



DSA Structural Amendments under review are highlighted in GRAY

Template 21-27

2001 CBC - Chapter 21A
MASONRY

Section - 2106A - GENERAL DESIGN REQUIREMENTS

Subsection(s) - 2106A.2.14.1 - 2106A.2.14.4

2106A.2 Working Stress Design and Strength Design Requirements for Unreinforced and Reinforced Masonry.

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1 **2106A.2.14 Placement of embedded anchor bolts.**

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3 **2106A.2.14.1 General.** Placement requirements for anchor
4 bolts shall be determined in accordance with this subsection. *An-*
5 *chor bolts shall be hex headed bolts conforming to ASTM A 307*
6 *with the dimensions of the hex head conforming to ANSI/ASME*
7 *B18.2.1 or plain rod conforming to ASTM A 36 with threaded ends*
8 *and double hex nuts at the anchored end. Bent bar anchor bolts*
9 *shall not be used.*

10

11 *The maximum size anchor shall be 1/2-inch (13 mm) diameter*
12 *for 6-inch (152 mm) nominal masonry, 3/4-inch (19 mm) diameter*
13 *for 8-inch (203 mm) nominal masonry, 7/8-inch (22 mm) diameter*
14 *for 10-inch (254 mm) nominal masonry, and 1-inch (25mm) diam-*
15 *eter for 12-inch (304.8 mm) nominal masonry.*

16

17 The effective embedment depth l_b for * * * anchor bolts shall
18 be the length of embedment measured perpendicular from the sur-
19 face of the masonry to the bearing surface of the * * * head of the
20 anchorage. * * * All bolts shall be grouted in place with at least 1
21 inch (25 mm) of grout between the bolt and the masonry, *and shall*
22 *be accurately set with templates.*

23

24 **2106A.2.14.2 Minimum edge distance.** The minimum anchor
25 bolt edge distance l_{be} measured from the edge of the masonry par-
26 allel with the anchor bolt to the surface of the anchor bolt shall be
27 1-1/2 inches (38 mm).

28

29 **2106A.2.14.3 Minimum embedment depth.** The minimum
30 embedment depth of anchor bolts l_b shall be *eight bolt* diameters
31 *but not less than 4 inches (102 mm).*

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33 **2106A.2.14.4 Minimum spacing between bolts.** The mini-
34 mum center-to-center distance between anchor bolts shall be *eight*
35 *bolt* diameters *but not less than 4 inches (102 mm).*

Template 21-27**CBC Section 2106A.2.14 Placement of embedded anchor bolts**

DSA Comments:

1. The 2003 IBC does not contain the 1997 edition UBC section 2106.2.14 provisions for anchor bolts, and instead relies on reference standard ACI 530-02/ASCE 5-02/TMS 402-02.
2. The 2006 IBC will reference ACI 530-05/ASCE 5-05/TMS 402-05.
3. The ACI 530-05/ASCE 5-05/TMS 402-05 standard contains the following provisions regarding anchor bolts (plated, headed, and bent-bar type anchor bolts):
 - Section 2.1.4 (allowable stress design)
 - Section 3.1.6 (strength design)

PREVIOUS RULEMAKING RECORD EXCERPTS (April 1995 Monograph)

SUBITEM 8 - AMEND SECTION 2106A OF THE CALIFORNIA BUILDING CODE AS FOLLOWS:**2106A.2.14 Placement of embedded anchor bolts.**

2106A.2.14.1 General. Placement requirements for ~~plate anchor bolts, headed anchor bolts, and bent bar anchor bolts,~~ shall be determined in accordance with this subsection. ~~The bent bar anchor bolt shall have a hook with a 90-degree bend with an inside diameter of three bolt diameters, plus an extension of 1 1/2 bolt diameters at the free end. Headed a~~ Anchor bolts shall *be hex headed bolts conforming to ASTM A307 with the dimensions of the hex head conforming to ANSI/ASME B18.2.1 or plain rod conforming to ASTM A-36 with threaded ends and double hex nuts at the anchored end.* ~~have a standard bolt head. Plate anchor bolts shall have a plate welded to the shank to provide anchorage equivalent to headed anchor bolts. Bent bar anchor bolts shall not be used.~~

The maximum size anchor shall be 1/2-inch (13 mm) diameter for 6-inch (150 mm) nominal masonry, 3/4-inch (19 mm) diameter for 8-inch (200 mm) nominal masonry, 7/8-inch (22 mm) diameter for 10-inch (250 mm) nominal masonry, and 1-inch (25 mm) diameter for 12-inch (300 mm) nominal masonry.

The effective embedment length l_b for ~~plate or headed~~ anchor bolts shall be the length of embedment measured perpendicular from the surface of the masonry to the bearing surface of the ~~plate or~~ head of the anchorage, ~~and l_b for bent bar anchors shall be the length of embedment measured perpendicular from the surface of the masonry to the bearing surface of the bent end minus one anchor bolt diameter.~~ All bolts shall be grouted in place with at least 1 inch of grout between the bolt and the masonry *and shall be accurately set with templates.*

2106A.2.14.2 Minimum edge distance. The minimum anchor bolt edge distance l_{be} ...

2106A.2.14.3 Minimum embedment depth. The minimum embedment depth of anchor bolts l_b shall be ~~four~~ eight bolt diameters but not less than 4 inches (102 mm) ~~2 inches (51 mm)~~.

2106A.2.14.4 Minimum spacing between bolts. The minimum center-to-center distance between anchor bolts shall be eight ~~four~~ bolt diameters.

THE FOLLOWING ARE THE REASONS FOR PROPOSING THIS PARTICULAR RULEMAKING ACTION.

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These amendments were determined necessary to provide the seismic performance required for schools and essential services buildings. These facilities require a higher degree of post earthquake performance than ordinary structures, as they are used for post disaster recovery. Schools, while not explicitly listed as essential facilities, are generally used as post disaster shelters. The Uniform Building Code provisions are oriented to life safety and prevention of collapse, not continued function.

SUBITEM 8 - AMEND SECTION 2106A

Recent research at Clemson University by Brown and Whitlock [Ref. 1] demonstrated that bent bar anchor bolts perform in an inconsistent manner in both shear and tension. Tests by Tennessee Valley Authority [TVA] for the Nuclear Regulatory Commission [Ref. 2] and others [Ref. 3] of standard bolts with hexagonal heads perform in a consistent manner for both shear and tension. The performance of these hex head bolts is far superior to bent bar anchor bolts. The TVA study also showed that plate anchor bolts tended to perform similar to bent bar anchor bolts. In addition, closely spaced plate anchor bolts create planes of weakness in the grout. Section 1925, Anchorage to Concrete, allows only headed bolts or studs. This change makes the provisions for anchor bolts consistent between masonry and concrete.

The minimum embedment depth and spacing are set to ensure that the bolts will deform in a ductile manner rather than fail in a brittle manner by pullout or pushout of the concrete.

References: 1. Brown, R.H., and Whitlock, A.R., "Strength of Anchor Bolts in Masonry", Clemson University, Aug. 1983; 2. ____, "Anchorage to Concrete", *Research and Development Report No. 75-32*, Tennessee Valley Authority, Dec. 1976; 3. McMackin, P.J., Slutter, R.G., and Fisher, J.W., "Headed Steel Anchors Under Combined Loading", *AISC Engineering Journal*, 2nd Quarter 1973