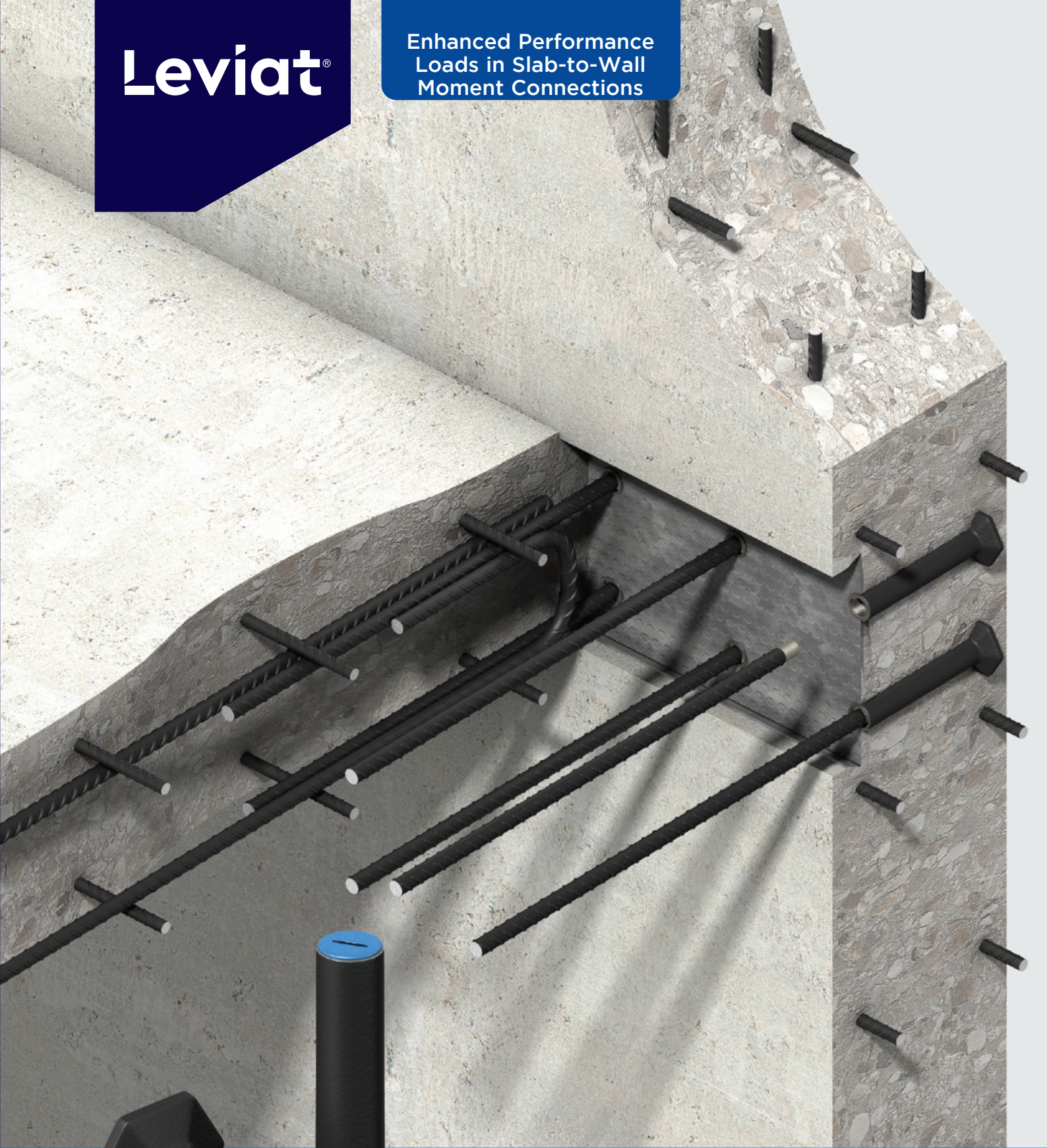


Leviat[®]

Enhanced Performance
Loads in Slab-to-Wall
Moment Connections



Ancon[®]
KSN Anchors

Reinforcement Continuity
System

September 2021

Leviat

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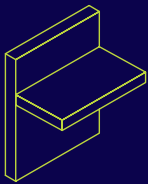
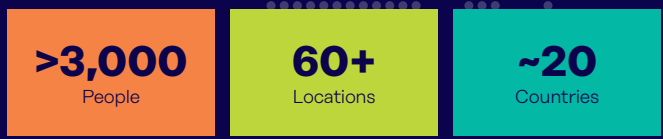
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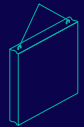


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Systems to form robust, efficient connections, and continuity of concrete reinforcement as necessary, between walls, slabs, columns, beams and balconies, providing structural integrity as well as enhanced thermal and acoustic performance.

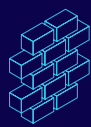
- Insulated balcony connectors
- Reinforcing bar couplers
- Concrete Connections
- Reinforcement continuity systems
- Punching shear reinforcement
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- Precast / Reinforced Columns
- Infrastructure Products
- Precast Connections
- Acoustic dowels and bearings
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Other areas of expertise:



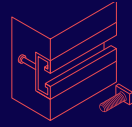
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Systems for the safe and efficient transportation, lifting and temporary bracing of cast concrete elements and tilt-up panels before permanent structural connections are made.



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Systems for the safe and thermally-efficient fixing of the external building envelope, including brick and natural stone, insulated sandwich panels, curtain walling and suspended concrete façades, and also the repair and strengthening of existing masonry installations.



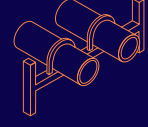
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Systems for fixing secondary fixtures to concrete, including anchor channels, bolts and inserts; also tension rod systems for roofs and canopies.



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Non-structural accessories that complement our engineered solutions and help keep your construction environment operating safely and efficiently, including moulds for casting standard and special concrete elements and construction essentials such as reinforcing bar spacers.



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Mounting channels, pipe clamps and other versatile framing systems that provide safe fixing in a wide range of industrial applications.

Leviat product ranges:

Ancon | Aschwanden | Connolly | Halfen | Helifix | Isedio | Meadow Burke | Modersohn | Moment | Plaka | Scaldex | Thermomass

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.



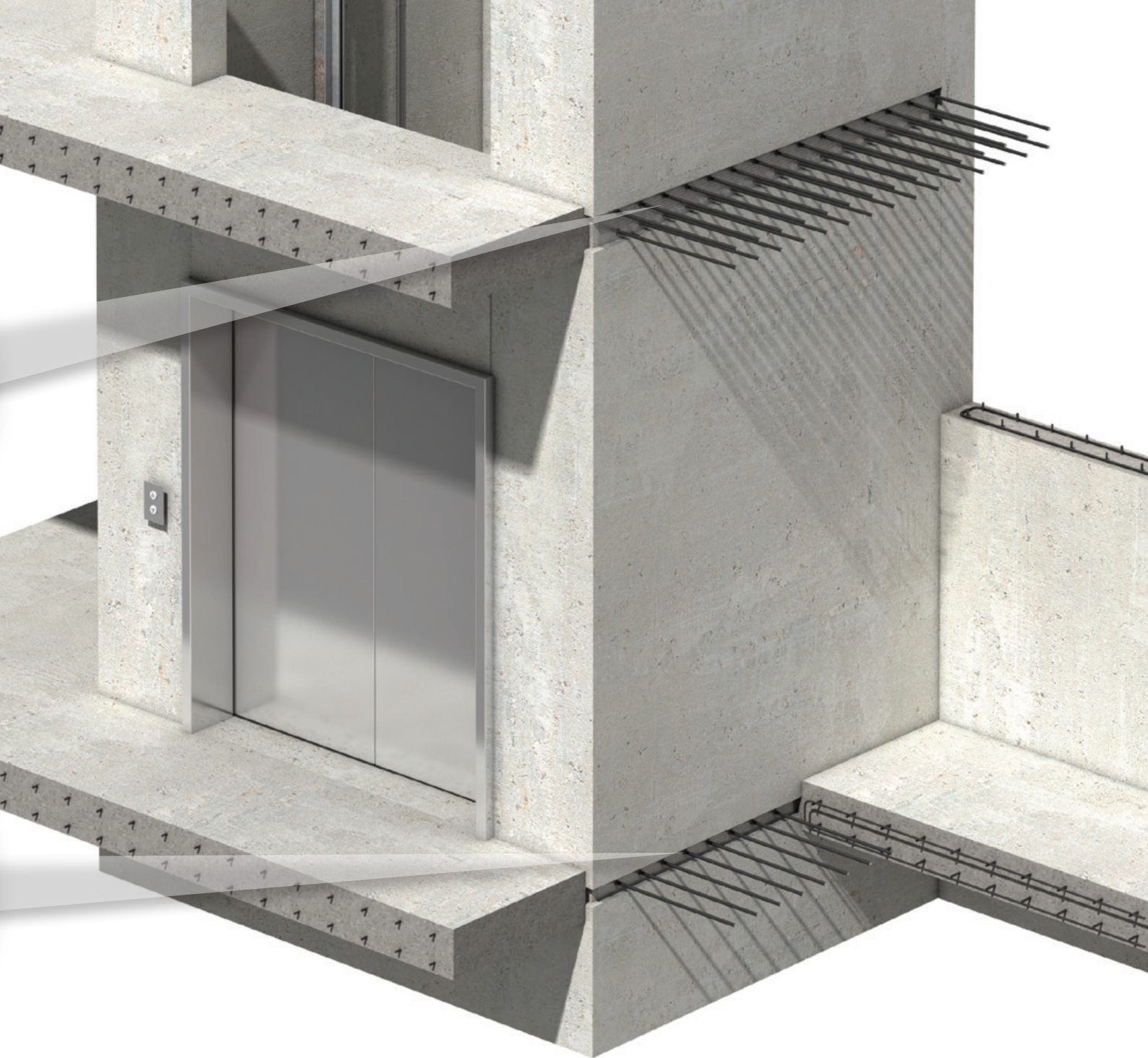
High performance KSN Anchor System. Bars are installed when required. No bending of bars. Less congestion in the wall.

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 coggled 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.

$$N \leq \phi_s N_s \leq \phi_c N_c \text{ where } \phi_s = 0.8, \phi_c = 0.6$$



Associated References:

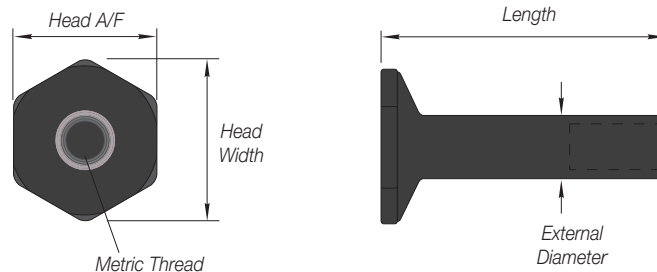
AS 3600 Clause 19.3.1(c): Fixings shall be designed to yield before ultimate failure in the event of overload. Clause 19.3.3, cast-in fixings shall be designed in accordance with AS 3850.1, Appendix B.



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

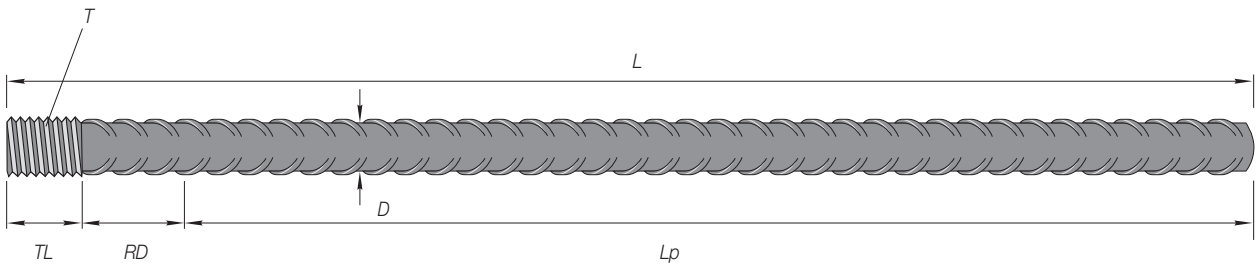
| Anchor Part No. | Anchor Length mm | Min. Wall Thickness mm KSNBLOCK | Min. Wall Thickness mm KSNBOX |
|-----------------|------------------|---------------------------------|-------------------------------|
| KSN12S | 115 | 200 | 185 |
| KSN12M | 150 | 200 | 220 |
| KSN16S | 130 | 200 | 200 |
| KSN16M | 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.*

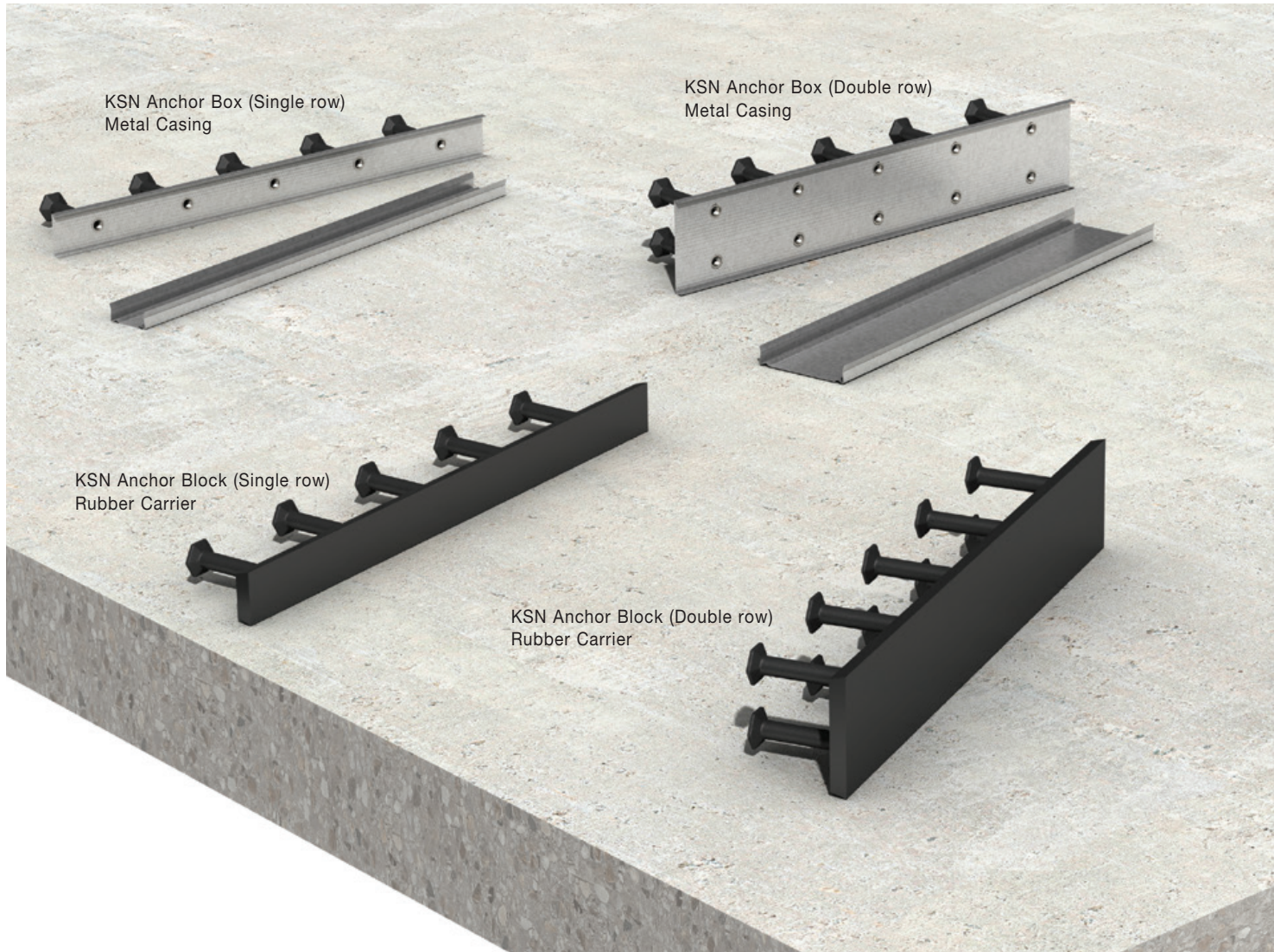
Reinforcement Characteristic Yield Load

| 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 available in system widths of 120mm and above) | KSN Block = 600, 800, 1000, 1200mm |
| KSN16M | | KSN Block available widths = | | Welded Bar = 600, 800, 1000, 1200mm |
| KSN16L | | 90, 200mm | | |
| KSN20S | | | | |
| KSN20M | | | | |
| KSN20L | | | Number of anchors per row | |

Specification Clause

Headed Anchors shall be Ancon KSN Anchors as manufactured by Leviat.

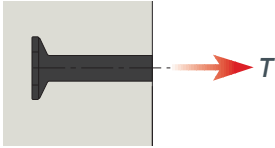
Reinforcement shall be Ancon BT Threaded Starter Bars as manufactured by Leviat.

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 $N_{Rk,c}^0$ is determined from the formula, $N_{Rk,c}^0 = k_{cr} \cdot f_c^{0.5} \cdot h_{eff}^{1.5}$

Where:

- $N_{Rk,c}^0$ 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 $\phi_c = 0.6$ in accordance with table 2.2.2 of AS 3600:2018.

$$N_{Rd,c}^0 = \phi_c N_{Rk,c}^0$$

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

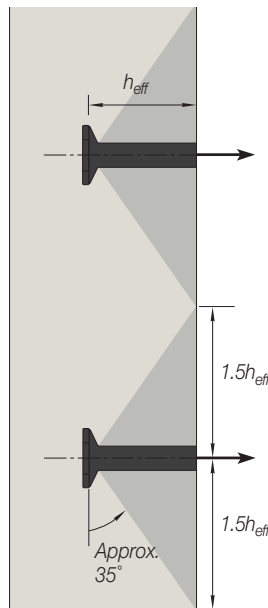
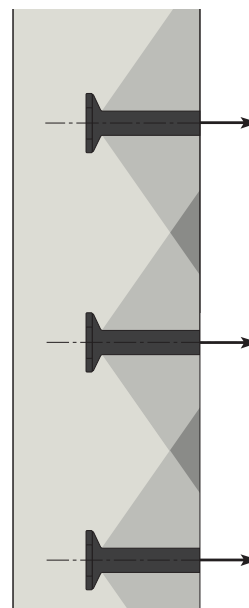
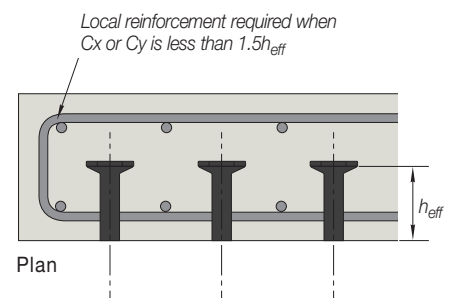
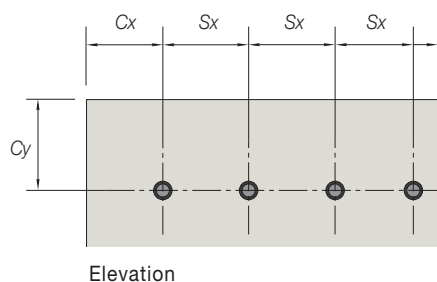


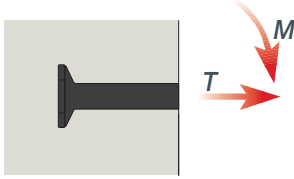
Fig B. Reduced Spacings



The tables on pages 15 to 23 assume that the close edge distances C_x and C_y are catered for by either (1) ensuring C_x and C_y are equal to or greater than $1.5 \times h_{eff}$ 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.



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.

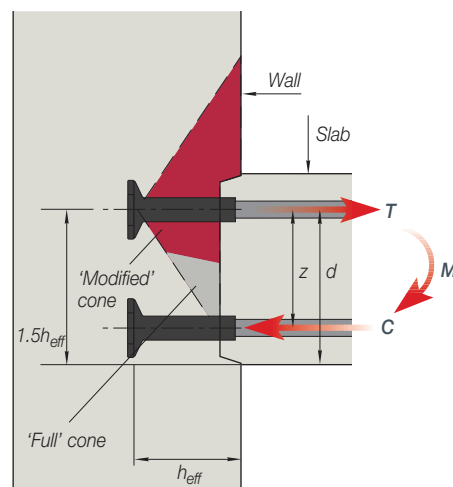


Fig 1. Idealised modified concrete failure. Paired arrangement used in testing.

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.

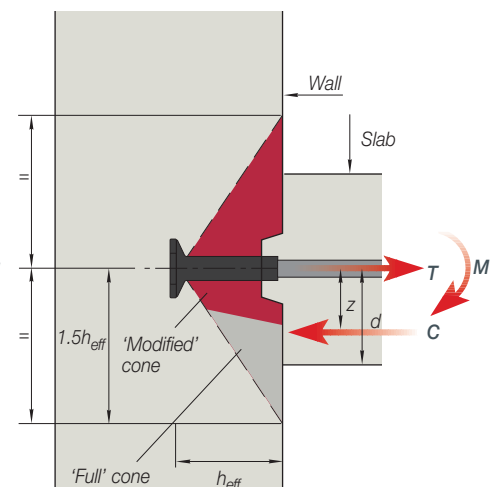


Fig 2. Idealised modified concrete failure. Single line of Anchors is shown.

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 $\geq 1.5h_{eff}$ 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.

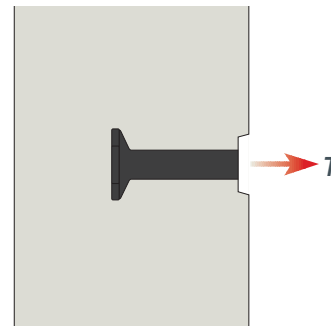
Design Examples

| | | |
|-----------|---|---|
| A) | Load condition: Wall depth: Wall concrete: Minimum cover: Tension applied: Starter bar size and spacing: Assuming anchors at 200mm c/c: | Direct tensile load 180 mm 32MPa 25mm 165kN/m N16@200 $N_{Ed} = 165 \times 0.200 = 33\text{kN}$ 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.



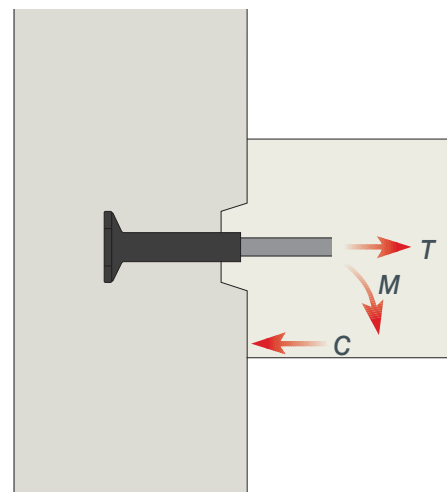
| | | |
|-----------|---|--|
| B) | Load condition: Anchor: Method of fixture: Anchor effective embedment: Anchor spacing: Concrete: Slab depth: Wall depth: Anchor reinforcement location: | Moment connection KSN16M x 160mm long KSNBLOCK 159mm 200mm 32MPa 250mm 200mm Mid slab depth |
|-----------|---|--|

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 $l_a = 0.85 \times d_{eff}$ & $d_{eff} = 100\text{mm}$) $(80.4 \times 0.10 \times 0.85) \times (1000/200) = 34.2\text{kNm}$ 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.



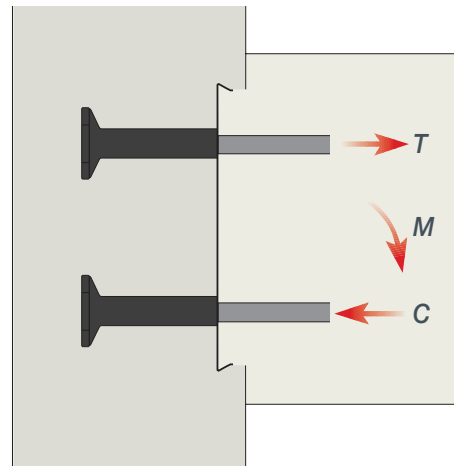


| | | |
|-----------|--------------------------------|--------------------------|
| C) | Load condition: | Moment connection |
| | Anchor: | KSN16M x 160mm long |
| | Method of fixture: | KSNBOX casing 36mm deep |
| | Anchor effective embedment: | 190mm |
| | Anchor spacing: | 200mm |
| | Concrete: | 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 $l_a = 0.85 \times d_{eff}$ & $d_{eff} = 192\text{mm}$) $(80.4 \times 0.192 \times 0.85) \times (1000/200) = 65.6\text{kNm}$ per metre.

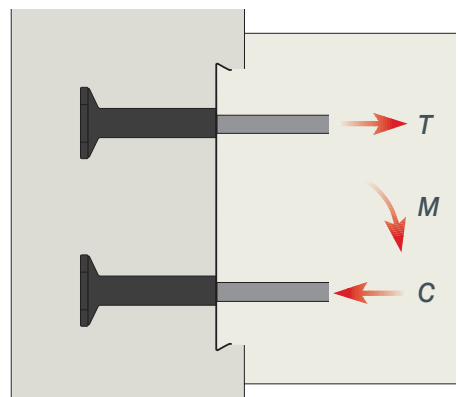


| | | |
|-----------|--------------------------------|--------------------------|
| D) | Load condition: | Moment connection |
| | Anchor: | KSN20S x 150mm long |
| | Method of fixture: | KSNBOX casing 36mm deep |
| | Anchor effective embedment: | 180mm |
| | Anchor spacing: | 250mm |
| | Concrete: | 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.

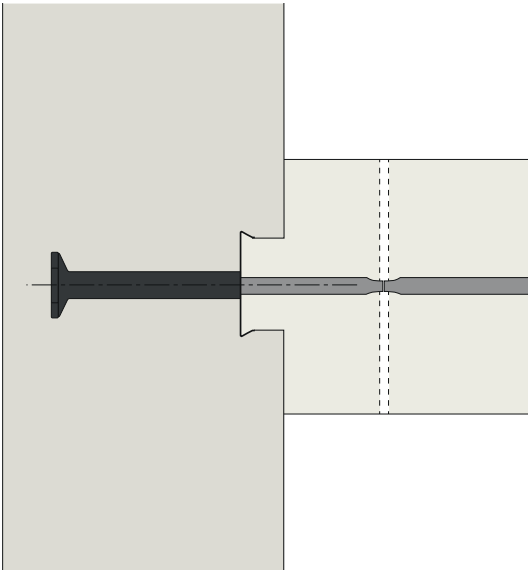
An estimate of the design moment capacity per metre width (where the lever arm $l_a = 0.85 \times d_{eff}$ & $d_{eff} = 215\text{mm}$) $(100.6 \times 0.215 \times 0.85) \times (1000/250) = 73.5\text{kNm}$ per metre.



Ancon KSN Anchors

Direct Tensile Concrete Characteristic Load Data

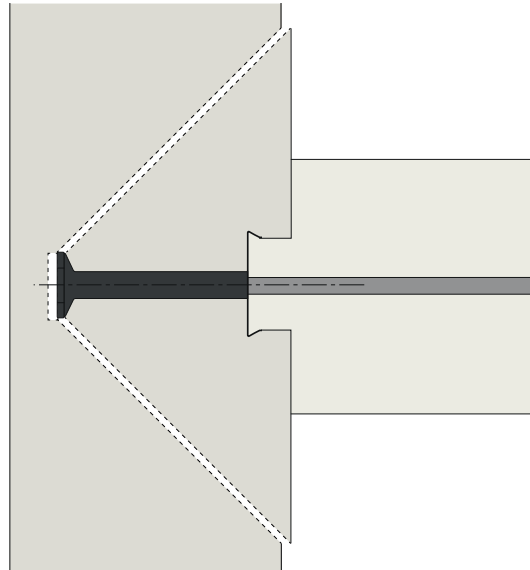
Failure modes related to headed anchors in slab/wall connections:



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 breakout capacity will normally not suffice for the concrete breakout strength to exceed the capacity of the connected reinforcement bar.

Mode of Failure

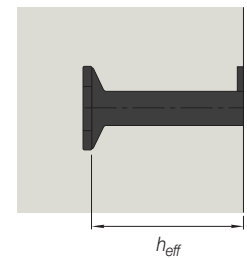
By increasing the embedment depth, the capacity of the KSN Anchor can be improved. The tables on pages 15 to 23 provide the tensile design resistance load of each anchor for the four installation methods. **Bold** figures indicate performance equal to or greater than reinforcement design resistance load $N_{Rd,s}$, 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

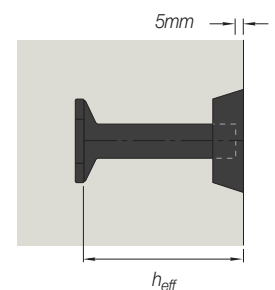
KSN Anchors Welded on Bar (Flush with Concrete)

| 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 |



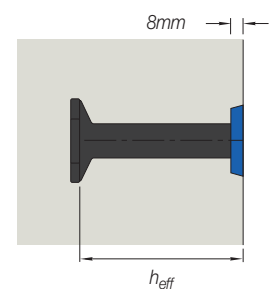
KSN Anchor Block (Additional 5mm Embedment)

| | | | | | | | | | | | |
|--------|-----|----|-----|-----|------|-------|------|-------------|-------------|-------------|-------------|
| 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 |



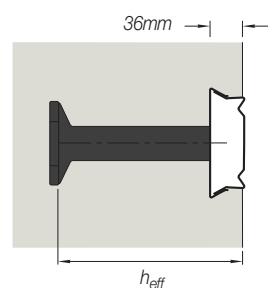
KSN Anchors with Individual Nailing Plate (Additional 8mm Embedment)

| | | | | | | | | | | | |
|--------|-----|----|-----|-----|------|-------|-------------|-------------|-------------|-------------|-------------|
| 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)

| | | | | | | | | | | | |
|--------|-----|----|-----|-----|------|------|-------------|-------------|-------------|-------------|-------------|
| 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 |



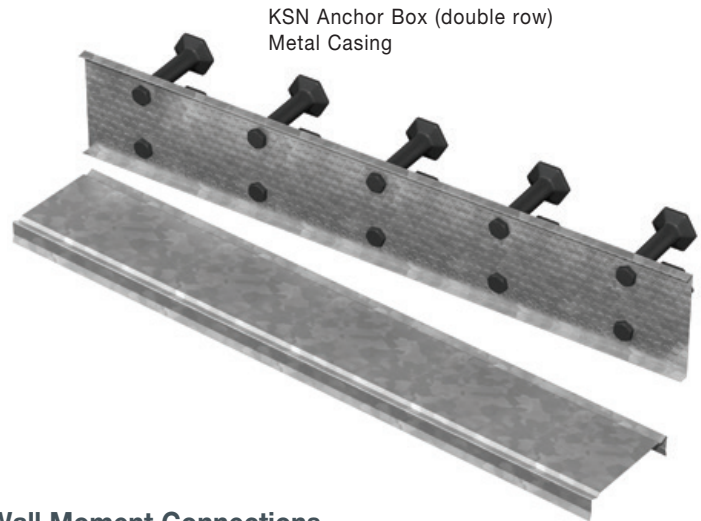
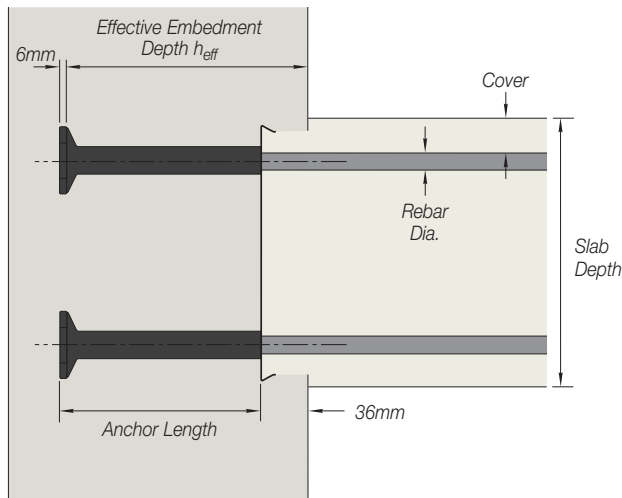
* Design example, see page 12

Notes: All edges assumed to be at least $1.5 \times h_{eff}$ 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



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) | | | | | | |
| | | | | 150 | 175 | 200 | 225 | 250 | 275 | 300 |
| KSN Anchor Box with KSN12S | | | | | | | | | | |
| 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 $1.5 \times h_{eff}$ 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) | | | | | | |
| | | | | 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 | 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

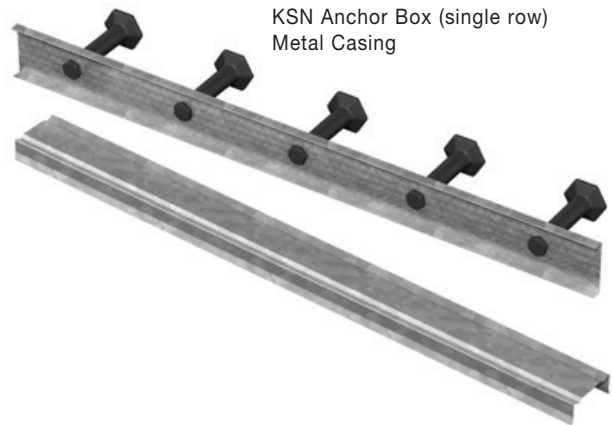
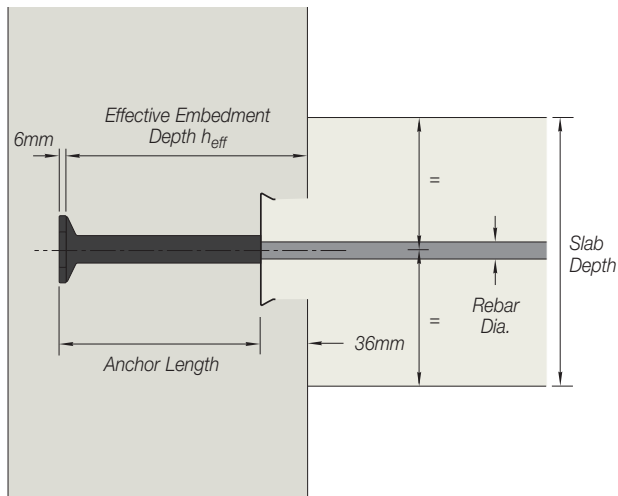
Notes: All edges assumed to be at least $1.5 \times h_{eff}$ from anchor centreline.

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



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 $1.5 \times h_{eff}$ from anchor centreline.

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



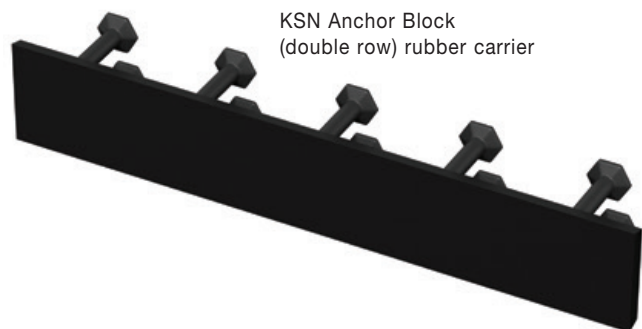
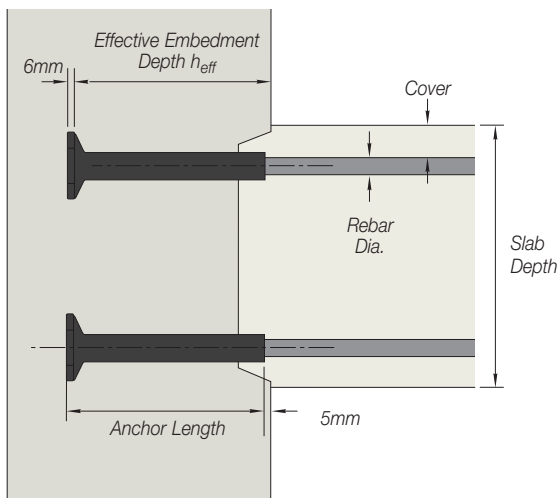
| Rebar Dia. (mm) | Anchor Length (mm) | Embedment Depth h_{eff} (mm) | Slab Depth (mm) | Anchor - Enhanced Tensile Resistance Load N_{Rd} (kN) 32MPa Concrete at Various Spacing | | | | | | |
|-----------------------------------|--------------------|--------------------------------|-----------------|--|-------------|-------------|--------------|--------------|--------------|--------------|
| | | | | 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 $1.5 \times h_{eff}$ 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



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 Block with KSN12S | | | | 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 | 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 $1.5 \times h_{eff}$ 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 |

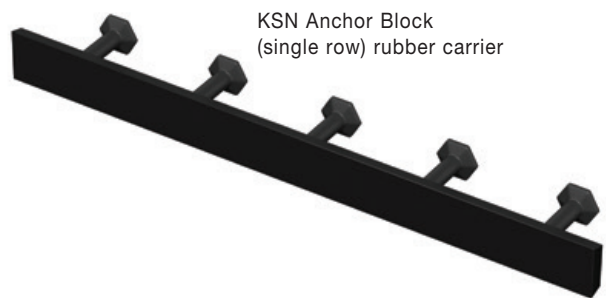
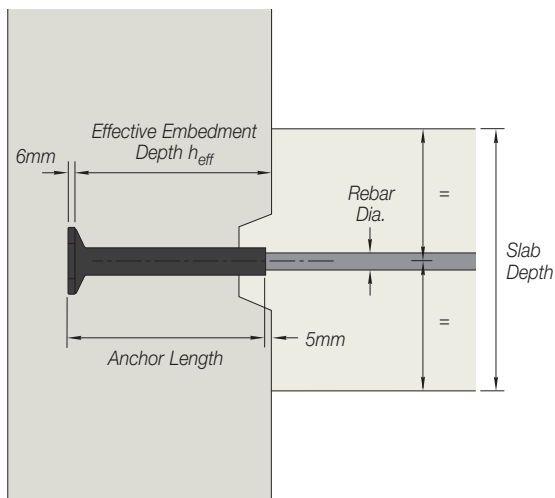
Notes: All edges assumed to be at least $1.5 \times h_{eff}$ from anchor centerline.

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

| 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 Block KSN12S | | | | | | | | | | |
| 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 | | | | | | | | | | |
| 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 | | | | | | | | | | |
| 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 | | | | | | | | | | |
| 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 $1.5 \times h_{eff}$ 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) | | | | | | |
| | | | | 150 | 175 | 200 | 225 | 250 | 275 | 300 |
| KSN Anchor Block KSN16L | | | | | | | | | | |
| 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 $1.5 \times h_{eff}$ from anchor centerline.

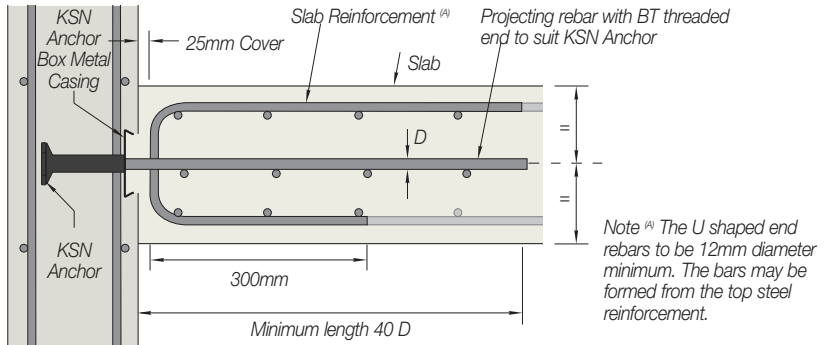
Bold figures indicate performance equal or greater than reinforcement design resistance.

Ancon KSN Anchors

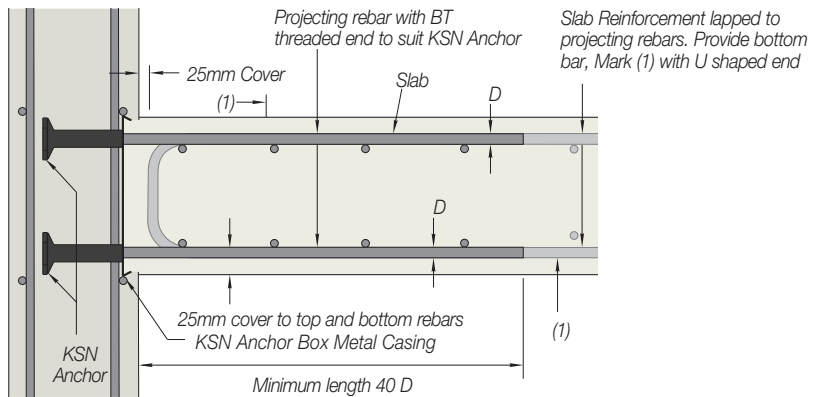
Reinforcement Details

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

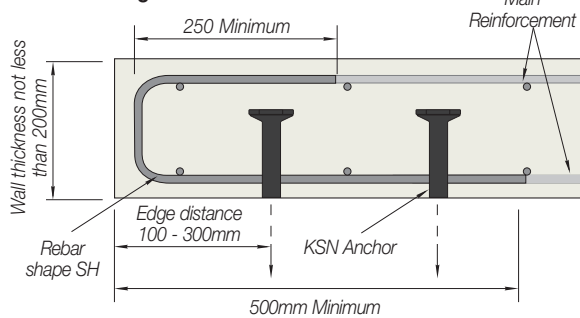
Mid Slab Anchor Connection



Top and Bottom Slab Anchor Connection

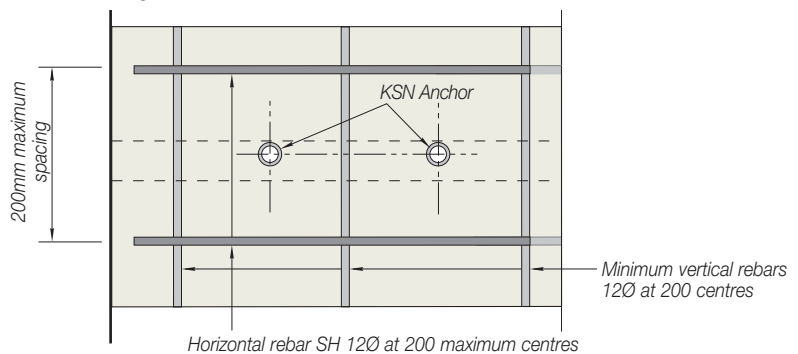


Wall-Part Edge Section



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

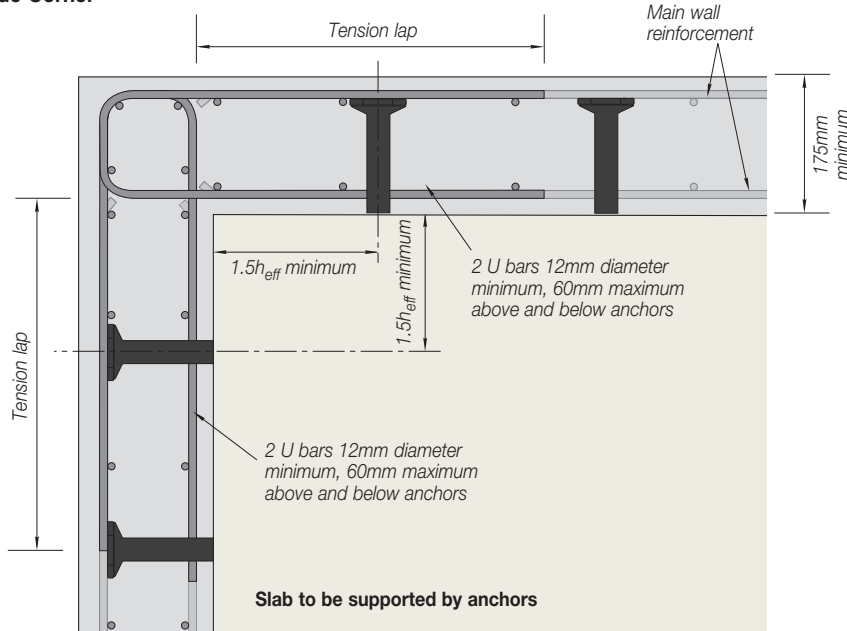
Wall-Part Edge Elevation



KSN Corner Guidance

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

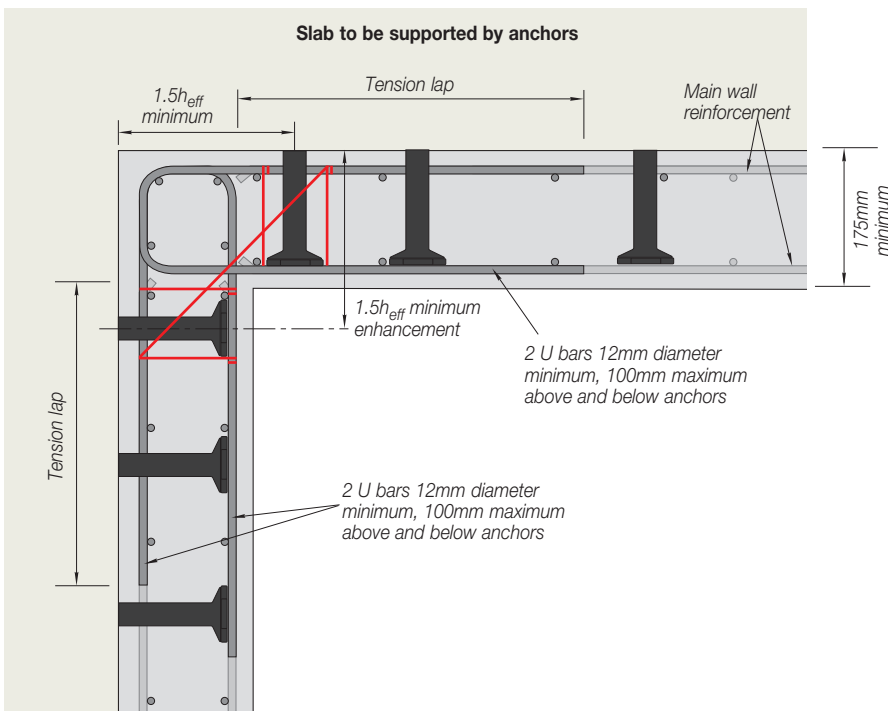
Inside Corner



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.

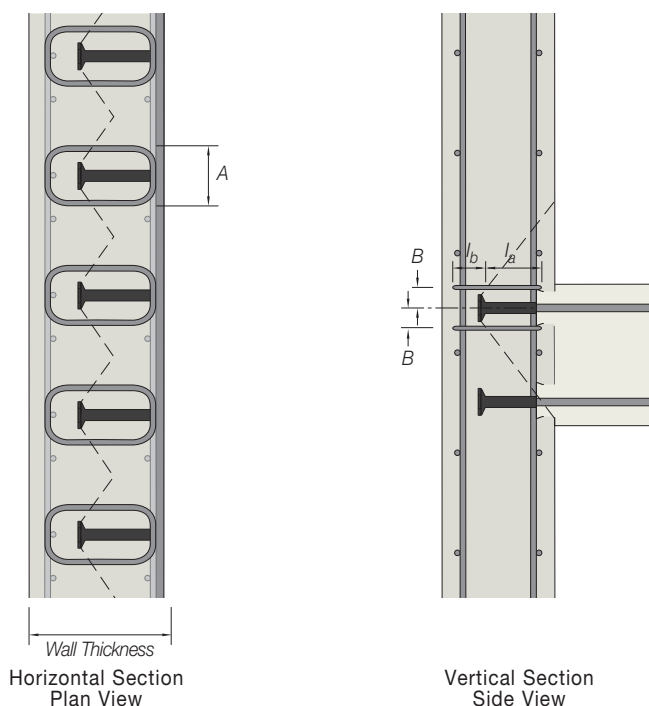
AS 5216 - Design of Post-Installed and Cast-In Fastenings in Concrete provides guidance on supplementary reinforcement around anchors. According to section 5 of AS 5216:2018, the supplementary reinforcement is a deformed bar with a diameter not more than 16mm and shall be designed in accordance to section 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.



| 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)

$$N_{Rd,c} = 37.2 \text{ kN}$$

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

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

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

$$V_{Rd,s} = 0.8 \times 0.62 \times 201.06 \text{ mm}^2 \times 500 \text{ MPa} \\ = 49.86 \text{ kN}$$

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

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

Where

(EN 1993-1-1 Eq. 6.18)

$$V_{pl,RD} = A_v (f_y / \sqrt{3}) / \gamma_{M0} \\ = 53 \text{ kN}$$

and

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

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

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

$$V_{Rd,1} = 22.11 \text{ kN}$$

Therefore

$$V_{Rd,D} = 22.1 \text{ kN}$$

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

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

$$\mu = 0.6$$

$$c = 0.35$$

$$\sigma_n = 0$$

$$\alpha = 90$$

$$f_{ctd} = 1.38$$

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

$$\rho = \text{interface area} = 250 \times 1000)$$

Therefore

$$V_{Rdi} = 1.13 \text{ MPa}$$

Provided shear resistance per anchor (lever arm = 125)

$$V_{Rd} = 28.4 \text{ kN}$$

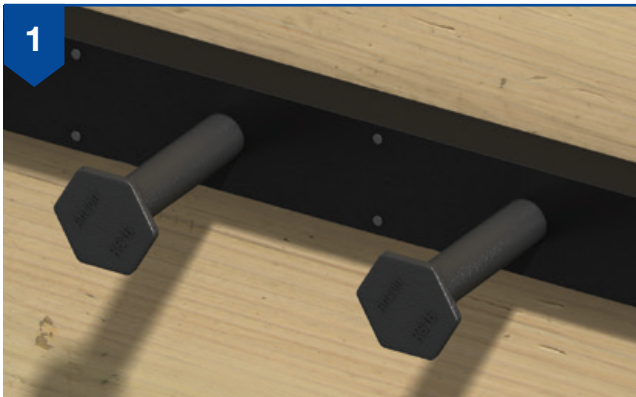
Shear capacity of KSN16S @ 200 with KSN Anchor Box for 250 slab with 32MPa concrete is the minimum value of above calculated values which is 22.1kN per anchor or 110.5kN per metre.

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

Ancon KSN Anchors

Installation Guidance

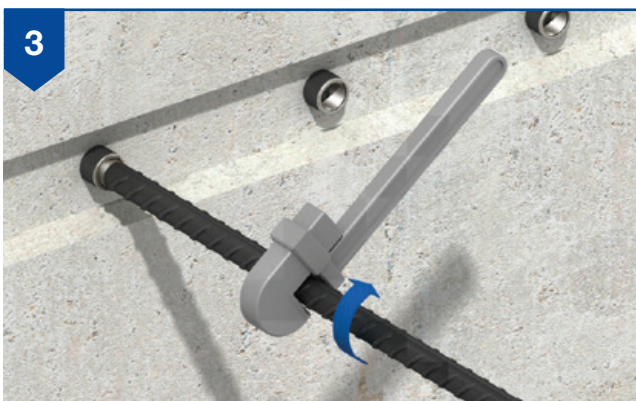
Re-Useable KSN Anchor Block



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.

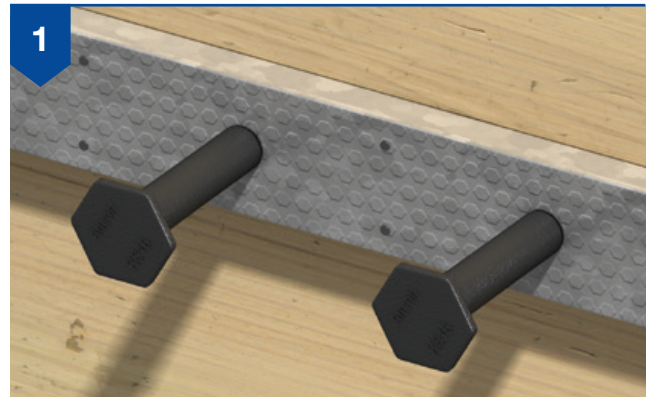


When a connection is required, the Ancon KSN Anchor Block is removed and retained for future use.



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.



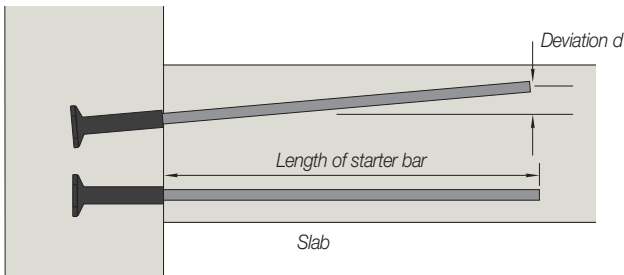
The BT parallel threaded reinforcing bar is rotated into the KSN Anchor and tightened using a wrench. No more than 2mm of thread should be left exposed on the bar. Fix the slab reinforcement and pour the concrete to complete the installation.

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.

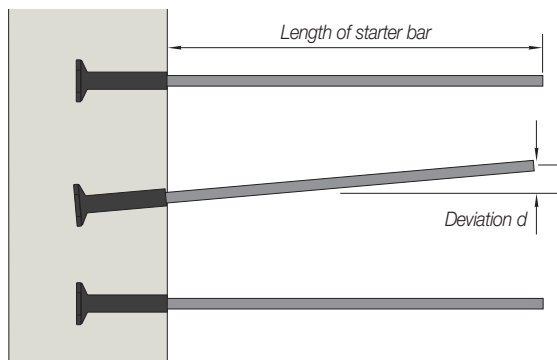


KSN Anchor Box and Anchor Block Deviation Allowances



Vertical Transverse Section Alignment of Anchor Side View

Allowable vertical deviation: $d = -5, +10\text{mm}$ 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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