

# ANCHOR RODS (BOLTS) CONNECTING STEEL TO CONCRETE: 2019 CBC

**Disciplines:** Structural

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## PURPOSE

This Interpretation of Regulations (IR) clarifies the acceptability and dimensional requirements for both full diameter body and reduced diameter body style cast-in-place anchor rods used to fasten structural steel to concrete on construction projects under the jurisdiction of the Division of the State Architect (DSA). ←

## SCOPE

American Institute of Steel Construction (AISC) 303 defines an anchor rod as “*a mechanical device that is either cast or drilled and chemically adhered, grouted or wedged into concrete and/or masonry for the purpose of the subsequent attachment of structural steel*”. This IR is specifically applicable to the specification and acceptance of cast-in-place anchor rods.

## BACKGROUND

Anchor rods have traditionally been referred to as anchor bolts and some reference documents cited herein, such as American Society for Testing and Materials (ASTM) F1554, continue to use this terminology. Where this IR, American Society of Mechanical Engineers (ASME) standards indicated below, or other documents cited herein refer to “bolt” the provisions shall be understood to be applicable to anchor rods.

Dimensional requirements for bolts are given in ASME B18.2.1, “Square, Hex, Heavy Hex, and Askew Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series),” and ASME B18.2.6, “Fasteners for Use in Structural Applications.” Bolt threads are formed either by cutting or rolling. Dimensional requirements for threads are given in ASME B1.1, “Unified Inch Screw Threads, UN and UNR Thread Form,” and ASME B1.3, “Screw Thread Gaging Systems for Acceptability: Inch & Metric Screw Threads (UN, UNR, UNJ, M, MJ).”

## 1. DESIGN REQUIREMENTS

**1.1** Cut-thread or rolled-thread bolts of **full diameter body style** shall meet the requirements of ASME B18.2.1 or ASME B18.2.6 (Section 3 below). ←

**1.2** Rolled-thread bolts of **reduced diameter body style** shall meet the requirements of ASME B18.2.1 (Section 4 below). ←

**1.3** The construction documents shall require the anchor rods to comply with ASTM F1554. The anchor rods shall be designed in accordance with American Concrete Institute (ACI) 318 Chapter 17 as modified by California Building Code (CBC) Section 1905A.1.8. Refer to ACI 318 Section 17.4.1.2 and its corresponding commentary for the definition of effective cross-sectional area.

**1.4** The minimum number of anchor rods required for a column base plate is four (4) per Title 8, Industrial Relations, Section 1710(f)(1)(A). Steel posts weighing 300 pounds or less as defined by Title 8 Section 1710(b) are not subject to this requirement.

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**1.5** Base plate holes for anchor bolts may be oversized per AISC 360 Section J9, and AISC Steel Construction Manual, 15<sup>th</sup> Edition, Table 14-2. When oversized base plate holes are used, the base plate design shall satisfy CBC Section 2204A.4 requirements.

### 2. BOLT TYPES

Anchor rods are manufactured from bolt blanks, which are headed smooth rod or bar intended for subsequent threading. Blanks come in full body diameter and reduced body diameter styles.

Commercially, the terms “cut-thread” and “rolled-thread” may not indicate the method of forming threads. The term “cut-thread bolt” may refer to either a cut-thread bolt or a full diameter body style rolled-thread bolt. The term “rolled-thread bolt” may refer to a reduced diameter body style rolled-thread bolt.

#### 2.1 Cut-Thread Bolts

The original blank is full diameter body style, and equal to the major thread (outside) diameter. Threads are formed by cutting and removing metal from the blank.

#### 2.2 Full Diameter Body Style Rolled-Thread Bolts

The original blank is full diameter body style, and the threaded length portion is reduced to the thread pitch diameter during extrusion. Threads are formed by rotating dies that displace the metal.

#### 2.3 Reduced Diameter Body Style Rolled-Thread Bolts

Similar to full diameter body style rolled-thread bolts, except the blank diameter is reduced for the entire bolt length.

### 3. FULL DIAMETER BODY STYLE BOLTS

Dimensional requirements for cut-thread or rolled-thread bolts with full diameter body style are given in Table 3-1.

<b>Nominal Size (inches)</b>		<b>Body or Shank Diameter (inches)<sup>3</sup></b>	
		<b>Maximum</b>	<b>Minimum</b>
1/2	0.5000	0.515	0.482
5/8	0.6250	0.642	0.605
3/4	0.7500	0.768	0.729
7/8	0.8750	0.895	0.852
1	1.0000	1.022	0.976
1-1/4	1.2500	1.277	1.223
1-1/2	1.5000	1.531	1.470
1-3/4	1.7500	1.785	1.716
2	2.0000	2.039	1.964

**Notes:**

- 1) Adopted from ASME B18.2.1 and ASME B18.2.6.
- 2) For bolt diameters not indicated, refer to ASME B18.2.1 and B18.2.6.
- 3) The body or shank of a bolt is the smooth portion between the head and the threads.

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**4. REDUCED DIAMETER BODY STYLE BOLTS**

Dimensional requirements for rolled-thread bolts with reduced diameter body style are given in Table 4-1.

<b>Table 4-1 Diameters of Reduced Diameter Body Style Bolts <sup>1, 2</sup></b>				
<b>Nominal Size (inches)</b>		<b>Threads per Inch (TPI) <sup>4</sup></b>	<b>Body or Shank<sup>3</sup> Diameter (inches)</b>	
			Maximum	Minimum
1/2	0.5000	13	0.482	0.444
5/8	0.6250	11	0.605	0.559
3/4	0.7500	10	0.729	0.677
7/8	0.8750	9	0.852	0.795
1	1.0000	8	0.976	0.910
1-1/4	1.2500	7	1.223	1.148
1-1/2	1.5000	6	1.470	1.381
1-3/4	1.7500	5	1.716	1.608
2	2.0000	4-1/2	1.964	1.843

**Notes:**

- 1) Body diameters are based on ASME B18.2.1, Table 2, Notes 7 & 13, and ASTM B1.1, UNRC or 8 UNR series, Class 2A threads.
- 2) For bolt diameters not indicated, refer to ASME B18.2.1, B18.2.6 and ASTM B1.1.
- 3) The body or shank of a bolt is the smooth portion between the head and the threads.
- 4) TPI means threads per inch (ASTM B1.1, UNRC or 8 UNR series, Class 2A threads).

**REFERENCES:**

2019 California Code of Regulations (CCR) Title 24  
 Part 2: California Building Code (CBC), Sections 1905A.1.8 and 2204A.4

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