DSA IR 22-2

ANCHOR RODS CONNECTING STEEL TO CONCRETE: 2022 CBC

Disciplines: Structural

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Division of the State Architect (DSA) documents referenced within this publication are available on the DSA Forms or DSA Publications webpages.

PURPOSE

This Interpretation of Regulations (IR) clarifies the acceptable use of 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 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 Head 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, UNR, and UNJ Thread Forms) and ASME B1.3: Screw Thread Gaging Systems for Acceptability: Inch and 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 and ASME B18.2.6. See Section 3 below.

1.2 Rolled-thread bolts of **reduced diameter body style** shall meet the requirements of ASME B18.2.1 Section 3.5. See 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 17.6.1.2 and its corresponding commentary for the definition of effective cross-sectional area. The construction documents shall require full diameter body style anchors rods unless the lesser dimensions of the reduced diameter body style have been accounted for in the anchor rod design.

1.4 The minimum number of anchor rods required for a column base plate is four 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.

1.5 Base plate holes for anchor rods may be oversized when the design complies with AISC 360 Section J9 and CBC Section 2204A.4 and hole sizes are specified on the construction drawings. Refer to AISC Steel Construction Manual, 15th Edition, Table 14-2 for additional information.

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. See Section 3 below.

2.2 Rolled-Thread Bolts

2.2.1 In the full diameter body style, the original blank is the full diameter, and the threaded length portion is reduced to the thread pitch diameter during extrusion. Threads are formed by rotating dies that displace the metal. See Section 3 below.

2.2.2 The reduced diameter body style is similar to the full diameter body style, except the blank diameter is reduced for the entire bolt length. See Section 4 below.

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 below.

Table 3-1 Diameters of Full Diameter Body Style Bolts [1, 2]

Nominal Size (inches)		Body or Shank Diameter (inches) [3]	
		Maximum	Minimum
1/2	0.500	0.515	0.482
5/8	0.625	0.642	0.605
3/4	0.750	0.768	0.729
7/8	0.875	0.895	0.852
1	1.000	1.022	0.976
1-1/4	1.250	1.277	1.223
1-1/2	1.500	1.531	1.470
1-3/4	1.750	1.785	1.716
2	2.000	2.039	1.964

Notes:

1) Adopted from ASME B18.2.1 Tables 2 and 3 and ASME B18.2.6 Table 2.1-1.

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 below.

Table 4-1 Diameters of Reduced Diameter Body Style Bolts [1, 2]

Nominal Size (inches)		Threads per Inch (TPI) [4]	Body or Shank Diameter (inches) [3]	
			Maximum	Minimum
1/2	0.500	13	0.482	0.4435
5/8	0.625	11	0.605	0.5588
3/4	0.750	10	0.729	0.6773
7/8	0.875	9	0.852	0.7946
1	1.000	8	0.976	0.9101
1-1/4	1.250	7	1.223	1.1476
1-1/2	1.500	6	1.470	1.3812
1-3/4	1.750	5	1.716	1.6085
2	2.000	4-1/2	1.964	1.8433

Notes:

1) Body diameters are based on ASME B18.2.1 Table 2, and ASME B1.1 Table 2A for UNC series Class 2A threads. In accordance with ASME B18.2.1 Section 3.5 the maximum body diameter is equal to the minimum full body diameter and the minimum diameter is equal to the minimum pitch diameter of the thread (refer to ASME B1.1).

2) For bolt diameters not indicated, refer to ASME B18.2.1 and ASME B1.1.

3) The body or shank of a bolt is the smooth portion between the head and the threads.

4) Threads per inch are taken from ASME B1.1 Table 2A.

REFERENCES:

2022 California Code of Regulations (CCR) Title 24
Part 2: California Building Code (CBC), Sections 1905A.1.8 and 2204A.4