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## EVALUATION REPORT

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Report No. 4133

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Filing Category: FASTENERS—Concrete and Masonry Anchors (066)

**DRILLCO MAXI-BOLT BEARING TYPE,  
UNDERCUT ANCHORS**  
DRILLCO DEVICES, LTD.  
POST OFFICE BOX 6205  
10-05 35TH AVENUE  
LONG ISLAND CITY, NEW YORK 11106

I. **Subject:** Drillco Maxi-Bolt Bearing Type, Undercut Anchors.

II. **Description:** A. **General:** The Maxi-Bolt anchor is a bearing-type undercut anchor installed in a hole with a conical undercut near its blind end. The anchor consists of a stud bolt, conical nut, expansion sleeve, distance tube, washer and heavy hex nut. See Figure No. 1 for assembly details. The stud bolt and conical nut are fabricated from ASTM Grade B7 material.

The Maxi-Bolt is designed to be a ductile anchor which transfers loads in the anchor stud to the concrete surrounding the undercut portion of the hole through bearing.

Table No. I notes the allowable shear and tension anchor loads and Table No. II notes center-to-center spacing, edge distance and embedments requirements for anchors installed in  $f'_c = 3,000, 4,000$  and  $5,000$  psi concrete.

The allowable loads noted in Table No. I may be assigned to each anchor in a multiple-anchor attachment. A single anchor used to anchor an attachment shall be designed for one half of the allowable loads noted.

Where shear loads are present, attachment displacements may exceed  $1/16$  inch at design load levels unless sufficient friction resistance is present.

Component parts of the anchor must be used as a complete unit and must not be disassembled. The Maxi-Bolt is available in  $1/4$ -,  $3/8$ -,  $1/2$ -,  $5/8$ -,  $3/4$ -, 1- and  $1 1/4$ -inch stud diameters. Table No. II lists the stud lengths for the anchors.

Maxi-Bolt undercut anchors may be used for doweling applications to connect new concrete to existing concrete elements, provided:

1. The Maxi-Bolt is installed in accordance with this report.
2. The nut or washer bears against the surface of the existing concrete.
3. The anchor stud has two heavy hex nuts.
4. The anchor stud extends far enough into the new pour to provide the required shear strength.

The shear stud is designed in accordance with Sections 2611 (h) and 2624 and Table No. 26-F of the code.

For design purposes, the maximum allowable yield strength for anchor studs is 60,000 psi.

B. **Installation:** The Maxi-Bolt is installed in four steps:

1. A hole is drilled in concrete.
2. The hole is undercut using a Drillco undercutting tool.
3. The hole is cleaned of concrete dust and debris using appropriate means such as oil-free compressed air or by vacuuming.
4. The anchor is set by drawing the stud and conical nut inside the expansion sleeve forcing the expansion sleeve to expand laterally into the undercut portion of the hole.
5. The material to be fastened is located and the stud tensioned.

Table No. III lists drill and undercutting tool dimensions and tolerances. The undercutting tool is designed to produce a fixed angle cut in the concrete which matches the angle formed on the conical nut. Figure No. 3 depicts the undercut-

ting tool and shows how the cutter insert blade opening (Dimension B) is measured. A proper undercut is made when Pin D is at the bottom of Slot E as noted in Figure No. 3.

Steps four and five serve to proof load the anchor and to minimize anchor deflections upon loading of the attachment. After installation, measurement of the stud projection beyond the concrete may be used to provide additional verification that the conical nut is properly seated in the undercut portion of the hole. Stud projection from the concrete surface or from the surface of the attachment where the sleeve is allowed to extend through the hold in the plate, equals the overall stud length minus the combined distance of the anchor tube and expansion sleeve lengths with a tolerance of  $-1/4$  inch or  $+1/2$  inch on the measured projections.

A special inspector, in accordance with Section 306 of the code, must be present to ensure that anchors are installed in accordance with this report. Additionally, representative sampling of 10 percent of bolts installed must be proof tested either by direct tensioning to approximately 80 percent of the yield strength of anchor bolts or by torquing to the manufacturer's recommended torque value. If there are any failures, immediately adjacent bolts must also be tested.

After installation of  $1/2$ -inch,  $5/8$ -inch and  $3/4$ -inch Maxi-Bolts five bolt threads should be visible above the heavy hex nut. One-inch and  $1 1/4$ -inch Maxi-Bolts should show six threads.

C. **Identification:** The anchor is identified by its packaging bearing a label noting the company name, address and trade name (Maxi-Bolt) as well as the anchor size, quantity, catalog part number, lot number and carton number. There is also a distinctive end mark on the anchor. See Figure No. 2 for end-marking details.

III. **Evidence Submitted:** Descriptive data, product brochure, installation procedure, and test results covering static and dynamic tensile and shear loading conditions, loss of preload with time and cracked concrete.

### Findings

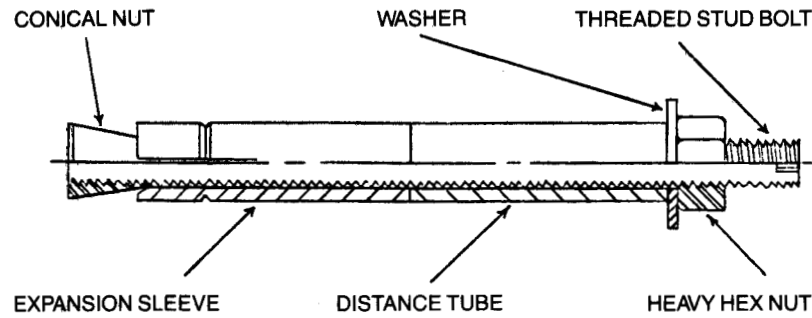
IV. **Findings:** That the Drillco Maxi-Bolt anchors described in this report are alternate connectors to those specified in the 1991 Uniform Building Codes, subject to the following conditions:

1. Anchors are installed as noted in this report and the manufacturer's instructions.
2. Allowable shear and tension loads are as set forth in attached tables.
3. Allowable loads for anchors subjected to combined shear and tension forces are determined by the ratio of the actual shear to the allowable shear plus the ratio of the actual tension to the allowable tension not exceeding 1.00.
4. The anchors must be installed with drill bits manufactured by Drillco Devices Limited.
5. The anchors must be installed under special inspection in accordance with Section 306 of the code.
6. The allowable loads may not be increased for duration of load.

This report is subject to re-examination in two years.

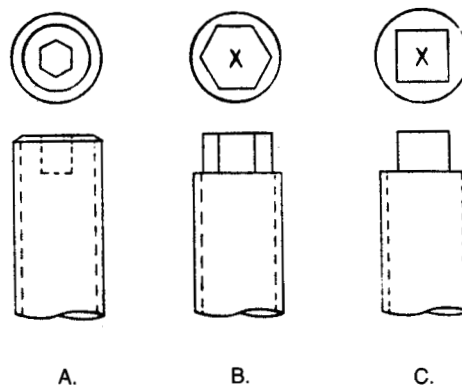
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**NOTE:** 1/4" and 3/8" anchors have no distance tube

FIGURE NO. 1—ANCHOR DETAILS



- A. Base overall length anchors, diameters 1/2 inch and larger, are identified by an internal hex in the end of the anchor's stud.
- B. Anchors with an overall length longer than that of the base length anchor for a particular diameter have an external hex head. The external hex head is stamped with a number to indicate how many inches longer than the base length the anchor is.
- C. Anchors with an overall length shorter than that of the base length anchor for a particular diameter have an external square head. The external square head is stamped with a number to indicate how many inches shorter than the base length the anchor is.
- D. The 1/4-inch and 3/8-inch anchors are manufactured to one length only and are provided with wrench flats.

FIGURE NO. 2—ANCHOR IDENTIFICATION DETAILS

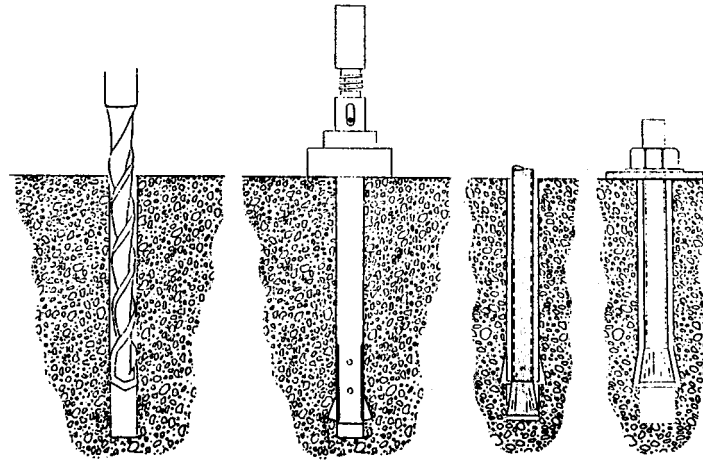
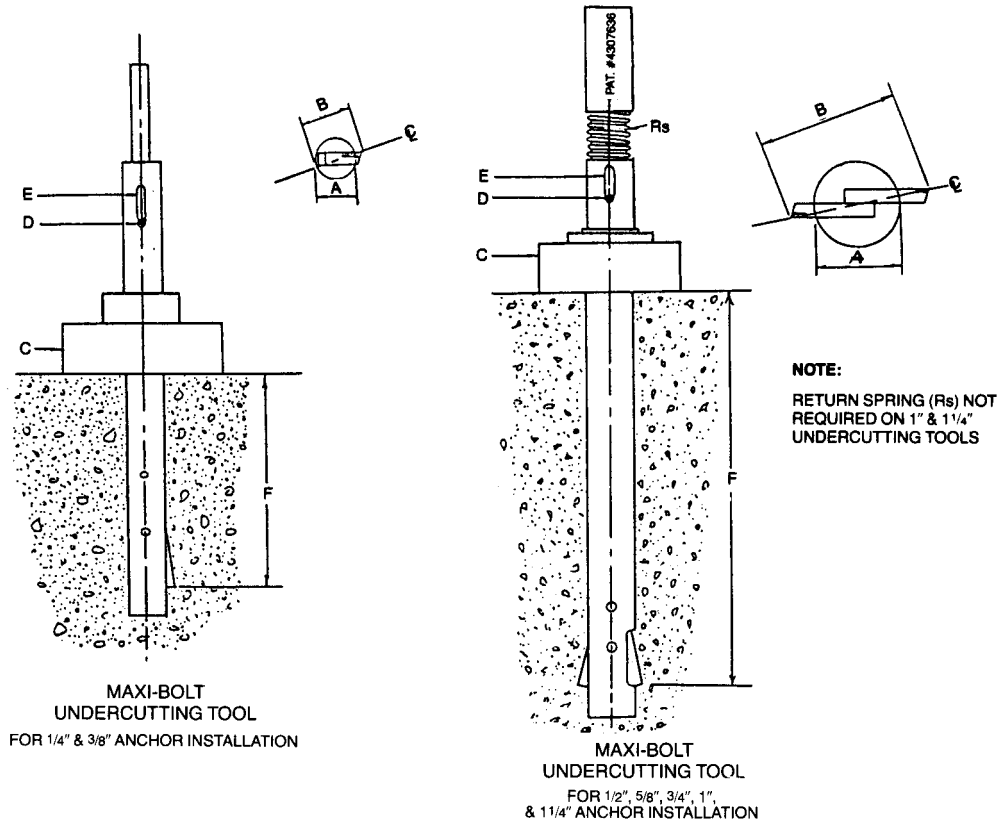


FIGURE NO. 3—ANCHOR INSTALLATION DETAILS

TABLE NO. I—ALLOWABLE LOADS FOR DRILLCO MAXI-BOLTS (Pounds)

ANCHOR DIAMETER (Inches)	TENSION	SHEAR CASE 1	SHEAR CASE 2
1/4	1,600	830	1,060
3/8	3,900	2,025	2,580
1/2	7,105	3,690	4,695
5/8	11,305	5,870	7,475
3/4	16,710	8,680	11,045
1	30,315	15,750	20,040
1 1/4	50,015	25,980	33,065

**NOTES:**

1. Case 1 applicable for grouted plates. Case 2 applicable for plates in contact with concrete surface.
2. Use straight-line interaction for combined tension and shear loading.
3. All load allowables are premised on the anchor's ability to develop 100 percent of the stud bolt's minimum ultimate capacity. Table No. II specifies combinations of concrete compressive strength, anchor embedment, center-to-center spacing ad edge distance which will allow the anchor to develop its ultimate capacity.
4. The allowable loads noted in the above table may be assigned to each anchor in a multiple-anchor attachment. A single anchor used to anchor an attachment shall be designed for one half of the allowable loads noted.

**TABLE NO. II—EMBEDMENT AND CENTER-TO-CENTER SPACING REQUIREMENTS  
FOR UP TO SIX MAXI-BOLTS IN A RECTANGULAR PATTERN**

ANCHOR PART NO.	ANCHOR STUD DIAMETER (Inches)	MAXIMUM ATTACHMENT THICKNESS (Inches)	EMBEDMENT (Inches)	3000 psi CONCRETE		4000 psi CONCRETE		5000 psi CONCRETE	
				Minimum Center to Center Spacing (Inches)	Minimum Edge Distance (Inches)	Minimum Center to Center Spacing (Inches)	Minimum Edge Distance (Inches)	Minimum Center to Center Spacing (Inches)	Minimum Edge Distance (Inches)
MB-250-4 <sup>1</sup> / <sub>4</sub> -2	<sup>1</sup> / <sub>4</sub>	1.50	2	*4.50	4.50	*4.50	4.25	*4.50	4.00
MB-250-4 <sup>1</sup> / <sub>4</sub> -2 <sup>3</sup> / <sub>4</sub>	<sup>1</sup> / <sub>4</sub>	1.00	2 <sup>3</sup> / <sub>4</sub>	6.00	4.50	5.00	4.25	4.50	4.00
MB-375-6-3 <sup>1</sup> / <sub>2</sub>	<sup>3</sup> / <sub>8</sub>	2.50	3 <sup>1</sup> / <sub>2</sub>	*7.50	6.75	*7.50	6.25	*7.50	6.00
MB-375-6-4 <sup>1</sup> / <sub>2</sub>	<sup>3</sup> / <sub>8</sub>	1.50	4 <sup>1</sup> / <sub>2</sub>	9.00	6.75	7.50	6.25	6.50	6.00
MB-500-8 <sup>1</sup> / <sub>4</sub> -6	<sup>1</sup> / <sub>2</sub>	1.00	6	12.50	8.75	10.00	8.25	9.00	7.75
MB-500-11 <sup>1</sup> / <sub>4</sub> -8	<sup>1</sup> / <sub>2</sub>	2.00	8	8.50	8.75	7.00	8.25	6.00	7.75
MB-500-13 <sup>1</sup> / <sub>4</sub> -10	<sup>1</sup> / <sub>2</sub>	2.00	10	6.00	8.75	4.50	8.25	4.00	7.75
MB-625-10-7 <sup>1</sup> / <sub>2</sub>	<sup>5</sup> / <sub>8</sub>	1.25	7 <sup>1</sup> / <sub>2</sub>	16.00	11.00	13.00	10.25	11.50	9.75
MB-625-13-9 <sup>1</sup> / <sub>2</sub>	<sup>5</sup> / <sub>8</sub>	2.25	9 <sup>1</sup> / <sub>2</sub>	11.50	11.00	9.50	10.25	8.50	9.75
MB-625-16-12	<sup>5</sup> / <sub>8</sub>	2.75	12	8.00	11.00	6.50	10.25	5.50	9.75
MB-750-13 <sup>1</sup> / <sub>2</sub> -9 <sup>1</sup> / <sub>4</sub>	<sup>3</sup> / <sub>4</sub>	2.75	9 <sup>1</sup> / <sub>4</sub>	18.50	13.00	15.00	12.25	13.50	11.75
MB-750-16 <sup>1</sup> / <sub>2</sub> -11 <sup>1</sup> / <sub>2</sub>	<sup>3</sup> / <sub>4</sub>	3.50	11 <sup>1</sup> / <sub>2</sub>	14.00	13.00	12.00	12.25	10.50	11.75
MB-750-18 <sup>1</sup> / <sub>2</sub> -13	<sup>3</sup> / <sub>4</sub>	4.00	13	12.00	13.00	10.00	12.25	8.50	11.75
MB-1000-16 <sup>1</sup> / <sub>2</sub> -12 <sup>1</sup> / <sub>2</sub>	1	2.00	12 <sup>1</sup> / <sub>2</sub>	24.50	17.50	20.00	16.25	18.00	15.50
MB-1000-22 <sup>1</sup> / <sub>2</sub> -16 <sup>1</sup> / <sub>2</sub>	1	3.50	16 <sup>1</sup> / <sub>2</sub>	17.00	17.50	14.50	16.25	12.50	15.50
MB-1000-26 <sup>1</sup> / <sub>2</sub> -20 <sup>1</sup> / <sub>2</sub>	1	3.50	20 <sup>1</sup> / <sub>2</sub>	12.00	17.50	9.50	16.25	7.50	15.50
MB-1250-20-16	<sup>1</sup> / <sub>4</sub>	1.75	16	31.50	22.00	26.00	20.50	23.00	19.25
MB-1250-30-23	<sup>1</sup> / <sub>4</sub>	5.00	23	19.50	22.00	16.00	20.50	14.00	19.25
MB-1250-37-29 <sup>1</sup> / <sub>2</sub>	<sup>1</sup> / <sub>4</sub>	5.50	29 <sup>1</sup> / <sub>2</sub>	12.00	22.00	8.50	20.50	6.50	19.25

\*Recommendation based on independent laboratory testing. All other embedment and center to center recommendations based on design by analysis provisions of ACI 349, Appendix B.

**NOTES:**

- Maximum attachment thickness is based on torque tensioning of anchor. Any lesser attachment thickness may be used. Where the anchor is to be hydraulically tensioned, maximum attachment thicknesses will be reduced by one stud diameter.
- Consideration of stress area reduction for limited concrete depth is not reflected in the above table. Minimum concrete depth = anchor embedment plus (center-to-center spacing/2).
- Maxi-Bolt part numbers are specified as follows:  
MB—Diameter Series Number—Overall Length—Sleeve Length (combined expansion sleeve and distance tube lengths).
- Minimum edge distances quoted are for shear or combined tension and shear. For tension loading, edge distance may be reduced to 75 percent of given value.
- Allowable values are limited to a maximum of six bolts in a two-row, three-column, or three-row, two-column arrangement. Allowable values may also be used for anchors placed in a single line and separated from other anchor lines by a minimum distance of two times the anchor embedment length.
- In-place embedment length is determined by subtracting the overall length (second number shown in Anchor Part No. column) from the exposed projection.

**TABLE NO. III**

NOMINAL ANCHOR SIZE (Inches)	DRILL DIAMETER MAXIMUM (Inches)	MINIMUM HOLE DEPTH, ANCHOR EMBEDMENT PLUS	UNDERCUTTING TOOL			TENSIONING TORQUE (Ft.-Lbs.)	SETTING LOAD 50% F <sub>y</sub> (Pounds)	TENSIONING LOAD 81% F <sub>y</sub> (Pounds)
			Diameter A (Inches)	Diameter B (Inches)	Tolerance (Inches)			
<sup>1</sup> / <sub>4</sub>	0.530	1 inch	0.500	0.625	+0.010 -0.030	9-12	1,700	2,700
<sup>3</sup> / <sub>8</sub>	0.655	1 inch	0.625	0.750	+0.010 -0.030	40-44	4,100	6,600
<sup>1</sup> / <sub>2</sub>	0.778	1 inch	0.709	0.949	+0.010 -0.030	80-85	7,455	12,077
<sup>5</sup> / <sub>8</sub>	0.975	1 inch	0.905	1.176	+0.010 -0.030	185-190	11,865	19,221
<sup>3</sup> / <sub>4</sub>	1.172	1 <sup>1</sup> / <sub>2</sub> inches	1.102	1.550	+0.010 -0.040	345-350	17,535	28,406
1	1.690	2 inches	1.625	2.275	+0.010 -0.050	645-650	31,815	51,540
1 <sup>1</sup> / <sub>4</sub>	2.065	2 inches	2.000	2.770	+0.010 -0.060	1,470-1,475	52,485	85,024
<sup>1</sup> / <sub>2</sub> " Heavy	0.845	1 inch	0.812	1.120	+0.010 -0.030	80-85	7,455	12,077

**NOTES:**

- Undercutting tool diameter A is given for identification purposes only. No tolerance applies to this dimension.
- Undercutting tool diameters A and B are noted in Figure No. 3