloading while perched on a ladder attached to the rear of the truck. After the drum is completely unloaded, drivers hose down both the outside and the inside of the truck. Cleaning out the drum requires the driver to lean into the drum opening while standing on a fixed metal ladder attached to the truck. Drivers wore work boots and heavy, waterproof gloves.

Ferrara Brothers, Hunts Point, NY

Ferrara Brothers operates a "central mixing" plant with about 40 trucks. At central mixing plants, also known as "wet" plants, water is measured and added to the ready mixed concrete at the plant rather than in the field. This procedure was introduced to the industry for quality control and requires drivers to drop their loads within 90 minutes of leaving the plant. Driver activities at this plant were similar to the ones per-

formed by drivers at Empire Cement. We did not observe unloading procedures.

The company had an active safety program and regular safety tool box meetings. It has implemented several innovative safety features in plant operations and vehicles aimed at reducing hazards associated with climbing, driving, and operating equipment. This company has also repositioned the filling ports on the truck water tanks so that drivers can access them from the ground rather than ladders. Another innovation is the installation of a "slump rack" in the yard so that drivers can hose off their trucks and make slump observations from an elevated platform. This equipment reduces the need for drivers to climb and perform these duties from ladders. The chute at the back of the truck can be automatically moved to give easier access to the mixing blades without having to maneuver it manually. In addition, a barrier was installed at the drum opening to prevent drivers from leaning too far into it during hose downs. To reduce the hazards and discomforts of over the road driving, especially with empty loads, the company has installed special suspension systems on concrete trucks.

Potential Hazards of Ready Mixed Concrete Drivers

The following potential job safety and health hazards associated with the ready mixed industry were identified through observations at these sites and discussions with drivers, owners, and union representatives:

1. Slips, trips and falls from truck equipment, elevated work stations, and walking surfaces
2. Chemical exposure and contact with concrete products and additives
3. Exposure to ergonomic risk factors: awkward postures, forceful exertions, vibrations and contact with cold surfaces and temperatures
4. Noise
5. Burns from contact with hot surfaces and hot water
6. Eye hazards during unloading operations
7. Impact and mechanical hazards during equipment operations

During the next six months, these potential hazards and recommendations to prevent them will be further investigated and described.

Other Comments

The business agents talked about the risk of roll-overs, especially when descending steep inclines on construction sites. One of them had been in such a rollover. In NYC, the drivers do not clean out the inside of the trucks or pour in additives.

The conditions for drivers in NYC are apparently not typical. This would be particularly true for non-union sites. If possible, a location in upstate New York or New Jersey will be visited for comparison.

Appendix B: Summaries of Selected Research

Ergonomic Risk Factors

1. Are occupational drivers at an increased risk for developing musculoskeletal disorders? (Magnusson, 1996)

Purpose of study: The study analyzed the health effects of long-term exposure to occupational driving among truck and bus drivers in Sweden and the United States. The objective was to establish the effect of mechanical and psychosocial factors in reporting back, neck, and shoulder pain and work loss among truck drivers, bus drivers and a control group (sedentary workers). Exposures included whole-body vibration (WBV), frequent lifting, and heavy lifting.

Vibration exposure was obtained by directly measuring the vibration on the driver during a typical workday. Lifting exposure was attained by questionnaire. Cumulative exposure was computed based on work history. Musculoskeletal health information, physical and psychosocial aspects of the work environment were collected by questionnaire.

Findings: Of the sample, 50% reported low back pain, with no difference between countries. The highest risk factors for back and neck pain were long-term vibration exposure, heavy lifting, and frequent lifting. A combination of long-term vibration exposure and frequent lifting carried the highest risk of low back pain. Work loss from low back pain was influenced by perceived job stress.

Recommendations for controlling exposures: (a) Design cab layouts to reduce WBV (isolate vehicle cabs from vibration, apply ACGIH WBV TLVs, decrease exposure time, use “air-ride” suspended seats, provide fully padded seat pan and backrest, adjustable backrest and seat pan tilt, adjustable seat pan height and depth, adjustable lumbar support, adjustable and padded armrests, (b) enlarge cabs, (c) provide handholds for stability and support while entering and leaving the cab, (d) lift with partner, (e) reduce lifting loads, (f) provide on-going maintenance of vehicle suspension systems, (g) provide proper tire inflation.

2. *Mechanical stress reduction during seated jolt/vibration exposure (Wilder, 1996)*

Purpose of study: The study described the mechanical factors that contribute to stress of the intervertebral disc in the lumbar spine while sitting, the effects of postural constraints and vibration on the spine, the results of expected and unexpected mechanical jolts on the trunk, and provided solutions to WBV.

Findings: A constrained, seated posture, in combination with exposure to whole-body, jolt/vibration can impose significant stresses on the intervertebral disc and can lead to back muscle fatigue.

Recommendations for controlling exposures: Interventions that reduce the jolt/vibration magnitude and duration of exposure will decrease the mechanical work performed on the intervertebral disc. Such interventions consist of jolt/vibration isolating seats and vehicle cabs, decreasing exposure time and maintaining simple supported postures when entering and exiting the cab. In addition, avoidance of lifting or bending from the low back or hips just after exposure to WBV is recommended. Upon entrance or exit from the cab/vehicle, avoid spinal or trunk twisting or rotation. Improvements in seat configuration, such as increasing the trunk-thigh angle (to just beyond 90 degrees), can reduce the intervertebral disc pressure and strain on the disc. Design vehicles to reduce WBV with proper tires, suspensions and chassis.

3. *Low back pain disorders and exposure to whole-body vibration in the workplace (Bovenzi, 1996)*

Purpose of study: Occupational exposure to whole-body vibration (WBV) and postural stress in a driving environment may contribute to an increased risk for low back pain (LBP) disorders. This paper summarizes the findings of two studies of male bus drivers and tractor drivers in northern Italy. In both studies vibration was measured under working conditions. A postural checklist was developed to assess the frequency and duration of awkward postures. Musculoskeletal symptoms were collected among WBV-exposed drivers.

Findings: The studies of bus and tractor drivers revealed that LBP disorders were found to be associated with age, back accidents, cumulative WBV dose, and postural overload, although the actual amount of exposure needed to cause LBP was unclear.

Recommendations for controlling exposures: For protection against LBP arising from WBV, the author directed his readers to the “Directive for physical agents,” by the Council of the European Union (1994). The quantities are based on a daily, 8-hour WBV exposure. The Directive defines a threshold level (the exposure value below which no adverse health effects are expected), an action level (the value above which technical, administrative or medical provisions should be initiated), and an exposure limit value (the exposure value above which an unprotected worker is exposed to unacceptable risks). Other controls include using suspended cabs, air-ride suspended seats, and avoidance of lifting or bending from the hips or low back immediately following exposure to WBV.

4. *Self-reported back pain in fork-lift truck and freight-container tractor drivers exposed to whole-body vibration (Boshuizen, 1992)*

Purpose of study: To study the long-term health effect of whole-body vibration (WBV), a questionnaire on symptoms of ill health was mailed to 242 fork-lift truck and freight-container tractor drivers. Vibration levels during a typical working period for fork-lift trucks and freight-container tractors were measured.

Findings: Young drivers, with less than 5 years of vibration exposure, reported a higher frequency of LBP than did an unexposed group of a comparable age. In older drivers, no differences were noted when compared to a similar age group unexposed to WBV. There were some indications that drivers develop LBP during the first 5 years of driving.

Recommendations for controlling exposures: In addition to WBV, drivers were also exposed to prolonged sitting (possibly in awkward postures), and frequent twisting (rotation) of the spine. Physical inactivity, resulting from prolonged sitting, can interrupt the nutrition of the intervertebral disc. Muscular fatigue, leading to LBP, can also result from prolonged sitting. And a fully rotated spine is particularly susceptible to damage by sudden jerks. One solution for reducing these potential adverse health effects is to leave the cab and take frequent rest and recovery pauses. Another is to avoid looking backwards for prolonged periods or repeatedly. When entering or exiting the cab, use neutral postures (avoiding spinal twisting) and slow down. (Neutral postures, as compared to awkward postures, place less mechanical stress and strain on the musculoskeletal system. They also place the musculoskeletal system in a biomechanical advantage: it doesn't have to work as hard.)

5. *Back disorders and occupational exposure to whole-body vibration (Boshuizen, 1990)*

Purpose of study: This study sought to determine the relationships among long-term sick leaves and disability among crane-operators and tractor drivers, and the frequency of back pain among tractor drivers, helicopter pilots and lift-truck drivers. Acceleration measurements were conducted to establish WBV levels of the tractors, helicopters and lift-trucks. Questionnaires were administered to determine frequency of back pain.

Findings: The frequency of back pain was significantly higher among workers exposed to WBV compared to workers not exposed to WBV. The number of new cases of sick leave and disability due to back disorders, particularly intervertebral disc disorders, were higher in occupations that expose workers to WBV. The relationship between vibration exposure and the frequency of back pain was examined. Findings indicate that an increase in exposure to WBV results in an increase in LBP, and that above a certain "dose," tractor drivers, fork-lift drivers and helicopter pilots may have a 10%-20% increase in the frequency of back pain.

Recommendations for controlling exposures: The combination of WBV, prolonged sitting and twisting of the spine seems to increase back pain, disability and sick leave. Therefore, reductions in these exposures should be a consideration in the prevention of LBP.

6. *Back pain and exposure to whole body vibration in helicopter pilots (Bongers, 1990)*

Purpose of study: This study sought to determine the frequency of back pain in helicopter pilots and a control group of non-flying air force officers. Since pilots document their hours of flight in a flight log, an accurate estimate of the duration of exposure could be made. Vibration levels of the helicopters were also measured and a cumulative vibration dose was calculated for each pilot.

Findings: Acute back pain of a short duration was more frequent among the pilots compared to the non-exposed group, and the frequency of chronic back pain was also higher among the helicopter pilots. Acute back pain and chronic back pain seemed to be related to the average hours of flight per day and the total hours of flight. A higher frequency of chronic back pain was observed after 2000 hours of flight. The observed health effects may be due to vibration or constrained posture, but are most likely associated with exposure to both factors.

Recommendations for controlling exposures: The authors conclude that acute and chronic back pains are related to increasing daily exposure to WBV. Limiting daily exposures to WBV and static, constrained postures and taking hourly rest and recovery pauses may reduce the adverse health effects associated with these exposures.

7. *Self-reported low back symptoms in urban bus drivers exposed to whole-body vibration (Bovenzi, 1992)*

Purpose of study: The frequency of self-reported low back symptoms was investigated using a postal questionnaire in a group of urban bus drivers exposed to whole-body vibration and postural stress and in a control group of maintenance workers employed at the same bus company. The average whole-body vibration on the seat pan of the buses was measured.

Findings: Bus drivers had an increased frequency for several types of low back symptoms (leg pain, acute low back pain, low back pain) compared to controls. The occurrence of low back symptoms increased with increasing whole-body vibration exposure, vibration magnitude, and duration of exposure (years of service). The highest frequency of disc protrusion was found among the bus drivers with more severe whole-body vibration exposure. Frequent awkward postures at work were also related to some types of low back symptoms.

The authors concluded that bus driving is associated with an increased risk for low back troubles. The increased risk may be due to whole-body vibration exposure and prolonged sitting in a constrained posture. The findings of this study also indicated that the bus drivers' low back symptoms occurred at whole-body vibration exposure levels that were lower than the health-based exposure limits proposed by the International Standards Organization (ISO, 1985).

Recommendations for controlling exposures: Work practice and engineering controls are identical to previous recommendations

8. *An updated review of epidemiologic studies on the relationship between exposure to whole-body vibration and low back pain (1986-1997) (Bovenzi, 1999)*

Purpose of study: The aim of this study was to update information on the scientific evidence of the adverse health effects of whole-body vibration (WBV) on the spine through a review of the studies published between 1986 and 1997. A search of studies of low back pain (LBP) disorders and occupations with exposure to WBV was performed.

Findings: The findings of studies showed that occupational exposure to WBV was associated with an increased risk for LBP, sciatic pain, and degenerative changes in the spine, including lumbar intervertebral disc disorders.

Recommendations for controlling exposures: Work practice and engineering controls are identical to previous recom-

mentations.

9. *Vertical vibration of seated subjects: effects of posture, vibration level, and frequency (Griffin, 1975).*

Purpose of study: The study was conducted to determine what effects frequency and level of vibration and posture of subjects' bodies have on seated subjects undergoing head vibration. "Most severe" posture was defined as when vibration of the subject's head was maximum; "least severe" posture was when vibration of the subject's head was minimum. This information could then be used, in part, to determine what effect head vibration has on vision.

Findings: Posture was found to have a very large effect on the vibration of the head. Subjects confirmed that the severe posture was extremely uncomfortable compared to the least severe posture. In the severe posture, subjects frequently reported blurring of their visual field; under least severe posture, blurring was rarely reported.

Recommendations for controlling exposures: When dealing with seat design in a vibration environment, three factors should be considered: (a) the seat should be designed to maximize comfort during dynamic sitting postures; (b) it should have effective vibration transmissibility (i.e., transmission from seat pan, back rest, and armrests to persons should be minimized); and (c) it should be comfortable during static postures. The author concluded that some of the current vibration problems may be reduced by changing postures of the exposed persons.

Noise Exposure

1. *NIOSH Health Hazard Evaluation Report: RMC Lonestar. HETA# 98-0289-2743 (Tubbs, 1999)*

Purpose of study: In 1998 NIOSH responded to a request for a health hazard evaluation from RMC Lonestar and Teamster's Union Local 216 to investigate and evaluate noise exposure of Ready mixed concrete truck drivers at a San Francisco Ready mixed concrete plant. NIOSH investigators measured noise exposures to drivers during loading concrete at the plant, driving to the delivery site, and returning to the plant for additional loads. Noise exposures were also evaluated during activation of an audible tracking signal (used to maintain communications between driver and dispatcher) and in the drivers' break room.

Findings: Fourteen of the 16 daily noise doses were higher than the OSHA General Industry action level of 85 dbA (as measured using OSHA criteria) which requires a hearing conservation program; and all noise exposures exceeded the NIOSH recommended limit of 85 dbA (as measured using NIOSH criteria). Drivers were in their trucks anywhere 8.5 hours to 13 hours. The median sound levels for work activities were as follows: loading operations at the plant was 86.3 dbA; time in transit between plant and construction site was 85.6; dropping off the load at the construction site was 83.8; and time in the break room was 79.1 dbA (higher levels were measured with door opened). Some loading and unloading operations reached peak levels in excess of 100 dbA. The peak noise level of the tracking signal was 72 dbA; investigators described the noise as bothersome and suggested that the audible signal be changed or replaced.

Recommendations: NIOSH investigators made the following recommendations for reducing noise exposure for Ready mixed cement truck drivers: 1) the company should continue to provide hearing conservation program to its employees; 2) drivers should have their hearing tested regularly; 3) workers should be provided with custom fit ear plugs which are designed to reduce noise exposure and still enable the driver to hear warning signals; 4) the company should implement a preventative maintenance program aimed at reducing noise sources from loose and vibrating truck and equipment parts; and, 5) when planning new facilities, the company should incorporate noise reduction measures into the construction. NIOSH also recommended that workers 1) report rattles, squeaks, and other noises inside the truck cab so that they can be repaired; 2) make an effort to have a hearing test each year; 3) keep break room door closed; and, 4) reduce noise exposure away from the job.

2. *Use of Hearing Protection and Perceptions of Noise Exposure and Hearing Loss Among Construction Workers (Lusk, 1998)*

Purpose of study: This study was to describe construction workers' use of hearing protection devices (HPDs) and to determine their perceptions of noise exposure and hearing loss. Four hundred experienced and apprentice carpenters, operating engineers, and plumbers/pipe fitters were recruited through trade unions and trade group associations in the Midwest. Construction workers were surveyed through a self-administered questionnaire. Noise exposure was estimated by workers' perceptions of the percentage of time on their job sites that they were exposed to high noise. High noise was defined as a noise level causing the worker to shout to be heard by a coworker three feet or less away from them. Perception of hearing loss was measured by asking if the worker thinks they have had any hearing loss.

Findings: Operating engineers reported the most exposure to noise (61%), use of HPDs (49%), and perceived hearing loss (65%). Carpenters reported the least exposure to noise (45%), use of HPDs (18%), and amount of hearing loss (44%). Plumbers/pipe fitters reported noise exposure (45%), use of HPDs (32%), and hearing loss (49%). Though there is no way to validate these workers' perceptions of hearing loss, the high proportion of workers maintaining that perception (44-65%) is alarming. Since noise-induced hearing loss is an irreversible but preventable impairment, such a high self-reporting of hearing loss suggests a failure in providing a safe and healthful work place for these tradesworkers.

Recommendations: The authors recommended a holistic approach to bolstering hearing conservation programs in construction by 1) purchasing or retrofitting quieter equipment; 2) educating both employers and workers about different types HPDs, such as level dependent HPDs, communication headsets, and sound neutralizing devices; 3) incorporating surveillance data into the program; and 4) designing worker training programs for specific trade groups and considering psychosocial factors on HPD use.

3. *Occupational Noise Exposure of Operators of Heavy Trucks (Seshagiri 1998)*

Purpose of study: This study assessed the noise exposure of truck drivers operating in 18-wheeler hauling trucks in Canada. Trucks were mostly double-axle with exhaust pipes situated behind the cab. Researchers measured interior noise levels while driving long haul and pickup-delivery trips under varying conditions of windows and air vents closed or opened, and radio and CB operating or not operating, and on varying highway types. One hundred seventy-nine drivers participated in the study and more than 400 measurements were taken.

Findings: Major contributors of truck noise are: engine noise (combustion and mechanical), engine exhaust, fan, air intake into engine, transmission (gear meshing), tires (effect of tires on roadway at high speeds), and aerodynamics (from air passing over truck cab and body).

Under best noise control conditions (windows and vents closed, radio and CB off), mean noise exposure inside the truck cab was 82.7 dbA. When the driver's side window was opened, passenger side window closed, and radio on mean noise levels inside the cab were 86.6 dbA. This study concluded that the vast majority of truck drivers are likely to exceed the current ACGIH limit of 85 dbA, if they drive with the driver's side window open and the radio on. Short haul, pick up and delivery drivers were also exposed to noise during loading and unloading operations.

Recommendations: Researchers recommend that: 1) decibel levels be reduced inside the cab by keeping the radio low and the windows closed; 2) trucks be equipped with air conditioning; 3) speakers be properly located in the cab; 4) vehicles be routinely maintained; 5) simple noise control devices such as sound absorbing materials be used inside truck cab; 6) all openings that permit sound transmission into the cab be sealed; 7) good quality engine mounts and exhausts be installed; and 8) drivers be trained about noise exposure and hearing conservation.

4. *Noise Exposure of Truck Drivers: A Comparative Study (Van den Heever, 1996)*

Purpose: This study evaluated noise exposure of drivers inside the cabs of two different trucks in South Africa. Although the two trucks, MAN and Mercedes brands, differed in cab design, the motors were identical. Sixteen 8-hour (minimum) noise exposures were measured with personal dosimeters.

Findings: The highest average readings for the Mercedes truck driver was 88.6 dbA compared with 86.4 dbA for the MAN truck driver; maximum sound pressure levels were 118.5 dbA and 115 dbA respectively. Results were compared with South African noise exposure standard of 85 dbA (8-hour time-weighted average (TWA)) with a 3 dbA doubling rate (sound level doubles for every increase of 3 dbA). Noise exposure was inconsistent over the work shift. Drivers experienced extended periods of low noise exposure during loading and unloading activities. Peak noise levels were associated with drivers having their windows open. The study showed that truck drivers are exposed to hazardous noise levels which could result in hearing loss.

Recommendations: To reduce risk of noise-induced hearing loss, researchers recommended that: 1) truck cabs be equipped with air conditioning so that windows could be kept closed; 2) drivers wear hearing protectors while driving; and 3) noise prevention programs be implemented in the trucking industry.

5. *An Assessment of Occupational Noise Exposures in Four Construction Trades (Neitzel, 1999)*

Purpose: This study was designed to evaluate noise exposure among workers from four different construction trades, carpenters, laborers, ironworkers and operating engineers. Samples were collected from 133 workers at four different sites. Workers were sampled for an entire work shift on each sampling day using data logging noise dosimeters, which recorded both daily time weighted averages and one minute averages. Workers also filled out questionnaires detailing the tasks performed and the tools used during the shift. Results were compared with both the OSHA 5 dbA doubling rate and the NIOSH/ISO 3 dbA doubling rate. (For a 5 dbA doubling rate, it is assumed the sound level doubles for every increase of 5 dbA; the 3 dbA doubling rate is more protective. In addition the NIOSH method includes lower sound levels than does the OSHA method.)

Findings: Construction workers are routinely exposed to excessive noise. No significant differences were found among trade groups. The mean TWA for 338 samples was 82.8 dbA. Forty percent of these exceeded 85 dbA, the OSHA action level and 13% exceeded 90 dbA, the OSHA PEL. When measurements were taken using NIOSH/ISO criteria, 82% exceeded 85 dbA and 43% exceeded 90 dbA. Highest levels were associated with structural phases of construction and multiple concrete construction methods. Tools associated with the highest exposure levels were those involving pneumatically operated tools (jackhammer, chipping gun, LeJeune gun, bulldozer, and rotohammer) and heavy equipment. Workers were also exposed to excessive impact noise. The study confirmed that construction workers are at risk for noise-induced hearing loss.

Recommendations: Researchers recommended that 1) hearing conservation programs be implemented in construction; 2) workers be trained in the need and use of hearing protection devices; 3) engineering controls be sought and implemented; 4) noise transmission barriers be installed on the cabs of heavy equipment; 5) the placement of noise sources be situated away from reflective surfaces; 6) the use of HPDs by construction workers be evaluated.

6. *Noise, Vibration, and Heat and Cold (Schneider, Johannings, Beland, and Engholm 1995)*

Summary: This article reviews construction worker exposures to noise, vibration, heat and cold. Exposure problems and preventive measure are described for each of the four problem areas.

Silica

1. *Illinois Ready Mixed Concrete Association Industrial Hygiene Study, (Williams and Sam 1997)*

Purpose of study: In response to the OSHA special emphasis program on silica, the Illinois Ready Mixed Concrete
Clark, Dropkin, and Kaplan

Association requested assistance from the Illinois Department of Commerce and Community Affairs On-site Consultation Program to evaluate employee exposure to silica in Ready mixed concrete facilities. In addition to loading and delivering Ready mixed concrete to construction sites, truck drivers also periodically remove dried concrete from inside the truck mixer drum using pneumatic chippers and hammers. Investigators evaluated worker exposure to silica dust during concrete removal using a variety of combinations of ventilation and wetting controls.

Findings: The results of personal air sampling indicated that, without any controls in place, drivers were exposed to silica in excess of the OSHA PEL. Various dilution and ducted ventilation configurations were evaluated for effectiveness in exposure reduction. Air monitoring results indicated that these efforts did not substantially reduce exposures and in some cases enhanced them. Likewise wetting the concrete prior to chipping had limited benefits because the concrete quickly dried up releasing dust into the air. However, when the concrete surface was soaked prior to chipping and continuously throughout the operation, silica exposure was substantially reduced. Investigators and drivers attached a water spray nozzle to the chipper so that a continuous spray was constantly applied to the chisel head. Drivers noticed significant reduction in dust being generated inside the drum mixer during chipping. The use of this nozzle on the chipper reduced exposure to total dust with silica by 85% and reduced exposure to respirable dust with silica by 70%.

Recommendations: Investigators recommended the following procedures for chipping out concrete from the truck mixer drum:

1. Keep the hatch open
2. Place a box fan horizontally in hopper
3. Set the fan on high speed and exhaust the airflow out of the drum
4. Use a chipping hammer equipped with water spray nozzle
5. Initially spray the entire inner surface of the drum with water
6. Adjust the water spray so that it is aimed at the point of the chisel
7. Ensure that water sprays at all times when the chipper is in operation
8. If during the cleaning procedure, concrete surfaces dry to the point that dust is being generated while chipping the surface should re-sprayed with water.

2. *Industrial Hygiene Survey of Respirable Crystalline Silica Dust Exposure in the Ready-Mixed Concrete Industry (Goby, 1995)*

Purpose of study: NIOSH investigated respirable crystalline silica exposure in industries where silica is a constituent material. Ready mixed concrete was identified as an industry to investigate because of the potential for respirable crystalline silica exposure from the silica sand which comprises 10-20% of concrete.

Findings: Personal and area sampling were conducted to assess potential exposures to respirable crystalline silica. The sampling included respirable dust samples along with bulk samples of the cement, sand and fly ash. The bulk respirable dust samples and personal respirable dust samples were collected in dusty areas around the plants, according to NIOSH Method 7500.

Dust concentrations were calculated by weighing the dust collected on the filters for personal and area samples. None of the airborne dust samples contained enough crystalline silica for a quantitative measurement. Only two of the dust samples had a detectable but not a quantifiable amount of crystalline silica. The highest concentrations of dust at Ready mixed concrete plants are generated for brief periods during the addition of the cement component to the concrete mix. Even though most measurements were not detectable, day to day variability in work practices and weather conditions could produce higher levels of exposure.

Recommendations: The only source for silica exposure in the study was found to be road dust. Exposure to this could be easily suppressed by wetting down the road.

3. *Industrial Survey of Respirable Crystalline Silica Dust Exposure in the Concrete Products Packaging Industry, by Goby M (NIOSH: Division of Respiratory Disease Studies, 10/95)*

Purpose of study: These studies were part of a larger effort to investigate respirable silica dust exposure in the concrete packing industry. The surveys included a tour of the plant to acquaint the investigator with the operations, full shift personal air sampling, employee interviews, ventilation surveys, bulk sample collections, reviews of the respirator program, hazard communication program, and OSHA200 log of injury and illnesses. Investigations were staged at Master Builders, Inc., Fischer and B&O RR Inc., and Union Sand and Supply Corp.

Findings: Workers were exposed in some cases to levels above the OSHA PEL for silica dust during packaging and bagging operations. Employees removed dust accumulated in their clothing by using compressed air. To clean work areas the workers used brooms and shovels which re-introduce the dust into the workplace air where it again becomes a hazard to the employees. The plant lacked a written respirator program with standard operating procedures.

Recommendations: Since there was no written respirator program, it was recommended that one be put into place. It was also suggested that instead of dry sweeping, a wet mop should be used to keep dust from re-introducing into the environment. Recommendations to lower dust levels included improvements to the ventilation and dust collection systems. A vacuum system should be used for use in cleaning work areas at the end of each work shift.

4. *Environmental Surveillance Report, West Virginia Department of Highways Bridge Demolition (NIOSH, 1992)*

Purpose of study: On this site visit NIOSH visited a bridge demolition operation to observe pavement cutting and Ready Mixed Concrete Truck Drivers: Work-Related Hazards and Recommendations for Controls

drilling work and to obtain air samples of workers potentially exposed to respirable silica dust. Workers used hand held drills and a concrete saw in demolition activities.

Findings: Personal breathing zone and general area air samples were taken over a shortened workday. Results indicated that if work was carried on for an entire shift exposures would exceed the OSHA PEL by a factor of eight.

Recommendations: To reduce silica dust levels, controls such as wet saws and respirators should be in place.

5. *Environmental Surveillance Report, Golden Triangle Construction, Concrete Drilling (NIOSH, 1993)*

Purpose of study: The site was a repair project on a four lane highway in which blocks of concrete were removed and then replaced with newly poured concrete. Worker exposure to silica dust was assessed.

Findings: Personal breathing zone air samples indicated that workers were exposed to excessive levels of silica dust. The site did not have a dust collection system or a wetting system for the pneumatic drills being used. Workers wore disposable particulate respirators or half face respirators.

Recommendations: Engineering controls such as dust collection or water sprays should be used to reduce worker exposure to silica dust.

6. *Environmental Surveillance Report, International Association of Machinists Building (NIOSH, 1992)*

Purpose of study: This site was a building under construction, in which a sandblaster and a helper were assigned to blast off the surface of a poured concrete structure.

Findings: Results of silica samples exceeded the NIOSH recommended exposure limit and the OSHA permissible exposure limit for the helper and for the sample taken outside the blaster's helmet. The sandblaster wore a supplied air respirator; however, his helper did not use any respiratory protection.

Recommendations: NIOSH recommended that: 1) alternate blasting materials be used instead of silica sand; 2) helpers be protected; and, 3) workers not directly related to the work be in an area where exposure is not of concern.

Silica: OSHA Survey Results

In 2000, the OSHA Area Office in Marlton, New Jersey, initiated a program designed to reduce employee exposure to silica dust in the concrete and related industries in southern New Jersey. This silica control initiative has several components ranging from educational seminars for industry personnel to enforcement through job place inspections. In order to evaluate this initiative and collect baseline data on employer health and safety programs for silica exposed workers, OSHA requested that the International Brotherhood of Teamsters (IBT) distribute a baseline questionnaire to their local affiliates in southern New Jersey area. The questionnaire was designed to collect information about plant products, job titles, local union representation, and health and safety programs for silica dust. Local union shop stewards at Ready mixed concrete plants filled out the questionnaires for their plants and returned them to the Health and Safety Department of the IBT. Nine questionnaires were completed for concrete plants that employed a total of 273 workers, including truck drivers, maintenance mechanics, mixers, engineers, bucket loaders, fork lift drivers, service workers, and batch men. Responses showed that Ready mixed concrete employers in this region are doing little to protect workers from silica dust hazards. A summary of questionnaire responses, for the question, "Does your company have (a): respirator program, effective ventilation system, monitoring program, training program, and medical surveillance" is presented here:

Summary of OSHA questionnaire responses about silica health and safety programs in the ready mixed concrete industry in southern New Jersey, 2000.

	Yes	No	Partial	Uncertain
Respirator program	1	7	1	0
Effective ventilation system	1	6	1	1
Monitoring program	1	7	1	0
Training program	2	6	1	0
Medical surveillance	2	7	0	0

Cement Dermatitis

Skin and eye contact with cement products, including Ready mixed concrete, has long been known to cause a range of health conditions among exposed workers. Ready-mixed concrete truck drivers may contact wet concrete during loading, unloading and clean up operations. The Center to Protect Workers' Rights recently published a comprehensive guide: A Safety and Health Practitioner's Guide to Skin Protection and companion training and educational materials for employers and workers. These materials offer important information on recognizing, evaluating and controlling "cement dermatitis".

Contact with cement products, such as Ready mixed concrete, irritates the skin because cement is a highly alkaline material (pH 12-14) when wet, it reacts with skin, mucous membranes, and eye moisture; it is hygroscopic, drawing moisture from skin; and it's abrasive. Cement also causes allergic skin responses because it contains hexavalent chromium, a powerful skin sensitizer. There are four types of skin conditions caused by contact with cement products: 1) mild irritant contact dermatitis (MICD), characterized by dry or irritated skin which may include scaling, itching, burning and redness; 2) irritant contact dermatitis (ICD), a more intense condition which may be accompanied by pain, itching, blisters, rashes, fissures, and watery discharge; 3) allergic contact dermatitis (ACD), an immune response caused by sensitization to hexavalent chromium and other metals in the cement, which results in skin disruptions similar to ICD

and is provoked by subsequent exposure to cement; 4) caustic burns, second and third degree burns resulting in blisters, dead or hardened skin, and/or black or green skin. Many workers in the cement and concrete trades suffer from these skin conditions. A 1997 survey of 442 apprentice cement masons found that 71% of them had one or more skin problems. (10).

Recommendations: Unfortunately efforts to reduce alkalinity or remove the hexavalent chromium from cement products have not been successful in this country. Protection from contact with cement products rests on using best practices at work and at home. Best practices at work include: washing hands with running water and pH-neutral or mildly acidic soaps; wearing correct gloves (butyl or nitrile rubber); trying a neutralizing spray on the hand; wearing long sleeved shirts taped inside gloves; wearing rubber boots with pant legs taped inside; never letting cement or concrete stay on skin or clothes; avoiding barrier creams; and seeing a doctor for any persistent skin problems. Workers should never use lanolin or petroleum jelly as a skin protector because it can seal cement residues to the skin. At home workers should use pH-neutral or mildly acidic soaps and wash their clothes separately. Employers and workers should be trained about recognizing and reducing cement dermatitis.

Admixtures

Several material safety data sheets(MSDSs) for cement dispersing agents were reviewed. As a group these products contain moderately irritant substances, such as triethanolamine, and pose skin and eye hazards. the pH for these materials range from 8 - 12.8. It is not known if these MSDSs are representative of the products that are added to concrete formulations by truck drivers. It is recommended that a more thorough review of admixture products be carried out.

Appendix C: Photographs

1. A truck discharges concrete at a construction site. Monitoring the load while standing on the truck ladder increases the risk of driver slips and falls



2. A driver uses a water hose to wash out a drum interior. This activity presents serious fall and mechanical hazards.



3. Innovation: The filling port on this water tank has been lowered so that the driver can fill the tank from ground level. Eliminating climbing on truck ladders reduces risk of slipping and falling.



4. Innovation: The driver is washing the truck from an elevated platform equipped with guardrails. This platform was constructed so that driver could reach truck mixing drum from a safe working surface.



5. Innovation: A slump meter has been attached to the truck behind the cab so that the driver can check the condition of the concrete from ground level.



