SECTION 9. DESIGN FOR COMBINED COMPRESSION AND BENDING

BS 5628-2:2005 Clause 8.3 applies to masonry "which is subjected simultaneously to substantial vertical and horizontal loading or to eccentric vertical loads where the resultant eccentricity exceeds 0.05 times the thickness of the member in the direction of the eccentricity."

The limiting slenderness ratio for such walls is as noted above in Section 6.

9.1 Design of short columns

When the slenderness ratio of a column does not exceed 12, it is generally only necessary to consider single axis bending. Clause 8.3.3.1.1 states that even where it is possible for significant moments to occur simultaneously about both axes, it is usually sufficient to design for maximum moment about the critical axis only.

The cross-section of a short column can be analysed to determine the design moment of resistance and the design vertical load resistance using the assumptions given in the code for the analysis of members subjected to bending, or the following design method can be used:

a) When the design vertical load, *N,* does not exceed the value of the design vertical load resistance, N_d, calculated using the following equation, only the minimum reinforcement is required.

$$N_d = f_k \, b \, (t - 2 e_x) / \gamma_{mm}$$

Where: b = the width of the section;

e_x = the resultant eccentricity;

f_k = the characteristic compressive strength of the masonry;

t = the equivalent bedded thickness of the member in the plane of bending;

γ_{mm} = the partial safety factor for strength of masonry.

It should be noted that the above formula does not apply when the resultant eccentricity exceeds 0.5*t*.

b) When the design vertical load, *N,* is greater than the value of the design vertical load resistance, N_d, calculated using the equation above, the strength of the section should be designed to the equation given in BS 5628-2:2005 Clause 8.3.3.1.1b) using the masonry and the reinforcement in compression.

c) When it is necessary to consider biaxial bending in a short column, BS 5628-2:2005 Clause 8.3.3.1.2 states that a symmetrically reinforced section may be designed to withstand an increased moment about one axis given by the formulas in that clause.

9.2 Design of slender columns

BS 5628-2:2005 Clause 8.3.3.1.3 states that when the slenderness ratio of a column exceeds 12 it is essential to take account of biaxial bending where appropriate, and it is essential to also design for an additional moment, M_a, induced by the vertical load due to lateral deflection. The additional bending moment M_a can be calculated using the following equation:

$$M_a = N (h_{ef})^2 / 2000t$$

Where: t = the equivalent bedded width of the column in the plane of bending;

h_{ef} = the effective height of the column;

N = the design vertical load.

BS 5628-2:2005 Clause 8.3.3.1.3 permits the cross-section being analysed using the assumptions outlined in Clause 8.2.4.1 (for masonry members subjected to bending) to determine its design moment of resistance and design vertical load resistance. As an alternative, slender columns subjected to bending about one axis only may be designed in the same way as short columns but for an increased moment calculated using the above formula.

9.3 Design of short walls

BS 5628-2:2005 Clause 8.3.3.2.1 states that when the slenderness ratio of a wall does not exceed 12, the wall may be analysed to determine the design moment of resistance and the design vertical load resistance using the same assumptions as those used for masonry members subjected to bending. These are summarised in Section 8 above.

It also states that "If the resultant eccentricity, e_x, exceeds 0.5t, the member may be designed as a member in bending in accordance with 8.2, discounting the vertical load."

9.4 Design of slender walls

BS 5628-2:2005 Clause 8.3.3.2.2 states that when the slenderness ratio of a wall exceeds 12, the wall should be designed in accordance with rules for short walls but with an additional bending moment M_a calculated using the formula in 9.3 above to account for lateral deflection of the wall. Note however that in the design tables in Part 2 of this Manual, walls have been designed as unreinforced for compression and the effects of M_a are taken into account when the slenderness ratio exceeds 6. The design tables in Part 2 allow for combined bending and compression including the additional moment M_a, but it is up to the designer to increase the design eccentricity to provide for bending moments arising from the application of lateral loads if any.