Table 2.5 Moisture movement in different building materials

Materials	*Movement* (%)	
	Irreversible	*Reversible*
Clay bricks	0.10–0.20 (expansion)	negligible
Calcium silicate	0.001–0.05	0.001–0.05
Metal and glass	nil	nil
Dense concrete and mortar	0.02–0.12 (drying shrinkage)	0.01–0.055

m intervals as a general rule. However, the length of the panel without movement joint should not exceed twice the height.

Some indication of reversible or irreversible movement of various building materials is shown in Table 2.5.

The EC6 gives guidance for the design values of dimensional changes for unreinforced masonry, which are given in Chapter 4 (section 4.4).

2.2.7 Soluble salts

(a) Efflorescence

All clay bricks contain soluble salts to some extent. The salt can also find its way from mortar or soil or by contamination of brick by foreign agents. In a new building when the brickwork dries out owing to evaporation of water, the dissolved salts normally appear as a white deposit termed 'efflorescence' on the surface of bricks. Sometimes the colour may be yellow or pale green because of the presence of vanadium or chromium. The texture may vary from light and fluffy to hard and glassy. Efflorescence is caused by sulphates of sodium, potassium, magnesium and calcium; not all of these may be present in a particular case. Efflorescence can take place on drying out brickwork after construction or subsequently if it is allowed to become very wet. By and large, efflorescence does not normally result in decay, but in the United Kingdom, magnesium sulphate or sodium sulphate may cause disruption due to crystallization. Abnormal amounts of sodium sulphate, constituting more than 3% by weight of a brick, will cause disruption of its surface. Brick specimens showing efflorescence in the 'heavy' category are not considered to comply with BS 3921.

(b) Sulphate attack

Sulphates slowly react in the presence of water with tricalcium aluminate, which is one of the constituents of Portland cement and

hydraulic lime. If water containing dissolved sulphate from clay bricks or aggregates reaches the mortar, this reaction takes place, causing mortar to crack and spall and thus resulting in the disintegration of the masonry. Sulphate attack is only possible if the masonry is exposed to very long and persistent wet conditions. Chimneys, parapets and earth-retaining walls which have not been properly protected from excessive dampness may be vulnerable to sulphate attack. In general, it is advisable to keep walls as dry as possible. In conditions of severe exposure to rain, bricks (L) or sulphate-resistant cement should be used. The resistance of mortar against sulphate attack can be increased by specifying a fairly rich mix, i.e. stronger than grade (iii) mortar (1:1:6) or replacing lime with a plasticizer. Calcium silicate and concrete units do not contain significant amounts of sulphate compared to clay bricks. However, concrete bricks of minimum 30 N/mm^2 strength should be used $1{:}\frac{1}{2}{:}4\frac{1}{2}$ in mortar for earth-retaining walls, cills and copings.

2.2.8 Fire resistance

Clay bricks are subjected to very much higher temperatures during firing than they are likely to be exposed to in a building fire. As a result, they possess excellent fire resistance properties. Calcium silicate bricks have similar fire resistance properties to clay bricks. Concrete bricks and blocks have 30 min to 6 h notional fire resistance depending on the thickness of the wall.

2.3 MORTAR

The second component in brickwork is mortar, which for loadbearing brickwork should be a cement:lime:sand mix in one of the designations shown in Table 2.6. For low-strength bricks a weaker mortar, 1:2:9 mix by volume, may be appropriate. For reinforced and prestressed brickwork, mortar weaker than grade (ii) $(1{:}\frac{1}{2}{:}4\frac{1}{2})$ is not recommended.

2.3.1 Function and requirement of mortar

In deciding the type of mortar the properties needing to be considered are:

- Development of early strength.
- Workability, i.e. ability to spread easily.
- Water retentivity, i.e. the ability of mortar to retain water against the suction of brick. (If water is not retained and is extracted quickly by a high-absorptive brick, there will be insufficient water left in the mortar joint for hydration of the cement, resulting in poor bond between brick and mortar.)