## 4.6 Walls

### 4.6.1 Introduction

This subsection describes the final design of stocky reinforced concrete walls that may provide the lateral stability to reinforced concrete framed buildings.

The general procedure to be adopted is as follows:

1. check that walls providing lateral stability are continuous through the height of the building and that their shear centre coincides approximately with the line of the resultant of the applied horizontal loads in two orthogonal directions; if not, calculate the resulting twisting moments and check that they can be resisted
2. check that walls within any storey height are not slender
3. check that the section complies with the requirements for fire resistance
4. check that cover and concrete comply with durability requirements
5. calculate axial loads and moments according to clause 4.6.3
6. design section and reinforcement.

### 4.6.2 Slenderness, fire resistance and durability

#### 4.6.2.1 Slenderness

The ratio of the effective height of stocky walls to their thickness should be 15 or less. The thickness should not be less than 150mm, but to facilitate concreting 180mm is preferable. The effective height should be obtained by multiplying the clear height between floors by the factor obtained from Table 33.

**Table 33 Effective height factors for walls**

| 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: Wall connected monolithically to slabs on either side that are at least as deep as the overall thickness of the wall. Where the wall is connected to a foundation, this should be designed to carry moment, in order to satisfy this condition.

Condition 2: Wall connected monolithically to slabs on either side that are shallower than the overall thickness of the wall, but not less than half the wall thickness.

Condition 3: Wall connected to members that do not provide more than nominal restraint to rotation.

#### 4.6.2.2 Fire resistance

The minimum dimensions and covers should be obtained from Table 34.

#### 4.6.2.3 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 35 for various environments.

As *(a)* and *(b)* at present cannot be checked by methods that are practical for use during construction, Table 35 gives, in addition, the characteristic strengths that have to be specified in the UK to ensure that requirements *(a)* and *(b)* are satisfied.

**Table 34 Fire resistance requirements for walls**

| Fire rating h | Minimum dimension mm | Cover to vertical reinforcement mm |
|---|---|---|
| 1 | 150† | 25 |
| 1½ | 175† 150* | 25 |
| 2 | 160* | 25 |
| 3 | 200* 150** | 25 |
| 4 | 240* 180** | 25 |

†These walls may have less than 0.4% reinforcement.
*These walls to have between 0.4% and 1% reinforcement.
**These walls to have more than 1% reinforcement.

**Table 35 Durability requirements for walls above ground**

| 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 35
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 the the bar size.

The strengths quoted in Table 35 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.

## 4.6.3 Axial loads and moments

### 4.6.3.1 In-plane bending

The axial load on the wall should be calculated to obtain the most onerous conditions using the partial safety factors for loads in Table 1, and on the assumption that the beams and slabs transmitting forces into it are simply supported.