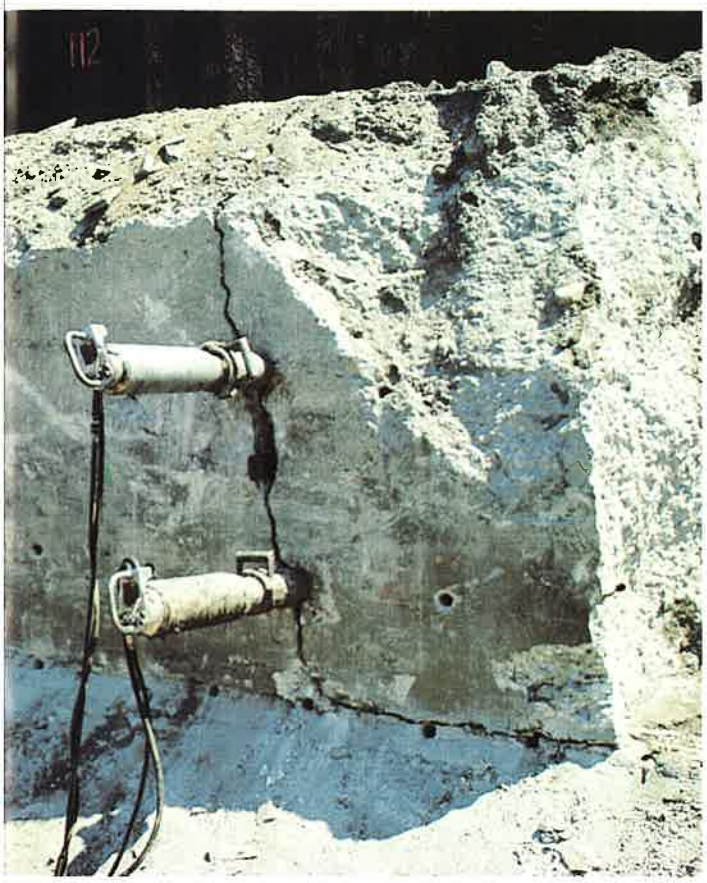

HYDRAULIC SPLITTING

A New Method for Breaking Rock and Concrete

by Edward R. Langfield

NEW METHOD BOOKLET

Within the past 30 years, two very different tools available have changed the approach to some demolition work. Although very different in operation, these tools have proven to be very effective in reducing the time it takes to break rock and/or concrete.

One tool works on the impact principle to break material, while the other works from the inside of rock or concrete to break the mass. Sometimes both of these tools can be very effective when used together.

The impact ram mounted on a rig, such as a backhoe, is powered by air or hydraulics. Its action is like a giant jackhammer producing many tons of impact force. The ram is very effective in many types of demolition work. Impact tools are available in various sizes and there are many proficient operators available.

Now this unique "Hydraulic Splitter" introduced some 30 years ago to the Construction Industry works on a completely new concept requiring a new approach. The operator requires some knowledge, and when used properly can save time, reduce hazards, reduce costs, and fully control breaks in both rock and concrete. It was also found that the pre-split method reduced the amount of work for impact tools.

In 30 years, our staff has been on hundreds of demolition job sites in North America. With this variety of experiences, we have published some fundamental principles and applications on the use of splitting equipment in the following pages.

This booklet will give you some idea of how this new method can be applied to many different types of demolition work. In addition to this book, we offer assistance in the following manner:

1. *PRELIMINARY PLANNING*—Upon request, we can suggest how to approach a demolition project; we will recommend a tool size; and most important, the *drill hole pattern*. We will recommend other equipment if we feel that the Splitter would not prove effective. This service is free, but requires some basic information such as dimensions, locations, types of material, etc. Blueprints are very helpful in suggesting a hole pattern. In most cases, this service can be given over the telephone. With over 150 outlets, we can name a local dealer to contact to let you know where you can buy or rent this equipment.

2. *JOB SITE ASSISTANCE*—is an additional service available for a daily fee. Many projects have a tight time schedule, and cost problems. Our job site assistance will assure the maximum use of these powerful tools in the shortest length of time. Our staff will train the operators and supervise drilling and breaking of rock and/or concrete. A skillful operator who knows and understands the tool can increase production severalfold.

Mr. Edward R. Langfield introduced the new Splitting Method in North America in 1967, and has extensive experience in using Hydraulic Splitting tools for demolition work.

Mr. Langfield has used Hydraulic Splitters on many construction projects. This includes dams, bridges, tunnels, highways, and atomic plants. He has used Splitters on such dams as Dworshak, Grand Coulee, and Courtwright. This method was used in tunnels such as Norad, in Colorado. The unit works well underwater for general demolition work without any modifications to the equipment.

Industrial plants have used Mr. Langfield's suggested Splitting Methods for demolition and renovation projects.

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HOW TOOL OPERATES

The hydraulic splitting cylinder contains one plug and two feathers.

The basic parts of the splitter consist of two cylinders. The upper cylinder houses the piston which moves the plug in the lower cylinder.

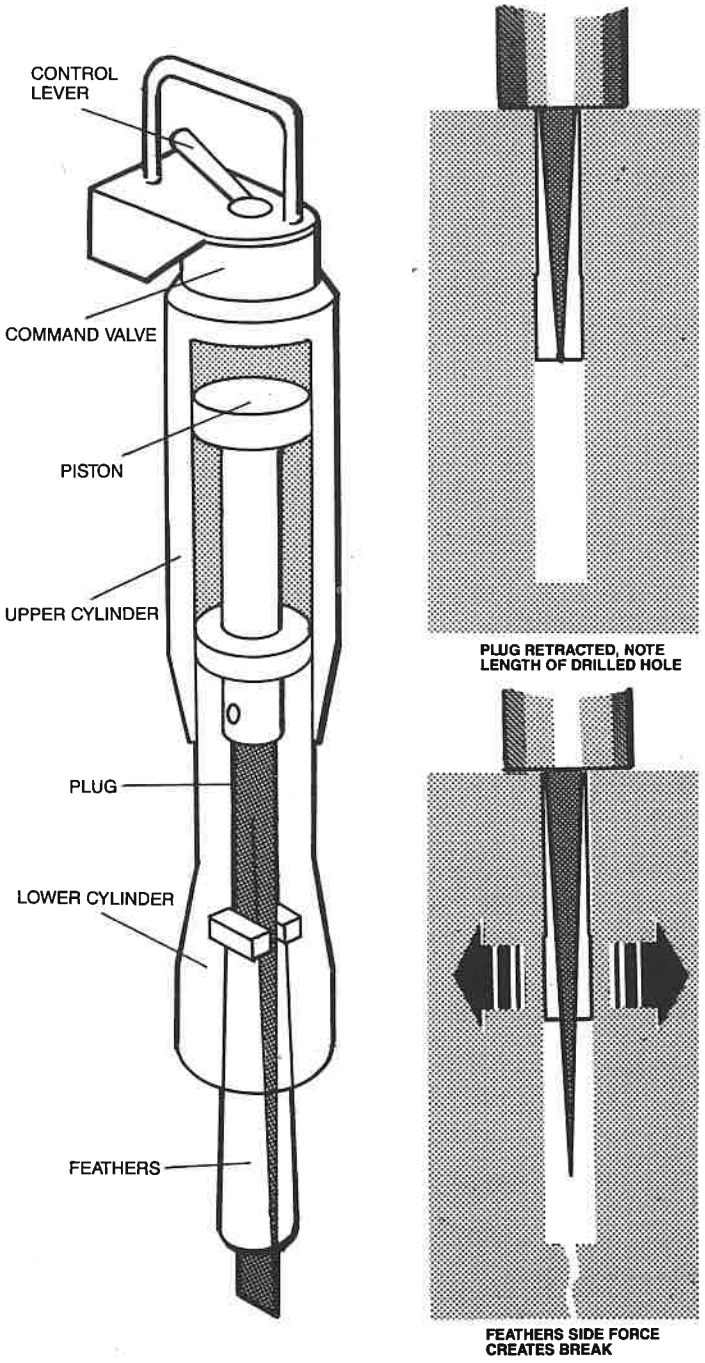
The command valve is operated by a single lever on top of the unit. The plug is extended or retracted by the command valve.

The cylinder operates at 7100 PSI hydraulic pressure. After the plug is extended, the pressure-matic valve automatically lowers the pressure to approximately 900 PSI; in a neutral position, the PSI drops under 50.

This assembly is inserted into a pre-drilled hole with the plug in a retracted position. When the control lever is turned to "(F)" forward position, the plug advances and the two feathers are forced sidewards against the wall of the hole and with hundreds of tons of pressure tears rock or concrete apart. With the control lever on top of the cylinder, the plug can be advanced, retracted or held in any position. A break usually occurs within 10 seconds but with extremely hard material, it could be up to 60 seconds.

SPLITTER MODEL	SPLITTING FORCE IN TONS	HOLE DIA.	HOLE DEPTH	EXPANSION INCHES
2	220	1-3/16″	12″	.35
3	250	1-5/16″	18″	.39 – 1.57**
7*	220	1-3/4″	18″	.70 – 1.77**
8*	350	1-3/4″	26″	.78 – 1.97**
9	220	1-3/4″	18″	.70 – 1.73**
12	385	1-3/4″	26″	.78 – 1.97**

*No longer in Production
**Using Enlarging Feathers



SELECTION OF POWER UNIT

Power unit and rock splitter are connected with a pair of high and low pressure hydraulic hoses. Flow distribution bars are available which permit the use of up to four splitters from one large power unit. Note that they can only operate simultaneously, not intermittently or individually.

Hydraulic pressure applied (Maximum 7100 PSI) is used by all size splitters enabling the same hydraulic pump to be used for all models.

Power units are available in three types—Air, Gas and Electric to suit all job conditions. When selecting a power unit, the following points should be considered:

Job conditions usually determine type of power for the hydraulic pump.

AIR—Since most of the time air power is used to drill, power unit with air motor will always be useful. No exhaust gases, not affected by water.

GAS—When all available air must be used for drilling, or when compressor is removed prior to splitting, or where power unit must be moved around frequently, a gas power unit is advantageous.

ELECTRIC—It is quiet, no exhaust gases, useful inside buildings, crusher installations. Less maintenance required.

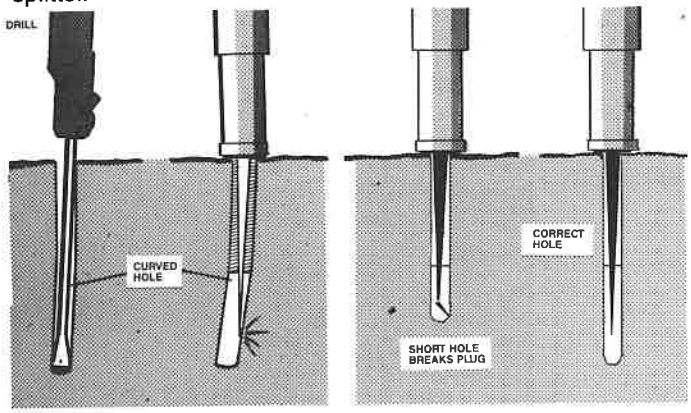
All models can be converted from one power unit to another. Gas to air, electric to gas, air to electric.

Caution: In order for the splitter to operate, it is essential that the plug and feathers are lubricated before operation. Failure to apply the recommended lubricant before each break, will reduce the breaking force and could bind the metal surfaces together and damage the tool. See the operating instructions for the recommended lubricant that is required to operate the splitter. Only well-lubricated plug and feathers will operate the splitter at peak efficiency.

ELCO offers free of charge, information on the Hydraulic Splitter and how it may apply to your work. This service is as close as your telephone. Contact our headquarters in New Jersey. No charge or obligation.

DRILLING HOLES FOR SPLITTER

Hole drilling is usually done with a conventional rock drill. To prevent dust, either a vacuum attachment or water flushing can be used. On work where all noise and dirt must be prevented such as in hospitals, computer centers, or control towers, a diamond core drill is usually used to pre-drill the holes required for the splitter.



It is very important that the holes should be of *exact diameter, length and straight.*

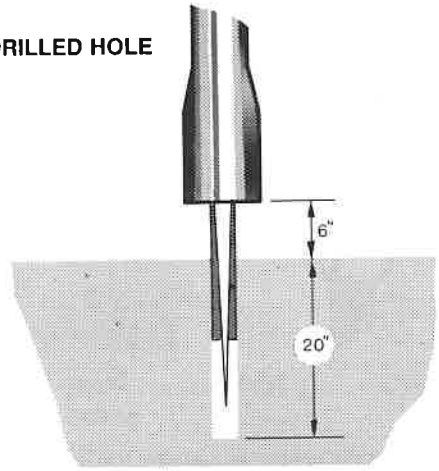
Integral drill steel is readily available which combines accurate diameter with short effective length to permit comfortable drilling. Notice the importance of having a close-hole diameter.

If for some reason the drilled holes are short, it is possible to hold the tool out of the hole the same distance as the difference between the actual hole and 26″.

EXAMPLE: Drilled holes are only 20″ deep—then hold splitter 6″ out of the hole. See illustration.

Do not hold tool more than 8″ out of hole for best results.

SHORT DRILLED HOLE



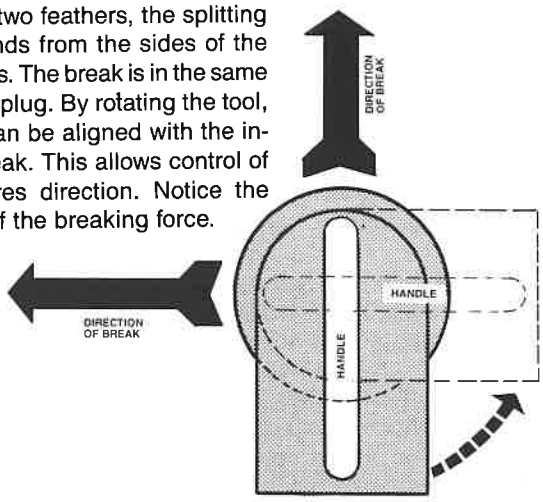
Drill operator should keep drill steel firmly positioned in center of hole from beginning to end; otherwise, a crooked hole will result causing deformation of plug and feather assembly. Repeated deformation will lead to fatigue and breakage of the entire plug and feather assembly or part thereof. If deeper holes are drilled using two lengths of drill steel, make sure the lower part of the hole has almost the same diameter as on top. A step in the hole could cause "hang up" and possible breakage of wedge. Drill steel is available which is just long enough to permit drilling entire hole in one operation.

If many holes are drilled by different operators, the hydraulic splitter operator should check each hole with a ruler or broomstick to make sure that hole is deep enough and free from hard obstructions. The plug will break if it is forced against solid rock.

CONTROLLING DIRECTION OF BREAKS

This is a simple operation, just line-up the handle in the same direction of the intended break—the plug and feathers will then be in the proper position for a controlled break.

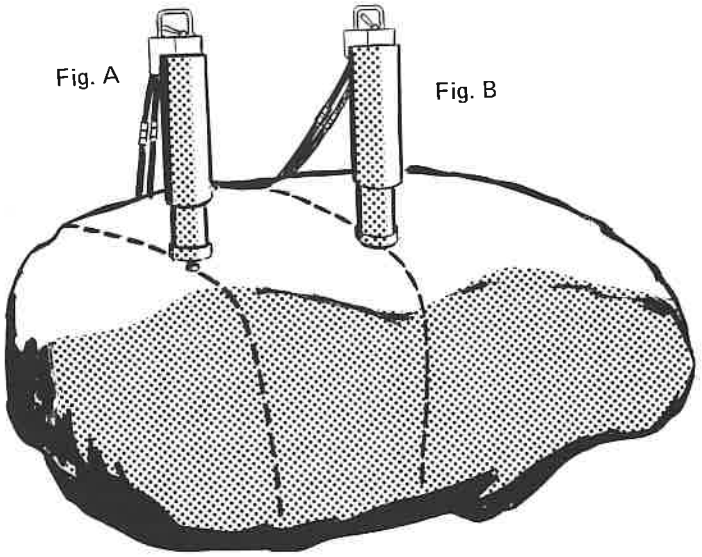
As the piston pushes the plug between the two feathers, the splitting force extends from the sides of the two feathers. The break is in the same line as the plug. By rotating the tool, the plug can be aligned with the intended break. This allows control of the fractures direction. Notice the direction of the breaking force.



To speed up production, it is suggested that several test breaks be made to determine the hardness of the material to be removed. With test breaks, the pattern of holes as well as the number of holes can be determined. As drilling is a longer operation than splitting, the number of holes should be kept to a minimum.

TEST BREAK

To make a test, break a small section first (Fig A). If this works well, increase the size of the break until the maximum split is determined. Always keep in mind the size of rock or concrete that your removal equipment can handle.



The dotted lines show the direction of the intended break in a boulder. For a maximum break, drill a hole in the center, (Fig. B) of the rock. Now place the splitter in the hole and make sure that handle is in the same line as the intended break. Depending on the quality and structure of the rock, the crack can be placed with great accuracy. After the rock has been broken in half, use same procedure with each half. Do not drill unnecessary holes as this is wasted effort.

BREAKING REINFORCED CONCRETE

The controlled force of the hydraulic splitter is very effective in breaking reinforced concrete. This method requires that both the concrete and the concrete bond on the rod be broken in one operation. The drawing shows a typical rod pattern in concrete.

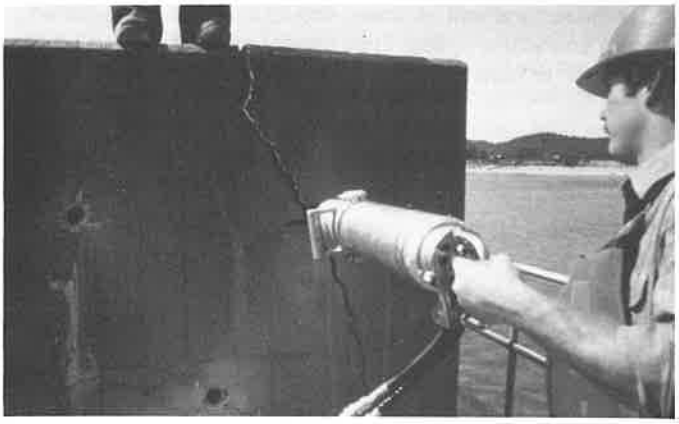
First a hole is drilled between the rods (See A). The splitter is placed into the hole and positioned (by rotating) so the breaking force will be at a *45 degree angle.* (Heavy arrow with hole shows direction of force). As the concrete breaks on an angle (B), it moves across the rod both vertically (C) and horizontally (D). This procedure is repeated each time. The spacing for holes is approximately every two feet on the horizontal, and 18 inches vertically. The 45 degree breaking angle is used in all holes. If the hole pattern is too far apart, the bond of the concrete to the rod will not break.

Moving the concrete ½ inch apart enables the workmen to remove the broken concrete with light chipping hammers or a small pinch bar.

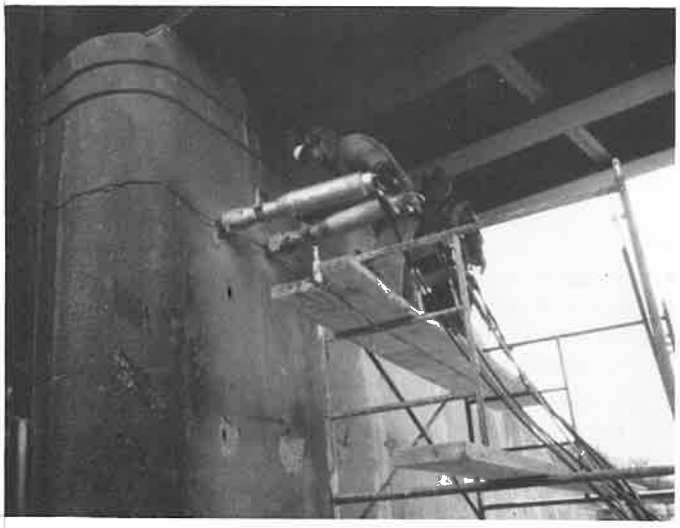
Heavy walls and slabs can be presplit and removed with larger impact tools. Presplitting reduces the time of impact tool operation. A great savings can be realized by using the presplitting method.

If the concrete is very heavily reinforced, the hole spacing of under 2′ is recommended.

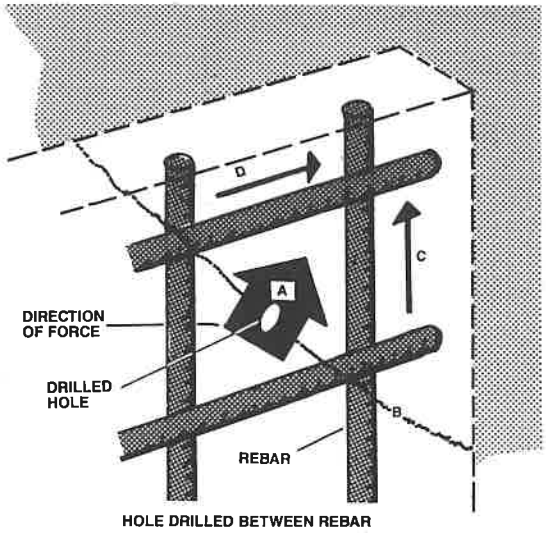
Call for recommended tool size.



Concrete being removed on Ohio River Dam.

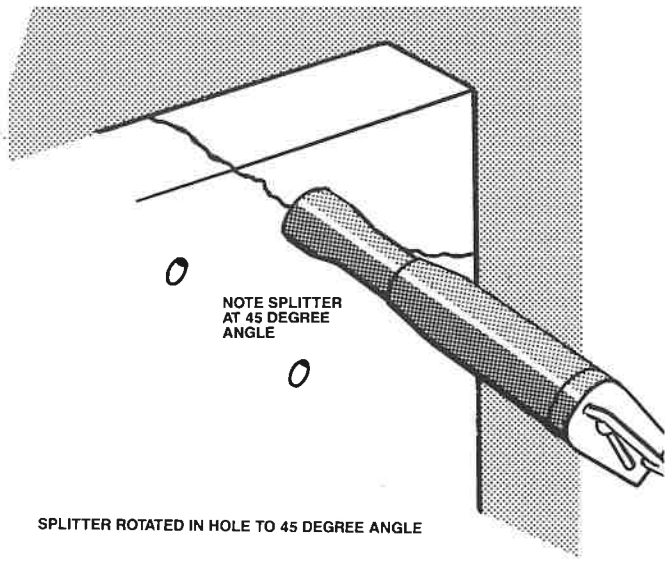


Top of bridge pier columns cut off with two hydraulic splitters. Remaining section to remain as base for new and expanded pier tops.



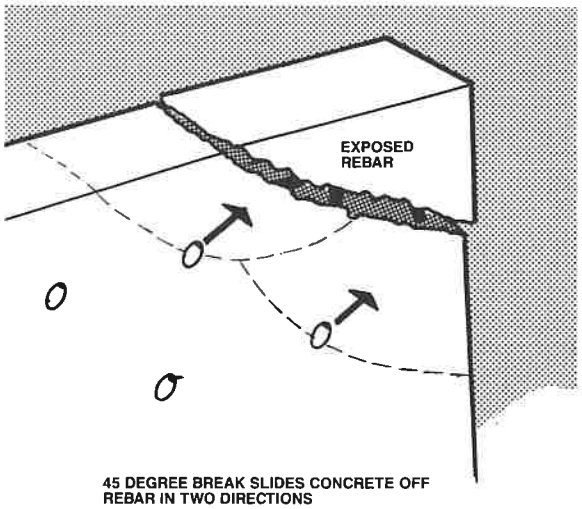
HOLE DRILLED BETWEEN REBAR

Arrow shows the direction of splitting force to break bond on rebar in both directions.



SPLITTER ROTATED IN HOLE TO 45 DEGREE ANGLE

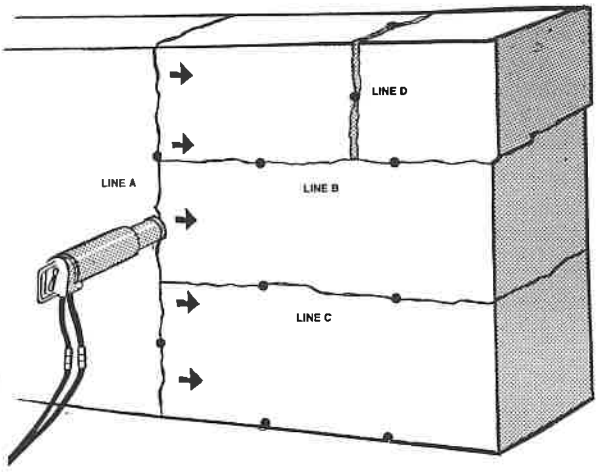
Splitter positioned to break reinforced concrete at 45 degree angle.



45 DEGREE BREAK SLIDES CONCRETE OFF REBAR IN TWO DIRECTIONS

Bond is broken on rebar both vertically and horizontally. Crack can be widened to cut rebar. Note the suggested hole pattern.

BREAKING CONCRETE WALLS

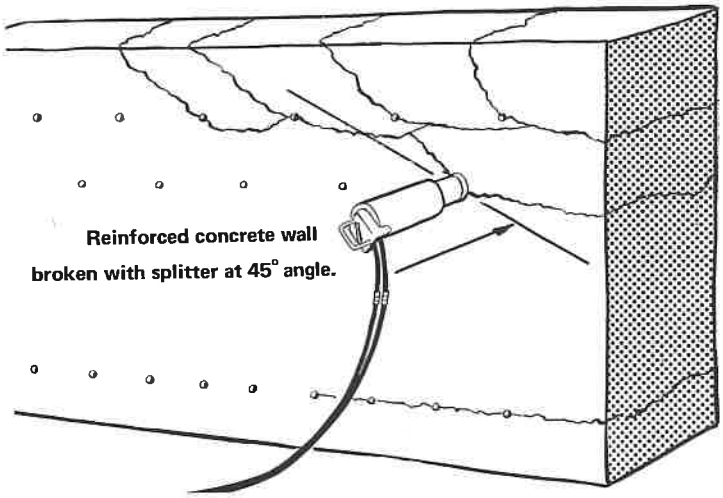


A wall of non-reinforced concrete usually can be broken into pieces as large as the removal equipment can handle. The above drawing is one example of a method that is recommended.

First, a series of holes are drilled along Line A and a break is made (note that future breaks will not run past this line). Second, drill holes along Line B and break. Third, drill along Line C and break. Fourth, drill and break the floorline.

Next, start at the top, determine the size the removal equipment can handle and drill a hole on top or on the side and break. (See Line D).

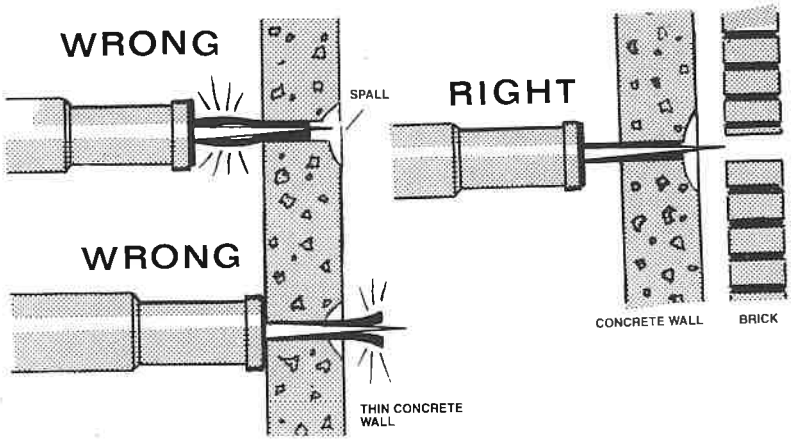
The spacing and the number of holes is determined by the size and mass of the wall. If the wall is very thick, two splitters are recommended.

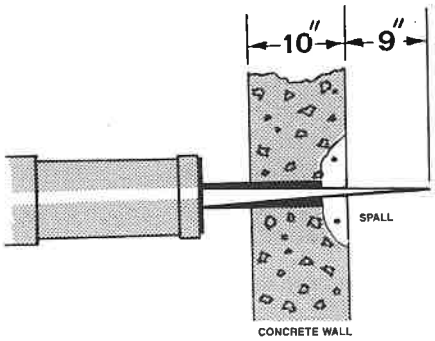


REINFORCED CONCRETE

In breaking a reinforced concrete wall, the bond between the rod and concrete must be broken first. The drawing shows the suggested pattern of holes which should be from 1 to 3 feet apart, depending on the type and size of wall.

In order to "slide" the concrete along the rod, the splitter is placed at a 45 degree angle (see drawing). This will allow the tool to move the concrete just enough to break the bond. Now drill the next hole and if a full break appears, continue to drill a line of holes as depicted in the drawing. Note how the breaks should appear. The size of the rod and wall thickness should dictate the hole pattern, spacing and size of splitter to be used. Exposed rod can be cut with a torch or cutter and these sections can then be removed.





BREAKING THIN CONCRETE WALLS

The placement of the plug and feathers is critical when breaking a wall of concrete that is thinner than the length of the tools plug and feathers. Be sure to avoid the following.

First do not let the feathers protrude beyond the wall, as all of the splitting force of the wedging action is outside the wall. If this end is exposed with no resistance such as a wall or rock, you will be exerting all pressure on the ends of the feathers causing them to bend outward and possibly fracture.

If the tool is not inserted into the hole far enough, it will cause the feathers to belly out. About half the tool should be in the hole and it should be firmly held until it is lodged in the hole.

In most cases, the larger tools can be used as long as a deep enough hole is provided for the travel of the plug; but if this is not possible, such as inside the drum of a ready mix truck, the smaller tools are then necessary.

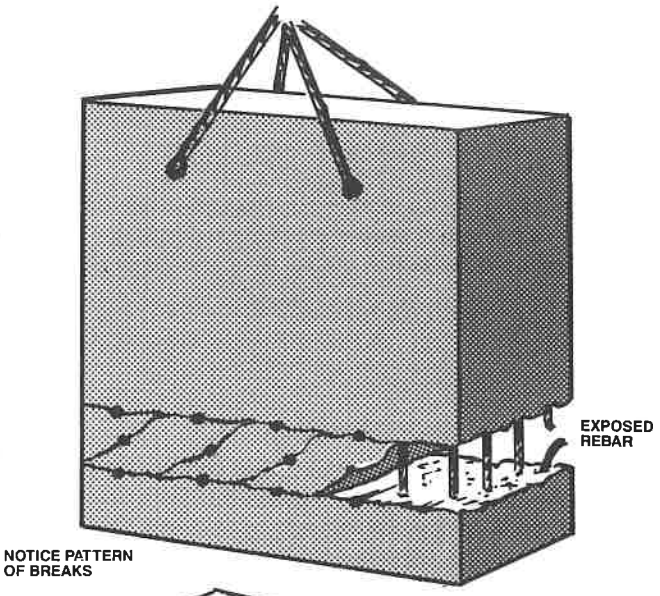
Keep in mind that it is not always necessary to have all of the splitter in the hole for an efficient break. As long as at least a half of the total length of the feathers is fully supported in the material you are trying to break, there is little chance of damaging them.

It is quite possible to break a wall as small as 10" thick with a #12 splitter. See illustration.

Do not let feathers protrude beyond wall as they could be bent.

REMOVE LARGE CONCRETE PIERS

1. Determine the weight of the piece of concrete that your equipment can safely lift.
2. Drill a line of holes about 2 feet apart.
3. Drill a second line of holes at least 1 foot below the first line.
4. Place several splitters in the top line break. Do the same at the bottom line. You should have two broken lines that run through the width of the piece.
5. Drill a 3rd line of holes between the two broken lines about 1-½ feet apart.
6. Place a splitter into the nearest hole at the end and break the section on a 45 degree angle. This will break the bond on the rebar in both directions. This broken section can be removed with a light hammer.
7. Drill several holes through in order to pass a cable through and snug it up with your lift before cutting rebar.
8. When the area between the line breaks have been removed, the exposed rebar can be cut and the entire section can be lifted and removed.



REMOVING BRIDGE PIER TOPS

Method for the removal of bridge pier tops to road level in order to extend additional lanes. Two splitters are required for this procedure.

Drill two holes, approximately one foot from each end of column, preferably through the column to give maximum splitting control (Fig. A).

Two #12 splitters working together will control this first break and prevent any fractures from carrying past this line into the concrete that is to remain. This break separates the two parts of the column.

Second, after the horizontal break, the vertical splits are made to remove the top. Holes are spaced (black dots) and drilled vertically about 1-½ feet apart. (See Fig. B for hole pattern.)

Note that a 45 degree breaking angle is used to break the bond on the rod. (See Fig. B). Arrows show how the splitter should be positioned to make this break.*

*See Page No. 5

Third (Fig. C), the broken concrete can now be removed with chipping hammers or pry bars. Rods can be cut or burned. The procedure is a fast and effective way to remove whole or parts of concrete columns without damaging the remaining section.

Call for recommended tool size including enlarging feathers.**

**See Page No. 23

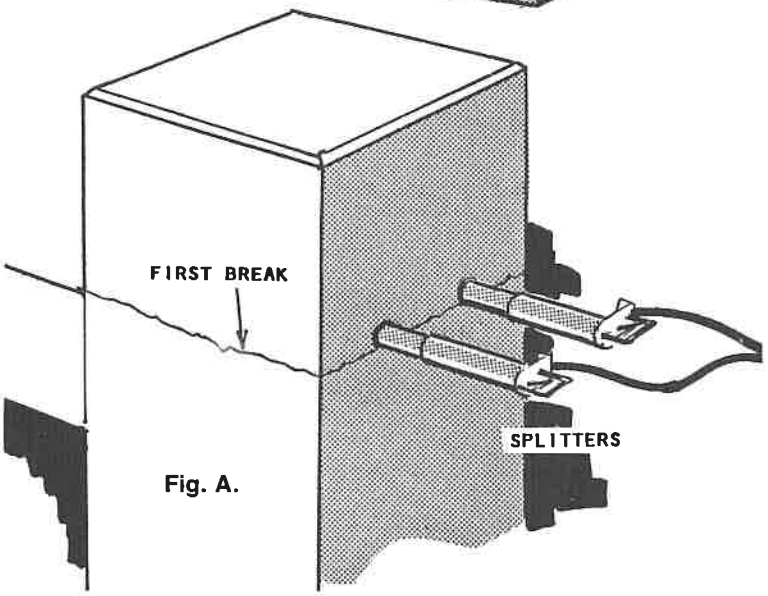


Fig. A.

FIRST BREAK IS HORIZONTAL

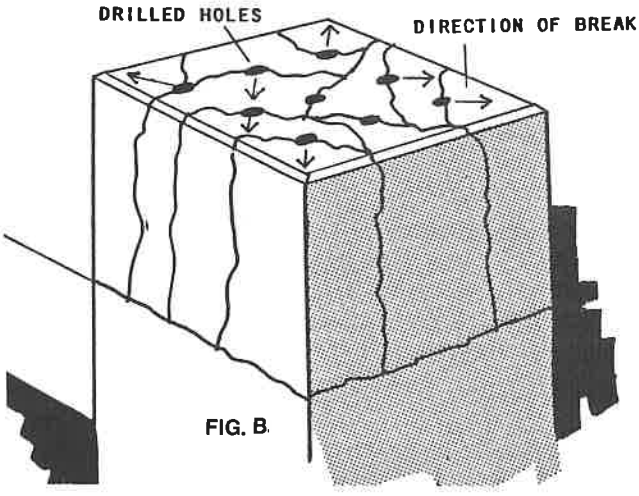


FIG. B.

DRILLED HOLE PATTERN

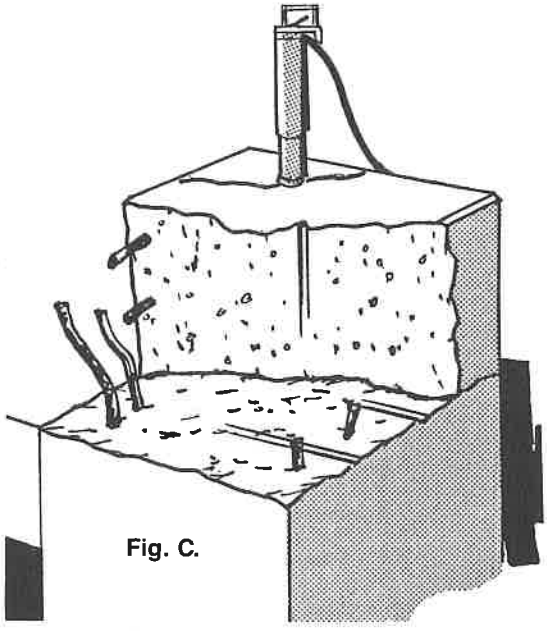


Fig. C.

REMOVE BROKEN PIECES WITH CHIPPING HAMMER OR PRY BAR

BREAKING OPENINGS IN CONCRETE WALLS

After the opening is determined, the first step is to drill a pattern of holes at each corner. These drilled holes will prevent the final splits from going past the planned corner. See Fig. D, E and F for the suggested drilling and spacing.

When breaking into a solid face such as a concrete wall, you must create an open face in order to move the broken piece. See below for a suggested method to create an open face or slot. Fig. A.

Below also describes the steps in breaking pieces from the drilled slot. (See Fig. C.)

METHODS OF LINE DRILLING

A series of 2-½" diameter holes drilled on 4" centers is the first step. Next drill out the space between the holes using the 2-½" hole size. When completed, this will provide a slot. This line drilling method will create a face to break to.

The same method is used to make a corner slot. See **FIG. B**

An alternative method is to drill two 2-½" holes on 6-¼" centers. Then drill a 4" hole between each smaller hole.

A "guide" is required to hold the drill in the correct position if you use this method.

A line slot or a corner slot can be created by using one or the other method described. (See drawings)

FIG. A

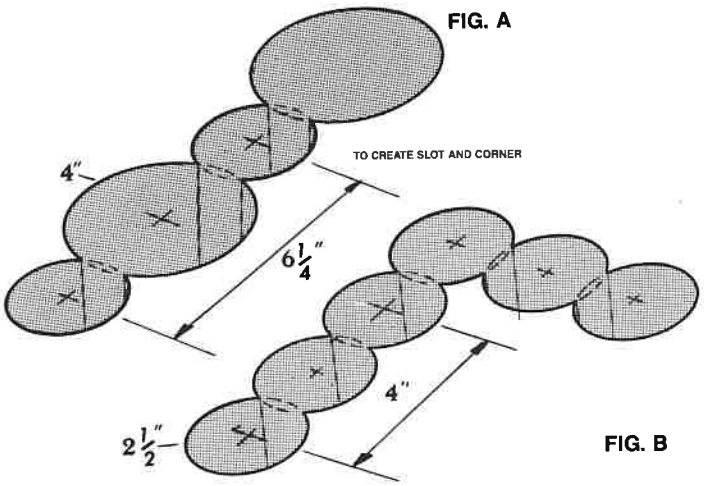


FIG. B

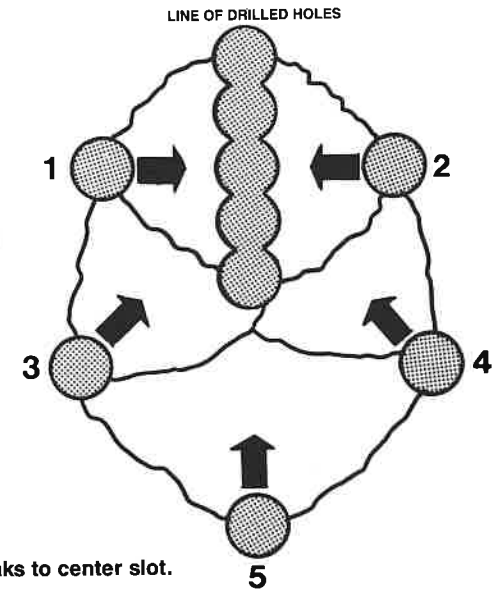


FIG. C

Sequence of breaks to center slot.

First, drill slot at center to create a face.

FIG. D

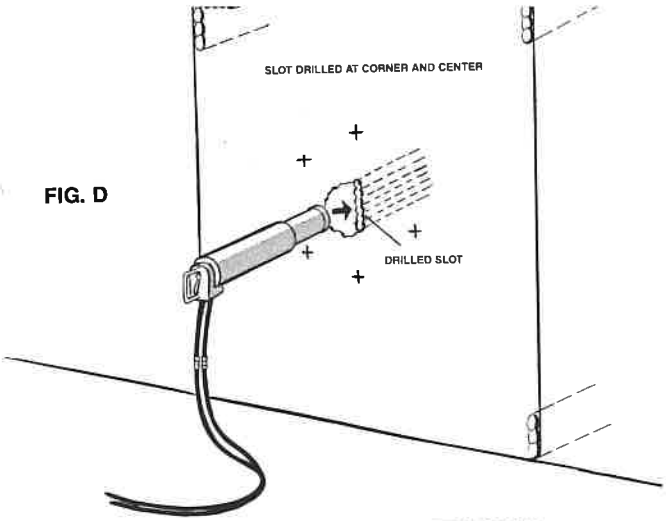
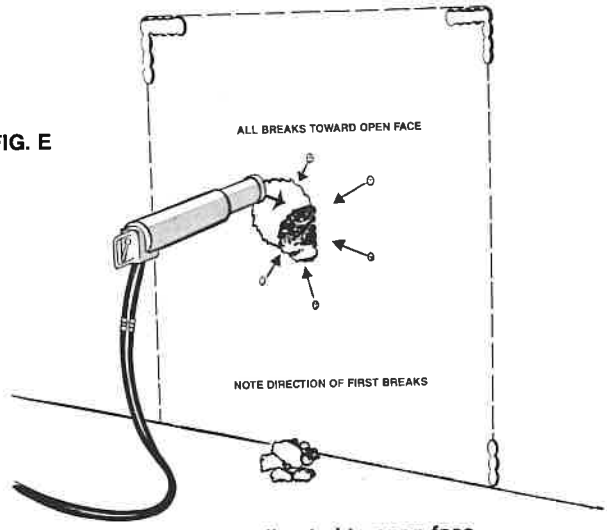
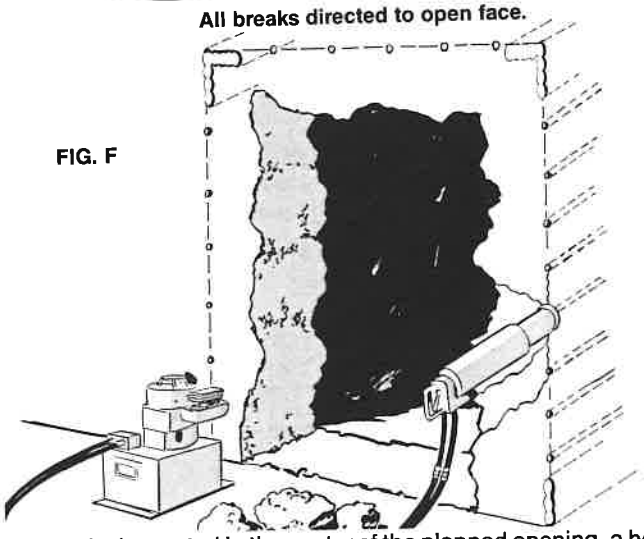


FIG. E



All breaks directed to open face.

FIG. F



After a slot is created in the center of the planned opening, a hole (#1) is drilled very close to the slot and a break is made. #2 hole is drilled and a second break is made. Note that the lines from each hole indicates the direction the handle must be in to push the concrete toward the open slot. After the first several breaks are made and the opening becomes larger, the spacing of the holes can increase. **FIG. C**

Depending on the thickness and hardness of the concrete determine how far from the face each set of holes must be placed. Note the holes should be in a circular pattern around the slot as you begin the opening.

BRIDGE PIER REMOVAL

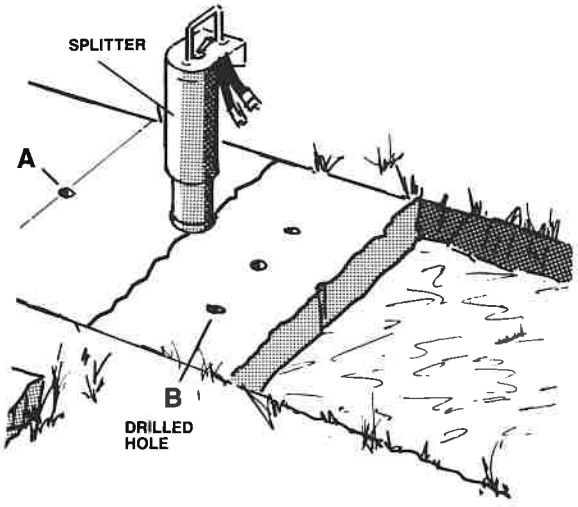
A replacement for a river bridge was planned so that sections of the existing bridge piers could be used. A reduction in costs would be realized if sections of the pier could be used as part of the new bridge.

To determine if the piers could be used, a load test would be made and if proven usable, they would have to be modified and expanded to construct a larger pier. It was determined that the sides and top of each pier would have to be cut off so additions could be added for a larger pier.

A 7-stage approach using hydraulic splitters to remove unwanted concrete without damaging the remaining structure was worked out.

1. To conduct a required load test, a line of holes were drilled across the nose of the pier; this would create an open slot across the 2-½′ nose. (See Fig. 1)
2. Other holes were drilled below the slot about 1-½′ to 2′ apart. (See Fig. 1) A Hydraulic Splitter was to be placed into these holes and a break ran from the slot to the bottom of the pier.
3. This section below the slot was completely removed using the splitter to break out all the remaining concrete below the slot. (See Fig. 2)
4. A load test was conducted in the area of the removed concrete and the structure proved to be usable. (See Fig. 2)
5. After the load test, holes were drilled along the top half of the remaining nose and the splitter broke the remaining pieces on the line shown in Fig. 2. This completed the removal of the full nose from the side of the pier.
6. To remove the pier top, a number of holes were drilled across the top. (See Fig. 3) Using several splitters, a split was made across the width.
7. To remove the top section, holes were drilled from the top down. (See Fig. 4) Note the splitter was positioned to break the concrete on a 45 degree angle for easy removal.

Using the controlled Hydraulic Splitting method, the pier was quickly altered for the additions to sides and top without any damage to the remaining section.



SIDEWALK/SLAB REMOVAL (NO REBAR)

Sidewalks of all thickness can be sliced into manageable sections using a #2 hydraulic splitter. If large pieces can be handled, then one hole drilled at (A) is required. The break is made across the width of the walk. For smaller pieces, another hole is drilled at (B). These whole pieces, large or small, could be used for retaining banks, sea walls, etc.

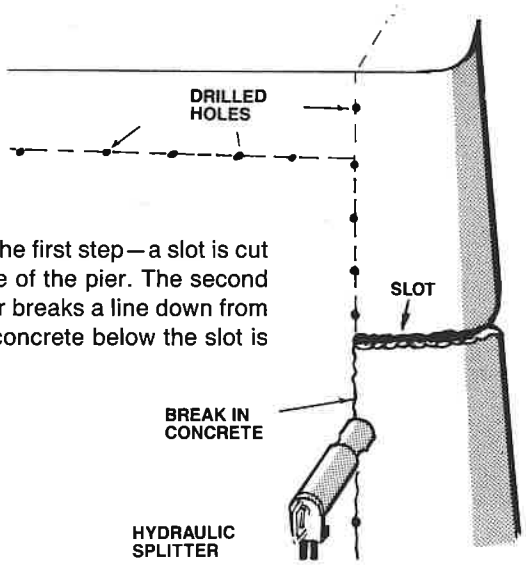


FIG. 1

Drawing shows the first step—a slot is cut through the nose of the pier. The second step—the splitter breaks a line down from the slot and all concrete below the slot is removed.

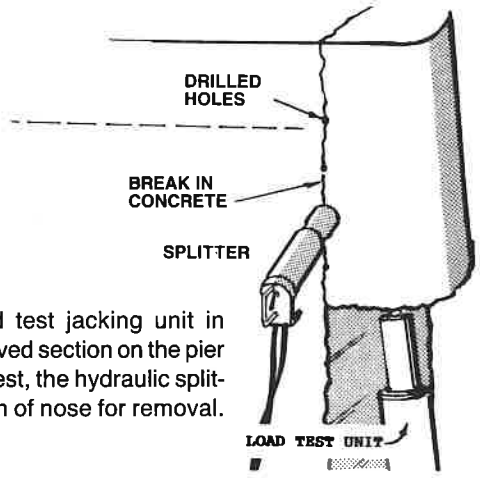


FIG. 2

Drawing shows load test jacking unit in place below the removed section on the pier nose. After the load test, the hydraulic splitter breaks top section of nose for removal.

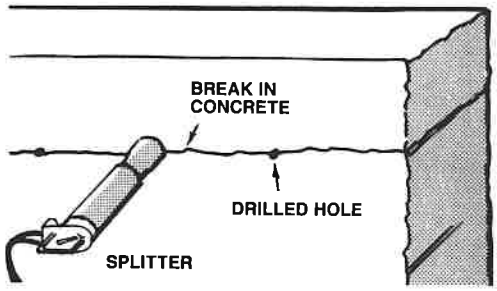


FIG. 3

Drawing shows the splitter breaking the top section of the pier.

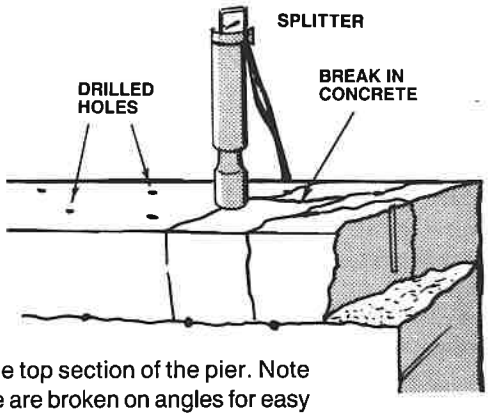
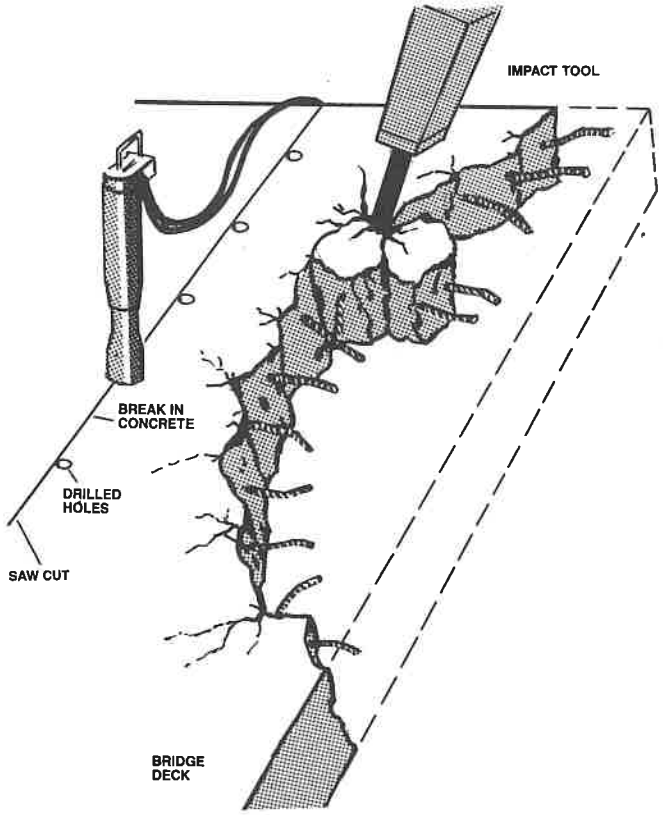


FIG. 4

Final break up of the top section of the pier. Note sections of concrete are broken on angles for easy removal.



NOTE: For saw and split operation, the drilled hole for the splitter is *NEXT* to the saw cut, not over the saw cut. A saw blade can be placed into the cut and used as a guide when drilling the hole. (See Drawing.)

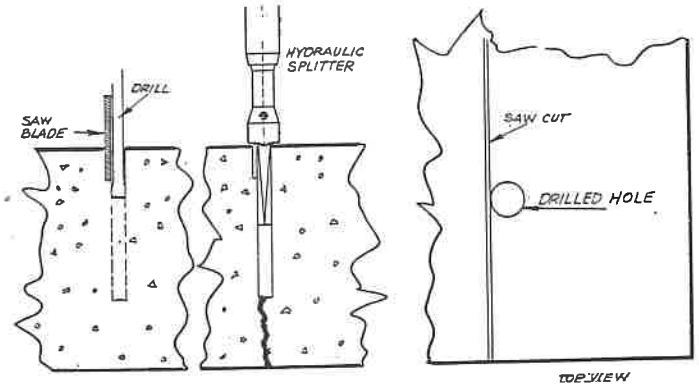
SAVING PART OF BRIDGE OR SLAB

To remove a part of bridge deck or slab, a ram or other impact tools can be used to break some sections of the concrete.

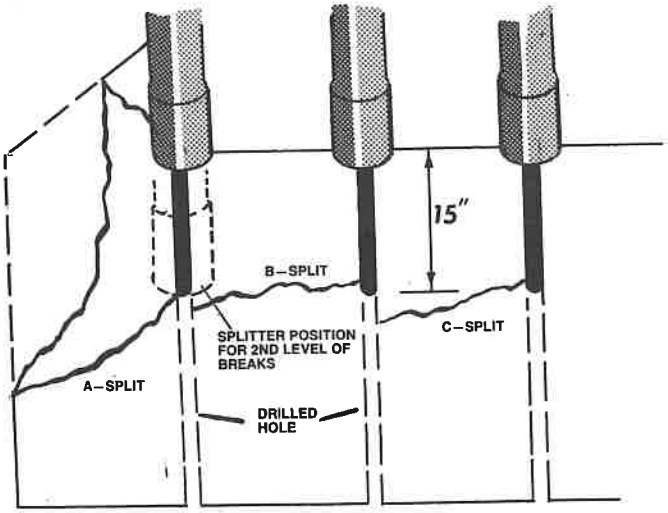
As impact tools will cause small cracks in all directions, it is recommended to end the impact demolition about 20" from the final demolition line.

To safely remove the remaining section, the following method will eliminate impact damage.

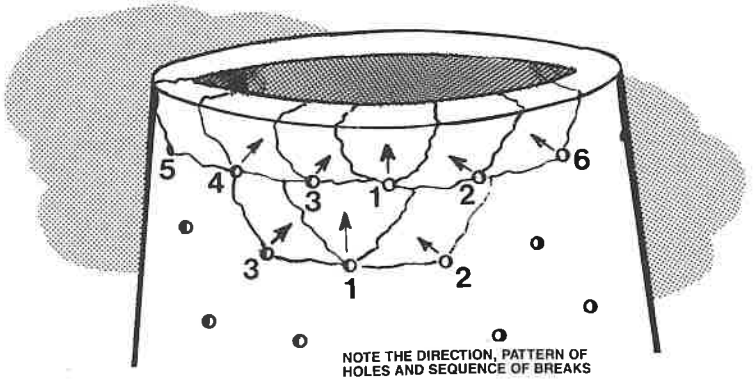
1. Drill a series of holes about 18 inches apart along the cut line. Using several hydraulic splitters in line, the break can be controlled along the cut line without cracks running into the area that is to be used.
2. To have a straight, clean line, the bridge deck can be sawed to a depth of 2 inches. Holes are then drilled on the outside of this sawed line (see drawing). When the hydraulic splitters are used, the break will follow the saw line and a clean, even break will result.



REMOVING THICK CONCRETE SLABS



To remove a thick slab of concrete, it is recommended that holes be drilled completely through the slab. These holes can be used again to make deeper breaks. The first split will follow Line (A), the second Line (B), and the third Line (C). After the top is clear, a second line of breaks are made using the same drilled holes. It is also recommended to rotate the tool so that it breaks the pieces at a 45 degree angle. See Pages 5 and 11 for the hole pattern on top of a slab.



STACK REMOVAL

To remove a stack, a series of drilled holes drilled through the wall is required. The holes are spaced about 1-½′ apart. Note that the hole pattern is staggered, the second row of holes is in between the first row, the third is in between the 2nd and so on.

The drawing shows each drilled hole and a number, which indicates the sequence of placing the splitter in each hole and making the break. Sequence in the second row of holes is similar to the first row.

Note that the splitter is placed so each break is about 45 degrees to the rebar in the stack. See arrows that indicate direction of break.

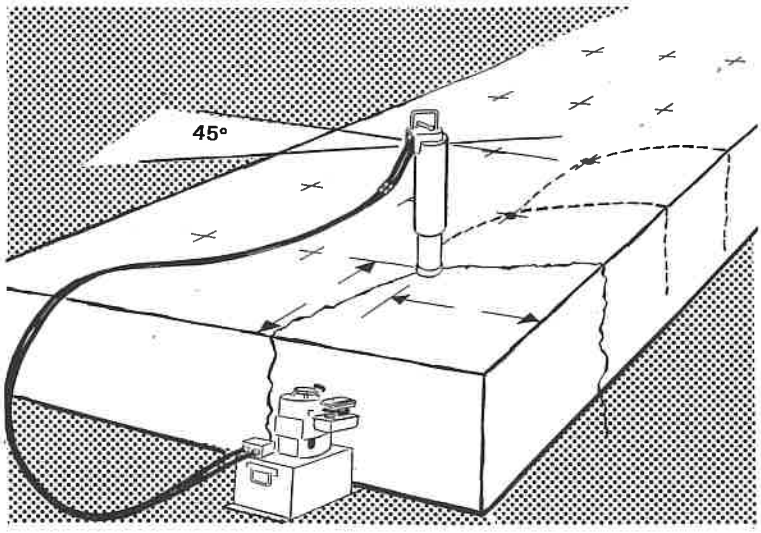
Using the pattern of holes and breaking at an angle, breaks the concrete bond on the rebar inturn making it easier to remove.

Please note on page 6. This drawing shows the correct position of the plug and feathers in a drilled hole for a thin wall.

Call for recommended tool size.

REINFORCED CONCRETE

Concrete walls, abutments, floors and foundations are generally reinforced with steel and the splitters can be used effectively in the demolition process if the following drill pattern and techniques are used.

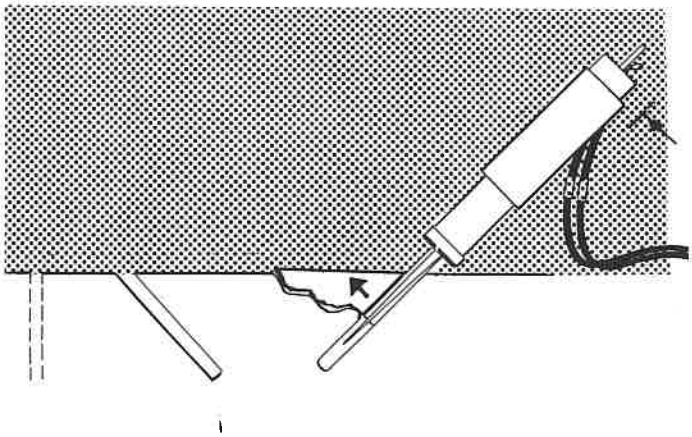


If the wall thickness is 18″ or more, the #12 splitter is most effective, as when it expands to its fullest extent, it actually pushes the concrete off the reinforcing rods breaking the firm bond previously holding them together.

The drilling pattern recommended accomplishes this end result, enabling the workmen to continue the demolition by use of a light breaker or as in many cases just using a pinch bar.

Note the direction that the cylinder is placed in to make the 45° diagonal split. This method is just as effective in heavy floors, foundations and machine bases.

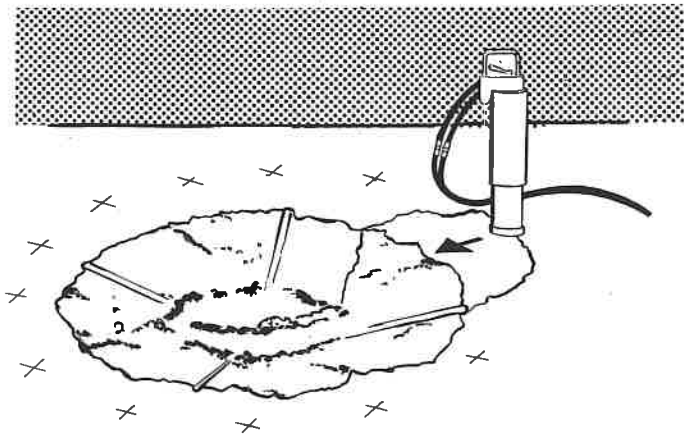
A pattern of holes drilled every two feet (2′) horizontally and every one and a half feet (1-½′) vertically, has been found to be very successful. If the wall is less than 18″ thick the pattern can be extended slightly.



Reinforced concrete broken with hydraulic splitter.

Floor slab cracks without damage to nearby equipment.

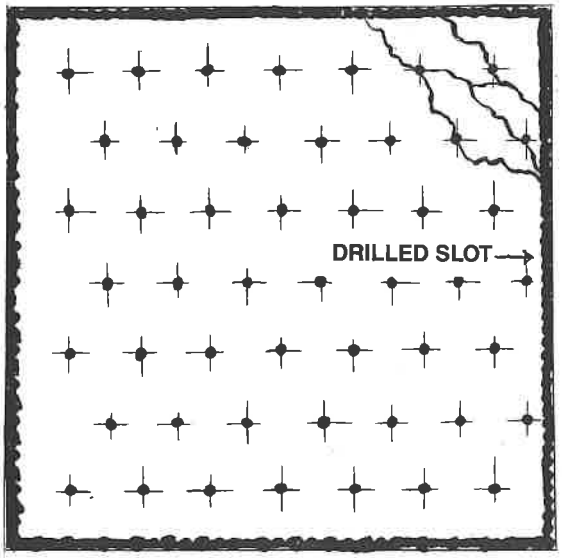
It is suggested that before pre-drilling the entire wall or floor, you first try 6 to 10 holes to determine if your pattern is satisfactory for your particular job.



HOW TO START AN OPENING ON A FLAT SURFACE

To start an opening into a solid slab requires that you again create an open face. Here is one method to start a vertical opening. First the drilled hole is made on approximately 45° angle to the surface. The splitter is placed so the break will be toward the surface. (See drawing). With this type of break a word of caution, there is a tendency for the tool to flex. Do not allow the tool to flex more than 1 inch before turning unit off. If allowed to flex more than 1 inch, the plug and feathers could be bent or broken. However, if a full break did not occur the material still has been broken and it merely means a little more work with a paving breaker to get the pieces out.

Repeat this operation until you have an opening that is large enough to start the second phase of the breaking. Again pattern your drilled holes around the face moving back only the distance for a full break. The thickness and hardness of the material will determine the distance. Do not drill all your holes until you have made several breaks. The above method has been used by many contractors to start openings in slabs.



HOLE PATTERN IN SOLID WALL

Start of an opening in a lock. (Note line drilled holes to right to create face.)

OPENING FOR LOCKS-DAMS

The above drawing shows the drilling pattern and breaking method of removing concrete for 7′ 3″ x 7′ 3″ opening in the face of a dam.

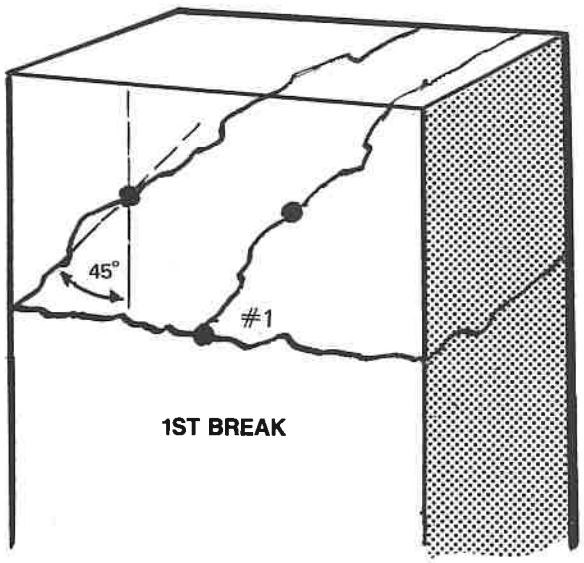
First—Create an open slot around the outline of the opening. Slots are described on Page No. 8. This created an open slot on each side. Job conditions may make it feasible to line drill with the four sides making it easier to trim the entire perimeter and eliminate the use of paving breakers or rock breaker points.

Second—Holes inside the outline are drilled on approximately 12″ centers. Note staggered pattern.

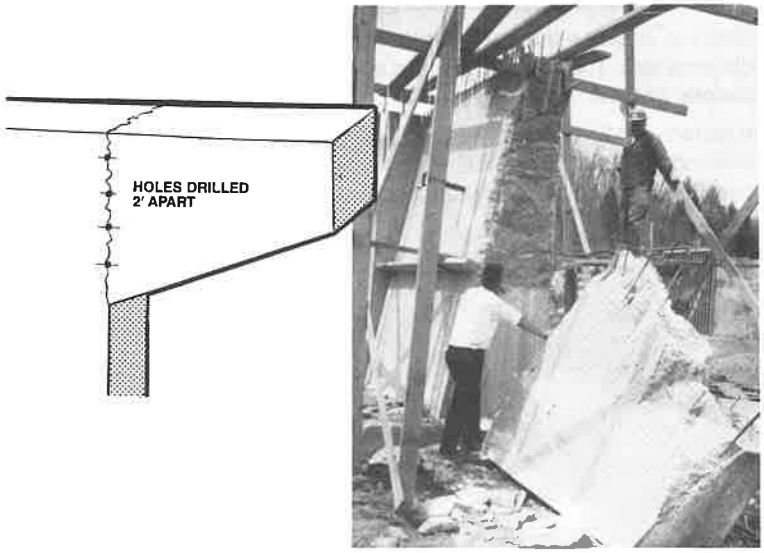
Third—The splitter inserted with the handle on a 45° angle breaks concrete from hole to side, *not* hole to hole.

The holes in the remaining sides should be drilled about 6 inches apart. The breaks here should be from hole to hole.

The rock splitter is a simple and easy tool to operate; however, the pattern of drilled holes should be thoroughly planned before using the cylinder. Planning holes also insures the fast production.



1ST BREAK



DIRECTIONAL SPLITTING

Controlled directional splitting is required for columns, walls, abutment wing walls, floors, bridge decks.

The Hydraulic Splitter is exceptional in demolition projects where controlled splitting is necessary. The following shows a few common applications that many firms are called upon to do.

Reinforced columns can be split as shown if a section has to be removed and still leave the main part intact and free of cracks. The first hole (#1) should be at the desired point and the others at points that will facilitate removal of the undesired part. If the entire column is to be removed, drill holes over 2′ up the center and make the splits at a 45° angle to facilitate easy removal.

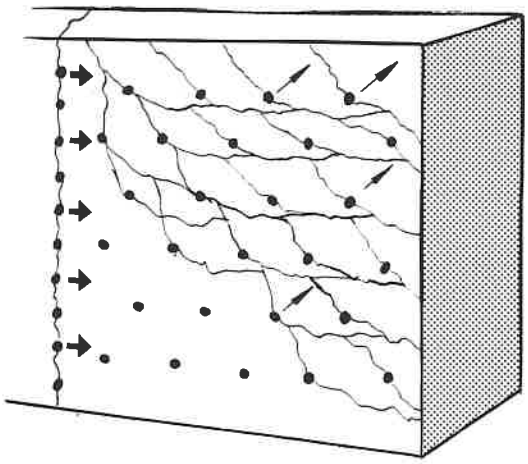
DIRECTIONAL SPLITTING

These wing walls were removed by drilling four 1¾″ holes approximately 2′ apart. The Hydraulic Splitter #12 was used to split the 2-1/2′ thick reinforced concrete and the contractor then chipped down to the reinforcing from the side to be disposed of. When exposed, contractor burned the rods with a torch. With a few men, six of these sections were dropped in three days.

CAUTION:

When attempting to break pre-stressed or post-tensioned concrete, be sure that the tension on the stress cables or rods has been relieved. Otherwise, the split usually follows the direction of the cables or rods ***regardless*** *of the position of the splitter. This makes accurate, controlled splitting impossible.*

CONCRETE WALL REMOVAL



The above drawing shows the method to save a section of concrete and remove a part without damage to that which remains.

The first step is to drill a line of holes along the section that is to remain. These holes should be approximately 12″ apart to assure a straight line for the break.

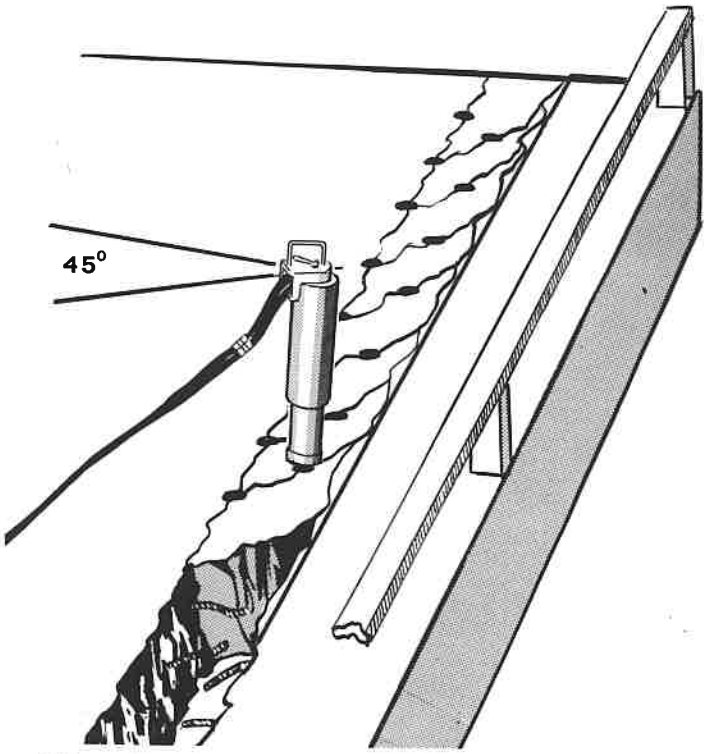
One or more hydraulic splitters are placed into this line of drilled holes and rotated until the handles align up with the direction of the split. If the wall is very thick and has rebar, use several splitters for this operation.

After this break has been completed through the entire wall, the section to be removed can then be drilled. If the concrete contains rebar, a hole pattern similar to those on pages 5, 6 and 11 must be used. For nonreinforced concrete, see page 6.

If a wall has to be sheared, the sketch shows the recommended method. Drill the same pattern as for reinforced concrete and split back to within approximately 18″ or 2′ of the desired line. The shear line should be line drilled as shown on 1′ centers and split from hole to hole.

Large sections of concrete road is removed after split into sections with the hydraulic splitter.

BRIDGE DECK REMOVAL



Bridge widening wall and curb to be removed and reinforcing were left intact to tie new deck to old.

Drop balls and heavy impact equipment were not used when within several feet of finish line for fear of transmitting fractures into existing deck.

When railing and sidewalk and part of deck had been demolished to within several feet of new line, 1¾″″ holes were drilled every foot along the length of the deck. Additional holes were drilled every 2′ midway between the finish line and the point where heavy demolition equipment was used. The splits were made on line #1 to presplit the concrete and then the intermediate holes (Figure #2) were split to facilitate easy removal of the concrete.

Example of controlled splitting. Note exposed rebar.

BREAKING REINFORCED SLABS-PILLOWS

A slab or pillow with reinforced concrete calls for a different method of using the splitter. Usually, the reinforcing is placed only a few inches from the outside wall in shape of a cage.

First, you must expose this cage before trying to break the rest of the material.

Second, drill horizontally approximately a foot down from the top and about 1 to 1½ feet in from the corner (drill holes all the way around).

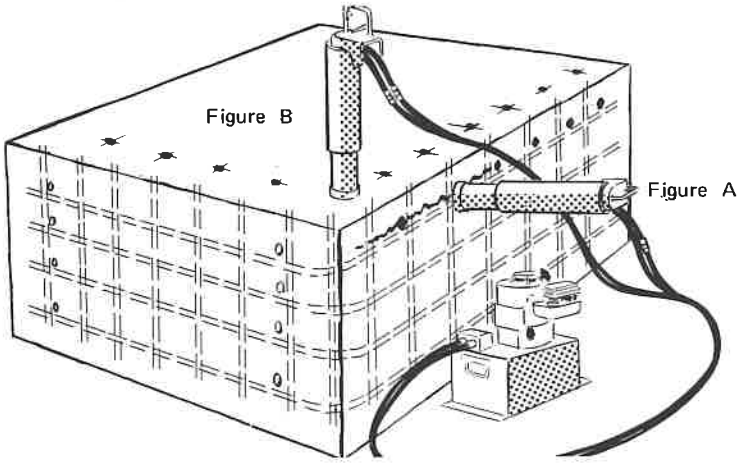
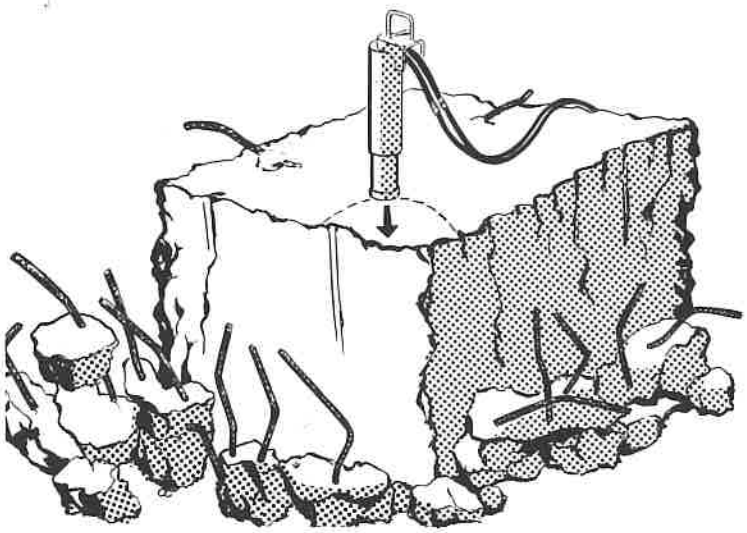


Figure A

Third, insert tool in drilled hole and turn directional handle to parallel the top. In this manner break the top off. Fig. A

Fourth, after top mat is removed, drill holes vertically around pillow as shown, then insert splitter and break all sides off. Fig. B

After all the rod is removed, you now can proceed with the drilling of holes and breaking as with a regular slab of concrete (see page 15).

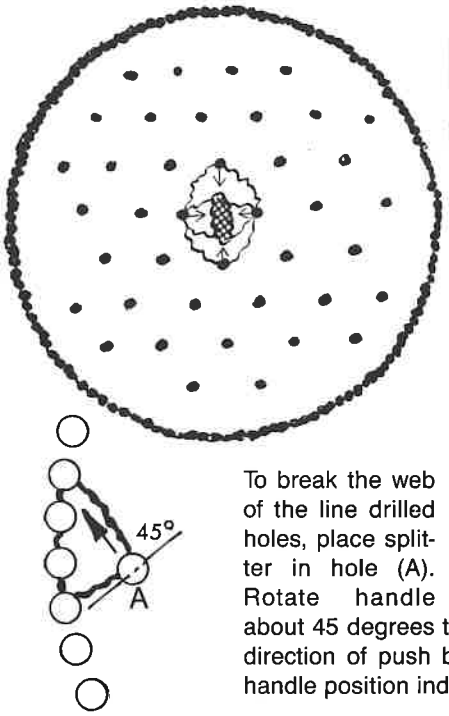


MAKING A SYMMETRICAL OPENING

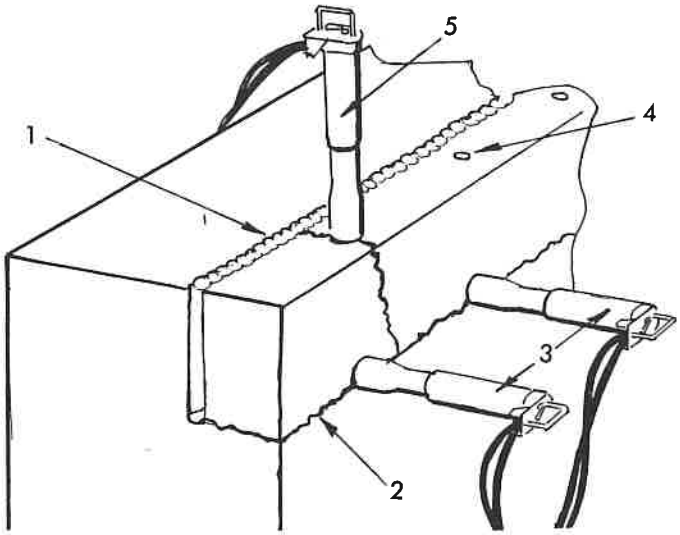
In order to maintain a symmetrical 8′ diameter opening, drill 1-3/4″ holes 24″ deep a foot apart around the circumference. This could be done beforehand at all six locations.

Then try to put in either a center hole 4″ or larger, or line drill in the center 5 to 8 1-3/4″ holes to give you a face toward which to work. (See Page 8, Figure C)

Pattern the rest of your holes as shown a foot to a foot and a half on center, always pushing to the center core. The broken lines show how the splits occur. As the center gets wider, you keep moving to the next line of holes. There is very little chance that the split will continue past the outer circle and if they appear to be going past, you can stop the operation of the tool immediately. In most cases, especially on concrete, you have control of the direction of the split.



To break the web of the line drilled holes, place splitter in hole (A). Rotate handle about 45 degrees to line holes. Arrow indicates direction of push by the splitter. Note: Splitter handle position indicated by line.



REMOVING A CORNER OF CONCRETE

1. Line drill a series of holes across the length of the section to be removed. This creates a slot that separates one side of the corner from the section that is to remain. (See Drawing)
2. Along the base of the section that is to be removed, drill a series of holes 2½ to 3 feet apart.
3. Place two hydraulic splitters into the first two drilled holes. The break should follow the drill hole line. When crack appears, remove splitters and place into next holes. The crack should run all the way to the line drill slot.
4. After the base is split lengthwise, holes can be drilled on top (See Drawing) and can be spaced 3 to 4 feet apart.
5. Place splitter into the drilled holes on top of the section to make the final breaks and removal.

REMOVING ROAD BARRIERS

Concrete road barriers can be quickly broken for removal by using a hydraulic splitter. Pieces can be cut to sizes that can be handled. Only one drilled hole is required to break a section. Drill a hole on an angle (See Fig. A). The splitter is placed into the hole (Fig. B) and a break is made in a few seconds. The broken sections are easily removed without a lot of dust and rubble. This method speeds up work and cuts costs.

Call for recommended tool size.

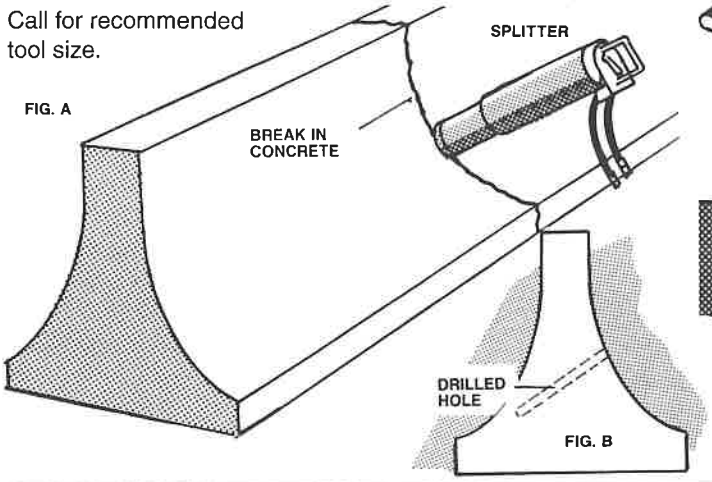


FIG. A

FIG. B

REMOVING ROAD CURBS

Concrete road curbs can be split to the level of a road bed with controlled hydraulic splitting. A hole is drilled into the curb (See Fig. A). Note the angle of the hole. The splitter breaking horizontally shears the curb as indicated in Fig. B. This is a fast, easy way to remove concrete curbs to road level.

Call for recommended tool size.

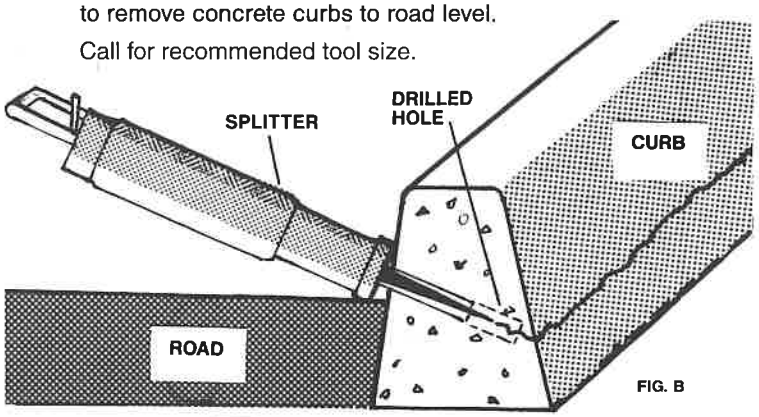
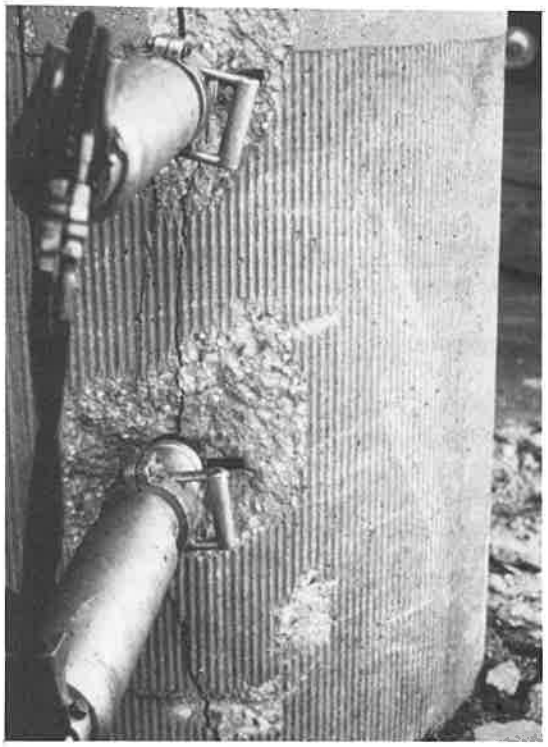


FIG. B

Bridge pier broken with two hydraulic splitters. Bottom section was saved for foundation of new pier.



Nose of pier columns broken with two hydraulic splitters.

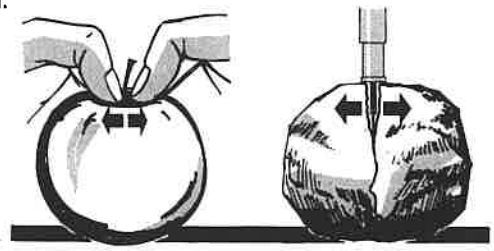
Culvert wall broken in seconds with hydraulic splitter.

Broken pieces are easily pushed over with back hoe. This job was finished in hours rather than days.

ROCK REMOVAL

HOW TO GET THE MAXIMUM PRODUCTION OUT OF THE HYDRAULIC SPLITTER

Breaking of rock or massive pieces of concrete can best be compared to the breaking of an apple. The pulling force of your thumbs is applied to the tops while no force is applied on the bottom of the apple. The same principle is followed when using the Hydraulic Splitter.



Drill your hole in such a way that the working tip of your splitter is somewhere between the surface of the mass to be split and its center.

The following table serves as a rough guide in finding the tool you would use for your job.

NUMBER OF SPLITTERS AND TOOL SIZE REQUIRED TO BREAK VARIOUS TYPES OF ROCK AND DIFFERENT SIZES OF CONCRETE

Material	4' Dia.*	6' Dia.*	8' Dia.*	10' Dia.*
Sandstone	1-#2	1-#9 1-#12	1-#12	1-#12
Limestone	1-#2	1-#9 1-#12	1-#12	1-#12 2-#12
Marble	1-#2	2-#2	2-#9	2-#9
Granite	1-#9	1-#12	1-#12 2-#12	2-#12
Basalt	1-#9 1-#12	1-#12	1-#12 2-#12	2-#12 3-#12
Concrete Non-Reinforced	1-#2 1-#9	1-#9 1-#9 1-#12 1-#12	1-#12 1-#12 2-#9	2-#12
Concrete Reinforced	1-#12 1-#9	1-#9 1-#12		2-#12

*Approximate diameter or cross-section intended break

For best control of break or for increased force, use two or more tools simultaneously. In soft or stratified materials, or reinforced concrete, use enlarging feathers for increased expansion.

Where material is more or less confined, such as in trenches or tunnels and material is hard, use two or more splitters.

TYPES OF ROCK

Some knowledge of the material to be broken is helpful. The following information should be of some aid in planning operation of the splitter.

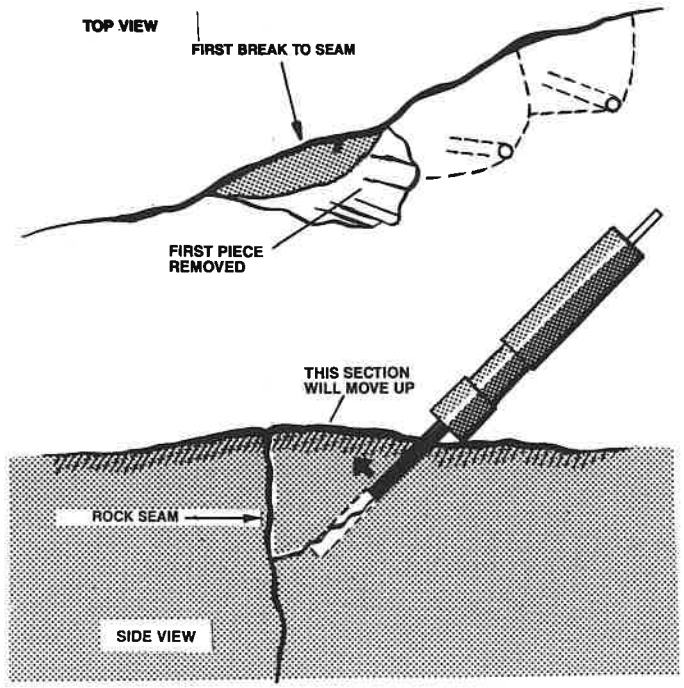
SOFT	SOFT TO HARD	HARD
Shale Shist	Sandstone Marble Limestone	Granite Gneiss Bluestone Basalt

Certain rocks, not necessarily the hardest, produce fast wear on drill . . . Silica sandstone is such a material. Locating and choosing the direction of the split is important.

As indicated in the table, tensile strength, important for splitting, is much less than compressive strength. For larger blocks to be split along larger areas, 2 or more splitters are to be used. Because of the tremendous stresses which plug and feathers must undergo, it is advisable to avoid any secondary stresses by drilling holes as straight as possible. This way, bending of plug and feathers under stress are avoided, which when repeated, would lead to premature failure. Holes should be drilled as straight as possible as it extends considerably the life of the plug and feather assembly.

ROCK	APPROXIMATE TENSILE STRENGTH	COMPRESSIVE STRENGTH APPROXIMATE PSI
Basalt	— — —	25,000 - 30,000
Bluestone	1,200	— — —
Gneiss	— — —	9 - 15,000
Granite	1,000	33,000
Granite, altered	— — —	8 - 9,000
Marble	7 - 800	30,000
Limestone	500	10,000
Sandstone	100 - 200	6 - 12,000
Shist	— — —	5 - 17,000

HOW TO BREAK TO A SEAM



How to create a face in a rock with a vertical seam. The following procedure is recommended:

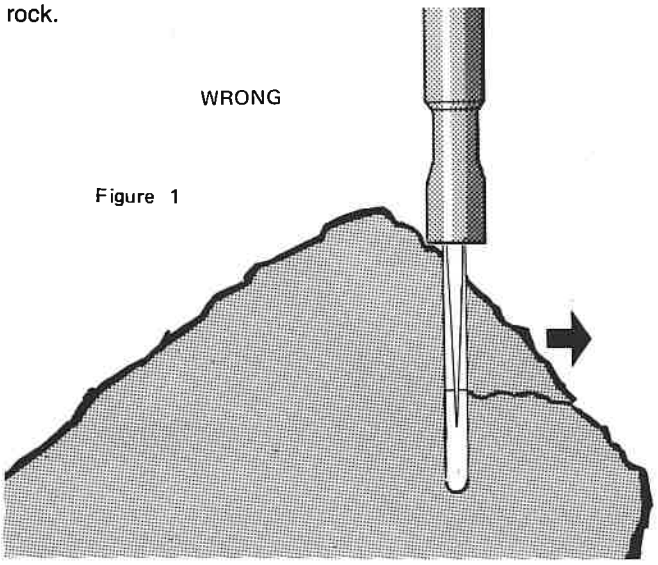
1. Drill the first hole about 1-½' from the seam.
2. Drill the hole at a 45 degree angle.
3. Place the splitter in the hole and rotate the tool until the handle is parallel to the seam. This will break out a triangular piece of rock. Repeat this several times to enlarge a good working face. Rock can now be broken on either side of the seam.

SELECTING THE PROPER LOCATION TO DRILL HOLE

When drilling, visuallize future breaking. Always drill more or less perpendicular to largest even area parallel to possible strata in rock.

WRONG

Figure 1



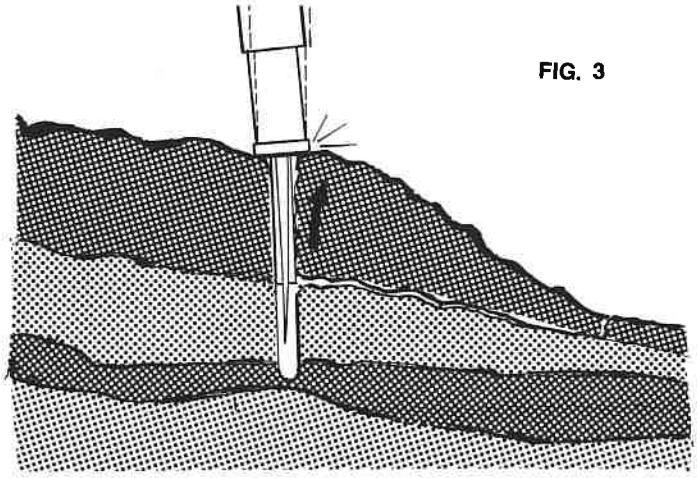
Splitting is very inefficient when drilled hole is placed in the wrong position (Fig. #1)

First, the drilled hole is not perpendicular to the surface; and in addition, it is off center. When plug is extended, the weak side will peel off and only a small piece will break off. This type of hole placed on the side, will restrict the movement of the splitter causing the plug and feathers to bend. It is important that the tool move freely while the power is applied.

ROCK WITH SEAMS

Very seamy rock will break in an irregular pattern. Sometimes the split stops at the first major seam. As layers do not only move horizontally, but also vertically, the rock splitter will move accordingly. Retract the tool as soon as this movement exceeds 2" as there is no benefit and the strain on the tool could cause breakage.

FIG. 3



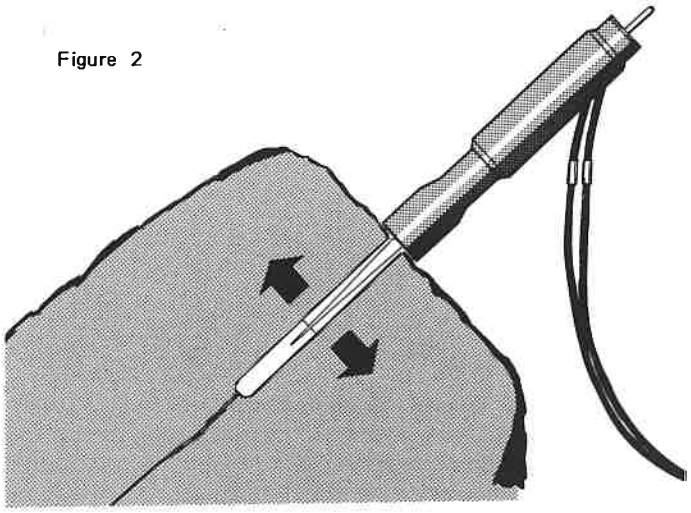
Once a free face has been created, the rock usually will break down to the first seam below the tip of the feathers. Fig. 3 shows splitter at work in this type of rock. Remember to retract plug if there is movement of the tool, as this also will avoid breaking of plug and feathers.

In seamy rock be cautious of possible rock blistering, followed by jamming of the plug and feathers. Avoid this by careful layout of the split.

This drawing (Fig. 2) shows the correct method to break this shape rock. Note the splitter is perpendicular to the largest area parallel to the possible strata in the rock. This approach will give best results in sound material.

RIGHT

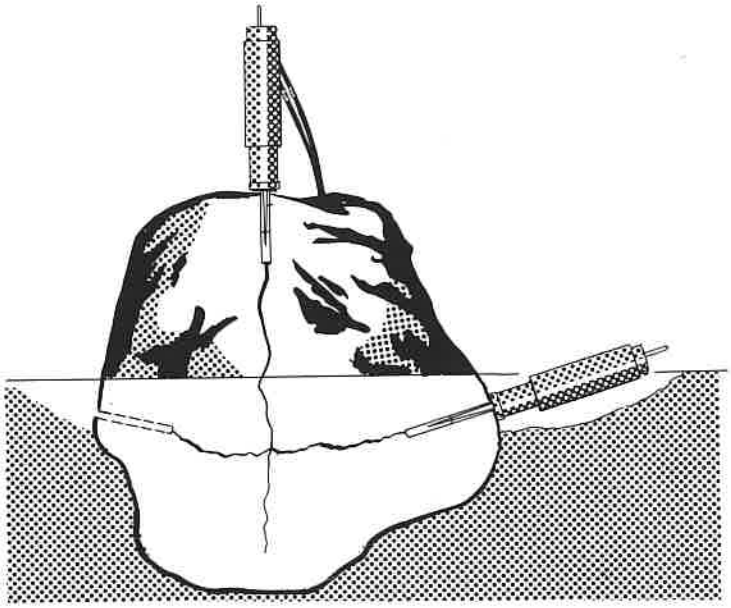
Figure 2



The rock or concrete will usually split along the flat side plane of the plug (wedge). This is a most useful feature as it permits the operator to control splitting as required. It is usually most economical to make sizes as large as can be removed with available excavating or hoisting equipment—pieces can be made as large as several tons or as small as 1 cu. ft.

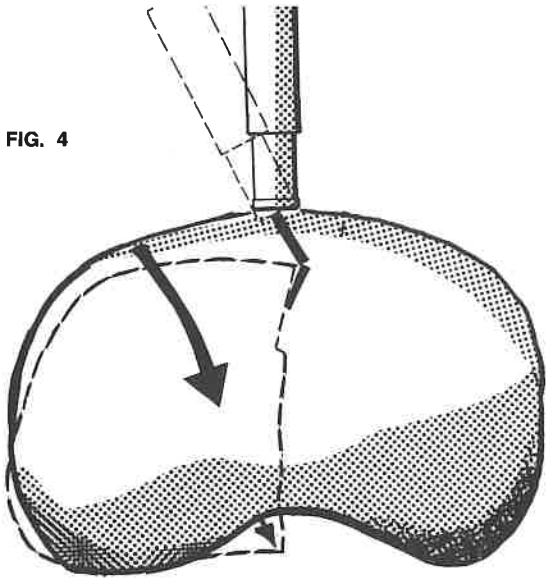
BELOW GRADE BREAKS

To break a boulder off below grade level should be an easy operation. First, if the rock is not too large, drill a hole near the center and see if this will make a break. When broken from the top, excavate below grade level and drill holes around rock. Place tool so break is toward the surface. Broken sections can be split into small sections for convenient removal. If the rock is very large, more holes must be drilled. Remember, do not try to make too large a break at first.



Using this method, rocks or boulders in confined areas can be broken and removed with complete safety without vibration or shock waves.

FIG. 4



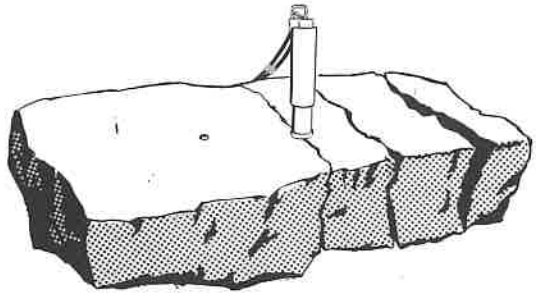
Splitting a large rock which is not free to move calls for a special technique. Fig. 4 shows what could happen. Note that after the crack occurs, the right side of the rock will raise upwards and push one feather upwards along the plug. The cylinder will lean to the left. The plug and feathers will be bent and in extreme cases, breakage of both plug and feathers occurs.

The rock or concrete should not be supported in a bridge fashion as shown, since if it is split in this position, it could cause the shearing of the plug and feather assembly due to the sudden sliding of excessive weight.

To prevent this breakage, it is advisable to retract the plug immediately once a deflection of more than 2″ occurs. Then reset the cylinder and repeat the same action. Under difficult conditions this may have to be repeated several times until rock is fractured enough for removal. Above drawing shows how rock with round bottom could roll after splitting in half.

Large rock "sliced" with hydraulic splitter.

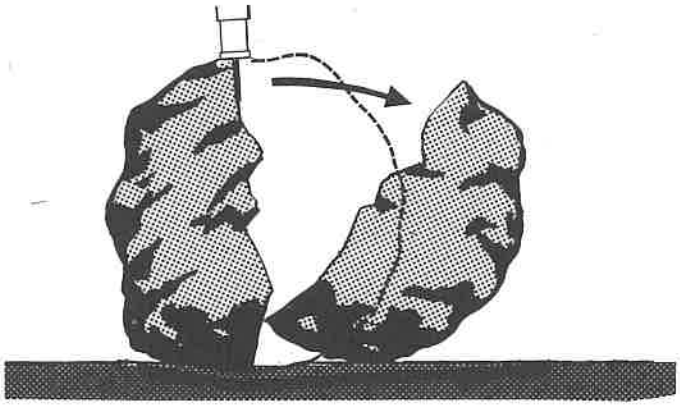
For best economy, split rock as large as your equipment on the job can handle. This granite rock is sliced exactly as required with holes and the cylinder positioned correctly.



If the mass of rock is not as great as the above drawing, holes can be drilled near the center. However, if the mass is quite large, then a hole drilled near the side about 1 foot to 2 feet back from the face would give the operator an indication of what would be a satisfactory pattern.

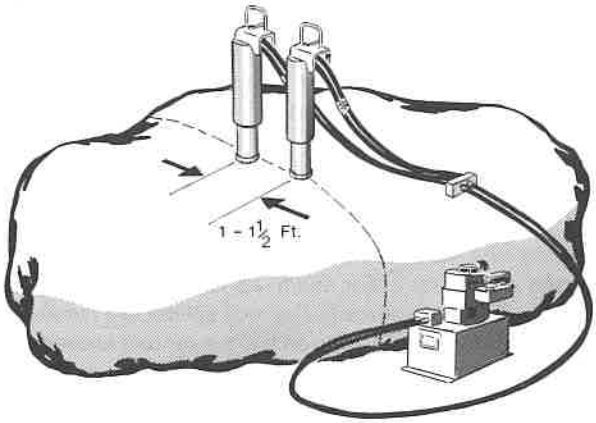
WATCH FOR MOVING ROCK

Before splitting boulders and ledge rock, anticipate direction rock will take after being split. It is often necessary to support the cylinder so that it does not fall with the rock if it is a protruding ledge or end piece.



BREAKING LARGE HARD BOULDERS

On large or extremely hard boulders or concrete blocks, which might be impossible to break with one tool alone, two or more tools can be hooked up in parallel doubling the force and greatly increasing production. Granite boulders over 20′ in diameter have been broken in half with this technique.

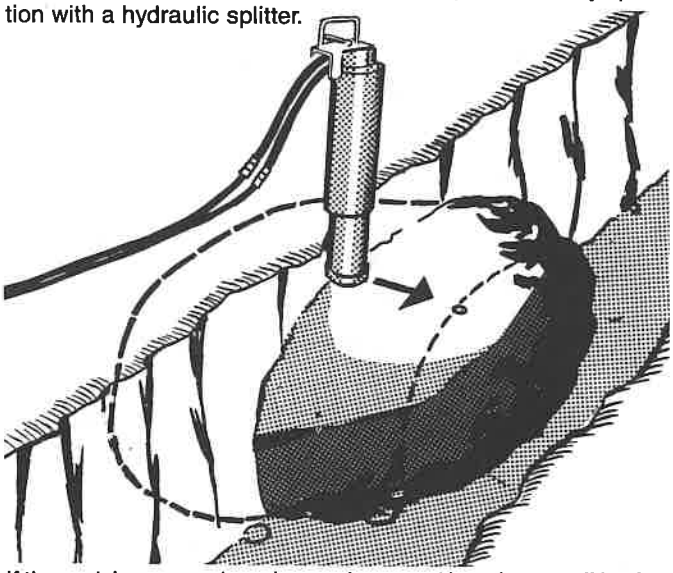


Drill two holes approximately 1 to 1½ feet apart in the center of the boulder, be sure that both units are facing in the same direction—line up the two handles as shown in drawing. If boulder is extra hard, this can be repeated along the line to be broken.

Two hydraulic splitters break submerged boulder 15′ across, 12′ deep and 20′ long.

BREAKING ROCK IN TRENCHES

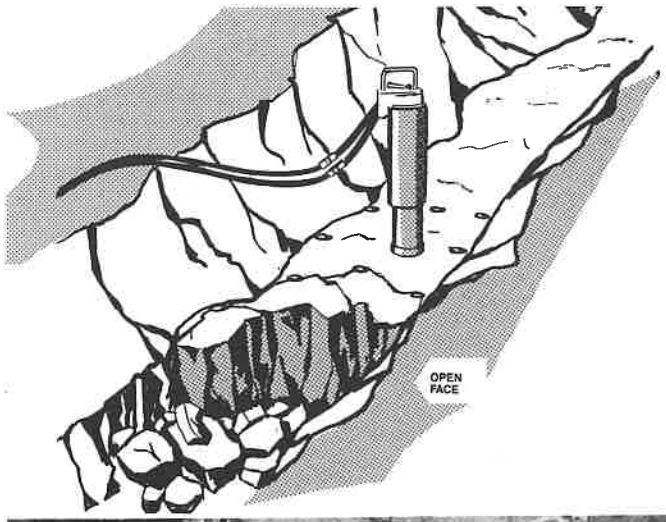
Removing boulders from a trench can be a quick and easy operation with a hydraulic splitter.

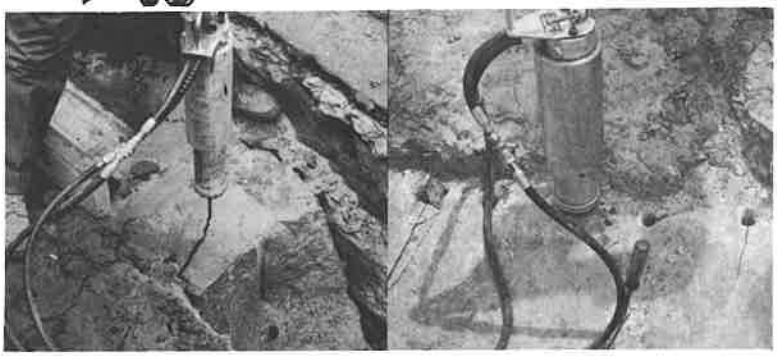


If the rock is exposed as shown above and is rather small in size, a hole drilled into the side should be sufficient to make a complete break. However, if the boulder is large and hard, two or more drilled holes may be required to break off smaller pieces and work back to the side. Remember the direction of break should be in line with the handle before plug is extended.

TRENCH EXCAVATION—OPEN FACE

Where rock has to be excavated to a depth of 2′ or more in a trench, the #12 splitter is most effective. Holes 1¾″ x 26″ or more in depth, spaced 12″ to 18″ apart and arranged in a pattern as shown, have been found to be very effective.

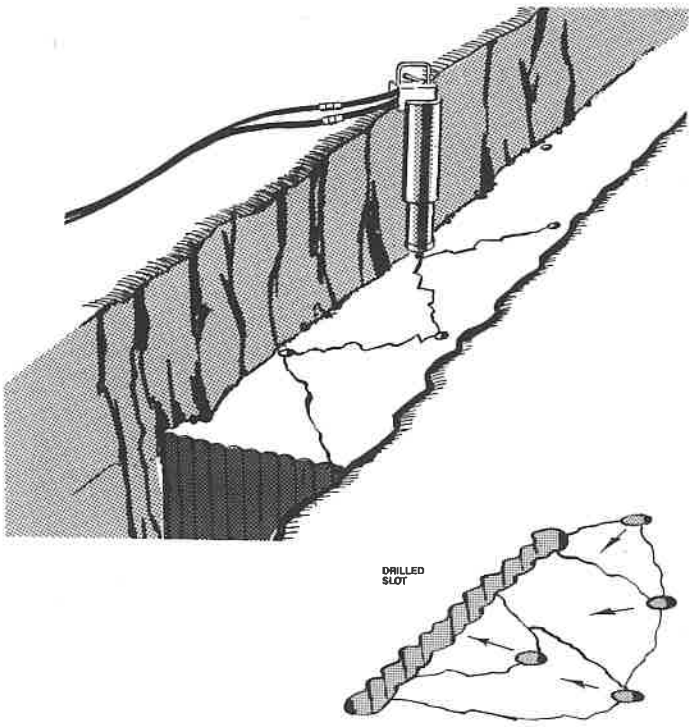




Examples of difficult rock in trench being broken with the hydraulic splitter. An open face is required to remove the rock.

TRENCH EXCAVATION—SOLID ROCK—NO FACE

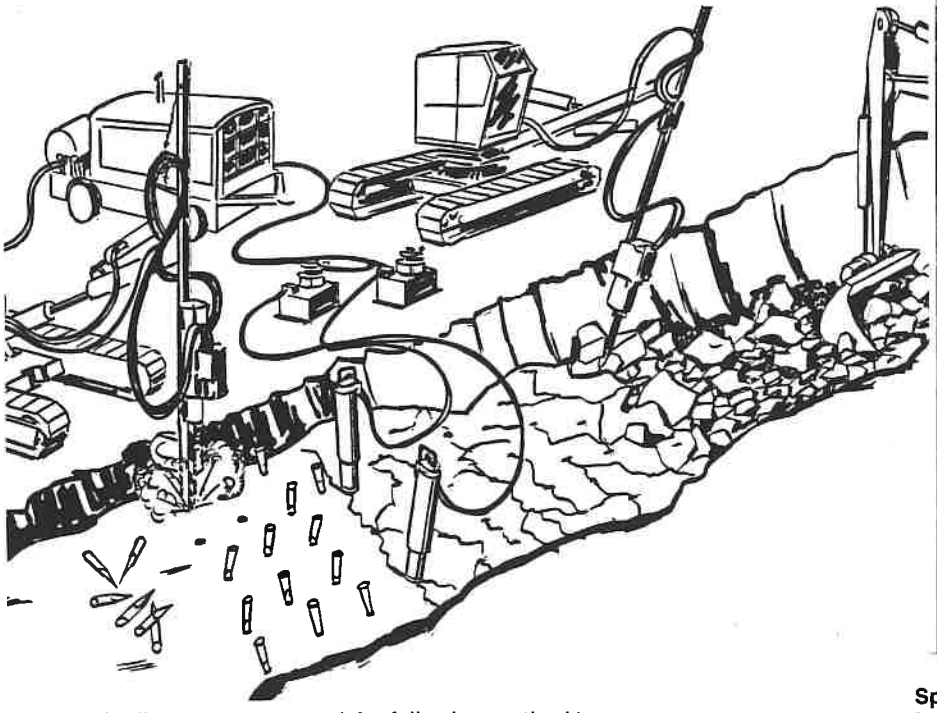
Where solid rock has to be excavated and there is no open face several methods have been used successfully. One is to drill your hole pattern in a zig zag fashion as shown with a spacing of 12″ to 18″ apart. Intermittent holes are used to shear off the sides of the trench.



The other method would be to establish a face by line drilling a series of holes the depth to be reached and then working toward this face as in open face work. (See Fig. A) (See Page No. 8 on method to create open slot or face).

Splitter breaking rock in small trench.

BREAKING ROCK IN TRENCH FOR PIPELINE



Splitters work in pairs to break solid rock in pipeline trench.

A large pipeline contractor used the following method to remove over a mile of solid rock for a pipeline trench.

The trench was 6 feet wide and 8 feet deep as required for a 30 inch pipeline. Blasting was not permitted because of an existing nearby pipeline.

Four teams of equipment were used in this operation including track drills, hydraulic rock splitters, air rams and backhoes.

After the rock was exposed, holes were drilled on 1 foot centers the full depth of the trench.

Two splitters working as a team broke the rock, 3 to 4 feet in depth.

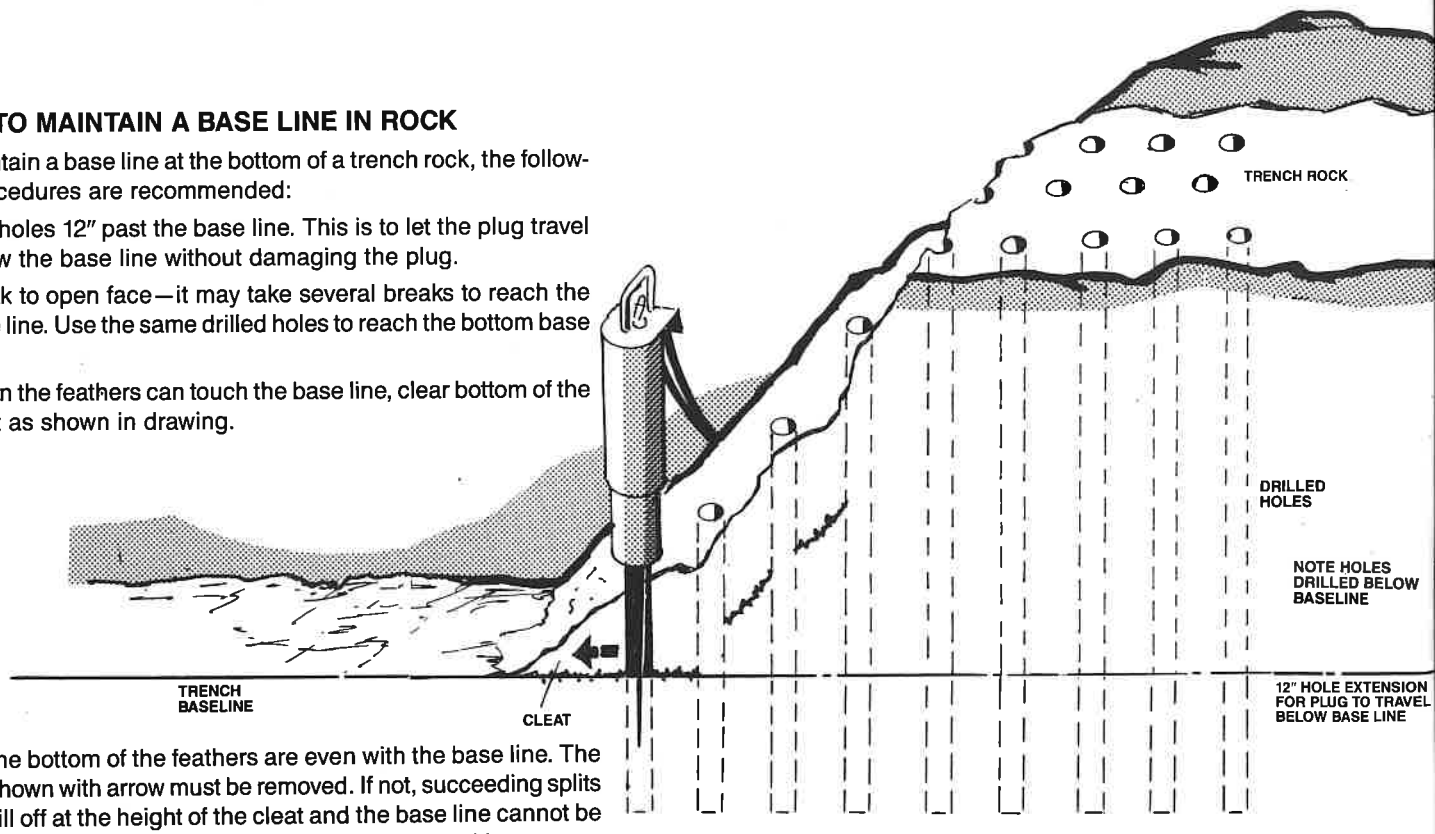
The air ram separated the broken rock which was removed with a backhoe.

After the first layer of rock was removed, the pre-drilled holes were cleared with air. The splitter then made deeper breaks until the full depth of the trench was reached. Drawing depicts the full operation.

HOW TO MAINTAIN A BASE LINE IN ROCK

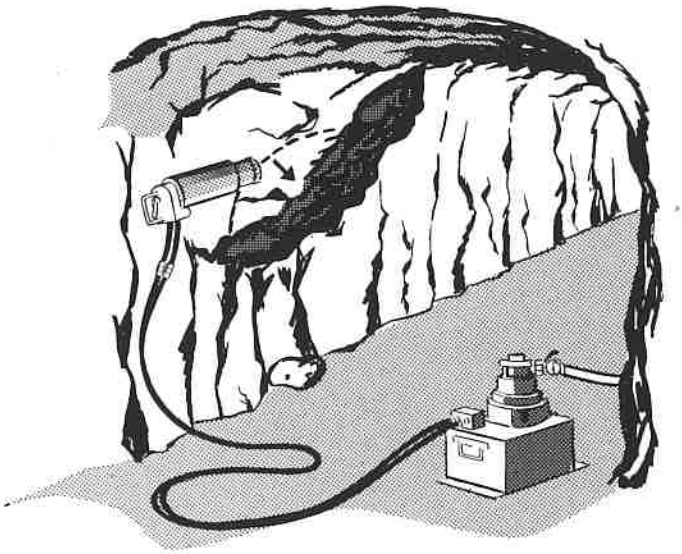
To maintain a base line at the bottom of a trench rock, the following procedures are recommended:

1. Drill holes 12″ past the base line. This is to let the plug travel below the base line without damaging the plug.
2. Break to open face—it may take several breaks to reach the base line. Use the same drilled holes to reach the bottom base line.
3. When the feathers can touch the base line, clear bottom of the cleat as shown in drawing.



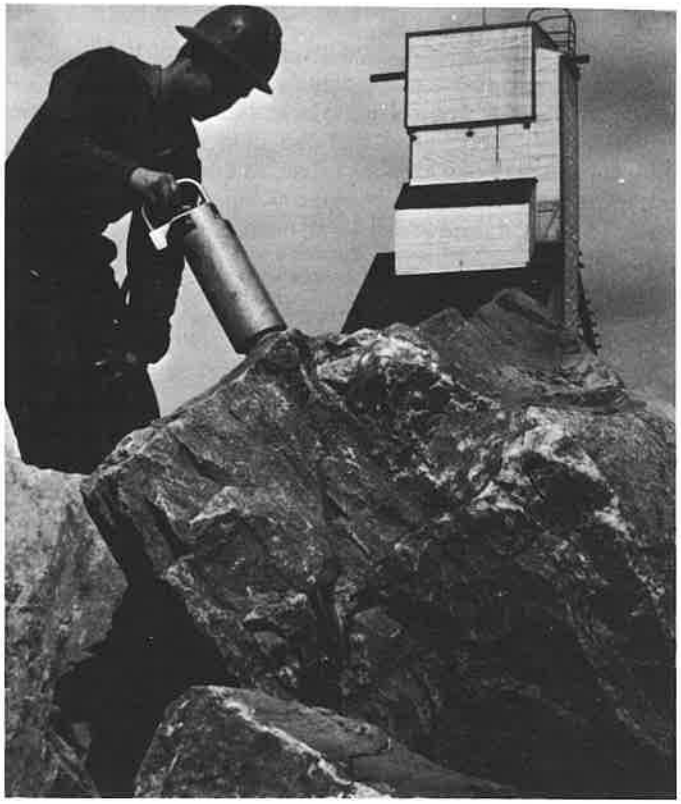
Note the bottom of the feathers are even with the base line. The cleat shown with arrow must be removed. If not, succeeding splits will spill off at the height of the cleat and the base line cannot be maintained without trimming this rock with ram, jackhammer or paving breaker.

TUNNELS – MINES – QUARRIES



REMOVING "TIGHTS"

The hydraulic splitter can easily remove "Tights" without blasting or causing damage to nearby equipment or tunnel as the power unit can be air-powered. The hole pattern can be determined after a few breaks, then the tool can be used in any position or angle and underground areas can be enlarged quickly with the splitter. Boulders too large for removal can be broken easily. Note the tool should be supported so it will not fall after a break.



Splitter used for secondary mine work.

PLANNING LONG STRAIGHT BREAKS

Three hydraulic splitters were used to split this huge section of granite. Size 30′ x 12′. Break was made in 2 minutes.

A long straight break in material such as marble requires only a partial break in the first operation.

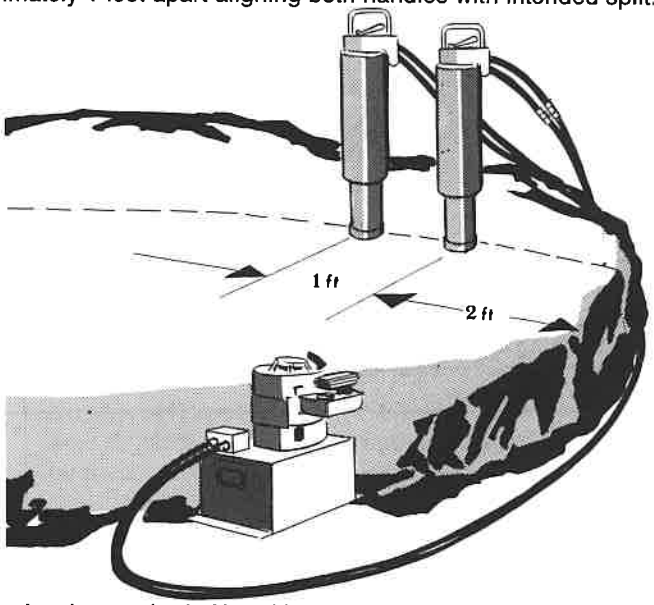
For this it is advisable to drill holes from 1 to 3 feet apart. Now place the splitter into the first hole and make a partial break. To apply partial force, a pressure gauge is required and can be placed at any convenient location in the high pressure line.

When pre-stressing is complete, then place splitters as shown above and complete the break.

Several tools can be used for this type operation and only one gauge is required if both splitters are operated from a single power unit.

USING TWO SPLITTERS TO INCREASE PRODUCTION

For maximum breaking force, two tools are usually placed approximately 1 foot apart aligning both handles with intended split.



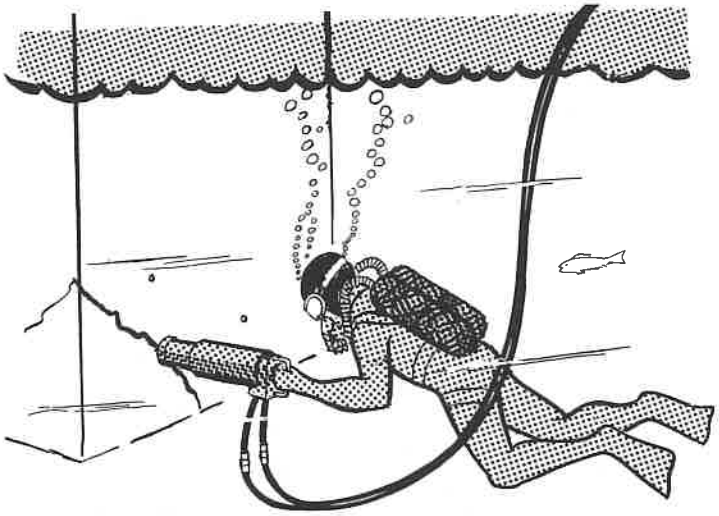
Another method of breaking a large boulder with two splitters is suggested in the above drawing. Instead of placing units in the center place them about 1 ft. apart and 1-½ to 2 ft. from the edge of rock. Be sure both handles are in line with the intended break. Proceed along dotted line until break is made.

BREAKING ROCK STUCK IN JAW CRUSHER

The splitter will quickly free rock stuck in jaw crusher, shutes, transfer points. Requiring only a small drilled hole, the unit will operate with complete safety to equipment and personnel.

UNDERWATER USE

The Hydraulic Splitter will work well underwater. Techniques are same as working above water, only the drilling is done using a compressed air drill. The tool has to be lubricated somewhat more frequently. We recommend that the plug and feathers are lubricated above water for each break. At the end of a working day, remove plug and feathers and dry and wipe with oil rag to prevent rusting. If used in salt water, flush with fresh water first. ,



Hydraulic Splitter is lowered into New York's East River for underwater operation.

Use of two or more splitters can quickly double or triple the breaking force on massive sections of concrete or rock. The above shows three splitters breaking a 10' concrete wall in a few seconds.

Several hydraulic splitters used to break bridge pier. This method allows the control of the length and direction of breaks.

SUMMARY

This publication briefly outlines a few of the hundreds of applications using the Hydraulic Splitting Method. This method has many advantages over other methods of demolition of both rock and concrete, including control, time saving and labor saving, both of which reduce costs. It is also simple for operator to use.

It should be noted that the effective use of Hydraulic Splitting is planning and selecting the various hole patterns. There are a number of them outlined in this book and on a number of jobs, a combination of hole patterns should be used. Our headquarters can advise you of these various patterns with over 30 years of field experience on many different and complex demolition applications.

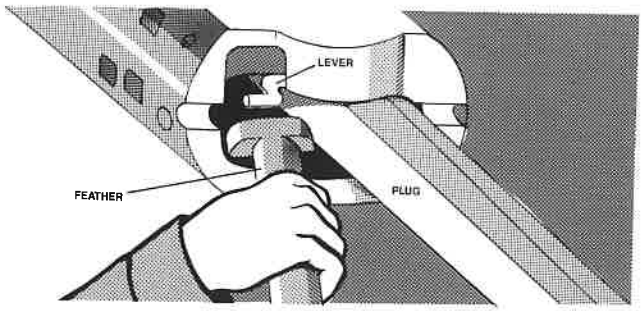
This method has advantages over Expanding Chemicals as it works in minutes rather than days. Also, it does not require as many drilled holes which takes time and is costly. The tool also operates in any temperature and underwater.

The tool system is manufactured to the highest standards and with good service, will last many years and pay for itself many times over. Some tools are still in operation after 25 years of use.

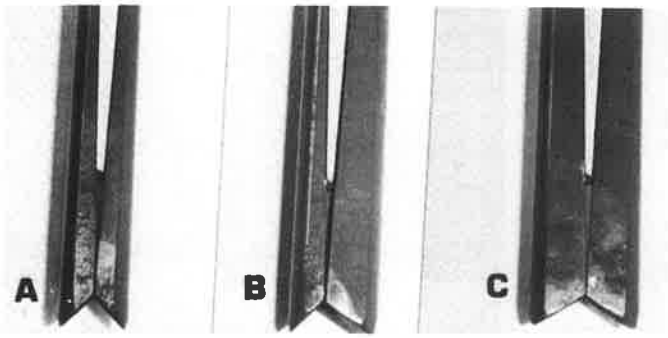
If you would like to explore this method on your next project, we will advise you how the tool could be used in the demolition of concrete, reinforced concrete and the various types of rock. Call our toll-free number, **800-631-3816.**

INCREASE SIZE OF BREAKS

Splitters allow the operator to change the size of the tool to increase the width of breaks.



The hand operated lever located at the cylinder end releases the feathers in seconds—larger feathers can be installed to increase breaks eliminating use of Shims.



The initial break is started with a 1-3/4 inch hold and can be expanded up to 3/4 inch (Fig. A). Replace one standard feather with the larger one and the width can be increased up to 1-½ inch (Fig. B).

Using two larger feathers, the break can be increased up to 1-7/8 inch.

This method of enlarging breaks is helpful in reinforced concrete where rebar must be cut for removal.

NOTE: Break should be held open with metal wedge or rock so each larger size will fit into hole.

CASE HISTORY ON SAVINGS

"On our job, three men did five times more work per day using the Hydraulic Splitter than was accomplished before with seven men using paving breakers."

JOB A

$$\frac{\text{(5 times, new production) x (7 men, old method)}}{\text{(3 men, new method)}} = \frac{5 \times 7}{3}$$

$$= \textit{11.6 times faster or cheaper}$$

"Before we heard about the Hydraulic Splitter, we used three tractor-mounted impact tools with all related operators and other equipment and excavated 45 tons per day. The second day after we had the Hydraulic Splitter on the job, we hauled away 100 tons per day without using any of the tractor-mounted impact tools."

JOB B

" In order to do a quick approximation, we assume that the cost of using an air drill and one Hydraulic Splitter is half as much as using a large compressor with one tractor-mounted impact tool."

$$\frac{\text{)0 tons, new method) x (3 impact tools, old method)}}{\text{5 tons, old method) x (1 Splitter, new method) x (1/2 cost for new tool)}} =$$

$$\frac{100 \times 3}{45 \times 1 \times 1/2} = \textit{13.3 times better}$$

USE OF SHIMS TO WIDEN BREAKS

Step 1 Widening of crack, using one rock splitting cylinder only

Split concrete

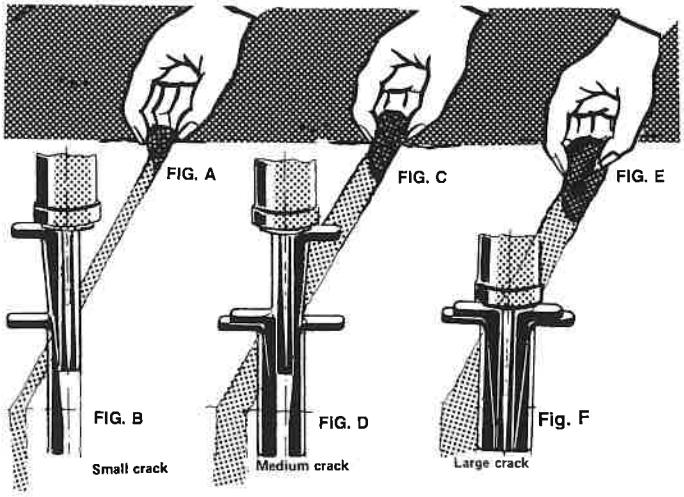
Hold crack open by inserting wedge or other suitable object (Fig. A)

Retract tool and insert with shims (Fig. B)—expand crack

Move wedge to hold crack in wider position (Fig. C)

Retract and lower tool with shims—expand

Move wedge and/or add other suitable object to hold crack open



Step 2

Retract & lift tool and place second set of shims with tool (Fig. D)—expand

Proceed as above (Fig. E)

Step 3

Retract and lower tool with shims (Fig. F)—expand

Proceed as above

If necessary, add shims and repeat the above sequence as required.

ESTIMATING FACTORS

The following factors should be considered in estimating demolition costs using the hydraulic splitting method:

1. **Number of Holes Required**—Hole spacing on the demolition work should be planned in advance. Drilling holes that will not be used increases costs.

2. **Drilling Time**—Use hand drill for small jobs or track drill for very large jobs.

3. **Breaking Time Per Hole**—This includes lubrication of the tool, time to place into drilled hole and removal. Breaking can vary from 15 seconds to 1 minute.

4. **Size Of Broken Pieces**—Large broken pieces reduce removal time.

5. **Equipment**—The size of the broken pieces should determine the size and type of removal equipment.

HYDRAULIC SPLITTING

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