Strategies to Prevent Trenching-Related Injuries and Deaths

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Abbreviations

BLS	U.S. Bureau of Labor Statistics
Cal/OSHA	California State OSHA program
CFOI	Census of Fatal Occupational Injuries, BLS
IMIS	Integrated Management Information System, OSHA
NIOSH	National Institute for Occupational Safety and Health
OSHA	U.S. Occupational Safety and Health Administration

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In most cases, a cave-in was the main event leading to the death. As might be expected, dirt, earth, channels, ditches, and trenches inflicted the injury more than half the time. A single cubic yard of dirt can weigh between 3,000 and 4,000 pounds, depending on soil type and moisture content, highlighting the importance of protecting workers from cave-ins (Deatherage and others 2004). The next-most-common source of injury was backhoes, which caused 25 (7%) and 6 (11%) deaths in 1992-2002 and 2003, respectively. More than half of the victims were construction laborers. Other occupations affected included supervisors/managers, plumbers/pipefitters/steamfitters, and operating engineers. Of the 57 deaths in 2003, 19 (33%) were Hispanic workers (CFOI).

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5. Nature of trenching- and excavation-related injuries, fatal and nonfatal,

workers will enter trenches five feet or deeper; this program could help identify trenching companies for outreach activities.

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Near-Misses and Cave-Ins Described by Interview Participants

"The cave-in happened when I was 22 on a jobsite in Dallas. We were laying a large-diameter pipe in a lot of different soils that were layered. There were two of us in a 20-foot deep trench that had no protection. The top 10 feet of soil was black clay, the bottom of the trench was solid rock, and in between the two layers was a wet spring. The operators had cut almost-vertical walls with some layback. We were worried about collapse, but went ahead doing 8-foot sections of pipe at a time. When I noticed a sidewall starting to shift, I pushed my buddy about 15-16 feet up the ramp. I did not make it out. I was covered up to my neck with my arms raised above my head. I do not remember anything after that except that when they pulled me out, my jeans and boots did not come out with me. They were pulled off and left in the hole as the workers grabbed my arms and pulled me out of the cave-in. After that we made a lot more demands for safety."

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"In a large excavation, we were using a huge trench box. The sides of the excavation started to cave in. The chunks of falling soil were as big as a Volkswagen bug. The trench box functioned as it was supposed to and protected the employees. I now use this as a training example."

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"When I was working as a safety person, there was

They noted that companies lacking a commitment to safety fail to conduct a proper job hazard analysis and are ill-prepared to address hazards when they open a trench.

Lack of training

The safety experts in particular cited lack of appropriate safety training for competent persons and workers as a major barrier to trench safety. Untrained, poorly trained, or inexperienced competent persons and workers are unable to recognize hazards and therefore do not know how to work safely in a trench. Many of those interviewed, including training providers and excavation company representatives, said there was a pressing need to provide more safety training in Spanish to accommodate the Hispanic workers who make up the largest part of their workforce. Also, many construction workers move from one employer to another, making it hard for workers to receive training on a regular basis.

In addition to inadequately trained workers, the Cal/OSHA staffers referred to contractors who are inexperienced and ignorant about trenching hazards. While contractors may know that some kind of cave-in protection is required, they may lack information about the specific protection needed, where to get it, or the fact that it may be rented. The problem is particularly acute among contracting companies that employ fewer than 10 workers. Such employers fail to provide adequate safety training and have the worst safety records, according to many respondents. One

Other barriers
The following barriers to trenching safety were also mentioned:

- Overly complicated regulations
- Lack of certification or a training standard for competent-person training providers
- The workers' compensation insurance system(s), for not providing adequate financial incentives for employers to create exemplary safety programs; also for not holding employers financially responsible for unsafe conditions resulting in serious injury or death, for instance, through substantially higher premiums.

Suggestions for improving trench safety

The interviewed stakeholders offered recommendations centering on improved training and outreach on trenching hazards, as well as increased regulatory actions and advances in technology. (The authors have incorporated many of these suggestions in the recommendations; *see* page 12.)

Training and outreach
Those interviewed generally agreed that the best way to prevent trenching injuries is to provide adequate training in trench safety, aimed at both workers and employers. Training providers, employer representatives, and trade association representatives alike emphasized the need to train employers on the requirements of the OSHA excavation standard as well as the reasons for using the protective equipment. They said employers also need information about available trench shielding methods. A union representative stressed letting companies know that trench box rental is less expensive than they may realize.

Managers need trench safety training because they make the decisions about renting or purchasing trench protective systems, said a company representative. According to a training instructor, such training is also needed for project designers responsible for specifying what safety equipment is used onsite.

Other suggestions to improve training and outreach

- Making free/low-cost training for workers, competent persons, and employers more widely available through partnerships
- Ensuring that the instructors have experience in excavation so they will have credibility with the audience
- Having a survivor of a trench collapse discuss what happened
- Using a video or other visual method to illustrate the rate of collapse
- Using case studies of trench collapses addressing "lessons learned"
- Combining classroom and field work, allowing trainees to gain hands-on experience and observe the complexities of trenching
- Developing interactive, web-based training on trench safety
- Disseminating practical checklists for trench inspection and other tools for hazard recognition
- Monitoring the work practices and performance of recently trained competent persons to ensure they are adequately prepared to assess and address hazards under a variety of conditions

- Developing and distributing a list of local training providers who offer competent-person training for trench safety
- Creating a web-based library of trenching-related photographs and videos for trainers to use
- Distributing trenching safety materials at places where contractors and others can easily find them, such as utility location services, permitting agencies, and fire departments
- Conducting public information campaigns using billboards, public service announcements, and a toll-free number for reporting unsafe conditions, to encourage workers and the public to recognize and report unsafe trenches.

Regulatory action

The interview participants recommended the following regulatory actions for improving trenching safety:

- Increasing OSHA fines to demonstrate the seriousness of the violations and to motivate the industry to improve safety practices. A substantial initial fine would keep employers from becoming repeat offenders, said one respondent.
- Increasing enforcement of the OSHA multi-employer citation policy. This was suggested as a way to get general contractors more involved in day-to-day site safety management.
- Mandating that competent-person trainers be certified (for instance, by a state agency) to ensure that the training they provide is adequate
- Prosecuting willful violators of the excavation standard on criminal charges
- Making protective systems a bid item per linear foot in all public works project bids, as is done in Texas and Washington (Hinze and Walsh 1997)
- Linking revocation of contractor licenses to OSHA trenching violations.

Technology improvements

Safety experts focused on technology as a means of improving trench safety. One expert said that developing lighter-weight shielding would help bring down the cost of transporting and installing it, increasing the likelihood that employers would use the shielding. Another safety specialist urged the use of trenchless technology, such as horizontal drilling, where appropriate. (A video, in Spanish and English, on horizontal drilling is at www.elcosh.org.) It was also suggested that employers use a competent engineer to design protective systems for complicated jobs.

Jobsite Visits

The authors visited four jobsites to observe the use of "best practices" in trench safety and to become more familiar with trench protection equipment and techniques. The authors interviewed each jobsite's competent person, as well as other laborers and operators (9 interviews). The participating companies were identified through the authors' contacts. (The companies that agreed to the visits likely would believe they followed good safety practices. The sites observed were not necessarily typical of the industry, in which most construction companies employ fewer than 20 workers.)

The jobsites were operated by three companies; one ran two sites. Two companies were in the private sector, each employing more than 200 workers. The third was a public-sector utility with several thousand employees. All four sites employed union labor. The observed activities included replacing water lines and installing sewer lines and storm drains. The trenches ranged in

depth from 5 to 16 feet, and protective systems in use were aluminum hydraulic shoring, slide rail systems, and sloping. On each site, the interviewed laborers and operators (a total of 5) were able to identify the competent person. The workers appeared knowledgeable about trench safety issues, such as the requirements for protective systems, soil testing, and means of egress. All employees wore hard hats, safety glasses, work boot

favor of clear visuals/graphics are recommended. (*See*

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Annex A. Review of Training Programs and Materials

The authors attended and reviewed two 8-hour competent-person training programs for excavation safety, which were sponsored by safety or trade organizations. The authors also reviewed five written manuals designed for training of competent persons for trenching operations and other identified training materials.

- *Managing Excavation Hazards Handbook*

- "Introduction to Trenching Hazards," 27-minute video (Construction Safety Association of Ontario, Canada, 1991): Provides a comprehensive overview of excavation site hazards as well as the causes of cave-ins (particularly useful for introductory training).Video clips of excavation sites and graphics clearly illustrate trenching hazards and protective systems, supplementing a clear and understandable narrative. Soil types are described in a non-technical manner, using the terms "good," "fairly good," and "bad." An accompanying manual contains additional detail. A disadvantage is that it presents Canadian rather than U.S. regulatory requirements.
- An untitled DVD containing material produced by the Chicago Laborers' Training Fund, the Underground Contractors Association, and the National Utility Contractors Association (distributed by the Underground Contractors Association of Illinois 2003): Includes a 10-minute segment on trench shoring, featuring ten rules for using this method safely; includes construction site video footage and slides for a final review. The segment does not include information on how to determine proper spacing of shoring. The DVD also does not cover other types of protective systems or how to choose which system is best for any particular jobsite.
- Online trench safety training by ClickSafety (available at www.clicksafety.com): The online program includes four modules pertaining to trench safety, covering the OSHA excavation standard and how to apply it, as well as employers' and employees' responsibilities concerning the competent person. The training is self-paced and includes quizzes at the end of each section. The program uses animated graphics, photographs, and text, but not video clips. The primary disadvantage is that there is no opportunity for a trainee to ask questions or obtain clarification.
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