ICC-ES Evaluation Report

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DIVISION: 03 00 00—CONCRETE Section: 03 16 00—Concrete Anchors Division: 05 00 00—METALS Section: 05 05 19—Post-Installed Concrete Anchors	REPORT HOLDER: MKT METALL-KUNSTSTOFF-TECHNIK GmbH & Co. KG	EVALUATION SUBJECT: MKT SZ CARBON STEEL AND SZ A4 STAINLESS STEEL, HIGH LOAD ANCHORS FOR CRACKED AND UNCRACKED CONCRETE	

1.0 EVALUATION SCOPE

Compliance with the following codes:

■ 2024, 2021, 2018, and 2015 *International Building Code*® (IBC)

■ 2024, 2021, 2018, and 2015 *International Residential Code*® (IRC)

Main references of this report are for the 2024 IBC and IRC. See Table 5 and Table 6 for applicable sections of the code for previous IBC and IRC editions.

■ 2013 *Abu Dhabi International Building Code* (ADIBC)†

†The ADIBC is based on the 2009 IBC. 2009 IBC code sections referenced in this report are the same sections in the ADIBC.

Property evaluated:

■ Structural

2.0 USES

The MKT SZ High Load Anchor is used to resist static, wind, and seismic (Seismic Design Categories A through F) tension and shear loads in cracked and uncracked normal-weight or lightweight concrete having a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa) [minimum of 24 MPa is required under ADIBC Appendix L, Section 5.1.1].

The anchoring system complies with Section 1901.3 of the 2024 IBC The anchors may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 MKT SZ:

3.1.1 General: The MKT SZ Carbon Steel or MKT SZ Stainless Steel A4 High Load Anchor, designated as the SZ or SZ A4 respectively, is a torque-set, sleeve-type mechanical expansion anchor. The SZ is comprised of seven components which vary slightly according to anchor diameter, as shown in Figure 1 of this report. It is available in three head configurations, illustrated in Figure 1 of this report. Only the sizes M8, M10 and M12 are available with a countersunk head.

All carbon steel parts receive a minimum 0.0002-inch-thick (5 µm) galvanized zinc coating according to EN ISO 4042.

Dimensions and installation criteria are set forth in Table 1. The anchors are manufactured using metric units.

3.1.2 SZ-B (Stud Style, Figure 1): The anchor consists of a threaded stud (1), hexagon nut (7), steel washer (2), distance sleeve (3), collapsible ring (4), steel expansion sleeve (5) and threaded cone (6) (See Figure 1). This anchor is available in carbon steel or in stainless steel A4 (type 316). The material specifications are as follows:

- Threaded stud: Steel, strength class 8.8, EN ISO 898-1 or stainless steel, EN 10088
- Hexagon nut: Steel, strength class 8, EN ISO 898-2 or stainless steel, ISO 3506, strength class 70, coated
- Washer: Steel, EN 10139 or stainless steel, EN 10088
- Distance sleeve: Precision steel tubes EN10305-02 or EN 10305-3or stainless steel tubes, EN 10217-7 or EN 10216-5
- Ring: Polyethylene
- Expansion sleeve: Steel, EN 10139 or stainless steel, EN 10088
- Threaded cone: Steel, EN 10263 or EN 10087 or stainless steel, EN 10088, coated

Application of torque at the head of the anchor causes the cone to be drawn into the expansion sleeve. This in turn causes the sleeve to expand against the wall of the drilled hole. Application of the specified installation torque induces a tension force in the stud that is equilibrated by a precompression force in the concrete acting through the component being fastened. Deformation of the collapsible ring prevents buildup of precompression in the distance sleeve in cases where the sleeve is in contact with the washer, and permits the closure of gaps between the concrete and the component being fastened. Application of tension loads that exceed the precompression force in the bolt will cause the cone to displace further into the expansion sleeve (follow-up expansion), generating additional expansion force.

3.1.3 SZ-S (Bolt Style, Figure 1): The anchor has the same components and material specifications as the SZ-B with the exception that the threaded stud and hexagonal nut are replaced by a hexagon head screw (8) made of carbon steel per EN ISO 898-1, strength class 8.8 or stainless steel, EN ISO 3506-1.

3.1.4 SZ-SK (Countersunk Head, Figure 1): The anchor has the same components and material specifications as the SZ-B with the exceptions that the threaded studs replaced by a countersunk head screw (9) made of carbon steel per EN ISO 898-1, Strength class 8.8 or stainless steel, EN ISO 3506-1 and the washer is replaced by a countersunk washer (10) made of carbon steel per EN 10083-2 or stainless steel, EN 10088.

3.2 Concrete:

Normal-weight and lightweight concrete must comply with Sections 1903 and 1905 of the 2024 IBC.

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

Design strength of anchors complying with the 2024 IBC, as well as Section R301.1.3 of the 2024 IRC must be determined in accordance with ACI 318-19 Chapter 17 and this report.

Design parameters provided in Tables 2A, 2B, 3A and 3B and references to ACI 318 are based on the 2024 IBC (ACI 318-19), unless noted otherwise in Sections 4.1.1 through 4.1.11 and in Tables 2A, 2B, 3A and 3B of this report. The anchor design must satisfy the requirements in ACI 318-19 Section 17.5.1.2, except as required in ACI 318-19 Section 17.10. Strength reduction factors, ϕ, as given in ACI 318-19 Section 17.5.3, and noted in Tables 2A, 2B, 3A and 3B of this report, must be used for load combinations calculated in accordance with Section 1605.1 of the 2024 IBC and Section 5.3 of ACI 318-19. Strength reduction factors, ϕ, corresponding to brittle steel elements must be used.

4.1.1 Requirements for Static Steel Strength in Tension, N_{sa}: The nominal steel strength of a single anchor in tension, N_{sa}, in accordance with ACI 318-19 Section 17.6.1.2 is provided in Tables 2A and 2B of this report. Strength reduction factors, ϕ_{sa}, corresponding to brittle steel elements as described in Tables 2A and 2B must be used.

4.1.2 Requirements for Static Concrete Breakout Strength in Tension, N_{cb} or N_{cbg}: The nominal concrete breakout strength of a single anchor or group of anchors in tension, N_{cb} and N_{cbg}, respectively, must be calculated according to ACI 318-19 Section 17.6.2, with modifications as described in this section. The basic concrete breakout strength of a single anchor in tension, N_b, must be calculated according to ACI 318-19 Section 17.6.2.2, using the values of h_{ef} and k_{cr} as given in Tables 2A and 2B. The value of f'_c used in the calculations must be limited to a maximum of 8,000 psi (55.2 MPa), in accordance with ACI 318-19 Section

17.3.1. The nominal concrete breakout strength in tension in regions where analysis indicates no cracking at service loads in accordance with ACI 318-19 Section 17.6.2.5.1(a) must be calculated with $\psi_{c,N}$ = 1.0 and using the value of k_{uncr} as given in Tables 2A and 2B.

4.1.3 Requirements for Static Pullout Strength in Tension, $N_{p,cr}$ and $N_{p,uncr}$: The nominal pullout strength of a single anchor in accordance with ACI 318-19 Sections 17.6.3.1 and 17.6.3.2.1 in cracked and uncracked concrete, $N_{p,cr}$ and $N_{p,uncr}$, respectively, is given in Tables 2A and 2B. For all design cases $\Psi_{c,P}$ = 1.0. In accordance with ACI 318-19 Section 17.6.3.3, the nominal pullout strength in cracked concrete may be calculated in accordance with the following equation:

$$N_{p,f'_c} = N_{p,cr}\sqrt{\frac{f'_c}{2{,}500}} \quad \text{(lb, psi)} \qquad \text{(Eq-1)}$$

$$N_{p,f'_c} = N_{p,cr}\sqrt{\frac{f'_c}{17.2}} \quad \text{(N, MPa)}$$

In regions where analysis indicates no cracking in accordance with ACI 318-19 Section 17.6.3.3, the nominal pullout strength in tension may be calculated in accordance with the following equation:

$$N_{p,f'_c} = N_{p,uncr}\sqrt{\frac{f'_c}{2{,}500}} \quad \text{(lb, psi)} \qquad \text{(Eq-2)}$$

$$N_{p,f'_c} = N_{p,uncr}\sqrt{\frac{f'_c}{17.2}} \quad \text{(N, MPa)}$$

Where values for $N_{p,cr}$ or $N_{p,uncr}$ are not provided in Table 2A or Table 2B, the pullout strength in tension need not be evaluated.

4.1.4 Requirements for Static Steel Strength in Shear, V_{sa}: The nominal steel strength in shear, V_{sa}, of a single anchor in accordance with ACI 318-19 Section 17.7.1.2 is given in Tables 3A and 3B of this report and must be used in lieu of values derived by calculation from ACI 318-19 Eq. 17.7.1.2b. Strength reduction factors, ϕ_{sa}, corresponding to brittle steel elements as described in Tables 3A and 3B must be used.

4.1.5 Requirements for Static Concrete Breakout Strength of Anchors in Shear, V_{cb} or V_{cbg}: The nominal concrete breakout strength for a single anchor or group of anchors in shear, V_{cb} and V_{cbg}, respectively, must be calculated in accordance with ACI 318-19 Section 17.7.2, with modifications as described in this section. The basic concrete breakout strength in shear, V_b, must be calculated in accordance with ACI 318-19 Section 17.7.2.2.1, using the values of l_e and d_a (d_0) described in Tables 3A and 3B of this report. The value of l_e used in ACI 318-19 Eq. 17.7.2.2.1a must be taken as no greater than $8d_a$. The value of f'_c used for calculation purposes must not exceed 8,000 psi (55.2 MPa) in accordance with ACI 318-19 Section 17.3.1.

4.1.6 Requirements for Static Concrete Pryout Strength of Anchor in Shear, V_{cp} or V_{cpg}: Static nominal concrete pryout shear strength for a single anchor or group of anchors, V_{cp} or V_{cpg}, respectively, must be calculated in accordance with ACI 318-19 Section 17.7.3, modified by using the value of k_{cp} described in Tables 3A and 3B of this report and the value of N_{cb} or N_{cbg} as calculated in accordance with Section 4.1.2 of this report.

4.1.7 Requirements for Minimum Member Thickness, Minimum Anchor Spacing, and Minimum Edge Distance: In lieu of ACI 318-19 Section 17.9.2, values of s_{min} and c_{min} as given in Tables 1A and 1B of this report must be used. In lieu of ACI 318-19 Section 17.9.4, minimum member thicknesses, h_{min}, as given in Tables 1A and 1B of this report must be used. Intermediate values between s_{min} and c_{min} can be calculated by linear interpolation. Figure A of this report provides more detail.

4.1.8 Requirements for Critical Edge Distance, c_{ac}: In applications where $c < c_{ac}$ and supplemental reinforcement to control splitting of the concrete is not present, the concrete breakout strength in tension for uncracked concrete, calculated according to ACI 318-19 Section 17.6.2, must be further multiplied by the factor $\psi_{cp,N}$ given by Eq-3:

$$\Psi_{cp,N} = \frac{c}{c_{ac}} \qquad \text{(Eq-3)}$$

whereby the factor $\psi_{cp,N}$ need not be taken as less than $\frac{1.5h_{ef}}{c_{ac}}$. For all other cases, $\psi_{cp,N}$ = 1.0.

In lieu of ACI 318-19 Section 17.9.5, the critical edge distance, c_{ac}, required to develop the basic concrete breakout strength of a post-installed anchor in uncracked concrete without supplementary reinforcement, given in Tables 2A and 2B, must be used.

4.1.9 Requirements for Seismic Design: For load combinations including earthquake, the design must be performed according to ACI 318-19 Section 17.10. Modifications to ACI 318-19 Section 17.10 shall be applied under Section 1905.7 of the 2024 IBC.

The nominal steel strength and the nominal concrete breakout strength for anchors in tension, and the nominal concrete breakout strength and pryout strengths for anchors in shear, must be calculated according to ACI 318-19 Sections 17.6 and 17.7, respectively, taking into account the corresponding values given in Tables 2A and 2B or 3A and 3B of this report.

The anchors comply with ACI 318-19 Section 2.3, as brittle steel elements and must be designed in accordance with ACI 318-19 Sections 17.10.4, 17.10.5, 17.10.6, and 17.10.7. Strength reduction factors, ϕ, as given in Tables 2A, 2B, 3A and 3B of this report.

Seismic Shear: The nominal concrete breakout strength and pryout strength for anchors in shear must be calculated according to ACI 318-19 Sections 17.7.2 and 17.7.3, respectively, as described in Sections 4.1.5 and 4.1.6 of this report. In accordance with ACI 318-19 Section 17.7.1.2, the appropriate value for nominal steel strength for anchors in shear for seismic loads, $V_{sa,eq}$, must be evaluated with the values given in Tables 3A and 3B in lieu of V_{sa} as applicable.

Seismic Tension: The nominal steel strength and nominal concrete breakout strength for anchors in tension must be calculated according to ACI 318-19 Sections 17.6.1 and 17.6.2, respectively, as described in Sections 4.1.1 and 4.1.2 of this report. In accordance with ACI 318-19 Section 17.6.3.2.1, the appropriate pullout strength in tension for seismic loads, $N_{p,eq}$ given in Tables 2A and 2B must be used in lieu of N_p, as applicable. The value of $N_{p,eq}$ may be adjusted by calculation for concrete strength in accordance with Eq-1 of this report and Section 4.1.3. When values for $N_{p,eq}$ are not provided in Table 2A or Table 2B, the static design strength values govern and the pullout strength in tension for seismic loads does not need to be considered. If no values for $N_{pn,eq}$ are given in Tables 2A and 2B, the static design strength values govern. (See Section 4.1.3 of this report.)

4.1.10 Lightweight Concrete: For the use of anchors in lightweight concrete, the modification factor λ_a equal to 0.8λ is applied to all values of $\sqrt{f'_c}$ affecting N_n and V_n.

The value of λ shall be determined in accordance with ACI 318-19.

4.1.11 Interaction of Tensile and Shear Forces: For loadings that include combined tension and shear, the design must be calculated in accordance with ACI 318-19 Section 17.8.

4.2 Allowable Stress Design (ASD):

4.2.1 General: Design values for use with allowable stress design (working stress design) load combinations calculated in accordance with Section 1605.1 of the 2024 IBC must be established using the following relationships:

$$T_{allowable,ASD} = \frac{\phi N_n}{\alpha} \quad \text{(Eq-4)}$$

and

$$V_{allowable,ASD} = \frac{\phi V_n}{\alpha} \quad \text{(Eq-5)}$$

where

$T_{allowable,ASD}$ = Allowable tension load (lbf or kN).

$V_{allowable,ASD}$ = Allowable shear load (lbf or kN).

ϕN_n = Lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318-19 Chapter 17 and 2024 IBC Section 1905.7, and Section 4.1 of this report, as applicable (lbf or kN).

ϕV_n = Lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318-19 Chapter 17 and 2024 IBC Section 1905.7, and Section 4.1 of this report, as applicable (lbf or kN).

α = Conversion factor calculated as a weighted average of the load factors for the controlling load combination. In addition, α must include all applicable factors to account for nonductile failure modes and required over-strength.

The requirements for member thickness, edge distance and spacing, as described in this report, must apply. Allowable stress design loads for selected cases are provided in Tables 4A and 4B.

4.2.2 Interaction of Tensile and Shear Forces: Interaction of tensile and shear loads must be calculated and consistent with ACI 318-19 Section 17.8 as follows:

If $T_{applied} \leq 0.2T_{allowable,ASD}$, then the full allowable strength in shear, $V_{allowable,ASD}$, is permitted.

If $T_{applied} \leq 0.2T_{allowable,ASD}$, then the full allowable strength in tension, $V_{allowable,ASD}$, is permitted.

For all other cases:

$$\frac{T_{applied}}{T_{allowable,ASD}} + \frac{V_{applied}}{V_{allowable,ASD}} \leq 1.2 \qquad \text{(Eq-6)}$$

4.3 Installation:

Installation parameters are provided in Tables 1A and 1B and in Figure 2 of this report. Anchors must be installed per the manufacturer's published instructions and this report. Anchor locations must comply with this report and plans and specifications approved by the code official. Anchors must be installed in holes drilled using carbide-tipped drill bits conforming to ANSI B212.15-1994 as given in Tables 1A and 1B. The nominal bit diameter must be equal to the nominal anchor size. The minimum drilled hole depth is given in Tables 1A and 1B. Prior to anchor installation, dust and debris must be removed from the hole using a hand pump, compressed air or a vacuum. The anchor must be driven into the predrilled hole using a hammer until the proper nominal embedment depth is achieved. The anchor is tightened until the installation torque, T_{inst}, specified in Table 1A or Table 1B is achieved.

4.4 Special Inspection:

Periodic special inspection is required in accordance with Section 1705.1.1 and Table 1705.3 of the 2024 IBC. The special inspector must make periodic inspections during anchor installation to verify anchor type, anchor dimensions, concrete type, concrete compressive strength, hole dimensions, hole cleaning procedures, edge distance(s), anchor spacing(s), concrete thickness, embedment depth, tightening torque and adherence to the manufacturer's installation instructions.

The special inspector must be present as often as required in accordance with the "statement of special inspection." Under the 2024 IBC, additional requirements as set forth in Sections 1705, 1706 and 1707 must be observed, where applicable.

5.0 CONDITIONS OF USE:

The MKT SZ Carbon Steel or Stainless Steel High Load Anchors described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 Anchor sizes, dimensions, and installation parameters are as set forth in this report.

5.2 The anchors must be installed in accordance with the manufacturer's published instructions and this report. In case of conflicts, this report governs.

5.3 The anchors must be installed in cracked and uncracked, normal-weight or lightweight concrete having a specified compressive strength, f'c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa) [minimum of 24 MPa is required under ADIBC Appendix L, Section 5.1.1].

5.4 The values of f'c used for calculation purposes must not exceed 8,000 psi (55.1 MPa).

5.5 Strength design values must be established in accordance with Section 4.1 of this report.

5.6 Allowable stress design values must be established in accordance with Section 4.2 of this report.

5.7 Anchor spacing, edge distance, and minimum member thickness must comply with Tables 1A and 1B and Figure A.

5.8 Prior to installation, calculations and details justifying that the applied loads comply with this report must be submitted to the code official for approval. The calculations and details must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.9 Since ICC-ES acceptance criteria for evaluating data to determine the performance of expansion anchors subjected to fatigue or shock loading is unavailable at this time, the use of these anchors under such conditions is beyond the scope of this report.

5.10 Anchors may be installed in regions of concrete where cracking has occurred or where analysis indicates cracking may occur (ft > fr), subject to the conditions of this report.

5.11 Anchors may be used to resist short-term loading due to wind or seismic forces in locations designated as Seismic Design Categories A through F, subject to the conditions of this report.

5.12 Where not otherwise prohibited in the code, MKT SZ and MKT SZ A4 anchors are permitted for use with

fire-resistance-rated construction provided that at least one of the following conditions is fulfilled:

- Anchors are used to resist wind or seismic forces only.
- Anchors that support a fire-resistance-rated envelope or a fire-resistance-rated membrane are protected by approved fire-resistance-rated materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.
- Anchors are used to support nonstructural elements.

5.13 Use of zinc-coated carbon steel anchors is limited to dry, interior locations.

5.14 Use of stainless steel anchors (type 316) is permitted for exterior exposure or damp environments.

5.15 Special inspections are provided in accordance with Section 4.4 of this report.

5.16 Anchors are manufactured in Weilerbach, Germany, under an approved quality-control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Mechanical Anchors in Concrete Elements AC193 (24), published April 2025, which incorporates requirements in ACI 355.2 (-19 and -07) for use in cracked and uncracked concrete; and quality-control documentation.

7.0 IDENTIFICATION

7.1 The ICC-ES mark of conformity, electronic labeling, or the evaluation report number (ICC-ES ESR-3173) along with the name, registered trademark, or registered logo of the report holder must be included in the product label.

7.2 In addition, anchors are identified by packaging labeled with the anchor name and size, and the manufacturer's name (MKT) and contact information. The MKT SZ and MKT SZ A4 anchors have the letters SZ embossed on the expansion sleeve. The MKT SZ A4 has an additional marking of "A4" for stainless steel.

7.3 The report holder's contact information is the following:

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TABLE 1A—SZ CARBON STEEL INSTALLATION INFORMATION[1]

SETTING INFORMATION	SYMBOL	UNITS	NOMINAL ANCHOR DIAMETER					
			M8	M10	M12	M16	M20	M24
Anchor Outside Diameter	d_a	in. (mm)	0.45 (11.5)	0.57 (14.5)	0.69 (17.5)	0.93 (23.5)	1.08 (27.5)	1.26 (32)
Drill Bit Diameter	d_{bit}	mm	12	15	18	24	28	32
Minimum Hole Depth	h_0	in. (mm)	3.15 (80)	3.74 (95)	4.13 (105)	5.12 (130)	6.3 (160)	7.08 (180)
Minimum Base Plate Clearance Hole Diameter [2]	d_c	in. (mm)	0.55 (14)	0.67 (17)	0.79 (20)	1.02 (26)	1.22 (31)	1.38 (35)
Installation Torque (Carbon Steel)	T_{inst} B / S	ft-lbf (N-m)	22.1 (30)	36.8 (50)	59 (80)	118 (160)	207 (280)	207 (280)
	T_{inst} SK	ft-lbf (N-m)	18.4 (25)	40.6 (55)	51.6 (70)	-	-	-
Embedment Depth	h_{nom}	in. (mm)	2.72 (69)	3.25 (82.5)	3.72 (94.5)	4.65 (118)	5.83 (148)	6.65 (169)
Effective Embedment Depth	h_{ef}	in. (mm)	2.4 (60)	2.8 (71)	3.1 (80)	3.94 (100)	4.92 (125)	5.92 (150)
Minimum Edge Distance	c_{min1}	in. (mm)	2.4 (60)	2.8 (70)	3.5 (90)	4.7 (120)	7.1 (180)	5.92 (150)
Minimum Spacing [3]	s_{min1}	in. (mm)	4.9 (125)	6.9 (175)	7.9 (200)	12.6 (320)	21.3 (540)	11.8 (300)
Minimum Edge Distance	c_{min2}	in. (mm)	3.9 (100)	5.1 (130)	6.3 (160)	7.1 (180)	11.8 (300)	11.8 (300)
Minimum Spacing [4]	s_{min2}	in. (mm)	2.4 (60)	3.1 (80)	3.1 (80)	3.9 (100)	4.9 (125)	5.92 (150)
Minimum Concrete Thickness	h_{min}	in. (mm)	4.7 (120)	5.5 (140)	6.3 (160)	7.9 (200)	9.8 (250)	11.8 (300)

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.

[1]The information presented in this table must be used in conjunction with the design requirements of ACI 318-19 Chapter 17, as applicable.
[2]The clearance must comply with applicable code requirements for the connected element.
[3]s_{min1} applies when c_{min1} is provided.
[4]s_{min2} applies when c_{min2} is provided.

TABLE 1B—SZ A4 STAINLESS STEEL INSTALLATION INFORMATION[1]

SETTING INFORMATION	SYMBOL	UNITS	NOMINAL ANCHOR DIAMETER			
			M8	M10	M12	M16
Anchor Outside Diameter	d_a	in. (mm)	0.45 (11.5)	0.57 (14.5)	0.69 (17.5)	0.93 (23.5)
Drill Bit Diameter	d_{bit}	Mm	12	15	18	24
Minimum Hole Depth	h_0	in. (mm)	3.15 (80)	3.74 (95)	4.13 (105)	5.12 (130)
Minimum Base Plate Clearance Hole Diameter [2]	d_c	in. (mm)	0.55 (14)	0.67 (17)	0.79 (20)	1.02 (26)
Installation Torque (Stainless Steel)	T_{inst} S	ft-lbf (N-m)	22.1 (30)	36.8 (50)	59 (80)	125 (170)
	T_{inst} B	ft-lbf (N-m)	25.8 (35)	40.5 (55)	66.3 (90)	125 (170)
	T_{inst} SK	ft-lbf (N-m)	12.9 (17.5)	31.3 (42.5)	36.8 (50)	-
Nominal Embedment Depth	h_{nom}	in. (mm)	2.72 (69)	3.25 (82.5)	3.72 (94.5)	4.67 (118.5)
Effective Embedment Depth	h_{ef}	in. (mm)	2.4 (60)	2.8 (71)	3.1 (80)	3.9 (100)
Minimum Edge Distance	c_{min1}	in. (mm)	2.9 (75)	3.3 (85)	3.9 (100)	7.1 (180)
Minimum Spacing [3]	s_{min1}	in. (mm)	5.3 (135)	7.2 (185)	8.3 (210)	7.1 (180)
Minimum Edge Distance	c_{min2}	in. (mm)	3.9 (100)	5.5 (140)	6.7 (170)	7.1 (180)
Minimum Spacing [4]	s_{min2}	in. (mm)	2.8 (70)	3.3 (85)	3.9 (100)	7.1 (180)
Minimum Concrete Thickness	h_{min}	in. (mm)	4.7 (120)	5.5 (140)	6.3 (160)	7.8 (200)
Thickness of fixture	$t_{fix,min}$	in. (mm)	0	0	0	0
SZ-B and SZ-S	$t_{fix,max}$	in. (mm)	7.8 (200)	7.8 (200)	9.8 (250)	11.8 (300)
Thickness of fixture	$t_{fix,min}$ [5]	in. (mm)	0.4 (10)	0.5 (14)	0.7 (18)	-
SZ-SK	$t_{fix,max}$	in. (mm)	7.8 (200)	7.8 (200)	9.8 (250)	-
Thickness of countersunk washer SZ-SK	t_{sk}	in. (mm)	0.20 (5)	0.24 (6)	0.27 (7)	-

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.

[1]The information presented in this table must be used in conjunction with the design requirements of ACI 318-19 Chapter 17.
[2]The clearance must comply with applicable code requirements for the connected element.
[3]s_{min1} applies when c_{min1} is provided.
[4]s_{min2} applies when c_{min2} is provided
[5]Depending on the present shear load, the thickness of the fixture may be reduced to the thickness of the countersunk washer t_{sk}. It must be verified that the present shear load can be transferred completely into the distance sleeve (bearing of hole).

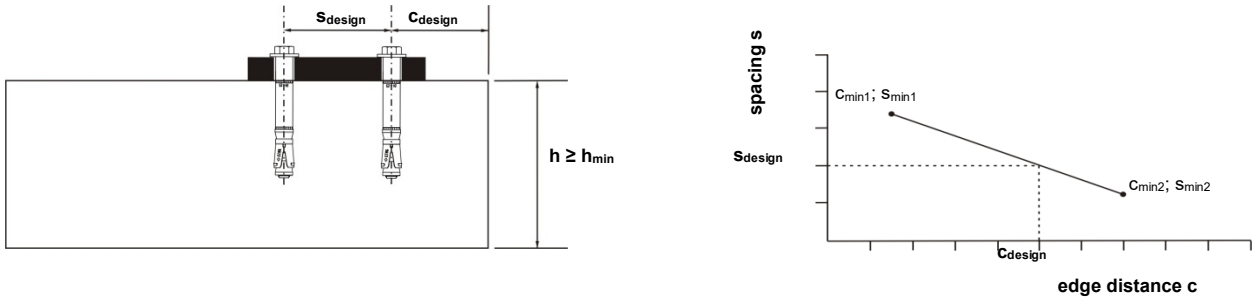


FIGURE A—EXAMPLE OF ALLOWABLE INTERPOLATION OF MINIMUM EDGE DISTANCE AND MINIMUM SPACING

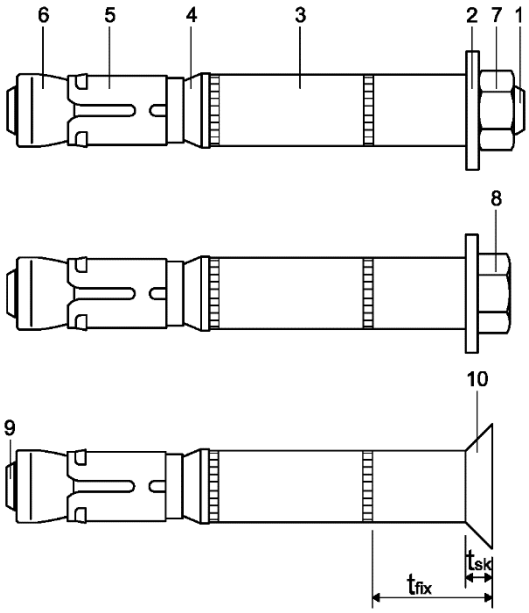


FIGURE 1—MKT SZ ANCHOR (STUD, BOLT, COUNTERSUNK)

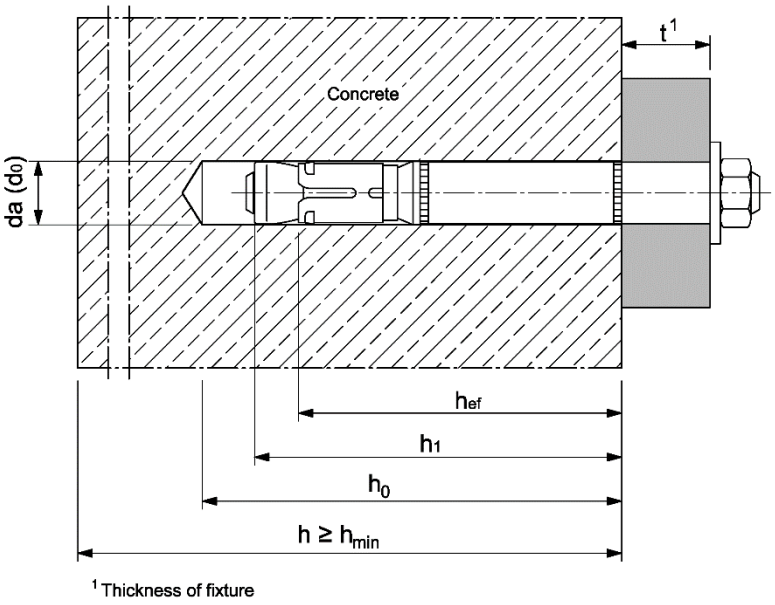


FIGURE 2—MKT SZ ANCHOR (INSTALLED)

TABLE 2A—SZ CARBON STEEL CHARACTERISTIC TENSION STRENGTH DESIGN INFORMATION[1]

CHARACTERISTIC	SYMBOL	UNITS	NOMINAL ANCHOR DIAMETER					
			M8	M10	M12	M16	M20	M24
Anchor Category	1,2 or 3	-	3	1	1	1	1	1
Embedment Depth	h_{nom}	in. (mm)	2.76 (70)	3.31 (84)	3.74 (95)	4.65 (118)	5.83 (148)	6.65 (169)
Steel Strength in Tension								
Specified Yield Strength	f_{ya}	psi (N/mm²)	92,888 (640)	92,888 (640)	92,888 (640)	92,888 (640)	92,888 (640)	92,888 (640)
Specified Tensile Strength	f_{uta}	psi (N/mm²)	116,110 (800)	116,110 (800)	116,110 (800)	116,110 (800)	116,110 (800)	116,110 (800)
Effective Tensile Stress Area	A_{se}	in² (mm²)	0.06 (36.6)	0.09 (58)	0.13 (84.3)	0.24 (156.7)	0.38 (244.8)	0.55 (352.8)
Tension Resistance of Steel	N_{sa}	lbf (kN)	6,580 (29.3)	10,427 (46.4)	15,155 (67.4)	28,171 (125.4)	44,009 (195.8)	63,486 (282.4)
Strength Reduction Factor-Steel Failure [2]	Φ_{sa}	-	0.65	0.65	0.65	0.65	0.65	0.65
Concrete Breakout Strength in Tension								
Effective Embedment Depth	h_{ef}	in. (mm)	2.4 (60)	2.8 (71)	3.1 (80)	3.94 (100)	4.92 (125)	5.92 (150)
Critical Edge Distance	c_{ac}	in. (mm)	5.2 (132)	7.0 (178)	6.3 (160)	9.1 (230)	11.3 (288)	12.2 (310)
Effectiveness Factor-Uncracked Concrete	k_{uncr}	-	24 (10)	24 (10)	24 (10)	27 (11.3)	27 (11.3)	27 (11.3)
Effectiveness Factor-Cracked Concrete	k_{cr}	-	17 (7.1)	17 (7.1)	17 (7.1)	21 (8.8)	21 (8.8)	24 (10)
Modification Factor	$\Psi_{c,N}$	-	1.0	1.0	1.0	1.0	1.0	1.0
Strength Reduction Factor-Concrete Breakout Failure [3]	Φ_{cb}	-	0.45	0.65	0.65	0.65	0.65	0.65
Pull-Out Strength in Tension								
Pull-Out Resistance Cracked Concrete (f'_c = 2,500 psi) [5]	$N_{pn,cr}$	lbf (kN)	2,911 (12.9)	N/A [4]	N/A [4]	N/A [4]	N/A [4]	N/A [4]
Pull-Out Resistance Uncracked Concrete (f'_c = 2,500 psi) [5]	$N_{pn,uncr}$	lbf (kN)	3,887 (17.3)	4,734 (21.1)	N/A [4]	N/A [4]	N/A [4]	N/A [4]
Strength Reduction Factor-Pullout Failure [6]	Φ_p	-	0.45	0.65	0.65	0.65	0.65	0.65
Tension Strength for Seismic Applications								
Tension Resistance of Single Anchor for Seismic Loads (f'_c = 2,500 psi) [5]	$N_{pn,eq}$	lbf (kN)	2,911 (12.9)	N/A [4]	N/A [4]	N/A [4]	N/A [4]	16,748 (74.5)
Strength Reduction Factor-Pullout Failure [6]	Φ_{eq}	-	0.45	0.65	0.65	0.65	0.65	0.65
Axial Stiffness in Service Load Range, Cracked Concrete [7]	β_{cr}	lb/in. (kN/mm)	145,923 (25.6)	229,946 (40.3)	143,155 (25.1)	57,102 (10)	142,754 (25)	217,714 (38.1)
Axial Stiffness in Service Load Range, Uncracked Concrete [7]	β_{uncr}	lb/in. (kN/mm)	386,670 (67.7)	455,987 (80.0)	483,412 (84.7)	114,203 (20)	485,364 (85)	1,056,000 (184.8)

For **SI:** 1 inch = 25.4mm, 1lbf = 0.00445kN, 1 lb/in = 0.175 N/mm, 1 psi = 0.00689 N/mm², 1 in² = 645 mm².

[1]The information presented in this table must be used in conjunction with the design requirements of ACI 318-19 Chapter 17.

[2]The tabulated value of ϕ_{sa} applies when the load combinations of Section 1605.1 of the 2024 IBC, or ACI 318-19 Section 5.3, are used. The anchors are brittle steel elements as defined in ACI 318-19 Section 2.3.

[3]The tabulated value of ϕ_{cb} applies when both the load combinations of Section 1605.1 of the 2024 IBC, or ACI 318-19 Section 5.3, are used and the requirements of ACI 318-19 Table 17.5.3(b) for supplementary reinforcement not present are satisfied. For installations where complying supplementary reinforcement can be verified, the ϕ_{cb} factors described in ACI 318-19 Table 17.5.3(b) for supplementary reinforcement present are allowed.

[4]As described in Section 4.1.3 of this report, N/A (Not Applicable) denotes that pullout resistance is not critical and need not be considered.

[5]For all design cases, $\Psi_{c,N}$ = 1.0. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) must be used.

[6]The tabulated value of Φ_p or Φ_{eq} applies when both the load combinations of Section 1605.1 of the 2024 IBC, or ACI 318-19 Section 5.3, are used and the requirements of ACI 318-19 Table 17.5.3(b) for supplementary reinforcement not present are satisfied. The values also apply where pullout strength governs. For installations where complying supplementary reinforcement can be verified, the Φ factors described in ACI 318-19 Table 17.5.3(b) for supplementary reinforcement present are allowed.

[7]Minimum axial stiffness values. Actual stiffness may vary depending on the concrete strength, loading and geometry of the application.

TABLE 2B—SZ A4 STAINLESS STEEL CHARACTERISTIC TENSION STRENGTH DESIGN INFORMATION[1]

CHARACTERISTIC	SYMBOL		UNITS	NOMINAL ANCHOR DIAMETER			
				M8	M10	M12	M16
Anchor Category	1, 2 or 3		-	1	1	1	1
Embedment Depth	h_{nom}		in. (mm)	2.72 (69)	3.25 (82.5)	3.72 (94.5)	4.67 (118.5)
Steel Strength in Tension							
Specified Yield Strength	f_{ya}	S	psi (N/mm²)	65,312 (450)	65,312 (450)	65,312 (450)	65,312 (450)
		B		81,277 (560)	81,277 (560)	81,277 (560)	81,277 (560)
		SK		65,312 (450)	65,312 (450)	65,312 (450)	65,312 (450)
Specified Tensile Strength	f_{uta}		psi (N/mm²)	101,600 (700)	101,600 (700)	101,600 (700)	101,600 (700)
Effective Tensile Stress Area	A_{se}		in² (mm²)	0.06 (36.6)	0.09 (58)	0.13 (84.3)	0.24 (157)
Tension Resistance of Steel	N_{sa}		lbf (kN)	5,845 (26)	9,217 (41)	13,263 (59)	24,429 (110)
Strength Reduction Factor-Steel Failure [2]	Φ_{sa}		-	0.65	0.65	0.65	0.65
Concrete Breakout Strength in Tension							
Effective Embedment Depth	h_{ef}		in. (mm)	2.4 (60)	2.8 (71)	3.1 (80)	3.94 (100)
Critical Edge Distance	c_{ac}		in. (mm)	7.1 (180)	9.3 (235)	10.4 (265)	13.0 (330)
Effectiveness Factor-Uncracked Concrete	k_{uncr}		-	24 (10.0)	24 (10.0)	24 (10.0)	27 (11.3)
Effectiveness Factor-Cracked Concrete	k_{cr}			17 (7.1)	17 (7.1)	17 (7.1)	24 (10)
Modification factor for uncracked concrete[8]	$\Psi_{c,N}$		-	1.0	1.0	1.0	1.0
Strength Reduction Factor-Concrete Breakout Failure [3]	Φ_{cb}		-	0.65	0.65	0.65	0.65
Pull-Out Strength in Tension							
Pull-Out Resistance Cracked Concrete (f'_c = 2,500 psi) [5]	$N_{pn,cr}$		lbf (kN)	2,700 (12)	3,600 (16)	N/A [4]	N/A [4]
Pull-Out Resistance Uncracked Concrete (f'_c = 2,500 psi) [5]	$N_{pn,uncr}$		lbf (kN)	3,600 (16)	5,600 (25)	N/A [4]	N/A [4]
Strength Reduction Factor-Pullout Failure [6]	Φ_p		-	0.65	0.65	0.65	0.65
Tension Strength for Seismic Applications							
Tension Resistance of Single Anchor for Seismic Loads (f'_c = 2,500 psi) [5]	$N_{pn,eq}$		lbf (kN)	2,700 (12)	3,600 (16)	5,685 (25.3)	N/A [4]
Strength Reduction Factor-Pullout Failure [6]	Φ_{eq}		-	0.65	0.65	0.65	0.65
Axial Stiffness in Service Load Range, Cracked Concrete [7]	β_{cr}		lb/in. (kN/mm)	74,200 (13)	62,800 (11)	85,600 (15)	103,000 (18)
Axial Stiffness in Service Load Range, Uncracked Concrete [7]	β_{uncr}		lb/in. (kN/mm)	285,000 (50)	211,000 (37)	114,000 (20)	365,000 (64)

For **SI:** 1 inch = 25.4mm, 1lbf = 4.45N, 1 lb/in = 0.175 N/mm, 1 psi = 6.89 Pa, 1 in² = 645 mm², 1 lb/in = 0.175 N/mm.

[1]The information presented in this table must be used in conjunction with the design requirements of ACI 318-19 Chapter 17.

[2]The tabulated value of ϕ_{sa} applies when the load combinations of Section 1605.1 of the 2024 IBC, or ACI 318-19 Section 5.3, are used. The anchors are brittle steel elements as defined in ACI 318-19 Section 2.3.

[3]The tabulated value of ϕ_{cb} applies when both the load combinations of Section 1605.1 of the 2024 IBC, or ACI 318-19 Section 5.3, are used and the requirements of ACI 318-19 Table 17.5.3(b) for supplementary reinforcement not present are satisfied. For installations where complying supplementary reinforcement can be verified, the ϕ_{cb} factors described in ACI 318-19 Table 17.5.3(b) for supplementary reinforcement present are allowed.

[4]As described in Section 4.1.3 of this report, N/A (Not Applicable) denotes that pullout resistance is not critical and does not need to be considered.

[5]The characteristic pull-out resistance for greater concrete compressive strengths may be increased by multiplying the tabular value by $(f'_c / 2{,}500)^{0.5}$ in accordance with Section 4.1.3 of this report.

[6] The tabulated value of Φ_p or Φ_{eq} applies when both the load combinations of Section 1605.1 of the 2024 IBC, or ACI 318-19 Section 5.3, are used and the requirements of ACI 318-19 Table 17.5.3(b) for supplementary reinforcement not present are satisfied. The values also apply where pullout strength governs. For installations where complying supplementary reinforcement can be verified, the Φ factors described in ACI 318-19 Section 17.5.3(b) for supplementary reinforcement present are allowed.

[7]Minimum axial stiffness value. Actual stiffness may vary depending on the concrete strength, loading and geometry of the application.

[8]For all design cases, $\Psi_{c,N}$ = 1.0. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) must be used.

TABLE 3A—SZ CARBON STEEL CHARACTERISTIC SHEAR STRENGTH DESIGN INFORMATION[1]

CHARACTERISTIC	SYMBOL	UNITS	NOMINAL ANCHOR DIAMETER													
			M8			M10			M12			M16		M20		M24	
Anchor type			B	S	SK	B	S	SK	B	S	SK	B	S	B	S	B	S
Anchor Category	1,2 or 3	-	3			1			1			1		1		1	
Embedment Depth	h_{nom}	in. (mm)	2.76 (70)			3.31 (84)			3.74 (95)			4.65 (118)		5.83 (148)		6.65 (169)	
Steel Strength in Shear																	
Shear Resistance of Steel	V_{sa}	lb (kN)	5,457 (24.3)			8,793 (39.1)			13,037 (58.0)			19,100 (85)	21,600 (96)	22,400 (100)	27,600 (123)	44,984 (200.1)	
Strength Reduction Factor-Steel Failure [2]	Φ_{sa}	-	0.6			0.6			0.6			0.6		0.6		0.6	
Concrete Breakout Strength in Shear																	
Anchor Outside Diameter	d_a (d_{nom})	in. (mm)	0.45 (11.5)			0.57 (14.5)			0.69 (17.5)			0.93 (23.5)		1.08 (27.5)		1.26 (32)	
Load Bearing Length of Anchor in Shear	l_e	in. (mm)	0.91 (23)			1.14 (29)			1.38 (35)			1.85 (47)		2.17 (55)		2.52 (64)	
Strength Reduction Factor-Concrete Breakout Failure[3]	Φ_{cb}	-	0.7			0.7			0.7			0.7		0.7		0.7	
Concrete Pryout Strength in Shear																	
Coefficient for Pryout Strength	k_{cp}	-	1			2			2			2		2		2	
Strength Reduction Factor-Concrete Pryout Failure [4]	Φ_{cp}	-	0.7			0.7			0.7			0.7		0.7		0.7	
Shear Strength for Seismic Applications																	
Shear Resistance of Single Anchor for Seismic Loads (f'_c = 2,500 psi)	$V_{sa,eq}$	lb (kN)	3,934 (17.5)			6,627 (29.5)			8,977 (39.9)			9,217 (41)		22,256 (99)		35,992 (160.1)	
Strength Reduction Factor-Steel Failure	Φ_{eq}	-	0.6			0.6			0.6			0.6		0.6		0.6	

TABLE 3B—SZ A4 STAINLESS STEEL CHARACTERISTIC SHEAR STRENGTH DESIGN INFORMATION[1]

CHARACTERISTIC	SYMBOL	UNITS	NOMINAL ANCHOR DIAMETER			
			M8	M10	M12	M16
Anchor Category	1,2 or 3	-	1	1	1	1
Embedment Depth	h_{nom}	in. (mm)	2.72 (69)	3.25 (82.5)	3.72 (94.5)	4.67 (118.5)
Steel Strength in Shear						
Shear Resistance of Steel	V_{sa}	lb (kN)	5,463 (24.3)	8,273 (36.8)	13,668 (60.8)	19,963 (88.8)
Strength Reduction Factor-Steel Failure [2]	Φ_{sa}	-	0.60	0.60	0.60	0.60
Concrete Breakout Strength in Shear						
Anchor Outside Diameter	d_a (d_{nom})	in. (mm)	0.45 (11.5)	0.57 (14.5)	0.69 (17.5)	0.93 (23.5)
Load Bearing Length of Anchor in Shear	l_e	in. (mm)	0.91 (23)	1.14 (29)	1.38 (35)	1.85 (47)
Strength Reduction Factor-Concrete Breakout Failure[3]	Φ_{cb}	-	0.7	0.7	0.7	0.7
Concrete Pryout Strength in Shear						
Coefficient for Pryout Strength	k_{cp}	-	2	2	2	2
Strength Reduction Factor-Concrete Pryout Failure [4]	Φ_{cp}	-	0.7	0.7	0.7	0.7
Shear Strength for Seismic Applications						
Shear Resistance of Single Anchor for Seismic Loads (f'_c = 2,500 psi)	$V_{sa,eq}$	lb (kN)	2,158 (9.6)	3,012 (13.4)	5,485 (24.4)	15,983 (71.1)
Strength Reduction Factor-Steel Failure	Φ_{eq}	-	0.60	0.60	0.60	0.60

For **SI:** 1 inch = 25.4mm, 1 lbf = 0.00445 kN, 1 psi = 0.00689 N/mm², 1 in² = 645 mm².

[1]The information presented in this table must be used in conjunction with the design requirements of ACI 318-19 Chapter 17.

[2]The tabulated value of ϕ_{sa} applies when the load combinations of Section 1605.1 of the 2024 IBC, or ACI 318-19 Section 5.3, are used.

[3]The tabulated value of ϕ_{cb} applies when both the load combinations of Section 1605.1 of the 2024 IBC, or ACI 318-19 Section 5.3, are used and the requirements of ACI 318-19 Table 17.5.3(b) for supplementary reinforcement not present are satisfied. For installations where complying supplementary reinforcement can be verified, the ϕ_{cb} factors described in ACI 318-19 Table 17.5.3(b) for supplementary reinforcement present are allowed.

[4]The tabulated value of Φ_{cp} applies when both the load combinations of Section 1605.1 of the 2024 IBC, or ACI 318-19 Section 5.3, are used and the requirements of ACI 318-19 Table 17.5.3(b) for supplementary reinforcement not present are satisfied. These values also apply where pryout strength governs. For installations where complying supplementary reinforcement can be verified, the Φ factors described in ACI 318-19 Table 17.5.3(b) for supplementary reinforcement present are allowed.

TABLE 4A—SZ CARBON STEEL EXAMPLE ALLOWABLE STRESS DESIGN VALUES FOR ILLUSTRATIVE PURPOSES[1,2,3,4,5,6,7]

Nominal Anchor Diameter	Embedment Depth, h_{nom} (in.)	Effective Embedment Depth, h_{ef} (in.)	Allowable Tension Load, $\Phi N_n / \alpha$ (lbf)
M8	2.76	2.4	1,182
M10	3.31	2.8	2.079
M12	3.74	3.1	2,877
M16	4.65	3.94	4,637
M20	5.83	4.92	6,470
M24	6.65	5.92	8,540

For **SI:** 1 inch = 25.4 mm, ft-lbf = 1.356 N-m, 1 lbf = 4.45 N.

[1]Single anchor with static tension load only
[2]Concrete determined to remain uncracked for the life of the anchorage
[3]Load combination from ACI 318-19 Section 5.3 (no seismic loading) with Φ_{sa} =0.65, Φ_{cb} = 0.45, and Φ_p = 0.45 (M8) and Φ_{sa} =0.65, Φ_{cb} = 0.65, and Φ_p = 0.65 (M10 – M24)
[4]30% dead load and 70% live load. Controlling load combination is 1.2*D* + 1.6*L*. Calculation of α based on weighted average: α = 0.3*1.2 + 0.7*1.6 = 1.48
[5]f'_c = 2,500 psi (normal weight concrete)
[6]$c_{a1} = c_{a2} \geq c_{ac}$
[7]$h \geq h_{min}$

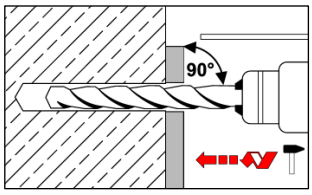
TABLE 4B—SZ A4 STAINLESS STEEL EXAMPLE ALLOWABLE STRESS DESIGN VALUES FOR ILLUSTRATIVE PURPOSES[1,2,3,4,5,6,7]

Nominal Anchor Diameter	Nominal Embedment Depth, h_{nom} (in.)	Effective Embedment Depth, h_{ef} (in.)	Allowable Tension Load, $\Phi N_n / \alpha$ (lbf)
M8	2.72	2.4	1,581
M10	3.25	2.8	2,459
M12	3.72	3.1	2,877
M16	4.67	3.94	4,637

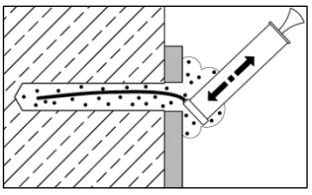
For **SI:** 1 inch = 25.4 mm, ft-lbf = 1.356 N-m, 1 lbf = 4.45 N.

[1]Single anchor with static tension load only
[2]Concrete determined to remain uncracked for the life of the anchorage
[3]Load combination from ACI 318-19 Section 5.3 (no seismic loading) with Φ_{sa} =0.65, Φ_{cb} = 0.65, and Φ_p = 0.65.
[4]30% dead load and 70 % live load. Controlling load combination is 1.2*D* + 1.6*L*. Calculation of α based on weighted average: α = 0.3*1.2 + 0.7*1.6 = 1.48
[5]f'_c = 2,500 psi (normal weight concrete)
[6]$c_{a1} = c_{a2} \geq c_{ac}$
[7]$h \geq h_{min}$

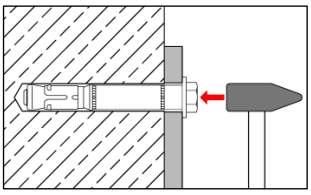
INSTALLATION INSTRUCTIONS



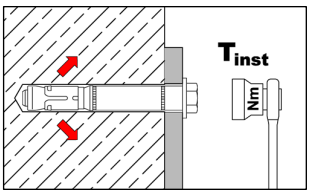
Step1:
Select the correct diameter metric drill bit, drill hole to minimum required hole depth or deeper.



Step 2:
Remove drilling debris with a blowout bulb, compressed air or vacuum.



Step 3:
Using a hammer, tap the anchor through the part being fastened into the drilled hole until the washer is in contact with the fastened part.
Do not expand anchor by hand prior to installation.



Step 4:
Using a torque wrench, apply the specified installation torque to the anchor.

TABLE 5— APPLICABLE SECTIONS OF THE IBC UNDER EACH EDITION OF THE IBC

2024 IBC	2021 IBC	2018 IBC	2015 IBC
Section 1605.1		Section 1605.2 or 1605.3	
Section 1705.1.1 and Table 1705.3			
Section 1901.3			
Sections 1903 and 1905			
Section 1905.7	Section 1905.1.8		

TABLE 6— APPLICABLE SECTIONS OF ACI 318 UNDER EACH EDITION OF THE IBC

2024 IBC	2021 IBC	2018 IBC	2015 IBC
ACI 318-19		**ACI 318-14**	
2.3		2.3	
5.3		5.3	
Chapter 17		Chapter 17	
17.5.1.2		17.3.1	
17.5.1.3		17.3.1.1	
17.5.3		17.3.3	
17.6.1		17.4.1	
17.6.1.2		17.4.1.2	
17.6.2		17.4.2	
17.6.2.1		17.4.2.1	
17.6.2.2		17.4.2.2	
17.6.2.5.1(a)		17.4.2.6	
17.6.3		17.4.3	
17.6.3.1		17.4.3.1	
17.6.3.2.1		17.4.3.2	
17.6.3.3		17.4.3.6	
17.7.1		17.5.1	
17.7.1.2		17.5.1.2	
Eq. 17.7.1.2b		Eq. 17.5.1.2b	
17.7.2		17.5.2	
17.7.2.1		17.5.2.1	
17.7.2.2.1		17.5.2.2	
17.7.3		17.5.3	
17.8		17.6	
17.9.2		17.7.1 and 17.7.3	
17.9.4		17.7.5	
17.9.5		17.7.6	
17.10		17.2.3	
17.10.3		17.2.3.3	
17.10.4, 17.10.5, 17.10.6, 17.10.7		17.2.3.4, 17.2.3.5, 17.2.3.6, 17.2.3.7	