10.3.3 Resistance to racking shear

Shear walls are designed to resist horizontal forces in their own plane. In certain cases flexural stresses are significant and the strength of the wall may be closely predicted by assuming that all the vertical reinforcement has yielded and that the compression zone is located at the 'leeward' toe of the wall. If, however, flexural stresses are reduced by the presence of vertical loading it has been found that a lower bound on shear strength of 0.7N/mm^2 may be assumed for walls having more than 0.2% reinforcement. If the vertical compression is higher than 1.0 N/mm^2 this will be exceeded by the strength of an unreinforced wall and in such a case the effect of the reinforcement could be neglected in assessing the design strength. The presence of reinforcement, however, is important in seismic conditions in developing a degree of ductility and in limiting damage.

10.4 DEFLECTION OF REINFORCED MASONRY BEAMS

The deflection of a reinforced masonry beam can be calculated in a similar way to that of a reinforced concrete beam with suitable adjustments for different material properties. Experiment has shown that the following moment-curvature relationship can be assumed:

$$\theta = \frac{M}{EI_u} + \frac{M - M_{cr}}{0.85EI_{cr}} \tag{10.8}$$

where M is the applied moment, EI_u is the flexural rigidity of the transformed uncracked section, EI_{cr} is the flexural rigidity of the transformed cracked section, $M_{cr}=I_{cr}f_t/(H-d_c)$ is the cracking moment, f_t is the apparent flexural tensile strength of the masonry (or composite brick/concrete in a grouted cavity beam), H is the overall depth of the section and d_c is the neutral axis depth.

The mid-span deflection of a beam of span L for various loading cases is given in Table 10.1 in terms of θ.

Table 10.1 Relationship between curvature and deflection at mid-span for various loading cases

Loading	*Central deflection*
Concentrated load at mid-span	$\theta L^2/12$
Uniformly distributed load	$\theta L^2/9.6$
Equal end moments	$\theta L^2/8$

10.5 REINFORCED MASONRY COLUMNS, USING BS 5628: PART 2

10.5.1 Introduction

Elements such as columns, which are subjected to both vertical loading and bending, are classified as either short or slender and different equations are used for the design of the two classes. Additionally bending may be about one or two axes so that a number of cases can be identified.

In the code, short columns are defined as those with a slenderness ratio (see Chapter 5) of less than 12 and, although uniaxial and biaxial bending are discussed for short columns, very little guidance is given for the case of biaxial bending of slender columns.

The stress-strain relationships assumed for the masonry and the reinforcement are the same as those assumed for the case of bending only and are as described in section 10.2.1.

10.5.2 Additional assumptions and limitations

Assumptions 1, 2 and 6 given in section 10.2.2 are assumed to apply also to column design. Additionally:

- The effective height and thickness are as given in Chapter 5.
- The maximum strain in the outermost compression fibre at failure is taken as 0.0035.

This latter assumption together with the assumption that the strains in both materials are directly proportional to the distances from the neutral axis are used as the starting point for considering a number of possible cases (see Fig. 10.10).

For each case the maximum compressive strain is assumed to be 0.0035 and the maximum compressive stress f_k/γ_{mm}.

Also for each case the strain at the level of the reinforcement near the more highly compressed face (ε_1) is of such a magnitude that the stress at this level (f_{s1}) is equal to $0.83f_k$.

The strain (ε_2) at the level of the reinforcement near the least compressed face is a function of d_c, the depth of the masonry in compression. In practice the value of d_c is assumed and the stress in this reinforcement (f_{s2}) determined by means of the following simplifying assumptions.

1. The value of d_c is assumed to be greater than $2d_1$.
2. If d_c is chosen to be between $2d_1$ and $t/2$ then f_{s2} is taken as f_y.
3. If d_c is chosen to be between $t/2$ and (t-d_2) then f_{s2} is found by interpolation using

$$f_{s2} = 2f_y(t - d_2 - d_c)/(t - 2d_2)$$