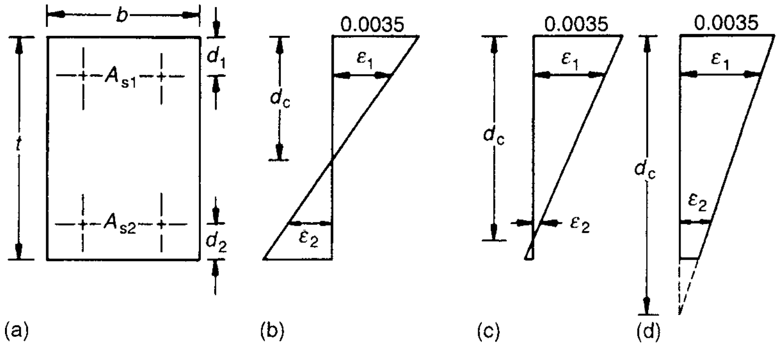

Fig. 10.10 Strain distribution in columns.

4. If d_c is chosen to be between $(t\text{-}d_2)$ and t then f_{s2}=0.
5. For a strain distribution similar to Fig. 10.10(d) the stress in A_{s2} will be compressive and will vary between 0 and -0.83f_y. An additional assumption regarding the value of the strain at depth t would be required in order to determine the interpolated value.

10.5.3 Short columns

(a) Uniaxial bending

Based on the assumption given above three cases for the design of short columns subjected to bending about one axis are outlined in the code.

Case (a)

This case applies when the design axial load, *N*, is less than the value of the design axial load resistance, N_d, given by

$$N_d = f_k b(t - 2e_x)/\gamma_{mm} \tag{10.9}$$

For this case only a minimum amount of reinforcement is required and the code suggests that designers should consider if design in accordance with BS 5628: Part 1 would be more appropriate.

Case (b)

This case applies when the design axial load *N* is greater than the value of the design axial load resistance N_d, given in case (a). The basic equations can be derived in a similar manner to the method used in section 10.2.3 for bending by

- determining the total force in the stress diagram and
- taking moments about the mid-section.

The resulting equations are:

$$N_d = \frac{f_k b d_c}{\gamma_{mm}} + \frac{0.83 f_y A_{s1}}{\gamma_{ms}} - \frac{f_k A_{s2}}{\gamma_{ms}} \qquad (10.10)$$

$$M_d = \frac{0.5 f_k b d_c (t - d_c)}{\gamma_{mm}} + \frac{0.83 f_y A_{s1}(0.5t - d_1)}{\gamma_{ms}} + \frac{f_k A_{s2}(0.5t - d_2)}{\gamma_{ms}} \qquad (10.11)$$

The values of N_d and M_d calculated using these equations must be greater than N and M, the applied axial load and bending moment. Trial sections and areas of reinforcement are first assumed and then f_{s2} determined from an assumed value of d_c following the method outlined in section 10.5.2. This method is cumbersome and interaction diagrams are available for a more direct solution of the equations. In these diagrams M/bt^2f_k is plotted against N/bt^2f_k for a range of values of $?/f_k$ and separate diagrams are available for different values of the ratio d/t and f_y.

Case (c)

In this case, which is used when the eccentricity M/N is greater than (t/2-d_1), the axial load is ignored and the section designed to resist an increased moment given by

$$M_a = M + N(t/2 - d_1) \qquad (10.12)$$

For this method the area of tension reinforcement can be reduced by $N\gamma_{ms}/f_y$

(b) Biaxial bending

For short columns the code states that it is usually sufficient to design for uniaxial bending even when significant moments occur about both axes. However, a method is included to deal with the biaxial case by increasing the moment about one of the axes in accordance with

$$M_x' = M_x + \alpha\left(\frac{p}{q}\right) \qquad \text{for } \frac{M_x}{p} > \frac{M_y}{q} \qquad (10.13)$$

$$M_y' = M_y + \alpha\left(\frac{q}{p}\right) \qquad \text{for } \frac{M_x}{p} < \frac{M_y}{q} \qquad (10.14)$$

Taking the design axial load resistance for the complete section (A_m) and ignoring all bending as

$$N_{dz} = f_k A_m \qquad (10.15)$$

the value of a can be determined from Table 10.2.