Table 29 Effective height factors for columns

End condition at top	End condition at bottom		
	1	2	3
1	0.75	0.80	0.90
2	0.80	0.85	0.95
3	0.90	0.95	1.00

Condition 1: Column connected monolithically to beams on each side that are at least as deep as the overall depth of the column in the plane considered. Where the column is connected to a foundation this should be designed to carry moment, in order to satisfy this condition.
Condition 2: Column connected monolithically to beams or slabs on each side that are shallower than the overall depth of the column in the plane considered, but generally not less than half the column depth.
Condition 3: Column connected to members that do not provide more than nominal restraint to rotation.

Table 30 Fire resistance requirements for columns

Fire rating h	Minimum dimension mm			Cover to main reinforcement mm
	Fully exposed	50% exposed	One side exposed	
1	200	200	200	25
1½	250	200	200	30
2	300	200	200	35
3	400	300	200	35
4	450	350	240	35

4.5.2.3 Durability

The requirements for durability in any given environment are:

(a) an upper limit to the water/cement ratio
(b) a lower limit to the cement content
(c) a lower limit to the thickness of the cover to the reinforcement
(d) good compaction and
(e) adequate curing.

Values for *(a)*, *(b)* and *(c)* that, in combination, will be adequate to ensure durability are given in Table 31 for various environments.

As *(a)* and *(b)* at present cannot be checked by methods that are practical for use during construction, Table 31 gives, in addition, the characteristic strengths that have to be specified in the UK to ensure that requirements *(a)* and *(b)* are satisfied.

The strengths quoted in Table 31 will often require cement contents that are higher than those given in the Table. The potential problems of increased shrinkage arising from high cement and water contents should be considered in the design.

Table 31 Durability requirements for columns

Conditions of exposure (For definitions see Appendix C)	Cover to *all* reinforcement mm	mm	mm
Mild	25	20	20
Moderate	—	35	30
Severe	—	—	40
Very severe	—	—	50
Maximum free water/cement ratio	0.65	0.60	0.55
Minimum cement content, kg/m^3	275	300	325
Characteristic concrete strength in the UK, N/mm^2	30	35	40

Notes to Table 31
1. The cover to *all* reinforcement should not be less than the nominal maximum size of the aggregate.
2. The cover in mm to the *main* reinforcement should not be less than the bar size.

4.5.3 Axial loads and moments

The minimum design moment for any column in any plane should be obtained by multiplying the ultimate design axial load by an eccentricity, which should be taken as 0.05 times the overall column dimension in the relevant plane but not exceeding 20mm.

When column designs are required in the absence of a full frame analysis the following procedure may be adopted:

(a) The axial loads may generally be obtained by increasing by 10% the loads obtained on the assumption that beams and slabs are simply supported. A higher increase may be required where adjacent spans and the loadings on them are grossly dissimilar.

(b) The moments in the columns may be obtained using the subframes shown in Fig. 13, subject to the minimum design moments above.

Alternatively, axial loads and moments may be obtained from the frame analysis outlined in subsection 4.3.

4.5.4 Section design

Sections should normally be designed using the charts in Appendix D. Alternatively, the following simplified procedures may be adopted where applicable:

(a) In the case of columns where only the minimum design moment (see clause 4.5.3) applies, the ultimate axial load capacity in N of the column may be taken as

$$0.4 f_{cu} A_c + 0.75 f_y A_{sc}$$

where f_{cu} = characteristic concrete cube strength in N/mm^2
A_c = area of concrete in mm^2
A_{sc} = area of longitudinal reinforcement in mm^2
f_y = characteristic strength of reinforcement in N/mm^2

(b) In the case of columns supporting an approximately symmetrical arrangement of beams (i.e. where adjacent spans do not differ by more than 15%), subject to uniformly distributed loads, the ultimate axial load capacity of the column may be taken as:

$$0.35 f_{cu} A_c + 0.67 f_y A_{sc}$$

where the terms have the same definitions as above.