

Diamond wire cutting: an option for concrete removal

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When a mill shuts down a machine for a rebuild, oftentimes, the project will involve adding a piece of equipment, such as another calender stack, or removing a piece of equipment, such as a fourdrinier, so that a wider machine can be installed. These modifications usually require the demolition and removal of concrete supports that can weigh several tons. How can a project of this magnitude be handled?

Traditional impact methods such as jack hammers can be used to break the concrete into removable pieces. Diamond wire sawing, originally used to cut stone from quarries, is finding a niche in pulp and paper mills. Gary Manning and Tim Beckman discussed how this technology works and how it can be used to expedite rebuild projects. Manning and Beckman worked for ICS International Ltd. at the time of this writing.

TJ: Under what circumstances would a contractor need to remove concrete sections for a rebuild? In what parts of the mill would such a practice be undertaken?

Manning: When replacing drive foundations, trackbeams, and modifying sections of walls and floors. Generally this is required for plant modernization, system upgrades, or large maintenance projects.

All areas of the mill, inside and out, are subject to concrete removal. The largest need for precision cutting, such as the diamond wire cutting system, is usually inside the mill where costly shutdowns are scheduled in fractions of an hour. Complete machines and drive foundations may have to be removed in a matter of hours, not days. Couch pits, head boxes, and even sections under the rewinders may need major structural changes.

Outside the mill, you might need precision cutting in such areas as the bark hog tower to prevent disruption of sensitive underground utilities. However, the majority of the concrete removed is performed inside the mill.

TJ: What options are available for removing concrete from a mill site?

Using a wire saw, ICS technicians cut an 8-ton concrete section measuring 8 ft in diameter x 3 ft from a mill operating floor.



Manning: When time is a major consideration or dust or vibration need to be minimized, diamond cutting systems (wire saws, track saws, slab saws and core drills) are the preference. Other applications may opt for conventional methods, such as jack hammers or hoe-rams, with or without the aid of expansive grouts. Hydraulic splitting may also be employed, but usually when reinforcement is minimal and/or cut lines don't need to be exact. Superficial work may be done with a scabber — a carbide tooth machine that grinds thin surface layers of concrete — or a diamond grooving/grinding machine.

TJ: How is diamond wire cutting done? What equipment is involved?

Beckman: A diamond wire saw (Fig. 1) usually consists of a hydraulic drive wheel mounted on an adjustable frame with locking wheels. The "pulley" has a V-shaped groove and rubber liner to maintain good frictional contact with the diamond cutting cable. The drive wheel is usually 2–4 ft in diameter. Smaller idler wheels (6–16 in. in diameter) are mounted on and off the saw

Rebuilds

assembly to control the wire and maintain alignment with the cut plane.

An electric, gas, or diesel-drive hydraulic power unit is needed to run the saw assembly. The power unit is connected to the saw via hydraulic hoses. An operator controls the speed and direction of the wire with hydraulic valves, while monitoring the wire action and various gauges. Tension on the wire is maintained by a secondary hydraulic system, which translates forces to the drive wheel carriage with a hydraulic cylinder or rack and pinion drive.

Diamond wire cutting is done by looping a diamond cutting cable (Fig. 2) around or through a concrete section, then around the drive wheel and pulleys and finally attaching together with a metal connector. With minimal tension and speed, the cut is begun as water is added to eliminate dust and flush out the cut line. When any sharp corners are rounded and the cable establishes a groove, the speed and pressure are increased. If access holes are required to define a cut line, such as a partial foundation cut or doorway, a diamond core drill may be utilized to make a small hole, usually 1–3 in. in diameter.

TJ: What are the advantages of diamond wire cutting for concrete removal?

Manning: Diamond wire cutting, like other diamond tools, is fast, dust free, and vibration free. It can also access unusual areas, cut in limited space, avoid nearby utilities and process systems, or cut virtually unlimited sizes. Diamond wire sawing may also cut under operating equipment, even with tons of concrete and equipment on top of the wire.

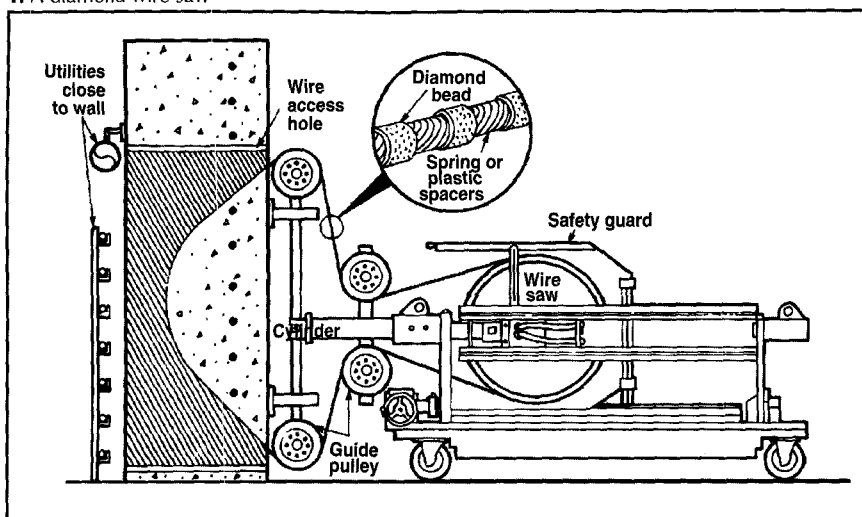
TJ: What are the disadvantages to diamond wire cutting?

Manning: A diamond wire saw generally does not cut as straight as a track saw, since it usually wraps a large area and takes the path of least resistance. Reinforcing bars at non-right angles to the cut plane can cause a dip in the cut. Diamond wire saws have only become more common in the past few years, so there are fewer units and experienced operators available in the industry (compared with more traditional equipment).

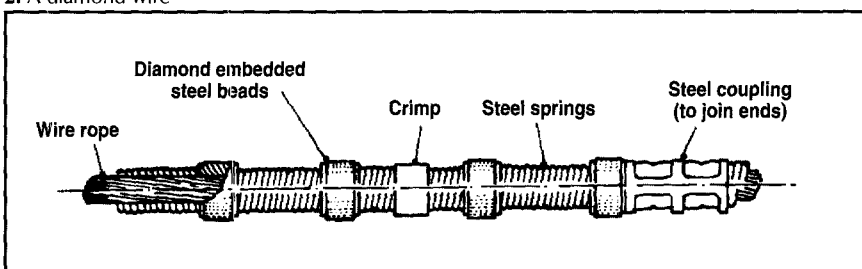
TJ: Who would be involved in selecting and working with the diamond wire cutting company?

Beckman: Selection is usually left up to the discretion of the general contractor, but engineers and owners may recommend or require diamond wire cutting. Much of the industry is still unaware of this option and may continue with the status quo.

1. A diamond wire saw



2. A diamond wire



TJ: What steps are involved in the planning phase of a typical concrete removal job? Who should be involved in decision making and project management?

Beckman: In the planning phase, the engineers, owners, and contractors are concerned with safe and expedient concrete removal while maintaining their project budget. Parts of a project may require unusual access or limitations set by adjacent operations that cannot be interrupted.

To minimize the time and expense of cutting the operations floor, for example, plan to remove the largest sections that can be safely handled and moved outside. Further cutting or breaking can be done at this noncritical location. A skilled diamond-cutting contractor can then help plan a sequence of cuts that facilitate the removal plan. Various cut sizes, thickness, and accessibility are among the factors that will determine what cutting tool is most appropriate. Coordinated input from the engineer, contractor, and cutting specialist is helping today's project management establish a more reliable cost and schedule plan for the owner.

TJ: Describe step-by-step how a diamond wire cutting operation is conducted, using a typical example and covering the planning, execution, and follow-up phases. What is an average amount of time required to complete a typical project?

Beckman: A typical diamond wire cutting operation for a mill outage is usually planned weeks in advance of the cut date. The

I. An overview of concrete cutting systems¹

Conventional concrete removal systems	Diamond cutting systems
Time	
Slow, methodical Labor intensive Preoutage work not possible Metal cutting required	Fast Fewer operators Preoutage work possible Cuts rebar and other metals
Dimensional tolerance	
Uncontrolled openings Extensive patchwork required	Precise cuts Limited patchwork required
Structural integrity	
High impact vibration causes microfractures of concrete Potential damage to remaining structures or nearby equipment	No impact No vibration Ability to remove large amounts of concrete with no structural damage
Noise, dust, debris	
Disruptive Loud Creates rubble Extremely dusty Time-consuming cleanup	Nondisruptive to surrounding operations Relatively quiet Pieces cut to size Dust free Large bulk removal capability
Limited access	
Inflexible equipment Restricted movement Underwater operations difficult or impossible Difficult to work around piping and existing equipment	Remote operations possible Cuts in close spaces Underwater operations possible Easily cuts around existing pipes, electrical fixtures, and equipment
¹ GE Superabrasives, "The diamond advantage in construction renovation." Copyright 1993.	

placement of new concrete or equipment. Core drills may also provide access for anchors, electric and mechanical systems.

TJ: How is the old concrete disposed of? Is it used for anything after it is removed from the site?

Manning: Disposal criteria are changing faster than the cutting techniques, especially in large urban areas. Sometimes complete separation of reinforcing steel and concrete is required; the steel is recycled, and the concrete is crushed for road fill.

Areas located by bodies of water are utilizing large concrete sections for artificial reefs, fish habitats, and airport runway extensions. In the rural settings, pulp and paper mills usually allow large concrete sections to be buried or the concrete is rubblized within the mill boundaries.

TJ: What are some factors that may cause problems when using diamond wire cutting?

Beckman: The biggest factors are unknown electric and process lines that intersect the cut planes. As-built drawings may be in error or misleading and you can easily cut a conduit that was thought to be parallel to a cut, not intersecting to the cut. If this occurred in the preoutage work, it could cause a very costly and early plant shutdown. According to material provided by GE Superabrasives, before beginning a concrete removal project, it's helpful to answer these questions:

cutting specialist must have the right combination of personnel, equipment, and diamond wire available for preoutage, outage and postoutage operations. After site mobilization, a large project may require a week's worth of advance cutting, drilling, and setups.

Depending on the outage time frame and size of the project, 2–10 saws may be lined up, partially cut and ready to go at the shutdown. Due to the speed and large cut areas performed by diamond wire saws, the cutting time in the "average" outage is usually reduced to 2–4 days.

Removal activities can easily run in parallel and can be completed within hours of the final cut. Additional cutting or breaking outside the plant depends on spoil location and type of hauling vehicle.

After large concrete sections are removed, additional saw cutting may be employed to complete the removal and facilitate

1. What is the aggregate material to be cut? Limestone is the softest; flint is the hardest.

2. Is the concrete laced with reinforcing bars?

3. How accessible is the cutting area?

These factors will determine the type of tool needed for the job (flat saw, wall saw, curb saw, or core drill), the tool's speed and feed rates, and the diamond concentration.

"Over the past 10 years of construction wire sawing in North America, the pulp and paper industry has increased its use of diamond wire cutting services for plant outages," says Beckman. "As more mills become aware of the technology, this trend will continue." ■

Clites is associate editor of Tappi Journal.