These calculations are carried out in terms of design loads and are to be compared with the design strengths of the material in compression and shear. The design of the beam would be carried out in accordance with the relevant code of practice.

8.2 INTERACTION BETWEEN WALL PANELS AND FRAMES

8.2.1 Introduction

Wall panels built into frameworks of steel or reinforced concrete contribute to the overall stiffness of the structure, and a method is required for predicting modes of failure and calculating stresses and lateral collapse loads.

The problem has been studied by a number of authors, and although methods of solution have been proposed, work is still continuing and more laboratory or field testing is required to verify the proposed theoretical approaches.

A theoretical analysis based on a fairly sophisticated finite element approach which allowed for cracking within the elements as the load was increased was used by Riddington and Stafford-Smith (1977). An alternative method developed by Wood (1978) was based on idealized plastic failure modes and then applying a correcting factor to allow for the fact that masonry is not ideally plastic.

These methods are too cumbersome for practical design purposes, and simplifying assumptions are made for determining acceptable approximate values of the unknowns.

The basis of the design method proposed by Riddington and Stafford-Smith is that the framed panel, in shear, acts as a diagonal strut, and failure of the panel occurs owing to compression in the diagonal or shear along the bedding planes. The beams and columns of the frame are designed on the basis of a simple static analysis of an equivalent frame with pin-jointed connections in which panels are represented as diagonal pin-jointed bracing struts.

A description of the design method proposed by Wood is given below.

8.2.2 Design method based on plastic failure modes

(a) Introduction

In the method proposed by Wood (1978) four idealized plastic failure modes are considered, and these together with the location of plastic hinges are shown in Fig. 8.11.

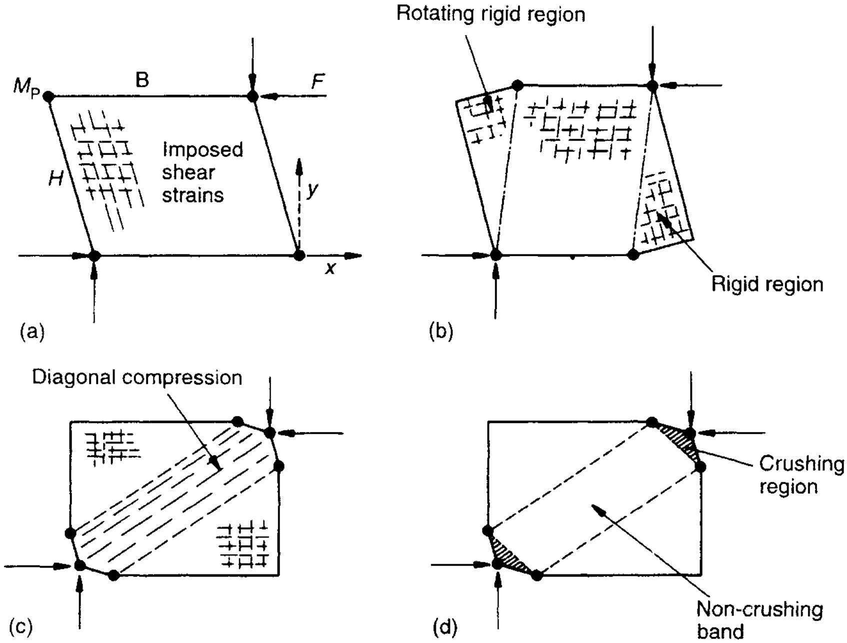

Fig. 8.11 Idealized plastic failure modes for wall frame panels: (a) shear mode S (strong frame, weak wall); (b) shear rotation mode SR (medium strength walls); (c) diagonal compression mode DC (strong wall, weak frame); (d) corner crushing mode CC (very weak frame). From Wood (1978).

A parameter m_d is introduced defined as

$$m_d = 8M_p\gamma_m/(f_k tL^2) \qquad (8.16)$$

where M_p is the lowest plastic moment of beams or columns, and f_k the characteristic strength of the masonry. This parameter which represents a frame/wall strength ratio is shown to be the factor which determined the mode of collapse.

- For $m_d < 0.25$ the collapse mode is DC (diagonal compression) or CC (corner crushing).
- For $0.25<m_d<1$ the collapse mode is SR (shear rotation).
- For $m_d>1$ the collapse mode is S (shear).

(b) Design procedure

Initially the nominal value of m_d is calculated using equation (8.16) and then corrected using the factor δ_p obtained from Fig. 8.12. The corrected value (m_e) is given by $m_e=m_d/\delta_p$.