

Concrete Fasteners: Types, Load Considerations & Installation Methods

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Key Takeaways

097 - Lifting Eye Bolt — GB/T 825 □ DIN 580 (Series 036) — GB/T 825 □ DIN 580

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- Concrete anchor selection must begin with defined tension, shear, or combined loads and whether the concrete is cracked or uncracked under service conditions.
- Safe working loads for static applications are typically limited to a fraction of the ultimate capacity, commonly 25% per ACI 318 design philosophy.
- Installation method—torque-controlled, displacement-controlled, adhesive, or screw-type—directly influences anchor reliability and requires strict adherence to manufacturer instructions.
- Corrosion protection options range from zinc plating for dry interiors to stainless steel A4 (316) for marine or chemical exposure.
- Anchor approvals per ICC-ES, ETA, or ASTM E488 provide validated load data and should be matched to regional building code requirements.

Which concrete anchor will reliably secure equipment to a concrete slab without risking pull-out failure?

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Concrete fasteners—also referred to as anchors—are critical for attaching structural elements, heavy machinery, and fixtures to concrete, masonry, or brick. In B2B procurement, selecting the correct anchor type demands a clear understanding of substrate condition, load demands, and installation environment. This guide outlines the main anchor categories, key specifications, and industrial purchasing considerations to help sourcing professionals and engineers make informed decisions.



► Watch video: <https://www.youtube.com/watch?v=7UQd1yGgwM>

HOW TO SET A CONCRETE ANCHOR — by Caliber8 Tools & DIY on YouTube Learn how to set a concrete anchor. Learn how to use a rotary hammer drill. Sign up for the email list. Grab some great tools and u00a0...

Specification overview for concrete fasteners

While exact values vary by design and manufacturer, the following parameters typify a comprehensive industrial concrete fastener line:

- **Diameters/thread sizes:** Common ranges span from 1/4 in. (M6) to 1-1/4 in. (M30), depending on anchor type.
- **Thread pitch:** Coarse (UNC) threads are standard for most mechanical anchors; fine-thread variants are available in select adhesive anchor studs.
- **Lengths:** Standard embedment depths are matched to anchor diameter; overall lengths cover thin fixtures to deep embedments (e.g., 1-1/2 in. to 12 in.).
- **Head/drive types:** Hex nuts and washers for wedge and sleeve anchors; hex-washer-head or flat-head for concrete screws; internal threads for drop-in anchors.
- **Material grades:** Carbon steel (often with property class 5.8 or 8.8 for metric), stainless steel (A2/304 or A4/316 for corrosion resistance), and occasionally high-strength alloy steels.
- **Property class:** For metric bolting, typical classes are 5.8, 8.8, and 10.9; stainless anchors are commonly classified as A2-70 or A4-80 per ISO 3506.
- **Surface finish:** Zinc plating (clear or yellow chromate), hot-dip galvanizing for outdoor and corrosive environments, and proprietary coatings for enhanced chemical or weather resistance.

Variants in a typical concrete fastener line

Industrial fastener manufacturers offer multiple anchor designs to address different substrates and load scenarios:

- **Wedge anchors:** Mechanical expansion anchors designed for solid concrete. They provide high pull-out strength and are commonly used in structural steel connections.
- **Sleeve anchors:** Versatile expansion anchors suitable for concrete, brick, and block. Their multi-piece sleeve expands against the hole wall, making them a go-to for moderate loads in varied base materials.
- **Concrete screw anchors:** Self-tapping fasteners that cut threads directly into concrete. Removable and suitable for light-to-medium loads; often specified for MRO and equipment mounting. They require no expansion, minimizing stress to the substrate.
- **Drop-in anchors:** Internally threaded female anchors that are set into a drilled hole and expanded with a setting tool. Ideal for flush-mount applications where the bolt can be removed.
- **Adhesive anchors:** Two-component chemical systems (epoxy, polyester, or hybrid) that bond a threaded rod into the substrate. They are preferred for high loads, cracked concrete, and dynamic/seismic conditions.
- **Cast-in-place anchors:** Embedded before concrete is poured—used in new construction for heavy-duty connections. Typically headed studs or J-bolts.

Selecting between a wedge anchor and a concrete screw often depends on load magnitude and removability. Wedge anchors achieve higher ultimate strengths, while screw anchors offer easier installation and reusability. For hollow masonry, sleeve anchors or specialized toggle-type anchors are recommended.

Typical applications and buyer scenarios

Concrete fasteners serve a broad range of industrial applications:

- **Heavy machinery anchoring:** Generators, compressors, and heavy production equipment secured to concrete pads—often requiring high-capacity wedge or adhesive anchors.
- **Structural connections:** Steel columns, beam seats, and bracing fastened to concrete foundations or walls. Adhesive anchors are common where seismic loads apply.
- **Racking and shelving systems:** Industrial storage racks anchored to warehouse floors with concrete screws or expansion anchors.
- **Pipe and conduit supports:** Regular and strut-based attachments using a variety of anchor types depending on vibration and load.
- **Curtain wall and façade systems:** Anchoring to concrete edges and slabs, often requiring anchors approved for cracked concrete and exposure conditions.
- **MRO and repair:** On-site maintenance that demands fast, reliable fastening into existing concrete—screw anchors and sleeve anchors are popular choices.

Load types include static, dynamic, and seismic. Shear and tension capacities are influenced by concrete compressive strength, edge distance, spacing, and embedment depth. Adhesive anchors often excel in cracked concrete and tension zones due to their bond strength and stress distribution.

Customization and branding options

For large procurement programs, manufacturers typically offer:

- **Special dimensions:** Non-standard diameters, lengths, or custom undercut profiles to match unique joint designs.
- **Alternative coatings:** Hot-dip galvanizing, PTFE, Xylan, or organic finishes for enhanced corrosion resistance, chemical exposure, or color coding.
- **Head marking:** Custom stamping of manufacturer logo, grade, or traceability codes on anchor heads or nuts, ensuring compliance with project quality requirements.
- **Packaging customization:** Private-labeled boxes, poly bags, or industrial bulk pails; kitting of anchor assemblies with matched drill bits or setting tools.

Ordering parameters

Industrial buyers should anticipate the following when sourcing concrete fasteners:

- **MOQ (Minimum Order Quantity):** Varies by anchor type, material, and size. Custom or non-stock products usually carry higher minimums.
- **Lead time:** Standard catalog items typically ship within a few days from regional stock; factory-direct orders for large volumes or specials may require 2–4 weeks.
- **Packaging:** Options range from bulk cartons (e.g., 50 or 100 pieces per box) to job-site packs (plastic pails with smaller quantities) and individual blister packs for installer convenience.

Next steps for tailored procurement

To receive a detailed quotation, contact your supplier with the following: anchor type, diameter, required embedment depth, material grade, finish, and estimated annual usage. Providing project specifications or engineering drawings allows technical teams to validate the most suitable concrete fastener and prepare a competitive price proposal.

Concrete Fastener Selection: Matching Anchor Type to Load and Substrate

Selecting the correct concrete fastener begins with a clear definition of the load conditions, base material properties, and installation environment. The anchor type—mechanical expansion, screw, adhesive, or cast-in—must be matched to the expected tension, shear, or combined loading, as well as whether the concrete is cracked or uncracked under service conditions.

Key Selection Criteria at a Glance

- **Load type:** Tension, shear, or combined static/dynamic loading dictates anchor working principle and embedment depth.
- **Base material:** Compressive strength, aggregate type, and presence of cracks influence anchor capacity and approval (e.g., cracked vs. uncracked concrete per ACI 318).
- **Installation method:** Torque-controlled expansion, displacement-controlled expansion, adhesive bonding, or cast-in integration.

- **Corrosion protection:** Electroplated zinc, hot-dip galvanizing (HDG), or stainless steel (A2/A4 or 304/316) for aggressive exposures.
- **Approval basis:** Anchors evaluated per ICC-ES (USA), European Technical Assessment (ETA) under EAD 330232, or ASTM E488 test protocols provide predictable load data.

Understanding Load Types for Concrete Anchors

Concrete fasteners must resist tension (pull-out), shear (sideways force), or a combination of both. Industry guidance for static loading, such as that found in ACI 318 anchoring provisions, limits allowable working loads to a fraction of the ultimate capacity—commonly 25% of the mean ultimate load determined by testing to ASTM E488. For dynamic or seismic loads, additional reduction factors and qualification testing (e.g., ICC-ES AC193 for mechanical anchors) apply. Combined loading reduces the anchor's capacity in each direction; interaction equations from ACI 318 or product-specific evaluation reports should govern design.

Base Material Considerations

Anchor performance is heavily dependent on concrete compressive strength (generally $f'_c \geq 2,500$ psi for most anchor approvals). Higher-strength concrete permits greater loads but can be more brittle. Cracked concrete assumptions (required for most overhead or seismic applications) demand anchors tested and qualified for such conditions; these typically incorporate expansion mechanisms that continue to provide load resistance after crack formation. Lightweight or sand-lightweight concrete may require additional testing or de-rated capacities.

Installation Methods and Their Impact on Performance

The installation process directly influences anchor reliability:

- **Torque-controlled expansion anchors** (e.g., wedge anchors, sleeve anchors): Proper drilling depth, hole cleaning, and tightening torque are critical. Under-torquing reduces expansion and load capacity; over-torquing can strip threads or damage concrete.
- **Displacement-controlled anchors** (e.g., drop-in anchors): Setting requires a specific hammer blow count or setting tool to expand the internal plug. Inadequate setting often leads to premature slip under load.
- **Adhesive anchors** (e.g., epoxy, vinylester, hybrid systems): Hole drilling, cleaning (brush + blow + repeat), and precise adhesive injection temperature and gel-time compliance are essential. Unfilled voids or dusty holes sharply reduce bond strength.
- **Screw anchors** (concrete screws): Self-tapping threads cut into the concrete; correct pilot hole diameter and deep thread engagement are necessary. Over-tightening can strip the threads in the concrete, reducing capacity.

All post-installed anchors require adherence to manufacturer's printed installation instructions (MPII) to achieve published load values. Jobsite quality assurance, such as pre-installation tension tests or torque audits, is common for critical connections.

Corrosion Protection and Environmental Suitability

Corrosion resistance selection depends on service environment:

- **Interior, dry:** Zinc-plated carbon steel (min. 5 μm per ASTM B633 or ISO 4042) suffices.

- **Exterior, mildly corrosive:** Hot-dip galvanized (HDG) to ASTM A153 (min. 50 µm coating) or mechanically galvanized coatings provide long-term protection.
- **Marine, chemical, or high-humidity:** Stainless steel grades A2 (304) or A4 (316) per ISO 3506 are typical; for extreme chlorides, duplex stainless or special alloys may be specified.

Protective coatings also influence installation: HDG can alter [thread dimensions](#) and require thicker nuts or washers; stainless anchors in submerged or oxygen-depleted environments may be subject to crevice corrosion.

Consolidated Selection Overview

Concrete Fastener Selection by Application Criteria

Criterion	Typical Anchor Types	Key Considerations
Predominantly tension load	Wedge anchors, adhesive anchors, undercut anchors	Embedment depth governs pull-out resistance; cracked concrete may require special versions
Predominantly shear load	Sleeve anchors, through-bolts, screw anchors	Edge distance and anchor spacing critical to avoid concrete edge failure
Dynamic/seismic loading	Adhesive anchors with seismic approval, wedge anchors with ICC-ES AC193 qualification	Must be tested for cracked concrete and cyclic tension/shear; special installation often required
Overhead/non-standard orientation	Drop-in anchors (with setting tool), concrete screws	Ensure proper setting and avoid dust shavings interfering with expansion
Corrosive environment	Stainless steel (A2, A4), HDG coated anchors	Coating thickness, grade specification, and compatibility with substrate to avoid galvanic corrosion
Fast, removable connections	Screw anchors (concrete screws)	Removable and reusable in the same hole if not overloaded; lower load capacity than same-diameter wedge anchors

For tailored procurement, submit your project specifications—anchor type, diameter, embedment depth, material grade, finish, and estimated quantities—to receive a detailed quotation for concrete fasteners meeting your exact performance and certification requirements.

Frequently Asked Questions

What are the different types of concrete fasteners?

Concrete fasteners fall into four main categories: mechanical expansion anchors (e.g., wedge, sleeve, drop-in), concrete screw anchors, adhesive (chemical) anchors, and cast-in-place anchors. Each operates on a different principle—expansion, thread interlock, bond, or embedment—and is selected based on load type, base material condition, and environment.

How much weight can a concrete screw anchor hold?

The allowable load for a concrete screw anchor depends on its diameter, embedment depth, and the concrete compressive strength. Under static tension in uncracked concrete, a typical 3/8-inch diameter screw anchor may have a safe working load in the range of several hundred pounds when following manufacturer-published values, with actual capacity determined by product-specific testing and safety factors.

Are concrete screw anchors or wedge anchors better?

Screw anchors offer easier installation, removability, and closer spacing flexibility, making them suitable for light to medium-duty applications in uncracked concrete. Wedge anchors provide higher ultimate loads in tension and shear and are often preferred for heavy machinery anchoring and structural connections in cracked or uncracked concrete, but require precise torque control during setting.

Do you hammer in concrete anchors?

Some concrete anchors, such as drop-in anchors, require hammer setting: the anchor body is driven into the drilled hole until the lip contacts the base material, expanding an internal plug. Other types, like wedge anchors, are set by applying torque to the nut, not by hammering. Hammer-set sleeve anchors also exist for lighter load applications.

How do you install anchor bolts in a concrete foundation?

Installation of post-installed anchor bolts generally involves drilling the correct diameter and depth hole per manufacturer instructions, thoroughly cleaning the hole of dust and debris (often with brush and compressed air), inserting the anchor, and setting it either by hammering (drop-in) or tightening the nut to the specified torque (wedge or sleeve anchors). Adhesive anchors require mixing and injecting the resin before inserting the threaded rod, with a prescribed curing time before loading.

Categories [Uncategorized](#)