Concrete masonry:
Strong, durable and attractive
Guidelines on the DETAILING OF CONCRETE MASONRY

VOLUME 2 HOLLOW UNITS – 140mm and 190mm

Editors: J W Lane J E Cairns JH Catsavis
Successful masonry depends on adequate design and specification of materials, sound construction practice and an acceptable quality of workmanship. Good workmanship is in turn dependent on access to accepted norms of local detailing practice and materials.

The purpose of this booklet is to provide guidelines for the detailing of concrete masonry structures. It should be read in conjunction with the Concrete Manufacturers Association’s Masonry Manual, the National Building Regulations, and National Home Builders Registration Council Home Building Manual the relevant South African Bureau of Standards specifications and codes of practice.
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140 mm and 190 mm HOLLOW UNITS
SINGLE LEAF WALLS (REFERENCE H-**-*)

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Reference:
Refer to: Volume 1 for details of 140 mm solid unit walls
Volume 3 for details of cavity walls
# GUIDELINES ON THE DETAILING OF MASONRY STRUCTURES REFERENCES CODING SYSTEM

## DESCRIPTION OF WALL

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## POSITION IN WALLS

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### Notes:

The computer reference number is the file name under which the individual drawings are stored. The last two digits (indicated with an asterisk above) represent the numbering of drawing in that particular category. Where the last two digits are replaced with the letter “NB”, this file contains notes which are pertinent to the drawings in the particular category.
Concrete masonry has wide applications in modern industrial, commercial, educational and residential buildings.

The main types of masonry walls dealt with in these guidelines are: single leaf walls using solid units (Part 1), single leaf walls using hollow units (Part 2) and cavity walls (Part 3).

The details shown in this publication are intended merely as a guide. Each construction situation is unique and there are many factors to be considered before a detail is finalised – far too many for inclusion here.

The purpose of good detailing is to assist in achieving sound construction and a buildable structure that will perform well in service.

The following factors must be taken into account when detailing for concrete masonry structures:

Materials:
- Concrete masonry units:
  - solid/hollow – dimensions
  - non-face/face – texture, colour and profile properties and availability.
- Mortar:
  - Class to be used plus materials. (Will mortar sand result in high shrinkage of mortar and wall?)

Environmental conditions:
- Environment:
  - Orientation
  - Likelihood of significant movement due to temperature and moisture variations
- Earth/Seismic movement

Service conditions:
- Loading:
  - dead, imposed, wind, unexpected
- Aggressive conditions:
  - corrosion

Type of structure
- Unreinforced/reinforced/prestressed
- Composite structure:
  - masonry/reinforced concrete
  - masonry/prestressed concrete
  - masonry/structural steel
  - masonry/timber and their interaction

Degree of fixity between elements and likely movement.

Special finishes and specification requirements.

Workmanship quality

Design

- Modular co-ordination of building elements-work to 200mm module horizontally and 100mm (and 200mm when using facings) vertically.

Details in these guidelines do not necessarily apply to masonry structures over four storeys in height.

Unless otherwise stated, the details shown are based on the “deemed to satisfy” clauses of SANS 10400 and the NHBRC Home Building Manual (HBM).

In this code of practice, only strip foundations are covered, but there may be a need for special foundations in particular cases. Authoritative advice should be obtained in this regard.

The information contained in this publication is intended as a guide only. The Concrete Manufacturers Association cannot be held responsible for its interpretation and use.
**H-FG-01**
See H-FG-NB

- Weephole in perpend joints every 800mm
- Bond block may be used here concrete/mortar infill sloped outside

**H-FG-02**
See H-FG-NB

- Weephole in perpend joints every 800mm
- Bond block may be used here concrete/mortar infill sloped outside

**H-FG-03**
See H-FG-NB

- Weephole in bedding course on top of foundation 30mm wide every 600mm
- Shell bedding

**STRIP FOUNDATION**

**THICKENED SLAB FOUNDATION**
**Note:**

1. Thickened slab foundations may cause cracking with ground floor slab. Consider use of fabric reinforcement in slab to limit cracking.
2. The bearing capacity and sensitivity to moisture changes of soil may be unsatisfactory with thickened slab foundations.
3. Refer to SANS 10161 for foundation sizes based on specific soil conditions and Home Building Manual.
4. Bond or U-blocks, without damp-proof sheeting, may be used in place of traditional DPCs. The position of weepholes is changed – see details below. In all cases the mortar bedding is shell bedding with no mortar under webs.
5. Foundation material conditions will determine whether wall, concrete or steel columns share a common foundation around the column foundation area. Estimates of likely settlement between wall and column will determine the need or otherwise for movement (control) joints in the wall.
**H-FG-05**
See H-FG-NB

Cores filled with 15 MPa concrete

DPC

Screed

Concrete floor slab

Dampproof sheeting turned up at ends and hidden behind screed or skirting

**H-FG-06**
See H-FG-NB

Cores filled with 15 MPa concrete

Concrete floor slab

Dampproof sheeting continuous under slab

**H-FG-07**
See H-FG-NB

Concrete foundation & floor slab

Dampproof sheeting continuous under concrete foundation

**STRIP FOUNDATION**

**THICKENED SLAB FOUNDATION**
Note:

It is recommended that the external sloping face of masonry sills be painted with a clear coating of water repellent.

Note:

1. Refer to CMA Design Guide and Technical Notes on lintels.
2. Units manufactured in different lengths

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**WINDOW FRAME DETAILS – STEEL FRAMES**

**H-WF-01**
See H-SI-01/05
See H-LI-01/04

**FRONT ELEVATION**

**SECTION**

**PLAN AT X – X**

**Note:**
Sill blocks can be used on sides of windows. See H-WW-06

**STEEL WINDOW FRAMES OF MODULAR DIMENSIONS**

Overall window frame size:
625, 825, 1025, 1425, 1625
WINDOW FRAME DETAILS - STEEL FRAMES

H-WF-02
See H-SI-01/05
See H-LI-01/04

Lintel to suit

Cut unit under sill to fit modular coursing

Lintel to suit

Cut unit under sill to fit modular coursing

Adjust joint-widths or cut units to fit

Lugs to frame turned down into core filled with 15MPa concrete

Lintel reinforcement

Overall window frame size:

359, 654, 949, 1245, 1540, 1854

Overall window frame size:

353, 1022, 1511, 2000, 2489

Note:
Sill blocks can be used on sides of windows. See H-WW-06

PLAN AT X – X

Sash block

Plaster

Sash groove

Sealant

STEEL WINDOW FRAMES OF NON-MODULAR DIMENSIONS
Door size 762 x 1981

Finished floor level

Lugs to frame turned down into core filled with 15MPa concrete

20 modules = 2000

35

8 modules = 800

140/190

35

762

832

Steel door frame 762 x 1981 to fit modular space 800 x 2000mm
Lugs to frame turned down into core filled with 15MPa concrete

Door size 813 x 2032

Finished floor level

Joint widths adjusted to fix door frame in masonry except for fluted or scored units where modular size frame required

9 modules = 900

813 883 35

Steel door frame 813 x 2032 to fit modular space 900 x 2100mm
ALUMINIUM DOOR FRAME 813 x 2032 TO FIT MODULAR SPACE 900 x 2100mm
Many factors influence the detail to be used at the junction of suspended concrete floors. Consideration should be given to the following:

**STRUCTURAL ASPECTS**
- Is wall below slab structural or non-structural (i.e. infilling panel)?
- Is allowance to be made between top of supporting structural wall and slab for horizontal movement i.e. sliding? Or should there be fixity between wall and slab?

(Note: Sliding or fixity considerations are significant factors in design of both wall and slab)

**DETAILING ASPECTS**
- Does suspended slab bear on full or part width of wall?
- Is exterior of wall face or plastered?
- Is damp proofing required?

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**EXTERNAL**
- STRUCTURAL
- NON-STRUCTURAL

**INTERNAL**
- STRUCTURAL
- NON-STRUCTURAL
**H-SF-01**
See H-SF-NB

**PLASTERED STRUCTURAL WALL SUPPORTING SLAB**

- 30mm wide weep hole in bedding mortar above DPC spaced at maximum 600mm centres
- V-joints in plaster
- Plaster
- DPC bent up and hidden behind skirting or topping
- Topping if required
- Slip plane – see note
- U/bond block beam suitably reinforced

**H-SF-02**
See H-SF-NB

**FACE STRUCTURAL WALL SUPPORTING SLAB OF NON-MODULAR THICKNESS**

- 30mm wide weep hole in bedding mortar above DPC spaced at maximum 600mm centres
- 6mm bar cast in U/bond block beam with projecting leg to hold 90mm block above in position
- Facework
- DPC bent up and hidden behind skirting or topping
- Cast in-situ 20MPa concrete fillet
- Topping if required
- Concrete slab of non-modular thickness
- Slip plane – see note, 90mm minimum bearing under slab
1. If floor slab span exceeds 6m spanning on to wall and large movements expected consider a slip joint on top of wall, such as two layers of DPC or galv. sheet iron with grease between sheets or kilcher bearing or similar.

2. Structural stability & robustness may preclude use of slip joint.

3. If designer assumes wall laterally restrained by slab then slip joint not advisable.

4. Suspended floors either precast or cast-in-situ unless otherwise stated.

5. Where fixity required between slab and wall, reinforcement to be used to be determined by calculation.

6. Slabs of non-modular thickness require concrete infill (under modular size) or cut block (over modular size) to restore block coursing.

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**Note:** If upper wall structural check if load on cut block is sufficient to dislodge.

---

**H-SF-NB**

**Research:**

- Spacing of perpend joints
- Special metal ties
**FACE STRUCTURAL WALL SUPPORTING SLAB OF MODULAR THICKNESS**

**H-SF-04**
See H-SF-NB

- 30mm wide weep hole in bedding mortar above DPC spaced at maximum 600mm centres
- DPC bent up and hidden behind skirting or topping
- Topping if required
- Concrete slab of non-modular thickness
- Slip plane – see note.
- 90mm minimum bearing under slab
- Facework

**FACE STRUCTURAL WALL SUPPORTING SLAB OF MODULAR THICKNESS**

**H-SF-05**
See H-SF-NB

- 30mm wide weep hole in bedding mortar above DPC spaced at maximum 600mm centres
- DPC bent up and hidden behind skirting or topping
- Spacing of perpend joints
- Special metal ties
- Topping if required
- Concrete slab of modular thickness
- Cut block (hollow, U- or bond block) mortared to slab and use special ties
- U/bond block beam suitably reinforced
- Slip plane – see note.
- 90mm minimum bearing under slab

**Note:**
If upper wall structural check if load on cut block is sufficient to dislodge
SUSPENDED FLOORS ON EXTERNAL WALLS

H-SF-06
See H-SF-NB

PLASTERED STRUCTURAL WALL WHERE FIXITY BETWEEN WALL & SLAB REQUIRED

H-SF-07
See H-SF-NB

FACE STRUCTURAL WALL WHERE FIXITY BETWEEN WALL & SLAB REQUIRED OF MODULAR THICKNESS
NON-STRUCTURAL INFILL PANEL WALL-LATERAL SUPPORT

**H-SF-08**

See App C

- DPC bent up and hidden behind skirting or topping
- 30mm wide weep hole in bedding mortar above DPC spaced at maximum 600mm centres
- 10mm minimum gap sealed with sealant
- Anchor shown in perpend joint. If anchor in block core use open-ended blocks for easy construction. Core filled with 15 MPa concrete. Grease anchor

**Note:**

Non-structural walls not to be built tight to underside of slab

**H-SF-09**

See App C

- DPC bent up and hidden behind skirting or topping
- 30mm wide weep hole in bedding mortar above DPC spaced at maximum 600mm centres
- Sections of metal channel fixed to slab soffit to project into top of bond block. Gap between top of block and slab soffit sealed with sealant.

**NON-STRUCTURAL INFILL PANEL WALL-LATERAL SUPPORT**

**H-SF-10**

See App C

- DPC bent up and hidden behind skirting or topping
- 30mm wide weep hole in bedding mortar above DPC spaced at maximum 600mm centres
- 90mm wide unit resting on MS angle (galv. if required) fixed to slab
- 10mm min. gap between top of block and angle soffit sealed with sealant.

**FACE NON-STRUCTURAL INFILL PANEL WALL - NO LATERAL SUPPORT**

- Concrete slab of modular thickness
- Use cornice fixed to slab to hide gap
### H-SF-11
See H-SF-NB1

- Topping if required
- Concrete slab
- Joint in slab

**Check if bearing area adequate**

**Structural Wall Supporting Jointed Slab & Wall Above**

### H-SF-12
See H-SF-NB1

- Topping if required
- Concrete slab
- Joint in slab
- Angle to support slab

**Structural Wall Supporting Jointed Slab & Wall Above**

### H-SF-13
See H-SF-NB1

- Topping if required
- Concrete slab

**Structural Wall Supporting Continuous Slab & Wall Above**

### H-SF-14

- If slab and topping continuous over support consider light fabric reinforcement in topping
- Concrete slab

**Structural Wall Supporting Slab Only**

### H-SF-NB1

**Note:**

If thickness of slab is not modular then concrete infill or cut blocks to be used in first course above slab to restore unit coursing to bond with external walls.
Suspended Floors on Internal Walls

**H-SF-15**
*See App C*
*See H-SF-NB1*

- Topping if required
- Concrete slab
- MS angles fixed to slab soffit only providing lateral restraint. If lateral support not required replace angles with cornices fixed to soffit of slab only.

**Note:**
Non-structural walls not to be built tight to soffit of slab.

**NON-STRUCTURAL WALL WITH LATERAL SUPPORT AT SLAB SOFFIT**

**H-SF-16**
*See App C*
*See H-SF-NB1*

- Topping if required
- Concrete slab
- Metal channel fixed to slab soffit to project into top of bond block
- 10mm minimum gap filled with compressible joint filler and or sealed

**Note:**
Non-structural walls not to be built tight to soffit of slab.

**NON-STRUCTURAL WALL WITH LATERAL SUPPORT AT SLAB SOFFIT**

**H-SF-17**
*See App C*
*See H-SF-NB1*

- Slab
- Fixing
- Anchor
- Concrete slab
- Masonry anchor in metal fixed to soffit of slab at 800mm maximum spacing, with wall ties, sliding on anchor, built into bedding joint.
- Anchor shown in perpend joint. If anchor in block core use open-ended blocks for easy construction. Core filled with 15 MPa concrete. Grease anchor.

**Note:**
Non-structural walls not to be built tight to soffit of slab.

**NON-STRUCTURAL WALL WITH LATERAL SUPPORT AT SLAB SOFFIT**
**PRECAST CONCRETE COPING ON BEAM**

**H-PW-01**  
See H-PW-NB  
Precast concrete coping to suit with recessed water drips

**H-PW-02**  
See H-PW-NB  
Precast concrete coping to suit with recessed water drips

**LIQUID APPLIED WATERPROOFING SYSTEM**

**H-PW-03**  
See H-PW-NB  
Liquid applied reinforced emulsion waterproofing system with non-woven fabric on bond or U-beam or unit filled with 20 MPa concrete

**H-PW-04**  
See H-PW-NB  
0.6 to 0.8mm galvanised or prepainted metal cap flashing usually 3m lengths – lapped at joints – screw fixed to back of wall – horizontally slotted holes in cap – on bond or U-beam or unit filled with 20 MPa concrete

**MASONRY COPING**

**H-PW-05**  
See H-PW-NB  
Liquid applied reinforced emulsion waterproofing system with non-woven cloth

**H-RS-01**

**Note:**  
1. Parapet walls to be designed for wind loading  
2. Where conditions are such that the coping is likely to be dislodged some mechanical fixing of coping to wall to be considered  
3. Parapet walls to be designed to accommodate horizontal movements whilst maintaining structural stability

**Note:**  
It is recommended that the external sloping face of sill block be painted with a clear water repellent.

**Sill block used as coping**

**Top of roof slab**

**WATERPROOFING – PARAPET WALLS / ROOF SCREEDS**
ROOF ANCHORAGE TO BEAM

Galv. steel wire or hoop iron strap wrapped around reinforcing bar and cast into U-beam, fixed to roof truss. Where length of anchorage is inadequate use bond/U-beam over opening then ends of beam to be anchored to greater depth into wall.

ROOF ANCHORAGE TO WALL

Galv. steel wire or hoop iron strap placed in cores of blocks. Cores filled with 15 MPa concrete.

BEAM FILLING

Galv. steel wire or hoop iron strap placed in cores of blocks. Cores filled with 15 MPa concrete. Mesh to support concrete infilling.

ANCHORING ROOF TRUSSES OVER OPENINGS

Anchors to tie lintel to wall where required, bent into lintel. U-block on end can be used to close end of masonry lintel.

H-RT-01
See App D
See H-RT-04

H-RT-02
See App D

H-RT-03
See App D

H-RT-04
See App D
**ROOF TRUSS FIXING TO PARAPET WALL**

**H-RT-05**
See App D

- Hollow units supporting roof truss members to be filled with 15 MPa concrete to take bolts
- Mesh to support concrete in core
- Fixing to hollow unit cores filled with 15 MPa concrete or angle support
- Standard shoe to support roof truss to wall
- Flashing
- Roof sheeting/tiles
- Coping to suit

**ROOF TRUSS FIXING TO PARAPET WALL**

**H-RT-06**
See App D

- Dampproofing of wall requires special attention. Check structural stability
- Provide DPC
- Inner leaf in modular bricks
- Roof truss
- Wall plate if required
- 90 90
- 190

**H-RT-07**
See App D

- Metal roof sheeting
- Roof truss
- Wall plate if required
- 190

**ROOF TRUSS FIXING TO WALL – COVERED WITH CONTINUOUS SHEETING**
MASONRY BOND PATTERNS AND JOINT PROFILES

H-BP-01
STRETCHER OR RUNNING BOND

H-BP-02
STACK BOND

H-BP-03
QUARTER BOND

H-BP-04
COURSED ASHLAR BOND

H-BP-05
ASHLAR BOND

Ties required between pier and wall

H-BP-06
STRETCHER BOND WITH STACK BOND PIER
MASTORY BOND PATTERNS AND JOINT PROFILES

H-BP-07

H-BP-08

BANDING

DIAGONAL PATTERN

H-JP-01

See S-JP-NB

For 10mm joint use 12mm ruling tool

CONCAVE VEE WEATHERED FLUSH RAKED STRUCK

* GOOD PRACTICE * FAIR PRACTICE * POOR PRACTICE *

Note:
With plastered walls a recessed joint to assist bonding of plaster to walls is preferable.

JOINT PROFILES FOR EXTERNAL WALLS SUBJECT TO WEATHER

H-JP-02

Fair face masonry with joint widths 10mm use 12mm Ø rod to rule joints when mortar thumb print hard. Rockface masonry with joint width 10mm use 9mm Ø rod to rule joints.

Fluted and scored rockface masonry with joint widths 10mm use 8x8mm square bar to rule joints when mortar thumb print hard. If concave joint profile required use 8mm Ø rod

PLAN: FLUTED UNIT

FINISHING OF BEDDING AND PERPEND JOINTS

Fluted or scored units joint profile square and finished to fillet of fluting or scoring, unless otherwise specified.
WALL TO WALL INTERSECTIONS – CORNERS

H-WW-01

140mm WALL: 400mm HORIZONTAL MODULE

H-WW-02

190mm WALL: 400mm HORIZONTAL MODULE

H-WW-03

140mm WALL: 300mm HORIZONTAL MODULE
**FACE UNITS: EXTERIOR**

- Course 1
- Course 2

**Note:**
Bedding and perpend joint profiles, mortar – colour and texture – to suit profile, colour and texture of unit

**FACE UNITS: INTERIOR AND EXTERIOR**

**Note:**
Bedding and perpend joint profiles, mortar – colour and texture – to suit profile, colour and texture of unit

**SILL BLOCK FORMING CORNER**

- Sill block filled solid with 15 MPa concrete
- 30mm wide x 3mm thick metal strap anchored in concrete every second course
BONDING OF INTERSECTING STRUCTURAL WALLS WITH TIES – 300mm AND 400mm MODULE

**H-WW-07**

- Strap shape when walls built separately
- Metal strap 3mm thick x 30mm wide every second course
- Cores of units filled with 15 MPa concrete

**COURSE 1**

**COURSE 2**

Mesh supporting concrete in core above or cores filled solid

BONDING OF INTERSECTING STRUCTURAL WALLS OF SAME THICKNESS – 400mm MODULE

**H-WW-08**

- Strap shape when walls built simultaneously
- Metal strap 3mm thick x 30mm wide every second course
- Cores of units filled with 15 MPa concrete

**COURSE 1**

**COURSE 2**

Metal strap

Mesh supporting concrete in core above or cores filled solid

BONDING OF NON-STRUCTURAL WALLS

**H-WW-09**

- Cores of units filled with 15 MPa concrete
- 10x30 mesh 0.6mm thick x 1.0mm wide lathing 60mm wide x 550mm long every alternate course
**PIER IN WALLS – FAIR-FACE UNITS – 300 MODULE**

**H-CM-01**
See H-CM-NB

**COURSE 1**
- Metal strap

**COURSE 2**
- 3mm thick x 30mm wide metal strap every second course

**290mm WIDE PIER 290mm PROJECTION – 140mm WALL, 300mm MODULE**

**H-CM-02**
See H-CM-NB

**COURSE 1**
- Cores filled solid with 15 MPa concrete
- Control joint

**COURSE 2**
- Cores filled solid with 15 MPa concrete
- Control joint

**290mm WIDE PIER 290mm PROJECTION – 140mm WALL, 300mm MODULE WITH CONTROL JOINT**
PIER IN WALLS – FAIR-FACE UNITS – 400 MODULE

H-CM-03
See H-CM-NB

390mm WIDEPIER 390mm PROJECTION – 190mm WALL, 400mm MODULE

H-CM-04
See H-CM-NB

390mm WIDEPIER 390mm PROJECTION – 190mm WALL, 400mm MODULE WITH CONTROL JOINT

Note:
1. At the end of a free-standing wall the pier width and projection must be of the same dimension as internal piers. The two adjacent piers at control joints must together be of the same overall dimension as an internal pier.

2. The thickness of the wall shown is that at the base and may be reduced nearer the top of the wall. See SANS 10400-K – Free Standing Walls

3. Refer to CMA Design Guide on Free Standing Walls, and SANS 10400-K
PIER IN WALLS – ROCK FACE UNITS

COURSE 1

- Metal strap
- 10x30 mesh 0.6mm thick x 1.0mm wide lathing 150mm wide x 900mm long
- Control joint

COURSE 2

- Rock face unit
- 2-10x30 mesh 0.6mm thick x 1.0mm wide lathing 150mm wide x 450mm long

390mm WIDE PIER 390mm PROJECTION – 190mm WALL, 400mm MODULE – FACE UNITS

H-CM-05
See H-CM-NB

COURSE 1

- Metal strap
- Fair face units
- 3mm thick x 30mm wide metal strap every second course
- Core filled solid with 15 MPa concrete

COURSE 2

- Rock face unit
- Core filled solid with 15 MPa concrete
- 10x30 mesh 0.6mm thick x 1.0mm wide lathing 150mm wide x 900mm long every second course

390mm WIDE PIER 390mm PROJECTION – 190mm WALL, 400mm MODULE WITH CONTROL JOINT – FACE UNITS

H-CM-06
See H-CM-NB

COURSE 1

- Metal strap
- Fair face units
- Core filled solid with 15 MPa concrete
- Control joint

COURSE 2

- Rock face unit
- Core filled solid with 15 MPa concrete
- 2-10x30 mesh 0.6mm thick x 1.0mm wide lathing 150mm wide x 450mm long every second course
**PILASTER AND PIER BLOCKS IN WALLS**

**H-CP-01**
See H-CP-NB

**PILASTER BLOCK IN WALL**

**H-CP-02**
See H-CP-NB

**PILASTER BLOCK AT T-JUNCTIONS**

**H-CP-03**

**OCTAGON SHAPED PIER BLOCK**

**H-CP-NB**

**Note:**
1. Pilaster blocks provide lateral support while permitting longitudinal movement, provided no metal ties are used between wall and pilaster block.
2. Pilaster block shape adjusted to suit number of intersecting walls and aesthetic considerations.
3. Pilaster blocks may be filled with concrete and reinforced if required.
CONCRETE COLUMN/WALL INTERSECTIONS

WALL FIXED TO CONCRETE COLUMN PROVIDING LATERAL SUPPORT

COURSE 1
Concrete column

Cores filled solid with 15 MPa concrete

COURSE 2
Concrete column
Metal dovetail shaped anchor slot cast into column to take dovetail shaped tie – every second course

Control joint

WALL FIXED ONE SIDE TO CONCRETE COLUMN PROVIDING LATERAL SUPPORT, WITH CONTROL JOINT

COURSE 1
Concrete column

Metal dovetail shaped anchor slot cast into column to take dovetail shaped tie – every second course

Cores filled solid with 15 MPa concrete

Control joint

WALL FIXED ONE SIDE TO CONCRETE COLUMN PROVIDING LATERAL SUPPORT, WITH CONTROL JOINT

COURSE 1
Control joint

This end greased or enclosed in plastic envelope to permit sliding movement in concrete core

COURSE 2
Control joint

30mm wide x 3mm thick metal strap, one end anchored in concrete in core of unit. Other end cast in concrete core of unit at bedding joint level every second course.

H-CC-01

H-CC-02
See App E

H-CC-03
See App C+E

CONCRETE COLUMN/WALL INTERSECTIONS
CONCRETE COLUMN/WALL INTERSECTIONS

H-CC-04
See App C+E

190mm WALL RIGIDLY FIXED TO CONCRETE COLUMN – 400mm MODULE

3mm thick x 30mm wide metal strap fixed to column every second course

Mesh to support 15 MPa concrete in core above, or cores filled solid with concrete without mesh

COURSE 1

COURSE 2

H-CC-05
See App C+E

WALL FIXING TO CONCRETE COLUMN PERMITTING LONGITUDINAL MOVEMENT – 400mm MODULE

15 MPa concrete in cores

This end greased or enclosed in plastic envelope to permit sliding movement

COURSE 1

COURSE 2

H-CC-06
See App C+E

140mm WALL RIGIDLY FIXED TO CONCRETE COLUMN 300mm MODULE (OR 400mm MODULE)

3mm thick x 30mm wide metal strap fixed to column every second course

Mesh to support 15 MPa concrete in core above or cores filled solid with concrete without mesh

COURSE 1

COURSE 2
CONCRETE COLUMN/WALL INTERSECTIONS

**H-CC-07**

**See App C**

- Concrete column
- Metal angle fixed to column with outstanding leg projecting into groove of sash block
- Control joint
- Sash block

**WALL FIXED TO CONCRETE COLUMN PERMITTING LONGITUDINAL MOVEMENT**

**H-CC-08**

**See App C**

- Concrete column
- Control joint
- Cold rolled light gauge metal channel fixed to column

**CHANNEL IN OPEN END OF UNIT**

**H-CC-09**

**See App C**

- Concrete column
- Metal angles fixed to concrete column

**WALL FIXED TO CONCRETE COLUMN PERMITTING LONGITUDINAL MOVEMENT**

**TWO ANGLES TO HOLD UNIT**
CONCRETE COLUMNS WITH ROCKFACE SURROUNDS

**H-CC-10**

**COURSE 1**

Concrete column 290mm or cut unit

Rock face unit

**COURSE 2**

Concrete column 290mm or cut unit

**H-CC-11**

**COURSE 1**

Concrete column 290mm or cut unit

Rock face unit

**COURSE 2**

Concrete column 290mm or cut unit

**CONCRETE COLUMN 400 x 400 WITH EXTERNAL FACE UNITS**

**CONCRETE COLUMN 400 x 400 BOXED IN WITH EXTERNAL FACE UNITS**
CONCRETE COLUMNS WITH ROCKFACE SURROUNDS

CONCRETE COLUMN 300 x 300 BOXED IN – EXTERNAL FACE UNITS

CONCRETE COLUMN 300 x 300 – 190mm EXTERNAL FACE UNITS
WALL FIXED TO COLUMN PROVIDING LATERAL SUPPORT

**H-CS-01**

- Metal dovetail shaped tie fixed to a bar, welded to steel column.
- Cores filled with 15 MPa concrete.

**H-CS-02**

- Dovetail shaped metal tie fixed to a bar, welded to steel column.
- Cores filled with 15 MPa concrete.

**H-CS-03**

- 30 mm wide x 3 mm thick metal strap fixed to column one side, other side anchored in core every second course.
- Cores filled with 15 MPa concrete.

### WALL FIXED TO COLUMN PROVIDING LATERAL SUPPORT, WITH CONTROL JOINT

**COURSE 1**

- Control joint

**COURSE 2**

- Control joint

### ONE SIDE WALL RIGIDLY FIXED TO COLUMN OTHER SIDE FREE TO MOVE LONGITUDINALLY

**COURSE 1**

- Control joint

**COURSE 2**

- Control joint
**WALL FIXED TO STEEL COLUMN**

30mm wide x 3mm thick metal strap fixed to column and anchored in 15 MPa concrete in unit core every second course.

Mesh to support concrete in core above or core filled solid without mesh.

**WALL BUTTING AGAINST STEEL COLUMN**

Cores filled with 15 MPa concrete.

**WALL FIXED TO STEEL COLUMN PROVIDING LATERAL SUPPORT WITH CONTROL JOINT**

30mm wide x 3mm thick metal strap fixed to column and anchored in 15 MPa concrete in unit core every second course.

Control joint

Mesh in course below to support 15 MPa concrete in core.
COURSE 1

Cores filled with 15 MPa concrete

10 x 30 mesh 0.6mm thick x 1.0mm wide lathing – 60mm wide – every second course

COURSE 2

STEEL COLUMN BOXED IN

H-CS-07

H-CS-08

STEEL COLUMN/WALL INTERSECTIONS

COURSE 1

Cores of units filled with 15 MPa concrete

10 x 30 mesh 0.6mm thick x 1.0mm wide lathing – 60mm wide – every second course

COURSE 2

STEEL COLUMN BOXED IN
STEEL COLUMN/WALL INTERSECTIONS – ROCKFACE FINISH

H-CS-09

STEEL COLUMN BOXED IN WITH CONTROL JOINTS

COURSE 1

COURSE 2

H-CS-10

STEEL COLUMN BOXED IN WITH ROCK FACE UNITS WITH CONTROL JOINT

COURSE 1

COURSE 2
STEEL COLUMN BOXED IN WITH ROCK FACE UNITS

H-CS-11

COURSE 1

Rockface

Mesh to support concrete in core above or core filled solid

30mm wide x 3mm thick metal strap anchored in concrete in core of unit

COURSE 2

Rockface

Mesh to support concrete in core above or core filled solid

STEEL COLUMN BOXED IN WITH ROCK FACE UNITS

H-CS-12

COURSE 1

10 x 30 mesh 0.6mm thick x 1.0mm wide lathing – 60mm wide – every second course

COURSE 2

Rockface

CORNER STEEL COLUMN BOXED IN WITH ROCK FACE UNITS
Note:
Bearing stresses under steel beam will determine if steel bearing plate below beam required and depth and extent of concrete infill of cores of blocks.

WALL SUPPORTING OF STEEL BEAM

ANCHOR BOLTS TO SUPPORT VERTICAL OR HORIZONTAL LOADS
30mm wide x 3mm thick metal strap placed in bedding joint. Cores of units filled with 15 MPa concrete, one end fixed, other end free to slide every second course.

**H-CJ-01**
See H-CJ-NB (1 TO 4)

This half of strap greased or enclosed in plastic envelope to permit sliding movement

**H-CJ-02**
See H-CJ-NB (1 TO 4)

15 MPa concrete infill in cores on either side of control joint

**H-CJ-03**
See H-CJ-NB (1 TO 4)

15 MPa concrete infill in cores on either side of control joint

**CONTROL JOINTS IN WALLS**

**BUTT JOINT WITH STRAP TO GIVE LATERAL STABILITY**

**BUTT JOINT WITH CRUCIFORM STRIP IN SASH UNIT GROOVES – NO LATERAL STABILITY**

**BUTT JOINT – NO LATERAL STABILITY**
CONTROL JOINTS IN WALLS

**H-CJ-04**

See H-CJ-NB (1 TO 4)

Open end of block on one side lined with plastic or paper & cavity filled with 15 MPa concrete

**H-CJ-05**

H-CJ-NB (1 TO 4)

12mm Ø dowel rod greased one side

Dowel rod across control joint

**BUTT JOINT IN U OR BOND BEAMS WITH ROD TO GIVE LATERAL STABILITY**
CONTROL JOINTS IN WALLS

Note:
1. Control joints may be filled with a joint filler such as fibre board, polystyrene or polyurethane strips, sponges, tubes or rods and sealed with sealants such as silicones, polyurethanes, polysulphides, bitumen, acrylic or polyisobutylene.
   Refer to manufacturers specification.

**INTERNAL WALL**

2. If plastered then V-joint is to be cut into plaster over line of control joint.

3. Control joint may be covered by a cover plate.

**EXTERNAL WALL**

H-CJ-NB1

3. Control joint may be covered by a cover plate.
CONTROL JOINTS IN WALLS – LOCATIONS

H-CJ-NB2

ELEVATION OF WALL SHOWING CONTROL JOINT POSITIONS
BETWEEN OPENINGS, HORIZONTAL & VERTICAL REINFORCEMENT

H-CJ-NB3

ELEVATION OF WALL SHOWING CONTROL JOINT POSITIONS
AT EDGE OF OPENINGS, HORIZONTAL & VERTICAL REINFORCEMENT

H-CJ-NB4

Note:
Control joint spacing not to exceed recommended maximum, i.e. for unreinforced walls 6m, or twice the height of the wall. For reinforced walls 18m.
Every course reinforced.

For detailed information refer to CMA Masonry Manual and SANS 10145 Concrete Masonry Construction
DETAILS OF TYPES OF REINFORCEMENT AND FIXING

H-RE-01

REINFORCEMENT BOTTOM ONLY

REINFORCEMENT TOP ONLY

REINFORCED AROUND CORNER

CUT HOLLOW UNITS TO ACCOMMODATE REINFORCEMENT

H-RE-02

SINGLE VERTICAL BAR

VERTICAL AND HORIZONTAL BARS

VARIOUS WIRE POSITIONERS TO HOLD REINFORCEMENT IN POSITION BEFORE CONCRETING
DETAILS OF TYPES OF REINFORCEMENT AND FIXING

H-RE-03

LADDER PATTERN

TRUSS PATTERN

VARIOUS TYPES BEDDING JOINT REINFORCEMENT

H-RE-04

SINGLE BLOCK BEAM

Concrete infill
Horizontal reinforcement
Mesh to support concrete in block bond beam above

H-RE-05

DOUBLE BLOCK BEAM

Bond block
Link
Lintel block
Horizontal reinforcement
Reinforcing bars alternate sides if required to engineers’ requirements.

CANTILEVER WALL

SINGLE BAR IN BEAM

H-RE-06

H-RE-07
See H-RE-NB
TWO BARS IN BEAM

Maximum diameter of longitudinal bar 6mm. Ladder or truss shape bedding reinforcement preferable.

REINFORCEMENT AROUND CORNERS IN BEDDING JOINT
REINFORCED MASONRY – FOUNDATIONS

TOLERANCES OF SURFACES OF FOUNDATIONS, BEAMS OR SLABS SUPPORTING STRUCTURAL MASONRY

H-RE-10

Underside first course

Zone requiring removal

10mm mortar bed target thickness

Concrete foundation, beam or slab

Zone requiring infill

H-RE-11

Top of concrete foundation

Cranking

Starter bar

H-RE-12

Starter bars

Top of foundation

H-RE-13

New bar

Epoxy grout

Drill hole in concrete

Remedial work ‘out of position’ starter bars

Vertical bar

First course inspection & clean out unit

Starting bar in bond beam

Cranking not permitted
Note:
Bond blocks can be cut or manufactured. Typical dimensions as shown.
Outer shell thickness:
• Fairface – 32mm
• Rockface – 42mm
Bond blocks can be made with same colour and texture as standard blocks.

Note:
Usually 190mm long, in fair face only with sash groove in soffit

**U-BEAM OR LINTEL BLOCK**

**TWO BLOCK BEAM USING LINTEL BLOCK**

**TWO BLOCK BEAM USING BOND BLOCKS**

**REINFORCEMENT COVER IN BEDDING JOINT**
H-AC-01

Grille/screen blocks

Air conditioning unit in steel sheet frame slid into opening in wall

DPC sill
DPC with weepholes at 600mm
Bond block or lintel block

Grille/screen blocks

AIR CONDITIONING UNIT INSTALLATION
LOCATION OF SERVICES IN/ON WALLS

H-SV-01
See H-SV-NB

ELECTRICAL CONDUITS PLACED IN CORES OF HOLLOW UNITS

- Electrical conduit in core of hollow unit
- Block cut to take electrical box
- Mortar to hold box in position
- Mortar to support mortar
- Electrical conduit in core of hollow unit
- Mesh

H-SV-02
See H-SV-NB

WATER PIPES PLACED IN CORES OF HOLLOW UNITS

- Hollow units
- Hot water
- Cold water
- Hollow units filled with 15 MPa concrete to take supporting bolts of fittings
- Basin
- Mesh
LOCATION OF SERVICES IN/ON WALLS

H-SV-03
See H-SV-NB

H-SV-04
See H-SV-NB

ELECTRICAL CONDUITS CHASED INTO SOLID UNITS

WATERPIPES CHASED INTO SOLID UNITS
ELEVATION SECTION ELEVATION SECTION

HORIZONTAL SERVICES LOCATED IN U-BLOCKS

- Services chased into shell of hollow units
  - Chases cut into surface with angle grinder or similar

VERTICAL SERVICES CHASED INTO SHELLS OF HOLLOW UNITS

Note:
If chases through shell of unit then core to be filled with 15 MPa concrete

H-SV-NB

Note:
1. ‘Sleeves, chases and holes should, as far as possible, be provided during the erection of the masonry, or purpose-made chased units should be built in position agreed by the designer’. Refer to SANS 10164-1
2. Vertical chases in solid units should not exceed one third of the wall/leaf thickness and horizontal chases should not exceed one sixth of the wall/leaf thickness. (See Note 4)
3. Walls constructed of hollow units should not be chased at all and services should be located in the unit cavities. Where chasing in these units is unavoidable it should be no deeper than 15mm or the core of the unit shall be filled with 15 MPa concrete.
4. Horizontal chasing should be avoided where possible. Ensure that chases do not impaire strength, stability and fire resistance properties of the walling below the minimum permitted.
# APPENDICES

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| APPENDIX F | DETAILING PRACTICE FOR REINFORCED MASONRY | 71 |
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APPENDIX A DEFINITIONS

Masonry wall means an assemblage of masonry units joined together with mortar or grout. Masonry units may be either solid or hollow, and of brick or block size¹.

Block means any masonry unit having dimensions, which satisfy any one of the following conditions:
   a) length between 300mm and 650 mm;
   b) width between 130mm and 300 mm; or
   c) height between 120mm and 300 mm.

Brick means any masonry unit which is not a block. A masonry unit having dimensions, which satisfy all of the following conditions:
   a) length not more than 300 mm;
   b) width not more than 130 mm; and
   c) height not more than 120 mm.

Hollow masonry unit: A masonry unit containing cavities in excess of 25% but not exceeding 60%, of the gross volume of the unit¹.

Masonry accessories: These include masonry anchors, connectors and ties other than wall ties; shelf angles and their fixings; wall ties that transmit shear; and bed joint mesh¹.

Masonry unit: A unit of a rectangular shape and that is intended for use in the construction of bonded masonry walling¹.

Solid masonry unit: A masonry unit either containing no cavities or containing cavities not exceeding 25% of the gross volume of the unit¹.

Types of masonry

Prestressed masonry: Masonry in which pre-tensioned or post-tensioned steel is incorporated to enhance resistance to tensile or shear forces¹.

Reinforced masonry: Masonry in which steel reinforcement is incorporated to enhance resistance to tensile, compressive or shear forces¹.

Grouted-cavity masonry: Two parallel single-leaf walls spaced at least 50 mm apart, effectively tied together with wall ties. The intervening cavity contains steel reinforcement and is so filled with infill concrete or grout as to result in common action with the masonry under load¹.

Reinforced hollow blockwork: Hollow blockwork that is reinforced horizontally or vertically (or both) and subsequently wholly or partly filled with concrete¹.

¹ SANS 10164-2 (See Appendix B)
APPENDIX B REFERENCES

STANDARDS AND CODES OF PRACTICE ON THE USE OF CONCRETE MASONRY

MANUFACTURE OF CONCRETE MASONRY UNITS
SANS 1215 – 1984 Concrete masonry units

USE OF MASONRY UNITS
Planning, design and specifications
SANS 993-1972
Modular coordination in building
SANS 10021-2002
Waterproofing of buildings
SANS 10155-1980
Accuracy in buildings
SANS 10249-1993
Masonry walling
NBRI R/Bou – 602
Fire resistance ratings – wall constructed of concrete blocks

Building Regulations
National Building Regulations and Building Standards
Act 1977 revised 1990
SANS10400-1990
Application of the National Building Regulations
National Home Builders Registration Council Home
Building Manual

Structural Design
SANS  10100-1:2000
The structural use of concrete
Part 1: Design
SANS  10160 –1989
The general procedures and loadings to be adopted for the design of buildings.
SANS 10161-1980
The design of foundations for buildings
SANS 10164.
The structural use of masonry
Part 1-1980: Unreinforced masonry walling
Part 2-2003: Reinforced and prestressed masonry walling
SANS 1504-1990
Prestressed concrete lintels
Crofts, FS: Lane JW Structural concrete masonry, a design guide.

Concrete Masonry Construction
SANS 073-1974
Safe application of masonry-type facings to buildings
SANS 10145-2000
Concrete masonry construction
SANS 10155-1980
Accuracy in buildings

MATERIALS OF CONSTRUCTION
Aggregates
SANS 794-2002
Aggregates of low density
SANS 1083-2002
Aggregates from natural sources – aggregates for cement.

Cement
SANS 50197-1:2000
Cement
Part 1: Composition, specifications and conformity criteria, for common cements.
SANS 50413-1:1994
Masonry cement
SANS 1491-1989
Portland cement extenders
Part 1: Ground granulated blastfurnace slag.
Part 2: Fly ash.
Part 3: Condensed silica fume.

Dampproof courses
SANS 248-1973
Bituminous dampproof course
SANS 298-1975
Mastic asphalt for dampproof courses and tanking
SANS 952-1985
Polyolefin film for dampproofing and waterproofing in buildings

Reinforcement
SANS 190-2:1984
Expanded metal
Part 2: Building products
SANS 920-1985  
Steel bars for concrete reinforcement

SANS 1024-1991  
Welded steel fabric for reinforcement of concrete

Sealants

SANS 110-1973  
Sealing compounds for building industry, two-component, polysulphide base

SANS 1077-1984  
Sealing compounds for the building and construction industry, two component polyurethane base

SANS 1305-1980  
Sealing compounds for the building industry, one-component silicone-rubber base

Lime

SANS 523-2002  
Limes for use in building

Sand

SANS 1090-2002  
Aggregates from natural sources. Fine aggregate for plaster and mortar

Wall ties

SANS 28-1986  
Metal ties for cavity walls

USEFUL BRITISH STANDARDS

BS 1014-1975 (1986)  
Pigments for portland cement and portland cement products

BS 4551-1998  
Methods of testing mortar, screeds and plasters

BS 4887  
Mortar admixtures  
Part 1: 1986: Specification for air-entraining (plasticizing) admixtures  

BS 6477-1984  
Water repellents for masonry surfaces

CONCRETE MANUFACTURERS ASSOCIATION PUBLICATIONS


Free-standing walls  Design guide  
Technical note: Unreinforced  
Reinforced
Anchors are used for tying metal straps, angles and wall accessories to masonry, concrete or steel, at wall/concrete, wall/wall, wall/steel intersections, or to support a leaf of a wall or service. Anchors function by being held in position in the base material by friction, keying, bonding or a combination of these factors. Essentially the fixing of anchors to any member requires either the drilling of a hole to house the anchor, or the firing of the anchor into the supporting material.

In general terms shot-firing anchors into brittle material such as concrete or masonry may shatter the material and the quality of support may then become suspect. Drilling is preferable where anchorage stress level is significant.

Firing into ductile materials such as steel or timber is an easy and quick method of anchoring.

In both cases the amount of force exerted in drilling or shot firing should not disturb the bonding of masonry units to adjacent units.

The position of the anchor is important in ensuring optimum load carrying capacity.

In the case of angles supporting a non-structural outer leaf of a wall to the main structure then the position of the hole in the vertical leg of the angle should be as near the top of the angle as possible. It is also preferable to use an unequal angle with the longer leg of the angle in the vertical direction.

With straps holding walls to columns to provide lateral support, the anchor should be placed as near as possible to the right angle bend in the strap. This is to prevent the straightening out of the bend, with, say, shrinkage of the wall, which would tend to lift the masonry unit above the horizontal section of the strap, opening the bedding joint.

Normally a single anchor in the vertical leg of the strap is adequate but if two anchors are necessary then the spacing of these anchors should be such as not to reduce the overall anchorage. When shot firing into brittle materials the spacing should be at least 100 mm.

Heated drawn steel should be used for straps that are bent and twisted. Normally stainless steel cannot be shaped to the required shape.

The type, size and position of anchorage to be shown on drawings and/or clearly specified.

**APPENDIX C ANCHORS – WALLS**
APPENDIX D ROOFING FIXING

Types of Anchor (refer SANS 10400-K)

<table>
<thead>
<tr>
<th>Roof Slope, Degrees</th>
<th>Max Roof Truss, Rafter or Beam spacing mm</th>
<th>Type of anchor required</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Light Roof</td>
<td>Heavy Roof</td>
</tr>
<tr>
<td>Less than 15</td>
<td>760</td>
<td>A, B or C</td>
</tr>
<tr>
<td></td>
<td>1050</td>
<td>B or C</td>
</tr>
<tr>
<td></td>
<td>1400</td>
<td>C</td>
</tr>
<tr>
<td>15-30</td>
<td>760</td>
<td>A, B or C</td>
</tr>
<tr>
<td></td>
<td>1050</td>
<td>B or C</td>
</tr>
<tr>
<td></td>
<td>1400</td>
<td>C</td>
</tr>
<tr>
<td>Greater than 30</td>
<td>Any</td>
<td>A, B or C</td>
</tr>
</tbody>
</table>

Anchors

Type A: 2 Strands 4 mm Galvanised Steel Wire
Type B: 30 mm x 1.2 mm Galvanised Steel Strap
Type C: 30 mm x 1.6 mm Galvanised Steel Strap

<table>
<thead>
<tr>
<th>Length of Anchorage</th>
<th>Type of Roof</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 mm</td>
<td>Heavy roof (Concrete or clay tiles or slate)</td>
</tr>
<tr>
<td>600 mm</td>
<td>Sheeted Roof</td>
</tr>
</tbody>
</table>

Note:
Details of types of anchors apply to buildings not exceeding two storeys in height and where span of the roof truss does not exceed 10 m.
# APPENDIX E: TIES, STRAPS AND BEDDING REINFORCEMENT

## DETAILS OF REINFORCEMENT USED IN BEDDING JOINTS

<table>
<thead>
<tr>
<th>Type</th>
<th>Ladder Type</th>
<th>Truss Type</th>
<th>Mesh/Lathing for reinforcement and tying intersecting leaves of wall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Two longitudinal wires with transverse wires</td>
<td>Two longitudinal wires with diagonal transverse wires.</td>
<td>Diagonal flat expanded metal with diamond shape openings</td>
</tr>
<tr>
<td>Sketch</td>
<td><img src="image" alt="Sketch of Ladder Type" /></td>
<td><img src="image" alt="Sketch of Truss Type" /></td>
<td><img src="image" alt="Sketch of Mesh/Lathing" /></td>
</tr>
<tr>
<td>Width (w), mm</td>
<td>75/150/230</td>
<td>60/110/160</td>
<td>50/150</td>
</tr>
<tr>
<td>Diameter of wire, mm</td>
<td>2,5/2,8/3,15/3,55</td>
<td>3,25/3,55</td>
<td>3,15</td>
</tr>
<tr>
<td>Wire spacing (s), mm</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size of opening b x ℓ, mm</td>
<td></td>
<td></td>
<td>10 x 30</td>
</tr>
<tr>
<td>Length rolls, m</td>
<td>20/25</td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>Length flats, m</td>
<td>3</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>Size of sheet, m x m</td>
<td>1,2 x 2,4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Note:</td>
<td>Wire manufactured for bedding joint reinforcement from high tensile steel should preferably be flat i.e. not in rolls.</td>
<td>Only available flat</td>
<td>Dimension and properties to be confirmed with local supplier. Consider stronger ties is lateral load transfer is significant</td>
</tr>
</tbody>
</table>

Check availability and quality. For quality, check if commercial or stated quality, whether mild, galvanised or stainless steel, or coated for corrosion resistance.
# DETAILS OF REINFORCEMENT USED IN BEDDING JOINTS

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Hoop Iron</th>
<th>Straps</th>
<th>Rods/Bars</th>
<th>Wall Ties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anchor wall to wall sliding joints (Concertina strap)</td>
<td>- Anchoring - concrete and steel columns to walls - Anchoring walls to wall sliding joint - wall to wall sliding joints</td>
<td>Reinforcement of: - bedding joint - hollow unit core - cavity Bars can be used in place of straps for anchorage</td>
<td>Connecting two leaves of a cavity wall to ensure that the wall acts as a unit in resisting applied loads - In multileaf walls ensures monolithic action - In diaphragm walls provides shear transfer between web and flange</td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td>Normally cut from offcuts of rolls of sheet steel - regarded as commercial quality</td>
<td>Normally cut from flat steel sheets - regarded as stated quality</td>
<td>Mid steel or high tensile steel. May be stainless steel or coated for corrosion resistance</td>
<td>Material determined by the likelihood of corrosion viz. galvanised mild steel, copper, copper-zinc or austenitic stainless steel</td>
</tr>
<tr>
<td>Shape</td>
<td>Flat</td>
<td>Concertina at joint</td>
<td>Flat</td>
<td>Of various shapes</td>
</tr>
<tr>
<td>Thickness, ( \text{mm} )</td>
<td>1.2/1.6</td>
<td>1.2/1.6</td>
<td>2.5/3.0</td>
<td>1.5 4.0</td>
</tr>
<tr>
<td>Width, ( \text{mm} )</td>
<td>30</td>
<td>20 30 40</td>
<td>30 40</td>
<td>13 20</td>
</tr>
<tr>
<td>Diameter, ( \text{mm} )</td>
<td></td>
<td></td>
<td>6 &lt; ( \varnothing ) &lt; 32</td>
<td>2.8 3.15 4.0 4.5</td>
</tr>
<tr>
<td>Fixing</td>
<td>One end of strap embedded in concrete in core of unit or in bedding joint mortar; other end fixed to roof truss or wall plate See Appendix D</td>
<td>Both ends embedded in mortar joint</td>
<td>Placed in: - bedding joint - core hollow unit - bond and U-beams - cavity walls and filled with mortar or infill concrete</td>
<td>Placed in bedding mortar</td>
</tr>
</tbody>
</table>

General requirements for provision of ties

<table>
<thead>
<tr>
<th>Size of cavity</th>
<th>Ties/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 75 mm</td>
<td>2.5</td>
</tr>
<tr>
<td>75 - 100 mm</td>
<td>3</td>
</tr>
<tr>
<td>100 - 150 mm</td>
<td>5</td>
</tr>
</tbody>
</table>

Check material providing connection between structural masonry elements can safely transfer loads and forces while providing lateral support.
1. INTRODUCTION

Drawings depicting details of reinforcement in masonry elements, supplemented by specifications are required to translate designs into physical realities. Detailing is therefore the most important link between good design and quality construction. Accordingly detailing of reinforcement should be kept simple, clear and practical while drawings should clearly define and depict the design requirements in a comprehensible manner. SANS 10164-2 offers guidance in this regard, the main provisions of which are highlighted and illustrated hereunder:

Reinforcement should be located to suit simple masonry bonding patterns. Cutting of masonry units should be kept to a minimum while the bonding of masonry should be such that an adequate void for grouting is maintained. Common practical bonding arrangements are illustrated below.

The detailing of reinforced masonry differs somewhat to that of reinforced concrete; the principle differences being:

- distribution steel is not required in certain masonry bonding patterns since bonded masonry can often span and distribute forces between reinforcing bars.
- reinforcing bars often have to be protected against corrosion in reinforced masonry applications where mortar infill is employed.
- the characteristic anchorage bond strength between mortar and steel is significantly less than that between concrete and steel.

2. MORTAR AND CONCRETE INFILL (SANS 10164-2; CI 5.4)

Only Class I and Class II mortar (refer to SANS 10164-1) should be used in the bedding course for reinforced masonry applications. Where masonry cement is used, the bond between steel and mortar should be investigated.

Infill concrete should be grade 25 concrete or better. Mixes should have adequate workability with a slump of between 75 and 175mm. The nominal aggregate in such concrete should be at least 5 mm less than the permitted cover to any reinforcement.
3. DETAILING RULES (SANS 10164-2; CI 7.6)

3.1 Main and secondary reinforcement

The main provisions of SANS 10164-2 which relate to the manner in which steel is located in reinforced elements are summarised in Table 1.

**Table 1: Detailing of main and secondary reinforcement**

<table>
<thead>
<tr>
<th>LOCATION OF STEEL WITHIN ELEMENT</th>
<th>MAXIMUM BAR SIZE mm</th>
<th>SECONDARY REINFORCEMENT+</th>
<th>MAXIMUM BAR SPACING mm</th>
<th>SPECIAL PROVISIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grouted cavity</td>
<td>25</td>
<td>$A_s &gt; 0.05 bd$</td>
<td>500</td>
<td>Low lift construction Provide ties in accordance with SANS 10164-1 High lift construction Provide purpose made ties in accordance with Appendix A of SANS 10164-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$100$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pockets</td>
<td>32</td>
<td>Not required*</td>
<td>No upper limit</td>
<td>Only one bar may be used if pocket is less than 125 mm x 125 mm</td>
</tr>
<tr>
<td>Quetta bond</td>
<td>25</td>
<td>$A_s &gt; 0.05 bd$</td>
<td>500</td>
<td>Only one bar may be used if core is less than 125 mm x 125 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$100$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cores of hollow units</td>
<td>25</td>
<td>$A_s &gt; 0.5 bd$</td>
<td>500</td>
<td>Only one bar may be used if core is less than 125 mm x 125 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$100$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bed joints</td>
<td>6#</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Wall has enhanced lateral resistance if $A_s &gt; 14 \text{mm}^2$ is provided at vertical centres $\geq 450 \text{mm}$</td>
</tr>
</tbody>
</table>

* Prestrectched hard drawn wire with a minimum proof stress of 485 N/mm² as supplied by a manufacturer of welded steel fabric reinforcement is suitable for such reinforcement. (Standard bar diameters are 3.55; 4 and 5.6);

+ $b$ = breadth of section; $d$ = depth to neutral axis. $A_s$ = cross sectional area of reinforcement.

# Distribution steel is not required since bonded masonry, particularly in the horizontal direction, can span and distribute forces between reinforcing bars. However, distribution steel may be required to control shrinkage.

Usually reinforcement acts in tension. However, where reinforcement acts in compression, such reinforcement must be restrained against the tendency to buckle. This achieved by the inclusion of secondary steel reinforcement in the form of distribution steel, links or binders.

In all cases, the minimum clear horizontal or vertical distance between parallel bars should be as follows:

- Greater of aggregate size + 5mm and bar size
- Greater of aggregate size + 5mm and bar size
- Greater of aggregate size + 5mm and bar size
1.2 Anchorage bond, laps and joints

For reinforcement to develop the design stress, it must be adequately bonded into the surrounding masonry. This may be achieved by ensuring that:

- the cover of concrete or mortar infill is at least equal to the bar diameter; and
- a sufficient length of bar (anchorage length) extends beyond any section to develop the necessary force at that section.

The length of bar required for anchorage purposes may be calculated as follows:

\[ l_{ba} = \frac{f_y \gamma_{sb} \varnothing}{K \gamma_{ms} f_b} \]

where:

- \( \varnothing \) = nominal bar diameter
- \( \gamma_{sb} \) = partial safety factor for bond strength
- \( \gamma_{ms} \) = partial safety factor for strength of steel
- \( f_y \) = characteristic anchorage bond strength
- \( f_b \) = characteristic tensile strength of reinforcing steel
- \( A_s \) = cross sectional area of steel
- \( K \) = ratio of anchorage bond length to bar diameter (see Table 2)

Thus \( l_{ba \ required} = K \varnothing \frac{A_s \ required}{A_s \ provided} \)
### Table 2: Ratio of anchorage bond length to bar diameter

<table>
<thead>
<tr>
<th>TYPE OF REINFORCEMENT</th>
<th>CHARACTERISTIC TENSILE STRENGTH MPa</th>
<th>RATIO OF ANCHORAGE BOND LENGTH TO BAR DIAMETER (K)°</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mortar Infill</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tension</td>
</tr>
<tr>
<td>Hot rolled mild steel plain bar as in SANS 920</td>
<td>250</td>
<td>51</td>
</tr>
<tr>
<td>Hot rolled high yield deformed bar as in SANS 920</td>
<td>450</td>
<td>68</td>
</tr>
<tr>
<td>Hard drawn steel wire as in SANS 1024</td>
<td>485</td>
<td>98</td>
</tr>
<tr>
<td>Stainless steel grades 304515, 316531 and 316533 as in BS 970-1</td>
<td>460</td>
<td>93</td>
</tr>
<tr>
<td>– plain bar</td>
<td>70</td>
<td>58</td>
</tr>
<tr>
<td>– deformed bar</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The effective anchorage length of a hook or bend, measured from the start of the bend to a point four times the bar size beyond the end of the bend should be taken as the lesser of:

- 24 times the bar size.
- 8 times the internal radius of a hook.
- 4 times the internal radius of a 90 degree bend.

![Effective anchorage length](image)
Note: Minimum radius of any bend
- = 2 ø (mild steel)
- = 3 ø (high yield steel)

The beginning of hooks should be located inside the face of support as follows:

Joints in reinforcement may be achieved by means of mechanical couplers or simply by lapping reinforcing bars of follows:

Generally, laps should be located away from areas of high stress and should be staggered. Account of the construction sequence, build-ability, stress considerations, congestion of reinforcement etc., should be taken in the location of laps and joints.

1.3 Links

Links may be required to restrain reinforcement acting in compression or to provide shear reinforcement. Links may only be considered to be fully anchored if they are detailed as follows:
Shear reinforcement links in beams should be provided as follows:

Where compression steel is used in beams, links should be provided as for columns. Column links are required when the area of steel exceeds 0.25% of the gross area of the column and the design load exceeds 25% of the resistance capacity of the column. In such circumstances, links should be proved as follows:

3.4 Curtailment of bars
Reinforcing bars acting in tension at simply supported ends of members should be terminated as follows:
However, should the distance between the face of the support and the edge of the nearest principal load be less than twice the effective depth, reinforcement should be curtailed as follows:

Reinforcing bars which are subjected to bending and terminate other than at an end support, should continue for a distance beyond the point at which they are no longer required, equal to the greater of the effective depth of the member or 12 times the bar size, provided, however, that one or more of the following is satisfied:

- bars extend for a distance at least equal to the effective anchorage bond length;
- the design shear strength of the section is at least twice that of the applied shear force;
- the remaining reinforcement provides at least twice the area of reinforcement required to resist the applied bending moment.
4. RESISTANCE OF METAL COMPONENTS TO CORROSION (SANS 10164-2; Cl 9.2)

4.1 General

The resistance of metal components to corrosion depends upon the following:

- exposure environment
- type and quality of cementitious surround, i.e., mortar or infill concrete
- cover
- type of protective coating of steel.

4.2 Exposure classification

The exposure classification may be established from Table 3 and Figure 1 or Table 17 of SANS 10164-2. Elements which may be subjected to more severe exposure than the remainder of a building, such as parapets, chimneys and sills should be regarded as being located in an environment classified as E3.

<table>
<thead>
<tr>
<th>EXPOSURE CLASSIFICATION</th>
<th>EXPOSURE ENVIRONMENTS FOR SURFACES OF REINFORCED MEMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>Protected by an impermeable membrane</td>
</tr>
<tr>
<td></td>
<td>Exposed to the elements in:</td>
</tr>
<tr>
<td></td>
<td>- inland areas as shown in Figure 1.</td>
</tr>
<tr>
<td></td>
<td>- interiors of buildings.</td>
</tr>
<tr>
<td></td>
<td>Beneath coatings that resist moisture penetration.</td>
</tr>
<tr>
<td>E2</td>
<td>Exposed to the elements in:</td>
</tr>
<tr>
<td></td>
<td>- inland areas as shown in Figure 1.</td>
</tr>
<tr>
<td></td>
<td>- interiors of industrial buildings where humidity is high or where repeatedly washed.</td>
</tr>
<tr>
<td></td>
<td>Submerged in non-aggressive soils.</td>
</tr>
<tr>
<td>E3</td>
<td>Exposed to the elements in:</td>
</tr>
<tr>
<td></td>
<td>- areas within 3 km of industries that discharge atmospheric pollutants.</td>
</tr>
<tr>
<td></td>
<td>- areas within 1 km of the coastline or shoreline of large expanses of salt water.</td>
</tr>
<tr>
<td></td>
<td>Submerged in fresh water.</td>
</tr>
<tr>
<td>S</td>
<td>Submerged in aggressive soils.</td>
</tr>
<tr>
<td></td>
<td>Submerged in sea water, running water or soft water.</td>
</tr>
<tr>
<td></td>
<td>In contact with corrosive liquids or gas.</td>
</tr>
</tbody>
</table>

SANS 10164-2 contains recommendations regarding the minimum levels of protective coatings for reinforcement and masonry accessories used in various types of construction and exposure conditions. These recommendations are not necessarily the desirable levels of protection that may be required since local conditions or specific circumstances may warrant a higher degree of protection.
4.3 Corrosion protection

The degree and type of corrosion protection required, if any, for various types of steel should be determined in accordance with Table 4, read in conjunction with Table 5. The zinc coating on galvanised steel ties should be at least equal to that in Table 2 of SANS 935 for normal environments and 470 g/m² for highly corrosive environments.

Table 4: Corrosion-resistance rating for steel in masonry

<table>
<thead>
<tr>
<th>CORROSION-RESISTANCE RATING</th>
<th>TYPE, OR COATING, OF STEEL (OR BOTH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Uncoated carbon steel; or steel whose coating is less than required for C2 rating.</td>
</tr>
<tr>
<td>C2</td>
<td>Galvanized steel; for products made from:</td>
</tr>
<tr>
<td></td>
<td>a) sheet steel – the coating class shall be at least Z 275 as in SANS 934;</td>
</tr>
<tr>
<td></td>
<td>b) wire of circular cross-section up to 6.0 mm diameter – the coating shall be as for class A wire in Table 2 of SANS 935;</td>
</tr>
<tr>
<td></td>
<td>c) other forms of steel – the coating mass shall be as in Table 1 of SANS 763.</td>
</tr>
<tr>
<td>C3</td>
<td>Galvanized steel; for products made from:</td>
</tr>
<tr>
<td></td>
<td>a) sheet – the coating class shall be at least Z 600 as in SANS 934.</td>
</tr>
<tr>
<td></td>
<td>b) other forms of steel – the coating shall be as for rating C2.</td>
</tr>
<tr>
<td>C4</td>
<td>Steel, or steel coating, whose type and thickness are specially selected to withstand the particular corrosive conditions to which that steel and its masonry may be exposed.</td>
</tr>
</tbody>
</table>
4.4 Cover

Cover to reinforcement should be as follows:

<table>
<thead>
<tr>
<th>LOCATION OF REINFORCEMENT CLASSIFICATION</th>
<th>EXPOSURE RESISTANCE</th>
<th>CORROSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Located in grouted cavities or in Quetta bond construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) where concrete infill employed</td>
<td>E1, E2 and E3 S E1 E2 and E3 S</td>
<td>C1 or higher C4</td>
</tr>
<tr>
<td>b) where mortar infill is employed</td>
<td></td>
<td>C1 C2 or higher C4</td>
</tr>
<tr>
<td>In bed joints</td>
<td>E1 E2 E3 S</td>
<td>C1 or higher C2 or higher C3 C4</td>
</tr>
</tbody>
</table>

Recommended minimum cover given in Table 6

POCKET TYPE

QUETTA BOND

HOLLOW UNITS

BED JOINT

15mm minimum
The tooling of mortar joints gives a dense, water-shedding finish. Tooling of joints should be undertaken in elements located in environments which are classified as E3 or S.

5. **FIRE RESISTANCE**

SANS 10164-2 does not contain any guidance on the fire resistance of reinforced elements and simply makes reference to a code which is still in the course of preparation. BS 5628 Part 2 (Structural use of Reinforced and Prestressed Masonry) suggests that the masonry itself be considered as part of the cover and that the recommendations of BS 8110 (Structural use of Concrete) be followed. AS 3700 (SAA Masonry Code), on the other hand, specifies a minimum cover to the reinforcement for a specific fire resistance period. (See Table 7).

---

**Table 6: Minimum concrete cover for carbon steel reinforcement**

<table>
<thead>
<tr>
<th>EXPOSURE CONDITION</th>
<th>MINIMUM THICKNESS OF CONCRETE COVER, mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Concrete grade (as in SANS 10100)</td>
</tr>
<tr>
<td></td>
<td>25</td>
</tr>
<tr>
<td>Minimum cement content kg/m³</td>
<td></td>
</tr>
<tr>
<td>250</td>
<td>300</td>
</tr>
<tr>
<td>E1</td>
<td>20</td>
</tr>
<tr>
<td>E2</td>
<td>–</td>
</tr>
<tr>
<td>E3</td>
<td>–</td>
</tr>
<tr>
<td>S</td>
<td>–</td>
</tr>
</tbody>
</table>

---

**Table 7: Protection to reinforcement for structural adequacy (AS 3700)**

<table>
<thead>
<tr>
<th>FIRE RESISTANCE PERIOD, MINUTES</th>
<th>30</th>
<th>60</th>
<th>90</th>
<th>120</th>
<th>180</th>
<th>240</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum dimension from the reinforcement to the exposed face of the masonry, mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>30</td>
<td>30</td>
<td>40</td>
<td>55</td>
<td>65</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX G V-JOINTS IN PLASTER AND MORTAR

JUNCTION OF TWO WALLS AT CONTROL JOINT

JUNCTION OF WALL WITH CONTROL COLUMN
ACKNOWLEDGEMENTS

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USE OF COMPUTER AIDED DESIGN (CAD)

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DETAILING OF CONCRETE MASONRY
Volume 1 – Solid Units 140mm

Isikhova / 2004 / MAY 2011