SAFETY AND HEALTH COMMISSION FOR THE MINING AND OTHER EXTRACTIVE INDUSTRIES

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Committee on Surface Workings

GUIDANCE FOR CARRYING OUT

RISK ASSESSMENT

AT

SURFACE MINING OPERATIONS

Introduction

This publication sets out basic advice for carrying out **Risk Assessment** at **Surface Mining Operations**.

Surface mining operations are defined as activities undertaken during **winning**, **transporting** and **processing** of minerals mined from the surface. The steps to carry out the necessary risk assessment before each operation is carried is addressed in this publication.

Risk Assessment.

Definition.

Risk assessment is all about prevention of accidents and there is a need to be aware that there is the risk of an accident before steps can be taken to prevent it happening. It may not always be obvious that a workplace task could lead to an accident. This is why risk assessments are carried out.

In risk assessment the words **Hazards** and **Risks** are often used and it is necessary to be clear what **Hazards** and **Risks** are:-

- A **hazard** is anything that has the potential to cause harm.
- The **risk** is how likely it is that a hazard will cause actual harm.

Having defined the work to be undertaken risk assessment will give a clearer picture of what could go wrong and how serious an accident could be. It will depend upon following a set model which will enable the risk to be assessed.

General principles.

The core of any risk assessment is the application of basic health and safety principles. In the context of this publication the following precautionary principles are applicable.

- **House keeping** - the provision and maintenance of a safe and healthy workplace is the most basic principle of health and safety. Dirty and untidy workplaces or walkways contribute to a very large proportion of trip and fall accidents.

  In the context of surface mining the provision of well defined roadways and walkways clear of obstruction, and regular cleaning up of spillage will greatly reduce the potential for this type of accident. Lack of maintenance may well lead to roadways and walkways being unsuitable for use.

- **The work** - the application of risk assessment depends upon a full understanding of all aspects of the job being undertaken. In carrying out a risk assessment in relation to a particular task the evaluation must include a review of the knowledge, experience and training of those persons carrying out the work.

- **Personal Competence** - it follows that the knowledge, experience and training of personnel involved in work is critical to the result of any risk assessment. A knowledgeable, experienced well trained and competently supervised workforce will be at a lower risk of accidents occurring than a poorly trained and badly supervised workforce.

- **Co-ordination** - a competent person should be given the responsibility for overseeing and co-ordinating work. It is essential that the co-ordinator ensures that everyone engaged in the work is capable and understands the role of others and their responsibility for each other. This is particularly important when contract workers undertake part or all of the work to be carried out.

- **Plant and Equipment** - there is an assumption in risk assessment that plant and equipment are suitable for the work being undertaken and have been designed, manufactured and installed to at least the minimum standards for health and safety. Failure to meet the standard will result in people being at higher risk and remedial steps should be put in hand to make good the shortfall. Other interim arrangements should be implemented to protect any persons exposed to latent danger. Maintenance of plant and equipment to agreed specification, whether original or upgraded to the latest health and safety standards, is essential.

- **Dangerous parts of machinery** - such as revolving parts, inrunning nips and entrapment between reciprocating parts as defined in European and National standards should be protected to those standards.

- **Workplaces** - access to both above and below ground workplaces should be by well constructed and maintained permanent fixed means. When practical stairways and

shallow inclined walkways are preferred to vertical ladders, which in some circumstances can be the cause of very high risk. The sides of all workplaces from which persons may fall should always be protected.

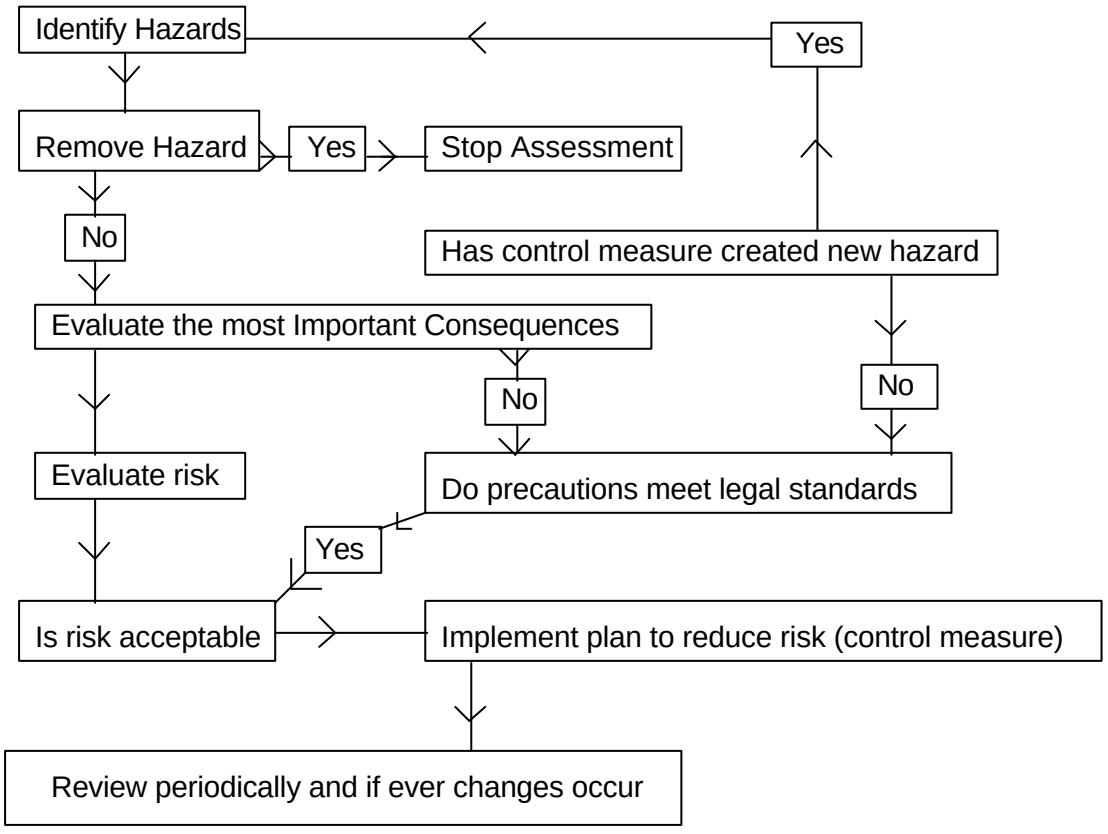
- **Health hazards** - For the purposes of this document health hazards should be interpreted as being harmful dust, vibration and noise which is emitted during surface mining operations, as well as the handling of heavy loads.

  While elimination and often suppression at source is not presently available in some cases the normal control of health hazards is still applicable in this industry.

- **Personal Protective Equipment (PPE)** - should be of good construction, suitable for the hazard e.g. a dust respirator fitted with the correct filter to capture the particular hazardous dust, and maintained to recommended standards. As personal protective equipment only affords limited protection it should only be used as a last resort and then as an interim arrangement until other steps are taken to reduce the risk of personal injury to an acceptable level.

- **Traffic Movement** - should only take place within designated areas and over suitable roadways. Adopting one way traffic movement systems are preferred to two directional traffic systems. The risk of accidents due to traffic movement is much less with a one way than a two way system.

Model for Risk Assessment



This model is best understood by working through the steps listed below :-

1. Identify the hazard - How an accident might happen? Consider what or how things could go wrong when the activity is carried out.

2. Identify who is at risk - Who is involved in the activity? Who else could be at risk?

3. Remove the hazard - Can the activity be carried out in another way so as to eliminate the hazard.

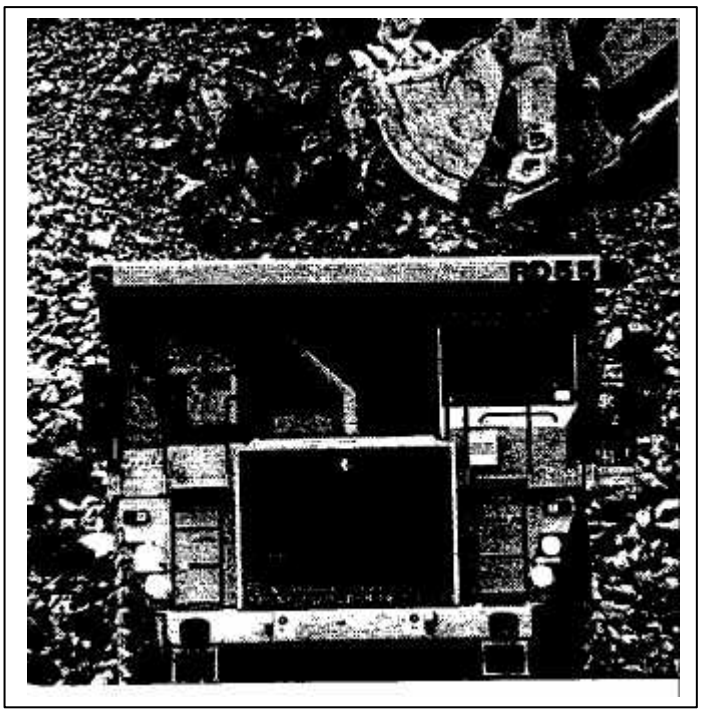
4. Evaluate the risk - How likely is an accident to happen? How serious would the injury be if there is an accident while carrying out the activity?

5. Decide on control measures - look at what measures have been taken already to ensure that persons do not have an accident. For example, have suitable and sufficient guards been fitted? Decide whether anything else needs to be done. For example, it may be necessary to provide extra training in the safe use of machinery and only allow trained workers to use it.

6. Record the assessment - The risk assessment should be recorded.

7. Review - The assessment will need to be reviewed every time there are changes in the workplace, for example new members of staff, new equipment, new systems of work and new location.

Surface Mining Operations
Section 1
Winning



This first part of this publication is concerned with **winning** the mineral.

Winning.

Winning may be categorised as shown in the following diagram.

Mineral	Rock	Coal	Clay	Sand & Gravel
	Drilling Drilling	Drilling Excavating		Blasting
Blasting	Blasting	Dredging		Loading
Loading	Pumping	Loading		Sawing
Excavating	Settling			
			Loading	
			Washing	

Winning the mineral.

Whenever mineral is mined the first step in winning the product is the preparation of the site. The four main stages in the preparation are :-

Planning Surveying Clearance Laying out

Planning

The risk of injuries can be significantly reduced if sufficient regard is given to health and safety at the planning stage of a new or developing mine.

Planning is the stage at which risk assessment can best be applied. Short, medium and long term planning of the mine can eliminate many hazards and contribute to a reduction in the potential for injury, in cases when the hazard cannot be eliminated.

Time taken at this stage to consider the best layout of the mine and the equipment to be used will greatly reduce the risk of accidents to persons and plant during the working life of the mine. For example designing low gradient roads and one way travel for traffic will considerably reduce the probability of runaway and collision accidents.

The danger of being struck by large moving vehicles can largely be eliminated by using trained drivers and providing the vehicles with suitable appliances, such as aids to ensure the driver has all round visibility. The danger can be further reduced by designing and implementing one way traffic systems and ensuring that open edges of roadways are suitably protected to prevent accidental driving off the edge. Additionally, ensuring that the vehicles are properly maintained in good working condition, particularly the braking system, will go a long way to help the driver control the vehicle.

Proper regard to the elevation of conveyors (dealt with in Part 2) will help to eliminate spillage

from steeply inclined belt conveyors, and remove the necessity for personnel to work at heights from which they may be liable to fall.

Well-designed access and working platforms will also reduce the possibility of a fall.

Surveying.

Surveying has its hazards, for example surveyors are likely to be seriously injured if they fall from heights or are thrown out of overturning vehicles.

Since the hazards are created by ground formation it is unlikely that they can be removed.

Those normally at risk would be the surveying team of the surveyor and assistants.

Individuals working at the edge of vertical faces or on very steep undulating ground are at greater risk than those working on level ground. Driving over steep rough terrain is more dangerous than driving over gentle slopes.

It is necessary to give clear positive instruction and ensure vehicles used to gain access to the areas to be surveyed are well maintained and suitable for the terrain over which access is to be gained.

Clearance

Clearance covers all the activities associated with preparing a site ready for laying out primary roads for working a face.

It may include tree clearance, demolition of buildings and the removal of the top layers of earth. In some cases it may include re-routing of services, roads and waterways e.g. rivers.

The primary hazards are being struck by falling trees and debris from demolition of buildings, use of power saws, equipment used in the removal of the top layers of earth and plant used to convey it to storage areas, and the possibility of being struck by mobile plant.

The hazards are created in clearing the site. While the clearing of the site cannot be avoided hazards can be controlled by adopting the safest methods to carry out the work. For example, fully trained persons should be used in tree felling operations. Well maintained fully protected power saws should be used and the operatives should wear full personal protection e.g. safety helmets, ear defenders, face shields, gloves, fully protective leggings (trousers) and boots.

Laying out

There are many different ways of starting and working mines but careful planning particularly concerning the order of laying out the mine will reduce hazards.

The hazards prevalent during the construction of new roads and buildings are mainly, overhead electricity lines, falls while working at heights, plant running out of control and individuals being struck by moving vehicles.

The construction of a small single storey building will normally create less hazards than a large high rise building. Similarly building roadways on level ground will involve less hazards than building on steeply inclined terrain.

One of the hazards to be assessed is earth moving vehicles such as bulldozers being driven off the edge of roadways under construction.

While all persons working at civil and construction works are at high risk those working at height or working with cranes, large earth moving plant and explosives will be at greater risk than those persons concerned with surveying, setting out and conveying supplies to the primary workers or those working at ground level.

While the potential for risk of serious injury is high during civil and building operations the risk of injury can be significantly reduced if the work is properly planned and executed. Good well maintained plant and equipment is essential to reduce the risk of injuries.

If suitable equipment is not used, for example if poor and badly constructed scaffolding is used there is a much higher probability of persons falling from heights or the scaffolding collapsing than if good properly constructed scaffolding is used.

It is necessary to ensure that scaffolding is only constructed by persons competent to do the work.

To reduce the risk of injuries while using cranes, large earth moving equipment and vehicles drivers and those giving signals should be well trained. The lack of training and competence in the use of such equipment is the biggest cause of cranes failing and accidents involving the use of other plant.

WINNING

Drilling

Drilling is common to the winning of rock, coal and clay. The main hazards associated with drilling are :-

- Falls from the edge of a bench
- Dust created during the drilling operations
- Noise
- Entrapment in or being struck by a moving part of the drilling equipment.

Risk assessment.

Falls from the edge of a bench

While the primary hazard is that of the driller falling over the edge of a working or abandoned bench the risk of minerals or materials falling onto workers at the foot of the face should not be overlooked.

A face and bench is a necessary part of a working quarry and therefore it is not possible to remove the hazards associated with them.

While others may need to work at or near the edge of a working bench the person most at risk during the drilling operation is the driller. Others such as the manager of the mine or maintenance personnel, may approach the bench edge during the drilling operation in the event of a break down of the drilling equipment.

Clearly people are only at risk when they approach edge of the bench. In normal circumstances there is no need for anyone to be so close to the bench edge as to be liable to fall over it. However anyone working within say three metres of the edge would be liable to fall over it should they trip or accidentally slip while carrying out their work and might be considered at high risk.

The highest risk will occur during the drilling of the first line of holes parallel with the working edge of the bench. Subsequent parallel lines of holes should not give rise to such a high-risk of falling off the edge of the bench.

A number of control measures can be taken and the first is to ensure that the equipment is suitable for the job and that the person in charge of the drilling machine is competent to carry out the drilling operation; part of the training should include instructions to always face towards the open edge of the bench so that any inadvertent backward step is away from the edge.

One of the measures that can be taken to reduce the risk off the edge of the bench is to provide suitable portable rail fencing which can be erected between the drilling operations and the edge of the bench. Another is to attach a safety line to the drilling rig and provide a harness for the driller to wear.

Another is to restrict access to the area to all persons except those necessary for the drilling operation.

Dust from the drilling operation

The hazard is the inhalation of dust which is created during the drilling operation.

While it is not presently possible to totally remove the hazard properly applied control measures can substantially reduce the risk.

The person primarily at risk is the drill operator.

Control measures vary from using water during the drilling operation to the provision of local exhaust ventilation which removes the dust from the head of the hole to a dust collection unit to

the provision of a ventilated cabin provided for the operator. The most effective of these precautions is the provision of a control cabin on the drilling rig provided with a suitable ventilation system fitted with a dust filter to remove harmful dust and maintain the dust level within the cabin to below acceptable control levels.

Any ventilation equipment should periodically be examined to ensure that it is maintained to its design standard.

Noise

Drilling operations give rise to harmful levels of noise. It is created by both drilling the hole and the operation of the drill rig itself.

It is impractical to remove the hazard at the hole but new generations of drill rig should be quieter by virtue of its design. The noise created is harmful to anyone who is within a zone around the drilling machine at which the noise level is above that considered to be safe for persons to work without having to use control measures.

The noise levels around drilling equipment should be measured and the risk assessed. Unless control measures are in place no-one, except those necessary for the work in hand, should be allowed inside the designated noisy area.

In most cases this will be the drill operator.

The risk is highest at older machines. Newer large drilling machines are provided with sound insulated operating cabins which control the noise level within the cabins to acceptable levels.

Other control measures will include training operators and providing them with ear protection, although the latter should only be seen as an interim precaution until a permanent solution can be found.

The risk is very high when no control measures are provided. However if full measures are provided the risk will be low.

Entrapment in or being struck by a moving and revolving part of the drilling equipment.

There may be a number of hazards, principally those of moving the drilling rig around the site, traps between reciprocating and fixed parts of the rig and revolving parts such as the drill rods and bit.

The primary hazards associated with the movement of equipment on site and dangerous parts of the drilling rig are an integral part of operating a mine.

Those most at risk will be persons having need to move and operate the drilling rig.

The risk of an accident occurring will be low if the dangerous parts of the equipment are properly guarded, operators are well trained and supervised and only those essential to the

work are involved in the activities.

However, the risk of an accident will be high if the dangerous parts are exposed and the operators poorly trained and supervised.

Explosives

Explosives by virtue of their nature have the potential for the most serious and catastrophic accidents in the mining industry yet the way they are used is an excellent example of how risk assessment is properly applied. For example no one would allow any person to use explosives with out first having been properly trained in its handling and use.

Increasingly use of explosives is specialist work. Planning for a round of shots is necessary to ensure that the face is properly surveyed, holes correctly drilled, direction logged, the weight of explosive suitable for good fragmentation and the continuity of the initiator are but a few of the steps necessary to ensure its safe use.

Poorly designed shots can result in misfires, early ignition and flying rock.

The more sophisticated type of explosive demands properly trained persons to carry out the blast design, charge and fire a round of explosives.

If within a company there is no competent person to do this work competent contractors should be engaged to carry it out.

Face stability

Face instability gives rise to rock falls or slides.

Face instability can arise because of adverse geological faulting or poor work methods.

Those at greatest risk will be face workers engaged in loading material and driving vehicles.

DIAGRAM 1

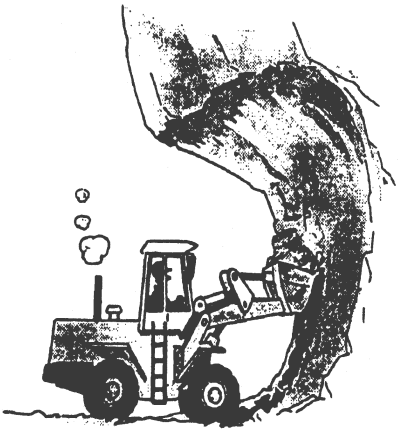


DIAGRAM 2

Before any loading takes place the face must be examined and remedial measures taken to make it safe if there is any doubt that a collapse could take place. The working of the face should be in a direction that has taken into account the geology such that the face and quarry sides remain stable.

Particular care must be taken to ensure that the working face at a sand and gravel mine is in proportion to the height of the loader in use.

Loading

The main hazard associated with loading is rock falling on to the driver, plant toppling over due to uneven ground, failure of hydraulic systems, fires and falls while gaining access to operating cabins.

Electrocution, and failure of wire ropes are added hazards with some dragline equipment.

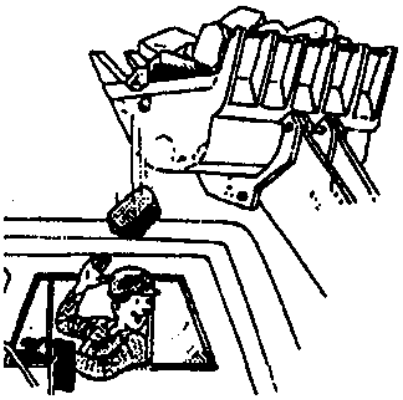


DIAGRAM 3

Good access must be provided to operators cabins which should be of suitable strength to protect the driver in the event of rock falling against the cab or if the vehicle rolls over.

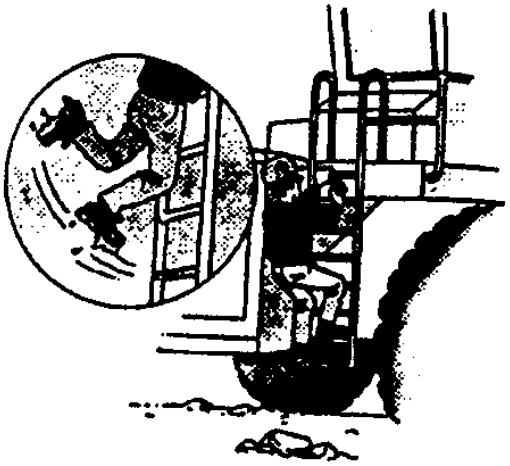


DIAGRAM 4

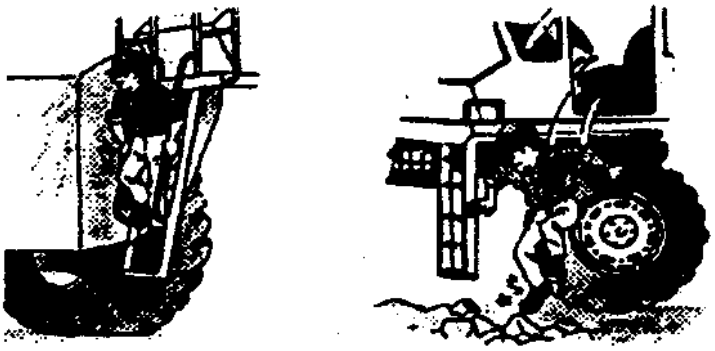


DIAGRAM 5

In addition it is necessary to ensure that the electrical supply to draglines is properly installed with adequate earth continuity and earth leakage protection. Also all wire ropes should the suitable for the work under taken and be examined periodically.

Added risks at sand and gravel mines is the danger of the loaders toppling over if not on secure ground. It is absolutely necessary to ensure that they are positioned sufficiently away from the face edge so that they are not liable to topple into workings.

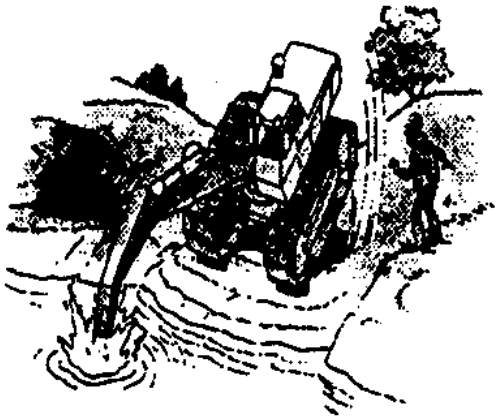


DIAGRAM 6

There is the danger of drowning at sand and gravel pits and suitable precautions must be taken in the form of training and provision and use of rescue equipment.

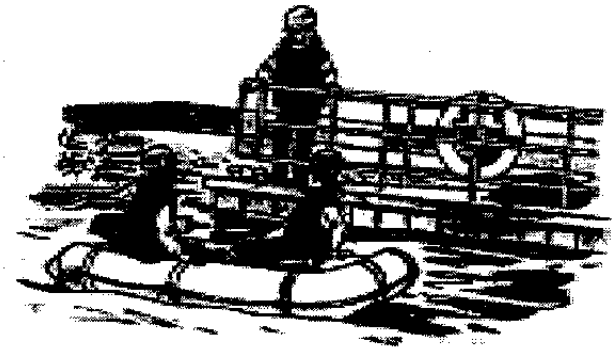


DIAGRAM 7

While the people at work are at most risk, ramblers and trespassers should be included in the risk assessment.

Hydraulic mining

Associated with mining for clay is the danger of using large quantities of water at pressure.

Those persons at risk are the operators and any other person who might move in front of the water monitors.

The risk of injuries can be greatly reduced by limiting access to the area to only those necessary for controlling the operations, and implementing a system of work such that the pumping and water supply is isolated when person's are carrying out maintenance or extending the system.

Wet working

There are particular hazards associated with winning minerals in water laden strata and in its storage and use in lagoons.

They are stability of the working face, stability of machinery, collapse of lagoon walls and drowning.

Those most at risk will be plant operators although a catastrophic failure of a lagoon wall could lead to serious damage outside the boundary of the mine. Access of the public to wet areas should be included in the risk assessment.

Preventative measures to reduce the risk of accidents include the working of the mine so that the winning does not undermine the stability of equipment. The provision of suitable and adequate fencing around the water laden area, the provision of suitable buoyancy aids for person's working on the lagoons and proper design, planning and building of waste tips where water could affect it and stability of lagoon walls etc.

Lagoon walls and tips should be regularly examined by competent persons to establish that there is no danger of failure which could lead to a slide or collapse.

Ornamental stone quarries

Ornamental stone quarrying produces blocks of marble and other ornamental stones for subsequent sawing.

The main safety problems involved arise from primary block extraction.

Most accidents are associated with the specific operations to separate the primary blocks from the rock ledge, toppling, subdividing the blocks at the quarry, and movement of the materials and equipment.

Initial separation and subdivision into mill blocks can be carried out using automatic drills, chain cutters or wire sawing with diamond or helicoidal wire, depending on the nature of the stone to be extracted and the operational choices made.

The current trend is towards greater use of equipment with wires moving at high speed, to allow greater square footage to be cut per unit of time.

Primary block extraction

As a preventive measure, trained workers must wash the block if necessary and check it for stability and flaws, depending on how it is to be cut. The shape of the block to be separated must be properly outlined.

When helicoidal wire saws are used, the wire must be arranged in the most suitable manner in order to safeguard workers near the sawing operation. In particular, guards must be in place

while the wire is moving and precautions taken in case it breaks.

When cutting is performed with a diamond wire saw, the tracks must be placed on well-levelled ground. Wear of the flywheel tread must always be checked so that no work has to be done once cutting has started.

The greatest risk to workers from diamond wire cutting arises from high-velocity projection of the beads if the wire breaks. Safeguards must therefore be provided for the cutting operation and the quarry in general.

The machine's control panel must be placed to one side of the cut plane and at an adequate distance, depending on the height of the cut. If several cutting operations are carried out on the same bench or quarry floor, the machines must be so positioned that the workers cannot be endangered by flying beads if the wire should break. If a mechanical cutter is used, it must be properly positioned to ensure machine stability and operator safety.

Subdivision into mill blocks and squaring

The cutting phase of this operation involves the same risks as primary block extraction and the same precautions must therefore be taken to ensure workers' safety.

Block toppling

Blocks which have been separated from the rock ledge may be toppled by means of inflatable bags, hydraulic jacks, hauling with ropes using a winch or bucket loader, direct pushing with a loader or tilting with an excavator.

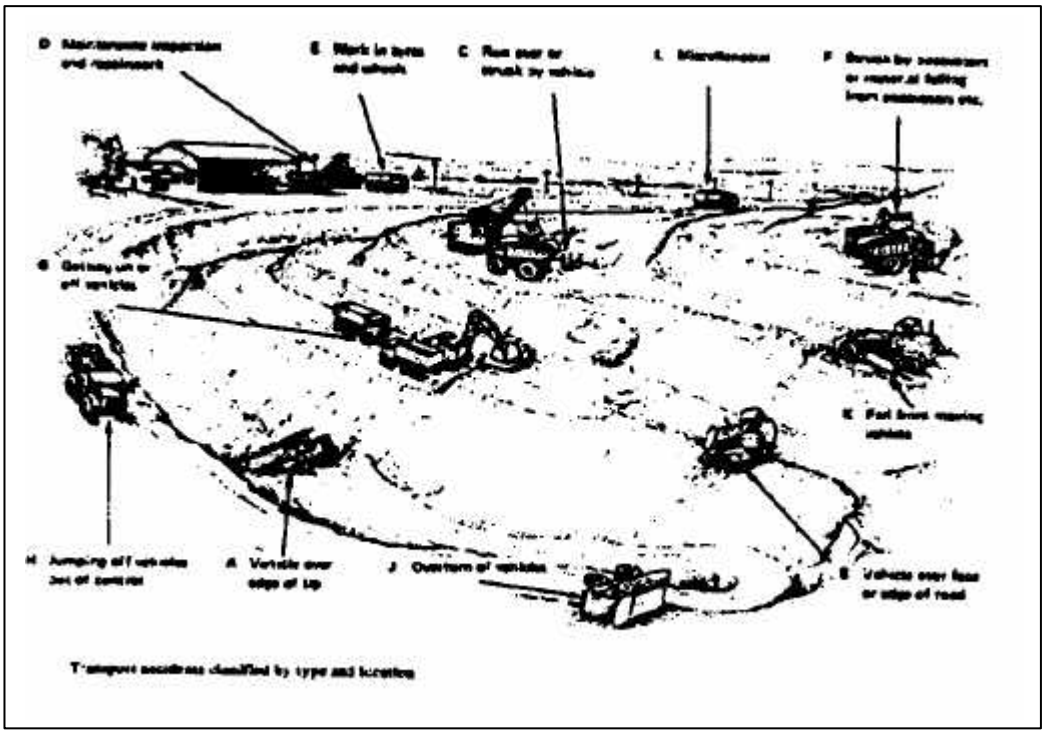
The main risk is that the workers involved may be crushed if the operation miscarries because the bearing surface is unstable or the block or traction equipment fails. Flying fragments may result from plant operation or the impact of the block striking the ground.

On-site block handling

The purpose of handling blocks in the quarry is to position them for subdivision and squaring, to store them in suitably prepared areas and to load the trucks for transport to the processing mill.

The material is moved with derricks or bucket loaders, which must be regularly maintained to keep them in good working order. It is particularly important to safety for the dimensions and surfaces of haul roads, benches and quarry floors to satisfy the operational requirements of the plant.

Surface Mining Operations
Section 2
Transport



This part of the publication is concerned with **transporting** the mineral.

Transporting

Transporting may be categorised as any means of moving the raw product from the working face to the process plant.

The usual method of transporting minerals from the working face is by truck. Large earth moving plant belt conveying systems are the norm for transporting mineral from the primary crusher and from the loaders used in sand and gravel pits. Additionally hydraulic conveying is often used in sand and gravel and clay mining.

This volume will deal with hazards associated with the equipment used.

Transporting the mineral

Heavy vehicles

The main hazards arising from the use large earth moving vehicles are incompetent drivers, brake failure, lack of all around visibility from the drivers position, access to the cab, vehicle movements particularly reversing, roll over, vibration, noise, dust and maintenance. Those most at risk are the driver and pedestrians likely to be struck by the vehicle, and drivers of smaller vehicles, which cannot be seen from the cabs of large vehicles.

Visibility defects can be eliminated by the use of visibility aids such as Closed Circuit Television (CCTV) rear view cameras with monitors situated in the drivers cab, radar and suitable mirrors. Closed circuit cameras are particularly helpful when reversing towards the edge of a working bench or tipping loads into primary crushers.

Edge protection is always necessary to prevent inadvertent movement over the edge of a roadway, a bench or into a crusher or hopper.

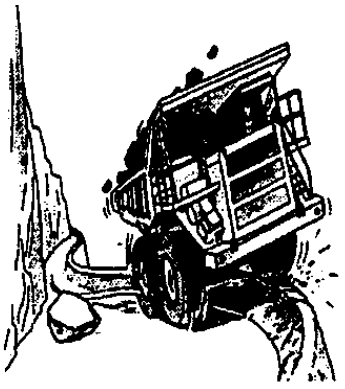


DIAGRAM 8

Seat belts will protect drivers in the event of a vehicle roll.

The risk of drivers falling as they gain access to and egress from cabs can largely be eliminated by the provision and maintenance of good access to the cabs and other parts of large vehicles where access is necessary. Any working platform on the vehicle should be suitably protected by outer edge rails.

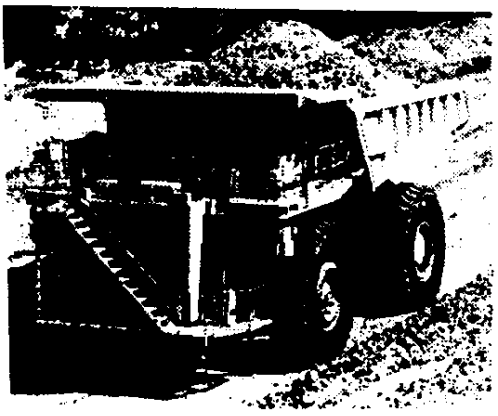


DIAGRAM 9

Good maintenance and regular testing are necessary to reduce the possibility of brake failure. An area should be set out as a testing area where daily tests are carried out on the effectiveness of a vehicles braking system.

Accidents often occur when vehicles break down. Dumper and similar tipper vehicles should be provided with a scotch or prop to prevent the free fall of components should the hydraulic ram system fail. Access to the vehicles should always be restricted to those people necessary for the work in hand.

Belt conveyors

The hazards associated with belt conveyors are mainly inrunning nips between the belt and driven and direction change rollers and falls from heights.

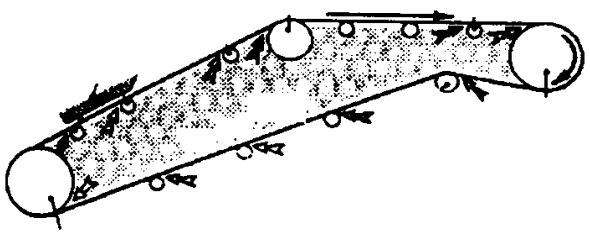


DIAGRAM 10

Those at risk are operators, maintenance staff, persons employed to clean spillage and others

using walkways to gain access to other parts of the plant.

Preventative measures include the provision of fixed guarding at all dangerous in running nips, to a distance as to prevent anyone reaching into the nip.

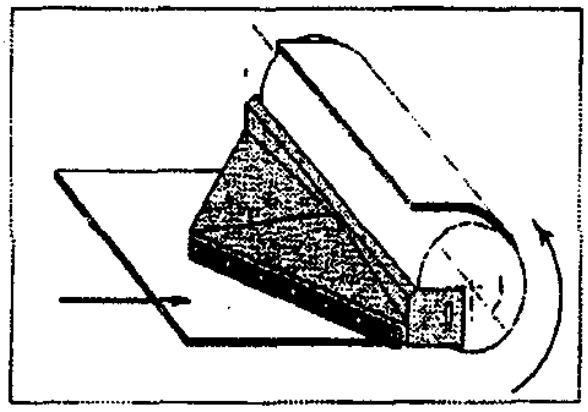


DIAGRAM 11

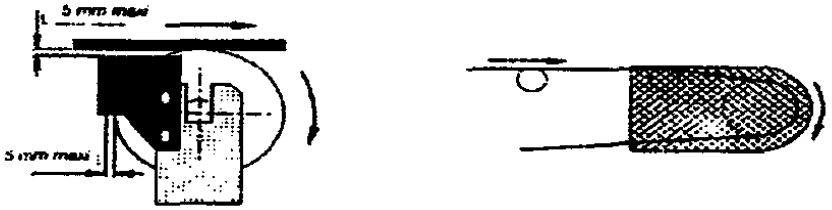


DIAGRAM 12

When for any reason it is necessary to remove the guards the belt system should be electrically isolated before any work is carried out.

Unless the conveyor has adequate capacity to carry the maximum load and has been installed at an inclination which eliminates spillage then provision must be made to allow cleaning spillage without removing the guards.

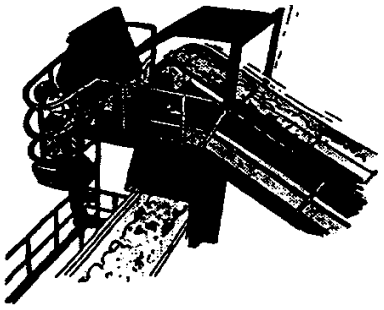


DIAGRAM 13

A means of isolating the electrical supply by the provision of switches which lock off the supply activated by pull wires along the length of conveyor runs should be provided.

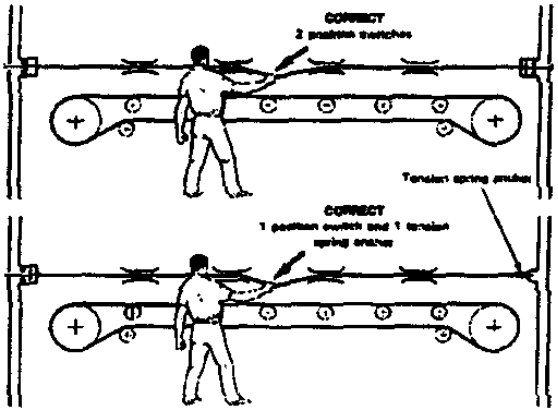


DIAGRAM 14

Falls from a height

Falls from a height often lead to fatal injuries. Many are due to the absence of, or poorly maintained, edge protection.

Adequate and properly maintained walkways and working platforms should be provided along the length of the conveyors. The open side of walkways and platforms should be provided with a suitable hand rail, lower rail and toe boards to prevent persons inadvertently slipping off.

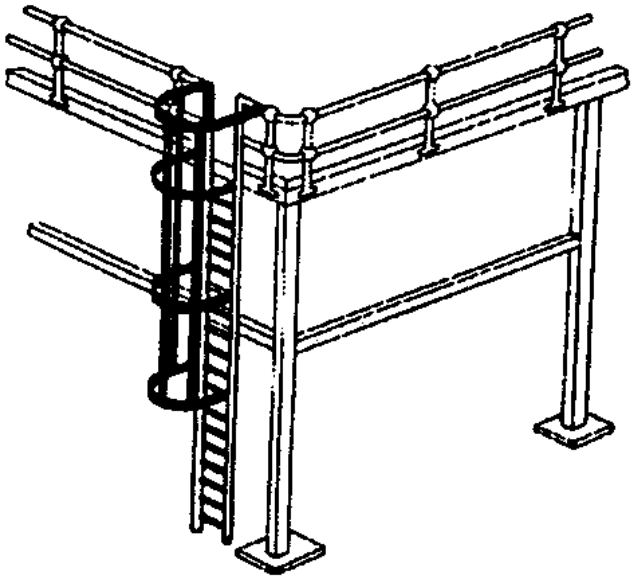


DIAGRAM 15

Proper arrangements should be provided for lifting heavy plant during maintenance work.

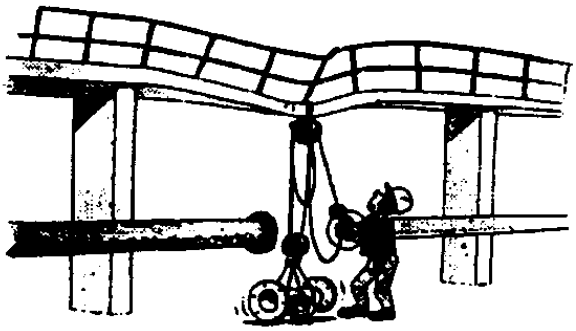


DIAGRAM 16

Hydraulic systems

The hazard is proportional to the pressure of the conveying system.

Those most at risk are the people at either the feed or delivery ends of the system. Should there be the catastrophic break in any other part of the system others may also be at risk .

The risk can be largely eliminated by good design, manufacture, installation and maintenance.

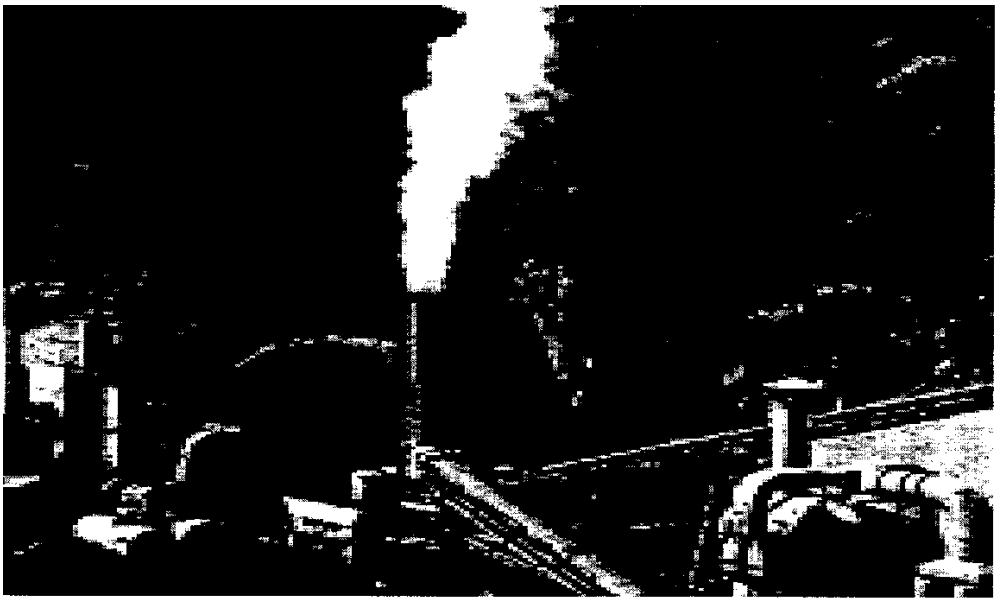
Other transport systems

Hazards associated with rail are not too dissimilar from self-propelled vehicular systems and include being struck by or crushed between trucks making up the train.

Those most at risk will be the users of the system although casual pedestrians and vehicle operators may also be at risk.

It is essential that rail systems are properly planned and managed to ensure that there is good control of rail and road traffic. Highly trained operatives and well maintained plant are essential.

Surface Mining Operations
Section 3
Processing



Introduction

This part of the publication is concerned with **processing** the mineral.

Processing

Processing is essentially sizing the material by means of crushing, milling, screening, washing, primary sizing within the quarry, sawing and splitting.

Processing the mineral

Crushing

The hazards are blockages, tramp metal, high noise and dust levels and vibration.

At risk are the machine operators, maintenance and cleaning staff.

The preventative measures include the use of hydraulic hammers to break up blockages and providing noise insulated control cabins which also have mechanical ventilation systems designed to remove any harmful dust. The cabins should also be provided with vibration damping devices to isolate them from any harmful vibration.

Careful attention must be paid to guarding dangerous parts of the equipment and handling heavy components during maintenance work.

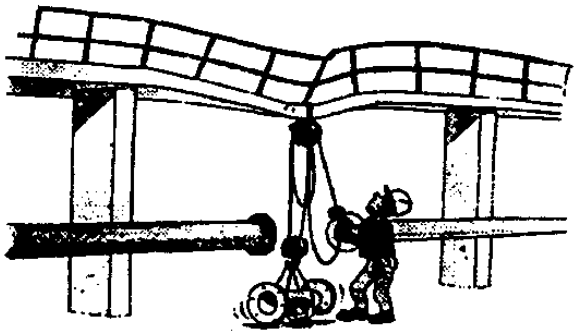


DIAGRAM 17

During maintenance work persons may have to enter some parts of the machinery which are confined spaces and need good isolation procedures to eliminate risks from oxygen deficiency, fires and explosion risks and engulfment by material.

Milling

The hazards are noise, dust, entrapment, confined spaces and chemical additives.

The risks are confined normally to operators and maintenance personnel.

Noise and dust hazards can be reduced by the provision of control cabins insulated to protect the operator from noise in excess of control levels and fitted with an air filtration system that protects the operator from inhaling harmful dust. Suitable personal protective equipment will need to be provided for maintenance personnel.

Dangers from the use of chemical additives can be reduced by the adoption of normal preventative measures such as substitution, implementing controls such as automatic piped feeds, personal protection and ventilation.

Screening

The main hazards are dust, noise and vibration, and falls from height during maintenance work.

The provision of a noise and dust insulated air conditioned cabin is sufficient during normal operations.

During maintenance work care must be taken to ensure that adequate temporary working platforms are provided as the screen system is dismantled to prevent person's falling through the resultant opening. It may also be necessary to provide people with suitable protective equipment to safeguard them against the inhalation of residual dust.

Sawing

This is normally limited to the processing of free stone such as slate, marble and granite.

The main hazards are noise and dust, particularly at circular saw machines, entrapment and manual handling.

The precautions to reduce the risk of injury include noise and dust insulated and air conditioned cabins, personal protection such as ear defenders, water sprays to suppress dust and training operators and their assistants to recognise the dangers when approaching reciprocating equipment.

The dangers associated with manual handling should be identified so that handling aids can be provided and the necessary training given to educate operators in the correct means of handling heavy, often irregular shaped material.

Splitting

The hazards are dust, noise and manual handling.

Those at risk are essentially the operators.

Preventative measures for dust is the provision of local exhaust ventilation preferably of the high velocity low volume type and dust respirators.

Noise prevention is limited to the provision of suitable ear defenders.

Manual handling difficulties must be identified, when possible suitable mechanical aids provided and good training for operators in the techniques of lifting and estimating loads and difficulty of lifting.