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ANCHOR BOLTS AND ATTACHMENT HARDWARE

KINETICS Noise Control

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KCAB Wedge Type Seismic Anchor Data

The Seismic Certification programs written and used by Kinetics Noise Control use the model ***KCAB Wedge Type Anchor*** data listed in Table P10.2.1-1 below. The various terms and dimensions referenced in this document are defined in Figure P10.2.1-1. Any anchors that are substituted and/or supplied by others must be evaluated and approved by the Design Professional of Record. The data listed in Table P10.2.1-1 is drawn form ***ICBO*** report data. All relevant factors for proper installation of these anchors are defined in documentation provided by Kinetics Noise Control.

The data provided in Table P10.2.1-1 is based on concrete with a minimum compressive strength of ***3,000 psi*** and a minimum embedment depth equal to ***8*** anchor diameters.

Table P10.2.1-1: KCAB Wedge Type Seismic Anchor Basic Capacities (Reference: Figure P10.2.1-1)

Anchor Size[3] (in)	Minimum Embedment (in)	Basic ASD Tensile Allowable[1] (lbs)	Basic ASD Shear Allowable[1] (lbs)	Minimum Spacing[2] (in)	Minimum Edge Distance[2] (in)
1/4	2	280	400	4	3-3/8
3/8	3	588	1,018	6	4-7/8
1/2	4	874	1,769	7	6-3/4
5/8	5	1,317	2,640	8	8-1/4
3/4	6	1,668	4,225	10-1/4	9-3/4
7/8	7	2,264	6,210	12-5/16	9-1/8
1	8	2,535	8,328	14-5/8	13-1/2
1	9	2,730	8,328	12	13-1/2
1-1/4	10	5,105	9,918	15	12-15/16

1) For Non-California projects these values may be inflated by 33-1/3% for seismic and wind applications. For California Non-OSHPD projects these values must be reduced by 20%. For California OSHPD projects the allowable loads for lightweight, 2,000 psi, concrete must be reduced by 20% to simulate cracked concrete. In this case the values listed here do not apply.
2) Minimum spacing and edge distance are required to develop the maximum listed allowable loads.
3) If the Clearance Hole Diameter is greater than or equal to 1/8″ more than the Anchor Size, fill the clearance space with grout or epoxy, or use the appropriate Kinetics Noise Control model TG Grommet.

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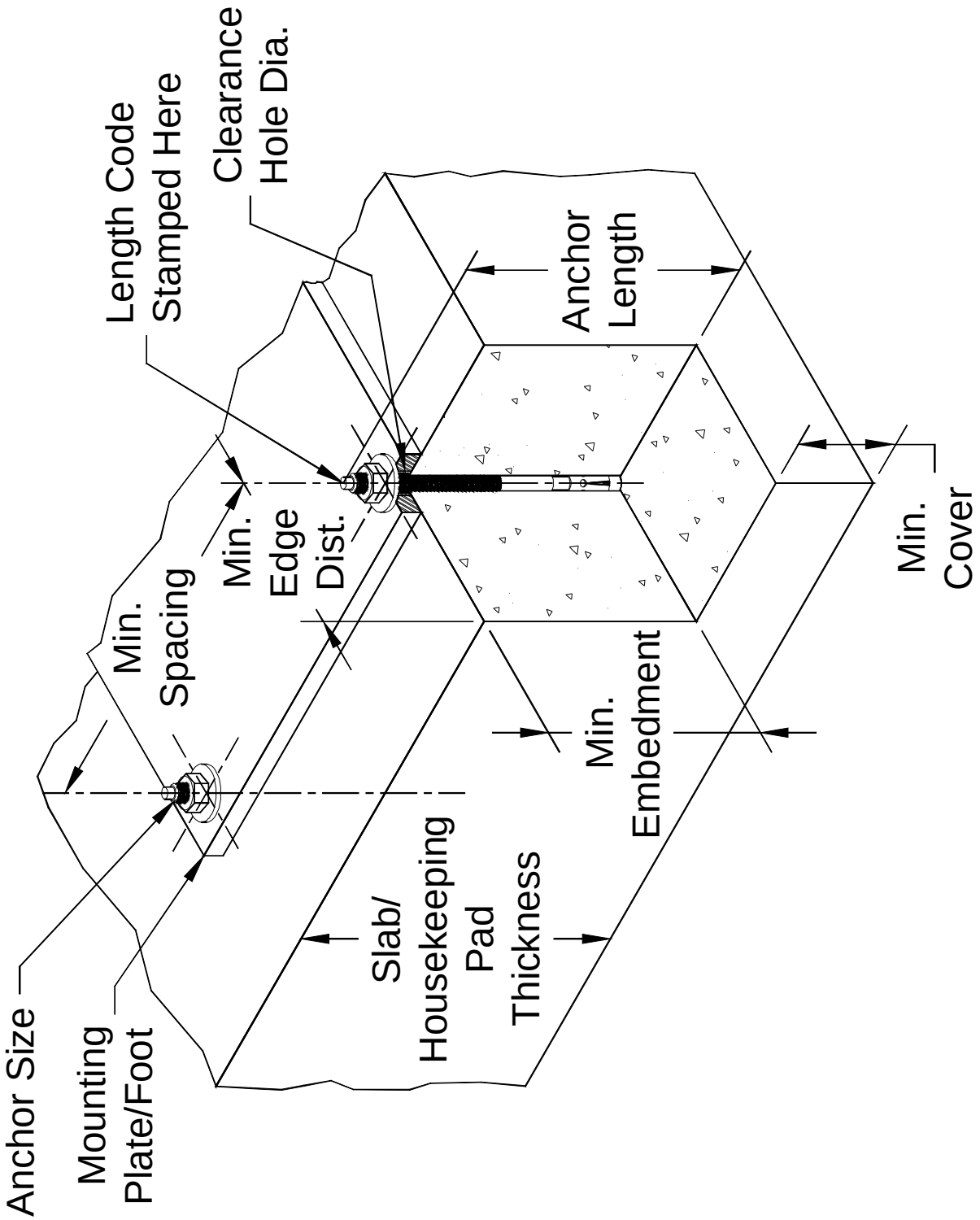

Figure P10.2.1-1: KCAB Wedge Type Seismic Anchor Installation Guide.

KCAB WEDGE TYPE SEISMIC ANCHOR DATA

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Table P10.2.1-2: Anchor Length by Length Code Stamp (Anchor Size Independent)

Length Code Stamp	Anchor Length (in)	Length Code Stamp	Anchor Length (in)
A	1.5 to 2.0	K	6.5 to 7.0
B	2.0 to 2.5	L	7.0 to 7.5
C	2.5 to 3.0	M	7.5 to 8.0
D	3.0 to 3.5	N	8.0 to 8.5
E	3.5 to 4.0	O	8.5 to 9.0
F	4.0 to 4.5	P	9.0 to 9.5
G	4.5 to 5.0	Q	9.5 to 10.0
H	5.0 to 5.5	R	10.0 to 11.0
I	5.5 to 6.0	S	11.0 to 12.0
J	6.0 to 6.5	----------	----------

Table P10.2.1-3: Anchor Size vs. Tightening Torque for Standard Weight Concrete

Anchor Size (in)	Anchor Tightening Torque (ft-lbs)
1/4	8.00
3/8	25.00
1/2	55.00
5/8	90.00
3/4	175.0
7/8	250.0
1	300.0

Table P10.2.1-4: Minimum Cover Requirements per ACI 318-02

Minimum Cover (in)	Concrete Exposure Condition Cast-in-Place & Nonprestressed
3	Cast-in-place and permanently exposed to the ground.
1-1/2	Exposed to the ground or weather.
3/4	Slabs, walls, or joists not exposed to the weather or ground.
1-1/2	Beams or Columns not exposed to the weather or ground.
3/4	Shells or folded plate members not exposed to the weather or ground.

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KUAB Type P Undercut Seismic Anchor Data

The Seismic Certification programs written and used by Kinetics Noise Control use the model ***KUAB Type P Undercut Anchor*** data listed in Tables P10.2.2-1, P10.2.2-2, and P10.2.2-3 below. ***Type P*** indicates that the anchor is a ***pre-setting*** or ***pre-positioning*** type of anchor. The various terms and dimensions referenced in this document are defined in Figures P10.2.2-1, P10.2.2-2, and P10.2.2-3. Any other anchors that are substituted and/or supplied by others must be evaluated and approved by the Design Professional of Record. The data listed in Tables P10.2.2-1 through P10.2.2-3 is drawn from ***ICC ES Report ESR-1546 (Issued August 1, 2004)***. All relevant factors for proper installation of these anchors are defined in documentation provided by Kinetics Noise Control.

The values in Table P10.2.2-1 are based on normal-weight concrete with a compressive strength of ***3,000 psi***, and are adjusted for seismic and wind loading applications in accordance with the provisions established in ***ACI 318-02 Appendix D***.

Table P10.2.2-1: KUAB Type P Undercut Seismic Anchor Capacities.
(Reference: Figure P10.2.2-1)

Undercut Anchor Model	Anchor Size[1] mm (in)	Req. Embed.[2] mm (in)	Seismic Tensile Allow. ASD[3] N (lbs)	Seismic Shear Allow. ASD[3] N (lbs)	Req. Spacing[2] mm (in)	Req. Edge Dist.[2] mm (in)	Length Code Stamp
KUAB-01	M10 (3/8)	100 (3.94)	19,424 (4,365)	8,869 (1,993)	300 (11.81)	150 (5.91)	I
KUAB-02	M12 (1/2)	125 (4.92)	24,284 (5,457)	12,856 (2,889)	375 (14.76)	188 (7.38)	L
KUAB-03	M16 (5/8)	190 (7.48)	48,567 (10,914)	23941 (5,380)	570 (22.44)	285 (11.22)	R
KUAB-04	M20 (3/4)	250 (9.84)	72,851 (16,371)	36797 (8,269)	750 (29.53)	375 (14.76)	V

1 - If the Clearance Hole Diameter is greater than or equal to 1/8″ more than the Anchor Size, fill the clearance space with grout or epoxy, or use the appropriate Kinetics Noise Control model TG Grommet.

2 - Required embedment, spacing, and edge distance are required to develop the maximum listed allowable loads.

3 - These values *may not* be inflated by 33-1/3% for seismic and wind applications!

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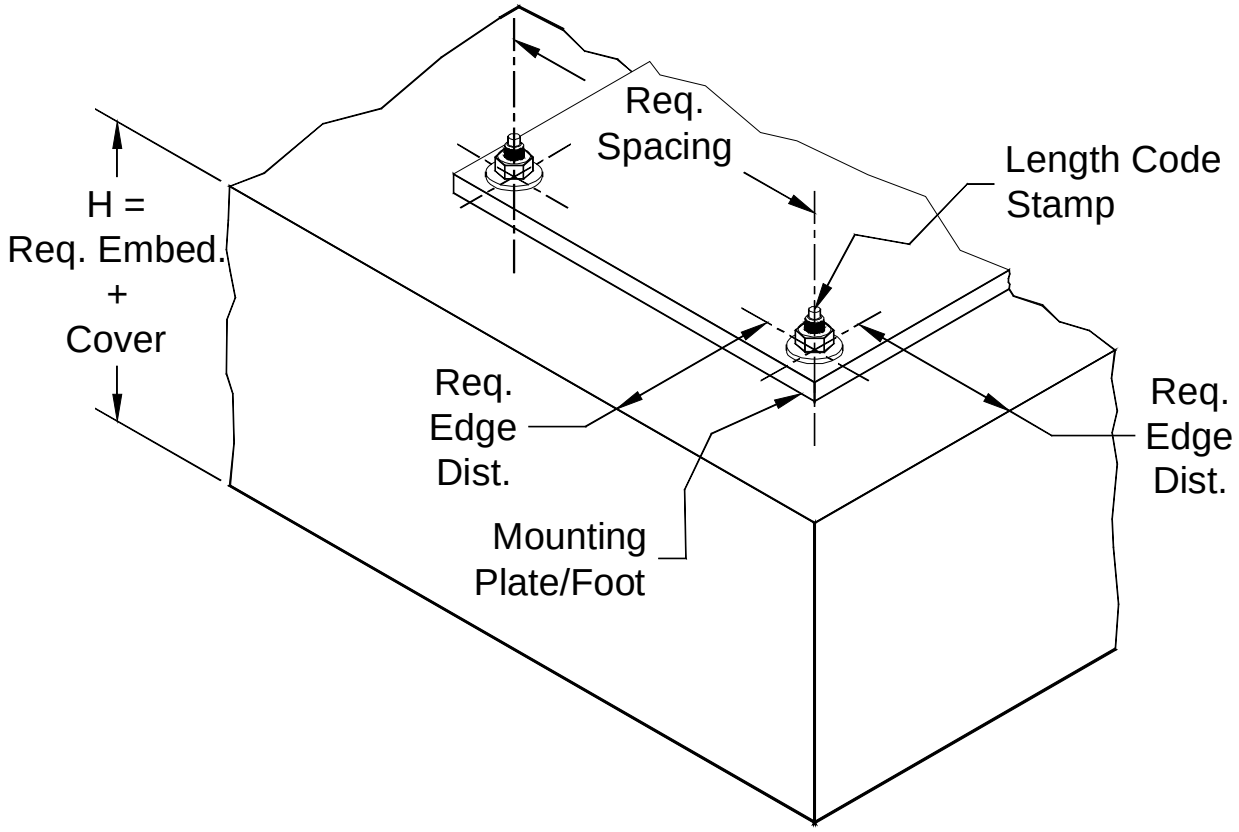

Figure P10.2.2-1: KUAB Type P Undercut Seismic Anchor Placement Guide.

Table P10.2.2-2: KUAB Type P Undercut Seismic Anchor Dimensional Data. (Reference: Figure P10.2.2-2)

Undercut Anchor Model	Anchor Size mm (in)	ΦA mm (in)	B mm (in)	C mm (in)	ΦD mm (in)	ΦE mm (in)	F mm (in)	ΦG mm (in)	H mm (in	Length Code Stamp
KUAB-01	M10 (3/8)	20 (0.79)	107 (4.21)	20 (0.79)	12 (0.47)	10 (0.39)	17 (0.67)	27.5 (1.08)	170 (6.69)	I
KUAB-02	M12 (1/2)	22 (0.87)	135 (5.31)	30 (1.18)	14 (0.55)	12 (0.47)	19 (0.75)	33.5 (1.32)	190 (7.48)	L
KUAB-03	M16 (5/8)	30 (1.18)	203 (7.99)	40 (1.57)	18 (0.71)	16 (0.63)	24 (0.94)	45.5 (1.79)	270 (10.63)	R
KUAB-04	M20 (3/4)	37 (1.46)	266 (10.47)	50 (1.97)	22 (0.87)	20 (0.79)	30 (1.18)	50 (1.97)	350 (13.78)	V

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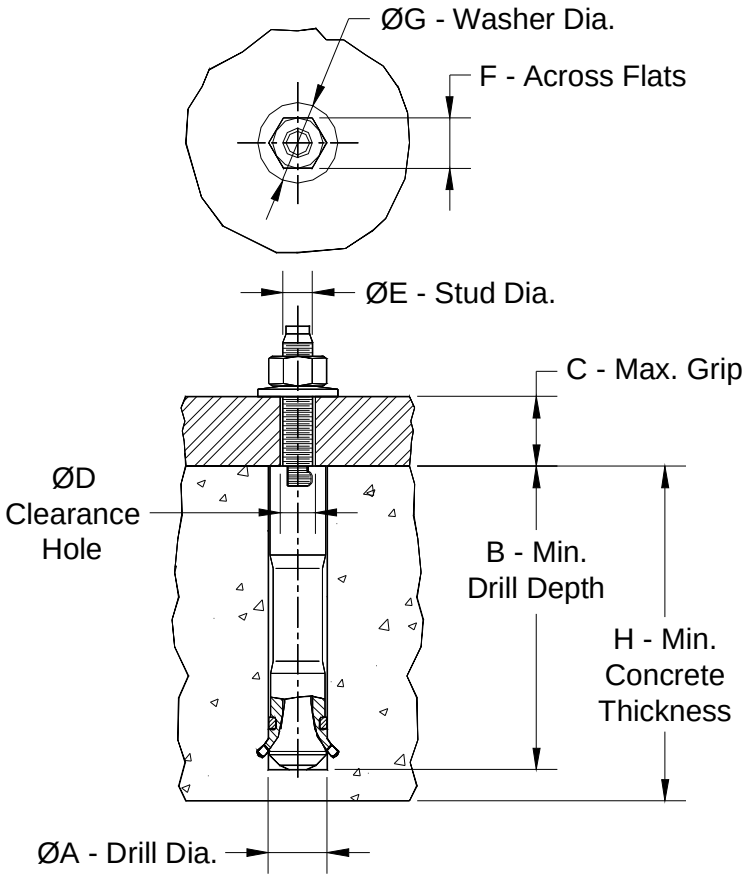

Figure P10.2.2-2: KUAB Type P Undercut Seismic Anchor Installation Guide.

Table P10.2.2-3: Anchor Size vs. Tightening Torque for Standard Weight Concrete.

Undercut Anchor Model	Anchor Size mm (in)	Anchor Tightening Torque N-m (ft-lbs)	Length Code Stamp
KUAB-01	M10 (3/8)	50 (37)	I
KUAB-02	M12 (1/2)	80 (59)	L
KUAB-03	M16 (5/8)	120 (88)	R
KUAB-04	M20 (3/4)	300 (221)	V

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TG Bolt Isolation Grommet Submittal Data

The Kinetics Noise Control model ***TG Bolt Isolation Grommet*** is used primarily to fill the excess clearance in the anchor/bolt holes in equipment/isolator mounting plates/feet. The codes and best practice require that the diameter of an anchor/bolt hole not exceed the diameter of the anchor/bolt by more than ***1/8 inch***. In many cases, the seismic analysis will indicate that an anchor/bolt of smaller size than that provided for in the mounting plate/foot may be used for a specific application. The Kinetics Noise Control model ***TG Bolt Isolation Grommet*** may be used in these cases to bring the anchor/bolt hole clearance into line with the code and best practice recommended clearance for the smaller anchor/bolt size. In order to perform satisfactorily in this type of application, the material used for the model ***TG Bolt Isolation Grommet*** is ***80 Durometer Neoprene***. A typical Kinetics Noise Control model ***TG Bolt Isolation Grommet*** is shown below in Figure P10.2.3-1. The dimensional data for the product family line is given in Tables P10.2.3-1 and P10.2.3-2. A typical ***TG Bolt Isolation Grommet Installatio***n is shown in Figure P10.2.3-2.

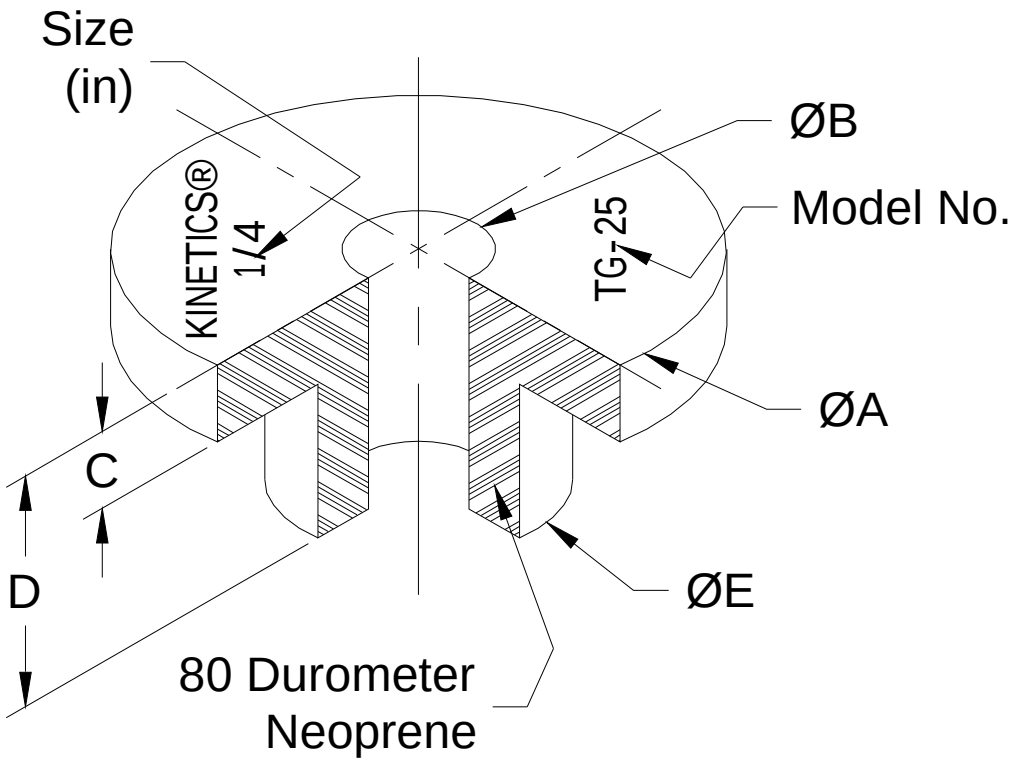

Figure P10.2.3-1: Typical Model TG Bolt Isolation Grommet.

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Table P10.2.3-1: TG Bolt Isolation Grommet English Dimensional Data.

Model	Anchor/ Bolt Size (in)	ΦA (in)	ΦB (in)	C (in)	D (in)	ΦE (in)
TG-25	1/4	1.00	0.25	0.13	0.38	0.50
TG-38	3/8	1.25	0.38	0.13	0.50	0.63
TG-50	1/2	1.63	0.50	0.13	0.50	0.75
TG-63	5/8	2.00	0.63	0.19	0.63	0.88
TG-75	3/4	2.25	0.75	0.19	0.63	1.00
TG-100	1	2.75	1.00	0.25	0.88	1.25
TG-125	1-1/4	3.25	1.25	0.25	0.88	1.50
TG-150	1-1/2	3.75	1.50	0.25	1.00	1.75

Table P10.2.3-2: TG Bolt Isolation Grommet Metric Dimensional Data.

Model	Anchor/ Bolt Size (in)	ΦA (mm)	ΦB (mm)	C (mm)	D (mm)	ΦE (mm)
TG-25	1/4	25.4	6.4	3.2	9.5	12.7
TG-38	3/8	31.8	9.5	3.2	12.7	15.9
TG-50	1/2	41.3	12.7	3.2	12.7	19.1
TG-63	5/8	50.8	15.9	4.8	15.9	22.2
TG-75	3/4	57.2	19.1	4.8	15.9	25.4
TG-100	1	69.9	25.4	6.4	22.2	31.8
TG-125	1-1/4	82.6	31.8	6.4	22.2	38.1
TG-150	1-1/2	95.3	38.1	6.4	25.4	44.4

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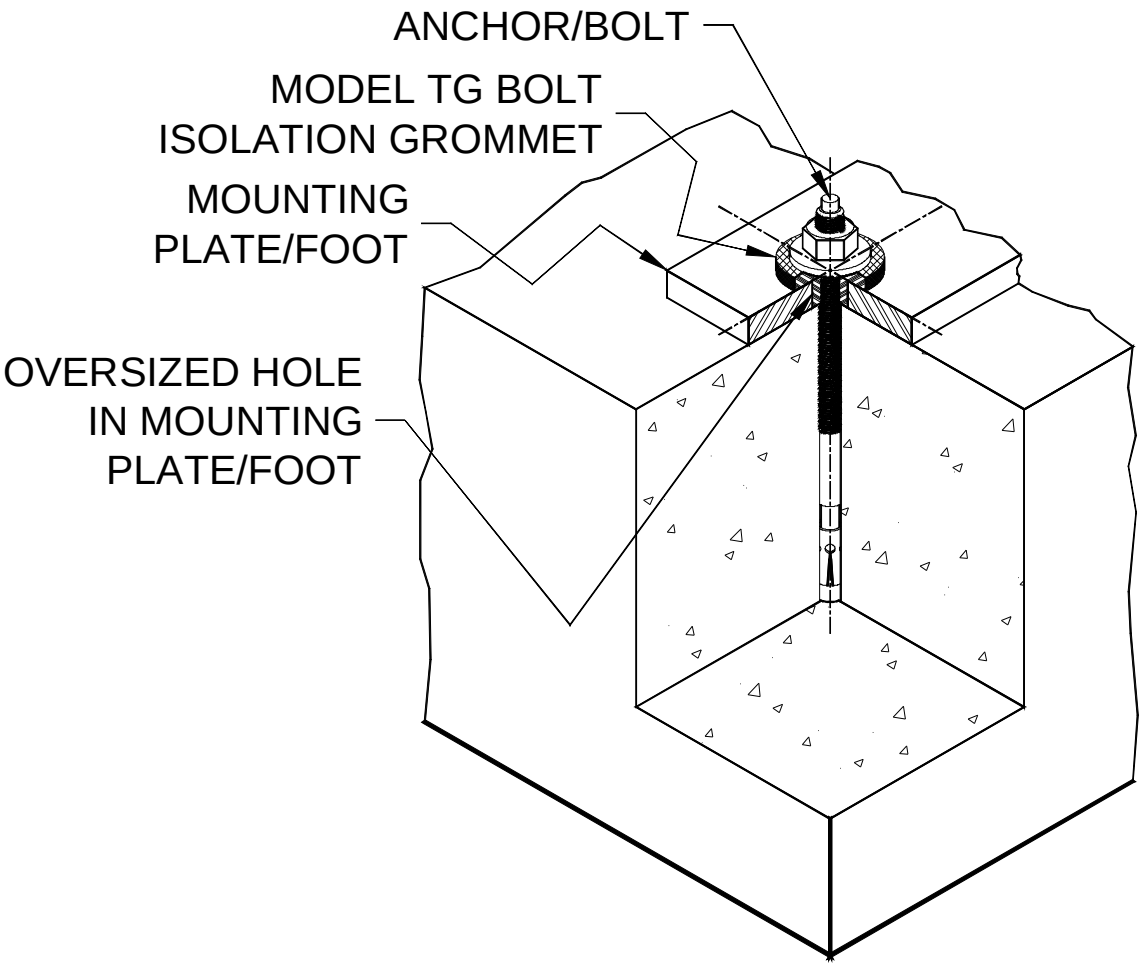

Figure P10.2.3-2: Typical TG Bolt Isolation Grommet Installation.

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KCCAB CRACKED CONCRETE WEDGE TYPE SEISMIC ANCHOR DATA

Table P10.2.4-1; Model KCCAB Anchor Capacities – Standard Embedment in 3,000 psi Normal Weight Concrete

Anchor Size (in)	Pilot Hole Depth (in)	Anchor Embedment (in)	Allowable Tensile Load (ASD) (lbs)	Allowable Combined Load (ASD) (lbs)	Allowable Shear Load (ASD) (lbs)	Critical Anchor Spacing (in)	Critical Anchor Edge Distance (in)	Minimum Concrete Thickness (in)
3/8	2 5/8	2	808	567	922	6	4 3/8	4
1/2	4	3 1/4	1,750	1,251	2,082	9 3/4	7 1/2	6
5/8	4 3/4	4	2,079	1,675	3,430	12	9	6
3/4	5 3/4	4 3/4	3,133	2,525	5,177	14 1/4	11 3/4	8

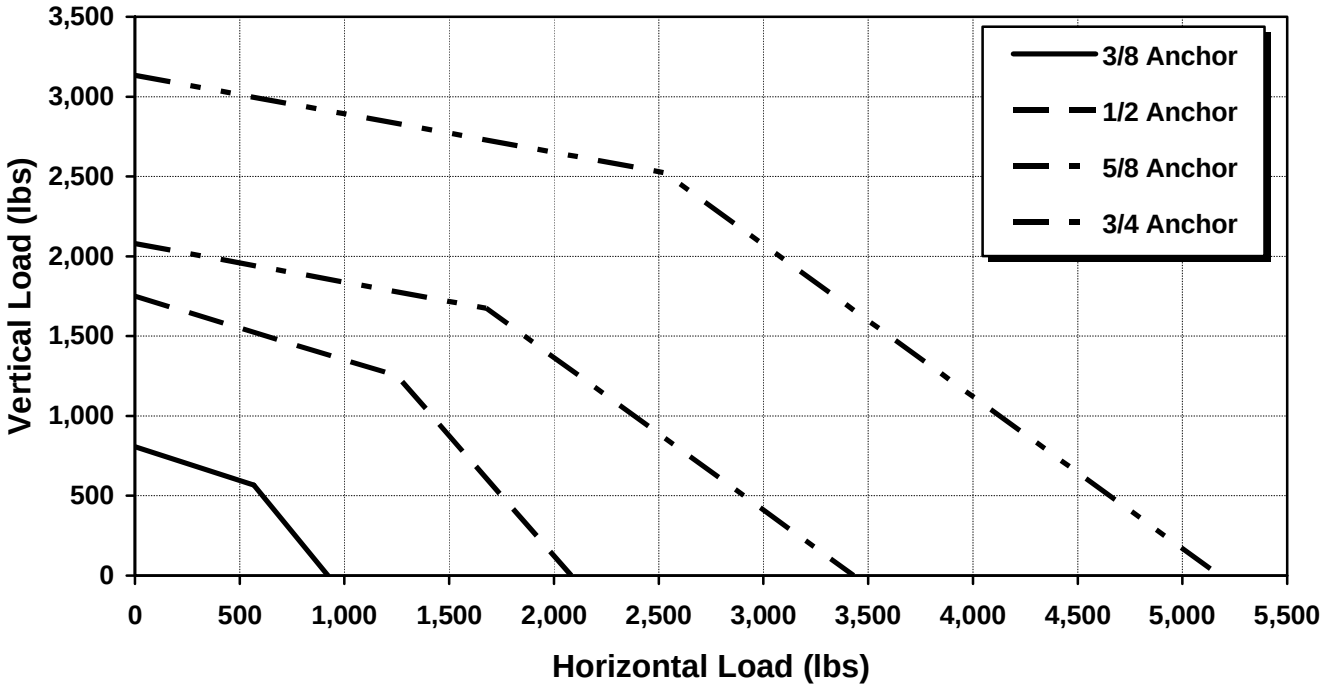

Figure P10.2.4-1; Seismic Capacity Envelopes for Model KCCAB Concrete Anchors with Standard Embedment

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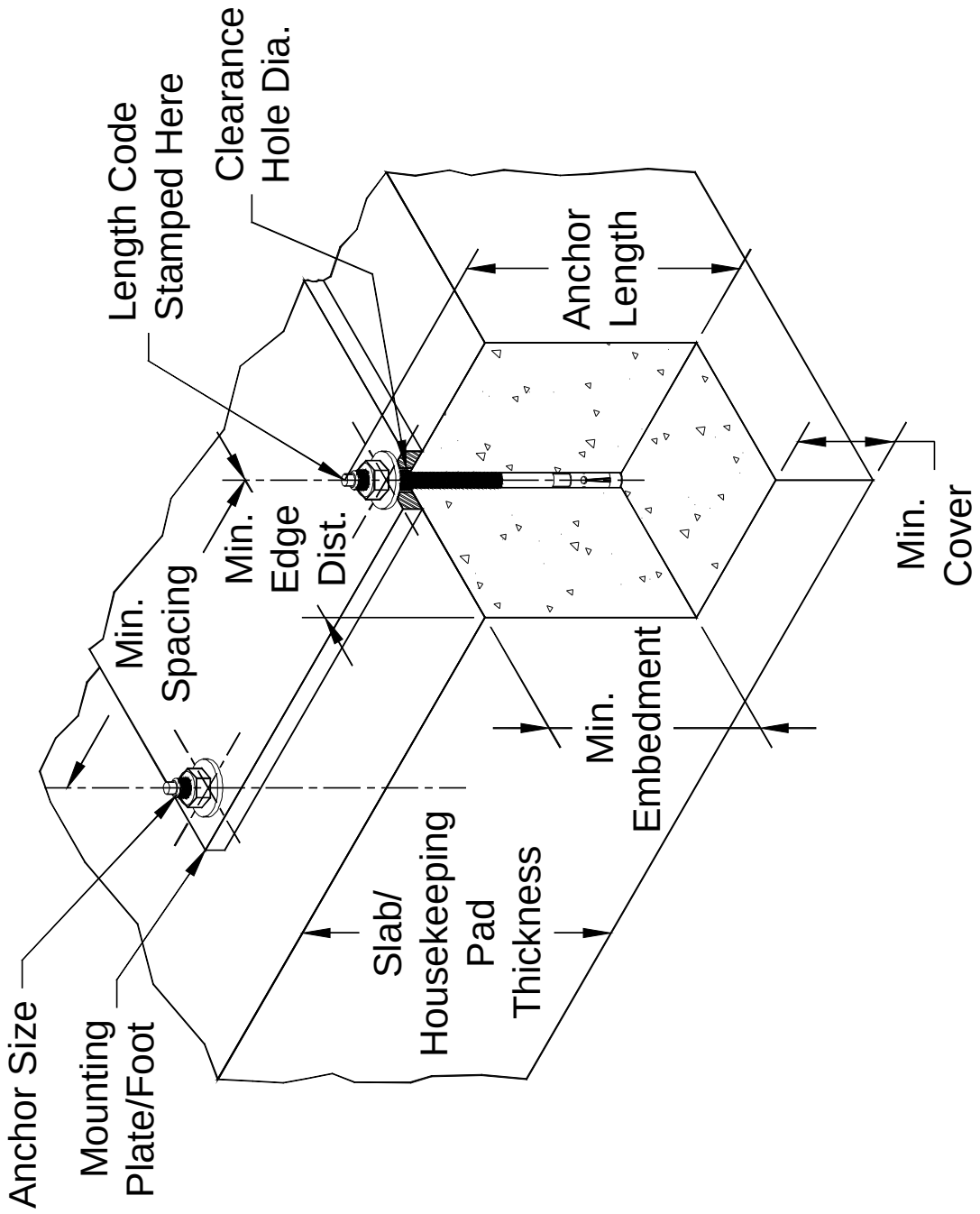

Figure P10.2.4-2; KCCAB Cracked Concrete Seismic Anchor Installation Guide

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Table P10.2.4-2: Anchor Length by Length Code Stamp (Anchor Size Independent)

Length Code Stamp	Anchor Length (in)	Length Code Stamp	Anchor Length (in)
A	1.5 up to 2.0	M	7.5 up to 8.0
B	2.0 up to 2.5	N	8.0 up to 8.5
C	2.5 up to 3.0	O	8.5 up to 9.0
D	3.0 up to 3.5	P	9.0 up to 9.5
E	3.5 up to 4.0	Q	9.5 up to 10.0
F	4.0 up to 4.5	R	10.0 up to 11.0
G	4.5 up to 5.0	S	11.0 up to 12.0
H	5.0 up to 5.5	T	12.0 up to 13.0
I	5.5 up to 6.0	U	13.0 up to 14.0
J	6.0 up to 6.5	V	14.0 up to 15.0
K	6.5 up to 7.0	W	15.0 up to 16.0
L	7.0 up to 7.5	----------	----------

Table P10.2.4-3: Anchor Size vs. Tightening Torque for Standard Weight Concrete

Anchor Size (in)	Anchor Tightening Torque (ft-lbs)
3/8	25.00
1/2	40.00
5/8	60.00
3/4	110.0

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KCAB Wedge Type Anchor Selection Guide

For wedge type concrete anchors, the factor of safety is computed using the following equation.

$$F.S. \geq 1 = 1/[(T/T_A)^{(5/3)} + (P/P_A)^{(5/3)}] \qquad \textbf{(Eq. P10.3.1-1)}$$

Where:

F.S. = the factor of safety.
T = the applied tensile force acting on the anchor (lbs).
T_A = the allowable tensile load for the specified anchor size (lbs).
P = the applied shear force acting on the anchor (lbs).
P_A = the allowable shear load for the specified anchor size (lbs).

It is possible to use Equation P10.3.1-1 to compute an allowable combined anchor load where the applied tensile force is equal to the applied shear force. With this information, a capacity envelope may be constructed for the various wedge type concrete anchors that are specified and used by Kinetics Noise Control. In Equation P10.3.1-2 the applied tensile load has been made equal to the applied shear load, and is designated as F_C.

$$1 = 1/[(F_C/T_A)^{(5/3)} + (F_C/P_A)^{(5/3)}] \qquad \textbf{(Eq. P10.3.1-2)}$$

Solving Equation P10.3.1-2 for F_C and simplifying will yield the following result.

$$F_C = (T_A * P_A) * [1/(T_A^{(5/3)} + P_A^{(5/3)})]^{(3/5)} \qquad \textbf{(Eq. P10.3.1-3)}$$

The data provided in Table P10.3.1-1 is based on concrete with a minimum compressive strength of ***3,000 psi*** and a minimum embedment depth equal to ***8*** anchor diameters. The capacity envelopes for the anchors presented in Table P10.3.1-1 are plotted in Figures P10.3.1-1 through P10.3.1-4.

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Table P10.3.1-1; KCAB Wedge Type Anchor Basic Capacities.

Anchor Size[2] (in)	Minimum Required Embed. Depth (in)	ASD Allow. Tensile Load[1] (*T=0*) (lbs)	ASD Allow. Shear Load[1] (*P=0*) (lbs)	ASD Allow. Comb. Load[1] (F_C=*T=P*) (lbs	LRFD Allow. Tensile Load[1] (*T=0*) (lbs)	LRFD Allow. Shear Load[1] (*P=0*) (lbs)	LRFD Allow. Com. Load[1] (F_C=*T=P*) (lbs)
1/4	2	280	400	215	392	560	301
3/8	3	588	1,018	480	823	1,425	672
1/2	4	874	1,769	744	1,224	2,477	1,041
5/8	5	1,317	2,640	1,118	1,844	3,696	1,565
3/4	6	1,668	4,225	1,486	2,335	5,915	2,080
7/8	7	2,264	6,210	2,044	3,170	8,694	2,861
1	8	2,535	8,328	2,346	3,549	11,659	3,285
1	9	2,730	8,328	2,503	3,822	11,659	3,504
1-1/4	10	5,105	9,918	4,301	7,147	13,885	6,021

1) For Non-California projects these values may be inflated by 33-1/3% for seismic and wind applications. For California Non-OSHPD projects these values must be reduced by 20%. For California OSHPD projects the allowable loads for lightweight, 2,000 psi, concrete must be reduced by 20% to simulate cracked concrete. In this case the values listed here do not apply.
2) If the Clearance Hole Diameter is greater than or equal to 1/8″ more than the Anchor Size, fill the clearance space with grout or epoxy, or use the appropriate Kinetics Noise Control model TG Grommet.

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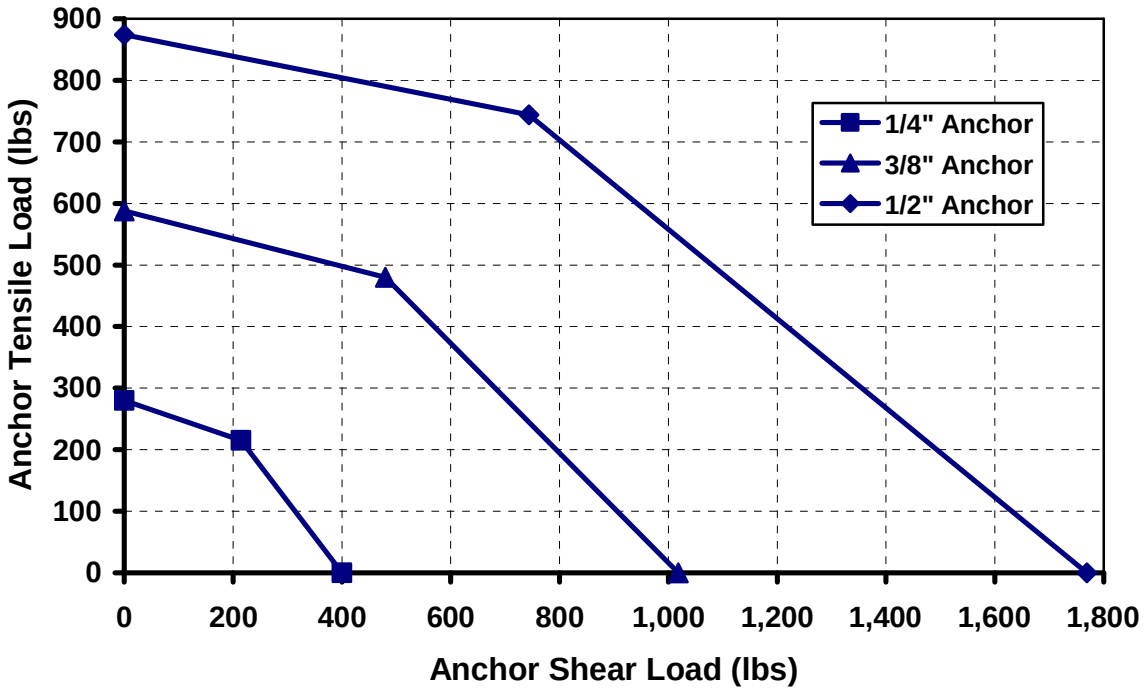

Figure P10.3.1-1; Basic ASD Values for 1/4″ through 1/2″ Anchors.

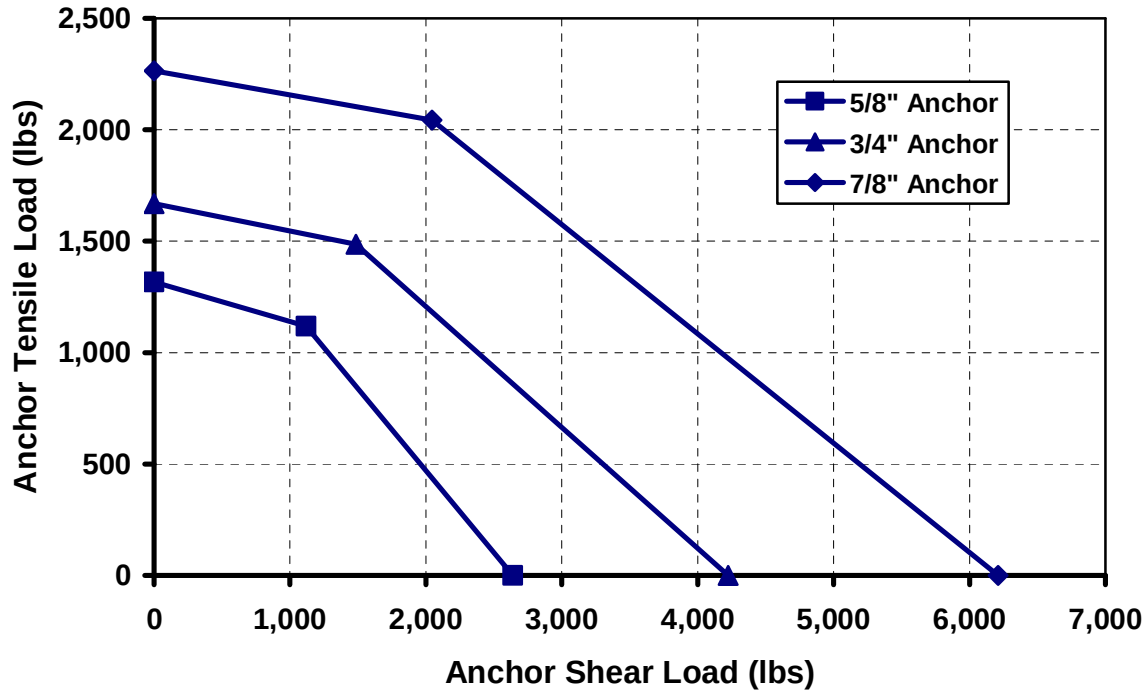

Figure 10.3.1-2; Basic ASD Values for 5/8″ Though 7/8″ Anchors

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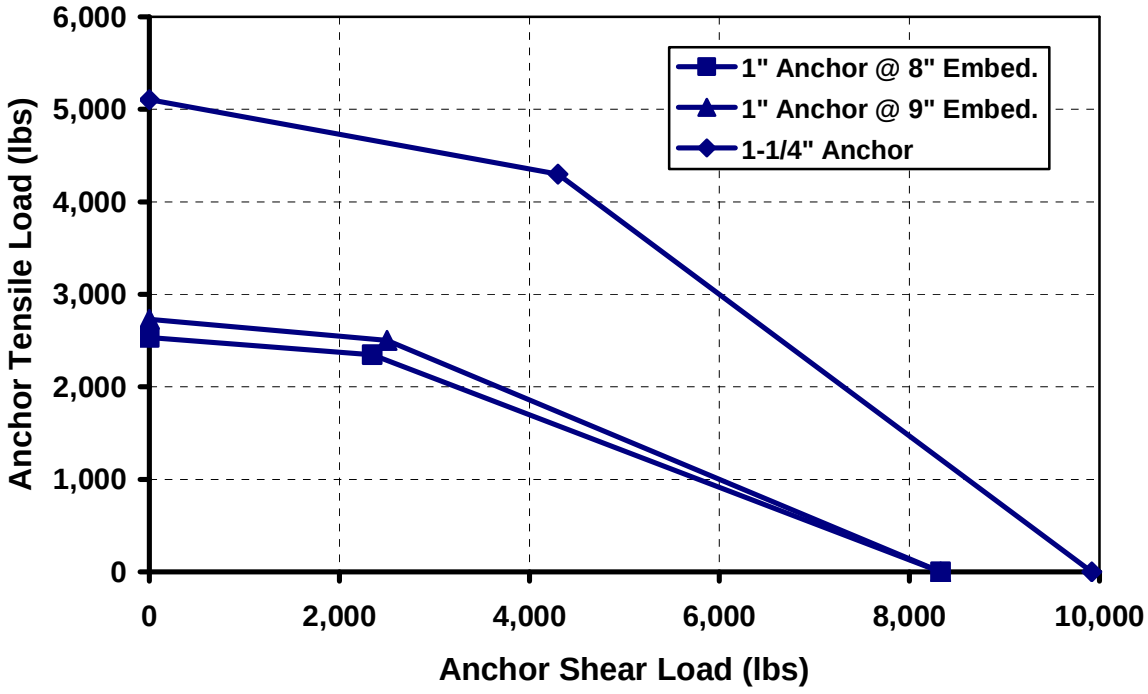

Figure P10.3.1-3; Basic ASD Values for 1″ through 1-1/4″ Anchors.

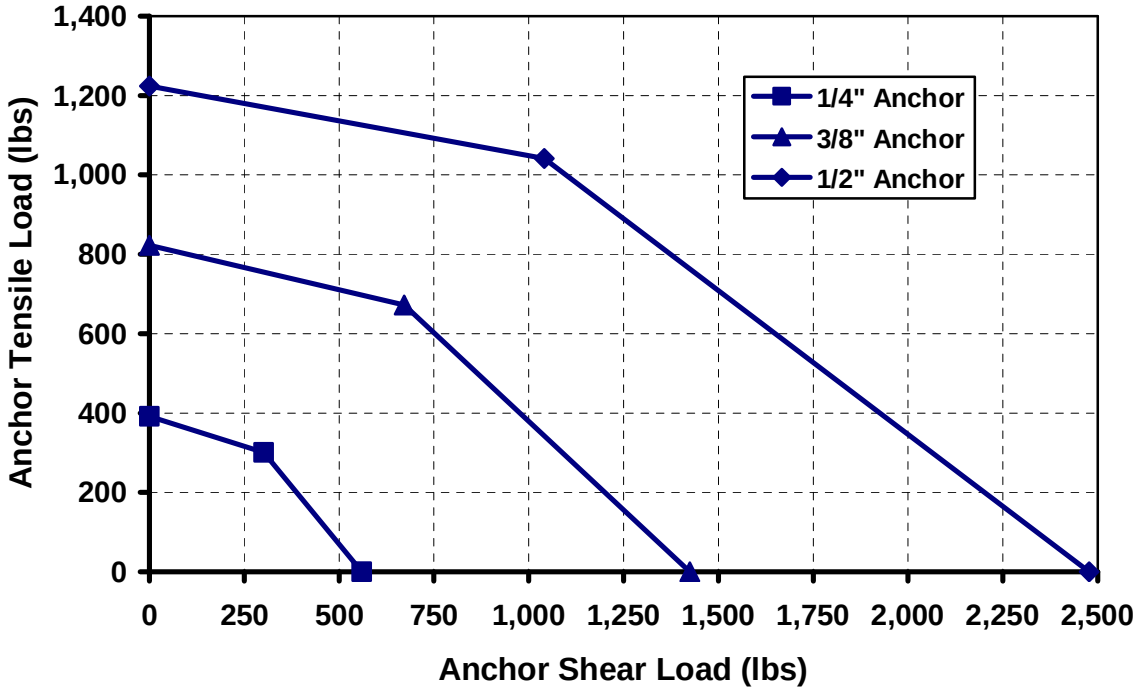

Figure 10.3.1-4; Basic LRFD Values for 1/4″ Though 5/8″ Anchors

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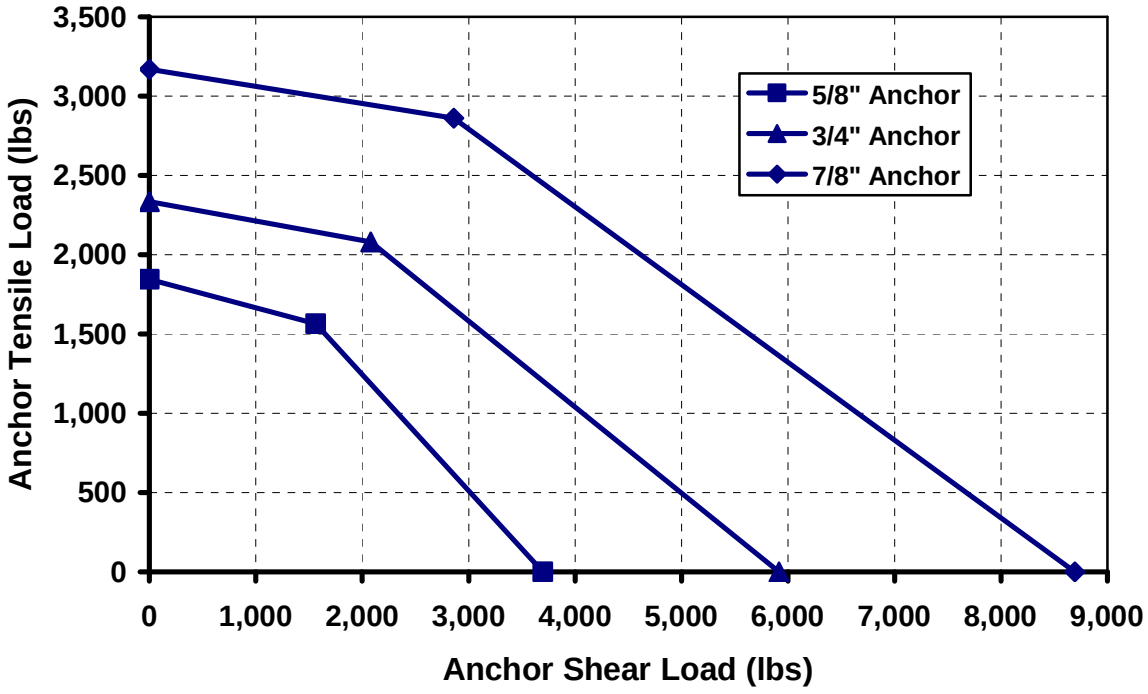

Figure P10.3.1-5; Basic LRFD Values for 5/8″ through 7/8″ Anchors.

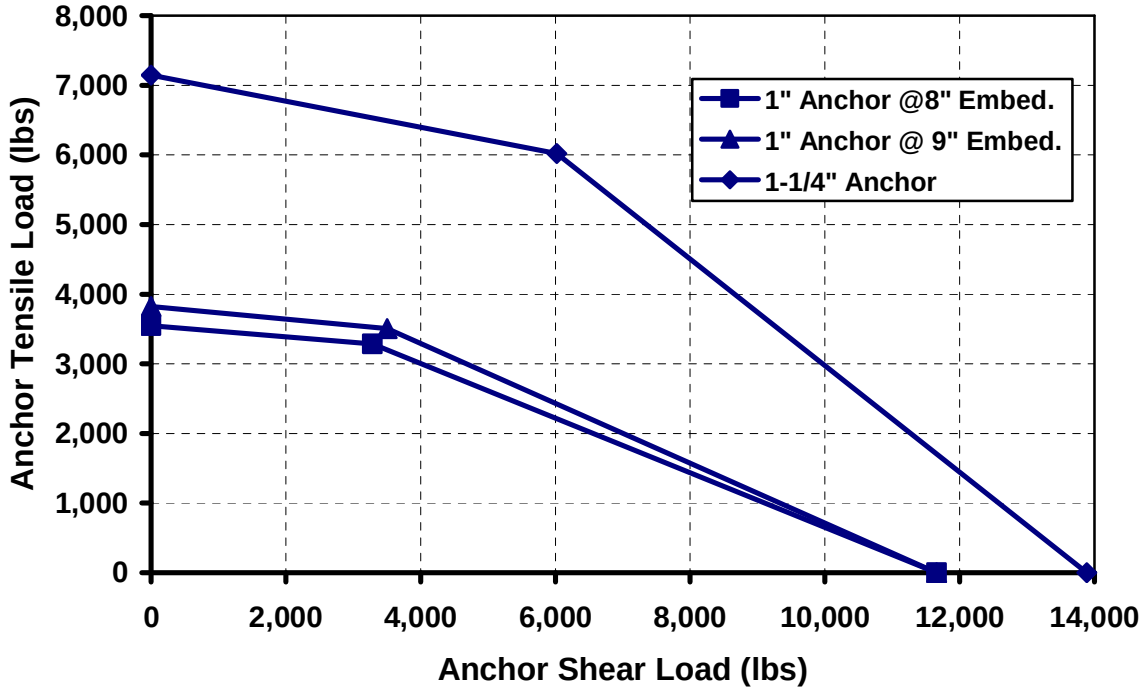

Figure 10.3.1-2; Basic LRFD Values for 1″ Though 1-1/4″ Anchors

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KUAB Type P Undercut Seismic Anchor Selection Guide

The **Kinetics Noise Control** model ***KUAB Type P*** Undercut Seismic Anchors are purchased from **HILTI, Inc.**, and are described in Document P.10.2.2. The Seismic Restraint Envelopes for this type of anchor will be constructed according to the information found in **ICC ES Report** number ***ESR-1546***, Section 4.2.1. In this document, the following definitions will apply.

T = the applied tensile load in the anchor.
T_A = the allowable tensile load in the anchor, **ASD** or **LRFD**.
P = the applied shear load in the anchor.
P_A = the allowable shear load in the anchor, **ASD** or **LRFD**.
F_C = the combined load case where $T = P$.

For applied shear loads $P \leq 0.2P_A$ the full allowable load in tension T_A may be taken. For applied tensile loads $T \leq 0.2T_A$ the full allowable load in shear P_A may be taken. For all other conditions;

$$(T/T_A) + (P/P_A) \leq 1.2 \qquad \textbf{(Eq. P10.3.2-1)}$$

Setting $T = P = F_C$, and solving for the combined load F_C will provide the closing data point for the Seismic Restraint Envelopes.

$$F_C = 1.2T_AP_A/(P_A+T_A) \qquad \textbf{(Eq. P10.3.2-2)}$$

The ASD, and LRFD Allowable Tensile, Shear, Combined Loads for the **Kinetics Noise Control** model ***KUAB Type P*** Undercut Seismic Anchors are given in Table P10.3.2-1. The Seismic Restraint Envelopes for those anchors are presented in Figures P10.3.2-1 and P10.3.2-2 for ASD values, and Figures P10.3.2-3 and P10.3.2-4 for LRFD values.

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Table P10.3.2-1; KUAB Type P Undercut Seismic Type Anchor Capacities (HILTI HDA-P Undercut Concrete Anchors)

Anchor Size[1] (mm) [Φ Stud] (in)	Min. Req.'d Embed. Depth (in)	ASD Allow. Tensile Load[2] (*T=0*) (lbs)	ASD Allow. Shear Load[2] (*P=0*) (lbs)	ASD Allow. Comb. Load[2] (F_C=*T*=*P*) (lbs)	LRFD Allow. Tensile Load[2] (*T=0*) (lbs)	LRFD Allow. Shear Load[2] (*P=0*) (lbs)	LRFD Allow. Comb. Load[2] (F_C=*T*=*P*) (lbs)
M10 [3/8]	4	4,365	1,993	1,642	6,111	2,790	2,299
M12 [1/2]	5	5,457	2,889	2,267	7,640	4,045	3,174
M16 [5/8]	7-1/2	10,914	5,380	4,324	15,280	7,532	6,054
M20 [3/4]	9-7/8	16,371	8,269	6,593	22,919	11,577	9,230

1) If the Clearance Hole Diameter is greater than or equal to 1/8″ more than the Anchor Size, fill the clearance space with grout or epoxy, or use the appropriate Kinetics Noise Control model TG Grommet.
2) These values ***may not*** be inflated by 33-1/3% for seismic and wind applications!

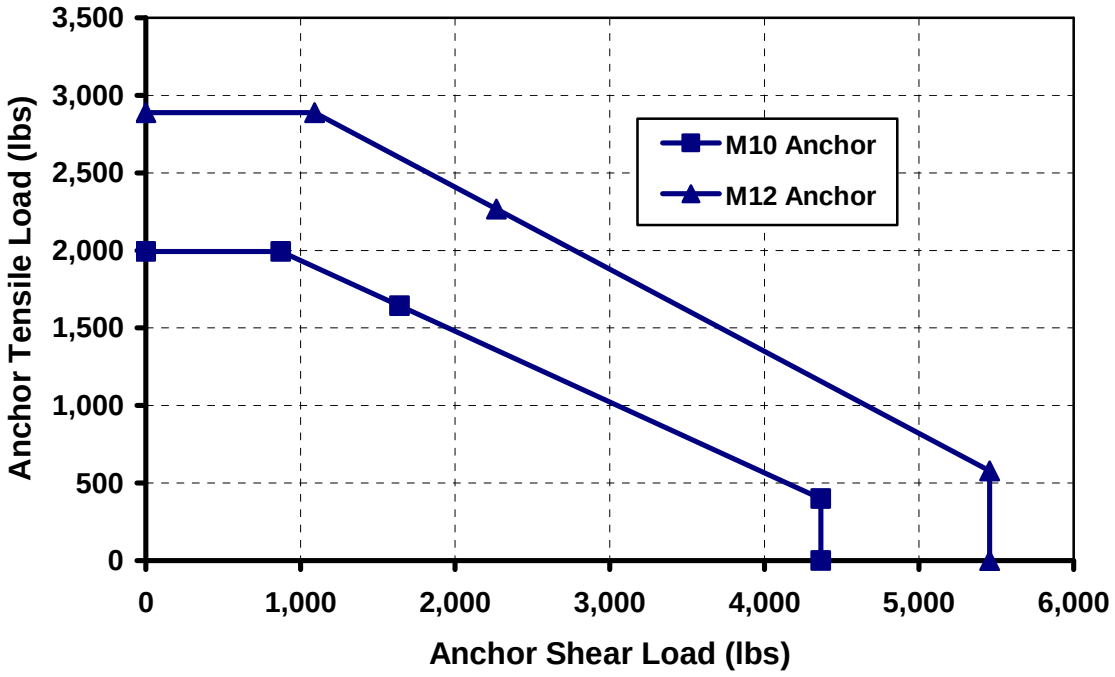

Figure P10.3.2-1; Basic ASD Values for M10 and M12 Anchors.

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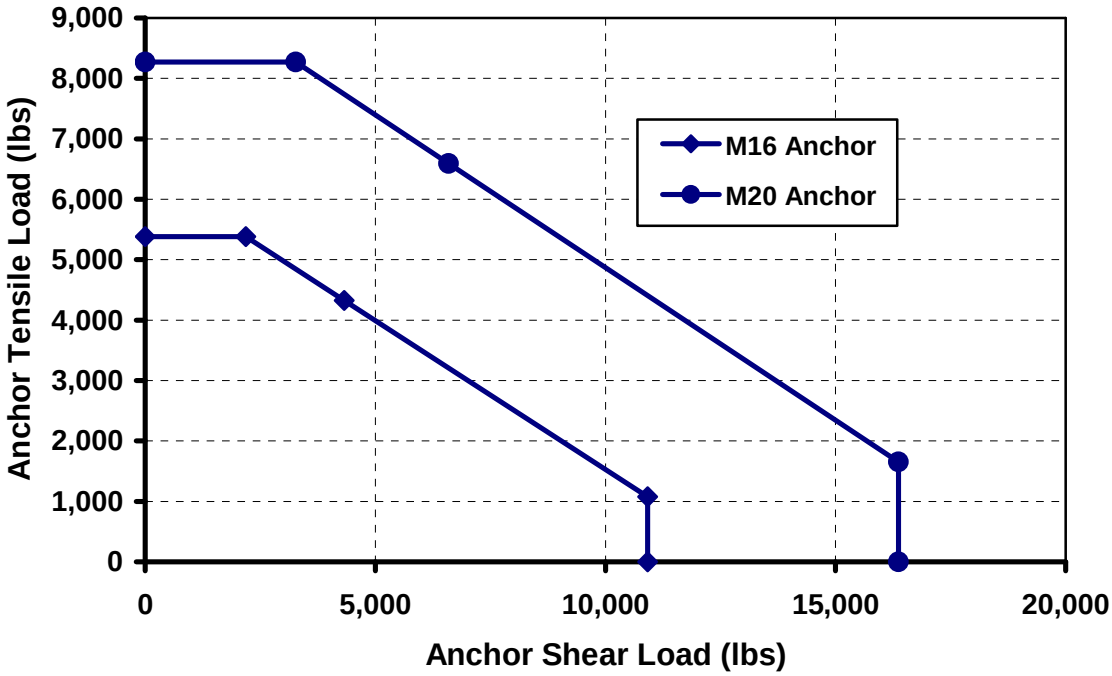

Figure P10.3.2-2; Basic ASD Values for M16 and M20 Anchors.

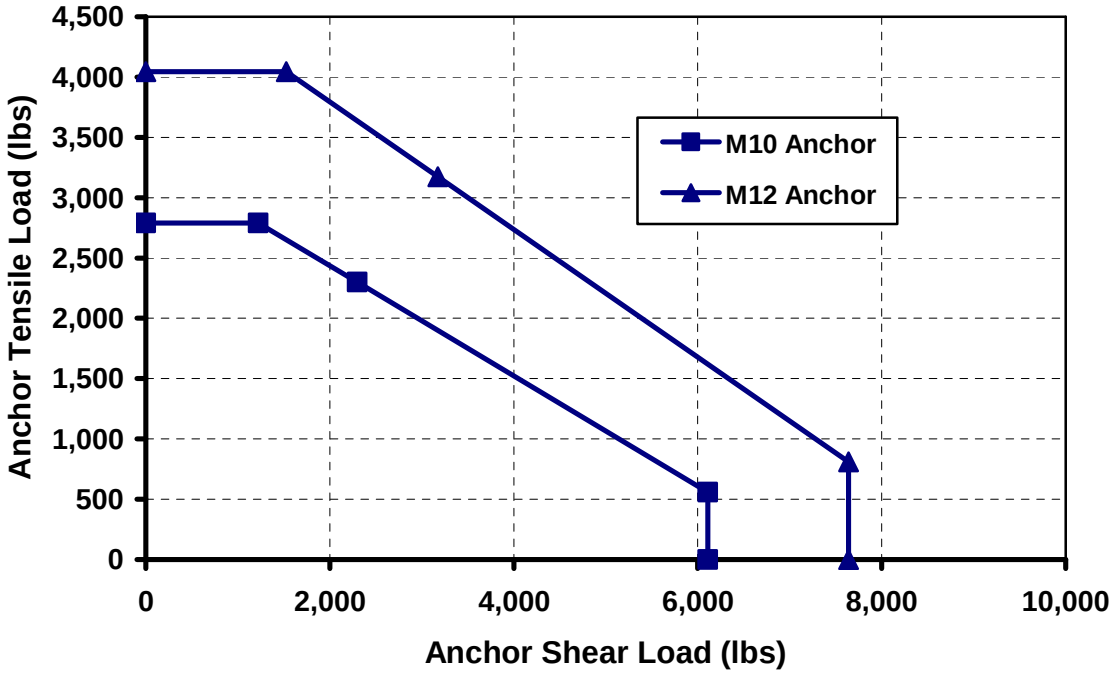

Figure P10.3.2-3; Basic LRFD Values for M10 and M12 Anchors.

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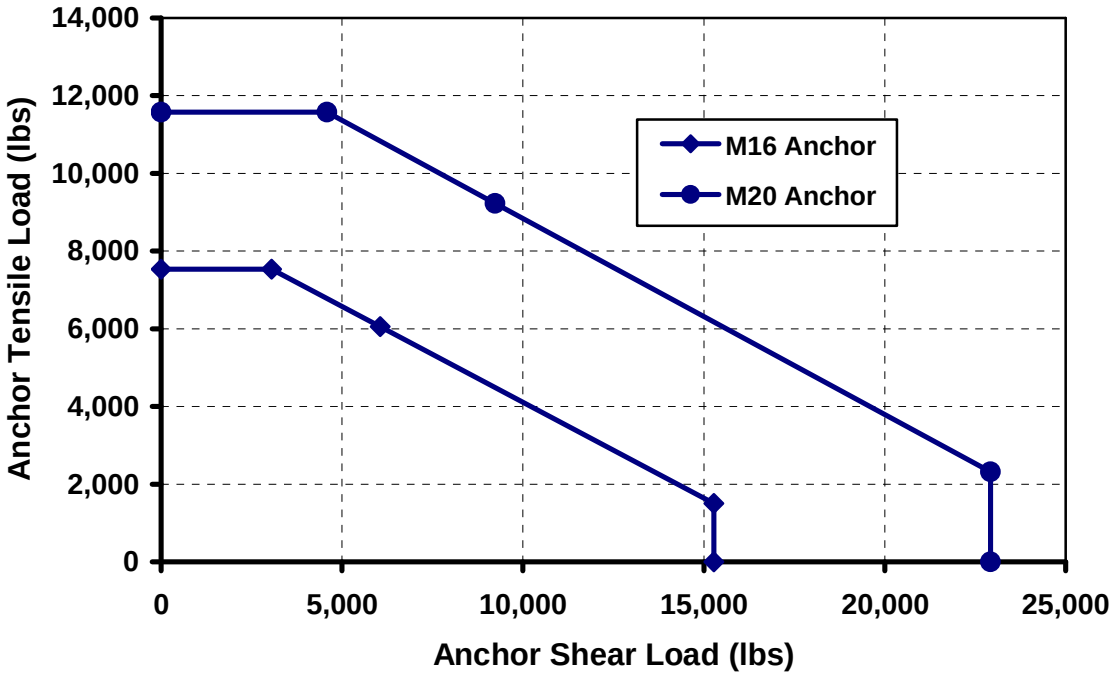

Figure P10.3.2-4; Basic LRFD Values for M16 and M20 Anchors.

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ANCHOR INSTALLATION INSTRUCTION KCAB-KCCAB

KCAB and KCCAB anchors shall be installed in holes drilled into the base material using carbide-tipped masonry drill bits complying with ANSI B212.15-1994. The nominal drill bit diameter shall be equal to that of the anchor. The drilled hole shall exceed the required anchor embedment depth by at least one anchor diameter to permit over-driving of anchors and to provide a dust collection area.

Anchors shall be installed to a minimum embedment depth and with at least the minimum edge distance as specified in the table below.

	KCAB Data		KCCAB Data	
Anchor Size	Minimum Embedment (in)	Minimum Edge Distance (in)	Minimum Embedment (in)	Minimum Edge Distance (in)
0.25	2.0	3.38		
0.38	3.0	4.88	2.00	6.50
0.50	4.0	6.75	3.25	7.50
0.62	5.0	8.25	4.00	8.75
0.75	6.0	9.75	4.75	9.00
1.00	8.0	13.50		
1.00 (Hi Capacity)	9.0	13.50		

The anchor shall be hammered into the predrilled hole until at least 6 threads (KCAB) or 4 threads (KCCAB) are below the fixture surface. The nut shall be tightened against the washer until the torque values specified in the table below are obtained.

	KCAB Data		KCCAB Data	
Anchor Size	Torque (in lb)	Torque (Nm)	Torque (in lb)	Torque (Nm)
0.25	4	6		
0.38	20	27	25	34
0.50	40	54	40	54
0.62	85	115	60	81
0.75	150	202	110	149
1.00	325	439		

See page to follow for detailed installation procedure.

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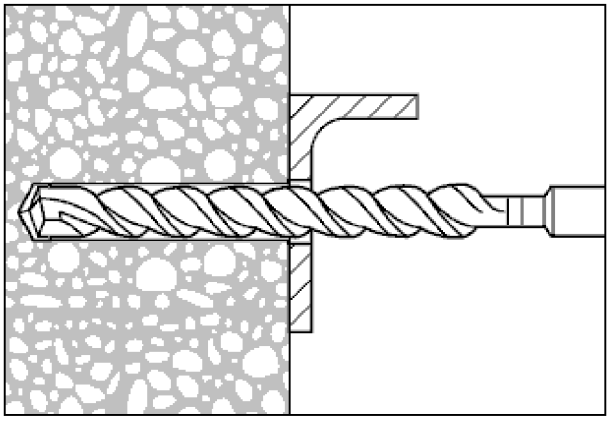

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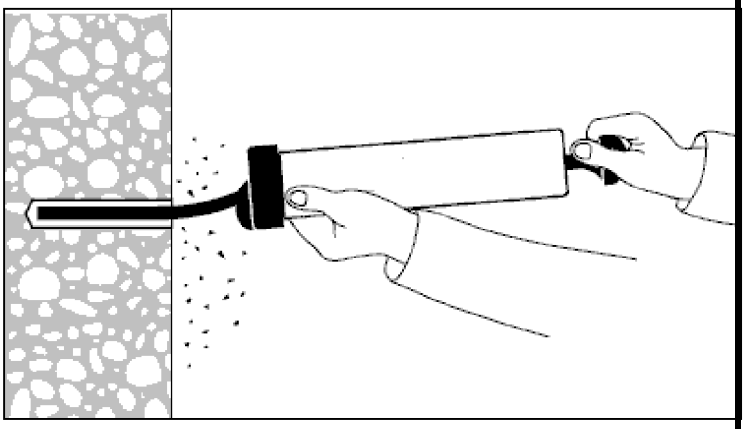

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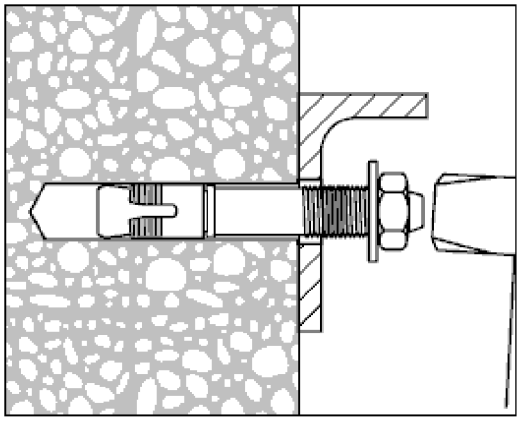

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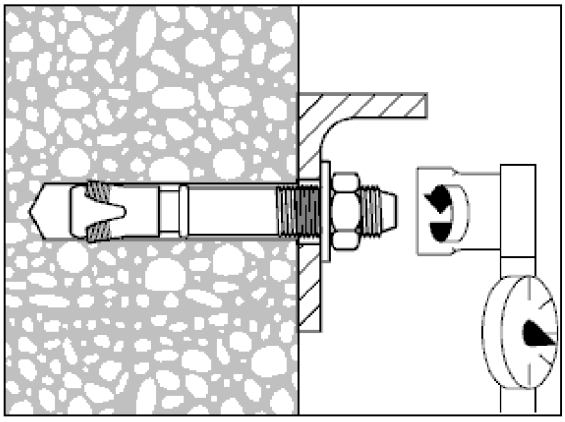

4

1) Hammer drill a hole to the same nominal diameter as the KCAB or KCCAB using a bit complying with ANSI B212.15-1994. The hole depth should exceed the listed embedment depth by 1 anchor diameter. The component being restrained can be used as a guide to properly locate the hole.
2) Clean the hole using an air source to blow the debris out.
3) Drive the anchor bolt into the hole using a hammer.
    a) KCAB anchors should be driven in to their rated embedment depth (with at least 6 threads being driven below the surface against which the nut will bear).
    b) KCCAB anchors should be driven in to their rated embedment depth (with the marker on the side of the anchor flush with the concrete surface and with at least 4 threads being driven below the surface against which the nut will bear).
4) Tighten the nut to the recommended installation torque.

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