SECTION 6. DESIGN FOR AXIAL COMPRESSION

Mortarless masonry walls and piers cannot be designed as reinforced masonry for the compression loads because reinforcement in compression members must be restrained in two directions by ties at close centers. For example in 140 thick walls it would be necessary to install ties at 140mm centers on all vertical bars, and in 200 thick walls it would be necessary to install ties at 200mm centers. This is simply not possible in masonry walls. Tied column cages may be appropriate in larger freestanding masonry piers or columns, however there is no masonry unit manufactured in the ***mortarless*** range at present for such piers or columns.

Mortarless walls and piers should therefore be designed as core filled but unreinforced in compression. Any vertical reinforcement is simply ignored in the calculation of compression capacity (Clause 7.1)

Design of *mortarless* masonry in compression using the rules for unreinforced masonry:

The capacity of an unreinforced member in compression is dependent on the following:

- Slenderness
- Effective eccentricity at each end
- Characteristic compressive strength of the masonry
- Cross sectional area of the masonry.

When a wall or isolated pier is required to carry a vertical (compression) load, the bending moments resulting from the worst combination and disposition of design loads shall be considered at the top and bottom of the member by regarding the compression load as acting at effective eccentricities e_1 and e_2 respectively.

For fully grouted ***mortarless*** masonry where no testing is done (i.e. no testing on fully grouted block specimens), the basic compressive capacity of the cross section (F_0) is calculated as follows:

$$F_0 = 0.50\, f'_m A_b + 0.70\, (f'_{cg}/1.3)^{1/2} A_g$$

Where f'_m = the characteristic compressive strength of the masonry (Clause 3.3.2)
A_b = the bedded area of a masonry cross-section (Clause 4.5.4)
f'_{cg} = the design characteristic compressive strength of the grout in MPa but not greater than 1.3 f'_{uc} (Clause 3.5)
A_g = the design cross sectional area of the grout (Clause 4.5.7)

Table C1 below schedules the ***mortarless*** block properties and the design characteristic strength used in the above formula.

Table C2 below schedules the basic compressive capacity of fully grouted ***mortarless*** masonry with grade 15 and grade 20 ***mortarless*** blocks and various grout strengths.

Table C1: Properties of *mortarless* masonry units:

Mortarless Block	O/A width mm	Chamfer Width (ext) mm	Chamfer Width (int) mm	Bedded Width mm	Core Width mm	A_b sq.mm./m	A_g sq.mm./m	A_d sq.mm./m	f'_{uc} MPa	f'_m MPa
140	140	0	14	114	83	31000	83000	114000	15 20	8.1 9.3
150	150	0	17	124	87	37000	87000	124000	15 20	8.1 9.3
200 Chamfered	200	5	14	164	133	31000	133000	164000	15 20	8.1 9.3
200	200	0	19	174	133	41000	133000	174000	15 20	8.1 9.3

Table C2: Basic compressive capacity (F_o) of *mortarless* masonry:

			F_o (kN/m)		
			Grout strength (cylinder strength)		
Mortarless Block	f'_{uc} MPa	f'_m MPa	**15 MPa**	**20 MPa**	**25 MPa**
140	15	8.1	322	350	350
	20	9.3	342	372	399
150	15	8.1	356	385	385
	20	9.3	379	411	439
200 Chamfered	15	8.1	441	485	485
	20	9.3	460	509	552
200	15	8.1	481	526	526
	20	9.3	507	556	599

6.1 Design by simple rules - *mortarless* masonry members in compression:

- Design by simple rules applied to walls with or without engaged piers and to isolated piers of rectangular cross section.
- Resistance to lateral load must be checked independently and there is no need to consider interaction of vertical and lateral loads acting simultaneously if the member is being designed by simple rules.
- If a member has insufficient capacity when designed by simple rules, its capacity can be determined using refined calculations.

The simple rules have been introduced in AS3700 to minimise the calculation effort required but that is not an issue when using this design manual. Walls designed by simple rules will be of lesser capacity than the same walls designed by refined calculation and for the purposes of this design manual only the refined calculation method will be used for the calculation of compression load capacities.

6.2 Design by refined calculation - *mortarless* masonry members in compression:

Unreinforced ***mortarless*** masonry walls, with or without engaged piers, and isolated piers can be designed by refined calculation. The possibility of buckling about each of the two principal axes must be considered when designing isolated piers.

The rules apply to uniform symmetrical members in uniaxial bending and compression. (Refer AS 3700 Clause 7.3.4.1).

Uniaxial bending and compression:

The following relationship must be satisfied:

$$F_d \leq k \, F_o$$

Where:

F_d = the design compressive force that acts on the cross-section of a member simultaneously with a bending moment, shear force or other load action

k = a reduction factor for slenderness and eccentricity

F_o = the basic compressive strength capacity

For ***mortarless*** masonry walls without lateral support along one or both of their vertical edges, the slenderness ratio:

$$S_r = \frac{a_v H}{k_t \, t}$$

Where:

k_t = a thickness coefficient to account for any monolithically engaged piers

= 1 for walls without engaged piers

For ***mortarless*** masonry walls laterally supported along one or both of their vertical edges, the slenderness ratio:

$$S_r = \frac{a_v H}{k_t \, t} \quad ; \quad \text{or}$$

$$= \frac{0.7}{t} \sqrt{a_v H a_h L} \quad \text{whichever is less}$$

There are tables in the subsequent Parts of this design manual that provide compression load capacities for walls of various heights where effective height determines the design slenderness ratio, and walls of various lengths where effective length determines the design slenderness ratio of the wall.