Part 4
ACCOMMODATION OF MOVEMENT

4.1 OVERALL MOVEMENT

All buildings are subjected to varying degrees of dimensional change after being built. Many factors affect movement, such as the temperature and moisture changes of the surrounding atmosphere, the characteristics of the masonry and mortar, the degree of restraint imposed by foundations, roof trusses and suspended slabs, and the imposed loads on the walls.

In general, it is simpler to adopt empirical rules rather than to try and estimate movement in a building from first principles. SABS 0249: *Masonry Walling* has a section on movement in masonry.

4.2 THERMAL MOVEMENT

An increase in the temperature of a wall will induce expansion. The degree of movement is equal to the temperature range multiplied by the appropriate coefficient of thermal movements overcoming restraint in the wall itself (see Table 3). A decrease in temperature will result in the shortening of the wall that may induce cracks. However, the movement that actually occurs within a wall after construction depends not only on the range of temperatures, but also on the initial temperatures of the units as laid, their moisture content and the degree of restraint. To determine the effective free movement that could occur, therefore, some estimation of the initial temperature and temperature range has to be made. The effective free movement that is calculated should still be modified to allow for the effects of restraints.

Table 3: Linear thermal movement of masonry units and mortar

Material	Coefficient of linear thermal movement per degree °C x 10^{-6}	Movement per 10 m of wall for 50°C temperature change (mm)
Burnt clay masonry units (see note 1)	4 – 8	2 – 4
Concrete masonry units (see note 2)	7 – 14	3,5 – 7
Mortars	11 – 13	5,5 – 6,5

Notes:
1) Thermal movement of burnt clay masonry units depends on the clay mixture and its firing.
2) Thermal movement of concrete masonry units depends on the type of aggregate and the mix proportions.

4.3 IRREVERSIBLE MOISTURE EXPANSION MOVEMENT (refer to section 3.5)

The continuing expansion of bricks justifies earlier recommendations to avoid problems in buildings. Building problems caused by the expansion of bricks can be avoided by using mortar that can accommodate at least some of the expansion, avoiding designs such as short offsets in long runs of brickwork, and by incorporating adequate movement joints.

SABS 0249 recommends design for potential movement due to moisture expansion, in mm/m, of < 0,5 for category I bricks, 0,5-1,0 category II and 1,0-2,0 for category III bricks.

4.4 MOISTURE CONTENT MOVEMENT

Burnt clay units exhibit little movement with changes in moisture content. Movement is normally not more than 1 mm in every 10 m of length and rarely more than 2 mm in every 10 m of length. This movement is reversible.

4.5 MOVEMENT IN ADJOINING STRUCTURES

Structural movement in adjoining concrete or steel structures can cause distress. Distress can occur in either supported or enclosed brickwork, and can arise from elastic and creep deformation and deflection under stress, and from shrinkage in the case of reinforced concrete components.

Problems can arise when elements supporting masonry walls, such as foundations and suspended concrete floor and roof slabs, deflect and impose unanticipated stresses on the brickwork. Infill brickwork panels in reinforced concrete framed buildings can be stressed because of the shortening of the concrete columns due to elastic and creep stresses and shrinkage of the concrete (normal 1,2 to 1,5 mm/m for shortening of columns). Thus, the top of infill panels must be separated from the structural member above by a gap of between 5 and 12 mm.

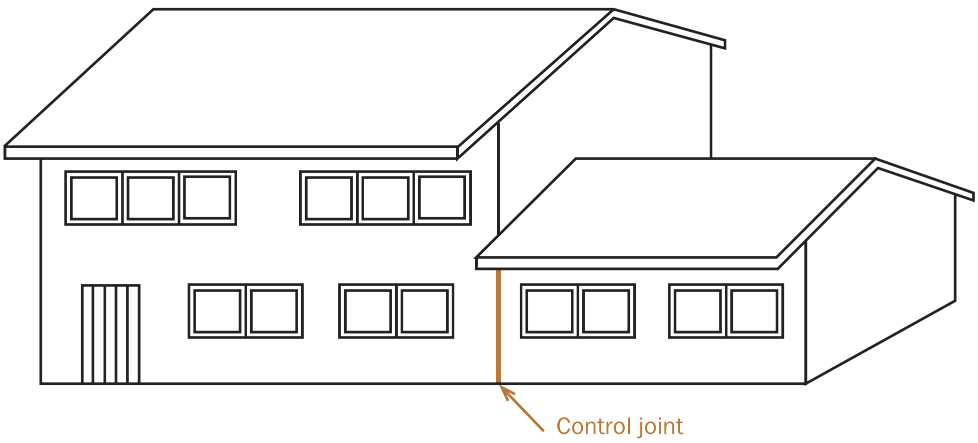
4.6 PROVISION OF CONTROL JOINTS

Movement in masonry can be accommodated by designing the masonry so that it is separated into discrete panels through the provision of control (movement) joints that reduce stress build-up.

The design and positioning of control joints should accommodate movements but should not impair the stability of the wall or any of its functions such as impermeability, sound insulation and fire-resistance.

Figures 3, 4 and 5 show the position of control joints in buildings and free-standing walls.

Figure 3: Location of control joints in buildings



CONTROL JOINT AT CHANGE IN EXTERNAL WALL HEIGHT

Figure 4: Position of control joints at set backs

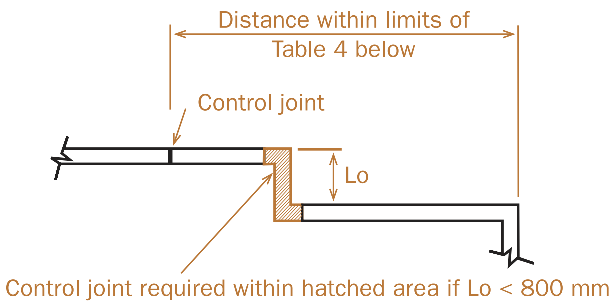


Table 4: Maximum vertical control joint spacing in walls

Unit type	Moisture expansion (%)	Appropriate spacing of vertical joints 10-12 mm wide	
		Free-standing wall (m)	Housing units (m)
Unreinforced masonry			
Burnt clay	<0,05 0,05-0,10 0,10-0,20	16 10 6	18 14 10
Masonry with bed joint reinforcement			
Burnt clay	<0,05 0,05-0,10 0,10-0,20	16 12 8	18 16 12

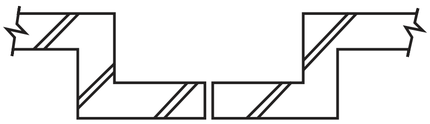
Figure 5: Location of control joints in freestanding walls

OR

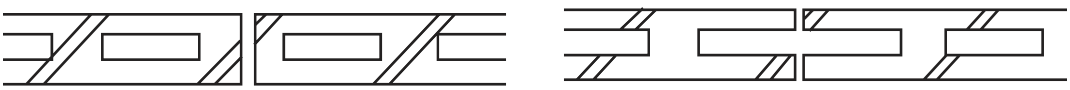
PIERS PROJECTING ON ONE SIDE ONLY

OR

PIERS PROJECTING ON BOTH SIDES



Z-SHAPED



OR

DIAPHRAGM

Table 5: Freestanding walls (solid units)

Nominal wall thickness (T) (mm)	Maximum height (H) (m)	Nominal dimensions of piers (overall depth X width; D X W) (mm)	Maximum pier spacing (centre to centre; S) (m)
No piers			
90	0,8		
110	1,0		
140	1,3		
Z-shaped			
90	1,8	390 x 90	1,2
90	2,0	490 x 90	1,4
110	1,6	330 x 110	1,5
110	2,1	440 x 110	1,5
140	2,2	440 x 140	2,0
140	2,5	590 x 140	2,5
Piers projecting on one side			
90	1,4	290 x 290	1,4
90	1,5	390 x 290	1,6
90	1,7	490 x 290	1,6
110	1,5	330 x 330	1,8
110	1,5	440 x 330	1,8
110	1,9	550 x 330	2,0
140	1,7	440 x 440	2,2
140	1,8	590 x 390	2,5
Piers projecting on both sides			
90	1,5	490 x 290	1,4
110	1,6	550 x 330	1,8
140	1,6	440 x 440	2,2
Diaphragm walls			
90	2,1	290 x 190	1,4
90	2,7	390 x 190	1,4
110	2,6	330 x 220	1,6

Note

1. No earth to be retained by walls.
2. Piers to extend to top of wall without any reduction in size.
3. Walls to terminate in a pier or a return.