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KS Threaded Anchors

For the Construction Industry

Ancon®

BUILDING PRODUCTS

Ancon KS Threaded Anchors

REINFORCEMENT CONTINUITY AT CONSTRUCTION JOINTS

The use of Ancon KS Threaded Anchors with BT threaded reinforcing bars can simplify concrete design at construction joints, typically in wall-to-slab applications.

The anchor is cast into the face of the concrete wall. When the formwork and thread protection is removed, the reinforcing bar is screwed into the anchor. Once all other reinforcement is installed, the adjoining slab is cast to complete the installation.

This system eliminates the need to drill either formwork or concrete. It replaces cogged or hooked bar ends simplifying bar scheduling and can be used to minimise congestion in the wall.

Alternatively, the Ancon KS Anchor can be used to provide a high capacity fixing point for a standard metric bolt.

CONTENTS

COMPONENTS

KS Threaded Anchor

The KS Threaded Anchor is machined from solid bright drawn steel bar. The head is hot forged. It complies with AS 3600: 2009, whereby the area under the anchor head must be at least ten times the cross-sectional area of the reinforcing bar for it to be considered fully anchored.

There are five anchors in the KS range, comprising two thread sizes and three lengths.

The KS12 and KS16 are the core anchors in the range. The shorter versions of these anchors have the suffix 'S' i.e. KS12S and KS16S, and are suitable for use in a 150mm core wall. The longest anchor in the range is the KS16L which has been designed for use where the standard embedment offered by the KS16 is insufficient for the performance required.

Minimum Wall Thickness

Anchor Ref.	Anchor Length mm	Min. Wall Thickness mm
KS12S / KS16S	106	150
KS12 / KS16	130	200
KS16L	144	200

Note: *Where the anchors are installed within a Keybox metal casing, the minimum wall thickness shall be 225mm*

Threaded Bar

KS Anchors are designed for use with 12mm and 16mm grade 500 reinforcing bar, threaded with a BT metric thread. The BT system produces a full strength joint. The bar end is cut square and enlarged by cold forging. This increases the core diameter of the bar to ensure that the joint is stronger than the bar. Parallel metric threads are cut onto the enlarged ends. The threaded ends are protected by an external plastic sheath. An M16 thread is cut onto an 12mm bar and an M20 on an 16mm bar.

Standard lengths, 40 times the bar diameter, are held in stock. The maximum bar length is 6000mm.

Specification Clause

Headed Anchors shall be KS Threaded Anchors as manufactured by Ancon Building Products. Reinforcement shall be BT Thread Continuation Bars as manufactured by Ancon Building Products.

INSTALLATION METHODS

The anchors can be installed in a number of ways. Selection is based on various factors including quantity, spacing and embedment depth. In all methods, the internal threads of the anchor are protected until they are required.

Welded Bar

KS Anchors can be supplied welded, at the designed spacing, to a flat steel bar. The bar is nailed directly to the formwork which installs the anchors flush with the concrete face. This method is ideal for use where the anchors are being used to provide a metric bolt attachment. A plastic end cap protects the thread.

Keyblock

KS Anchors can be installed, at the designed spacing, using the Ancon Keyblock, a re-useable HDPE mould. The Keyblock protects the internal threads until they are required. It is then removed and retained for use elsewhere on the same site or on a future project. This method increases the load capacity of the anchor by providing an additional embedment of 5mm from the face of the concrete.

Individual Nailing Plate

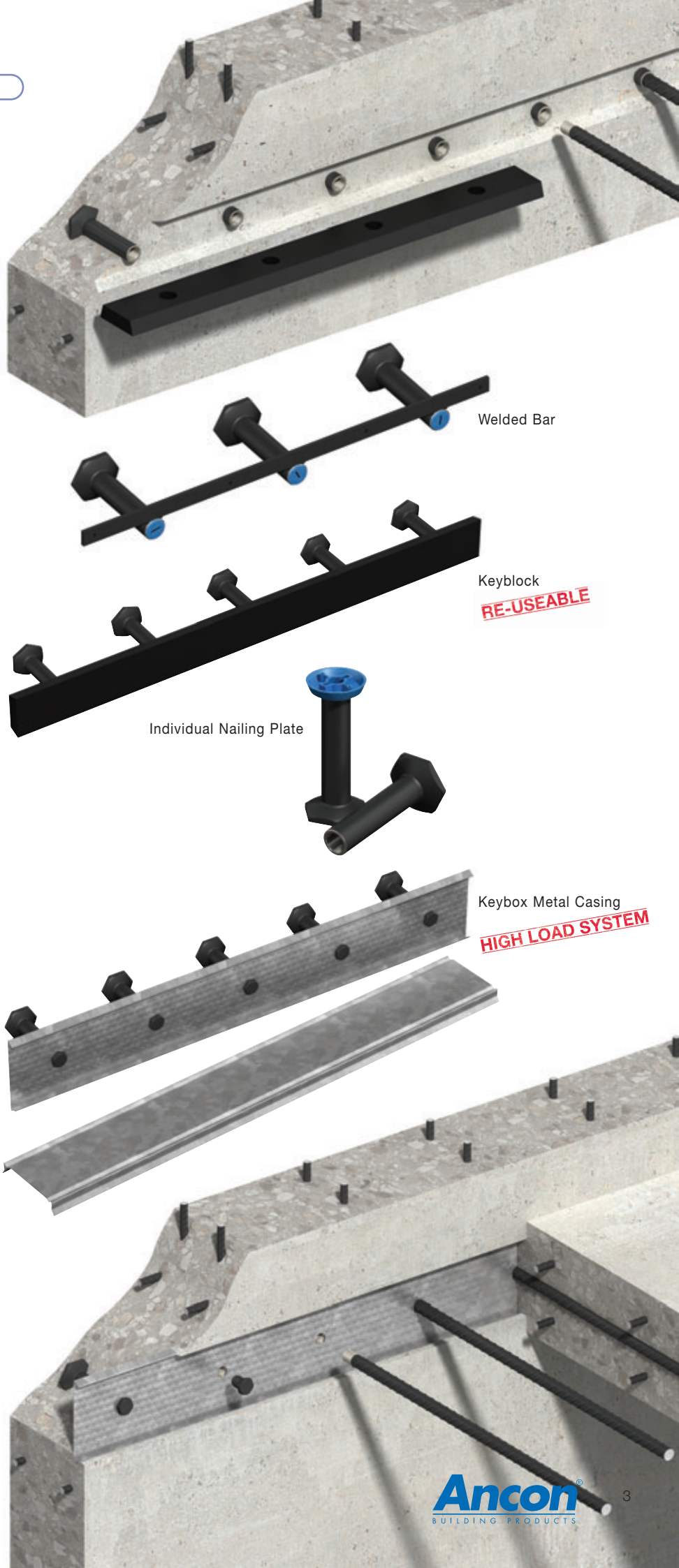
KS Anchors can be installed individually with a plastic nailing plate. This method provides an additional embedment of 10mm, but requires anchors to be spaced on site. This method is ideal for the individual fixing application or where a line of anchors are to be installed at considerable centres.

Keybox Metal Casing

KS Anchors can be supplied, at the designed spacing, in an Ancon Keybox metal casing. This installation method provides the highest load capacity. The galvanised steel casing provides the anchors with an additional 36mm embedment. This casing remains embedded in the wall and is filled with concrete when the next section is poured. The dimpled surface of the casing provides an efficient key and each end of the unit is sealed in order to prevent the ingress of concrete.

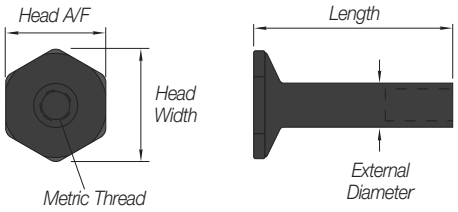
Additional Embedment Given

Installation Method	Additional Embedment
Welded to Rail	None
Re-useable Moulding	5mm
Individual Nailing Plate	10mm
Keybox Metal Casing	36mm



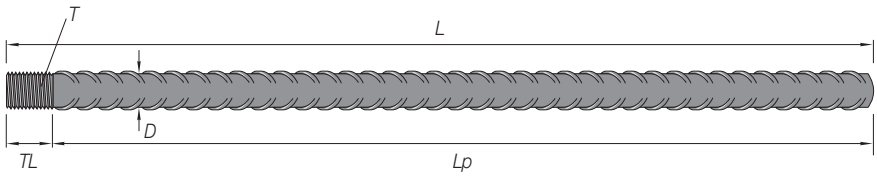
Ancon KS Threaded Anchors

DIMENSIONS



KS Threaded Anchor Dimensions

Anchor Ref.	Anchor Length (mm)		External Diameter (mm)	Metric Thread	Head Width (mm)	Head A/F (mm)
KS12S	Short	106	21	M16x2.0	52	45
KS12	Standard	130	21	M16x2.0	52	45
KS16S	Short	106	28	M20x2.5	65	58
KS16	Standard	130	28	M20x2.5	65	58
KS16L	Long	144	28	M20x2.5	65	58



BT Thread Continuation Bars Dimensions

Anchor Ref.	Bar Diameter (D)	Thread Size (T)	Thread Length (TL)	Length 40D (Lp)	Total Length (L)
KS12S KS12	12mm	M16	16mm	480mm	496mm
KS16S KS16 KS16L	16mm	M20	20mm	640mm	660mm

PERFORMANCE

Tensile Cone Theory

The pull out strength of anchors embedded in concrete has been the subject of extensive research and testing over many years. To determine the pull out strength of KS Anchors, Ancon commissioned a test programme at the Heriot Watt University, UK[1]. The test results and subsequent analysis aligned closely with established formula[2] for the pull out strength of anchors.

The pull out strength is based on a model with a break out prism angle of approximately 35 degrees.

The anchor ultimate concrete tensile load $N_{ULT,c}$ is determined from the formula:

$N_{ULT,c} = k_1 \cdot f_{ck}^{0.5} \cdot h_{ef}^{1.5}$

Where:

$N_{ULT,c}$ is the anchor ultimate tensile strength of a single anchor remote from edge effects (kN)

f_{ck} is the characteristic concrete cylinder compressive strength (MPa)

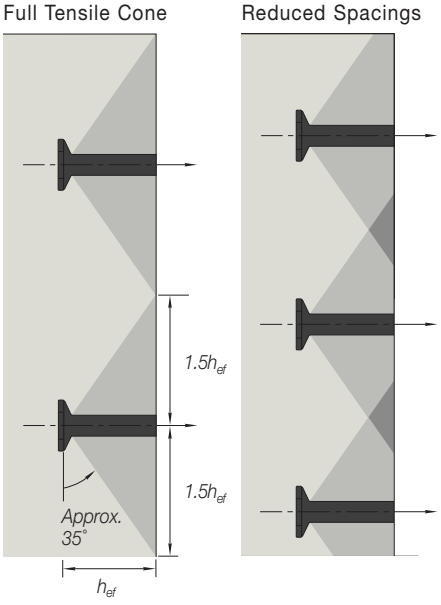
h_{ef} is the effective embedment depth of the anchor (mm)

k_1 is an empirical coefficient determined from test results

To achieve the maximum anchor load the required minimum spacing is three times the effective embedment depth of the anchor h_{ef}.

Although the KS Anchor can create an anchorage that is stronger than the reinforcing bar, it should be noted that when the spacing of adjacent anchors, or the position of edge distances, affect the development of the full cone, the anchor capacity will be reduced. Load data for reduced anchor spacing is provided in the tables on page 5.

KS Anchor Spacings



Reinforcement Characteristic Yield Load

Bar Diameter	Yield Load (kN)
12	56.5
16	100.5

[1] *Report of Structural Tests of Keybox Studs (KS Anchors), Heriot Watt University, Edinburgh UK. Author: Dr J Cairns*

[2] *CEB Design of Fastenings to Concrete & Masonry Structure, Thomas Telford, London and the American Concrete institute. ACI 318-08 Building Code Requirements for Structural Concrete, Appendix D. ACI Michigan USA*

Design Example

The tensile ultimate loads are the concrete pull out loads in tension and require the necessary reduction factor to be applied in accordance with AS3600 to arrive at the tensile design resistance for the anchor at any given spacing.

KS16L Anchor with Keybox Metal Casing

Anchor spacing = 250mm

Direct tensile ultimate load (see table) = 82kN

Apply partial safety factor (reduction factor Φ) in accordance with AS3600, shown in this instance to be 0.70.

Direct tensile resistance load = 0.70 x 82 = 57.4kN

The applied factored loads must not exceed the direct tensile resistance load.

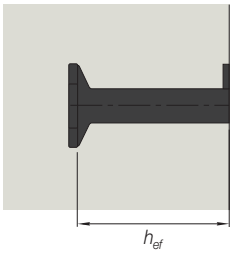
Embedment Depth

By increasing the embedment depth, the capacity of the KS Anchor can be improved. The following tables provide the tensile design resistance for the four installation methods.

Embedment Depth h_{ef} =
Anchor Length – Head Thickness (6mm) +
Additional Embedment

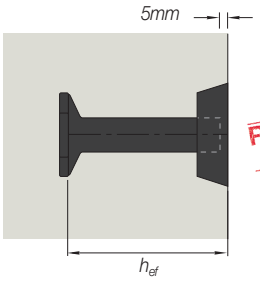
KS Anchors with Welded Bar (Flush With Concrete)

Anchor Ref.	Metric Thread	Rebar Dia. (mm)	Embedment Depth h_{ef} (mm)	Direct Tensile Ultimate Load $N_{ULT,c}$ (kN) 32MPa Concrete at Various Anchor Spacing (mm)						
				150	200	250	300	350	400	450
KS12S	M16x2.0	12	100	37.1	48.3	59.5	70.7	70.7	70.7	70.7
KS16S	M20x2.5	16	100	37.1	48.3	59.5	70.7	70.7	70.7	70.7
KS12	M16x2.0	12	124	42.3	54.8	67.2	79.7	92.2	97.6	97.6
KS16	M20x2.5	16	124	42.3	54.8	67.2	79.7	92.2	97.6	97.6
KS16L	M20x2.5	16	138	45.2	58.3	71.5	84.6	97.8	110.9	114.6



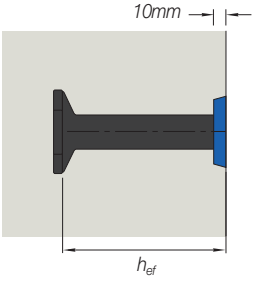
KS Anchors with Keyblock (Additional 5mm Embedment)

Anchor Ref.	Metric Thread	Rebar Dia. (mm)	Embedment Depth h_{ef} (mm)	Direct Tensile Ultimate Load $N_{ULT,c}$ (kN) 32MPa Concrete at Various Anchor Spacing (mm)						
				150	200	250	300	350	400	450
KS12S	M16x2.0	12	105	38.2	49.7	61.2	72.6	76.1	76.1	76.1
KS16S	M20x2.5	16	105	38.2	49.7	61.2	72.6	76.1	76.1	76.1
KS12	M16x2.0	12	129	43.3	56.0	68.8	81.5	94.2	103.6	103.6
KS16	M20x2.5	16	129	43.3	56.0	68.8	81.5	94.2	103.6	103.6
KS16L	M20x2.5	16	143	46.2	59.6	73.0	86.4	99.8	113.2	120.9



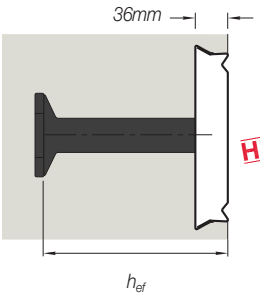
KS Anchors with Individual Nailing Plate (Additional 10mm Embedment)

Anchor Ref.	Metric Thread	Rebar Dia. (mm)	Embedment Depth h_{ef} (mm)	Direct Tensile Ultimate Load $N_{ULT,c}$ (kN) 32MPa Concrete at Various Anchor Spacing (mm)						
				150	200	250	300	350	400	450
KS12S	M16x2.0	12	110	39.3	51.0	62.8	74.5	81.6	81.6	81.6
KS16S	M20x2.5	16	110	39.3	51.0	62.8	74.5	81.6	81.6	81.6
KS12	M16x2.0	12	134	44.4	57.3	70.3	83.2	96.2	109.2	109.7
KS16	M20x2.5	16	134	44.4	57.3	70.3	83.2	96.2	109.2	109.7
KS16L	M20x2.5	16	148	47.2	60.8	74.5	88.1	101.7	115.3	127.3



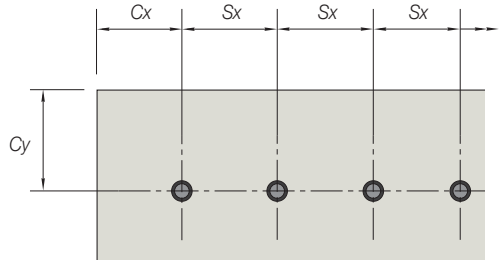
KS Anchors with Keybox Metal Casing (Additional 36mm Embedment)

Anchor Ref.	Metric Thread	Rebar Dia. (mm)	Embedment Depth h_{ef} (mm)	Direct Tensile Ultimate Load $N_{ULT,c}$ (kN) 32MPa Concrete at Various Anchor Spacing (mm)						
				150	200	250	300	350	400	450
KS12	M16x2.0	12	160	49.6	63.8	78.0	92.1	106.3	120.4	134.6
KS16	M20x2.5	16	160	49.6	63.8	78.0	92.1	106.3	120.4	134.6
KS16L	M20x2.5	16	174	52.4	67.2	82.0	96.7	111.5	126.3	141.0

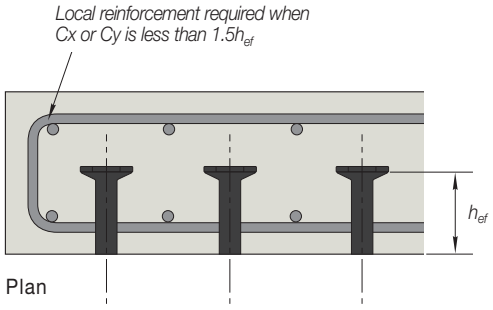


Note:

These ultimate concrete tensile load figures $N_{ULT,c}$ assume that either (1) a minimum edge distance Cx or Cy is provided and is equal to or greater than 1.5 X h_{ef} or (2) the close edge is reinforced locally, see page 7.



Elevation



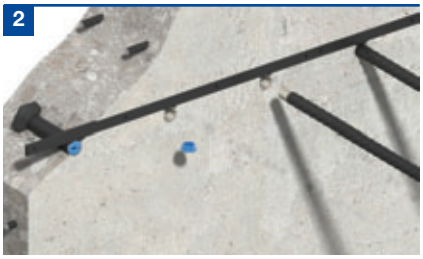
Plan

Ancon KS Threaded Anchors

INSTALLATION PROCEDURE

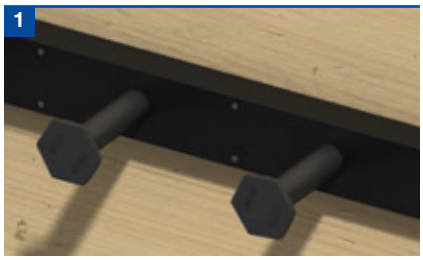
Welded Bar

The welded unit is nailed to the formwork using all fixing holes. The necessary reinforcement is installed, the concrete is cast and once it reaches sufficient strength, the formwork is removed.



When a connection is required, the end cap on each KS Anchor is removed to reveal the threads.

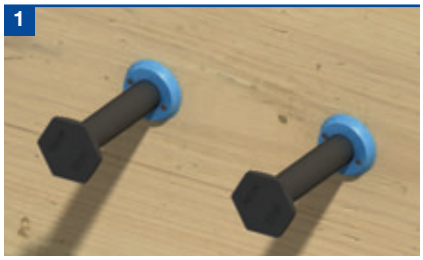
Re-Useable Keyblock



KS Anchors are inserted into the Ancon Keyblock. The unit is then nailed to the formwork. The necessary reinforcement is installed, the concrete is cast and once it reaches sufficient strength, the formwork is removed.

When a connection is required, the Keyblock is removed and retained for future use.

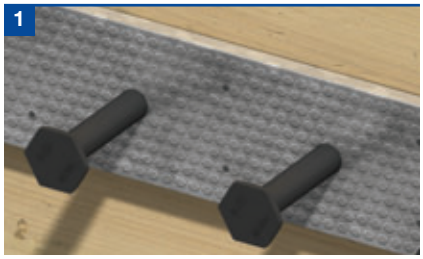
Individual Nailing Plate



The end cap on the KS Anchors is removed and replaced by a Nailing Plate. The unit is then nailed to the formwork. The necessary reinforcement is installed, the concrete is cast and once it reaches sufficient strength, the formwork is removed.

When a connection is required, the Nailing Plate is removed to reveal the threads.

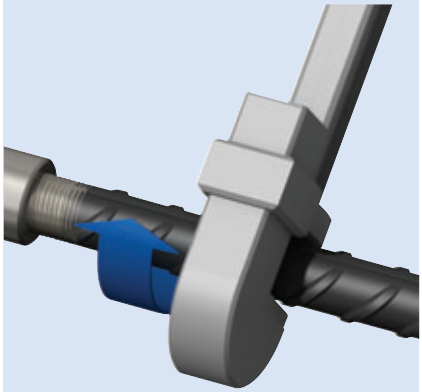
Keybox Metal Casing



Nail the casing tight to the formwork. The necessary reinforcement is then installed, the concrete is cast and once it reaches sufficient strength, the formwork is removed to reveal the steel cover.

When a connection is required, the cover is removed and the bolts which originally held the Anchors to the casing prior to installation are removed to reveal the threads.

Step 3 Continuation Bar Installation

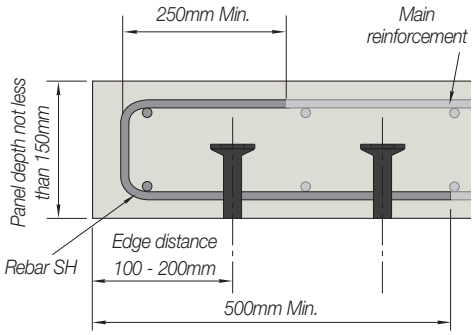


The BT threaded reinforcing bar is rotated into the KS Anchor and tightened using a wrench. No more than 2mm of thread should be left exposed on the bar. Fix the slab reinforcement and pour the concrete to complete the installation.

REINFORCEMENT DETAILS

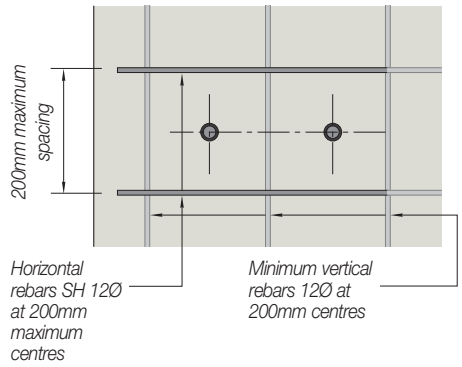
Correct detailing of reinforcement in accordance with appropriate design codes and the recommendations provided here will ensure Ancon KS Anchors attain the designed performance.

Section

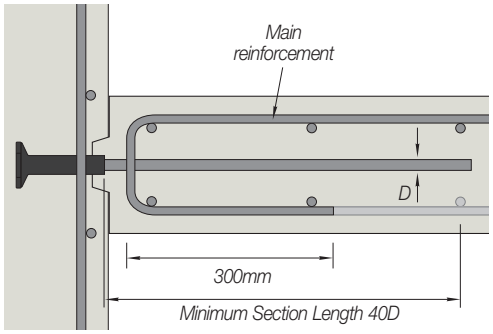


Reinforcement: *Minimum edge reinforcement, 12Ø diameter Grade 500N. The main reinforcement can be detailed to incorporate the above shape noted as rebar SH.*

Elevation



Section

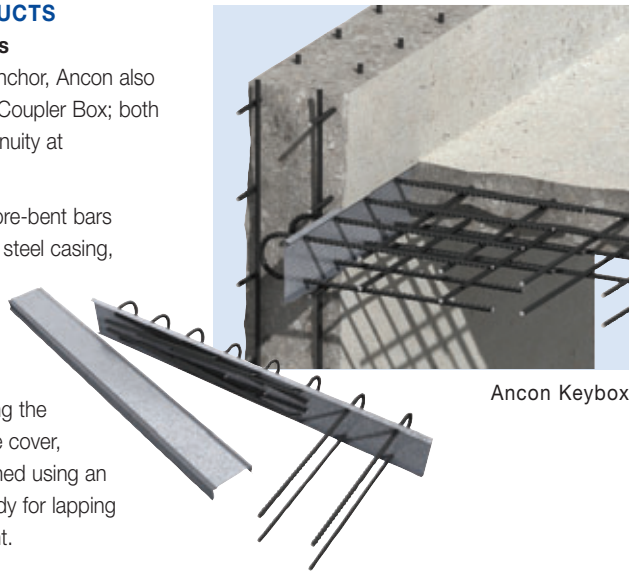


OTHER ANCON PRODUCTS

Other Continuity Systems

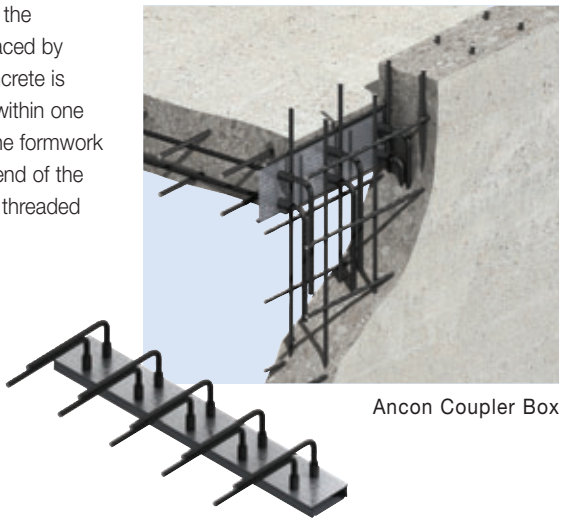
As alternatives to the KS Anchor, Ancon also manufactures Keybox and Coupler Box; both provide reinforcement continuity at construction joints.

Ancon Keybox comprises pre-bent bars housed within a galvanised steel casing, enclosed by a protective cover and sealed at each end. Anchorage in the concrete is provided by the U-shaped bars. After striking the formwork and removing the cover, the bent bars are straightened using an Ancon re-bending tool, ready for lapping onto the main reinforcement.



Ancon Keybox

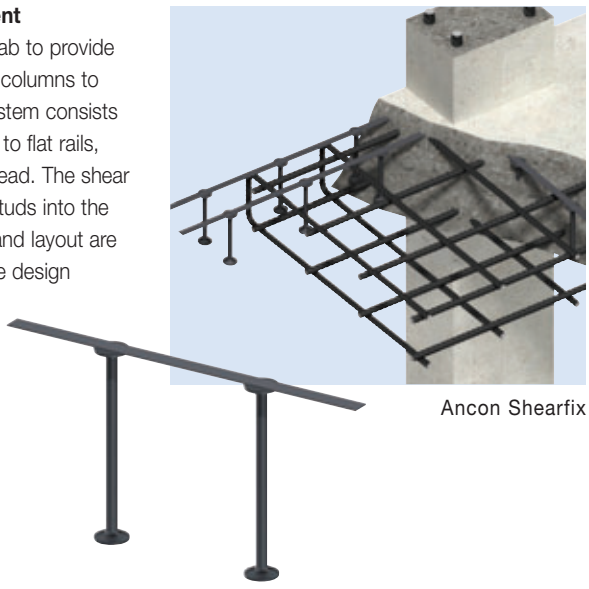
An Ancon Coupler Box is similar to the Keybox, but the bent bars are replaced by BT Couplers. Anchorage in the concrete is provided by hooked bars installed within one half of the couplers. After striking the formwork and removing the cover, the other end of the Coupler is revealed to accept a BT threaded continuation bar, as used in the KS Anchor system.



Ancon Coupler Box

Punching Shear Reinforcement

Ancon Shearfix is used with a slab to provide additional reinforcement around columns to alleviate punching shear. The system consists of double-headed studs welded to flat rails, positioned around the column head. The shear load is transferred through the studs into the column. Dimensions, spacings and layout are determined by calculation. A free design program is available from Ancon to simplify specification.



Ancon Shearfix

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