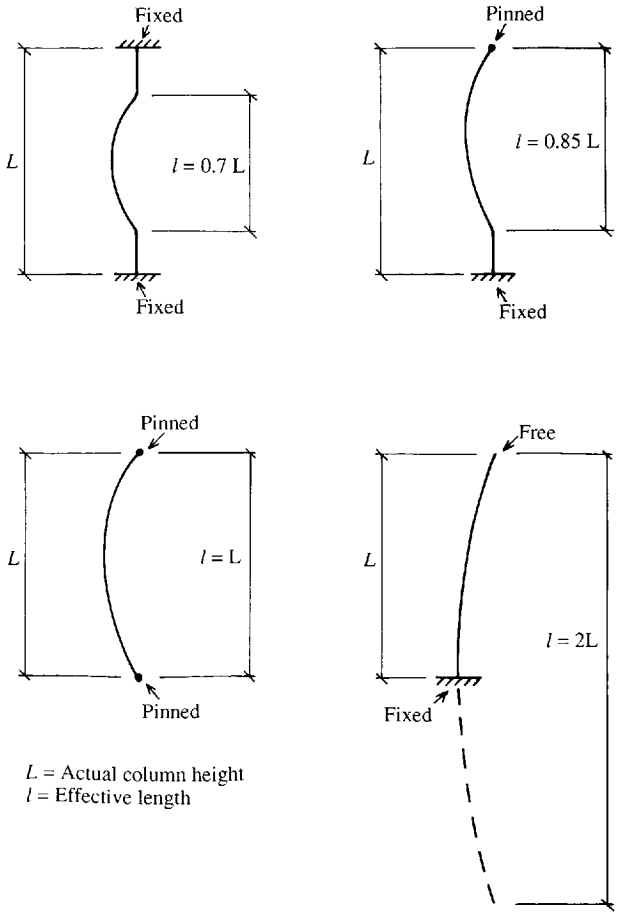

Figure 1.24 *Effective length conditions for columns*

1.7 Summary

There are few aspects of structural design that do not benefit from the adoption of a methodical procedure to minimize the chance of error.

In relation to the general matters dealt with in this chapter, these may be summarized into the following procedural list:

(a) Evaluate the loads acting on the structure.

(b) Determine the loads acting on the individual structural members.

(c) Calculate the forces, shears, bending moments and so on induced in each member by the loads.

(d) Design the respective members.

Step (d) depends on the design guidelines for the particular material from which the members are formed. The reader should therefore refer to the relevant chapter of this manual for the design of structural elements in a specific material.

2 Timber elements

2.1 Stress grading

Of all the materials used for construction, timber is unique by virtue of being entirely natural. Whilst this gives it a deserved aesthetic appeal, it also creates an initial problem for the structural engineer.

In order to design any structural component efficiently, it is necessary to know in advance the strength capability of the material to be used. Timber presents a problem in this respect since we have no apparent control over its quality. All the other materials we use structurally are man made and therefore some form of quality control can be exercised during their production.

To overcome this difficulty and to enable timber to compete equally with other structural materials, the stress grading method of strength classification has been devised. This is based on an assessment of features in timber that are known to influence strength. Guidance for such assessment either by visual inspection or by use of stress grading machines is given for softwoods in BS 4978 'Specification for softwood grades for structural use'. The implications of this code will be discussed in more detail here. For guidance on the stress grading of tropical hardwoods reference should be made to BS 5756 'Specification for tropical hardwoods graded for structural use'.

Visual stress grading is a manual process carried out by approved graders who have been trained and have demonstrated their proficiency in the technique. The grader examines each piece of timber to check the size and frequency of specific physical characteristics: knots, slope of grain, rate of growth, wane, resin pockets and distortion. These are compared with the permitted limits given in BS 4978 to determine whether a piece is accepted into one of the two visual stress grades or rejected. The two visual grades referred to in the standard are general structural (GS) grade and special structural (SS) grade.

The machine stress grading method is based on the principle that strength is related to stiffness. Therefore, since stiffness may be established by measuring deflection under load, the method offers the basis for a non-destructive testing technique. Stress grading machines employ such a technique. Timber is passed through the machine and, by means of a series of rollers, some static and some exerting pressure, bending is induced at increments along its length. The resulting deflection is measured by a computer linked to the machine and compared simultaneously with pre-programmed parameters for accepting or rejecting the timber into one of four machine grades.

The four machine grades specified in BS 4978 are MGS, MSS, M50 and M75. In order that stress graded timber may be identified, every piece is indelibly marked, on at least one face, with its grade and the company or machine which graded it.