CONCRETE CUTTING SAWS BY RAY DOWNEY

Rescuers face many challenges when operating at incidents involving concrete. Making access by moving or penetrating concrete is a formidable task. Generally, one cubic foot of 4,000-psi reinforced concrete weighs about 150 pounds. Simple math tells us that any substantial section of concrete will be too heavy to move, even by modern-day body-building rescuers.

When you can't move the concrete, your first alternative is to go around it. In most incidents this method is not possible due to the way concrete sections settle after a collapse, earthquake, explosion, etc. If such is the case—as it was with many rescue operations at the Armenian, Mexican, Philippine, and Californian earthquakes—the only other alternative is to penetrate the concrete. The lessons learned at these and other incidents have provided the rescue community with the ammunition and incentives to improve our rescue capabilities for these types of incidents.

THE EVOLUTION OF THE POWER SAW

For many years, technology from many industrial and commercial businesses has provided the fire service with tools and equipment adapted or modified for use in rescues. (This can be evidenced at any fire convention or conference where exhibitors display their latest tools and equipment.)

The power saw that was introduced back in the '60s for the fire service (basically just a larger version of a homeowner's circular saw) initially was thought to be an ideal tool for cutting roofs for ventilation and cutting openings in floors and walls. It wasn't long before metal- and concrete-cutting blades were added to the inventory of this power saw. One type of blade used with this saw was the silicone carbide (abrasive disk). Cutting concrete is actually grinding; so when you used a silicone carbide blade, the blade became worn and eventually ineffective.

The '90s brought the introduction of "diamond blades." These blades have four basic components: diamond, matrix/bond, weld, and metal core. The metal core serves primarily as a heat sink, dissipating the heat generated during cutting. The weld joint—be it laser-welded or silver-soldered—is a method of attaching the segments to the core. The matrix is simply a tool holder. It holds the diamond abrasive securely in place. The diamond abrasive cuts the work piece, removing small chips of material as it is rotated through the cut.

Rubble size and collapse patterns of collapsed concrete structures often make penetration the only way to access voids. Recent incidents have shown that rescuers need tool technology that meets rescue expectations. (Photos courtesy of author.)

THE DIAMOND BLADE

The enhanced cutting capability of the diamond blade is obvious to the tool operator. It cuts one-third faster and lasts 80 to 100 times longer. Cost differences between the diamond and silicone carbide blades are also apparent; an appropriate analogy would be the Cadillac vs. the Yugo. You get what you pay for; and in the life-saving community, it's performance that counts, not cost. [Most operations personnel would agree, but unfortunately that's not always the case with management. This is the uphill battle (the "management mentality") that the "grunts" (the rescuers) continually encounter while trying to do their job.]

The direction of rotation for a diamond

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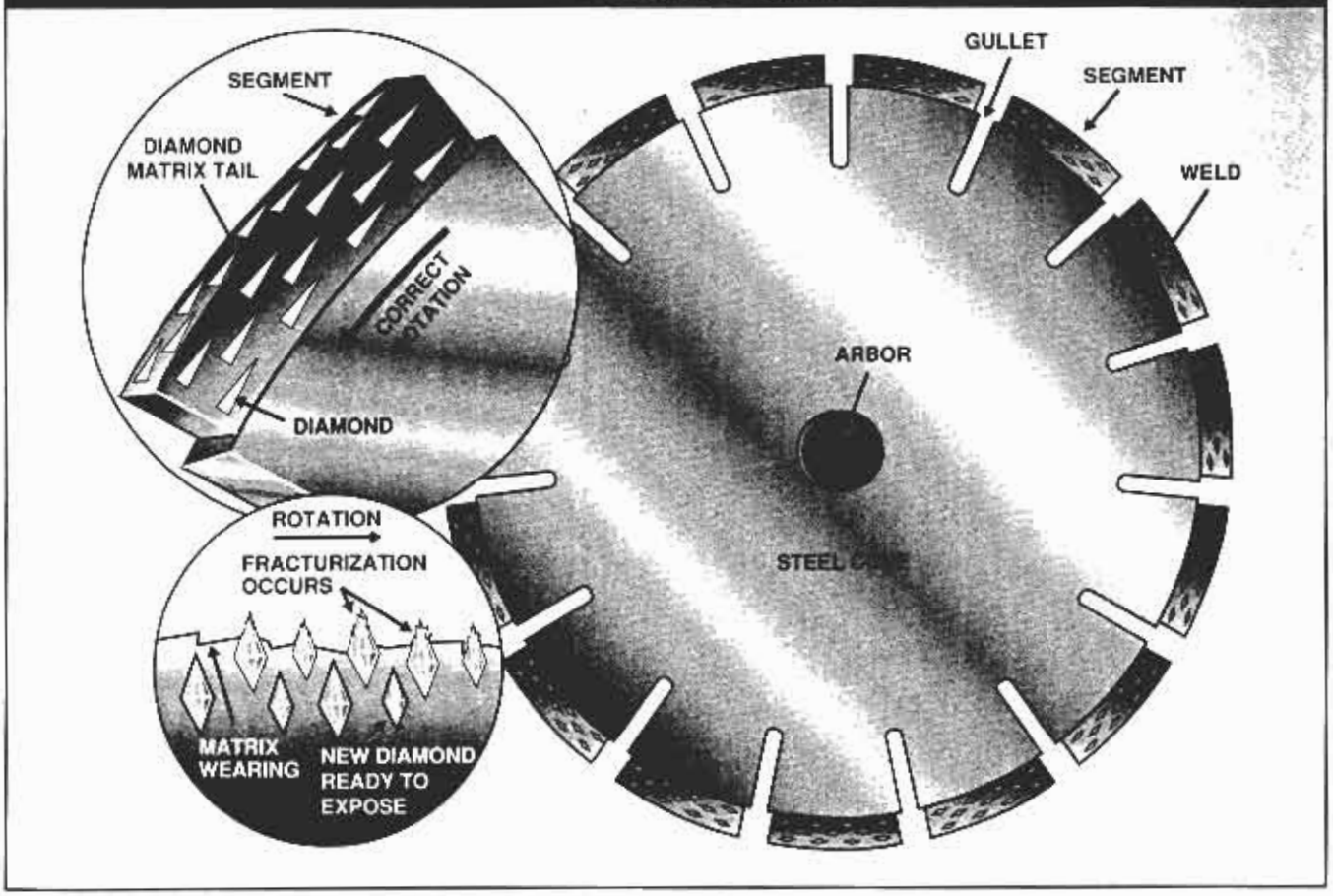
(Top left) The dry-cut blade and (top right) the wet-cut blade. Never use a wet-cut blade without a continuous water supply for wetting.

blade is critical. As the blade operates only in one direction, most manufacturers stamp an arrow indicating the direction of rotation on the steel core of the blade. If the arrow is not obvious, close inspection of the segments can indicate the proper direction: When looking at a segment, you will see the small dark chunks of diamond set in the steel matrix. Behind the diamond will appear a tail of matrix. When the blade is in the correct rotation, the diamond should lead and the tail should follow (like the tail of a comet).

A multitude of blade specifications for cutting specific materials are available. These specifications can vary greatly between any two materials. Take green concrete and marble, for example. Green concrete is relatively soft and abrasive, and marble is hard and smooth. A good rule of thumb is to use a hard blade for soft materials (like green concrete) and a soft blade for hard materials (like marble). The blade required to cut the green concrete will have a harder matrix to resist premature blade wear; the blade used for the marble will have a softer matrix to allow for easier erosion on the smooth material. On a diamond blade, the diamonds are the cutting teeth—similar to those of a conventional wood-cutting saw. Smaller in size, they chip and scrape away material like the wood-cutting saw. The major difference is that diamond teeth resharpen themselves.

There are dry-cut blades and wet-cut blades. Wet-cut blades require water for wetting during operations. Never attempt to use a wet-cut blade without water. Dry-

THE DIAMOND BLADE



PROCEDURES AND HINTS FOR WET- AND DRY-CUT BLADES

- Match blade specifications with material.
- Inspect diamond product for damage of undue wear prior to mounting and using blade.
- Ensure arbor hole matches that of saw and that direction of rotation is correct.
- Verify that operating speed is within that recommended for blade size and type.
- Inspect blade periodically for damage during use.
- Use blade guards at all times.
- Do not force blade into material; blade should be cut freely at its own speed.
- Make shallow, intermittent cuts with dry-cut blades, and allow the blades to cool by running freely out of cut.
- Keep your cuts straight and do not exert side pressure or flex the blade at any time.
- You can use a dry-cut blade wet but not a wet-cut blade dry.
- In any situation when a blade becomes glazed or the cutting action is slow, the blade can be "dressed" easily by running it through some abrasive material. Most commonly used materials are very abrasive and will expose new diamond very quickly.
- Do not attempt to cut steel unless it is embedded in concrete (rebar). Steel will smooth out the periphery or glaze the cutting surface, stopping the blade from cutting.
- Wear proper safety equipment and observe safe operating procedures.

(Top) A water-cooled hydraulic diamond chain is excellent for making plunge cuts. (Left) The capabilities of power tools for specific applications are in part dependent on the power source required.

cut blades, which also can be used with water, are intended for intermittent cutting only. These blades must be allowed to cool—from time to time, run them fully out of the cut. Any attempt to make long, continuous cuts will result in blade warping, cracking, and potential personal injury.

THE DIAMOND CHAIN SAW

Another innovative tool for cutting con-

PROCEDURES AND HINTS FOR CHAIN SAWS

- Use the proper chain. Different chains are required for cutting concretes of different consistencies.
- To prevent costly, premature chain wear, you must operate with the proper hydraulic oil flow, oil pressure, water flow, and water pressure.
- Power units are the recommended dedicated source of power. They can be powered from any vehicle equipped with hydraulics (i.e., trucks, backhoes, or miniexcavators).
- Cutting without water will destroy the chain.

crete is the diamond chain saw. These water-cooled hydraulically powered chain saws cut in any direction. Plunge cuts, notch cuts, trim cuts, and corner cuts—generally associated with wood cutting—are now possible in concrete cutting with these chain saws. Plunge cuts up to 18 inches are one of the unique capabilities of these saws. To start the plunge cut, simply place the blade up against the area to be cut and apply direct pressure, letting the saw do the work. In industrial and commercial settings, plunge cuts mainly provide window and door openings and air-conditioner cutouts in walls and notch or trim concrete pipe. In rescue work, they make cutouts or openings for rescue access and victim egress.

These chain saws weigh less than 30 pounds (easily a one-man operation) and require a water flow of up to nine gpm and a pressure of up to 2,500 psi. One manufacturer offers seven different chains for use on concrete types ranging from very hard to green. In addition, some of the diamond-chain blades will cut various sizes of reinforcing steel; others will not. (This is a good reason for rescuers to know the blade capabilities before selecting a blade.)

LIMITATIONS OF THE MODERN SAW

Like any tool or piece of rescue equipment, there are advantages and disadvantages to concrete-cutting saws. Many of the limitations are related to power selection. For example:

- Fuel-powered saws, which generate fumes, can't be used in confined spaces or areas lacking adequate ventilation unless the fumes can be exhausted from the area or the tool is properly protected from the fumes.
- Electrically and pneumatically powered saws require additional power sources (i.e., electrical power and extension lines and SCBA, air carts, or sources of air).
- Hydraulically operated saws require a power unit. These lightweight, compact units can be transported directly to the scene of an operation. If the power unit is vented properly, the saws can be used in confined spaces. Water supply is required for wet-cut blades; the saw requires a flow of seven to nine gpm, available from booster tanks of apparatus or from domestic water supplies.

A tool is only as good as the operator. Know your tool and its capabilities and limitations. Always train with the tool. ■