Table 3.2 Compressive strength of bricks and prisms compressed in different directions[a]

(a) Brick strength (N/mm^2)

Brick type	*Tested*		
	On bed	*On edge*	*On end*
14 hole	74.3 (100)	26.2 (35)	10.4 (14)
10 hole	70.2 (100)	29.5 (42)	21.7 (31)
3 hole	82.0 (100)	53.2 (65)	40.2 (49)
5 slots	64.1 (100)	51.8 (81)	13.8 (22)

(b) Prism strength (N/mm^2)

Brick on end	*Laid*		
	On bed	*On edge*	*On end*
14 hole	28.9 (100)	8.5 (29)	14.6 (51)
10 hole	22.0 (100)	15.0 (66)	20.0 (91)
3 hole	37.6 (100)	30.5 (78)	21.8 (56)
5 slots	34.1 (100)	29.0 (85)	13.9 (41)

[a] Figures in brackets indicate relative strengths. Mortar $1:\frac{1}{4}:3$.

calculated as if the unit was solid. The strength of shell-bedded masonry should be calculated on the basis of the mortared area of the units.

Conventionally, the compressive strength of hollow block masonry built with the cores filled with concrete is taken to be the sum of the strengths of the hollow block and the concreted core tested separately. However, even when the materials are of approximately the same nominal strength, this rule is not always reliable as there can be a difference in the lateral strains of the block and fill materials at the ultimate load, resulting in a tendency for the fill to split the block. Various formulae have been devised to calculate the strength of filled block masonry, as for example the following which has been suggested by Khalaf (1991) to give the prism strength (f'_m) of this type of masonry:

$$f'_m = 0.3 f_b + 0.1 f_{mr} + 0.25 f_c \tag{3.1}$$

where f_b is the unit material compressive strength, f_{mr} is the mortar compressive strength and f_c is the core infill compressive strength.

3.3 STRENGTH OF MASONRY IN COMBINED COMPRESSION AND SHEAR

The strength of masonry in combined shear and compression is of importance in relation to the resistance of buildings to lateral forces. Many tests on masonry panels subjected to this type of loading have been carried out with a view to establishing limiting stresses for use in design. Typical results are shown in Fig. 3.3. It is found that there is a Coulomb type of relationship between shear strength and precompression, i.e. there is an initial shear resistance dependent on adhesion between the units and mortar augmented by a frictional component proportional to the precompression. This may be expressed by the formula:

$$\tau = \tau_0 + \mu \sigma_c \qquad (3.2)$$

where τ_0 is the shear strength at zero precompression, μ is an apparent coefficient of friction and σ_c is the vertical compressive stress.

This relationship holds up to a certain limiting value of the vertical compression, beyond which the joint failure represented by the Coulomb equation is replaced by cracking through the units. For clay bricks this limit is about 2.0 N/mm^2. The shear strength depends on the mortar strength and for units with a compressive strength between 20 and 50 N/mm^2 set in strong (1:$\frac{1}{4}$:3) mortar the value of t_0 will be approximately 0.3 N/mm^2 and 0.2 N/mm^2 for medium strength (1:1:6) mortar. The average value of μ is 0.4–0.6.

The shear stresses quoted above are average values for walls having a height-to-length ratio of 1.0 or more and the strength of a wall is calculated on the plan area of the wall in the plane of the shear force.

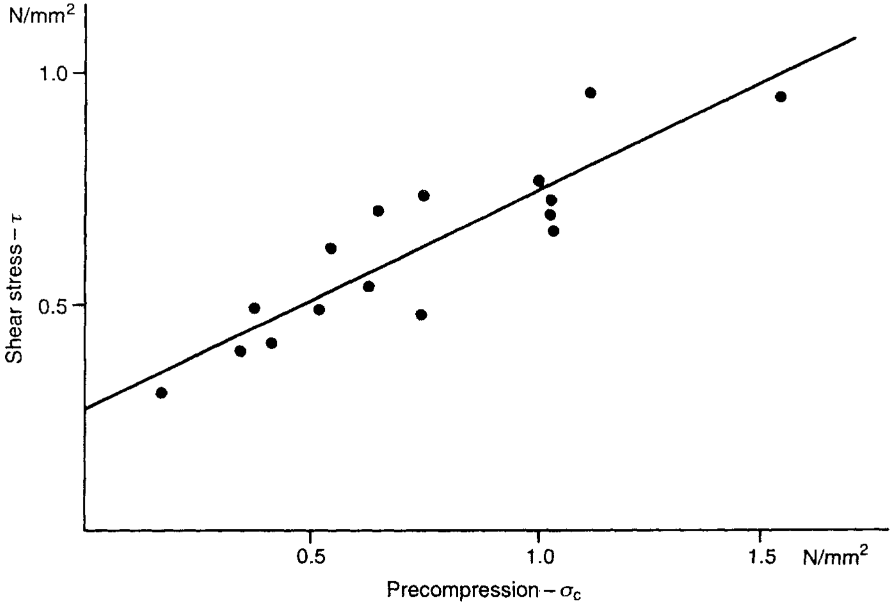

Fig. 3.3 Typical relationship between shear strength of brickwork and vertical precompression from test results.