Whether it is new construction or a building renovation, virtually any project in the $100 billion non-residential construction market involves anchoring. Every application, ranging from hanging acoustical ceilings and installing window and door frames to performing seismic upgrades, requires the use of an anchoring product.

Drilled-in, or post-installed, anchors have been used since ancient times to secure building components. Originally, a plug of wood or lead plug was carved to size and driven into a hole in the base material. As a screw or nail was driven into the plug, it expanded in the hole.

Commercially manufactured anchors were first made from lead or fiber material in a variety of sizes to match a bolt or screw. As the materials and techniques used in building construction changed, new anchors were developed. Today, a variety of anchors is available to meet most applications.

Anchors generally fall into three categories: cast-in-place, forced-entry and drilled-in anchors.

While cast-in-place anchors have been used in the past to attain high load capacities, positioning them into form work is difficult and alignment errors are common. Typically, 25 percent to 30 percent of cast-in-place anchors are either misplaced or omitted completely.

Forced-entry fasteners driven by hand, pneumatic tool or powder-actuated tools are driven directly into the base material without pre-drilling. However, they should used only for light duty, static load applications.

Drilled-in, or post-installed, anchors provide the user flexibility to install an anchor exactly where it is required without the intricate advanced planning associated with cast-in-place anchors. Although drilled-in anchors are supplied in many styles, they can be grouped into two categories—mechanical expansion, discussed in depth here, and banded anchors.

**Mechanical Expansion Anchors**

Mechanical expansion anchors usually can be loaded immediately after installation, an advantage versus bonded anchors that must cure prior to loading. Steel expansion anchors generally have better resistance to heat or fire when compared to bonded anchors that use ester-based resins or epoxies.

Anchors of this type can be distinguished by their style and method of expansion. One-step anchors do not require layout or hole-spotting since the drilled hole required is the same size as the anchor diameter. Bolt or screw anchors are installed flush with the surface of the base material and have internal threads to accept a bolt, screw or threaded rod. Hollow wall anchors are specifically designed for applications in hollow base materials such as wallboard, concrete plank, block and structural clay tile.

Mechanical expansion anchors achieve their load capacities based on friction, clamping, compression, undercutting or a combination of methods.

Friction anchors such as concrete screw anchors do not expand but develop load capacity by creating a friction force between the shank of the anchor and the base material as they...
are driven into an undersize hole. Anchors of this type are generally suitable for light-duty, static load conditions.

Clamping anchors such as toggles achieve their capacities by clamping the fixture to the base material. Tension loads are developed by spreading the load over the back face of the hollow material such as concrete block.

Most drilled-in mechanical anchors can be described as compression anchors. They have an expansion device-such as a sleeve, slotted shell or wedge assembly-that, when mechanically expanded, compresses against the wall of a drilled hole.

Some types of compression anchors, such as the Powers Rawl Spike® are pre-expanded to eliminate the need for secondary setting operations, decreasing the total installation time.

Undercut anchors expand at the bottom of the anchor hole, simi-
lar to a standard compression anchor, except that the diameter of the expanded area is wider than the drilled hole. Anchors of this type can be self-undercutting or may require a second operation to form the undercut. During installation, the expansion mechanism undercuts the base material to form a large bearing area. This allows higher loads to be transferred to the base and permits undercut anchors to be used in cracked concrete.

For increased performance and resistance to vibratory loads, some styles of undercut anchors expand at two levels, both in the anchor sleeve and cone.

**Bonded Anchors**

Bonded anchors normally have higher load capacities since the base material does not have to withstand the expansion force created by mechanical anchors. Loads are transferred to the base material by the bond formed between the anchor rod and the walls of the drilled hole. Performance when subjected to dynamic and shock loads is usually superior to mechanical expansion anchors.  

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Chemical or adhesive anchors typically use an ester-based resin or an epoxy to bond threaded rod or reinforcing bars into the anchor hole. Normally, the hole size is only slightly greater than the rod or bar size. Typical two-part systems include an encapsulated glass design, plastic cartridges and foil packs.

**Anchor Installation**

As with any building component, proper installation is the key to a successful application once the anchor has been selected. Installation should be done according to the manufacturer’s instructions. Use of proper diameter drill bits is critical. Anchor holes should be drilled to the proper depth based on anchor style. Proper cleaning of the drilled hole, especially with adhesives, and the installation of the anchor to the required embedment should be strictly observed.

**Installation Costs**

The advantages of drilled-in mechanical expansion anchors make them extremely flexible with regard to design, layout and changes during construction. From a design standpoint, it is not necessary to provide the detailed drawings associated with cast-in-place anchors, which are often misplaced during construction.

With many types of drilled-in anchors, the fixture can be used as a template to reduce layout time, simplify installation and decrease overall costs. When changes occur with regard to placement of a fixture, it is a simple matter to install drilled-in anchors where required. On renovation projects, drilled-in anchoring is usually the only option.

**About the Author**

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