Construction OS&H

Horizontal movement

Summary

Common hazards with horizontal movement
General principles of safety for moving plant
Excavating plant
Earthmoving and compacting plant
Road-making plant
Concrete production and movement
Site transport

What are the common hazards with horizontal movement?

Methods of horizontal movement which are often used on construction projects should not give rise to any hazards.

Spend 10 minutes thinking about why hazards arise, and list ten possible causes.

Site transport

The underlying cause of most site traffic incidents is the failure to plan a safe system of work and to train workers how to follow it. Common causes are one or a combination of the following factors:

- Bad driving techniques which include reversing blind
- Carelessness or ignorance of special hazards [power lines or excavations]
- Carrying unauthorized passengers
- Poor maintenance of vehicles
- Overloading or bad loading
- Site congestion
- Poor traffic layout
- Lack of proper roadways combined with uneven ground and debris

Many of the hazards which arise have these causes

- Poor mechanical design (breaks in use, not powerful enough, components fracture or malfunction)
- Poor functional design (not properly designed for the stated purpose)
- Poor workplace design
- Signalling systems (manual, mechanical, electronic) malfunction
- Misuse (not used as designed)
- Loads insecurely attached
- Release of pressure (concrete pumps)
- Poor maintenance (breaks or emits noxious gases)

These cause the following hazards

- Loads fall from vehicles
- Crushing due to impact of moving or toppling plant and equipment
- Impact from release of pressure (eg concrete exploding from concrete pump hose failure)
- Falling from plant and equipment
- Falls caused by swinging loads, plant and equipment
- Limbs or bodies caught in machinery
- Poor ergonomics
- Physiological and psychological damage through repetitive work
- Stress caused by poor environment (noise, heat, poor ventilation, chemicals, noxious gases)

Other hazards

These are, of course, just some of the main hazards; there are many more which are specific to particular projects.

Each project must be assessed specifically and all hazards taken into account.

General principles of safety of moving plant (1)

Machine Safety Checks

Operators and drivers should check their machine before starting work.

Items to be checked should include:

- Fuel, oil, and water levels
- Water, fuel, and hydraulic lines for leaks
- The condition of the tracks or tyres
- The condition of attachment cutting edges and teeth
- That good visibility is possible from the cab, windows, mirrors, and lights
- Steps and pedals do not have worn or slippery surfaces
- Warning devices are working
- There is no loose gear or material on the machine

General principles of safety of moving plant (2)

Any defects noticed should be immediately reported to the supervisor for correction. If any defect affects the safe operation of the machine, it should be rectified before the machine is used.

After starting the engine and before moving off, operators should check that the brakes, controls and gauges are functioning correctly, and that other workers are clear.

The drivers and operators of vehicles and earth-moving or materials-handling equipment should be medically fit, trained and tested and of a prescribed minimum age as required by national laws and regulations.

Hours of work must be controlled. Driving and using moving plant safely requires concentration and long hours make this difficult.

Site traffic control

On all construction sites on which vehicles, earthmoving or materials handling equipment are used:

Safe and suitable access ways should be provided for them

Traffic should be so organised and controlled as to secure their safe operation

When construction plant, equipment and vehicles have to travel through densely populated public areas, they should be escorted by a banks-man (perhaps two banks-men in some circumstances) at all times.

The photo shows two banksmen escorting a vehicle in a busy street.

This street had been completely cleared of non-construction vehicles and blocked to pedestrians (except residents) and the work was mainly done at night to minimize the hazards to residents (and perhaps for other reasons) although the noise probably kept them all awake.

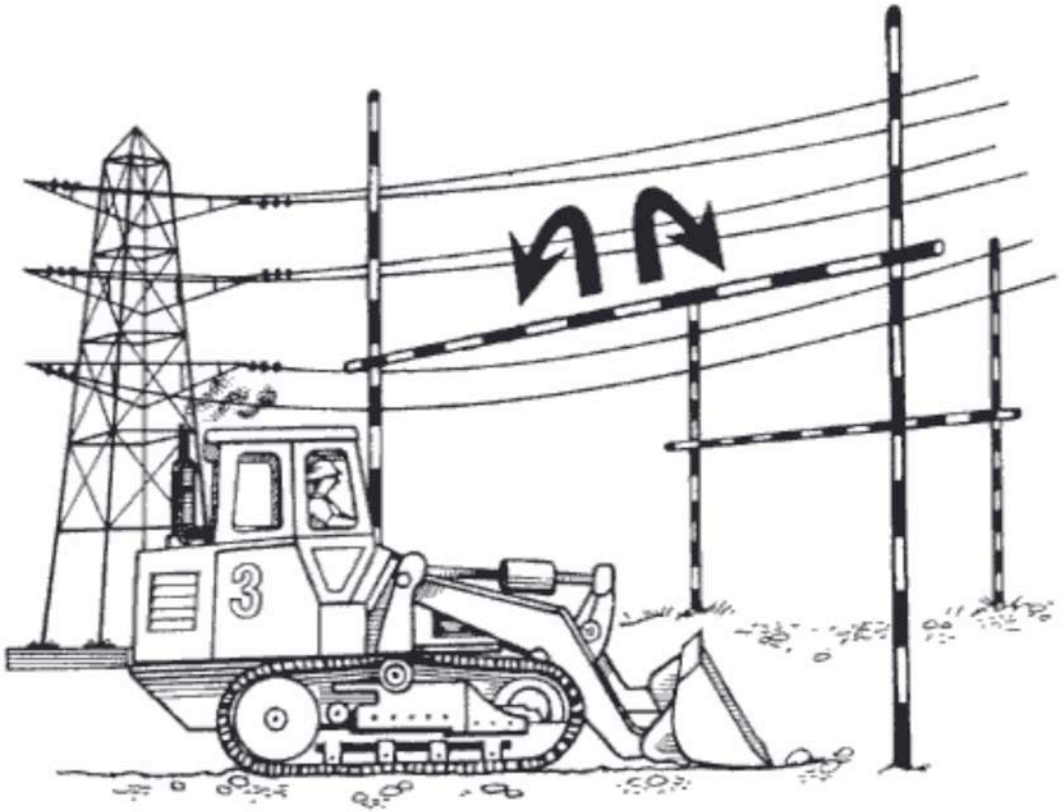
Signals

Adequate signalling or other control arrangements or devices should be provided to guard against danger from the movement of vehicles and earth-moving or materials-handling equipment. Special safety precautions should be taken for vehicles and equipment when manoeuvring backwards.

The assistance of a trained and authorised signaller should be available when the view of the driver or operator is restricted. The signalling code should be understood by all involved.

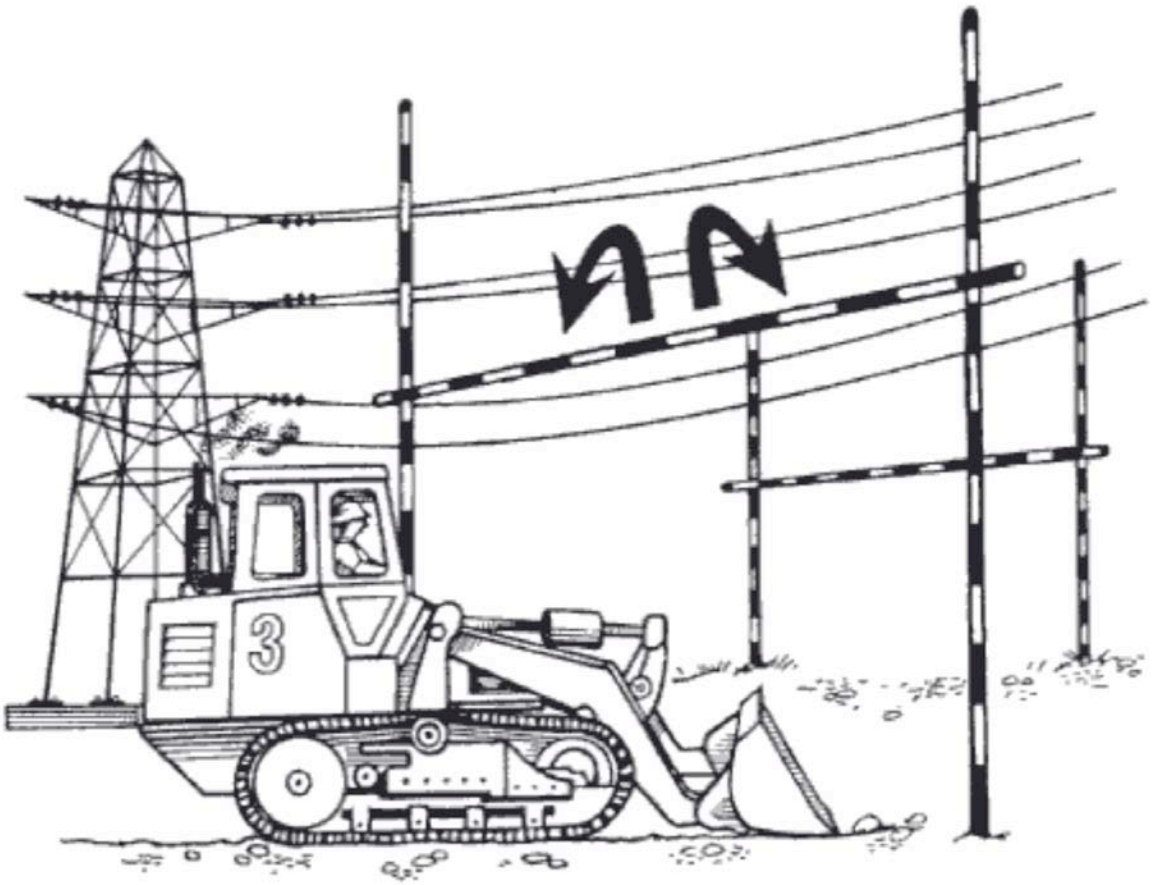
Electrical power lines

When earth-moving or materials-handling equipment is required to operate in dangerous proximity to live electrical conductors, adequate precautions should be taken, such as isolating the electrical supply or erecting overhead barriers of a safe height.



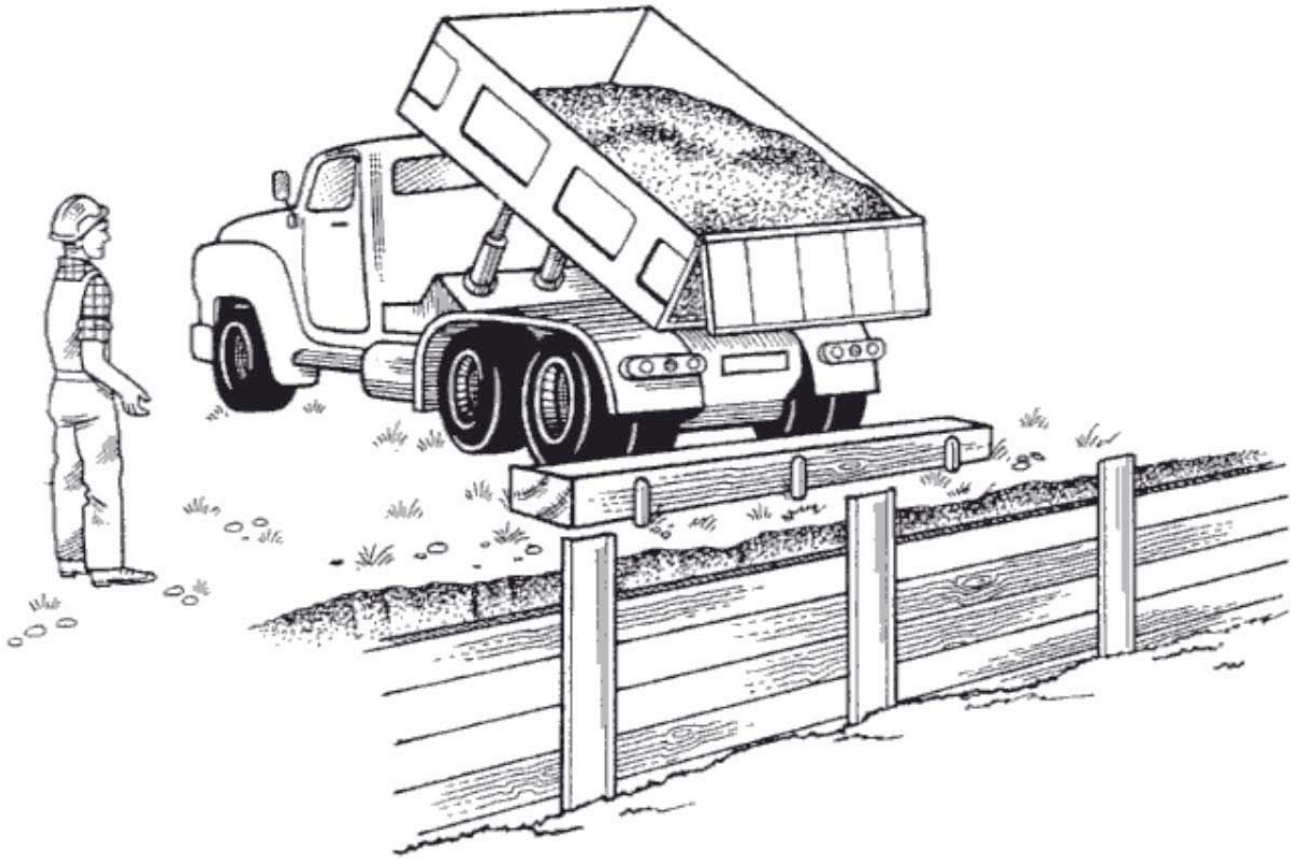
‘Goal post’ warning barriers

The crossbar should be of rigid material, preferably timber, and painted in two contrasting warning colours. In the case of power lines, there should be a barrier on both sides of the line and set at least 6m horizontal distance away.



Vehicles and excavations

Preventive measures should be taken to avoid the fall of vehicles and earth-moving or materials-handling equipment into excavations or into water.



Sites should be securely fenced to protect the public from moving construction plant and equipment. The photo below shows very secure, double fencing around a site near a popular public footpath.

Warning notices should be prominently displayed.

Excavating plant

Before leaving the excavator the operator should:

•Disengage the master clutch.

•Lower the bucket or grab to the ground.

•Buckets and grabs of power shovels should be propped to restrict movement while they are being repaired or teeth are being changed.

•When an excavator is at work near a wall or similar construction, persons should be prevented from entering the danger zone in which they may be crushed when the machine turns.

Trucks should not be loaded in any place where there may be danger from materials such as rocks falling from buckets passing overhead; where this cannot be avoided, no person should remain in the cab during loading.

Trucks should be stationed at such a distance from the excavator that there is a clearance of at least 60cm between the truck and the superstructure of the excavator even when it turns.

Dos and Don’ts (1)

Do – When excavating trenches, place the excavated material at least 600 mm clear of the edge, where there is no danger of it falling back into or collapsing the side of the trench.

Do – Create a level area to operate from when working on a steep grade. If you cannot do this, avoid swinging your boom downhill any further than necessary and operate your machine slowly to maintain stability.

Do – When travelling up or down a steep slope, place the track sprockets at the rear of the machine. For uphill travel extend the boom and bucket forward, and for downhill travel place them close in, in order to maximise stability and traction.

Do – Watch boom clearance when travelling. Uneven ground may cause the boom to weave or collide into obstructions.

Dos and Don’ts (2)

Do – Take care at the point of balance on the peak of a steep slope. Reduce speed and maintain stability until on level ground.

Do – Avoid jerky swings or sudden braking. These can make the machine unstable and overload machine components.

Do - Use boom to maximise stability and traction when going up or down hill.

Don’t – Turn sharply while travelling up a steep slope, because the machine’s stability will be threatened.

Dos and Don’ts (3)

Do – prevent boom of excavators from accidentally swinging during operation or transport.

Do – Prevent the bucket or grab of an excavator from accidentally dipping, tipping or swinging in operation.

Don’t –Attempt to operate attachments while travelling as this may starve one of the track drive motors and result in an unintended turn.

Bulldozers

Before leaving a bulldozer the operator should:

- Apply the brakes
- Lower the blade and ripper
- Put the shift lever in neutral

Bulldozers

At the close of work bulldozers should be left on level ground.

When a bulldozer is moving uphill the blade should be kept low.

Bulldozer blades should not be used as brakes except in an emergency.

Dos & Don’ts (1)

Do – Wherever possible avoid side-hill travel. Drive straight up and down slopes. If the machine starts to slide sideways when working across a slope, turn the machine downhill and drop the blade. Watch for falls of rocks and trees when slip clearing.

Do – If you have to drive down a steep slope, keep a good bladeful of spoil in front of the blade on the way down. If dirt is being lost, lowering the blade slightly may help, but lowering it too far brings the danger of overturning.

Do – When you are working on slip-clearing, proceed with caution and watch the slope. Further falls may occur.

Dos & Don’ts (2)

Do – When clearing trees, watch out for dead branches in tree tops as abrupt contact with a butt may dislodge them.

Do – Avoid obstacles such as rocks or logs. If you are forced to cross them, use extreme caution and change to the lowest gear. Ease up to the break-over point and ease down to minimise the jolt on contact on the other side.

Do – Be careful when working near the edge of banks and ditches or under overhanging material. The vibration and weight of your machine may cause the edge to give way or overhanging material to fall.

Scrapers and graders

Scraper bowls should be propped while blades are being replaced.

Scrapers moving downhill should be left in gear.

Dos & Don’ts - Scrapers

Do - Place warning signs when operating on roads.

Do – Face in the direction of travel. If you have to watch the operation of rear equipment, use your rear-vision mirror.

Do – When entering sharp turns, fill areas or downgrades, apply retarder and/or service brakes. Select the correct gear before travelling downhill.

Do – On long downgrades use the engine to assist braking. Avoid ‘fanning’ the air brake pedal. Repeated light application of the brake may exhaust air pressure faster than the system is able to replenish it, leading to brake failure.

Do – Drop the bowl in an emergency!

Don’t – Speed as a relief from boredom!

Don’t – Accelerate a tandem scraper’s rear engine when entering a sharp turn, or the machine may jack-knife.

Dos & Don’ts - Graders

Do – When grading across a slope, avoid blade down-pressure and obstacles, as either can tip the machine. For maximum stability operate at low speed, lean the front tyres towards the uphill side, and cast material to the downhill side of the machine.

Do – Operate on as level a surface as possible when cutting high banks. With the blade raised, the grader is less stable than normal.

Do – When working on existing roads, place warning signs and watch out for that unexpected vehicle.

Asphalt layers and finishers

Asphalt layers and finishers (1)

When asphalt plants are working on public roads, an adequate traffic control system should be established and reflective jackets provided for the workers.

A sufficient number of fire extinguishers should be kept in readiness on the worksite, including at least two on the spreader.

Material should only be loaded on to the elevator after the drying drum has warmed up.

No naked flame should be used for ascertaining the level of asphalt in the tank.

Asphalt layers and finishers (2)

Thinners (cut-backs) should not be heated over an open flame.

If a burner flame is extinguished:

- The fuel supply should be cut off
- The heating tube should be thoroughly blown out by the fan to prevent a backfire

Inspection openings should not be opened while there is pressure in the boiler.

Pavers are very complex items of machinery and require skill to operate safely.

All those involved must be properly and thoroughly trained.

Spreading asphalt by hand causes another set of hazards: heat, chemical contamination etc

What is going on here?

Rollers should be sprayed with water to stop the asphalt sticking to them.

Water system may be broken, water not available or asphalt not hot enough to use it.

The women are in hazardous positions. If the driver changes direction in error, they will be crushed.

Before a road roller is used

The ground should be examined for bearing capacity and general safety, especially at the edges of slopes such as embankments.

Rollers should not move downhill with the engine out of gear.

When a roller is not in use the:

- Brakes should be on
- Engine should be put into bottom gear if the roller is facing uphill
- Engine should be put into reverse if the roller is facing downhill
- Wheels should be blocked

Dos & Don’ts – Road Rollers

Do – Take care not to overbalance over the edge of a road formation. Examine edges for soft spots before starting work.

Do – Avoid gear changes on steep sections. Remember that a missed gear change may result in loss of control and the roller overturning. Hand or parking brakes should not be relied on to maintain control.

Do – Park on the flat. If you must park on a slope, chock your wheels.

Don’t – Climb onto a moving roller

Concrete distribution

While the drum of a concrete mixer is being cleaned, adequate precautions should be taken to protect the workers inside by locking switches open, removing fuses or otherwise cutting off the power.

Loaded concrete buckets should be guided into position by appropriate means.

Pipes for carrying pumped concrete should be:

- Securely anchored at the ends and at curves
- Provided near the top with air release valves
- Securely attached to the pump nozzle by a bolted collar or equivalent means

Crane and skip, or pump? (1)

A large building will have a basement 10 metres deep (measured to the underside of the base slab from finished ground level).

The ground conditions cause concern, so the decision has been made to construct the base slab as quickly as possible.

The whole slab requires 400 cubic metres of concrete, and rather than pour it in a number of separate bays, it will all be poured as one continuous activity.

Crane and skip, or pump? (2)

The slab can be poured using the tower cranes and concrete skips, or by using concrete pumps.

The concrete will be delivered at the site entrance and moved by 1 cubic metre capacity dumpers to the skips, or the pumps can be stationed at the entrance and pump directly.

Detailed analysis shows that, in practical and economic terms, there is no difference between the two methods.

Which is likely to be the safest for the workers?

Crane and skip, or pump? (3)

The OS&H analysis should include the following factors:

Crane and skip

- Hazards of moving traffic (-)
- Crane driver can see the skip and workers (+)
- Swinging skips can be dangerous (-)

Pump

- Operator will not be able to see the end of the pump (it will be down the excavation) (-)
- Pump discharge puts concrete exactly where required (+)
- Less manual effort overall (+)

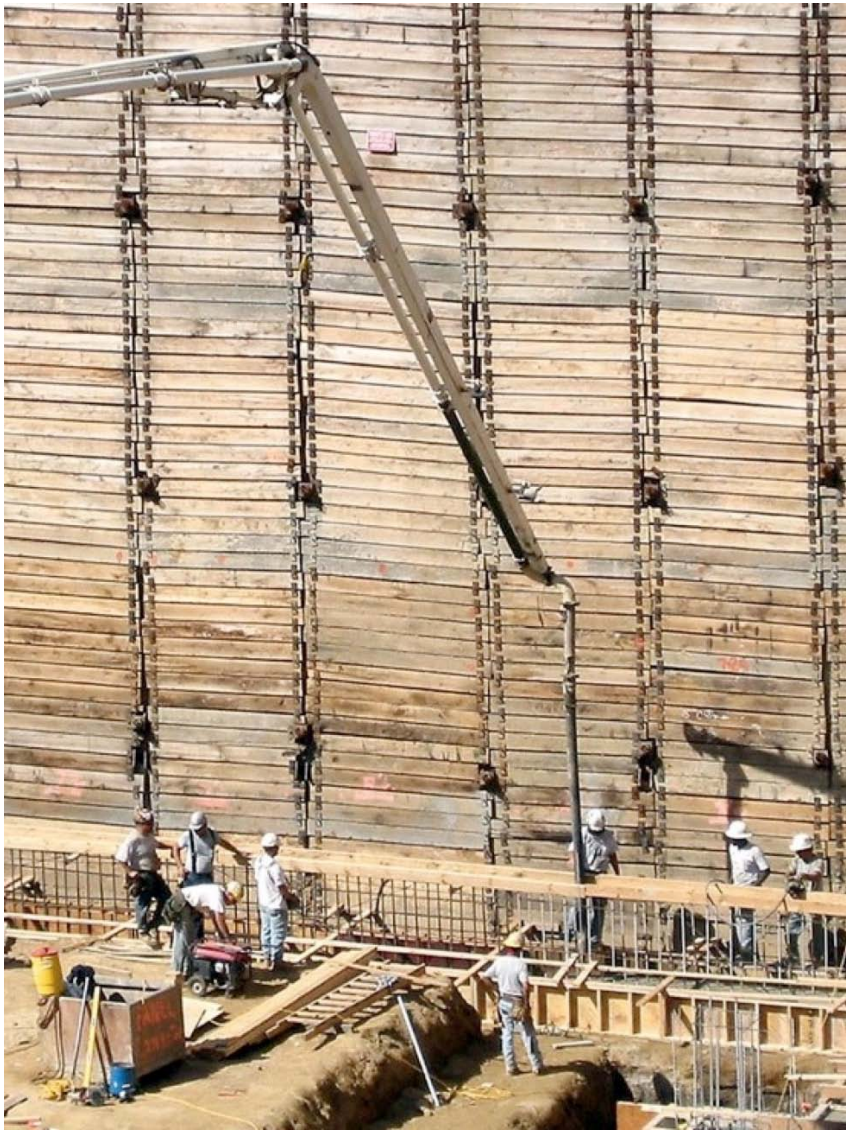
Conclusion: overall, the pump is probably safer

Using a concrete pump

Workers must take care when handling the discharge end of a concrete pump.

This is a very heavy item and concrete is being driven out of it by strong pressure, so there is a health hazard of back and other muscular strains.

The pump operator has a very important part to play in placing the boom so that the worker at the discharge end does not have to exert much force to place the concrete accurately.



Site transport

The underlying cause of most site traffic accidents is the failure to plan a safe system of work and to train workers how to follow it.

Causes of incidents

Common causes of incidents are one or a combination of the following factors:

- Bad driving techniques which include reversing blind
- Carelessness or ignorance of special hazards, e.g. work near overhead power lines or excavations
- Carrying unauthorized passengers
- Poor maintenance of vehicles
- Overloading or bad loading
- Site congestion
- Poor traffic layout
- Lack of proper roadways combined with uneven ground and debris

Safety precautions (1)

Drivers must be properly trained and to take a vehicle on or across a public road requires a National driving licence. It is good practice for all drivers to possess a licence in any case. Training should include instruction on negotiating steep slopes; driving a vehicle up and down the slope rather than across it wherever practicable.

Routes should be levelled, marked and planned in such a way as to avoid potential hazards such as overhead power lines and steeply sloping ground. Where possible a one-way system should be used. Speed limits should be required and clearly displayed, they should be reduced for adverse site conditions and for areas near work in progress.

Safety precautions (2)

Vehicles travelling backwards when the driver's rear view is obscured frequently strike workers.

The help of another worker is required, who must be kept in view at all times.

If no one is available, the driver must walk round to the rear of the vehicle themselves to see that all is clear and give a sound signal before starting to reverse.

Many vehicles now have an audible warning device such as a horn or warning hooter which sounds when reverse gear is engaged, but drivers should not rely on this alone.

Safety precautions (3)

An unattended vehicle should have the engine switched off, and unless the vehicle is on a marked incline the gear should be left in neutral and the handbrake on; on sloping ground the wheels should also be chocked.

Tipping bodies should be lowered when the machine is unattended, but if it is occasionally necessary to leave them in the raised position they should be blocked to prevent their fall.

Foot injuries to drivers and their assistants during loading and unloading are common, so they should wear safety boots or shoes.

Maintenance

Maintenance of vehicles falls into three categories:

- A daily check by the driver of water, oil, fuel, lights, inflation of tyres and brakes – remember the acronym WOFLIB
- A weekly check by a fitter
- Periodic servicing to the manufacturers' requirements

A written record of maintenance and repairs should be kept on site

Points to remember

All vehicles should be kept tidy and the cab free from tools and material which might obstruct the controls.

Speed limits must be enforced.

Passengers should only be carried in properly designed passenger vehicles.

Vehicles should not be driven across a slope.