# ROOF SCREENING: BEST PRACTICES AND ROOF BOLTING MACHINES

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## ABSTRACT

Many injuries are caused each year by rock falls in coal mines. Most of these injuries are not caused by major roof collapses, but from falls of smaller rocks from the immediate top or roof skin. Various surface controls are used in mines to control this surface rock. One that has been found to be very effective is roof screening. Depending on the size of the screen, roof coverage approaching 100% can be achieved. Many mines are reluctant to use screen for primary skin control because of additional costs of time and materials, but others are having great success at both controlling costs and surface rock. Data is presented from two mines that show a dramatic reduction in roof skin injuries when screening is used. Much of this success is due to innovations in roof bolting machines. Four case studies of roof screen experience are presented along with associated costs of materials, impact on bolting advance rates, and potential ergonomic risks. The effects of roof screening on skin control and safety are also included. Finally, this paper will provide information about features of different roof bolting machines that affect production and safety.

## INTRODUCTION

The chances are high that anyone who has worked at a coal mine face area has been struck by or injured from falling rock. These chances are even greater if the miner was a roof bolter operator. From 1995-1999, an average of 700 reported injuries per year, including 1 or 2 fatalities per year, resulted from rock falls of coal mine roof. All of these injuries occurred under supported roof. The majority of these injuries, about 99%, are not caused by a major roof collapse, but from falls of smaller rocks from the immediate roof (1).

This type of roof failure has also been termed skin or surface fall. These are falls that do not extend more than a few ft into the roof. The supports used to prevent these falls are called surface controls. Greater use of surface controls has been found to decrease roof skin falls, decrease the likeliness of an injury, and possibly reduce clean up time.

Coal mines make use of various surface controls such as large roof bolt plates, steel straps, header boards, large bearing plates, and steel screen or mesh. Each control has its own application and effectiveness depending on the geology of the roof and the life of the entry in which it was installed. Some roof is of such poor quality that nothing short of full coverage will provide the best protection. In such adverse conditions, roof screen can provide the necessary protection for miners. Figure 1 shows roof screen effectively controlling weak roof skin.

Figure 1. Roof screen effectively controlling weak roof skin.

Unfortunately, many operators, especially in the eastern United States, do not yet think of screening as an appropriate support, especially in cycle. There are a number of barriers, which prevent its full acceptance, including material costs, time for installation, and possible ergonomic risks to the operators. Handling of screen can be difficult, especially with an aging workforce. The concern is that the use of roof screen may increase the likelihood of musculoskeletal injuries such as strains and sprains. One factor affecting these injuries is the design of the roof bolting machine utilized.

The purpose of this investigation is to provide information about roof screening and the current practices used today, and to address barriers preventing acceptance of this support. Analyses of injury data pertaining to roof screening, along with a review of four case studies of roof screening are included in this report. In addition, a state-of-the-art roof bolting machine with a new material handling system (MHS) is discussed. This system focuses on eliminating difficulties with loading and handling screen and as well as other roof bolting supplies.

## EFFECTS OF ROOF SCREENING ON SKIN CONTROL

The mines visited for this study had a variety of roof skin conditions that were difficult to control. The roof skin commonly consisted of clayshale, soapstone, or highly laminated shale. The rock was of poor quality. Clay veins, slickensides, and/or potting were problematic. Roof skin fell immediately during mining or soon after between bolts because of three primary factors: weak rock, horizontal stress, or weathering.

An advantage of using roof screen is the large amount of coverage achievable compared to other surface controls. Close to 100% roof coverage can be achieved. Taken from a recent study conducted by the National Institute for Occupational Safety and Health (NIOSH), a mine with 18-ft entries using a 16 ft x 6 in steel strap every 4-ft of advance achieves an 11% roof coverage. If the mine used 13 x 5 ft sheets of screen (4-in grid), it can achieve 72% coverage (1).

While some mines use plastic geogrid screen for surface control, most that are currently roof screening make use of steel wire sheets with a 4-in grid pattern. Screen can be ordered in many sizes depending on the coverage desired or attainable. One problem is that the reach of some bolting units limits how far screen can be bolted toward the rib. A gap may exist between the end of the last bolt and the rib, allowing guttering to occur. To combat this problem, brow tenders (also known as short straps or extended straps) can be used to extend the coverage of roof screen. Bolting machines capable of installing angle bolts also make it possible for the roof screen to be extended further to the rib. Figure 2 shows how roof screen can be supported to within in from the rib. In this figure, 94% roof coverage was achieved by roof screening.

Figure 2. Roof screen achieving up to 94% roof coverage.

Besides screen size, sheets can also be ordered in different steel gauge strengths. These strengths (2) along with the rock load height they support are shown in figure 3. The rock density used to calculate rock load height was 162 psf. All the mines visited during this investigation used 8-gauge steel wire sheets with a 4-in grid pattern capable of supporting 2.1 ft of roof skin. This is quite sufficient to contain most skin falls, especially after weathering effects.

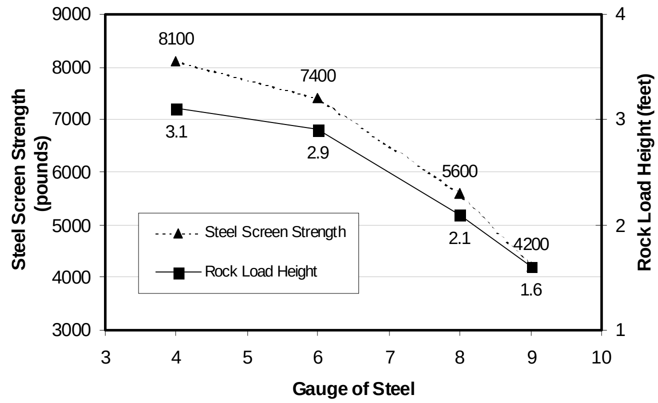


Figure 3. Different strengths and rock load heights for 4 gauges of steel screen.

## THE EFFECTS OF ROOF SCREENING ON SAFETY AND ERGONOMICS

The Mine Safety and Health Administration (MSHA) injury data from two mines was analyzed to determine the effect of screening on safety. One, located in the northeastern U.S., had roof conditions that deteriorated to a point where roof screening was necessary everywhere. After screening was implemented, injuries dropped from an average of 14 to 3 per year (figure 4). At the other, in the central U.S, similar circumstances were encountered that required roof screening. Injuries there subsequently dropped from an average of 7.0 to 0.25 per year (figure 5). Clearly, screening can dramatically reduce rock fall injuries.

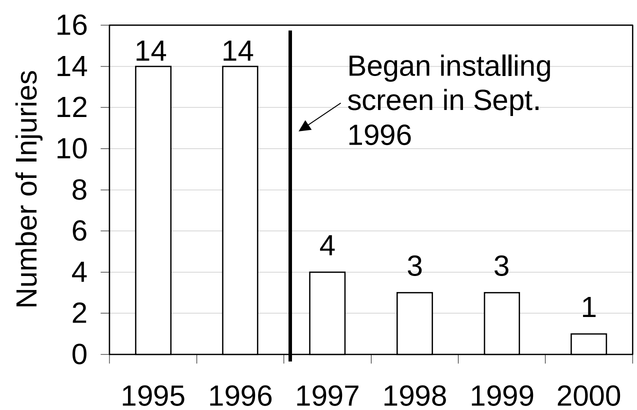


Figure 4. Number of skin fall injuries per year at a northeastern U.S. mine before and after the implementation of screening.

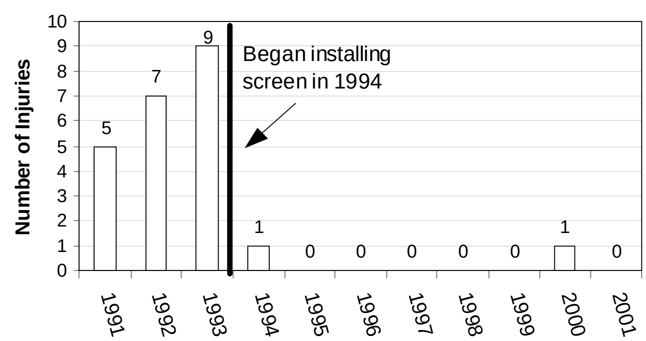


Figure 5. Number of skin fall injuries per year at a central U.S. coal mine before and after the implementation of screening.

This effectiveness of roof screening may be due to its being the only type of skin control that protects roof bolter operators during the drilling process. The screen is placed against the roof when the ATRS is raised. According to a study conducted by the U.S. Bureau of Mines in 1993, drilling is the most hazardous job task performed by the bolter operator, producing 31.4% of all roof bolting injuries. Out of these drilling injuries, almost half (45.9%) were due to falling rocks or coal from the roof. (3). Therefore, this immediate protection while drilling is quite significant. These percentages may be slightly lower now because of the higher use of roof bolter canopies.

There is also a cost savings when injuries are prevented or decreased. In 2000, NIOSH created a model to estimate "societal" costs for MSHA lost-time injuries (4). The average cost for this injury type (injuries from roof due to broken rock or coal) from 1997-1999 was $9,937 per injury. This cost is specific for underground coal mines at the face area and does not include outby injuries from roof skin falls. The cost to the mine may be higher because this model does not take into account the cost of damaged equipment/materials, replacement, or retraining. For example, the cost savings from the reduction of injuries for the mine in figure 4 would be over $100,000 per year. This is achieved by reducing lost-time injuries from an average of 14 to 3 per year.

Even though roof screening has been shown to reduce skin fall injuries, a concern remains that material handling injuries may increase due to increased materials and supplies. Additional materials and bolts used in conjunction with roof screen offer a challenge for the roof bolter operator. Roof bolting machines do not have space to hold roof screen and associated supplies. In one instance, a mine needs 4-ft bolts to install the first sheet of screen in a new cut where the primary support is already in place. Also, 12 x12 in header boards (figure 2) made of plywood are needed to place between the screen and the bolt plate to avoid damaging the screen.

Besides additional materials and not enough storage capacity on roof bolting machines, screen handling is also a challenge for the operators. The hand loading of roof screen onto the machine occurs quite often during uneven and muddy floor conditions. Overhead lifts and awkward positioning, along with lifting, pulling, and twisting movements, may have negative ergonomic consequences on operators.

In addition, sheets of screen can be cumbersome to handle. A 16 x 5 ft sheet of 8-gauge steel weighs approximately 30 pounds. Therefore, handling screen may increase the chance of musculoskeletal injuries such as sprains/strains. This is a significant issue. As much as 29.7% of all mining industry lost time days (1997-1999, excluding fatalities) are from strain/sprain injuries of the back, knee, or shoulder. Also, 27% of all lost time days were from material handling injuries. Using the NIOSH cost model, the average cost of material handling injuries from 1997-1999 was $22,284 per injury (4). Therefore, an increase or difficulty in material handling should be a major concern for mine operators. Any innovations in bolting machines, supplies, or processes that could eliminate or reduce material handling are worthy of consideration for the safety of the workforce.

## THE EFFECTS OF ROOF SCREENING ON MATERIAL COSTS AND BOLTING ADVANCE RATES

Two barriers to roof screening are material costs and slower bolting advance rates due to screen handling. A comparison of material costs was recently conducted by NIOSH between the use of steel straps and roof screen. Costs for roof bolts and plates were not included. The cost of a 16 ft x 6 in steel strap was $8.00. The cost of a 13 x 5 ft sheet of 8-gauge steel screen was $10.32. Assuming a 4-ft spacing between straps and a 12-in overlap between sheets of screen, the material cost per foot of advance for steel straps is $2.00. The cost per foot of advance for steel screen is $2.58. As previously mentioned, the roof coverage in an 18-ft wide entry was 11% for steel straps and 72% for roof screen. The use of roof screen provides a significant increase in roof coverage (61%) with only a $0.58/ft increase in costs over the use of steel straps (1).

The other barrier to the widespread use of screen for primary skin control is the additional time and labor required to handle and install. Four in-mine studies to document the impact of screening (in cycle) on bolting advance rates are presented below. For these studies, only activities that delayed the bolting advance rates were considered as time to handle the screen. For example, a scoop operator delivering screen to a cut does not slow down bolting. But, the time taken by the roof bolt operators to load the screen onto the bolter and then handle these sheets does slow down bolting. The following factors influence the bolting advance rate and labor costs as well as safety when handling and installing screen:

1. Design of the bolting machine – storage and maneuverability to handle screen, and the positioning of the roof bolt operators.
2. Installation procedure for handling screen and loading it onto the bolter.
3. Number of persons involved in handling screen.

**CASE 1**

A mine in central West Virginia recently began roof screening because of difficulties with a weak claystone, weathering, clay veins, and potting. In general, the newly exposed roof skin shows little damage, but can be expected to deteriorate in 3 to 4 months after mining. The coal mine roof rating (CMRR) is 22, which is in the weak to very weak range. The CMRR, ranging from 0 to 100, is the NIOSH system for classifying the integrity of a coal mine roof (5).

Two roof bolter operators and one bolter helper install roof screen. They operate a J. H. Fletcher DDR, twin boom bolter with mast feed that enables angle bolting. The mining height is 65 to 75 in and entries are 18 ft wide. They install 8-gauge steel screen that is 13 ft long and 5 ft wide. An overlap of 6 to12 in between sheets makes for a 4- to 4.5-ft of advance per sheet of screen. Because the sheets are only 13 ft long, the potential of guttering along the ribline still remains.

Activities included in installing mesh are the following:

- The scoop pulls up behind the bolting machine loaded with screen.
- The roof bolter helper and scoop operator then load approximately 10 sheets (1 or 2 cuts) onto the rear of the machine on top of bolting supplies. During this time, primary roof bolting operations and screen installation are not interrupted.

- After each 4-ft of advance, the ATRS is lowered and an auger is placed in the chuck to help control movement of the screen on the ATRS
- Operators then lift and carry the sheets from the rear to the front of the machine, then onto the lowered ATRS.
- Operators center the screen across the ATRS, maneuver into position for a 6-in overlap between sheets, and raise the ATRS. At this point, the screen handling time is over unless the screen needs to be adjusted.

No time can be attributed to the loading of screen because the roof bolter helper and scoop operator do it. It takes an average of 1.72 minutes to place each sheet of screen onto the ATRS and slide it into position, per 4-ft of advance. For a bolting advance of 120 ft per shift, screening time would add an additional 52 minutes per shift.

During this screening process, operators encountered ergonomic problems and time delays due to material handling. The screen sometimes snagged on bolting materials or on other pieces of damaged screen. The damage occurred when the scoop moved the screen from place to place before loading it onto the bolter. The screen also got damaged when tramming around corners. Because of this damage, the operators had to jerk the sheets apart from each other, therefore subjecting themselves to injury.

Also, the sheets were cumbersome to handle, and involved lifting, pulling, reaching, and twisting motions. The bolters had difficulty keeping the screen from sliding around on the ATRS. Twice during the study, the screen slid inby the ATRS making the sheets difficult to recover. This sliding made up a majority of the time spent on handling screen.

In summary, the screen effectively controlled the roof. The timely use of screening minimized skin hazards in high travel entries and reduced cleanup. However, even with three miners, the crew struggled with the installation procedures. This may have been partially owing to the recentness of screen implementation at this mine. The miners had not yet adjusted to the installation procedures. Lost time for installation and ergonomic risks were hurdles that this mine must combat.

**CASE 2**

A mine in the northeastern U.S. has been screening because of difficulties with clay shale roof, which is highly slickensided and brittle. It appears wet, but is actually glassy due to the extreme number of slickensides. Loose rock falls immediately upon mining and also spalls out because of mine humidity. Miner operators normally must cut down 3 to 30 in of drawrock and try to hold the rest with screen. The CMRR at this mine is 19-33 and is in the weak to very weak range. They install screen mine-wide. The mine claims that without the use of screening, mining would be very tough due to an increased cleanup time, higher risk of injury, and slower bolting advance rates.

Two roof bolter operators and one bolter helper, also serving as a rib bolter, install roof screen. In the mine's approved roof control plan, roof screening and rib bolting must occur in cycle. The rib bolter operator installs two rib bolts and still has time to help the bolter operators handle roof screen. The bolting machine is a Fletcher CHDDR walk-thru bolter. A rib bolting machine, retrofitted onto the bolter, inhibits screen from being loaded onto the rear of the bolter.

Entries are an average of 16.5 ft wide. They install 8-gauge steel sheets of screen that are 14 ft long and 5 ft wide. The sheets extend to within 1.25 ft from the rib after screen installation. Screen installation activities are the following:

- The scoop operator delivers screen for each cut along the rib.
- The rib bolter carries the screen along side of the bolter and then lifts the screen up to the roof bolt operators.
- The roof bolters grab and pull the screen up and across the ATRS..
- Operators center the screen across the ATRS, maneuver into position for a 6-in overlap, and raise the ATRS. At this point, the screen handling operations are complete unless screen adjustments are required.

It takes an average of 0.42 minutes to handle each piece of screen per 4-ft advance. This time includes operators waiting for and taking the screen from the rib bolter operator, and then placing it across the ATRS. Any adjustment of screen position was also included. The total bolting time for a 4-ft advance, including drilling, installing, maneuvering, setting the ATRS, and screening, was 8.36 minutes. The screening time comprised only 5% of this total. For a bolting advance of 120 ft, screening would add an additional 12.6 minutes. Mine management feels that this is a small price to pay for superior roof coverage and decreased risk of injury (figure 4).

Some difficulties or concerns are that the screen can get damaged when moved around by the scoop. The rib bolter must carry the screen along the side of the bolter, making it difficult to see his/her footing. The screen must be lifted from the ground to an overhead position, putting the person at risk of musculoskeletal injury. Adding to these problems, the walk-thru bolters is about 1.5 ft higher because of the elevated walkway.

The bolter operator can load the screen from either the back or side of the machine. But because it is easier, the bolters choose to load screen from the side. This positioning between the rib and the machine can subject operators to potential injury from rib falls and machinery accidents. This mine did not have difficulty in keeping the screen from sliding on the ATRS because of operator positioning. While under support, one operator was able hold the screen in place from the center while the other raised the ATRS. This in an advantage of using a walk-thru bolter.

In summary, roof screen effectively controls the roof surface and has been proven to dramatically decrease roof skin injuries. The mine has been roof screening for over 5 years and operators have adjusted quite well to the installation procedures. The mine can install screen with only a 5% increase in the bolting advance rate utilizing the labor of 3 miners. The positioning of the operators using the walk-thru bolter enables them to control movement of the roof screen. However, an ergonomic risk may be present due to the installation procedure.

**CASE 3**

This mine, located in Illinois, has a weak, laminated shale top with a CMRR of 22. The unconfined compressive strength is 2,500 psi. Poor conditions were due to three primary factors: weak roof, horizontal stress, and weathering. After moving from much better roof conditions to the weaker roof, the mine's strategy to control this top was to begin installing roof screen. It has been found that not only does the steel screen support the roof, but also injuries due to rock falls dramatically decreased at this mine from an average of 7 to 0.25 per year (figure5).

Two roof bolters load and handle roof screen, and operate a Fletcher CHDDR walk-thru bolter. There is a storage area at the rear of this bolter for bolting supplies, with roof screen loaded on top of these supplies. Mining height ranges from 7.5–9 ft. Entries are 16 ft wide and dimensions of the screen are 15 x 5 ft. The screen extends to within 6 in from the rib for an effective roof coverage of 94%.

Activities included in installing and handling screen during this study are the following:

- The scoop operator spots screen at an outby entry.
- Bolter operators back up the machine to where the screen is spotted, then load enough sheets (5-7) to bolt the next cut.
- After each 4-ft advance, the ATRS is lowered and one bolter operator walks back to where the screen is stored.
- Next, the operator lifts and pulls the screen towards the front of the bolter, swings the screen towards the other operator, and they then place it across the ATRS.
- One operator holds the screen in place from the middle of the machine, while the other raises the ATRS. At this point, the handling time is over unless the screen needs adjustment.

It takes an average of 0.73 minutes to load each sheet onto the rear of the bolter. It then takes 0.72 minutes to place the screen onto the ATRS, including an adjustment for sliding. The total time handling screen is 1.45 minutes per 4-ft advance. For a bolting advance of 120 ft per shift, screening time would add an additional 39 minutes. With the walk-thru bolter, sliding of the screen is minimal because an operator is able to hold the screen in place.

Because the sheets are quite long, sheets of screen can get damaged while making a turn. Damaged wires on sheets snag on other sheets. Sometimes the screen gets caught on the bolting materials stored underneath. This makes it difficult for operators to remove the sheets from each other or from the supplies. In addition, it is strenuous to lift and pull the screen to the front of the bolter. The operator must lift the screen overhead and then twists before the other bolter handles the sheet. The screen must be placed over the bolter canopies and on top of the ATRS.

Like Case 2, roof screening at this mine effectively controls the roof surface and has been proven to dramatically decrease roof skin injuries. The walk-thru bolter allows the operators to better handle the roof screen. This mine has been screening for over 7 years and installation procedures have become routine. Installation time was not as low as Case 2, but only two roof bolter operators installed the screen instead of three. An ergonomic risk may be present due to the awkward positioning, pulling, and overhead lifting during screen installation.

**CASE 4**

Case 4 is from a different section at the same Illinois mine in Case 3. The section uses a Fletcher CHDDR walk-thru bolter equipped with a material handling system (MHS) shown in figure 6. This state-of-the-art system has many features that reduce material handling and address ergonomic principles. There is a separate screen tray that minimizes the potential for screen damage and snagging on other supplies. Bolting supplies are not hand-loaded onto the bolter while underground, but are loaded outside by vendors into material pods (figure 6) and then brought into the mine on supply cars. A larger left pod and smaller right pod contains supplies such as bolts, plates, headers, and resin boxes. These pods are also pulled onto the bolting machine by a winch.

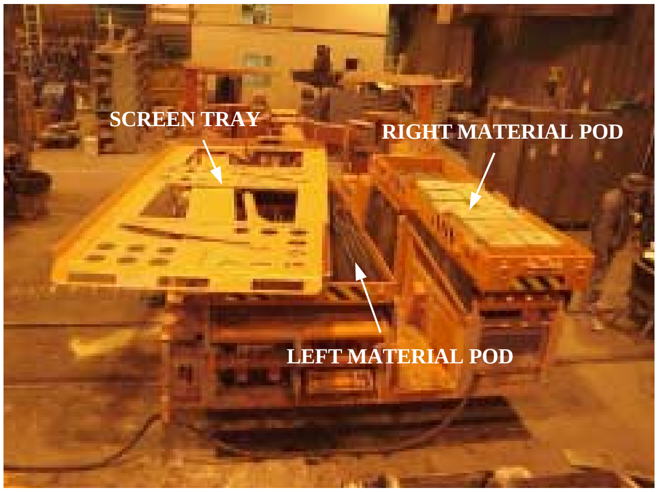


Figure 6. The J.H. Fletcher material handling system: left and right material pods and roof screen tray.

Bolter tram and the movement of the screen tray, material pods, and winch are all controlled remotely. For roof bolt operators, the only hands-on activity is to hook up the winch rope to the screen and pods. Then the machine does the rest of the work with operations being remotely controlled.

In this case study, activities for operators installing screen are the following:

- The scoop operator drops off a bundle of mesh containing 25 sheets behind the bolter.
- Utilizing remote control, the operator extends the screen tray toward the rear of the machine. The front and rear lift cylinders decline the tray towards the mine floor. The tray is placed at a ramped angle making it easier to pull screen onto the tray.
- The winch rope is hooked to the bundle, and then the screen is pulled onto the tray. The tray can move in 8 directions enabling it to be positioned so that the screen is pulled on straight.
- The tray is then secured in place with a pin and sleeve assembly and the winch attachment is then disconnected.
- The tray is then lowered and moved toward the center of the machine protecting the screen from damage when tramming around corners.
- At the next cut, the screen tray is raised to an ergonomically friendly elevation so that each sheet is pulled straight off without lifting the sheets.
- The screen is then handled and installed the same as in Case No. 3.

It takes a total of 3.9 minutes to load a bundle of screen onto the tray, which is an average of 0.16 minutes per sheet. It then takes 0.68 minutes to handle each sheet of screen. The total time for handling and installing is 0.84 minutes per sheet or 4-foot advance. For a bolting advance of 120 ft per shift, roof screening adds 25.2 minutes. Compared to Case 3, the time for placing screen onto the ATRS is very similar. But because of the MHS, load times were lower by as much as 0.6 minutes per screen. In addition to the timesaving, the operators' exposure to ergonomic injury is decreased significantly.

e strain/stress is reduced in handling screen because the operator can pull off the screen at a more comfortable level. The screen has less chance of becoming damaged because the bundles are handled less and do not get damaged when turning corners. Roof bolters do not have to struggle to retrieve bolting materials because the screen is on a separate tray. Fatigue is reduced because operators do not hand-load screen and supplies. The large sheets of screen would obviously cover the walkway when loaded onto the machine. This would not allow a clear exit from the machine boom in case of emergency. But by design, the tray has eight directions of movement and can be moved out of the way.

In summary, roof screening effectively controls the roof surface and has been proven to dramatically decrease roof skin injuries. The screen handling time was lower than Case 3. This is due to the loading procedure of the screen. Compared to case 2, the handling time was slightly higher, but only two roof bolter operators are needed instead of three. The material handling system practically eliminates the hand loading of screen and provides an easier method for handling the screen reducing ergonomic risks to the operators.

## ADDITIONAL FEATURES OF THE MATERIAL HANDLING SYSTEM

Timesavings can be achieved when loading bolting supplies with the MHS. A comparison was made of operators loading supplies in Case 3 and Case 4. In Case 3, it takes 3 men approximately 13 minutes to hand-load a shift's worth of supplies onto the bolter. In Case 4, it takes 2 men about 6.0 minutes to load the left and right material pods onto the bolter, including the removal of the empty pods, based on accounts of bolter operators and mine personnel. Each pod contains a shift's worth of materials. Any supplies left on the empty pods are taken outside, removed by vendors, and credited to the mine's account.

Material pods are easily pulled onto the scoop bucket because the pod height is low enough to be pulled under the scoop ram. Both the left and right pods can fit into the scoop bucket. The pods are pulled onto the bolting machine directly off of the scoop. The machine has a rear lift system that places the rear bumper on the mine floor. This creates a ramp that allows the material pod to be pulled onto the machine. The pod is manufactured with guides on each side that run its full length and mate with the runners on the machine frame. These guides also secure one pod atop another for transportation into and out of the mine. The bottom of the pod is exposed to rollers on the frame that reduce the force required to pull the pod onto the machine. Once loaded, pins are placed through the pods and machine frame to keep the pod in place.

These pods are loaded by remote control without the necessity of an operator near the machine. The operator has better visibility from remote controls because he has freedom to move around the machine. Comparing Case 3 and 4, there is a significant decrease in exposure to injury due to the MHS. All trips made to the roof-bolting machine while hand loading supplies are eliminated. The risk of sprain/strain, slip/trip, crush, or cut type injury is reduced.

Designed in the MHS are flattop canopies and rounded ATRS edge pads. These features reduce the physical effort required to move the screen into place. They reduce the likelihood of material snagging. There is another safety feature for controlling the movement of screen. Clamps are built onto the ATRS that hold the screen in place while being raised. Once the ATRS is against the roof, these clamps retract. The operators in Case 4 do not have many problems keeping the screen in place because of the walk-thru bolter unless they are in bad top. In that case, they find the clamps to be very helpful. The operators in Case 1 may have benefited from these clamps because positioning with the bolter makes it difficult movement of the screen.

## SUMMARY AND CONCLUSIONS

The use of screen has been found to be very effective in controlling roof skin. Compared to other skin controls installed in cycle, roof screening provides the most coverage for the mine roof. Analyses thus far from mines using roof screen have shown that injuries from rock falls have been reduced dramatically. This may be due in part to the protection roof bolter operators receive during the hazardous drilling process. Increased acceptance of regular, in cycle roof screening in adverse conditions should help reduce the number of skin fall injuries annually.

Time studies documenting the handling and installation of screen have been presented. Results show significant variation in the additional time necessary for screening. This reflects the experience and resources of the individual mine. A lower bolting advance rate is a barrier that can be reduced with time and practice.

There is a concern, though, that injuries from handling screen may be increased. The additional materials and awkward positioning can increase fatigue for roof bolt operators. The design of the roof bolting machine affects the costs of loading and handling screen times, manpower requirements, and ergonomic exposure to risks. The new J.H. Fletcher materials handling system is a state-of-the-art system that decreases material handling of roof screen and supplies. It reduces the risk of injury, screening time, and damaged materials. Examples like the J.H. Fletcher MHS show how equipment manufacturers are willing to listen to the needs and suggestions of a safety conscious mine operator to create a safer workplace for miners.

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