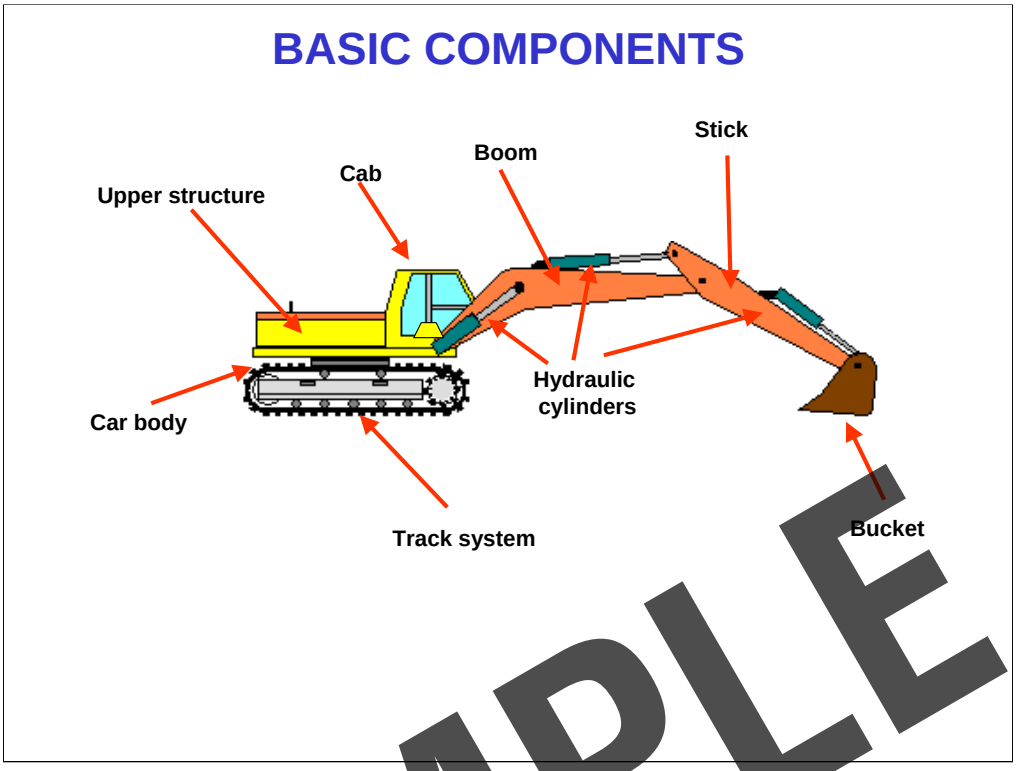
EXCAVATOR

SAFETY TRAINING

This training course is intended for those who operate and/or work with excavators. The training material is designed to allow the trainer to add or delete material in order to tailor the course to their particular situation.

Course Outline: The following topic are covered in the course material:

- Basic components of the excavator
- Inspecting the excavator
- Operator responsibilities and safety precautions
- Moving the excavator about the worksite
- Hand signals
- Excavating and trenching
- Lifting with the excavator
- Transporting the excavator



Purpose of Slide: This slide shows the basic components of the excavator.

Review the terms used to identify the basic components of the excavator as used in this course material.

Some terms may vary. One in particular is the term ‘stick’. This component is sometimes referred to as the dipper. Individuals in the class may use other names for different components. It is good to make sure everyone understands the terms used here to avoid any confusion.

INSPECTION CHECKLIST

INSPECTION AREA	INSPECTION RESULTS			
	Sat.	Unsat.	N/A	Comments
Carrier & Car Body				
Rotation system				
Tracks				
Rollers				
Frame, welds, bolts				
Drive system				
Upper Structure				
Radiator fluid				
Engine oil				
Belt tensions				
Batteries				
Hydraulic fluid				
Hydra. pumps & hoses				
Engine exhaust syst.				
Cab				
Seat belt				
Guages				
Controls & Labels				
Fire extinguisher				
Glass				
Warning Alarms				
Lights				
Swing Brakes				
Electrical System				
Safety Equipment				
Operator's Manual				
Boom & Stick				
Hydraulic cylinders				
Hydraulic hoses				
Hinge pins & bushings				
Deformations, Cracks				
Bucket				
Teeth				
Welds & bolts				
Pins & busings				

Purpose of Slide: To discuss the need for inspecting the machine.

Prior to the excavator being placed into service at the beginning of a shift, the operator should conduct a basic inspection of the machine. That inspection may include:

- All safety devices: Horns, lights, guards and shields, fire extinguisher, glass and wipers.
- Engine and hydraulic fluid levels
- Boom, stick, and bucket
- Hydraulic leak
- All controls for proper function

A more thorough inspection should be conducted on a periodic basis. Typically, this is on a monthly basis, but depending on the amount of time the machine is being used and under what conditions more or less frequent inspections may be necessary. The inspection check list shown on the slide is an aid in conducting the thorough inspection. The operator's manual should be consulted to identify any additional inspection requirements.

WARNING LABELS

DANGER

Indicates imminently hazardous situation. If not avoided will result in death or serious injury.

WARNING

Indicates potentially hazardous situation. If not avoided could result in death or serious injury.

CAUTION

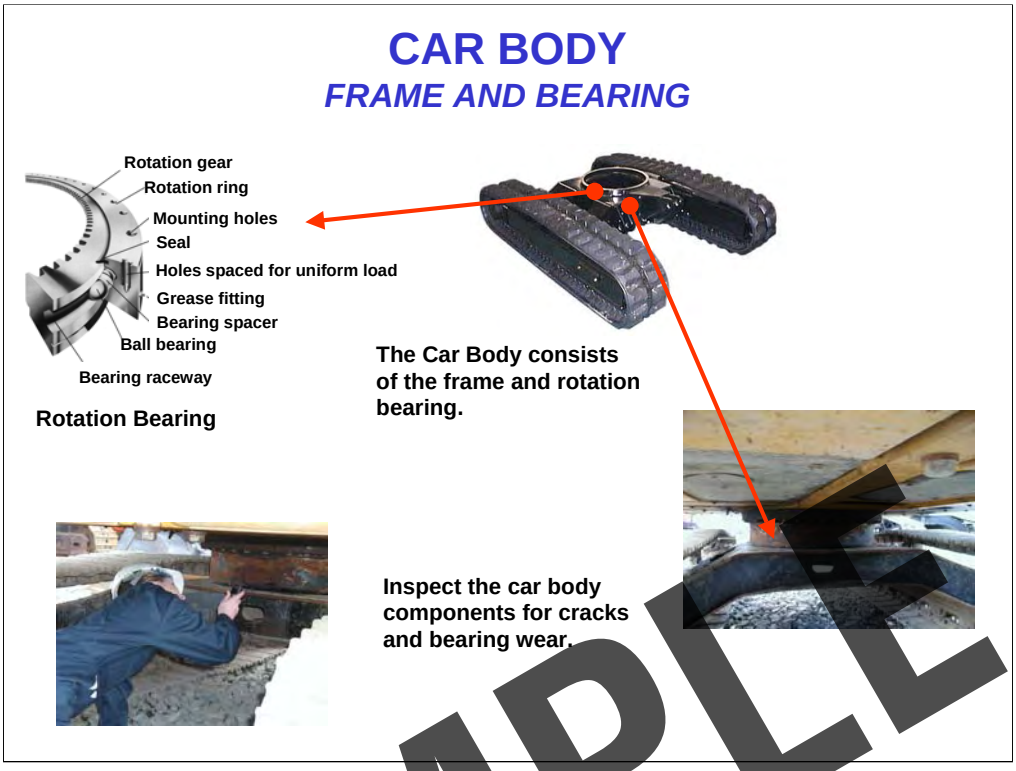
Indicates potentially hazardous situation. If not avoided may result in minor or moderate injury.

All warning labels need to be legible and replaced as necessary.

Purpose of Slide: To review the requirement for all warning labels to be readable.

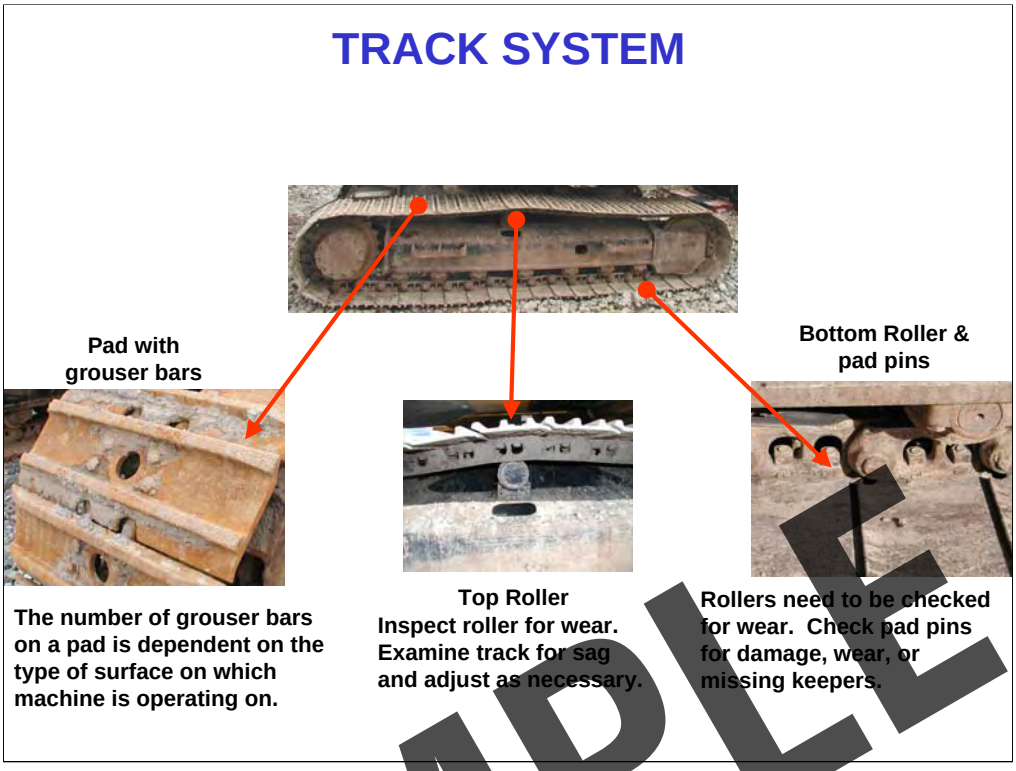
Warning labels that were on the machine when manufactured need to be maintained in readable condition. Damaged labels need to be replaced.

The standard three levels of warning are Danger, Warning, and Caution. Review the intent of these labels with the students. Remind the students that it is the operator's responsibility to know and understand the intent of each label.



Purpose of Slide: To discuss the inspection of the frame and rotation bearing of the excavator.

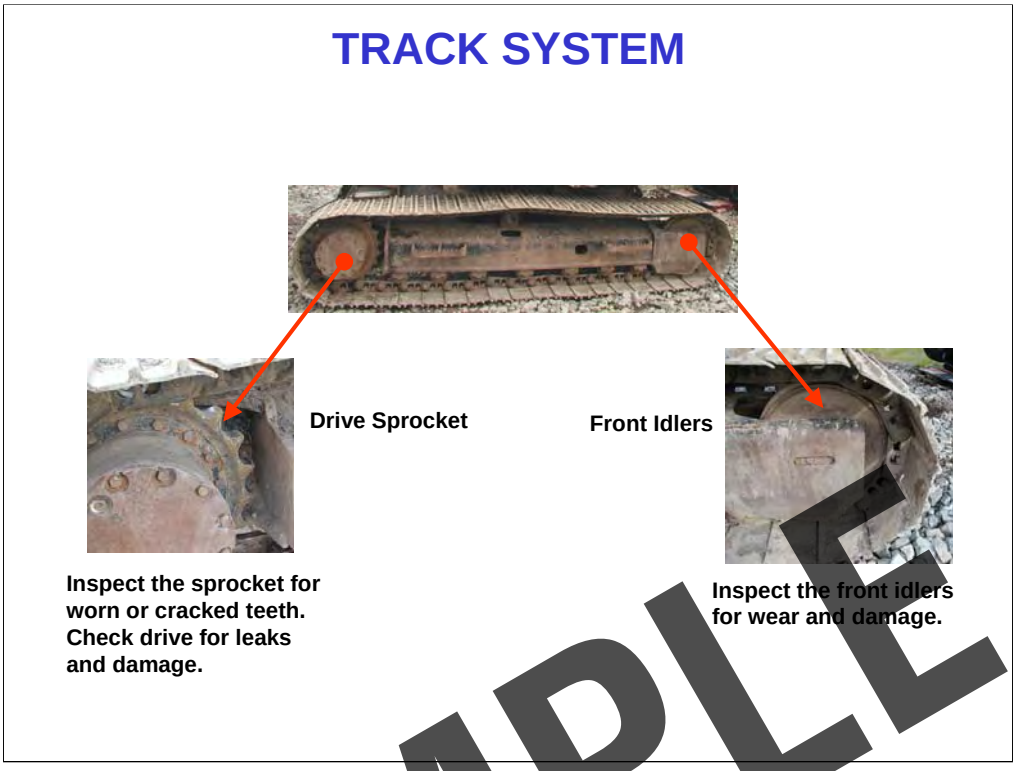
The frame of the excavator needs to be inspected for cracked welds and loose bolts. This will require crawling under the machine to perform this inspection. Often because of wet or muddy conditions, these inspections are overlooked. As the machine gets older, the potential for failed welds or fasteners increases. An illustration of a typical rotation bearing is shown in the slide. One half of the bearing is attached to the frame and the other half is attached to the upper structure. The only thing holding the two halves of the bearing together are the ball bearings. When digging and lifting with the excavator, this bearing experiences tremendous loads and therefore needs to lubricated regularly. Excessive bearing wear can be detected by first observing the relative location of the two bearing halves with each other with the bucket off the ground. Next, place the bucket on the ground and slightly lift the tracks off the ground with the boom. Again, observe the relative location of the two bearing halves. If the bearing halves separate more than .060 of an inch, the manufacture should be consulted to determine the amount of allowable play.



Purpose of Slide: To review the basic inspection criteria for the tracks.

The tracks need to be checked for cracked or damaged pads. Also, the condition of the grouser need to be examined. The number of grousers per pad is normally dependent on the surface on which the machine will be working. For earth work, normally only one grouser would be needed. For working on pavement, the pad may have three grousers to prevent surface damage when maneuvering the machine.

- Check for loose bolts attaching the pads to the track links and check the pins connecting the pads together for wear or damage.
- Check the top and bottom rollers for wear and especially for flat spots.
- Check the operator's or maintenance manual for the proper track adjustment.



Purpose of Slide: To discuss the inspection of the track sprocket and idler.

Inspect the drive sprocket for worn or cracked teeth. A broken tooth on the sprocket will cause excessive wear to the pad sockets. Check the drive seals for leaks.

The front idler needs to be checked for wear and flat spots. Depending on the type of material the excavator has been working in, the perimeter of the idler can be chipped or nicked which can result in wear to the pad sockets.

UPPER STRUCTURE

Engine Compartment

Inspect the engine for leaks. Keep the radiator free of dirt.

Before starting the machine at the beginning of a shift, the basic engine checks need to be made. Refer to the operator's manual for a complete list of inspection items.

Check the oil frequently.

Check the radiator for coolant.

Check the belts for proper tension and radiator hoses for cracks.

Purpose of Slide: To review the inspection of the engine compartment.

At the beginning of every shift the level of all fluids should be checked. Depending on the condition of the engine, it may be necessary to check fluids throughout the shift. Check belts for proper tension and wear. A broken belt can result in a project being shut down for several hours.

Check radiator and other hoses for cracks.

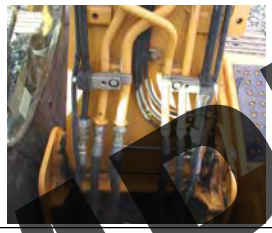
The engine compartment , especially the radiator, can become very dirty. Frequent cleaning may be necessary to kept dirt from building up in the radiator and on the engine itself. Excessive dirt can cause the engine to run hotter than normal which will reduce its life.

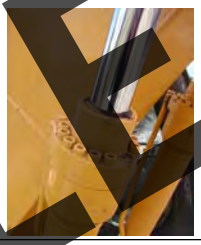
UPPER STRUCTURE

Check for proper hydraulic fluid level. Refer to the operator's manual for the correct position of the boom, stick & bucket for the measurement.

Inspect all lights to ensure proper working order.

Check the hydraulic system, pumps, hoses, lines and cylinders, for leaks.





Purpose of Slide: This slide reviews the inspection of the upper structure components.

Before operating the machine, the hydraulic fluid level needs to be checked. The fluid level is normally checked with the stick and bucket fully retracted and the boom down. Check the operator's manual for specific instructions.

Check the hydraulic pump and compartment for leaking fluid and general condition of the hoses and fittings.

Inspect all hydraulic hoses for leaking fluid. Where hoses bend over metal edges, check the hoses for chaffing. Even though the edge may be smooth, chaffing can still occur. Fluid weeping out of the compression flange on a hose fitting needs to be investigated and the hose replaced as necessary.

Hydraulic cylinders need to be inspected for fluid leaks at the fittings and where the cylinder rod comes out of the cylinder. All leaks need to be corrected and any nicks in the cylinder rod need to be smoothed out to prevent damage to the cylinder's wiper seal.

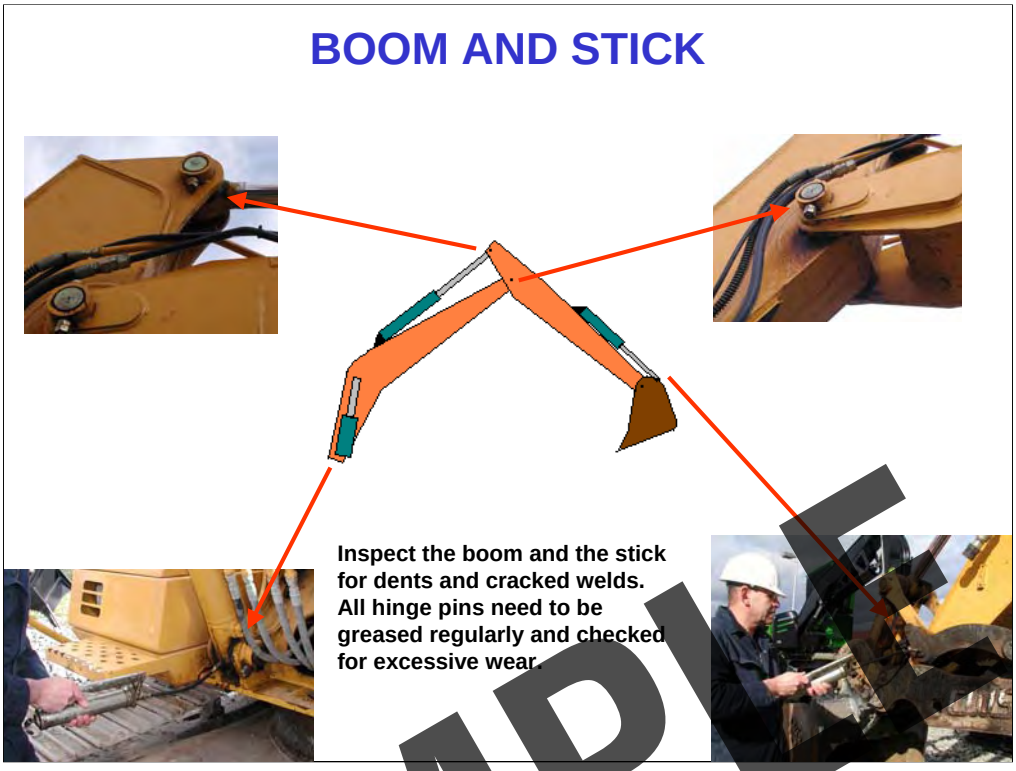
All lights on the machine should be in working condition.

Purpose of Slide: To review the inspection and maintenance of the operator's cab.

The operator's cab needs to be kept clean of dirt, grease and objects which could interfere with the safe operation of the machine. It is recommended that basic housekeeping items be kept on the machine to facilitate keeping it clean. The glass in the machine need to free of cracks that would impair the vision of the operator. Clean the glass regularly to increase visibility and to avoid reflection in sunlight. The windshield wipers need to work and the blade should be replaced periodically to avoid streaking.

All controls need to be properly labeled with their function and direction of motion. Test each control before starting work to confirm they are in proper working order.

The cab should have a fire extinguisher that has a current inspection label.



Purpose of Slide: This slide discusses the inspection of the boom and stick and the greasing of its joints.

Inspect the boom and stick for dents and bends. Significant dents need to be evaluated by a competent individual to determine if the structural strength has been compromised. This is especially critical when the excavator is being used for lifting. All welded joints need to be inspected for cracks. The hinge joints need to be greased regularly according to the manufacture's recommendations. After greasing, excessive grease should be wiped away with a rag. Keeping these components free of excessive grease will reduce the buildup of grit which can accelerate wear. Check the hydraulic hoses at the hinge points for wear.

BUCKET

If so equipped, check the 'thumb' for damage

Inspect the bucket linkages for damage & worn pins

Check the locking pins that hold the teeth for damage.

Inspect the lifting points on the bucket and stick damage.

Purpose of Slide: This slide discusses the inspection and maintenance of the bucket.

Inspect the bucket for cracked welds, particularly where the hinge gussets are attached.

Inspect bucket hinge pins and linkages for excessive wear, missing keeper pins and other damage.

Make sure the pins or bolts used to attach the teeth to the bucket are in place and not excessively worn. Also, evaluate the wear on the teeth for planning the next change out.

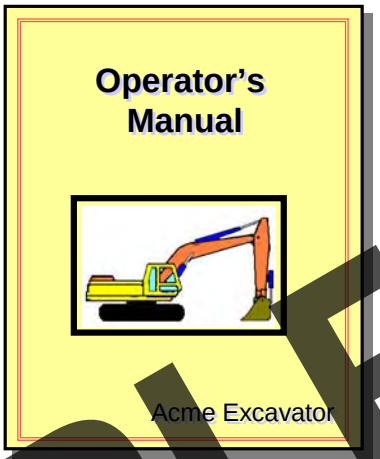
If the excavator is fitted with a thumb, inspect the hinge pin and associated linkages for wear and damage.

The frequency of greasing the bucket hinge pins is dependent on weather conditions and the type of material being excavated. In sandy or powdery material it may be necessary to grease these components two to three times a shift. The fine material will have a tendency to work their way into the hinges and accelerate wear. Frequent greasing will keep pushing this material out. Buckets that will be digging below water need frequent greasing to keep it fresh. At the end of the shift where the machine will sit overnight, grease all these area again to prevent corrosion. After greasing, exercise the bucket to distribute the grease.

OPERATOR'S MANUAL

The operator's manual is to be on the machine.

The operator is to have read and understood the manual.



Purpose of Slide: To discuss the purpose and requirements for the operator's manual.

The operator's manual is required to be on the machine or readily available to the operator. Being kept in the job shack or back in the office does not meet this requirement.

The operator is also responsible for having read and understood the manual. It is the employer's responsibility to ensure the operator has read the manual before allowing him to operate the machine.

The manual contains important information about the operation and maintenance of the excavator. Though very similar, not all excavators are the same, particularly with respect to maintenance. The manual will contain operating information and load capacity charts that must be used when the machine is utilized for lifting.

SEAT BELTS

• Inspected Each Day

• Should Be Worn When Operating The Machine

Purpose of Slide: To discuss the use of seat belts.

Seat belts are a safety device and as such must be kept in operating condition. Worn or damage belts need to be replaced.

When moving the machine over rough terrain or on steep slopes, the seat belt will help keep the operator in the seat allowing him to maintain control of the machine.

Some manufactures recommend replacing the whole seat belt assembly every three years regardless of appearance.

CLIMBING ON AND OFF THE MACHINE

When climbing on and off the machine, the operator should always face the machine. Use the the three point contact method when climbing: Two hands and a foot or two feet and a hand.

Purpose of Slide: Review the proper method for climbing on and off the machine.

One of the prime causes of ankle and back injuries to operators is the improper method to climbing on and off the excavator. The standard three point method is recommended. This method is simply keeping two feet and a hand or two hands and foot in contact with the machine while moving the remaining hand or foot. Enter and exit the machine while facing it. This will allow the operator to use all the handrails provided. Avoid jumping from the machine.

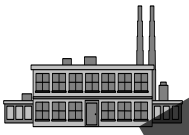
Cleaning footwear of excessive mud or grease will help prevent slipping.

OPERATOR RESPONSIBILITIES

Operator

People Around Machine

The Machine

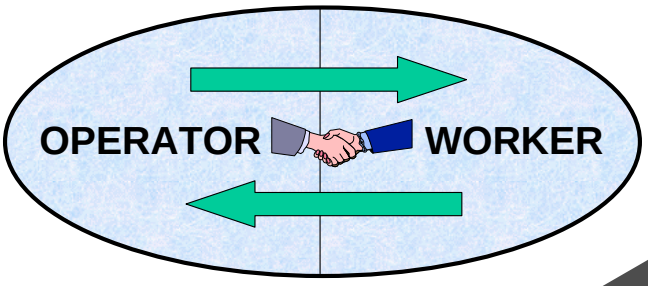


Property

Purpose of Slide: To review the operator's responsibilities.

The operator of an excavator is responsible for safe operation of the machine and the safety of those working in the vicinity of it. The next few slides cover these responsibilities in greater depth.

JOB SITE SAFETY



EVERYONE IS RESPONSIBLE FOR THEIR SELF AND THE OTHER PERSON

Purpose of Slide: To discuss the importance of everyone working together for job site safety.

Job site safety is everyone's responsibility. When performing operations with an excavator, the operator of the machine and those assisting him on the ground need to work together as a team. Those on the ground need to notify the operator if they notice anything out of order with the machine. The operator needs to be aware of where workers on the ground are and stop operations when anyone comes within range of the machine. Everyone on the job site is responsible for their self and the other person.

OPERATOR AWARENESS FACTORS

FATIGUE & HUNGER

WEATHER: HEAT, COLD

EMOTIONAL LEVEL

PHYSICAL HEALTH

WORKING CONDITIONS

OTHER PEOPLE

Purpose of Slide: To discuss how different factors can affect an operator's awareness while operating an excavator.

Several factors can affect an operator's ability to stay focused on operating their machine.

Fatigue & Hunger: Fatigue can result from working too many hours, lack of sleep, hunger or monotonous, repetitive work. When an operator shows signs of fatigue, they should be relieved to get rest or exercise to refresh their alertness.

Weather: Some excavators are open to the elements. An operator needs to dress appropriately for the weather to prevent stress on their body.

Emotional Level: Operators under emotional stress may not be able to stay focused. It may be necessary at times to remove such an operator from a machine until emotional equilibrium is restored.

Physical Health: Operators suffering from health problems affecting their machine operating ability should not be allowed on a machine. Even workers taking cold medicine may have their alertness compromised.

Working Conditions: Some worksites that have many activities occurring simultaneously can distract an operator. Operators must be able to block out such distractions while operating a machine.

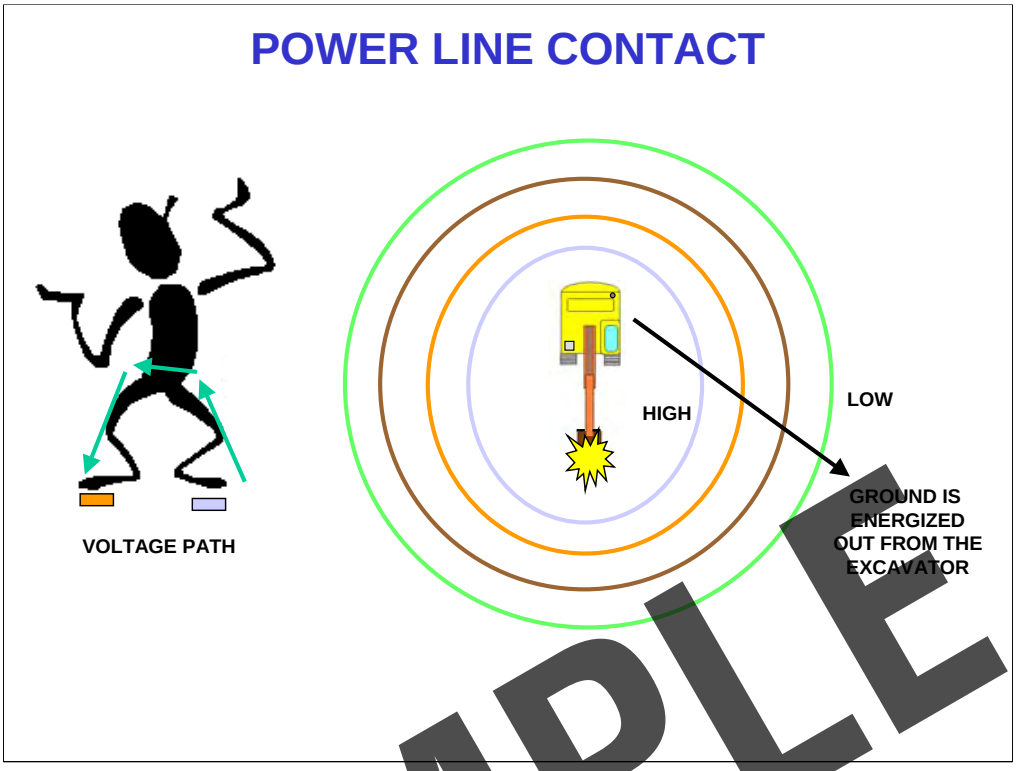
Other People: People should not attempt to talk to or in any way distract an operator who is operating a machine. Wait until they are finished with an operation before approaching or talking to the individual.

FOR SAFE OPERATION

- ✓ **Never Take Anything For Granted**
- ✓ **Face the Machine When Climbing on and off**
- ✓ **Keep The Machine Clean**
- ✓ **Clean Mud And Grease From Shoes**
- ✓ **Avoid Loose Clothing And Jewelry**
- ✓ **Wear Protective Equipment**
- ✓ **Never Operate Machine Without Protective Guards**
- ✓ **Always Check Height, Width, and Weight Restrictions**
- ✓ **Keep all Safety Devices in Place and Working**
- ✓ **Plan Ahead**
- ✓ **Learn Beforehand About the Work Area**

Purpose of Slide: To discuss items that affect the safety of those working with and around excavators.

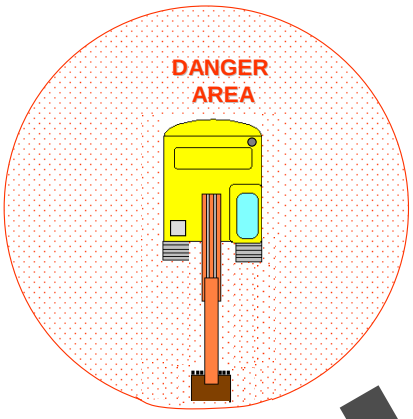
The above is a list of items which affect the safety of excavator operations. The merits of each item should be discussed and invite class members to add additional items to the list. If there are company policies regarding the operation of this machine, now is a good time to discuss those also.



Purpose of Slide: To discuss what should be done in case of a power line contact.

1. When the excavator comes in contact with a live power line, the whole machine becomes electrified. Due to the different current paths that the electricity can follow, parts of the machine could be at different voltages. If the operator touches different parts of the machine, his body could create a current path which could result in electrocution.
2. The ground around the excavator can also become electrified. The voltage in the soil nearest the machine will be greater than that further away from it. When moving away from the excavator, individuals should shuffle to avoid creating a current path from one foot to the other.
3. The operator should remain with the excavator if at all possible until the power company indicates it is safe to leave the machine. This is because the excavator components could be at different voltages and touching parts of the machine could result in being electrocuted.
4. No one should be allowed to approach the excavator or to touch it. If the operator is unconscious, no attempt should be made to rescue him until the power company indicates it is safe to do so.
5. If the operator must leave the excavator due to fire, he should move slowly to the edge of the cab without touching it and carefully jump to the ground. Once on the ground, he should shuffle away from the machine.

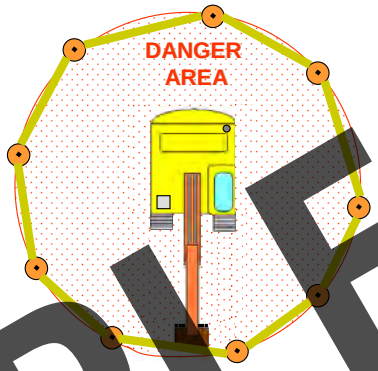
DANGER AREA



Purpose of Slide: To discuss the dangers of workers entering the swing area of an excavator.

When the excavator is in operation, no one should enter the full swing area of the machine. The operator's vision of this area is not always clear and anyone entering may not be seen by the operator. Workers not only need to watch for boom and bucket movement but also for the counterweight.

DANGER AREA

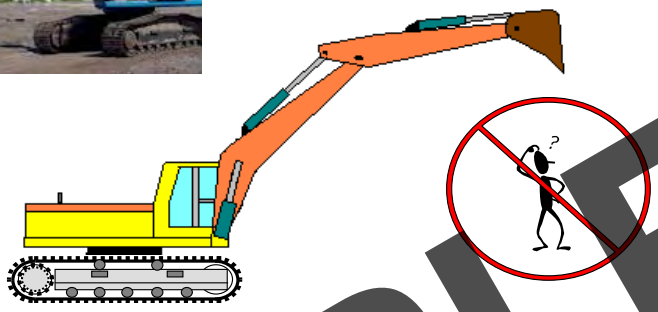


To prevent people from entering the danger area of the machine, this area may need to be barricaded to limit access. This is particularly true when working in a public area.

Purpose of Slide: To discuss requirements for controlling access to a worksite.

Before excavating work begins, access to the worksite by unauthorized persons needs to be controlled. Barriers of cones, barrels or other structures can establish the work area perimeter. Caution tape, barricade safety fencing or other well-marked material should be placed between the vertical barriers to prevent people from accidentally entering the work area.

ALWAYS WORK FACING THE MACHINE

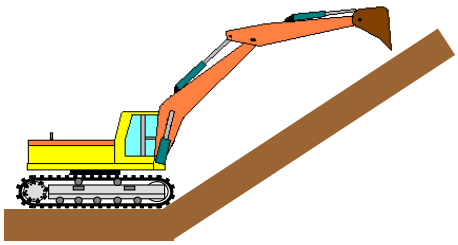


Never assume the operator can always see you.

Purpose of Slide: To discuss the dangers of working around an excavator.

When working around an excavator, the worker should always work facing the machine. The worker should consider the machine as a continuous threat to his/her safety and thus constantly keep an eye on its movements.

MOVING UP A SLOPE



When preparing to move the excavator up a slope, make sure the seat belt is fastened.

- **At the base of the slope extend the boom and stick up the slope. This will help place more weight on the front to increase traction.**
- **The tracks should be in line with the slope to prevent the machine from traversing up the slope at an angle.**

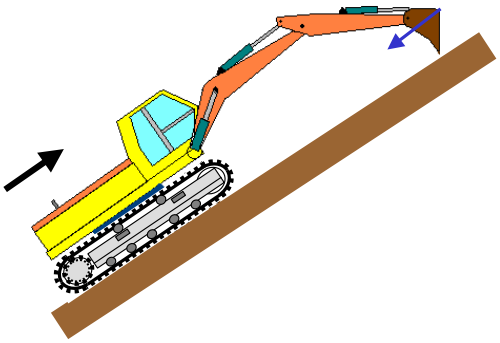
Purpose of Slide: To review the basics for moving an excavator up a slope.

Before moving the excavator up a slope, the operator should make sure that his/her seat belt is properly fastened.

When approaching the slope the position of the drivers either in front or in the rear is a matter of opinion. Some prefer them in the rear but others, including some manufacturers recommend them to be in the front.

As the excavator starts up the incline the boom will need to be lowered to keep the bucket a foot or so off of the slope. When the machine is on the slope and climbing, the operator needs to monitor the traction of each track and make sure the machine is traveling in a straight line up the slope. If one track has less traction than the other the machine will tend to veer to one side causing the down hill track to dig in which may make the machine unstable. On soft material, the excavator tracks may tend to dig in at the rear which will tip the machine backwards and could result in a rear roll over.

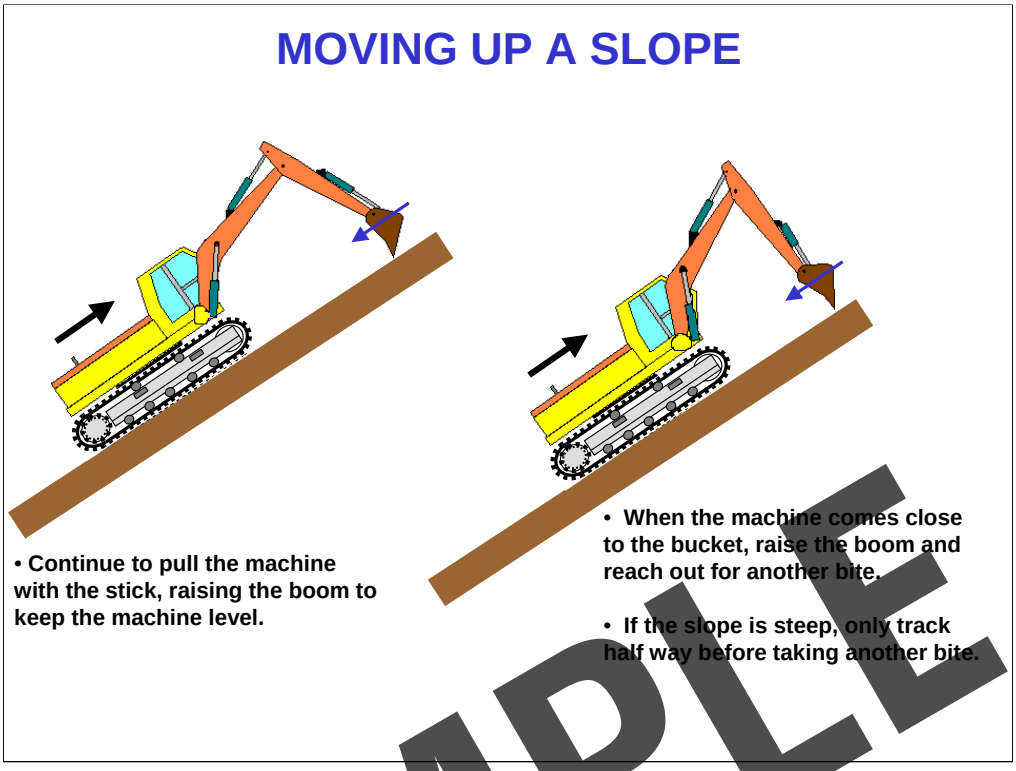
MOVING UP A SLOPE



- **If the slope is too steep and the material is loose, the rear of the machine may settle allowing the excavator to roll over backwards.**
- **Keeping the boom and stick extended will help distribute the load on the tracks more evenly which improves traction.**
- **If the excavator is unable to continue to climb due to slope, set the teeth of the bucket into the slope and start pulling the machine with the stick.**

Purpose of Slide: To review the basics for moving an excavator up a slope.

If traction becomes a problem the bucket teeth can be set into the slope and the stick can be used to pull the excavator up the hill

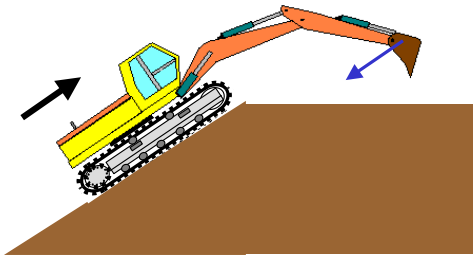


Purpose of Slide: To review the basics for moving an excavator up a slope.

The operator will need to watch the front of the tracks to make sure the machine is not being tipped backwards as the stick is pulled in. The operator will need to raise the boom as the stick is pulled in to keep the full surface of the tracks in contact with the slope.

When the bucket comes close to the machine, the bucket will need to be extended up the slope for another bite. As the bucket is pulled out of the hill to get another bite, the operator needs to watch the machine to make sure it will not slide back down the hill. On steep slopes, the bites need to be made more frequently so as to keep boom and stick uphill for better traction and stability.

MOVING UP A SLOPE



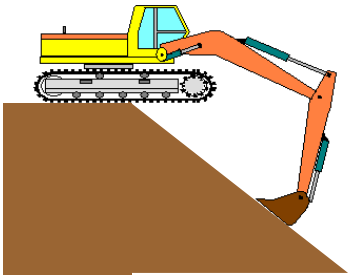
- **When the excavator comes close to the top of the slope, reach out with the stick and boom and sink the teeth into the ground beyond the crest of the slope.**

- **Continue to pull the machine up until it wants to tip forward. Lower the front of the machine with the boom and continue to tack from the slope.**

Purpose of Slide: To review the basics for moving an excavator up a slope.

Until the machine has crested the top of the hill and is fully on top, keep the bucket extended forward.

MOVING DOWN A SLOPE



When preparing to move the excavator down a slope, make sure the seat belt is fastened.

- **If possible, remove some of the material at the crest of the slope where the excavator will break over the top.**
- **Extend and lower the boom and stick out over the slope and place the bucket on the surface of the slope. Slowly track forward and keep the bucket in contact with the slope by lowering the boom.**

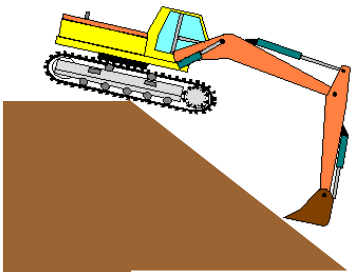
Purpose of Slide: To review the basics for moving an excavator down a slope.

Before moving the excavator down a slope, the operator should make sure that his/her seat belt is properly fastened.

When approaching the crest of the slope, position the machine so that both tracks will go over the crest at the same time. If possible, to reduce the teetering of the excavator as it moves over the crest, cut the top off at two places where the tracks will break over the crest.

With the machine at the crest, extend the boom and stick over the slope and put the bucket on the ground. As the machine tracks forward, the boom will need to be lowered to keep the bucket on the ground.

MOVING DOWN A SLOPE

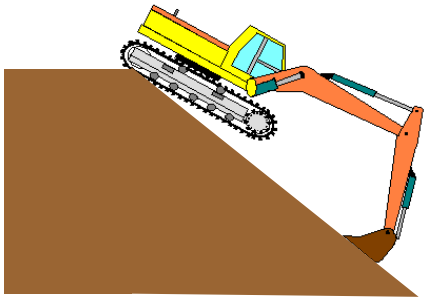


- **When the center of the excavator is at the crest of the slope, raise the boom slightly to see if the machine will tilt forward. If not, slowly track forward and try again.**

Purpose of Slide: To review the basics for moving an excavator down a slope.

When the center of the machine is at the crest of the slope, raise the boom slightly to see if the machine will tip forward. If it doesn't nose over to match the slope, lower the boom and track forward a little more and try again. Once the machine noses over smoothly, the excavator can be tracked forward down the slope.

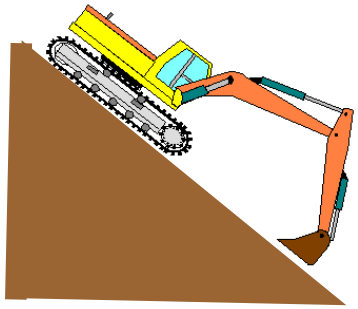
MOVING DOWN A SLOPE



- **The excavator should slowly nose over the crest. Gently lower the machine with the boom until the tracks are in contact with the surface of the slope.**

Purpose of Slide: To review the basics for moving an excavator down a slope.

MOVING DOWN A SLOPE



- **Raise the bucket off the surface of the slope and see if the tracks will hold the machine on the slope.**
- **If the tracks will hold the machine, continue tracking down the slope with the bucket slightly off of the ground.**

Purpose of Slide: To review the basics for moving an excavator down a slope.

As the machine approaches the bottom of the slope, raise the boom sufficiently to keep the bucket above the ground. When the tracks reach the bottom of the slope they may dig. To help prevent this, the boom can be used to raise the front of the excavator a little and the machine pulled forward with the stick. This will make for a better transition to the bottom of the slope.

HAND SIGNALS

STOP

EMERGENCY STOP

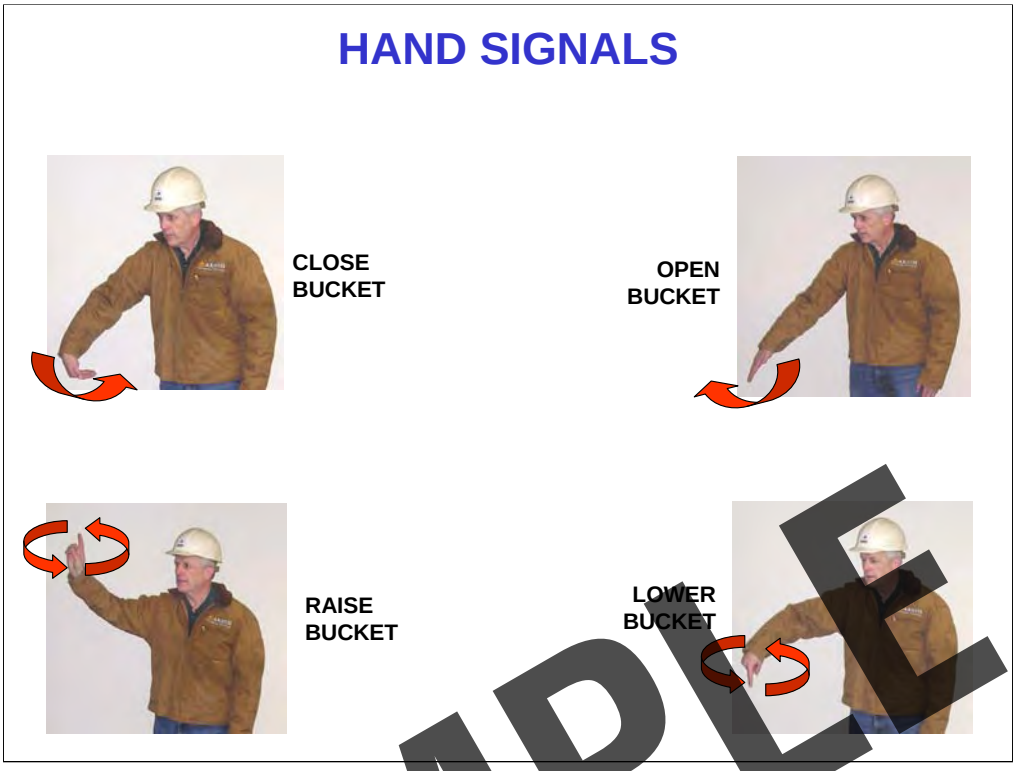
LOAD UP SLOWLY

LOAD DOWN SLOWLY

Purpose of Slide: To review the basic hand signals used with the excavator.

Communication between the operator and those directing the excavation work is extremely important.

All hand signals should be giving in a big and bold manner and visible to the operator. Makeshift signals can be confusing and have been the cause of serious accidents.



Purpose of Slide: To review the basic hand signals used with the excavator.

HAND SIGNALS

STICK (DIPPER) IN

STICK (DIPPER) OUT

BOOM UP

BOOM DOWN

Purpose of Slide: To review the basic hand signals used with the excavator.

HAND SIGNALS

MOVE AWAY FROM ME

MOVE TOWARD ME

DOG EVERYTHING (HOLD)

STOP ENGINE

Purpose of Slide: To review the basic hand signals used with the excavator.

HAND SIGNALS

SWING/MOVE MACHINE
TO THE RIGHT

SWING/MOVE MACHINE
TO THE LEFT

GO
THIS
FAR

Purpose of Slide: To review the basic hand signals used with the excavator.

EXCAVATING

Before starting to excavate, assess the situation:

- **What will be the maximum depth of the excavation?**
- **Where will the spoil be placed?**
- **How will the excavation be backfilled and with what material?**
- **Assess soil condition and its ability to support the excavator?**

Purpose of Slide: To discuss the need for assessing the job site prior to beginning work.

Before beginning work, the operator and those working with him should take a moment to assess the site to plan how the work will progress. An assessment of soil conditions is important to ensure that the excavator will be stable throughout the project.

When excavating a large site, taking time to plan out the excavation process can save time and money. Things to consider are:

- Will the spoil be placed along the excavation or need to be removed?
- If material is to be moved away from the excavation by truck, what type will be used and how will they access the site for loading?
- What is the depth and grade of an excavation, will the grade checker be required to enter the excavation and can it be done safety?

EXCAVATING

- **Is the work site on a slope?**
- **What other work will be taking place in the area of the excavation?**
- **If compaction is required, how will it be done?**
- **Will the excavator be required to place objects in the excavation?**

Purpose of Slide: To continue to discuss the need for assessing the job site prior to beginning work.

Besides excavating, the excavator is often used to perform other tasks at the job site. If the machine will be used for lifting, the type and size of the lift load needs to be considered to ensure the excavator is adequate.

EXCAVATING

Call Before You Dig!

Before starting an excavation of any type, it is important to determine if there are any underground utilities in the area.

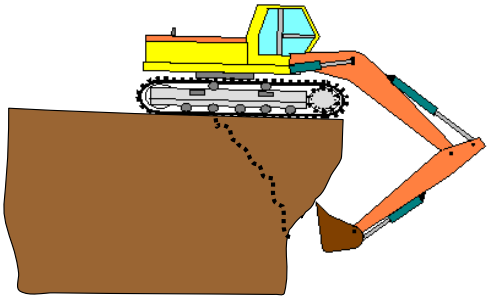
Most areas have a One-Call number which will contact local utilities companies of your location. Representatives from these companies will come to your work site and mark the location of these utilities.

Contact one of your local utility companies or search the Internet for the 1-800 number.

Purpose of Slide: To discuss the need for assessing the job site prior to beginning work.

Excavating in an area where utilities are present is always a challenge and can be deadly. Before digging in any area where utilities are suspected, local utility companies need to be contacted to determine where they are located. Planning the site work will allow time for the utility providers to send out representatives to locate and mark their underground utility.

EXCAVATING



AVOID UNDERCUTTING!

Purpose of Slide: To review the safety requirements for excavating.

When excavating, the operator must always be alert to where the machine is in relationship to the edge of the excavation. Even if no undercut is made, the edge of the excavation may not be strong enough to support the weight of the machine.

TRENCHING

Trenching is one of the common uses of the excavator. Before starting the trenching, evaluate the job site for hazards, type of soil, access to the site and where the spoil will be placed.

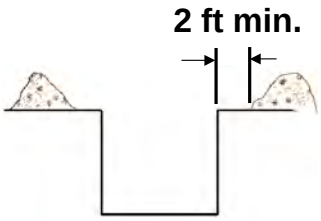
Purpose of Slide: To introduce the discussion of trenching with an excavator.

Before trenching begins, the location of the excavation should be clearly marked with all buried utilities clearly identified.

When excavating along side an of existing structure, care must be exercised not to weaken the structure's supporting soil.

If trench shielding or shoring will be required, the trench must be wide enough to accommodate them.

GENERAL TRENCH PRECAUTIONS



- **Keep material & equipment a minimum of 2 ft. from edge of excavation. Greater distance may be required, based on soil stability.**
- **Provide barricades or equivalent to prevent people from falling into trench.**

Purpose of Slide: Review precautions which should be observed when a trench is under excavation.

Material excavated from a trench should be placed a minimum of two feet from the edge of the trench. This distance may need to be greater depending on soil type. The slope of the spoil pile should be flat enough to prevent material from sliding into the trench.

Also note in the above picture that there are workers in the trench without having adequate shielding or shoring in place.

GENERAL TRENCH PRECAUTIONS

Workers are not to be in a trench while it is being excavated.

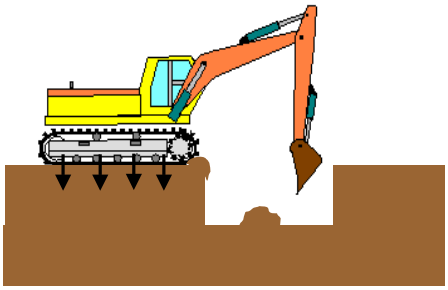
Based on soil type, shoring normally is required before a worker enters the excavation.

Purpose of Slide: Discuss general trench safety precautions to be observed.

Workers should not be in a trench that is being excavated. Adequate trench shoring or shielding needs to be installed before the worker enters the trench.

TRENCHING

Cleaning Out Cave-ins



Cave-ins may occur requiring the excavator to clean or dig the trench back to grade.

One way is to clean the trench from the top edge.

If the soil is soft sand or loam, position the excavator with the tracks perpendicular to the trench. This will distribute the weight of the machine back away from the edge reducing the possibility of more cave-ins.
The disadvantage to this approach is the machine will need to be repositioned frequently.

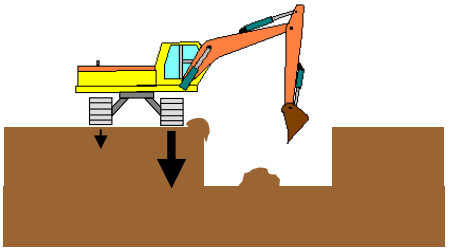
Purpose of Slide: To discuss basic for clearing out trench cave-ins.

Occasionally it will be necessary to remove cave-in material from a trench. The ideal method is to approach the trench with the track perpendicular to the trench. This reduces the potential for additional material sloughing into the trench.

TRENCHING

Cleaning Out Cave-ins

With the tracks parallel to the edge of the trench the machine can be repositioned quickly but the load on the trench edge is significant. This could result in further cave-ins and the excavator sliding into the trench. This approach should only be used if the soil is stabile enough to support the concentrated weight.



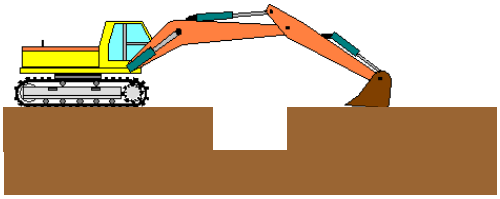
Purpose of Slide: To discuss basic for clearing out trench cave-ins.

When the machine needs to be positioned along a trench with the track parallel with it, greater pressure is placed on the edge of the trench. If the soil is weak additional cave-ins may occur or the excavator may slide into the trench. The operator must continually monitor the condition of the soil and watch for cracks which will indicate potential soil failure.

STRADDLING A TRENCH

Vertical Walls

When the trench walls are vertical and the soil is firm the excavator can be positioned over the trench to do cleaning or addition excavations. Make sure the trench width is less than the length of the machine's tracks.



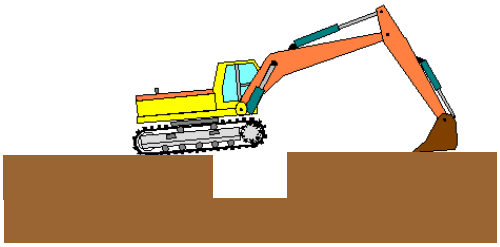
Position the excavator with the tracks perpendicular to the trench and back a few feet from the edge. Extend the boom and stick and place the bucket on the opposite side of the trench, a minimum of 6 feet from the edge.

Purpose of Slide: To discuss basic method for straddling a vertical wall trench.

The next three slides describe the basic method for straddling a vertical wall trench.

STRADDLING A TRENCH

Vertical Walls

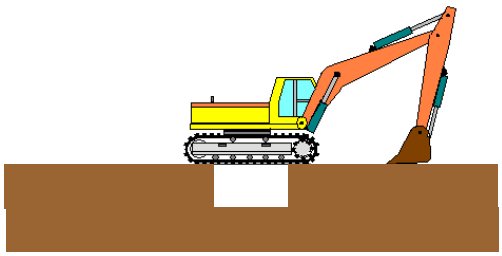


Raise the front of the machine so the front of the tracks are off the ground and begin to track forward. At the same time, raise the boom slowly and pull the stick to maintain the slight up angle of the tracks.

Purpose of Slide: To discuss basic method for straddling a vertical wall trench.

STRADDLING A TRENCH

Vertical Walls



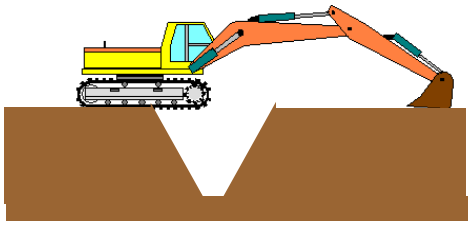
Continue this forward motion process until the tracks are evenly positioned on each side of the trench. While straddling the trench, all movements should be slow to prevent disturbing the trench walls.

To move the excavator off of the trench, reverse the process. Start backing up slowly to prevent the trench wall at the rear of the machine from being pulled into the trench.

Purpose of Slide: To discuss basic method for straddling a vertical wall trench.

STRADDLING A TRENCH

Sloping Walls



If it becomes necessary to straddle a sloping wall trench to reset the grade due to cave-ins or other problems, bring the excavator up to the edge of the trench with the tracks perpendicular to the edge. Extend the boom and stick beyond the edge of the other side and place the bucket on the ground. Watch the earth movement under the front of the tracks when extending. Elevate the front of the tracks with the boom and begin to track forward, keep the machine at the same angle with the boom and stick.

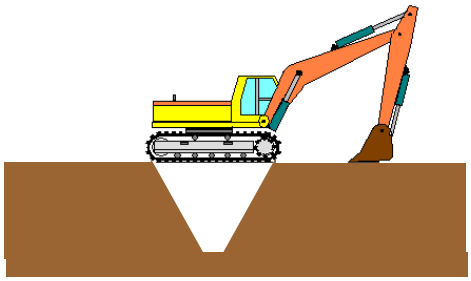
Purpose of Slide: To discuss basic method for straddling a sloping wall trench.

This maneuver requires experience and the operator should practice on trenches that are not very wide or deep. The operator also needs to be vigilant in watching the condition of soils as the machine moves into the trench. The slope of the trench walls also affects the successful performance of this maneuver.

This slide and the three that follow describe the process of straddling a sloping wall trench.

STRADDLING A TRENCH

Sloping Walls

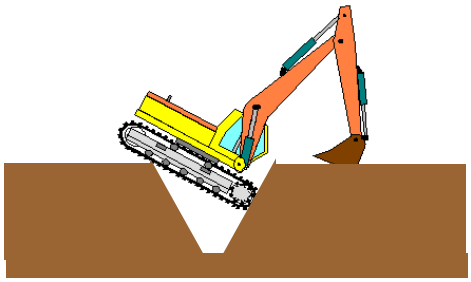


When the front of the tracks reach the other side of the trench the rear of the machine may begin to settle. Adjust the boom and stick to level the machine. Once the excavator has settled into the 'V' of the trench, excavating can begin.

Purpose of Slide: To discuss basic method for straddling a sloping wall trench, continued.

STRADDLING A TRENCH

Sloping Walls

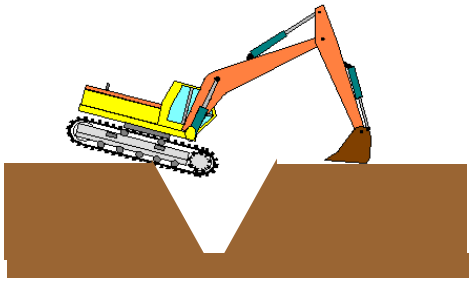


To remove the excavator from the trench, track the excavator in reverse and allow the front to dip down into the trench. This will help keep the rear tracks from digging into the wall. Track in reverse and use the stick to push the excavator backwards.

Purpose of Slide: To discuss basic method for straddling a sloping wall trench, continued.

STRADDLING A TRENCH

Sloping Walls



Continue the reverse process until the machine is back on the surface of the trench edge.

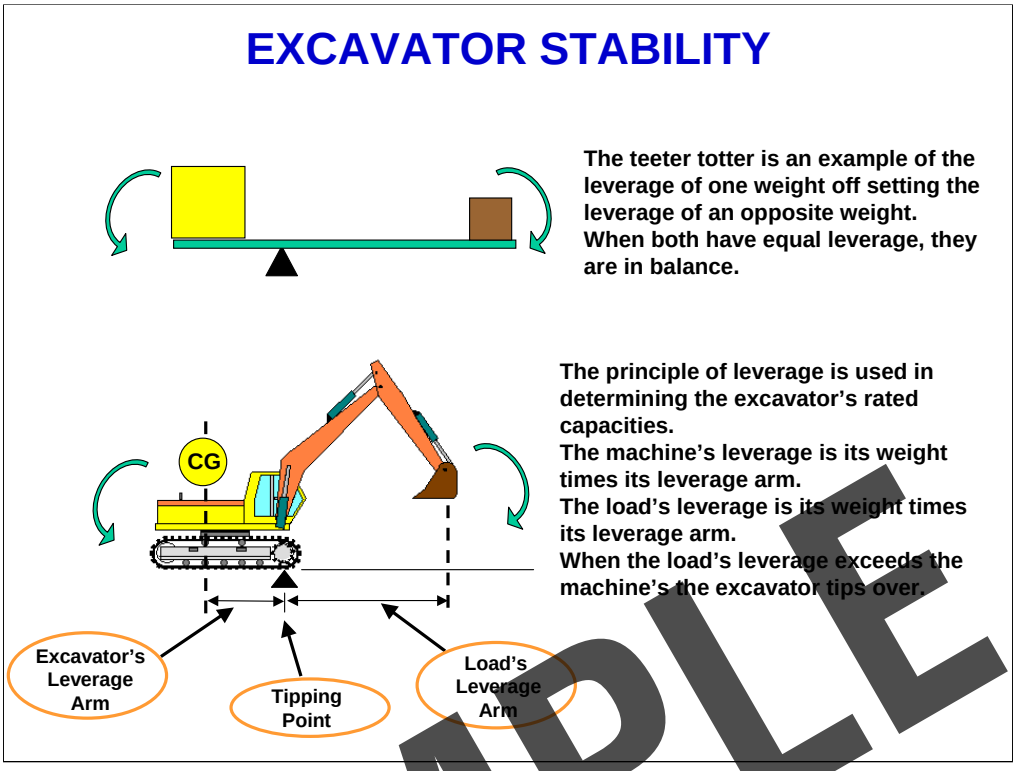
Purpose of Slide: To discuss basic method for straddling a sloping wall trench, continued.

LIFTING WITH THE EXCAVATOR

Purpose of Slide: To discuss the basics for using the excavator for lifting.

Excavators are frequently used to lift and place objects at the work site. The next few slides discuss the basics for doing this.

Remember, when the excavator is used for lifting, the machine is functioning as a crane and the operator is responsible for all the regulation governing crane operations.

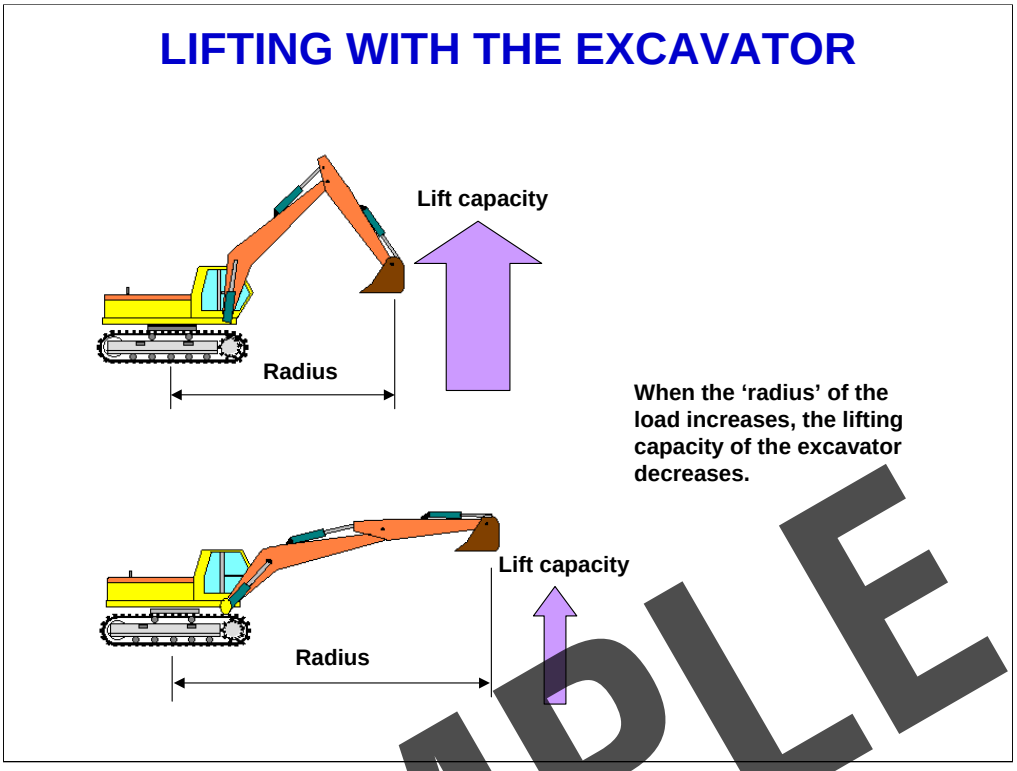


Purpose of Slide: To discuss the principle of leverage as used to determine the stability and thus the lifting capacity of an excavator.

For riders on a teeter totter to be in balance, the leverage created by one rider has to equal that of the other rider. The leverage of each rider is the result of the rider's weight times his distance from the tipping point. If one rider is heavier than the other, then he will have to be closer to the tipping point than the other rider.

For an excavator, the tipping point is the point of the tracks which is under the boom. This could be at the end of the tracks or at the side of the tracks. The excavator's leverage is the weight of that part that is behind the tipping point times the distance from the tipping point to its center of gravity. This leverage is basically fixed. The load's leverage is the weight of the load and that portion of the boom, stick and bucket plus the load attached to the bucket. The load's leverage is not fixed. When the boom and stick extend the load away from the machine, the load's leverage increases due to its increased leverage arm.

Based on the dimensions of the excavator's tracks, the machine typically will have more lifting capacity over the ends of the tracks than over the side.



Purpose of Slide: To discuss how the capacity of the excavator decreases as the load is moved away from the machine.

This slide is used as a follow up for the previous slide. It illustrates the relationship between load radius and the machine's lifting capacity.

LIFTING WITH THE EXCAVATOR

The Lift Capacity chart has a section for "Over the Front" and for "Over the Side".

If the load is lifted over the front and will be swung to over the side, use the over the side chart for determining maximum capacity.

Over the Front

Load Point Height	Radius (Horizontal distance rotation centerline)			
	10 ft	15 ft	20 ft	25 ft
25 ft		6895 lbs		
20 ft		10496 lbs	10248 lbs	
15 ft		13218 lbs	11176 lbs	10390 lbs
10 ft			13030 lbs	10979 lbs
5 ft			14874 lbs	10968 lbs
Ground level			15206 lbs	10728 lbs
-10 ft	8768 lbs	18281 lbs	13790 lbs	

Over the Side

Load Point Height	Radius (Horizontal distance rotation centerline)			
	10 ft	15 ft	20 ft	25 ft
25 ft		6895 lbs		
20 ft		10496 lbs	10248 lbs	
15 ft		13218 lbs	10212 lbs	6913 lbs
10 ft			9668 lbs	6717 lbs
5 ft			9132 lbs	6467 lbs
Ground level			8797 lbs	6285 lbs
-10 ft	8768 lbs	13766 lbs	8828 lbs	

Note the difference in capacity. This is because of machine stability.

Purpose of Slide: To demonstrate how a load capacity chart is used to determine maximum lifting capacity for various radii.

The above load capacity chart is representative of a typical chart found in most operator manuals.

The chart is divided into two sections: One for a lift made straight over the front of the machine, and one for lifts made with the machine swung to the side. Notice how the capacity for lifts made at the same radius decreases as the machine is swung to the side. Maximum capacity lifts made over the front of the machine can, if swung to the side, tip the machine over.

LIFTING WITH THE EXCAVATOR

ATTACHING THE LOAD

Most excavators have lifting eyes mounted to the end of the stick and on the back of the bucket.

Attach the load to the lifting eyes with a load rated shackle.

Objective: To discuss how loads can be lifted with the loader.

The operator's manual for each machine includes a section on load capacity for the loader bucket. On some machines, lifting capacity is limited by the capacity of the hydraulic system. Some buckets come with lifting eyes welded to the back side. Chain slings can be attached at these points and the chain run over the front of the bucket. Blocking or some other form of protection should be used to prevent the chain from being damaged where it bends over sharp edges. Slings should not be attached to the lifting arms of the loader, or around any of the hydraulic lift cylinders.

If a load is moved by traveling the machine, it should be kept as low to the ground as possible. This will help to maintain control of the load while traveling and allow the load to be quickly lowered if it gets out of control. Always travel at the slowest speed when traveling with a suspended load.

LIFTING WITH THE EXCAVATOR

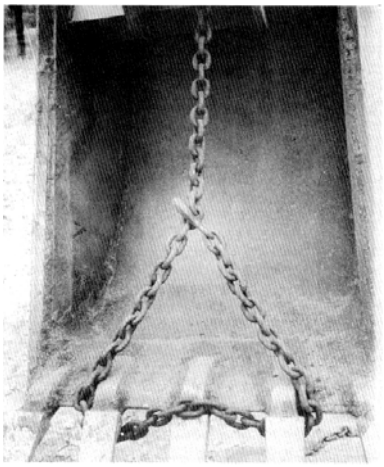


Fig. A

When attaching a chain for lifting on buckets without lifting eyes, the chain should be attached as shown in Fig. A and brought over the back of the bucket as shown in Fig. B. Never make a lift with a chain or sling attached solely to the teeth.

Fig. B

Purpose of Slide: To show how a load can be attached to an excavator that doesn't have designated lifting attachment points.

For buckets which do not have designated lifting attachment points, a chain can be attached as shown in the above figures. The excavator bucket needs to be rotated outward so that the teeth point downward at all times during the full range of motion of the boom and the stick. The chain is attached to the bucket as shown in figure A. The chain then is placed over the back of the bucket as shown in figure B. Where the chain bends over sharp edges, blocking between the edge and the chain should be used to prevent damage to the chain. Such damage could result in chain failure.

LIFTING WITH THE EXCAVATOR

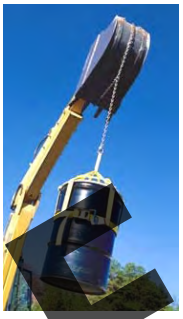
Special lifting attachments need to be load rated and the weight of the attachment needs to be included in the total weight that the excavator will be lifting.

Purpose of Slide: To discuss various types of lifting hardware for lifting various objects.

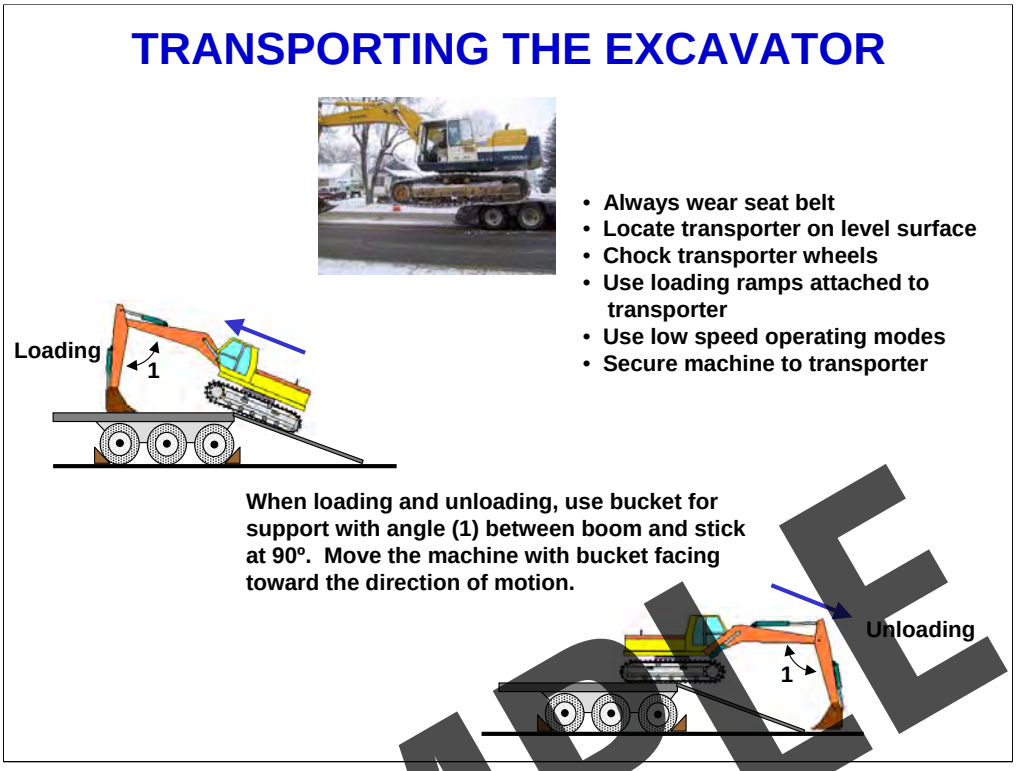
Various lifting hardware have been manufactured to use for different lifting applications. All hardware used for lifting must be load rated by the manufacturer and used according to their instructions. Prior to use, this hardware needs to be inspected by a competent individual. When not in use, the hardware should be stored to prevent damage and deterioration due to weather.

LIFTING WITH THE EXCAVATOR

All slings and lifting hardware need to be load rated and approved for the type of work being done.



Purpose of Slide: To discuss various types of lifting hardware for lifting various objects.



Purpose of Slide: To briefly discuss the loading and unloading of the excavator.

When preparing to transport the excavator, consult the operator's manual to identify specific things that need to be done.

When loading the machine onto a ramp truck or trailer, make sure wheels are blocked. Clean off any mud from the ramps to prevent the machine from slipping off them. Once the machine is in position for traveling, lower the bucket as necessary and chain the machine to the transport vehicle. Avoid running the tie-down chains over hydraulic cylinders and/or other parts that could be damaged. Tie-down chains should be installed in a cross configuration, both side to side and fore to aft.

When unloading the machine, make sure all tie-down chains are removed and the transport vehicle wheels blocked. Carefully descend the ramps, keeping the bucket high enough to clear the ramp and ground.