TO: Director, National Institute for Occupational Safety and Health

FROM: California Fatality Assessment and Control Evaluation (FACE) Program

SUBJECT: Laborer dies in trench cave-in in California

SUMMARY
California FACE Report #95CA017

A 51-year old Hispanic male laborer (victim) died after being trapped in soil up to his neck as a result of a trench that caved-in. The victim was digging out the bottom of the trench in order to lay a pipe. There was water in the bottom of the trench from ground water collection. No trench box was used and the trench was not shored, benched or sloped. The soil had been previously disturbed and no initial hazard assessment had been done. The victim and another laborer who was in the trench noticed that the wall was collapsing and they ran for the ladder at the end of the trench when the west wall caved-in. The CA/FACE investigator concluded that, in order to prevent future occurrences, employers should:

- Assure that the sides of all excavations are shored, laid back to a stable slope, or provided with other equivalent protection where employees may be exposed to moving ground or cave-ins.
- Have a competent person frequently inspect excavations in which the soil was previously disturbed or where there are variations in the moisture content of the soil, loading due to equipment or stored materials, or vibration from equipment or traffic.
- Train employees, including periodic refresher training, to be aware of and understand the hazards of the job.
- Perform an initial hazard assessment of the job prior to beginning work and when there is a situation change that presents different hazards.

INTRODUCTION

On November 7, 1995, at 10:48 a.m., a 51-year old Hispanic male laborer was buried in a trench cave-in at a construction site and was declared dead at 11:30 a.m. The victim was buried in soil up to his neck and his coworker up to his hip. The CA/FACE investigator learned of the incident on November 8, 1995 through a newspaper article. The CA/FACE investigator responded to the site of the incident on November 22, 1995 and met with the project superintendent and the construction foreman. A copy of the police report, including

photographs; the fire/paramedic report; the coroner's report; the death certificate; and the CAL/OSHA form 36 were obtained by the CA/FACE investigator.

The construction company has been in business for 26 years. They had been working at the site where the fatality occurred for about one and one-half years. The victim had been on this job site working for this construction company since June of 1994. He had also worked previously for the same construction company on other jobs.

The company employs 125 people with 14 working at the site at the time of the fatality. The employer did not know if the victim had specific training with regard to excavations. The victim did have general safety training through his union and the construction company held weekly safety meeting.

INVESTIGATION

After the initial meeting with the project superintendent, the CA/FACE investigator walked with the project superintendent to the site of the fatality where he met with the construction foreman **(Exhibit 1)**. The area of the trench is parallel to a public roadway. The roadway runs north and south and is two lanes wide in each direction. Each direction also has a wide bike lane adjacent to the right-hand lane.

The trench was dug about twenty feet long in a north/south direction and, originally, about four and one-half feet deep **(Exhibit 2)**. It was about ten feet from the edge of the roadway. The ground was level from the roadway on the east to the west trench wall. Above the west trench wall was a hillside which measured 13 feet high. The CA/FACE investigator also measured the slope and found it to be 2.5 to 1. At the top of the hill was a large flat area used for a pedestrian walkway. The soil in the area appeared to be heavy clayey (a cohesive soil having properties similar to clay), although a granular material, which appeared to be a type of alluvium, was noted throughout the area where the trench had been covered. The hillside appeared to be dry, packed clayey with the granular soil intermixed.

The job site is a large construction project which involves grading, draining, road building, paving, and bridge fabrication. There is a rail road right of way passing east and west through the project. Trains travel over the bridge which crosses over the four-lane roadway. The major project was a grade separation (lowering the roadway) between the rail road bridge and the roadway. The specific job on the day of the fatality involved the digging of a trench to lay 6-inch pipe for a sub-drain system. The trench had originally been dug one month before for this job and refilled. Due to an elevation error in the engineering drawings, the trench had to be reopened with all of the backfill being removed.

The city which had contracted with the construction company for the project, had also hired an engineering company to draw the blueprints. There was a known water line passing east and west through the trench. Two of the blueprints did not agree with the elevation of sub-drain line with respect to this water line. The major portion of the sub-drain had been laid previously, but a small section had been left out because of interference of the water line. The sub-drain line had been placed 4.33 feet below the top of the grade line for a future sidewalk. In order to access the previously placed sub-drain pipe, the trench was dug approximately four and one-half feet deep. The plan was to install the 6-inch sub-drain line over the top of the water line

so it could be completed and the trench refilled.

The right-hand and bike lanes of the southbound roadway had been closed to traffic before the trench was reopened. Any vehicular traffic was at least 25 feet away from the trench. The only construction equipment was a rental backhoe. The backhoe was on the extreme north end of the trench. The spoils were placed on the east side of the trench approximately two feet from the edge. Company officials stated that there was an aluminum ladder at the north end of the trench. The surviving laborer stated, however, that there was only small ramp at the north end of the trench. Police photos taken very shortly after the fatality show an aluminum ladder at the north end.

The decedent and another laborer were working in the trench. They were attempting to uncover the sub-drain pipe. Although the plan was to lay the sub-drain pipe over the top of the perpendicular water line, the laborers found it necessary to dig under the water line to install the sub-drain below the water line. Because the trench varied in depth, the only way the connection could be made to the previously laid sub-drain line was to go under the water pipe.

The employer stated that there was about six to eight inches of water in the trench due to what was thought to be ground water because there was no rise in its level. The coworker of the decedent stated that the water had come up over his boots, about 16 to 18 inches, in the area where they had dug the trench deeper **(Exhibit 3)**. The water would be expected to be deeper in the deeper areas of the trench.

According to the survivor, about two hours prior to the cave-in, the decedent went to the construction foreman and told him that the wall was caving in. Although the sides of the trench were dry, the bottom where the water was standing was beginning to erode. The foreman inspected the site and noted that a 6-inch square chunk of soil 2 feet long had sloughed off the bottom of the trench. The foreman stated that the situation was acceptable and the laborers went back to work. In the area where the sub-drain was to pass under the water line, the trench had been dug to approximately five and one-half feet. The surviving laborer is 5'6" tall and stated that the top of the trench in the area where they were working was even with the top of his head. There was some discrepancy concerning the depth of the trench. Although the employer stated that the depth was a maximum of 4.33 feet, the fire department indicated it was about 5 feet deep and 5 feet wide. The police department stated that the trench was 5 to 6 feet deep and about 15 to 20 feet long. Cal/OSHA measured it at one point to be 5 feet deep and estimated it to be 6 feet, nine inches at its deepest point **(See Exhibit 4)**. The question of depth aside, industry standards dictate that shoring be installed along the entire length of the trench when soil is classified as type C soil.

At the time of the incident, the backhoe was shut down per normal company procedure. No machine excavating is done when workers are in the trench. The backhoe operator had been watching the workers, but had walked away just prior to the cave-in. Additionally, a city inspector was watching the work being performed. As the city inspector turned around to walk away, the west trench wall suddenly began to collapse. The laborers noticed this and yelled to each other to get out. The trench wall collapsed along with about 4 feet of the adjacent hillside. The two laborers, with the decedent trailing, were running toward the north end in an attempt to get out of the trench. The cave-in trapped both laborers. The decedent was trapped up to his

neck. The other laborer was trapped up to his hip, but according to the employer, was able to free himself with the help of several men who were working nearby. Two city police officers responded and arrived at 1050 hours. They reported that they found the decedent covered by a mud slide with only his head and neck exposed. The remainder of his body was covered with wet dirt and mud. Two fellow workers on the site were attempting to dig the decedent out of the caved-in trench with shovels. No power equipment was used. A gas company employee attempted to give the decedent cardiopulmonary resuscitation (CPR). The decedent's coworker had already been freed and was sitting nearby.

The county fire department and paramedics were dispatched at 10:50 a.m. and arrived at 10:53 a.m. At the time of their arrival, the decedent been had freed down to his knees. The paramedics scrambled into the trench to render medical assistance. The paramedics continued CPR after the decedent was removed from the excavation, but there was no response. The decedent was transported to the local medical center by private ambulance and was pronounced dead at 11:30 a.m. The decedent's coworker was also transported to the local medical center where he was treated and released for leg and hip injuries.

CAUSE OF DEATH

The death certificate stated the cause of death to be exsanguination due to laceration of the inferior vena cava resulting from multiple rib and sternal fractures.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Assure that the sides of all excavations are shored, laid back to a stable slope, or provided with other equivalent protection where employees may be exposed to moving ground or cave-ins.

Discussion: The classification of soil in which the excavation was made should have been Type C. The excavation was previously disturbed because it had been opened for the same job on a prior occasion several months earlier. Moreover, there was an existing utility (water line) running in a perpendicular manner through the excavation which means another, separate excavation had been dug on a prior occasion to lay the water line. In addition to being previously disturbed, water was freely seeping near the bottom of the excavation and water was standing in the bottom. The hillside which abutted the west side of the excavation would have been considered a slope. The CA/FACE investigator measured the slope at 2.5 feet horizontal distance to each one foot of vertical rise (2.5:1). Although this does not exceed the 1.5:1 allowed, the hillside did add additional surcharge pressure to an already tenuous excavation. Type C soil is defined in section 1541.1(b) Appendix A, (Definitions) of Title 8 of the California Code of Regulations (CCR's). It states: "Type C soil: (1) Cohesive soil with an unconfined compressive strength of 0.5 tsf or less;. or (2) Granular soils including gravel, sand, and loamy sand; or (3) Submerged soil or soil from which water is freely seeping; or (4) Submerged rock that is not stable; or (5) Material in a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or steeper." Type C soil must be shored or appropriately sloped. Section 1541.1 Appendix B, Plate B-1.3 (Requirements) of Title 8 of the California Code of Regulations (CCR's) states: "Excavations made in Type C soil: 2.

All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or supported to a height at least 18 inches above the top of the vertical side." Title 8 of the California Code of Regulations (CCR's), section 1541.1(h)(1), Protection from hazards associated with water accumulation states: "Employees shall not work in excavations in which there is accumulated water, or in excavations in which water is accumulating, unless adequate precautions have been taken to protect employees against the hazards posed by water accumulation. The precautions necessary to protect employees adequately vary with each situation, but could include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of a safety harness and lifeline." Many safety precautions were ignored in this case. A visual test of the soil was made, but no manual test was done by the employer. Both a visual and manual test are required by regulation. Since the soil was clayey mixed with a more granular soil and since the soil had been previously disturbed, assumptions regarding the soil's classification should not have been made. Water accumulation in the bottom of the excavation began to erode the vertical walls causing a bell-shaped excavation. Portions of the side wall were sloughing off. Small spalls are an indication of moving ground and a potentially hazardous situation. The spalls were not thought by management to be serious enough to require that a protective system be put into place. Proper soil testing, consideration of water accumulation, and the condition of the previously disturbed soil should be considered as factors in excavation and the provision of proper shoring.

Recommendation #2: Have a competent person frequently inspect excavations in which the soil was previously disturbed or where there are variations in the moisture content of the soil, loading due to equipment or stored materials, or vibration from equipment or traffic.

Discussion: There were a number of physical factors that may have affected the safety of the excavation. The soil had been previously disturbed, there was water accumulation, it was near a public roadway, the backhoe was operating within 10 feet of the employee work area, spalls were falling from the sides, and there was a 13-foot hillside immediately adjacent to the west wall. The many hazard-increasing situations required that a competent person frequently inspect the excavation. These situations individually could be considered serious or potentially serious, but as a group, necessitated the removal of employees until the excavation was made safe. Section 1541.1(k)(2) of Title 8 of the California Code of Regulations (CCR's) states: "Where the competent person finds evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, exposed employees shall be removed from the hazardous area until the necessary precautions have been taken to ensure their safety." Had there been more frequent inspections, proper review of the hazards, and the provision of appropriate protection, this incident may not have happened.

Recommendation #3: Train employees, including periodic refresher training, to be aware of and understand the hazards of the job.

Discussion: The decedent did not receive any training from the company for whom he worked

other than generic weekly safety meetings. It was unknown if those meetings specifically addressed the job which the decedent was performing. The company stated that he may have had training through his union program prior to being hired. Section 1510(a) of Title 8 of the California Code of Regulations states: "When workers are first employed they shall be given instructions regarding the hazards and safety precautions applicable to the type of work in question and directed to read the Code of Safe Practices." Additionally, Section 1510(c) states: "Where employees are subject to known job site hazards, such as ... they shall be instructed in the recognition of the hazard, in the procedures for protecting themselves from injury, and in the first aid procedures in the event of injury." Had the decedent received specific training concerning protective systems for excavations, the recognition of the hazards of excavations, and his right to refuse to work in unsafe working conditions, this incident most likely would not have occurred.

Recommendation #4: Perform an initial hazard assessment of the job prior to beginning work and when there is a situation change that presents different hazards.
Discussion: No initial hazard assessment of the specific worksite was performed. Normally, the contractor would go over the hazards of the site with the employees and the site specific addendum to their Injury and Illness Prevention Program (IIPP). This was not done. The job was laid out for the laborers, both of whom had performed this function before. However, the situation had changed because the soil had been previously disturbed and there was water accumulation. Under Title 8 of the California Code of Regulations, Section 1511(b): "Prior to the presence of its employees, the employer shall make a thorough survey of the conditions of the site to determine, so far as practicable, the predictable hazards to employees and the kind and extent of safeguards necessary to prosecute the work in a safe manner in accordance with the relevant parts of Plate A-2-a and b of the Appendix." Ongoing hazard assessment and appropriate follow-up would have decreased the likelihood of an event such as this from occurring.

References
Barclays Official Code of Regulations, Vol. 9., Title 8, Industrial Relations. South San Francisco, CA, 1990.

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FATALITY ASSESSMENT AND CONTROL EVALUATION PROGRAM

The California Department of Health Services, in cooperation with the Public Health Institute and the National Institute for Occupational Safety and Health (NIOSH), conducts investigations of work-related fatalities. The goal of this program, known as the California Fatality Assessment and Control Evaluation (CA/FACE), is to prevent fatal work injuries in the future. CA/FACE aims to achieve this goal by studying the work 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. NIOSH-funded, state-based FACE programs include: Alaska, California, Iowa, Kentucky, Massachusetts, Michigan, Minnesota, Nebraska, New Jersey, New York, Oklahoma, Oregon, Washington, West Virginia, and Wisconsin.

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Additional information regarding the CA/FACE program is available from:

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