



OREGON FATALITY ASSESSMENT AND CONTROL EVALUATION (OR-FACE)

www.ohsu.edu/or-face

Oregon Institute of Occupational Health Sciences



Fatality Investigation Report

OR 2016-16-1

SPECIAL ALERT Trench collapses are a recurring contributing factor to occupational fatalities in Oregon.

Construction worker killed when trench collapsed

SUMMARY

On May 5, 2016, a 29-year-old construction worker employed by a small excavation contractor was killed when the trench he was working in collapsed and buried him in approximately 6 feet of dirt. The worker was part of a crew installing a sewer pipe at a residential property. The trench was 10 feet deep and approximately 3 feet wide in the area where the collapse occurred. The collapse occurred in an unprotected area of the trench, between two pieces of shoring that were spaced 15 feet apart (see Figure 1).

When the trench collapsed, co-workers called 911 and attempted unsuccessfully to locate and dig the worker out. When emergency responders arrived, their first task before commencing rescue and recovery efforts was to shore up the trench to prevent risk of additional collapse and injuries (see Figure 2). Emergency responders spent several hours recovering the worker's body.

Key factors identified in this investigation included an inadequate trench protective system; no ladder available for entry or egress; and a spoils pile being placed too close to the edge of the trench. Underlying contributing factors were the lack of oversight by a competent person; and insufficient employee training on recognizing and reporting hazards.



Figure 1. View from front of house: area of incident showing placement of shoring; collapse occurred in between the two pieces of shoring spaced 15 feet apart (indicated by arrows)



Figure 2. Emergency responders preparing to install a trench box before starting rescue and recovery work, to prevent risk of additional collapse and injuries

RECOMMENDATIONS

- Employers who have employees working in trenches that are 5 feet deep or deeper must select and install appropriate protection systems for the conditions present to protect workers from cave-ins. For trenches less than 5 feet deep, examination by a competent person for potential cave-in indicators is required.
- Excavation work requires a designated competent person on site who has both the knowledge and authority to identify and promptly correct hazards; this includes daily inspections prior to the start of work and as needed throughout the work shift, and any time site conditions change.
- To select appropriate trench protective systems for a given jobsite, the competent person should visually and manually test the soils, and also consult the shoring or shielding manufacturer's tabulated data or OR-OSHA's tables and charts designed for this purpose.
- Employers must provide sufficient means of safe access and egress for workers in any trench excavation of 4 feet deep or deeper, which may include ladders, ramps, or stairs.
- Keep excavated soil (spoils) and other materials and tools at least 2 feet from the edge of any trench.
- Before working in and around trenches, employees should receive training on trenching safe practices, and on recognizing and reporting hazards.
- Employers should develop and maintain a safety culture where employees are encouraged to voice concerns about unsafe work conditions.

OR-FACE supports the prioritization of safety interventions using a hierarchy of safety controls, where top priorities are hazard elimination or substitution, followed by engineering controls, administrative controls (including training and work practices), and personal protective equipment.

INTRODUCTION

On May 5, 2016, a 29-year-old construction worker died when the wall of the trench he was working in caved in (collapsed) and covered him in approximately 6 feet of dirt. He was part of a crew installing a new sewer pipe at a residential property. OR-FACE received notification of the incident from OR-OSHA. This report is based on review of investigation documents from OR-OSHA and on follow-up discussions with the OR-OSHA investigators and a subject matter expert.

The decedent was employed by a small, residential construction contractor that provided excavation and sewer replacement services. At the time of the incident, the company had been in business for 16 years and had a total of 11 employees. Up to eight employees were working on this site during the project, which included work at the front and at the back of the house. On the day of the incident, two or three employees were working in or around the trench in front of the house, and additional employees were working at the back of the house or in other areas of the property. The construction project involved replacing a 180-foot-long sanitary sewer line at a residential property. It was reported that the expected duration of the project was one week; the incident occurred on the second day of the work. The incident occurred in the trench in front of the house.

The property was heavily wooded (shown in Figure 1). It was reported that at the time of the incident the excavation was 75 long and 3 feet wide. The trench depth ranged from 5 feet to 13 feet deep along its length. In the work area where the incident occurred, the trench was 10 feet deep. The contractor was using aluminum hydraulic shoring in the trench. Other equipment in use at various times on the jobsite included hand tools, a backhoe, and a dump truck (specific details about makes and models of this equipment are not known).

The trench collapse occurred when decedent was working in an unprotected area of the trench between two pieces of shoring that were spaced 15 feet apart. The specific task being performed by the decedent at the time of the incident is uncertain. It was reported that he may have been checking the grading of the new sewer line. Other evidence suggests he may have been hand digging a high spot of soil or preparing to put in a pipe connector.

The employer, who was the owner of the excavation company, had obtained an appropriate plumbing permit to perform the work for this project. The employer stated in interview remarks that he was familiar with and had experience in proper shoring installation, and that he was the designated competent person for the jobsite.

Trench safety practices used by the contractor at other jobsites are not known. It was reported in OR-OSHA interview notes that the excavation company held periodic safety meetings but did not document them.

Specific details about the decedent's tenure with the employer is uncertain. It was reported that he had approximately 6-7 years' experience in the construction industry, and that most or all of that work experience may have been with this employer. It was reported that he had a good work ethic and worked hard. It is not known what specific training he may have had regarding excavation work, and there was no documentation showing evidence of any safety training for any of the employees.

INVESTIGATION

On the day of the incident, the decedent and a co-worker were working in the trench in front of the house (see Figure 3). As shown in the photos, the property was heavily wooded, and soil conditions around the property varied (see Figures 1 through 4). Two pieces of aluminum hydraulic shoring were installed in the trench. The foreman had installed the shoring. Evidence suggests that the foreman was less knowledgeable and experienced than the employer/owner (competent person) in installation of shoring systems. It was also reported that the competent person did not inspect the shoring before work started or during the work shift, as required.

It was also reported that the competent person (company owner) had not performed an assessment of the soils and site conditions prior to starting work. He did not consult the shoring manufacturer's tabulated data to select appropriate protective systems or refer to the OR-OSHA tables and charts designed for this purpose, nor did he perform a manual or visual test to determine the soil type. OR-OSHA interview records indicated that he had defaulted to Type C soils, which could be considered "worst case" (the least stable type of soil). However, the maximum horizontal spacing for Type C soils is no more than 6 feet and a waler system is required. The two pieces of shoring in the area where the incident occurred were spaced 15 feet apart, and no waler system was in use. The decedent was working between the two pieces of shoring when the trench collapsed and buried him in approximately 6 feet of dirt.



Figure 3. View of trench work area in front of house



Figure 4. View from house showing trench work area and general soil conditions

Both the excavation company owner and the foreman were on site at the time of the incident. The foreman was operating a back hoe near the trench. The owner was assisting a dump truck that was backing up. It was reported that the owner and foreman were working approximately 15 to 20 feet from where the decedent was working, within visual sight of the area.

According to interview records, the owner reported he had observed the two employees standing between the shoring, but he did not stop work to take corrective action (as required of the competent person). The owner also reported that he thought he observed the decedent step approximately 18 inches outside of the shoring, when the trench wall collapsed. Subsequent discussion between OR-FACE and OR-OSHA personnel indicated the decedent may have been up to 5 feet away from the shoring at the time of the incident.

In addition, the OR-OSHA investigation found there was no means of egress, such as ladders, stairways, ramps, or other means, as required for trench excavations that are 4 feet deep or more. It was reported that workers climbed in and out of the trench, by jumping down into the trench at the lowest point to enter, and pulling themselves out at the lowest point to exit the trench. It was also reported that this was not an uncommon practice in this company. It was later determined that no ladder was available on site.



Figure 5. View of work area under deck of house where spoils had been placed at the open edge of the trench

Another hazard identified was the placement of excavated soil (spoils) on the edge of the trench that was located underneath the deck at the front of the house (see Figure 5). The spoils pile in this location was reported to be approximately 2 to 3 feet high. Spoils piles should be placed at least 2 feet from the edge to prevent creating a surcharge (meaning that it places extra pressure on the trench wall and affects trench stability). Alternatively, retaining devices may be used to prevent material from falling into trench.

In addition, while not specifically related to the collapse, the owner was reported to have said they would have been unable to install any form of shoring in the area underneath the deck (shown in Figure 5). Investigation findings suggest that while this may be the case, the contractor could have used alternative, safer practices to reduce cave-in risk in this situation. Examples could include use of boring equipment that could eliminate the need for a worker to enter a hole that cannot be protected with shoring or other protective systems.

CAUSE OF DEATH: Traumatic compression asphyxia.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers who have employees working in trenches that are 5 feet deep or deeper must select and install appropriate protection systems for the conditions present to protect workers from cave-ins. For trenches less than 5 feet deep, examination by a competent person for potential cave-in indicators is required.

- Trench protective systems should be selected based on soil characteristics/type and site conditions. This should include use of the manufacturer's tabulated data or OR-OSHA tables and charts, and visual and manual test of the soils. As required in OR-OSHA 1926.652(b) and (c) (OAR Division 3, Subdivision P, adopted from Federal OSHA rules), this pre-work assessment should include:
 - Soil characteristics that affect its stability, such as granularity, saturation, cohesiveness, and unconfined compression strength (the capacity of the soil to withstand pressure);
 - Site conditions such as the presence of previously disturbed soils, potential vibration sources, stability of adjacent structures, and utility locations;
 - Factors such as excavation depth and width, the nature of the work, and any nearby activities that could increase the risk of collapse.
 - Note that OSHA regulations (1926.652(a)(1)) do not require a protective system when an excavation is made entirely of stable rock, or when an excavation is less than 5 feet deep and a competent person has examined the ground and found no indication of a potential cave-in.
- Trench protective systems may include shoring, sloping, and/or shielding. When shoring is selected as the appropriate protection system, the competent person must implement proper horizontal and vertical spacing, which includes placing the shoring the proper distance apart (in this case, a maximum horizontal spacing of 6 feet for Type C soils). However, the shoring in this case was spaced 15 feet apart (too wide to adequately support the trench wall) and it failed to protect the worker in the trench.

Recommendation #2: Excavation work requires a designated competent person on site who has both the knowledge and authority to identify and promptly correct hazards; this includes daily inspections prior to the start of work and as needed throughout the work shift, and any time site conditions change.

- The competent person is responsible for selecting and inspecting the appropriate trench protective systems for a given jobsite, including classifying the soil and assessing and monitoring site conditions throughout the project.
- The competent person must be on site to oversee proper installation of the appropriate trench protective systems and to perform regular and frequent inspections daily. Inspections should be conducted before work commences, as needed throughout the work, and at any time site or soil conditions change, such as after a rainstorm or any other occurrence that may increase hazards.

- In this case, the shoring was installed by the foreman, who was less knowledgeable in classifying soils and installing trench protective systems, and the competent person (the owner) did not oversee or inspect the installation.
- The competent person observed the shoring spaced too far apart but did not stop the work to correct the hazard it presented.

Recommendation #3: To select appropriate trench protective systems for a given jobsite, the competent person should visually and manually test the soil, and also consult the shoring or shielding manufacturer’s tabulated data or OR-OSHA’s tables and charts designed for this purpose.

- In this case the competent person reported defaulting to a presumed worst-case soil type (Type C, the least stable type of soil). However, performing a visual and manual test and consulting the tabulated data or the OSHA tables and charts would have provided a better understanding of soil and site conditions including any surface encumbrances and other potential hazards to be mitigated prior to starting work. Making assumptions about site conditions devalues the need for a knowledgeable competent person and increases risk of injury. Further, the maximum horizontal spacing for Type C soil is no more than 6 feet (along with a waler system). The shoring in this trench was spaced 15 feet apart and omitted a waler system.
- It also is important to consider any obstructions that might hamper the use of standard protective equipment, and to take the time to determine ways to abate any hazards and/or identify alternative safe measures for performing the work. Do not take shortcuts or ignore these conditions. For example, the property in this case was heavily wooded. Per discussion with an OR-OSHA investigator, a large tree root ball in one area of the trench obstructed an area where shoring would have been placed. One possible alternative for an obstructed area could be to use a trench box or shield instead of shoring.

Recommendation #4: Employers must provide sufficient means of safe access and egress for workers in any trench excavation of 4 feet deep or deeper, which may include ladders, ramps, or stairs.

- Ladders or other provisions for egress or ingress should be located so that workers do not have to travel more than 25 feet laterally within the trench.
- In this case, no ladder was available on site. Workers jumped down into the trench at the lowest point to enter the trench, and pulled themselves out at the lowest point to exit. The trench was 75 feet long at the time of the incident.

Recommendation #5: Keep excavated soil (spoils) and other materials and tools at least 2 feet from the edge of the trench.

- Placing a load too close to the edge of the trench imposes a surcharge. This means that the spoils increase lateral pressure on the affected zone of the trench, thereby impacting the stability of the trench.
- In this case, the spoils from under the deck in front of the house were placed at the edge of the trench in that location.

Recommendation #6: Before working in and around trenches, employees should receive training on safe trenching practices, and on recognizing and reporting hazards.

- Employers need to train employees on recognizing and avoiding hazards and unsafe conditions on their jobsites and how to eliminate, control, and protect themselves from those hazards, as well as how to report hazardous or potentially hazardous conditions.

Recommendation #7: Employers should develop and maintain a safety culture/climate where employees are encouraged to voice concerns about unsafe work conditions.

- Safety climate is employees' shared perceptions about the priority of safety throughout the organization relative to other potentially competing demands (e.g., productivity, quality).
- Ways to strengthen safety culture/climate and effectively communicate the value of safety include:
 - Safety role modeling – What leaders say and do has a big impact on employee perceptions about the importance of safety within the organization and on their own safety motivation and compliance. This includes non-verbal body language as well as verbal communications;
 - Frequent leadership communication such as routinely providing safety toolbox talks, pre-task planning meetings, coaching on safety practices;
 - Regular inspection of work practices and stopping work to correct unsafe conditions or practices when they see them, providing appropriate personal protective equipment.

REFERENCES

Oregon OSHA, Oregon Administrative Rules (OAR) Chapter 437, Division 3 – Construction, Subdivision P, Excavations (29 CFR 1926.650 through 1926.652) Available online:

<https://osha.oregon.gov/OSHARules/div3/div3P.pdf>

Oregon OSHA (2/15). Publication # 440-2174. Excavations: Safe Practices for Small Business Owners and Contractors. Available online: <https://osha.oregon.gov/OSHAPubs/2174.pdf>

Oregon OSHA Fact Sheet FS-68 (Rev 10/16). Excavation Safety: Requirements for Competent Persons. Available online: <https://osha.oregon.gov/OSHAPubs/factsheets/fs68.pdf>

US Department of Labor – OSHA (2015). Publication #2226-10R-2015. Trenching and Excavation Safety. Available online: <https://www.osha.gov/Publications/osh2226.pdf>

OSHA Susan Harwood Training Grants – Excavation and Trenching. Training materials available online: https://www.osha.gov/dte/grant_materials/material_listing_topic.html#e

OSHA Quick Card. Protect Yourself – Trench Safety
https://www.osha.gov/Publications/quickcard/trenching_en.pdf

OSHA Quick Card (OSHA 3243-2018). Working Safely in Trenches (English). Available online: https://www.osha.gov/Publications/trench/trench_safety_tips_card.pdf

OSHA Quick Card (OSHA 3243-2018). Working Safely in Trenches (Spanish: Trabajo Seguro en Zanjas/Excavaciones). Available online: <https://www.osha.gov/Publications/OSHA3243.pdf>

OSHA Fact Sheet (OSHA FS3476-2011). Trenching and Excavation Safety (English). Available online: https://www.osha.gov/OshDoc/data_Hurricane_Facts/trench_excavation_fs.pdf

OSHA Fact Sheet (OSHA FS 3480-2011). Trenching and Excavation Safety (Spanish: Seguridad para el zanjado y la excavación). Available online: https://www.osha.gov/OshDoc/data_Hurricane_Facts/trench_excavation_fs-sp.pdf

FOR MORE INFORMATION

OR-FACE/Oregon Institute of Occupational Health Sciences
Oregon Health & Science University (OHSU)
3181 SW Sam Jackson Park Rd, L606
Portland OR 97239-3098

Phone: (503) 494-2281

Email: orface@ohsu.edu

Website: <http://www.ohsu.edu/or-face>

Oregon Fatality Assessment and Control Evaluation (OR-FACE) is a project of the Oregon Institute of Occupational Health Sciences at Oregon Health & Science University (OHSU). OR-FACE is supported by a cooperative agreement with the National Institute for Occupational Safety and Health (NIOSH) (grant #U60OH008472) through the Occupational Public Health Program (OPHP) of the Public Health Division of the Oregon Health Authority.

OR-FACE reports are for information, research, or occupational injury control only. Safety and health practices may have changed since the investigation was conducted and the report was completed. Persons needing regulatory compliance information should consult the appropriate regulatory agency.