KSN SOFTWARE AUSTRALIA USER MANUAL

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1 Product overview

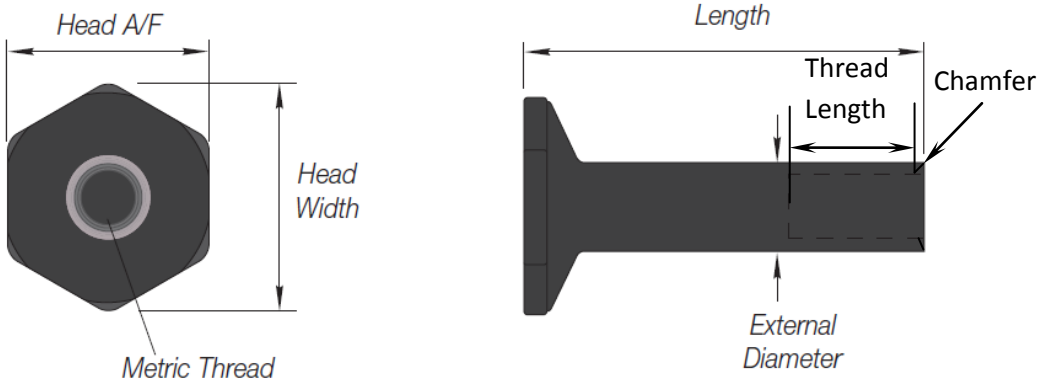
1.1 Description and advantages of using Ancon KSN anchors

1.1.1 Description and current range

KSN Anchors

The Ancon KSN anchors are hot forged headed anchors manufactured from highly reliable Cr-Mo alloy steel for casting into concrete.

KSN Anchors, eight standard sizes available from stock



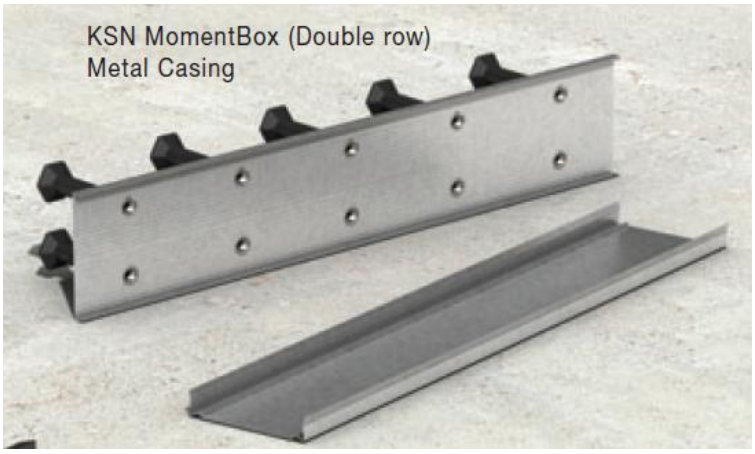
Anchor Ref.	Nominal External Diameter (mm)	Metric Thread (mm)	Nominal Head Width (mm)	Nominal Head A/F (mm)	Anchor Length (mm)	Thread Length (mm)
KSN12S KSN12M	22	M16 x 2.0	46	40	115 150	18
KSN16S KSN16M KSN16L	28	M20 x 2.5	61	53	130 160 190	22
KSN20S KSN20M KSN20L	32	M24 x 3.0	75	65	150 190 230	27

Anchor installation methods:

The most common installation method for the use of Ancon KSN anchors is the use of KeyBox and MomentBox Metal Casings.

A galvanised steel casing is supplied with KSN Anchors installed at the specified design spacing. The unit is sealed at each end to prevent the ingress of concrete and the steel is dimpled to provide a key for the concrete. Contact Ancon if using high slump superplasticised 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.



Other possible carriers:

KeyBlock and MomentBlock Reusable Mould: 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 reloaded 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.

Individual Nailing Plate

Individual Nailing Plates may be used to place KSN Anchors singularly or in groups to provide metric thread fixing points. 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 10mm however it is unsuitable for moment connections.

Welded 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 male component.

Additional Embedment Given

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

** Standard casing depth. Other depths available on request. Lead time will vary.*

Table 2

1.1.2 Advantages

Used in combination with BT parallel-threaded reinforcing bars, they provide a quicker, easier and above all safer continuity system.

Quicker: No formwork drilling required, fast installation against formwork, fast installation of the continuation bars.

Easier: Easy installation in wall, minimise reinforcement congestion and simplify bar scheduling, easier installation of the continuation bars than pull-out bars, allows virtually any length for the continuation bars.

Safer: Their use avoids the use of projecting bars or on-site bar straightening.

1.2 Typical Applications

The typical application for the use of the Ancon KSN anchors is a wall to slab construction joint.

Wall to slab construction joint using KSN anchors

KSN Anchors can be used to anchor the slab top and/or bottom reinforcement following the requirement of AS3600[1] and the indentation created by the carrier can be used to resist the shear. In this configuration, if a moment is applied to the connection, a series of test has shown that the compression induced by the moment modifies the pull-out cone of the top anchor and in some circumstances this results in an enhanced pull-out capacity for the top anchors. This design software assesses the conditions and calculates an enhanced pull-out capacity when possible.

Other applications are possible but care should be taken that the design assumptions stated in the next pages are applicable.

If in doubt, please contact Ancon.

1.3 Design Assumptions

Notations:

The notations used in this document have, when possible, been set to be consistent with the references they come from.

$A_{a,Rd}$	Area of slab bottom reinforcement to be anchored in the wall
C_x	Side edge distance: distance of first or last anchor in a row with edge perpendicular to the line of anchors
d_{eff}	Effective depth of the slab
f'_c	Characteristic compressive cylinder strength of concrete at 28 days.
f_y	Design yield strength of reinforcement
h_{eff}	Effective embedment of the anchor, refer to figure 1.
M_{Ed}	Design value of the applied internal bending moment
$N_{Rd,a}$	Anchors design strength
$N_{Rd,c}$	Concrete design strength
$N_{Rd,c,enh}$	Concrete design strength taking into account moment enhancement when applicable.
$N^0_{Rd,c}$	Concrete pull-out design strength without consideration of geometric constraints
$N_{Rd,s}$	Reinforcement tensile design strength
S_x	Anchors horizontal spacing
V_{Ed}	Design value of the applied shear force
V_{Rd}	Design strength of the concrete shear key provided by Ancon standard carrier
z	Lever arm of internal forces

1.3.1 Concrete state

The design is based on the anchors being cast in uncracked concrete. This is generally the case for anchors cast in walls subjected mainly to compression.

The performance of the anchors in cracked concrete would be significantly reduced and this calculation is not at the moment available within this software.

The structural concrete compressive cylinder strength used in this software is in the range 25MPa to 50MPa.

1.3.2 Wall minimum thickness

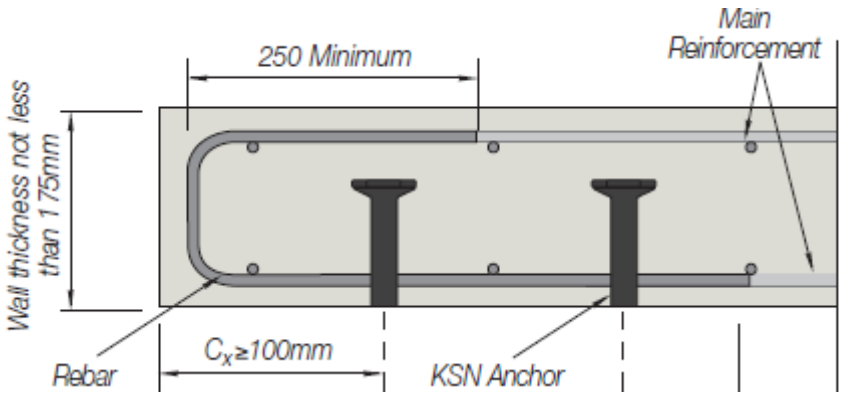
The wall where the anchors are embedded should be at least 175mm thick.

1.3.3 Minimum edge distances

The proximity of edges can significantly reduce the capacity of anchors. It is therefore important to consider any edge that could affect the anchor performance.

Side edge

The side edge distance Cx as shown on figure 2 below, should be at least 100mm.



Wall plan view

Top edge

The top edge of the wall in which the anchors are embedded should be at least $1.5h_{eff}$ away from the top row anchors. In addition, if the top edge is at least $3h_{eff}$ away from the top row of anchor, and a moment is applied to the connection, a capacity enhancement may be achieved and will be calculated by the software if applicable (see concrete pull-out design for details).

Bottom edge

The bottom edge of the wall in which the anchors are embedded should be at least $1.5h_{eff}$ away from the bottomrow anchors. In addition, if the top edge is at least $3h_{eff}$ away from the top row of anchor, and a moment is applied to the connection, a capacity enhancement may be achieved and will be calculated by the software if applicable.

1.3.4 Minimum anchor distances

For the design to be valid the minimum anchor horizontal spacing Sx should be at least equal to 5 times the anchor shank diameter (Refer to table page 4) for shank diameter of KSN)

1.3.5 Wall cover

The software assumes a wall reinforcement cover of 25mm. If more cover is required, care should be taken with the choice of anchor length and setting to ensure that the anchors will not encroach in the cover zone.

1.3.6 KSN Anchor design

The design procedure used in this software is based on the KSN anchors resisting tension only, while the applied shear is resisted by the concrete shear key provided by the carrier. When using a bespoke carrier a separate shear check will be required to be performed by the designer to ensure that the shear can be resisted by the shear key created or by other means.

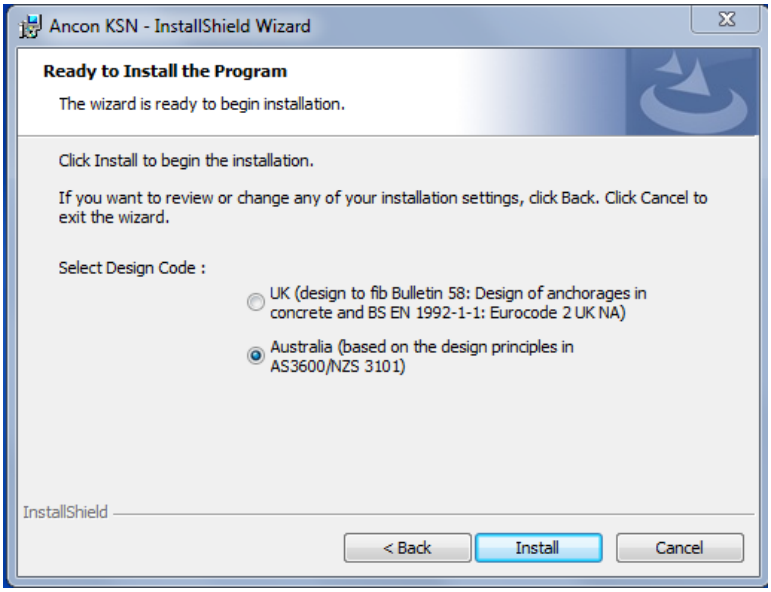
2 Software overview: Quick start guide

2.1 Software installation

After downloading the software, run the AnconKSNSetup.exe file.

Note that you will require administrative rights to install the software.

As part of the setup you will be prompted to choose your design region (see Design codes for more details).



The design region can be changed at a later date however calculations that are created in one design code cannot later be opened in another.

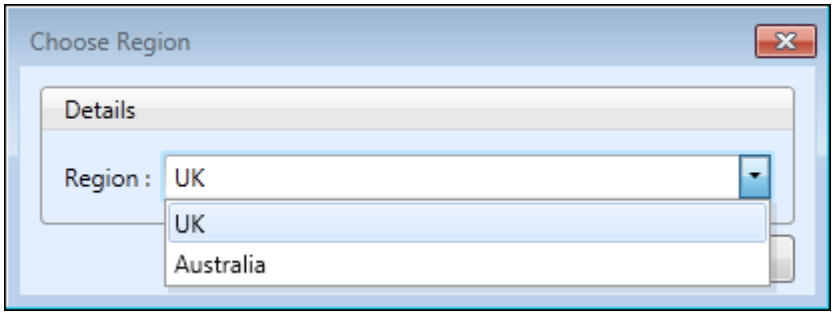
2.2 Design codes

The software proposes the choice between two types of design based on the following codes:
- Region Australia: Design according to fib Bulletin 58: Design of anchorages in concrete [3] and based on the design principles in AS3600 / NZS 3101[1]&[2].
- Region UK : Design according to fib Bulletin 58: Design of anchorages in concrete[3] and based on the design principles of BS EN 1992-1-1: Eurocode 2, UK national Annex .
This manual refers to the Australian design, refer to the UK manual for details on the UK design.

2.3 Changing design codes

It is possible to change design code, however the current project input will not be saved and you will be required to input the data again.

To change the design code, click on the A icon on the top left corner and select Change Design Code.



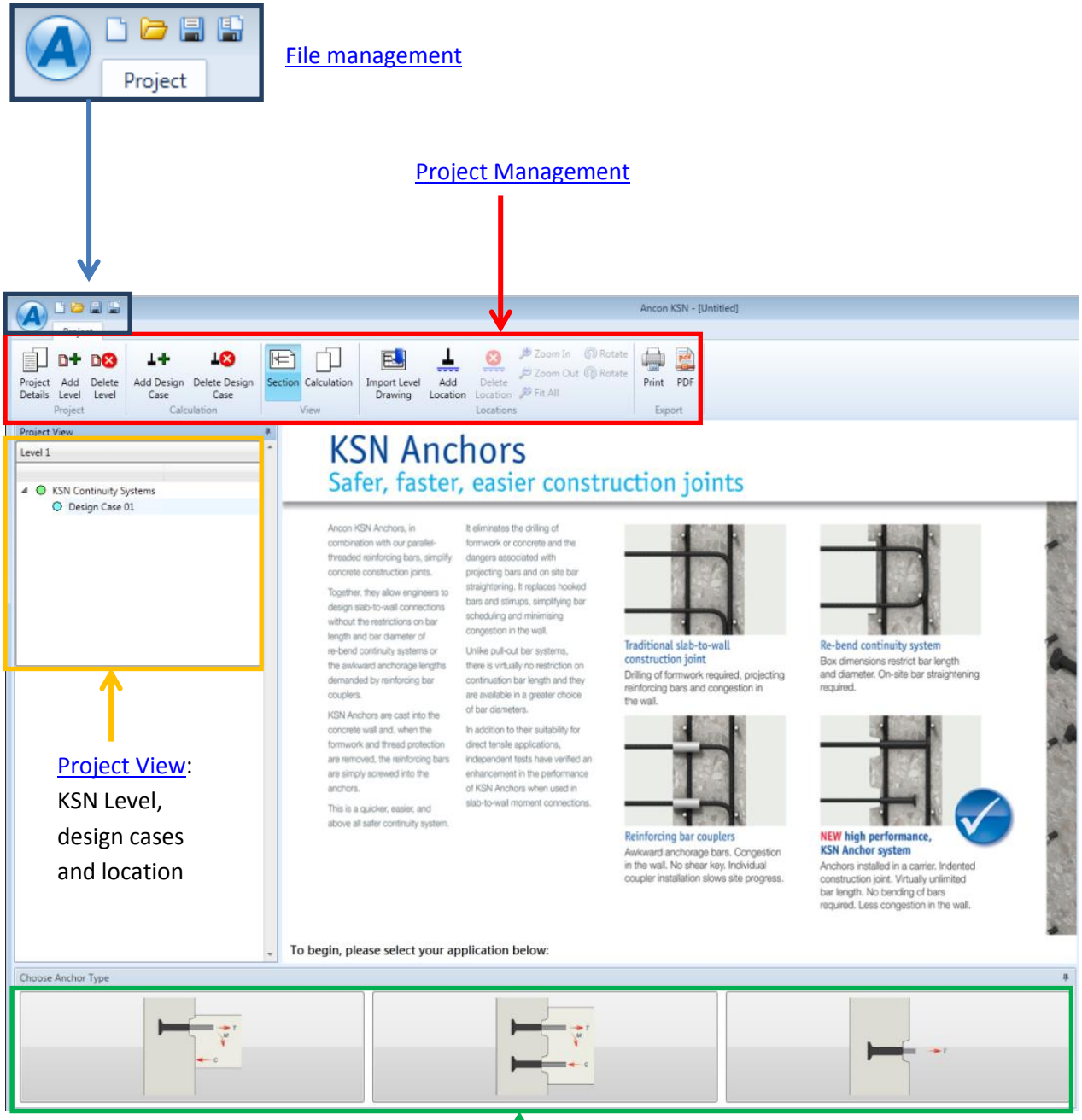
Once the new region chosen, the software will restart.

2.4 File management

The KSN software saves each project in .apd format that is specific to the Ancon KSN Software.

Standard file management (file saving, new file creation and file opening) is provided within the menu obtained by clicking the icon A on the top left corner of the window or the icons located to its right.

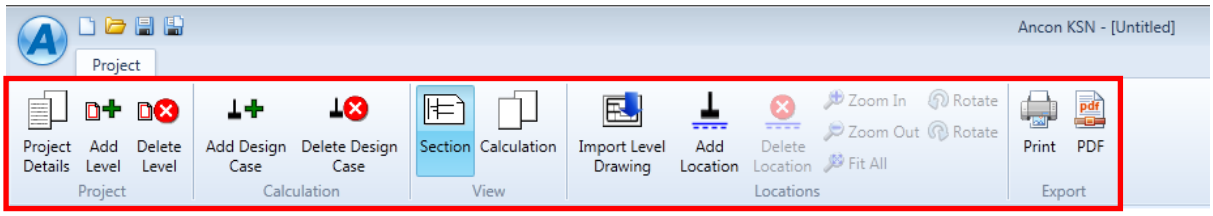
2.5 Software presentation



Project View: KSN Level, design cases and location

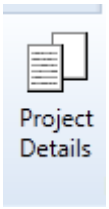
Choice of design case type

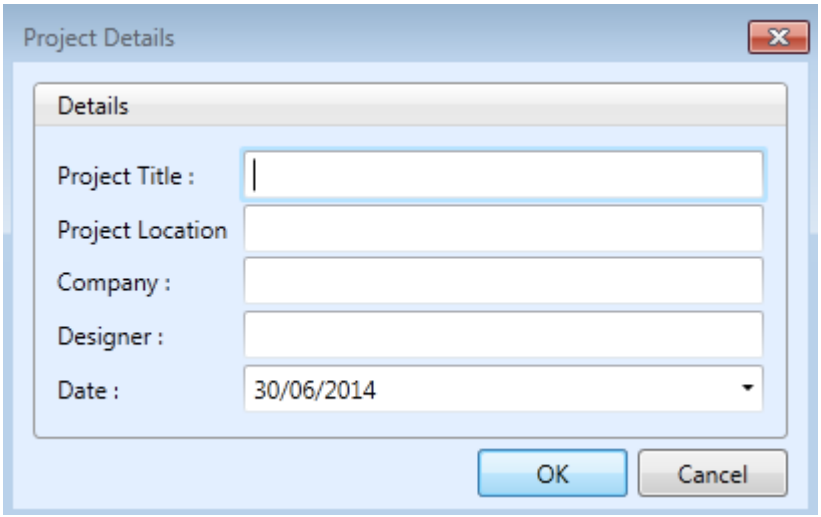
2.6 Setting up your project



2.6.1 General project information

In the project management part of the ribbon, click on the Project Details icon to enter the general project information



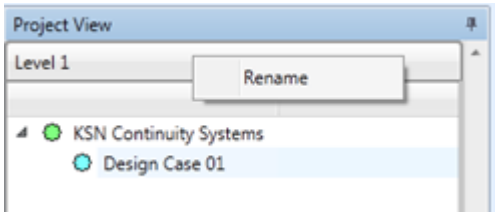


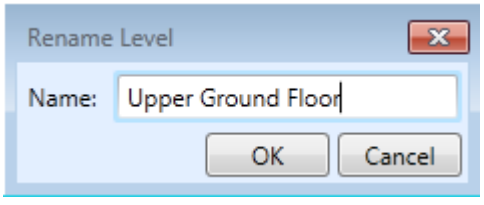
The information provided will appear in the header of the calculation note.

2.6.2 Setting up levels, design cases and locations.

By default the first level automatically created is named as Level 1.

All levels can be renamed, by placing the cursor above the name to be changed, right-clicking and selecting *Rename* as shown below





For each level, it is possible to import a level drawing in a pdf format to assign several locations to each design case.

This step is optional and can be done at a later stage if necessary.

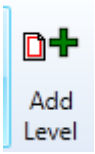
2.6.3 Importing level drawings

The following steps describe how to import a plan and assign a design case to several locations identified on the plan.

Click on Import Level Drawing on the Project Management Ribbon and select the pdf file to be used.

Confirm by pressing OK

The pdf will then appear on the main window.

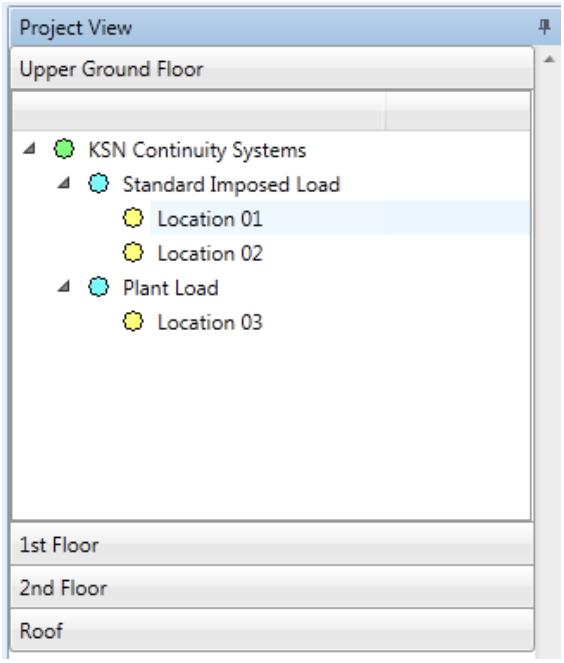


You can add plans for each level of the project, by adding levels, selecting the relevant level and repeating the above steps.

For each level, Design cases can be added by clicking the Add Design Case icon

Design cases can be renamed in the same way as the levels.

If a pdf drawing was inserted for the level, locations can be added by highlighting them on the drawing for each design case. The different levels, design cases and locations are shown on the Project view window.

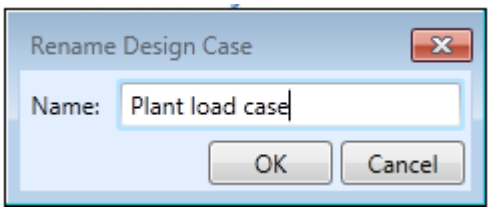


Example:

Design cases renamed as Standard Imposed Load and Plant Load, with location added.

2.7 Choice of design case type

The first design case created by default is called Design case 01 and can be renamed in the same way as the levels using a right click on the name of the Design case.

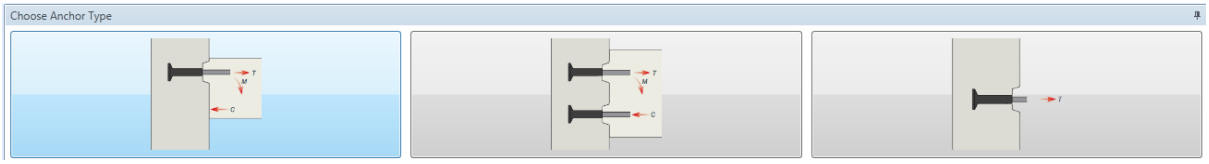


Additional design cases can be created by clicking on the Add Design case icon in the project Management ribbon.

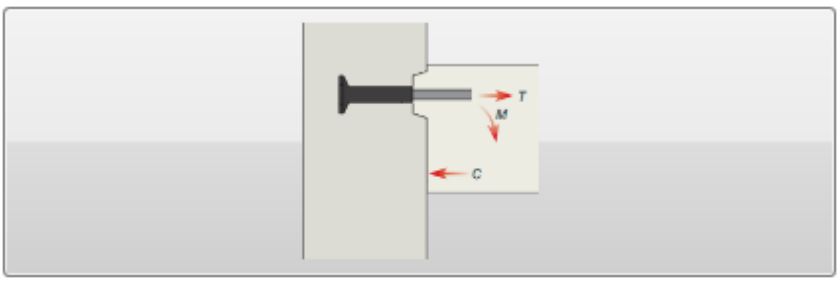
Before starting the design, the choice of configuration required needs to be made.

Select the design case you want to consider from the Project view window: a choice of configuration will appear.

3 configurations are available at this stage:

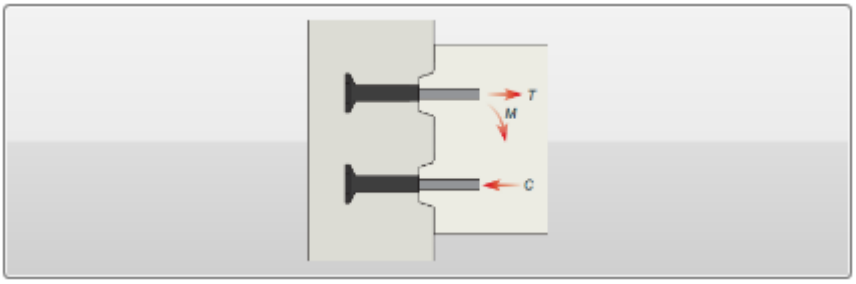


1st configuration: Moment connection: One row of anchors



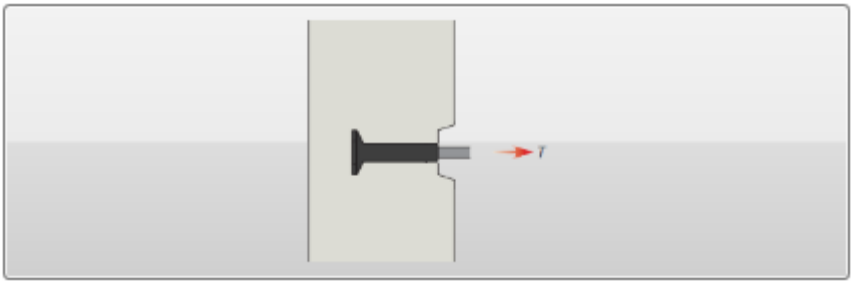
- KSN top anchors are used to resist the tension induced by the moment.
- Enhanced anchor capacity may be provided due to the modified cone if applicable.
- Note that in this configuration the shear is not checked by the software.

2nd configuration: Moment connection: Two rows of anchors



- KSN top anchors are used to resist the tension induced by the moment as per above configuration.
- Enhanced anchor capacity may be provided due to modified cone if applicable.
- Bottom anchors are used to provided bottom reinforcement anchorage
- Shear is resisted by the shear key provided by the use of the standard carrier

3rd configuration: Tension only: One row of anchors.



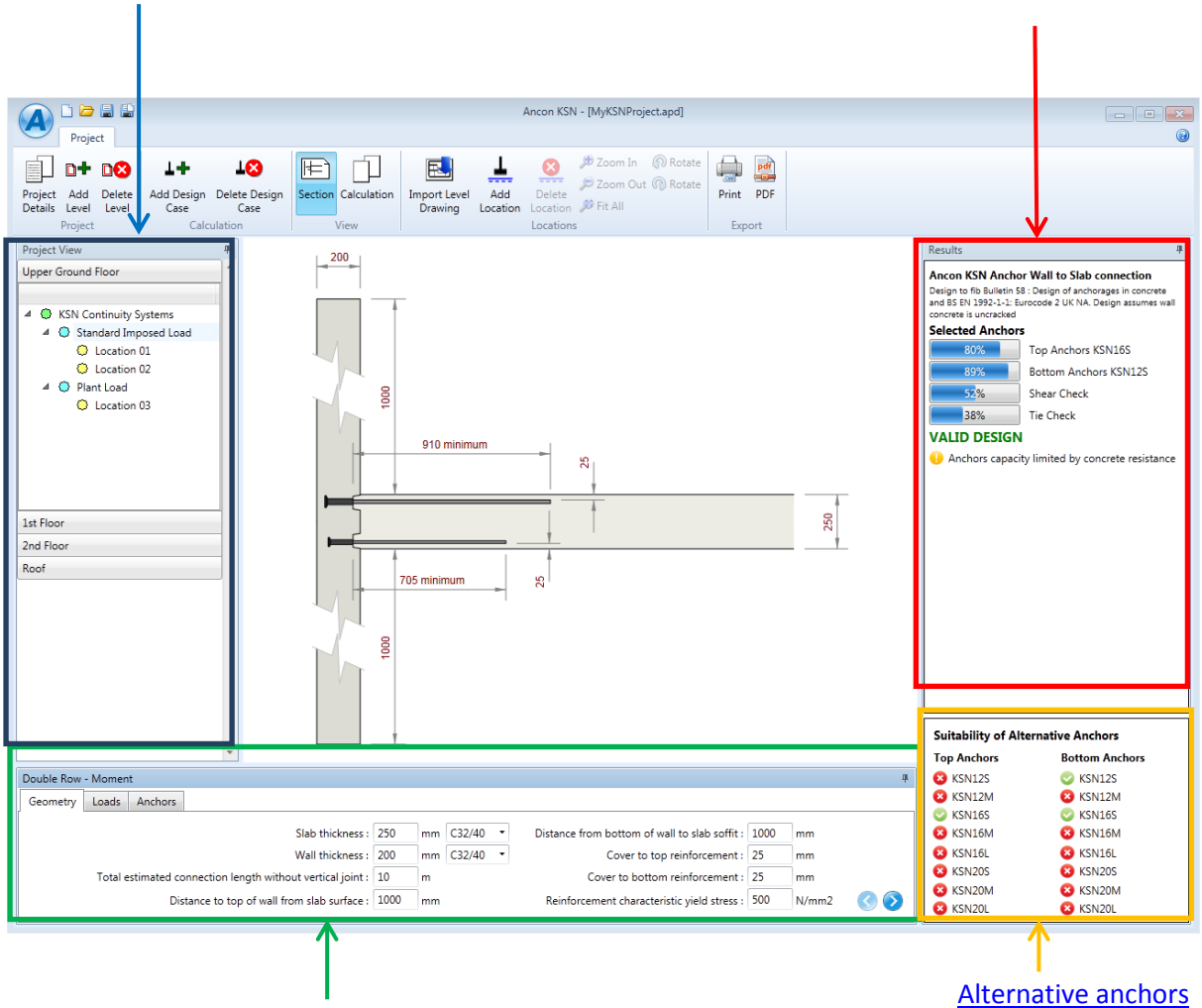
- KSN top anchors are used to resist the applied tension. No moment is applied.

The choice of configuration depends on the application and in particular the anchor arrangement (one or two rows) and the loads applied .

Once the configuration is chosen, the software layout becomes:

Level and Design case selection window

Result summary



Input window

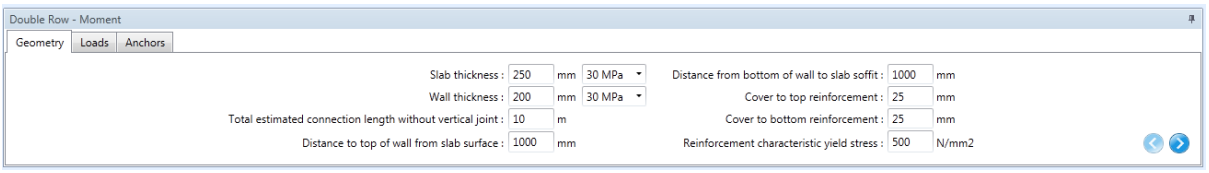
Alternative anchors

2.8 Input

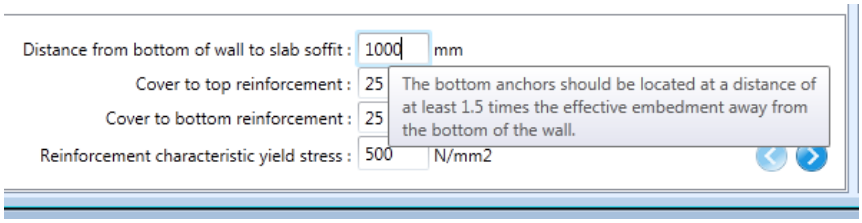
When a Design case is created some default input values are shown. Geometry, Load and Anchor information need to be updated to the current design case.

The first tab of the input window contains the geometry information of the design case.

2.8.1 Geometry



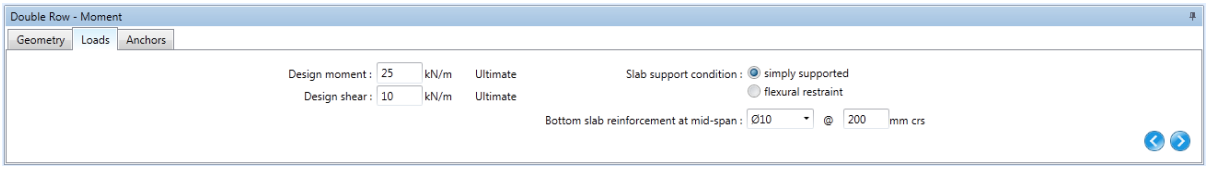
Limitations: Information on input limitations is explained in the help window that appears by keeping the cursor on the input box for a few seconds



The software checks the validity of the input values provided and warnings will appear in the result summary if any input value is not within the range of the software calculation.

The next tab requires the input of the loads and support conditions.

2.8.2 Loads and support condition (when applicable)



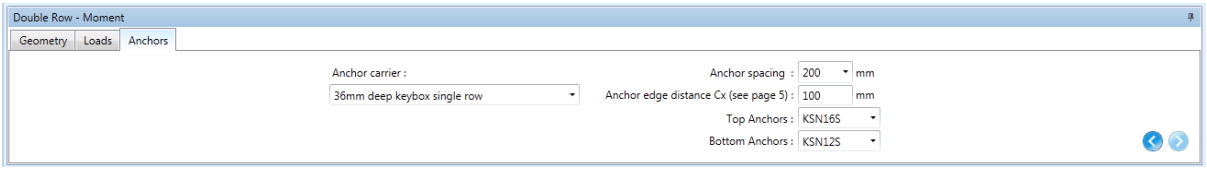
Design loads (factored) are to be provided. Depending on the configuration selected they can be Moment, Shear, Tension and Tie Force as applicable.

Slab support condition: The design of the bottom anchor when applicable will depend on the slab support condition.

The bottom anchor is checked to fulfil the requirement of AS3600 Clause 9.1.3.1 (ii or iii).
Amount of reinforcement to be anchored at the support:
Simply supported slab: 50% of span reinforcement to be anchored at support at least $8d_b$ past the face of the support
Flexural restraint: 25% of span reinforcement to be anchored at support

The last tab is specific to the input of the anchor information.

2.8.3 Selection of anchors



Choice of carrier

A drop down list is provided with the standard Ancon Keybox and Momentbox carrier or a bespoke setting option.

For Keyblock, MomentBlock, nailing plate , welded bar or any other carrier, use the bespoke carrier option and input the additional embedment (refer to table 2 page 7 for values for Keyblock, MomentBlock, nailing plate and welded bar)

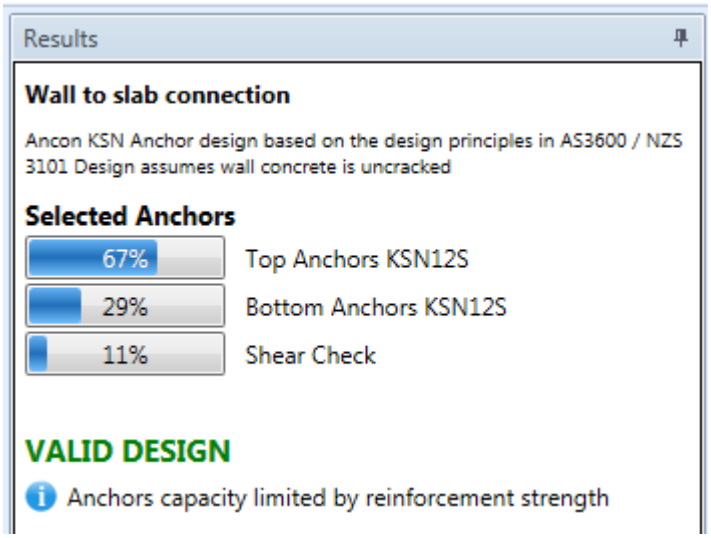
Note that the shear will not be checked if a bespoke carrier is selected due to the unknown characteristics of the shear key.

Choice of anchors

Input of anchor horizontal spacing and size is required as the last step.

2.9 Results summary

2.9.1 Current anchor selection results



Design code

Utilisation ratio of the current selection of anchors and shear key if applicable

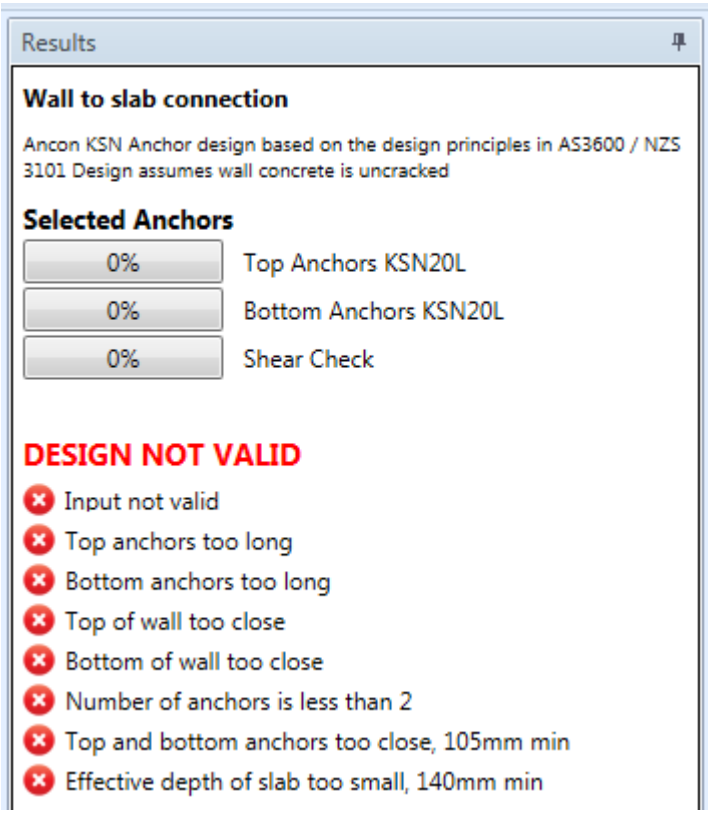
Design status
Design Notes when applicable

The software provides 3 possible design status:

- Valid Design: The current chosen anchors are satisfactory for the loads and geometry provided.
- Design Not Valid: Input not valid for the current choice of anchors
- Fail: Input valid but current choice of anchors' capacity not sufficient.

The design status is provided in the result summary box which allows for a quick and easy assessment of the current anchor selection.

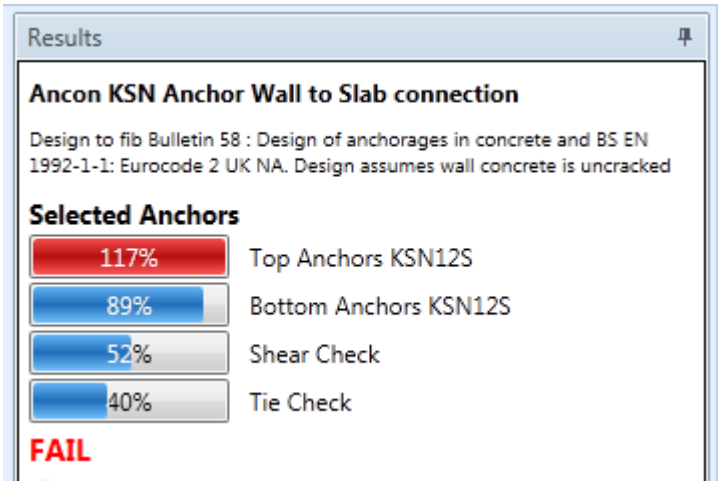
Design not valid result



Design Not Valid result for current selection

List of reasons provided

Fail result

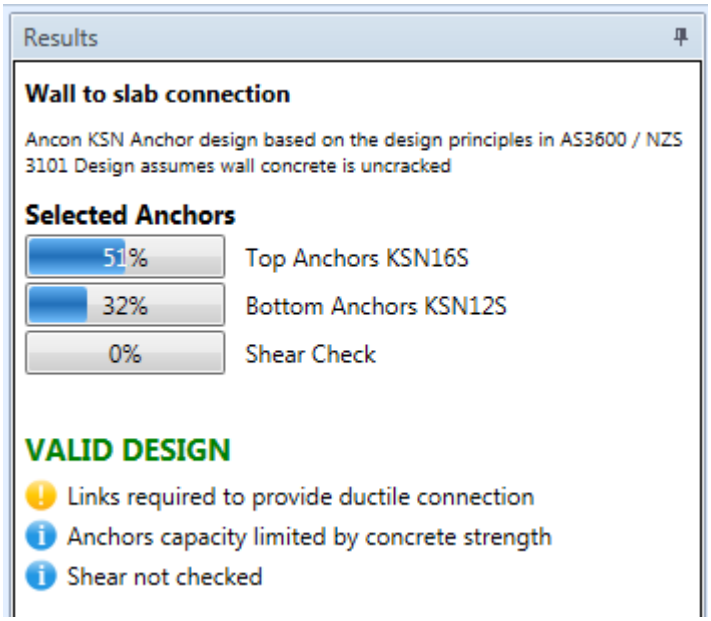


The design status reflects the fact that the top anchors do not provide enough capacity for the applied load as shown on the utilisation ratio summary.

Valid Design Warning and notes:

A warning is displayed if additional links are required to provide a ductile connection (see wall reinforcement requirement for robustness).

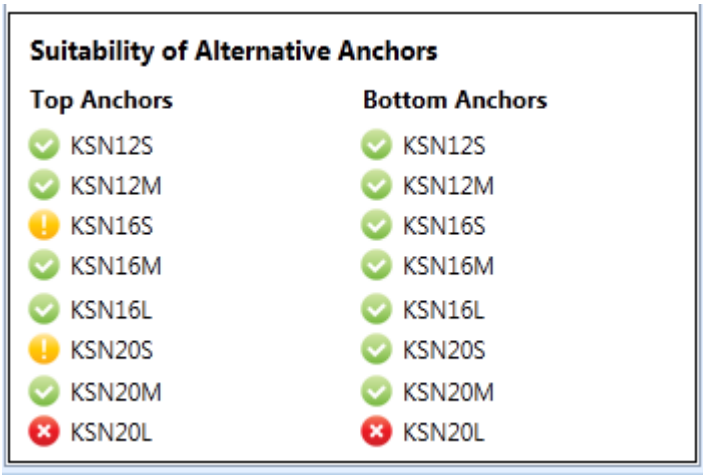
Valid Design Notes:



Self-Explanatory notes on the design are provided.

2.9.2 Alternative anchors

A window is provided showing information on suitability of alternative anchors



The list of alternative top anchors and bottom anchors (if applicable) is provided to facilitate the choice of anchors.

This warning icon indicates that the alternative anchor is suitable but will require the use of additional links in the wall if a ductile connection is required (see wall reinforcement requirement for robustness).

This icon indicates that the alternative anchor is suitable and will provide a ductile connection without additional links in the wall,

This icon indicates that the alternative anchor is not suitable for the input provided.

2.9.3 Tips for optimum KSN Design

- Anchors in the Suitability of Alternative Anchors window are listed with the most cost effective anchors for the configuration provided located at the top of the list.
- If the current chosen anchor selection shows in the result summary a warning that links are required to provide a ductile connection, review the list of alternative anchors and look for the icon to find a solution without links requirement.

2.10 Calculation note and detail of design principles

2.10.1 Calculation note

Ancon KSN - Calculation

Project : A Project, A Location
Calculation: Level 1 - Design Case 01
By: A Designer - A Company - 01/01/2014

Input

Geometry

Wall thickness	250	mm	
Slab thickness	200	mm	
Slab support condition	simply supported		
Bottom slab reinforcement at mid-span	–10	@ 200	mm c/c

Materials

Wall concrete Grade	30 MPa	Concrete of the wall assumed uncracked	
Slab concrete Grade	30 MPa		
Reinforcement characteristic yield stress	500	N/mm^2	

Anchors

Top Anchors	KSN12S	Effective embedment	145 mm
Top Anchor length	115	mm	
Bottom Anchors	KSN12S	mm	
Bottom Anchor length	115	mm	
Anchor spacing	200	mm	
Anchor carrier 36mm deep keybox single row			
Anchor setting from face of wall	36	mm	
Anchor edge distance Cx (see page 5)	100	mm	
Distance to top of wall from slab surface	1000	mm	
Distance from bottom of wall to slab soffit	1000	mm	
Cover to top reinforcement	25	mm	
Cover to bottom reinforcement	25	mm	

Applied Forces

Design moment	30	kN.m/m
Design shear	10	kN/m

Input Summary

Results VALID DESIGN

Design Status

Design based on Ancon extensive test results

Top anchor

Single Top Anchor Design Strength	N_{Rd} =	45.2	kN	Limited by reinforcement design strength
Applied tension to top anchor	N_{Ed} =	36.8	kN	Tension due to the applied moment
	N_{Rd}	≥	N_{Ed}	

Bottom Anchor

Anchorage Force Strength	N_{Rd} =	184	kN/m	
Anchorage Force required	N_{Ed} =	54	kN/m	
	N_{Rd}	≥	N_{Ed}	
Shear Resistance at wall/slab interface	V_{Rd} =	88.34	kN/m	
Design shear	V_{Ed} =	10	kN/m	

Results Summary

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2.10.2 Detail of design principles

The software performs the following calculations and checks:

- Calculation of the concrete pull-out strength of the top anchors,
- Calculation of the top reinforcement pull-out strength,
- Determination of the top anchor design strength from the results obtained,
- Calculation of the applied tension in the top row of anchors and check that it is less than the top anchor design strength,
- Shear check at the interface between wall and slab when KSN are used with standard carrier,
- Calculation of the bottom anchors design strength and check according to AS3600-2009 requirements to confirm suitability,
- Determination of the minimum length of the top and bottom continuation bars according to AS3600-2009,
- Specification of additional wall reinforcement for ductile behaviour when required,
- Determination of suitability of other anchors based on the same geometry.

2.10.2.1 Concrete pull-out Design

The concrete characteristic load capacity of an isolated top anchor is calculated according to fib Bulletin 58 [3] Clause 19.1.1.4.

$N^0_{Rk,c} = k_1 f_{ck}^{0.5} h_{eff}^{1.5}$ with k_1=12.5 empirical value

The design strength is then calculated using the relevant reduction factor ϕ= 0.6

$N^0_{Rd,c} = \phi N^0_{Rk,c}$

The concrete design strength of the group of anchors is then calculated using the reduction factors for spacing and edge distance:

$\Sigma N_{Rd,c} = (n_a - 2)\, \psi_{A,N,1}\, N^0_{Rd,c} + 2\, \psi_{A,N,2}\, \psi_{s,N}\, N^0_{Rd,c}$

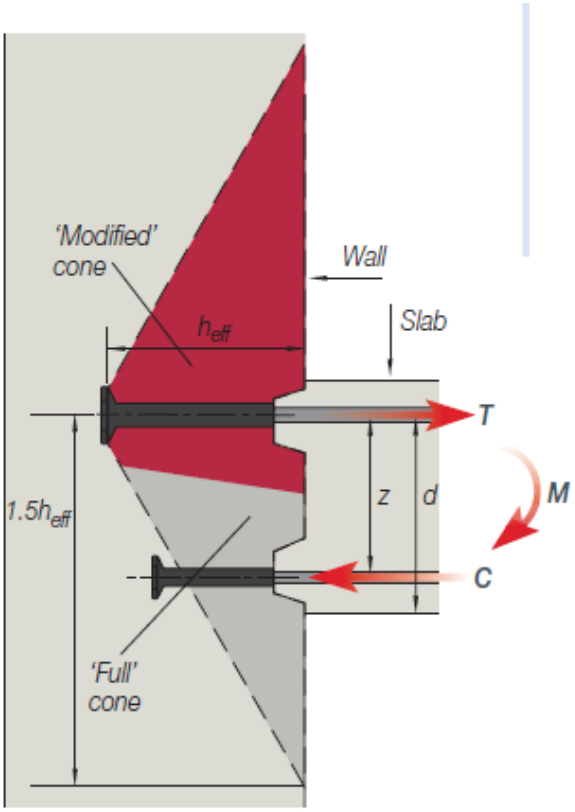
The formula above was developed for direct tension.

When a moment is applied to the connection, Ancon identified during tests a potential increase in anchor performance when the compression part of the moment couple lies within the pull-out cone.

Ancon commissioned an extensive series of tests at Heriot Watt University to determine the degree of enhancement and establish a design method based on the results.

The tests verified an enhancement in concrete cone capacity, when the pull-out failure surface is modified by the presence of an adjacent compression force from the concrete forming part of the couple. The results showed a significant enhancement in some cases; the enhancement being strongly influenced by the ratio of the depth of the embedment of the head of the anchor to the effective depth of the slab.

Following the tests, a design method was established to calculate the enhanced anchor capacity when applicable $\Sigma N_{Rd,c,enh}$.



Idealised modified concrete failure.
Paired arrangement used in testing.

The reinforcement design strength is calculated based on the following:

$N_{Rd,r} = \phi \pi d_b^2/4xf_y$

The anchor design strength is the maximum of the anchor design concrete strength but limited to the reinforcement design strength.

2.10.2.2 Applied Tension due to moment.

The calculation of the applied tension to the top anchors is based on the calculation of the lever arm z between the compression block and the anchors according to AS3600-2009 using a rectangular stress block. See clause 8.1.3 for details.

$N_{Ed}=M/z$

Determination of the level arm z:

Uniform compressive stress $\alpha_2 f'_c$ with $\alpha_2=1.0-0.003f'_c$ and $0.67 \le \alpha_2 \le 0.85$

$M=F_{cc}z=F_{st}z$ with $F_{cc}= \alpha_2 f'_c \gamma k_u db \phi$ with b width of the section and ϕ reduction factor

So $M= \alpha_2 f'_c \gamma k_u db \phi z$ and $z= d-\gamma k_u d/2$

$M = [\alpha_2 f'_c \gamma k_u db \phi (d-\gamma k_u d/2)]$

$M = \alpha_2 f'_c \gamma k_u db \phi d - \alpha_2 f'_c \gamma k_u db \phi \gamma k_u d/2$

$M= \alpha_2 f'_c \gamma k_u d^2 b \phi - \alpha_2 f'_c \gamma^2 k_u^2 d^2 b \phi/2$

$\phi \alpha_2 f'_c \gamma^2 k_u^2 d^2 b/2 - \phi \alpha_2 f'_c \gamma k_u d^2 b + M=0$

$\phi \alpha_2 f'_c \gamma d^2 b/2 [\gamma k_u^2 - 2k_u + 2M/(\phi \alpha_2 f'_c \gamma d^2 b)]=0$

$\gamma k_u^2 - 2 k_u + 2M/(\phi \alpha_2 f'_c \gamma d^2 b)=0$

Quadratic equation to resolve: $ax^2+bx+c=0$
$\Delta = b^2-4ac$
Solution $x= (-b \pm \Delta^{0.5})/(2a)$
In our case
$a=\gamma$
$b=- 2$
$c= 2M/(\phi \alpha_2 f'_c \gamma d^2 b)$
$\Delta= 2^2 - 4\gamma\, 2M/(\phi \alpha_2 f'_c \gamma d^2 b)$
$= 4-4 \gamma\, 2M/(\phi \alpha_2 f'_c \gamma d^2 b)$
solution $k_u=(2- \Delta^{0.5})/(2 \gamma)$ as $k_u<0.36$ (AS 3600 clause 8.1.5)

calculation steps:

- Calculate α_2 and γ
- Calculate Δ and k_u
- Calculate z and the Tension per anchor $N_{Ed}=M S_x/z$

The applied tension is then compared to the anchor design strength.

2.10.2.3 Shear check

The shear at the slab/wall interface is considered to be resisted only by the shear keys created by the carriers.

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The stress resistance at the interface is $\phi\tau_u$ calculated according to AS3600-2009 clause 8.4.3:

$\tau_u = \mu(A_{sf} f_{sy}/(s\, b_f)+g_p/b_f)+k_{co}f'_{ct} \le \min(0.2f'_c, 10MPa)$

With
τ_u = unit shear strength
g_p = permanent distributed load normal to the shear interface per unit length (kN/m)
μ = coefficient of friction given in table 8.4.3.
k_{co} = cohesion coefficient given in table 8.4.3.
b_f = width of the shear plane in mm
A_{Sf} = Area of fully anchored shear reinforcement crossing the interface in mm^2
f_{sy} = yield strength of shear reinforcement not esceeding 500MPA
s = spacing of anchored shear reinforcement crossing interface.

In our case,
$A_{sf}=g_p=0$
k_{c0}= 0.4 from table 8.4.3

$\tau_u = 0.4\, f'_{ct} \le \min(0.2f'_c, 10MPa)$
ϕ= 0.7 from table 2.2.2
Applied shear stress $\tau = V_{Ed}/(n_{key}\, b_{key})$

2.10.2.4 Bottom anchor design.

The bottom anchor is checked to fulfil the requirement of AS3600 Clause 9.1.3.1 (ii or iii)
Two criteria need to be verified:

- Amount of reinforcement to be anchored at the support:

Simply supported slab: 50% of span reinforcement to be anchored at support at least $8d_b$ past the face of the support
Flexural restraint: 25% of span reinforcement to be anchored at support

- Force to be resisted by the anchorage:

Reinforcement needs to be anchored to resist Force equivalent to the $8d_b$ anchorage required:

$F = 8d_b f_{sy}/L_{sy,t}$
where $L_{sy,t}$ is the full anchorage length calculated according to 13.1.2.2.

$L_{sy,t} = L_{sy,tb} = 0.5k_1k_3f_{sy}d_b/(k_2(f'_c)^{0.5}) \ge 29k_1d_b$

where k_1=1.3 for horizontal bar with more than 300mm concrete cast below the bar k_1=1.0 otherwise. In our case k_1 will always be equal to 1 as slab depth is limited to 300mm.
k_2= (132-d_b)/100
k_3= 1.0-0.15(c_d-d_b)/d_b with 0.7≤k_3≤1.0
c_d= minimum between cover and distance between bars.

Once Lsy,t is calculated anchorage force required is calculated:
$F= 8d_b f_{sy}/L_{sy,t}$
The capacity of the bottom anchors in tension is calculated using the same principle as the top anchors but without enhancement and compared to the anchorage force requirement.

2.10.2.5 Wall Reinforcement Requirement for Robustness

The design of slab-wall connections should not be made in isolation but should be as part of a structural system. Ductility requirement 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.

If the wall thickness is more than the maximum recommended wall thickness i.e. the back of the anchor is not within the back of the wall reinforcement , links are specified to provide a ductile connection as required by AS3600 Clause 14.3.
The links are calculated to provide the upper characteristic breaking strength of the bar as per NZS3101 Clause 8.6.11.1.
Based on grade 500N, according to AS/NZS 4671:2001, the maximum upper characteristic yield strength of the bar is $R_{ek,U}$=650 MPa (Table 2) and the upper characteristic breaking strength of the bar is 1.15x$R_{ek,U}$ (NZS3101:2006 Clause 8.6.11.2).
Links are calculated based on those values bars and are to be located above and below the top row of anchors.

Glossary

Glossary of terms used in the software and brochure.

Anchor carrier: The KSN anchors are typically supplied with a keybox or MomentBox carrier that ensures the correct spacing of the anchors and after removal creates a shear key for the construction joint. It is possible to purchase the anchors individually and use an alternative carrier however this will affect the design and therefore should be taken into account when using the software by selecting the option bespoke when selecting the carrier.

Anchor design strength N_{Rd} : The anchor design strength is the lesser of the calculated concrete design strength and the reinforcement design strength.

Anchor edge distance: The proximity of edges can significantly reduce the capacity of anchors. It is therefore important to consider any edge (joint, void or any interruption in the concrete at proximity of the anchors) that could affect the anchor performance (side edge, top edge and bottom edge).

Anchor spacing: Anchor horizontal spacing along a row; for the standard systems the centres are between 150 and 300mm.

Bespoke Carrier: Carrier other than Ancon standard carrier that will be used to maintain the anchors in position against the formwork. When using a bespoke carrier, the setting of the anchor in the wall is required to calculate the anchor capacity. No shear check is performed when using a bespoke carrier.

Concrete state: The software assumes uncracked concrete

Concrete design strength: The concrete design strength is the calculated concrete pull-out design strength based on the Fib Bulletin 58 and formulas derived from it, based on an extensive series of tests to take into account the moment enhancement when applicable.

Design moment: Factored applied moment. Positive value required.

Design shear: Factored applied shear. Positive value required.

Ductile connection: connection with sufficient ductility and capable of absorbing significant strain energy without rupture.

Effective embedment of anchors: Embedment of the anchors measured from the face of the wall to the front face of the anchor head (see figure 1).

Moment enhancement: Possible anchor capacity enhancement due to the modified cone induced by the applied moment (see Concrete pull-out design)

Reinforcement design strength: Design strength of the reinforcement bar connected to the KSN anchor.

Slab support condition:

Simply supported: Connection designed to resist only a nominal moment and where the slab was designed as simply supported at this location.

Flexural restraint: Connection designed to resist a moment and where the slab was designed as restrained at this location.

3 References

[1] AS3600-2009: Australian Standard: Concrete Structures.

[2]NZS3101:2006: New Zealand Standard: Concrete Structures Standard. Part 1 The design of Concrete Structures.

[3] fib bulletin 58: Design of anchorages in concrete, 2011.

[4] AS/NZS 4671:2001: Australian/New Zealand Standard : Steel reinforcing materials