



Heavy Civil Construction Safety
Part 3. Equipment Operation Safety

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by

John E. Kristensen PE., PLS., PMP.



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Introduction

Welcome to this PDH course on Construction Safety. This is the Third Part of this series. If interested, please consider taking the previous courses for a better understanding of the series format. Hopefully, you will find the courses interesting and informative. It is the intent of the course to provide the reader with a sound knowledge base of the fundamentals of safety so they can be considered one of the Industry's Competent Safety Personnel. Supervisory engineering responsibilities require this type of training so leaders can help the staff they oversee to avoid accidents.

The series of courses will attempt to make this material easy to read and understand. It does not go into any depth on technical subjects but will provide enough material for the reader to be aware of the basics in a wide variety of subject areas. Some topics may



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not directly affect a present job, but it is important to become well rounded in all safety areas and to understand why certain things are done for better safety.

Course Topics of this series may include:

General OSHA and MSHA Responsibilities, Personal Protection, Hand and Power Tools, Ladders and Scaffolds, Excavation and Trenches, Equipment Operations, Crane Safety, Rigging Safety, Traffic Control, Fire Protection, & Equipment Transporting

The goal of this third course is to review basic heavy equipment operation safety. The material will include general discussions of the various equipment available and some of the hazards/precautions needed to safely work around them. Anyone who works around heavy equipment knows that there are hazards involved and that they are not to be taken lightly. It is not the purpose of this course to teach people to be equipment operators. It is the purpose to teach people safe practices and procedures to reduce the chance of equipment operation safety accidents.

General

The setup of this section will be a few paragraphs about general equipment safety and then specific concerns about specific pieces of equipment. The equipment covered will include:

Dump Trucks / End Dumps	Scrapers Dozers	Paving Machines Rollers
Readi Mix Concrete Trucks	Graders Front End Loaders	Milling Machines Belt Conveyors
Agitor Trucks	Backhoes	

A blindspot diagram is provided with each of the above pieces of equipment to detail the operator's ability to see personnel and objects near & around the equipment when in use. These diagrams are available online from NIOSH and were copied from the below website link.



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The National Institute for Occupational Safety and Health (NIOSH)
HIGHWAY WORK ZONE SAFETY

Construction Equipment Visibility

Diagram Lookup:

<https://www.cdc.gov/niosh/topics/highwayworkzones/BAD/imagelookup.html>

As a note, when we think about hazardous equipment, we might think that cranes are among the most dangerous. They are. For that reason, they deserve their own course and will not be covered here. The equipment listed above have many safety concerns. While we cannot cover every hazard, we hope to cover some of the more unique ones.

General Comments

If we were training equipment operators and drivers about how to safely operate their equipment, we would just copy the equipment operator's manual and have everyone read them. That is not what this course is about. There is no substitute for reading the operating manuals, even though that is rarely done. Think about whether you read the operating manual for the car you're driving. Probably not, even though it covers many safety features that you should be aware of. We all know it all. When it comes to heavy equipment, this is definitely not true.

Operators should read the manual especially for the equipment they are expected to operate. They may find they do not know it all. For this course we will skim the manuals. Copying a manual would take thousands of pages. We will cover things that supervisors and other personnel should know, plan ahead for, and to watch out for. Although I am not an equipment operator (what little experience I have operating Heavy Civil Equipment has given me a tremendous respect for the professionals who do operate the equipment daily at project sites) the material below has been gathered by



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interviewing operators, mechanics, safety managers, and the equipment manufacturers and sales representatives, which has been summarized as follows through the course.

This General Information section would be too boring and repetitive include in each equipment section, so they are listed here. Things such as seat-belts, roll-over protective structures, back-up alarms, fire extinguishers, etc... are very well known. Instead, piece by piece specifics are identified in their respective sections. But first,

OSHA general requirements for all equipment:

- All equipment left unattended at night, adjacent to highways, in normal use, shall have lights or reflectors, or barricades equipped with lights or reflectors to identify location of the equipment.
- All cab glass shall be safety glass or equivalent
- Equipment parked on inclines shall have wheels chocked and the parking brake set

MSHA general requirements:

- Mobile equipment carrying loads that project beyond the sides or more than 4 feet beyond the rear of the equipment shall have a warning flag at the end of the projection
- Parking brakes shall be capable of holding equipment with its typical load on the maximum grade it travels. MSHA reserves the right to test brakes during inspections

Army Corp of Engineers general requirements:

- Inspection by a competent mechanic prior to first use of any equipment, permanent records shall be kept in project file
- Equipment requiring an operator shall not be permitted to run unattended.
- No one shall be permitted in the truck cab during loading operations except the driver



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- Steering or spinner knobs shall not be attached to the steering wheel
- Recommended general requirements:
- All operators and drivers must bring immediate attention of any defective equipment especially safety equipment like back-up alarms or mirrors.
- All equipment should be provided with proper access equipment such as steps, ladders, and handrails and shall be maintained.
- Any equipment operated on highways posted 55mph or greater that cannot maintain a traveling speed of at least 40mph should have either a shadow vehicle (rear escort) with high intensity warning lights or shall use far right lane and be equipped with high intensity warning lights

These are just a few noteworthy general requirements.

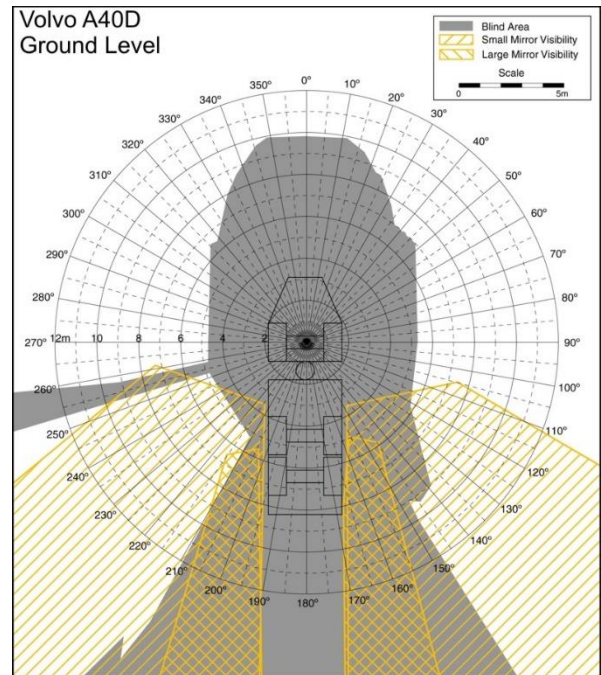
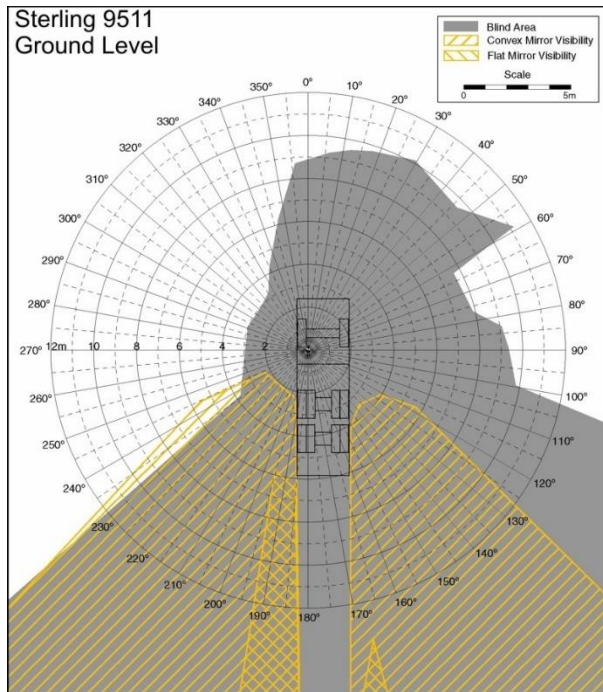




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Dump Trucks / End Dumps





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What injures more truck drivers than any other cause? Injuries from falls off the truck while getting on or off (more off than on). What can we do about it? Keep both the hand holds and the steps in good shape and make sure drivers use them. No Jumping, and instruct drivers to use three points of contact when ascending or descending steps or ladders.

In our business, whether on construction job or on a paving contract, dump trucks are major concerns because of their huge blind spot. Most of the truck drivers spend most of their day in reverse. Beyond mandatory back-up alarms drivers should be instructed regarding the use of a signal person. They should only backup when signaled and should only take instruction from ONE signalperson (although an emergency stop can come from anyone). This should be a designated spotter, a responsible member of the ground crew. In operations that require a queue or a lineup of trucks before backing in a place, the trucks should be spread out a reasonable distance so that they don't have to back so far. Backing across intersection should be avoided as far as possible, and when necessary, traffic controlling items should be required.



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One other backing situation we need to be aware of involves equipment which dumps over edges of banks or stockpiles. These types of situations can involve accidents which occur when the truck ends up getting dumped over the edge along with the material. Banks should have berms or stop logs which are to be dumped over. If they aren't there, then the load should be dumped away from the edge and pushed over by a dozer.

On-road and off-road dump trucks are useless if they don't raise their bodies now and again. There are a number of items to consider when performing this task. If the vehicle is not relatively level ground, the truck can tip over. This is especially so with the articulated vehicles like the Volvo shown in the picture above. We also see tip overs as a result of drivers not bringing their vehicle to a stop before raising the body. The only time a dump type vehicle should be moving while it is dumping is when it is under the control of the paving equipment that it is feeding. It's still must stop first before raising the body. Also, drivers who haul material should never leave the driver's seat and walk away with a raised body.

Construction requires all dump vehicles to be equipped with warning lights in the cab which signal to the driver that the body is in a raised position. This help prevent the problem of drivers leaving an area and bringing complete sets of telephone, electric, cable TV wires with them. Worse yet we hope you never have to see the consequences of a raised dump body hitting an overhead bridge. There's no more effective braking system in the world than that. Paving operations should be set up so that there is a designated person who is looking out for overhead wires. That person should keep the truck spotter informed, and that may be the same person, of the approach. Overhead lines are less visible at night. For nighttime hauling, prior to the operation, go ahead and mark the roadway with paint or signs to showing the locations of overhead wires.

The last major concern about raised truck bodies involves maintenance. Dump trucks have positive locking devices which prevent the body from falling on mechanics and others who work on the equipment. There are braces, cable type devices, locking pins



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etc., which are used to accomplish this. Unfortunately, people who work under the body tend to be there for such a short period of time, and they often don't feel the need to use these devices. They're often dead wrong.

Drivers should be cautioned to stay in their cab while they're being loaded. Trucks should not be loaded if the drivers are not in their seat.

Asphalt plant trucks should only proceed under the plant to be loaded when the plant traffic light is green. If the light is still red, they may get a lap full of asphalt mix.

Seatbelts are required to be worn when driving a truck. Even in a runaway vehicle, drivers should stay with their seatbelt fastened. The most frequent cause of haul road accidents is loss of control. It is impossible to maintain control of the vehicle if the cab is bouncing you all over the place cause you're not wearing your seatbelt. Seatbelts are required in all dump vehicles and drivers have an obligation to wear them.

Loaded trucks always have the right of the way on an off-highway Haul Road. Traffic patterns should be arranged that loaded truck drivers are in the inside as opposed to the outside edge of the haul road and empty trucks drive on the bank side. It's easier to roll over when loaded.

No extra riders should be in the cab. Only under special circumstances which are approved by the person in charge. A notable exception would be during the first day when someone may ride with a driver to see how well they handle the truck.

Whenever driving over a windrow, the equipment should drive over them at angles to the windrow so that one wheel at a time is crossing them. This reduces the amount of bounce to the driver.

Continued application of the service brakes on a downhill road or fanning the brakes will reduce the air pressure severely and possibly lead to a loss of breaking power. Grades should be anticipated and driver should let the engine or retarder do the work.



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Operators need to bleed off water from air tanks routinely (at least daily) especially in cold weather this reduces the problems of airbrake power loss.

Drivers have been injured because they fell from the side equipment while cranking the covers over the load. Drivers are in an awkward position while cranking the cover. Additional handholds can be welded to the underside of the cab overhang or inside the truck body ribs.

The last subject we want to discuss involving dump type vehicles is driving habits. Most of what we learn about driving we learned at a very early age and in a short period of time. Habits we learned about driving were learned when most people were 16 (The speed that's comfortable for us was chosen, the distance we follow people on, the meaning of a yellow light, whether to use our signals or to let others fend for themselves, and so on...). Very few people change their driving habits after those first decisions unless they are forced to by too many traffic violations or by an accident. If a driver drives 35 mph, it doesn't feel that fast in a residential area that is posted at 25 mph. Nothing is going to make someone go slower unless they get cited for a ticket or they can't stop in time to avoid an accident. The sad part is that the accident probably would not have happened to 25 mph. The stopping distancing, as well as, the additional time to observe the situation is much greater.

What's the point? Now, if we're going to drive a 23,000 pound truck loaded with 30,000 pounds of materials, we need to change our driving habits from driving a car at 3,000 pounds loaded with 500 pounds of materials. Does the following distance change? Will the blinkers be used? Maybe. Will they drive at 25 mph in a residential zone? If there's an accident between that vehicle waiting 53,000 pounds and one weighing 3,500 pounds who's going to win? Whatever it takes to get the message across. Drive carefully.



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Redi-mix Trucks



Redimix truck drivers tend to have more accidents than drivers who drive dump trucks. One big reason is that there is more work involved. The driver will typically encounter a wider variety of jobsite conditions, they have to handle chutes, have a more involved cleanup operation, and have to deal with customers who simply aren't prepared or knowledgeable about the business. Add in year-round deliveries (which means work in snowy and icy conditions), a rotating load, and little to no assistance at the delivery end, and you begin to see why transit mix drivers are hurt more often. That doesn't mean they have to be. It just means there are more hazards to look out for.



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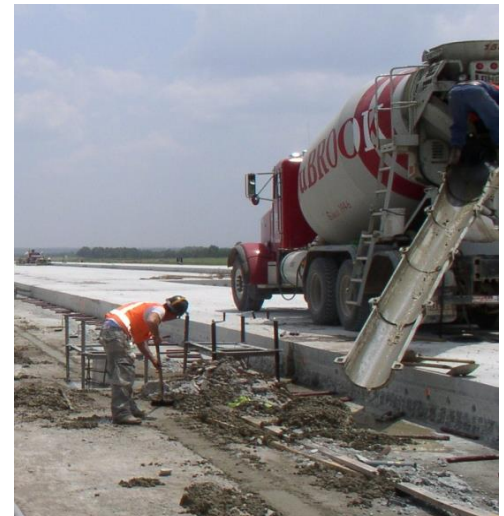
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Most of us who have contact with Redimix trucks have that contact as it's users. We built the forms or pour and finish the concrete. Below are items to make the task a little safer for the driver:

- Arrange traffic flow to a eliminate or minimize backing.
- Direct trucks as they are backing.
- Keep ramps or slopes to grades below 15%.
- Provide enough side and overhead clearance.
- Make sure the haul roads in ramps will support trucks of 60,000 pounds.
- Check to be certain that truck to choked before unloading.
- Check to be certain that everyone is clear before signaling a truck to move.
- Remember that Redimix trucks tip over easy keep trucks away from soft banks or fill areas.
- Keep people off the truck or mixer.
- Stay on sight side of the driver.
- Don't walk behind the unit.
- Use clearly understood hand signals.
- Remember the driver can't turn or stop instantly give the driver time to react.

Concrete chute hazards:

- First, the power chute is hydraulically operated. When filling wheelbarrows or forms, the chute should be positioned at the correct height to clear the wheelbarrow or form, and then swung from side to side as opposed to up-and-down. Since the chute has a tendency to drop, allow enough room to clear the edge when you swing away.
- Many of the injuries we see happen because of poor footing while carrying chutes. Work areas must be relatively level and housekeeping should be kept up.





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- Chutes also bite fingers off! Placing and connecting chutes requires that fingers be kept away from the lip edges.
- Once in place they should be locked down and then the extension chutes should be removed prior to moving around congested areas, and certainly before leaving the site.

Drivers are required to wear personal protective gear; full length work pants, shirts with sleeves, sturdy work boots, a hardhat whenever the driver is out of the vehicle, safety glasses are required when the truck driver is pouring concrete, and gloves are desired when handling the chutes and cleaning up.

Jobsite hazards:

First, drivers are supposed disengage mixer when going over uneven terrain. Redimix trucks should not get sideways on a hill, they're top-heavy and will turnover. All wheels must be remain on solid ground. Redimix trucks tip easy and soft ground and when one set of tandems is not in full contact with the ground.

Redimix trucks can weigh up to 60,000 pounds. Put that next to the edge of a high bank, or along a retaining wall and you're asking for trouble. Trucks should stay away from high banks and deep footings. Ready mixed trucks have taken dives into septic tanks, water under posted bridges, and into sewer lines. Home driveways are not constructed to take the weight of a loaded mixer – they will break up.

When trucks are traveling over highways and maneuvering on rough roads, drum rotation should be set at minimum speed. Ground conditions should be inspected for stability. With rear discharge mixers, it is desirable for the driver to back straight towards the operation at a right angle to assure solid footing. With front discharge mixers, it's preferable to drive straight up at a right angle.

Clearance issues involve overhead wires, narrow haul roads, and accounting for the hopper which protrudes out behind the truck that many spotters don't see.

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Agitators



Agitor trucks are really a mix between a dump truck and a redimix truck. Since we've covered those at some length already, this section will be shortened to avoid repetition.

This information comes from a manufacturer, Maxon Truck:

- The agitor body must be completely down and directly under the mixer when loading.
- Do not hoist the body in transit
- For discharging, always open gate first, and then, with the agitator turning in the direction of discharge, hoist the body.



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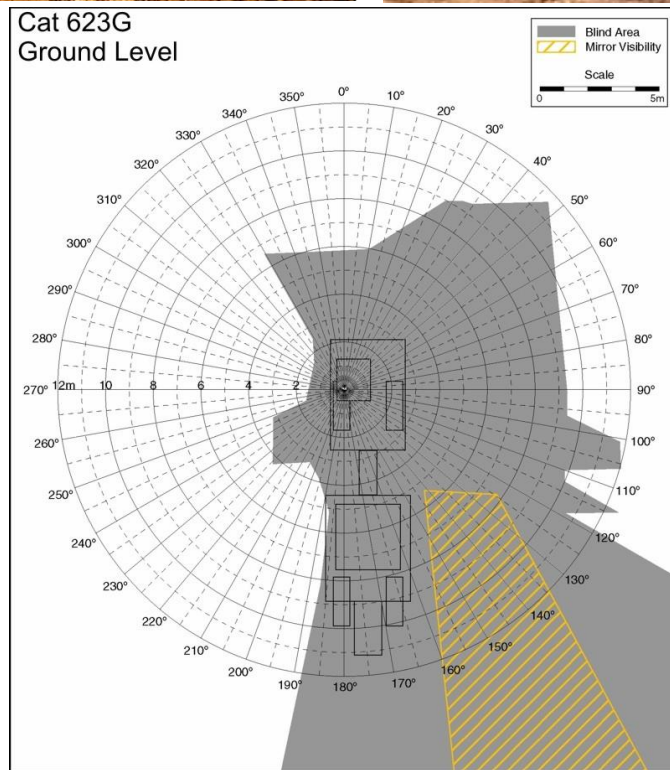
- When using the equipment for loading concrete buckets, where a quick shutoff is needed. Shut down the agitator after you close the gate or the concrete will build up against the gate and flow over the top.
- Never drop the body when loaded. The operator can slowly lower the body if needed. Dropping the body quickly and then stopping it by moving the hoist valve to “hold” can cause severe damage to equipment.
- Never move the truck with the body in a hoisted position when fully loaded, the truck can easily tip over.
- If the concrete will not discharge, make sure the truck is not moving. With the gate fully open, and the agitator turning in the discharge position, hoist the body no more than 2 to 3 feet. Rock the agitator by reversing the direction until it turns. Try using the body vibrators. If it still won't discharge, return to the dump/pit site – the concrete will not be usable now even if it does come out. Lock the truck brakes, get everyone away from the vehicle. With the operator standing on the ground, hoist the body in small increments up to 6 feet, turning the agitator and vibrator to break loose the load. If it still doesn't discharge, the load must be broken out with jackhammers, because further elevation of the load is unadvised.
- Keep the length of chutes to a minimum. Let the driver get as close as possible.
- Never haul loads with the body in the diagonal position, it will be overwidth. A maximum speed of 5 mph is recommended for travel with the body in the diagonal position.
- Do not leave the body hoisted for overnight storage.



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Scrapers





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Once again, the biggest source of accidents involve falls getting on and off this equipment. Scrapers deserve a little more attention in the field to this problem because the access steps on scrapers are more subject to damage than other pieces of equipment.

Hazards associated with scrapers:

Because of the configuration of the bowl and apron, entry into the bowl requires that workers pass through the opening between the two. Often people cleaning down the body will stand in this area. If the apron is not blocked and falls unexpectedly (it happens more often that you might suspect) serious or fatal injuries will occur to that person since the apron weighs about 2500 lbs.

Each year fatalities occur in construction staging yards when scrapers are being put to rest after a day's work. Many contractors park them end to end and someone gets caught between units. Why? Scrapers with front and rear engines have rear engine shut offs located directly in the back of the scraper, in the center of the machine. This requires someone to be back there. In other cases without rear engines, the spotter or the mechanic working on the first machine parked will get pinched. The problem is compounded by the fact that scrapers are long, and the distance is hard to judge by the operators when backing. Also, the retarder on many units is a foot pedal located right next to the brake, which can be easily mistaken.

To avoid this hazard, scraper tractors should be parked side by side rather than end to end if possible. No one should get between units unless the tractor of both units are completely shut down.

Scrapers give a rough ride. Seatbelts must be worn.

Scrapers are often push loaded. Signals must be worked out between operators and the spotters must be kept clear of the area. Operators should know where their spotters



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are at all times. Alignment of the two pieces of equipment is important and excessive wheel spinning means the operator is inexperienced.

Scrapers are meant to travel quickly. It doesn't help if the haul road is bumpy, unmaintained, or has sharp turns.

The bowl should be carried as low as possible. Lower the apron immediately after spreading. The bowl should be high enough to clear obstacles, but low enough to maintain stability.

A traffic pattern should be maintained and updated daily by the foreman.

When hooking up tractors to scraper pans, ground workers must be accounted for by the operator before any movement.

When towing a scraper, from job to job, a scraper bowl safety latch or a safety bolt placed in the push beam will reduce the chance of the bowl dropping and hitting an obstacle.

Bowls and aprons must be blocked before any work is performed on them, even routine cleaning.

With elevating scrapers (self-loading) never place your hands on the ejector roller track and never reach between an apron arm and yoke arm. Do not make adjustments on the elevator while it is running.

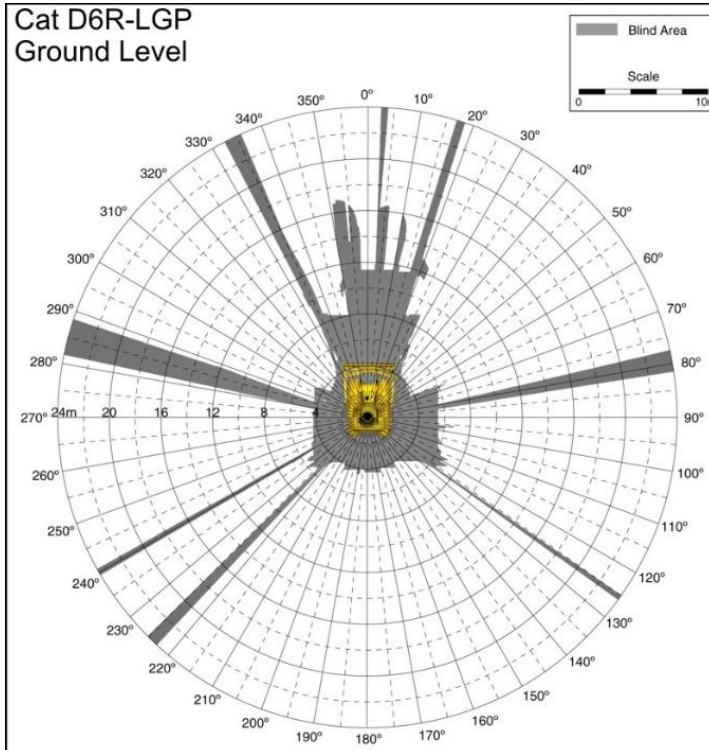
When working inside the bowl behind the ejector, block the ejector securely in the full forward position.



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Dozers





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What causes most injuries to dozer operators? Do we have to ask? Falls getting on and off equipment. This is particularly troublesome with dozers because the access



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equipment provided is not easily climbed. Access for tracked equipment is always complicated and getting on and off the equipment is accomplished on smaller equipment by using handholds at the rear and using the tracks themselves, or on larger pieces, going over the sides with steps inside the tracks.

Most serious dozer accidents occur from rollovers. Dozers should have proper ROPS protection. In order the ROPS to work, the operator must wear a seatbelt. A Rollover Protection Structure (ROPS) will not protect someone who is not inside it. While a dozer is rolling over, the operator will not be able to jump clear. The dozer itself will end up rolling over on the operator. It is not physically possible to jump up over the top of the dozer while it is rolling down. The ROPS will hold up and with the exception of a few bumps and bruises from being jostled around, an operator wearing a seatbelt will avoid serious injury.

Bulldozers should be worked up and down slopes perpendicular to the slope. Side hill operations should be avoided. If side hill operations are absolutely necessary, it is possible to tie off the dozer to another tracked piece of equipment located uphill on level ground. Otherwise, operators should be instructed to turn the dozer downgrade immediately if the tractor starts to slip sideways on the slope.

When a bulldozer is going to be ridden down a slope, three or four bowls of dirt should be dozed to the edge of the slope and the operator should ride down the slope with the dirt in front of the blade. If it is lost on the way down, operators should not lower the blade to regain the load. Bulldozer blades should not be used as a brake for going down a steep slope except in extreme emergencies.

The blade should be kept as low as possible for stability.

Dozers used for clearing operations should be equipped with screening to prevent limbs and branches from striking the operators. Ground people should be kept away from the clearing operation.



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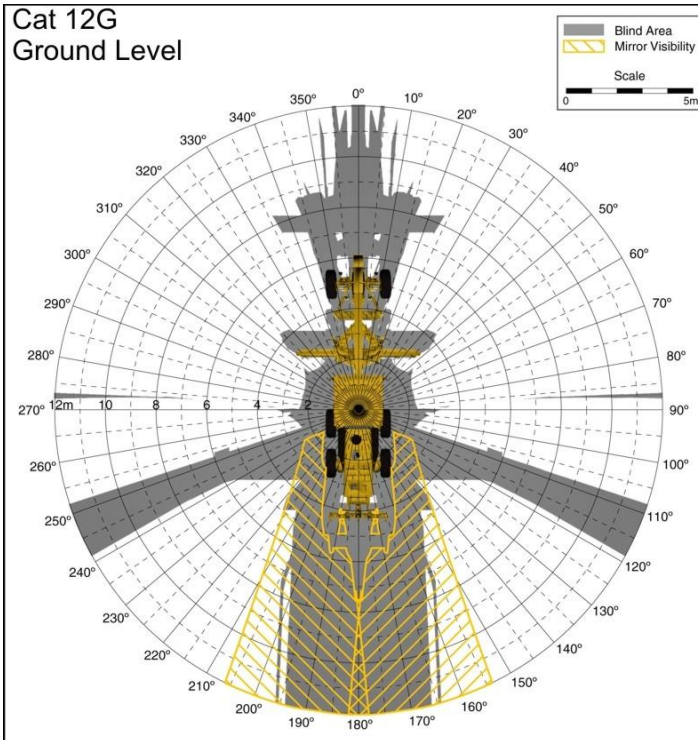
Dozers are used to push material over edges and to clear overhangs, but this work is tricky and requires a fair amount of skill. Overhangs are not cleared from below and are not cleared by starting at the edge on top. The edge must be worked towards with a good bowl of material and a downward wedge shape to coax the overhang to collapse. Material being pushed over an edge must be checked frequently to make sure an overhang has not been created.



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Graders





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Grading work requires that others work in the vicinity of graders on foot. Surveyors, grade checkers, grade foremen, inspectors, etc. Despite their appearance, they have poor lines of sight and are among the most frequently cited pieces of equipment involving backing fatalities.

Graders also have equipment access problems because the travel of the blade prevents providing steps low enough to the ground to be proper first steps.

Graders are often operated on or near active roadways. They must be provided with slow moving vehicle signs and must keep to the right. Preferably they will work behind barriers.

Operators must be aware of obstructions at all times.

When operating on a slope, cross obstacles at an angle and avoid blade down pressure which could cause a tip over.

Graders are more maneuverable than most heavy equipment and should yield the right-of-way to other equipment, especially loaded equipment.

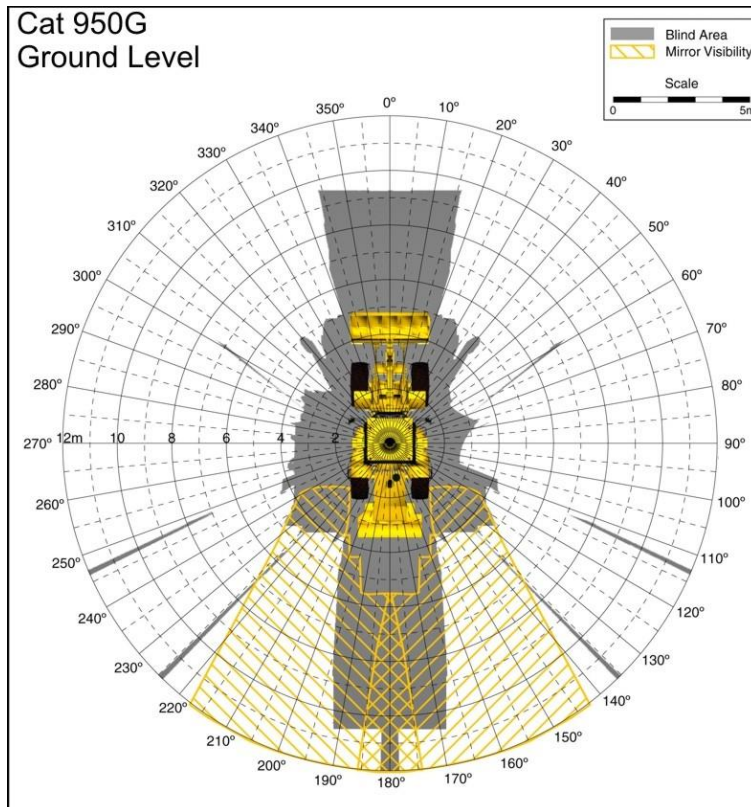




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Front End Loaders





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Loaders are one of the most versatile pieces of equipment at any Heavy Civil Construction Project and therefore they are found on almost every site. Some are tractor-loader-backhoes, although most are straightforward front-end loaders.

Many operators spend the better part of their career in front end loaders. Do they get hurt? Actually, the record for loader operators is pretty good. They don't have the same frequency of falls, (probably because the cab is so high that operators have to use the ladders.) They don't have the same problem rollovers to any degree, (probably because most loaders are operated on relatively level ground.)

Still, they can get into serious situations.

One that comes quickly to mind involves loaders that are used up close to, and into high banks of materials. It takes some experience and a good deal of coaching to get operators up to speed on this work. If it is done improperly, the banks can slide and engulf the loader. Several dozen reports of such fatalities occur at surface mines each year for this hazard. It is important to have a good ground control plan for these operations.

Other hazards occur when the people around the equipment (not the operator) misuse the loader. Accidents happen when people stand in the pivot area of a loader and people should be warned to not get caught in this area. It sometimes happens to people



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hitching a ride, which is why it's not allowed. Another very common problem is when people use the bucket as a work platform. It may be handy, but it's also dangerous. It's not a good platform for one thing, and the operator could easily overreact and dump or pinch someone. If it is a common practice where you work, bring it up at the next safety meeting. It is not allowed.

As with other equipment, keep the bucket as low as possible for stability, but high enough to clear obstacles. On ramps there should be adequate berms to prevent rollovers and stop logs at the top to prevent over travel on the ramp.

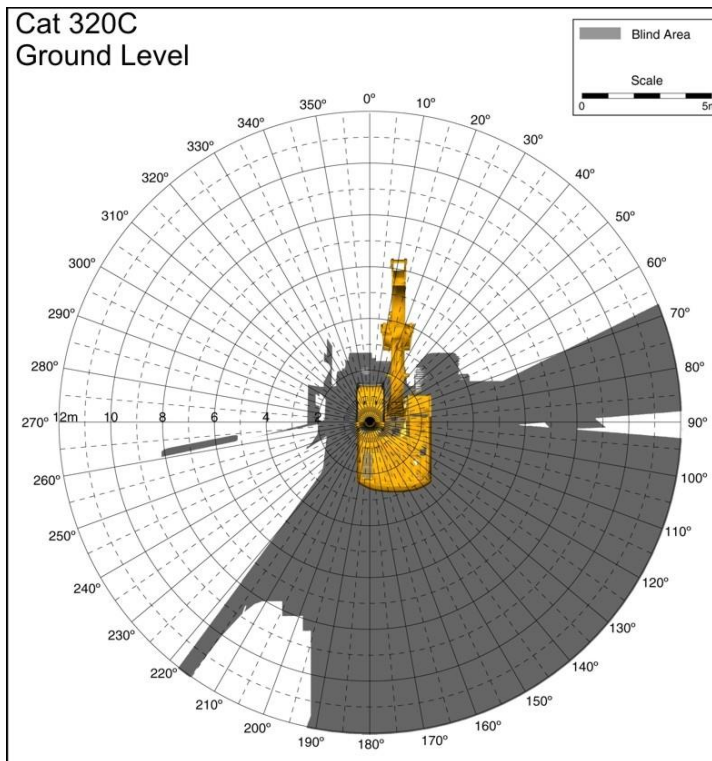
Loaders are often provided with hooks to assist in the handling of pipe and other materials. There are many schools of thought on this. Some say the hook should be on the other side of the bucket near the knuckle, others say the inside of the bucket on the top edge, other say the top of the bucket near the edge, and still others say they shouldn't be hooks on buckets at all and that pipe should be lifted with slings rigged from the teeth. Each loader has a load capacity which must be considered first when lifting a load. The load capacity charts are in the equipment manual. The most prevalent method is to put hooks on the underside of the bucket at the rear. This helps keep the load as close to the center of gravity as possible and prevents the slings from rubbing on the cutting edge. It also puts less strain on the hydraulics since they are retracted. Lastly, it gives the operator a clearer view of the operations in most cases.



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Excavators





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Excavators are an essential part of most Heavy Civil Construction Projects. Besides the falls from getting on and off, excavators are well known for certain other types of accidents. First comes utility contact. Overhead wires are a rather obvious but often ignored hazard. The stick cannot come within 10 feet of an overhead line unless precautions are taken.

Trenching and excavation hazards, and underground utility line hazards may be the topic of a future course in this series, but are a serious cause of accidents, injuries, and fatalities associated with this piece of equipment. Call the One call system in your area before any digging takes place. Hand dig to locate utilities as excavation operations approach the located marks provided from the call. All excavated trenches must follow OSHA's trench excavation guidelines and certain soil types and depths of excavations over 20 feet must be designed and stamped by a professional engineer before allowing workers to enter the area. Do not ever enter a trench excavation if it has not been constructed by an OSHA trained competent person.

Excavators are involved in "struck by" accidents when workers get hit by the swinging backhoe bucket. Workers in trenches and excavation should be instructed to stay clear of the bucket. These are tight areas with limited maneuverability for people to avoid incidents if the machine slips or lurches from conditions or operator error. The excavator will do the work, there is no need for others to be near the bucket.

Excavators are used to lift and load materials. Usually soil or rock but they are often used to move other items like storm sewer pipe and structures. The equipment manual load charts must be checked for the excavator's lifting capacity in various positions. This is true when sizing the excavator bucket used for digging. Operators may be tempted to put a larger bucket on the excavator for better production. Maybe they can and maybe they can't. If it is too large, it will overload the equipment.

Do not operate excavators close to retaining walls or close to the edge of an improperly constructed slope. The weight of the machine and its load put large pressures on



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excavation walls. The location and type of excavator must be considered in these circumstances. For instance, track excavators have more stability than wheeled excavators and distribute the load over a larger area producing a lower psf.

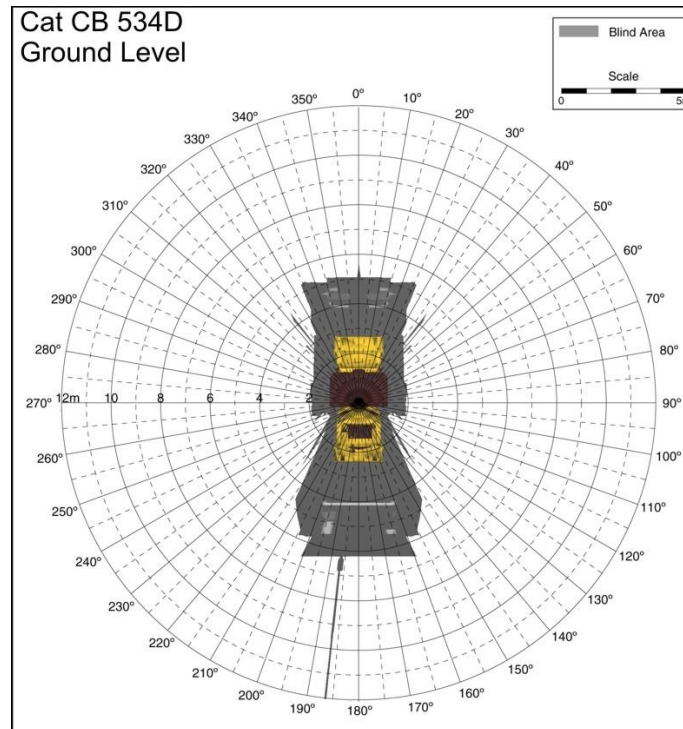
Do not load trucks with an excavator before they are properly in position. When in position, load trucks over the rear or the side. Never load from the front of the truck over the cab, any problems with the loading could injure the driver.



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Asphalt Pavers





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Most injuries involving paving equipment follow the same line as everything else, injuries come from jumping off the equipment. However, with paving equipment situations may necessitate these possibly lesser injuries when considering the possible alternatives. Pavers do not have ROPS. Jumping off the rear of the paver in a roll over could clear the operator from being rolled over if they lost control on hills and equipment veered off the roadway. Even more often, operators jump off equipment that was on fire. No one is expected to stick with a piece of equipment that is on fire.

Other injuries come from falling off the platform when the paver moves or is bumped, burns from hot equipment, pinches from moving parts such as hopper wings, getting hit by objects falling off the paver, getting run over by the paver, and lifting injuries from maintenance and repair items. Other safety steps needed to help avoid paving hazards include:

No one should be located between the dump trucks and the paver.

Never fuel a paver with the screed burners operating.

Never use the wash-down system with the screed burners operating.

Do not jump from the equipment.

Do not climb down from the machine on the traffic side.

Do not fuel the machine with the machine running.

Do not service the machine with the paver running.

Do not install the automatics with the paver running. You could get caught up in the augurs or pinched by the side arms.

Keep all guards in place.

Keep the operator's platform clean and clear of clutter.

Before starting the machine make sure all controls are in neutral and the parking brake is on.



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Shift the machine into “pave” or “intermediate” range before entering any grade greater than 6%.

Reduce travel speed by moving the direction control lever before applying brakes.

Make sure both brakes are applied evenly.

Make sure the screed supports are locked in place whenever the screed is raised.

Stand clear of the augers and conveyors while they are operating.

Do not allow anyone to stand in the hopper with the machine running.

Check the screed to make sure that fuel oil has not built up before lighting the burners.

Do not operate the paver with the governor bypass pulled out unless you are in “travel”.

Do you not use your hand to locate a hydraulic leak.

At least (1) 20-pound multipurpose fire extinguisher should be available on the paver.

Auger extension should be guarded.

Pavers should have flashing traffic lights installed for use at dusk, dawn, at night, and when traveling in traffic.

When trucks are backing up to the hopper, no one should be standing on the screed platform. They could be bumped off if the truck makes contact roughly.

Pavers require a slow-moving vehicle emblem posted on the rear paver.

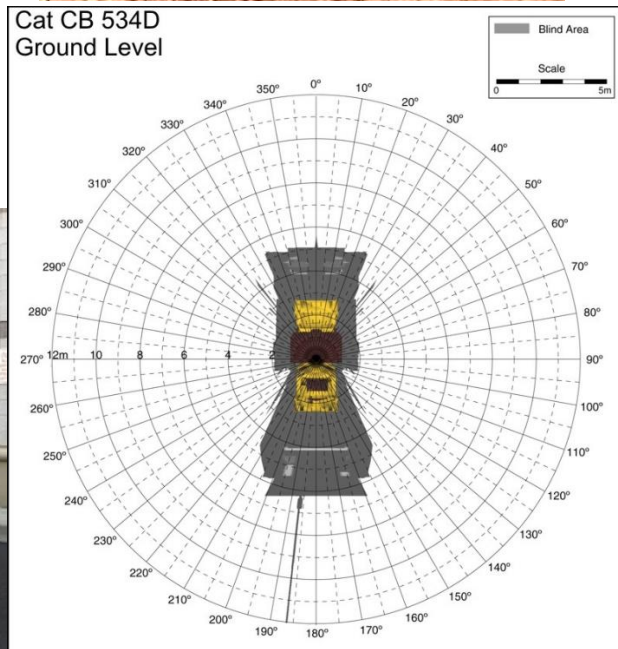
Do not try to force the hopper rings up if the hydraulics aren't working. They're too heavy with the hydraulics working against you. Fix the hydraulics instead.

Most machines are equipped with a safety latch on the direction controls which prevent the operator from moving directly from forward to reverse. The latch should be kept in place during paving.

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Rollers





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Roller accidents are infrequent and when they occur, they are usually either a fall from the equipment, or when they roll something more than they are supposed to like pickup trucks or signs. Occasionally they will roll over because they are top heavy and most don't have a capacity to operate sideways on inclines.

Rollers are slow moving vehicles and need escorting when traveling on public highways or require to be truck hauled for longer travels.

Usually rollers are an exception to the heavy equipment backing alarm rule because they have an excellent view in the rear and are made to run equally forward and backward (especially rollers used for asphalt paving). The operators must be aware of ground crews and obstructions in the vicinity, should not change directions quickly, and must use their view to check if someone has been following on foot or in an errant vehicle.

Articulated rollers have a hazard in the pivot area which must be kept clear.

Because they are slow, ground crews can be tempted to mount the roller while it is moving to talk to the operator. This is must not be permitted.

Earthwork rollers usually have ROPS, operators should stay in their seat with their seatbelts in place.

Rollers on paving operations usually do not have ROPS protection.

Watch out for overhead obstructions, tree branches cause injuries.

Watch out for obstructions and holes. Plan your moves carefully. Rollers are not very maneuverable and direction changes are slow to respond. Reversal is usually the best way out of a possible tipping or obstruction hazard.

Do not exit the machine on the traffic side.

Vibrating machines may require hearing protection.



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Some older rollers have poor access steps and handholds which should be improved to prevent falls from mounting and dismounting the equipment.

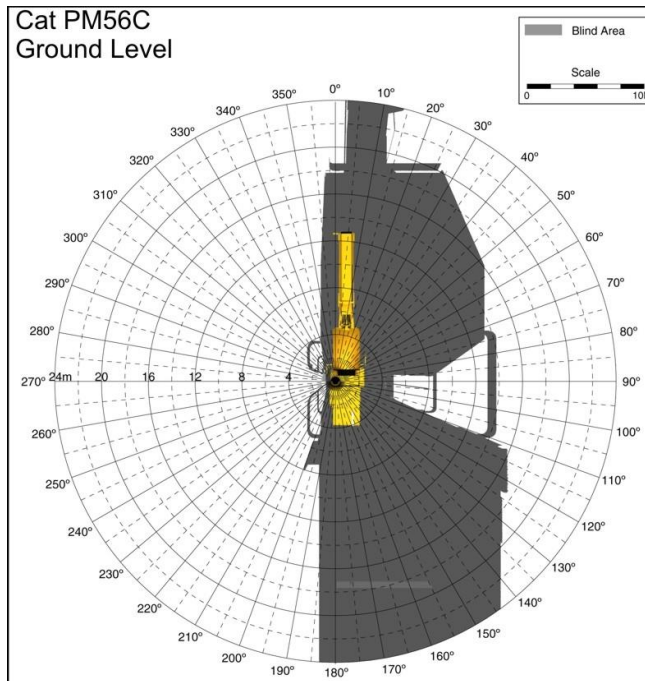
The vibration from a vibratory roller do not normally present any health and personal safety concerns but their operation can cause damage to homes, sensitive manufacturing facilities, hospitals, and other structures. Often the vibrating frequency can be altered which may be enough to prevent property damage. A good practice is for the operator to turn off the vibrator as the equipment come to the end of a run near such places. The vibrator is then tuned back on after the machine reverses and runs in the opposite direction. It has been found that damages from vibrating, like cracks in old plaster, may occur when the vibratory machines switch from forward to reverse without turning their vibrator off.



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Milling Machines





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Milling machines are dangerous. That is obvious even to the most casual observer. Industry wide, the accident history for Milling Crews is excellent when compared to the other equipment discussed. Why? Probably because they're so obviously dangerous that everyone is more cautious when working with milling operations. It may also be related to the fact that the crews who routinely use this equipment are specialize in this work and are very familiar with the potential hazards.

The biggest hazards are to the ground support personal. The operator's view is extremely limited. The machine could run over someone, and the operator would never know it because of the limited sight lines, the noise of the operations, and the fact that the machine wouldn't even hesitate. With this in mind, some simple rules must be followed:

Minimize the number of people in the area necessary to run the machine. Observers should be kept at a distance. All crewmembers should wear high visibility reflective traffic vest. Early training of new crewmembers must emphasize where and where not to be while the machine is running. An emergency stop button should be provided on both sides of the machine. If not actually a stop button, the button should at least activate a horn or an alarm at the operator station. Hooks for hanging hand tools and miscellaneous other items like water jugs, lunchboxes, and hoses, should not be attached to the machine sides. Such hooks ask people to get near the machine and that's why the manufacturer doesn't put them there in the first place. Lastly, the machine should not be fueled on the run.

Milling machines also throw rocks, primarily from the belt loader. Keep people away from the belt.

Milling operations produce loud noise. All crew members crew must wear hearing protection. No exceptions. Regular crewmembers need to have their hearings evaluated on an annual basis.

Trucks being loaded preferably should be backed into position with a spotter so the belt won't be hit. Trucks should back to the conveyor to be loaded so the conveyor cannot



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throw material through the windshield and the milling machine won't hit the cab if it reverses or rocks forward. Milling machines can jump back or lurch forward several feet if they contact in a sufficient obstruction. With that in mind, the area must be checked out in advance for such structures like manholes, shut-off's, rock ledge, and other hard objects.

The machine must be secured with pins and blocking if anyone is under the machine for repairs or maintenance.

Guards must be left on the machine. The conveyor must be shut down and locked out for repair and maintenance.



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Track Drills



[Heights Quarry - geograph.org.uk - 494023.jpg](https://www.geograph.org.uk)

Heights Quarry Quarry face showing the sandstone and shale overburden above the Great Limestone behind the quarry's drill rig.

[Helen Wilkinson](#)

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[[File:Heights Quarry - geograph.org.uk - 494023.jpg|Heights_Quarry_-_geograph.org.uk_-_494023]]

<https://commons.wikimedia.org/w/index.php?search=track+drill+rige&title=Special:MediaSearch&go=Go&type=image>

Track drills are the Billy goats of equipment. They go places most equipment wouldn't dream of going. Because of this, most accidents involving drills are associated with the terrain. Falls in the area, slips, trips, getting caught between the drill and some rock, or getting struck by a sliding drill.



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Besides those operational hazards, there's a problem with excessive noise and dust requiring hearing protection and dusk masks and glasses. Personal protection must be worn. This can be one of the most difficult things to enforce because of their isolated and remote operations and generally it seems most drillers just don't seem to care. Still, we are responsible for their safety and must require this equipment.

Drill rigs are involved in catastrophic accidents from rock wall face collapses while they're drilling nearby, drilling into unexploded explosives, and walking off of cliffs.

Drill steel is heavy and awkward to set up. Drillers must practice proper lifting techniques, get help from others if available, and should use the assists provided by the machine.

Tram controls are spring-loaded to return them to the neutral when released. Operators should regularly test them to make sure they are working properly.

Operators should always check out new and repaired equipment for its operation. Hose lines are easy to cross on this equipment and can be accidentally crossed when hooked up. Operators don't need to be surprised by a forward and reversal.

As with all boom equipment, overhead powerlines must be considered. The mast can easily contact such lines when it's raised and most drillers forget this. To avoid this, and for stability, tramming for any distance should be done with the boom down and centered over the machine.



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Belt Conveyor Trucks



The last piece of equipment to cover is the Belt Conveyor Truck.

First, an extendable conveyor is just that, a conveyor. The rules don't change because it's on the truck chassis and extends. Just as OSHA's requirement for any conveyor, they must be locked out before any work is performed on the conveyor. When they jam up, and they do on a regular basis, they must be immobilized before a person gets into /onto them to fix them. This is especially true on this piece of equipment because the extendable parts make the system even more hazardous than a normal fixed conveyor.

Next, repairs should be done from the ground or on some type of platform with the belt lowered. Working up on the belt is hazardous. People are thrown off the belt while trying to work on them either by the belt being started or the boom being standard when not properly locked out.



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When operating:

The outriggers must be fully extended and placed on firm footing.

If it's being controlled remotely (as shown in picture above, the operator is at the top of the bank), the operator must be sure no one is around the equipment, other than the dump man, and possibly an oiler, and they must be in sight.

Watch out for overhead lines.

The discharge chute should have a safety chain attached since the whole assembly can be pulled down from the weight of the concrete. This includes the shoe, and the elephant trunk.



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CONCLUSION

There are so many other types of equipment, and each have their unique hazards. Hopefully each of the equipment pieces chosen in this course represents a category of equipment that can have transferrable knowledge when applying to pieces not specifically addressed and the reader can use the information as a foundation to learn more about the specific equipment they encounter at project sites.



As previously stated, this is the third course in a proposed series on Construction Safety. The series of courses offer only a brief introduction to each topic and do not offer or imply any type of certification or level of expertise upon completion. For a better understanding, the reader should consider getting their OSHA 10-hour and OSHA 30-



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hour Construction Safety and Health Card by successfully completing OSHA recognized Classes.

Lastly, safety must be a constant focus of every operation. Because of the variability of Heavy Civil Construction Projects, they are often chosen to be constructed in some of the most adverse and inaccessible areas imaginable. Working with extreme weights, at excessive heights, in adverse conditions, and around large equipment requires safety diligence from every stakeholder. Personal protective devices must be worn at all times. **Please be safe.**

