That is to say, if a wall has returns at right angles to the direction of the shear force, the area of the returns is neglected in calculating the shear resistance of the wall.

3.4 THE TENSILE STRENGTH OF MASONRY

3.4.1 Direct tensile strength

Direct tensile stresses can arise in masonry as a result of in-plane loading effects. These may be caused by wind, by eccentric gravity loads, by thermal or moisture movements or by foundation movement. The tensile resistance of masonry, particularly across bed joints, is low and variable and therefore is not generally relied upon in structural design. Nevertheless, it is essential that there should be some adhesion between units and mortar, and it is necessary to be aware of those conditions which are conducive to the development of mortar bond on which tensile resistance depends.

The mechanism of unit-mortar adhesion is not fully understood but is known to be a physical-chemical process in which the pore structure of both materials is critical. It is known that the grading of the mortar sand is important and that very fine sands are unfavourable to adhesion. In the case of clay brickwork the moisture content of the brick at the time of laying is also important: both very dry and fully saturated bricks lead to low bond strength. This is illustrated in Fig. 3.4, which shows the results of bond tensile tests at brick moisture contents from oven-dry to fully saturated. This diagram also indicates the great variability of tensile bond strength and suggests that this is likely to be greatest at a moisture content of about three-quarters of full saturation, at least for the bricks used in these tests.

Direct tensile strength of brickwork is typically about $0.4 N/mm^2$, but the variability of this figure has to be kept in mind, and it should only be used in design with great caution.

3.4.2 Flexural tensile strength

Masonry panels used essentially as cladding for buildings have to withstand lateral wind pressure and suction. Some stability is derived from the self-weight of a wall, but generally this is insufficient to provide the necessary resistance to wind forces, and therefore reliance has to be placed on the flexural tensile strength of the masonry.

The same factors as influence direct tensile bond, discussed in the preceding section, apply to the development of flexural tensile strength.

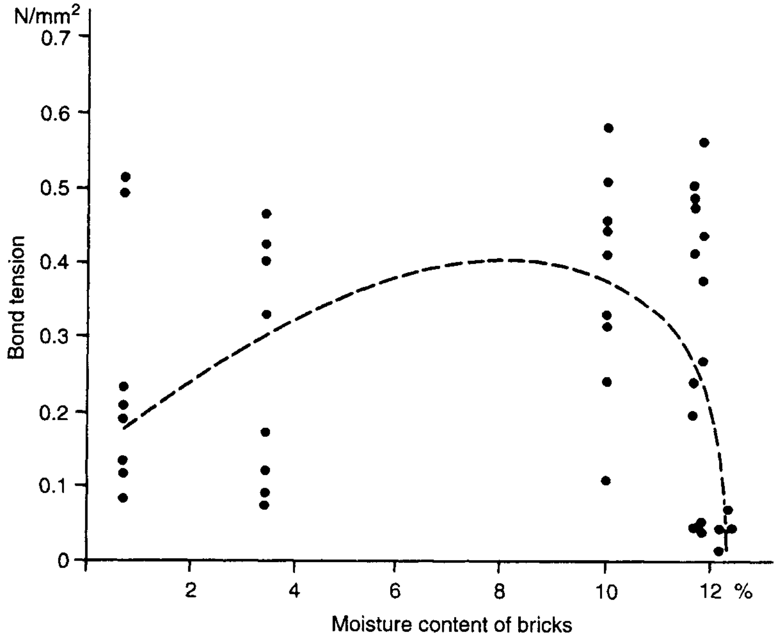

Fig. 3.4 Variation of brick-mortar adhesion with moisture content of bricks at time of laying.

If a wall is supported only at its base and top, its lateral resistance will depend on the flexural tensile strength developed across the bed joints. If it is supported also on its vertical edges, lateral resistance will depend also on the flexural strength of the brickwork in the direction at right angles to the bed joints. The strength in this direction is typically about three times as great as across the bed joints. If the brick-mortar adhesion is good, the bending strength parallel to the bed joint direction will be limited by the flexural tensile strength of the units. If the adhesion is poor, this strength will be limited mainly by the shear strength of the unit-mortar interface in the bed joints.

The flexural tensile strength of clay brickwork ranges from about 2.0 to $0.8 N/mm^2$ in the stronger direction, the strength in bending across the bed joints being about one-third of this. As in the case of direct tension, the strength developed is dependent on the absorption characteristics of the bricks and also on the type of mortar used. Calcium silicate brickwork and concrete blockwork have rather lower flexural tensile strength than clay brickwork, that of concrete blockwork depending on the compressive strength of the unit and the thickness of the wall.