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Bureau of Mines Damage-Resistant Brattice

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By Edward D. Thimons, Joseph E. Matta, and Fred N. Kissell

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ILLUSTRATIONS

BUREAU OF MINES DAMAGE-RESISTANT BRATTICE

by

Edward D. Thimons,[1] Joseph E. Matta,[2] and Fred N. Kissell[3]

ABSTRACT

The Bureau of Mines has developed a damage-resistant brattice, intended for use as a stopping in locations where blast damage to stoppings is a problem, the roof is relatively flat, and the differential pressure across the stopping is not high. Damage-resistant brattices consist of a series of vertically hung brattice panels joined to each other by Velcro connections that improve the airtightness of the brattice. When the brattice is subjected to strong blast forces, the Velcro connections peel apart, allowing the panels to open without incurring damage. The Velcro connections can then be resealed in a matter of minutes.

A preliminary test in the Bureau's Safety Research Mine and subsequent long-term testing at the White Pine copper mine in Michigan and the Retsof salt mine in New York show that damage-resistant brattices withstand blasting better than conventional stoppings, while still performing as efficient air barriers when the Velcro connections are sealed.

INTRODUCTION

Many hardrock mines, particularly those with large airways, have difficulty maintaining stoppings near working areas because of the strong blast forces to which they are regularly subjected. Rigid stoppings of concrete block or timber are expensive and time consuming to build. Although they are good air seals, they are constantly damaged or destroyed by blasts because of their inability to yield to blast forces.

A conventional alternative to these rigid stoppings comprises brattice stoppings formed by hanging a series of vertical overlapping panels of brattice cloth. These panels are generally 6 to 8 feet wide and can hang free or be pinned together with nails. If the panels hang free, the stopping will

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avoid blast damage, but there is substantial air leakage at the panel overlaps. Pinning adjacent panels together reduces leakage, but it increases the work of construction and can result in blast damage to the stopping because movement of the stopping to relieve blast forces is restricted.

To improve on the current state of the art, the Bureau of Mines developed a new stopping called a damage-resistant brattice. A damage-resistant brattice has the twofold advantage that it forms an efficient air barrier while still yielding to blast forces sufficiently to avoid damage. However, it should be noted that the damage-resistant brattice will not work well in areas where the differential air pressure across the stopping is high or where the roof is arch shaped. For such conditions the Bureau of Mines developed the quick-fix blowout stopping.[4]

ACKNOWLEDGMENTS

The authors greatly appreciate the cooperation of the management and personnel of both the White Pine Copper Co., White Pine, Mich., and the Retsof salt mine, International Salt Co., Retsof, N.Y.; Jack Bjork of White Pine copper mine and Art Geary of Retsof salt mine gave special assistance to the Bureau in this work.

CONSTRUCTION OF A DAMAGE-RESISTANT BRATTICE

The damage-resistant brattice material consists of ordinary brattice cloth having a 2-inch-wide strip of Velcro hooks sewn along one edge of its length and a 2-inch-wide strip of Velcro pile sewn along the other edge of its length, both on the same face of the brattice cloth. In this way a Velcro seal can be formed between adjacent vertical panels (fig. 1). This Velcro seal has a leading edge which is perpendicular to the brattice itself and which points either towards, or away from, the blast forces; the brattice works equally well in either case. When the brattice is subjected to a blast force, the Velcro seals peel open (fig. 2) to avoid any permanent damage. Following a blast, the panels hang either totally or partially detached from each other (fig. 3) and can be resealed by reconnecting the Velcro strips. Generally, the Velcro seals do not open to the extent shown in figure 3. In many cases some of the seals do not open at all, while others open only slightly.

[4] Thimons, E. D., and F. N. Kissell. Quick-Fix Blowout Stoppings for Hardrock Mines. BuMines TPR 100, 1976, 8 pp.

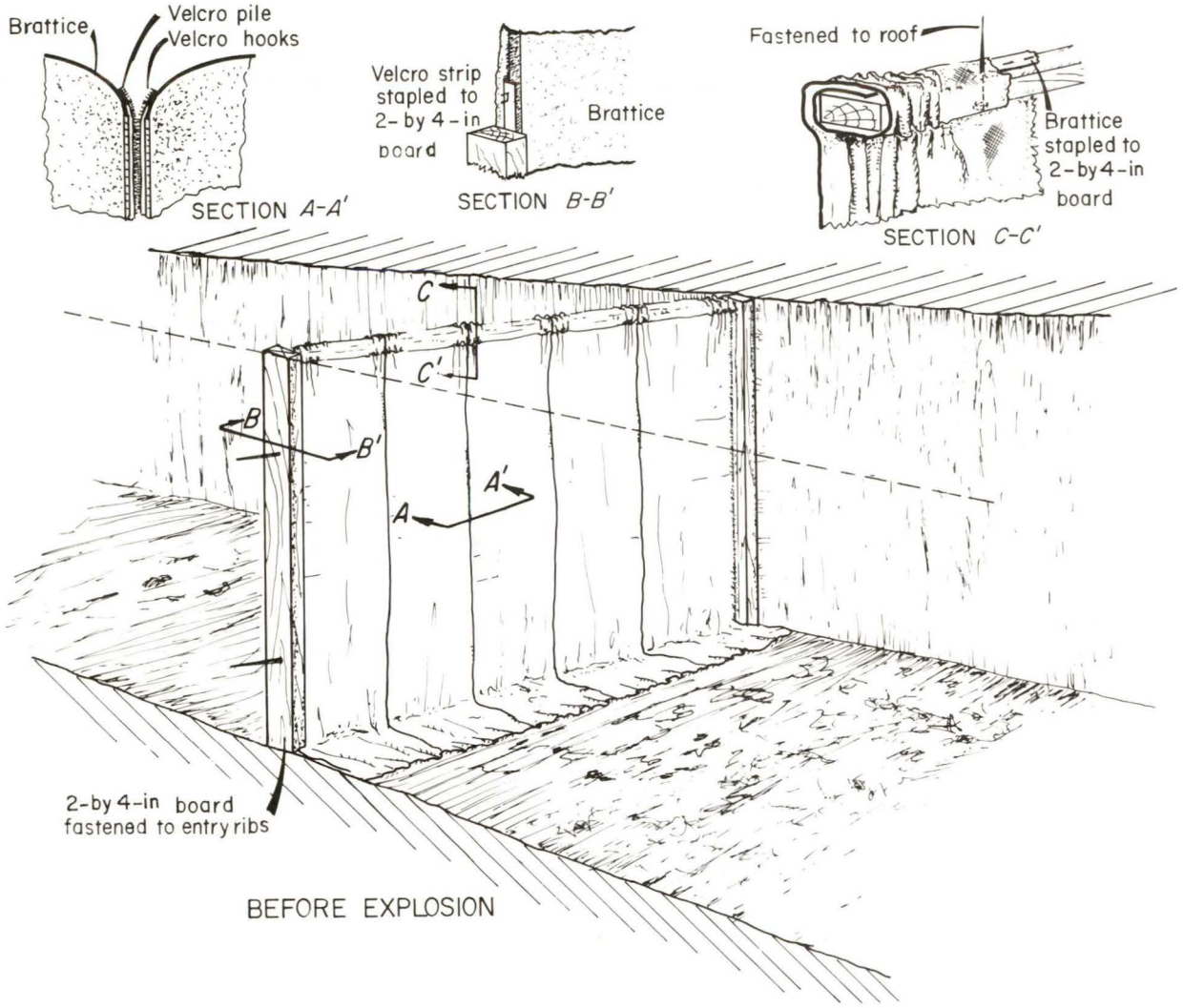

FIGURE 1. - Damage-resistant brattice before blasting.

To construct a damage-resistant brattice, lengths of the brattice cloth approximately 3 feet longer than the height of the airway to be sealed are cut from the roll. This additional 3 feet of brattice allows 1 foot for attachment to the roof and 2 feet for forming a good air seal at the floor.

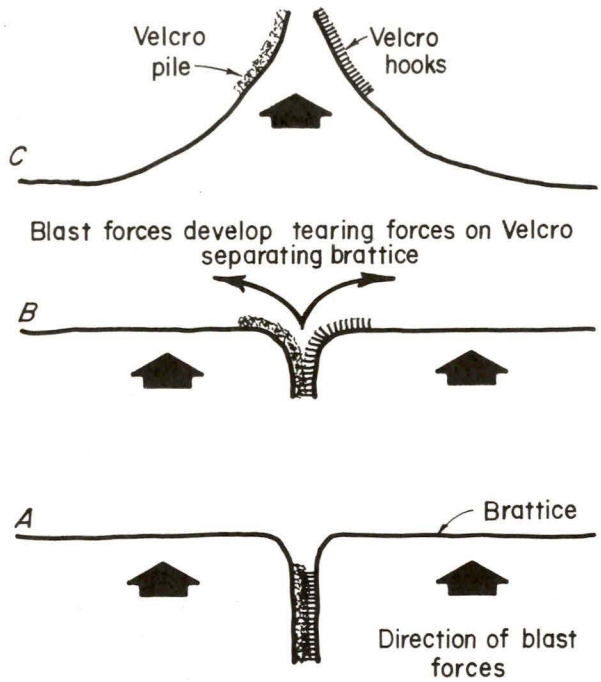

FIGURE 2. - Velcro seal peeling open during blasting.

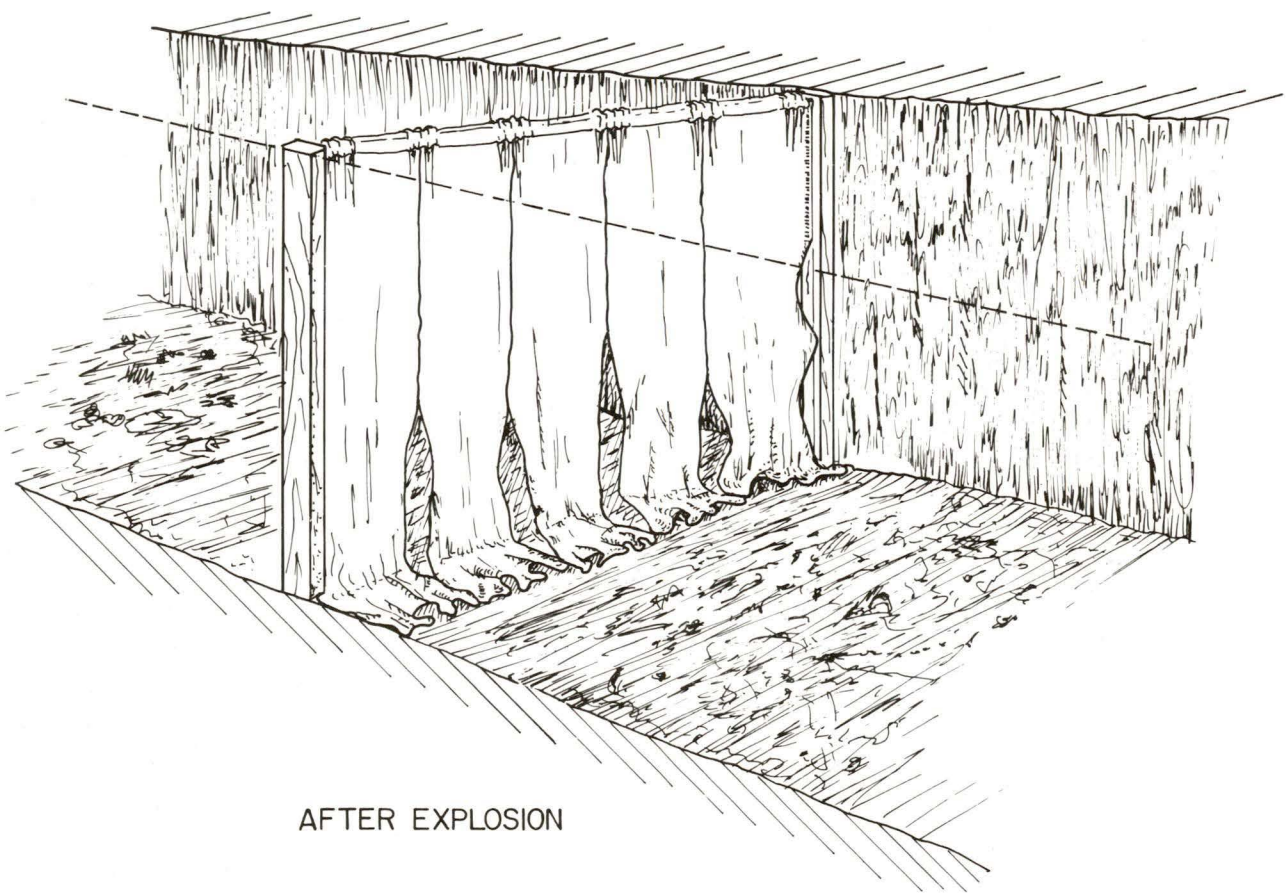

FIGURE 3. - Damage-resistant brattice after blasting.

Each brattice panel is wrapped once or twice around a 2- by 4-inch or 1- by 3-inch wood board that is 10 or 12 inches shorter than the width of the panel (fig. 4). For convenience in hanging the panel, it is best to staple the brattice to this board at a few locations. The panel is hung by attaching the board to the roof with Ramset[5] pins, expansion bolts, or other practical means. Boards holding adjacent panels are butted against each other across the airway roof. This leaves an additional 5 or 6 inches of overlapping brattice material, which is used to join adjacent panels by means of the Velcro strips. The Velcro seals face either towards or away from the source of the blast forces. The Velcro seals are perpendicular to the brattice (fig. 1), and it is advisable to erect the brattice so the Velcro seals can be made on the side of the brattice that will be the more accessible.

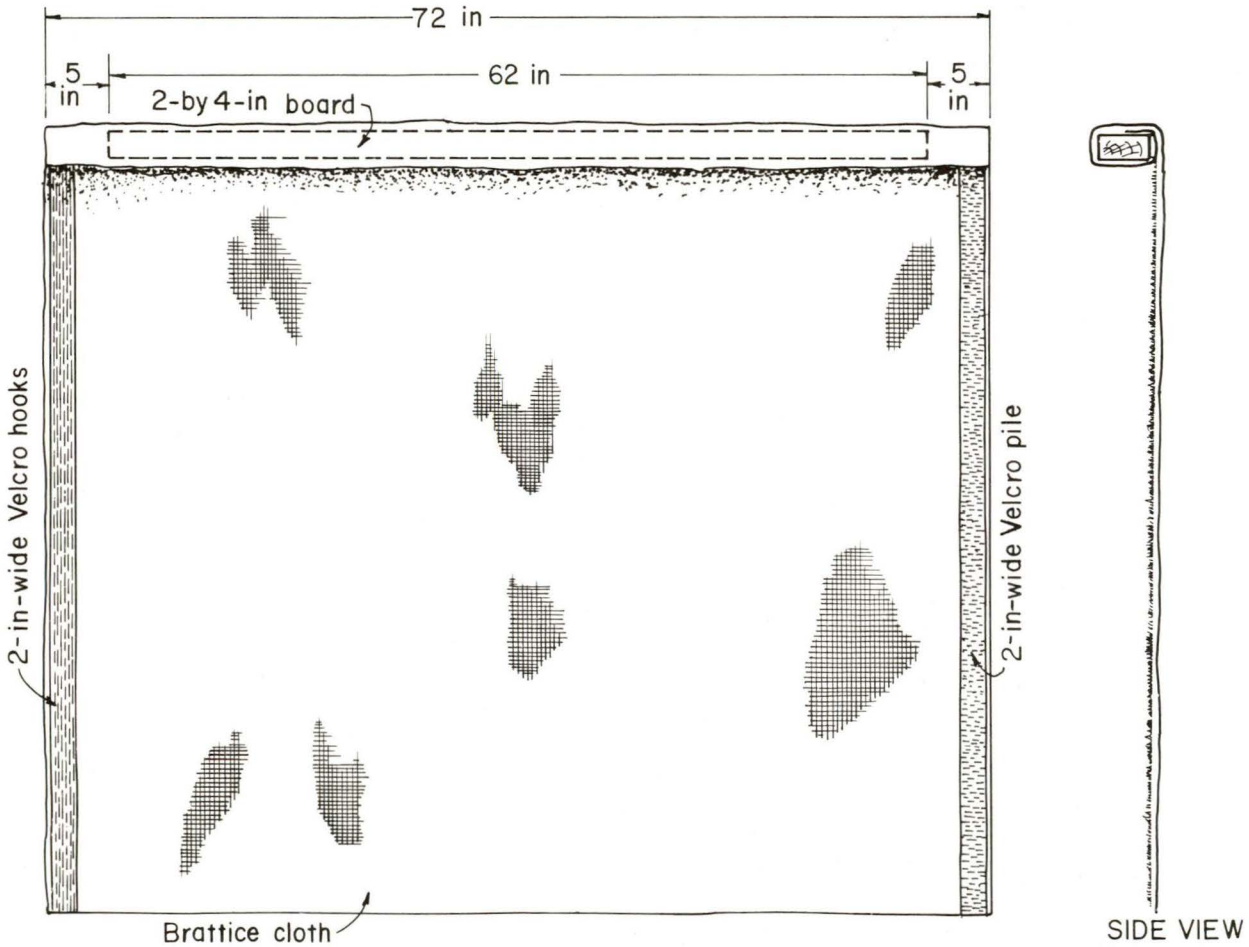

FIGURE 4. - Individual brattice panel wrapped around a 2- by 4-inch board.

[5]Reference to specific trade names does not imply endorsement by the Bureau of Mines.

Where pipes, electrical conduits, or other obstructions hang from the roof, it is necessary to cut the brattice panel vertically, slide it around the obstructions, wrap it around the board, staple it, and attach the board to the roof.

The end panels of the damage-resistant brattice can be attached to the walls or left to hang free, depending upon how complete an air seal is needed. If the brattice is to be attached to the walls, a Velcro seal is obtained by attaching boards down the walls and stapling Velcro hook or pile strips to these boards (fig. 5). The end panel edges can be attached to these boards. It is important to leave 1 foot or more of excess material on the end panels to make these wall attachments.

If the Velcro seals on a damage-resistant brattice begin to lose their effectiveness owing to mud or dirt, they can be hosed off. If after a long time the seals become so weak that even washing them does not help, they can be stapled shut. Generally by this time the active face will be far enough advanced that the stopping will no longer be subject to substantial blast forces.

A damage-resistant brattice can be converted to a permanent stopping by stapling the panels together, putting waste material on the excess brattice at the floor, and sealing around the walls and roof with foam or some other filler material.

FIGURE 5. - End panel being attached to wall with Velcro seal.

PRELIMINARY TESTING OF THE DAMAGE-RESISTANT BRATTICE

A preliminary test of the damage-resistant brattice was made in the Bureau's Safety Research Coal Mine at Bruceton, Pa. A damage-resistant brattice was erected in an airway, 12 feet wide and 7 feet high, 35 feet from the blasting face. The brattice consisted of three panels, each 5 feet wide, with 1-inch Velcro strips sewn down the vertical edges. No wall attachments were made.

Before construction of the brattice, the airflow in this airway was 8,900 cfm. After construction, the airflow was no longer measurable, even with smoke, and the differential pressure across the brattice was 0.1 inch water gage.

A series of regular face shots failed to affect the brattice, but a heavy shot did partially open the panels at the Velcro seals without damage to the brattice. The Velcro seals were reclosed, and the brattice was reestablished in less than 1 minute. However, the test did indicate that 2-inch-wide Velcro strips would resist normal ventilation air pressures across the brattice better than 1-inch-wide strips. The 2-inch Velcro strips also simplify installation and resealing.

FIELD-TESTING OF THE DAMAGE-RESISTANT BRATTICE

A damage-resistant brattice was constructed in a working area of the White Pine copper mine. The location was a 10.5-foot-high by 26-foot-wide crosscut through which there was substantial airflow. The only obstructions in this airway were a power cable 8 feet from one wall and 1 foot from the roof and dual 6-inch-diameter pipes 3 feet from the other wall and 2 feet from the roof. The distance of the brattice from the blasting locations ranged from 300 to 800 feet (fig. 6). Shots of 700 pounds of nitrate, with 50 pounds of dynamite, were fired 19 times a week at various locations, as shown in figure 6.

The brattice was constructed of six panels, each 6 feet in width. Each panel was cut 13.5 feet long. This allowed 1 foot for wrapping around a board for attachment to the roof and 2 feet to lay on the floor to form an air seal. The panels were attached to the roof by wrapping them around 2- by 4-inch boards and fastening these boards to the roof with 6-inch expansion bolts. With the exception of the end panels, the 2- by 4-inch boards were cut to 5-foot, 2-inch lengths so as to leave an extra 5 inches of brattice at each end. The 2- by 4-inch boards were butted against each other across the airway roof, and the 5-inch brattice overlaps were sealed by Velcro strips. Where the pipes and electrical conduit hung from the roof, the panel was cut vertically, pulled up around the obstruction, wrapped around the board, and fastened to the roof. The installation time for the damage-resistant brattice was 3-1/4 hours for three men.

Anemometer and smoke measurements taken in the airway prior to the brattice installation indicated that approximately 18,500 cfm of air was moving

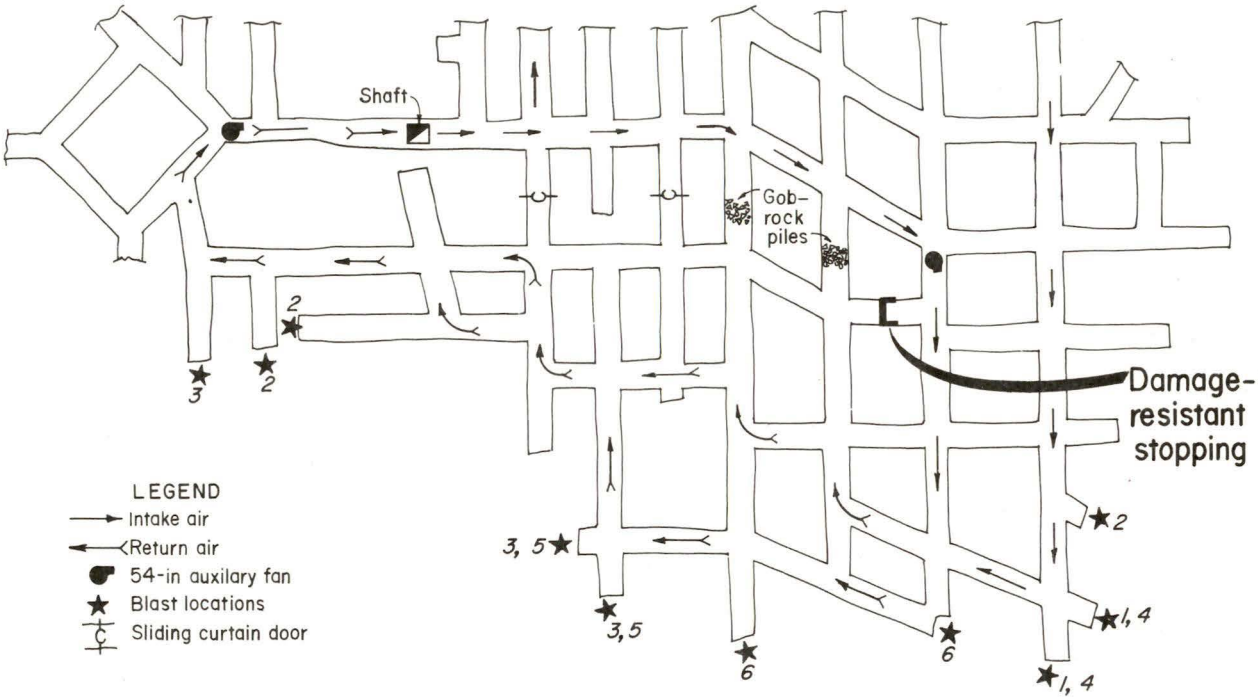

FIGURE 6. - Installation location at the White Pine copper mine.

through it. When the damage-resistant brattice was completed (fig. 7), there was no measurable airflow in the airway, although some leakage occurred at the walls where the brattice hung unattached.

At the initial construction of the brattice, the end panels hung free at the walls. This resulted in some leakage. After the brattice survived three blasts (locations labeled 1, 2, and 3 in figure 6) without suffering damage, these end panels were sealed to the walls by attaching 2- by 4-inch boards down each wall and stapling 2-inch-wide strips of Velcro pile or hook to them. The Velcro strips on the edges of the end panels were sealed to these strips. The wall attachments required 1 hour for two men. The first blast after the wall seals were made (locations 4 in figure 6) opened the Velcro seals at the wall about 4 feet from the floor and opened the middle panel seals about 6 feet from the floor (fig. 8). There was no damage, and the damage-resistant brattice was resealed in a matter of minutes. Blasts at locations 5 and 6 also opened the Velcro seals at the walls. Currently, this brattice has been in use at the White Pine mine for 6 months without any damage.

A second damage-resistant brattice was constructed in the International Salt Co. Retsof mine in New York. The crosscut where the stopping was built is about 10.5 feet high by 64 feet wide. The roof height varies because of irregularly spaced offsets of from 1 to 12 inches. The stopping was built with 13 panels, 6 feet wide by 13 feet long. The panels were wrapped around 5-foot, 2-inch-long boards, which were attached to the roof with expansion

FIGURE 7. - Damage-resistant brattice at White Pine copper mine.

bolts. Velcro strips were stapled to boards bolted to the walls. Total installation time for three men was 6.5 hours.

This brattice withstood a blast of 500 pounds of nitrate and 35 pounds of dynamite originating only 180 feet away. The brattice peeled open at one wall, and a few of the center panels opened slightly.

The mine personnel planned to eventually make this a permanent stopping by stapling the seals, foaming around the roof and walls, and piling fine waste salt on the excess brattice at the floor. This brattice has been in place for 4 months.

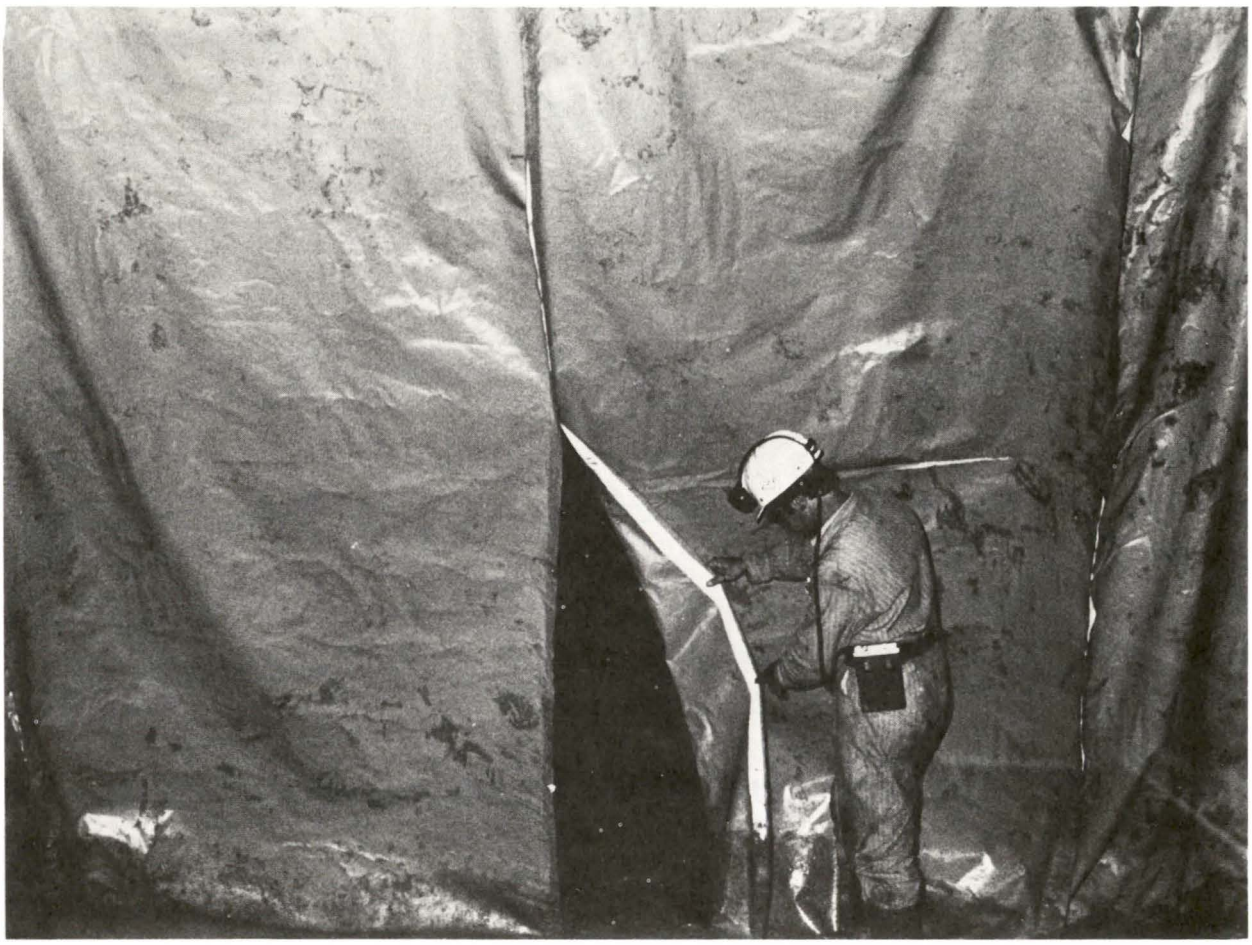

FIGURE 8. - Brattice peeled open by blast.

MATERIAL COST

The brattice erected at White Pine in the 10.5-foot-high by 26-foot-wide airway cost $144, and the brattice at Retsof in the 10.5-foot-high by 64-foot-wide airway cost $312 (1977 prices).

CONCLUSIONS

A new concept in mine stoppings, damage-resistant brattice, has been successfully tested by the Bureau of Mines. Damage-resistant brattice is for use in locations where blast damage to stoppings is common. These brattices avoid damage because the Velcro seals, which hold adjacent panels together, peel open under strong blast forces. After blasting, the Velcro seals are reclosed and the airtightness of the brattice is reestablished. When the working face moves far enough away that the brattice is no longer subject to blasting, the brattice can be converted into a permanent stopping, or the material can be reused in a location close to blasting again.

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