SAFE TRENCHES 2010
Dirt. We all know we can dig it up, move it around, and plant stuff in it. But just what exactly is it? Well putting it simply, dirt is rock. Rock that has broken down smaller and smaller over time, beginning it’s life as a boulder. The boulder is broken up into pieces we call gravel. Gravel is broken down into tiny pieces we call sand. And it’s at this stage in the game where we find dirt or soil.

To the left is a graphic representation of a piece of sand. Notice how it isn’t perfectly round and smooth, like most of us likely imagine it to be. Sand is actually a tiny piece of a much larger rock that has broken up, leaving imperfections from stress fractures or impact. Sand we find at the beach has been polished over time, churning in water with other rocks.

The USDA defines sand as being 2.00 mm - 0.05 mm in diameter.

So what happens when a grain of sand gets broken up? The answer to that question is silt. Silt is micrometers in diameter. Silt can pass through a #200 sieve (who’s holes are so small we can’t see them without using a magnifying glass), while sand cannot.

The USDA defines silt as being 0.05 mm - 0.002 mm in diameter.

Even smaller still, are tiny pieces of silt, that has broken up into fragmented shards we call clays. Clay is the only type of soil we refer to as being plastic. Plastic soil is one that can be deformed or molded without appreciable deformation (volume change). Think of making a “snake” out of molding clay. The shape of the clay changes, but the amount of clay stays the same. Molecules of H2O or water, align themselves along the outside of the extremely small shards of clay. The middle of the shard is charged as negative, and the ends of the shard are positively charged. This effectively turns each piece of clay into a tiny bar magnet.

The USDA defines clays as being smaller than 0.002 mm in diameter.

That meniscus of water is what holds dirt together. The meniscus creates a bond between the grains of sand, acting like glue. To the right is an illustration, depicting the meniscus in action in granular soil. This bond is referred to as cohesion. Whenever soil cohesiveness is discussed in reference to trench failure, it is the lack of cohesion that leads to failure under stress.

To the left is a graphic representation of mixed soils. Water molecules hold clays, silt, and sand together. Mixed soils are quite common, and may be classified as either A, B, or C. Depending on what the ratios are of sand, silt, and clay, along with water content determines what the soil type is.

The meniscus, by definition, is the curve in the upper surface of a standing body of a liquid. It is produced in most liquids, when the attractive force between the liquid and the surface it is touching is different. This is the phenomena of surface tension. This either pushes or pulls on the liquid, causing it to “stick” to the sides of the surface. In a graduated cylinder, the surface is the container. In the ground, the surface is soil.
What does all this have to do with you? If you are digging a trench for work to be done, and you want to be working in accordance with OSHA standards by protecting yourself and co-workers from a trench collapse, it is vital information for you. Classifying the soil type is a large part of OSHA compliance. One of the first questions you should ask yourself is: “Is this soil plastic or not?” Now, in all likelihood you will be thinking something more like: “Is this a sandy soil?” But the principle is the same, in that the desire to classify the soil type exists.

Why classify soil in the first place? By determining what the soil type is, you are also determining other factors at play. Water content and standing time must be realized, in order to know what the appropriate protective equipment for the job is. Shoring may not be the right choice, you may need a trench box. If you have standing water in the bottom of a trench, different pumps must be used for different soil types. Basically, different protective systems may or may not be appropriate based on your findings.

Plasticity is often overlooked. Determining soil plasticity (is it present: yes or no) is vital to the proper classification of the soil in the trench you are about to enter. This also plays a huge role in selecting the proper protective equipment for the job. Often times a trench is dug, and a box is just thrown in assuming that everything is fine. When in reality, doing it that way is rolling the dice with your personal safety, and possibly your life.
Soil classification in the field can be done with a tool almost everyone has with them, all of the time. Your thumb. In order to test the soil you are about to dig up, simply press your thumb into the dirt. If your thumb nail alone goes in, this is a type A soil. If your thumb goes in halfway, you have (quite literally) type B soil on your hands. And if your thumb goes in all of the way, you have a type C soil. Pretty simple isn't it?

But what if you require more detail specific information regarding soil strength? There are devices out there that measure soil type, and shear strength. These instruments are calibrated in tons per square foot (tsf) or kilograms per square centimeter (kPa).

**Penetrometer**

Pocket Pentrometers are direct-read, spring operated devices used to determine the compressive strength of cohesive soils. Indicates consistancy, shear strength and approximate unconfined shear strength. Pentrometers have an error range of plus or minus 20-40%.

**Shearvane/ Torvane**

A Shearvane/ Torvane is a handheld device that measures shear strength in soil at the surface, the sides of test pits, exavations and trenches. It can also test samples and chunks of soil removed from test pits. It measures soil compression strength by inserting spade-like blades into a section of undisturbed soil. A torsional knob is turned until soil failure occurs. A direct instrument reading is taken, and must be multiplied by 2 in order to provide results in either tsf, or kPa.

11/18/2008 Lawton, OK

A man working on a sewer line was covered in clay soil, when the trench he was working in collapsed around him. The man was working on a sewer line in a trench connecting to a manhole, when he suddenly became buried up to his neck. Firefighters reported that an estimated 120,000 to 150,000 pounds of clay had fallen onto the worker. Rescue crews had to take their time, due to the imminent threat of another collapse. Paramedics were able to pump oxygen to the trapped man, as well as administer fluids through an IV solution. The man was trapped for 14 hours, before being transported to the hospital. A city inspector was on site 40 minutes prior to the cave-in but did not report any safety violations, because there were no workers in the unprotected trench at the time of his visit. The construction company had a trench box on site at the time, but it sat unused near the entrance to the construction site a half-mile away. According to the city inspector; he had no authority to shut down the construction site even if he saw a violation, unless something was occurring that threatened public safety due to the project being a private development. He went on to say that had he seen any safety violations, all he could do would be to address the site foreman with his concerns. According to OSHA, site inspectors have the responsibility of following OSHA regulations too. There are many variables at play but ultimately the employer is responsible to follow regulations, and the inspector has a moral obligation to report any safety violations. The inspector in this matter was left wishing he saw a violation to report.
FISSURES

Here we have a solid land mass, that has never been dug up before. It is a type A soil, which has been determined by the thumb test penetrating only a thumbnail, and verified by a Torvane.

In order to run a water main for example, a trench has been dug.

Almost immediately as the trench is dug using a backhoe, extension cracks -or fissures- form at random intervals.

These extension cracks, known as fissures, extend along the entire length of the trench.

The fissures weaken the soil over time. As soon as a trench is dug however, the now disturbed soil is already much weaker than before it was dug.

The section of removed soil - the trench itself - provides room for a combination of gravity and time to allow a section of the fissures to collapse into the trench.
So what happens if you dig a brand new trench, in an area such as a right-of-way that has an old trench running parallel to yours? Well, by default you must be digging in type B soil because it has been dug up before - even if you are next to a old trench.

The extension cracks -or fissures- from the old trench are still there, even if they have been hidden by dirt or debris - even if the old trench has been backfilled.

Here is an example of how deep a previously existing fissure can be, if you dig a new, shallower trench than the old one running parallel to it. Suppose your trench is for an electric line, and you are digging next to an old trench dug for a water main. The fissures from the old trench can run at least half the depth of the first trench. This puts your trench - almost or all of the entire depth - next to a dangerous fissure. This is high risk for a collapse!

And now lets imagine a need could arise to dig two trenches perpendicular to each other, that even intersect at some point. The fissures in this example will eventually overlap. This creates a high-risk area for collapse. The intersecting trenches cause the two sets of fissures from each trench to essentially “dice” the corners where the two trenches meet.

This is what happens every time a manhole with more than one inlet is dug. And guess where you get to work? Right in the middle, at the manhole location itself. As you can see, the manhole location is surrounded by 4 high-risk areas. This of course is an understatement, as the whole trench itself is a high-risk area, if left unprotected.

To the left is an example of how fissures or extension cracks are formed at each end of a single trench. The manhole location is shown in this example as well, to graphically show how even if there is only one outlet, the high risk areas still exist. This is the case for every trench dug, no matter how shallow or deep. It is this very diagram that explains how depending on what soil type your digging in, using only a single trench box can have an open - end collapse.
Two men were working in a 10 ft. deep trench, when it suddenly collapsed. The men were digging to relieve pressure on a sump pump at the time. One man was able to climb out of the trench and use a backhoe to scoop dirt off his co-worker in a rescue attempt. He was too late. Over 50 rescue personnel arrived at the scene. 2 OSHA inspectors had already arrived in two hours from the time of the initial call. According to an Underground Focus interview with the Fire Chief placed in charge of the scene:

"I was the first to arrive on scene," says the Fire Chief. "It was soon after, that the victim was assessed and the scene went from rescue to recovery. The other guy was running the backhoe trying to remove the dirt from the trench where it collapsed, and a lengthy discussion entailed about what to do with the backhoe. Regulations state that they are to shut down and lock out any equipment on site. However, because of the precarious position of the backhoe, it was decided that it needed to be moved for the safety of the rescuers.

The ground pads had been laid on both sides of the trench and the rescuers began the process of shoring up the trench. The initial width of the trench was that of the backhoe bucket, thought to be approximately 36 inches. Once the shoring was installed, the width for the fire crew to work in became even smaller. So much so, that some of the men who were specially trained in trench rescue were incapable of getting into the trench.

Bucket after bucket went up full of dirt that was being shoveled out from around the victim. Although there were no other collapses prior to or during the rescue; when the fatal collapse occurred it was like a chunk of dirt had dislodged, slid down and fell across the victim. The victim was trapped standing up with his arms around his head. Because of the compacted earth around him, rescuers had to dig the dirt from above the victim's head all the way passed the bottom his shoes in order to complete the recovery.

Two hours after the initial call out, OSHA investigators were already on scene. The total time it took to complete the rescue was 4 ½ hours, which wasn’t an extraordinary amount of time."

Photos courtesy of the Lowell Volunteer Fire Dept.
What is the one constant that dictates if a trench will collapse? The answer is time. No matter what soil type you are digging in, all trench walls will eventually collapse if left unprotected. The real question is not “if,” but “when?” Remember: Collapse = Gravity + Time!

Fissures cause sections of the surrounding soil to collapse as a shear. What does this mean? By definition, a shear is a stress which is applied either parallel (lengthwise) or tangential (at an angle) to the face of a material. This is different than a “normal stress” which is applied perpendicularly (downward, or straight-on). Therefore, soil fails in shear.

<table>
<thead>
<tr>
<th>Wedge No.</th>
<th>Time to Failure</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Minutes to Hours</td>
</tr>
<tr>
<td>2</td>
<td>Minutes to Hours</td>
</tr>
<tr>
<td>3</td>
<td>Days</td>
</tr>
<tr>
<td>4</td>
<td>Months</td>
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</tbody>
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To the right, the illustration depicts a trench collapse caused by a soft zone failure. The soft zone is a layer of soft soil, sandwiched horizontally between two layers of stable soil. The soft zone causes the top layer of stable soil to have a weak foundation, leading to collapse. The introduction of water to a stable trench can undermine the soil, creating a soft zone. Soft zones also occur naturally over time, as soil layers are formed.

Sloughing occurs when a trench wall becomes so dry that it creates a weak area. Wind blowing into an open trench is a common cause of sloughing. This weak area cannot support the weight of the soil above, and will eventually cause the trench to collapse.
A soft pocket is found, when an area containing varying soil types is trenched. The more stable soil encompasses most of the trench area. However, soft areas of sandy soil are exposed at depths greater than surface level. These soft, sandy areas are weak spots. The weaker soil areas will cave-in or collapse first, causing an unstable region beneath more stable soils. This leaves a void area, that gravity and time will fill with the above section of soil by way of a trench collapse.

**SOFT POCKETS**

One of the ways that the void will be filled by a collapse, is found in the example of a wedge failure. A large section of the trench wall will collapse by sliding down into the trench at an angle, as a shear failure. This is because the fissures along the trenchline act to provide a stress fracture that continues from the surface, down to the void area.

Another way that the void can be filled from a collapsed soft pocket is a rotational failure. In this example, the wedge stress fracture area doesn't slide in at an angle. A large section of the trench wall will collapse by rotating down wards into the trench, as a shear failure.

**WEDGE FAILURE**

**ROTATIONAL FAILURE**

The photograph above shows a wedge failure. This was caused by a fissure that formed when the trench was dug. Even after this collapse occurred, we can still see a worker in the unprotected trench! The photo to the right is an example of a soft zone failure. The trench had been dug, and left open during a rainstorm. The resulting water undermined the soil beneath the brick wall, leading to it's collapse. This just goes to show that even if you think a trench wall face looks stable, you might be wrong about that. Always remember the addage “You’re not smarter than dirt!”
9/17/2010 Grosse Pointe Shores, MI
A man was covered in dirt and trapped while working in a trench. The man was in an unprotected trench he had dug to waterproof a basement, when the walls suddenly collapsed burying him to his upper chest in dirt. A call was placed which summoned a technical rescue team. Due to how increasingly panicky the trapped man was becoming, the Police officers arriving on scene began hand-digging to free the man from the 9 ft deep by 4 ft wide trench. An hour and a half later the man was pulled out, just as the rescue team arrived. The wall that collapsed was apparently weakened by placement of the ladder used by the man to enter the trench. The man was taken to the hospital with fractured ball joints in his hips, caused by the weight of the soil that fell on him.

7/21/2010 Collegedale, TN
A worker inside of a trench box was buried up to his head, when the trench he was working in collapsed. The 20 ft high walls gave way to the front part of the trench box that was open. The resulting flow of loose earth filled the trench box from the unprotected area. 150 rescue personnel worked on-rotation for 4 hours to free the trapped worker. He was taken to the hospital and survived.
1/5/2009 Gordon, GA - Wilkinson County GA * 18 year killed when a wall of dirt collapsed while digging a tunnel

1/6/2009 Bakersfield, CA 
Construction worker falls 15 feet into a open trench, slipped while walking along the edge.

1/11/2009 Port Charlotte, FL * 15 year old boy after jumping into trench to get water for his dad who was mixing concrete at a church site.

1/13/2009 Hattiesburg, MS*** OSHA says company agrees to pay $39,500.00 in fines for the deaths of 3 workers on 3/38/2008

1/22/2009 Daviess County, Owensboro, KY* 70 year old man volunteering, digging a trench on church property to check for a water line, part of the wall collapsed killing him

1/23/2009 Tampa, FL Contractor fined $119,000.00 for 7 violations by OSHA following inspections in July and August, 2008.

1/23/2009 Philadelphia, PA 
Plumbing contractor doing sewer work became trapped when one of the wall blew out. One of the workers was climbing out to install some support braces when it caved in.

1/23/2009 Kansas City, KS* Man dies while working with a plumber in his back yard to repair a broken sewer line - 8 - 10 feet deep.

1/26/2009 Manhattan, KS* Man in his twenties dies at a new housing construction site setting plumbing lines. It appears that the man was alone while installing plumbing lines in the 10 foot deep unprotected trench at the time of the collapse. 9 hours after the 911 call was placed, firefighters retrieved the body from the trench. This was the second trench death in North-East Kansas in a 3 day period.

2/3/2009 Marietta, GA OSHA proposed $108,000.00 in penalties after two job site inspections against company on 7 violations.

2/4/2009 Fort Smith, AR OSHA investigation found 5 employees working in a 7" deep trench, not adequately sloped. Proposed fines = $102,600.00

2/4/2009 Bartow County, Cartersville, GA* Man dies while working on a sewer tunnel 30' deep, 40' inside of tunnel when protective casing fell.

2/7/2009 Ellenwood, GA * 20 year old worker killed when he fell into a 60' deep shaft at a landfill.

2/9/2009 Southwest Ranches, FL 
Worker trapped by a cement pipe in the trench. Unclear as to how this happened.

2/13/2009 Eastchester, NY Worker trapped 9' deep when dirt and concrete fill in on him.

2/18/2009 Metairie, LA 6' deep laying water line - 3 men in trench, 1 got out, 2nd man trapped 1 1/2 feet deep in mud, 3 rd man rescued by fire department.

2/19/2009 Paso Robles, CA Company fined $140,000 after two men drowned last October when excavator struck a water line that trapped two workers 10' deep.

2/25/2009 Bloomer WI OSHA fines company nearly $700,000.00 in penalties for numerous lifethreatening violations at a trenching site on Weston, WI in September 2008. This same company has received 38 OSHA citations since 1982.

2/27/2009 Mattapoisett, MA A new law - requiring anyone excavating a trench must first obtain a city permit, in memory of a 4 year old girl who fell into an open trench from 1999 after all workers left the job site.

3/2/2009 Las Cruces, NM 3 workers rescued by fire department after being trapped - 12' deep.

3/5/2009 Robbins Air Force Base, GA* One worker killed by a blow to the head after water pipe burst in unshored trench 5 1/2' deep. OSHA proposed $8,000.00 fine.

3/7/2009 Falls Church, VA Contactor working on a sewer line in front of a home, 9' deep when partial collapsed trap the worker.

3/10/2009 Weslaco, TX Construction worker trapped for about 1 hour, fixing a pipeline in a trench when the walls collapsed - about 8' deep.

3/10/2009 Tallahassee, FL 
Not reported on last year but added to 2008 - A company is fined $48,000.00 violation for allowing two men to continue working in a trench after the shield was removed. One killed when trench collapsed.

3/12/2009 Verdel, Neb NE OSHA proposed fines to contractor of $201,600.00 on 4 trench deaths from 09/12/2008

3/11/2009 Dripping Springs, TX Key Enterprise from Austin fined $50,000.00 by OSHA for safety violations from a job site inspection on Sept 22, 2008

3/17/2009 Niagara Falls, NY 
OSHA inspection against company fined $43,050.00 for failing to provide cave-in protection for employees working in an unprotected trench 5’8” deep.

3/23/2009 Baltimore, MD 
During the course of a routine sewer line repair, a worker was pinned beneath a wall of dirt. Roughly ¾ of his body was covered when the trench he was working in collapsed. During the course of a nearly 6 hour rescue, the man was communicating with rescuers. By the time the rescue crew had secured the wall with shielding, several hours had already passed before the digging could begin to get the man out. The man was taken to a hospital, and an investigation into why safety measures weren’t used immediately commenced.

3/25/2009 Richmond, VA 
Rescue workers spent 6 hours digging out a buried plumber from a hole dug to fix a sewage leak. The hole was roughly 15 feet wide at the surface, and narrowed to a 2 foot diameter at the bottom of the pit. The plumber in the unprotected trench was rescued after specially trained firefighters worked for hours to secure the sides of the pit with shielding and pneumatic supports before they could dig him out. The gaping hole was left open and unprotected, and remained the plumber’s responsibility, even as he was transported to the hospital for treatment.

3/29/2009 St. Louis, MO 
3 St Louis city workers trapped in a 12' deep trench trying to clear a sewer.

3/30/2009 Baltimore, MD 
Man trapped in a 10' deep trench - took 6 hours for rescuers to free him.

3/31/2009 Prince William County, Woodbridge, MD 
Man in trench or fell in - 15' deep - large pipe broke free from the chain and hit the man on the shoulder - possible no shoring according to report

3/31/2009 Horn Lake, MS ** OSHA penalty from the death and injury of two worker last year $70,000.00

4/3/2009 San Diego, CA 8” water main broke when a contractor doing work on s sewer line collapsed and the water main broke.

4/10/2009 Lowell, IN* Two men in 10’ deep trench when it collapsed - one got out, one died in collapse.

4/14/2009 New Richmond, WI* Worker killed in trench while using a saw to cut pipe, when saw kicked back and cut his throat. Same contractor that was fined in Feb $700,000.00 by OSHA.

4/22/2009 Dothan, AL 
OSHA proposed $60,000 in fines against company for failing to provide cave-in protection for workers in a 6’3” deep trench.

4/24/2009 Dothan, AL 
OSHA proposed $53,400 in fines against company following inspection at job site in Dothan.

4/23/2009 Lawton, OK

* Denotes Fatal Accident

OSHA proposed $700,000.00 in penalties for non-compliance at a trenching site on Weston, WI in September 2008. This same company has received 38 OSHA citations since 1982.
Worker trapped for 14 hours - Worker lost both legs fines by OSHA of $10,000.00

4/24/2009 Wallbach County, IL
Worker injured when trench he was working in collapsed. Blog info - only waist deep and the owner of the plumbing company was the local fire chief.

4/27/2009 Huntington Beach, CA
Two workers in the trench when it collapsed - one dead at the scene. CSHO officer arrived at a jobsite, he observed an village public worker in a 7 deep unshored trench. The inspector identified the hazards and the supervisor removed the employee from the trench. At that point the wall collapsed sending 4 of water into the trench from a water main break.

4/27/2009 Calumet City, IL
2 workers were trapped 4 wide - 8 deep

5/4/2009 Arlington, TX*
A wall of a trench dug at a water tower construction site collapsed, killing a worker. The 10 foot deep trench was dug to run power to the new water tower. Firefighters arriving said the man was only partially covered in dirt from the collapse. Officials reported no evidence of shoring was on-site upon their arrival.

5/6/2009 Phoenix, AZ *
Worker suffocates in 15’ deep trench collapse

5/11/2009 Hollidaysburg, PA
Worker trapped - OSHA investigated - fined $48,500.00

5/14/2009 Edmond, OK
OSHA proposed fines of $46,200 against company for failure to prevent cave-in 7’ deep.

5/18/2009 Avon Lake, OH
28 year old man trapped in trench collapsed after he fell in. Working with a water proofing contractor and after his fall found himself buried up to mid chest.

5/27/2009 Chicago, IL
Worker trapped in a collapsed 5’ x 5’ x 10’ deep, buried up to his knees.

6/1/2009 Belvidere, IL
A worker was rescued from a collapsed trench dug to run new utility lines at a fast-food restaurant. The man was in the trench hand digging with a shovel due to the proximity to known power lines. That is when the trench collapsed, burying him up to his chest in mud. The trenched he was trapped in was 8 feet deep, and a very cramped 2 ½ feet across. Rescue crews had the trapped worker out in only 2 ½ hours.

6/6/2009 Phoenix, AZ *
Trench collapse kill one worker - 5 to 6 deep

6/9/2009 Long Beach, CA
Two workers received electrical shock in trench

6/10/2009 Phoenix, AZ
Trenching and cut a gas line - not injuries

6/11/2009 Reading, PA *
Man dies - 8 deep in trench collapse.

6/12/2009 Rock Island, IL
Worker injured when a piece of equipment be lowered into the trench hit him in the back: 10’ - 12’ deep. Trench was shored.

6/29/2009 Peosta, IA
Man buried up to his neck.

6/29/2009 Carson City, NV
Two workers briefly trapped - possible track hoe bucket came off.

7/7/2009 Detroit, MI*
Man died in trench 12’ deep trench. 10’13 MOISHA investigated 7 deep. One was trapped and one killed. Proposed $131,600.00 in fines.

7/10/2009 Coushatta, LA
13 deep in a trench in trench gave way trapping the two men inside a steel safety box. A third mind jumped in to assist and a secondary bank collapsed trapped him from waist down.

7/20/2009 Powder Springs, GA
OSHA investigation found employees working in dangerous condition in a 25’ deep trench. Proposed fines $136,000.00.

7/31/2009 Cleveland, OH
Trench collapse - brick wall fell on to two men

8/11/2009 Woodbrige NJ*
Man killed in trench when steel road plate came loose from chains and hit the Township, man in the head. Lucas Construction Group.

8/12/2009 Conroe, TX
Three men working in a shored up trench when heavy rains hit, two men got out, third man swept into sewer system. UPDATE 11/21/2009 OSHA proposed penalties of $7,500.00.

8/23/2009 Chicago, IL
2 men were trapped in a 14 foot deep pit when the wall of dirt and sand partially collapsed. The hole one of the men was working in was dug for installation of a sewer flood control system. When one of the men became covered chest deep in sand from the partial wall collapse, the other man jumped down into the hole and used his body and arms to hold back the wall from further collapse that would have buried his head. The responding Fire-Rescue crew had both men out of the pit in around 90 min.

8/24/2009 Sacramento County, CA
Sales rep from Trench Plate Rental fell into a trench 26’ deep and 4’ wide.

8/26/2009 Kalamazoo, MI
58 year old man digging a trench in his back yard collapsed breaking his leg. 8 wide, 10 deep.

8/27/2009 Charlestown, RI
17 year old boy digging in the sand at the beach became trapped up to his neck. Took two hours to rescue him.

8/27/2009 Englewood, CO
OSHA Investigation on a Denver based company fined $75,000.00 for trench violations.

8/27/2009 Englewood, CO
OSHA Investigation on a Denver based company fined $67,000.00 for trench violations.

8/31/2009 Magnolia, WA
Worker was digging in a trench 15’ deep when the sides collapsed and trapped him to his waist.

9/11/2009 Englewood, CO
OSHA investigation of company - proposed $40,000 in fines.

9/11/2009 Englewood, CO
OSHA investigation - different company - proposed $40,000 in fines.

9/12/2009 Bedford, VA*
Man killed in trench - no shoring in place.

9/14/2009 Norman, OK
Crews working in a 10’ deep sewer trench when one man was trapped outside the box.

9/14/2009 (Earth Words Solutions, WI)*
During culvert removal preparations the worker placed himself in an excavation with no cave-in protection. The worker was killed in a cave-in.

9/16/2009 Pocatello, ID*
A man was covered in what is said to be the equivalent of a dump truck full of dirt, while working in a trench. Other workers were digging for 2 and a half hours before they could reach the deceased pipe layer. The man was apparently working in an area outside of the installed trench box, when the trench wall collapsed. OSHA fined the company $44,500 for not adequately addressing the hazards and not providing adequate safety measures, citing the site foreman for not acting to correct the known hazards.

9/28/2009 Phoenix, AZ
Two workers, one 35’ deep in a trench communicating with crane operator when the crane swung into some power lines shocking both workers.

9/28/2009 Drumond, OK
OSHA proposed $142,800 in fines from an inspection back on March 30 at two separated work sites near Drumond, OK - Lack of adequate protection.

9/29/2009 Bakersfield, CA
Firefighters rescue two men trapped by tree roots while trying to move a tree.

9/29/2010 Melvin, TX*
Employees were installing a tilt-wall into a trench. Decedent was inside the trench when the earth collapsed.

10/1/2009 Rockford, IL
Worker in a trench when a brick
ACCIDENT ROLL

veneer wall along the side of it fell on top of him.

10/1/2009 Las Vegas, NV
Local man survived a fall 25' deep into a trench. The construction company did not know the man had fallen until paramedics arrived on the scene. The man was able to use his cell phone to call for help.

10/5/2009 Orange County, FL (Disney) FL
A man working on a trench fell up 5' deep this morning injuring his back.

10/5/2009 Eaton, OH
Two workers buried in a trench, one up to his knees and the 2nd worker was completely buried.

10/6/2009 Ayer, MA
OSHA proposed $35,000.00 in fines against company for a willful violation for lack of trench protection 7' deep

10/6/2009 Pittsfield, NH
OSHA Proposed $55,000.00 in fines after investigation following a cave-in. OSHA showed up to a job site 10' to 11' deep and ordered the worker to get out of the unprotected trench. 5 minutes later it caved in.

10/15/2009 Atlanta, GA*
Two men fell into the hole - 9' deep one killed. One man killed when trench collapsed 10' deep. From OSHA - Worker was working in an unprotected trench installing a sewer/water line. A portion of the trench caved in, fully engulfing the worker and trapping another employee, who was hospitalized. It is believed that heavy rainfall weakened the integrity of the trench, leading to the trench collapse. Rescuers worked for 4 hours to retrieve the worker. OSHA fined the company $89,500 in penalties.

10/20/2009 Columbus, MO
Two traffic lights went out when trench collapsed.

10/26/2009 Canandaigua, NY*
Man operating backhoe, got off and went into the 7' deep trench for unknown reasons, wall collapsed burying him completely.

10/27/2009 Lexington, KY
Man trapped in a trench working on a foundation trapped up to his armpits.

11/3/2009 Gary, IN
Took firefighters 30 minutes to rescue a worker in a 14' deep hole.

11/6/2009 Chico, CA
Worker working in a trench 30' deep when the dirt wall collapsed on him. Fractured leg and pelvis.

11/8/2009 Joice, IA*
A farmer died when a drainage trench wall collapsed, burying him with dirt. The farmer was attempting to fix a drainage problem in a field. The trench was about 7 feet deep, which he had dug with a backhoe to access the clogged drainage tile. Authorities found the backhoe still running and the farmer in the trench.

11/12/2009 Modesto, CA
Two in 15' deep when trench collapsed trapping one worker for about 15 minutes on a farm. 30' long x 8' wide.

11/14/2009 San Antonio, TX
Worker was deep in a trench wrapping fence wire around the roots of an oak tree being transplanted. The wire broke and he was caught in a cave-in.

11/17/2009 Sioux Falls, SD
A worker was buried alive while working in a trench at a construction site.

11/17/2009 Boston, MA
OSHA investigation in downtown Boston lead to $33,700.00 in proposed fines. Company had 3 employees in an unprotected trench.

11/19/2009 Conroe, TX
3 men in 15' deep when trench collapsed, sending one to the hospital.

11/25/2009 Danville, IL
OSHA investigated company on job in Danville, IL in May 2009 - proposed penalties total $130,200.00. 8' deep without cave in protection.

12/5/2009 Kosiusko County, IN
Man trapped in a 6' deep trench on Saturday afternoon.

12/24/2009 Hickory, NC*
Worker was in a trench installing 8-inch pipes for a new sewer line. As another worker operated the excavator, he noticed the worker covered waist deep in dirt. After 20 minutes the worker was removed from the trench and transported to the hospital where he died.

2/23/2010 Williamsport, PA
A man was buried in dirt when a trench he was working in collapsed without warning. He was in the 10 ft deep trench working on a sewer lateral, without shoring. His co-workers quickly came to his aid, uncovering his head almost immediately. It took rescue crews nearly 4 hrs to free the worker, who was also stuck knee-high in concrete-like clay. Rescue crews used shiuling and pneumatic supports to prevent further collapse while getting the man to safety. The man survived.

4/7/2010 Hudson, OH*
It took more than 60 rescue workers over 2 hrs of digging to reach 2 men trapped in a trench. The 15 ft deep, 120 ft long trench was dug to install a sewer line, which the 2 men were working on when the cave-in occurred. One man survived, and was pulled free 6 hours after the rescue team arrived. The deceased man was retrieved after 7 ½ hours of digging. There was a trench box installed in the trench, but the men were working 30 feet away in an unprotected area. OSHA fined the company a total of $140,000 for 2 willful violations, and 2 citations.

4/24/2010 Crofton, NE*
A worker died while installing a new water line, when the 5 to 6 ft deep trench he was working in collapsed. The man was buried up to his waist in dirt, which was loosened by a half-inch of rain that fell the night before. OSHA fined the company $4,410 for finding 3 violations. The most serious violation being that the company failed to bench or shore the trench, and reports say dirt was piled closer than 2 feet from the sides of the trench.

6/5/2010 District Heights, MD
A man was covered in dirt above his head, while working in a trench doing foundation work. Three other men who were working with him, quickly uncovered his face allowing him to breathe. They continued digging him out more, removing the dirt down to his waist inside the 7 ft deep trench. Firefighters used shoring to secure the trench walls while they worked to rescue the trapped worker. After about 2 hrs, he was flown to the trauma center in critical condition.

6/20/2010 Kirkland, OH
A man working in a trench was completely covered in dirt, when a wall collapsed. Other workers jumped in the 9 ft deep trench, to uncover the trapped man’s face and chest. Rescuers hand dug and used a backhoe to shore the trench walls before pulling the man to safety. He was then transported by helicopter to the hospital. No safety precautions were used.

6/2/2010 De Moines, IA
A plumber was covered in dirt when a trench he was working in caved in. Co-workers were working to remove enough dirt so the man could breathe. Rescue crews arrived at the scene weren’t able to see the man, still covered in 10 in of dirt, but they could hear him. It took an hour for the rescue team to pull the man from the trench.

6/28/2010 Charles City, IA
A firefighter was working in a trench to connect the sewer line to his new home, when the trench collapsed on top of him. Fortunately, the man’s son was working nearby and was able to hear his fathers calls for help. The son found his dad buried in dirt up to his head and struggling to breathe, and called 911 while trying to dig out the mud. Local police and fellow firefighters arrived quickly, working to free the assistant fire chief from the trench. The assistant fire chief had actually been the one to train the firefighters in trench rescue. He escaped with a broken pelvis.

* Denotes Fatal Accident
6/28/2010 Tamaqua, PA
The owner of a plumbing and heating company was working in a trench when the walls collapsed around him. A worker jumped into the collapsed trench, and was trying to dig him out until rescue teams arrived. The man was flown to the hospital.

7/14/2010 San Francisco, CA
A worker was trapped when a trench he was in collapsed. Coworkers were able to hand dig to free his head so he could breathe. Rescue crews worked for 4 hours to pull the man free from the trench. DIBI investigation showed that no protective measures were in place at the time of the accident, fining the contracting company $1,000.

7/20/2010 Baltimore, MD*
A utility worker repairing a sewer line died, when the trench he was working in collapsed. The worker had just stepped onto a ladder, when he suddenly fell backwards into the collapsing trench. The 15 ft deep trench was unprotected. The resulting flow of loose earth filled the trench box from the unprotected area. 150 rescue personnel worked on-rotation for 4 hours to free the trapped worker. He was taken to the hospital and survived.

8/5/2010 Pallisades Highlands, CA*
A construction worker was found dead, buried under 11 ft of dirt. He was working on installing a French drain, and was working in the L-shaped 8 ft x 8 ft x 11 ft trench the crew had previously dug. Firefighters arriving on scene realized the depth of the trench, and called in a specialized rescue team. A vacuum excavation truck was used to reach the body of the worker, who was trapped in compacted adobe-like clay. It appears the trench was unprotected.

10/24/2010 Augusta, GA*
Two plumbers were working in a trench when water started seeping in, weakening the trench walls, leading to collapse. Firefighters dug my hand to rescue the trapped plumbers. One of the men died after being transported to the hospital. The second man survived. It appears trench protection was not in place.

10/15/2010 Greenwood, IN
A man was injured when a trench he was working in was dug for utility work at a residence, when the concrete slab beneath the front door collapsed in on the worker. Rescue crews worked for hours into the night to retrieve the body. A second worker was injured in the accident and survived.

International Trench Accident Report:
5/25/2009 Chennai, India*
12 dead in trench collapse, including 8 women and a 12 year old boy.

6/7/2009 Sidmouth, UK
Man suffers broken ribs in collapse.

7/10/2010 Panorama Hills, Calgary, AB, Canada
Man survives trench collapse.

7/14/2010 Calgary, Alberta, Canada
Worker survives trench collapse.

10/17/2010 Bradford, West Yorkshire, UK*
Worker dies of head injuries when a trench he was working in collapsed.
Local contractor ‘casts-its-way’ through Raleigh neighborhood with help from Efficiency Production Slide Rail System

By James McRay

Moffat Pipe, Inc. (MPI), based in Wake Forest, North Carolina, is currently in the process of installing 320 linear feet of 5x10 foot cast-in-place concrete culvert pipe through the neighborhoods of Raleigh, North Carolina.

The new storm-sewer installation is part of the Carolina Pines Dam Rehabilitation Project for the City of Raleigh Storm-Water Division.

Cast-in-place pipes and culverts present several challenges for contractors performing the installation work. Not the least of which is keeping workers safe in the pipeline trench that generally needs to be kept open and exposed longer than traditional precast pipe.

Compounding that challenge for MPI is that the new pipeline is running directly through a portion of Raleigh’s residential neighborhoods where active shoring with low vibration adjacent to existing structures is required. And, “North Carolina DOT has some very strict requirements for shoring,” said Keith Moffat, one of the officer’s of MPI. And, “North Carolina DOT has some very strict requirements for shoring,” said Keith Moffat, one of the officer’s of MPI.

MPI has used both tight sheeting and Slide Rail, but thought Slide Rail would be preferable on the Carolina Pines project. MPI contacted Efficiency Production Inc.—a leading manufacturer of Slide Rail and other trench safety equipment—for consultation on shoring this excavation project.

Slide Rail is a component shoring system comprised of steel panels (similar to trench shield sidewalls) and vertical steel posts. Efficiency’s versatile system can be used in a variety of configurations, such as small four-sided pits; large unobstructed working pits as big as 50 x 50 ft. with Efficiency’s ClearSpan™ System; or in a four-sided or linear Multi-Bay™ configuration to install length of pipe over 40 feet.

Efficiency’s team of Slide Rail experts recommended a five-bay, Linear Multi-Bay™ Configuration which provided a long and wide working area to cast-in-place the large culverts. Cast-in-place pipes and culverts present a greater safety challenge as the pipeline trench generally needs to be kept open and exposed longer than traditional precast pipe.

“Slide Rail really isn’t new... but I still meet engineers and contractors who’ve never seen it used before…”

“That usually leaves only tight sheeting or Slide Rail—systems the state considers ‘active shoring’—as viable options for shoring excavation projects within NCDOT right-of-ways encroachment agreements. MPI has used both tight sheeting and Slide Rail, but thought Slide Rail would be preferable on the Carolina Pines project. MPI contacted Efficiency Production Inc.—a leading manufacturer of Slide Rail and other trench safety equipment—for consultation on shoring this excavation project.

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MPI anticipated that they would be using Slide Rail extensively in the future, so they purchased the entire system from an Indianapolis-based trench safety equipment distributor and requested that Efficiency Production paint the Slide Rail panels red, MPI’s corporate colors.

Excavators in use by MPI are a John Deere 350D and a Deere 200C Excavator, plus a Deere TC62 Loader. MPI’s $1.25 million Dam Rehabilitation project began at the end of April and will be completed this November.

Moffat Pipe, Inc. specializes in water main, sanitary sewer and storm sewer installation and repair. Moffat has experience serving a variety of customers from schools, businesses and municipalities to commercial developers and heavy highway contractors.

UF
Both Shoring and Shielding are modular in design. This allows for re-configuration on-the-fly, as site conditions change.

Shoring or Waling, is the method of sliding vertical supportive panels downward along the face of the trench wall. Crossmembers, or braces are placed perpendicular to the trench wall face, at a 90 degree angle, or level. The use of Shoring applies pressure on the trench wall face, acting as a direct support system. Types of bracing includes hydraulic, screw, and pneumatic. OSHA specifies vertical shoring must extend 3ft past the opening of the trench.

Always refer to the Manufacturers Tabulated Data sheet (MTD) that is included with the purchase or rental of the trench protective equipment. Have it out for reference at the install. This sheet takes the guesswork out of it, and is intended for this purpose. But it only works if you use it!

Other Systems would effectively include any supportive system an engineer can come up with. The types of support systems can include timber support systems made of wood planks and beams, creative use of shoring or slide-rail systems, or quite literally, anything a professional engineer can come up with!

Sloping and Benching are the only 2 ways to move dirt around to make the trench safe enough to work in. These methods require an exponentially greater amount of training and knowledge in order to properly distinguish how each method needs to be applied, based on soil conditions. Due to the complex nature of these protective methods, the following methods of protection UF Mag: Safe Trenches 2010 is going to discuss will be only those classified under Support Systems. For more information on Sloping and Benching contact your local OSHA representative.

Shielding refers to the literal use of a pre-constructed box that acts as a shield. Shielding differs from shoring in that shielding functions as a shield from collapse, while not always supporting the trench wall itself. This means shielding is generally an indirect support system. Braces in different sizes and lengths are available to suit a variety of widths. The side shield components or wales are also available in a variety of heights and widths, to suit differing site conditions as well.

SHORING

SLOPING or BENCHING

SUPPORT SYSTEMS

OTHER SYSTEMS

PROTECTIVE SYSTEMS

SHIELDING
SAFETY FIRST

There is no protective system in place here to ensure worker safety when entering the excavation. Here safety is being overlooked by allowing work to take place outside of the trench shield; also a lack of proper access/egress, and spoil pile is too close to the edge. There is no protective system in place here to ensure worker safety when entering the excavation.

A critical aspect of trench safety, in addition to the protective system, is instruction in the areas of Excavation Competent Person Training and Confined Space Training, offered at United Rentals Trench Safety locations and other sources. A lot of issues here: improper sloping and benching system, lack of proper access and egress, and worker safety jeopardized by vibrations from the compactor being operated within the excavation.

Worker safety can never be compromised. Employers need to ensure that surface encumbrances are supported for worker safety.
Engineered jobs often integrate components from more than one type of protective system to arrive at a solution that is practical, efficient and economical.

Road plates, placed on-end outside a trench shield, may seem like the correct thing to do. But the combined weight of the plates and the soil may exceed the Manufacturer’s Tabulated Data (MTD), putting the excavation at risk of a cave-in.

An understanding of soil types and Manufacturer’s Tabulated Data (MTD) are both important when configuring a protective system. A system that performs well under one set of site conditions may be inappropriate with a different soil type.

Trench shields must be installed to restrict lateral movement. Workers are at risk without a professional protective system in place.

OSHA has specific safety guidelines for certain installations, such as proper placement of the first hydraulic strut. Also refer to Manufacturer’s Tabulated Data (MTD) for the proper use of hydraulic struts and sheeting.

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A trench shield within a trench shield may be safe as long as the workers follow the Manufacturer’s Tabulated Data (MTD) or engineering specifications and comply with all applicable standards.