CHAPTER 5

STRUCTURAL MASONRY WITH CLAY BRICK

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Background

The National Building Regulations are generally functional in nature, i.e. they do not prescribe how a building should be constructed, but rather stipulate the qualitative performance requirements that the building design or construction of the building must satisfy. To facilitate the use and application of the National Building Regulations the functional regulations are supported by a set of deemed-to-satisfy rules which are published in SANS 10400, The Application of the National Building Regulations – Part K: Walls. The deemed-to-satisfy provisions describe design and construction methods, materials and solutions, which if applied, will ensure that the building so designed and constructed will satisfy the functional requirements of the regulations.

SANS 10400-Part K: Walls provides deemed-to-satisfy or empirical rules to satisfy the National Building Regulations. Any masonry structure of a wall of such structure that falls outside the scope of SANS 10400-K is subject to a rational design to provide structural integrity, stability and serviceability; this is carried out using South African National Standards, such as the loading and structural masonry standards, i.e. SANS 10160 and 10164, Parts 1 and 2 respectively (soon to be superseded by Eurocode 6).

In addition to the aforementioned there are also technical requirements published by the National Home Builders Registration Council (NHBRC) in terms of the Housing Consumer Protection Measures Act.

The Clay Masonry Manual summarizes key aspects of the deemed-to-satisfy rules in SANS 10400-Part K with the understanding that these documents shall be consulted.

Empirical Design of masonry walls (SANS 10400-K)

Introduction

SANS 10400-K is a comprehensive standard that inter alia outlines aspect of permissible wall panel sizes for single and double storey dwellings and framed buildings, foundation and freestanding walls (boundary, retaining, balustrade and parapet), define and detail lateral support to walls, detail control, movement and articulation joints and various fixing details, arches, anchoring details of roofs and provide information on lintels. Salient features of SANS 10400-K will be summarized to illustrate the use of the deem-to-satisfy rules.

Although reference has been made to “brick” in earlier chapters it is important to note that SANS 10400-K does not refer to a brick or a block but to solid or hollow masonry units. Except for the section on control joints no reference is made to the type of masonry material, i.e. clay or concrete.

Building Limitations (Clause 4.2.1)

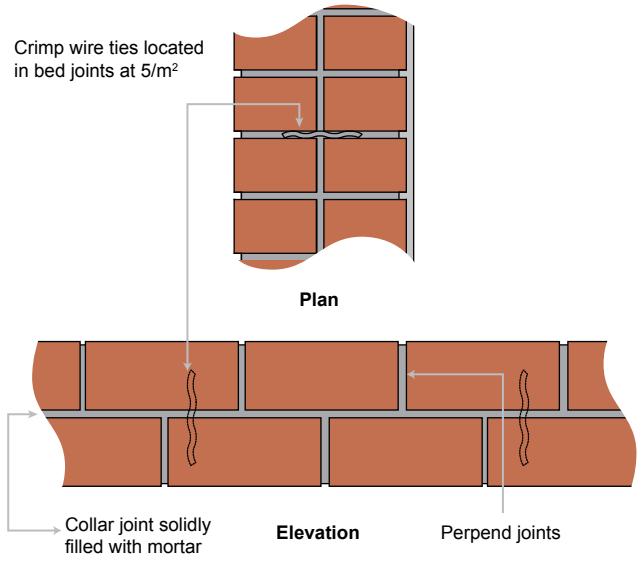
The provisions hereafter apply only to masonry walls in dwelling units, dwelling houses, educational buildings, hospitals, hotels and other institutional occupancies and general offices where the imposed floor load does not exceed 3,0 kN/m^2 that are not exposed to severe wind loadings arising from crests of steep hills, ridges and escarpments, in:

a) single storey buildings or the upper storey of double storey buildings where:

- the foundations for masonry walls satisfy the requirements of SANS 10400-H: Application of the National Building Regulations – Part H: Foundations and the supporting members satisfy the requirements of SANS 10400-B: Structural Design;
- the span of roof trusses or rafters (or both) between supporting walls does not exceed:
  - 6,0 m in respect of a single leaf wall with a thickness less than 110 mm;
  - 8,0 m in respect of 140 mm, or greater, single leaf walls and all cavity and collar jointed walls. A collar jointed wall comprises parallel single leaf walls with the space between them not exceeding 25 mm, filled solidly with mortar and tied together with wall ties know as crimp ties (see figure 6)
- the nominal height of masonry above the top of openings is not less than 0,4 m;
- the average compressive strength of hollow and solid masonry units is not less than 3,0 MPa and 4,0 MPa, respectively;
- Class II mortar satisfying the requirements of SANS 2001-CM1, Construction standards – Part: CM1: Masonry walling, is used;
- the mass of the roof covering in roofs other than concrete slabs does not exceed 80 kg/m^2;
- the span of the concrete roof slabs between supporting walls does not exceed 6,0 m;
- concrete roof slabs are not thicker than 255 mm if of solid construction, or the equivalent mass if of voided construction;
- foundation walls are not thinner than the walls which they support; and
- the height of foundation walls does not exceed 1,5 m,

b) the lower storey in a double storey building where the requirements listed in a) are still relevant but the average compressive strength of the hollow and solid masonry units are not less than 7,0 MPa and 10 MPa respectively; the following requirements are also applicable:

- the height measured from the ground floor to the top of an external gable does not exceed 8,0 m;
- the storey height measured from floor to wall plate level or to the underside of the first floor does not exceed 3,0 m;
- the walls supporting floor elements are of cavity construction or have a nominal thickness of not less than 140 mm.



5.1 - Collar-jointed walls

c) infill panels in concrete and steel framed buildings of four storeys or less where:

- the average compressive strength of hollow and solid masonry units is not less than 3,0 MPa and 5,0 MPa respectively;
- Class II mortar (as previously) is used;
- the walls are either of a cavity construction or have a nominal thickness of not less than 140 mm; and
- the nominal height of masonry above openings is not less than 0,4 m; and the storey height measured from floor to soffit of the floor above does not exceed 3,3m.

d) freestanding, retaining, parapet and balustrade walls where:

- the average compressive strength of hollow and solid masonry units is not less than 3,0 MPa and 5,0 MPa respectively; and
- Class II mortar is used.

Limitations of masonry walling in single and double storey buildings (Clause 4.2.2)

Masonry wall panels in single and double storey buildings shall have dimensions not longer than that derived from Figure 4 in SANS 10400-K, reproduced here as Figure 5.3. Six tables summarizes the maximum lengths of openings and the minimum distances between the face of supports and openings and between successive openings in accordance with the provisions of detailed figures.

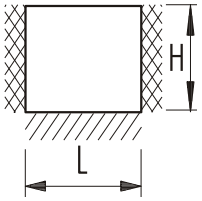
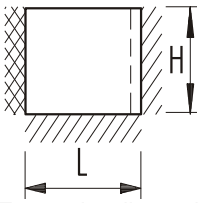
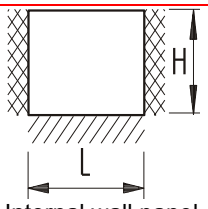
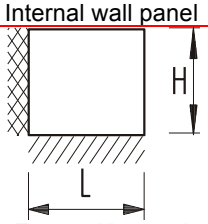
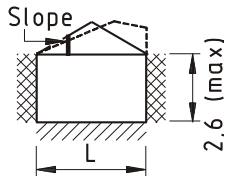
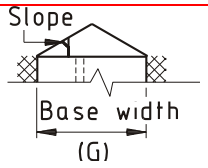
Summary of limitations

Figure 5.2 gives a summary of the detailed wall panel configurations with various support conditions as reproduced in Figure 5.3. 220 collar jointed and 110 single leaf wall types horizontally supported and with vertical supports (excluding vertical butt joints) shall have wall panel sizes as indicated in Figure 5.2; Figure 5.3 below in conjunction with SANS 10400-K shall be consulted for other wall configurations with nominal wall thicknesses and other types of support conditions. Panels incorporating full height doors shall be treated as being supported on the one side only.

Support conditions	Description	Summary
	Horizontal support Vertical support (cross wall or return) Vertical tied butt control joint providing lateral stability	• External wall panel: A 220 collar jointed wall supported on both sides made up of solid units can be built to a maximum length (L) and height (H) of 9,0m and 4,6m respectively with openings in excess of 15 % • Internal wall panel: A 110 single leaf wall supported on both sides made up of solid units can be built to maximum length (L) and height (H) of 5,5m and 3,6m respectively with or without openings. • A 220 collar jointed external gable wall with a symmetrical 26º slope supported on both sides can have a maximum base width (G) of 80 m • The maximum dimension for a 220 collar jointed internal and external wall panels supported on one side only (or with a door on the one side) can be built to maximum length (L) and height (H) of 3,1m and 3,6m respectively

5.2 - Summary of wall panel sizes in single and double storey buildings

SANS 10400-K limitations

Wall configuration	Table	Commentary
 External wall panel	Table 1 in SANS 10400-K is reproduced as Table 6 hereafter. Maximum dimensions for external unreinforced wall panels supported on both sides are given.	Applicable to panels which don't incorporate gable ends. Wall panel sizes are sensitive to panel openings. Two categories of opening are provided for: - less than 15 % of wall area - greater than 15 % of wall area *Figure 5.2 refers: A 220 collar jointed wall panel made up of solid units can be built to a maximum length (L) and height (H) of 9,0m and 4,6m respectively with openings in excess of 15 %*
 External wall panel	Table 2 in SANS 10400-K dimensions for external unreinforced wall panels supported on both sides incorporating a tied control/articulation joint. Refer to SANS 10400-K	Applicable to panels which don't incorporate gable ends. Wall panel sizes arehttp://www.hikethelycian.com/ sensitive to panel openings. Two categories of opening are provided for: - less than 15 % of wall area - greater than 15 % of wall area *Figure 5.2 refers: A 220 collar jointed wall panel made up of solid units with openings in excess of 15 % units can be built to L = 8,5m and H = 4,6m*
 Internal wall panel	Table 3 in SANS 10400-K gives the maximum dimensions for internal unreinforced wall panels supported on both sides with or without openings. Refer to SANS 10400-K	Wall panel size is not governed by openings. *A 110 single leaf wall panel made up of solid units can be built to L = 5,5m and H = 3,6m*
 External/Internal panel supported	Table 4 in SANS 10400-K gives the maximum dimensions for internal and external unreinforced wall panels supported on one side only. Refer to SANS 10400-K	Panels which incorporate full height doors are treated as walls supported on one side only with openings. Wall panel is sensitive to openings (no size of opening is specified). *A 110 single leaf wall panel made up of solid units can be built to L = 5,5m and H = 3,6m*
	Table 5 in SANS 10400-K gives the maximum length of external unreinforced wall panel 2,6 m (max.) high supporting a freestanding (isosoles) gable triangle or portion thereof. Refer to SANS 10400-K	Applicable to panels which incorporate gable ends or portion thereof which have a panel height not exceeding 2,6m. Wall panel is sensitive to panel openings. Triangular portion of gable above eaves level needs to comply with the provisions of table 6 in SANS 10400-K. Internal walls with gables (fire walls) are to be designed in accordance with the provisions of table 1 (no openings). *The maximum L of a 110 and 220 thick wall panel made up of solid units supporting a gable wall with a 26º slope is limited to 3,5 & 8,0 m respectively*
	Table 6 in SANS 10400-K gives the maximum base width (G) of external triangular unreinforced gable end. Refer to SANS 10400-K	The base width (G) must be reduced by the length of any openings within the gable. *The maximum G of a 110 and 220 thick gable wall made up of solid units supporting a 26º slope is limited to 5,5 & 8,0 m respectively*

5.3 - Table selection chart for the determination of wall panel sizes in single and double storey buildings

Table 5.1 - Maximum dimensions for external masonry wall panels supported on both sides

1	2	3				4				5			
Nominal wall thickness mm	***Wall type***	**Panel A no openings**				**Panel B openings ≤ 15 % wall area**				***Panel C*** **openings > 15 % wall area**			
		L m	**H** m	**L** m	**H** m	**L** m	**H** m	**L** m	**H** m	**L** m	**H** m	**L** m	**H** m
Solid units													
90	single leaf	3,2	2,4	2,8	3,4	2,7	2,4	2,5	3,4	2,7	2,4	2,3	3,4
90-90	cavity	5,5	2,7	5,5	3,9	5,5	2,7	5,0	3,9	5,5	2,4	4,5	3,9
110	single leaf	4,5	2,7	4,0	3,6	4,0	2,7	3,5	3,6	3,5	2,7	3,0	3,6
110-110	cavity	7,0	3,3	6,0	4,4	7,0	2,4	5,5	4,4	6,5	2,4	5,0	4,4
140	single leaf	7,0	3,3	6,0	4,3	6,5	2,4	5,2	4,3	6,0	2,7	5,0	4,3
190	collar jointed	8,0	4,6	8,0	4,6	8,0	4,6	8,0	4,6	8,0	4,0	7,5	4,6
220	collar jointed	9,0	4,6	9,0	4,6	9,0	4,6	9,0	4,6	9,0	4,6	9,0	4,6
Hollow units													
90	single leaf	2,8	2,4	2,5	3,4	-	-	-	-	-	-	-	-
90-90	cavity	5,0	2,7	4,5	3,9	4,5	2,4	4,0	3,9	4,0	2,7	3,5	3,9
110	single leaf	3,5	2,4	3,3	3,6	3,0	2,4	2,8	3,6	3,0	2,4	2,8	3,6
110-110	cavity	6,0	2,4	5,0	4,2	5,0	2,4	4,2	4,2	4,5	2,7	4,2	4,2
140	single leaf	5,5	2,4	4,5	4,2	4,5	2,7	4,0	4,2	4,2	2,4	3,7	4,2
190	single leaf	7,5	2,7	6,0	4,4	6,5	2,4	5,0	4,6	6,0	2,7	4,8	4,4

Note:

1. Two alternative panel sizes (L x H) are provided in respect of each panel type; the left hand column for each panel type provides dimensions for the maximum length (L) and the right hand column the corresponding maximum height dimension (H). Linear interpolation is permitted between these two sets of panel dimensions but not between wall types.
2. The values tabulated in respect of solid units may be used for corresponding walls of hollow unit construction provided that the following reinforcement is provided:
   a) Truss type brickforce having main wires of not less than 3,55 mm diameter built into courses at vertical centres not exceeding 400 mm; and
   b) Either two 5,6 mm diameter rods in 90 mm and 110 mm single leaf and cavity walls in the bed joint immediately above window level, or a single Y8 bar in a bond block in 140 mm and 190 mm single leaf walls at this same level, such reinforcements extending across the entire length of the panel and into the supports.
3. Where collar joints in collar jointed walls are not fully mortared, such walls shall be treated as cavity walls.
4. Panels incorporating full height doors or doors with fanlights are to be treated as panels supported on one side only.

Limitations of infill masonry panels in framed buildings (Clause 4.2.3)

Infill masonry wall panels in framed buildings of four storeys and less are sized in a similar manner as those in the previous section and shall have dimensions not longer than those contained in Table 3 or Figure 10 of SANS 10400-K or derived from Tables 9 to 15 in the Standard. Panel sizes are subject to the maximum lengths of openings and the minimum distances between the face of supports and openings and between successive openings. Vertical supports, which are provided by means of intersecting masonry walls are similar as before (See Figure 5.2), whilst infill masonry wall panels shall be connected to reinforced concrete columns and slab soffits. All joints shall be filled with elasto-plastic sealants to accommodate movement.

Summary of limitations

Figure 5.5 gives a summary of the order of magnitude of wall panel configurations with various support conditions; panels incorporating full height doors shall be treated as being supported on the one side only. Jointed and 110 single leaf wall types horizontally supported and with vertical supports (excluding vertical butt joints) shall have wall panel sizes as indicated in Figure 5.2; Figure 5.3 below in conjunction with SANS 10400-K shall be consulted for other nominal wall thicknesses and other types of support conditions.

Summary

- A 220 collar jointed external wall panel wall supported on both sides made up of solid units can be built to a maximum length (L) and height (H) of 9,0m and 3,3m respectively with openings in excess of 15 %
- As the support conditions become less effective, i.e. if provided with a tied joint on one side the same wall becomes smaller, i.e. and can be built to a maximum length (L) and height (H) of 9,0m (or 8,0m) and 2,4m (or 3,3) respectively
- If provided with a tied joint on both sides the same wall becomes even smaller, i.e. and can be built to a maximum length (L) and height (H) of 7,0m (or 5,5m) and 2,4m (or 3,3) respectively
- If provided with a tied joint on both sides the same wall becomes even smaller, i.e. and can be built to a maximum length (L) and height (H) of 7,0m (or 5,5m) and 2,4m (or 3,3) respectively

5.5 - Summary of wall panel sizes in framed buildings

5.2.5.1 Free-standing boundary and garden walls (Clause 4.2.4.2)

Where any free-standing wall is a masonry wall the thickness and pier size of such a wall shall conform to the relevant values given in Table 5.2; such walls retain no earth, have piers extending to the top of the wall without any reduction in size, terminate in a pier or a return a have solidly filled cores in all piers where units are hollow. No horizontal damp proof course shall be provided in free-standing boundary and garden walls.

Table 5.2 - Free-standing walls (solid units)

1 Nominal wall thickness (T) mm	2 Maximum height (H) m	3 Nominal dimensions of piers (overall depth x width (D X W) mm	4 Maximum pier spacing (centre to centre; S) m
No piers			
90	0,8	-	-
110	1,0	-	-
140	1,3	-	-
190	1,5	-	-
220	1,8	-	-
290	2,2	-	-
Z shaped			
90	1,8	390x90	1,2
90	2,0	490x90	1,4
110	1,6	330x110	1,5
110	2,1	440x110	1,5
140	2,2	440x140	2,0
140	2,5	590x140	2,5
190	2,1	390x190	2,5
190	2,5	490x190	3,0
220	2,4	440x220	3,0
220	2,8	550x220	4,0
Piers projecting on one side			
90	1,4	290x290	1,4
90	1,5	390x290	1,6
90	1,7	490x290	1,6
110	1,5	330x330	1,8
110	1,5	440x330	1,8
110	1,9	550x330	2,0
140	1,7	440x440	2,2
140	1,8	590x390	2,5
190	2,0	590x390	2,8
220	2,3	660x440	3,2
Piers projecting on both sides			
90	1,5	490x290	1,4
110	1,6	550x330	1,8
140	1,6	440x440	2,2
190	1,8	590x390	2,8
220	2,1	660x440	3,2
Diaphragm walls			
90	2,1	290x190	1,4
90	2,7	390x190	1,4
110	2,6	330x220	1,6

NOTE:
D = total depth of pier plus wall thickness; W = width of pier; S = centreline spacing of piers.

Free-standing parapet and balustrade walls (Clause 4.2.5)

Free-standing balustrade and parapet walls of solid units shall have a thickness of not less than the height of the wall above the base divided by 5 or 4,5 if no dpc is present and if dpc is present at the base respectively.

Balustrades and parapet walls made up of solid units that have returns which continue for a distance of at least 0,75 metres from the external face of such walls or are fixed to columns at centres not exceeding 3,5 metres, shall have a thickness of not less than 110.

Free-standing retaining walls (Clause 4.2.4.1)

Free-standing retaining walls shall be designed and constructed so that:

a) the height of fill retained by free-standing retaining walls does not exceed the values given in Table 5.5;
b) piers, where required in terms of Table 5.5, project on the opposite side of the wall to the fill that is being retained;
c) control joints are located at intervals not exceeding 10m;
d) no surcharge of fill is placed within a distance equal to the height of the amount of fill being retained; and
e) sub-soil drainage is provided behind the wall by providing weepholes formed by building into the wall, 50 mm diameter plastic pipes, with the non-exposed end covered with geofabric, at a height not exceeding 300 mm above the lower ground level, at centres not exceeding 1,5 metres.
f) No horizontal damp proof course shall be provided.

Table 5.3 - Retaining walls (solid units)

1	2	3	4	5
Nominal wall thickness (T) mm	**Wall Types**	**Maximum height retained (h) without piers m**	**Nominal pier dimension (D) mm**	**Maximum pier spacing m**
Solid units				
140	Single leaf	1,3	600 x 300	1,8
190	Collar jointed	1,3	600 x 300	2,5
190	Collar jointed	1,6	800 x 400	2,6
220	Collar jointed	1,7	660 x 330	3,0
220	Collar jointed	1,8	880 x 440	3,1
290	Collar jointed	1,0	-	-
330	Collar jointed	1,2	-	-

Foundation walls (Clause 4.2.2.6)

Foundation walls shall not exceed 1,5 m in height and be of a thickness not less than the wall it supports. The cores in hollow units and cavities in cavity walls shall be filled with grade 10; infill concrete. The height of fill retained behind a masonry foundation wall shall not exceed the values given in Table 5.6; the height being the difference in ground level between the soffit of the surface bed and the external ground level

1	2	3
Nominal wall thickness mm	**Wall type**	**Maximum difference in ground levels - mm**
90 and 110	single leaf	200
140	single leaf	400
190	single leaf / collar jointed	600
220	collar jointed	700
90-90	cavity	700
110-110	cavity	1000
290	collar jointed	1000
330	collar jointed	1200

Empirical Rules for Foundations (SANS 10400-H)

Empiricla rules apply to buildings not exceeding two storeys in height and with loadings not exceeding those detailed in building limitations for empirical design, except in cases where the founding material consists of a problem soil, i.e. heavy soil or shrinkable clay or a soil with collapsible fabric.

These rules include that:

- Walls are to be placed centrally on foundations.
- Concrete should have a compressive strength of at least 10MPa.
- Any continuous strip foundation shall have a thickness of not less than 200mm.
- The minimum width any continuous strip foundation shall not be less than 600mm for a wall supporting a roof covered with concrete tiles, clay tiles or thatch; 400mm for a wall supporting a roof covered with metal or fibre-cement sheets or metal roof tiles.

SABS 0161: The design of foundations for buildings contains recommendations with regard to site investigations and inspections, materials, design considerations, earthworks and excavations, and foundation types.

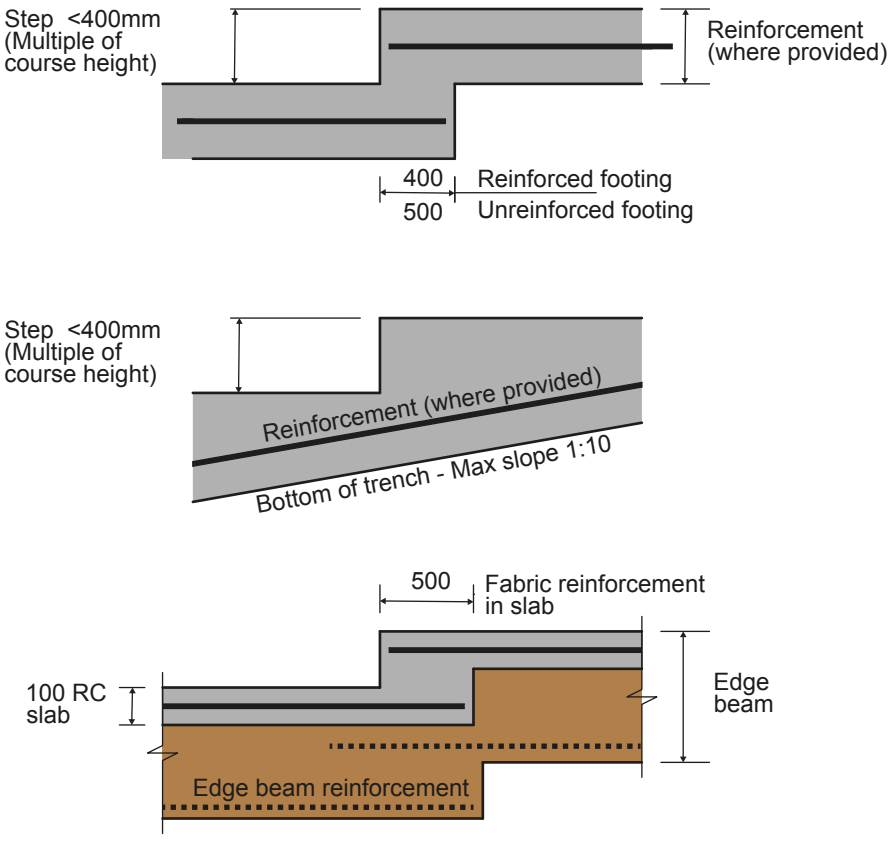
Foundation Preparation

- Top soil containing grass roots must be removed from the area where unreinforced or reinforced slabs are to rest. Loose or disturbed ground must be compacted.
- The accuracy of the setting out shall be achieved through positive control measures: their relative location to site boundaries and adjacent structures shall be verified. Regular checks on the trench widths trench lengths and the length of diagonals across external corners must be carried out.
- On sloping ground, foundation trenches for strip footings may be stepped so that the required foundation depth is attained as shown in Figure 5.3.
- Sites of receive 'slab-on-the-ground foundations' shall be levelled. All necessary filling shall comply with the requirements of compaction provided below. The bases of edge beams shall be sloped not more than 1:10. Steps in slabs in excess of 400mm shall only be permissible if approved by a competent person.
- Steps in foundations shall not be provided within 1,0m from corners.
- Excavations shall be deepened locally to remove soft spots where necessary. Hard spots shall be removed wherever practicable. Where soft spots / isolated boulders do not exceed 1 500mm in diameter, unreinforced strips foundations may be centrally reinforced with two No Y12 bars externally a distance of not less than 1 500mm beyond the face of such soft spots as shown in Figure 5.2.
- Excavations should be prodded with a 10-12mm diameter bar prior to the casting of concrete. Uniform penetration should be obtained. Where this is not the case the soft spots (where penetration is greater than in the surrounding areas), should be dealt with as shown in Figure 5.2.

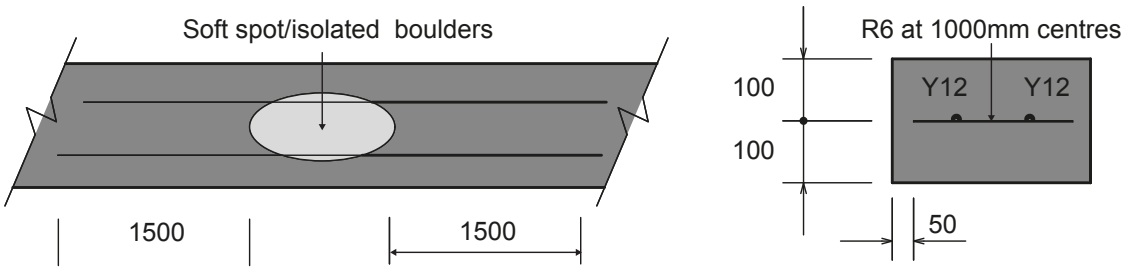
Excessive foundation excavations shall be avoided.

Any fill upon which edge beams of 'slab-on-the-ground' foundations and strip footings are to be founded, shall be placed under the supervision of a competent person or shall be deepened to be founded on in situ material. The controlled fill shall continue past the edge of the foundation and at least 1 000mm shall be retained or battered beyond this point by a slope not steeper than 1 : 2 (vertical : horizontal).

- Trenches shall be kept free of surface water.
- Where the bottom part of foundations has dried out excessively due to exposure or has softened due to rain or ground water, the excavation shall be re-bottomed prior to concreting.



5.6 - Methods for stepping strip footings and slab-on-the-ground foundations



5.7 - Reinforcement in strip footings at soft spots/isolated boulders

Minimum width of Strip Foundations in Single Storey Structures – SABS 0161: Part 4, Section 2, Table 2

Table 5.5: Minimum width of strip foundations

Founding Material Type	Tile / Sheeted Roof		Reinforced Concrete Roof	
	Internal Wall (mm)	External Wall (mm)	Internal Wall (mm)	External Wall (mm)
Rock	400	400	400	400
Soil	400	500	600	750

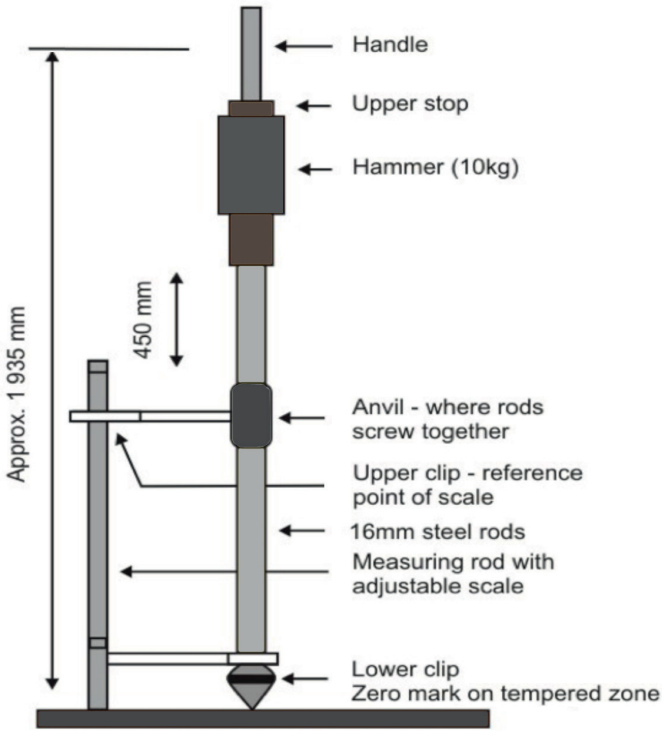
NOTE:

Internal walls upon which reinforced concrete roofs do not bear may have a foundation width of 400mm

Compaction

The maximum height of fill beneath floor slabs and 'slab-on-the-ground' foundations, measured at the lowest point shall not exceed 400mm unless certified by a competent person. Fill shall be moistened prior to compaction so that a handful squeezed in the hand is firm but does not show signs of moisture. Fill shall be placed in un-compacted layers not exceeding 100mm in respect of hand compaction or 150mm in respect of compaction by mechanical means.

Each un-compacted layer shall be well compacted before additional fill material is added. Compaction in excess of 3 blows of a dynamic cone penetrometer (See figure 10) is required to penetrate 100mm of the fill provided that fills do not comprise more than 10% gravel of size less than 10mm and contain no isolated boulders.



5.8 - Dynamic cone penetrometer

Minimum thickness of foundation walls (SABS 0400 Table 4 – Part KK9)

- The height of any foundation wall not acting as a retaining wall shall not exceed 1,5m.
- Where a difference in ground level, including backfill exists between the two foundation walls such difference shall not exceed 1,0m.
- No foundation wall shall have a thickness less than the relevant value given in Table 5.3; provided that such thickness shall not be less than:
  - The thickness of the wall carried by such foundation wall; or
  - If it is the wall carried by the foundation wall, the sum of the thicknesses of the leaves of such a cavity wall.

Table 5.6 - Minimum thickness of foundation walls

Type of foundation wall	Acting as a retaining wall			Not acting as a retaining wall			
	Difference in ground level (mm)			Height (mm)			
	Less than 500	500 to 750	750 to 1000	Less than 300	300 to 500	500 to 1000	1000 to 1500
Single Leaf Brick							
External	140	190	230	140	140	140	190
Internal	-	190	230	90	140	140	190
Single Leaf hollow block (cavities filled with concrete)							
External	140	190	230	140	140	140	190
Internal	140	190	230	90	140	140	190
Cavity Wall							
External (cavity filled to 150mm below damp-proof course level)	190	190	230	190	190	190	190

Rain Penetration Requirements (SABS 10400:Part K:Section 4.5:Annexure C)

The resistance of external walls to rain penetration shall be in accordance with Table 5.7 when tested in accordance with the requirements of Annexure C, SANS 10400: Part K.

Category 1 Building

Building which:

a) Is designated as of class A3, A4, F2, G1, H2, H3 or H4 occupancy (See regulation A20 in SANS 10400-A),
b) Has no basements,
c) Has a maximum length of 6,0m between intersecting walls or members providing lateral support, and
d) Has a floor area that does not exceed 80m^2

Table 5.7 – Rain penetration acceptance criteria

Building Category	Acceptance criteria when tested in accordance with the requirements of Annexure C
Category 1	Moisture which penetrates the wall of insufficient intensity to run down the wall onto the floor of the house.
Other than category 1	No damp patches are visible on the inside of the wall.

Stainless steel (Grade 816) ties shall be used in the following areas:

- Sea spray zones; and
- Tidal and splash zones.

Coastal areas are situated between the coastline and an imaginary line 30km inland, parallel with the coastline, or the top of the escarpment or watershed of the first mountain range inland, if these are less than 30km from the coastline. The entire area of jurisdiction of any local authority whose area is cut by the line demarcating these coastal areas is taken as falling within the coastal area.

Mortar

Four types of building mortar are detailed in SABS specifications (SABS 0164-1 and SABS 0249):

- Common cement: sand
- Common cement: lime; sand
- Common cement: sand plus mortar plasticiser
- Masonry cement: sand.

Table 5.8 - Proportions of mortar

Mortar class	Common Cement (kg)	Lime (Litres)	Sand (measured loose and damp) (Litres Max.)	Masonry Cement; Sand or Common Cement, Sand with Mortar, Plasticiser	
				kg	Litres Max
I	50	0-10	130	50	100
II	50	0-40	200	50	170
III	50	0-80	300	50	200

Mix Proportions

The approximate limiting proportions of these mortars are detailed in Table 5.8.

Class II mortar is the general purpose mortar for all brickwork. Concrete wheelbarrows have 65 litres and a sand volume of 200 litres is achieved by using three wheelbarrows of sand. The addition of lime is optional. A maximum of 40 litres is permitted per 50 kg unit of common cement.

A competent person is required to design mixes for mortars that use materials or mix proportions other than those described above.

Cement

Cements for use in mortar shall be common cements complying with SABS E 197-1, and masonry cements complying with SABS ENV 413-1.

Cement Designation	Strength Glade
CEM I	42,5N
CEM II A-L	32,5N or higher
CEM II A-M	42,5N
CEM II A-S	32,5N or higher
CEM II A-V	32,5N or higher
CEM II B-S	32,5N or higher
CEM II BV	32,5N or higher
CEM III	32,5N or higher

Lime

The use of Lime in mortar mixes is optional. Lime imparts the properties of plasticity and water retention to mortar. The latter property is important as it prevents mortar drying out, resulting in the incomplete hydration of the common cement.

Lime used in mortar is hydrated lime (commercial bedding lime) and not quicklime or agricultural lime. Lime gives the best results when used with coarse sands. Lime with clayey sands can make tile mortar over-cohesive and difficult to use. Lime should not be used with masonry cement.

Sand

Sand for mortar should comply with SABS 1090 and must be well graded from 5mm downwards in accordance with Table 5.8

In the assessment of mortar sands grading is only one factor to be considered, with shape, surface area character of fines and average particle size of the sand also being important. A simple practical field test that includes these factors is the cement and concrete institute test.

Provided that the choice of sand yields a smooth, plastic and cohesive mix, its quality, based on “water demand” can be determined by the following test. Quantities used should be weighed on a kitchen scale that is accurate, and tile test should be carried out on a smooth impervious surface. It is also important that the sample used is fairly representative of the bulk supply.

Size of square apertures (mm)	Percentage by mass passing	
	Fine aggregate Plaster	Fine aggregate Mortar
4,750	100	100
2,360	90-100	90-100
1,180	70-100	70-100
0,600	40-90	40-100
0,300	5,65	5,85
0,150	0-20	0-35
0,075	0-7,5	0-12,5

Procedure:

- Dry out a wheelbarrow full of sand to be tested.
- Weigh 5kg cement and 25kg of dry sand.
- Measure 5 litres, 1 litre and 1,5 litres water into separate containers.
- Mix the cement and sand until the colour is uniform.
- In succession, mix in each of the volumes of water (5 litres, 1 litre and 1,5 litres) until the mix reaches a consistency suitable for plastering.

Then:

- If 5 litres is enough -the sand is of “good” quality
- If 5 litres + 1 litre is enough -the sand is of “average” quality
- If 5 litres + 1 litre + 1,5 litres is enough -the sand is “poor”
- If more than 7.5 litres is needed -the sand is “very poor”’
- A “good “ or “average” sand should be used for mortar in walling below the damp-proof course”.

Mortar Plasticisers

Mortar plasticisers exercise a desirable effect on the workability and plasticity of the mortar in which they are used. Generally,

the admixtures have no effect on setting time (they do not accelerate or retard the mortar setting) but may cause air-entrainment.

The use of mortar plasticisers is optional. Their effectiveness varies with the quality of sand, the composition of the cement, its fineness, the water-cement ratio, temperature of the mortar, volume of plasticiser and other factors, such as site conditions.

Pigments

Pigments may be used to colour mortar, with the dosage depending on the specific colour required. The recommended limit on mineral oxide content is 7% of common cement content. Pigmented mortar with face brickwork can change the appearance of a building dramatically.

Ready-Mixed Mortar

Ready-mixed mortar with an extended board life has been successfully used over a number of years. Ready-mixed mortar has advantages of convenient need on site as it is delivered at a consistency ready for use. Usually it is delivered in ready-mix trucks or containers. It is stored in containers on site in a "protective manner" that minimises loss due to evaporation and protects the mortar from freezing in cold weather. No other materials or admixtures are added on the site.

The mortar contains a regulator, which is a retarding type admixture that controls the initial hydration period of the cement. This allows the mortar to remain plastic and workable for a period, generally between 24 and 36 hours, but sometimes as long as 72 hours. At any time during this period when the mortar is used, suction by the masonry units will occur and initial set takes place in a normal manner. The early strength that develops is satisfactory for the walls to be constructed at a normal rate and the mortar will retain enough water to ensure long-term strength development.

NOTES