Calculation Method

The design of Ancon Shearfix follows the general specifications set out in Clause 9.3 of AS3600: 2018, but the major part of the design is based on the research presented by F K Lim and B V Rangan from the School of Engineering at Curtin University of Technology in Perth. The design calculations check the shear stresses imposed on the critical shear perimeter surrounding the column, with Ancon Shearfix stud reinforcement provided as required.

Design Actions

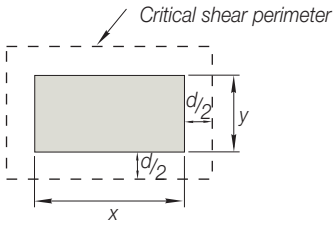
When checking the shear capacity of the slab, the design shear force V* and design transfer moments from the slab into the support $M^*_{col,x}$ and $M^*_{col,y}$ must be taken into account. These values need to be calculated and inserted into the software.

Critical Shear Perimeter

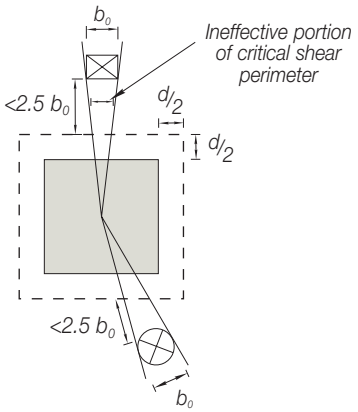
The first critical shear perimeter "u_0" is the boundary of the effective area of a support or concentrated loads located at a distance of d/2, (d = effective depth of the slab).

For rectangular columns:

$u_0 = 2x+2y+4d$



Where there are critical openings within 2.5 b_0 from the critical perimeter, the projected width of the opening will be ineffective and will reduce the length of the critical perimeter.



Calculation of Shear Stress

The shear capacity of the slab is determined in accordance with Clause 9.3.3 for the case where there are no transfer moments (M* is zero), or Clause 9.3.4 for the case where there are transfer moments (M* is not zero).

For the case where M* is zero

$V_{u0} = ud_{0m}(f_{cv} + 0.3\sigma_{cp})$

Where –

V_{u0} = shear capacity of the slab
σ_{cp} = average pre-stress in concrete
f_{cv} = concrete shear strength

Where –

$f_{cv} = 0.17(1 + \frac{2}{\beta_h})\sqrt{f'_c} \leq 0.34\sqrt{f'_c}$

β_h is the ratio of the effective loaded area = X/Y (X≥Y)

For the case where M* is not zero –

$V_u = V_{u0}/[1.0 + uM^*_v/(8V^* ad)]$

Where "a" is the dimension of the critical shear perimeter parallel in the direction of M_v^*.

If $V^* > \phi V_u$ or ϕV_{u0}, then Ancon Shearfix studs are required.

To determine the shear capacity of the slab with Ancon Shearfix studs, the following modified Lim and Rangan equations are used:

$V_u = V_{u0}(0.75 + k)$

OR

$$V_u = \frac{V_{u0}}{\left(\frac{1}{0.75 + k} + uM^*_v/(8V^* ad)\right)}$$

(the lesser result of the two equations)

where –

$k = \frac{1}{V_{u0}} A_v f_{vy} \frac{d}{s} \frac{u}{a} \geq 0.25$

A_v = cross sectional area of a row of studs
f_{vy} = yield strength of the stud (500 MPa)
a = width of the critical shear perimeter perpendicular to the direction M_v^*

To determine the rail length, continue adding studs until the shear stress along the critical shear perimeter located at d/2 from the outermost stud is less than the concrete shear capacity.

The Ancon Shearfix Design Program automatically determines the diameter, spacing and number of studs required.

Detailing

The following detailing is used by the software to arrange the Ancon Shearfix rails around the column:

- The position of the first stud from the column face is predefined as 0.5d but a value between 0.35d – 0.5d can be chosen by the user (d=effective depth of slab)
- The distance between the studs within one rail is a minimum of 75% of the slab thickness, 70% of the stud height and 500mm
- There is always a minimum of 2 rails per column side
- The distance between individual rails is limited to a minimum of the slab thickness and 600mm

Please contact the Leviat technical team on 1300 304 320 or email technical.au@leviat.com should you have any questions about the calculation method or the software.