**MODULE NUMBER 11**
**OF**
**INSTRUCTION GUIDE NUMBER 40**

**ON-THE-JOB TRAINING**
**FOR THE**
**SAND, GRAVEL, AND CRUSHED STONE INDUSTRY**

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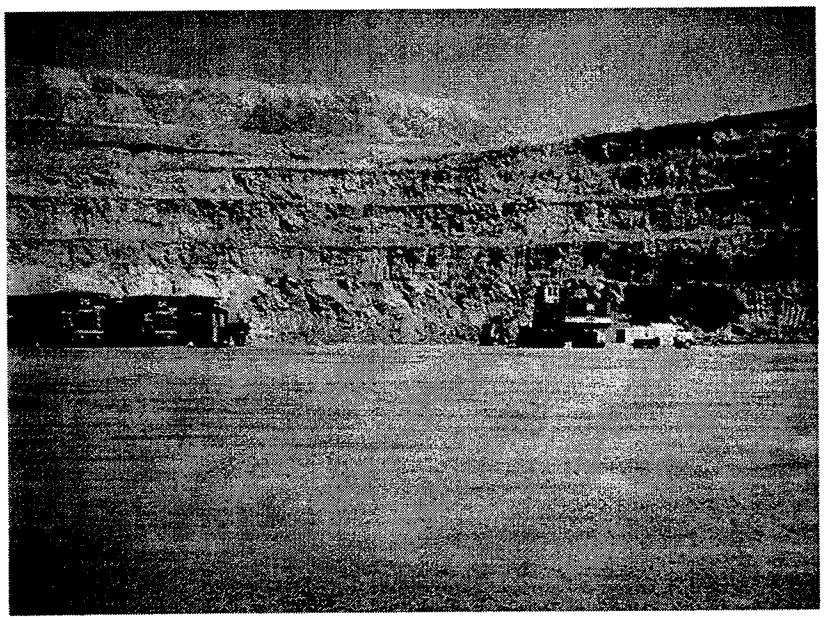
# GROUND CONTROL



This module describes basic job steps, potential hazards and accidents, and recommended safe job procedures for ground control. This module provides the miner with information on ground control, and hazards associated with highwalls, water pools, pits, spoil banks, and other dangers that are particular to sand and gravel, and to crushed stone operations.

This job is usually done by a supervisor, or a competent person assigned by the supervisor. The supervisor, or a competent person, must examine the working area and the working faces for unsafe conditions, at least at the beginning of each shift, and after blasting. Miners must

examine their working places before starting work, and frequently thereafter. Any unsafe condition must be corrected.

Highwalls must be controlled along haulageways, and all other work areas. A highwall is defined as the unexcavated face of exposed overburden and material on an open face or bank. Miners must be concerned with new mine development, as well as normal mining operations.

A variety of ground control hazards exist in sand and gravel operations, and in crushed stone operations. Very serious, and sometimes fatal, injuries can result from falls of highwall, and falling, rolling, or sliding material. All members of the work force need to know how to recognize these hazards.

Under federal regulations, standards for the safe control of pit walls, including the overall slope of the pit wall, must be established and followed by the operator. These standards shall be consistent with prudent engineering design, the nature of the ground, and the type of material mined; and shall ensure safe working conditions. Mining methods, including benching, shall be selected which will ensure wall and bank stability, in order to obtain a safe overall slope.

Three types of slope failure are the most serious hazards faced by surface miners: rock falls, plane shear, and rotational shear.

Rock fall slope failures are caused by planes of weakness. The most common types of rock fall slope failures are due to weaknesses caused by: bedding planes, fractured rock, faults, joints, and water pressure.

Plane shear (translational slope failure, or linear slope failure) occurs in highwalls or cliffs that have strata (layers) of different types of material. Most failures occur along existing fault planes, or other planes of weakness, causing a wedge shaped mass of earth to break free and fall.

Rotational shear (rotational slope failure) is uncommon in surface mining, because this type of failure usually occurs in banks, or highwalls, that are made of the same material throughout, with no natural planes of weakness. When a rotational shear does occur, a mass of the slope, or bank, breaks loose in a semi-circular, or bowl shaped form.

The highwall face should be uniformly straight. If a section juts out, watch for cracks that indicate that the section is about to fall. Be alert to potential slope failures promoted by extreme weather - rain, snow, freezing, thawing. A slope that is safe during dry weather can very quickly become unsafe during wet weather. Water control is necessary in order to minimize erosion of the highwall, and other slopes.

By being alert to possibly unsafe conditions, the miner is in a better position to be protected, see that appropriate corrective measures are taken, warn fellow workers of possible dangers, and change individual work habits when necessary.

Various techniques are used to control ground hazards, and reduce potential ground control problems.

Earth-moving techniques of ground control include sloping, benching, and stripping overburden above the highwall.

Sloping:

-- Establishes a stable angle of ground.

Benching:

-- Establishes terrace-like steps in steep hillsides.

-- Used to prevent slides.

-- When used for roadways, usually built so that two haulage trucks can pass each other.

Mechanical techniques of ground control include the use of rock bolts and barriers.

Rock bolts:

-- Are metal rods at least 4 feet long.

-- Have bearing plates between the bolt head and the rock, in order to distribute the bolt tension.

-- Are installed in holes that are drilled into the highwall in a predetermined pattern.

-- Are tightened to a proper torque, which needs to be checked periodically.

Barriers:

-- Are nylon screens, metal fences, baffle boards, or wooden posts and planks.

Maintenance techniques for ground control include: scaling loose rock, controlling drainage, and using explosives.

Scaling:

-- Miners must approach loose rock from above, and scale from a safe location. When there is a danger of falling, miners must be properly tied off.

-- When scaling loose rock, use a long scaling bar.

-- Front-end loaders, power shovels, or draglines may be used to scale hazardous rock.

Controlling drainage:

-- Horizontal drain holes, or vertical drainage wells, are used to reduce subsurface water pressure in highwalls.

-- Collector drains located above highwalls are used to divert surface water away from highwalls.

Explosives:

-- Are used to bring down overhangs.

The following safe job procedures will help minimize incidents which adversely affect production and cause injuries:

REQUIRED, OR RECOMMENDED, PERSONAL PROTECTIVE EQUIPMENT:
HARD HAT, STEEL-TOED SHOES, SAFETY GLASSES, HEARING PROTECTION

| SEQUENCE OF BASIC JOB STEPS | POTENTIAL ACCIDENTS OR HAZARDS | RECOMMENDED SAFE JOB PROCEDURES |
|---|---|---|
| 1. Examine working areas. | 1. A) Struck by falling material. | 1. A) Inspect working areas for:<br>1. Overhanging material<br>2. Loose rock<br>3. Vertical and horizontal cracks<br>4. Boulders, trees, or other material which might fall<br>5. Jagged sections of highwall<br>6. Undercuts<br>7. Fallen material<br>8. Debris<br>9. Compliance with standard procedures for degree of slope, benching, etc. |
| | B) Slips and falls. | B) Be aware of weather changes which affect ground conditions, including rain, snow, freezing, and thawing. Be sure all work areas are sufficiently illuminated to inspect ground conditions. |

| SEQUENCE OF BASIC JOB STEPS | POTENTIAL ACCIDENTS OR HAZARDS | RECOMMENDED SAFE JOB PROCEDURES |
|---|---|---|
| 2. Report and/or correct any hazardous conditions. | 2. A) Personnel entering unsafe area. | 2. A) Report immediately to supervisor any unsafe conditions not readily corrected. Barricade and post areas where unsafe ground conditions have not been promptly corrected. |
| | B) Struck by falling material. Ground failure under weight of equipment or persons. | B) Do not perform other work where unsafe conditions exist until unsafe conditions are corrected. Approach loose rock from above. Use scaling bar long enough to remain out of danger of falling material. |
| | C) Fall over highwall or bank. | C) Safety belts and lines shall be worn where there is a danger of falling. Stay at least 6 feet back from a stable creast. |
| 3. Perform drilling and blasting duties. | 3. A) Overturning drilling equipment. | 3. A) Travel with drill mast (boom) in lowered position. Do not travel on steep grades where sliding or overturning could occur. Watch for soft shoulders. |
| | B) Ground failure under weight of drilling equipment. | B) Inspect drilling area for hazards, such as cracks in bench, before positioning drill. |

| SEQUENCE OF BASIC JOB STEPS | POTENTIAL ACCIDENTS OR HAZARDS | RECOMMENDED SAFE JOB PROCEDURES |
|---|---|---|
| | C) Runaway equipment. | C) Set brakes. |
| | D) Highwall hazards (jagged or loose material, overhangs) from improper drill-hole angle. | D) Level drill. Be sure mast (boom) is set straight, or at proper angle, if angle drilling is done. Start drill hole slowly. Keep drill steel in guides. |
| | E) Highwall hazards from improper drilling pattern. | E) Drill all holes to depth and pattern established by plan. |
| | F) Struck by falling material. | F) When drilling on lower levels, check ground above and correct any hazards. |
| | G) Stepping into open drill hole. | G) Cover, or guard, any drill holes large enough to create hazards. |
| | H) Explosives and blasting hazards. | H) Load hole according to supervisor's instructions. |
| | I) Overhangs and loose material created by blast may give way under a person's weight. Overhanging frozen material during cold weather can be especially hazardous. | I) Inspect blast area after air has cleared. Proceed carefully - do not hurry to highwall edge to see results of blast. |

| SEQUENCE OF BASIC JOB STEPS | POTENTIAL ACCIDENTS OR HAZARDS | RECOMMENDED SAFE JOB PROCEDURES |
|---|---|---|
| | J) Caught or struck by shifting rock. | J) Perform secondary breaking of material as required. Work from a safe location. Position, or block, material (except hanging material) to prevent hazardous movement. |
| 4. Operate mobile equipment. | 4. A) Collision with obstacles in roadway, or equipment overturning. | 4. A) Watch for ground hazards, including boulders or other obstacles in roadway, or washed out roadbed. Adjust speed to visibility, roadway conditions, and traffic. Wear seat belts where provided. |
| | B) Failure of ground under weight of equipment. | B) At dump locations, dump material back from edge if there is evidence of unstable ground. Do not drive, or position, equipment too close to edge or on soft shoulders. Be aware of weather changes which may weaken or loosen ground, or conceal holes, ruts, or other roadway hazards. |

| SEQUENCE OF BASIC JOB STEPS | POTENTIAL ACCIDENTS OR HAZARDS | RECOMMENDED SAFE JOB PROCEDURES |
|---|---|---|
| | C) Running equipment over the edge of a road, or work area. | C) Build berms at outer edge of elevated roadways. Be sure berms, bumper blocks, or equivalent are provided to prevent overtravel and overturning at dump points. Keep all wheels or tracks on solid ground. |
| 5. Work around highwalls. | 5. A) Struck by falling material. | 5. A) Be especially careful of potential rock fall hazards when working on foot around highwalls. Do not work between equipment and highwall where equipment may hinder escape. |

## GENERAL INFORMATION

This module is part of an Instruction Guide that was developed to assist the sand, gravel, and crushed stone industry in conducting effective on-the-job training (OJT) of new employees, or employees reassigned to different jobs. The use of training materials, such as this module, is an important part of an effective, systematic, OJT program.

This Instruction Guide uses a generic Job Safety Analysis (JSA) of jobs common to the industry. The JSA format facilitates uniform basic training in safe job procedures, while requiring only a minimum of time and effort on the part of the trainer. This material is generic to the industry; therefore, each company using this guide will need to tailor the material somewhat to fit their particular requirements. In some cases, the material must be general in nature, and will not include specific details of procedures or equipment that must be taught by the trainer.

Recommendations for an overall OJT program are contained in the Mine Safety and Health Administration (MSHA) guide: "Structuring Effective On-The-Job Training Programs"

## TRAINING RECOMMENDATIONS

On-the-job training is usually best done by the employee's immediate supervisor. If the supervisor relies on another employee to do certain parts of the training, the supervisor should be present to monitor the training. OJT is conducted at the actual job site, where the work will be done.

The supervisor/trainer should use the training materials (this module, or other materials) while the training is being done, to help ensure that all job steps are covered, and that no important safety precautions are omitted. Effective OJT should begin with an explanation (lecture and/or discussion) of the safe job procedure. The explanation should be followed by a hands-on demonstration of the proper job procedure. A good demonstration is, perhaps, the most important part of OJT. The demonstration is followed by supervised practice, during which the supervisor/trainer coaches (corrects and encourages) the employee, and evaluates when the employee is ready to do the job without direct supervision.

The first step - explaining the job to the employee - can be done in different ways. The supervisor/trainer and the employee can sit down and go through the training materials together. It may be advantageous to provide the employee with a copy of the training modules that are applicable to his/her job. The fact that most of the training is conducted at the job site does not preclude the use of a classroom, or a quiet office, for the first part of the training. Any general theory, or knowledge training, as well as the initial explanation of the job procedure, may be best done in an office/classroom setting; especially when noise levels, or other conditions at the job site, make communication difficult. A complete series of job steps could be presented through the use of slides developed at the mining operation.