

## 4.3 Standard Specifications for Concrete Masonry Buildings Not Requiring Specific Design

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### Introduction

The development of a Standard Specification is inevitably an attempt at consensus on the various specifications in current use. The assistance of several consultants who provided copies of their specifications is acknowledged. JASMAX were engaged to prepare an amalgamated specification which was subsequently circulated. In response to comments, the specification was amended by the CCANZ, who also provided the commentary clauses, drawn essentially from their Information Bulletin IB 61.

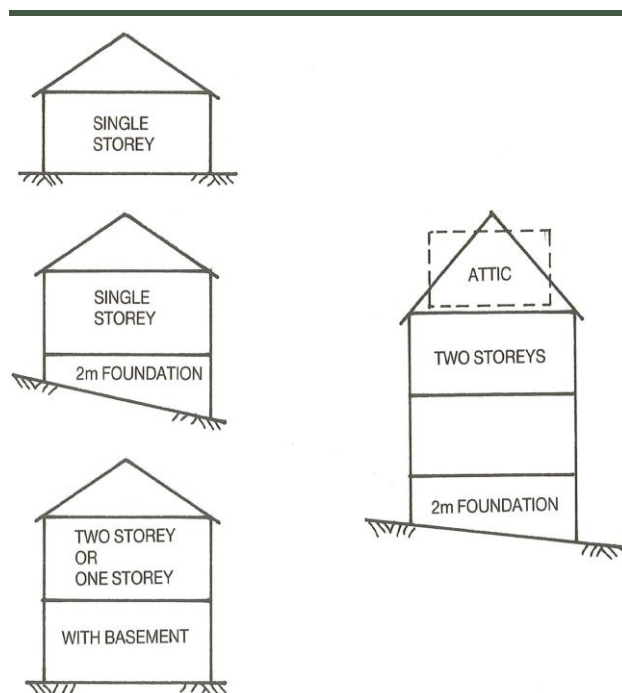
### 1.0 Preliminary

#### 1.1 NZS 4229:2013 Concrete Masonry Buildings Not Requiring Specific Design

The specification sets out the requirements for the construction of buildings not requiring specific design where the foundations and some or all the walls in any storey are constructed in masonry and the floors, ceilings and roofs are constructed in light timber frame construction, with the exception that ground floors can be slab-on-grade.

**COMMENTARY:** A considerable amount of masonry construction does not have each element

specifically designed in detail. This is known as the *Non Specific Design* approach. Tables and rules are set out to enable a building to be detailed without the need for structural calculations. NZS 4229 sets out these rules for a limited set of buildings. These are typically shown in Figure 1.



**Figure 1:** Examples of designing to NZS 4229 are shown in Section 4.2 'Reinforced Masonry'

Mixed construction is included in masonry lower walls with timber wall construction above. Timber floors are used throughout except a concrete slab-on-ground can be used.

### 1.2 Conditions of Contract

The work carried out by the contractor or sub-contractors under his control under this specification shall be subject to all the applicable provisions of the General and Special Conditions of Contract, the Preliminary and General sections of the Contract Documents.

**COMMENTARY:** In non-specific design work there may be no professional adviser. In these cases, a client may consider using New Zealand Standard NZS 3902:2004 "Housing, alterations and small buildings contract". Where a professional advisor is used, then normally NZS 3910:2003 "Conditions of contract for building and civil engineering

construction" provides a standard form of conditions of contract.

## 1.3 Scope

- (a) Work covered by this specification and contract documents include:
- (b) Supply, delivery and placing of all structural masonry.
- (c) Supply, delivery, cutting, bending and placing of steel reinforcing to cavities and cells as shown on the drawings or as specified in NZS 4229.
- (d) Grouting of walls to be as shown on the drawings or as specified in NZS 4229.
- (e) Building in all the necessary fittings and fixings as required.

**COMMENTARY:** Because NZS 4229 contains a significant number of building details, it is possible that contract drawings may reference these details without full repeating the information. The mason will need, therefore, to hold a copy or have access to NZS 4229.

## 1.4 Co-operation

All work shall be carried out with full co-operation between the Contractor and all other sub-contractors.

Any allowance for co-ordination shall be included in the tender or any negotiated agreements.

**COMMENTARY:** Often the masonry will be built under a Sub-contract arrangement. This means that the positioning of starter reinforcement for walls is the General Contractor's responsibility. Co-operation with the General Contractor in assisting with starter bar positioning is highly desirable. A CCANZ technical bulletin IB 47 goes some way to explaining how to set out the starter bars. It should be noted that locations of windows/doorways affect the position of starter bars.

## 1.5 Standards

Unless otherwise specified or otherwise shown on the drawings all masonry shall be constructed in strict accordance with:

- NZS 4229:2013 Concrete masonry buildings not requiring specific design.
- NZS 4210:2001 Masonry Buildings: materials and workmanship.

- AS/NZS 4455.1:2008 Masonry units, pavers, flags and segmental retaining wall units - Masonry units.
- NZS 3109:1997 Concrete Construction.
- AS/NZS 4671:2001 Steel reinforcing materials.
- AS 1478.1-2000 Chemical admixtures for concrete, mortar and grout - Admixtures for concrete.
- NZS 3122:2009 Specification for Portland and blended cements (General and special purpose).
- NZS 3604:2011 Timber-framed buildings.

The documents above, with current amendments, and all related documents cited in those documents, are deemed to form part of this specification. However this specification (which includes contract drawings) takes precedence in the event of it being at variance with the above documents.

**COMMENTARY:** The mason should hold up to date copies of NZS 4210 and NZS 4229. Reference to the other documents will be required on a more limited basis.

Generally masonry work built within the requirements of NZS 3604 will be under a Sub-contract situation and the General Contractor should have available a copy of this document.

## 1.6 Workmanship and Inspection

Construction of the blockwork shall comply with NZS 4210 and be under the control of a Licensed Building Practitioner – Blocklayer.

The licensed mason shall check the work at critical stages, such as set out, reinforcing, prior and during grouting and ensure that the work is in accordance with NZS 4210, NZS 4229 and all other relevant documents.

**COMMENTARY:** For the construction of buildings designed using non-specific design methods, there will usually be no intermediate formal inspections of the work by the Designer although there may be site visits by the Client.

Inspection requirements for the Local Authority Building Inspector are required. The mason should check these requirements before commencing work and ensure adequate notice for inspection is given.

The responsibility for ensuring that masonry work complies with the drawings and specification lies





with the mason himself. For this reason it is important that competency and knowledge of the building codes is shown by the mason. Hence the requirement that a licensed mason be used.

The Contractor shall give 24 hours notice to the inspecting mason of the typical critical stages and those the inspection mason will nominate prior to the commencement of the contract.

Masonry incorporating faulty masonry units, faulty mortar, faulty filling concrete, inadequate preparations, incorrect steel (placing and type), unapproved details or work practices, or any other aspects not complying with this specification as disclosed by testing or otherwise shall be rejected.

Any element of the construction that is rejected shall be made good at the Contractor's expense.

The Client, on completion of the work or later, may find a fault which shows a breach in interpretation of drawings, code or specification. In this case there will be redress and a requirement to correct the error. Corrections at this stage can be very costly.

## 1.7 Contractor's Responsibilities

The Contractor is responsible for ensuring that he can build the structure in accordance with the documents.

Should the Contractor find omissions or errors in the contract documents, then the Contractor shall immediately inform the Client/Designer of these findings. The Contractor will then receive instructions on the course of action to be taken to remedy the situation.

The Contractor shall not proceed with any alternative or remedial details of construction until he has received written instructions from the Client/Designer.

**COMMENTARY:** As the mason is often a Sub Contractor, the timing of construction work and its feasibility of construction within the general contract needs to be carefully studied.

## 1.8 Site Requirements

Chapter 3 of NZS 4229 shall be followed in every respect. If the Contractor finds that the site does not comply with NZS 4229 or as described in the contract documents then the Contractor shall immediately bring this situation to the Client/Designer's attention.

The Client/Designer will then issue written instructions to clarify that situation.

**COMMENTARY:** Chapter 3 of NZS 4229 deals with the aspects of safe bearing pressure, soil types, minimum depth of footing below ground, site clearance and permitted slopes.

The minimum safe bearing pressure, for example, is 100 kPa.

## 1.9 Quality Records

The mason shall keep accurate records relating to strength and quality of materials including cleanliness of sands use in the construction, and make available to the Client/Designer or Inspectors when requested.

Records to include:

- (a) Proportions of materials used for mortar.
- (b) Supplier of grout and control test certificates
- (c) Mix proportions for site mixed grout.
- (d) Daily spread of grout test values.
- (e) Expansive agent type and dosage if used.

**COMMENTARY:** Specific project testing of materials is not required. However the materials **MUST** comply with the minimum requirements set down in the documents and codes.

It is recommended that the mason, as a competent tradesman, should have compressive strength tests of mortar carried out at regular intervals, particularly if the source of supply of sand is changed. In addition to being a check on the suitability of the mortar mix, such tests serve as a check on the cleanliness of the sand.

## 2.0 Materials

### 2.1 Concrete Blocks

All concrete blocks shall comply with AS/NZS 4455 Part 1 and shall be dense, hard, sound and true to size and shape. Any necessary cutting shall be by saw, neat and true to lines.

All blocks shall be delivered to site, stored off the ground and kept clean and dry suitable for their end use.

**COMMENTARY:** The concrete blocks should be within  $\pm 3$  mm height tolerance and  $\pm 2$  mm for length and width. Minor chipping is acceptable but where the work is to be fair face the blocks supplied should be substantially free of defects. Discuss with the

block manufacturer **before** laying starts if there are any doubts on the quality of surface finish.

## 2.2 Other Masonry

Where other types of masonry unit are to be used as shown on the drawings or as specified in NZS 4229, then these units and their handling shall comply with NZS 4210 in all respects.

**COMMENTARY:** If natural sedimentary stone is used then a check is often needed on the bedding direction for laying. The stone needs laying with its natural bedding plane horizontal.

The reuse of masonry, particularly clay bricks, needs also to be considered with care since weathering and bonding characteristics may be unsatisfactory.

## 2.3 Cement

Cement shall comply with NZS 3122.

**COMMENTARY:** Cement should be stored off the ground and kept protected from the weather. To ensure it is free flowing it should not be stacked more than 1.5 m high and used on a first in first used basis as much as possible.

## 2.4 Lime

Building lime shall comply with BS 890.

## 2.5 Sand

Sand for mortar shall comply with NZS 3103. Sand for grout shall comply with NZS 3121.

## 2.6 Water

Water shall be fresh clean water and drinking quality for use in concrete, mortar, grout, cleaning out, wetting, working materials and curing.

## 2.7 Aggregates for Concrete Grout

Fine and coarse aggregates for concrete grout shall comply with NZS 3121.

**COMMENTARY:** Note that mortar sands are not generally considered suitable for substitution as a sand (fine aggregate) used for grout infill.

## 2.8 Reinforcing Steel

Reinforcing steel shall be grade 300 complying with AS/NZS 4671. All reinforcing shall be of the deformed type, except that ties and stirrups may be of the round bar.

Where noted on the drawings, Grade 500 reinforcing steel will be required.

Steel reinforcement shall be clean, rust scale-free and undamaged.

Steel reinforcement shall be cut, bent and placed for construction in accordance with NZS 4229 or as shown on the drawings.

**COMMENTARY:** The identification of steel is illustrated by the photograph below.



**Figure 2:** High strength (500) steel identified by the blank space in the deformations.

## 2.9 Admixtures

### 2.9.1 General

The inclusion of chemical admixtures to assist in construction of the masonry structure shall comply with AS 1478.1.

**COMMENTARY:** Traditionally, a small quantity of hydrated lime was used to improve the consistency of the mix. Today, chemical admixtures may sometimes be more convenient to use than lime. It is very important to ensure that you are measuring correct dosages for your mortar mix. Failure to comply with the manufacturers instructions can lead to problems of low strength in the mortar.

Some workability aids entrain air and unless there are careful adjustments to the mortar a significant loss in strength can occur. Excessive mixing time can cause more air entrainment and loss of strength.

*Final comments:*

1. Make absolutely sure you are using the correct dosage rate.
2. Do not mix admixtures without receiving clearance from the manufacturers.
3. Make some mortar cylinders from time to time to check strength levels.

### 2.9.2 Expansive Agent for Concrete Grout

Proprietary aluminium powder-based agents for the grouting method as detailed in Section 12.1 of this specification shall be used in strict accordance with NZS 4210 and the manufacturer's instructions.



**COMMENTARY:** It is important to use the gas forming expansive admixtures which cause an expansion of the grout in its plastic state. Expansion agents that cause expansion of the hardened grout are unsatisfactory for use in masonry.

Also, if the grout is to be strength tested using standard steel moulds, the grout sample must be taken **BEFORE** the expansive admixture is added.

## 3.0 Mortar

Mortar shall comply with NZS 4210.

### COMMENTARY:

#### Mix Proportions

Satisfactory mortars commonly fall within the following cement to sand proportions:

	Parts by Volume	
	Cement	Sand
For all reinforced masonry and all work below ground	1	3-4.5

To produce mortar of consistently the right quality, the volumes of materials should be measured using buckets or gauge boxes and not shovelled direct from the stock pile or cement bag into the mixer.

There is a difficulty in volume measuring sand because sand "bulks" up in volume depending upon the moisture content. Bulking of 15% is often used as a general guide. This really means that if you are batching to 1:3 cement/sand by volume you need 3.5 volumes of damp sand to each volume of cement.

Always keep a dry bucket reserved for measuring cement quantities and make sure you are measuring the correct amounts.

Materials should be thoroughly mixed in a mechanical mixer for a minimum of five minutes. Hand mixing of say three to four builder's buckets is permitted.

If a batch of mortar, not containing a special retarding admixture, has not been used with 1½ hours of adding the cement, it should be discarded.

Retempering mortar within this time may be done by adding water to a basin shape formed in the mortar and thoroughly remixing by hand or returning the mortar to the mixer for retempering, water adjustment and remixing.

Retempering by just dashing water over the mortar is not permitted.

### Workability

The water must be added carefully from a measured container and not directly from the end of a hose pipe. For a mortar to be satisfactory, it must have the correct workability which must be produced consistently by uniform batching and mixing.

In wet weather, the amount of water in the sand may be significantly higher, consequently you will need less added water to bring the mortar to the correct consistency. Where colour matching of mortar is extremely important, particularly for example where pigments have been used, it is recommended that the sand stockpile be covered to reduce moisture variations.

Each mason will have a way of telling whether the mortar is of the right consistency. One test is - scoop up mortar on the trowel, flick the trowel turning it over to see if the mortar will remain on the trowel face - see photo. If the mortar falls off, it is too wet or it may be too dry.



For speed of laying, avoiding significant extrusion of wet joints and therefore risk of marking faces and increased cleaning of cells, it pays to get the mortar absolutely right. The man on the mixer has a very important job.

### Coloured Pigments

Coloured mortars can be produced using mineral oxide pigments. Dosage of pigments must not exceed 6% by weight of cement.

It has been reported that additions of over 3% with some pigments may cause a reduction in bond strength.

Careful batching and uniform curing are essential if uniformity in colour between batches is to be

achieved. Premixing of pigment and cement helps with uniformity.

## 3.1 Mortar Strength

Mortar shall have a minimum 28 day compressive strength of 12.5 MPa.

**COMMENTARY:** Details of the testing method Specific Design Specification.

## 4.0 Concrete Grout

Coarse Grout (in terms of NZS 4210).

**COMMENTARY:** For most structural masonry grout infills, "coarse" grout will be used.

### 4.1 Blockwork Cavities

Grout for filling blockwork cavities shall comply in all respects with NZS 4210.

### 4.2 Compressive Strength

Specified minimum 28 day compressive strength equals 17.5 MPa or 20 MPa or 25 MPa.

**COMMENTARY:** The specified strength of grout may be 17.5, 20 or 25 MPa. The specified strength depends upon the durability zone the building is in:

Zone B:	17.5 MPa
Zone C:	20 MPa
Zone D:	25 MPa

Only 17.5 MPa can be produced on the construction site. 20 and 25 MPa must be supplied by ready mixed concrete plants working to NZS 3104.

If grout is to be sampled to test for compressive strength, the sample must be taken BEFORE any expansive admixture is added.

### 4.3 Spread

Spread Value = 450-530 mm

**COMMENTARY:** Grout must have good flowing characteristics in order to fill the cells. This flowing requirement makes it different to wet concrete. A simple test is used to determine the flowing characteristics and is called a spread test.

NZS 4210 requires a spread test each day that grout filling is taking place.

An inverted slump cone is used, being filled without rodding and the lifted 50 mm allowing the grout to

flow out. The diameter of the spread of grout is measured at two positions at right angles to one another. The average of these measurements is the spread value.

For concrete masonry the spread should be within the range 450 to 530 mm. It is important to be within the range, neither below it nor above. Grouts should be checked for this characteristic before commencing placement in the wall.

CCANZ Bulletin IB 50 explains in more detail the spread test.

### 4.4 Maximum Size of Aggregate/Sand

Maximum aggregate size = 13.2 mm

**COMMENTARY:** When grout spaces are narrow, less than 60 mm, then a grout consisting of concreting sand and cement must be used. Normally this would only apply to the 100 series hollow masonry or when a cavity less than 60 mm is to be filled between two masonry skins.

An admixture may also be used.

Coarse grouts contain a proportion of aggregate sizes, usually in the range 4.57 mm to 9.5 mm, but on occasion sizes up to 13.2 mm can be used although this would be uncommon. Segregation of the larger particle sizes becomes a significant risk when placing the grout material.

### 4.5 Expansive Admixture

Expansion prior to initial set = 2-4%

**COMMENTARY:** The structural integrity of any grouted walls is improved by using a gas forming expansive agent as specified in NZS 4210.

The expansive agent must be dosed at site immediately prior to placing, to ensure that the expansion takes place within the masonry cells. The dosage is specified by the manufacturer to give between 2-4% increase in volume before the grout sets.

Do not use expansion agents that cause hardened concrete to expand.

The principal advantages of using an expansive agent within the grouting method are:

- (i) the reduction in delay times resulting from consolidation in grout lifts of 1.2 m;
- (ii) better compaction and expulsion of free water; and
- (iii) better face shell bonding



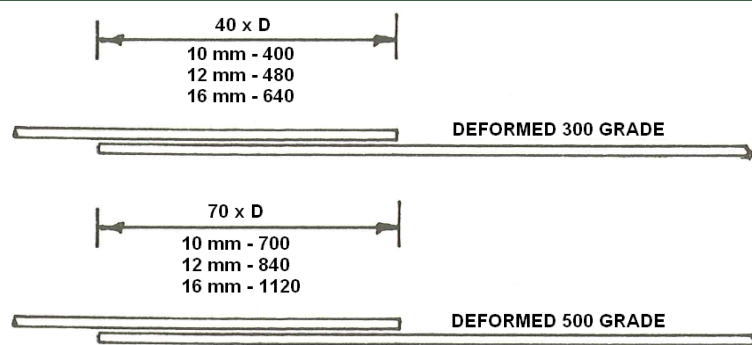


Figure 3: Lapping details

## 4.6 Delivery and Manufacture

### 4.6.1 Off the Site (Ready Mixed)

Grout supplied ready mixed from off the site shall comply with the relevant provisions of NZS 3104.

### 4.6.2 At the Site

17.5 MPa grout can be manufactured at the site providing it complies fully with NZS 4210.

**COMMENTARY:** While normal supplies would probably be ordered from a ready mixed concrete supplier, it is possible to site mix 17.5 MPa grout. 20 and 25 MPa site mixing is not permitted.

**Note:** You must use a concreting sand not the builders' sand you are using to produce the mortar.

A typical mix for a 50 litre 17.5 MPa mix is:

- 1½ buckets of cement
- 4 buckets of concreting sand
- 2 buckets of 4.75 mm to 9.5 mm coarse aggregate.

The added water will vary with the moisture contents of the sand/aggregate, but should be adjusted to bring the grout within the specified spread range of 450-530 mm for concrete masonry.

Mixing time should be not less than 1½ minutes. Larger mixes will require a longer time for mixing. Generally all grouts should be placed within 1½ hours of mixing unless retarding admixtures have been used.

## 5.0 Reinforcement Details

Unless shown on the drawings reinforcement details shall be as required by NZS 4229 and NZS 4210. Any reinforcement details or requirements not

specifically covered by NZS 4229 shall comply with those of NZS 3109.

### 5.1 Laps in Reinforcement

All lapping reinforcement, including starter bars, shall be securely fixed together. See Figure 3.

### 5.2 Placement and Cover to Reinforcement

All reinforcement, including starter bars, shall be carefully set out to suit masonry modules and required locations within cells and cavities, in accordance with the drawings or details as specified in NZS 4229.

The minimum cover to reinforcement shall be:

Zone B	45 mm
Zone C	50 mm
Zone D	60 mm

Reinforcement, including starter bars, shall be set out to the tolerances specified in NZS 4210.

#### COMMENTARY:

#### Position Tolerances

While 6 mm is the minimum dimension to a face shell, the overall cover from the outer face of the shell will vary depending on durability zone, i.e. 45 mm for Zone B, 50 mm for Zone C and 60 mm for Zone D.

Generally the requirements are that reinforcing steel should be prefixed with the block layer using open ended units as appropriate, e.g. typically Series 20.05 for partial fill walls and 20.16 for solid fill walls supplemented by other units as appropriate. It is recognised that on occasions it may be necessary in special circumstances to fix vertical steel after blocklaying. However, access to the starter bar is still mandatory since the vertical steel must be tied to the starter bar.

In order to ensure that the reinforcement remains in place during the grouting operation that follows, the steel must be adequately tied. First, it must be tied to the starter bars, and then it must be adequately and securely fixed as shown in Figure 4.

Note that when 12 mm bars were used no intermediate tie or spacer is required for the usual wall heights.

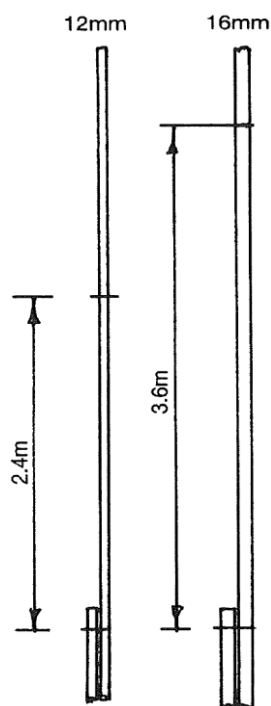
When the Client/Designer has not specified the position of the vertical bar, it is assumed that it is to be placed in the centre of the cell itself.

Horizontal steel should also be positively located by tying to stirrups or to vertical bars and must be at least 25 mm above or below the adjoining mortar joint.

The other important matter concerning steel reinforcement is that it must have sufficient concrete cover to ensure long term durability.

## 5.3 Starter Bars

The Client/Designer shall immediately be notified of any misalignment of cast-in starters or any other type of cast-in reinforcing. The Client/Designer will give written instructions to remedy the misalignment. Reinforcement shall not be bent on site to correct alignment.



**COMMENTARY:** The starter bars (Figure 6) should be checked for position BEFORE laying the first course. If they are incorrect, then it will be necessary to cut off bars, drill holes to a significant depth and grout in new steel with epoxy mortar.

Double cranking of steel is totally unacceptable, see diagram. **Note that starter bar positions are influenced by the windows in the wall.**

More details are found in CCANZ Bulletin IB 45.

## 6.0 Concrete Base

### 6.1 Initial Preparation

The concrete base (footing, foundation, wall, beam, slab, etc.) that is intended to support a masonry structure shall be built in accordance with NZS 4210 and NZS 4229.

**COMMENTARY:** The first step requires that the foundations be checked for line, level and dimension and that starter bars are in the correct position.

Tolerances for acceptance are governed by NZS 4210 and override NZS 3109 tolerances for construction.

Any discrepancies which would cause the bed joint to exceed 20 mm in thickness must be corrected. It should be noted that the minimum thickness is laid down as 7 mm for structural masonry or 4 mm for veneer construction.

Any concrete surface lying outside the tolerance limits shown in Figure 5 (page 9) needs correction before commencing the work of laying.

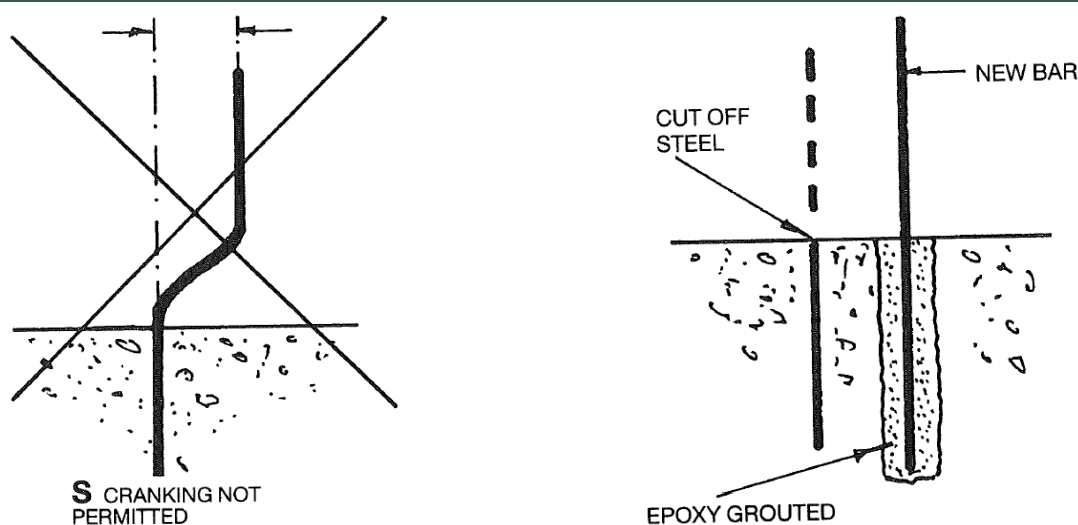
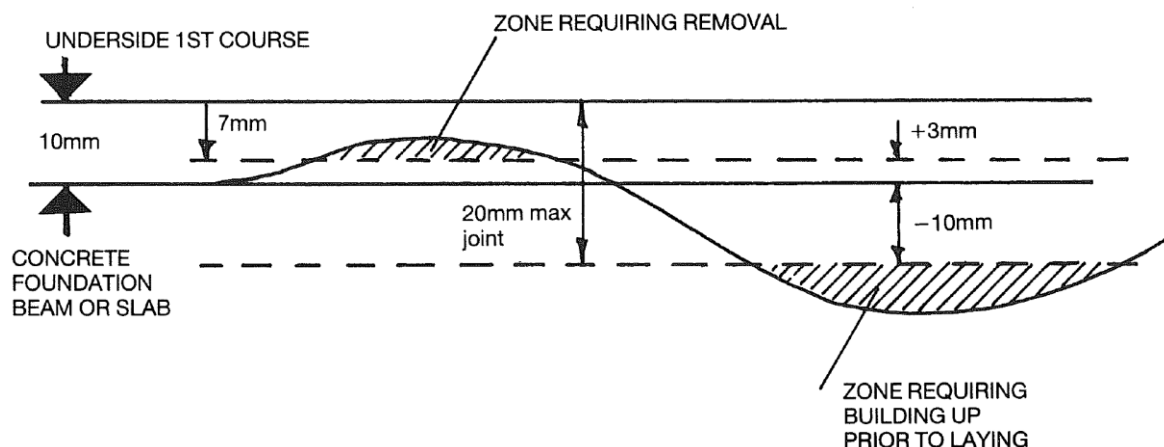


Figure 4: Starter Bars



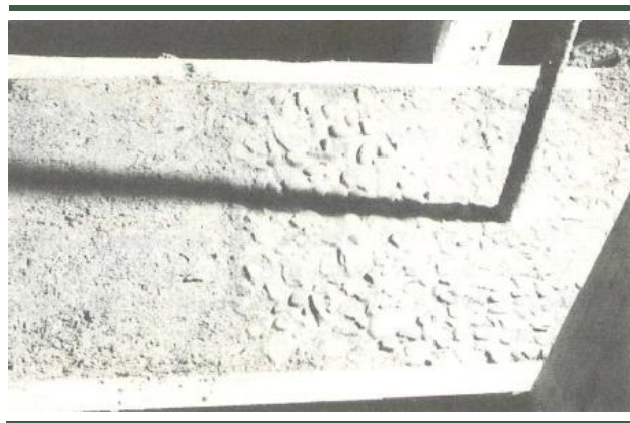


**Figure 5:** Concrete base – initial preparation

## 6.2 Foundation Surface

The Contractor shall ensure that the surface on which masonry is to be laid is free of all laitance, loose aggregate and any material that could reduce the bond between the masonry elements and the concrete base.

**COMMENTARY:** The image below depicts the appearance of a cleaned horizontal foundation concrete ready to receive the first course of masonry.



**Note:** This texture is achieved by washing and brushing the surface of the concrete approximately 12 hours after placing.

## 7.0 LAYING THE UNITS

### 7.1 Tolerances

Laying of masonry units shall be in accordance with NZS 4210. All masonry units shall be laid in mortar in courses, true to line, plumb, and level to the tolerances of NZS 4210, unless otherwise specified.

**COMMENTARY:** The tolerances from NZS 4210 follow below.

The concrete masonry units themselves should receive a visual inspection for defects prior to laying and should be laid air dry. However, some dampening of the surfaces to be bonded is often desirable.

**Table of Recommended Tolerances for Masonry Construction from NZS 4210**

Item	Tolerances
Deviation from the position shown on plan for a building more than one storey in height	15 mm
Deviation from vertical within a storey	10 mm per 3 m of height
Deviation from vertical in total height of building	20 mm
Relative displacement between load-bearing walls in adjacent storeys intended to be in vertical alignment	5 mm
Deviation from line in plan: (i) in any length up to 10 m (ii) in any length over 10 m	5 mm 10 mm total
Deviation of bed joint from horizontal: (i) in any length up to 10 m (ii) in any length over 10 m	5 mm 10 mm total
Average thickness of bed joint, cross joint, or perpend	±3 mm on thickness specified

## 7.2 Laying of Blocks

Blocks shall be laid in straight uniform courses with running bond unless specified otherwise on the drawings. Lay units with a consistent joint thickness throughout.

The moisture state of masonry units at the time of laying shall be as set out in NZS 4210. Upon completion of each day's work, exposed tops of blockwalls shall be protected from the weather.

**COMMENTARY:** Concrete blocks should not be laid saturated, since the subsequent drying out will result in a considerable amount of shrinkage movement leading to cracks in joints and, possibly, the units themselves.

Hollow masonry units should have a mortar bed for the face shells and should have all head joints filled to the same depth. It is also important to realise that when concrete masonry is only to be partially filled, certain cross webs to close a cell must be mortar jointed during the laying process, if loss of grout is to be avoided.

Solid masonry should have all joints completely filled and light furrowing of the bed joint is permitted to assist bedding.

## 7.3 Flashings

When flashings are specified these shall be built in to masonry in such a manner as not to weaken the structure. Joints around the flashings shall be made good as necessary to ensure waterproofness.

**COMMENTARY:** Grooves to receive flashings generally should not be deeper than 6-10 mm. Once the flashing is placed the groove will need to be caulked. The jointing material may be elastomeric type or rigid type and this should be specified on the drawings.

## 7.4 Weep Holes

Weep holes in ungrouted hollow masonry walls (above grade) shall be provided at the bottom of cells as necessary to drain moisture to the outside air.

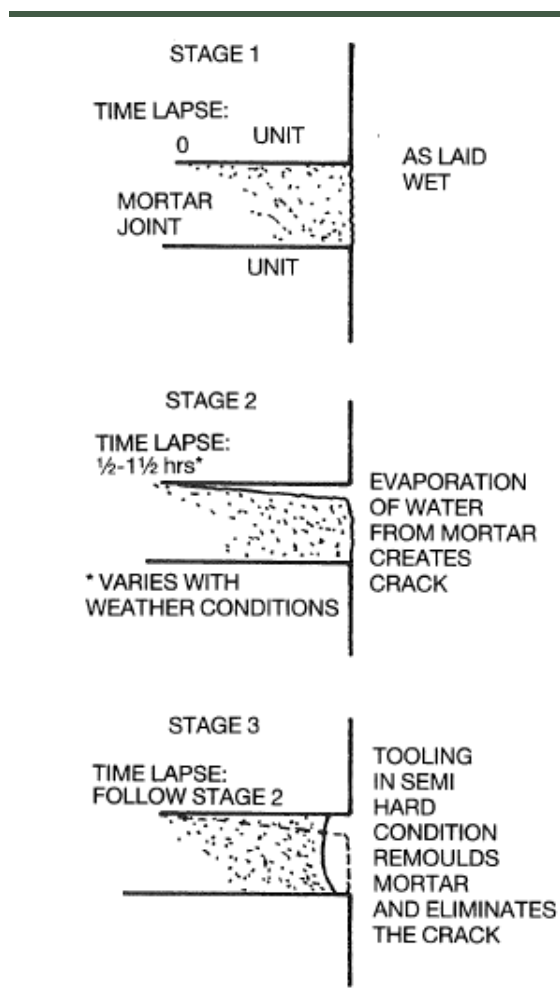
**COMMENTARY:** In partially grout filled masonry walls it is desirable to provide a drainage outlet at the bottom of the unfilled cell in the form of a 5 mm hole through the bed joint into the cell cavity.

## 7.5 Mortar Joints

Mortar joints shall be burnished smooth and

concave to a depth not exceeding 6 mm after the initial stiffening has occurred, unless otherwise specified.

**COMMENTARY:** Tooling of mortar joints after initial hardening is essential to achieve a **weatherproof wall**. Tooling to a depth of 6 mm is permitted. There consolidation of the front of the joint after initial water loss is seen as being vital to ensure a water tight joint. See diagram below.



Often tooling is carried out too early. The mortar should be "thumb nail hard" before tooling.

After tooling and when mortar is sufficiently set the work should be lightly brushed down with a soft bristle brush to remove any particles of mortar sticking to the block face. Rubbing the face of blockwork with a piece of masonry will also remove any "dags" of mortar.

## 8.0 Clean-out

Clean out details and requirements shall comply fully with NZS 4210.



## 8.1 Clean-out Openings

Temporary clean-out openings shall be provided and shall be of an adequate size and number to ensure satisfactory cleaning out and inspection as required by the specification. When constructed, clean-out openings shall be located at starter bar positions along the length of the first courses in all walls. Face shells shall be braced and used to close the temporary opening when a fair face finish is required.

**COMMENTARY:** In the first course it is necessary to provide clean out positions of at least 100 x 75 mm dimensions at each reinforcement position. For solid filled walls the use of an inverted 20.16 unit in the first course facilitates the subsequent cleaning out immediately prior to grouting. To reduce the risk of mortar droppings adhering to the base concrete, a layer 10-15 mm thick of sand is laid after placing the first course. This together with droppings is subsequently cleaned out.

In fair face work the sawn face shells can either be braced in position to resist the grout pressure or a recess created by a piece of timber formwork suitably braced and the face shells mortared into position after the grout filling.

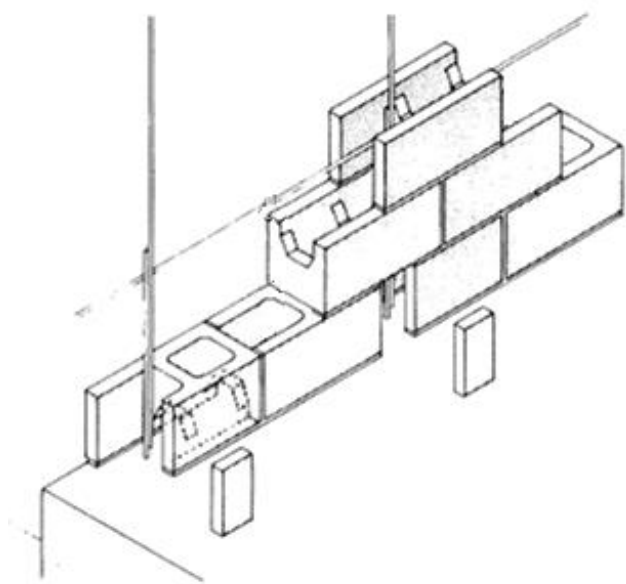


Figure 6: First course clean-out pockets

## 8.2 Cleaning Out

Grout spaces shall be cleaned out before any grout is poured.

**COMMENTARY:** After laying up the wall, it is necessary to clean out the bottom of cells to be grouted through the clean-out openings.

This can be done using a compressed air/water jet or by physically raking with a steel bar followed by washing out. If a sand bed was used it will be relatively easy to remove any debris with a water jet.

Once the base surface is clean, the clean out openings can be sealed by a timber shutter or by mortaring in a piece of face shell. However, in either case adequate bracing will be needed to prevent a blow out under grout pressure.

## 9.0 Temporary Bracing

The Mason shall be responsible for providing adequate temporary bracing to all masonry to resist any lateral loads until such time that the structure can support the masonry without any distress to either element.

**COMMENTARY:** A point which can often be overlooked is the need for temporarily bracing the concrete masonry during construction.

An ungrouted wall is very susceptible to failure from strong winds. Typically, a wall over one metre in height is at significant risk. See diagram below.

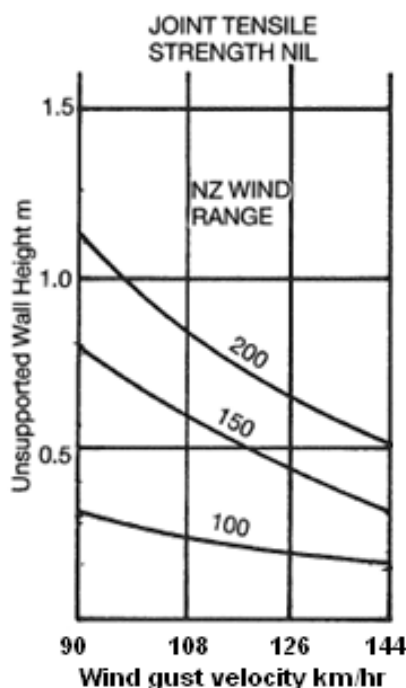
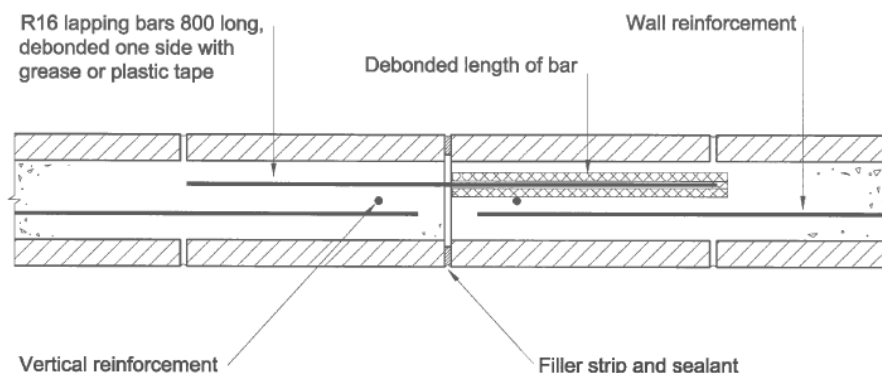


Figure 7: Maximum unsupported height of ungrouted masonry during construction

It is important to take some measures to brace the wall in order to prevent its premature failure. Typically bracing at 3 metre centres is recommended in line on both sides of the wall.



**Figure 8:** Control Joint Detail

## 10.0 Control Joints

### 10.1 Spacing

Spacing of vertical control joints shall not exceed 6 metres. Control joints shall be constructed in every respect to the details and requirements of NZS 4229 and NZS 4210, unless otherwise specified on the drawings.

**COMMENTARY:** Where there has been no specific design - control joints should be provided at spacings not exceeding 6 m but the final position is influenced by:

- (i) Major changes in wall height.
- (ii) Changes in wall thickness.
- (iii) Position of control joints in foundations, etc.
- (iv) Chases or recesses for services.
- (v) Wall intersections.
- (vi) Rear return angles in L, T and U shaped situations;
- (vii) At one or both sides of openings.

Ideally, no reinforcement should pass through the joint, but it is impracticable in New Zealand, due to earthquake forces. Accordingly, it is usual to de-bond any reinforcement passing through the joints for a certain distance on either side of the control joint. See Figure 8.

Concrete masonry in common with other building materials, is subject to some movements caused by changes in moisture content and temperature.

Since masonry generally will have a high moisture content initially, it loses moisture with time and consequently shrinks. It is usual to primarily design concrete masonry for shrinkage control joints.

### 10.2 Water and Fireproofing

The Contractor is responsible for ensuring that the control joints are waterproofed and fireproofed, as necessary, with appropriate fillers and sealers.

**COMMENTARY:** Control joints will always be undergoing some movement and it is necessary on exterior walls to form a suitable detail to allow for the sealing of the joint against weather penetration. This often takes the form of a 10 mm wide raked back vertical joint. Note that a sealant bond breaker should be used at the back of the joint.

## 11.0 Inspection Prior to Grouting

The Mason shall inspect the wall prior to grouting as a final check that the works comply with the drawings/specifications and with special reference to:

- (a) Cleanliness of cell for grouting.
- (b) Correct positioning and tying of reinforcement.
- (c) Sealing of all clean out holes and positions that would cause the loss of grout.

**COMMENTARY:** There is often no formal requirement for inspection by the Designer prior to grouting with buildings using the non-specific design code.

There may be requirements by the Territorial Authority, see Clause 1.6, and following a check by the mason the Territorial Authority may require pre-notification of the intention to grout the wall.

## 12.0 Grouting of Cells and Cavities

### 12.1 Grouting Methods

Grouting shall be in accordance with NZS 4210 and the following methods are acceptable:

- (a) High lift grouting with expansive admixture.
- (b) High lift grouting with reduced compaction.
- (c) Low lift grouting.



**COMMENTARY:** No structural masonry wall in New Zealand is complete without the grouting of reinforcement into the wall either by individual cell or the whole wall.

As discussed earlier, all cells should be cleaned out and clean out ports sealed before grouting commences. There are a number of different grouting methods available depending upon whether the construction work is to be inspected by the Designer. In unsupervised construction as defined in NZS 4230 as design grade B the following methods are acceptable:

- (i) High lift grouting with expansive admixture.
- (ii) High lift grouting with reduced compaction.
- (iii) Low lift grouting.

Note that all work based on the requirements of NZS 4229 is design grade B. For convenience the methods are presented in illustrated form in Information Bulletin IB66 which is part of the Masonry Manual. For convenience method (i) is shown on page 14.

A licensed building practitioner must be able to grout to any of the three methods. On occasions the mason may be able to choose an appropriate method, on others the method may well be specified.

**Note that mechanical vibration is a requirement of Method (ii) and an option in Method (i).**

A fourth method which is "High Lift Grouting Without Expansive Admixture" and is used only on Specific Design projects, requires mechanical vibration for reconsolidation of grout.

## 12.2 Extent of Grouting

The extent of grouting, whether partial filling or solid filling, shall be as shown on the drawings. Where specific details and localities of grouting are not provided then the grouting shall follow NZS 4229 in all respects.

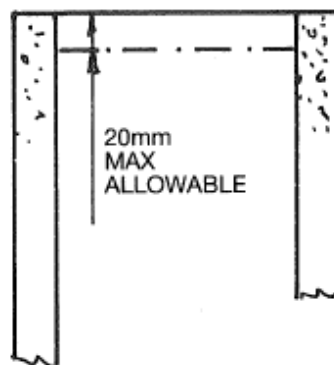
## 13.0 Construction Joints

### 13.1 Horizontal Construction Joints

Horizontal construction joints, when required, shall be formed at the top of the uppermost masonry units. In no case shall they be formed more than 20 mm below the top of the units.

**COMMENTARY:** Construction joints may be required between different masonry wall lifts. A horizontal construction joint will occur on the top of the uppermost masonry unit. The level of the

construction joint, however, should not be lower than 20 mm from the top of this unit. See below.



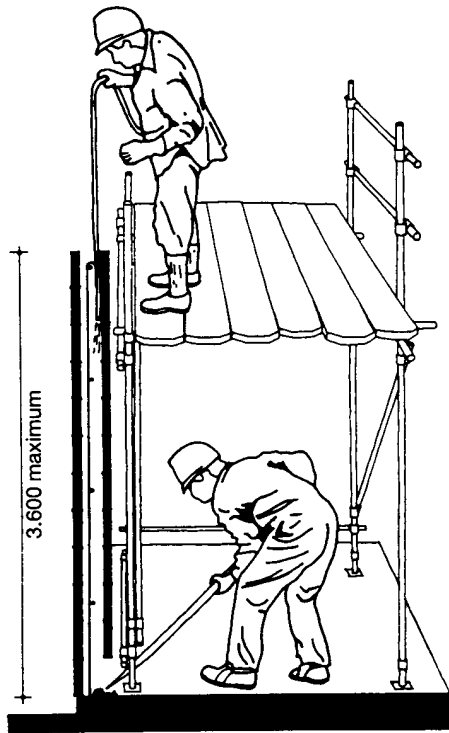
### 13.1 Preparation of Joints

Horizontal construction joints shall have all laitance, loose and foreign matter removed, surface dampened down, prior to the next grouting operation.

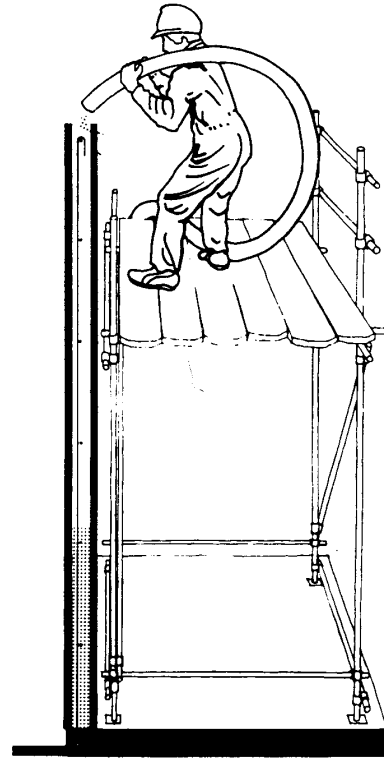
**COMMENTARY:** The horizontal construction joint should be roughened to remove laitance and any loose matter lying on the surface of the hardened grout. This is a similar process to the preparation of the construction joint between the masonry wall and its supporting concrete beam or foundation. It is generally easy to wash and brush the joint a few hours after the grout has hardened to provide a clean surface ready for the next lift. This provides a "sand paper" type of finish to the grout surface. See below.



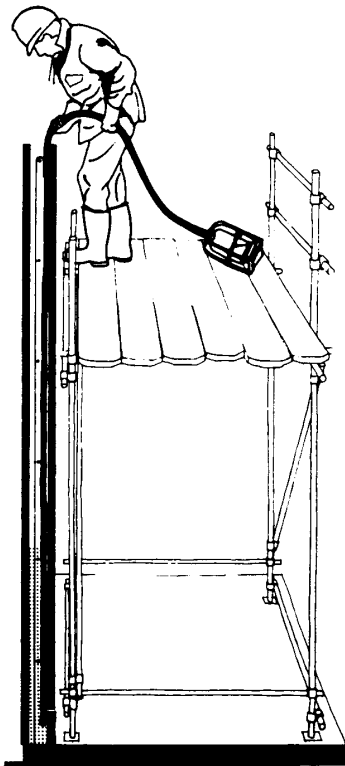
At the position of this intermediate horizontal construction joint it will, of course, be necessary to form clean out ports, as was required for starting off at the ground level. A sand covering of the cleaned surface will keep droppings from sticking to the surface. Cleaning out of the horizontal joint is required before placing the next lift. The surface should be wetted down immediately prior to grouting, being surface damp but no puddles of water present on the surface.



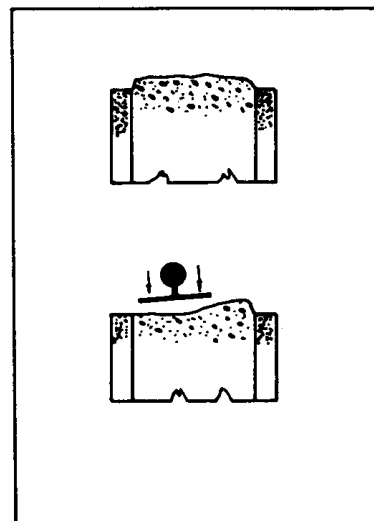
**Step 1:** Clean out grout space and remove all debris and loose material from construction joint.



**Step 2:** Grout the wall in a semi continuous operation to the top.



**Step 3:** Consolidate with vibrator or by rodding as work of filling proceeds to the top.



**Step 4:** After waiting for expansion, trowel down and recompact the top surface of the expanded grout. An alternative method is to place a weighted board on top of the wall to contain the expansion.

**Figure 9:** High lift grouting with expansive admixture. (Follow Steps 1-4 as illustrated).



## 14.0 Consideration of Weather

NZS 4210 specifies general and special requirements for construction of masonry in a variety of weather conditions. These requirements shall be followed in all respects.

### 14.1 Cold Weather Construction

Generally, masonry construction should not be carried out when the air temperature drops below about 4°C, unless precautions are carried out.

**COMMENTARY:** The precautions for cold weather construction are shown:

- (i) Water used for mixing mortar shall be heated.
- (ii) Masonry shall be protected for not less than 24 hours after laying by covers, blankets, heated enclosures, or the like to ensure that the mortar can gain strength without freezing or harmful effects from cold winds.
- (iii) No frozen materials nor materials containing ice shall be used.

### 14.2 Hot Weather Construction

When masonry Construction is carried out at an air temperature of more than 25 C the following precautions need to be taken.

- (i) Masonry units may be lightly dampened before laying.
- (ii) Mortar shall be kept moist and shall not be spread on the wall more than two unit lengths ahead of the units being placed.
- (iii) The mortar shall be prevented from drying so rapidly that it cannot cure properly; this may be done by applying a very light fog spray several times during the first 24 hours after laying or by other protective measures over the same period.

- (iv) Grout shall be protected from too rapid drying.

*CCANZ tests showed significant improvement in bond test results by lightly dampening down the surfaces to be bonded.*

*Having constructed the wall, some effort should be made to try and prevent the mortar from drying out too quickly by the use of some light spray. In addition, the tops of the walls will be very prone to drying out and this will affect the masonry grout. However, to overcome the problem, the tops of the walls should be temporarily covered to reduce the effects of the wind or rain.*

## 15.0 Protection and Cleaning of the Works

Keep fair faced masonry clean of all mortar droppings, grout splashes or stains of any kind as the work proceeds.

Keep the work site clean, tidy, orderly and in a safe state.

At the completion of the works, clean down all masonry and adjoining surfaces, floors, etc and remove all waste material and equipment from these areas.

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