RKALC Technical Note

Punching Shear in Flat Slabs

AS 3600 2018 and the 2026 public comment draft with Eurocode 2 parallels

RK Software Solutions | 13 November 2026 | Revision 0

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1. Design implications

This technical note is intended to assist Australian structural engineers in understanding the proposed punching shear provisions of AS 3600:2026 and preparing for their adoption. Familiarity with EN 1992-1-1:2023 (Eurocode 2) provides a useful starting point because the proposed Australian provisions use similar control perimeter geometry and reinforcement arrangements. The comparisons with Eurocode 2 are included to explain these concepts and support their application under the proposed Australian provisions.

The 2026 public comment draft changes how AS 3600 checks punching shear at slab–column connections. This note follows the design sequence from control perimeter and concurrent actions through concrete resistance, reinforcement and the outer perimeter.

The flowchart outlines the proposed design procedure. A compact internal column example then demonstrates the calculation, followed by an elongated column example that explains the reduced control perimeter. Results from the AS 3600:2018 torsion-strip method provide a baseline for understanding the practical implications of the proposed changes. The examples are illustrative and do not constitute software verification or project design.

2. What changes from the 2018 method

Check	AS 3600:2018 Clause 9.3	DR AS 3600:2026 Clause 9.3
Basic geometry	Critical perimeter offset by half the mean effective depth.	Basic perimeter at $0.5d_{av}$, with explicit reductions for large supports and checks at extended perimeters.
Moment transfer	Transferred moment modifies the available resistance in the torsion strip or spandrel model.	Eccentricity of the resultant relative to the control perimeter centroid increases design shear through β_e.
Concrete	Concrete stress expression depends on support aspect ratio and concrete strength.	Detailed route relates resistance to slab rotation. Simplified route uses bonded flexural reinforcement and geometry factors, subject to eligibility.
Shear reinforcement	Closed fitments are designed and detailed in torsion strips or spandrel beams. Closed fitments to extend along the torsion strip or spandrel beam at least L/4 from the face of the support or concentrated load, on one or both sides of the centroid axis as applicable	Credit the area of adequately anchored legs intersecting the failure surface. Check minimum steel, crushing and the outer concrete perimeter. The 2026 draft replaces that fixed extent with a calculated extent. Clauses 9.3.5 and 9.3.9 require successive perimeter checks until concrete alone can carry the design punching shear. Clause 9.3.10(h) then ties the position of the last reinforcement row to that effective outer perimeter.

The draft's design check compares factored demand with factored resistance. Show stress and force on the same effective shear area, $b_{0.5}d_{av}$, so that the two formats give the same utilisation.

3. Punching shear design flow

Workflow for an internal rectangular support under the Australian public comment draft.

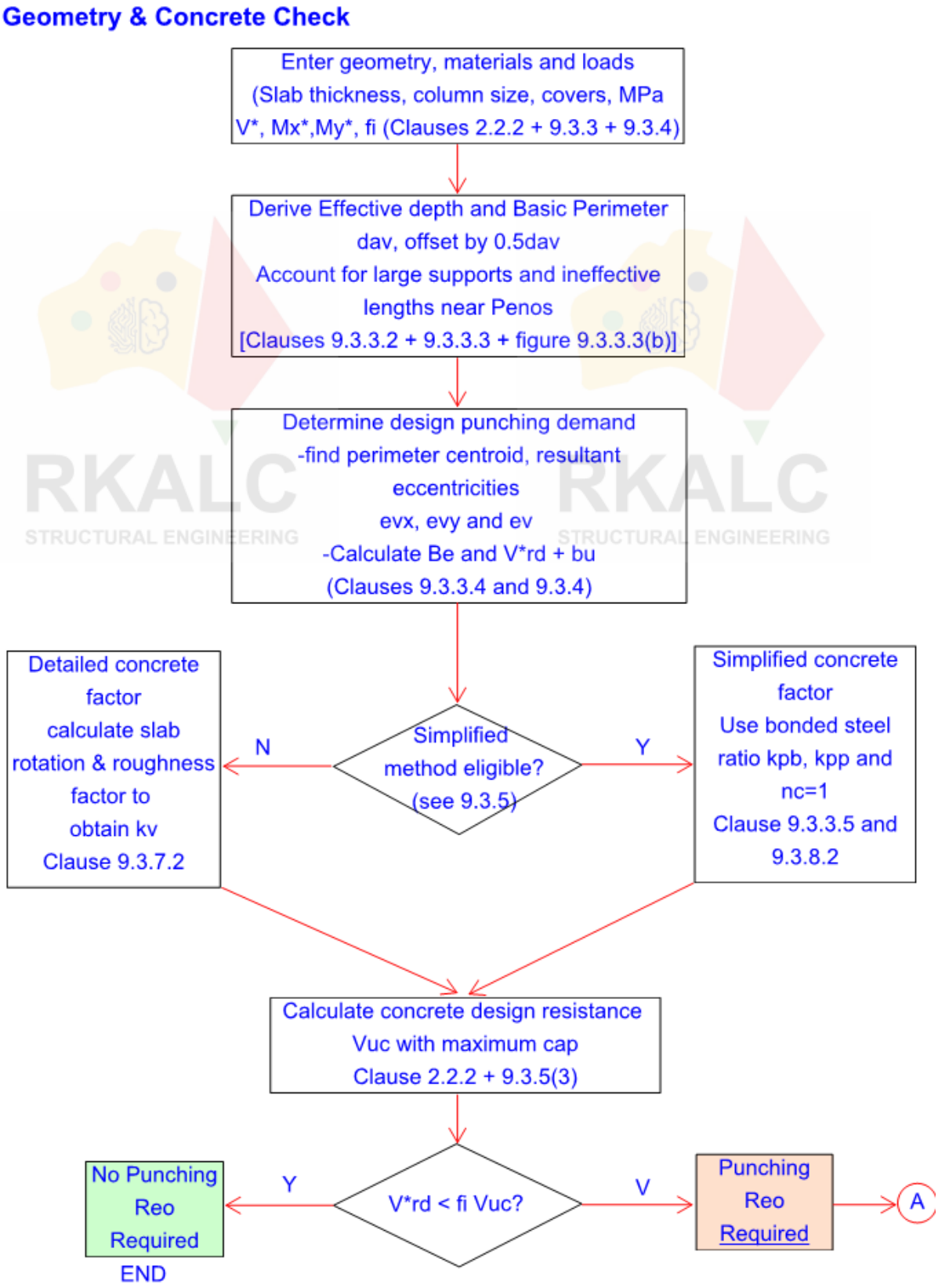


Figure 1 – AS3600-2026 Punching Shear Workflow – Part 1

Reinforced and Outer Perimeter Checks

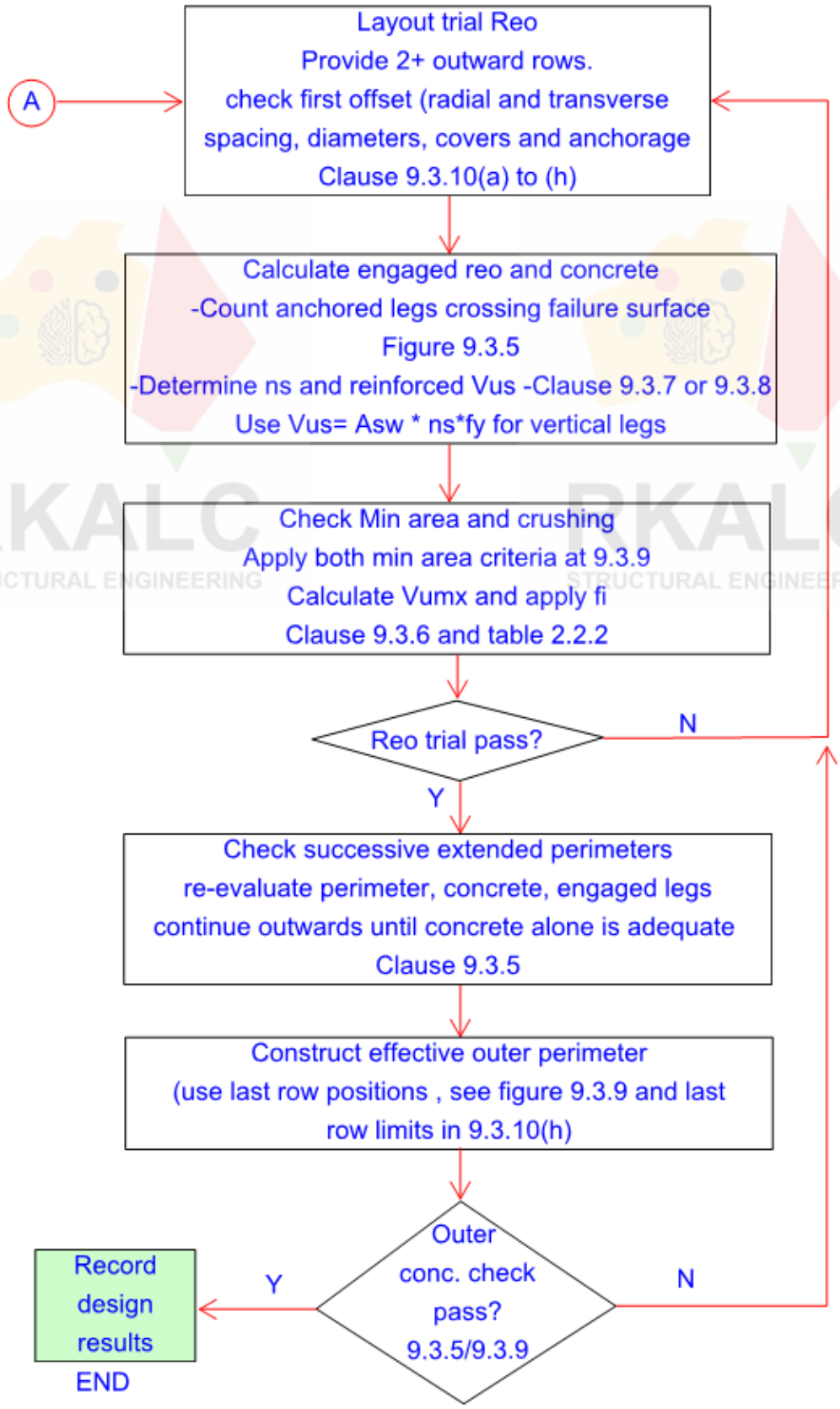
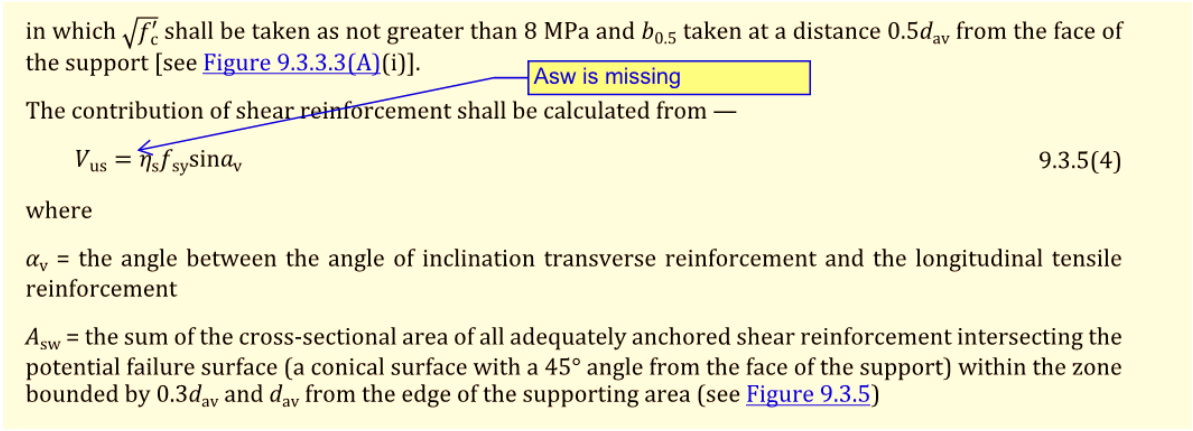


Figure 2 – AS3600-2026 Punching Shear Workflow – Part 2

4. Reinforced design workflow

- Check the concrete at the basic perimeter using the shear and transferred moments from the same load combination. Determine the governing case from utilisation after accounting for eccentricity.
- Check draft simplified-method eligibility before applying its concrete and steel factors.
- If reinforcement is required, position the first row strictly between $0.3d_{av}$ and $0.5d_{av}$ from the face.
- Provide at least two outward rows and limit radial spacing to the lesser of $0.75d_{av}$ and 300 mm.
- Check transverse spacing at the second row against $1.5d_{av}$.
- For vertical legs, use $V_{us} = A_s w \eta_s f_{sy}$. Draft Eq. 9.3.5(4) defines $A_s w$ below the equation but omits it from the printed expression. The expression used in this note restores the area term to obtain a force. Count only adequately anchored legs that intersect the assumed failure surface within the draft's engagement zone.



- *Figure 3 – Clause 9.3.5(4) of Draft AS3600-2026*

- Check reinforced resistance, minimum steel and crushing at applicable perimeters.
- Beyond the last row, calculate the effective outer perimeter from the actual leg positions, excluding unsupported portions between arms, and check concrete alone.
- In the design calculations, identify the shear reinforcement legs counted at the governing control perimeter and state the governing load combination.
- Show the concrete and steel contributions separately in MPa, then report the final design resistance and utilisation after applying the crushing limit.
- Check the closed-fitment bend and hook geometry, longitudinal bars, anchorage and cover against the actual slab reinforcement.
- Draft Clause 9.3.10(g) limits compression-side cover to the shear reinforcement to $0.167d_{av}$, subject to other applicable limits. For d_{av} = 152 mm this is 25.4 mm.

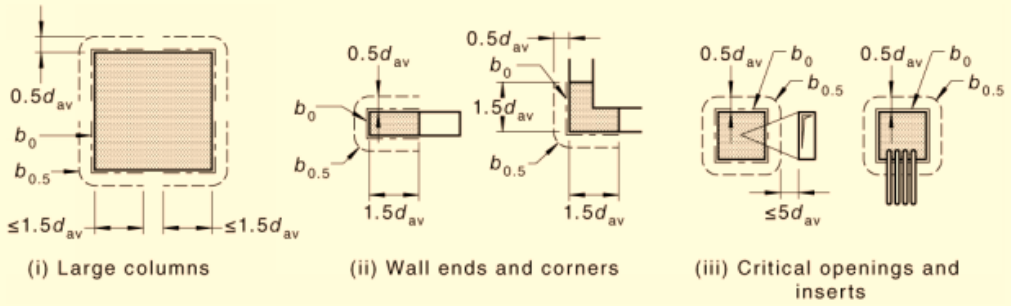
5. Eurocode geometry and Australian checks

EN 1992-1-1:2023 and the Australian draft show closely related control perimeter geometry.

Eurocode Figure 8.19(a) and draft Figure 9.3.3.3(B)(i) reduce the straight perimeter lengths credited at large supports.

The effect of concentrations of shear stress at the corners of large supporting areas shall be considered in the evaluation of punching shear strength. Alternatively, in lieu of a more precise calculation, stress concentrations may be accounted for by reducing the basic control perimeter such that the length of its straight segments does not exceed $3d_{av}$ for each edge [see Figure 9.3.3.3(B)(i)]. Similar consideration shall be made for the assessment around wall ends and wall corners [see Figure 9.3.3.3(B)(ii)].

The effect of non-critical openings or inserts may be neglected if the clear spacing between the edge of the opening and the control perimeter exceeds $5d_{av}$. Otherwise, the part of the control perimeter contained between the two tangents drawn to the outline of the opening from the centre of the supporting area shall be considered ineffective [see Figure 9.3.3.3(B)(iii)].

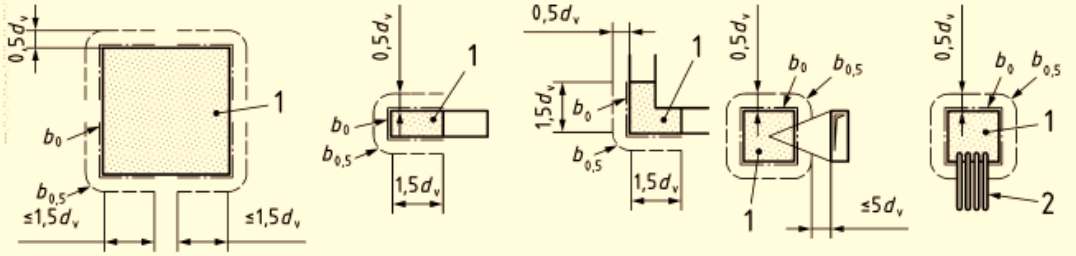


(i) Large columns (ii) Wall ends and corners (iii) Critical openings and inserts

Figure 9.3.3.3(B) — Adjustment of the basic control perimeter

Figure 4 – Draft AS3600-2026 Standard – Figure 9.3.3.(b)

(3) The effect of concentration of the shear forces at the corners of large supporting areas may be taken into account by reducing the control perimeter assuming that the length of its straight segments does not exceed $3d_v$ for each edge (refer to the reduced control perimeter length shown in Figure 8.19 a)). In large columns, without a detailed analysis, only the reduced control perimeter according to Figure 8.19 a) should be accounted for. In wall ends and wall corners, the load carried by the supporting areas defined in Figures 8.19 b) and c) should be verified for punching resistance whereas the load carried outside the supporting areas should be verified for shear according to 8.2.1 and 8.2.2. Columns where the width is larger than $6d_v$ may be considered as wall ends or wall corners. For edge and corner columns with overhangs, the length of the straight segments shown in Figures 8.18 d) and e) is also limited to $3d_v$.



a) around large supporting areas b) around wall end c) around wall corner d) near opening e) with inserts

Key

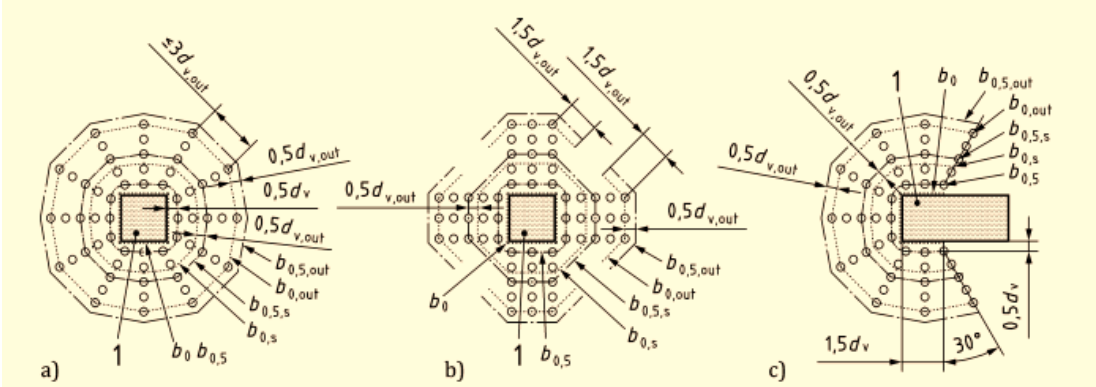
1 supporting area

2 inserts

Figure 8.19 — Length of control perimeter $b_{0,5}$ and support perimeter b_0 around supporting areas

Figure 5 – EC2-2023 Figure 8.19 and clause 8.4.2(3)

Eurocode Figure 8.24(b) and draft Figure 9.3.9 show the outer perimeter for a cruciform arrangement, including ineffective gaps between arms.



a) control perimeters for radial arrangements ($b_{0,5,s}$ and $b_{0,s}$ refer to the instance of the 3rd perimeter of shear reinforcement)

b) control perimeters for cruciform arrangements

c) control perimeters for wall ends, wall corners, large and elongated columns (instance of wall end with radial arrangement of shear reinforcement)

Key

1 supporting area

Figure 8.24 — Definition of control perimeters for punching reinforcement

Figure 6 – Figure 8.24 of EC2-2023

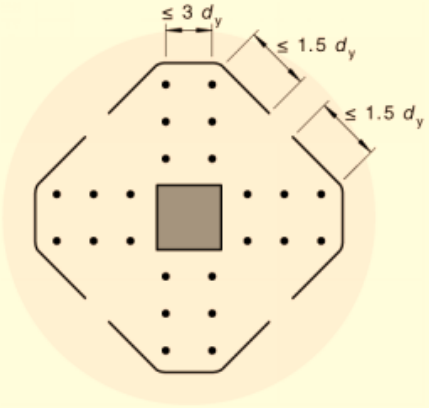


Figure 9.3.9 — Evaluation of extended control perimeter in slabs with punching shear reinforcement

Figure 7 – Figure 9.3.9 of Draft AS3600-2026

Subject	Implication for Australian draft design
Radial and transverse spacing	• Radial spacing is measured outward between rows. • Transverse spacing is measured between adjacent legs across a row, including gaps between fitments. • Draft Clause 9.3.10(e) specifies the second row. Eurocode Clause 12.5.1 includes an additional tighter first-row limit.

Subject	Implication for Australian draft design
Steel credit	• Eurocode Clause 8.4.4 uses a local reinforcement ratio based on spacing. • Draft Clause 9.3.5 uses the area A_{sw} of eligible legs. The plan should identify each leg counted.
Closed fitments	• Eurocode Figures 12.6 and 12.7 separate the physical anchorage detail from the plan arrangement. • Separate closed fitments and nested fitments produce different bar details even if their leg positions coincide.
Outer depth and effective length	• Eurocode accounts for anchorage geometry through d_v,out. • Apply the Australian draft's own depth, spacing and gap rules when reporting an Australian result.

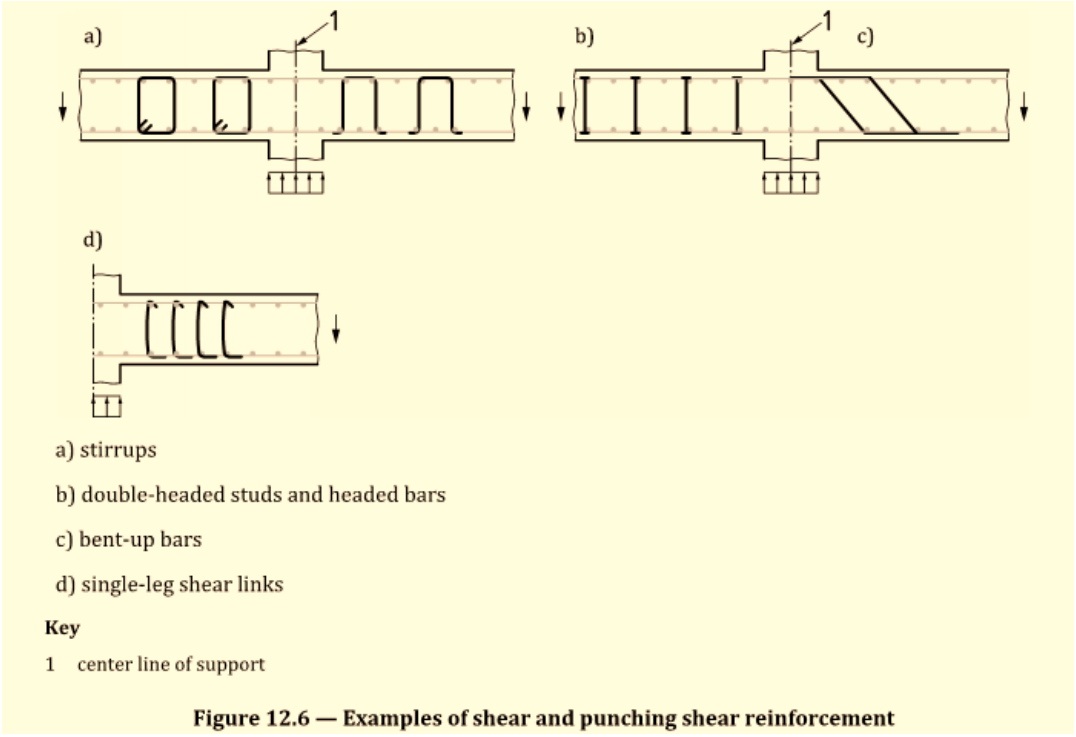


Figure 8 – EC2-2023 Figure 12.6

Check	EN 1992-1-1:2023	Draft AS 3600:2026
Basic perimeter at a large column	Figure 8.19(a) uses a perimeter offset by $0.5d_v$ and limits the effective straight length to $3d_v$ per edge.	Figure 9.3.3.3(B)(i) uses essentially the same geometry with dav.
Outer perimeter for a cruciform layout	Figure 8.24(b) shows a check beyond the last row and cuts out ineffective gaps between arms. The limits use dv,out, which accounts for the anchorage geometry.	Figure 9.3.9 shows the same layout and gap concept. The Australian clauses use dav.

Check	EN 1992-1-1:2023	Draft AS 3600:2026
Concrete contribution with shear steel	Eq. 8.105 explicitly defines ηc using the concrete-only resistance divided by the design stress.	Clause 9.3.8.2 uses a similar reduction. Eurocode helps explain which concrete resistance is meant, but RKALC should show the Australian denominator it uses.
Steel contribution	Clause 8.4.4 uses a local reinforcement ratio based on radial and tangential spacing at the perimeter being checked.	Clause 9.3.5 uses the total area Asw of adequately anchored legs intersecting the specified failure surface.
Detailing	Clause 12.5.1 includes a tighter tangential limit on the first row. Its closed-stirrup effective area is capped at that of a bar of diameter $11\sqrt{(d/200)}$.	Clause 9.3.10(e) explicitly checks transverse spacing on the second row. Its closed-fitment diameter is limited to $12\sqrt{(dav/200)}$.

6. Long supports and wall ends

Eurocode Clause 8.4.2(3) permits wall-end or wall-corner treatment for columns wider than $6d_v$.

In a wall-end assessment, check the shear carried by the local end area for punching and assess the shear carried elsewhere under the one-way shear rules.

Derive end actions from the structural analysis. Equal end reactions require a justified loading and geometry assumption.

Figure 8.24(c) illustrates reinforcement in front of and beside a wall-like tip. If the concrete check at a tip requires punching reinforcement, the layout should cover that zone and extend until the outer concrete check passes.

Figure 8.24(b) remains the benchmark for the overall four-arm layout. Eurocode's permissions for wall-end treatment and perimeter enlargement should not be assumed to apply unchanged in an Australian draft check.

Elongated internal columns. The RKALC internal-column check applies the full column shear action once to the combined retained perimeter. The eccentricity factor accounts for concurrent moment transfer. The check does not calculate separate tip reactions. For the 1000 × 200 mm column in Example 2, the middle portions of the two long faces are omitted from the basic perimeter under the adopted interpretation of draft Figure 9.3.3.3(B)(i).

Steel credited at the basic perimeter. In the RKALC plan, filled green dots identify legs included in V_{us} at the basic perimeter. Hollow grey dots identify legs drawn without steel credit at that perimeter, including legs along omitted middle portions of the long faces. Example 2 credits 24 N10 legs across two engaged rows. The effective outer check starts from the full last-row arrangement before applying perimeter length limits. Recalculate it if any fitment is removed.

Wall supports. Select Wall support in RKALC to check punching shear at one wall tip at a time. Enter the local ultimate shear and concurrent ultimate moments for that tip from the same load combination in the slab analysis. RKALC uses the local control perimeter shown in draft Figure 9.3.3.3(B)(ii). Repeat the check for the other tip and assess one-way shear along the intervening wall separately.

Eurocode 2 Clause 8.4.2(3) explicitly distinguishes local punching at wall ends from one-way shear along the remaining wall length. The Australian draft figure defines the local perimeter geometry, while the slab analysis determines the share of the wall reaction assigned to each tip.

7. Example 1 Compact internal column

Use a 400 × 400 mm internal column, 200 mm slab, effective depth 152 mm,

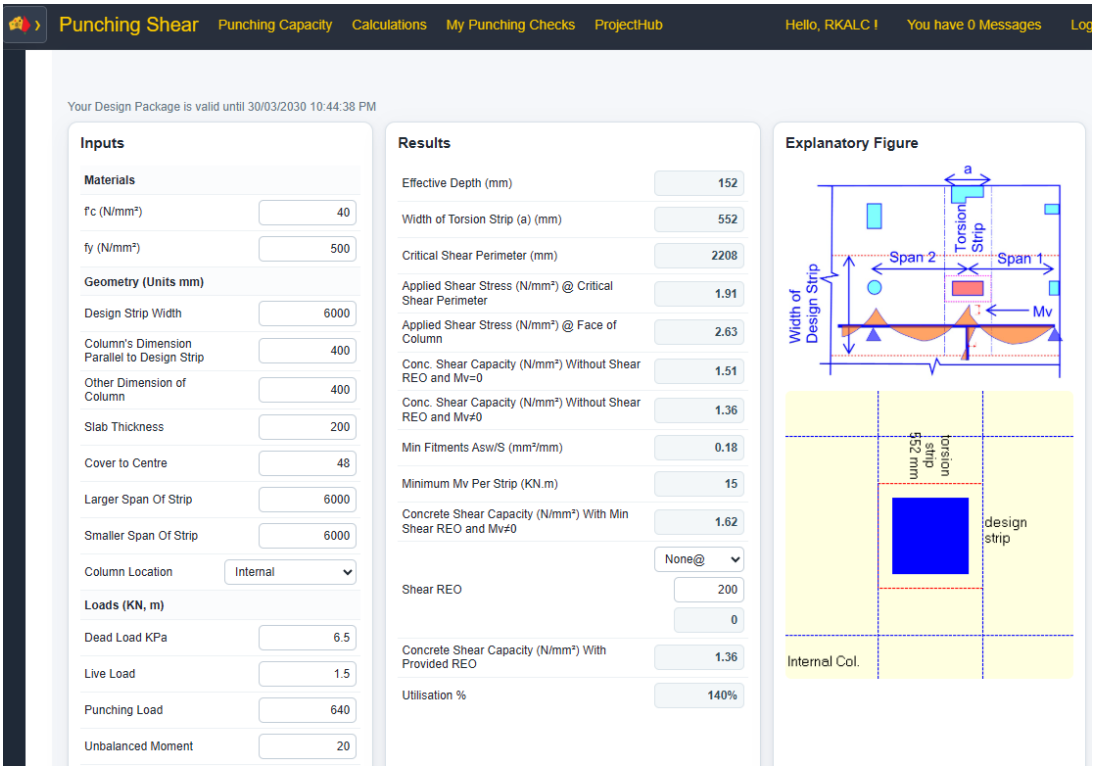
f'c = 40 MPa, fsy = 500 MPa, and ϕ = 0.70.

Both methods use V* = 640 kN with concurrent $M_x^* = M_y^* = 20$ kNm.

Assume the transferred moment governs over the directional minimum in each 2018 strip.

The draft example assumes 0.8% qualifying bonded longitudinal reinforcement each way, giving a steel index of 4.0 MPa in each direction, and normal-weight concrete with 20 mm aggregate.

Step	AS 3600:2018 RKALC	AS 3600:2026 draft
Perimeter	u = 4(400 + 152) = 2208 mm. Shear area = 335616 mm^2.	Four 400 mm straights plus four 76 mm radius quarter-circles. $b_{0.5}$ = 2077.5 mm and shear area ≈ 315783 mm^2.
Actions	Check both directions with full concurrent shear. Both strips have a = 552 mm and Mv* = 20 kNm.	Gross enclosed area ≈ 299746 mm^2, b_u = 617.8 mm and e_v = 44.19 mm. β_e = 1.0787 and Vrd* = 690.36 kN.
Concrete	β_h = 1, so fcv reaches $0.34\sqrt{40}$. ϕfcv = 1.505 MPa. Divide by the moment factor 1.103 to get about 1.36 MPa.	ρ_l = 0.008, k_{pp} = 1, ηc = 1 and k_{pb} = 1.438. k_v = 0.477. Nominal Vuc = 951.69 kN, design ϕVuc = 666.18 kN or 2.11 MPa.
Concrete-only check	Demand ≈ 1.91 MPa and utilisation ≈ 140%. The two directions are equal.	Demand = 2.19 MPa and utilisation = 103.6%. Proceed to a trial reinforced layout.



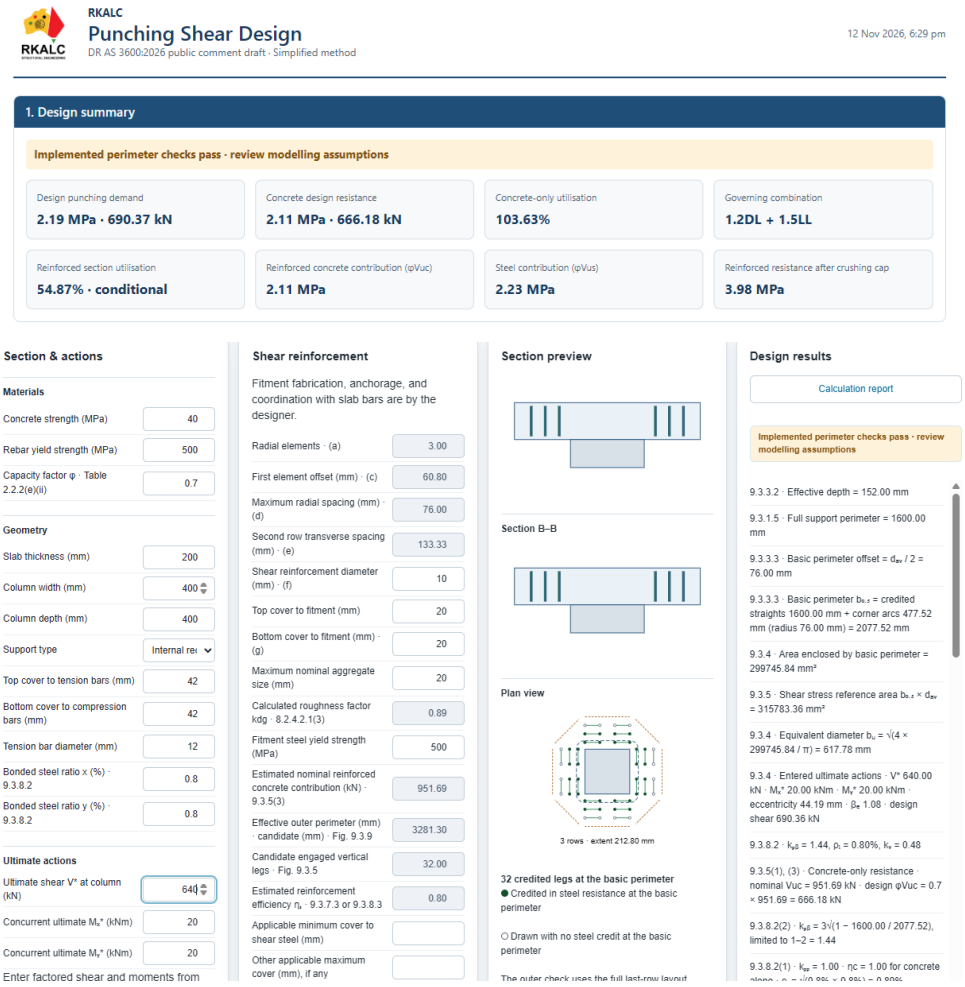


Figure 9 – RKALC Punching Shear App for AS3600-2018 and Draft AS3600-2026

8. Example 1 RKALC reinforcement layout and perimeter checks

RKALC distributes four N10 legs across each 400 mm face at 133.33 mm centres, paired as two closed fitments per face per row. The generated layout uses 3 radial rows at offsets of 60.8, 136.8 and 212.8 mm. The first row lies strictly between 45.6 and 76.0 mm. Radial spacing is 76 mm against a 114 mm limit, and second-row transverse spacing is 133.33 mm against 228 mm. N10 is below the 10.46 mm limit. The 20 mm compression-side fitment cover is below the 25.4 mm cap. Applicable minimum cover and fire requirements remain separate checks.

Check	Calculation and result
Basic engagement	• The first two rows have 16 legs each. • RKALC credits 32 legs under the assumed failure-surface and anchorage model. Their total area is 2513.3 mm^2.
Concrete and steel	• The concrete reduction factor is min(1, 666.18/640) = 1. • Aggregate roughness is 0.889 and steel efficiency reaches 0.80. • Nominal steel resistance is 1005.31 kN. • Design contributions are 2.11 MPa concrete and 2.23 MPa steel.
Minimum steel and crushing	• The required minimum steel area is 1151 mm^2 under the stated demand assumption. • The design crushing limit is 1258.23 kN or 3.98 MPa. • The nominal combined resistance is reduced by the design crushing cap.
Basic reinforced perimeter	• Design demand is 690.36 kN. • Capped resistance is 1258.23 kN. • Basic reinforced utilisation is 54.87%.
Intermediate perimeters	• The app checks half-depth increments with the basic design demand and the shifted engagement window. • 2555.0 mm with 32 credited legs gives 57.02%. 3032.6 mm with 16 credited legs gives 67.16%.
Outer concrete check	• The app uses the smaller of the retained offset perimeter and the effective last-row envelope. The adopted length is 3281.30 mm. • With the full basic design demand and a shear-gradient factor of 1.0, design resistance is 731.56 kN and utilisation is 94.37%.

The basic reinforced utilisation applies only at the basic perimeter. Read the intermediate and outer checks separately.

This example reproduces the app's stated modelling assumptions. Fitment fabrication and anchorage remain with the designer.

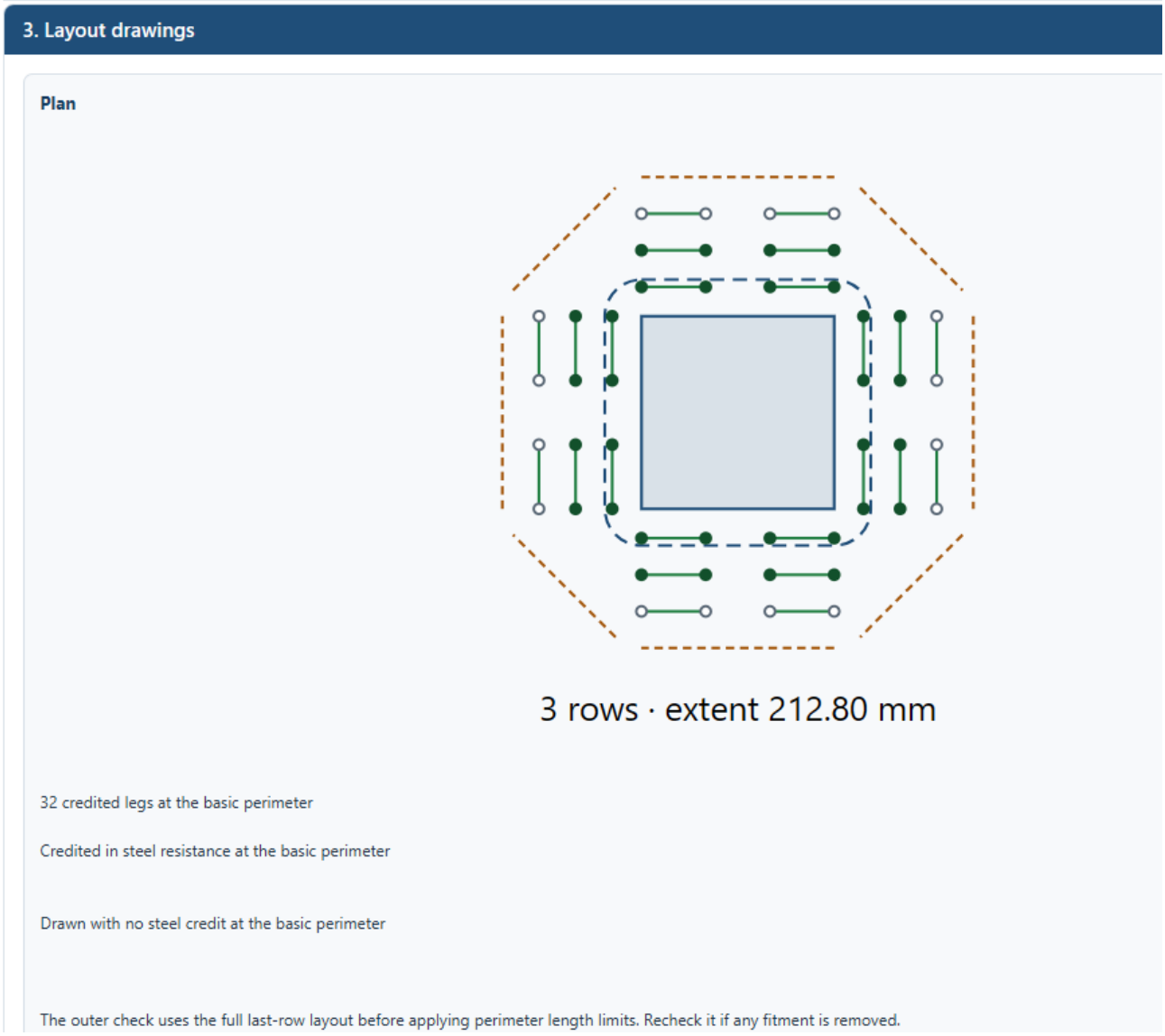


Figure 10 – Punching Shear Reo (RKALC App)

9. Example 2 Elongated internal column

Consider a 1000 × 200 mm internal column supporting a 200 mm slab. Use effective depth 152 mm, 40 MPa concrete, 500 MPa reinforcement, factored shear V* = 545 kN and concurrent transferred moments M_x^* = M_y^* = 50 kNm. Both methods use the same actions and ϕ = 0.70 for concrete alone. The draft additionally needs bonded flexural steel. This example assumes 0.8% in each direction.

Quantity	**2018 narrow strip** Figure 11	**2018 wide strip** Figure 12	**2026 draft reduced perimeter** Figure 13
Concurrent factored shear V*	545.0 kN	545.0 kN	545.0 kN
Concurrent moments Mx*, My*	50, 50 kNm	50, 50 kNm	50, 50 kNm
Effective perimeter	3008 mm	3008 mm	1790 mm
Shear used in punching check	545.0 kN	545.0 kN	653.9 kN (βe × V*)
Design resistance	292.9 kN	402.5 kN	602.1 kN
Stress used in punching check	1.19 MPa	1.19 MPa	2.40 MPa
Resistance stress	0.64 MPa	0.88 MPa	2.21 MPa
Utilisation	186.1%	135.4%	108.6%

All three columns use the same concurrent design actions. The 2018 checks keep the shear at 545 kN and account for the applicable 50 kNm moment by reducing the resistance for each torsion strip. The 2026 draft uses both moment components to obtain βe ≈ 1.200 and increases the shear used in its check to 653.9 kN.

Retain 456 mm of straight length along each long face and 200 mm along each short face. Add four quarter-circle arcs at radius 76 mm. The illustration pairs the retained face lengths with the shortened perimeter for k_{pb} and uses the gross offset footprint for the equivalent diameter b_u. These are stated modelling choices for this comparison.

The 2026 reduced-perimeter concrete-only check gives 108.6% utilisation. The narrow torsion strip governs the 2018 check at 186.1%. Both methods indicate that concrete alone is insufficient for this set of actions.

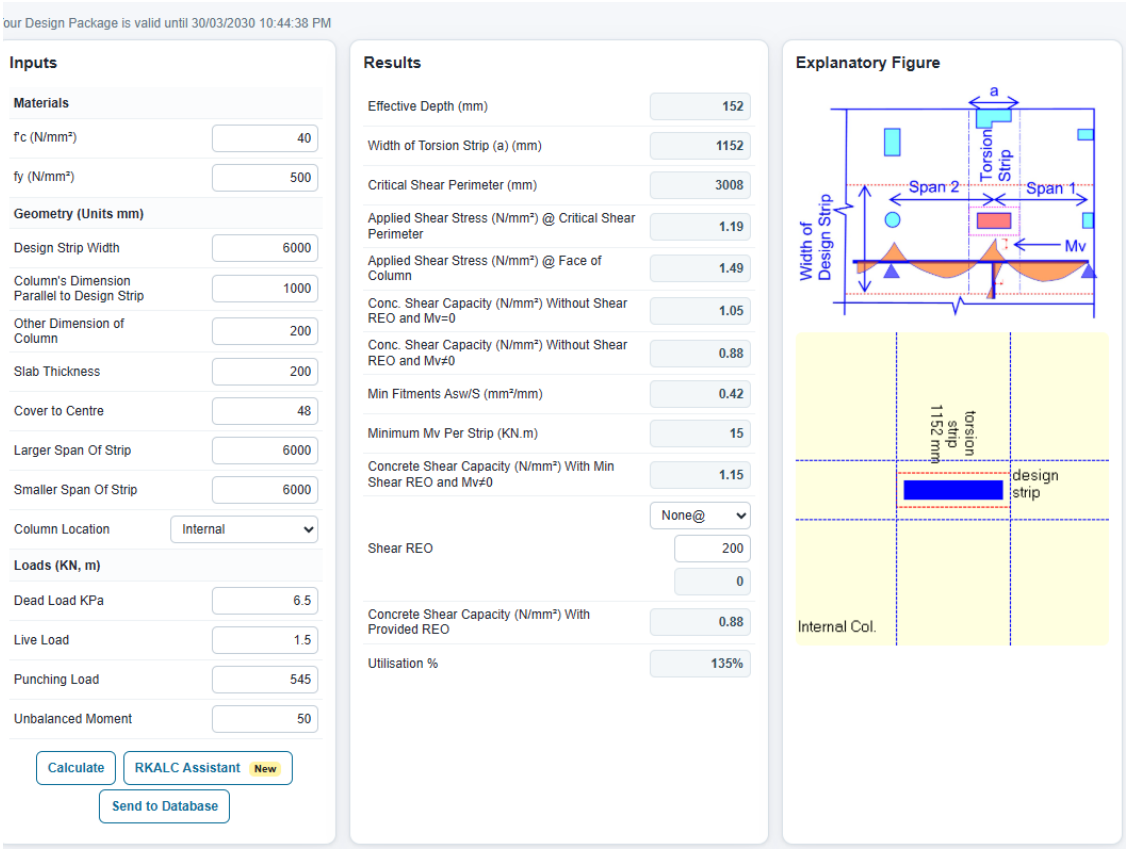


Figure 11 – Narrow Strip (RKALC App AS3600-2018) – Note Utilisation becomes 93% with N12-200 Reo

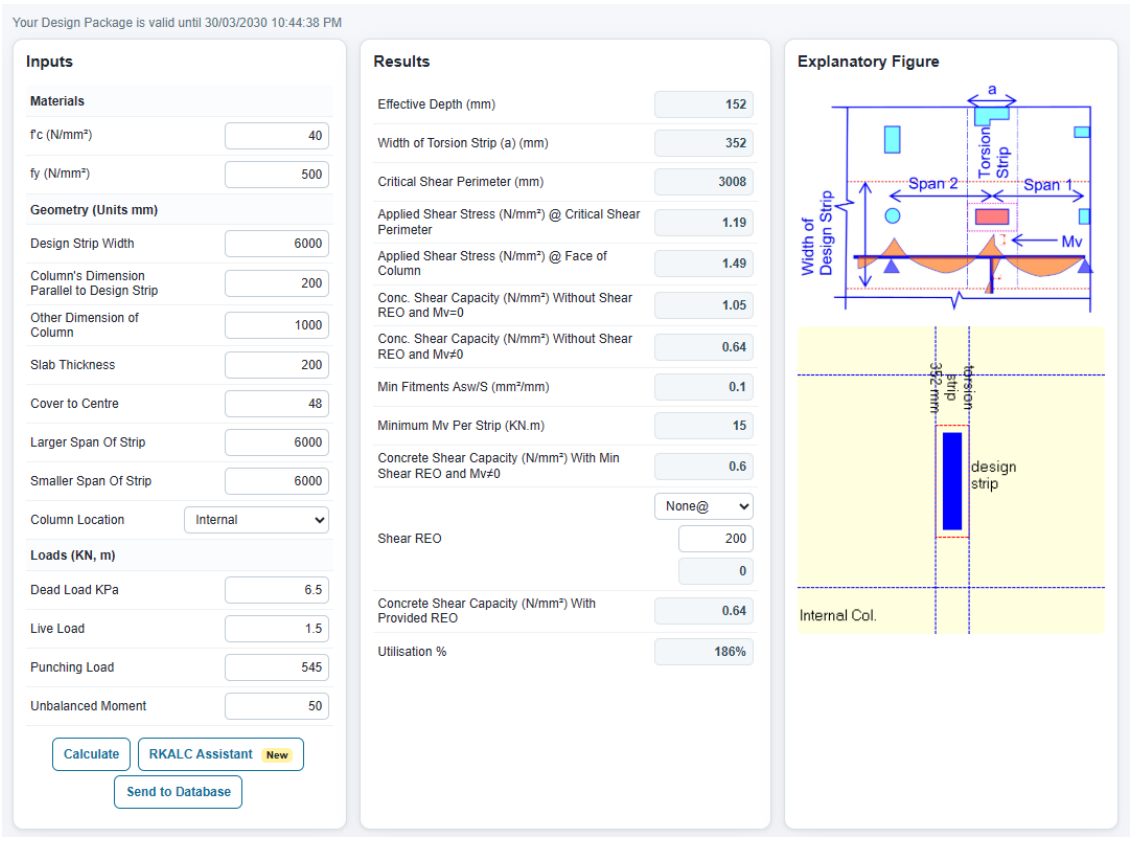


Figure 12 Wide Strip (RKALC App AS3600-2018) Note Utilisation becomes 98% with N12-200 Reo)

1. Design summary

Implemented perimeter checks pass · review modelling assumptions

Design punching demand	Concrete design resistance	Concrete-only utilisation	Governing combination
2.40 MPa · 653.90 kN	**2.21 MPa · 602.11 kN**	**108.60%**	**1.2DL + 1.5LL**

Reinforced section utilisation	Reinforced concrete contribution (φVuc)	Steel contribution (φVus)	Reinforced resistance after crushing cap
60.33% · conditional	**2.21 MPa**	**1.94 MPa**	**3.98 MPa**

Section & actions

Materials

Concrete strength (MPa)	40
Rebar yield strength (MPa)	500
Capacity factor φ · Table 2.2.2(e)(ii)	0.7

Geometry

Slab thickness (mm)	200
Column width (mm)	200
Column depth (mm)	1000
Support type	Internal re
Top cover to tension bars (mm)	42
Bottom cover to compression bars (mm)	42
Tension bar diameter (mm)	12
Bonded steel ratio x (%) · 9.3.8.2	0.8
Bonded steel ratio y (%) · 9.3.8.2	0.8

Ultimate actions

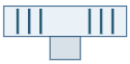
Ultimate shear V* at column (kN)	545

Shear reinforcement

Fitment fabrication, anchorage, and coordination with slab bars are by the designer.

Radial elements · (a)	3.00
First element offset (mm) · (c)	60.80
Maximum radial spacing (mm) · (d)	76.00
Second row transverse spacing (mm) · (e)	200.00
Shear reinforcement diameter (mm) · (f)	10
Top cover to fitment (mm)	20
Bottom cover to fitment (mm) · (g)	20
Maximum nominal aggregate size (mm)	20
Calculated roughness factor kdg · 8.2.4.2.1(3)	0.89
Fitment steel yield strength (MPa)	500
Estimated nominal reinforced concrete contribution (kN) · 9.3.5(3)	860.16
Effective outer perimeter (mm) · candidate (mm) · Fig. 9.3.9	3126.58
Candidate engaged vertical legs · Fig. 9.3.5	24.00
Estimated reinforcement efficiency η_s · 9.3.7.3 or 9.3.8.3	0.80

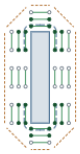
Section preview



Section B–B



Plan view



3 rows · extent 212.80 mm

24 credited legs at the basic perimeter

● Credited in steel resistance at the basic perimeter

Design results

Calculation report

Implemented perimeter checks pass · review modelling assumptions

9.3.3.2 · Effective depth = 152.00 mm

Support type review · Confirm this support should be checked as an internal column. For a wall, select Wall support to see the local check requirements.

9.3.1.5 · Full support perimeter = 2400.00 mm

9.3.3.3 · Retained straight length per edge = 200.00 mm and 456.00 mm. Limit $3d_{av}$ = 456.00 mm.

9.3.8.2 · Effective support length used for $k_{s\beta}$ = 1312.00 mm. Draft interpretation: use the support lengths corresponding to the retained perimeter.

9.3.3.3 · Basic perimeter offset = d_{av} / 2 = 76.00 mm

9.3.3.3 · Basic perimeter $b_{o.s}$ = credited straights 1312.00 mm + corner arcs 477.52 mm (radius 76.00 mm) = 1789.52 mm

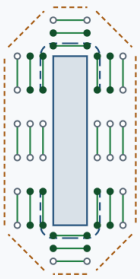
9.3.4 · Area enclosed by basic perimeter = 400545.84 mm²

9.3.5 · Shear stress reference area $b_{o.s} \times d_{av}$ = 272007.36 mm²

Figure 13 RKALC App for Draft AS3600-2026 (Detailed Results)

3. Layout drawings

Plan



3 rows · extent 212.80 mm

24 credited legs at the basic perimeter

Credited in steel resistance at the basic perimeter

Drawn with no steel credit at the basic perimeter

The outer check uses the full last-row layout before applying perimeter length limits. Recheck it if any fitment is removed.

Figure 14 – RKALC App for Draft AS3600-2026 (Punching Shear Reo)

10. How to reproduce the 2018 checks

AS 3600:2018 uses the torsion-strip method for transferred moment. Check the column in both principal directions. For each direction, orient the torsion strip perpendicular to the moment direction as shown in Figure 9.3(B), use the corresponding dimension a of the critical perimeter, and use the transferred moment for that direction. Keep the full concurrent shear in both checks. The two directional checks are not two separate column reactions.

The no-fitment calculation below follows the existing RKALC internal-column path. With the same column, swapping the direction changes a from 1152 mm to 352 mm. The perimeter and support aspect ratio are unchanged. The example uses 50 kNm in both directions and assumes the applied value governs over the directional minimum. In a project calculation, evaluate the applicable minimum moment for each direction using its strip loading and spans.

Step	Calculation for this example
Geometry	d_{om} = 152 mm. u = 2(1000 + 152) + 2(200 + 152) = 3008 mm. The two values of a are 1152 and 352 mm.
Concrete before moment	β_h = 1000/200 = 5. fcv = min[0.17(1 + 2/5), 0.34]$\sqrt{40}$ = 1.505 MPa nominal. ϕfcv = 1.054 MPa.
Moment adjustment	With no closed fitments, divide ϕfcv by 1 + uMv*/(8V*ad_{om}). The denominators are 1.197 and 1.645 for a = 1152 and 352 mm, respectively.
Direction governing	The narrow direction gives 0.641 MPa design resistance. Applied stress is 545000/(3008 × 152) = 1.192 MPa. The resulting utilisation is 186.1%.

The 2018 results are two uniaxial torsion-strip calculations under the same concurrent actions. They are presented as the existing RKALC workflow. No separate biaxial interaction model is assumed for the 2018 column. The draft, by comparison, combines the moments directly through the eccentricity magnitude.

11. How to reproduce the draft concrete check

Step	Calculation for the reduced-perimeter illustration
Retained geometry	• 3dav = 456 mm. • Retain 456 mm on each long face and 200 mm on each short face. • Straight length = 1312 mm. • Four rounded corners add π × 152 = 477.5 mm. • Effective b0.5 = 1789.5 mm.
Equivalent diameter	• Use gross rounded offset footprint A = (1152 × 352) − (4 − π) × 762 ≈ 400546 mm2 for this illustration. • bu = √(4A/π) = 714.1 mm. • The credited shear area is separate: b0.5dav ≈ 272007 mm^2 •
Biaxial eccentricity	• For the symmetric layout the centroid remains at the support centre. • Each moment corresponds to 50 × 1000/545 = 91.74 mm of eccentricity. • Resultant ev = √(91.742 + 91.742) = 129.74 mm.
Design demand	• βe = 1 + 1.1ev/bu = 1.19985. • Vrd* = βeV* = 653.92 kN. • On the retained shear area the equivalent stress is 2.404 MPa.
Concrete factors	• ρl = √(0.008 × 0.008) = 0.008. Use kpp = 1 and ηc = 1 for the concrete-only example. • The illustrative paired effective support length is 1312 mm. kpb = 3√(1 − 1312/1789.5) = 1.550.
Design resistance	• kv = min[0.50, 0.66kpbkpp(100ρlf'c)^(1/3)/√f'c] = 0.50. • Nominal stress = 0.50√40 = 3.162 MPa. • Multiply by ϕ = 0.70 to get 2.214 MPa or 602.11 kN.
Design result	• 653.92/602.11 = 108.6%. • The comparison is a concrete-only check. • A reinforced layout must also pass the checks below.

The full support reaction is used in the example.

Symmetric geometry does not justify halving the reaction when moment is transferred.

β_e amplifies the combined perimeter check and does not calculate separate tip stresses.

12. How to read the reinforced checks

The draft's detailed route evaluates k_v and η_s using the slab rotation and the conditions of the reinforcement. The simplified route in Clause 9.3.8 is available only within the eligibility limits in Clause 9.3.5. These include the concrete strength limit, the bonded longitudinal reinforcement limit and no net axial tension. Establish the bonded reinforcement in each support strip before calculating ρ_l. A bar that lacks the required development beyond the perimeter cannot simply be included in the ratio.

Output	What the reader should look for
Concrete contribution Vuc	• Show the concrete-only calculation first. • Then show the reduction ηc used when shear reinforcement is present, the reference concrete resistance and the denominator used to derive it. • The reinforced concrete contribution can be lower than the original concrete-only value.
Steel contribution Vus	• Show the actual coordinates and area of the engaged legs. • State the efficiency η_s, the shear steel yield strength and the draft failure surface. • Only count legs that intersect the surface and have adequate anchorage.
Minimum reinforcement	• Check Clause 9.3.9 independently of the force shortfall. • A small strength shortfall can still require more steel because of the minimum area check.
Crushing	• Apply Clause 9.3.6 to the combined resistance. • The higher ϕ allowance for qualifying Class N fitments does not apply to web crushing under Table 2.2.2(e).
Successive and outer checks	• Identify each applicable perimeter, its effective length and the steel engaged at that section. • At the outer concrete-only perimeter, remove ineffective gaps and verify that concrete alone carries the demand.

Report the concrete and steel terms on the same effective shear area in MPa, then report the capped resistance and utilisation.

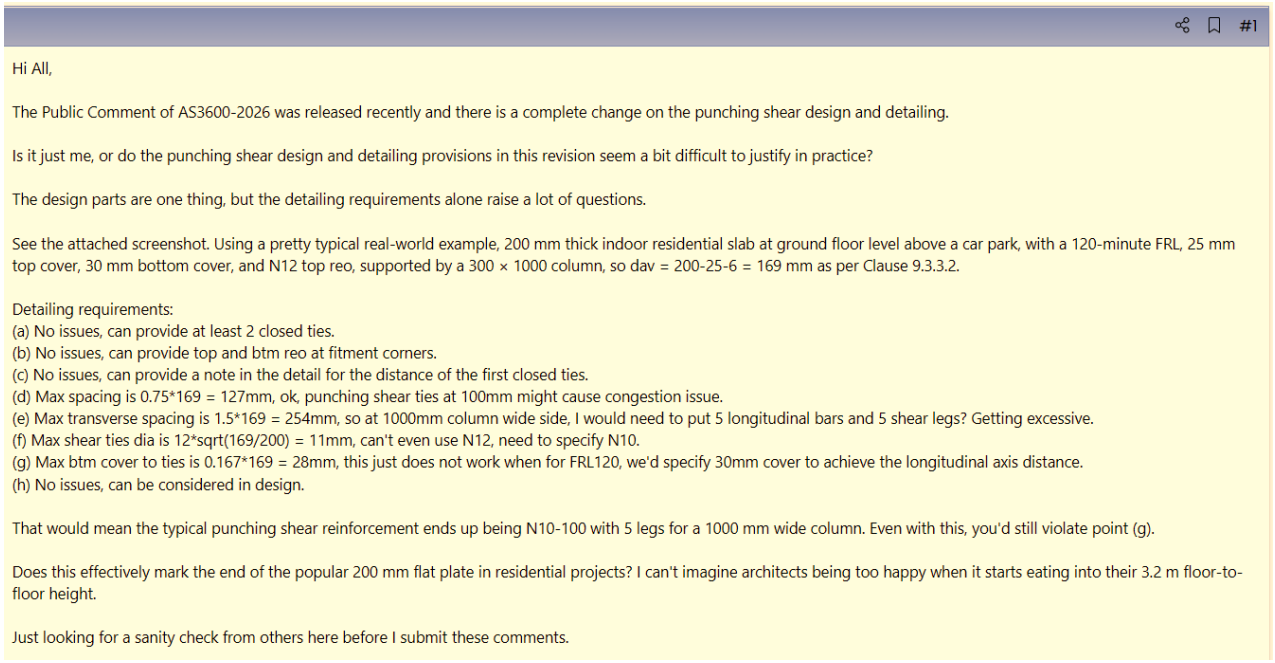
For a long support, show the gaps along the ineffective middle portions and mark the individual legs used in the resistance.

A single reinforced utilisation at the basic perimeter does not show whether the reinforcement extends far enough.

13. Community Feedback

Following post can be found online at this link

https://www.eng-tips.com/threads/as3600-2026-public-comment-punching-shear.587240/#post-9292841



#1

Hi All,

The Public Comment of AS3600-2026 was released recently and there is a complete change on the punching shear design and detailing.

Is it just me, or do the punching shear design and detailing provisions in this revision seem a bit difficult to justify in practice?

The design parts are one thing, but the detailing requirements alone raise a lot of questions.

See the attached screenshot. Using a pretty typical real-world example, 200 mm thick indoor residential slab at ground floor level above a car park, with a 120-minute FRL, 25 mm top cover, 30 mm bottom cover, and N12 top reo, supported by a 300 × 1000 column, so dav = 200-25-6 = 169 mm as per Clause 9.3.3.2.

Detailing requirements:
(a) No issues, can provide at least 2 closed ties.
(b) No issues, can provide top and btm reo at fitment corners.
(c) No issues, can provide a note in the detail for the distance of the first closed ties.
(d) Max spacing is 0.75*169 = 127mm, ok, punching shear ties at 100mm might cause congestion issue.
(e) Max transverse spacing is 1.5*169 = 254mm, so at 1000mm column wide side, I would need to put 5 longitudinal bars and 5 shear legs? Getting excessive.
(f) Max shear ties dia is 12*sqrt(169/200) = 11mm, can't even use N12, need to specify N10.
(g) Max btm cover to ties is 0.167*169 = 28mm, this just does not work when for FRL120, we'd specify 30mm cover to achieve the longitudinal axis distance.
(h) No issues, can be considered in design.

That would mean the typical punching shear reinforcement ends up being N10-100 with 5 legs for a 1000 mm wide column. Even with this, you'd still violate point (g).

Does this effectively mark the end of the popular 200 mm flat plate in residential projects? I can't imagine architects being too happy when it starts eating into their 3.2 m floor-to-floor height.

Just looking for a sanity check from others here before I submit these comments.

13.1. Summary of the Eng-Tips post.

The opening post asks whether the proposed punching shear detailing rules make 200 mm residential flat plates impractical. Its example is a 200 mm slab immediately above a car park, with a 120-minute FRL, a 300 × 1000 mm column and an assumed effective depth of 169 mm. [8]

The author identifies a closed-fitment diameter limit of about 11 mm, a compression-side cover cap of about 28 mm and potential congestion from the transverse leg spacing. The post does not give the design shear or transferred moments, so it leaves open whether this connection needs punching reinforcement.

Following is RKALC observations:

13.2. Fire rating and floors above parking

- In our experience, 90/90/90 is the more representative starting point for a typical Type A Class 2 residential floor. The post's 120/120/120 example is relevant immediately above a Class 7a car park where the applicable separation provisions require it.
- In the projects we encounter, this interface often coincides with a change in column grid and a transfer slab. We would not normally expect a 200 mm slab where substantial transfer is required. Where the grids align, a floor over parking may still require the higher FRL without acting as a transfer slab, so a local increase in slab thickness might not be a problem.
- Confirm the project requirements against NCC Volume One [5].

13.3. Nominal slab thickness and local reductions

- Our observation is that many residential projects are moving towards nominal slab depths of 230–250 mm to accommodate wet-area set-downs and falls. Embedded services and their coordination with reinforcement also often push the nominal depth above 200 mm.
- The critical case can still be a local section approaching 200 mm where a wet area or waste lies near a support. In our view, the forum's specific concern is strongest where that local thinning coincides with a 120/120/120 separation.
- The actual fitment and fire detail should still be checked for a typical 90/90/90 floor.

13.4. Stepped soffits and falls

- Some contractors and developers favour a nominal 200 mm slab with a local set-down and a step in the soffit. In our experience this is less typical than providing more nominal slab depth.
- Where falls are formed in the concrete, the wet-area section may be thicker around its perimeter and thin towards the drain, where the project may require a 200 mm minimum.
- Detail both levels and use the actual section where it intersects the punching zone.
- Where the declared design calls for cast-in falls, coordinate them in the structural drawings. AS 3740:2021 also allows falls formed by screed over the structural substrate in applicable details [6] (but this might be overwritten by the DPBA act)

13.5. Fitment cover and stud rails

- Check whether the 30 mm dimension in the example is cover to the outside of the fitment or a dimension chosen to achieve the fire axis distance to the flexural bars.
- For example, 30 mm clear cover to a bottom N12 flexural bar gives a 36 mm axis distance. If an N10 fitment sits directly outside and touches that bar, its outer face has 20 mm clear cover while the flexural bar retains its 36 mm axis distance. The 20 mm fitment cover is below the draft's 28.2 mm cap for the forum example. This illustrates the geometry.
- Verify the required fire axis distance, minimum cover to the fitment and any additional projection at bends or hooks for the actual detail.
- Show both dimensions on the same section, including the effect of bends and hooks.
- Proprietary stud rails are a viable solution where conventional fitments are difficult to install. Under the 2018 design basis a proprietary system may need a Performance Solution depending on the project compliance pathway [7]. Our preference is to use conventional closed fitments where they can be detailed and checked satisfactorily. The draft explicitly includes double-headed studs.

13.6. Capacity and fitment extent

- In our like-for-like examples the draft gives better calculated concrete-only punching capacity relative to demand than the governing 2018 torsion-strip check. The outcome still depends on the support geometry, the retained perimeter, bonded steel and transferred moments.
- The other practical change is the removal of the fixed quarter-span fitment extent. AS 3600:2018 Clause 9.3.6(a) requires closed fitments to extend at least one quarter of the clear span from the support face along the torsion strip or spandrel beam.
- The draft bases the extent on successive checks and the outer perimeter where concrete alone is adequate. This is closer to international practice and can keep fitments local to the support where the checks allow it.

14. References

[1] Standards Australia. AS 3600:2018, Concrete structures. Clauses 9.3.1–9.3.6 and Figure 9.3.6.

[2] Standards Australia. DR AS 3600:2026, Concrete structures, public comment draft, project MC-000341-01. Table 2.2.2 and Clauses 9.3.3–9.3.10.

[3] BSI. BS EN 1992-1-1:2023, Eurocode 2. Clauses 8.4.2, 8.4.4 and 12.5.1, Figures 8.19, 8.24 and 12.6–12.7.

[4] Sagaseta, J., Tassinari, L., Fernández Ruiz, M. and Muttoni, A. (2014). Punching of flat slabs supported on rectangular columns. Engineering Structures 77, 17–33. doi:10.1016/j.engstruct.2014.07.007.

[5] Australian Building Codes Board. NCC 2022 Volume One, Clause C3D10 and Table S5C11g.

[6] Standards Australia. AS 3740:2021, Waterproofing of domestic wet areas, Clause 2.5.2.

[7] Leviat. Ancon Shearfix punching shear reinforcement design information. *https://www.ancon.com.au/products/punching-shear-reinforcement/design-information*

[8] BacBac. AS3600-2026 Public Comment – Punching Shear. Eng-Tips, opening post, 18 June 2026. *https://www.eng-tips.com/threads/as3600-2026-public-comment-punching-shear.587240/#post-9292841*



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