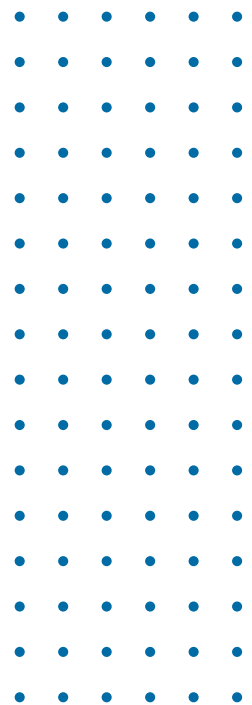


PSA

DESIGN GUIDE

PSA FORGE BAR SYSTEM





INTRODUCING PSA FORGE BAR SYSTEM

The PSA Forge Bar System is an advanced solution for joining and anchoring Grade 500N reinforcement bars, streamlining connections by eliminating traditional lap splices, cogs, and hooks. The system integrates reinforcement bars with upsized ends featuring precision-cut metric threads, robust full-strength couplers for bar-to-bar connections, and headed inserts for secure anchorage within concrete.

Precision Engineering for Superior Performance - Each bar and coupler pair features high-accuracy threading that ensures a consistently strong mechanical bond under both tensile and compressive loads. This precision minimizes variability and enhances overall structural reliability.

Efficient Anchorage in Dense Reinforcement Zones - Headed inserts offer effective anchorage, helping reduce congestion in heavily reinforced areas. This not only simplifies placement but also promotes safer and more efficient construction practices.

Built for Demanding Applications - Engineered to comply with stringent safety and performance standards, the PSA Forge Bar System enables quicker installation and increased jobsite efficiency. It is ideally suited for high-performance structural joints and any application requiring full-strength, cast-in threaded reinforcement connections.





FEATURES AND BENEFITS

FEATURES

- + **Standards Compliance:** The PSA Forge Bar System complies with the relevant requirements of AS/NZS 4671, and AS 3600, ensuring alignment with Australian standards for structural concrete and reinforcing steels.
- + **ACRS Certification:** PSA only uses reinforcement bar certified by the Australasian Certification Authority for Reinforcing and Structural Steels Ltd (ACRS), attesting to its quality and reliability.
- + **Independent Testing:** Fully tested in a third-party NATA-accredited facility to verify strength and slip requirements.
- + **Versatile Diameters:** Available in a wide range of system diameters, including 12mm, 16mm, 20mm, 24mm, 28mm, 32mm, 36mm and 40mm to suit diverse project requirements.

BENEFITS

- + **Enhanced Efficiency:** Forge Bar coupler connections eliminate the need for lap splicing, reducing reinforcement congestion and simplifying construction workflows.
- + **Corrosion Resistance:** All couplers are supplied with a galvanised finish, providing enhanced protection against corrosion and extending the lifespan of the system.
- + **Improved Safety:** Forge Bar insert connections eliminate the need for on-site bar re-bending, significantly reducing associated risks and enhancing site safety.
- + **Full Bar Strength Retention:** No reduction in bar cross-sectional area as the bars are upset forged before threading. Thread's minor diameter exceeds the original bar diameter, ensuring full structural capacity of the bar is maintained.
- + **Ease of Installation:** Bars can be seamlessly installed into couplers and inserts, ensuring quick and efficient assembly on-site.
- + **Versatile Finishes:** The PSA Forge Bar Headed Inserts are available in zinc or hot-dip galvanised finish, catering to various environmental and durability requirements.



PSA FORGE BAR SYSTEM COMPONENTS

FORGE BAR

PSA Forge Bar is a Grade 500N reinforcing bar, manufactured to meet the rigorous requirements of AS/NZS 4671. This premium product ensures compliance with industry standards and provides exceptional quality assurance. Designed for superior structural performance, PSA Forge Bar is a dependable solution for various construction applications, particularly in the precast and reinforced concrete sectors.

The standout feature of the PSA Forge Bar is its precisely machined metric thread at the bar ends, enabling seamless compatibility with Forge Bar Couplers and Forge Bar Inserts. The ends of the bars are cut square and upsized through an upset forging process, which increases the diameter of the bar ends to ensure the splice is stronger than the bar itself. Metric threads are then cut onto the enlarged ends to create a secure and reliable connection.

Every stage of production is conducted under strict QA/QC protocols to maintain the consistency and performance of the system. To safeguard the threads during handling and storage, the bar ends are fitted with durable plastic caps.

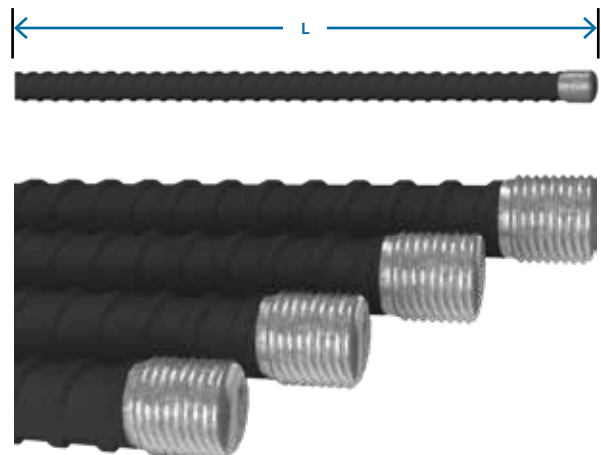
PSA FORGE BAR PROPERTIES

PART NO.	NOMINAL BAR DIAMETER	BAR CROSS SECTION	MIN. TENSILE STRESS	MIN. YIELD STRESS	MIN. TENSILE STRENGTH	MIN. YIELD STRENGTH	BAR WEIGHT
	(mm)	(mm ²)	(MPa)	(MPa)	(kN)	(kN)	(kg/m)
FB12-CUSTOM	12	113.1	540	500	61.1	56.5	0.93
FB16-CUSTOM	16	201.1	540	500	108.6	100.5	1.65
FB20-CUSTOM	20	314.2	540	500	169.6	157.1	2.58
FB24-CUSTOM	24	452.2	540	500	244.3	226.2	3.71
FB28-CUSTOM	28	615.8	540	500	332.5	307.9	5.05
FB32-CUSTOM	32	804.2	540	500	434.3	402.1	6.59
FB36-CUSTOM	36	1017.9	540	500	549.7	508.9	8.35
FB40-CUSTOM	40	1256.6	540	500	678.6	628.3	10.30

- + To order a custom length of reinforcement bar with forged thread, please use the part no. mentioned with the bar length in mm.
- + If nothing else is noted, bars will come with type A thread, please contact PSA for orders of bars with type C threads.

PSA FORGE BAR STARTER BARS

STARTER BAR PART NO.	NOMINAL BAR DIAMETER	BAR LENGTH (L)	BAR WEIGHT
	(mm)	(mm)	(kg)
FBSB12540	12	540	0.5
FBSB16700	16	700	1.2
FBSB20800	20	800	2.1
FBSB201000	20	1000	2.6
FBSB241000	24	1000	3.7
FBSB241200	24	1200	4.5
FBSB281170	28	1170	5.9
FBSB281400	28	1400	7.1
FBSB321330	32	1330	8.8
FBSB321600	32	1600	10.6
FBSB361600	36	1600	13.4
FBSB401800	40	1800	18.5



- + Forge Bar Starter bars come with a Type A Thread.
- + Forge Bar Starter Bars are delivered including a thread protection cap.
- + Forge Bar starter Bars can also be ordered with a Coupler installed, please add "-A" to item number.



PSA FORGE BAR SYSTEM COMPONENTS

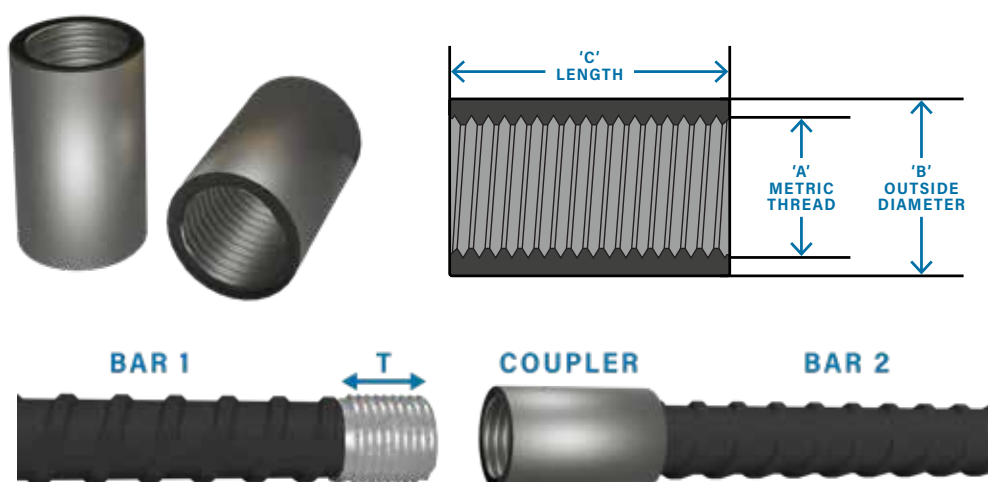
PSA FORGE BAR COUPLERS

PSA Forge Bar Couplers provide an efficient solution for connecting PSA Forge Bars, eliminating the need for splicing in reinforced concrete. Made from high-strength alloy, they deliver reliable load transfer and structural integrity under demanding conditions. Their slim product design reduces reinforcement congestion and maximizes cover for durability and compliance.

Galvanized finish for superior corrosion resistance, PSA couplers are designed for seamless integration with PSA Forge Bars. They simplify installation, ensure a secure fit with metric-threaded bars, and significantly reduce construction time. Designed and rigorously tested to comply with the stringent requirements of AS 3600 Cl 13.2.6, these couplers achieve a "bar break" failure mode and exhibit minimal slip under load.

The end surfaces of all couplers are colour coded to allow easy identification of the coupler size on the job.

PSA FORGE BAR COUPLER RANGE							
PART NO.	DESCRIPTION	BODY LENGTH C	BODY DIAMETER B	THREAD LENGTH T	NOMINAL THREAD A	SUITS BAR	COMPATIBLE NAILING PLATE
		(mm)	(mm)	(mm)	(mm)		
FBC12	PSA Forge Bar Coupler 12mm, Purple	30	20.0	15	M14 x 2.0	FB12 / FBSB12	FBNP12
FBC16	PSA Forge Bar Coupler 16mm, Blue	40	25.0	20	M20 x 2.5	FB16 / FBSB16	FBNP16
FBC20	PSA Forge Bar Coupler 20mm, Yellow	48	30.5	24	M24 x 3.0	FB20 / FBSB20	FBNP20
FBC24	PSA Forge Bar Coupler 24mm, Black	60	38.0	30	M30 x 3.5	FB24 / FBSB24	FBNP24
FBC28	PSA Forge Bar Coupler 28mm, Brown	66	42.5	33	M33 x 3.5	FB28 / FBSB28	FBNP28
FBC32	PSA Forge Bar Coupler 32mm, White	72	47.0	36	M36 x 4.0	FB32 / FBSB32	FBNP32
FBC36	PSA Forge Bar Coupler 36mm, Green	85	55.5	42.5	M42 x 4.0	FB36 / FBSB36	FBNP36
FBC40	PSA Forge Bar Coupler 40mm, Orange	90	58	45	M45 x 4.0	FB40 / FBSB40	FBNP40



PSA can supply Forge Bar Couplers pre-assembled with standard or custom-length tail bars upon request, catering to specific project requirements and simplifying on-site installation.



+ CONNECTION TYPES

PSA FORGE BAR COUPLER CONNECTION - TYPE A



Type A Connection is the standard solution for achieving full-strength reinforcement bar joints in a wide range of applications. Its installation requires that the second bar (Bar 2) can be freely rotated to engage the threaded connection.

System Components - The connection comprises two reinforcement bars with Type A threads—either FB Bars or FBSB Starter Bars of standard length—and one FBC Coupler. This configuration ensures reliable performance and seamless integration within reinforced concrete systems.

PSA FORGE BAR COUPLER CONNECTION - TYPE C

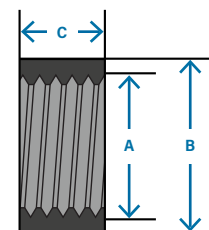


Type C Connection is designed for reinforcement bar applications where the second bar (Bar 2) cannot be freely rotated during installation. This scenario typically arises when Bar 2 is bent or when large-diameter bars are used, making unrestricted rotation impractical due to their weight and geometry.

Connection Components The system consists of:

- + One bar FBC1 with a Type C1 thread (half coupler length plus full lock nut length)
- + One bar FBC2 with a Type C2 thread (full coupler length plus full lock nut length)
- + One coupler FBC
- + Two lock nuts FBLN

PSA FORGE BAR - LOCK NUTS				
PART NO.	DESCRIPTION	BODY LENGTH C	BODY DIAMETER B	NOMINAL THREAD A
		(mm)	(mm)	(kg)
FBLN12	PSA Forge Bar Lock Nut 12mm	12	20.0	M14 x 2.0
FBLN16	PSA Forge Bar Lock Nut 16mm	12	25.0	M20 x 2.5
FBLN20	PSA Forge Bar Lock Nut 20mm	12	30.5	M24 x 3.0
FBLN24	PSA Forge Bar Lock Nut 24mm	15	38.0	M30 x 3.5
FBLN28	PSA Forge Bar Lock Nut 28mm	15	42.5	M33 x 3.5
FBLN32	PSA Forge Bar Lock Nut 32mm	15	47.0	M36 x 4.0
FBLN36	PSA Forge Bar Lock Nut 36mm	20	55.5	M42 x 4.0
FBLN40	PSA Forge Bar Lock Nut 40mm	20	58	M45 x 4.0





+ INSTALLATION

INSTALLATION OF TYPE A CONNECTIONS

STEP 1



If the first bar is not already supplied with a coupler installed, screw the coupler on the bar.

STEP 2



Screw the second bar into the coupler by rotating the bar, tighten by hand or wrench. No more than 1 thread should be exposed once tightened.

INSTALLATION OF TYPE C CONNECTIONS

STEP 1



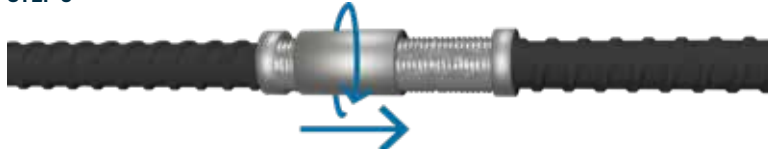
Screw the lock nut and the coupler to the threaded section of the bar with the type C2 thread. The bar end should be flush with the open end of the coupler.

STEP 2



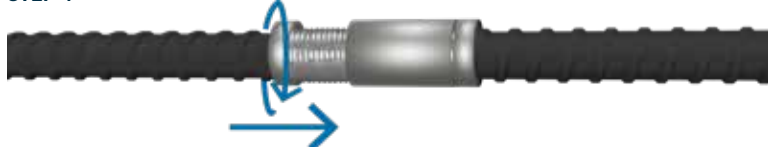
Screw the second lock nut on the bar with the type C1 thread. The lock nut should be screwed to the end of the thread.

STEP 3



Locate the second bar centrally against the open end of the coupler and rotate the coupler on the second bar. Lock the lock nut and the coupler against each other.

STEP 4



Lock the second lock nut against the coupler.



+ PSA FORGE BAR INSERTS

PSA Forge Bar Inserts provide a simple, efficient, and effective solution for wall-slab connections in both precast and in-situ applications. This system eliminates the numerous inefficiencies and complications associated with traditional coggled or hooked bar wall-slab connections.

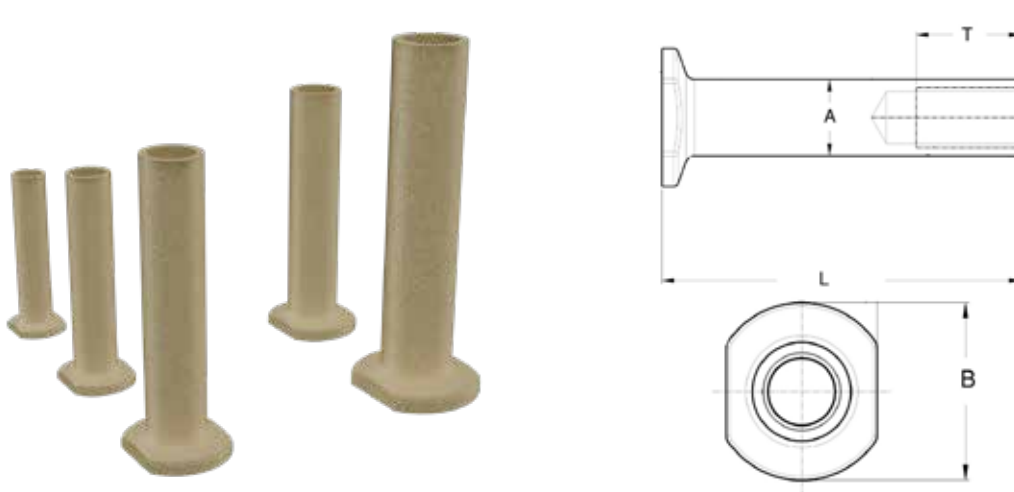
PSA Forge Bar Inserts are designed to achieve a concrete pull-out capacity that exceeds the yield capacity of grade 500N reinforcing bar, resulting in a ductile failure mode as required by AS 3600 – CI 19.3.

FEATURES AND BENEFITS

- + PSA Forge Bar Inserts are available for bar diameters: 12mm, 16mm and 20mm.**
- + Easy installation to jump forms and other types of formwork, with three available installation options:**
 - + Plastic nailing plates**
 - + Single-use bar boxes (pre-assembled with PSA Forge Bar Inserts)**
 - + Reusable polyurethane rebate boards.**
- + No drilling through formwork required.**
- + Eliminates on-site bar re-bending and associated risks.**
- + Metric thread minimises slip.**
- + All capacity data has been verified through independent third-party testing and analytical calculations, conducted in accordance with the methodologies outlined in AS 3600, AS 3850, and AS 5216.**

PSA FORGE BAR - FBI FORGE BAR INSERTS RANGE

PART NO.	DESCRIPTION	BODY LENGTH	BODY DIAMETER A	MAX FOOT DIAMETER B	NOMINAL THREAD	THREAD LENGTH T	SUITS BAR	COMPATIBLE NAILING PLATE
		(mm)	(mm)	(mm)	(mm)	(mm)		
FBI12-100	PSA Forge Bar Insert 12mm, 100mm long, Purple	100	20	34	M14 x 2.0	25	FB12 / FBSB12	FBNP12
FBI16-120	PSA Forge Bar Insert 16mm, 120mm long, Blue	120	25	46	M20 x 2.5	35	FB16 / FBSB16	FBNP16
FBI16-160	PSA Forge Bar Insert 16mm, 160mm long, Blue	160	25	46	M20 x 2.5	35	FB16 / FBSB16	FBNP16
FBI20-150	PSA Forge Bar Insert 20mm, 150mm long, Yellow	150	31	55	M24 x 3.0	40	FB20/ FBSB20	FBNP20
FBI20-190	PSA Forge Bar Insert 20mm, 190mm long, Yellow	190	31	55	M24 x 3.0	40	FB20/ FBSB20	FBNP20



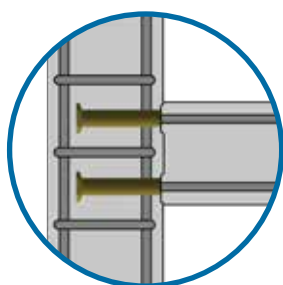


+ INSTALLATION OPTIONS

Forge Bar Inserts are primarily used in the joint zones between reinforced concrete slabs and walls to ensure structural continuity of reinforcement. Their integration helps maintain the integrity of load transfer across slab-to-wall interfaces.

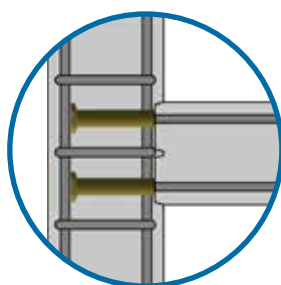
Depending on the construction methodology and preferences of the crew, there are three safe and reliable methods for connecting Forge Bar Inserts to wall formwork prior to wall casting:

PLASTIC NAILING PLATES



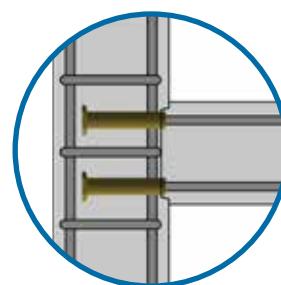
Forge Bar Inserts are connected to the wall formwork using TLP Nailing Plates.

SINGLE-USE BAR BOX



Bar Boxes, pre-assembled with Forge Bar Inserts are connected to the formwork.

RE-USABLE REBATE BOARD



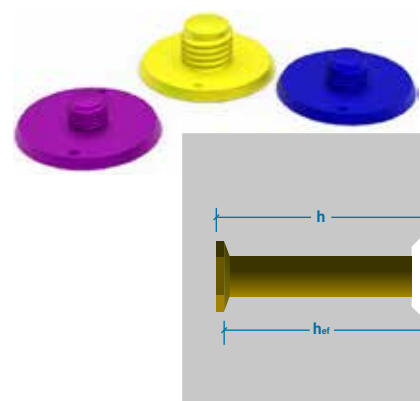
Re-usable Rebate Boards, preassembled with Forge Bar Inserts are connected to the formwork.

+ PLASTIC NAILING PLATES

Plastic Nailing Plates offer a solution for installing single or multiple Forge Bar Inserts onto timber or steel formwork. Their design also allows for secure attachment to recess formers when a shear key is required, facilitating structural continuity.

With a thickness of 8 mm, the nailing plates contribute to increased effective embedment depth (h_{ef}) of the Forge Bar Inserts, promoting improved anchorage capacity within the concrete structure.

In addition to their primary function, nailing plates can be utilized to mount starter bars equipped with FBC Couplers, further streamlining reinforcement installation and improving alignment during the casting process.



USE OF PSA FORGE BAR INSERTS WITH PLASTIC NAILING PLATES

PART NO. FBI	PART NO. NAILING PLATE	COLOUR	THICKNESS	TOTAL EMBEDMENT DEPTH h	EFFECTIVE EMBEDMENT DEPTH h_{ef}	MINIMUM WALL THICKNESS
			(mm)	(mm)	(mm)	(mm)
FBI12-100	FBNP12	Purple	8	108	104	150
FBI16-120	FBNP16	Blue	8	128	123	160
FBI16-160	FBNP16	Blue	8	168	163	200
FBI20-150	FBNP20	Yellow	8	158	152	190
FBI20-190	FBNP20	Yellow	8	198	192	230

+ PSA Nailing Plates for the Forge Bar System named after the bar size they fit.

+ FBNP Nailing plates in larger sizes to be used in conjunction with FBC Couplers are available on request.



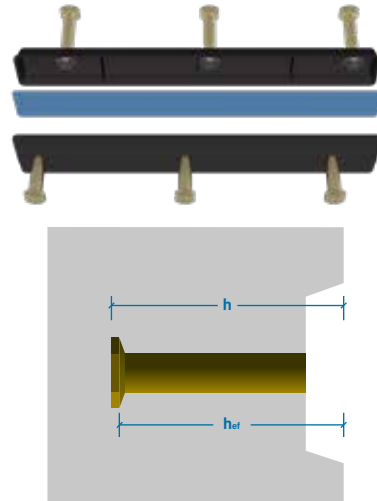
+ SINGLE-USE BAR BOXES(PRE-ASSEMBLED WITH FORGE BAR INSERTS)

Single-use Bar Boxes pre-assembled with PSA Forge Bar Inserts provide means to an efficient onsite installation.

Forge Bar Inserts are assembled on to the bar boxes using disposable plastic bolts. Starter bars can be screwed into the Forge Bar Inserts once the bolts are taken out post-pour.

ADVANTAGES

- + Facilitates 30mm recess for slab connections
- + Plastic housing and cap prevents concrete slurry leakage
- + Delivered to site fully assembled and ready for installation
- + Fast and easy installation onto formwork or reinforcement cage
- + Fast and easy post pour stripping
- + Available in a wide range of insert sizes and spacings
- + No need for bending of bars unlike pull out box connections
- + In-expensive sacrificial boxes
- + PSA Bar Boxes can be cut and sealed where needed



USE OF PSA FBI INSERTS WITH SINGLE-USE BAR BOXES

PART NO. FBI	TOTAL EMBEDMENT DEPTH (h)	EFFECTIVE EMBEDMENT DEPTH (h_{eff})	MINIMUM WALL THICKNESS
	(mm)	(mm)	(mm)
FBI12-100	130	126	160
FBI16-120	150	145	180
FBI16-160	190	185	220
FBI20-150	180	174	210
FBI20-190	220	214	250

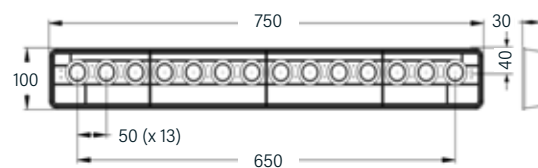
ITEM NOMENCLATURE FOR SPECIFICATION

Ex: BB16-120FBI3-300

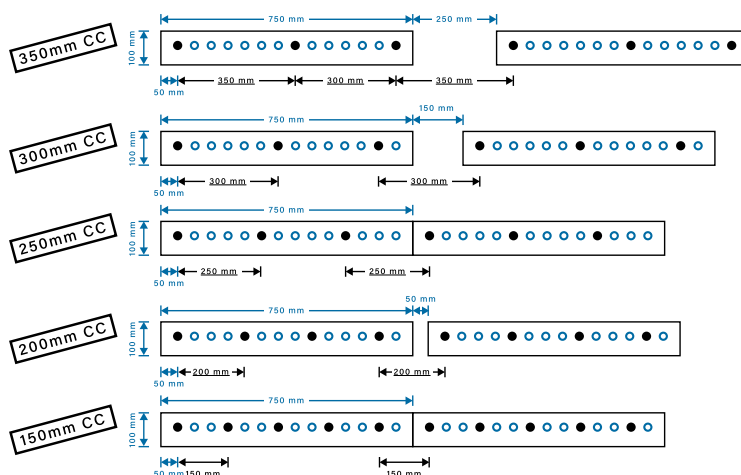
Bar box with 3 x FBI16-120 assembled @300 spacing

BB16-120FBI3-300 ← Spacing

↑ Insert Size ↑ No. of Inserts in a single bar box



PSA BAR BOX INSTALLATION FOR DIFFERENT SPACING APPLICATIONS





+ RE-USABLE POLYURETHANE REBATE BOARDS

Reusable rebate boards are the ideal solution when using Forge Bar Inserts for slab-wall connections in jump form systems. The rebate board features a series of slots to accommodate a single size of Forge Bar Inserts at various spacing configurations. Forge Bar Inserts can easily be pushed into these slots prior to the wall concrete pour.

Additionally, rebate boards are equipped with screw holes for installation onto formwork and M20 threaded bolt slots for jacking bolts used during stripping.

ADVANTAGES

- + Customized to suit various sizes and arrangements
- + Re-usable for multiple levels and projects
- + Fast and easy installation onto rolling shutters/jump forms
- + Remains in jump form when each level is typical
- + No need for bending of bars unlike pull out box connections
- + Suitable for 12mm, 16mm and 20mm Forge Bar Inserts

CRITICAL DIMENSIONS - 14MM RECESSED

PART NO.	TOTAL EMBEDMENT DEPTH (h)	EFFECTIVE EMBEDMENT DEPTH (h_{ef})	MINIMUM PANEL THICKNESS
	(mm)	(mm)	(mm)
FBI12-100	114	110	150
FBI16-120	134	129	175
FBI16-160	174	169	210
FBI20-150	164	158	200
FBI20-190	204	198	240

ITEM NOMENCLATURE FOR PLACING ORDERS

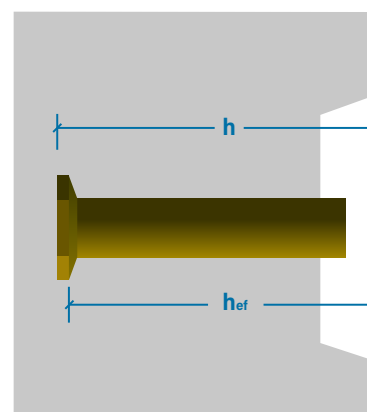
Ex: RB901000-3050FBI16S

90 wide x 1000 long x 30 deep Polyurethane Rebate Board – Slots at 50mm Centres – To Suit FBI16-xxx PSA Forge Bar Inserts

RB **90** **1000** **-30** **50** **FBI** **16** **S**

Width Length Depth Slot Spacing Insert Size

'S' - Single row
'D' - Double row



- •
- •

CONNECTION DESIGN

Connections with PSA Forge Bar Inserts need to be designed to conform AS3600 Clause 19.3.1

Above clause requires connections to yield prior to ultimate failure in the event of overload, thus achieving a ductile failure mode. Hence, all connections should satisfy below;

$$N^* \leq \phi_s N_s \leq \phi_c N_c$$

N^* = Tensile load

$$\phi_s = 0.85$$

N_s = Yield capacity reinforcement bar*

$$\phi_c = 0.6$$

N_c = Forge Bar Insert concrete capacity

* - The steel capacity of FBI Inserts always exceeds the tensile strength of the reinforcement bars.

PSA in conjunction with Swinburne University of Technology, conducted pullout testing on PSA Forge Bar Inserts to assess failure modes and determine the characteristic concrete tensile capacity of the Inserts. All tests were performed in reinforced concrete members with a reinforcement density that represents the minimum amount of reinforcement that would be found in a typical wall. Through analysing the outcomes of the test program, it was concluded that the performance of the Forge Bar Inserts exceeded the results of the design methods outlined in AS3850.1 Appendix B and this methodology can be adopted to calculate modified capacities for various Insert arrangements.

DIRECT TENSILE CONNECTIONS

When headed inserts are subjected to direct tensile loads, concrete failure typically occurs in a cone type failure mode. AS3850.1 Appendix B provide guidelines to determine concrete capacities based on this failure mode. Concrete cone capacity of a headed insert heavily depend on the concrete compressive strength, effective embedment depth, edge distance and spacing restrictions. Extensive research has been conducted to establish the relationship of these factors with concrete cone capacity. These relationships in combination with the tested capacities were used to determine capacities of PSA Forge Bar Inserts in various Insert arrangements.

To account for the increased design capacity provided by wall reinforcement, a formula incorporating embedment depth and concrete strength was developed. The capacities shown for all embeds with an embedment depth greater than 100mm on the following pages are calculated using this formula.

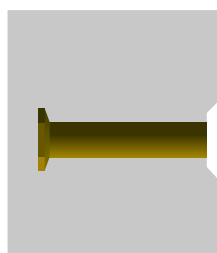
Refer to the design capacity tables **on page 13** for capacities relating to various Insert arrangements. All concrete capacities presented in this document includes a reduction factor $\phi_c = 0.6$, unless noted otherwise.

Concrete design capacities exceeding the yield capacity of reinforcement bar are highlighted in green in the design capacity tables. In applications where capacity of the connection is limited by the concrete design capacity, supplementary reinforcement is required to achieve a ductile connection.

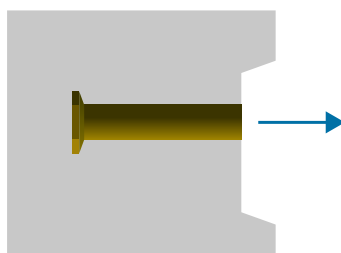
All concrete capacities published in this document relate to concrete compressive strength of 40MPa. To calculate the design capacity values for other common concrete compressive strengths, multiply the relevant design capacity value by A_c factor given in the table below.

The factor can be applied to the concrete capacities (on blue background) only!

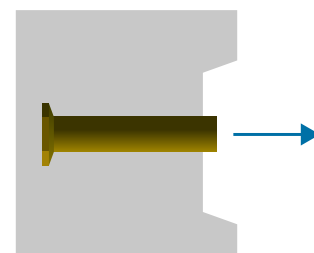
CONCRETE COMPRESSIVE STRENGTH EFFECT					
f'_c (MPa)	20	25	32	40	50
A_c	0.71	0.79	0.89	1.00	1.12



Direct tensile load on Forge Bar Inserts installed with nailing plates



Direct tensile load on Forge Bar Inserts installed with bar box



Direct tensile load on Forge Bar Inserts installed with rebate boards



DIRECT TENSILE CONCRETE CAPACITY DATA

Forge Bar Inserts installed with Screw-on Nailing Plate - 8mm recessed

PART NO.	BAR DIA. (mm)	BODY LENGTH (mm)	EFFECTIVE DEPTH (mm)	REDUCED ULTIMATE TENSILE CAPACITY @40MPa(kN)							
				ANCHOR SPACING C/C (mm)							
				150	200	250	300	350	400	450	500
FBI12-100	12	100	104	28.2	37.6	47.0	48.1	48.1	48.1	48.1	48.1
FBI16-120	16	120	123	32.2	43.0	53.7	64.5	75.2	79.3	84.4	85.5
FBI16-160	16	160	163	37.3	49.7	62.1	74.6	85.5	85.5	85.5	85.5
FBI20-150	20	150	152	35.9	47.9	59.9	71.8	83.8	95.8	107.7	115.9
FBI20-190	20	190	192	43.9	58.5	73.2	87.8	102.5	117.1	131.7	133.5

Forge Bar Inserts installed with Bar Box - 30mm recessed

PART NO.	BAR DIA. (mm)	BODY LENGTH (mm)	EFFECTIVE DEPTH (mm)	REDUCED ULTIMATE TENSILE CAPACITY @40MPa(kN)							
				ANCHOR SPACING C/C (mm)							
				150	200	250	300	350	400	450	500
FBI12-100	12	100	126	30.4	40.5	48.1	48.1	48.1	48.1	48.1	48.1
FBI16-120	16	120	145	34.4	45.9	57.3	68.8	80.2	85.5	85.5	85.5
FBI16-160	16	160	185	42.3	56.4	70.5	84.6	85.5	85.5	85.5	85.5
FBI20-150	20	150	174	39.8	53.1	66.3	79.6	92.9	106.1	119.4	132.6
FBI20-190	20	190	214	48.9	65.3	81.6	97.9	114.2	130.5	133.5	133.5

Forge Bar Inserts installed with re-usable polyurethane rebate boards - 14mm recessed

PART NO.	BAR DIA. (mm)	BODY LENGTH (mm)	EFFECTIVE DEPTH (mm)	REDUCED ULTIMATE TENSILE CAPACITY @40MPa(kN)							
				ANCHOR SPACING C/C (mm)							
				150	200	250	300	350	400	450	500
FBI12-100	12	100	126	29.0	38.7	48.1	48.1	48.1	48.1	48.1	48.1
FBI16-120	16	120	145	33.0	44.0	55.0	66.0	77.0	85.2	85.5	85.5
FBI16-160	16	160	185	38.7	51.5	64.4	77.3	85.5	85.5	85.5	85.5
FBI20-150	20	150	174	36.6	48.8	61.0	73.2	85.4	97.6	109.9	120.5
FBI20-190	20	190	214	45.3	60.4	75.5	90.6	105.7	120.8	133.5	133.5

- + Displayed design values include material safety factor of 0.85 for Steel and 0.6 for concrete.
- + Green background indicates ductile failure of the reinforcement bar.
- + Values based on testing in reinforced concrete.
- + All capacities are based on the assumption that concrete is un-cracked where the inserts are embedded.
- + Where bar yield cannot be achieved, supplementary reinforcement may be provided close to the insert to achieve ductile failure.

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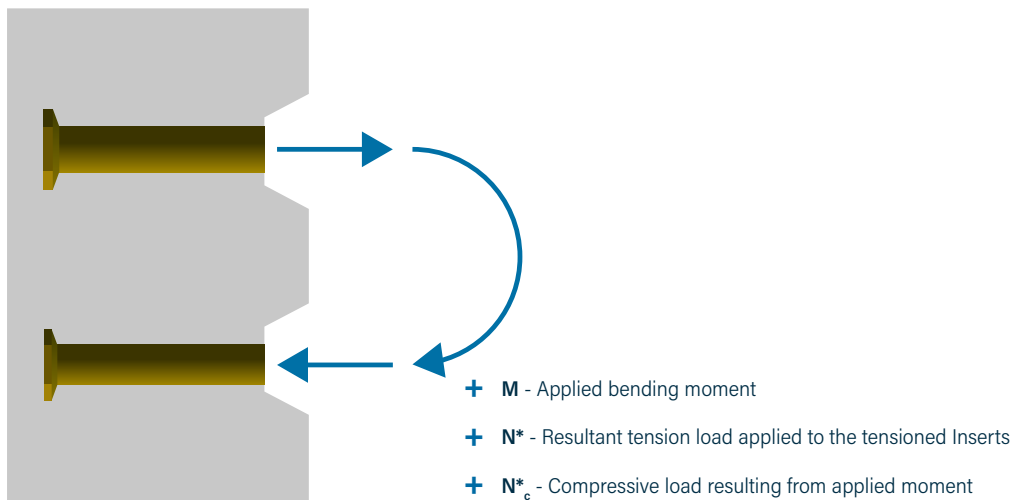
MOMENT CONNECTIONS

When PSA Forge Bar Inserts are used for slab-wall moment connections, Insert subjected to tensile load resulting from the applied moment, achieve an enhanced concrete cone capacity due to the adjacent compression load resulting from the moment.

Enhancement effect on concrete cone capacity can be quantified using the ψ_{MN} factor given in Clause 7.2.1.4(7) of EN1992-4 and Clause 6.2.3.7 of AS5216. Both standards provide similar instructions for calculating the enhancement effect and hence considered in the design capacities presented in **pages 15 to 17** in this document.

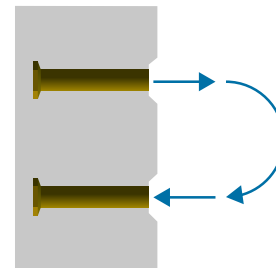
Ensure the following conditions are met prior to adopting the moment connection design capacities of PSA Forge Bar Inserts for design applications.

- + Edge distance to the Insert shall exceed $1.5 \times h_{ef}$
- + $N^*/N^* > 0.8$
- + Moment capacity of the wall shall be adequate to resist the applied bending moment
- + Concrete cover of slab main reinforcement is assumed to be 30mm. Contact PSA for applications with different concrete cover values
- + All capacities are based on the assumption that concrete is un-cracked where the Inserts are embedded
- + Capacity reduction factor(ϕ) of 0.6 for concrete failure and 0.85 for failure of the reinforcement bar included in all design capacity values



All concrete capacities published in this document relate to concrete compressive strength of 40MPa. To calculate the design capacity values for other common concrete compressive strengths, multiply the relevant design capacity value by A_c factor given in the table below.

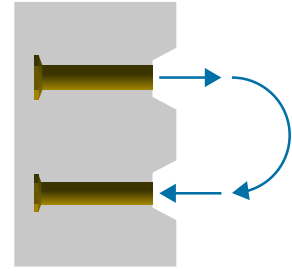
CONCRETE COMPRESSIVE STRENGTH EFFECT					
f'_c (MPa)	20	25	32	40	50
A_c	0.71	0.79	0.89	1.00	1.12



FORGE BAR INSERTS INSTALLED WITH SCREW-ON NAILING PLATE IN MOMENT CONNECTION - 8MM RECESS

SLAB THICKNESS (mm)	FBI INSERT	BODY LENGTH (mm)	REDUCED ULTIMATE TENSILE CAPACITY @40MPa(kN)							
			ANCHOR SPACING C/C (mm)							
			150	200	250	300	350	400	450	500
175	FBI12-100	100	35.3	47.1	48.1	48.1	48.1	48.1	48.1	48.1
	FBI16-120	120	44.4	59.3	74.1	85.5	85.5	85.5	85.5	85.5
	FBI16-160	160	54.6	72.8	85.5	85.5	85.5	85.5	85.5	85.5
	FBI20-150	150	54.1	72.1	90.1	108.1	126.2	133.5	133.5	133.5
	FBI20-190	190	62.8	83.7	104.6	125.6	133.5	133.5	133.5	133.5
200	FBI12-100	100	31.5	41.9	48.1	48.1	48.1	48.1	48.1	48.1
	FBI16-120	120	40.7	54.3	67.8	81.4	85.5	85.5	85.5	85.5
	FBI16-160	160	51.5	68.6	85.5	85.5	85.5	85.5	85.5	85.5
	FBI20-150	150	50.7	67.6	84.5	101.4	118.3	133.5	133.5	133.5
	FBI20-190	190	59.9	79.9	99.8	119.8	133.5	133.5	133.5	133.5
225	FBI12-100	100	28.4	37.9	47.4	48.1	48.1	48.1	48.1	48.1
	FBI16-120	120	37.0	49.3	61.6	73.9	85.5	85.5	85.5	85.5
	FBI16-160	160	48.4	64.5	80.6	85.5	85.5	85.5	85.5	85.5
	FBI20-150	150	47.3	63.1	78.9	94.7	110.4	126.2	133.5	133.5
	FBI20-190	190	57.0	76.0	95.0	114.0	133.0	133.5	133.5	133.5
250	FBI12-100	100	28.4	37.9	47.4	48.1	48.1	48.1	48.1	48.1
	FBI16-120	120	33.2	44.3	55.4	66.4	77.5	81.7	84.4	85.5
	FBI16-160	160	45.2	60.3	75.4	85.5	85.5	85.5	85.5	85.5
	FBI20-150	150	44.0	58.6	73.3	87.9	102.6	117.2	131.9	133.5
	FBI20-190	190	54.1	72.1	90.2	108.2	126.3	133.5	133.5	133.5
275	FBI12-100	100	28.4	37.9	47.4	48.1	48.1	48.1	48.1	48.1
	FBI16-120	120	32.5	43.3	54.1	64.9	75.7	79.9	84.4	85.5
	FBI16-160	160	42.1	56.2	70.2	84.3	85.5	85.5	85.5	85.5
	FBI20-150	150	40.6	54.1	67.7	81.2	94.7	108.3	121.8	123.4
	FBI20-190	190	51.2	68.3	85.4	102.4	119.5	133.5	133.5	133.5
300	FBI12-100	100	28.4	37.9	47.4	48.1	48.1	48.1	48.1	48.1
	FBI16-120	120	32.5	43.3	54.1	64.9	75.7	79.9	84.4	85.5
	FBI16-160	160	39.0	52.0	65.0	78.0	85.5	85.5	85.5	85.5
	FBI20-150	150	37.2	49.6	62.1	74.5	86.9	99.3	111.7	115.9
	FBI20-190	190	48.3	64.4	80.5	96.6	112.8	128.9	133.5	133.5

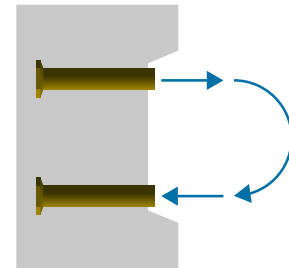
- + Displayed design values include material safety factor of 0.85 for Steel and 0.6 for concrete.
- + Green background indicates ductile failure of the reinforcement bar.
- + Values based on testing in reinforced concrete.
- + All capacities are based on the assumption that concrete is un-cracked where the inserts are embedded.
- + Where bar yield cannot be achieved, supplementary reinforcement may be provided close to the insert to achieve ductile failure.



FORGE BAR INSERTS INSTALLED WITH BAR BOXES IN MOMENT CONNECTION - 30MM RECESS

SLAB THICKNESS (mm)	FBI INSERT	BODY LENGTH (mm)	REDUCED ULTIMATE TENSILE CAPACITY @40MPa(kN)							
			ANCHOR SPACING C/C (mm)							
			150	200	250	300	350	400	450	500
175 ¹	FBI12-100	100	41.8	48.1	48.1	48.1	48.1	48.1	48.1	48.1
	FBI16-120	120	50.4	67.2	83.9	85.5	85.5	85.5	85.5	85.5
	FBI16-160	160	59.2	78.9	85.5	85.5	85.5	85.5	85.5	85.5
	FBI20-150	150	59.1	78.8	98.5	118.2	133.5	133.5	133.5	133.5
	FBI20-190	190	66.9	89.2	111.5	133.5	133.5	133.5	133.5	133.5
200 ¹	FBI12-100	100	38.4	48.1	48.1	48.1	48.1	48.1	48.1	48.1
	FBI16-120	120	47.0	62.7	78.3	85.5	85.5	85.5	85.5	85.5
	FBI16-160	160	56.3	75.1	85.5	85.5	85.5	85.5	85.5	85.5
	FBI20-150	150	56.0	74.7	93.4	112.0	130.7	133.5	133.5	133.5
	FBI20-190	190	64.2	85.6	107.0	128.4	133.5	133.5	133.5	133.5
225	FBI12-100	100	35.0	46.6	48.1	48.1	48.1	48.1	48.1	48.1
	FBI16-120	120	43.6	58.2	72.7	85.5	85.5	85.5	85.5	85.5
	FBI16-160	160	53.4	71.3	85.5	85.5	85.5	85.5	85.5	85.5
	FBI20-150	150	52.9	70.6	88.2	105.9	123.5	133.5	133.5	133.5
	FBI20-190	190	61.5	82.0	102.5	123.0	133.5	133.5	133.5	133.5
250	FBI12-100	100	31.6	42.1	48.1	48.1	48.1	48.1	48.1	48.1
	FBI16-120	120	40.3	53.7	67.1	80.6	85.5	85.5	85.5	85.5
	FBI16-160	160	50.6	67.4	84.3	85.5	85.5	85.5	85.5	85.5
	FBI20-150	150	49.8	66.5	83.1	99.7	116.3	132.9	133.5	133.5
	FBI20-190	190	58.8	78.4	98.0	117.6	133.5	133.5	133.5	133.5
275	FBI12-100	100	30.4	40.5	48.1	48.1	48.1	48.1	48.1	48.1
	FBI16-120	120	36.9	49.2	61.5	73.9	85.5	85.5	85.5	85.5
	FBI16-160	160	47.7	63.6	79.5	85.5	85.5	85.5	85.5	85.5
	FBI20-150	150	46.8	62.4	77.9	93.5	109.1	124.7	133.5	133.5
	FBI20-190	190	56.1	74.8	93.5	112.2	130.9	133.5	133.5	133.5
300	FBI12-100	100	30.4	40.5	48.1	48.1	48.1	48.1	48.1	48.1
	FBI16-120	120	34.4	45.9	57.3	68.8	80.2	85.5	85.5	85.5
	FBI16-160	160	44.8	59.8	74.7	85.5	85.5	85.5	85.5	85.5
	FBI20-150	150	43.7	58.2	72.8	87.4	101.9	116.5	131.0	133.5
	FBI20-190	190	53.4	71.2	89.0	106.8	124.6	133.5	133.5	133.5

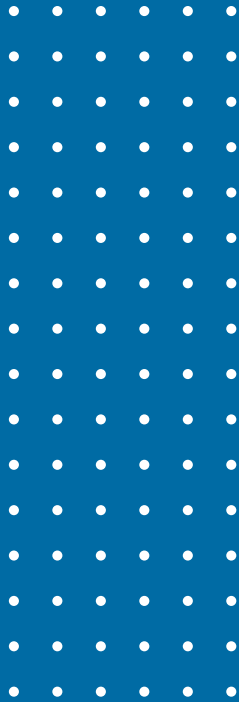
- + Slab thicknesses of 175mm and 200mm require custom rebate boards, no PSA Bar Box available for this size. (*)
- + Displayed design values include material safety factor of 0.85 for Steel and 0.6 for concrete.
- + Green background indicates ductile failure of the reinforcement bar.
- + Values based on testing in reinforced concrete.
- + All capacities are based on the assumption that concrete is un-cracked where the inserts are embedded.
- + Where bar yield cannot be achieved, supplementary reinforcement may be provided close to the insert to achieve ductile failure.



FORGE BAR INSERTS INSTALLED WITH RE-USABLE REBATE BOARD IN MOMENT CONNECTION - 14MM RECESS

SLAB THICKNESS (mm)	FBI INSERT	BODY LENGTH (mm)	REDUCED ULTIMATE TENSILE CAPACITY @40MPa(kN)							
			ANCHOR SPACING C/C (mm)							
			150	200	250	300	350	400	450	500
175	FBI12-100	100	37.2	48.1	48.1	48.1	48.1	48.1	48.1	48.1
	FBI16-120	120	46.2	61.5	76.9	85.5	85.5	85.5	85.5	85.5
	FBI16-160	160	55.9	74.5	85.5	85.5	85.5	85.5	85.5	85.5
	FBI20-150	150	55.5	74.0	92.5	111.0	129.5	133.5	133.5	133.5
	FBI20-190	190	63.9	85.3	106.6	127.9	133.5	133.5	133.5	133.5
200	FBI12-100	100	33.5	44.7	48.1	48.1	48.1	48.1	48.1	48.1
	FBI16-120	120	42.5	56.7	70.9	85.1	85.5	85.5	85.5	85.5
	FBI16-160	160	52.9	70.5	85.5	85.5	85.5	85.5	85.5	85.5
	FBI20-150	150	52.2	69.6	87.0	104.4	121.9	133.5	133.5	133.5
	FBI20-190	190	61.1	81.5	101.8	122.2	133.5	133.5	133.5	133.5
225	FBI12-100	100	29.8	39.7	48.1	48.1	48.1	48.1	48.1	48.1
	FBI16-120	120	38.9	51.9	64.8	77.8	85.5	85.5	85.5	85.5
	FBI16-160	160	49.8	66.4	83.0	85.5	85.5	85.5	85.5	85.5
	FBI20-150	150	48.9	65.3	81.6	97.9	114.2	130.5	133.5	133.5
	FBI20-190	190	58.3	77.7	97.1	116.5	133.5	133.5	133.5	133.5
250	FBI12-100	100	29.0	38.7	48.1	48.1	48.1	48.1	48.1	48.1
	FBI16-120	120	35.3	47.0	58.8	70.6	82.3	85.5	85.5	85.5
	FBI16-160	160	46.8	62.4	78.0	85.5	85.5	85.5	85.5	85.5
	FBI20-150	150	45.7	60.9	76.1	91.3	106.5	121.8	133.5	133.5
	FBI20-190	190	55.4	73.9	92.4	110.9	129.4	133.5	133.5	133.5
275	FBI12-100	100	29.0	38.7	48.1	48.1	48.1	48.1	48.1	48.1
	FBI16-120	120	33.0	44.0	55.0	66.0	77.0	85.2	85.5	85.5
	FBI16-160	160	43.7	58.3	72.9	85.5	85.5	85.5	85.5	85.5
	FBI20-150	150	42.4	56.5	70.6	84.7	98.9	113.0	127.1	133.5
	FBI20-190	190	52.6	70.1	87.7	105.2	122.7	133.5	133.5	133.5
300	FBI12-100	100	29.0	38.7	48.1	48.1	48.1	48.1	48.1	48.1
	FBI16-120	120	33.0	44.0	55.0	66.0	77.0	85.2	85.5	85.5
	FBI16-160	160	40.7	54.3	67.8	81.4	85.5	85.5	85.5	85.5
	FBI20-150	150	39.1	52.1	65.2	78.2	91.2	104.2	117.3	123.5
	FBI20-190	190	49.8	66.4	82.9	99.5	116.1	132.7	133.5	133.5

- + Displayed design values include material safety factor of 0.85 for Steel and 0.6 for concrete.
- + Green background indicates ductile failure of the reinforcement bar.
- + Values based on testing in reinforced concrete.
- + All capacities are based on the assumption that concrete is un-cracked where the inserts are embedded.
- + Where bar yield cannot be achieved, supplementary reinforcement may be provided close to the insert to achieve ductile failure.



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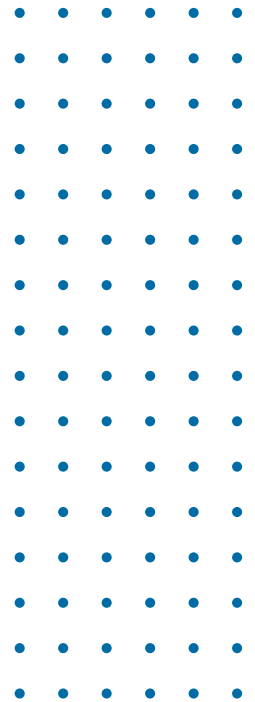
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