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A CRH COMPANY

Enhanced Performance Loads in Slab-to-Wall Moment Connections

Ancon®

KSN Anchors

Reinforcement Continuity System

September 2021

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KSN Anchors

Safer, faster, simpler construction joints

Ancon KSN Anchors, in combination with Ancon BT parallel-threaded reinforcing bars, offer designers the opportunity to simplify concrete slab-to-wall construction joints, when compared to traditional methods.

KSN Anchors are cast into the concrete wall and, when the formwork and thread protection are removed, the reinforcing bars are simply screwed into the anchors. This is a quicker, easier and above all, safer solution. It eliminates the drilling of formwork or concrete and the dangers associated with projecting bars and on-site bar straightening. The system replaces cogged or hooked bar ends, thereby simplifying bar scheduling and minimises congestion in the wall. The rebate formed in the wall can also improve the quality of the joint.

In addition to their use in direct tensile applications, KSN Anchors have been independently tested in moment connections where they provide enhanced performance. See page 11 for further information.

KSN Anchors may also be suitable for other applications where a cast-in threaded insert is required.

Traditional slab-to-wall construction method.

Projecting reinforcing bars and congestion in the wall.

High performance KSN Anchor System

Bars are installed when required. No bending of bars. Less congestion in the wall.

Ancon KSN Anchors are designed to create an anchorage exceeding the tensile capacity of Grade 500N reinforcement bars to create a ductile failure mechanism as specified in AS 3600:2018 - clause 19.3. Traditional threaded inserts are too short and normally can't meet the design requirement for reinforcement connections.

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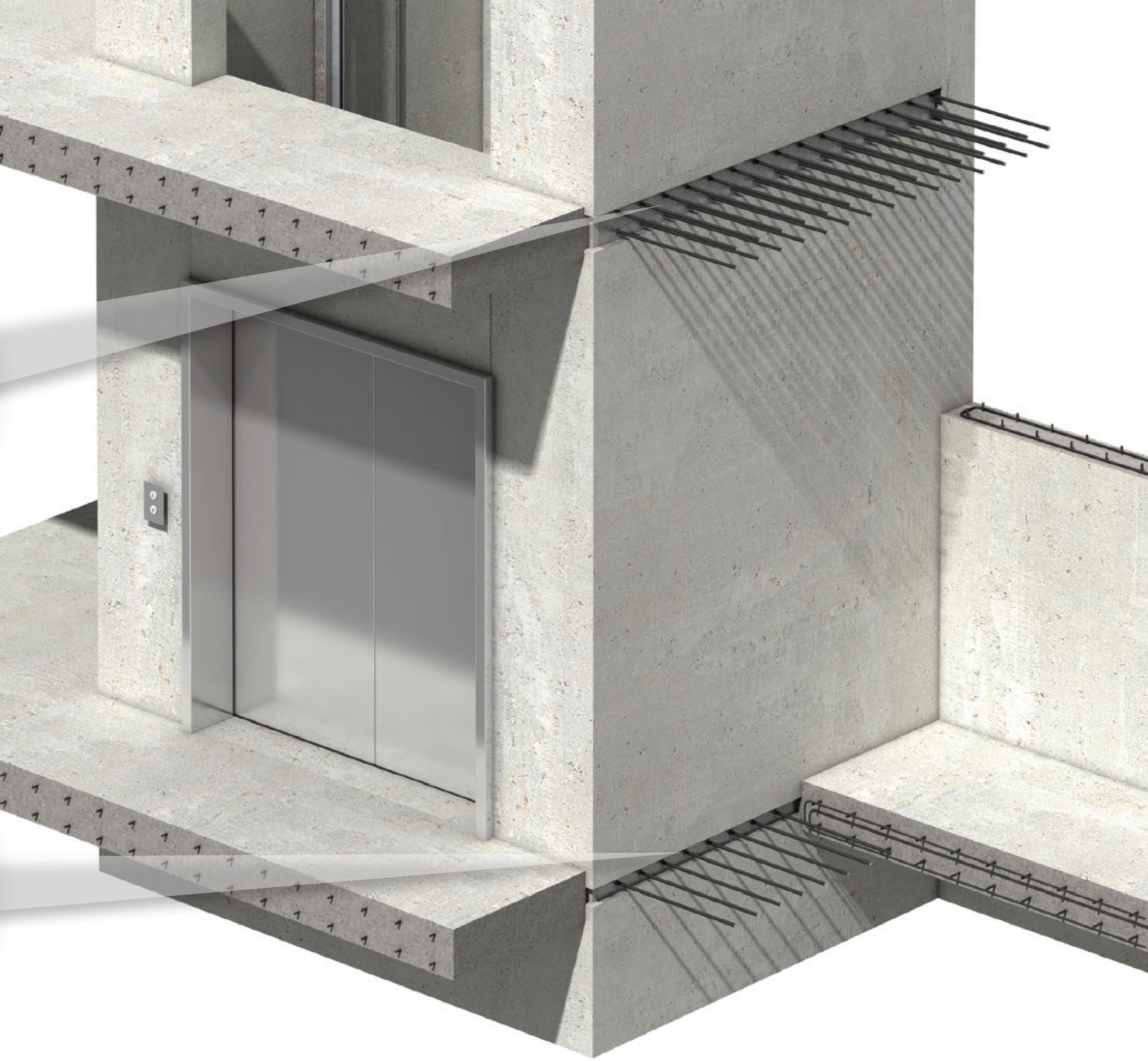


Eliminates risks associated with on-site bar straightening

Standard components for 'just-in-time' site delivery, direct from stock

Compatible with rebar up to 20mm diameter (bigger sizes available on request)

No drilling of formwork or concrete required

Reduces the dangers of exposed projecting rebars

Based on the design principles of AS 3600

Certainty of performance provided by comprehensive test data

Replaces cogged or hooked bars to simplify bar scheduling

Visual check of correct bar engagement

Ancon BT thread minimises slip

Reusable rebate former available

Anchor head exceeds requirements of AS 3600

Ancon KSN Anchors

Ancon KSN Anchors, in combination with BT parallel-threaded reinforcing bars, simplify concrete slab-to-wall construction joints when compared to traditional methods. This quicker, easier and above all, safer operation, eliminates the need for on-site bar straightening and the drilling of formwork or concrete. The system replaces cogged or hooked bar ends, thereby simplifying bar scheduling and minimising congestion in the wall.

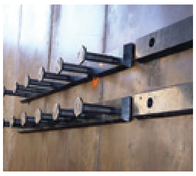
System Design

Standards require anchorages for bars and fixings to be designed for both strength and ductility. Ductile design requires the steel to fail by plastic yielding before brittle concrete failure.

$N \le \phi_S N_S \le \phi_C N_C$ where $\phi_S = 0.8$, $\phi_C = 0.6$

Associated References:

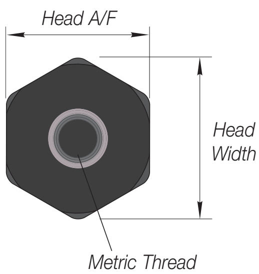
AS 3600 Clause 19.3.1(c): Fixings shall be designed to yield before ultimate failure in the event of overload. Clause 19.3.3, cast-in fixings shall be designed in accordance with AS 3850.1, Appendix B.

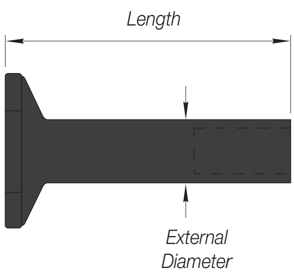


System Components

KSN Anchor

The KSN Anchor is machined from tough, high reliability, hot forged Cr-Mo alloy steel, with minimum 15% elongation, to form a blank that is subsequently hot forged to form the head. There are eight standard anchors in the KSN range to suit the requirements of most applications.





Minimum Wall Thickness

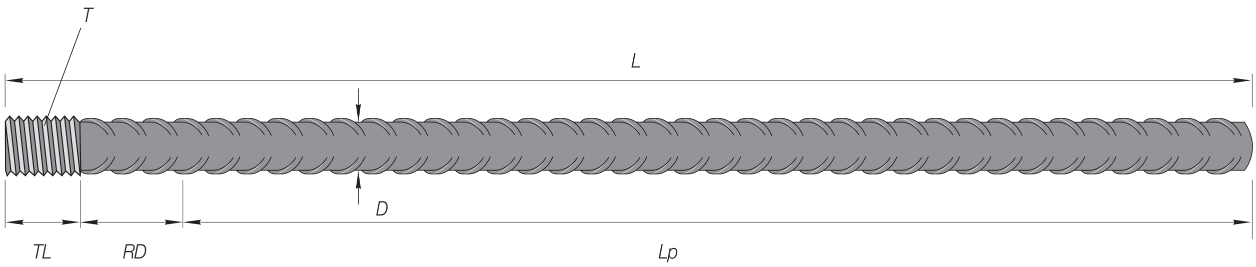
Anchor Part No.	Anchor Length mm	Min. Wall Thickness mm KSNBLOCK	Min. Wall Thickness mm KSNBOX
KSN12S	115	200	185
KSN12M	150	200	220
KSN16S	130	200	200
KSN16M	160	200	230
KSN16L	190	225	260
KSN20S	150	200	220
KSN20M	190	225	260
KSN20L	230	265	300

Note. Wall thicknesses of less than 200mm are possible, but cannot be used with the enhanced loads available in slab/wall moment connections due to the limited moment capacity of the walls. The minimum wall thickness for KSN12S, KSN16S and KSN20S used in direct tension are ***150mm***, ***160mm*** *and* ***180mm*** *respectively, for anchors cast flush with the face of the concrete. Minimum thicknesses based on minimum 30mm cover.*

Ancon KSN Anchor Dimensions

Anchor Part No.	Anchor Length (mm)	Nominal External Diameter (mm)	Metric Thread (mm)	Nominal Head Width (mm)	Nominal Head A/F (mm)
KSN12S	115	21	M14 x 2.0	46	40
KSN12M	150				
KSN16S	130	28	M20 x 2.5	61	53
KSN16M	160				
KSN16L	190				
KSN20S	150	32	M24 x 3.0	75	65
KSN20M	190				
KSN20L	230				

Note: Ancon KSN Anchors for bar diameters 24, 28 and 32mm are available on request.



Ancon BT Starter Bars

Ancon KSN Anchors are designed for use with 12mm, 16mm and 20mm diameter grade 500N reinforcing bar, threaded with Ancon BT metric threads. The Ancon 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 threaded portion of the bar to ensure that the strength of the bar is maintained. A parallel metric thread is cut onto the enlarged bar end. This process guarantees a ductile failure in the bar. For more information on the Ancon BT Coupler system please download the Ancon Reinforcing Bar Coupler brochure.

Ancon BT Starter Bars in standard lengths as shown in the table are held in stock. Non-standard bar lengths are available on request.

Ancon BT Starter Bars - Standard Dimensions

Part No.	Anchor Ref.	Bar Diameter (D)	Thread Length (TL)	Rebate Depth* (RD)	Required lap length** (Lp)	Standard Ancon cont. bar length (L)
BTTHB12535	KSN12	12mm	14mm	36mm	435mm	535mm
BTTHB16700	KSN16	16mm	20mm	36mm	624mm	700mm
BTTHB201000	KSN 20	20mm	24mm	36mm	850mm	1000mm

*Note: Custom bar lengths are available on request.*Rebate depth (RD) based on application with KSN Anchor Box - KSN Anchor Block, Nailing Plate and Welded Bar applications allow for shorter rebates. **Required lap lengths are determined based on a lap splice (AS 3600 - section 13.2.2) in 40MPa concrete and 25mm concrete cover.*

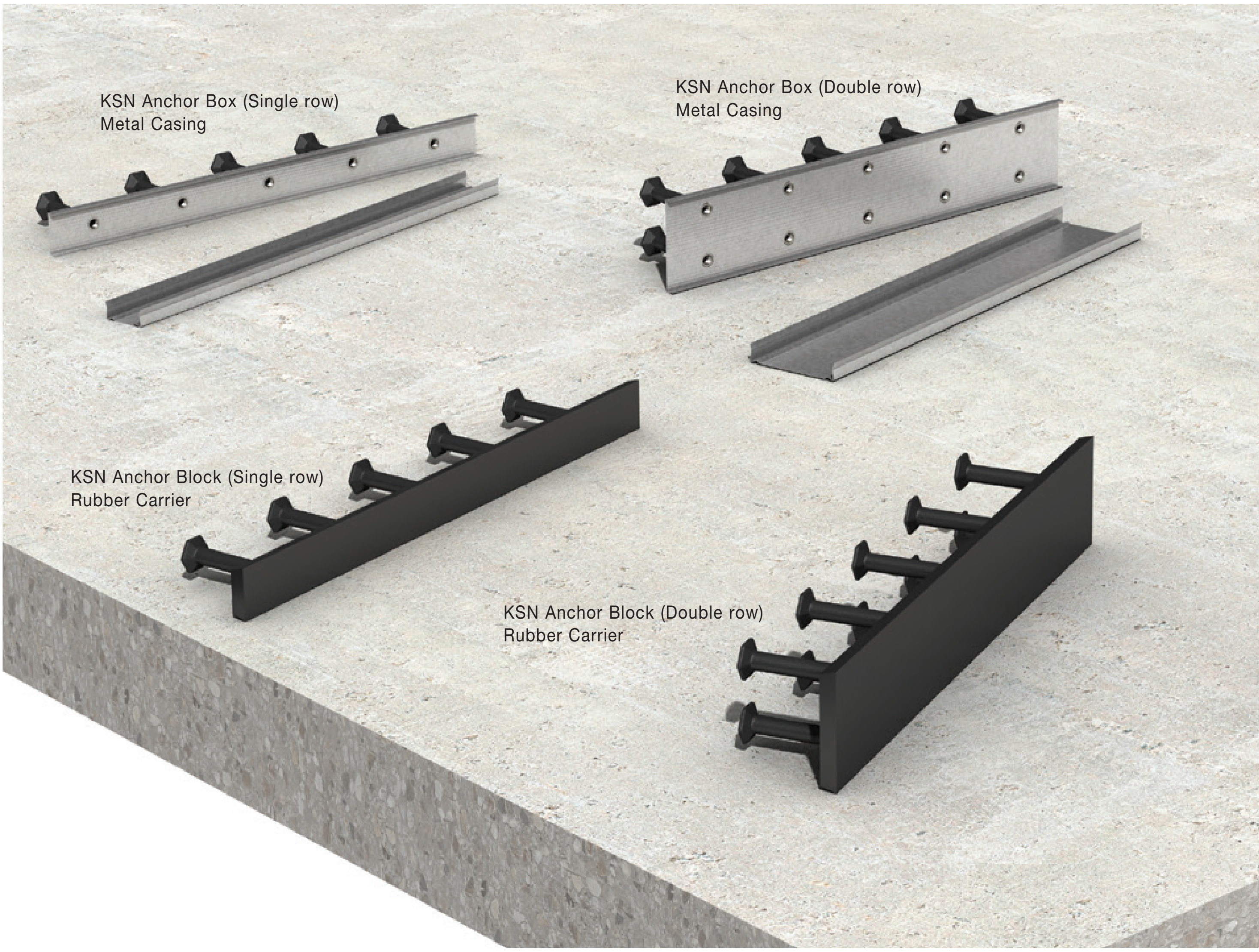
Reinforcement Characteristic Yield Load

Bar Diameter	Yield Load (kN)
12	56.5
16	100.5
20	157.0

Ancon KSN Anchors

Installation Methods

For maximum versatility, we provide a number of installation methods for the KSN Anchor.
Since trouble free installation and optimum performance requires clean threads, each system provides thread protection to exclude contamination.



Additional Embedment Given

Installation Method	Additional Embedment
Welded on bar	None
KSN Anchor Block	5mm
Individual Nailing Plate	8mm
KSN Anchor Box	36mm*

Specifying / Ordering

An Ancon KSN Anchor System is specified and ordered using the following identification method:

Anchor Ref. / Installation method / Box width / Anchor arrangement / No of anchors / Box length / Anchor spacing

e.g. KSN 12L - KSNBOX - 150 - AA - 3 - 600 @200

This is the reference for KSN12L anchors in a metal casing, 150mm wide, with a double row of anchors, 3 anchors per row, in a 600mm long unit with an anchor spacing of 200mm.

KSN Anchor System Options

KSN Anchor Box

A galvanised steel casing can be supplied with KSN Anchors installed at the specified design spacing. The unit is sealed at each end to prevent the ingress of concrete. Upon removal of the formwork, the casing remains embedded in the wall with the cover in place to prevent thread contamination. The cover is removed to install the threaded bars and the rebate formed by the boxes is filled with concrete when the adjoining slab is poured. This method provides KSN Anchors with an additional 36mm of embedment making it the highest load capacity installation method available, and suitable for moment connections.

KSN Anchor Block

This is a reusable plastic mould that is provided with mountings for the KSN Anchors at the specified design spacing. The blocks are loaded with KSN Anchors and fixed to the formwork where required. The block protects the internal threads of the anchors until it is removed, so should be left in position until this time. Once removed, the block may be equipped with KSN Anchors ready for use on the next set of formwork or may be retained for use on future projects. The block provides the KSN Anchor with 5mm of additional embedment by offsetting it from the formwork face. This offset and surrounding rebate increases the capacity and makes this installation method suitable for moment connections.

KSN Anchor with Individual Nailing Plate

Individual Nailing Plates may be used to place KSN Anchors singularly or in groups to provide anchor points for starter bars. They are also useful for placing anchors in lines where wide centres or congestion precludes the use of other installation methods, though care must be taken to ensure correct placement. The Individual Nailing Plate provides the Ancon KSN Anchor with an additional embedment of 8mm however it is unsuitable for moment connections.

KSN Anchor Welded on Bar

In this configuration, the KSN Anchors are supplied welded to a flat steel bar. The bar is nailed directly to the formwork, placing the anchor thread ends flush with the concrete face, and the anchors are tied to the wall reinforcement. There is no additional embedment of the anchor and this method is not suitable for moment connections. It is ideal where a metric bolt attachment is required. Thread protection is offered by plastic plugs that should be removed immediately prior to installation of the starter bar.

Information for Specifying and Ordering

Anchor Ref.	Installation Method	Unit Widths	Anchor Arrangement and Number of Anchors	Unit Lengths
KSN12S	KSNBOX	KSN Box available widths =	A = Single row	KSN Box = 600, 800,
KSN12M	KSNBLOCK	85, 120, 150,	AA = Double row	1000, 1200mm
KSN16S	WELDEDBAR	190, 220mm	(AA units are only	KSN Block = 600, 800,
KSN16M		KSN Block available widths =	available in system	1000, 1200mm
KSN16L		90, 200mm	widths of 120mm	Welded Bar = 600, 800,
KSN20S			and above)	1000, 1200mm
KSN20M			Number of anchors per row	
KSN20L				

Specification Clause

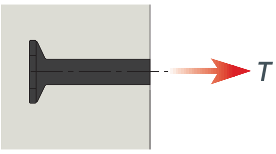
Headed Anchors shall be Ancon KSN Anchors as manufactured by Leviat.
Reinforcement shall be Ancon BT Threaded Starter Bars as manufactured by Leviat.

Ancon KSN Anchors

System Performance

The performance of KSN Anchors is presented for two load applications and is based on comprehensive test data.

Direct tensile concrete characteristic loads



The direct pull-out strength of anchors embedded in concrete has been the subject of extensive research over many years. To determine the direct pull strength of KSN Anchors, we commissioned a test programme at the Heriot Watt University, UK. The test results and subsequent analysis aligned closely with the Concrete Capacity Design (CCD) method.

The direct pull-out strength is based on a model with a break out prism angle of approximately 35 degrees. See Fig A.

AS 3600:2018 Cl 19.3.3 requires cast-in fixings to be designed in accordance with the Concrete Capacity Design (CCD) method as per AS 3850.1, Appendix B. The concrete characteristic tensile load $N^0_{Rk,c}$ is determined from the formula, $N^0_{Rk,c}=k_{cr}{\cdot}f'_c{}^{0.5}{\cdot}h_{eff}{}^{1.5}$

Where:

$N^0_{Rk,c}$ is the characteristic tensile strength of a single anchor remote from edge effects (kN)

f'_c is the characteristic concrete cylinder compressive strength (MPa)

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

k_{cr} is an empirical coefficient determined from tests

(k_{cr} = 13 for non-cracked concrete).

To achieve the maximum anchor load, the required minimum spacing is three times the depth of the anchor h_{eff}.

The design strength is calculated by multiplying the ultimate capacity from AS 3850.1, Appendix B with a reduction factor of $ø_c$= 0.6 in accordance with table 2.2.2 of AS 3600:2018.

$N^0_{Rd,c}= ø_c\ N^0_{Rk,c}$

The direct tensile design capacity is provided in the tables on page 15.

Anchor Spacings

Although KSN Anchors are able to provide an anchor that is equal to or greater than the characteristic yield strength of the reinforcing bars, this is dependent on their arrangement. The capacity of the anchors is reduced when the proximity of adjacent anchors or concrete edges affect the development of the full cone, as illustrated in Fig B.

Load data for reduced anchor spacing is printed in the tables on pages 15 to 23.

Fig A. Full Tensile Cone

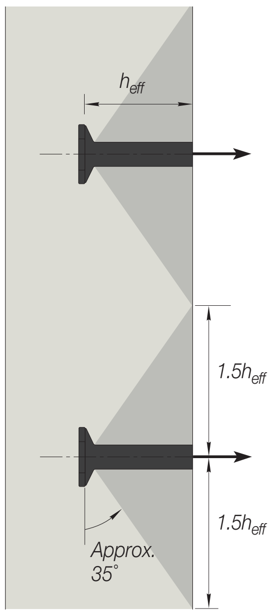
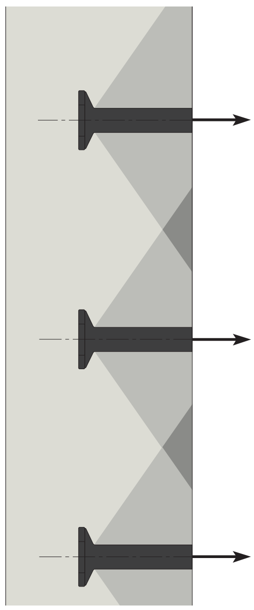
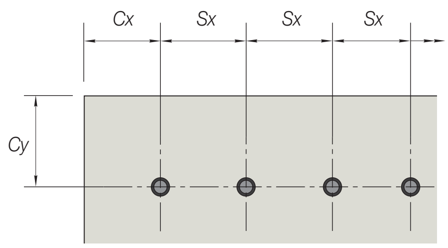


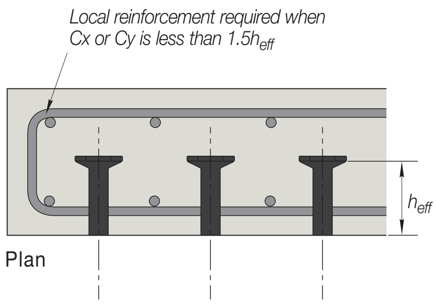
Fig B. Reduced Spacings



The tables on pages 15 to 23 assume that the close edge distances Cx and Cy are catered for by either (1) ensuring Cx and Cy are equal to or greater than 1.5 x h_{eff} or (2) local reinforcement is provided (see page 24). In addition, where moment connections are used, the top of the wall shall be at least three times the effective embedment of the anchor (h_{eff}) measured from the centre line of the anchor. If these conditions cannot be met, please contact us.

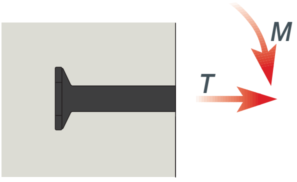


Elevation



Plan

Tensile concrete characteristic loads in slab-to-wall moment connections



From the tests conducted to determine the direct pull-out capacities of KSN Anchors (see page 10), we identified a potential increase in anchor performance when the compression part of the moment couple lies within the pull-out cone.

Although design procedures for the direct pull-out strength of cast-in anchors are well established, existing procedures do not cover anchors within moment resisting connections, such as slab-to-wall applications. Therefore, we commissioned a further test programme with the Heriot Watt University to determine the degree of enhancement in concrete cone pull-out capacity in typical slab-to-wall connections.

These tests verified that there is enhancement in concrete cone capacity, when the pull-out failure surface is modified by the presence of an adjacent compression force forming part of the couple. The enhancement is strongly influenced by the ratio depth of embedment of the head of the anchor to the effective depth of the anchor in the slab h_{eff}/d.

An empirical expression has been derived for the strength of KSN Anchors where the concrete cone failure is modified by an adjacent compression reaction. Load data for KSN Anchors in moment resisting slab-to-wall connections is provided in the tables on pages 16 to 23. These enhanced performance figures were quantified by our test programme and subsequent design procedure and are therefore specific to the range of Ancon KSN Anchors.

The tests used KSN Anchors in the arrangement shown in Fig. 1. The design procedures derived enabled us to calculate pull-out loads for KSN Anchors when they are located in the paired arrangement used in the tests and in a single line at the mid-depth of a slab (shown in Fig. 2). Fig. 1 and Fig. 2 illustrate how the full pull-out cone is modified by an adjacent compression zone in both applications.

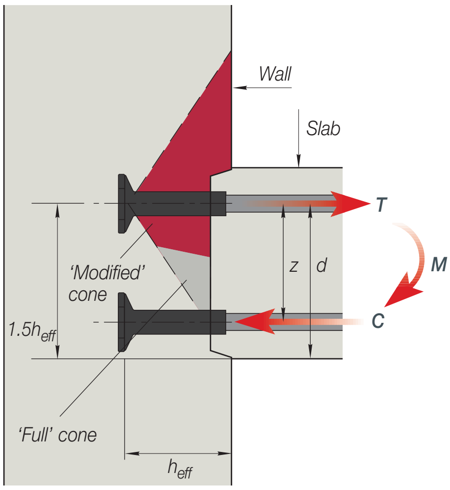


Fig 1. Idealised modified concrete failure. Paired arrangement used in testing.

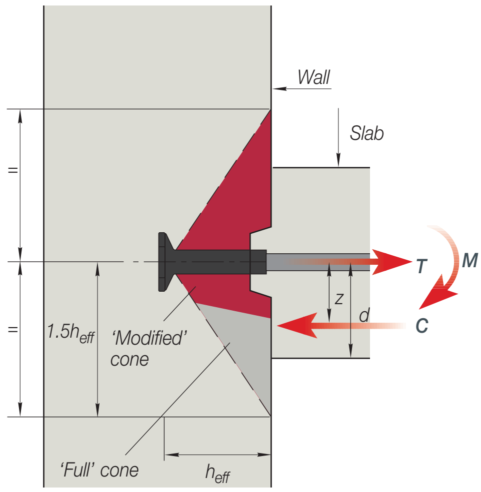


Fig 2. Idealised modified concrete failure. Single line of Anchors is shown.

Notes on the design tables for slab-to-wall moment connections

The load tables on pages 16 to 23 are applicable provided the following conditions are met.

- *The concrete characteristic pull-out loads are applicable for Ancon KSN anchor range, sizes 12mm to 20mm with anchor effective embedment between 109mm and 260mm.*
- *The structural concrete compressive strength shall be in the range N32/40 to N50/60. The letter N denotes normal weight concrete; the first figure, 32 is the minimum characteristic cylinder strength/ the second figure, 40 is the minimum characteristic cube strength.*
- *The design tables assume the concrete in which the KSN anchor is embedded is un-cracked. This in general would be the normal case for anchors embedded in walls.*
- *The minimum wall thickness shall be 200mm.*
- *Where other forms of loading give rise to cracks which intersect the failure surface, the design tables may over estimate the load capacity, e.g. seismic.*
- *The design tables assume no close edges, see pages 10 and 24.*
- *The design procedure assumes that the top of the wall is at least 3 times the effective embedment of the anchor (h_{eff}) measured from the centre line of the anchor.*
- *Provided the wall/slab connection comprises at least 5 KSN anchors, $\psi_{S,N}$, the edge distance reduction factor may be taken as 1.0 where the edge distances are ≥ $1.5h_{eff}$ or where local reinforcement is provided. If these conditions are not met, please contact us for further information.*
- *Analysis of the structure should be based on the assumption of linear elastic behaviour.*
- *Redistribution of elastic bending moments shall only be used if the greater of $\Sigma R_{d,c}$ and $\Sigma R_{d,s} \geq 1.25 \Sigma R_{d,y}$ this restriction is to ensure the anchor has sufficient capacity to develop strains in excess of those required for yield of the reinforcement.*
- *The shear capacity of the joint must be checked at all times. In tests with continuity bars at the top and bottom zones of the slab, no distress was evident that related to vertical shear in the plane of the wall, so it is unlikely vertical shear will be a problem. However, should the shear capacity be exceeded, then the designer may consider the use of debonded shear connectors.*
  The use of KeyBox metal casings approximately 85mm high x 36mm deep is considered a suitable alternative key. The effective wall depth to be used in the calculation of joint shear resistance is limited to 175mm or the anchor embedment, whichever is the greater.

Ancon KSN Anchors

Load Table Guidance

The KSN Anchor capacities on pages 15 to 23 are provided as design capacities N_{Rd}, which are taken as the minimum of the design capacities of the steel and concrete.

Design Examples

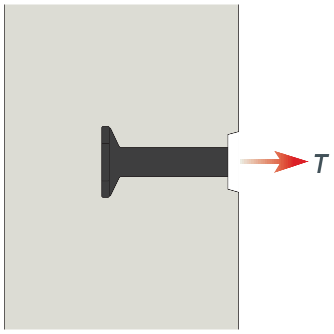
A)

Load condition:	**Direct tensile load**
Wall depth:	180 mm
Wall concrete:	32MPa
Minimum cover:	25mm
Tension applied:	165kN/m
Starter bar size and spacing:	N16@200
Assuming anchors at 200mm c/c:	N_{Ed} = 165 x 0.200 = 33kN per anchor

From the table on page 15 and by considering the anchor length and cover, the following anchors are suitable:

KSN16S@-KSNBLOCK 200c/c	Anchor design resistance N_{Rd}=33.4 kN
KSN16S@-Nailing Plate 200c/c	Anchor design resistance N_{Rd}=33.8 kN

The values in the table are not in bold which means that the **anchors are limited by the concrete design resistance,** thus supplementary reinforcement is required to ensure ductility of the connection.



B)

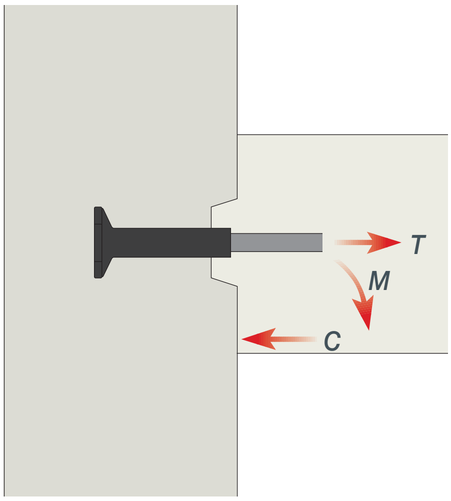
Load condition:	**Moment connection**
Anchor:	KSN16M x 160mm long
Method of fixture:	KSNBLOCK
Anchor effective embedment:	159mm
Anchor spacing:	200mm
Concrete:	32MPa
Slab depth:	250mm
Wall depth:	200mm
Anchor reinforcement location:	Mid slab depth

From the table on page 22 the anchor design resistance N_{Rd} is 80.4 kN

The value in the table is in bold which means that the **anchor design resistance is limited by the reinforcing bar yield capacity.** Therefore, the anchor is suitable for full elastic design.

An estimate of the design moment capacity per metre width (where the lever arm $l_a = 0.85 \times d_{eff}$ & $d_{eff} = 100$mm) (80.4 X 0.10 x 0.85) x (1000/200) = 34.2kNm per metre.

In cases where the anchor will be located to provide a mid slab connection, the joint design is generally considered as a pinned joint.

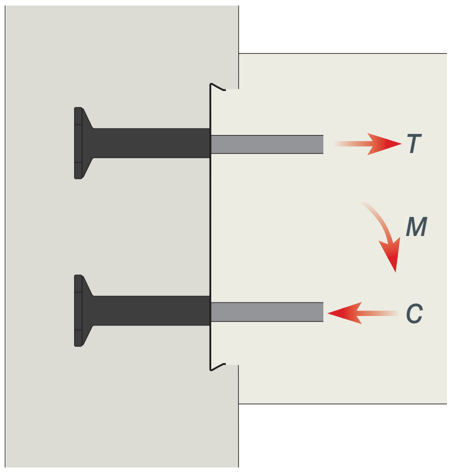


C)	Load condition:	**Moment connection**
	Anchor:	KSN16M x 160mm long
	Method of fixture:	KSNBOX casing 36mm deep
	Anchor effective embedment:	190mm
	Anchor spacing:	200mm
	Concrete:	32MPa
	Slab depth:	225mm
	Wall depth:	250mm
	Anchor reinforcement location:	Top and bottom of slab
	Cover:	25mm to top main steel

From the table on page 16 the anchor design resistance N_{Rd} is 80.4 kN.

The value in the table is in bold which means that the **anchor design resistance is limited by the reinforcing bar yield capacity.** Therefore, the anchor is suitable for full elastic design.

An estimate of the design moment capacity per metre width (where the lever arm l_a = 0.85 x d_{eff} & d_{eff} = 192mm) (80.4 X 0.192 x 0.85) x (1000/200) = 65.6kNm per metre.

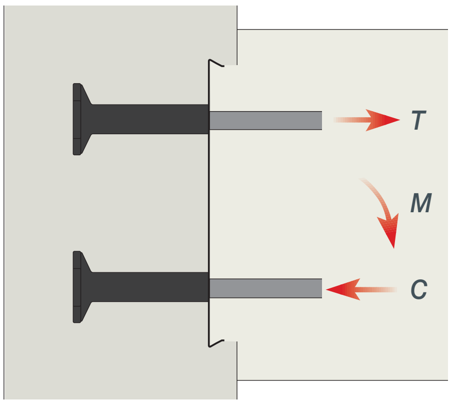


D)	Load condition:	**Moment connection**
	Anchor:	KSN20S x 150mm long
	Method of fixture:	KSNBOX casing 36mm deep
	Anchor effective embedment:	180mm
	Anchor spacing:	250mm
	Concrete:	32MPa
	Slab depth:	250mm
	Wall depth:	300mm
	Anchor reinforcement location:	Top and bottom of slab
	Cover:	25mm to top main steel

From the table on page 17 the anchor design resistance N_{Rd} is 100.6 kN.

The value in the table is not in bold which means that the **anchor is limited by the concrete design resistance,** thus supplementary reinforcement is required to ensure ductility of the connection.

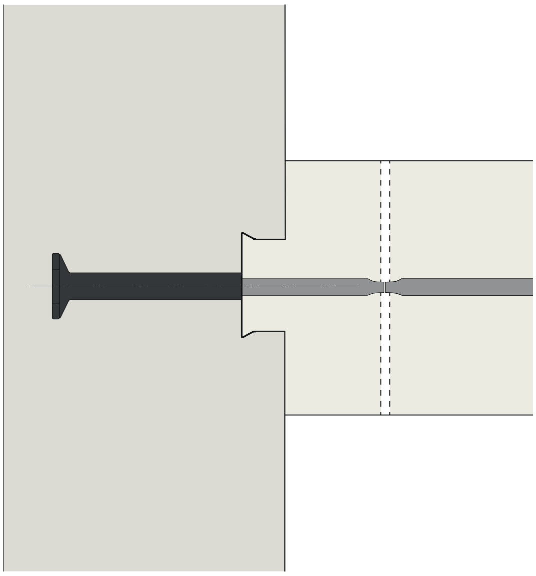
An estimate of the design moment capacity per metre width (where the lever arm l_a = 0.85 x d_{eff} & d_{eff} = 215mm) (100.6 X 0.215 x 0.85) x (1000/250) = 73.5kNm per metre.



Ancon KSN Anchors

Direct Tensile Concrete Characteristic Load Data

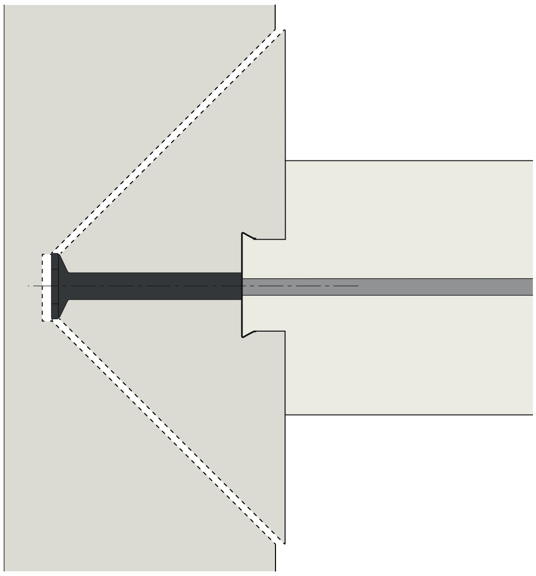
Failure modes related to headed anchors in slab/wall connections:



Yielding of reinforcement bar

Reinforcement yielding is the desired failure mode for reinforcement continuity systems. This failure mode provides the ductility that is required in the connection zone. Ancon KSN Anchors in combination with Ancon BT Threaded Starter bars ensure that the connection strength exceeds the strength of the Grade 500N bar.

Metric threaded bars that are often used in these applications will fail in the threaded connection zone of the bar and thus provide lower capacities and less ductility.



Concrete cone failure of the concrete surrounding the headed anchor

A tension failure in the concrete surrounding the headed anchor should be avoided as the concrete failure is considered a brittle failure mode. Ancon KSN Anchors are available in multiple lengths. It is recommended to always use the longest possible anchor for each condition and the maximum anchor length that fits in the wall section.

Threaded Inserts that are traditionally used for these connections have a reduced length and their concrete capacity will normally not suffice for the concrete breakout strength to exceed the capacity of the connected reinforcement bar.

Mode of Failure

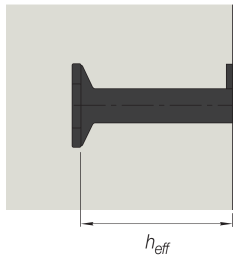
By increasing the embedment depth, the capacity of the KSN Anchor can be improved.
The tables on pages 15 to 23 provide the tensile design resistance load of each anchor for the four installation methods. **Bold** figures indicate performance equal to or greater than reinforcement design resistance load $N_{Rd,s}$, where $N_{Rd,s} = N_{ks} \times 0.8$. If a ductile behaviour is required but the anchor arrangement does not provide a ductile failure mode, such behaviour can be obtained with some additional reinforcement.

$N_{Rd,s}$ = reinforcement design resistance load
N_{ks} = reinforcement characteristic load
0.8 = material reduction factor for reinforcement

Effective embedment depth h_{eff} =
Anchor Length – Head Thickness (6mm) +
Additional Embedment

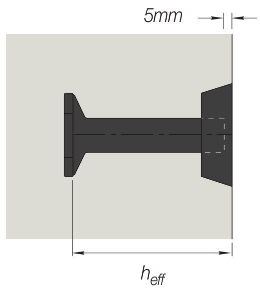
KSN Anchors Welded on Bar (Flush with Concrete)

Anchor Ref.	Metric Thread (mm)	Rebar Dia. (mm)	Anchor Length (mm)	Embedment Depth h_{eff} (mm)	Anchor - Direct Tensile Resistance Load N_{Rd} (kN) 32MPa Concrete at Various Anchor Spacing						
					150	200	250	300	350	400	450
KSN12S	M14	12	115	109	23.0	30.7	38.4	**45.2**	**45.2**	**45.2**	**45.2**
KSN12M	M14	12	150	144	26.5	35.3	44.1	**45.2**	**45.2**	**45.2**	**45.2**
KSN16S	M20	16	130	124	24.6	32.8	40.9	49.1	57.3	60.9	60.9
KSN16M	M20	16	160	154	27.4	36.5	45.6	54.8	63.9	73.0	**80.4**
KSN16L	M20	16	190	184	29.9	39.9	49.9	59.9	69.8	79.8	**80.4**
KSN20S	M24	20	150	144	26.5	35.3	44.1	52.9	61.8	70.6	76.2
KSN20M	M24	20	190	184	29.9	39.9	49.9	59.9	69.8	79.8	89.8
KSN20L	M24	20	230	224	33.0	44.0	55.0	66.0	77.0	88.1	99.1



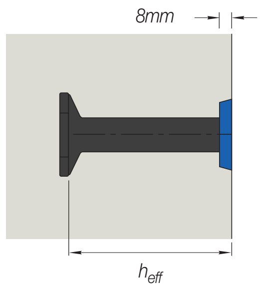
KSN Anchor Block (Additional 5mm Embedment)

Anchor Ref.	Metric Thread (mm)	Rebar Dia. (mm)	Anchor Length (mm)	Embedment Depth h_{eff} (mm)	150	200	250	300	350	400	450
KSN12S	M14	12	115	114	23.6	31.4	39.3	**45.2**	**45.2**	**45.2**	**45.2**
KSN12M	M14	12	150	149	26.9	35.9	44.9	**45.2**	**45.2**	**45.2**	**45.2**
KSN16S	M20	16	130	129	25.1	33.4*	41.8	50.1	58.5	64.6	64.6
KSN16M	M20	16	160	159	27.8	37.1	46.4	55.6	64.9	74.2	**80.4**
KSN16L	M20	16	190	189	30.3	40.4	50.5	60.7	70.8	**80.4**	**80.4**
KSN20S	M24	20	150	149	26.9	35.9	44.9	53.9	62.8	71.8	80.3
KSN20M	M24	20	190	189	30.3	40.4	50.5	60.7	70.8	80.9	91.0
KSN20L	M24	20	230	229	33.4	44.5	55.6	66.8	77.9	89.0	100.2



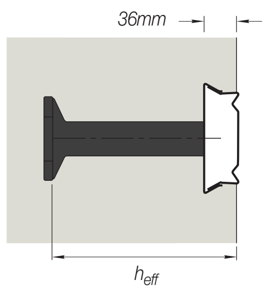
KSN Anchors with Individual Nailing Plate (Additional 8mm Embedment)

Anchor Ref.	Metric Thread (mm)	Rebar Dia. (mm)	Anchor Length (mm)	Embedment Depth h_{eff} (mm)	150	200	250	300	350	400	450
KSN12S	M14	12	115	117	23.9	31.8	39.8	**45.2**	**45.2**	**45.2**	**45.2**
KSN12M	M14	12	150	152	27.2	36.3	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
KSN16S	M20	16	130	132	25.3	33.8*	42.2	50.7	59.1	66.9	66.9
KSN16M	M20	16	160	162	28.1	37.4	46.8	56.2	65.5	74.9	**80.4**
KSN16L	M20	16	190	192	30.6	40.8	50.9	61.1	71.3	**80.4**	**80.4**
KSN20S	M24	20	150	152	27.2	36.3	45.3	54.4	63.5	72.5	81.6
KSN20M	M24	20	190	192	30.6	40.8	50.9	61.1	71.3	81.5	91.7
KSN20L	M24	20	230	232	33.6	44.8	56.0	67.2	78.4	89.6	100.8



KSN Anchor Box (Additional 36mm Embedment)

Anchor Ref.	Metric Thread (mm)	Rebar Dia. (mm)	Anchor Length (mm)	Embedment Depth h_{eff} (mm)	150	200	250	300	350	400	450
KSN12S	M14	12	115	145	26.6	35.4	44.3	**45.2**	**45.2**	**45.2**	**45.2**
KSN12M	M14	12	150	180	29.6	39.5	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
KSN16S	M20	16	130	160	27.9	37.2	46.5	55.8	65.1	74.4	**80.4**
KSN16M	M20	16	160	190	30.4	40.5	50.7	60.8	71.0	**80.4**	**80.4**
KSN16L	M20	16	190	220	32.7	43.6	54.5	65.4	76.4	**80.4**	**80.4**
KSN20S	M24	20	150	180	29.6	39.5	49.3	59.2	69.1	78.9	88.8
KSN20M	M24	20	190	220	32.7	43.6	54.5	65.4	76.4	87.3	98.2
KSN20L	M24	20	230	260	35.6	47.4	59.3	71.1	83.0	94.9	106.7



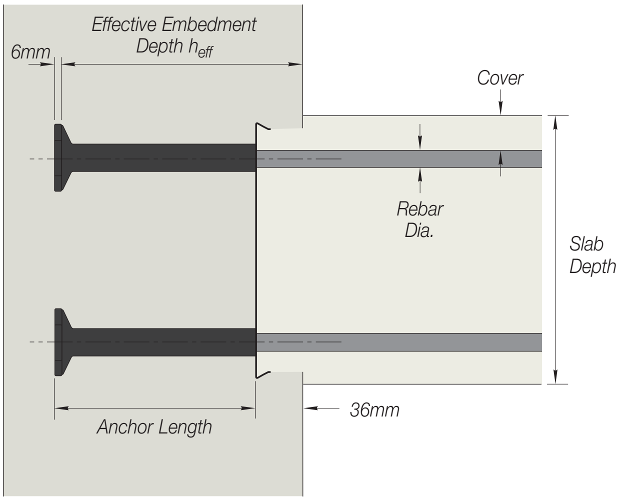
** Design example, see page 12*

***Notes:** All edges assumed to be at least 1.5 x h_{eff} from anchor centreline.*

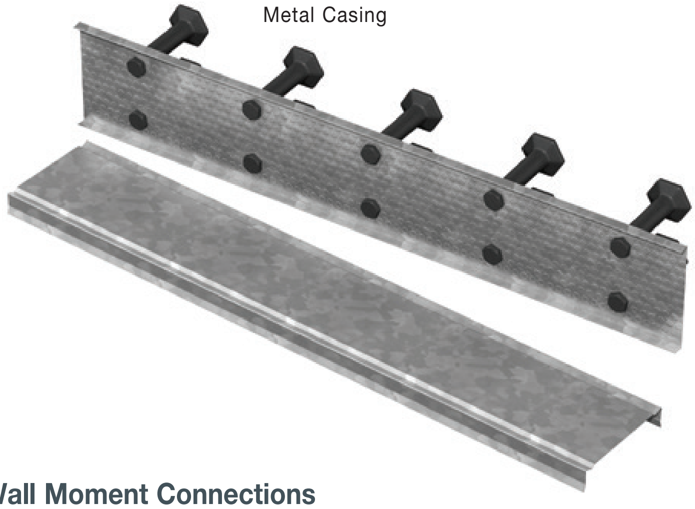
***Bold** figures indicate performance equal or greater than reinforcement design resistance.*

Ancon KSN Anchors

KSN Anchor Box (Additional Embedment 36mm)
Moment Connection - Two layers of starter bars with 25mm cover



KSN Anchor Box (double row)
Metal Casing



Tensile Concrete Characteristic Loads in Slab-to-Wall Moment Connections

Rebar Dia. (mm)	Anchor Length (mm)	Embedment Depth h_{eff} (mm)	Slab Depth (mm)	Anchor - Enhanced Tensile Resistance Load N_{Rd} (kN) 32MPa Concrete at Various Spacing						
				Horizontal Spacing (mm)						
KSN Anchor Box with KSN12S				150	175	200	225	250	275	300
12	115	145	175	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			200	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			225	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			250	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			275	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			300	39.2	39.2	39.2	39.8	44.3	**45.2**	**45.2**
KSN Anchor Box with KSN12M										
12	150	180	175	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			200	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			225	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			250	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			275	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			300	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
KSN Anchor Box with KSN16S										
16	130	160	175	69.8	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			200	69.8	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			225	69.8	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			250	69.8	72.0	72.0	72.0	72.0	72.0	72.0
			275	61.8	61.8	61.8	61.8	61.8	61.8	61.8
			300	53.5	53.5	53.5	53.5	53.5	53.5	55.8
KSN Anchor Box with KSN16M										
16	160	190	175	76.0	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			200	76.0	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			225	76.0	**80.4**	**80.4***	**80.4**	**80.4**	**80.4**	**80.4**
			250	76.0	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			275	76.0	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			300	76.0	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**

** Design example, see page 13*

Notes: *All edges assumed to be at least 1.5 x h_{eff} from anchor centreline.*

Bold *figures indicate performance equal or greater than reinforcement design resistance.*

The above tables are based on 25mm cover to the top main steel. For other cover please contact us.

Rebar Dia. (mm)	Anchor Length (mm)	Embedment Depth h_{eff} (mm)	Slab Depth (mm)	Anchor - Enhanced Tensile Resistance Load N_{Rd} (kN) 32MPa Concrete at Various Spacing						
				Horizontal Spacing (mm)						
KSN Anchor Box with KSN16L				150	175	200	225	250	275	300
16	190	220	175	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			200	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			225	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			250	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			275	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			300	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
KSN Anchor Box with KSN20S										
20	150	180	175	74.0	86.3	98.7	111.0	123.3	**125.7**	**125.7**
			200	74.0	86.3	98.7	111.0	123.3	**125.7**	**125.7**
			225	74.0	86.3	98.7	111.0	117.9	117.9	117.9
			250	74.0	86.3	98.7	100.6	100.6*	100.6	100.6
			275	74.0	86.3	86.9	86.9	86.9	86.9	86.9
			300	74.0	75.8	75.8	75.8	75.8	75.8	75.8
KSN Anchor Box with KSN20M										
20	190	220	175	81.8	95.4	109.1	122.7	**125.7**	**125.7**	**125.7**
			200	81.8	95.4	109.1	122.7	**125.7**	**125.7**	**125.7**
			225	81.8	95.4	109.1	122.7	**125.7**	**125.7**	**125.7**
			250	81.8	95.4	109.1	122.7	**125.7**	**125.7**	**125.7**
			275	81.8	95.4	109.1	122.7	**125.7**	**125.7**	**125.7**
			300	81.8	95.4	109.1	122.7	**125.7**	**125.7**	**125.7**
KSN Anchor Box with KSN20L										
20	230	260	175	88.9	103.8	118.6	**125.7**	**125.7**	**125.7**	**125.7**
			200	88.9	103.8	118.6	**125.7**	**125.7**	**125.7**	**125.7**
			225	88.9	103.8	118.6	**125.7**	**125.7**	**125.7**	**125.7**
			250	88.9	103.8	118.6	**125.7**	**125.7**	**125.7**	**125.7**
			275	88.9	103.8	118.6	**125.7**	**125.7**	**125.7**	**125.7**
			300	88.9	103.8	118.6	**125.7**	**125.7**	**125.7**	**125.7**

** Design example, see page 13*

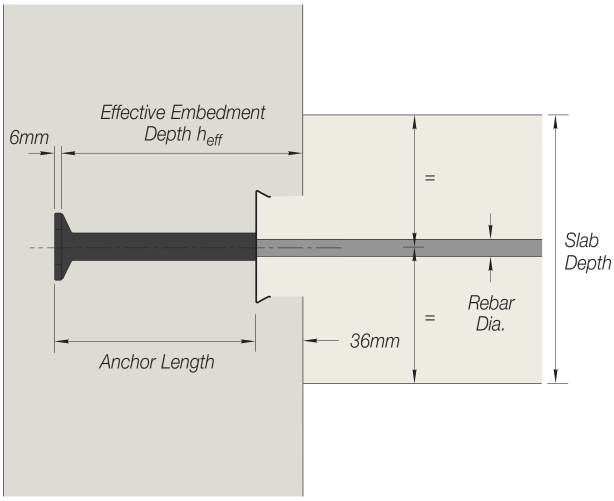
***Notes:** All edges assumed to be at least 1.5 x h_{eff} from anchor centreline.*

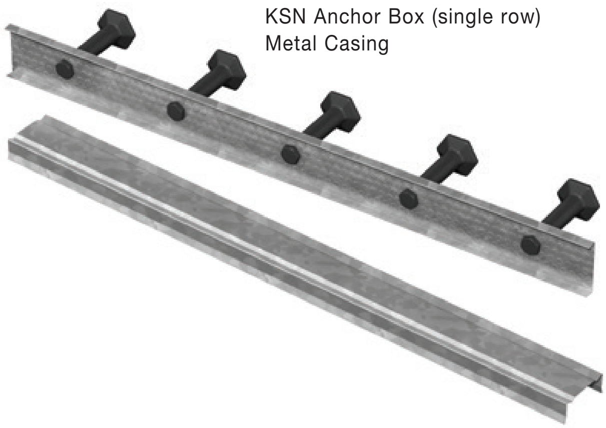
***Bold** figures indicate performance equal or greater than reinforcement design resistance.*

The above tables are based on 25mm cover to the top main steel. For other cover please contact us.

Ancon KSN Anchors

KSN Anchor Box (Additional Embedment 36mm)
Moment Connection - Starter bars located mid depth of slab





KSN Anchor Box (single row)
Metal Casing

Tensile Concrete Characteristic Loads in Slab-to-Wall Moment Connections

Rebar Dia. (mm)	Anchor Length (mm)	Embedment Depth h_{eff} (mm)	Slab Depth (mm)	Anchor - Enhanced Tensile Resistance Load N_{Rd} (kN) 32MPa Concrete at Various Spacing						
				Horizontal Spacing (mm)						
KSN Anchor Box with KSN12S				150	175	200	225	250	275	300
12	115	145	175	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			200	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			225	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			250	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			275	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			300	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
KSN Anchor Box with KSN12M										
12	150	180	175	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			200	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			225	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			250	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			275	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			300	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
KSN Anchor Box with KSN16S										
16	130	160	175	69.8	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			200	69.8	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			225	69.8	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			250	69.8	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			275	69.8	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			300	69.8	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
KSN Anchor Box with KSN16M										
16	160	190	175	76.0	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			200	76.0	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			225	76.0	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			250	76.0	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			275	76.0	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			300	76.0	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**

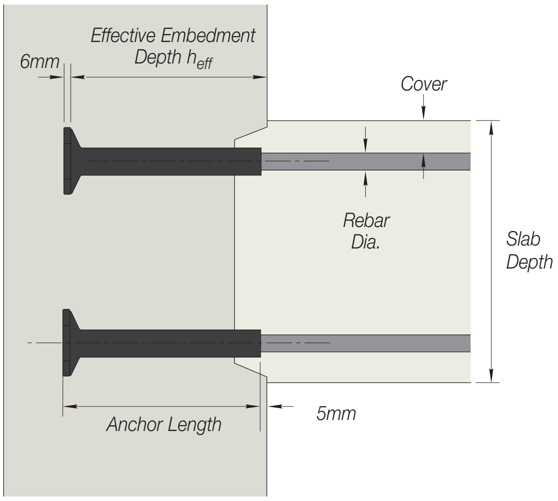
Notes: *All edges assumed to be at least 1.5 x h_{eff} from anchor centreline.*
Bold *figures indicate performance equal or greater than reinforcement design resistance.*

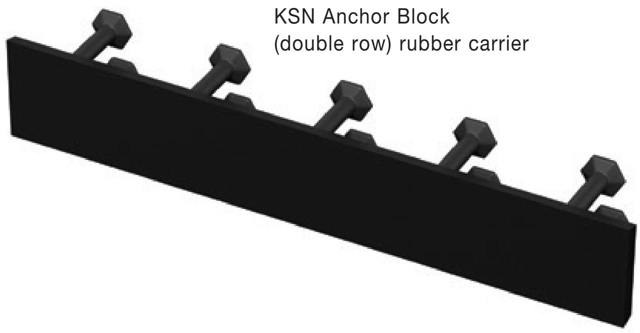
Rebar Dia. (mm)	Anchor Length (mm)	Embedment Depth h_{eff} (mm)	Slab Depth (mm)	Anchor - Enhanced Tensile Resistance Load N_{Rd} (kN) 32MPa Concrete at Various Spacing – Horizontal Spacing (mm)						
				150	175	200	225	250	275	300
KSN Anchor Box with KSN16L										
16	190	220	175	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			200	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			225	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			250	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			275	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			300	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
KSN Anchor Box with KSN20S										
20	150	180	175	74.0	86.3	98.7	111.0	123.3	**125.7**	**125.7**
			200	74.0	86.3	98.7	111.0	123.3	**125.7**	**125.7**
			225	74.0	86.3	98.7	111.0	123.3	**125.7**	**125.7**
			250	74.0	86.3	98.7	111.0	123.3	**125.7**	**125.7**
			275	74.0	86.3	98.7	111.0	123.3	**125.7**	**125.7**
			300	74.0	86.3	98.7	111.0	123.3	**125.7**	**125.7**
KSN Anchor Box with KSN20M										
20	190	220	175	81.8	95.4	109.1	122.7	**125.7**	**125.7**	**125.7**
			200	81.8	95.4	109.1	122.7	**125.7**	**125.7**	**125.7**
			225	81.8	95.4	109.1	122.7	**125.7**	**125.7**	**125.7**
			250	81.8	95.4	109.1	122.7	**125.7**	**125.7**	**125.7**
			275	81.8	95.4	109.1	122.7	**125.7**	**125.7**	**125.7**
			300	81.8	95.4	109.1	122.7	**125.7**	**125.7**	**125.7**
KSN Anchor Box with KSN20L										
20	230	260	175	88.9	103.8	118.6	**125.7**	**125.7**	**125.7**	**125.7**
			200	88.9	103.8	118.6	**125.7**	**125.7**	**125.7**	**125.7**
			225	88.9	103.8	118.6	**125.7**	**125.7**	**125.7**	**125.7**
			250	88.9	103.8	118.6	**125.7**	**125.7**	**125.7**	**125.7**
			275	88.9	103.8	118.6	**125.7**	**125.7**	**125.7**	**125.7**
			300	88.9	103.8	118.6	**125.7**	**125.7**	**125.7**	**125.7**

Notes: *All edges assumed to be at least 1.5 x h_{eff} from anchor centreline.*
Bold *figures indicate performance equal or greater than reinforcement design resistance.*

Ancon KSN Anchors

KSN Anchor Block (Additional Embedment 5mm)
Moment Connection - Starter bars with 25mm cover





KSN Anchor Block
(double row) rubber carrier

Tensile Concrete Characteristic Loads in Slab-to-Wall Moment Connections

Anchor - Enhanced Tensile Resistance Load N_{Rd} (kN), 32MPa Concrete at Various Spacing

Rebar Dia. (mm)	Anchor Length (mm)	Embedment Depth h_{eff} (mm)	Slab Depth (mm)	Horizontal Spacing (mm) 150	175	200	225	250	275	300
KSN Anchor Block with KSN12S										
12	115	114	175	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			200	38.2	38.2	38.2	38.2	39.3	43.2	**45.2**
			225	31.2	31.2	31.4	35.3	39.3	43.2	**45.2**
			250	25.8	27.5	31.4	35.3	39.3	43.2	**45.2**
			275	23.6	27.5	31.4	35.3	39.3	43.2	**45.2**
			300	23.6	27.5	31.4	35.3	39.3	43.2	**45.2**
KSN Anchor Block with KSN12M										
12	150	149	175	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			200	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			225	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			250	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			275	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			300	42.6	42.6	42.6	42.6	44.9	45.2	**45.2**
KSN Anchor Block with KSN16S										
16	130	129	175	62.6	68.7	68.7	68.7	68.7	68.7	68.7
			200	55.5	55.5	55.5	55.5	55.5	55.5	55.5
			225	45.8	45.8	45.8	45.8	45.8	45.9	50.1
			250	38.3	38.3	38.3	38.3	41.8	45.9	50.1
			275	32.3	32.3	33.4	37.6	41.8	45.9	50.1
			300	27.5	29.2	33.4	37.6	41.8	45.9	50.1
KSN Anchor Block with KSN16M										
16	160	159	175	69.5	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			200	69.5	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			225	69.5	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			250	69.5	70.7	70.7	70.7	70.7	70.7	70.7
			275	60.6	60.6	60.6	60.6	60.6	60.6	60.6
			300	52.2	52.2	52.2	52.2	52.2	52.2	55.6

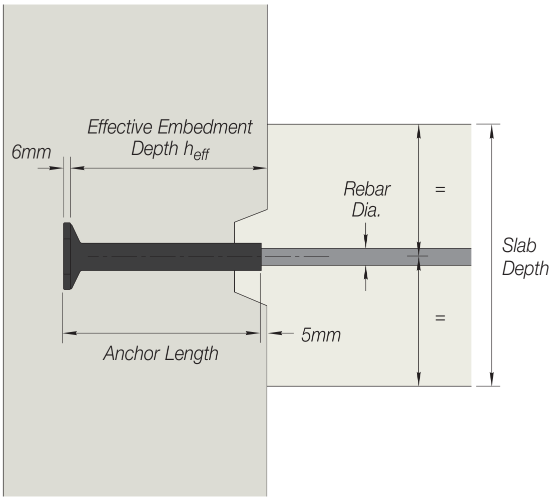
Notes: *All edges assumed to be at least 1.5 x h_{eff} from anchor centerline.*
Bold *figures indicate performance equal or greater than reinforcement design resistance.*
The above tables are based on 25mm cover to the top main steel. For other cover please contact us.

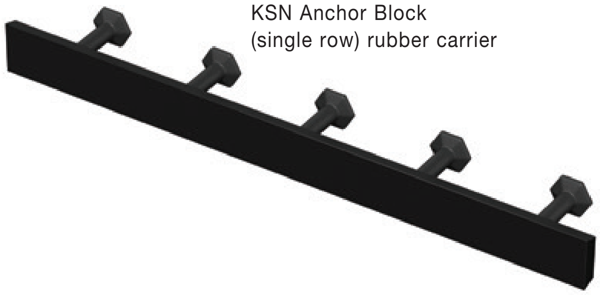
Rebar Dia. (mm)	Anchor Length (mm)	Embedment Depth h_{eff} (mm)	Slab Depth (mm)	Anchor - Enhanced Tensile Resistance Load N_{Rd} (kN) 32MPa Concrete at Various Spacing						
				Horizontal Spacing (mm)						
KSN Anchor Block with KSN16L				150	175	200	225	250	275	300
16	190	189	175	75.8	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			200	75.8	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			225	75.8	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			250	75.8	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			275	75.8	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			300	75.8	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
KSN Anchor Block with KSN20S										
20	150	149	175	67.3	78.5	89.8	100.3	100.3	100.3	100.3
			200	67.3	78.5	83.3	83.3	83.3	83.3	83.3
			225	67.3	69.3	69.3	69.3	69.3	69.3	69.3
			250	58.6	58.6	58.6	58.6	58.6	58.6	58.6
			275	50.0	50.0	50.0	50.0	50.0	50.0	53.9
			300	43.1	43.1	43.1	43.1	44.9	49.4	53.9
KSN Anchor Block with KSN20M										
20	190	189	175	75.8	88.5	101.1	113.7	**125.7**	**125.7**	**125.7**
			200	75.8	88.5	101.1	113.7	**125.7**	**125.7**	**125.7**
			225	75.8	88.5	101.1	113.7	**125.7**	**125.7**	**125.7**
			250	75.8	88.5	101.1	113.7	115.4	115.4	115.4
			275	75.8	88.5	99.9	99.9	99.9	99.9	99.9
			300	75.8	87.3	87.3	87.3	87.3	87.3	87.3
KSN Anchor Block with KSN20L										
20	230	229	175	83.5	97.4	111.3	125.2	**125.7**	**125.7**	**125.7**
			200	83.5	97.4	111.3	125.2	**125.7**	**125.7**	**125.7**
			225	83.5	97.4	111.3	125.2	**125.7**	**125.7**	**125.7**
			250	83.5	97.4	111.3	125.2	**125.7**	**125.7**	**125.7**
			275	83.5	97.4	111.3	125.2	**125.7**	**125.7**	**125.7**
			300	83.5	97.4	111.3	125.2	**125.7**	**125.7**	**125.7**

Notes: *All edges assumed to be at least 1.5 x h_{eff} from anchor centerline.*
Bold *figures indicate performance equal or greater than reinforcement design resistance.*
The above tables are based on 25mm cover to the top main steel. For other cover please contact us.

Ancon KSN Anchors

KSN Anchor Block (Additional Embedment 5mm)
Moment Connection - Starter bars located mid depth of slab





Tensile Concrete Characteristic Loads in Slab-to-Wall Moment Connections

Anchor - Enhanced Tensile Resistance Load N_{Rd} (kN), 32MPa Concrete at Various Spacing; Horizontal Spacing (mm)

KSN Anchor Block KSN12S

Rebar Dia. (mm)	Anchor Length (mm)	Embedment Depth h_{eff} (mm)	Slab Depth (mm)	150	175	200	225	250	275	300
12	115	114	175	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			200	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			225	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			250	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			275	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			300	45.1	45.1	45.1	45.1	45.1	45.1	**45.2**

KSN Anchor Block KSN12M

Rebar Dia. (mm)	Anchor Length (mm)	Embedment Depth h_{eff} (mm)	Slab Depth (mm)	150	175	200	225	250	275	300
12	150	149	175	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			200	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			225	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			250	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			275	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**
			300	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**	**45.2**

KSN Anchor Block KSN16S

Rebar Dia. (mm)	Anchor Length (mm)	Embedment Depth h_{eff} (mm)	Slab Depth (mm)	150	175	200	225	250	275	300
16	130	129	175	62.6	73.1	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			200	62.6	73.1	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			225	62.6	73.1	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			250	62.6	73.1	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			275	62.6	71.6	71.6	71.6	71.6	71.6	71.6
			300	62.6	64.0	64.0	64.0	64.0	64.0	64.0

KSN Anchor Block KSN16M

Rebar Dia. (mm)	Anchor Length (mm)	Embedment Depth h_{eff} (mm)	Slab Depth (mm)	150	175	200	225	250	275	300
16	160	159	175	69.5	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			200	69.5	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			225	69.5	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			250	69.5	**80.4***	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			275	69.5	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			300	69.5	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**

** Design example, see page 12*

***Notes:** All edges assumed to be at least 1.5 x h_{eff} from anchor centerline.*

***Bold** figures indicate performance equal or greater than reinforcement design resistance.*

Rebar Dia. (mm)	Anchor Length (mm)	Embedment Depth h_{eff} (mm)	Slab Depth (mm)	Anchor - Enhanced Tensile Resistance Load N_{Rd} (kN) 32MPa Concrete at Various Spacing						
				Horizontal Spacing (mm)						
KSN Anchor Block KSN16L				150	175	200	225	250	275	300
16	190	189	175	75.8	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			200	75.8	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			225	75.8	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			250	75.8	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			275	75.8	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
			300	75.8	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**	**80.4**
KSN Anchor Block KSN20S										
20	150	149	175	67.3	78.5	89.8	100.3	100.3	100.3	100.3
			200	67.3	78.5	89.8	100.3	100.3	100.3	100.3
			225	67.3	78.5	89.8	100.3	100.3	100.3	100.3
			250	67.3	78.5	89.8	100.3	100.3	100.3	100.3
			275	67.3	78.5	89.8	100.3	100.3	100.3	100.3
			300	67.3	78.5	89.8	95.5	95.5	95.5	95.5
KSN Anchor Block KSN20M										
20	190	189	175	75.8	88.5	101.1	113.7	**125.7**	**125.7**	**125.7**
			200	75.8	88.5	101.1	113.7	**125.7**	**125.7**	**125.7**
			225	75.8	88.5	101.1	113.7	**125.7**	**125.7**	**125.7**
			250	75.8	88.5	101.1	113.7	**125.7**	**125.7**	**125.7**
			275	75.8	88.5	101.1	113.7	**125.7**	**125.7**	**125.7**
			300	75.8	88.5	101.1	113.7	**125.7**	**125.7**	**125.7**
KSN Anchor Block KSN20L										
20	230	229	175	83.5	97.4	111.3	125.2	**125.7**	**125.7**	**125.7**
			200	83.5	97.4	111.3	125.2	**125.7**	**125.7**	**125.7**
			225	83.5	97.4	111.3	125.2	**125.7**	**125.7**	**125.7**
			250	83.5	97.4	111.3	125.2	**125.7**	**125.7**	**125.7**
			275	83.5	97.4	111.3	125.2	**125.7**	**125.7**	**125.7**
			300	83.5	97.4	111.3	125.2	**125.7**	**125.7**	**125.7**

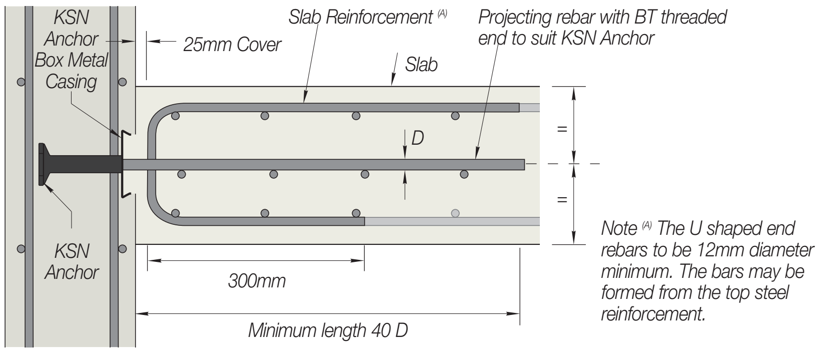
Notes: *All edges assumed to be at least 1.5 x h_{eff} from anchor centerline.*
Bold *figures indicate performance equal or greater than reinforcement design resistance.*

Ancon KSN Anchors

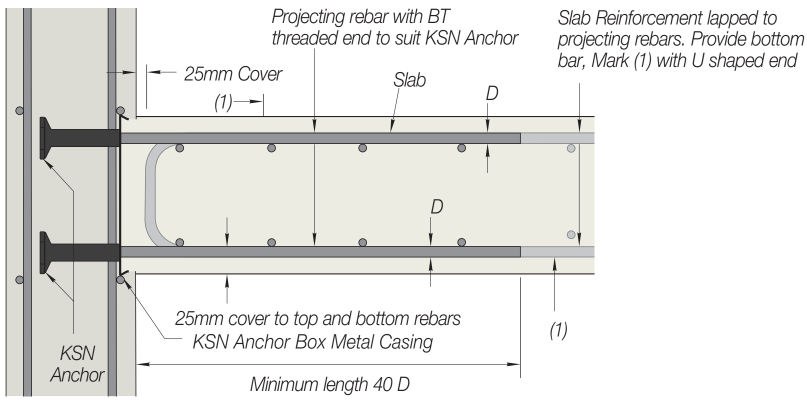
Reinforcement Details

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

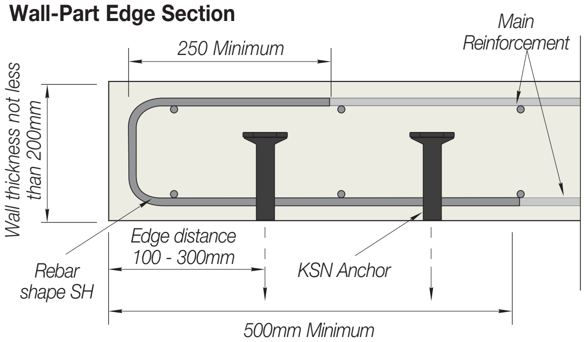
Mid Slab Anchor Connection



Top and Bottom Slab Anchor Connection

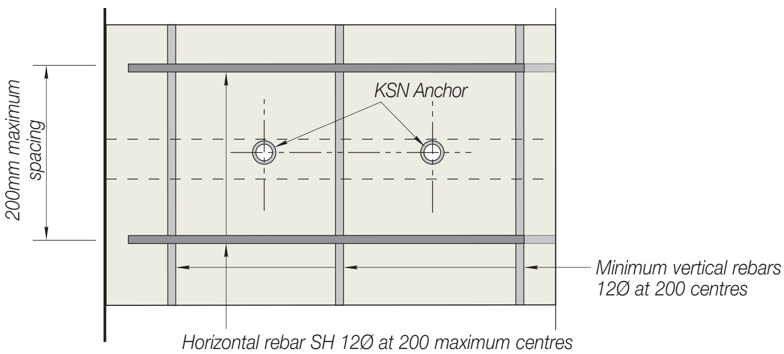


Wall-Part Edge Section



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

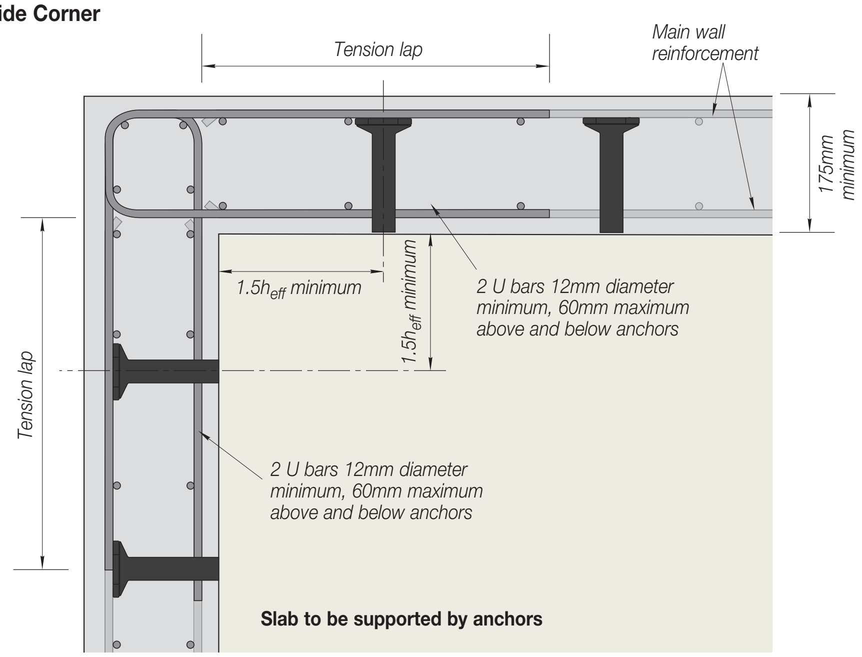
Wall-Part Edge Elevation



KSN Corner Guidance

KSN Anchors may be used to connect slabs to walls at corners as long as certain conditions are met.

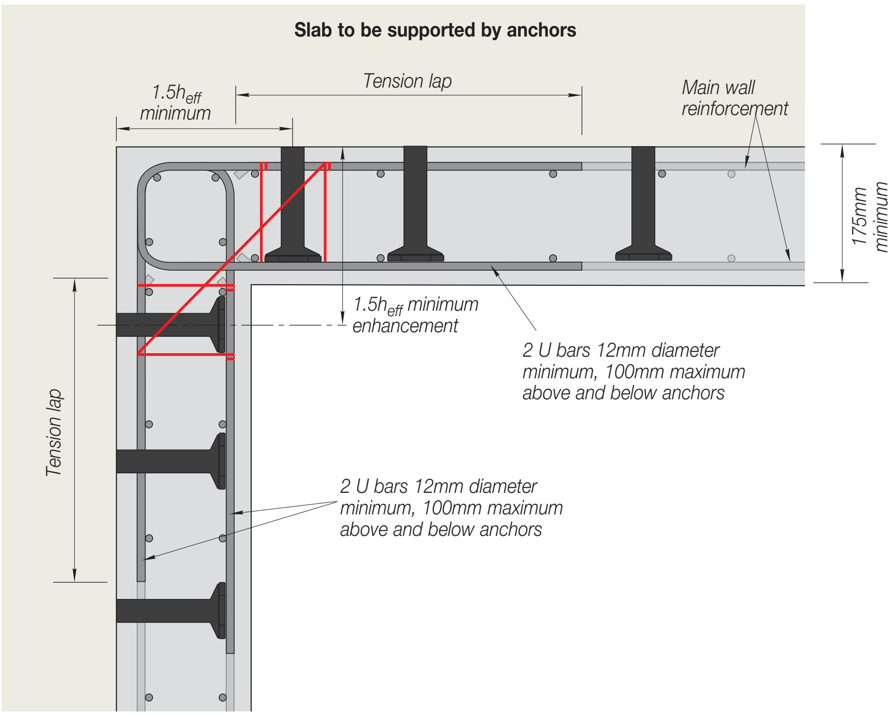
Inside Corner



Recommendations:

- Additional U-shaped rebars are to be provided above and below the corner anchors
- Careful attention to detailing of the anchors at corner locations is required to avoid the possibility of a clash of the continuity bars

Re-entrant Corner



Recommendations:

- Additional U-shaped rebars are to be provided above and below the corner anchors
- For high moments a special detail may be required, for example links and diagonal bars (shown red)
- Anchors at the re-entrant corner will have to resist higher loads than the current anchors due to the larger area of slab supported and therefore need to be designed for the specific loads applied to them

Ancon KSN Anchors

Guidance Regarding Ductility Requirement

The design of slab-wall connections should not be made in isolation but should be as part of a structural system. Ductility requirements of such a connection will depend on the robustness requirements of the structure of which it is part and the strategy chosen to achieve global robustness.

Fixings shall be designed to yield before ultimate failure in the event of overload (AS 3600:2018 Cl 19.3.1 c). In addition, when the structure is designed to earthquake requirements connections shall have sufficient ductility to preclude non-ductile failure (AS 3600:2018 Cl 14.4.2 b).

To achieve such ductility, adding supplementary reinforcement is recommended. The supplementary reinforcing bars shall be designed to take the KSN Anchor design loads.

AS 5216 - Design of Post-Installed and Cast-In Fastenings in Concrete provides guidance on supplementary reinforcement around anchors. According to section 5 of AS 5216:2018, the supplementary reinforcement is a deformed bar with a diameter not more than 16mm and shall be designed in accordance to section 13 of AS 3600. The provided strength by supplementary reinforcement shall be based on development length and related tensile stress in the reinforcing bar (σ_{st}) not exceeding yield strength of the bar.

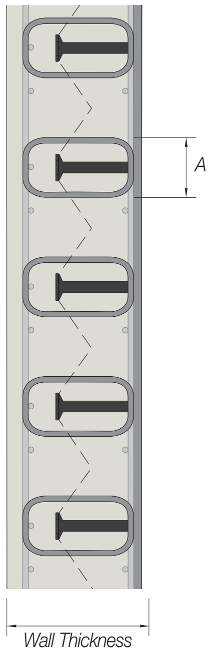
The supplementary reinforcing bar can be positioned directly next to the KSN Anchor or within a distance of up to 0.75 h_{eff}. The portion of the supplementary reinforcing bar located in the concrete failure cone may have the minimum length of,

- $l_a \geq 4d_b$ for bends, hooks or loops
- $l_a \geq 10d_b$ for straight bars

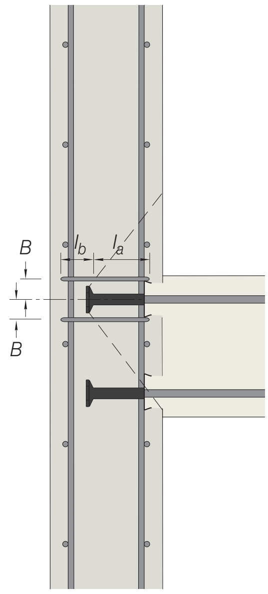
where d_b is the reinforcing bar diameter.

As the supplementary reinforcing bar engages only after the concrete cracks, the development length inside and outside of the concrete failure cone can be calculated by following the crack pattern. According to the CCD method, the angle between crack direction and the anchor is around 55°.

With l_a and l_b, the tensile stress in the reinforcing bar (σ_{st}) may be calculated by equation 13.1.2.4 of AS3600:2018. The supplementary reinforcement can be in the form of transverse links to be placed above and below the anchor in tension.



Horizontal Section
Plan View



Vertical Section
Side View

Anchor Ref.	Bar Diameter (mm)	Anchor Length (mm)	Min. Wall Thickness w. KSNBOX (mm)	Link Diameter (mm)	Dimension A (mm)	Dimension B (mm)
KSN12S	12	115	185	12	120	90
KSN12M	12	150	220	12	120	110
KSN16S	16	130	200	16	120	90
KSN16M	16	160	230	16	120	115
KSN16L	16	190	260	12	120	140
KSN20S	20	150	220	16	135	105
KSN20M	20	190	260	16	135	140
KSN20L	20	230	300	12	135	165

Guidance on Shear Checks

The shear capacity of the joint (vertical shear at the interface and horizontal shear in the wall) must be checked by the designer. Tests undertaken with top and bottom anchors have shown no sign of distress due to shear at the interface, however suitability must be checked by the designer. Ignoring the shear key effect, the shear capacity is the minimum of the following:

- Concrete pry-out capacity calculated by CCD method
- Steel shear capacity of the starter bar
- Dowel bending capacity
- Shear friction capacity

For example, for KSN16S @ 200 with KSN Anchor Box metal casing and slab thickness of 250mm the shear capacity can be calculated as below:

- Concrete shear pry-out calculated by CCD method (according to Appendix B of AS 3850)

$N_{Rd,c}$ = 37.2 kN

$V_{Rd,c} = 2 \times N_{Rd,c}$ = 74.4 kN

- **Steel shear capacity of the starter bar (AS 4100)**

$V_{Rd,s} = ø_s \times 0.62 \times A_s \times f_y$

$V_{Rd,s} = 0.8 \times 0.62 \times 201.06\ mm^2 \times 500MPa$

= 49.86 kN

- **Dowel bending capacity (EC-3 and EC-4) assuming 1mm gap**

$V_{Rd,D} = Min\ (V_{pl,RD}, V_{Rd,1})$

Where **(EN 1993-1-1 Eq. 6.18)**

$V_{pl,RD} = A_v\ (f_y / \sqrt{3}) / \gamma_{M0}$

= 53 kN

and

$V_{Rd,1} = 2M_{pl,\ Rd} / (f + a)$

$M_{pl,Rd} = W_{pl}\ f_y\ \gamma_{M0}$ = 310 kNmm

$a = V_{Rd1} / (øf_{cd,\ sup})$ = 27.07mm

$V_{Rd,1}$ = 22.11kN

Therefore

$V_{Rd,D}$ = 22.1kN

- **Shear friction capacity (EC-2)** **(EN 1992-1-1 - Clause 6.2.5)**

$V_{Rdi} = c\ f_{ctd} + \mu\ \sigma_n + \rho\ f_{yd}\ (\mu \sin \alpha + \cos \alpha) \leq 0.5\ v\ f_{cd}$

μ = 0.6

c = 0.35

σ_n = 0

α = 90

f_{ctd} = 1.38

$\rho\ f_{yd}$ = 1.088 (the f_{yd} is replaced by the tensile capacity from table on page 14,

ρ = interface area = 250* 1000)

Therefore

V_{Rdi} = 1.13 MPa

Provided shear resistance per anchor (lever arm = 125)

V_{Rd} = 28.4 kN

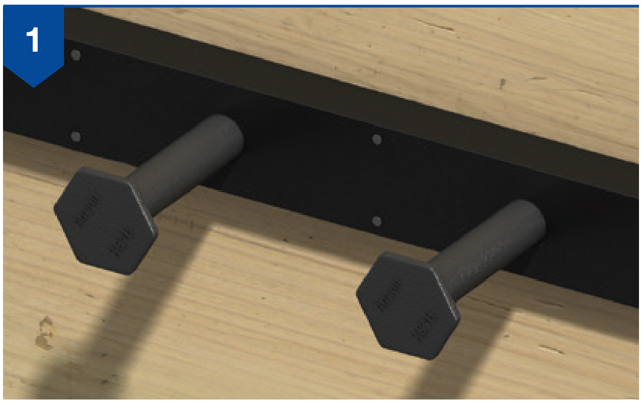
Shear capacity of KSN16S @ 200 with KSN Anchor Box for 250 slab with 32MPa concrete is the minimum value of above calculated values which is 22.1kN per anchor or 110.5kN per metre.

For advice please contact Leviat on 1300 304 320 or email technical.au@leviat.com.

Ancon KSN Anchors

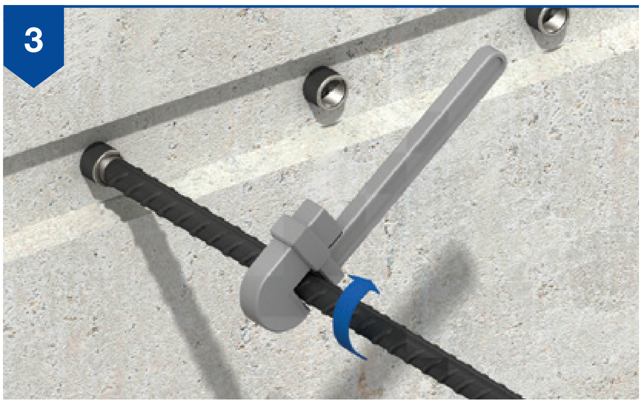
Installation Guidance

Re-Useable KSN Anchor Block



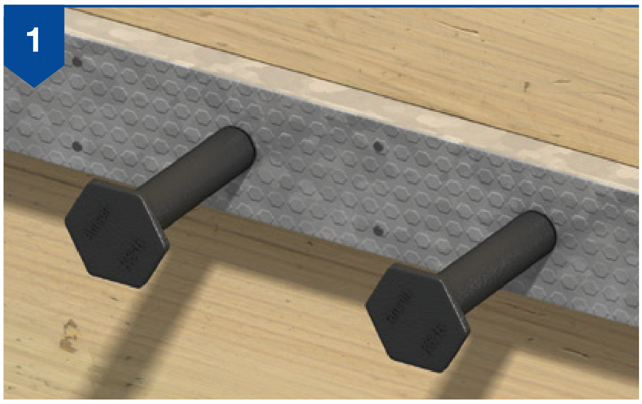
KSN Anchors are inserted into the Ancon KSN Anchor Block. The unit is then nailed to the formwork. The wall reinforcement is installed to which the anchors are tied. The concrete is cast and once it reaches sufficient strength, the formwork is removed.

When a connection is required, the Ancon KSN Anchor Block is removed and retained for future use.



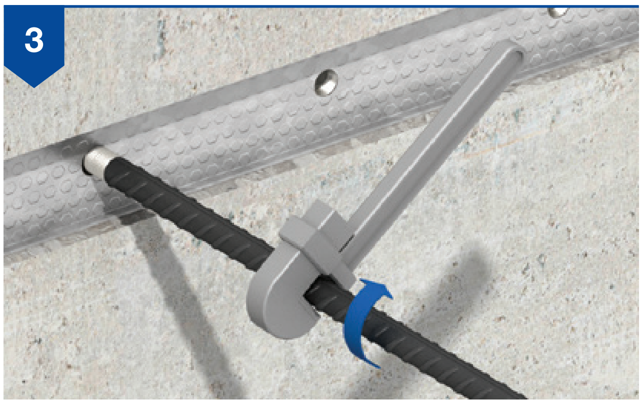
The BT parallel threaded reinforcing bar is rotated into the KSN Anchor and tightened using a wrench. No more than 2mm of thread should be left exposed on the bar. Fix the slab reinforcement and pour the concrete to complete the installation.

KSN Anchor Box



Nail the metal casing to the formwork. The wall reinforcement is installed to which the anchors are tied. The concrete is cast and once it reaches sufficient strength, the formwork is removed to reveal the steel cover.

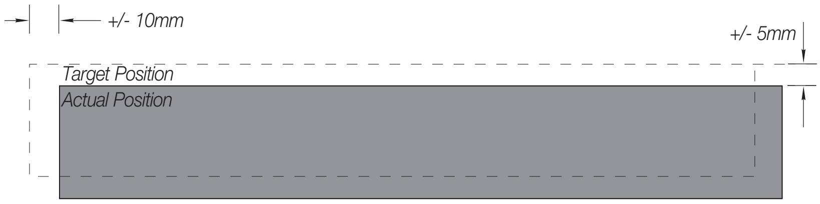
When a connection is required, the cover is removed and the bolts which held the Anchors to the casing prior to installation are removed to reveal the threads.



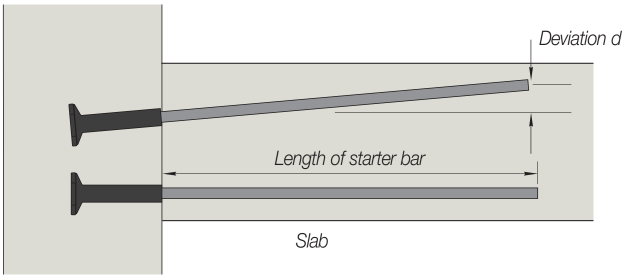
The BT parallel threaded reinforcing bar is rotated into the KSN Anchor and tightened using a wrench. No more than 2mm of thread should be left exposed on the bar. Fix the slab reinforcement and pour the concrete to complete the installation.

Installation Tolerances

In order to ensure adequate cover to the starter bar and to comply with the design, it is important that the KSN Anchor is set to the correct position and fixed to prevent any movement during concreting. The installation tolerances for the Ancon KSN Anchor Block and Ancon KSN Anchor Box are shown below.

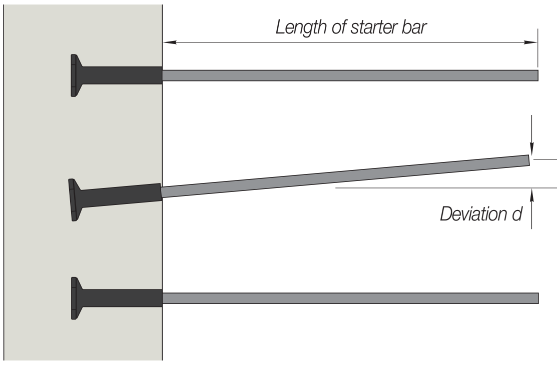


KSN Anchor Box and Anchor Block Deviation Allowances



Vertical Transverse Section Alignment of Anchor
Side View

Allowable vertical deviation: d=-5, +10mm where a positive value indicates the amount the cover increases and a negative value indicates the amount the cover decreases.



Horizontal Transverse Section Alignment of Anchor
Plan View

Allowable horizontal deviation: d=10% of the specified spacing or 15mm, whichever is greater.

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