LEARNING CENTRE

RKALC STRUCTURAL ENGINEERING

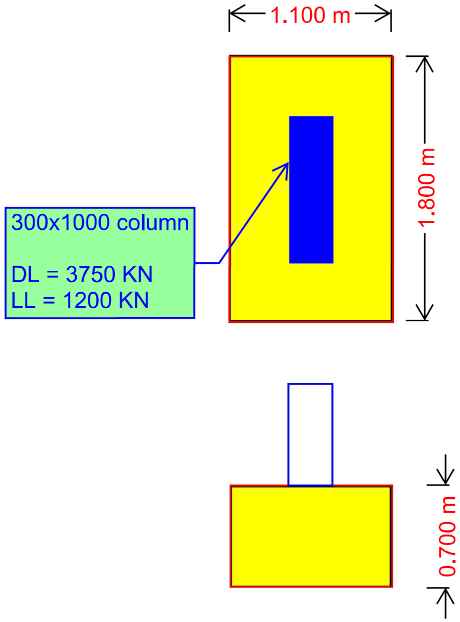
Pad Footings - On Rock and Otherwise

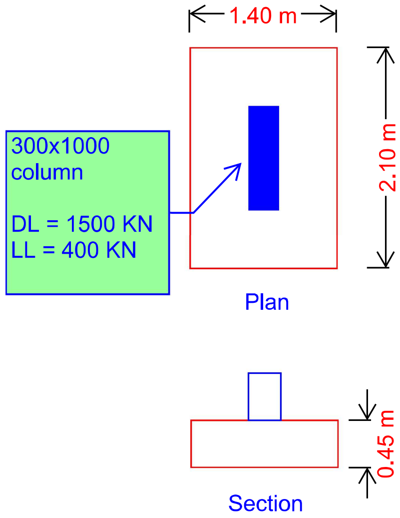
Pad Footings	By	RK
STM & Concrete Calculator	Sheet No. 1	Date 7/26

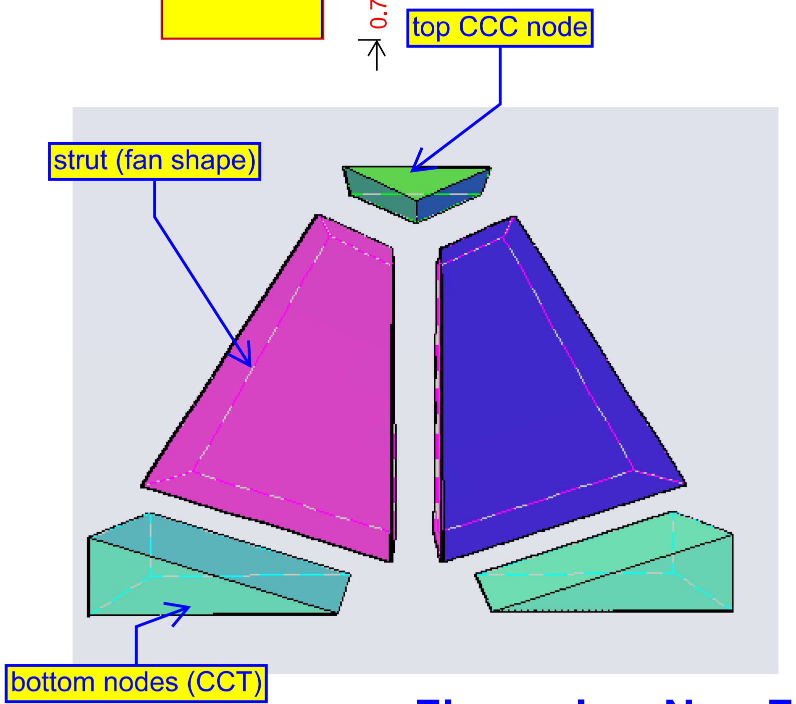
Sample Structure

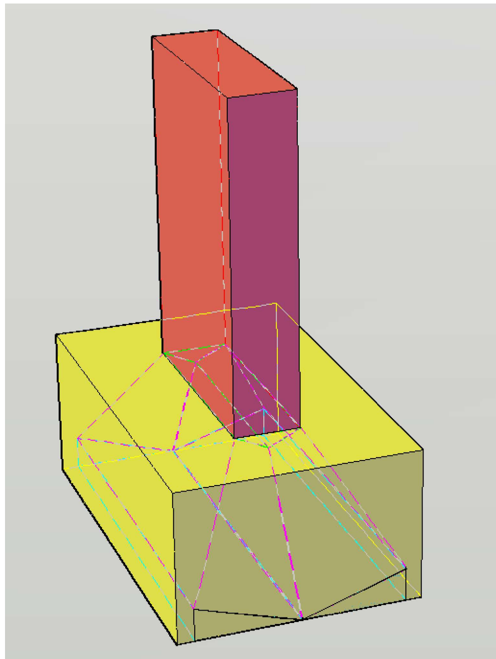
This document presents a complete worked example showing when a pad footing should be designed using conventional flexural theory versus when it should be treated as a Strut-and-Tie Model (STM) in accordance with AS3600-2018. It also demonstrates how the RKALC software automates both approaches.

If the span-to-effective-depth ratio exceeds about 1.5, the footing behaves predominantly as a flexural member, and conventional beam theory is appropriate.
If the span-to-depth ratio is less than about 1.5 (common on rock or very stiff founding material), the footing behaves as a deep member, where loads flow through compression struts rather than flexure. In this case, Strut-and-Tie Modelling (STM) should be used.









Flexural vs Non-Flexural Footings

Pad Footings

The following pages will include sample calculations for foundation not bearing on rock, this means the footing outstand would be large enough so the span to depth ratio becomes over 1.5 hence a flexural element.

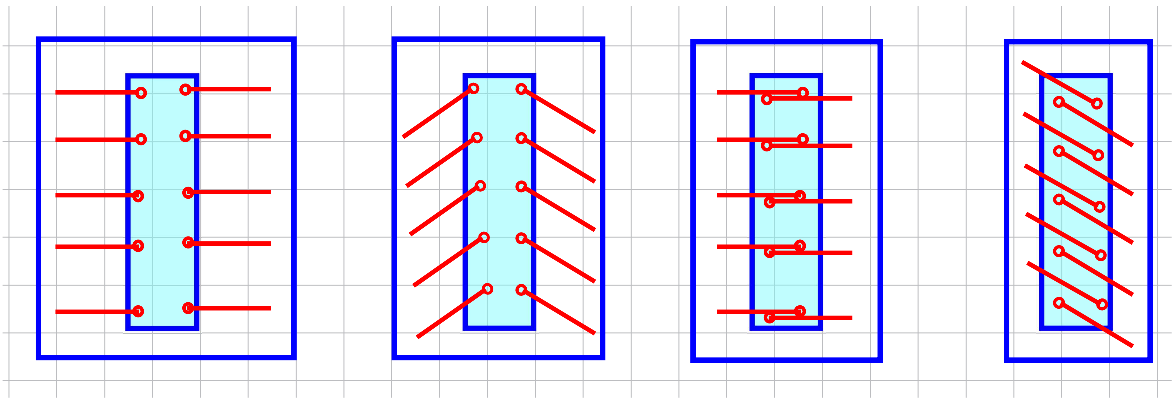
If we are to size the pad footing in next page, which is subject to 1900 KN service loading, and 700 KPa shale, consider the following:

1- Try to provide equal cantilever all around the column, in other words, the footing should be geometrically similar to the column,

2- I always recommend to provide equal reinforcement in both directions to avoid site mistakes,however, we can reinforce the pads unequally, based on the width, or maybe size the pad in such a way to have equal REO (by making the wider side of footing cantilevers more etc)

3- You might have a very small loading, for which the footing size would be also small, in this case the cantilever could be sized based on practicality of placing the column starters with 400 cog bars

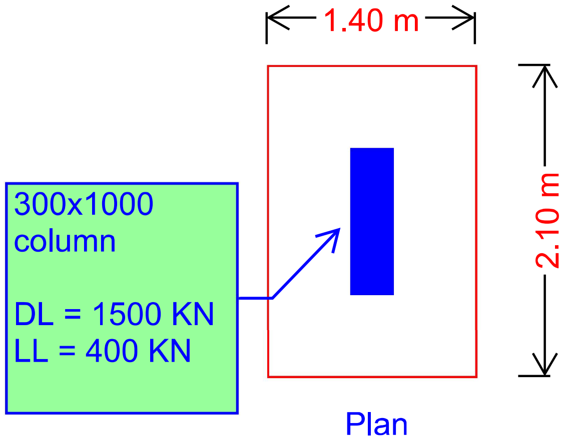
I usually provide minimum 400 "outstand", but if you are very keen:



4- The depth of the footing is function to flexure, shear, punching, and compression length. for the latter, be mindful that column reinforcement (starters) are most probably designed for column buckling case, so if we are using N28 in column, do not size the depth of pad for 22 dia, rather check how much reo should have been provided in that very column to resist the applied loads

Materials

- f'c = 40 MPa
- fy = 500 MPa



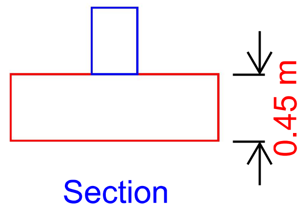
Plan

Applied Loads

- N DL = 1500 KN
- NLL = 400 kN
- N uls = 2400 KN
- N sls = 1900 KN

Applied Stressess

- Bearing Capacity = 700 kPa



Section

Applied soil stress = 1900 / (1.4 × 2.1) = 646 kPa

Ultimate soil stress = 646 × (2400 / 1900) = 816 kPa

Outstand Checks

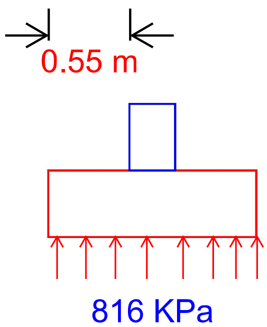
Cover to centre = 84 mm
Effective depth = 450 − 84 = 366 mm

Span-depth ratio = 550 / 366 = 1.503 > 1.5

Hence footing can be designed as flexural member
[Ref. 12.1.1 AS 3600-2018]

Flexural Design

M* = 816 × (0.55² / 2) = 123 kN·m (per meter)



As min= 0.19 × (D=450 / d=366)² × (0.6‹3240 / 500) (see sec 9

As/bd = 0.218% = 798 mm² ----Ref. 21.3.1

As Req = 123 E+6/0.7/500/366 = 960

Therefore
As = N16-200 EW

(Note: if the footing width is less than one metre, this 960 is to be provided within that width, or design the "beam" from first principles.)

Punching Shear Check

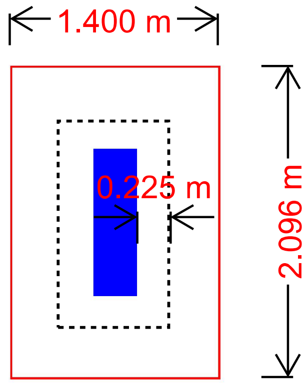
Critical shear perimeter

u = [(300+d)+(1000+d)] × 2 = 4064 mm

Punching reduction area @ d/2 =
((300+d)(1000+d) × 816)/10†66 = 742 kN

therefore punching shear force = 2400 − 742 = 1658 kN

Stress = $(1658 \times 10^3)/(4064 \times 366)$ = 1.115 MPa



fi*Fcv = 0.7 × 0.17 × (1 + 2×300/1000) × 40^0.5 = 1.204 MPa - ref 9.3.3

Utilisation = 1.115 / 1.205 = 93%

One Way Shear

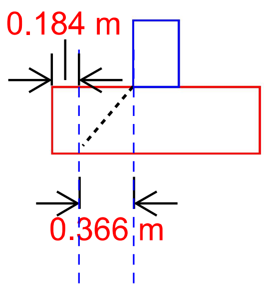
Applied shear = V* = 816 × 0.184

V* = 150 kN

Stress = $(150 \times 10^3)/(1000 \times 326)$ = 0.46 MPa
(note effective depth for shear is 0.72 * Depth for one way shear)

epsilon = 0.000376
kdg = 0.888888
dv = 326

therefore kv = 0.257 (see clause 8.2.4.2.1)
therefore vc = 0.257 * 40^ 0.5 * 0.7 = 1.137 MPa > 0.46



NOTE: RKALC app still uses AS3600-2009 which is more conservative (gives allowable shear stress of 0.89 using Beta factors

Column Bearing Check

Ref. 12.6

A1 = 300 × 1000 = 300000

A2 = (300 + 2×366)(1000 + 2×366) = 1,787,424

(A2/A1)^0.5 = 2.44 (max = 2)

Stress @ A1 = 8 MPa

Allowable stress = 0.6 × 0.9 × 40 × 2 = 43.20 MPa

Development Length of Rebar (Column)

Rebar dia: say N16

Compression length ›10 20 dia = 320 mm

Pad Footings

Do Not Use for Span/Depth Ratio < 1.5

Use STM Wall for Footing on Rock

Footing Capacity   Calculations   My Footings

Inputs

Materials

f'c (N/mm²)	40
fy (N/mm²)	500

Geometry (Units mm)

Width	1400
Length	2100
Depth	450
Cover to Centre	84
Soil Bearing Capacity KPa	700
Column Width	300
Column Length	1000
Column's rebar size	16

Loads (KN , m)

Dead Load	1500
Live Load	400
Ultimate Load	2400

Calculate

RKALC Assistant New

Send to Database

General

Effective Depth	366
Span-Depth Ratio	1.5
Max Outstand	550
Soil Pressure	646

Flexure-Critical Dir.

Design Moment KN.m/m	123
Bottom REO (mm² / m)	950
Min Depth (Development)*	548

**(anchorage length of Column reo that is needed for section capacity at face of footing, excercise judgement)*

Column Bearing

Stress under Col (A1)	8
Max Bearing Stress	43.2
Bearing Utilisation	19 %

Punching Shear

Punching Stress	1.11
Conc Punching Capacity	1.2
Punching Utilisation	93 %

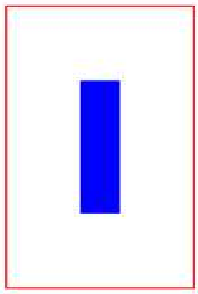
One Way Shear

(AS3600-2009 formulae 8.2.7.1)

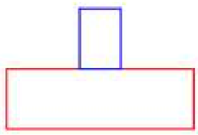
Applied Shear KN/m	150
Applied Shear MPa/m	0.41
Shear Cpacity MPa	0.89

Graphics

Plan



Section



Pad Footing Design - AS3600-2018

Flexural, bearing, punching shear and one-way shear assessment

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Calculations by
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1. Introduction

This document provides analysis and design of Pad Fotting in accordance with the Australian Standard AS3600-2009.

The following outcomes are provided:

- Felxural Design of Critical Direction
- Column Bearing Check
- Punching Shear Check
- One Way Shear Check

The design ensures structural integrity and compliance with the standard under the specified loading conditions. For detailed guidelines and requirements, refer to the relevant sections of AS3600-2018-A2.

> This calculation can be reproduced and checked independently. For more details, refer to the **RKALC website**.

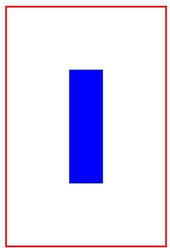
2. Material Properties

Property	Value	Unit
Concrete Strength f'c	**40**	MPa
Rebar fy	**500**	MPa

3. Geometry and Applied Loads

Geometry

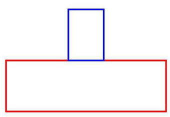
Geometry Parameter	Value	Unit
Footing Width	**1400**	
Footing Length	**2100**	
Footing Depth	**450**	
Cover to Centre of Reo	**84**	
Soil Bearing Capacity	**700**	
Column Width	**300**	
Column Length	**1000**	
Column Rebar Size	**16**	



Footing Plan

Applied Loads

Load Parameter	Value	Unit
DL	**1500**	KN
LL	**400**	KN
Ultimate Load	**2400**	KN



Footing Section

4. Results

General

General Result	Value	Unit
Effective Depth	**366**	KN
Span-Depth Ratio	**1.5**	KN
Max Outstand	**550**	mm^2
Soil Pressure (SLS)	**646**	KN

Fexural Check - Critical Direction

Flexural Result	Value	Unit
Design Moment	**123**	KN.m/m
Bottom REO	**950**	(mm^2 / m)
Min Depth (Development)	**548**	mm

Column Bearing Check

Bearing Result	Value	Unit
Stress under Col (A1) - Clause 12.6	**8**	MPa
Max Bearing Stress	**43.2**	MPa
Bearing Utilisation	**19 %**	

Punching Shear Check

Punching Shear Result	Value	Unit
Punching Stress	**1.11**	MPa
Conc Punching Capacity	**1.2**	MPa
Punching Utilsation	**93 %**	

One Way Shear Check - (AS3600-2009 formulae 8.2.7.1)

One Way Shear Result	Value	Unit
Applied Shear	**150**	KN/m
Applied Shear	**0.41**	MPa/m
Shear Cpacity	**0.89**	MPa

note RKALC still adopts 2009 standard here for simplicity, this will be changed after the 2026 new standard is mandated in NCC

NON-Flexural Footing

Loading

Nsls = 4950 kN
N* = 6300 kN

Bearing Capacity = 3000 kPa

deff = 615 mm
Cover to centre = 85 mm

Applied soil pressure =
4950 / (1.1 × 1.8) = 2500 kPa

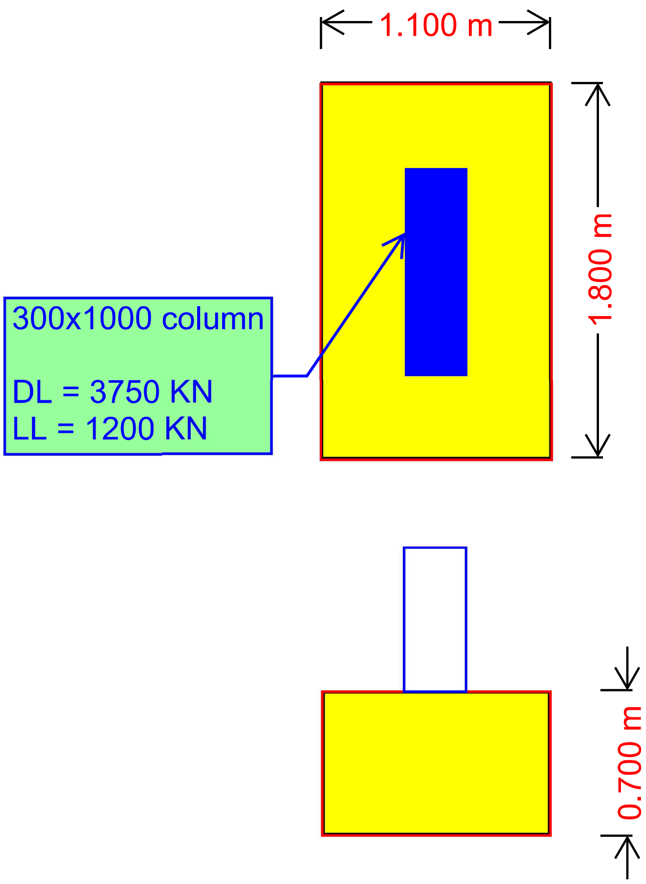
Ultimate pressure
2500 × (6300 / 4950) = 3181 kPa

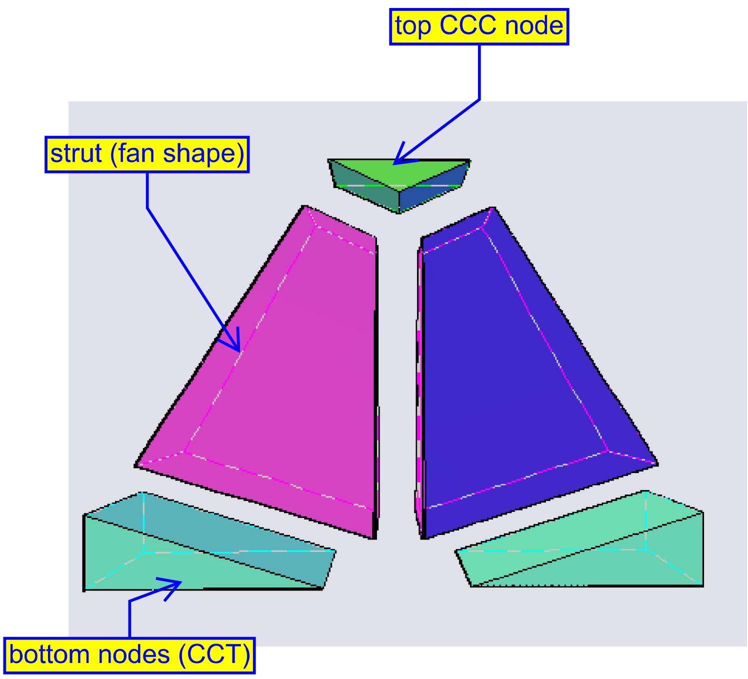
Span-depth ratio = 400 / 615 = 0.65 < 1

Therefore: Non-flexural member

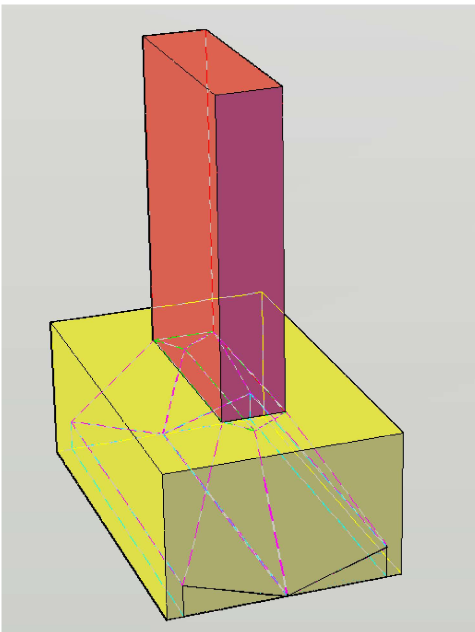
[Sec. 12.1.1 of AS 3600]

STRUT & TIE MODEL:

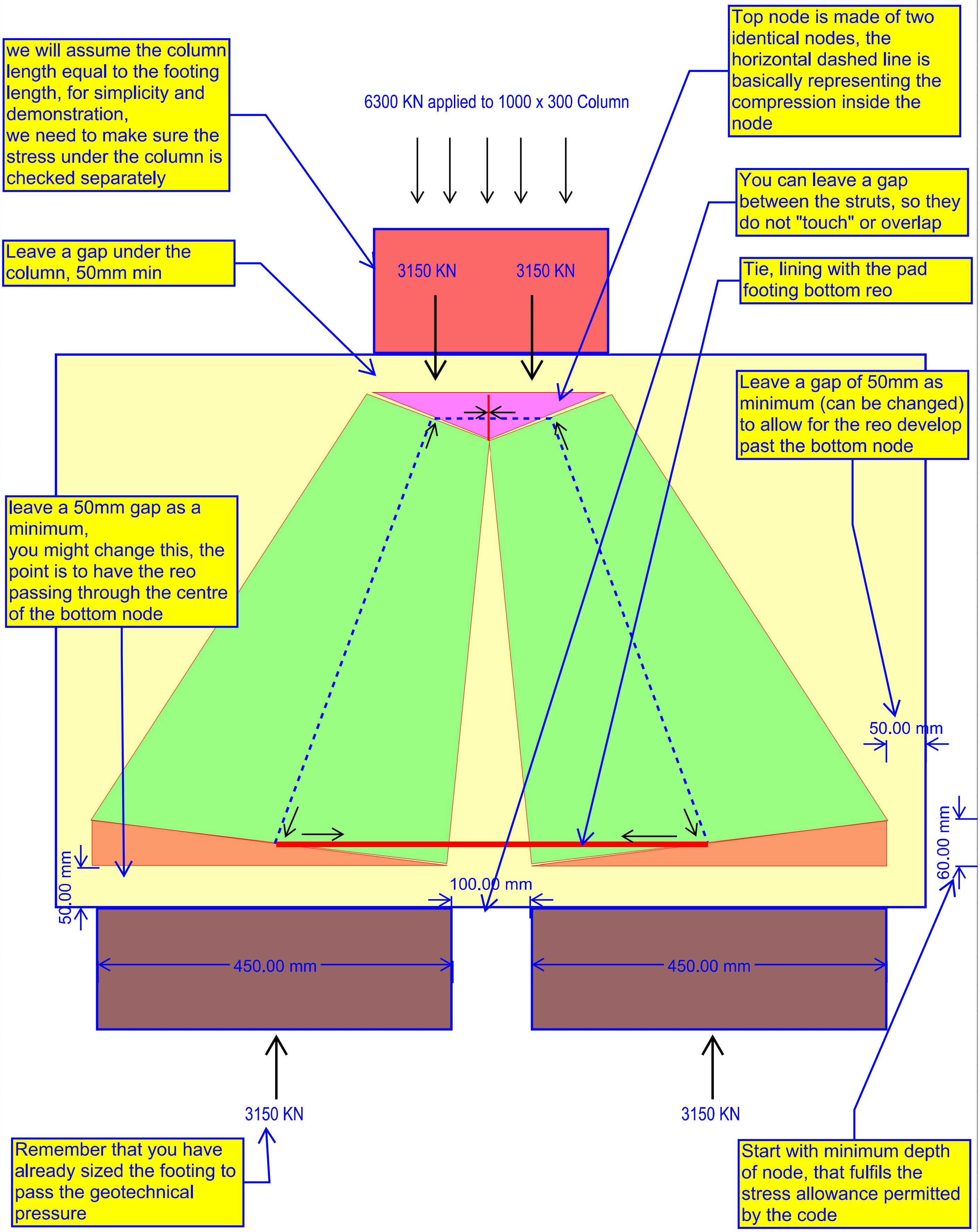




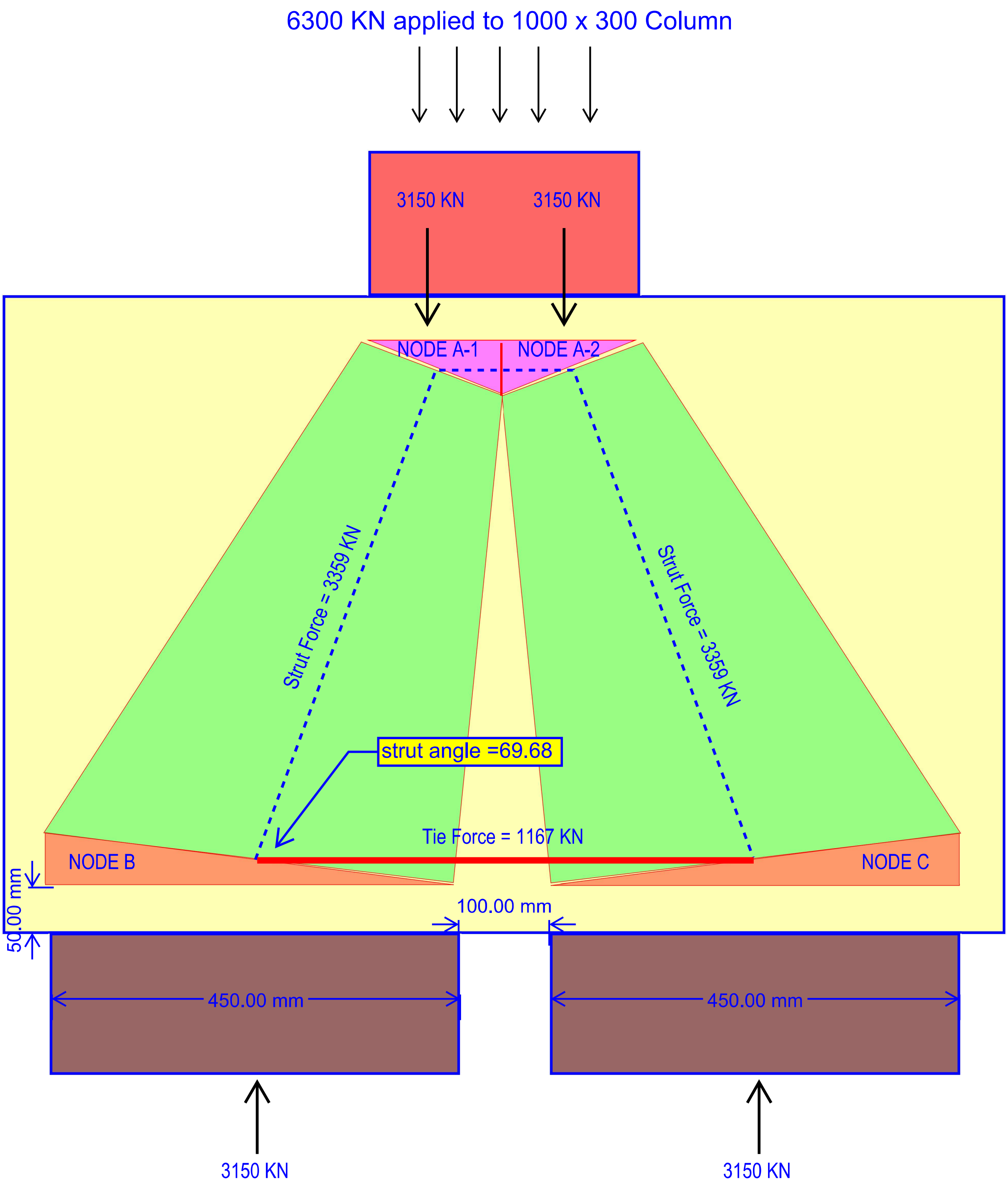
Components of the STM model



3D Shot showing the footing and proposed strut and tie mode


we will assume the column length equal to the footing length, for simplicity and demonstration,
we need to make sure the stress under the column is checked separately
6300 KN applied to 1000 x 300 Column
Top node is made of two identical nodes, the horizontal dashed line is basically representing the compression inside the node
You can leave a gap between the struts, so they do not "touch" or overlap
Leave a gap under the column, 50mm min
3150 KN
3150 KN
Tie, lining with the pad footing bottom reo
Leave a gap of 50mm as minimum (can be changed) to allow for the reo develop past the bottom node
leave a 50mm gap as a minimum,
you might change this, the point is to have the reo passing through the centre of the bottom node
50.00 mm
60.00 mm
50.00 mm
100.00 mm
450.00 mm
450.00 mm
3150 KN
3150 KN
Remember that you have already sized the footing to pass the geotechnical pressure
Start with minimum depth of node, that fulfils the stress allowance permitted by the code

Following figure shows the internal loads within the STM model, most important is to have everything in balance, start by calculating the reactions from the free body diagram of the whole footing (external forces), then calculate the strut / tie forces by balancing the nodes (projecting loads on X and Y axes etc).



Next step is to calculate the permitted stresses, refer to AS3600-2018 for this:

109 **AS 3600:2018**

7.4.2 Design strength of nodes

Where confinement is not provided to the nodal region, the design strength of the node shall be such that the principal compressive stress on any nodal face, determined from the normal and shear stresses on that face, is not greater than $\phi_{st}\beta_n 0.9 f'_c$ where— 0.65

(a) for CCC nodes β_n = 1.0; or That is node A-1 and A-2

(b) for CCT nodes β_n = 0.8; or Nodes B and C

(c) for CTT nodes β_n = 0.6.

The value of the strength reduction factor (ϕ_{st}) shall be taken from Table 2.2.4.

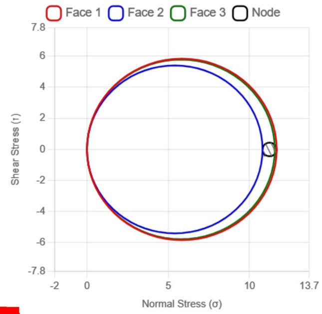
Where confinement is provided to the nodal region, the design strength of the node may be determined by tests or calculation, considering the confinement, but shall not exceed a value corresponding to a maximum compressive principal stress on any face of $\phi_{st}1.8 f'_c$.

With 40 MPa concrete, the following will be our allowance:

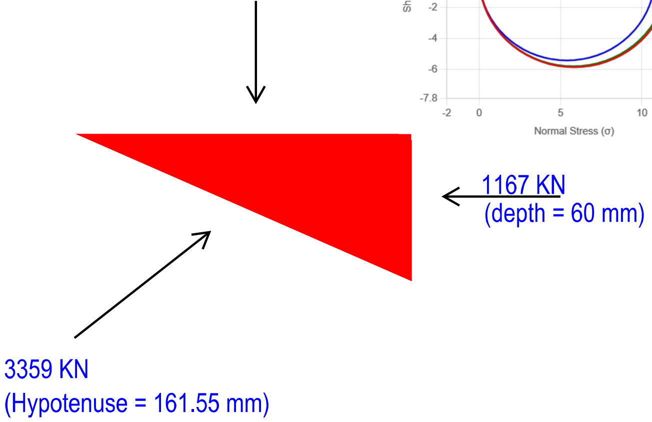
CCC node = 0.65 x 1.00 x 0.9 x 40 = 23.40 MPa
CCT node = 0.65 x 0.80 x 0.9 x 40 = 18.72 MPa

Next step is to calculate the stresses applied to each face of the nodes,

Starting with Node A-1 (top left node, which is a mirror image of the top right node in this very example)



Width (mm)	150	Top Stress	11.67
Height (mm)	60	Side Stress	10.8
Hypo (mm)	161.55	Incl. Stress	11.55
Strut/Node Angle	1.48	Shear Stress	0.3
Applied (MPa)	11.67	Allowed MPa	23.4



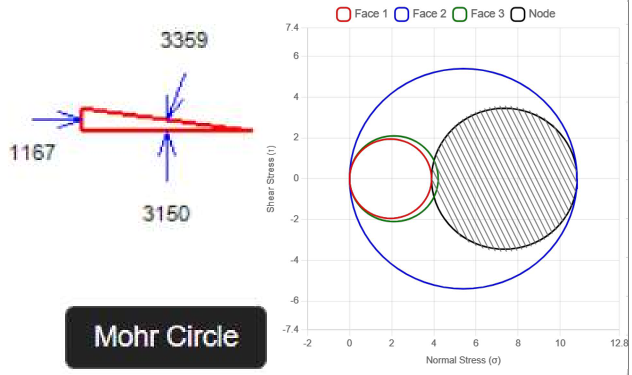
Note here that we've assumed the column length into the page = 1800 which is not accurate, (converted the matter to 2D rather than 3D) so if we are keen, all of the applied stresses should be increased by the ratio 1.8 / 1, again within the capacity of the node

Note: Mohr circle should be constructed to calculate the internal stresses resulting from the angle of the strut is not exactly normal to the triangle but in most cases this is a trivia check, do not need to be performed for straightforward questions

Similarly, bottom node (node B and C are similar):

Left Node

Width (mm)	450	Base Stress	3.89
Height (mm)	60	Side Stress	10.8
Hypo (mm)	453.98	Incl. Stress	4.01
Strt./Nd. Ang	12.73	Shear Stress	0.91
Applied (MPa)	10.8	Allowed MPa	18.72



Now that all of the nodes are ok, we can reinforce the pad, the tie force is 1167 KN hence the total required reo is

AS = 1167 x 1000 / 0.85 / 500 = 2745 mm² for the total length of the footing (1.8 m)
so per meter we will need 2745 / 1.8 = 1525 mm² (that is roughly N20 - 2000)
- NOTE
THIS MUST BE MORE THAN THE MINIMUM REO OF THE SECTION, SEE CLAUE 21.3)

Next Step is to Check the Stress inside the strut

First things first, we can't go ahead with this step unless the nodes pass the stress check, if yes, then we need to calculate the stress as the "smallest cross section" per clause 7.2.3 which is nothing but the smaller node at the top (a plane perpendicular to the axis of the strut).

The allowable stress formulae is similar to the node, with difference at the Betta factor, in struts it relates to the angle of the inclination, the more vertical, the higher efficiency
In our question, the stress = 3359 x 1000 / (1800 x 162 / cos (1.48)) = 12 MPa
Efficiency factor = 0.92 (for theta = 69.68)
allowed stress in strut = 0.65 x 0.92 x 0.9 x 40 = 21.5 MPa hence all good

7.2.3 Design strength of struts

The design strength of a concrete strut shall be taken as—

$$\phi_{st}\beta_s 0.9 f'_c A_c \qquad \ldots 7.2.3$$

where

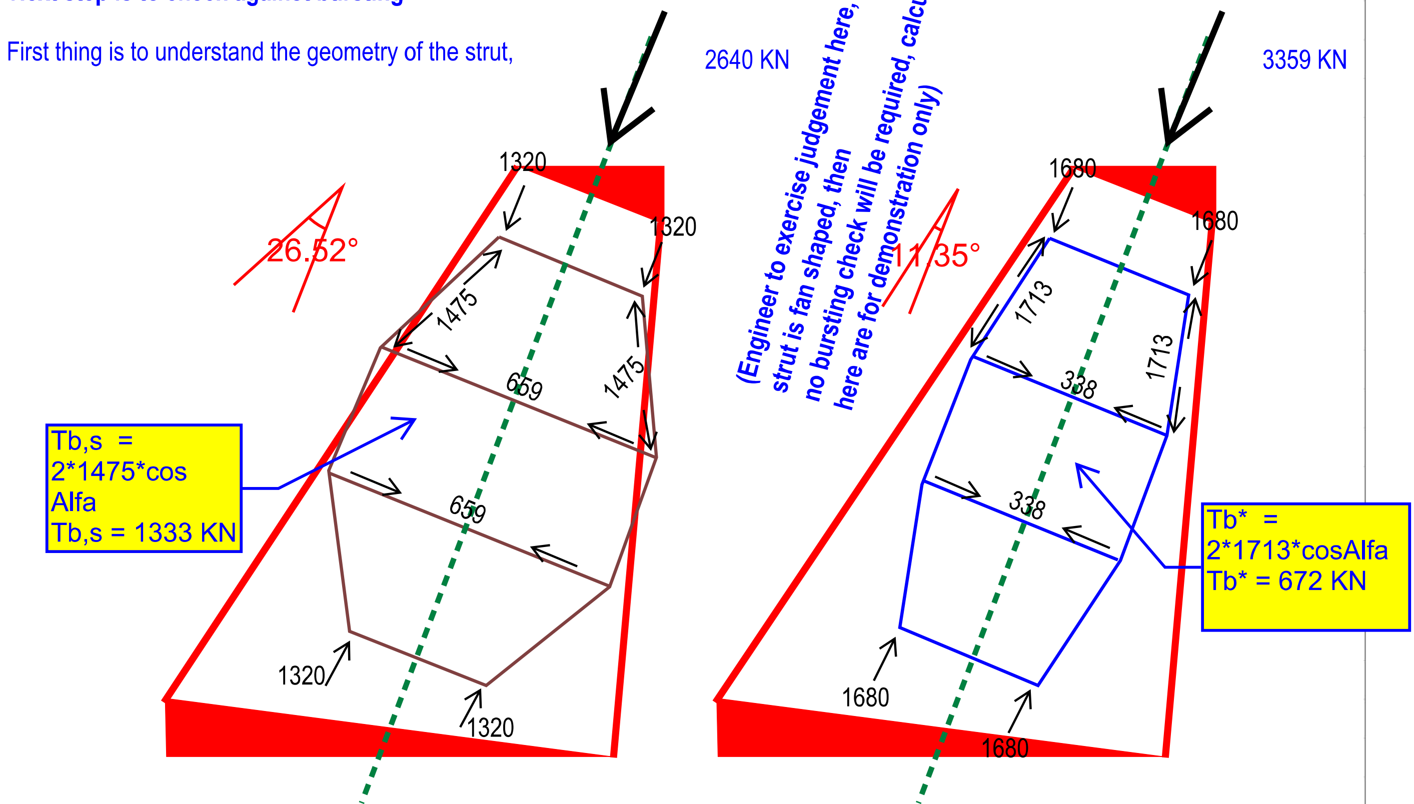
A_c = smallest cross-sectional area of the concrete strut at any point along its length and measured normal to the line of action of the strut

β_s = an efficiency factor given in Clause 7.2.2

$$\beta_s = \frac{1}{1.0 + 0.66\cot^2\theta} \qquad \text{(within the limits } 0.3 \le \beta_s \le 1.0\text{)}$$

Next step is to check against bursting

First thing is to understand the geometry of the strut,



Service (Alfa = 26.56) Ultimate (Alfa = 11.31)

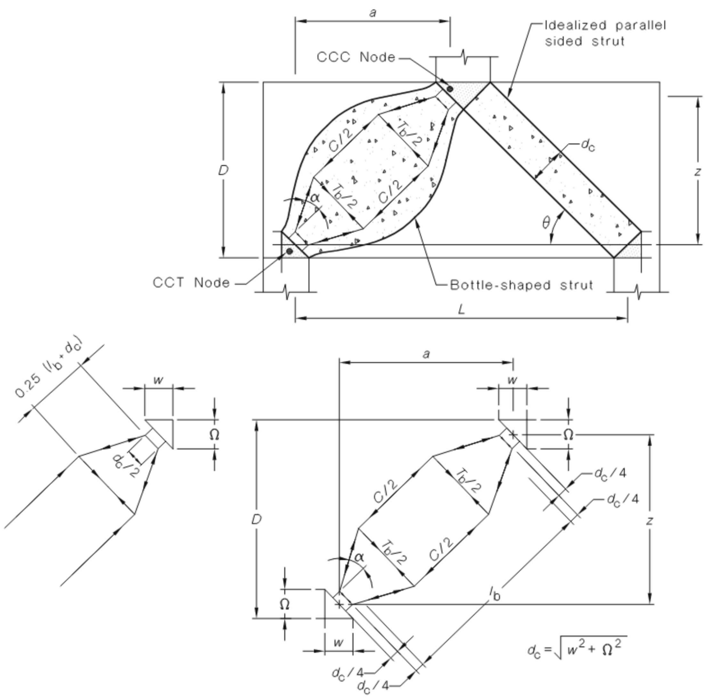


FIGURE 7.2.4(A) MODEL OF BURSTING FORCES IN BOTTLE-SHAPED STRUTS

Next is to calculate the capacity of the concrete at bursting

Average DC = (162+ 453)/2=308 mm
Strut length = SQRT(540^2+(540/tan Theta)^2) = 576
Lb = 576-308 = 28

Capacity of concrete at bursting = 0.7 x f'ct x Lb x B = 0.7 x 2.28 MPa x 268 x 1800 = 769 KN
(note LB to be calculated from the geometry, in this very example it is equal to 268 mm)

The code says:

If the calculated bursting force (T_b^*) is greater than $0.5T_{b.cr}$, with tan α taken as ½, then transverse reinforcement shall be provided in either—

(i) two orthogonal directions at angles γ_1 and γ_2 to the axis of the strut [see Figure 7.2.4(B)]; or

(ii) one direction at an angle γ_1 to the axis of the strut, where γ_1 shall be not less than 40°

and shall satisfy the following:

(A) For serviceability

$$\Sigma A_{si} f_{si} \sin\gamma_i \geq \max\left(T_{b.s}^*, T_{b.cr}^*\right) \quad \ldots 7.2.4(2)$$

(B) For strength

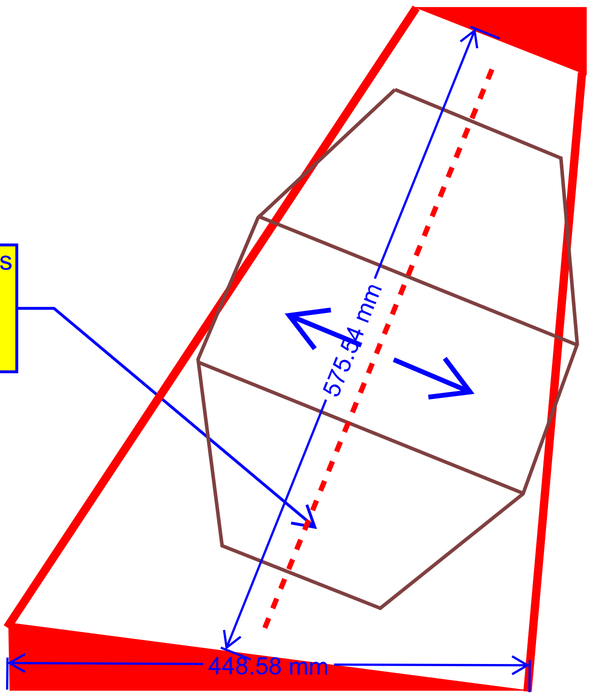
$$\phi_{st} \sum A_{si} f_{sy} \sin\gamma_i \geq T_b^* \quad \ldots 7.2.4(3)$$

The transverse reinforcement shall be evenly distributed throughout the length of the bursting zone (l_b), which is given by—

$$l_b = \sqrt{z^2 + a^2} - d_c \quad \ldots 7.2.4(4)$$

and a, d_c and z are the shear span, the depth of the idealized strut, and the projection of the inclined compressive strut normal to the shear span respectively [see Figure 7.2.4(A)].

this is the plane at which the bursting force is applied (cracks along this line)
The depth (into the page) is the other dimension of this plan



Which means we need to calculate the bursting force from ultimate load, but with an angle of 26.56, and compare this value with HALF of the concrete bursting capacity, if the load exceeds the HALF, then bursting reo will be required.

In this very example:
Capacity of concrete on bursting is 769 KN
Applied service bursting is 1318 KN (at angle of 26.56) ⟶ Hence we need to have bursting reo
Applied Ultimate Bursting is 676 KN (at angle of 11.31) ⟶ this is low

and
Applied Ultimate bursting at angle of 26.56 is 676 x 0.5 / 0.2 = 1691 KN (multiplied by tangent of alfas to work out the number) ⟶ Hence we need bursting REO because 1691 > 0.5 x 769

Calculation of Bursting REO:

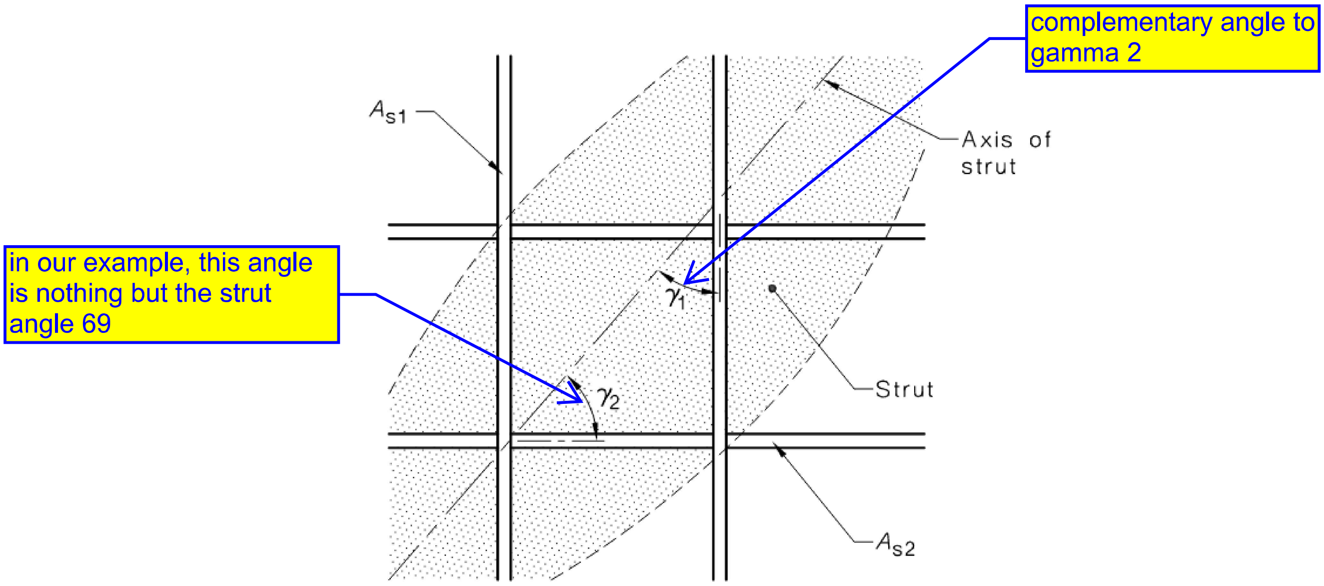


FIGURE 7.2.4(B) BURSTING REINFORCEMENT

For service
Max (Tb,s and Tbcr) < 250 MPa x [Ash x Sign(69) + Asv x Cos (69)] (note we used 250 MPa for service, read clause 12.7)
Max(1318x 769) = 1318 KN

try Ash = 4200 mm²

1317 x 1000 = 250 x (4200 x 0.93 + Asv x 0.36)
Hence Asv = 3800 mm²

(NOTE : see here the horizontal reo is most efficient)

(A) For serviceability

$$\Sigma A_{si} f_{si} \sin \gamma_i \geq \max\left(T^*_{b.s}, T^*_{b.cr}\right)$$

(B) For strength

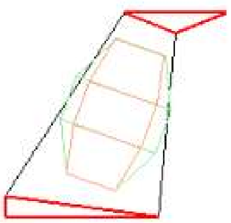
$$\phi_{st} \sum A_{si} f_{sy} \sin \gamma_i \geq T^*_b$$

For Ultimate
Capacity = 0.85 x 500 x (4200 x sin (69) + 3800 x cos(69)) = 2245 KN > 667 OK

Left Strut

Min WIdth	162
Max Width	454
Average Dc (mm)	308
Length	576
Lb	268
Strut Angle	69.68
Efficiency Factor	0.92
Strut Force KN	3359
Applied σ (MPa)	11.55
Allowed σ (MPa)	21.46
f'ct (MPa)	2.28
Tb,cr Bursting (KN)	769
SLS* Burst. (KN)	1333
ULS* Burst. (KN)	672
Hor.REO Total Both Faces mm	4149
Vert. REO Total Both Faces mm	4149
ULS Burst. Capacity	2666
SLS Burst. Capacity	1333

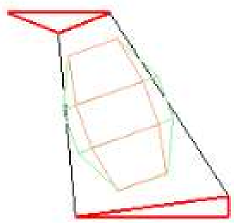
Strut Situation **OK**



Right Strut

Min WIdth	162
Max Width	454
Average Dc (mm)	308
Length	576
Lb	268
Strut Angle	69.68
Efficiency Factor	0.92
Strut Force KN	3359
Applied σ (MPa)	11.55
Allowed σ (MPa)	21.46
f'ct (MPa)	2.28
Tb,cr Bursting (KN)	769
SLS* Burst. (KN)	1333
ULS* Burst. (KN)	672
Hor.REO Total Both Faces mm	4149
Vert. REO Total Both Faces mm	4149
ULS Burst. Capacity	2666
SLS Burst. Capacity	1333

Strut Situation **OK**



The above means we need to add heavy bursting reo for the footing, we will need 4100 / 2 = 2050 mm² each face, these are the side bars plus 3950 / 2 = 2000 mm² vertical bars (footing reo cogged up - if we try N20-150 equals to 2093 mm² per meter)

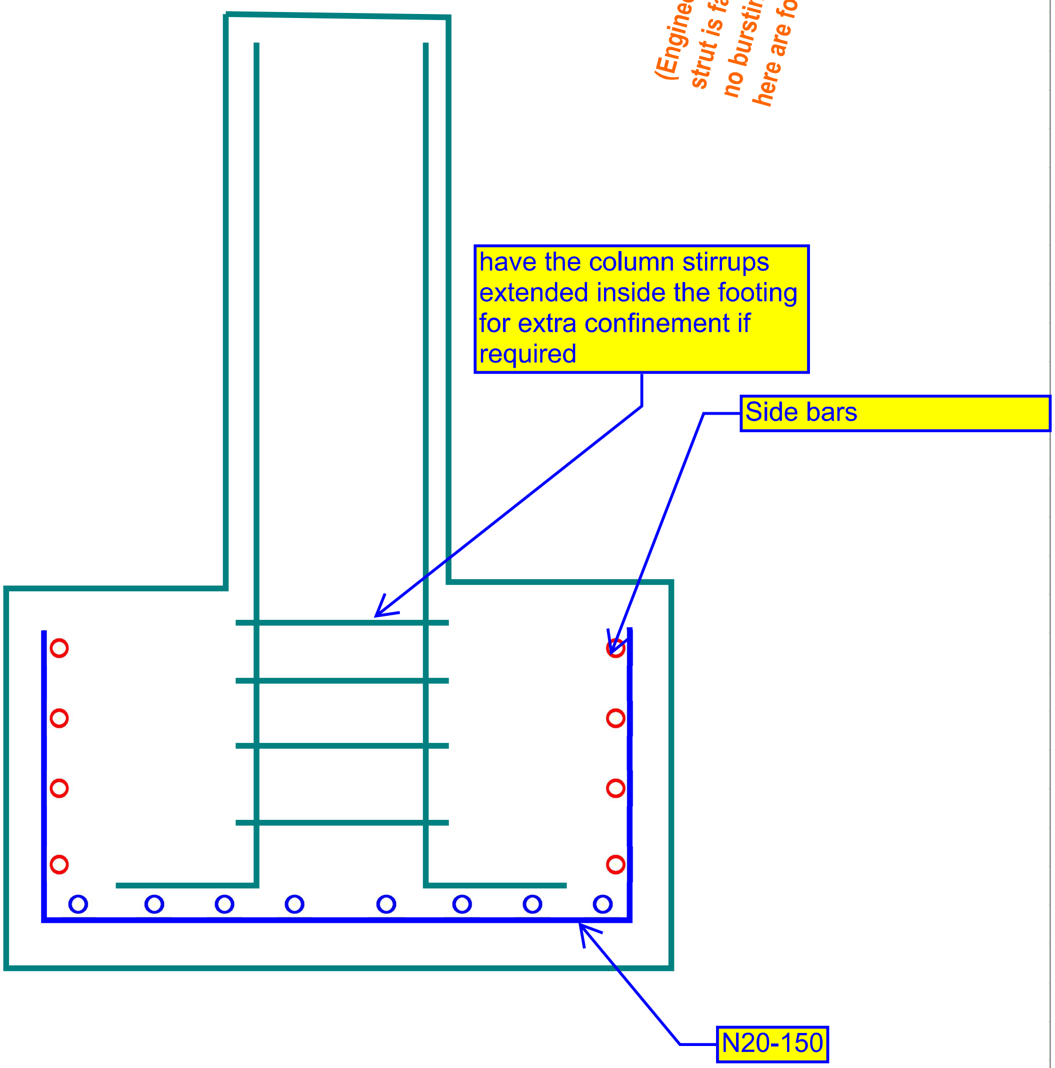
However, this problem can be mitigated as follows:

1- Study the footing with reduced live load,
2- increase the MPa of footing
3 - Reduce the tension force in the footing by employing the rock confinement around
4- Study the model in different ways, for example having 3 nodes at the bottom
5- Extend the column ties inside the footing

in this very example, we will need some 5 N 24 side bars each face, which seems too much.

(Engineer to exercise judgement here, if the strut is fan shaped, then no bursting check will be required, calculations here are for demonstration only)

SUMMARY



Note on Anchorage

Developing the REO is required as a matter of fact, see below figures taken from ACI318-M 2011 showing where to start the anchorage length from, in our example we had N20 bars, so without a hook (cog) we need some 40 x 20 = 800 mm this is reduce to some 400 for the existence of hooks.

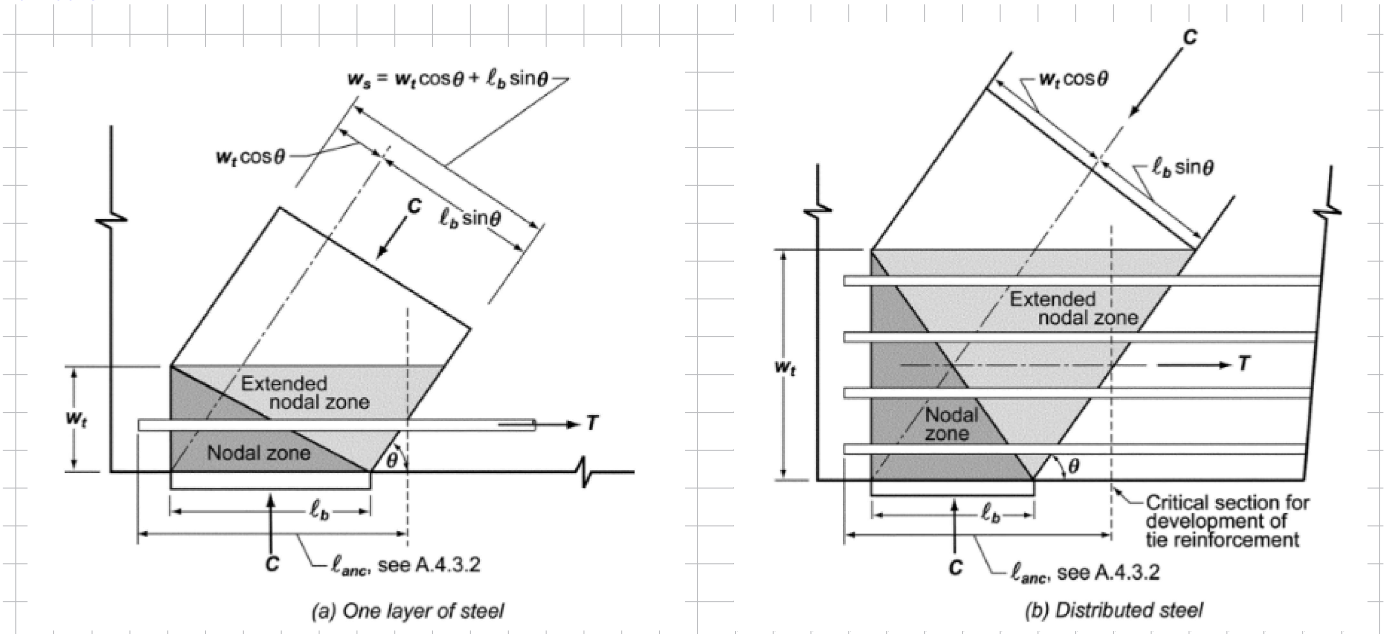


Fig. RA.1.5—Extended nodal zone showing the effect of the distribution of the force.

Note on Hydrostatic Nodes

See below from ACI

Nodal zone — Historically, hydrostatic nodal zones as shown in Fig. RA.1.4 were used. These were largely superseded by what are called extended nodal zones, shown in Fig. RA.1.5.

A ***hydrostatic nodal zone*** has loaded faces perpendicular to the axes of the struts and ties acting on the node and has equal stresses on the loaded faces. Figure RA.1.4(a) shows a ***C-C-C*** nodal zone. If the stresses on the face of the nodal zone are the same in all three struts, the ratios of the lengths of the sides of the nodal zone, w_{n1}: w_{n2}: w_{n3} are in the same proportions as the three forces C_1: C_2: C_3. The faces of a hydrostatic nodal zone are perpendicular to the axes of the struts and ties acting on the nodal zone.

These nodal zones are called hydrostatic nodal zones because the in-plane stresses are the same in all directions. Strictly speaking, this terminology is incorrect because the in-plane stresses are not equal to the out-of-plane stresses.

RA.5 — Strength of nodal zones

RA.5.1 — If the stresses in all the struts meeting at a node are equal, a hydrostatic nodal zone can be used. The faces of such a nodal zone are perpendicular to the axes of the struts, and the widths of the faces of the nodal zone are proportional to the forces in the struts.

Assuming the principal stresses in the struts and ties act parallel to the axes of the struts and ties, the stresses on faces perpendicular to these axes are principal stresses, and A5.1(a) is used. If, as shown in Fig. RA.1.5(b), the face of a nodal zone is not perpendicular to the axis of the strut, there will be both shear stresses and normal stresses on the face of the nodal zone. Typically, these stresses are replaced by the normal (principal compression) stress acting on the cross-sectional area A_c of the strut, taken perpendicular to the axis of the strut as given in A.5.1(a).

Introduction

This document provides analysis of non-flexural element design in accordance with the Australian Standard AS3600-2018. It covers both the ultimate and service conditions, addressing the following aspects:

- Flexural Reinforcement
- Nodal Stresses and compliance with the Standard
- Strut Checks, including bursting

The design ensures structural integrity and compliance with the standard under the specified loading conditions. For detailed guidelines and requirements, refer to the relevant sections of AS3600-2018-A2.

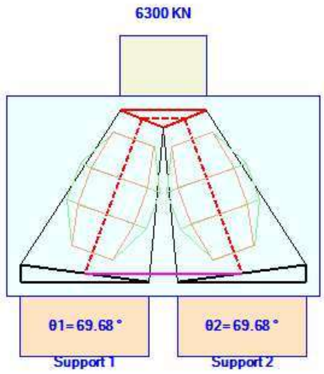
This calculation can be reproduced and checked independently. For more details, refer to the RKALC website.

Material Properties

Parameter	Value	Unit
Concrete Strength f'c	**40**	MPa
Rebar fy	**500**	MPa
SLS Rebar stress fys	**250**	MPa

Geometry

Parameter	Value	Unit
Wall Height	**700**	mm
Wall Width	**1100**	mm
Wall Thickness	**1800**	mm
Width of Left Support	**450**	mm
Width of Right Support	**450**	mm
Width of Applied Load	**300**	mm



Applied Loads

Parameter	Value	Unit
Ultimate Load	**6300**	KN
Service Load	**4950**	KN
Width of Applied Load	**300**	mm
Centre of Applied Load (from left edge of the wall)	**550**	mm

Nodal Assumptions

Top Node

The node at the top is recieving the load, width of which equal to the node's width. Node is essentailly divided into two triangulated nodes (left and right), these have widths constructed from the shares of load they take.

Parameter	Value	Unit
Top Node Width (total)	**300**	mm
Top Node Depth	**60**	mm
Node Thickness	**1800**	mm

Left Node

Parameter	Value	Unit
Left Node Width	**450**	mm
Left Node Depth	**60**	mm
Node Thickness	**1800**	mm

Right Node

Parameter	Value	Unit
Right Node Width	**450**	mm
Right Node Depth	**60**	mm
Node Thickness	**1800**	mm

Analysis and Required Reinforcement

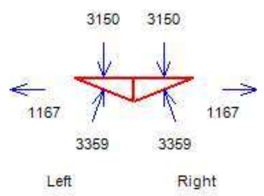
Parameter	Value	Unit
Span-Depth Ratio of the STM Model	**1.57**	
Left Node Reaction	**3150**	KN
Right Node Reaction	**3150**	KN
Resulting Tie Force	**1167**	KN
Required REO	**2745**	mm^2
Left Strut Force	**3359**	KN
Left Strut Angle	**69.68**	Degrees
Right Strut Force	**3359**	KN
Right Strut Angle	**69.68**	Degrees

> *Ensure the reinforcement is reasonable, not heavy. spread so the centre of bars is passing by the centre of the nodes at the bottom*

Nodal Capacity Check

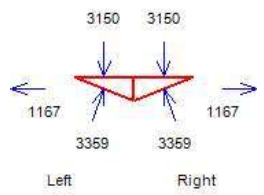
Top Node — Left part

Parameter	Value	Unit
Width (Based on Share of Load Taken)	150	mm
Base stress	1800	N/mm²
Side stress	10.8	N/mm²
Inclined stress	11.55	N/mm²
Shear stress	0.3	N/mm²
Allowed Stress (CCC Node)	23.4	N/mm²
Status	Pass	



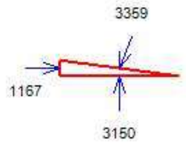
Top Node — Right part

Parameter	Value	Unit
Width (Based on Share of Load Taken)	150	mm
Base stress	1800	N/mm²
Side stress	10.8	N/mm²
Inclined stress	11.55	N/mm²
Shear stress	0.3	N/mm²
Allowed Stress (CCC Node)	23.4	N/mm²
Status	Pass	



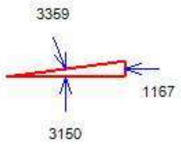
Bottom-Left node

Parameter	Value	Unit
Base stress	3.89	N/mm²
Side stress	10.8	N/mm²
Inclined stress	4.01	N/mm²
Shear stress	0.91	N/mm²
Allowed Stress (CCT Node)	18.72	N/mm²
Status	Pass	



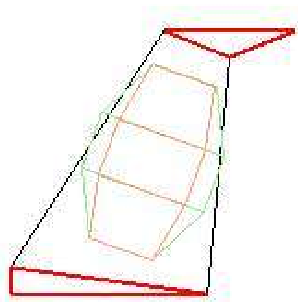
Bottom-Left node

Parameter	Value	Unit
Base stress	3.89	N/mm²
Side stress	10.8	N/mm²
Inclined stress	4.01	N/mm²
Shear stress	0.91	N/mm²
Allowed Stress (CCT Node)	18.72	N/mm²
Status	Pass	



Left Strut

Strut Parameter	Value	Unit
Average Dc	308	mm
Lb	268	mm
Angle	69.68	Degrees
Efficiency Factor	0.92	
Applied MPa	11.55	
Allowed MPa	21.46	
fct	2.28	MPa
Tb,cr Bursting	769	MPa
SLS* Bursting	1320	KN
ULS* Burst	672	KN
Hor.REO Total Both Faces mm	4108	mm^2
Vert.REO Total Both Faces mm	4108	mm^2
ULS Burst. Capacity	2639	KN
SLS Burst. Capacity	1320	KN
Strut Status	OK	



Right Strut

Strut Parameter	Value	Unit
Average Dc	308	mm
Lb	268	mm
Angle	69.68	Degrees
Efficiency Factor	0.92	
Applied MPa	11.55	
Allowed MPa	21.46	
fct	2.28	MPa
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ULS Burst. Capacity	2639	KN
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Strut Status	OK