SECTION 11. DESIGN FOR SHEAR

All ***mortarless*** walls are reinforced and fully grouted and they can readily be designed to satisfy the provisions of AS 3600:2009 for shear.

11.1 Shear resistance of reinforced *mortarless* members in bending

This covers ***mortarless*** beams and possibly short ***mortarless*** walls subjected to intermediate or uniformly distributed in-plane lateral loads. AS 3600 Clause 8.2.2 states that the design strength of a beam in shear shall be taken as:

$$\phi V_u$$

Where:

ϕ is the capacity reduction factor – refer 1.3.1 in this Part of the manual

$$V_u = V_{uc} + V_{us}$$

V_{uc} = The ultimate shear strength of the concrete
= $\beta_1\beta_2\beta_3 b_v d_o f_{cv}(A_{st}/b_v d_o)^{1/3}$

β_1 = $1.1(1.6 - d_o/1000) \geq 1.1$ if shear reinforcement equal to or greater than minimum area is provided

= $1.1(1.6 - d_o/1000) \geq 0.8$ otherwise

β_2 = 1 for members subject to pure bending

= $1 - (N^*/3.5A_g) \geq 0$ for members subject to axial tension

= $1 - (N^*/14A_g)$ for members subject to axial compression

β_3 = 1

d_o = the distance from the extreme compression fibre to the centroid of the outermost layer of tensile reinforcement

f_{cv} = $f'_c{}^{1/3} \leq 4$ MPa

A_{st} = cross-sectional area of tensile reinforcement provided in the tensile zone and fully anchored in accordance with the principles of Clause 8.1.10., in the direction of reducing moment, at the cross section under consideration

b_v = the effective width of the beam web for shear

Clause 8.2.5 contains the following rules regarding the provision of shear reinforcement:

a) Where $V^* \leq 0.5\Phi V_{uc}$ then no shear reinforcement is required unless the overall depth of the beam is greater than 750mm in which case minimum shear reinforcement ($A_{sv.min}$) shall be provided in accordance with Clause 8.2.8.
b) Where $0.5\Phi V_{uc} < V^* \leq \Phi V_{u.min}$ then minimum shear reinforcement shall be provided in accordance with Clause 8.2.8.
c) Where $V^* > \Phi V_{u.min}$ then shear reinforcement shall be provided in accordance with Clause 8.2.10

The minimum area of shear reinforcement ($A_{sv.min}$) is given in Clause 8.2.8 as follows:

$$A_{sv.min} = 0.06\sqrt{f'_c}\, b_v\, s / f_{sy.f} \geq 0.35\, b_v\, s / f_{sy.f}$$

Where:

s = center to center spacing of shear reinforcement measured parallel to the longitudinal axis of the beam

$f_{sy.f}$ = yield strength of the fitment reinforcement

The shear strength of a beam with minimum shear reinforcement ($A_{sv.min}$) is given in Clause 8.2.9:

$$V_{u.min} = V_{uc} + 0.10\sqrt{f'_c}\, b_v\, d_o \geq V_{uc} + 0.6\, b_v\, d_o$$

The contribution to shear strength of vertical shear reinforcement is given in Clause 8.2.10:

$$V_{us} = A_{sv}\, f_{sy.f}\, d_o / s \quad \text{(when } \theta_v = 45^o\text{)}$$

11.2 Shear resistance of reinforced *mortarless* walls subject to in-plane horizontal load

AS 3600 Clause 11.6 is devoted to the design of walls for in-plane shear.

Clause 11.6.1 states that the critical section for maximum shear shall be taken at a distance from the base of 0.5Lw or 0.5Hw whichever is less.

AS 3600 Clause 11.6.2 states that the design strength of a wall subject to in-plane shear shall be taken as:

$$\phi V_u$$

Where:

ϕ is the capacity reduction factor – refer 1.3.1 in this Part of the manual

$$V_u = V_{uc} + V_{us} \leq 0.2 f'_c (0.8 L_w t_w)$$

The shear strength of a wall excluding the wall reinforcement is given in Clause 11.6.3 as follows:

a) For walls where $H_w/L_w \leq 1$

$$V_{uc} = (0.66\sqrt{f'_c} - 0.21(H_w/L_w)\sqrt{f'_c}) \, 0.8 L_w t_w$$

b) For walls where Hw / Lw ≤ 1

$$V_{uc} = (0.05\sqrt{f'_c} + 0.1\sqrt{f'_c} / ((H_w/L_w)-1)) \, 0.8 L_w t_w$$

But not greater than V_{uc} calculated as given in a) above

The contribution to the shear strength of the wall reinforcement (V_{us}) is given Clause 11.6.4 as follows:

$$V_{us} = p_w f_{sy} (0.8 L_w t_w)$$

Where p_w is determined as follows:

For walls where $H_w/L_w \leq 1$, p_w is the lesser of the ratios of either the vertical or the horizontal wall reinforcement area to the cross-sectional area of the wall in the respective direction

or

For walls where $H_w/L_w > 1$, p_w is the ratio of the horizontal wall reinforcement area to the cross-sectional area of the wall per vertical metre.

11.3 Shear resistance of reinforced *mortarless* walls subject to out-of-plane horizontal load

Shear stress in a ***mortarless*** wall might need to be checked if the wall is subjected to significant out-of-pane lateral loads. In such circumstances the wall should be designed in the same way as a slab but consideration should be given to any permanent axial compression loads as these will increase the shear capacity of the concrete. It is most important however to only consider permanent axial compression loads when checking shear capacity.

The shear strength provisions for slabs apply to walls in these circumstances and Clause 9.2.2 states that where the shear failure can occur across the width of the slab, the design shear strength is to be calculated in accordance with Clause 8.2 (refer 11.1 above). In this case the value of β_2 will be increased due to the axial compression.