Product Submittal/Substitution Request

TO:

PROJECT:

PROJECT LOCATION:

SPECIFIED ITEM:

Section | Page | Paragraph | Description

PRODUCT SUBMIT TAL / SUBSTITUTION REQUESTED:

DEWALT® Engineered By Powers® Bang-It+ -

The attached submittal package includes the product description, specifications, drawings, and performance data for use in the evaluation of the request.

SUBMITTED BY:

Name: Signature:

Company:

Address:

Date: Telephone: Fax:

FOR USE BY THE ARCHITECT AND/OR ENGINEER

☐ **Approved** ☐ **Approved as Noted** ☐ **Not Approved**

(If not approved, please briefly explain why the product was not accepted.)

By: Date:

Remarks:

Questions or inquiries? Contact us at engineering@powers.com, or call 1.800.524.3244

DEWALT® Bang-It+ Submittal Section:

COMPETITIVE COMPARISON

BANG-IT®+ VS. SIMPSON* BLUE BANGER (MDI)

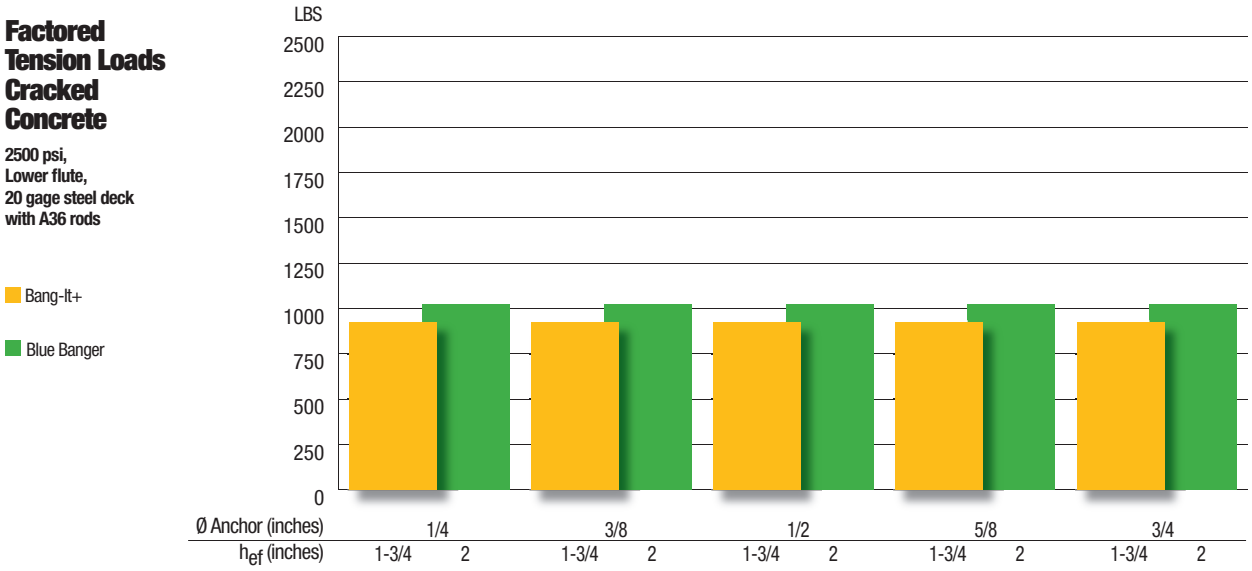
Product Comparison

Product Name	Bang-It+	Blue Banger
Company	DEWALT	Simpson*
Description	Deck Insert	Deck Insert
Size Range (inch)	1/4, 3/8, 1/2, 5/8, 3/4	1/4, 3/8, 1/2, 5/8, 3/4
ICC-ES ESR (concrete)	ESR-3657	ESR-3707
Issued	2016 Dec	2016 Jan
Cracked Concrete	Yes	Yes
Seismic Approval in Concrete	Yes	Yes

*Simpson are registered trademarks of Simpson Strong-Tie Company Inc.

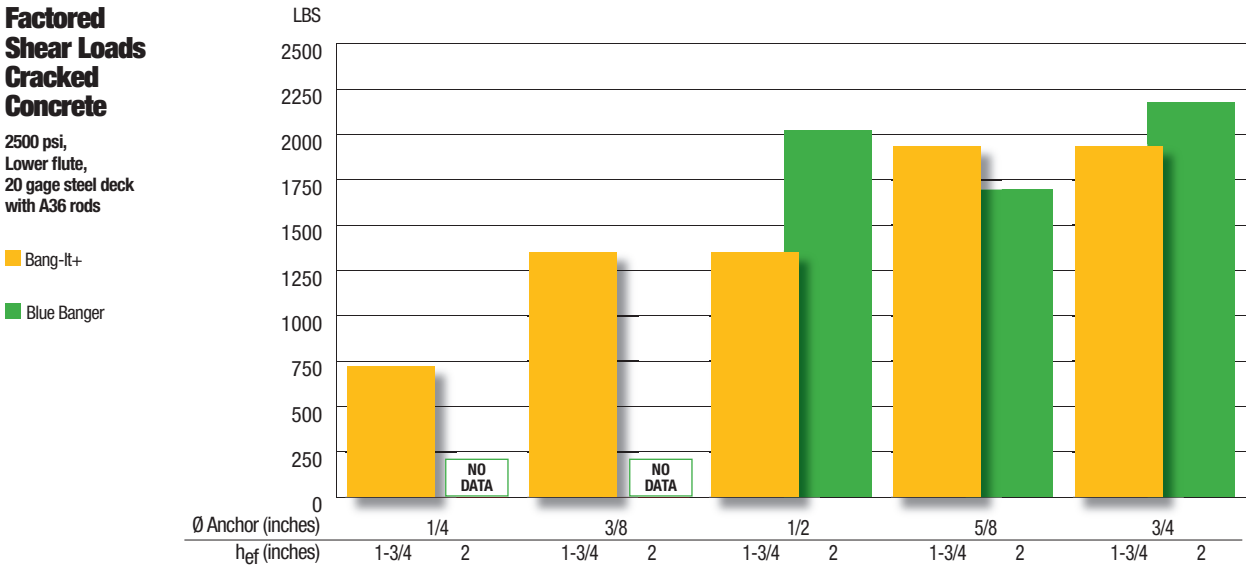
Factored Tension Loads Cracked Concrete

2500 psi, Lower flute, 20 gage steel deck with A36 rods



Factored Shear Loads Cracked Concrete

2500 psi, Lower flute, 20 gage steel deck with A36 rods



Source: ESR-3576 (Issued 2016 Dec), ESR-3707 (Issued: 2016 Jan)

COMPETITIVE COMPARISON

BANG-IT®+ VS. HILTI* KCS-MD

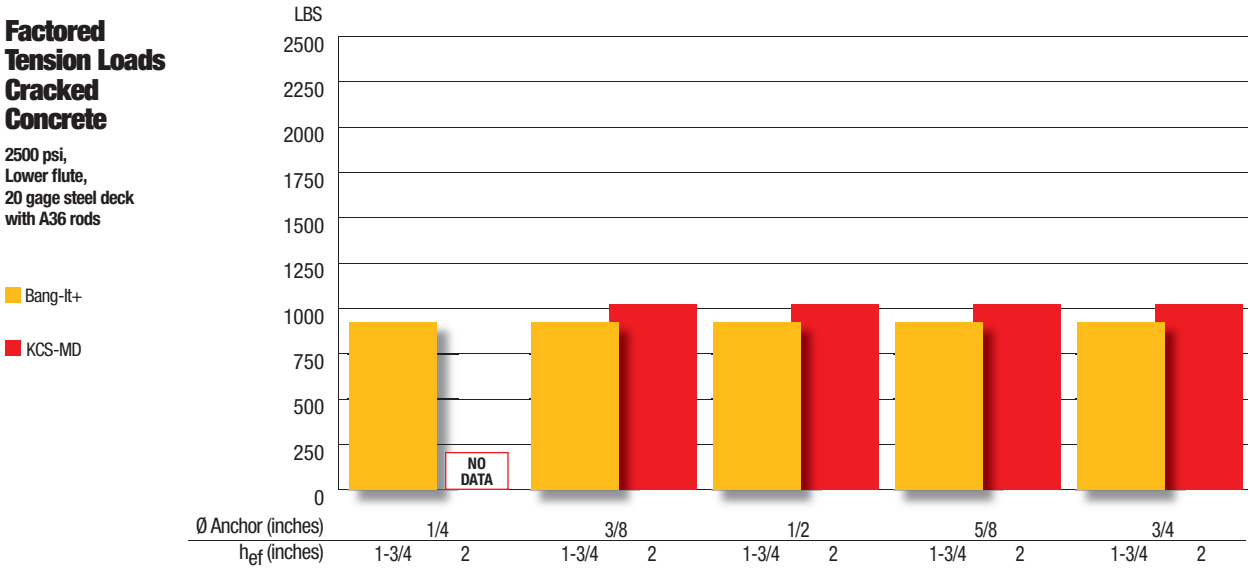
Product Comparison

Product Name	Bang-It+	KCS-MD
Company	DEWALT	Hilti*
Description	Deck Insert	Deck Insert
Size Range (inch)	1/4, 3/8, 1/2, 5/8, 3/4	3/8, 1/2, 5/8, 3/4
ICC-ES ESR (concrete)	ESR-3657	ESR-4006
Issued	2016 Dec	2016 Nov
Cracked Concrete	Yes	Yes
Seismic Approval in Concrete	Yes	Yes

* Hilti is a registered trademark of Hilti Corporation

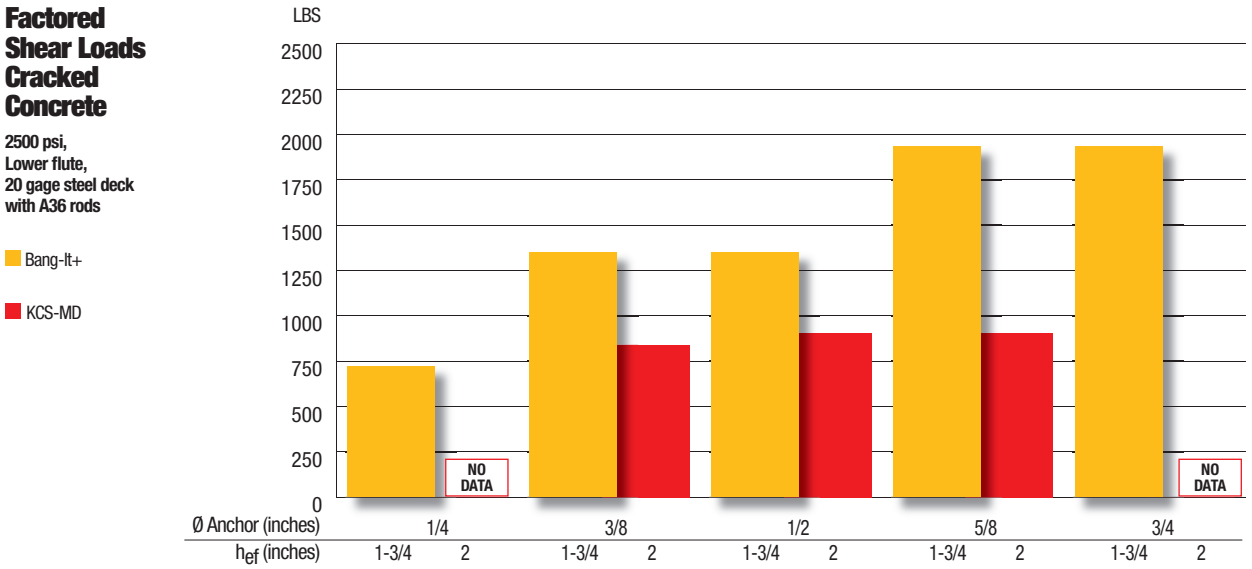
Factored Tension Loads Cracked Concrete

2500 psi, Lower flute, 20 gage steel deck with A36 rods



Factored Shear Loads Cracked Concrete

2500 psi, Lower flute, 20 gage steel deck with A36 rods



Source: ESR-3576 (Issued 2016 Dec), ESR-4006 (Issued: 2016 Nov)

GENERAL INFORMATION

BANG-IT®+

Concrete Inserts

PRODUCT DESCRIPTION

Bang-It+ concrete inserts are designed for installation in and through composite steel deck (i.e. “pan-deck”) used to support newly poured concrete floors or roof slabs.

Bang-It+ concrete inserts are specifically designed to provide hangar attachments for mechanical, electrical, plumbing (MEP) and fire protection.

After installation, the protective sleeve of the insert protrudes below the surface of the deck. The sleeves are color coded by size and allow overhead attachment of steel threaded rod in sizes ranging from 1/4" to 3/4" in diameter, including 1/4-3/8" and 3/8-1/2" multi version. The sleeve prevents sprayed fireproofing material and acoustical dampening products from clogging the internal threads of the insert. It also prevents burying, masking or losing the insert location. A hex impact plate offers resistance to rotation within the concrete as a steel threaded rod is being installed.

GENERAL APPLICATIONS AND USES

- Hanging Pipe and Sprinkler Systems
- HVAC Ductwork and Strut Channels
- Suspending Trapeze and Cable Trays
- Mechanical Unit Overhead Utilities
- Conduit and Lighting System
- Seismic Loading and Cracked Concrete

FEATURES AND BENEFITS

+ Fast and simple to install, low installed cost
+ Color coded by size for simple identification
+ Bang-It+ can be installed in upper and lower steel deck profiles with limited concrete topping thickness (see installation details)
+ Hex head does not rotate when set
+ Insert design allows for full thread engagement
+ Suitable for seismic and wind loading

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-3657 for concrete
- Code compliant with the 2018 IBC/IRC, 2015 IBC/IRC, 2012 IBC/IRC and 2009 IBC/IRC
- Tested in accordance with ASTM E488 and ICC-ES AC446 for use in cracked and uncracked concrete under the design provisions of ACI 318 (Strength Design method)
- Evaluated and qualified by an accredited independent testing laboratory for recognition in cracked and uncracked concrete
- Underwriters Laboratories (UL Listed) - File No. EX1289, see listing for sizes Also UL listed and recognized for use in air handling spaces (i.e. plenum rated locations)
- FM Approvals (Factory Mutual) – File No. J.I. 3015153

GUIDE SPECIFICATIONS

CSI Divisions: 03 15 19 - Cast-In Concrete Anchors and 03 16 00 - Concrete Anchors. Concrete inserts shall be Bang-It+ as supplied by DEWALT, Towson, MD. Anchors shall be installed in accordance with published instructions and the Authority Having Jurisdiction.

SECTION CONTENTS

BANG-IT+
STEEL DECK INSERT

ANCHOR MATERIALS

- Carbon Steel and Engineered Plastic

ROD/ANCHOR SIZE RANGE (TYP.)

- 1/4" to 3/4" threaded rod including 1/4"-3/8" and 3/8"-1/2" multi version

SUITABLE BASE MATERIALS

- Normal-weight Concrete
- Lightweight Concrete

TENSION ZONE CRACKED CONCRETE
SEISMIC REGION QUALIFICATION
CODE LISTED ICC-ES ESR-3657 CONCRETE
DDA DEWALT DESIGN ASSIST

MATERIAL SPECIFICATIONS

Bang-It+

Anchor Component	Component Material
Insert Body	AISI 1008 Carbon Steel or equivalent
Flange	AISI 1008 Carbon Steel or equivalent
Spring	Steel Music Wire
Protective Sleeve	Engineered Plastic
Zinc Plating	ASTM B 633 (Fe/Zn5) Min. Plating requirements for Mild Service Condition

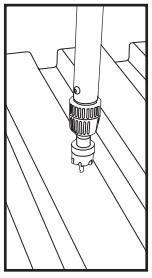
Material Properties for Threaded Rod

Steel Description	Steel Specification (ASTM)	Rod Diameter (inch)	Minimum Yield Strength, f_y (ksi)	Minimum Ultimate Strength, f_u (ksi)
Standard carbon rod	A 36 or A 307, Grade C	1/4 to 3/4	36.0	58.0
High strength carbon rod	A 193, Grade B7	1/4 to 3/4	105.0	125.0

INSTALLATION INSTRUCTIONS

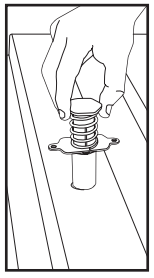
Installation Instructions for Bang-It+

Create Hole



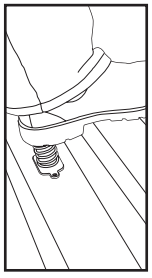
Step 1
Cut (e.g. drill/punch) a hole in the steel deck to the hole size required by the insert.

Position



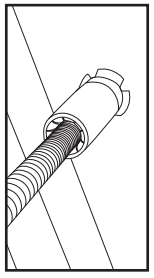
Step 2
Place the plastic sleeve of the insert through hole in steel deck.

Mount



Step 3
Step on or impact the insert head to engage. Optionally, base plate of insert can also be screwed to steel deck.

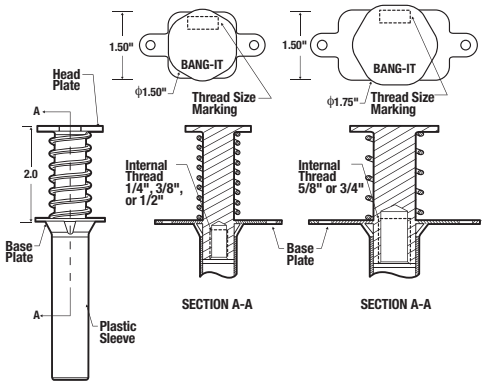
Attach



Step 4
After concrete pour and cure, install threaded steel element (rod/bolt) into the insert. Trim away plastic sleeve as needed for application and attach fixture as applicable (e.g. seismic brace).

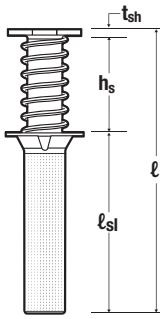
INSTALLATION SPECIFICATIONS

Bang-It+ Cast-In-Place Inserts for Concrete Filled Steel Deck Floor and Roof Assemblies



Bang-It+

Dimension	Units	Notation	Nominal Rod/Anchor Size								
			1/4-3/8" Multi"		3/8-1/2" Multi		1/4"	3/8"	1/2"	5/8"	3/4"
Thread Size, UNC	TPI	-	1/4-20	3/8-16	3/8-16	1/2-13	1/4-20	3/8-16	1/2-13	5/8-11	3/4-10
Approx. Internal Thread Length	in.	-	3/8	5/8	1/2	3/4	3/8	5/8	11/16	15/16	1-1/8
Approx. Internal Thread Projection through Deck Soffit, after setting	in.	-	0	5/8	0	3/4	3/4				
Base Plate Thickness	in.	-	1/16								
Length of Plastic Sleeve	in.	ℓ_{sl}	3-3/8								
Approx. Height of Spring	in.	h_s	1-13/16								
Steel Head Plate Thickness	in.	t_{sh}	1/8								
Overall Insert Length	in.	ℓ	5-7/16								
Metal Hole Saw Diameter	in.	-	13/16 or 7/8							1-3/16 or 1-1/4	
Sugg. Metal Hole Saw Drilling Speed	rpm	-	700-900							500-700	



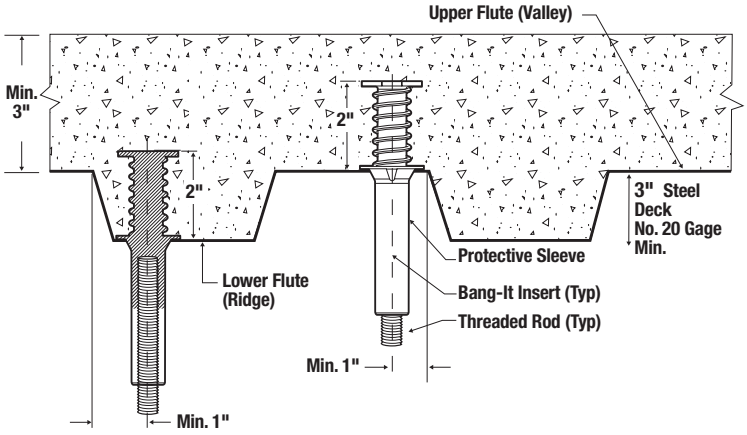
REFERENCE DATA (ASD)

Ultimate and Allowable Load Capacities for Bang-It+ Inserts Installed in Sand-Lightweight Concrete or Normal Weight over Steel Deck[1,2,3]

Rod/Insert Diameter d in.	Nominal Embedment Depth h_v in.	Flute Location in Deck	Insert Spacing in.	End Distance in.	f'c ≥ 3,000 psi			
					Ultimate Load		Allowable Load	
					Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.
1/4	2	Upper	6	6	4,450	2,500	1,115	835
		Lower			3,320	2,500	830	625
3/8	2	Upper	6	6	5,750	3,350	1,915	1,115
		Lower			3,320	3,350	830	840
1/2	2	Upper	6	6	7,110	3,350	2,370	1,115
		Lower			3,320	3,350	830	840
5/8	2	Upper	6	6	8,810	3,350	2,935	1,115
		Lower	6		3,960	3,350	990	840
3/4	2	Upper	6	6	8,810	3,350	2,935	1,115
		Lower	6		3,960	3,350	990	840

1. Allowable load capacities listed are calculated using an applied safety factor of 3.0 for installations in the upper flute and 4.0 for installations in the lower flute.
2. The allowable working load must be the lesser of the insert capacity or the steel strength of the threaded rod.
3. For 1/4", 3/8" and 1/2" Inserts:
   The allowable tension load for a single insert installed in the **upper** flute must be adjusted as follows for spacing less than 6 inches.
   When the insert are spaced 2" center-to-center across the flute the insert tension capacity must be reduced by 40 percent.
   When the insert are spaced 2" center-to-center along the flute the insert tension capacity must be reduced by 50 percent.
   The allowable tension load for a single insert installed into the **lower** flute must be adjusted as follows for spacing less than 6 inches.
   When the insert are spaced 2" center-to-center across the flute the insert tension capacity must be reduced by 30 percent.
   When the insert are spaced 2" center-to-center along the flute the insert tension capacity must be reduced by 35 percent.

Sand-Lightweight Concrete or Normal Weight Concrete over Steel Deck (Minimum 3,000 psi)



Allowable Steel Strength for Threaded Rod

Anchor Diameter d in.	Nominal Area of Rod in.²	Allowable Tension			Allowable Shear		
		ASTM A36 lbs.	ASTM A307 Grade C lbs.	ASTM A193 Grade B7 lbs.	ASTM A36 lbs.	ASTM A307 Grade C lbs.	ASTM A193 Grade B7 lbs.
1/4	0.0491	940	940	2,160	485	485	1,030
3/8	0.1104	2,115	2,115	4,375	1,090	1,090	2,255
1/2	0.1963	3,755	3,755	7,775	1,940	1,940	4,055
5/8	0.3068	5,870	5,870	12,150	3,025	3,025	6,260
3/4	0.4418	8,455	8,455	17,495	4,355	4,355	9,010

Allowable tension = f_u (A_{nom}) (0.33); Allowable shear = f_u (A_{nom}) (0.17)

STRENGTH DESIGN (SD)

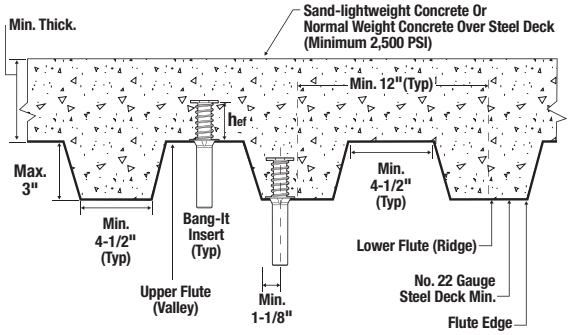
Bang-It+ Insert Design Information[1,2,3,4,5,6,7,8,9]

Design Information		Symbol	Units	1/4-inch	3/8-inch	1/2-inch	5/8-inch	3/4-inch
Insert O.D.		d_a (d_o)	in. (mm)	0.7 (18)	0.7 (18)	0.7 (18)	1.0 (25)	1.0 (25)
Insert head net bearing area		A_{brg}	in² (mm²)	1.20 (762)	1.20 (762)	1.20 (762)	1.30 (839)	1.30 (839)
Effective embedment depth		h_{ef}	in. (mm)	1.75 (45)	1.75 (45)	1.75 (45)	1.75 (45)	1.75 (45)
Minimum member thickness		h_{min}	-	See Deck Figures as applicable				
Minimum spacing and edge distances	Upper flute	s_{min}, c_{min}	-	See ACI 318 Section D.8.1 and D.8.2				
	Lower flute	s_{min}, c_{min}	-	See Deck Figures as applicable				
Effectiveness factor for cracked concrete		k_c	- (SI)	24 (10)	24 (10)	24 (10)	24 (10)	24 (10)
Modification factor for tension strength in uncracked concrete		$\Psi_{c,N}$	-	1.25	1.25	1.25	1.25	1.25
Nominal tension strength of single insert in tension as governed by steel strength (4-1/2" W-Deck, B-Deck, 3-7/8" W-Deck)		$N_{sa,insert}$	lb (kN)	10,440 (46.4)	10,440 (46.4)	8,850 (43.5)	11,985 (53.3)	11,985 (53.3)
Nominal tension strength of single insert in tension as governed by steel strength, for seismic loading (4-1/2" W-Deck, B-Deck, 3-7/8" W-Deck)		$N_{sa,insert,eq}$	lb (kN)	10,440 (46.4)	10,440 (46.4)	8,850 (43.5)	11,985 (53.3)	11,985 (53.3)
Nominal steel shear strength of single insert in the soffit of concrete on steel deck, (4-1/2" W-Deck)		$V_{sa,insert,deck}$	lb (kN)	2,280 (10.2)	2,280 (10.2)	2,280 (10.2)	3,075 (13.7)	3,075 (13.7)
Nominal steel shear strength of single insert in the soffit of concrete on steel deck, for seismic loading, (4-1/2" W-Deck)		$V_{sa,insert,deck,eq}$	lb (kN)	2,280 (10.2)	2,280 (10.2)	2,280 (10.2)	2,695 (12.0)	2,695 (12.0)
Nominal steel shear strength of single insert in the soffit of concrete on steel deck, (B-Deck, 3-7/8" W-Deck)		$V_{sa,insert,deck}$	lb (kN)	2,080 (10.2)	2,080 (10.2)	2,080 (10.2)	2,975 (13.2)	2,975 (13.2)
Nominal steel shear strength of single insert in the soffit of concrete on steel deck, for seismic loading, (B-Deck, 3-7/8" W-Deck)		$V_{sa,insert,deck,eq}$	lb (kN)	2,080 (10.2)	2,080 (10.2)	2,080 (10.2)	2,695 (12.0)	2,695 (12.0)

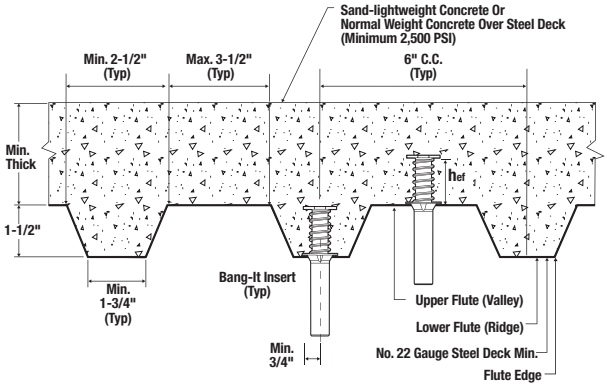
For SI: 1 inch = 25.4 mm, 1 inch² = 635 mm², 1 pound = 4.45 N, 1 psi = 0.006895 MPa. For pound-inch unit: 1 mm = 0.03937 inches.

1. Concrete must have a compressive strength f'c of 2,500 psi minimum.
2. Design of headed cast-in specialty inserts shall be in accordance with the provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D for cast-in headed anchors.
3. Strength reduction factors (ø) for the inserts are based on ACI 318-14 17.3.3 or ACI 318-11 D.4.3 for cast-in headed anchors. Condition B is assumed. Strength reduction factors for load combinations in accordance with ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2 governed by steel strength of the insert are taken as 0.65 for tension and 0.60 for shear; values correspond to brittle steel elements. The value of ø applies when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2 are used in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of ø must be determined in accordance with ACI 318-11 D4.4.
4. The concrete tension strength of headed cast-in specialty inserts in concrete filled steel deck assemblies shall be calculated in accordance with ACI 318-14 Chapter 17 or ACI 318-11 Appendix D and Deck Figures.
5. Insert O.D. is the outside diameter of the headed insert body.
6. Minimum spacing distance between anchors and minimum edge distances for anchors shall be in accordance with Deck Figures, as applicable, and noted provisions.
7. Only the largest size of threaded rod or bolt for the multi inserts (e.g. 1/2-inch diameter for 3/8- & 1/2-inch insert) must be used for applications resisting shear loads.
8. The strengths shown in the table are for inserts only. Design professional is responsible for checking threaded rod strength in tension, shear, and combined tension and shear, as applicable. See Steel Design Information table for common threaded rod elements.
9. The tabulated insert strength values are applicable to installations in the lower flute or upper flute of the steel deck profiles; see Deck Figures.

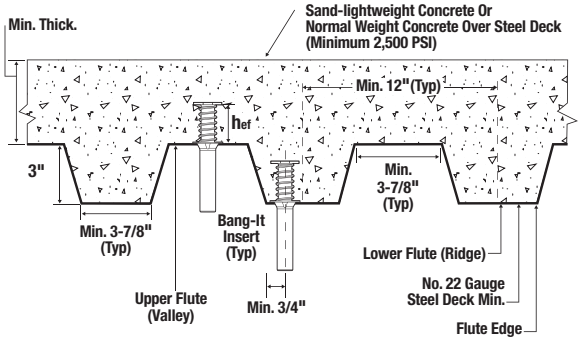
Bang-It+ Inserts Installed in Soffit of Concrete Filled Steel Deck Floor and Roof Assemblies, 4-1/2 -inch W-Deck[1,2,3,4]



Bang-It+ Inserts Installed in Soffit of Concrete Filled Steel Deck Floor and Roof Assemblies, B-Deck[1,2,3,4,5,6,7]



Bang-It+ Inserts Installed in Soffit of Concrete Filled Steel Deck Floor and Roof Assemblies, 3-7/8 -inch W-Deck[1,2,3,8]



1. Inserts may be placed in the upper flute or lower flute of the steel deck assembly. Inserts in the lower flute require a minimum 1.5" of concrete topping thickness (min. thick) from the top of the deck at the location of the installation. Upper flute installations require a minimum 3" topping thickness concrete (min. thick) from the top of the deck at the location of the installation.
2. Axial spacing for Bang-It inserts along the flute length shall be minimum $3h_{ef}$.
3. Upper flute Bang-It+ inserts are not subject to steel deck dimension limitations, or the minimum steel deck gauge limitations.
4. Inserts in the lower flute of 4-1/2-inch W-Deck may be installed with a maximum 1-1/8 -inch offset in either direction from the center of the flute. The offset distance may be increased for flute widths greater than those shown provided the minimum lower flute edge distance of 1-1/8 -inch is also satisfied.
5. Inserts in the lower flute of B-Deck may be installed with a maximum 1/8 -inch offset in either direction from the center of the flute. The offset distance may be increased for flute widths greater than those shown provided the minimum lower flute edge distance of 3/4 -inch is also satisfied.
6. Lower flute installations of B-Deck with flutes widths greater than 1-3/4 -inch are permitted.
7. Lower flute installations of B-Deck in flute depths greater than 1-1/2 -inch are permitted provided the minimum edge distance of 3/4 -inch is met and the minimum lower flute width is increased proportionally (e.g. applicable to a lower flute depth of 2-inch with a minimum lower flute width of 2-1/4 -inch).
8. Inserts in the lower flute of 3-7/8-inch W-Deck may be installed with a maximum 1-3/16 -inch offset in either direction from the center of the flute.

Specifications And Physical Properties Of Common Carbon Steel Threaded Rod Elements[1]

Threaded Rod Specification		Units	Min. Specified Ultimate Strength, F_{uta}	Min. Specified Yield Strength 0.2 Percent Offset, F_{ya}	F_{uta} — F_{ya}	Elongation Minimum Percent[5]	Reduction Of Area Min. Percent	Related Nut Specification[6]
Carbon Steel	ASTM A36/A36M[2] and F1554[3] Grade 36	psi (MPa)	58,000 (400)	36,000 (248)	1.61	23	40 (50 for A36)	ASTM A194 / A563 Grade A
	ASTM F1554[3] Grade 105	psi (MPa)	125,000 (862)	105,000 (724)	1.19	15	45	ASTM A194 / A563 Grade DH
	ASTM A193/A193M[4] Grade B7	psi (MPa)	125,000 (860)	105,000 (720)	1.19	16	50	

For SI: 1 inch = 25.4 mm, 1 psi = 0.006897 MPa. For pound-inch units: 1 mm = 0.03937 inch, 1 MPa = 145.0 psi.

1. Inserts may be used in conjunction with all grades of continuously threaded carbon steels (all-thread) that comply with code reference standards and that have thread characteristics comparable with ANSI B1.1 UNC Coarse Thread Series.
2. Standard Specification for Carbon Structural Steel.
3. Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
4. Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
5. Based on 2-inch (50 mm) gauge length except ASTM A193, which are based on a gauge length of 4d (d_{rod}).
6. Where nuts are applicable, nuts of other grades and style having specified proof load stress greater than the specified grade and style are also suitable.

Steel Design Information For Common Threaded Rod Elements Used With Concrete Inserts[1,2,3,4]

Design Information	Symbol	Units	1/4-inch	3/8-inch	1/2-inch	5/8-inch	3/4-inch
Threaded rod nominal outside diameter	d_{rod}	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)
Threaded rod effective cross-sectional area	A_{se}	in^2 (mm^2)	0.032 (21)	0.078 (50)	0.142 (92)	0.226 (146)	0.335 (216)
Nominal tension strength of ASTM A36 threaded rod as governed by steel strength	$N_{sa,rod,A36}$	lb (kN)	1,855 (8.2)	4,525 (20.0)	8,235 (36.6)	13,110 (58.3)	19,430 (86.3)
Nominal seismic tension strength of ASTM A36 threaded rod as governed by steel strength	$N_{sa,rod,A36,eq}$	lb (kN)	1,855 (8.2)	4,525 (20.0)	8,235 (36.6)	13,110 (58.3)	19,430 (86.4)
Nominal tension strength of ASTM A193, Gr. B7 threaded rod as governed by steel strength	$N_{sa,rod,B7}$	lb (kN)	4,000 (17.7)	9,750 (43.1)	17,750 (78.9)	28,250 (125.7)	41,875 (186.0)
Nominal seismic tension strength of ASTM A193, Gr. B7 threaded rod as governed by steel strength	$N_{sa,rod,B7,eq}$	lb (kN)	4,000 (17.7)	9,750 (43.1)	17,750 (78.9)	28,250 (125.7)	41,875 (186.0)
Nominal shear strength of ASTM A36 threaded rod as governed by steel strength	$V_{sa,rod,A36}$	lb (kN)	1,115 (4.9)	2,715 (12.1)	4,940 (22.0)	7,865 (35.0)	11,660 (51.9)
Nominal seismic shear strength of ASTM A36 threaded rod as governed by steel strength	$V_{sa,rod,A36,eq}$	lb (kN)	780 (3.5)	1,900 (8.4)	3,460 (15.4)	5,505 (24.5)	8,160 (36.3)
Nominal shear strength of ASTM A193, Gr. B7 threaded rod as governed by steel strength	$V_{sa,rod,B7}$	lb (kN)	2,385 (10.6)	5,815 (25.9)	10,640 (7.3)	16,950 (75.4)	25,085 (111.6)
Nominal seismic shear strength of ASTM A193, Gr. B7 threaded rod as governed by steel strength	$V_{sa,rod,B7,eq}$	lb (kN)	1,680 (7.5)	4,095 (18.2)	7,455 (34.2)	11,865 (52.8)	17,590 (78.2)

For SI: 1 inch = 25.4 mm, 1 pound = 0.00445 kN, 1 in^2 = 645.2 mm^2. For pound-inch unit: 1 mm = 0.03937 inches.

1. Values provided for steel element material types based on minimum specified strengths and calculated in accordance with ACI 318-11 Eq. (D-2) and Eq. (D-29).
2. ϕN_{sa} shall be the lower of the $\phi N_{sa,rod}$ or $\phi N_{sa,insert}$ for static steel strength in tension; for seismic loading $\phi N_{sa,eq}$ shall be the lower of the $\phi N_{sa,rod,eq}$ or $\phi N_{sa,insert,eq}$.
3. ϕV_{sa} shall be the lower of the $\phi V_{sa,rod}$ or $\phi V_{sa,insert}$ for static steel strength in tension; for seismic loading $\phi V_{sa,eq}$ shall be the lower of the $\phi V_{sa,rod,eq}$ or $\phi V_{sa,insert,eq}$.
4. Strength reduction factors shall be taken from ACI 318-14 17.3.3 or ACI 318-11 D.4.3 for steel elements. Condition B is assumed. Strength reduction factors for load combinations in accordance with ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2 governed by steel strength of the threaded rod are taken as 0.75 for tension and 0.65 for shear; values correspond to ductile steel elements. The value of ø applies when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2 are used in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of ø must be determined in accordance with ACI 318-11 D4.4.

Tension and Shear Design Strengths for Bang-It+ Inserts Installed in the Soffit of Uncracked Concrete Filled Steel Deck Floor and Roof Assemblies[1,2,3,4,5,6]

Nominal Anchor Diameter	Embed. Depth h_{ef} (in.)	Minimum Concrete Compressive Strength f'c = 3,000 psi											
		4-1/2" W-Deck				B-Deck				3-7/8" W-Deck			
		Upper Flute		Lower Flute		Upper Flute		Lower Flute		Upper Flute		Lower Flute	
		ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)
1/4	1-3/4	2,665	1,370	1,340	1,370	2,265	1,250	595	1,250	2,265	1,250	1,145	1,250
3/8	1-3/4	2,665	1,370	1,340	1,370	2,265	1,250	595	1,250	2,265	1,250	1,145	1,250
1/2	1-3/4	2,665	1,370	1,340	1,370	2,265	1,250	595	1,250	2,265	1,250	1,145	1,250
5/8	1-3/4	2,665	1,845	1,340	1,845	2,265	1,785	595	1,785	2,265	1,785	1,145	1,785
3/4	1-3/4	2,665	1,845	1,340	1,845	2,265	1,785	595	1,785	2,265	1,785	1,145	1,785

- Anchor Pullout/Pryout Strength Controls - Concrete Breakout Strength Controls - Steel Strength Controls

Tension and Shear Design Strengths for Bang-It+ Inserts Installed in the Soffit of Cracked Concrete Filled Steel Deck Floor and Roof Assemblies[1,2,3,4,5,6]

Nominal Anchor Diameter	Embed. Depth h_{ef} (in.)	Minimum Concrete Compressive Strength f'c = 3,000 psi											
		4-1/2" W-Deck				B-Deck				3-7/8" W-Deck			
		Upper Flute		Lower Flute		Upper Flute		Lower Flute		Upper Flute		Lower Flute	
		ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)
1/4	1-3/4	1,810	1,370	1,070	1,370	1,810	1,250	475	1,250	1,810	1,250	915	1,250
3/8	1-3/4	1,810	1,370	1,070	1,370	1,810	1,250	475	1,250	1,810	1,250	915	1,250
1/2	1-3/4	1,810	1,370	1,070	1,370	1,810	1,250	475	1,250	1,810	1,250	915	1,250
5/8	1-3/4	1,810	1,845	1,070	1,845	1,810	1,785	475	1,785	1,810	1,785	915	1,785
3/4	1-3/4	1,810	1,845	1,070	1,845	1,810	1,785	475	1,785	1,810	1,785	915	1,785

- Anchor Pullout/Pryout Strength Controls - Concrete Breakout Strength Controls - Steel Strength Controls

1- Tabular values are provided for illustration and are applicable for single anchors installed in sand-lightweight concrete with minimum slab thickness, $h_a = h_{min}$, and with the following conditions:
- c_{a1} is greater than or equal to the critical edge distance, c_{ac}.
- c_{a2} is greater than or equal to 1.5 times c_{a1}.

2- Calculations were performed following methodology in ACI 318-14 Chapter 17 or ACI 318-11 Appendix D. The load level corresponding to the failure mode listed [steel strength of insert ($N_{sa,insert}$, $V_{sa,insert}$), concrete breakout strength, or pryout strength] must be checked against the tabulated steel strength of the corresponding threaded rod type, ($N_{sa,rod}$, $V_{sa,rod}$), the lowest load level controls.

3- Strength reduction factors shall be taken from ACI 318-14 17.3.3 or ACI 318-11 D.4.3 for cast-in headed anchors. Condition B is assumed. Strength reduction factors for load combinations in accordance with ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2 governed by steel strength of the insert are taken as 0.65 for tension and 0.60 for shear; values correspond to brittle steel elements.Tabular values are permitted for short-term static loads only, seismic loading is not considered with these tables.

4- For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-14 Chapter 17 or ACI 318-11 Appendix D.

5- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths please see ACI 318-14 Chapter 17 or ACI 318-11 Appendix D and information contained in this product supplement. For other design conditions including seismic considerations please see ACI 318-14 Chapter 17 or ACI 318-11 Appendix D.

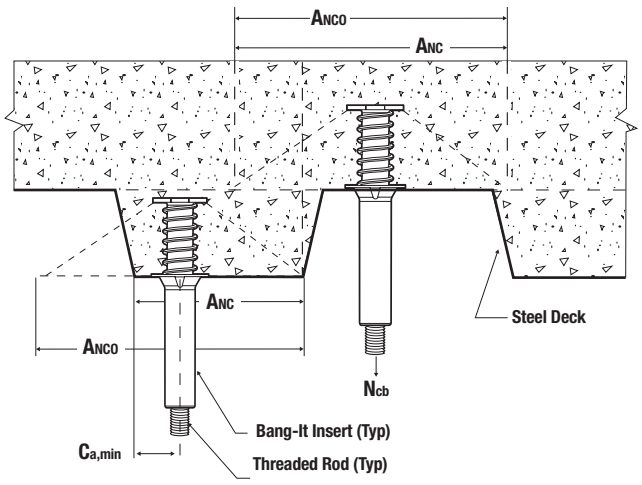
Tension and Shear Design Strength of Steel Elements (Steel Strength)[1,2,3,4]

Nominal Rod Diameter (in.)	Steel Elements - Threaded Rod			
	ASTM A36 and ASTM F1554 Grade 36		ASTM A193 Grade B7 and ASTM F1554 Grade 105	
	$\phi N_{sa,rod}$ Tension (lbs.)	$\phi V_{sa,rod}$ Shear (lbs.)	$\phi N_{sa,rod}$ Tension (lbs.)	$\phi V_{sa,rod}$ Shear (lbs.)
1/4	1,390	720	3,000	1,550
3/8	3,395	1,750	7,315	3,780
1/2	6,175	3,210	13,315	6,915
5/8	9,835	5,115	21,190	11,020
3/4	14,550	7,565	31,405	16,305

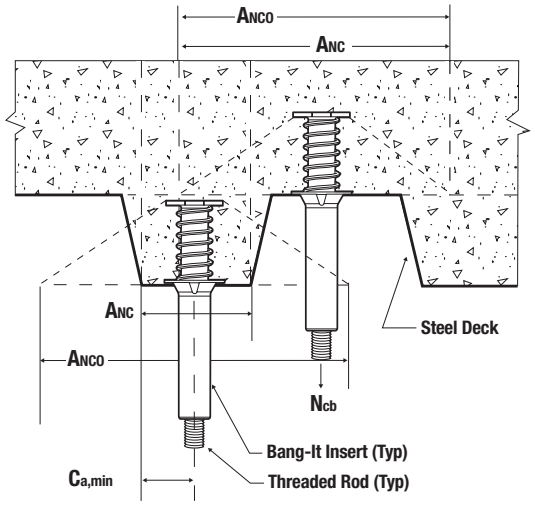
- Steel Strength Controls

1. Steel tensile design strength according to ACI 318 Appendix D and ACI 318 Chapter 17, $\phi N_{sa} = \phi \bullet A_{se,N} \bullet f_{uta}$
2. The tabulated steel design strength in tension for the threaded rod must be checked against the design strength of the steel insert, concrete breakout and pullout design strength to determine the controlling failure mode, the lowest load level controls.
3. Steel shear design strength according to ACI 318 Appendix D and ACI 318 Chapter 17, $\phi N_{sa} = \phi \bullet 0.60 \bullet A_{se,N} \bullet f_{uta}$
4. The tabulated steel design strength in shear for the threaded rod must be checked against the design strength of the steel insert, concrete breakout and pryout design strength to determine the controlling failure mode, the lowest load level controls.

Idealization of Concrete Filled Steel Decks for Determination of Concrete Breakout Strength in Accordance with ACI 318



Idealization of Standard Steel Deck Profiles

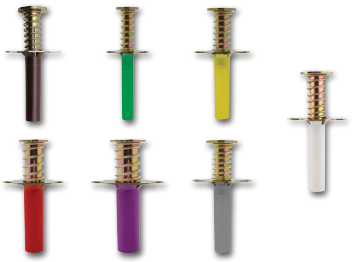


Idealization of B Deck Steel Deck Profiles

ORDERING INFORMATION

Bang-It®+ Steel Deck Insert (UNC internal thread)

Cat.No.	Description	Color Code	Pre-Drilled Hole	Std. Qty.
7540	1/4" Bang-It+	Brown	13/16" or 7/8"	100
7542	3/8" Bang-It+	Green	13/16" or 7/8"	100
7544	1/2" Bang-It+	Yellow	13/16" or 7/8"	100
7546	5/8" Bang-It+	Red	1-3/16" or 1-1/4"	50
7548	3/4" Bang-It+	Purple	1-3/16" or 1-1/4"	50
7543	3/8-1/2" Bang-It+ Multi Insert	Gray	13/16" or 7/8"	100
PFM3521438	1/4-3/8" Bang-It+ Multi Insert	White	13/16" or 7/8"	100
Inserts are color coded to easily identify location and diameter of the internally threaded coupling.				



Bang-It®+ Installation Accessories

Cat.No.	Description	Std. Qty.
7560	Bang-It Stand Up Pole tool	1
7562	13/16" Carbide Hole Saw for 1/4", 3/8" and 1/2" sizes	1
7564	1-3/16" Carbide Hole Saw for 5/8", 3/4" and 7/8" sizes	1
D180014IR	7/8" (22mm) Impact Ready® Hole Saw	1
D180020IR	1-1/4" (32mm) Impact Ready® Hole Saw	1
7566	Extra Carbide Hole Saw Center Bit	1
DWA1786IR	3/16" - 7/8" Impact Ready® Step Drill Bit	1
DWA1789IR	7/8" - 1-1/8" Impact Ready® Step Drill Bit	1
DCD980M2	20V Max* Lithium Ion Premium 3-Speed Drill/Driver Kit (4.0 Ah)	1
DWD220	1/2" VSR Pistol Grip Drill With E-Clutch Anti-Lock Control	1

ICC-ES Evaluation Report

ESR-3657

Reissued December 2018
Revised September 2019
This report is subject to renewal December 2019.

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DIVISION: 03 00 00—CONCRETE
Section: 03 15 19—Cast-In Concrete Anchors
Section: 03 16 00—Concrete Anchors

REPORT HOLDER:

DEWALT

EVALUATION SUBJECT:

WOOD-KNOCKER® II+ AND PAN-KNOCKER™ II+ CONCRETE INSERTS FOR FORMS AND BANG-IT®+ CONCRETE INSERTS FOR STEEL DECK IN CRACKED AND UNCRACKED CONCRETE (DEWALT)

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2018, 2015, 2012, and 2009 *International Building Code®* (IBC)
- 2018, 2015, 2012, and 2009 *International Residential Code®* (IRC)

For evaluation for compliance with the *National Building Code of Canada®* (NBCC), see listing report ELC-3657.

For evaluation for compliance with codes adopted by the Los Angeles Department of Building and Safety (LADBS), see ESR-3657 LABC and LARC Supplement.

Properties evaluated:

Structural

2.0 USES

The Wood-Knocker II+ and Pan-Knocker II+ concrete inserts are used as anchorage to resist static, wind, and seismic tension and shear loads in cracked and uncracked normal-weight concrete, sand-lightweight, and all-lightweight concrete having a specified compressive strength, f'_c, of 2,500 psi to 10,000 psi (17.2 MPa to 68.9 MPa).

The Bang-It+ steel deck concrete inserts are used to resist static, wind, and seismic tension and shear loads in the soffit of cracked and uncracked normal-weight concrete and sand-lightweight concrete on steel deck having a specified compressive strength, f'_c, of 2,500 psi to 10,000 psi (17.2 MPa to 68.9 MPa).

There are eleven models for the Wood-Knocker II+ inserts; eight fractional and three metric: $^1/_4$-inch, $^1/_4$ & $^3/_8$-inch multi, $^1/_4$ & $^3/_8$ & $^1/_2$-inch multi, $^3/_8$-inch, $^3/_8$ & $^1/_2$-inch multi, $^1/_2$-inch, $^5/_8$-inch, $^3/_4$-inch, M10, M10 & M12 multi, and M12 corresponding to the sizes of the threaded rods or bolts used for the inserts.

There are four models for the Pan-Knocker II+ inserts; three fractional and one metric: $^1/_4$ & $^3/_8$-inch multi, $^1/_4$ & $^3/_8$ & $^1/_2$-inch multi, $^3/_8$ & $^1/_2$-inch multi and M10 & M12 multi, corresponding to the sizes of the threaded rods or bolts used for the inserts.

There are ten models for the Bang-It+ inserts; seven fractional and three metric: $^1/_4$-inch, $^1/_4$ & $^3/_8$-inch multi, $^3/_8$-inch, $^3/_8$ & $^1/_2$-inch multi, $^1/_2$-inch, $^5/_8$-inch, $^3/_4$-inch, M10, M10 & M12 multi, and M12 corresponding to the sizes of the threaded rods or bolts used for the inserts.

Inserts denoted as 'multi' have an internal step thread and can accept more than one size of threaded rod or bolt, depending on the insert. For inserts that can accept multiple rod or bolt sizes, applications designed to resist shear loads must use the largest diameter threaded rod or bolt.

Reference to "inserts" in this report refers to the headed cast-in specialty anchorage products (Wood-Knocker II+, Pan-Knocker II+, and Bang-It+) used in concrete; reference to "steel elements" refers to threaded rods or bolts; reference to "anchors" in this report refers to the installed inserts in concrete with threaded rods or bolts.

The inserts are alternatives to cast-in anchors described in Section 1901.3 of the 2018 and 2015 IBC, Sections 1908 and 1909 of the 2012 IBC and Sections 1911 and 1912 of the 2009 IBC. The anchors may be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 Wood-Knocker II+, Pan-Knocker II+ and Bang-It+ Inserts:

The Wood-Knocker II+ and Pan-Knocker II+ inserts are cast-in concrete form inserts. The inserts consists of a steel internally threaded headed insert (body) and an outer plastic sleeve. The Wood-Knocker II+ also has nails used to attach the insert to the inside surface of concrete formwork, and the Pan-Knocker II+ is attached to the form without nails (e.g. using screws). The inserts are illustrated in Figure 1A, 1B and Figure 6. The internally threaded inserts are manufactured from low carbon steel. The inserts have minimum 5 µm (0.002-inch) zinc plating, except for the plastic sleeve which is fabricated from polypropylene.

The Bang-It+ steel deck inserts are cast-in concrete inserts. The insert consists of a steel internally threaded

headed insert (body), an outer spring, a plastic sleeve and a washer (base plate). The insert is illustrated in Figure 2 and Figure 6. The internally threaded insert and washer are manufactured from low carbon steel. The spring is manufactured from steel music wire. The Bang-It+ inserts have a minimum 5 µm (0.002-inch) zinc plating except for the the plastic sleeve which is fabricated from polypropylene.

The anchor assembly is comprised of a Wood-Knocker II+, Pan-Knocker II+ or Bang-It+ insert with a threaded steel element (e.g. rod or bolt). The Wood-Knocker II+ insert is installed on the inside surface of wood formwork and the head driven down until it comes into contact with the plastic sleeve and the nails enter the form. The Pan-Knocker II+ insert is installed on the inside surface of formwork and attached to the form with the insert base (e.g. using screws). The Bang-It+ insert is installed in a predrilled hole in the topside of the metal deck, and impacted with sufficient force to compress the spring and drive the flared plastic fins of the sleeve completely through the hole. Concrete can then be cast over the inserts.

3.2 Steel Elements:

3.2.1 Threaded Steel Rods and Bolts: Threaded steel rods (all-thread) or bolts must be threaded on their embedded end in diameters as described in Table 5 of this report. Specifications for grades of common threaded rod or bolts, including the mechanical strength properties are described in Table 4 of this report. Carbon steel threaded rods or bolts may be furnished with a minimum 0.0002-inch-thick (5 µm) zinc plating.

3.2.2 Ductility: In accordance with ACI 318 D.1, in order for a steel anchor element to be considered ductile, the tested elongation must be at least 14 percent and the reduction of area must be at least 30 percent. Steel elements with a tested elongation of less than 14 percent or a reduction of area less than 30 percent, or both, are considered brittle. Values for common steel threaded rod elements are provided in Tables 4 and 5 of this report. Where values are nonconforming or unstated, the steel element must be considered brittle

3.3 Concrete:

Normal-weight, sand-lightweight, and all-lightweight concrete must conform to Sections 1903 and 1905 of the IBC.

3.4 Steel Deck Panels:

Steel deck panels must be in accordance with the configuration in Figures 4A, 4B and 4C and have a minimum base steel thickness of 22 gage [0.034 inch (0.864 mm)]. Steel must comply with ASTM A653/A653M SS Grade 33 minimum and have a minimum yield strength of 33,000 psi (228 MPa).

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General: Design strength of anchors complying with the 2018 and 2015 IBC as well as Section R301.1.3 of the 2018 and 2015 IRC must be determined in accordance with ACI 318-14 Chapter 17 and this report.

Design strength of anchors complying with the 2012 IBC as well as Section R301.1.3 of the 2012 IRC, must be determined in accordance with ACI 318-11 Appendix D and this report.

Design strength of anchors complying with the 2009 IBC and Section R301.1.3 of the 2009 IRC must be determined in accordance with ACI 318-08 Appendix D and this report.

Design parameters provided in Tables 2, 3, and 5 of this report are based on the 2018 and 2015 IBC (ACI 318-14) and the 2012 IBC (ACI 318-11), as applicable, unless noted otherwise in Sections 4.1.1 through 4.1.12. The strength design of anchors must comply with ACI 318-14 17.3.1 or ACI 318-11 D.4.1, as applicable, except as required in ACI 318-14 17.2.3 or ACI 318 D.3.3, as applicable.

Strength reduction factors, ϕ, as given in ACI 318-14 17.3.3 and ACI 318-11 D.4.3, as applicable, for cast-in headed anchors, must be used for load combinations calculated in accordance with Section 1605.2 of the IBC, Section 5.3 of ACI 318-14 and Section 9.2 of ACI 318-11. Strength reduction factors, ϕ, as given in ACI 318-11 D.4.4 must be used for load combinations calculated in accordance with ACI 318-11 Appendix C. An example calculation in accordance with the 2012 IBC is provided in Figure 9. The value of f'_c used in the calculations must be limited to a maximum of 10,000 psi (68.9 MPa), in accordance with ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable.

The pullout strength in tension is not decisive for design and does not need to be evaluated.

4.1.2 Requirements for Static Steel Strength in Tension: The nominal static steel strength in tension, N_{sa}, of a single anchor must be calculated in accordance with ACI 318-14 17.4.1 or ACI 318-11 Section D.5.1, as applicable, for the threaded steel element, $N_{sa,rod}$, as illustrated in Table 5 of this report. The lesser of $\phi N_{sa,rod}$ in Table 5 or $\phi N_{sa,insert}$ provided in Tables 2 and 3 shall be used as the steel strength in tension.

4.1.3 Requirements for Static Concrete Breakout Strength in Tension: For the Wood-Knocker II+, Pan-Knocker II+, and Bang-It+ anchors, the nominal concrete breakout strength of a single anchor or group of anchors in tension, N_{cb} or N_{cbg}, respectively, must be calculated in accordance with ACI 318-14 17.4.2 or ACI 318-11 D.5.2 as applicable for cast-in headed bolts, with modifications as described in this section, and with Figures 3, 4A, 4B and 4C of this report, as applicable. The basic concrete breakout strength in tension, N_b, must be calculated in accordance with ACI 318-14 17.4.2.2 or ACI 318-11 D.5.2.2, as applicable, using the values of h_{ef} given in Tables 2 and 3, and with k_c = 24. The nominal concrete breakout strength in tension in regions where analysis indicates no cracking in accordance with ACI 318-14 17.4.2.6 or ACI 318-11 D.5.2.6, as applicable, must be calculated with $\Psi_{c,N}$ = 1.25. For the Bang-It+ inserts installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck assemblies, the contribution of the steel deck strength must be ignored and the calculation of A_{Nc} / A_{Nco} in accordance with ACI 318-14 17.4.2.1 or ACI 318-11 D.5.2.1, as applicable, and $c_{a,min}$ (minimum edge distance) must be based on Figures 4A, 4B and 4C.

4.1.4 Requirements for Static Side-Face Blowout Strength in Tension: For the Wood-Knocker II+ and Pan-Knocker II+ anchors, the nominal side-face blowout strength of a headed insert, N_{sb}, must be calculated in accordance with ACI 318-14 17.4.4.1 or ACI 318-11 D.5.4.1, as applicable, for the cast-in headed insert, in cracked and uncracked concrete, as applicable.

For the Bang-It+ anchors installed in the soffit of sand-lightweight or normal-weight concrete on steel deck floor

and roof assemblies as shown in Figures 4A, 4B and 4C, calculation of the concrete side blowout strength is not required.

4.1.5 Requirements for Static Steel Strength in Shear: For Wood-Knocker II+ and Pan-Knocker II+ anchors, the nominal static steel strength in shear, V_{sa}, of a single anchor must be taken as the threaded steel element strength, $V_{sa,rod}$, given in Table 5 of this report. The lesser of $\phi V_{sa,rod}$ in Table 5 or $\phi V_{sa,insert}$ in Table 2 shall be used as the steel strength in shear, and must be used in lieu of the values derived by calculation from ACI 318-14 Eq. 17.5.1.2a or 17.5.1.2b; or ACI 318-11 Eq. D-28 or D-29, as applicable.

For Bang-It+ anchors, the nominal static steel strength in shear, $V_{sa,deck}$, of a single Bang-It+ insert, in the lower flute and upper flute of concrete filled steel deck assemblies, must be taken as the threaded steel element strength, $V_{sa,rod}$, given in Table 5 of this report. The lesser of $\phi V_{sa,rod}$ in Table 5 or $\phi V_{sa,insert,deck}$ in Table 3 shall be used as the steel strength in shear, and must be used in lieu of the values derived by calculation from ACI 318-14 Eq. 17.5.1.2a or 17.5.1.2b; or ACI 318-11 Eq. D-28 or D-29, as applicable.

4.1.6 Requirements for Static Concrete Breakout Strength in Shear: For Wood-Knocker II+ and Pan-Knocker II+ anchors, the nominal concrete breakout strength of a single anchor or group of anchors in shear, V_{cb} or V_{cbg}, respectively, must be calculated in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable. The basic concrete breakout strength, V_b, must be calculated in accordance with ACI 318-14 17.5.2.2 or ACI 318-11 D.6.2.2, as applicable, based on the values provided in Table 1. The value of ℓ_e used in ACI 318-14 Eq. 17.5.2.2a or ACI 318-11 Eq. D-33, as applicable, must be taken as no greater than the lesser of h_{ef} or $8d_a$.

For the Bang-It+ anchors installed in the soffit of sand-lightweight or normal-weight concrete on steel deck floor and roof assemblies, as shown in Figures 4A, 4B and 4C, the breakout strength in shear need not be calculated.

4.1.7 Requirements for Static Concrete Pryout Strength in Shear: For Wood-Knocker II+ and Pan-Knocker II+ anchors, the nominal concrete pryout strength of a single anchor or group of anchors, V_{cp} or V_{cpg}, respectively, must be calculated in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable.

For the Bang-It+ anchors installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck assemblies, as shown in Figures 4A, 4B and 4C, calculation of the concrete pry-out strength in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, is not required.

4.1.8 Requirements for Seismic Design:

4.1.8.1 General: For load combinations including seismic, the design must be performed in accordance with ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable. Modifications to ACI 318-14 17.2.3 shall be applied under Section 1905.1.8 of the 2018 or 2015 IBC. For the 2012 IBC, Section 1905.1.9 shall be omitted. Modifications to ACI 318-08 D.3.3 shall be applied under Section 1908.1.9 of the 2009 IBC. The anchors may be installed in Seismic Design Categories A through F of the IBC.

For Wood-Knocker II+ and Pan-Knocker II+ anchors, the nominal concrete breakout strength and nominal concrete side-face blowout strength for anchors in tension; and the nominal concrete breakout strength and pryout strength in shear, must be calculated in accordance with ACI 318-14 17.4 and 17.5 or ACI 318-11 D.5 and D.6, as applicable.

For Bang-It+ anchors, the nominal concrete breakout strength for anchors in tension must be calculated in accordance with ACI 318-14 17.4 or ACI 318-11 D.5, as applicable.

4.1.8.2 Seismic Tension: For Wood-Knocker II+ and Pan-Knocker II+ anchors, the nominal steel strength in tension, N_{sa}, of a single anchor must be calculated in accordance with ACI 318-14 17.4.1 or ACI 318-11 D.5.1, as applicable, for the threaded steel element, $N_{sa,rod,eq}$, as given in Table 5, not to exceed the corresponding values of $N_{sa,insert,eq}$ in Table 2 of this report; the nominal concrete breakout strength for anchors in tension must be calculated in accordance with ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, as described in Section 4.1.3 of this report; the nominal concrete side-face blowout strength must be calculated in accordance with ACI 318-14 17.4.4.1 and 17.4.4.2 or ACI 318-11 D.5.4.1 and D.5.4.2, as applicable, and Section 4.1.4 of this report.

For Bang-It+ anchors, the nominal steel strength in tension, N_{sa}, of a single anchor must be calculated in accordance with ACI 318-14 17.4.1 or ACI 318-11 D.5.1, as applicable, for the threaded steel element, $N_{sa,rod,eq}$, as given in Table 5, not to exceed the corresponding values of $N_{sa,insert,eq}$ in Table 3 of this report; the nominal concrete breakout strength for anchors in tension must be calculated in accordance with ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, as described in Section 4.1.3 of this report; the nominal concrete pullout strength calculations in accordance with ACI 318-14 17.4.3.1 and 17.4.3.4 or ACI 318-11 D.5.3.1 and D.5.3.4, as applicable, are not required.

4.1.8.3 Seismic Shear: For Wood-Knocker II+ and Pan-Knocker II+ anchors, the nominal concrete breakout strength and pryout strength in shear must be calculated in accordance with ACI 318-14 17.5.2 and 17.5.3 or ACI 318-11 D.6.2 and D.6.3, as applicable, as described in Sections 4.1.6 and 4.1.7 of this report. In accordance with ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable, the nominal steel strength for seismic loads, $V_{sa,eq}$, must be taken as the threaded steel element strength, $V_{sa,rod,eq}$, given in Table 5 of this report, not to exceed the corresponding values of $V_{sa,insert,eq}$, in Table 2.

For Bang-It+ anchors, the nominal concrete breakout strength and pryout strength in shear, calculations in accordance with ACI 318-14 17.5.2 and 17.5.3 or ACI 318-11 D.6.2 and D.6.3, as applicable, as described in Sections 4.1.6 and 4.1.7 of this report, are not required. In accordance with ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable, the nominal steel strength for seismic loads, $V_{sa,eq}$, must be taken as the threaded steel element strength, $V_{sa,rod,eq}$, given in Table 5 of this report, not to exceed the corresponding values of $V_{sa,insert,eq,deck}$, in Table 3, for lower flute or upper flute of the concrete filled steel deck assembly, as applicable.

4.1.9 Requirements for Interaction of Tensile and Shear Forces: For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-14 17.6 or ACI 318-11 D.7, as applicable.

Due to the projection of the internally-threaded end of the Bang-It+ insert when installed in concrete filled steel deck assemblies (approximately $^3/_4$-inch), for anchors or groups of anchors that are subject to the effects of combined tension and shear forces, the design engineer must verify

the validity of the interaction equation in ACI 318-14 17.6 or ACI 318-11 D.7, as applicable.

4.1.10 Requirements for Minimum Member Thickness, Minimum Anchor Spacing and Minimum Edge Distance: Requirements on headed cast-in specialty anchor edge distance, spacing, member thickness, and concrete strength must be in accordance with the requirements in ACI 318 as applicable for cast-in bolts.

For Bang-It+ anchors installed in the soffit of sand-lightweight or normal-weight concrete over profile steel deck floor and roof assemblies, the anchors must be installed in accordance with Figures 4A, 4B and 4C and shall have a minimum axial spacing along the flute in accordance with Table 3.

4.1.11 Requirements for Critical Edge Distance: The critical edge distance, c_{ac}, must be calculated in accordance with ACI 318-14 17.7.2 or ACI 318-11 D.8.2, as applicable. The modification factor $\Psi_{cp,N}$ = 1.0 in accordance with ACI 318-14 17.4.2.5 or ACI 318-11 D.5.2.5, as applicable.

4.1.12 Sand-lightweight Concrete: For ACI 318-14, 318-11 and 318-08, when the Wood-Knocker II+ and Pan-Knocker II+ anchors are used in sand-lightweight or all-lightweight concrete, the modification factor λ_a or λ, respectively, for concrete breakout strength must be taken as 0.85 for sand-lightweight or 0.75 for all-lightweight according to ACI 318-14 17.2.6 (2018 and 2015 IBC), ACI 318-11 D.3.6 (2012 IBC) or ACI 318-08 D.3.4 (2009 IBC).

For Bang-It+ anchors in the soffit of sand-lightweight concrete-filled steel deck, λ_a or λ shall be taken as 0.85 and applied to the concrete breakout strength in tension only as applicable. Values are shown in Table 3 and installation details are shown in Figures 4A, 4B and 4C.

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 1605.3 of the IBC, must be established as follows:

$$T_{allowable,ASD} = \frac{\phi N_n}{\alpha}$$

$$V_{allowable,ASD} = \frac{\phi V_n}{\alpha}$$

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 318-14 Chapter 17 and 2018 or 2015 IBC Section 1905.1.8, ACI 318-11, -08 Appendix D, and 2009 IBC Section 1908.1.9, as applicable (lbf or N). For the 2012 IBC, Section 1905.1.9 shall be omitted.

ϕV_n = Lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318-14 Chapter 17 and 2018 or 2015 IBC Section 1905.1.8, ACI 318-11, -08 Appendix D, and 2009 IBC Section 1908.1.9, as applicable (lbf or N). For the 2012 IBC, Section 1905.1.9 shall be omitted.

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 non-ductile failure modes and required over-strength.

The requirements for member thickness, edge distance and spacing, described in this report, must apply. Examples of allowable stress design values for tension and shear for illustrative purposes are shown in Tables 6 through 9. The values presented in Tables 6 through 9 are only valid when all of the conditions given in the footnotes to the respective tables are applicable.

4.2.2 Interaction of Tensile and Shear Forces: For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-14 17.6 or ACI 318-11, -08 D.7, as applicable, as follows:

For shear loads $V_{applied} \leq 0.2V_{allowable,ASD}$, the full allowable load in tension must be permitted.

For tension loads $T_{applied} \leq 0.2T_{allowable,ASD}$, the full allowable load in shear must be permitted.

For all other cases:

$$\frac{T_{applied}}{T_{allowable,ASD}} + \frac{V_{applied}}{V_{allowable,ASD}} \leq 1.2 \qquad \text{(Eq-1)}$$

Due to the projection of the internally-threaded end of the Bang-It+ insert when installed in concrete filled steel deck assemblies (approximately $^3/_4$-inch), for anchors or groups of anchors that are subject to the effects of combined tension and shear forces, the design engineer must verify the validity of the interaction equation in ACI 318-14 17.6 or ACI 318-11, -08 D.7 as applicable.

4.3 Installation:

For the Wood-Knocker II+ and Pan-Knocker II+ inserts, installation parameters are provided in Table 2 and in Figures 3 and 7. For the Wood-Knocker II+, the head of the insert must be impacted with sufficient force until it comes into contact with the plastic sleeve and the nails enter the form completely. For the Pan-Knocker II+, the base of the insert must be attached to the form using screws or other means to secure the insert. From beneath the deck, following the concrete pour and form removal, a threaded rod or bolt element must be screwed into the internal threads of the inserts until fully seated in the inserts. The threaded steel rod or bolt element must have a minimum thread engagement equal to one steel element diameter.

For the Bang-It+ inserts, installation parameters are provided in Table 3 and in Figures 4A, 4B, 4C and 7. A hole must be made in the steel deck using a step-drill, hole saw, deck punch or equivalent in accordance with the following hole diameters: $^{13}/_{16}$-inch or $^7/_8$-inch (21 mm or 22 mm) bit diameter for Bang-It+ inserts up through $^1/_2$-inch nominal diameter, and $1^3/_{16}$-inch or $1^1/_4$-inch (30 mm or 32 mm) bit diameter for Bang-It+ inserts with $^5/_8$-inch or $^3/_4$-inch nominal diameter. The Bang-It+ plastic sleeve must be placed in the hole, and following this, the head of the insert must be impacted with sufficient force to compress the outer spring and drive the flared plastic fins of the sleeve completely through the hole in the steel deck. The Bang-It+ metal base plate may be screwed to the deck for additional stability (optional). Before or after Bang-It+ insertion in deck, a threaded rod or bolt element must be inserted through the plastic thread protector nozzle until

contact is made with the inner steel barrel. The threaded rod or bolt element must then be screwed into the Bang-It+ internal threads. The rod or bolt must be turned until fully seated in the insert, which will result in a thread engagement equal to a minimum of one rod diameter. The plastic sleeve must be cut and trimmed to the surface of the insert following the concrete pour if the insert is intended to resist shear loads. Bang-It+ inserts are permitted to be installed in either the upper or lower flute of the steel deck.

Installation of Wood-Knocker II+, Pan-Knocker II+, and Bang-It+ inserts must be in accordance with this evaluation report and the manufacturer's printed installation instruction (MPII) as provided in Figure 8 of this report. In the event of a conflict between this report and the MPII, this report governs.

4.4 Special Inspection:

Periodic special inspection is required in accordance with Section 1705.1.1 and Table 1705.3 of the 2018, 2015 or 2012 IBC, or Section 1704.15 and Table 1704.4 of the 2009 IBC, as applicable. The special inspector must make periodic inspections during installation of the headed cast-in specialty inserts to verify insert type, insert dimensions, concrete type, concrete compressive strength, insert spacing, edge distances, concrete member thickness, insert embedment, threaded rod fully seated into insert, and adherence to the manufacturer's printed installation instructions. The special inspector must be present as often as required in accordance with the "statement of special inspection." Under the IBC, additional requirements as set forth in Sections 1705, 1706 and 1707 must be observed, where applicable.

5.0 CONDITIONS OF USE

The Wood-Knocker II+, Pan-Knocker II+, and Bang-It+ concrete anchors described in this report are acceptable alternatives to what is specified in the codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 Specialty inserts are limited to dry interior locations.

5.2 Specialty insert sizes, dimensions, minimum embedment depths, and other installation parameters are as set forth in this report.

5.3 Specialty inserts must be installed in accordance with the manufacturer's printed instructions and this report. In case of conflict, this report governs.

5.4 Specialty inserts must be limited to use in cracked and uncracked normal-weight concrete, sand-lightweight concrete and all-lightweight concrete having a specified compressive strength, f'_c, of 2,500 psi to 10,000 psi (17.2 MPa to 68.9 MPa) for the Wood-Knocker inserts, and in cracked and uncracked normal-weight or sand-lightweight concrete filled steel deck assemblies having a specified compressive strength, f'_c, of 2,500 psi to 10,000 psi (17.2 MPa to 68.9 MPa) for the Bang-It+ inserts.

5.5 The values of f'_c used for calculation purposes must not exceed 10,000 psi (68.9 MPa).

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

5.7 Allowable design values are established in accordance with Section 4.2.

5.8 Specialty insert spacing and edge distance as well as minimum member thickness must comply with ACI 318-17 17.7 or ACI 318-11 Section D.8, as applicable, for cast-in-place headed anchors.

5.9 Prior to installation, calculations and details demonstrating compliance with this report must be submitted to the code official. 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.

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

5.11 Specialty inserts may be installed in regions of concrete where analysis indicates cracking may occur ($f_t > f_r$), subject to the conditions of this report.

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

5.13 Where not otherwise prohibited in the code, Wood-Knocker II+, Pan-Knocker II+, and Bang-It+ inserts are permitted for use with fire-resistance-rated construction provided that at least one of the following conditions is fulfilled:

- Headed cast-in specialty inserts 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.
- Headed cast-in specialty inserts are used to resist wind or seismic forces only.
- Headed cast-in specialty inserts are used to support nonstructural elements.

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

5.15 Special inspection must be provided in accordance with Section 4.4.

5.16 Specialty inserts are manufactured 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 Headed Cast-in Specialty Inserts in Concrete (AC446), dated February 2015, editorially revised January 2016; and Quality control documentation.

7.0 IDENTIFICATION

7.1 The inserts are identified by packaging labeled with the insert size, lot number, company name, insert name, and evaluation report number (ESR-3657). The inserts have the letters DEWALT or the product name, as applicable, and the specific size embossed atop the head of the insert, visible prior to installation for verification.

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

DEWALT
701 EAST JOPPA ROAD
TOWSON, MARYLAND 21286
(800) 524-3244
www.DEWALT.com
anchors@DEWALT.com

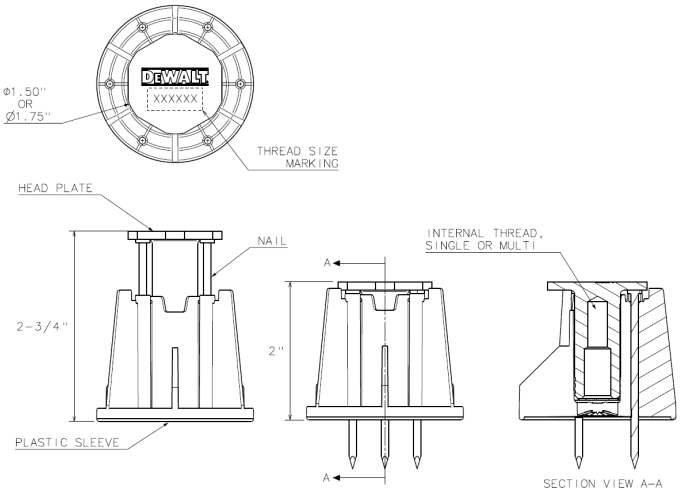


FIGURE 1A— WOOD-KNOCKER II+ CAST-IN-PLACE INSERTS FOR FORM POUR CONCRETE
Before Setting (head plate and nails starting in raised position) and After Setting (head plate in down position, nails into form)

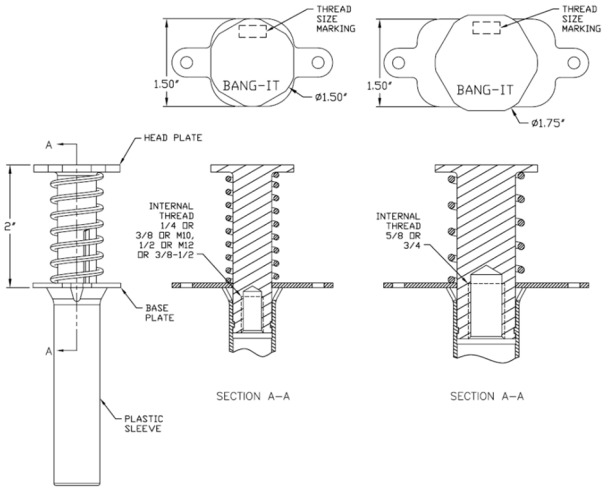


FIGURE 2—BANG-IT+ CAST-IN-PLACE INSERTS FOR CONCRETE FILLED STEEL DECK FLOOR AND ROOF ASSEMBLIES

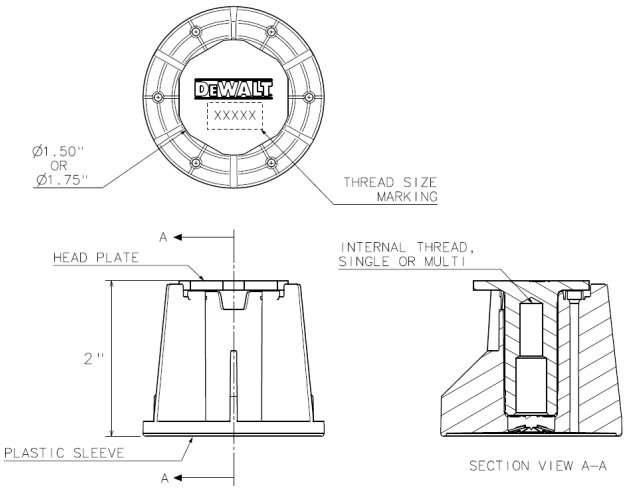


FIGURE 1B— PAN-KNOCKER II+ CAST-IN-PLACE INSERTS FOR FORM POUR CONCRETE
'No Nail' version of Wood-Knocker II+ (head plate in down position)

TABLE 1—DESIGN USE AND REPORT TABLE INDEX

DESIGN STRENGTH[1]		WOOD-KNOCKER II+ INSERTS	PAN-KNOCKER II+ INSERTS	BANG-IT+ STEEL DECK INSERTS	THREADED STEEL ELEMENTS
Steel	N_{sa}, V_{sa}	Table 2	Table 2	Table 3	Table 5
Concrete	N_{cb}, N_{cbg}	Table 2	Table 2	Table 3	Not applicable
	V_{cb}, V_{cbg}, V_{cp}, V_{cpg}	Table 2	Table 2	Not applicable	Not applicable
Side-face Blowout	N_{sb}	Table 2	Table 2	Not applicable	Not applicable

CONCRETE TYPE	CONCRETE STATE	INSERT / STEEL ELEMENT NOMINAL SIZE	SEISMIC DESIGN CATEGORIES[2]
Normal-weight and lightweight	Cracked	1/4", 3/8", M10, M12, 1/2", 5/8", 3/4"	A through F
	Uncracked	1/4", 3/8", M10, M12, 1/2", 5/8", 3/4"	A and B

For **SI:** 1 inch = 25.4 mm. For **pound-inch** units: 1 mm = 0.03937 inch.

[1]Reference ACI 318-14 17.3.1.1 or ACI 318-11 D.4.1.1, as applicable. The controlling strength is decisive from all appropriate failure modes (i.e. steel, concrete, pryout and side-face blowout, as applicable) and design assumptions. The pullout strength in tension is not decisive for design and does not need to be evaluated.

[2]See Section 4.1.8 for requirements for seismic design, where applicable.

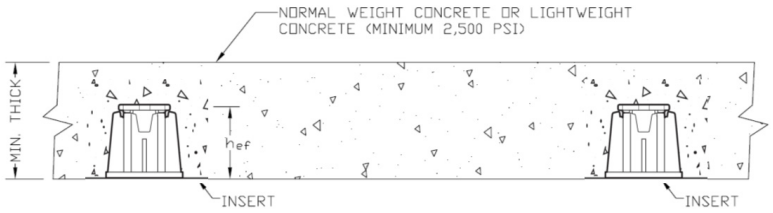


FIGURE 3—WOOD-KNOCKER II+ OR PAN KNOCKER II+ INSERTS INSTALLED IN FORM POUR CONCRETE FLOOR AND ROOF ASSEMBLIES

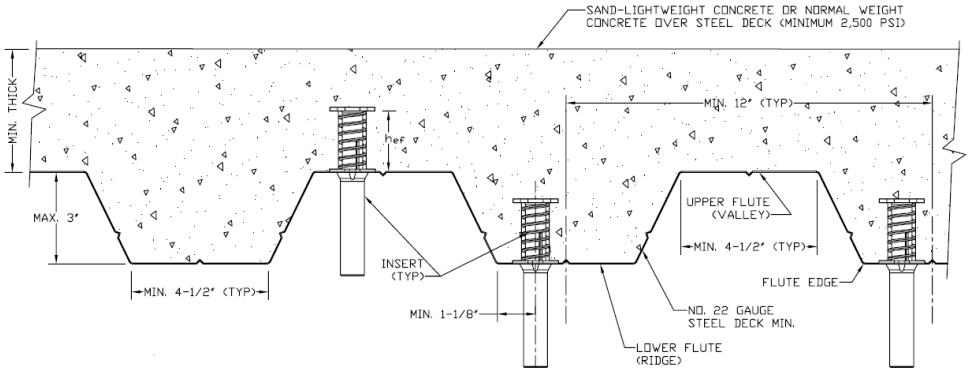


FIGURE 4A—BANG-IT+ INSERTS INSTALLED IN SOFFIT OF CONCRETE-FILLED STEEL DECK FLOOR AND ROOF ASSEMBLIES[1,2,3 4]

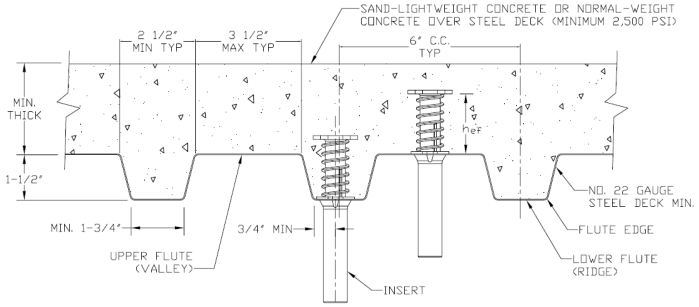


FIGURE 4B—BANG-IT+ INSERTS INSTALLED IN SOFFIT OF CONCRETE-FILLED STEEL DECK FLOOR AND ROOF ASSEMBLIES[1,2,3,5,6,7]

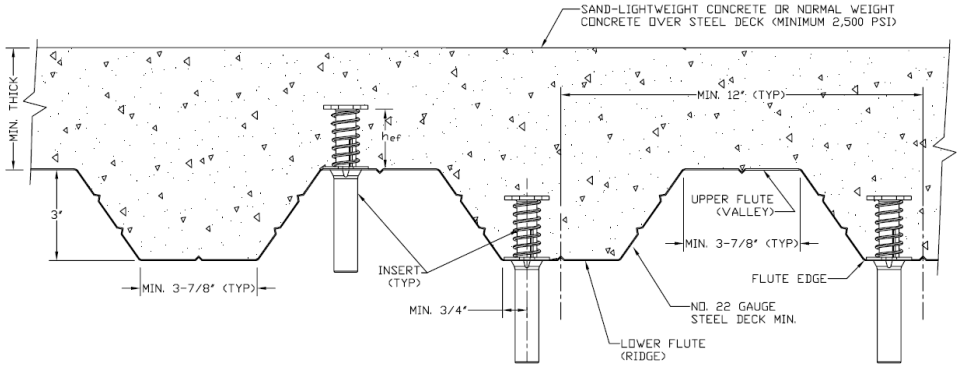


FIGURE 4C—BANG-IT+ INSERTS INSTALLED IN SOFFIT OF CONCRETE-FILLED STEEL DECK FLOOR AND ROOF ASSEMBLIES[1,2,3,8]

[1]Inserts may be placed in the upper flute or lower flute of the steel deck assembly. Inserts in the lower flute require a minimum 1.5" of concrete topping thickness (min. thick in Figures) from the top of the upper flute. Upper flute installations require a minimum 3" concrete topping thickness from the top of the upper flute. Inserts in upper flute may be installed anywhere across upper flute.

[2]Axial spacing for Bang-It+ inserts along the lower flute length shall be minimum $3h_{ef}$.

[3]Upper flute Bang-It+ inserts are not subject to steel deck dimension limitations, or the minimum steel deck gauge limitations.

[4]Inserts in the lower flute of Figure 4A may be installed with a maximum $1^1/_8$-inch offset in either direction from the center of the flute. The offset distance may be increased for flute widths greater than those shown provided the minimum lower flute edge distance of $1^1/_8$-inch is also satisfied.

[5]Inserts in the lower flute of Figure 4B may be installed with a maximum $^1/_8$-inch offset in either direction from the center of the flute. The offset distance may be increased for flute widths greater than those shown provided the minimum lower flute edge distance of $^3/_4$-inch is also satisfied.

[6]Lower flute installations of Figure 4B with flutes widths greater than $1^3/_4$-inch are permitted.

[7]Lower flute installations of Figure 4B in flute depths greater than $1^1/_2$-inch are permitted provided the minimum edge distance of $^3/_4$-inch is met and the minimum lower flute width is increased proportionally (e.g. applicable to a lower flute depth of 2-inch with a minimum lower flute width of $2^1/_4$-inch).

[8]Inserts in the lower flute of Figure 4C may be installed with a maximum $1^3/_{16}$-inch offset in either direction from the center of the flute.

TABLE 2—WOOD KNOCKER II+ AND PAN-KNOCKER II+ INSERT DESIGN INFORMATION[1,2,3,4,5,6]

DESIGN INFORMATION	SYMBOL	UNITS	1/4-inch	3/8-inch	M10	M12	1/2-inch	5/8-inch	3/4-inch
Insert O.D. (outside diameter of the headed insert body)	d_a	in. (mm)	0.7 (18)					1.0 (25)	
Insert head net bearing area	A_{brg}	in^2 (mm^2)	1.20 (762)					1.30 (839)	
Effective embedment depth	h_{ef}	in. (mm)	1.75 (45)					1.75 (45)	
Minimum member thickness	h_{min}	in. (mm)	3.5 (89)					3.5 (89)	
Minimum spacing and edge distances	s_{min} , c_{min}	-	See ACI 318 Section D.8.1 and D.8.2						
Effectiveness factor for cracked concrete	k_c	- (SI)	24 (10)						
Modification factor for tension strength in uncracked concrete	$\Psi_{C,N}$	-	1.25						
Nominal tension strength of single insert as governed by steel strength	$N_{sa,insert}$	lb (kN)	10,270 (45.7)				9,005 (40.1)	12,685 (56.4)	
Nominal tension strength of single insert as governed by steel strength, seismic	$N_{sa,insert,eq}$	lb (kN)	10,270 (45.7)				9,005 (40.1)	12,685 (56.4)	
Nominal steel shear strength of single insert	$V_{sa,insert}$	lb (kN)	7,180 (31.9)				7,180 (31.9)	9,075 (40.4)	
Nominal steel shear strength of single insert, seismic	$V_{sa,insert,eq}$	lb (kN)	7,180 (31.9)				7,180 (31.9)	9,075 (40.4)	

For **SI:** 1 inch = 25.4 mm, 1 pound = 0.00445 kN, 1 psi = 0.006895 MPa. For **pound-inch unit**: 1 mm = 0.03937 inches.

[1]Concrete must have a compressive strength f'_c of 2,500 psi minimum. Installation must comply with Sections 4.1.10 and 4.3, and Figure 3 of this report.
[2]Design of headed cast-in specialty inserts shall be in accordance with the provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable, for cast-in headed anchors. Concrete breakout strength must also be in accordance with Figure 3.
[3]Strength reduction factors for the inserts shall be taken from ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, for cast-in headed anchors. Strength reduction factors for load combinations in accordance with ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, governed by steel strength of the insert shall be taken as 0.65 for tension and 0.60 for shear; values correspond to brittle steel elements. The value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3, or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.
[4]Minimum spacing distance between anchors and minimum edge distance for cast-in headed Wood Knocker II+ and Pan-Knocker II+ anchors shall be in accordance with ACI 318-14 17.7 or ACI 318-11 D.8, as applicable.
[5]Only the largest size of threaded rod or bolt for multi inserts (e.g. 1/2-inch diameter for 3/8- & 1/2-inch insert) must be used for applications resisting shear loads.
[7]The strengths shown in the table are for inserts only. Design professional is responsible for checking threaded rod or bolt strength in tension, shear, and combined tension and shear, as applicable. See Table 5 for steel design information for common threaded rod elements.

TABLE 3—BANG-IT+ INSERT DESIGN INFORMATION[1,2,3,4,5,6,7]

DESIGN INFORMATION		SYMBOL	UNITS	1/4-inch	3/8-inch	M10	M12	1/2-inch	5/8-inch	3/4-inch
Insert O.D. (outside diameter of the headed insert body)		d_a	in. (mm)	0.7 (18)					1.0 (25)	
Insert head net bearing area		A_{brg}	in^2 (mm^2)	1.20 (762)					1.30 (839)	
Effective embedment depth		h_{ef}	in. (mm)	1.75 (45)					1.75 (45)	
Minimum member thickness		h_{min}	-	See Figures 4A, 4B and 4C as applicable						
Minimum spacing and edge distances	Upper flute	s_{min} , c_{min}	-	See ACI 318 Section D.8.1 and D.8.2						
	Lower flute	s_{min} , c_{min}	-	See Figures 4A, 4B and 4C as applicable						
Effectiveness factor for cracked concrete		k_c	- (SI)	24 (10)						
Modification factor for tension strength in uncracked concrete		$\Psi_{C,N}$	-	1.25						
According to Figures 4A or, 4B & 4C	Nominal tension strength of single insert as governed by steel strength	$N_{sa,insert}$	lb (kN)	10,440 (46.4)			9,850 (43.8)		11,985 (53.3)	
	Nominal tension strength of single insert as governed by steel strength, seismic	$N_{sa,insert,eq}$	lb (kN)	10,440 (46.4)			9,850 (43.8)		11,985 (53.3)	
According to Figure 4A	Nominal steel shear strength of single insert in the soffit of concrete on steel deck	$V_{sa,insert,deck}$	lb (kN)	2,280 (10.2)					3,075 (13.7)	
	Nominal steel shear strength of single insert in the soffit of concrete on steel deck, seismic	$V_{sa,insert,eq,\ deck}$	lb (kN)	2,280 (10.2)					2,695 (12.0)	
According to Figures 4B & 4C	Nominal steel shear strength of single insert in the soffit of concrete on steel deck	$V_{sa,insert,deck}$	lb (kN)	2,080 (10.2)					2,975 (13.2)	
	Nominal steel shear strength of single insert in the soffit of concrete on steel deck, seismic	$V_{sa,insert,eq,\ deck}$	lb (kN)	2,080 (10.2)					2,695 (12.0)	

For **SI:** 1 inch = 25.4 mm, 1 pound = 4.45 N, 1 psi = 0.006895 MPa. For pound-inch unit: 1 mm = 0.03937 inches.

[1]Concrete must have a compressive strength f'_c of 2,500 psi minimum. Installation must comply with Sections 4.1.10 and 4.3, and Figure 3 of this report.
[2]Design of headed cast-in specialty inserts shall be in accordance with the provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable, for cast-in headed anchors. Concrete breakout strength must also be in accordance with Figures 4A, 4B and 4C, as applicable.
[3]Strength reduction factors for the inserts shall be taken from ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, for cast-in headed anchors. Strength reduction factors for load combinations in accordance with ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, governed by steel strength of the insert shall be taken as 0.65 for tension and 0.60 for shear; values correspond to brittle steel elements. The value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.
[4]Minimum spacing distance between anchors and minimum edge distances for cast-in headed Bang-It+ anchors shall be in accordance with Figures 4A, 4B or 4C, as applicable, and noted provisions.
[5]Only the largest size of threaded rod or bolt for multi inserts (e.g. 1/2-inch diameter for 3/8- & 1/2-inch insert) must be used for applications resisting shear loads.
[6]The strengths shown in the table are for inserts only. Design professional is responsible for checking threaded rod strength in tension, shear, and combined tension and shear, as applicable. See Table 5 for steel design information for common threaded rod elements.
[8]The tabulated insert strength values are applicable to installations in the lower flute or upper flute of the steel deck profiles; see Figures 4A, 4B and 4C.

TABLE 4—SPECIFICATIONS AND PHYSICAL PROPERTIES OF COMMON CARBON STEEL THREADED ROD ELEMENTS[1]

THREADED ROD SPECIFICATION		UNITS	MIN. SPECIFIED ULTIMATE STRENGTH, f_{uta}	MIN. SPECIFIED YIELD STRENGTH 0.2 PERCENT OFFSET, f_{ya}	$\frac{f_{uta}}{f_{ya}}$	ELONGATION MINIMUM PERCENT[6]	REDUCTION OF AREA MIN. PERCENT	RELATED NUT SPECIFICATION[8]
Carbon Steel	ASTM A36/A36M[2] and F1554[3] Grade 36	psi (MPa)	58,000 (400)	36,000 (248)	1.61	23	40 (50 for A36)	ASTM A194 / A563 Grade A
	ISO 898-1[5] Class 4.6	MPa (psi)	400 (58,000)	240 (34,800)	1.67	22	-[7]	ISO 4032 Grade 4
	ASTM F1554[3] Grade 105	psi (MPa)	125,000 (862)	105,000 (724)	1.19	15	45	ASTM A194 / A563 Grade DH
	ASTM A193/A193M[4] Grade B7	psi (MPa)	125,000 (860)	105,000 (720)	1.19	16	50	

For **SI:** 1 inch = 25.4 mm, 1 psi = 0.006897 MPa. For **pound-inch** units: 1 mm = 0.03937 inch, 1 MPa = 145.0 psi.

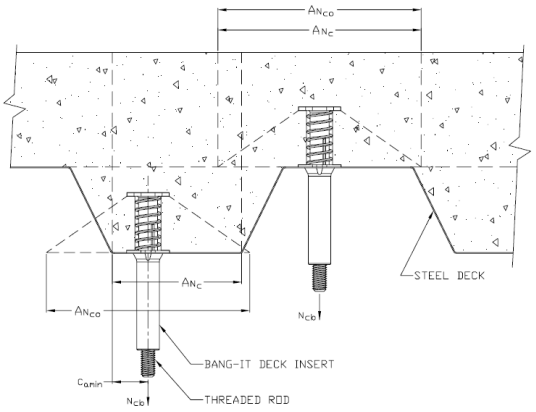
[1]Inserts may be used in conjunction with all grades of continuously threaded carbon steels (all-thread) that comply with code reference standards and that have thread characteristics comparable with ANSI B1.1 UNC Coarse Thread Series or ANSI B1.13M M Profile Metric Coarse Thread Series. Tabulated values correspond to anchor diameters included in this report. See Section 3.2.2 of this report for ductility of steel anchor elements.
[2]*Standard Specification for Carbon Structural Steel.*
[3]*Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.*
[4]*Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.*
[5]*Mechanical properties of fasteners made of carbon steel and alloy steel – Part 1: Bolts, screws and studs.*
[6]Based on 2-inch (50 mm) gauge length except ASTM A193, which are based on a gauge length of 4*d*.
[7]Minimum percent reduction of area not reported in the referenced standard.
[8]Where nuts are applicable, nuts of other grades and style having specified proof load stress greater than the specified grade and style are also suitable.

TABLE 5—STEEL DESIGN INFORMATION FOR COMMON THREADED ROD ELEMENTS USED WITH CONCRETE INSERTS[1,2,3,4]

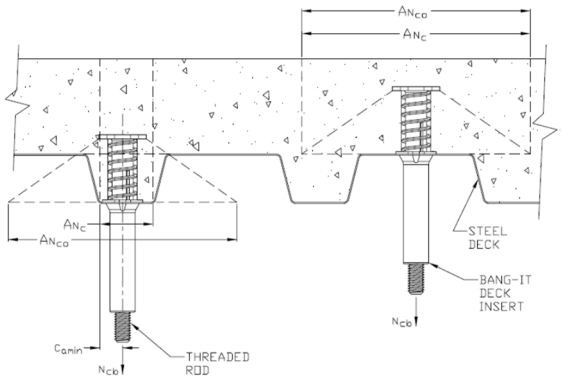
DESIGN INFORMATION		SYMBOL	UNITS	$^1/_4$-inch	$^3/_8$-inch	M10	M12	$^1/_2$-inch	$^5/_8$-inch	$^3/_4$-inch
Threaded rod nominal outside diameter		d_{rod}	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.394 (10)	0.472 (12)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)
Threaded rod effective cross-sectional area		A_{se}	in^2 (mm^2)	0.032 (21)	0.078 (50)	0.090 (58)	0.131 (85)	0.142 (92)	0.226 (146)	0.335 (216)
Nominal tension strength of threaded rod as governed by steel strength	ASTM A36	$N_{sa,rod,A36}$	lb (kN)	1,855 (8.2)	4,525 (20.0)	5,220 (23.2)	7,600 (33.8)	8,235 (36.6)	13,110 (58.3)	19,400 (86.3)
Nominal tension strength of threaded rod as governed by steel strength, seismic	ASTM A36	$N_{sa,rod,eq,A36}$	lb (kN)	1,855 (8.2)	4,525 (20.0)	5,220 (23.2)	7,600 (33.8)	8,235 (36.6)	13,110 (58.3)	19,400 (86.3)
Nominal tension strength of threaded rod as governed by steel strength	ASTM A193, Grade B7	$N_{sa,rod,B7}$	lb (kN)	4,000 (17.7)	9,750 (43.1)	11,250 (50.1)	16,375 (72.9)	17,750 (78.9)	28,250 (125.7)	41,875 (186.0)
Nominal tension strength of threaded rod as governed by steel strength, seismic	ASTM A193, Grade B7	$N_{sa,rod,eq,B7}$	lb (kN)	4,000 (17.7)	9,750 (43.1)	11,250 (50.1)	16,375 (72.9)	17,750 (78.9)	28,250 (125.7)	41,875 (186.0)
Nominal shear strength of threaded rod as governed by steel strength	ASTM A36	$V_{sa,rod,A36}$	lb (kN)	1,105 (4.9)	2,695 (12.0)	3,130 (13.9)	4,560 (20.3)	4,940 (22.0)	7,860 (35.0)	11,640 (51.8)
Nominal shear strength of threaded rod as governed by steel strength, seismic	ASTM A36	$V_{sa,rod,eq,A36}$	lb (kN)	780 (3.5)	1,900 (8.4)	2,190 (9.7)	3,190 (14.2)	3,460 (15.4)	5,505 (24.5)	8,160 (36.3)
Nominal shear strength of threaded rod as governed by steel strength	ASTM A193, Grade B7	$V_{sa,rod,B7}$	lb (kN)	2,385 (10.6)	5,815 (25.9)	6,750 (30.0)	9,825 (43.7)	10,640 (7.3)	16,950 (75.4)	25,085 (111.6)
Nominal shear strength of threaded rod as governed by steel strength, seismic	ASTM A193, Grade B7	$V_{sa,rod,eq,B7}$	lb (kN)	1,680 (7.5)	4,095 (18.2)	4,725 (21.0)	6,880 (30.6)	7,455 (34.2)	11,865 (52.8)	17,590 (78.2)

For **SI:** 1 inch = 25.4 mm, 1 pound = 0.00445 kN, 1 in^2 = 645.2 mm^2. For **pound-inch** unit: 1 mm = 0.03937 inches.

[1]Values provided for steel element material types, or equivalent, based on minimum specified strengths; $N_{sa,rod}$ and $V_{sa,rod}$ calculated in accordance with ACI 318-14 Eq. 17.5.1.2a and Eq. 17.5.1.2b or ACI 318-11 Eq. D-28 and Eq. D-29, respectively, as applicable. $V_{sa,rod,eq}$ must be taken as $0.7V_{sa,rod}$.
[2]ϕN_{sa} shall be the lower of the $\phi N_{sa,rod}$ or $\phi N_{sa,insert}$ for static steel strength in tension; for seismic loading $\phi N_{sa,eq}$ shall be the lower of the $\phi N_{sa,rod,eq}$ or $\phi N_{sa,insert,eq}$.
[3]ϕV_{sa} shall be the lower of the $\phi V_{sa,rod}$ or $\phi V_{sa,insert}$ for static steel strength in tension; for seismic loading $\phi V_{sa,eq}$ shall be the lower of the $\phi V_{sa,rod,eq}$ or $\phi V_{sa,insert,eq}$.
[4]Strength reduction factors shall be taken from ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, for steel elements. Strength reduction factors for load combinations in accordance with ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, governed by steel strength of ductile steel elements shall be taken as 0.75 for tension and 0.65 for shear. The value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.



Idealization of Steel Deck Profile (e.g. see Figures 4A and 4C)



Idealization of Steel Deck Profile (e.g. see Figure 4B)

FIGURE 5—IDEALIZATION OF CONCRETE FILLED STEEL DECKS FOR DETERMINATION OF CONCRETE BREAKOUT STRENGTH IN ACCORDANCE WITH ACI 318

TABLE 6—EXAMPLE ASD ALLOWABLE TENSION DESIGN VALUES FOR ILLUSTRATIVE PURPOSES[1,2,3,4,5,6,7,8,9]

CONCRETE STRENGTH (f'_c)	THREADED ROD SPECIFICATION (ASTM)	WOOD KNOCKER II+ AND PAN-KNOCKER II+ IN CONCRETE						
		$^1/_4$-INCH (lbs)	$^3/_8$-INCH (lbs)	M10 (lbs)	M12 (lbs)	$^1/_2$-INCH (lbs)	$^5/_8$-INCH (lbs)	$^3/_4$-INCH (lbs)
2,500	A36	940	1,640	1,640	1,640	1,640	1,640	1,640
	A193, Grade B7	1,640	1,640	1,640	1,640	1,640	1,640	1,640
3,000	A36	940	1,800	1,800	1,800	1,800	1,800	1,800
	A193, Grade B7	1,800	1,800	1,800	1,800	1,800	1,800	1,800
4,000	A36	940	2,080	2,080	2,080	2,080	2,080	2,080
	A193, Grade B7	2,025	2,080	2,080	2,080	2,080	2,080	2,080
6,000	A36	940	2,295	2,545	2,545	2,545	2,545	2,545
	A193, Grade B7	2,025	2,545	2,545	2,545	2,545	2,545	2,545
8,000	A36	940	2,295	2,645	2,940	2,940	2,940	2,940
	A193, Grade B7	2,025	2,940	2,940	2,940	2,940	2,940	2,940
10,000	A36	940	2,295	2,645	3,285	3,285	3,285	3,285
	A193, Grade B7	2,025	3,285	3,285	3,285	3,285	3,285	3,285

For **SI:** 1 pound = 4.45 N. For pound-inch unit: 1 inch = 25.4 mm.

Illustrative Allowable Stress Design Values in Table 6 are applicable only when all of the following design assumptions are followed:
[1]Concrete compressive strength, f'_c, given for normal weight concrete.
[2]Single anchors with static tension load with installation in accordance to Figure 3.
[3]Concrete determined to remain uncracked for the life of the anchorage.
[4]Load combinations from ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, (no seismic loading).
[5]30% dead load and 70% live load, controlling load combination 1.2D + 1.6 L.
[6]Calculation of the weighted average for α = 1.2*0.3 + 1.6*0.7 = 1.48.
[7]Assuming no edge distance influence ($c_{a1} \geq 1.5h_{ef}$) and no side-face blowout in tension.
[8]$h \geq h_{min}$ according to ACI 318-14 17.7 or ACI 318-11 D.8, as applicable.
[9]Values are for Condition B where supplementary reinforcement in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, is not provided.

TABLE 7—EXAMPLE ASD ALLOWABLE SHEAR DESIGN VALUE FOR ILLUSTRATIVE PURPOSES[1,2,3,4,5,6,7,8,9,10]

CONCRETE STRENGTH (f'_c)	THREADED ROD SPECIFICATION (ASTM)	WOOD KNOCKER II+ AND PAN-KNOCKER II+ IN CONCRETE						
		$^1/_4$-INCH (lbs)	$^3/_8$-INCH (lbs)	M10 (lbs)	M12 (lbs)	$^1/_2$-INCH (lbs)	$^5/_8$-INCH (lbs)	$^3/_4$-INCH (lbs)
2,500	A36	490	1,195	1,375	1,640	1,640	1,640	1,640
	A193, Grade B7	1,055	1,640	1,640	1,640	1,640	1,640	1,640
3,000	A36	490	1,195	1,375	1,800	1,800	1,800	1,800
	A193, Grade B7	1,055	1,800	1,800	1,800	1,800	1,800	1,800
4,000	A36	490	1,195	1,375	2,005	2,080	2,080	2,080
	A193, Grade B7	1,055	2,080	2,080	2,080	2,080	2,080	2,080
6,000	A36	490	1,195	1,375	2,005	2,170	2,545	2,545
	A193, Grade B7	1,055	2,545	2,545	2,545	2,545	2,545	2,545
8,000	A36	490	1,195	1,375	2,005	2,170	2,940	2,940
	A193, Grade B7	1,055	2,570	2,910	2,910	2,910	2,940	2,940
10,000	A36	490	1,195	1,375	2,005	2,170	3,285	3,285
	A193, Grade B7	1,055	2,570	2,910	2,910	2,910	3,285	3,285

For **SI:** 1 pound = 4.45 N. For pound-inch unit: 1 inch = 25.4 mm.

Illustrative Allowable Stress Design Values in Table 7 are applicable only when all of the following design assumptions are followed:
[1]Concrete compressive strength, f'_c, given for normal weight concrete.
[2]Single anchors with static shear load with installation in accordance with Figure 3.
[3]Concrete determined to remain uncracked for the life of the anchorage.
[4]Load combinations from ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, (no seismic loading).
[5]30% dead load and 70% live load, controlling load combination 1.2D + 1.6 L.
[6]Calculation of the weighted average for α = 1.2*0.3 + 1.6*0.7 = 1.48.
[7]Assuming no edge distance ($c_{a1} \geq 1.5h_{ef}$) or corner distance influence ($c_{a2} \geq 1.5c_{a1}$).
[8]Shear loads may be applied in any direction.
[9]$h \geq h_{min}$ according to ACI 318-14 17.7 or ACI 318-11D.8, as applicable.
[10]Values are for Condition B where supplementary reinforcement in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, is not provided.

FIGURE 6—WOOD-KNOCKER II+ AND PAN KNOCKER II+ CONCRETE INSERTS FOR FORMS

TABLE 8—EXAMPLE ASD ALLOWABLE TENSION DESIGN VALUES FOR ILLUSTRATIVE PURPOSES[1,2,3,4,5,6,7,8,9]

CONCRETE STRENGTH (f'_c)	THREADED ROD SPECIFICATION (ASTM)	BANG-IT+ IN CONCRETE-FILLED STEEL DECK (FIGURE 4A)[10]													
		1/4-INCH (lbs)		3/8-INCH (lbs)		M10 (lbs)		M12 (lbs)		1/2-INCH (lbs)		5/8-INCH (lbs)		3/4-INCH (lbs)	
		Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
2,500	A36	940	830	1,395	830	1,395	830	1,395	830	1,395	830	1,395	830	1,395	830
	A193, Grade B7	1,395	830	1,395	830	1,395	830	1,395	830	1,395	830	1,395	830	1,395	830
3,000	A36	940	905	1,530	905	1,530	905	1,530	905	1,530	905	1,530	905	1,530	905
	A193, Grade B7	1,530	905	1,530	905	1,530	905	1,530	905	1,530	905	1,530	905	1,530	905
4,000	A36	940	940	1,765	1,045	1,765	1,045	1,765	1,045	1,765	1,045	1,765	1,045	1,765	1,045
	A193, Grade B7	1,765	1,045	1,765	1,045	1,765	1,045	1,765	1,045	1,765	1,045	1,765	1,045	1,765	1,045
6,000	A36	940	940	2,160	1,280	2,160	1,280	2,160	1,280	2,160	1,280	2,160	1,280	2,160	1,280
	A193, Grade B7	2,025	1,280	2,160	1,280	2,160	1,280	2,160	1,280	2,160	1,280	2,160	1,280	2,160	1,280
8,000	A36	940	940	2,295	1,475	2,495	1,475	2,495	1,475	2,495	1,475	2,495	1,475	2,495	1,475
	A193, Grade B7	2,025	1,475	2,495	1,475	2,495	1,475	2,495	1,475	2,495	1,475	2,495	1,475	2,495	1,475
10,000	A36	940	940	2,295	1,650	2,645	1,650	2,790	1,650	2,790	1,650	2,790	1,650	2,790	1,650
	A193, Grade B7	2,025	1,650	2,790	1,650	2,790	1,650	2,790	1,650	2,790	1,650	2,790	1,650	2,790	1,650

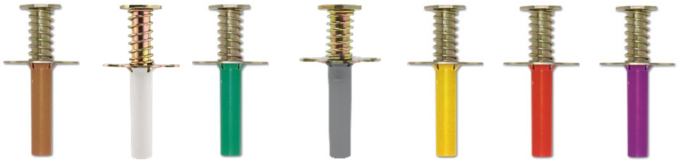
CONCRETE STRENGTH (f'_c)	THREADED ROD SPECIFICATION (ASTM)	BANG-IT+ IN CONCRETE-FILLED STEEL DECK (FIGURE 4B)[11]													
		1/4-INCH (lbs)		3/8-INCH (lbs)		M10 (lbs)		M12 (lbs)		1/2-INCH (lbs)		5/8-INCH (lbs)		3/4-INCH (lbs)	
		Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
2,500	A36	940	365	1,395	365	1,395	365	1,395	365	1,395	365	1,395	365	1,395	365
	A193, Grade B7	1,395	365	1,395	365	1,395	365	1,395	365	1,395	365	1,395	365	1,395	365
3,000	A36	940	400	1,530	400	1,530	400	1,530	400	1,530	400	1,530	400	1,530	400
	A193, Grade B7	1,530	400	1,530	400	1,530	400	1,530	400	1,530	400	1,530	400	1,530	400
4,000	A36	940	465	1,765	465	1,765	465	1,765	465	1,765	465	1,765	465	1,765	465
	A193, Grade B7	1,765	465	1,765	465	1,765	465	1,765	465	1,765	465	1,765	465	1,765	465
6,000	A36	940	570	2,160	570	2,160	570	2,160	570	2,160	570	2,160	570	2,160	570
	A193, Grade B7	2,025	570	2,160	570	2,160	570	2,160	570	2,160	570	2,160	570	2,160	570
8,000	A36	940	655	2,295	655	2,495	655	2,495	655	2,495	655	2,495	655	2,495	655
	A193, Grade B7	2,025	655	2,495	655	2,495	655	2,495	655	2,495	655	2,495	655	2,495	655
10,000	A36	940	730	2,295	730	2,645	730	2,790	730	2,790	730	2,790	730	2,790	730
	A193, Grade B7	2,025	730	2,790	730	2,790	730	2,790	730	2,790	730	2,790	730	2,790	730

CONCRETE STRENGTH (f'_c)	THREADED ROD SPECIFICATION (ASTM)	BANG-IT+ IN CONCRETE-FILLED STEEL DECK (FIGURE 4C)[12]													
		1/4-INCH (lbs)		3/8-INCH (lbs)		M10 (lbs)		M12 (lbs)		1/2-INCH (lbs)		5/8-INCH (lbs)		3/4-INCH (lbs)	
		Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
2,500	A36	940	705	1,395	705	1,395	705	1,395	705	1,395	705	1,395	705	1,395	705
	A193, Grade B7	1,395	705	1,395	705	1,395	705	1,395	705	1,395	705	1,395	705	1,395	705
3,000	A36	940	775	1,530	775	1,530	775	1,530	775	1,530	775	1,530	775	1,530	775
	A193, Grade B7	1,530	775	1,530	775	1,530	775	1,530	775	1,530	775	1,530	775	1,530	775
4,000	A36	940	890	1,765	890	1,765	890	1,765	890	1,765	890	1,765	890	1,765	890
	A193, Grade B7	1,765	890	1,765	890	1,765	890	1,765	890	1,765	890	1,765	890	1,765	890
6,000	A36	940	940	2,160	1,090	2,160	1,090	2,160	1,090	2,160	1,090	2,160	1,090	2,160	1,090
	A193, Grade B7	2,025	1,090	2,160	1,090	2,160	1,090	2,160	1,090	2,160	1,090	2,160	1,090	2,160	1,090
8,000	A36	940	940	2,295	1,260	2,495	1,260	2,495	1,260	2,495	1,260	2,495	1,260	2,495	1,260
	A193, Grade B7	2,025	1,260	2,495	1,260	2,495	1,260	2,495	1,260	2,495	1,260	2,495	1,260	2,495	1,260
10,000	A36	940	940	2,295	1,410	2,645	1,410	2,790	1,410	2,790	1,410	2,790	1,410	2,790	1,410
	A193, Grade B7	2,025	1,410	2,790	1,410	2,790	1,410	2,790	1,410	2,790	1,410	2,790	1,410	2,790	1,410

For **SI:** 1 pound = 4.45 N. For **pound-inch** unit: 1 inch = 25.4 mm.

Illustrative Allowable Stress Design Values in Table 8 are applicable only when all of the following design assumptions are followed:

[1]Concrete compressive strength, f'_c, given for sand-light weight concrete for Bang-It+ anchors.
[2]Single anchors; static tension load with installation in upper and lower flute locations in concrete-filled steel deck in accordance with Figures 4A, 4B or 4C, as applicable, and noted provisions.
[3]Concrete determined to remain uncracked for the life of the anchorage.
[4]Load combinations from ACI 318-14 5.3 or ACI 318-11 9.2, as applicable (no seismic loading).
[5]30% dead load and 70% live load, controlling load combination 1.2D + 1.6 L.
[6]Calculation of the weighted average for α = 1.2*0.3 + 1.6*0.7 = 1.48.
[7]$h \geq h_{min}$ according to ACI 318-14 17.7 or ACI 318-11 Section D.8, as applicable.
[8]Values are for Condition B where supplementary reinforcement in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, is not provided.
[9]Assuming no edge distance influence with $\Psi_{ed,N}$ = 1.0 and no side-face blowout in tension for upper flute anchors.
[10]For lower flute Bang-It+ anchors, the near edge distance, $c_{a,min}$, is 1.125-inch (see Figure 4A).
[11]For lower flute Bang-It+ anchors, the near edge distance, $c_{a,min}$, is 0.75-inch (see Figure 4B).
[12]For lower flute Bang-It+ anchors, the near edge distance, $c_{a,min}$, is 0.75-inch (see Figure 4C).



1/4-inch	3/8 & 1/2-inch	3/8-inch or M10	3/8- & 1/2-inch or M10 & M12	½-inch or M12	5/8-inch	3/4-inch
Brown	White	Green	Gray	Yellow	Red	Purple

FIGURE 7—BANG-IT+ INSERTS FOR CONCRETE-FILLED STEEL DECKS

TABLE 9—EXAMPLE ASD ALLOWABLE SHEAR DESIGN VALUE FOR ILLUSTRATIVE PURPOSES[1,2,3,4,5,6,7,8,9,10]

CONCRETE STRENGTH (f'_c)	THREADED ROD SPECIFICATION (ASTM)	BANG-IT+ IN CONCRETE-FILLED STEEL DECK (FIGURE 4A)													
		1/4-INCH (lbs)		3/8-INCH (lbs)		M10 (lbs)		M12 (lbs)		1/2-INCH (lbs)		5/8-INCH (lbs)		3/4-INCH (lbs)	
		Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
2,500 to 10,000	A36	490	490	925	925	925	925	925	925	925	925	1,245	1,245	1,245	1,245
	A193, Grade B7	925	925	925	925	925	925	925	925	925	925	1,245	1,245	1,245	1,245
CONCRETE STRENGTH (f'_c)	**THREADED ROD SPECIFICATION (ASTM)**	**BANG-IT+ IN CONCRETE-FILLED STEEL DECK (FIGURE 4B)**													
		1/4-INCH (lbs)		3/8-INCH (lbs)		M10 (lbs)		M12 (lbs)		1/2-INCH (lbs)		5/8-INCH (lbs)		3/4-INCH (lbs)	
		Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
2,500 to 10,000	A36	490	490	845	845	845	845	845	845	845	845	1,205	1,205	1,205	1,205
	A193, Grade B7	845	845	845	845	845	845	845	845	845	845	1,205	1,205	1,205	1,205
CONCRETE STRENGTH (f'_c)	**THREADED ROD SPECIFICATION (ASTM)**	**BANG-IT+ IN CONCRETE-FILLED STEEL DECK (FIGURE 4C)**													
		1/4-INCH (lbs)		3/8-INCH (lbs)		M10 (lbs)		M12 (lbs)		1/2-INCH (lbs)		5/8-INCH (lbs)		3/4-INCH (lbs)	
		Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
2,500 to 10,000	A36	490	490	845	845	845	845	845	845	845	845	1,205	1,205	1,205	1,205
	A193, Grade B7	845	845	845	845	845	845	845	845	845	845	1,205	1,205	1,205	1,205

For **SI:** 1 pound = 4.45 N. For **pound-inch** unit: 1 inch = 25.4 mm.

Illustrative Allowable Stress Design Values in Table 9 are applicable only when all of the following design assumptions are followed:

[1]Concrete compressive strength, f'_c, given for sand-light weight for Bang-It+ anchors.
[2]Single anchors; static shear load with installation in upper and lower flute locations in concrete-filled steel deck in accordance with Figures 4A, 4B or 4C, as applicable, and noted provisions.
[3]Concrete determined to remain uncracked for the life of the anchorage.
[4]Load combinations from ACI 318-14 5.3 or ACI 318-11 9.2, as applicable (no seismic loading).
[5]30% dead load and 70% live load, controlling load combination 1.2D + 1.6 L.
[6]Calculation of the weighted average for α = 1.2*0.3 + 1.6*0.7 = 1.48.
[7]Assuming no edge distance ($c_{a1} \geq 1.5h_{ef}$) or corner distance influence ($c_{a2} \geq 1.5c_{a1}$) upper flute anchors.
[8]Shear loads may be applied in any direction.
[9]$h \geq h_{min}$ according to ACI 318-14 17.7 or ACI 318-11 D.8, as applicable.
[10]Values are for Condition B where supplementary reinforcement in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable is not provided.

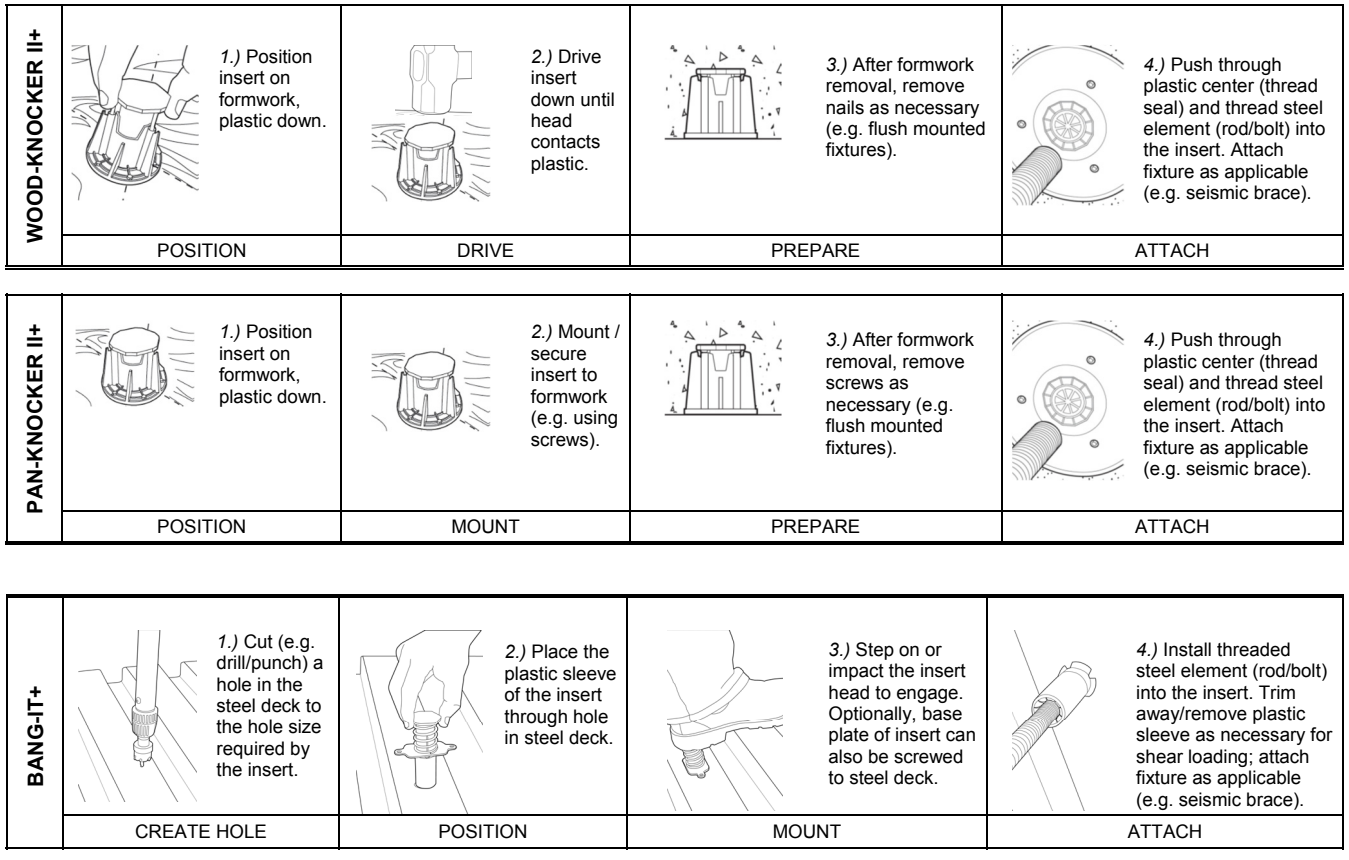
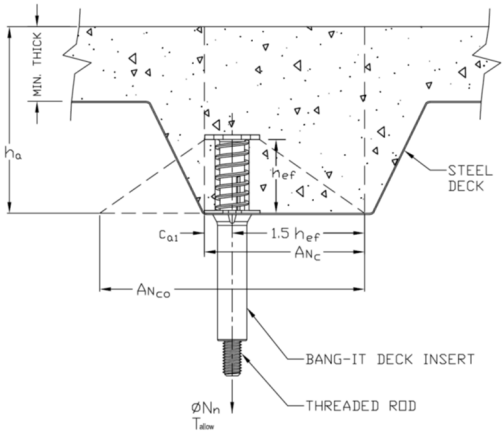


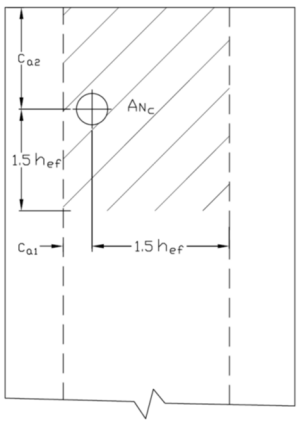
FIGURE 8—WOOD KNOCKER II+ AND PAN-KNOCKER II+ CONCRETE INSERTS FOR FORMS AND BANG-IT+ CONCRETE INSERTS FOR STEEL DECK, MANUFACTUERER PRINTED INSTALLATION INSTRUCTIONS (MPII)

Given:

One $^3/_8$" Bang-it+ insert with ASTM A36 rod installed in the lower flute of steel deck
Steel deck in accordance with Figure 4C of this report ($3^7/_8$" min. flute width)
Anchor is $1^3/_{16}$" offset from center of flute ($^3/_4$" from close edge, $3^1/_8$ from far edge)
Sand-lightweight concrete with compressive strength: (f'_c) = 3,000 psi
No supplemental reinforcement: *(Condition B per ACI 318-11 D.4.3 c)*
Assume cracked concrete and no seismic

h_a = 5 in. (2" topping thickness)
h_{ef} = 1.75 in.
$c_{a1} = c_{a,min}$ = 0.75 in.
$c_{a2} \geq 1.5h_{ef}$ (∴ taken as $1.5h_{ef}$)





Calculate the factored resistance design strength in <u>tension</u> and equivalent allowable stress design load for the anchor in the given configuration.

Calculation in accordance with ACI 318-14, ACI 318-11 and this report:	**ACI 318-14 Ref.**	**ACI 318-11 Ref.**	**Report Ref.**
Step 1. Verify minimum member thickness, spacing and edge distance: h_a = 5.0 in. (2" topping thickness, lower flute) ≥ h_{min} = 4.5 in. (1.5" topping thickness, lower flute) ∴ OK s_a = N/A (not applicable) c_{a1} = 0.75 in. ≥ $c_{a,min}$ = 0.75 in. ∴ OK	17.7	D.8	Table 3 Figure 4C
Step 2. Calculate steel strength of the anchor in tension: Calculate $\phi N_{sa,insert}$ and $\phi N_{sa,rod}$ and determine the controlling steel strength in tension	17.4.1.1 17.4.1.2	D.5.1.1 D.5.1.2	§4.1.2 Table 3 and Table 5
Step 2a. Calculate steel strength of the insert in tension: $\phi N_{sa,insert}$ = 0.65 • 10,440 lbs. = **6,785 lbs**.	17.4.1.1 17.4.1.2	D.5.1.1 D.5.1.2	§4.1.2 Table 3
Step 2b. Calculate steel strength of the threaded rod in tension: $\phi N_{sa,rod,A36}$ = 0.75 • 4,525 lbs. = **3,395 lbs**.	17.4.1.1 17.4.1.2	D.5.1.1 D.5.1.2	§4.1.2 Table 3
Step 2c. $\phi N_{sa,rod,A36} < \phi N_{sa,insert}$ ∴ threaded rod capacity controls steel strength in tension	17.4.1.1 17.4.1.2	D.5.1.1 D.5.1.2	§4.1.2
Step 3. Calculate concrete breakout strength of the anchor in tension: $N_{cb} = \frac{A_{Nc}}{A_{Nc0}} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b$	17.4.2.1(b)	D.5.2.1 (b)	§4.1.3
Step 3a. Calculate A_{Nco} and A_{Nc} $A_{Nco} = 9h_{ef}^2 = 9 \bullet (1.75)^2$ = **27.6 in.²** $A_{nc} = (c_{a1} + (1.5h_{ef})) \bullet (c_{a2} + 1.5h_{ef}) = (0.75 + 2.625) \bullet ((2.625 + 2.625))$ = **17.7 in.²** ∴ A_{Nc} = **17.7 in.²**	17.4.1.1(b)	D.5.2.1 (b)	§4.1.3 Figure 4C
Step 3b. Calculate $\psi_{ed,N}$ = 1.0 if $c_{a,min} \geq 1.5h_{ef}$; $\psi_{ed,N} = 0.7 + 0.3\frac{c_{a,min}}{1.5h_{ef}}$ if $c_{a,min} < 1.5h_{ef}$ $c_{a,min}$ = 0.75 in. < $1.5h_{ef}$ ∴ $\psi_{ed,N}$ = 0.7 + 0.3•(0.75/2.625) = **0.79**	17.4.2.5	D.5.2.5	§4.1.3 Table 3 Figure 4C
Step 3c. Calculate $\psi_{c,N}$ = **1.0** (for cracked concrete)	17.4.2.6	D.5.2.6	Table 3
Step 3d. Calculate $\psi_{cp,N}$ = **1.0** (for cast-in anchors)	17.4.2.7	D.5.2.7	-
Step 3f. Calculate $N_b = k_c \lambda_a \sqrt{f'_c}\, h_{ef}^{1.5} = 24\,(0.85)\sqrt{3{,}000} \bullet 1.75^{1.5}$ = **2,587 lbs.**	17.4.2.2 17.2.6	D.5.2.2 D.3.6	Table 3
Step 3g. Calculate concrete breakout strength of the anchor in tension: N_{cb} = (17.7/27.6) • 0.79 • 1.0 • 1.0 • 2,587 = 1,310 lbs. Calculate concrete breakout capacity = ϕN_{cb} = 0.70 • 1,310 = **917 lbs.**	17.4.2.1(a)	D.5.2.1 (a)	§4.1.3
Step 4. Calculate nominal pullout strength of a single anchor in tension: N/A (not applicable)	17.4.3.1	D.5.3.1	§4.1.1
Step 5. Calculate nominal side-face blowout strength of the anchor: N/A (not applicable)	17.4.4.1	D.5.4.1	§4.1.4
Step 6. Determine the controlling resistance strength of the anchor in tension: ϕN_n= min$\lvert \phi N_{sa}, \phi N_{cb} \rvert$ = ϕN_{cb} = **917 lbs.**	17.3.1	D.4.1	§4.1.1
Step 7. Calculate allowable stress design conversion factor for loading condition: Assume controlling load combination: 1.2*D* + 1.6*L* ; 30% Dead Load, 70% Live Load α = 1.2(0.3) + 1.6(0.7) = **1.48**	5.3	9.2	§4.2.1
Step 8. Calculate allowable stress design value: $T_{allowable,ASD} = \frac{\phi N_n}{\alpha} = \frac{917}{1.48}$ = **620 lbs.**		9.2	§4.2.1

FIGURE 9—EXAMPLE STRENGTH DESIGN CALCULATION FOR TENSION CAPACITY OF BANG-IT+ ANCHOR IN CONCRETE-FILLED STEEL DECK ASSEMBLIES

ICC-ES Evaluation Report

ESR-3657 LABC and LARC Supplement

Issued September 2019
This report is subject to renewal December 2019.

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DIVISION: 03 00 00—CONCRETE
Section: 03 15 19—Cast-in Concrete Anchors
Section: 03 16 00—Concrete Anchors

REPORT HOLDER:

DEWALT

EVALUATION SUBJECT:

WOOD-KNOCKER® II+ AND PAN-KNOCKER™ II+ CONCRETE INSERTS FOR FORMS AND BANG-IT®+ CONCRETE INSERTS FOR STEEL DECK IN CRACKED AND UNCRACKED CONCRETE (DEWALT)

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the DEWALT Wood-Knocker II+ and Pan-Knocker II+ concrete inserts for forms and Bang-It+ concrete inserts for steel deck in cracked and uncracked concrete, described in ICC-ES master evaluation report ESR-3657, has also been evaluated for compliance with the codes noted below as adopted by the Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2017 *City of Los Angeles Building Code* (LABC)
- 2017 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The DEWALT Wood-Knocker II+, Pan-Knocker II+, and Bang-It+ inserts in cracked and uncracked concrete, described in Sections 2.0 through 7.0 of the master evaluation report ESR-3657, comply with LABC Chapter 19, and LARC, and are subject to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The DEWALT Wood-Knocker II+, Pan-Knocker II+, and Bang-It+ inserts described in this evaluation report must comply with all of the following conditions:

- All applicable sections in the master evaluation report ESR-3657.
- The design, installation, conditions of use and labeling of the DEWALT Wood-Knocker II+, Pan-Knocker II+, and Bang-It+ inserts are in accordance with the 2015 *International Building Code®* (2015 IBC) provisions noted in the master evaluation report ESR-3657.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.
- The allowable and strength design values listed in the master evaluation report and tables are for the connection of the headed cast-in specialty inserts to the concrete. The connection between the headed cast-in specialty inserts and the connected members shall be checked for capacity (which may govern).

This supplement expires concurrently with the master report, reissued December 2018 and revised September 2019.

ICC-ES Evaluation Report

ESR-3657 FBC Supplement

Issued September 2019

This report is subject to renewal December 2019.

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DIVISION: 03 00 00—CONCRETE
Section: 03 15 19—Cast-in Concrete Anchors
Section: 03 16 00—Concrete Anchors

REPORT HOLDER:

DEWALT

EVALUATION SUBJECT:

WOOD-KNOCKER® II+ AND PAN-KNOCKER™ II+ CONCRETE INSERTS FOR FORMS AND BANG-IT®+ CONCRETE INSERTS FOR STEEL DECK IN CRACKED AND UNCRACKED CONCRETE (DEWALT)

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the DEWALT Wood-Knocker II+ and Pan-Knocker II+ concrete inserts for forms and Bang-It+ concrete inserts for steel deck in cracked and uncracked concrete, recognized in ICC-ES master evaluation report ESR-3657, have also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2017 *Florida Building Code—Building*
- 2017 *Florida Building Code—Residential*

2.0 CONCLUSIONS

The DEWALT Wood-Knocker II+, Pan-Knocker II+, and Bang-It+ inserts in cracked and uncracked Concrete, described in Sections 2.0 through 7.0 of the master evaluation report ESR-3657, comply with the *Florida Building Code—Building* and the *Florida Building Code—Residential*, when designed and installed in accordance with the 2015 *International Building Code®* provisions noted in the master report.

Use of the Wood-Knocker II+, Pan-Knocker II+, and Bang-It+ inserts in cracked and uncracked Concrete for compliance with the High-Velocity Hurricane Zone Provisions of the *Florida Building Code—Building* and *Florida Building Code—Residential,* has not been evaluated and is outside the scope of this supplement.

For products falling under Florida Rule 9N-3, verification that the report holder's quality-assurance program is audited by a quality-assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official, when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the master report, reissued December 2018 and revised September 2019.

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ELC-3657

Reissued 05/2019
This listing is subject to renewal 05/2020.

DIVISION: 03 00 00—CONCRETE
SECTION: 03 15 19—CAST-IN CONCRETE ANCHORS
DIVISION: 03 16 00—CONCRETE ANCHORS

REPORT HOLDER:

DEWALT

EVALUATION SUBJECT:

WOOD-KNOCKER® II+ CONCRETE INSERTS AND BANG-IT®+ CONCRETE INSERTS FOR STEEL DECK IN CRACKED AND UNCRACKED CONCRETE

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ELC-3657

Reissued May 2019

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CSI: DIVISION: 03 00 00—CONCRETE
Section: 03 15 19—Cast-In Concrete Anchors
Section: 03 16 00—Concrete Anchors

Product Certification System:

The ICC-ES product-certification system includes evaluating reports of tests of standard manufactured product, prepared by accredited testing laboratories and provided by the listee, to verify compliance with applicable codes and standards. The system also involves factory inspections, and assessment and surveillance of the listee's quality system.

Product: Wood-Knocker® II+ Concrete Inserts and Bang-It®+ Concrete Inserts for Steel Deck in Cracked and Uncracked Concrete

Listee: DEWALT

Compliance with the following standards:

- Annex D, Anchorage of CSA A23.3 (-14, -04), Design of Concrete Structures, CSA Group.

Compliance with the following codes:

Wood-Knocker® II+ concrete inserts and Bang-It®+ concrete inserts for steel deck in cracked and uncracked concrete, as described in this listing report, are in conformance with CSA A23.3 (-14, 04), Annex D, as referenced in the applicable section of the following code editions:

- *National Building Code of Canada*® 2015 and 2010
  Applicable Section: Division B, Part 4, Section 4.3.3.

Description of anchors:

The Wood-Knocker II+ inserts are cast-in concrete form inserts. The inserts consists of a steel internally threaded headed insert (body), an outer plastic sleeve and nails used to attach the insert to the inside surface of concrete formwork. The inserts are illustrated in Figure 1 and Figure 3. The internally threaded inserts are manufactured from low carbon steel. The Wood-Knocker inserts have minimum 5 µm (0.002-inch) zinc plating. The plastic sleeve is fabricated from polypropylene.

The Bang-It+ steel deck inserts are cast-in concrete inserts. The insert consists of a steel internally threaded headed insert (body), an outer spring, a plastic sleeve and a washer (base plate). The insert is illustrated in Figure 2 and Figure 4. The internally threaded insert and washer are manufactured from low carbon steel. The Bang-It+ inserts have a minimum 5 µm (0.002-inch) zinc plating. The spring is manufactured from steel music wire. The plastic sleeve is fabricated from polypropylene.

The anchor assembly is comprised of a Wood-Knocker II+ or Bang-It+ insert with a threaded steel element (e.g. rod or bolt). The Wood-Knocker II+ insert is installed on the inside surface of wood formwork and the head driven down until it comes into contact with the plastic sleeve and the nails enter the form. The Bang-It+ insert is installed in a predrilled hole in the topside of the metal deck, and impacted with sufficient force to compress the spring and drive the flared plastic fins of the sleeve completely through the hole. Concrete can then be cast over the insert.

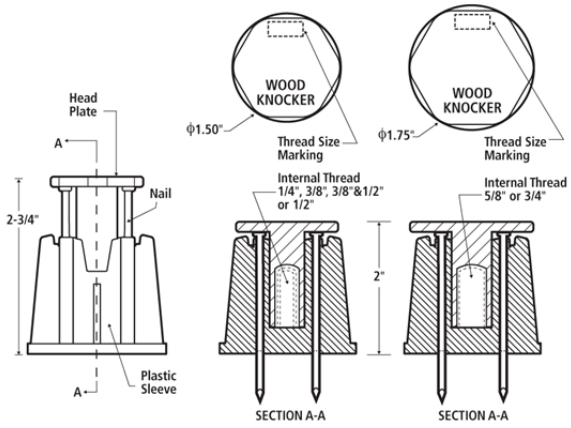


FIGURE 1— WOOD-KNOCKER II+ CAST-IN-PLACE INSERTS FOR FORM POUR CONCRETE
Before Setting (head plate starting position) and After Setting (head plate and nails down)

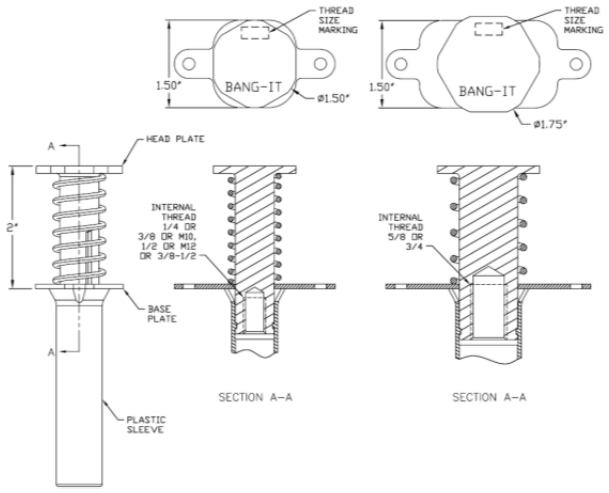


FIGURE 2—BANG-IT+ CAST-IN-PLACE INSERTS FOR CONCRETE FILLED STEEL DECK FLOOR AND ROOF ASSEMBLIES

WOOD-KNOCKER II+

$^{1}/_{4}$-INCH	$^{3}/_{8}$-INCH	$^{3}/_{8}$- & $^{1}/_{2}$-INCH	$^{1}/_{2}$-INCH	$^{5}/_{8}$-INCH	$^{3}/_{4}$-INCH
Brown	Green	Gray	Yellow	Red	Purple

FIGURE 3—WOOD-KNOCKER II+ CONCRETE INSERTS

$^{1}/_{4}$-INCH	$^{3}/_{8}$-INCH	M10	$^{3}/_{8}$- & $^{1}/_{2}$-INCH	M12	$^{1}/_{2}$-INCH	$^{5}/_{8}$-INCH	$^{3}/_{4}$-INCH
Brown	Green	Green	Gray	Yellow	Yellow	Red	Purple

FIGURE 4—BANG-IT+ INSERTS FOR CONCRETE-FILLED STEEL DECKS

Identification:

1. The inserts are identified by packaging labeled with the insert size, lot number, company name, listing report number (ELC-3657), and the ICC-ES listing mark. The inserts have the letters Wood-Knocker or Bang-It+, as applicable, and the specific size embossed atop the head of the insert, visible prior to installation for verification.

2. The report holder's contact information is the following:

   DEWALT
   701 EAST JOPPA ROAD
   TOWSON, MARYLAND 21286
   (800) 524-3244
   www.dewalt.com
   engineering@powers.com

Installation: The installation parameters are provided in Figure 5A and 5B. Installation of the inserts must be in accordance with the manufacturer's published installation instruction (MPII) as provided in the packaging and described in and Figure 5A and 5B.

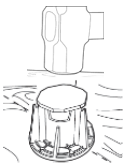
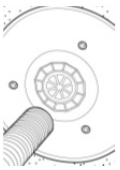
WOOD-KNOCKER II+	 *1.)* Position insert on formwork, plastic down.	 *2.)* Drive insert down until head contacts plastic.	 *3.)* After formwork removal, remove nails as necessary (e.g. flush mounted fixtures).	 *4.)* Install threaded steel element (rod/bolt) into the insert by pushing through plastic center (thread seal). Attach fixture as applicable (e.g. seismic brace).
	POSITION	DRIVE	PREPARE	ATTACH

FIGURE 5A—WOOD KNOCKER II+ CONCRETE INSERTS, MANUFACTUER PUBLISHED INSTALLATION INSTRUCTIONS (MPII)

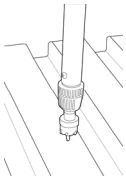
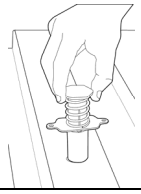
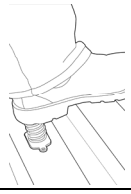
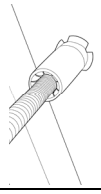
BANG-IT+	 *1.)* Cut (e.g. drill/punch) a hole in the steel deck to the hole size required by the insert.	 *2.)* Place the plastic sleeve of the insert through hole in steel deck.	 *3.)* Step on or impact the insert head to engage. Optionally, base plate of insert can also be screwed to steel deck.	 *4.)* Install threaded steel element (rod/bolt) into the insert. Trim away plastic sleeve for shear load applications and attach fixture as applicable (e.g. seismic brace).
	CREATE HOLE	POSITION	PREPARE	ATTACH

FIGURE 5B—BANG-IT+ CONCRETE INSERTS FOR STEEL DECK, MANUFACTUER PUBLISHED INSTALLATION INSTRUCTIONS (MPII)

Anchor setting information:

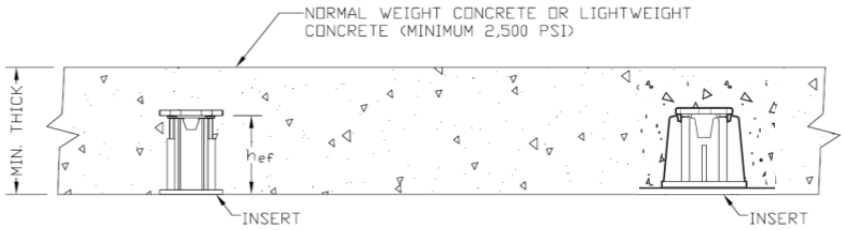


FIGURE 6—WOOD-KNOCKER II+ INSERTS INSTALLED IN FORM POUR CONCRETE FLOOR AND ROOF ASSEMBLIES

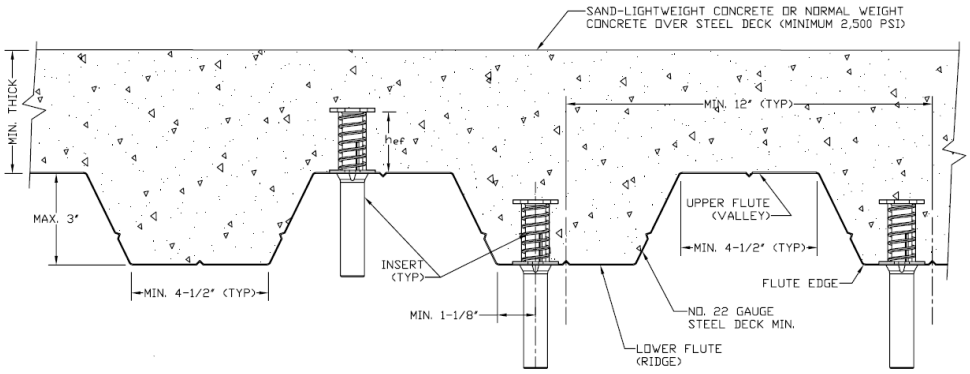


FIGURE 7A—BANG-IT+ INSERTS INSTALLED IN SOFFIT OF CONCRETE FILLED STEEL DECK FLOOR AND ROOF ASSEMBLIES[1,2,3 4]

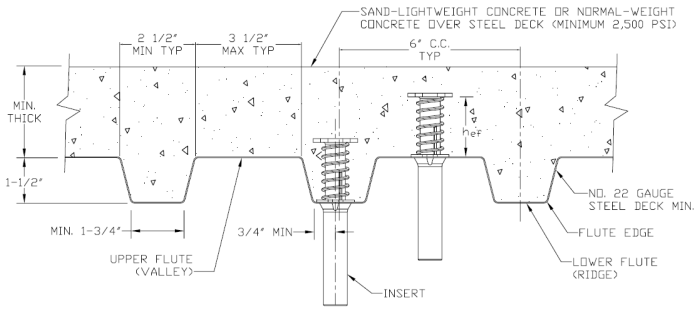


FIGURE 7B—BANG-IT+ INSERTS INSTALLED IN SOFFIT OF CONCRETE FILLED STEEL DECK FLOOR AND ROOF ASSEMBLIES[1,2,3,5,6,7]

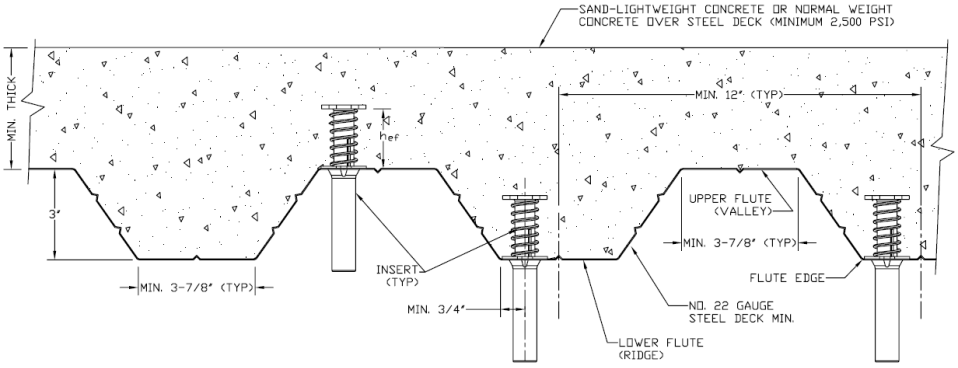


FIGURE 7C—BANG-IT+ INSERTS INSTALLED IN SOFFIT OF CONCRETE FILLED STEEL DECK FLOOR AND ROOF ASSEMBLIES[1,2,3,8]

[1]Inserts may be placed in the upper flute or lower flute of the steel deck assembly. Inserts in the lower flute require a minimum 37mm (1.5–inch) of concrete topping thickness (min. thick in Figures) from the top of the upper flute. Upper flute installations require a minimum 74mm (3-inch) concrete topping thickness from the top of the upper flute. Inserts in upper flute may be installed anywhere across upper flute.
[2]Axial spacing for Bang-It+ inserts along the lower flute length shall be minimum $3h_{ef}$.
[3]Upper flute Bang-It+ inserts are not subject to steel deck dimension limitations or the minimum steel deck gauge limitations.
[4]Inserts in the lower flute of Figure 7A may be installed with a maximum 29mm ($1^1/_8$–inch) offset in either direction from the center of the flute. The offset distance may be increased for flute widths greater than those shown provided the minimum lower flute edge distance of 29mm ($1^1/_8$–inch) is also satisfied.
[5]Inserts in the lower flute of Figure 7B may be installed with a maximum 3mm ($^1/_8$–inch) offset in either direction from the center of the flute. The offset distance may be increased for flute widths greater than those shown provided the minimum lower flute edge distance of19mm ($^3/_4$–inch) is also satisfied.
[6]Lower flute installations of Figure 7B with flutes widths greater than 44mm ($1^3/_4$–inch) are permitted.
[7]Lower flute installations of Figure 7B in flute depths greater than 38mm ($1^1/_2$–inch) are permitted provided the minimum edge distance of 19mm ($^3/_4$–inch) is met and the minimum lower flute width is increased proportionally [e.g. applicable to a lower flute depth of 51mm (2-inch) with a minimum lower flute width of 57mm ($2^1/_4$–inch)].
[8]Inserts in the lower flute of Figure 7C may be installed with a maximum 30mm ($1^3/_{16}$–inch) offset in either direction from the center of the flute.

Ultimate Limit States Design:

Design resistance of anchors for compliance with the 2015 NBCC must be determined in accordance with CSA A23.3-14 Annex D, and this listing report.

Design resistance of anchors for compliance with the 2010 NBCC must be determined in accordance with CSA A23.3-04 Annex D, and this listing report.

Design parameters provided in Table 1 through 4 of this listing report are based on the 2015 NBCC and 2010 NBCC (CSA A23.3-14 and CSA A23.3-04). The limit states design of anchors must comply with CSA A23.3 (-14, -04) D.5.1, except as required in CSA A23.3 (-14, -04) D.4.3.1.

Material resistance factors must be ϕ_c = 0.65 and ϕ_s = 0.85 in accordance with CSA A23.3 (-14, 04) Sections 8.4.2 and 8.4.3, and resistance modification factor, *R,* as given in CSA A23.3-14 Section D.5.3, or CSA A23.3-04 Section D.5.4, and noted in Tables 1, 2 and 4 of this listing report, must be used for load combinations calculated in accordance with Division B, Part 4, Section 4.1.3 of the 2015 and 2010 NBCC, or Annex C of CSA A23.3 (-14, -04). The nominal strength N_{sa} or V_{sa}, in Tables 1, 2, and 4 of this listing report must be multiplied by ϕ_s and *R* to determine the factored resistance N_{sar} or V_{sar}.

TABLE 1—WOOD KNOCKER II+ INSERT DESIGN INFORMATION[1,2,3,4,5,6,7]

DESIGN INFORMATION	SYMBOL	UNITS	$^1/_4$-inch	$^3/_8$-inch	M10	M12	$^1/_2$-inch	$^5/_8$-inch	$^3/_4$-inch
Insert O.D.	d_a	mm	18					25	
Insert head net bearing area	A_{brg}	mm^2	762					839	
Effective embedment depth	h_{ef}	mm	45					45	
Minimum member thickness	h_{min}	mm	89					89	
Minimum spacing and edge distances	s_{min} , c_{min}	-	See CSA A23.3 (-14, -04) Section D.9						
Effectiveness factor for cracked concrete	k_c	SI	10						
Modification factor for tension strength in uncracked concrete	$\Psi_{C,N}$	-	1.25						
Nominal tension strength of single insert as governed by steel strength	$N_{sa,insert}$	kN	45.7				40.1	56.4	
Nominal tension strength of single insert as governed by steel strength, seismic	$N_{sa,insert,eq}$	kN	45.7				40.1	56.4	
Nominal steel shear strength of single insert	$V_{sa,insert}$	kN	31.9				31.9	40.4	
Nominal steel shear strength of single insert, seismic	$V_{sa,insert,eq}$	kN	31.9				31.9	40.4	
Resistance modification factor for tension, steel failure modes	R	-	0.70						
Resistance modification factor for shear, steel failure modes	R	-	0.65						
Resistance modification factor for tension and shear, concrete failure modes, Condition B[8]	R	-	1.00						

For **SI:** 1 inch = 25.4 mm, 1 pound = 0.00445 kN, 1 psi = 0.006895 MPa. For **pound-inch unit**: 1 mm = 0.03937 inches.

[1]Concrete must have a compressive strength f'_c of 17.2MPa minimum. Installation must comply with Figure 5A and this listing report.
[2]Design of headed cast-in specialty inserts shall be in accordance with the provisions of CSA A23.3 (-14, -04) Annex D for cast-in headed anchors. Concrete breakout strength must also be in accordance with Figure 6.
[3]The values of the material resistance factors ϕ_c and ϕ_s, and resistance modification factor, *R*, applies when the load combinations of Division B, Part 4, Section 4.1.3 of the 2015 NBCC or 2010 NBCC, or Annex C of CSA A23.3 (-14, -04) are used. The *R* values correspond to brittle steel elements.
[4]Insert O.D. is the outside diameter of the headed insert body.
[5]Minimum spacing distance between anchors and minimum edge distance for cast-in headed Wood Knocker II+ anchors shall be in accordance with CSA A23.3 (-14, -04) Section D.9.
[6]Only the largest size of threaded rod or bolt for the $^3/_8$- & $^1/_2$-inch multi insert (i.e. $^1/_2$-inch diameter) must be used for applications resisting shear loads.
[7]The strengths shown in the table are for inserts only. Design professional is responsible for checking threaded rod or bolt strength in tension, shear, and combined tension and shear, as applicable. See Table 5 for steel design information for common threaded rod elements.
[8]Condition B applies where supplemental reinforcement is not provided or where pullout governs, as set forth in CSA A23.3-14 D.5.3(c) or CSA A23.3-04 D.5.4(c).

TABLE 2—BANG-IT+ INSERT DESIGN INFORMATION[1,2,3,4,5,6,7,8]

DESIGN INFORMATION		SYMBOL	UNITS	1/4-inch	3/8-inch	M10	M12	1/2-inch	5/8-inch	3/4-inch
Insert O.D.		d_a	mm	18					25	
Insert head net bearing area		A_{brg}	mm^2	762					839	
Effective embedment depth		h_{ef}	mm	45					45	
Minimum member thickness		h_{min}	-	See Figures 7A, 7B and 7C as applicable						
Minimum spacing and edge distances	Upper flute	s_{min} , c_{min}	-	See CSA A23.3 (-14, -04) Section D.9						
	Lower flute	s_{min} , c_{min}	-	See Figures 7A, 7B and 7C as applicable						
Effectiveness factor for cracked concrete		k_c	SI	10						
Modification factor for tension strength in uncracked concrete		$\Psi_{C,N}$	-	1.25						
According to Figures 7A, 7B & 7C	Nominal tension strength of single insert as governed by steel strength	$N_{sa,insert}$	kN	46.4			43.8		53.3	
	Nominal tension strength of single insert as governed by steel strength, seismic	$N_{sa,insert,eq}$	kN	46.4			43.8		53.3	
Resistance modification factor for tension, steel failure modes		R	-	0.70						
Resistance modification factor for tension, concrete failure modes, Condition B[8]		R	-	1.00						

For **SI:** 1 inch = 25.4 mm, 1 pound = 4.45 N, 1 psi = 0.006895 MPa. For pound-inch unit: 1 mm = 0.03937 inches.

[1]Concrete must have a compressive strength f'_c of 17.2MPa minimum. Installation must comply with Figure 5B and this listing report.
[2]Design of headed cast-in specialty inserts shall be in accordance with the provisions of CSA A23.3 (-14, -04) Annex D for cast-in headed anchors. Concrete breakout strength must also be in accordance with Figures 7A, 7B, 7C, and 8, as applicable.
[3]The values of the material resistance factors ϕ_c *and* ϕ_s, and resistance modification factor, *R*, applies when the load combinations of Division B, Part 4, Section 4.1.3 of the 2015 NBCC or 2010 NBCC, or Annex C of CSA A23.3 (-14, -04) are used. The *R* values correspond to brittle steel elements.
[4]Insert O.D. is the outside diameter of the headed insert body.
[5]Minimum spacing distance between anchors and minimum edge distances for cast-in headed Bang-It+ anchors shall be in accordance with Figures 7A, 7B or 7C, and CSA A23.3 (-14, -04) Section D.9, as applicable, and noted provisions.
[6]The strengths shown in the table are for inserts only. Design professional is responsible for checking threaded rod strength, as applicable. See Table 4 for steel design information for common threaded rod elements.
[7]The tabulated insert strength values are applicable to installations in the lower flute or upper flute of the steel deck profiles; see Figures 7A, 7B and 7C.
[8]Condition B applies where supplemental reinforcement is not provided or where pullout governs, as set forth in CSA A23.3-14 D.5.3(c) or CSA A23.3-04 D.5.4(c).

TABLE 3—SPECIFICATIONS AND PHYSICAL PROPERTIES OF COMMON CARBON STEEL THREADED ROD ELEMENTS[1]

THREADED ROD SPECIFICATION		UNITS	MIN. SPECIFIED ULTIMATE STRENGTH, f_{uta}	MIN. SPECIFIED YIELD STRENGTH 0.2 PERCENT OFFSET, f_{ya}	$\frac{f_{uta}}{f_{ya}}$	ELONGATION MINIMUM PERCENT[6]	REDUCTION OF AREA MIN. PERCENT	RELATED NUT SPECIFICATION[8]
Carbon Steel	ASTM A36/A36M[2] and F1554[3] Grade 36	MPa	400	248	1.61	23	40 (50 for A36)	ASTM A194 / A563 Grade A
	ISO 898-1[5] Class 4.6	MPa	400	240	1.67	22	-[7]	ISO 4032 Grade 4
	ASTM F1554[3] Grade 105	MPa	862	724	1.19	15	45	ASTM A194 / A563 Grade DH
	ASTM A193/A193M[4] Grade B7	MPa	860	720	1.19	16	50	

For **SI:** 1 inch = 25.4 mm, 1 psi = 0.006897 MPa. For **pound-inch** units: 1 mm = 0.03937 inch, 1 MPa = 145.0 psi.

[1]Inserts may be used in conjunction with all grades of continuously threaded carbon steels (all-thread) that comply with code reference standards and that have thread characteristics comparable with ANSI B1.1 UNC Coarse Thread Series or ANSI B1.13M M Profile Metric Coarse Thread Series. Tabulated values correspond to anchor diameters included in this report..
[2]*Standard Specification for Carbon Structural Steel.*
[3]*Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.*
[4]*Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.*
[5]*Mechanical properties of fasteners made of carbon steel and alloy steel – Part 1: Bolts, screws and studs.*
[6]Based on 2-inch (50 mm) gauge length except ASTM A193, which are based on a gauge length of 4*d*.
[7]Minimum percent reduction of area not reported in the referenced standard.
[8]Where nuts are applicable, nuts of other grades and style having specified proof load stress greater than the specified grade and style are also suitable.

TABLE 4—STEEL DESIGN INFORMATION FOR COMMON THREADED ROD ELEMENTS USED WITH CONCRETE INSERTS[1,2,3,4]

DESIGN INFORMATION		SYMBOL	UNITS	$^1/_4$-inch	$^3/_8$-inch	M10	M12	$^1/_2$-inch	$^5/_8$-inch	$^3/_4$-inch
Threaded rod nominal outside diameter		d_{rod}	mm (in.)	6.4 (0.250)	9.5 (0.375)	10 (0.394)	12 (0.472)	12.7 (0.500)	15.9 (0.625)	19.1 (0.750)
Threaded rod effective cross-sectional area		A_{se}	mm^2 (in^2)	21 (0.032)	50 (0.078)	58 (0.090)	85 (0.131)	92 (0.142)	146 (0.226)	216 (0.335)
ASTM A36	Nominal tension strength of threaded rod as governed by steel strength	$N_{sa,rod,A36}$	kN	8.2	20	23.2	33.8	36.6	58.3	86.3
	Nominal tension strength of threaded rod as governed by steel strength, seismic	$N_{sa,rod,eq,A36}$	kN	8.2	20	23.2	33.8	36.6	58.3	86.3
	Nominal shear strength of threaded rod as governed by steel strength	$V_{sa,rod,A36}$	kN	4.9	12.0	13.9	20.3	22.0	35.0	51.8
	Nominal shear strength of threaded rod as governed by steel strength, seismic	$V_{sa,rod,eq,A36}$	kN	3.5	8.4	9.7	14.2	15.4	24.5	36.3
	Resistance modification factor for tension	R	-	0.80						
	Resistance modification factor for shear	R	-	0.75						
ASTM A193, Grade B7	Nominal tension strength of threaded rod as governed by steel strength	$N_{sa,rod,B7}$	kN	17.7	43.1	50.1	72.9	78.9	125.7	186.0
	Nominal tension strength of threaded rod as governed by steel strength, seismic	$N_{sa,rod,eq,B7}$	kN	17.7	43.1	50.1	72.9	78.9	125.7	186.0
	Nominal shear strength of threaded rod as governed by steel strength	$V_{sa,rod,B7}$	kN	10.6	25.9	30.0	43.7	47.3	75.4	111.6
	Nominal shear strength of threaded rod as governed by steel strength, seismic	$V_{sa,rod,eq,B7}$	kN	7.5	18.2	21.0	30.6	34.2	52.8	78.2
	Resistance modification factor for tension	R	-	0.80						
	Resistance modification factor for shear	R	-	0.75						

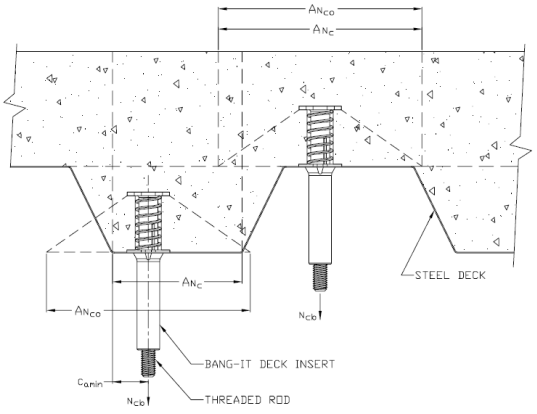
For **SI:** 1 inch = 25.4 mm, 1 pound = 0.00445 kN, 1 in^2 = 645.2 mm^2. For **pound-inch** unit: 1 mm = 0.03937 inches.

[1]Values provided for steel element material types, or equivalent, based on minimum specified strengths; $N_{sa,rod}$ and $V_{sa,rod}$ calculated in accordance with CSA A23.3-14 Eq. D.2 and Eq. D.31, as applicable. $V_{sa,rod,eq}$ must be taken as $0.7V_{sa,rod}$.

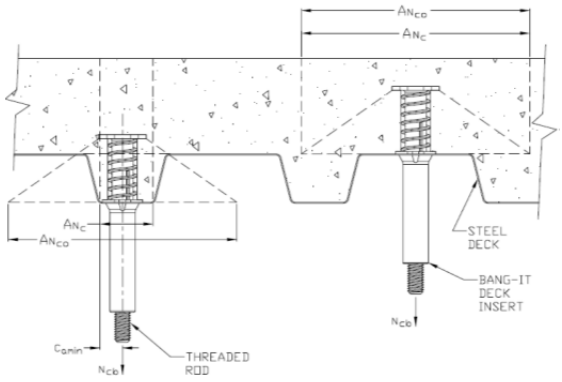
[2]$N_{sa}{\cdot}R$ shall be the lower of the $N_{sa,rod}{\cdot}R$ or $N_{sa,insert}{\cdot}R$ for static steel strength in tension; for seismic loading $N_{sa,eq}{\cdot}R$ shall be the lower of the $N_{sa,rod,eq}{\cdot}R$ or $N_{sa,insert,eq}{\cdot}R$.

[3]$V_{sa}{\cdot}R$ shall be the lower of the $V_{sa,rod}{\cdot}R$ or $V_{sa,insert}{\cdot}R$ for static steel strength in tension; for seismic loading $V_{sa,eq}{\cdot}R$ shall be the lower of the $V_{sa,rod,eq}{\cdot}R$ or $V_{sa,insert,eq}{\cdot}R$.

[4] The value of the material resistance factors ϕ_c *and* ϕ_s, and resistance modification factor, R, applies when the load combinations of Division B, Part 4, Section 4.1.3 of the 2015 NBCC or Annex C of CSA A23.3-14 are used. The R values correspond to ductile steel elements.



Idealization of Steel Deck Profile (e.g. see Figures 4A and 4C)



Idealization of Steel Deck Profile (e.g. see Figure 4B)

FIGURE 8—IDEALIZATION OF CONCRETE FILLED STEEL DECKS FOR DETERMINATION OF CONCRETE BREAKOUT STRENGTH IN ACCORDANCE WITH ACI 318

Conditions of listing:

1. The listing report addresses only conformance with the standards and code sections noted above.
2. Approval of the product's use is the sole responsibility of the local code official.
3. The listing report applies only to the materials tested and as submitted for review by ICC-ES.
4. Specialty insert sizes, dimensions, minimum embedment depths, and other installation parameters are as set forth in this listing report.
5. Specialty inserts must be limited to use in cracked and uncracked normal-weight concrete, sand-lightweight concrete and all-lightweight concrete having a specified compressive strength, f'_c, of 17.2 MPa to 68.9 MPa for the Wood-Knocker inserts, and in cracked and uncracked normal-weight or sand-lightweight concrete filled steel deck assemblies having a specified compressive strength, 17.2 MPa to 68.9 MPa for the Bang-It+ inserts.
6. The values of f'_c used for calculation purposes must not exceed 68.9 MPa.
7. Limit states design values must be established in accordance with this listing report.
8. The use of fatigue or shock loading for these anchors under such conditions is beyond the scope of this listing report.
9. Anchors may be used to resist short-term loading due to wind or seismic forces in locations designed according to NBCC 2015.
10. Where not otherwise prohibited in the code as referenced in CSA A23.3-14, Wood-Knocker® II+ concrete inserts and Bang-It®+ concrete inserts are permitted for use with fire-resistance-rated construction provided that at least one of the following conditions is fulfilled:
    a. Anchors are used to resist wind or seismic forces only.
    b. 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.
    c. Anchors are used to support nonstructural elements.
11. Use of zinc-coated carbon steel anchors is limited to dry, interior locations.