

## 3.1 Basic Masonry Construction

### Introduction

The design of reinforced concrete masonry walls is controlled primarily by:

- NZS 4230 *Design of reinforced concrete masonry structures*;
- NZS 4229 *Concrete masonry buildings not requiring specific engineering design*;
- and some further non-specific designs set out in NZS 3604 *Timber Framed Buildings*.

All these listed standards require Materials and Workmanship to follow the provisions of NZS 4210:2001 *Masonry construction: Materials and workmanship*.

The principal contents of Section 3 of the Masonry Manual relate to the provisions of NZS 4210 concerning construction, reinforcement and grouting. Information has been provided on manufacture of masonry, basic blocklaying and mortar joints in Section 1.

Section 4 will deal with aspects of design.

### Workmanship and Supervision

It is important to recognise that the Design Standard NZS 4230 places a significant importance to the overseeing of construction work under the term 'observation'.

It outlines three types of observation – A, B and C – and designates permitted design strengths to each observation level. The full specification details and contained in Table 3.1 of NZS 4320.

A summary is as follows:

Observation		Nominal Design MPa
C	No construction observation by design engineer	4
B	Inspection by design engineer or mason deemed to meet the competency requirements of NZS 4210	12
A	Additional levels of observation, see NZS 4230	>12

The implications of this were that Non-specific engineering design details of NZS 3604 are based on 4 MPa, and NZS 4229 are based on 8 MPa (but will be raised to 12 MPa at next amendment). Most specific engineered designed reinforced concrete masonry will be Type B.

The important correlation is that the New Zealand Masonry Trades Registration Board had examined masons in their competency understanding of NZS 4210 and hence using a Registered Mason for construction met the requirements of Type B observation.

At the time of writing, the Department of Building and Housing (DBH) is introducing the Licensing Building Practitioner (LBP) scheme wherein the competency check on the structural mason will be done by DBH (see Section 1.6).

In effect, a LBP registered in *Bricklaying and Blocklaying 2: Structural Masonry* will be the equivalent envisaged by NZS 4230 for a registered mason under the previous arrangement.

The DBH is introducing the term 'Restricted Work' but for the purposes of this industry section it will mean all structural masonry elements contained in NZS 3604, NZS 4229 and NZS 4230.

### Blocklaying Tolerances

While the full list of tolerances is contained in NZS 4210, Table 2.2, the principal values are set out here:

1. Deviation from position 15 mm
2. Vertical plumbness 10 mm in 3 metres
3. Total verticality in building height 20 mm
4. Deviation from plan line under 10 m in length 5 mm
5. Displacement in vertical alignment between load bearing walls 5 mm
6. Displacement in vertical alignment between masonry courses:
  - (a) Nominated fair face (one side only) 3 mm
  - (b) Structural face 5 mm

Other tolerances in joints are discussed in Section 1, Part 1.5.

It is worth pointing out that in many of the architectural applications, a tighter tolerance is desirable than the 3 mm specified in NZS 4210.

For such applications, the project specification needs to override NZS 4210. Typical value would be 1-1.5 mm.

## Grout Specification

There are two types of grout specified in NZS 4210, one for use in standard concrete masonry and one for use mainly in between skins of brick or blockwork.

The coarse grout specification can be summarised as a blend of concreting sand, 13.2-4.75 coarse aggregate (approximately 50% of sand quantity) and Portland cement.

The basic strength requirement is 17.5 MPa at 28 days but where construction is exposed and in Zone C (NZS 3604), 20 MPa strength is specified. Zone D (NZS 3604) require 25 MPa strength.

Currently NZS 4210 has a different coastal durability designation where in 25 MPa is the default value where 17.5 MPa is not acceptable.

The workability of the grout is measured by the spread test (see NZS 3112, Part 1, Section 11). The spread is required to be 450 mm to 530 mm for the grout to comply with NZS 4210. Refer to CCANZ Information Bulletin 50 *Spread Test* found at the end of this section.

It is strongly recommended that the grout should be specified to include an expansive admixture as defined in NZS 4210, clause 2.8.2.1(c).

The expanding admixture is to have 2-4% expansive properties occurring within four hours of dosing.

While the supply of grout will normally be via the ready mixed concrete industry via the basic specification, i.e. 17 MPa (or 25 MPa) at 28 days with spread value of 450-530 mm, the dosage of the expanding admixture must be done at site immediately prior to discharge into the masonry wall.

It should NOT be dosed at the ready mixed concrete plant.

The two photographs demonstrate the importance of using the expanding agent in terms of achieving a homogeneous infill.

**Figure 1** shows a cross-section through a section taken from a full height wall using the admixture.

The top reinforcement is fully encapsulated and face shells remain bonded to the core.

**Figure 2** shows a similar specimen but with no expanding admixture used. Air gap is visible under the steel and face shells have been lost.



Figure 1



Figure 2

The other important reason to use the expanding admixture relates to the method of filling and consolidation of the grout in the wall. This will be described in Section 3.3.

## Testing Requirements

Where buildings have specific engineering design it will be usual to require the following tests to be executed and/or results supplied:

1. Compressive strength of grout.
2. Spread of grout.

The compressive strength of grout will often be available from the ready mixed concrete supplier. However, if grout is site tested as described in NZS 4210, it must be sampled BEFORE any expanding admixture is added.

Other testing mentioned in NZS 4210 relates to mortar compressive and bond strengths which generally are of little significance to the overall performance of the reinforced masonry.

The expanding admixture testing has been superseded by manufacture performance criteria, i.e. the product is produced and warranted to give 2-4% expansion usually within some temperature limits.

Bond strengths are a critical requirement of veneer performance and are discussed in Section 5.



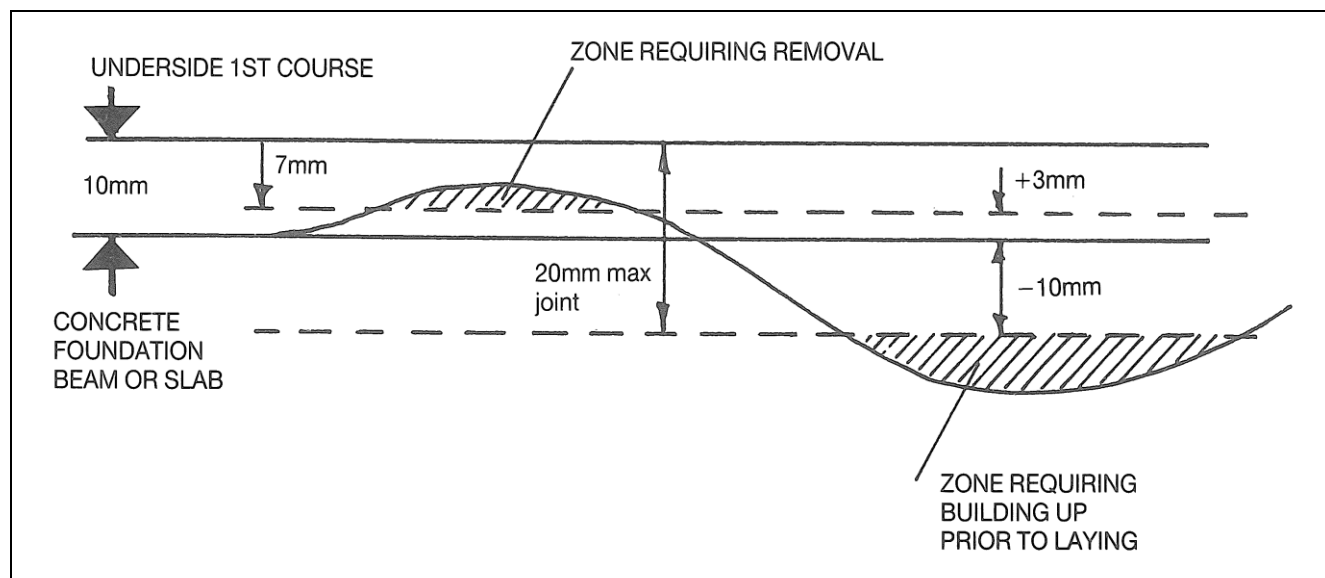


Figure 3

For non-specific engineering construction, the mason needs to retain records of the supply of materials and any supplier tests available.

## Concrete Foundations

Concrete foundations to receive a masonry wall must comply with the various design provisions from NZS 4230, NZS 4229 and NZS 3402.

Their construction, materials and workmanship are controlled by NZS 3109. As discussed in Section 1.4 *Mortar and Mortar Joints* the foundation surface level must be with the tolerances shown in Figure 3.

The surface should be cleaned prior to laying the first course of blocks (see Figure 4).

This should be the work of the foundation contractor as it is more easily done while the concrete is still green.

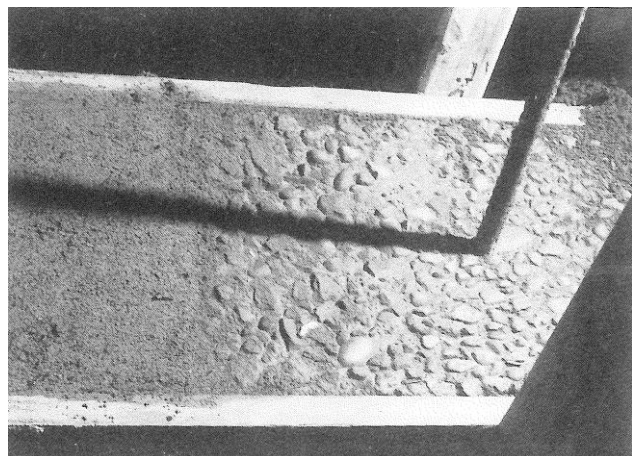


Figure 4

The first course should not overhand the supporting foundation by more than 20 mm. However, structural alignment restrictions may well rule on the issue in which case the overhang may have to be limited to 5 mm.

Reinforcing starter bars need to be positioned to suit the masonry block modules. Refer to CCANZ Information Bulletin 47 found at the end of this section.

Figure 5 (page 4) illustrates a typical wall elevation showing that starter bars are required at the jambs of windows and door openings which may not be on the regular spacing grid, i.e. the wall elevation drawing is needed before the starter bar positioning in the foundation can be decided.

The position of the starter bars needs to be checked immediately prior to laying the first course.

Where bars are missing or in the wrong position, additional steel will need to be inserted. S cranking of out of place steel is not permitted (see Figure 6, page 4).

The remedial work will require the specific permission of the designer.

The steel fixing tolerances are discussed in Section 3.2.

## Intersecting Partition Walls

For tying partition walls to other walls, strips of galvanised metal bonding, metal lath or 6 mm mesh galvanised netting are placed across the joint between the two walls.

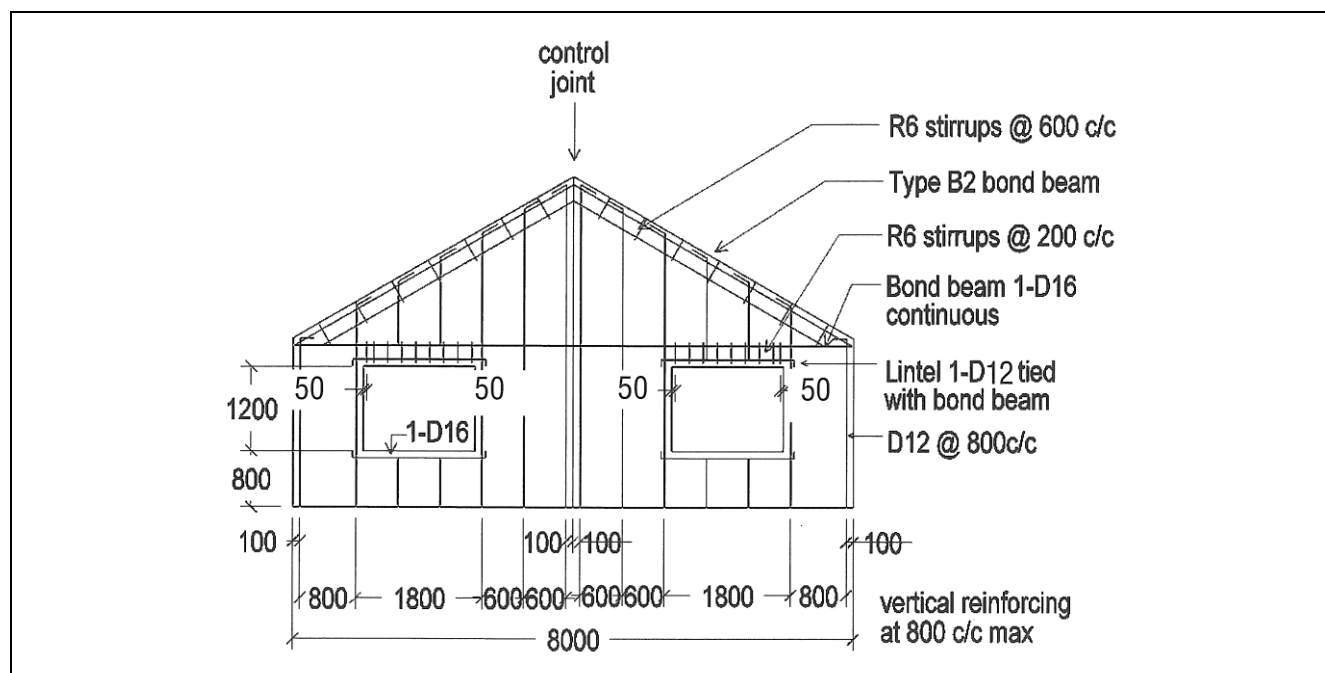


Figure 5

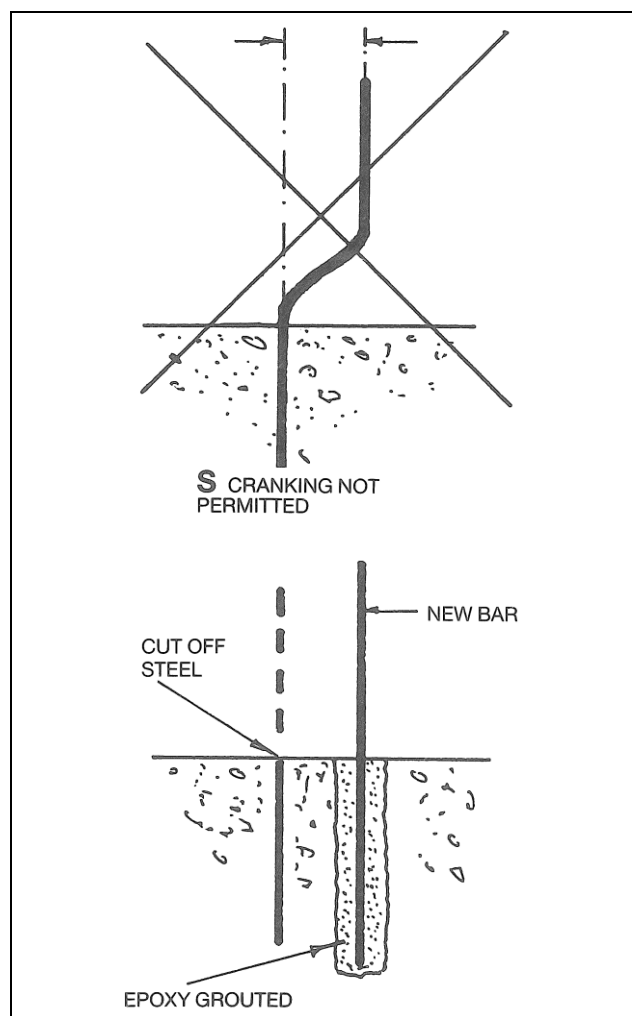


Figure 6

The metal strips are placed in alternative courses in the walls.

When one wall is constructed first, the metal strips are built into the wall and later tied into the mortar joint of the second wall. See Figure 7.

## Intersecting Masonry Walls

Intersecting concrete masonry walls may be bonded together as indicated in the accompanying details, provided the intersecting wall is not longer than 1.2 m or has been structurally considered and specifically designed.

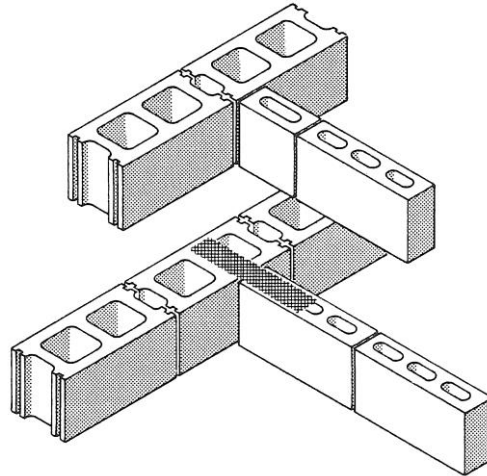
It is more common practice for the intersecting wall to terminate at the face of the other wall with a control joint in the intersecting wall approximately 1.2 m from the junction.

For lateral support, bearing walls are tied together by reinforced bond beams. See Figures 8 and 9.

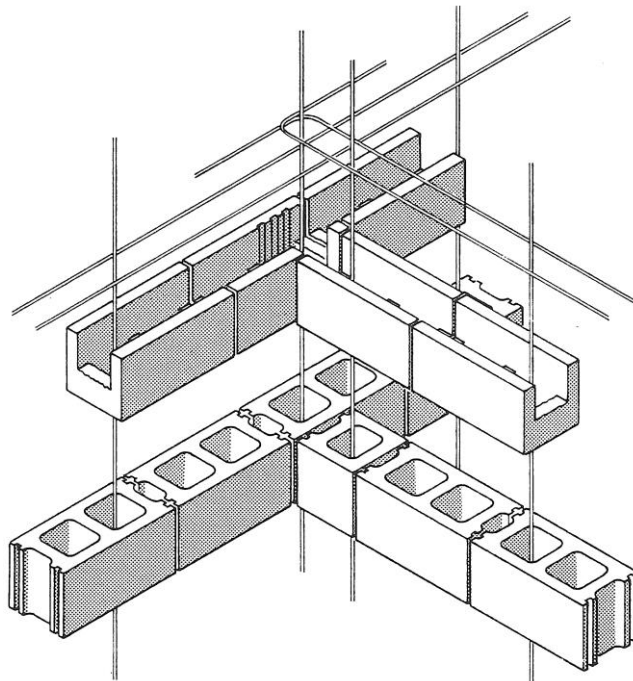
In minor structures where there might not be an intermediate bond-beam, it is recommended that the intersecting walls be tied together with galvanised metal bonding or lath or netting as specified above for intersecting partition walls.

If the joint at the intersection of the two bearing walls is to be exposed to the weather, it should be constructed and sealed with a caulking compound as described under Control joints.

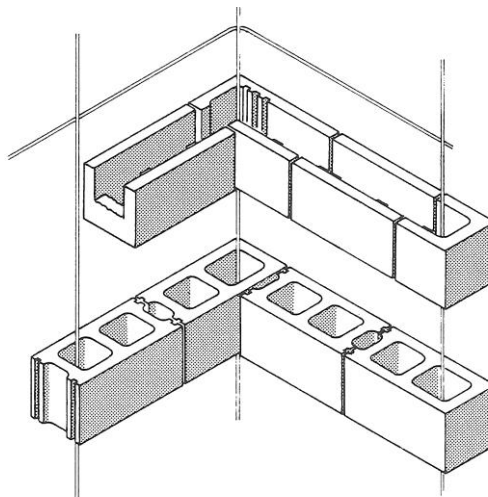




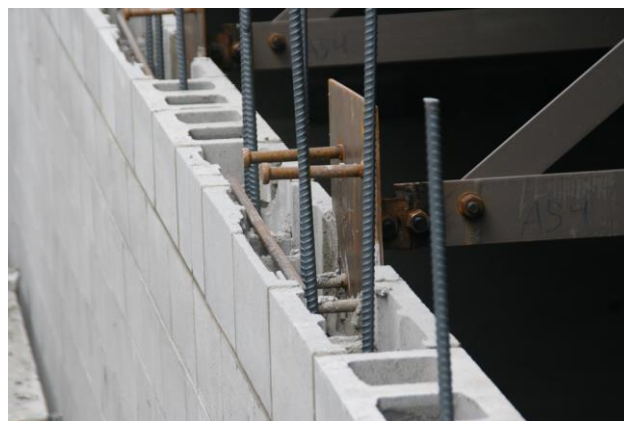
*Figure 7: Intersecting Partition Walls*



*Figure 8: Intersecting Masonry Walls*



*Figure 9: Intersecting Masonry Walls*



## Bonding Details

The following diagrams (page 7-17) illustrate the use of standard blocks in constructing corners, columns, cavity walls and intersections where walls of the same or different thicknesses meet. The illustrations are not intended as constructional details in themselves; rather they are guides to how construction details can be developed with standard modular units.

There might be some structural considerations that would suggest that some corners should be unbonded, perhaps more so in cases where the walls' thicknesses are markedly different (e.g. 10 to 25 series). Such corners would have to be specially considered and designed.

In most cases, except for when the 10 series is used as a masonry veneer supported by either a structural masonry or timber wall, there will be a need to tie intersections with horizontal reinforcement. Where this is required, it will be necessary to substitute the referenced block with a block designed to accommodate horizontal

reinforcement using either a depressed web or knock out web section. For example, a 15.01 could be replaced by a 15.14 or 15.16, a 20.01 replaced by 20.14 or 20.16, a 25.01 replaced by a 25.14 or 25.16 and a 30.04 replaced by a 30.14.

In some cases, there is no direct substitute block and it will be necessary to modify the referenced blocks by masonry saw cutting prior to laying to create a horizontal pathway for the reinforcement.

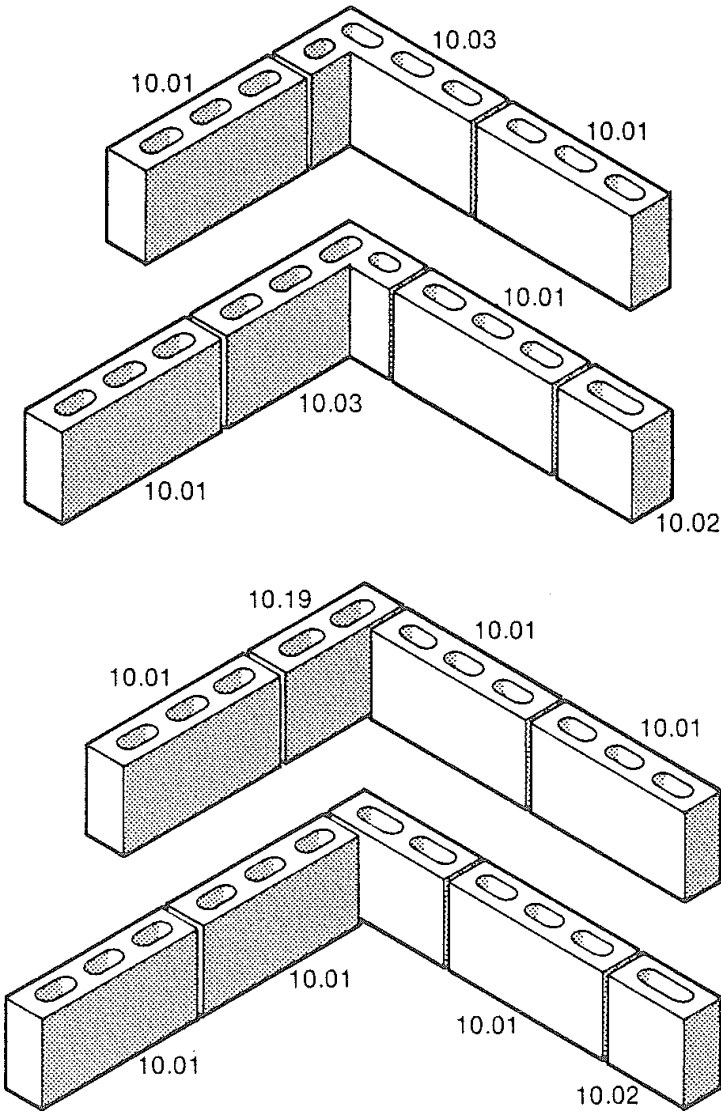
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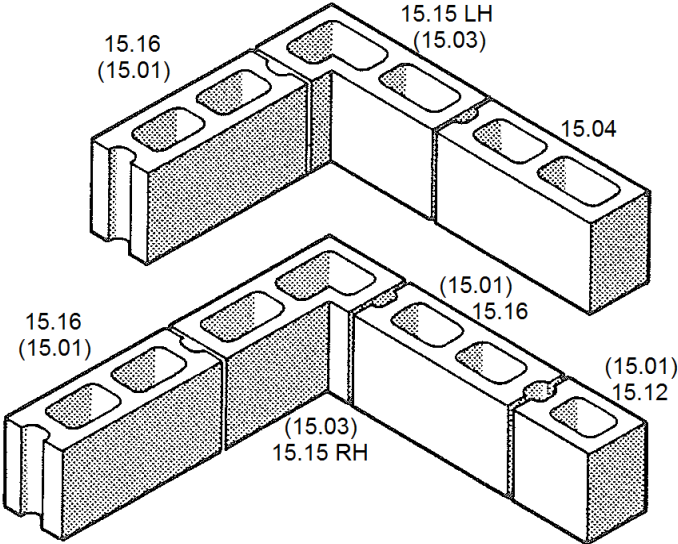
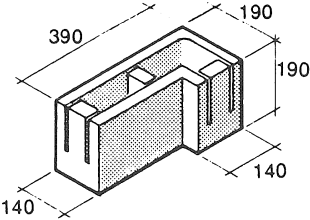
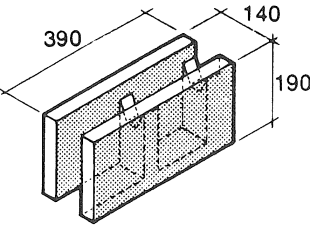
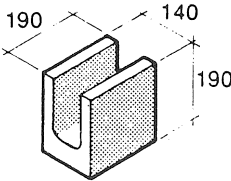
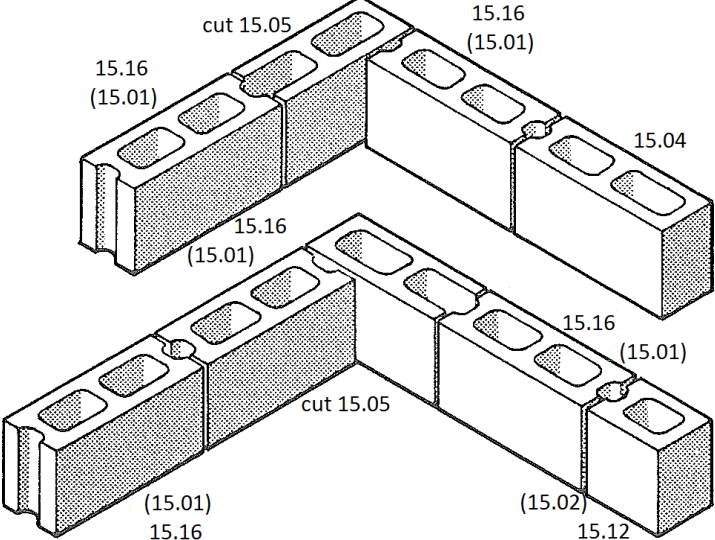
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## 10 Series Corners

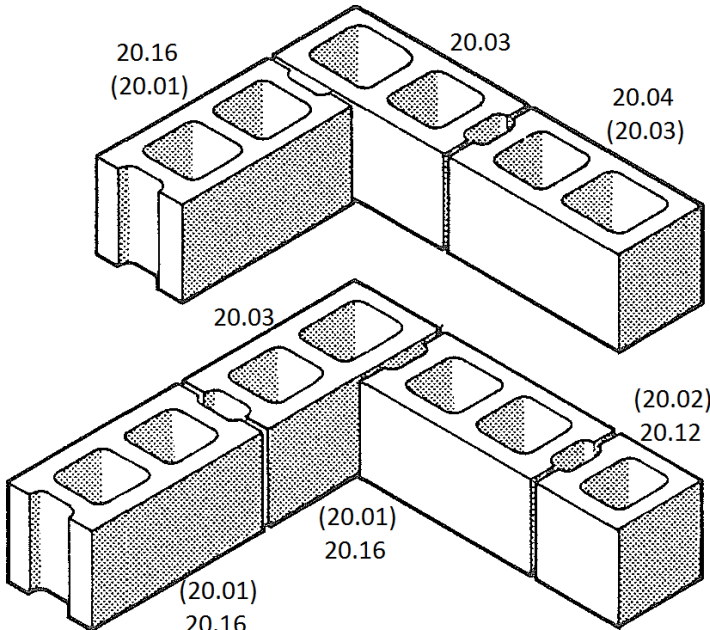
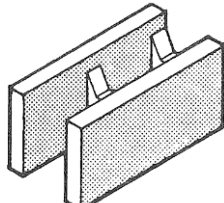
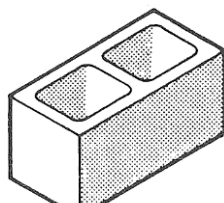
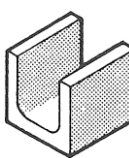
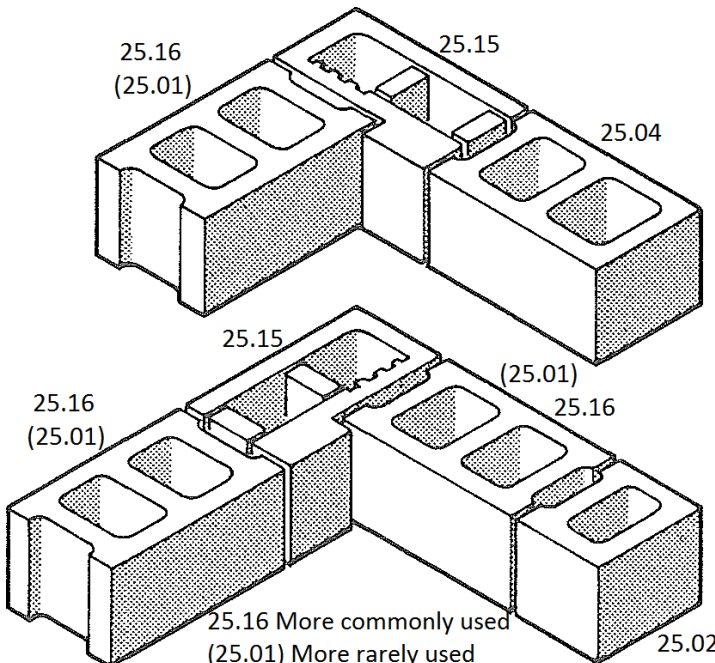
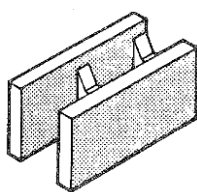
	200 mm module on outer face	200 mm module on inner face	Cores in line	Cores not in line	Common Blocks in Use and Other Remarks
<b>Normal System</b> 	<ul style="list-style-type: none"> <li>•</li> </ul>			<ul style="list-style-type: none"> <li>•</li> </ul>	<p>Use of two cores units or of 10.05 units instead of 10.01 units would align cores.</p>
		<ul style="list-style-type: none"> <li>•</li> </ul>		<ul style="list-style-type: none"> <li>•</li> </ul>	<p>Use of two cores units or of 10.05 units instead of 10.01 units would align cores.</p> <p>Recommended for use only where 200 mm module required on inner face.</p> <p>Also recommended bonding for half-high split-face and similar units.</p>

## 15 Series Corners

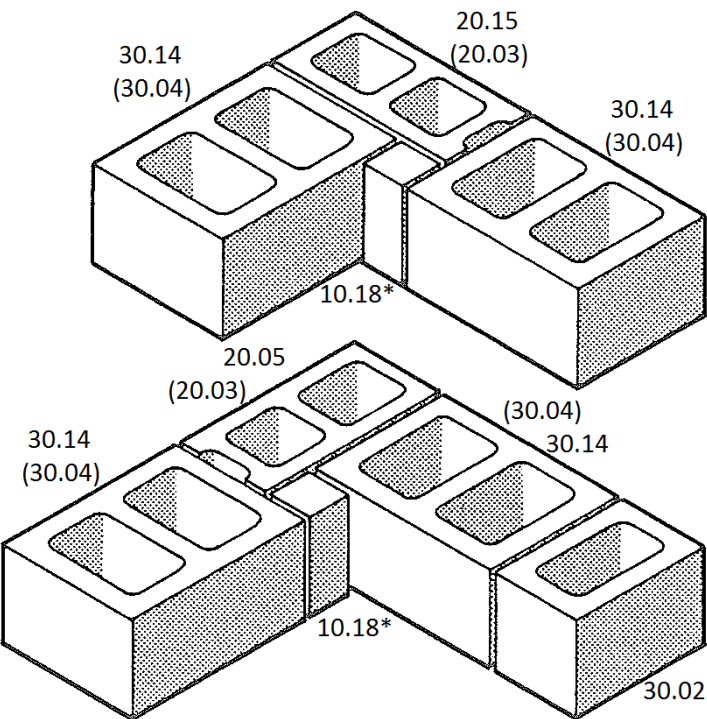
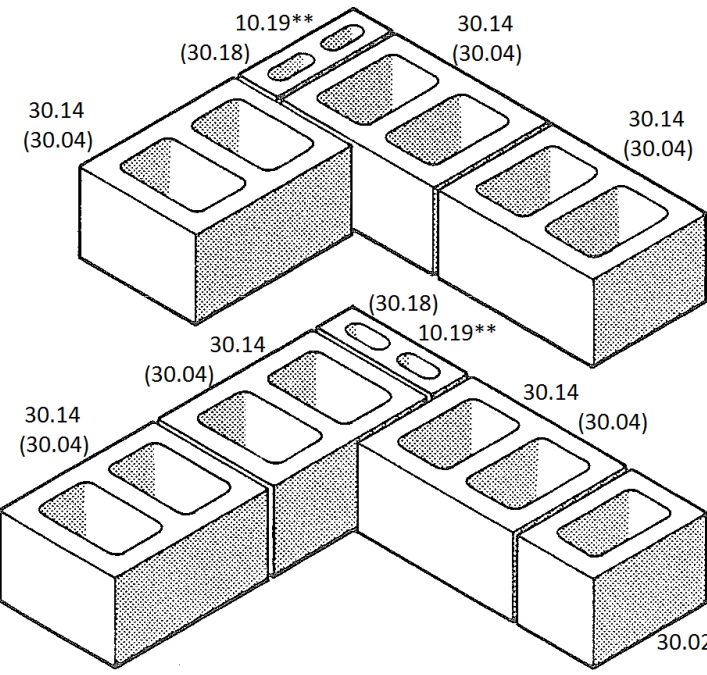
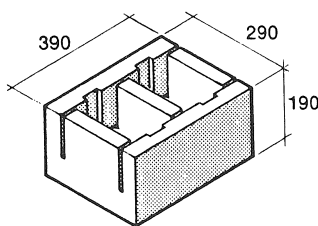
	200 mm module on outer face	200 mm module on inner face	Cores in line	Cores not in line	Common Blocks in Use and Other Remarks
	•		•		 <p>15.15 RH</p>  <p>15.16</p> <p>The corner blocks are 15.05 units cut on a table saw to 340 mm actual length.</p> <p>Recommended for use only where 200 mm module required on inner face.</p>  <p>15.12</p>
		•	•		<p><b>Note:</b> Modifications to standard blocks can also be made by blocklayer using a masonry saw.</p>



## 20 and 25 Series Corners

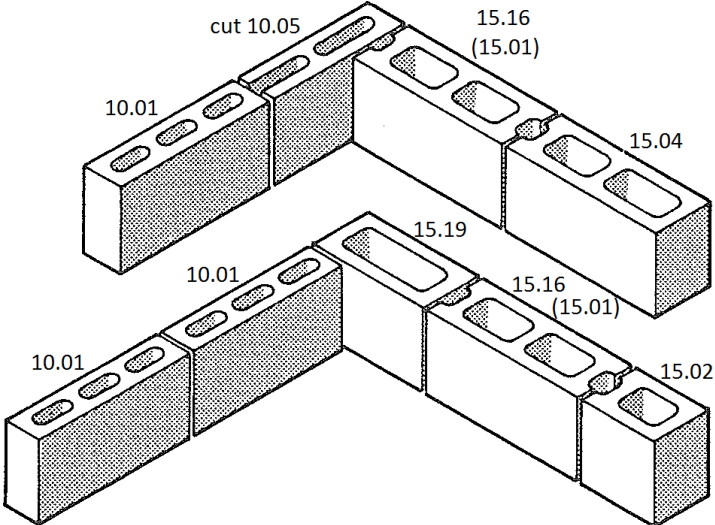
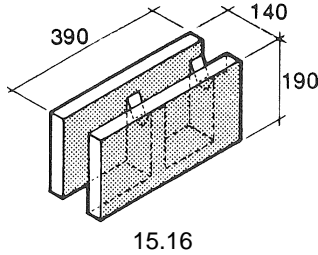
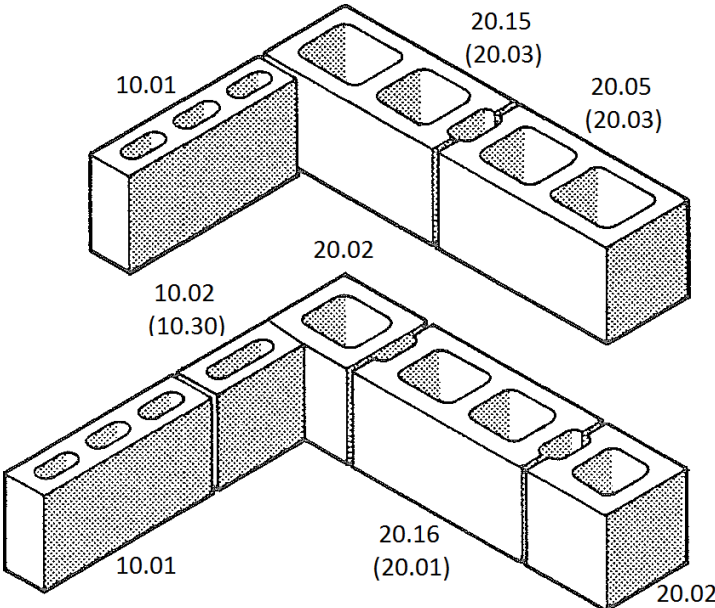
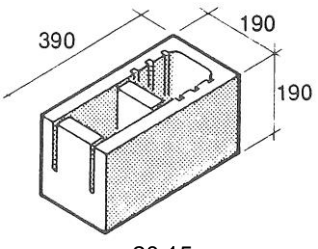
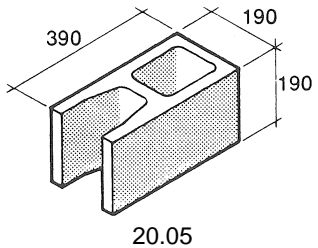
	200 mm module on outer face	200 mm module on inner face	Cores in line	Cores not in line	Common Blocks in Use and Other Remarks
<b>20 Series Corner</b> 	•	•	•		 <p>20.16</p>  <p>20.04</p>  <p>20.12</p>
<b>25 Series Corner</b> 	•	•			 <p>25.16</p> <p><b>Note:</b> Modifications to standard blocks can also be made by blocklayer using a masonry saw.</p>

## 30 Series Corners

	200 mm module on outer face	200 mm module on inner face	Cores in line	Cores not in line	Common Blocks in Use and Other Remarks
	•		•		<p>* 10.18 could be cut from 10.17 solid</p> <p>** 10.19 cut from 10.01.</p>
		•	•		<p>Recommended for use only when 200 mm module required on inner face.</p>  <p>30.14</p> <p>30.18 is also known as 10.19.</p> <p><b>Note:</b> Modifications to standard blocks can also be made by blocklayer using a masonry saw.</p>

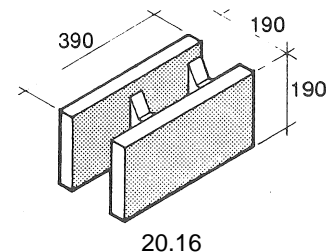
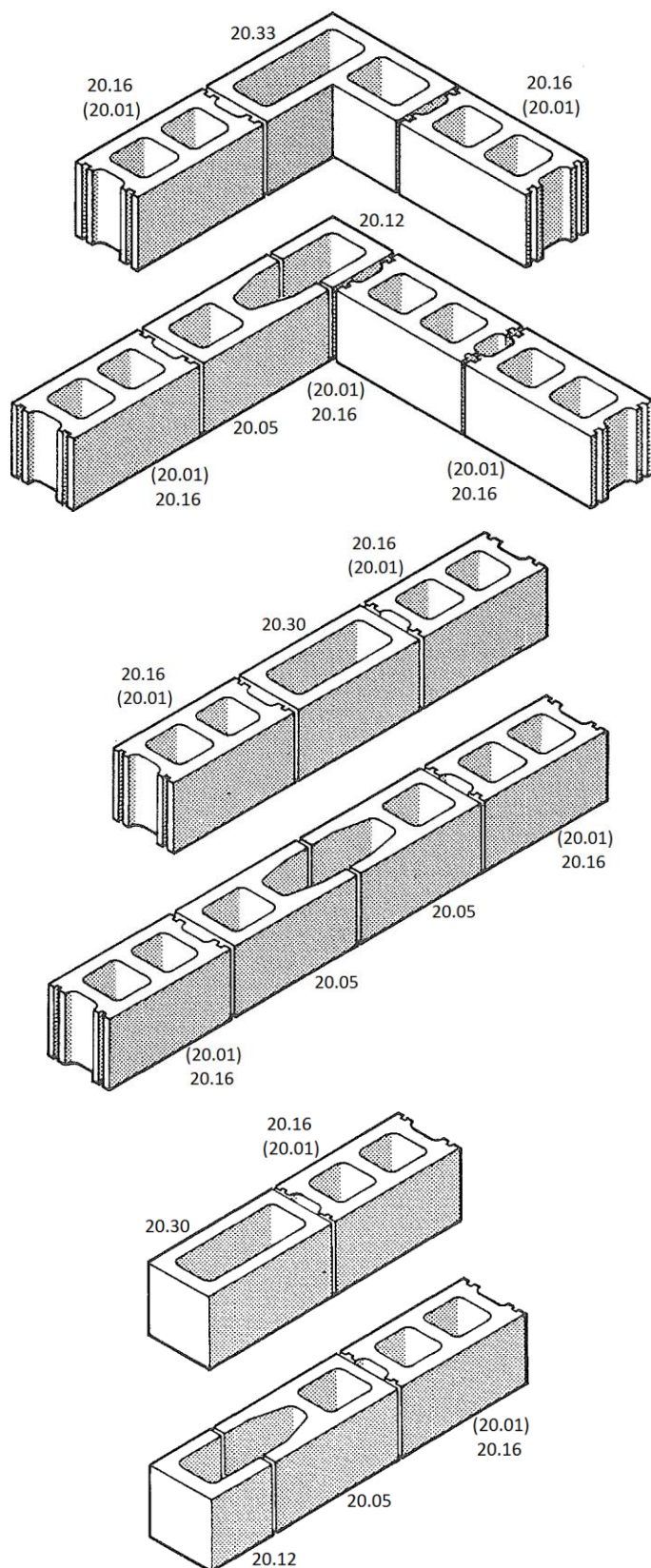


## 10/15 and 10/20 Series Corners

	200 mm module on outer face	200 mm module on inner face	Cores in line	Cores not in line	Common Blocks in Use and Other Remarks
<b>10/15 Series Corner</b> 		•		•	<p>10.05 unit cut to 340 mm actual length.</p> <p>Use of two cores units or of 10.05 units instead of 10.01 units would align cores.</p> 
<b>10/20 Series Corner</b> 		•		•	<p>Use of two cores units or of 10.05 units instead of 10.01 units would align cores.</p>   <p><b>Note:</b> Modifications to standard blocks can also be made by blocklayer using a masonry saw.</p>

## Flush Columns in 20 Series Walls

### Common Blocks in Use and Other Remarks



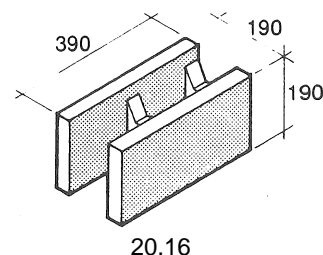
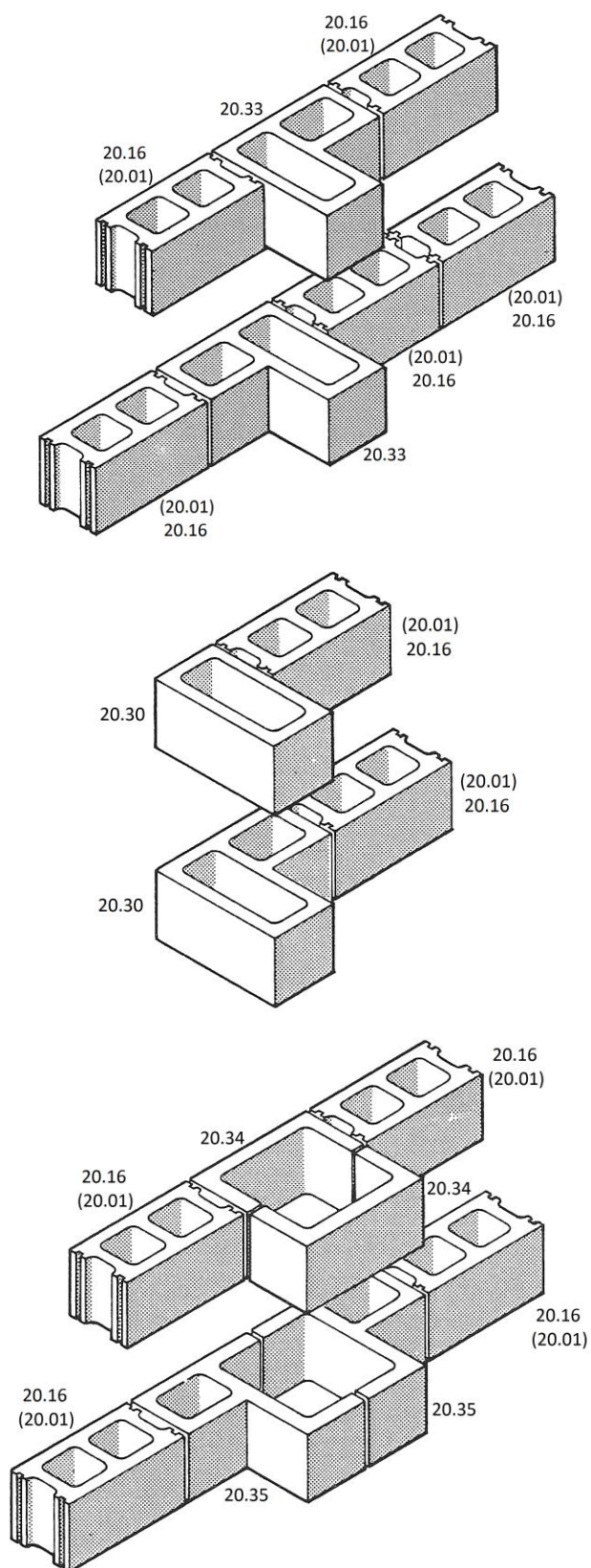
Bonded intersecting walls should not exceed 1.2 m in length unless specially designed.

**Note:** Modifications to standard blocks can also be made by blocklayer using a masonry saw.



## Columns in 20 Series Walls

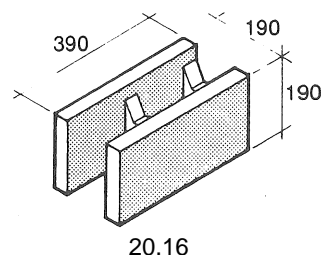
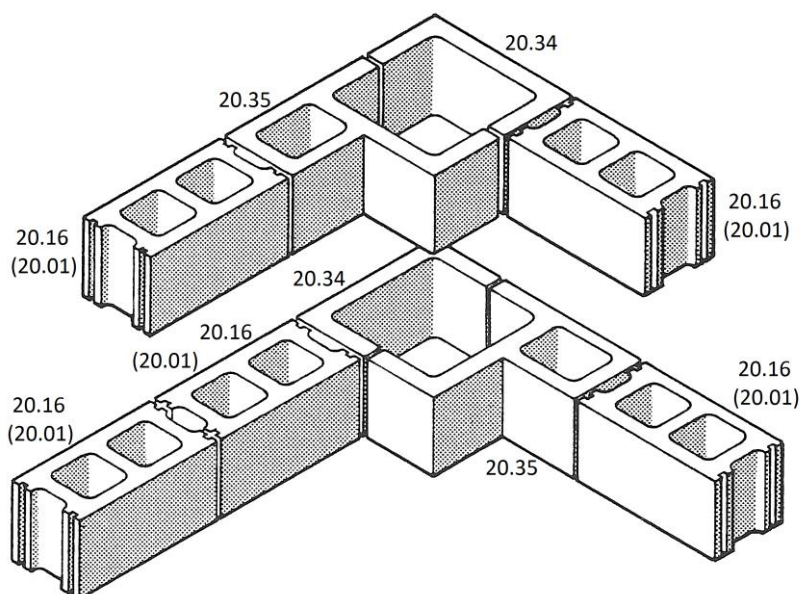
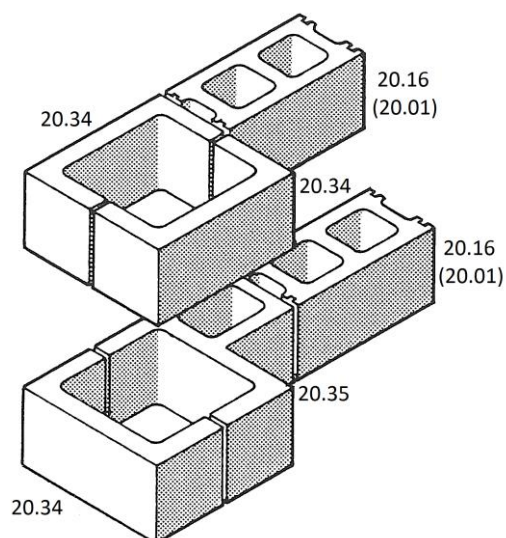
### Common Blocks in Use and Other Remarks



**Note:** Modifications to standard blocks can also be made by blocklayer using a masonry saw.

## Columns in 20 Series Walls continued

### Common Blocks in Use and Other Remarks

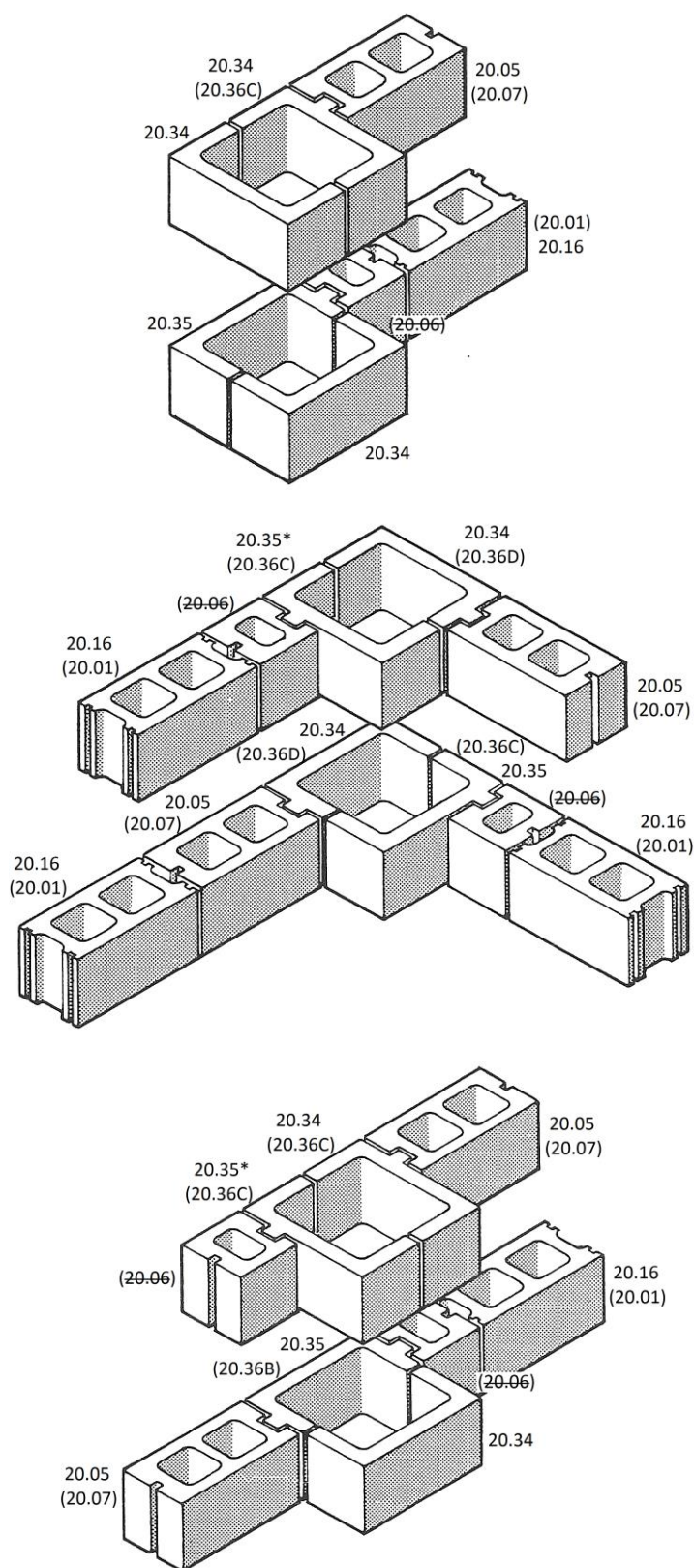


**Note:** Modifications to standard blocks can also be made by blocklayer using a masonry saw.



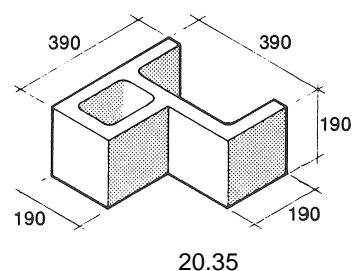
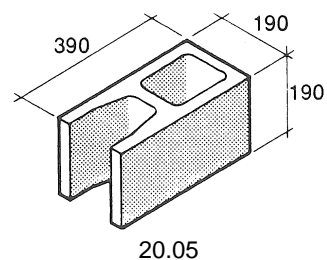
## Columns in 20 Series Walls continued

### Common Blocks in Use and Other Remarks



20.36 is superseded by 20.34.

20.07 is superseded by 20.05.



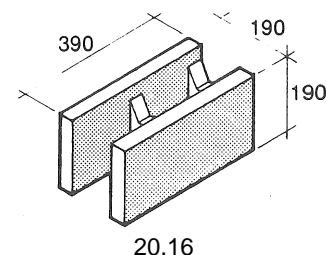
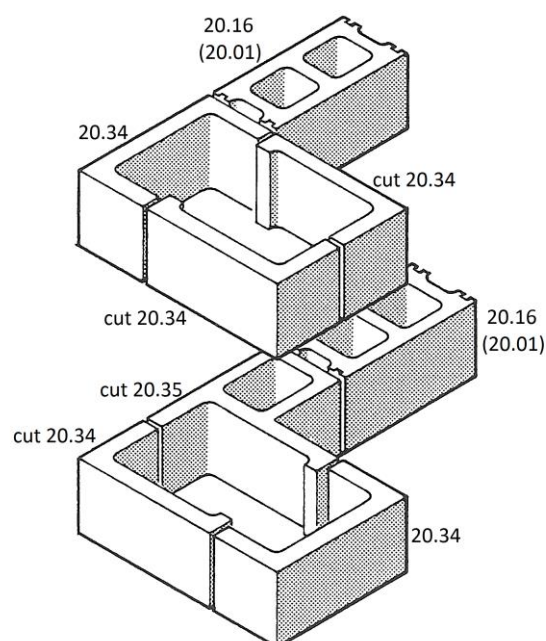
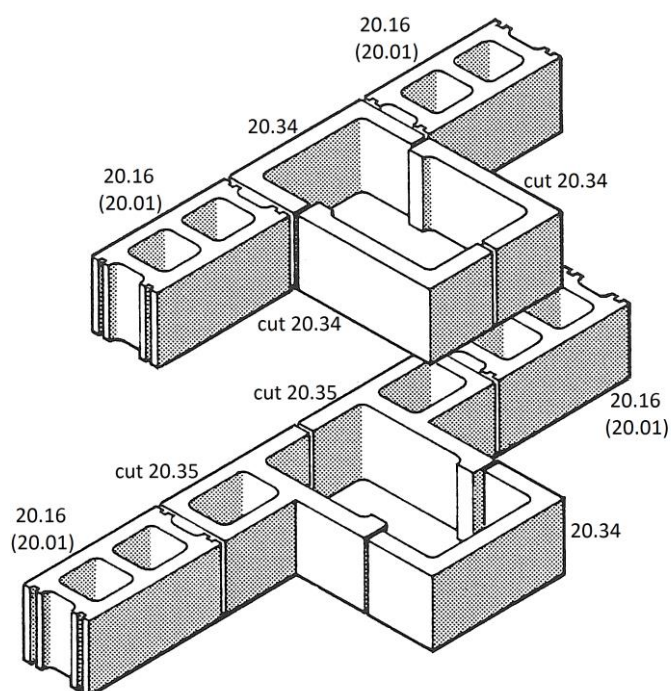
\* 20.35 is a composite of 20.36 and 20.06.

These column details facilitate control joints alongside the columns.

**Note:** Modifications to standard blocks can also be made by blocklayer using a masonry saw.

## Columns in 20 Series Walls continued

### Common Blocks in Use and Other Remarks



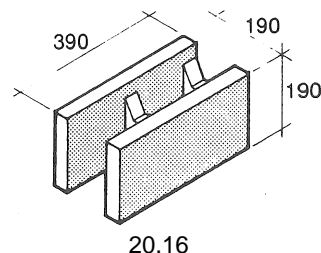
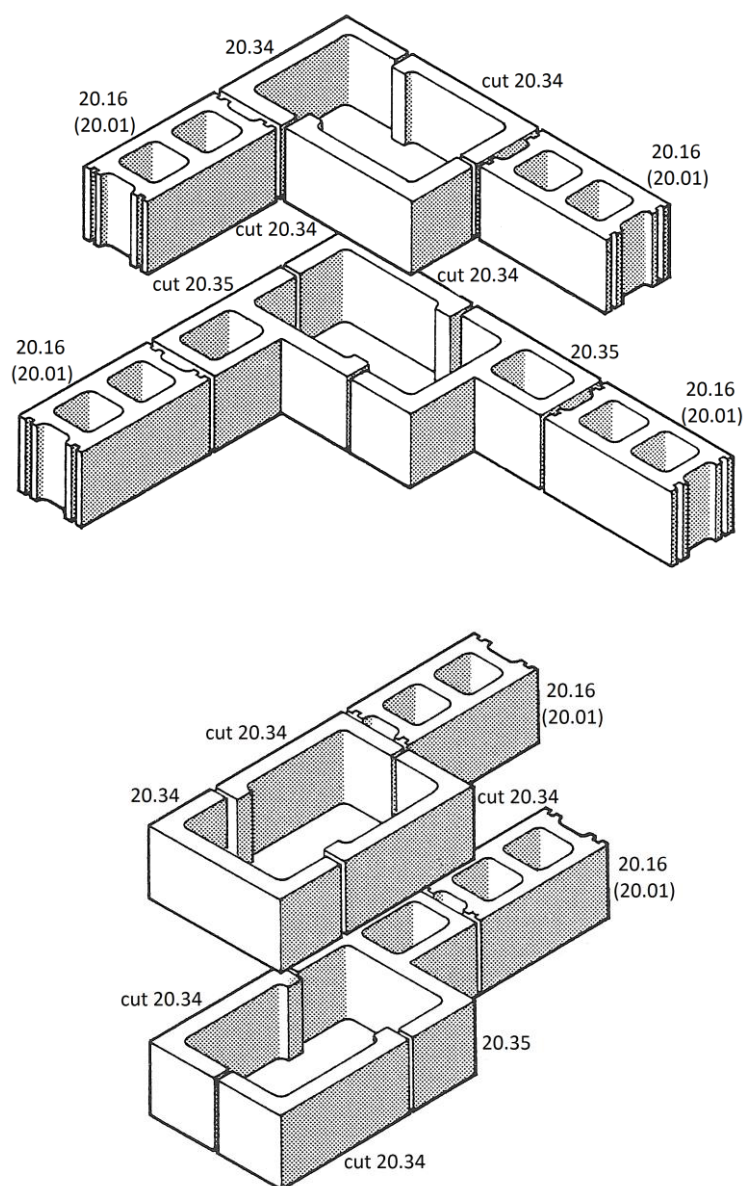
The shell faces of these column units must be supported by strapping and strutting during placing of grout filling and until grout has set.

**Note:** Modifications to standard blocks can also be made by blocklayer using a masonry saw.



## Columns in 20 Series Walls continued

### Common Blocks in Use and Other Remarks



The shell faces of these column units must be supported by strapping and strutting during placing of grout filling and until grout has set.

**Note:** Modifications to standard blocks can also be made by blocklayer using a masonry saw.



# INFORMATION BULLETIN: IB 50

*Spread Test* (As per NZS 3112, Part 1:1986)

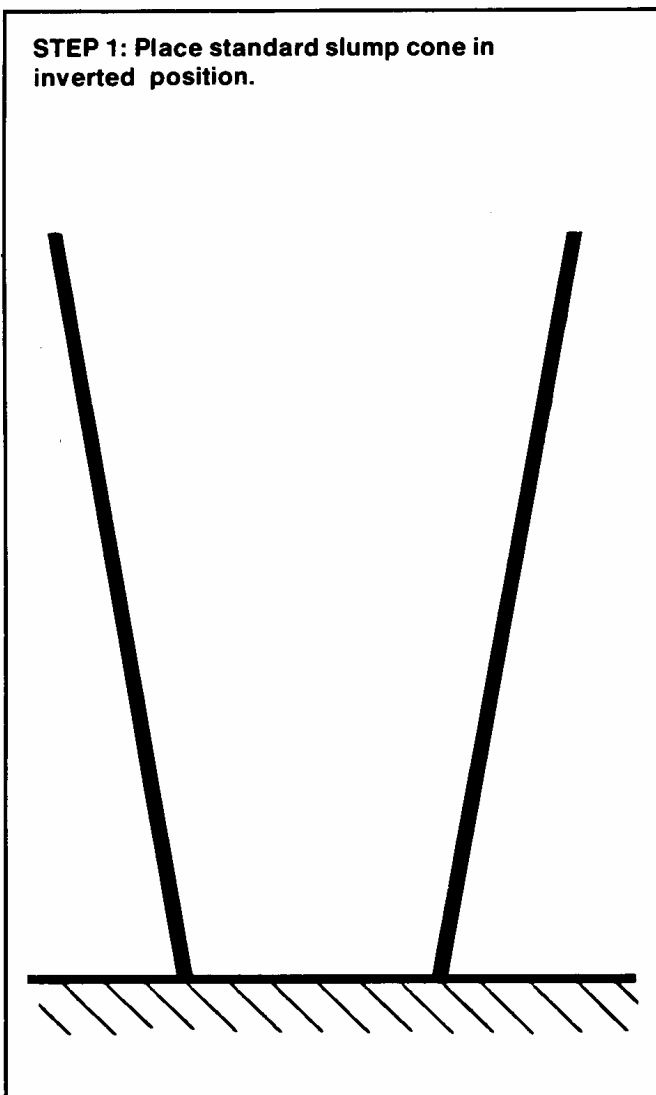
## INTRODUCTION

The spread test gives a quick assessment of the fluidity of high-slump concrete mixes used for filling the cavities in reinforced masonry construction. (Of course, fluidity is not the only practical criterion which such mixes should satisfy; thus, for example, maximum aggregate sizes must be compatible with the presence of reinforcement within cells of particular dimensions). Equipment for the spread test comprises a suitable base, a standard slump cone, metal scoop, metric rule, and some means of

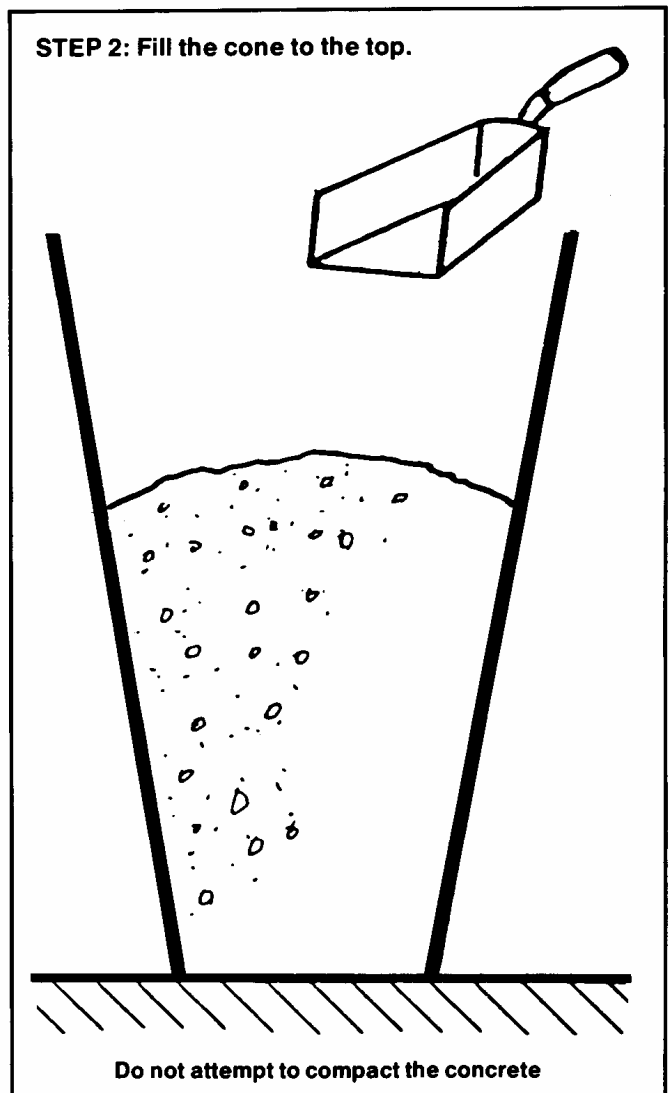
restricting cone uplift to 50 mm. The base should be clean, flat, smooth-surfaced, rigid, and non-absorbent, with a lateral dimension of not less than 600 mm. It should be level and free from vibration during the test. Where a smooth concrete slab or floor area (without surface flaws) is used as the base plate, this must be moistened prior to the test to inhibit absorption of fresh concrete. The limiting of cone uplift to 50 mm can be achieved by the provision of an upstand and cross bar arrangement.

## TEST PROCEDURE

**STEP 1: Place standard slump cone in inverted position.**

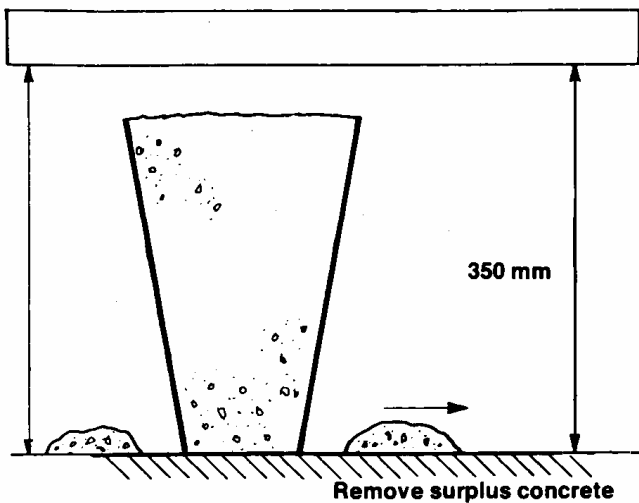


**STEP 2: Fill the cone to the top.**

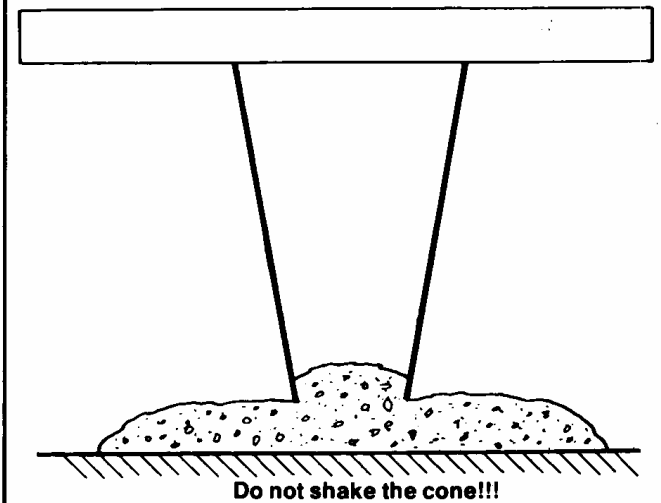




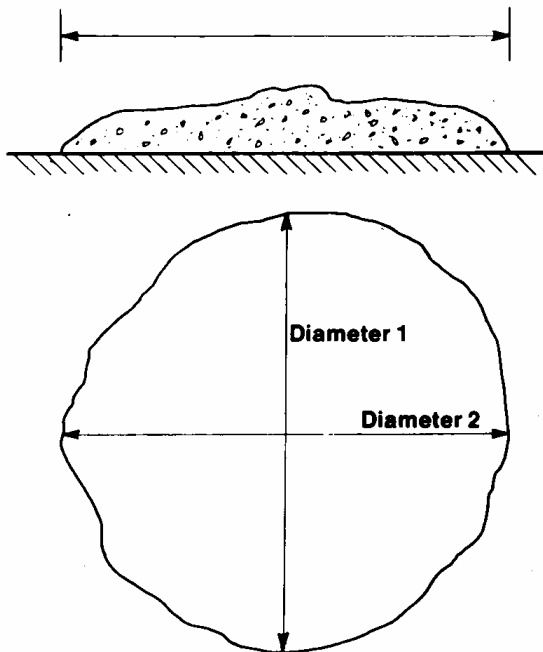
**STEP 3: Place crossbar over the cone.**



**STEP 4: Lift cone against bar and allow the concrete to flow out.**



**STEP 5: Remove the crossbar and measure the spread as the diameter of the flow in two directions.**



Place the moistened slump cone, narrow end downwards, on the center of the base plate.

- Step 1:** Remix the concrete sample thoroughly; and then fill the slump cone taking care to **avoid segregation and/or compaction**.
- Step 2:** Set up the stop device for limiting cone uplift, providing a clear height of 350 mm above the surface of the base plate.
- Step 3:** Subject the cone to a quick vertical lift of 50 mm. Hold the upper end of the cone against the stop device until the flow of concrete ceases.
- Step 4:** Remove the slump cone and stop device, and measure the "spread" of the concrete across two diameters at right angles.
- Step 5:** Average the two measurements. Report spread to the nearest 10 mm.

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# INFORMATION BULLETIN: IB 47

## Starter Bars – Concrete Masonry

### INTRODUCTION

Starter bar positions for concrete masonry are a vital part of the wall construction.

Errors in position can result in the wall being understrength and in many cases unable to be built without the replacing of the starter bars by drilling and epoxy grouting steel in the correct position. This is time consuming and wasteful, since errors are often only discovered when the blocklayer lays out the first course.

This design note is applicable to 100, 150, 200 and 250 series walls built to modular pattern.

**Note:** For non-specific design masonry buildings with solid filled walls:

Running bond: vertical bars will be D12 at 600 mm centres in earthquake zone A, and 800 mm centres in earthquake zones B and C.

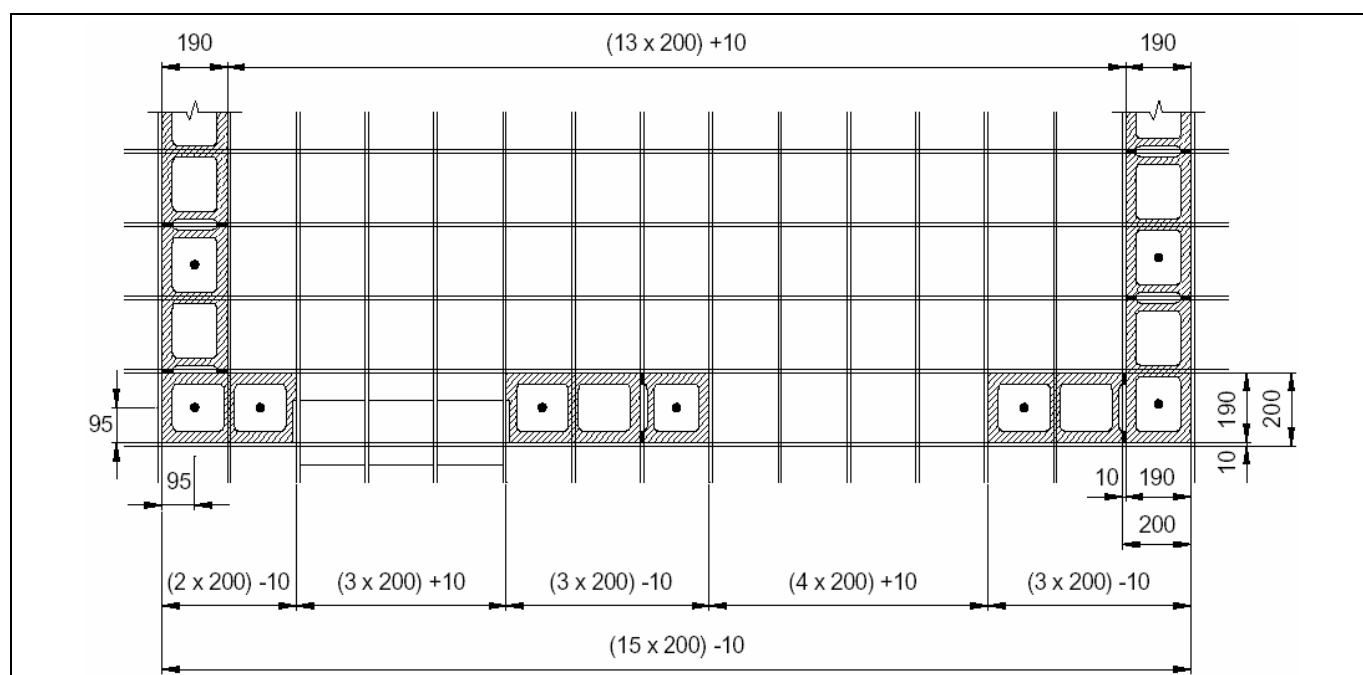
Stack bond: vertical bars will be D12 to 600 mm centres in all zones. For partial filling, vertical bars will be D12 at 600 mm centres in earthquake zones B and C only, and constructed in running bond.

Bar size limited to D10 in 10 series walls.

### REQUIREMENTS

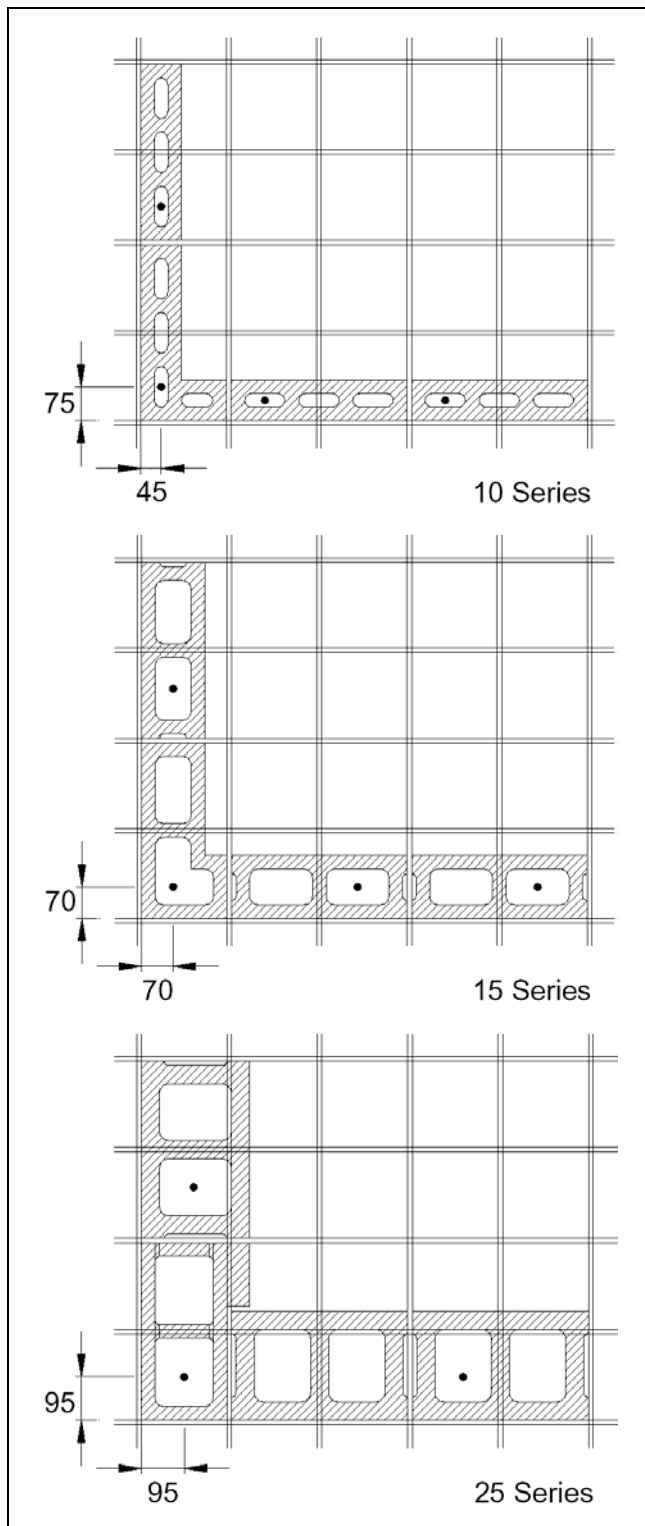
To be able to place the starter bars in the correct position, the contractor responsible for the foundation or floor construction must have the following information in addition to foundation dimensions:

1. Size and spacing of vertical bars.
2. Thickness of masonry walls to be built.
3. Edge support detail of masonry wall.
4. Positions of doorways.
5. Positions of windows.
6. Position for cut block on non-modular construction, if this is known.



**Figure 1: Planning on the standards concrete masonry grid.**





**Figure 2: Modular corner constructions**

## SETTING OUT

The details in this document are based upon the modular concept of 200 mm at each corner and intersection. Masonry units are produced in different thicknesses, yet may be put together to meet the modular concept (Figures 1 and 2). There are a number of basic rules which will apply to ALL masonry construction.

1. Every corner will be solid filled with grout and will contain a vertical reinforcing bar.
2. Every bonded T intersection will have a solid filled core and will contain a vertical reinforcing bar.
3. Each masonry cell immediately adjoining a door opening will be solid filled and will contain a vertical reinforcing bar.
4. Each masonry cell adjoining a window will be solid filled and contain a vertical reinforcing bar.

The starting point for setting out will be the corners of the building.

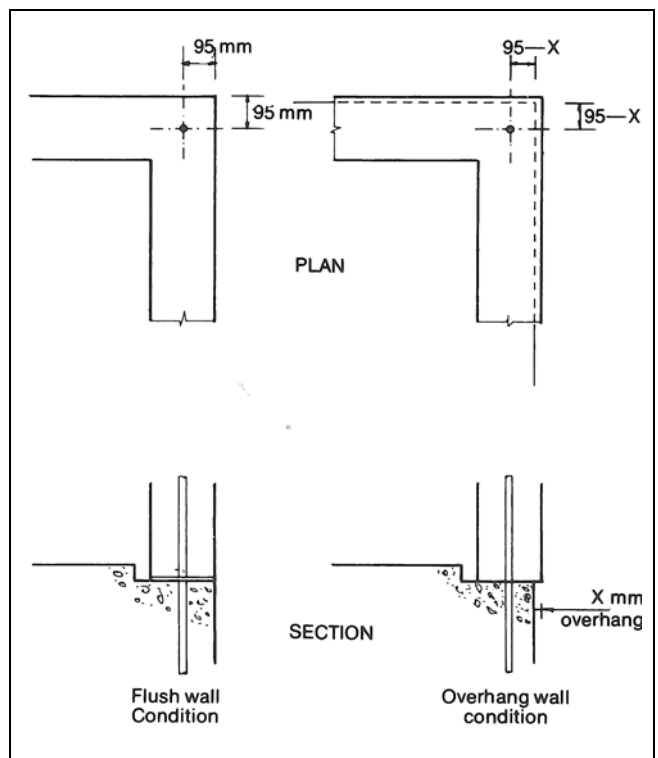
### Step 1:

Determine measuring position at a corner.

With modular construction for masonry walls of nominal 100 (2 holes), 150, 200 and 250, the position from the corner will be 95 mm.

If the block wall is to overhang the foundation then the overhang dimension must be subtracted from the 95 mm (see figure 3).

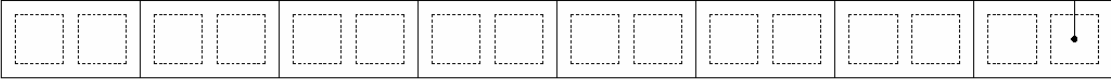
Put nail in timber shutter or mark steel shutter. The 100 series which has 3 holes per unit will have a starting dimension of 75 mm.



**Figure 3: Foundation corner detail 200 series**

**Table 1:**  
**Cumulative dimensions for start bar positions**

REINFORCEMENT	
800 ccs 5.6, 4.8, 4.0,	3.2 2.4 1.6 800
600 ccs 4.8, 4.2, 3.6,	3.0 2.4 1.8 1.2 600
400 ccs 4.4, 4.0, 3.6,	3.2 2.8 2.4 2.0 1.6 1.2 800 400
200 ccs 3.6, 3.4, 3.2,	3.0 2.8 2.6 2.4 2.2 2.0 1.8 1.6 1.4 1.2 1.0 800 600 400 200



## Step 2:

From this corner position, using Table 1, mark the running dimension positions on the shutter, depending upon the nominal centres of steel required. If the wall length is non-modular (i.e. not a multiple of 200 mm), it is recommended that bar positions be marked out from each corner (see step 3). A tape hooked on a nail or a special long gauge rod are the simplest ways of measuring out.

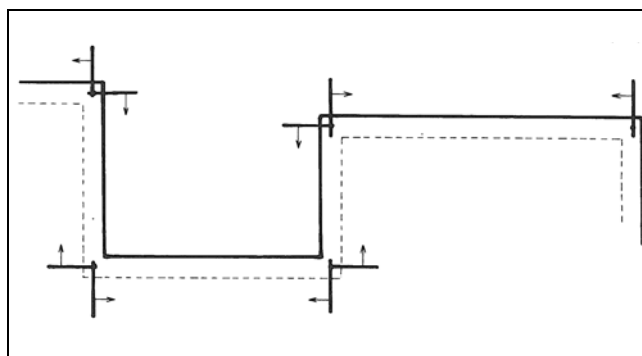
## Step 3:

From the opposite corner bar position, mark the running dimensions positions on the shutter until reaching the original set, Step 1. These may not match, so include an additional bar (figure 4).

## Step 4:

Mark positions of windows and doorways and ensure

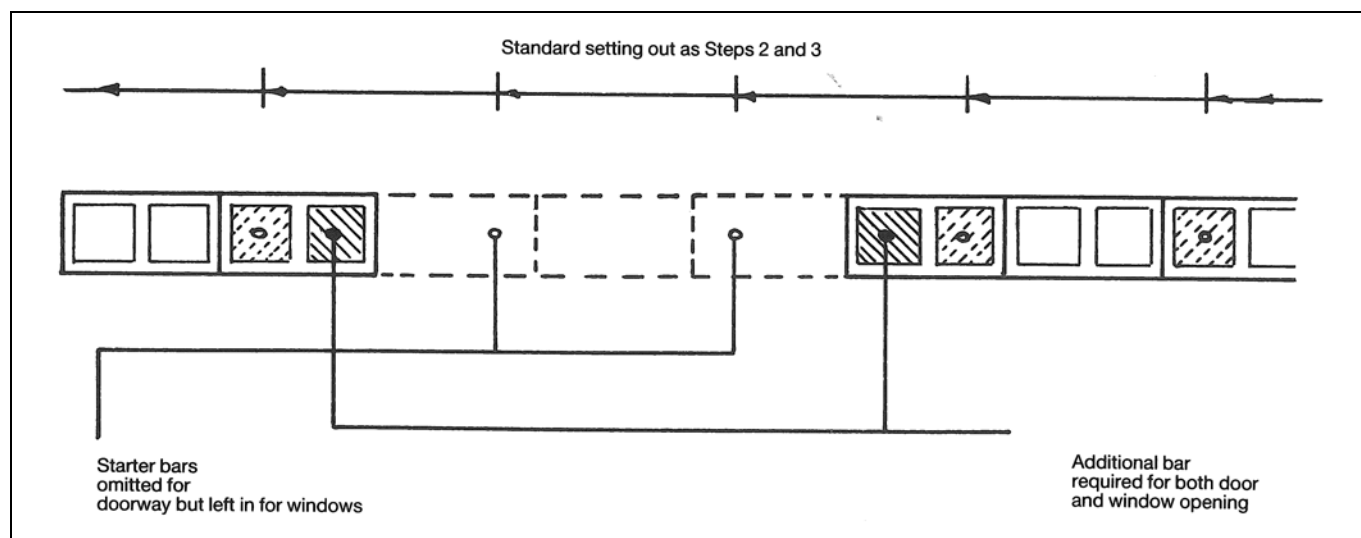
there is a reinforcing bar in the adjoining cell. Extra bars may be needed to cover this case (figure 5).



**Figure 4: Work dimensions from each corner**

## Step 5:

Positions of starter bars in the opening of doorways can be omitted (figure 5).



**Figure 5: Example of Steps 4 and 5**



## Step 6:

The position of the bar from the face of the block depends upon the wall thickness and bar size.

The dimension from the shutter face will therefore be figures from Table 2 if the block is to be placed flush with the foundation (see figure 6). If an overhang detail is used, the overhang dimension must be subtracted from the figures in Table 2 (figure 6). Note that the corner starter bar lies on centre line of wall (figure 7). This only corresponds with the setting out reference position on the 200 series.

**Table 2:**  
**Position of reinforcement from block face**

Nominal Wall Thickness (mm)	Face of block to	
	Centreline of bar (mm)	Face of 10/12 mm bar (mm)*
100	45	40
150	70	65
200	95	90
250	120	115

D12 bars are used in the non-specific design code NZS 4229.

D10 bars maximum size in 100 mm (10 series).

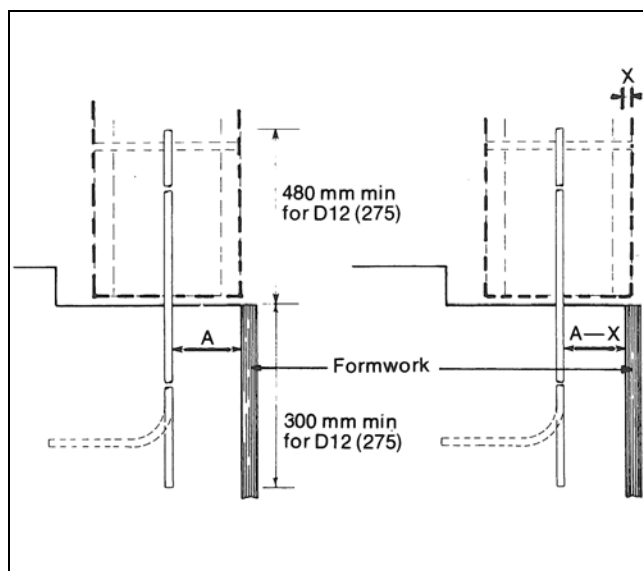
\* Dimensions have been rounded to nearest 5 mm

## Step 7:

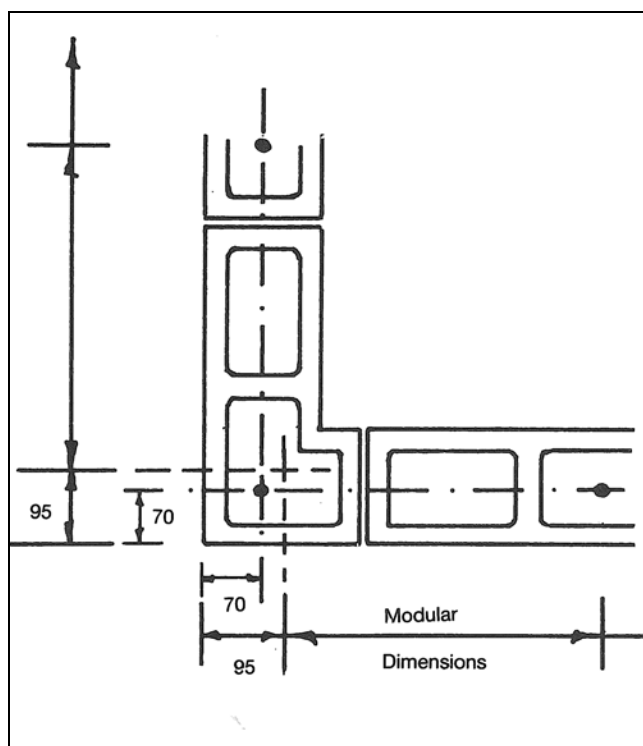
Fix starter steel to shape and dimensions required. Typical details for D12 bars are shown in figure 6.

## Step 8:

Immediately after concreting, make a running dimension check to see that steel is in correct position. Adjust as necessary, but make sure concrete around the starter is recompact.



**Figure 6: Position of bar from face of foundation**



**Figure 7: Positioning corner bar on 150 series**

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