3.5 STRESS-STRAIN PROPERTIES OF MASONRY

Masonry is generally treated as a linearly elastic material, although tests indicate that the stress-strain relationship is approximately parabolic, as shown in Fig. 3.5. Under service conditions masonry is stressed only up to a fraction of its ultimate load, and therefore the assumption of a linear stress-strain curve is acceptable for the calculation of normal structural deformations.

Various formulae have been suggested for the determination of Young's modulus. This parameter is, however, rather variable even for nominally identical specimens, and as an approximation, it may be assumed that

$$E = 700\,\sigma_c' \tag{3.3}$$

where σ_c' is the crushing strength of the masonry. This value will apply up to about 75% of the ultimate strength.

For estimating long-term deformations a reduced value of E should be used, in the region of one-half to one-third of that given by equation (3.3).

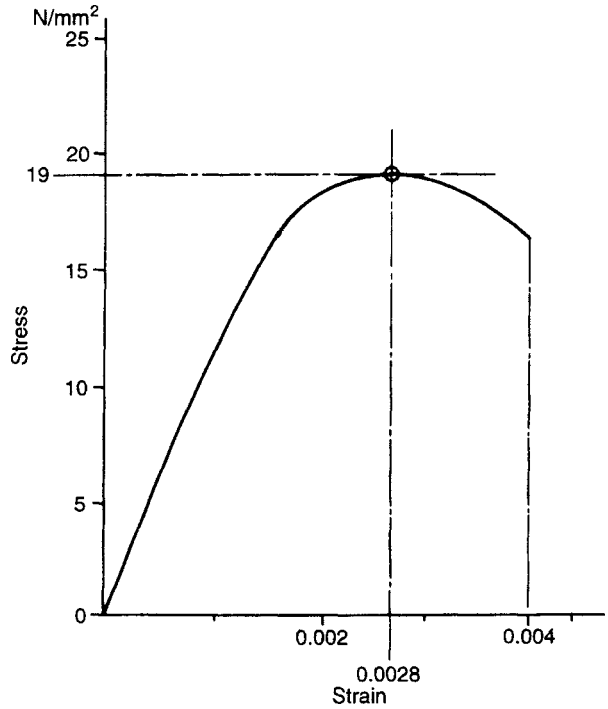

Fig. 3.5 Typical stress-strain curve for brick masonry.

3.6 EFFECTS OF WORKMANSHIP ON MASONRY STRENGTH

Masonry has a very long tradition of building by craftsmen, without engineering supervision of the kind applied to reinforced concrete construction. Consequently, it is frequently regarded with some suspicion as a structural material and carries very much higher safety factors than concrete. There is, of course, some justification for this, in that, if supervision is non-existent, any structural element, whether of masonry or concrete, will be of uncertain strength. If, on the other hand, the same level of supervision is applied to masonry as is customarily required for concrete, masonry will be quite as reliable as concrete. It is therefore important for engineers designing and constructing in masonry to have an appreciation of the workmanship factors which are significant in developing a specified strength. This information has been obtained by carrying out tests on walls which have had known defects built into them and comparing the results with corresponding tests on walls without defects. In practice, these defects will be present to some extent and, in unsatisfactory work, a combination of them could result in a wall being only half as strong in compression as it should be. Such a wall, however, would be obviously badly built and would be so far outside any reasonable specification as to be quite unacceptable.

It is, of course, very much better for masonry to be properly built in the first instance, and time spent by the engineer explaining the importance of the points outlined below to the brick- or blocklayer and his immediate supervisor will be time well spent.

3.6.1 Workmanship defects in brickwork

(a) Failure to fill bed joints

It is essential that the bed joints in brickwork should be completely filled. Gaps in the mortar bed can result simply from carelessness or haste or from a practice known as 'furrowing', which means that the bricklayer makes a gap with his trowel in the middle of the mortar bed parallel to the face of the wall. Tests show that incompletely filled bed joints can reduce the strength of brickwork by as much as 33%.

Failure to fill the vertical joints has been found to have very little effect on the compressive strength of brickwork but does reduce the flexural resistance. Also, unfilled perpendicular joints are undesirable from the point of view of weather exclusion and sound insulation as well as being indicative of careless workmanship generally.