New Zealand Standard

Code of Practice for Solid Plastering

Part 1 – Cement Plasters for Walls, Ceilings and Soffits

Superseding NZS 4251:1974 in part

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COMMITTEE REPRESENTATION

This Standard was prepared under the supervision of the Solid Plaster Committee (P4251) for the Standards Council established under the Standards Act 1988. The Committee consisted of representatives of the following:

Building Industry Authority
Building Officials Institute of New Zealand
Building Research Association of New Zealand
Cement and Concrete Association of New Zealand
New Zealand Plasterers Federation
Plaster Systems
Solid Plastering Consultant

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AMENDMENTS

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RELATED DOCUMENTS

Reference is made in this document to the following:

NEW ZEALAND STANDARDS

NZS 2295:1988	Building papers (breather type)
NZS 3103:1991	Specification for sands for mortars and plasters
NZS 3109:1997	Concrete construction
NZS 3111: 1986	Methods for test for water and aggregate for concrete
NZS 3113:1979	Specification for chemical admixtures for concrete
NZS 3114:1987	Specification for concrete surface finishes
NZS 3117:1980	Specification for pigments for Portland cement and Portland cement products
NZS 3121:1986	Specification for water and aggregate for concrete
NZS 3122:1995	Specification for Portland and blended cements (General and special purpose)
NZS 3123:1974	Specification for Portland pozzolan cement (type PP cement)
NZS 3125:1991	Specification for Portland-limestone filler cement
NZS 3152:1974	Specification for the manufacture and use of structural and insulating lightweight concrete
NZS 3602:1995	Timber and wood-based products for use in building
NZS 3604:1990	Code of practice for light timber frame buildings not requiring specific design (Currently under revision)
NZS 4203:1992	General structural design and design loadings for buildings
NZS 4210:1989	Code of practice for masonry construction: Materials and workmanship
NZS 4221:1972	Specification for fibrous plaster sheet
NZMP 3640:1992	Specification of the minimum requirements of the NZ Timber Preservation Council Inc.

JOINT AUSTRALIAN/NEW ZEALAND STANDARDS

AS/NZS 2269:1994 Plywood – Structural

NZS/AS 2908:- - - - Cellulose-cement products
Part 2:1992 Flat sheets

AS/NZS 4600:1996 Cold-formed steel structures

AUSTRALIAN STANDARDS

AS 1366:- - - - Rigid cellular polystyrene
Part 3-1992 Moulded

AS 1366:- - - - Rigid cellular polystyrene
Part 4-1989 Extruded

AS 1478-1992 Chemical admixtures for concrete

AS 1650-1989 Hot-dipped galvanized coatings on ferrous articles

AS 1672-1997 Building limes

AS 2185-1978 Fibrous plaster products

AS 2758:- - - - Aggregates and rock for engineering purposes
Part 1-1985 Concrete aggregates

AS 3566-1988 Screws – Self drilling – For the building and construction industries

AS 3972-1997 Portland and blended cements

BRITISH STANDARDS

BS 1881:- - - - Testing concrete
Part 124: 1988 Methods for analysis of hardened concrete

BS 3137: 1987 Methods for determining the bursting strength of paper and board

AMERICAN STANDARDS

ASTM C631-95 Specification for bonding compounds for interior gypsum plastering

ASTM C932-80(1990) Specification for surface-applied bonding agents for exterior plastering

ASTM C952-91 Test method for bond strength of mortar to masonry units

ASTM C1042-91 Test method for bond strength of latex systems used with concrete by slant shear

ASTM C1116-95 Specification for fiber-reinforced concrete and shotcrete

ASTM C1152-97 Test method for acid-soluble chloride in mortar and concrete

OTHER DOCUMENTS

Building Research Association of New Zealand, Good Stucco Practice 1996.

Building Industry Authority, The New Zealand Building Code.

The users of this Standard should ensure that their copies of the above-mentioned New Zealand Standards or of overseas Standards approved as suitable for use in New Zealand are the latest revisions or include the latest amendments. Such amendments are listed in the annual Standards New Zealand *Catalogue* which is supplemented by lists contained in the monthly magazine *Standards* issued free of charge to committee and subscribing members of Standards New Zealand.

FOREWORD

The draft of this Standard was initially released by Standards New Zealand as DZ 4251:Part 1 in 1995. It is based on a draft supplied by the Cement and Concrete Association of New Zealand following the directions of a Standards New Zealand Advisory Committee.

As a result of the consideration of comments received from persons and bodies having an interest in the Standard, the Solid Plaster Committee reviewed the earlier document and reformatted its contents.

The revised draft was further subjected to a selective public comment process. It now comprises five sections and covers internal and external plastering based on Portland cement. Section 1 contains the scope and interpretation of the Standard, section 2 includes general considerations for solid plastering common to all systems while application of plasters to various substrates is dealt with in three sections, namely, section 3, solid substrates, section 4, stucco on rigid backing and section 5, stucco on non-rigid backing.

Plastering of polystyrene blocks using conventional stucco and reinforcement has been included but the use of modified or proprietary modified plaster coatings is not included in this Standard at this time.

Plastering is a highly skilled work in which the finished quality depends greatly on the plasterer. The Committee has given emphasis on the specific critical issues such as the quality and type of plastering sand, and the requirements of mixing, application and curing of plaster in this Standard.

Part 2 of the Standard is intended to cover floors and steps based on Portland cement and will be issued later.

Further Parts for gypsum and modified cement plasters are anticipated.

REVIEW OF STANDARDS

Suggestions for improvement of this Standard will be welcomed. They should be sent to the Chief Executive, Standards New Zealand, Private Bag 2439, Wellington 6020.

NEW ZEALAND STANDARD

SOLID PLASTERING
Part 1
Cement plasters for walls, ceilings and soffits

1 SCOPE AND INTERPRETATION

1.1 Scope

1.1.1
This Standard sets out the requirements for solid plaster in buildings to achieve structurally sound, hard, durable and water resistant surfaces. It deals with the preparation, mixing and application of cement based plasters to walls, ceilings and soffits of solid substrates, and stucco on rigid backing and non-rigid backings. The Standard applies to exterior and interior walls where impact loads are limited to soft body impacts associated with domestic use. For use in interior spaces the relative humidity must be less than 90 %.

C1.1.1
Special applications such as squash courts and swimming pools are outside the scope of this Standard.

1.1.2
Gypsum based plaster and modified or proprietary modified plaster coatings are not included in this Part of the Standard.

1.2 Interpretation

1.2.1
For the purposes of this Standard the word "shall" refers to practices which are mandatory for compliance with the Standard. The word "should" refers to practices which are advised or recommended.

1.2.2
Clauses prefixed by "C" and printed in italic type are intended as comments on the corresponding mandatory clauses. They are not to be taken as the only or complete interpretation of the corresponding clause. The Standard can be complied with if the comment is ignored.

1.2.3
The term "informative" has been used in this Standard to define the application of an Appendix. An "informative" Appendix is not an integral part of a Standard but it provides information and guidance.

1.3 New Zealand Building Code
Cement plasters constructed in accordance with this Standard will meet the relevant requirements of the following clauses of the New Zealand Building Code as discussed below:

(a) Clause B1 Structure
Cement plasters described in this Standard can not be used to support any gravity loads other than their own self weight. They will withstand earthquake, wind and impact loadings associated with domestic soft body impacts. Their design will withstand the likely temperature variations experienced throughout New Zealand as well as the time dependent effects of shrinkage and creep.

(b) Clause B2 Durability
Cement plasters are moderately difficult to replace and therefore the Building Code's required durability is 15 years (i.e. New Zealand Building Code Clause B2.3.1(b)). Cement plasters constructed in accordance with this Standard will meet this requirement.

(c) Clause E2 External Moisture
Cement plaster to exterior walls constructed in accordance with this Standard meets the Building Code's requirements for preventing the penetration of water that could cause undue dampness or damage to building elements (i.e. New Zealand Building Code Clause E2.3.2).

(d) Clause E3 Internal Moisture
Cement plaster on interior surfaces that are constructed in accordance with this Standard and have a smooth trowelled (dado) finish coat will satisfy the code's requirement for an "impervious and easily cleaned" surface for solid substrates.

Where this Standard has provisions that are in non-specific or unquantified terms (such as where provisions are required to be appropriate, adequate, suitable, equivalent, satisfactory, acceptable, applicable or the like), then these do not form part of the means of compliance with the Building Code and must be to the approval of the territorial authority.

1.4 Application

1.4.1 *General*

1.4.1.1
Solid plasters on solid substrates do not require reinforcement or applied coatings except when using an expanded polystyrene block substrate which requires reinforcement in the solid plaster.

1.4.1.2
Stucco on rigid or non-rigid backings requires reinforcement for structural strength and applied coatings for weathertightness. The requirements of the applied coating and the reinforcement for stucco are given in 2.6, 4.3 and 5.3 respectively.

1.4.2 *Non-standard materials, installations or designs*
This Standard does not preclude the use of new materials or innovative systems or parts of systems. Such materials or systems however are outside of the scope of this Standard and full details of any such proposal would need to be submitted to the territorial authority for approval. See Appendix D for details.

C1.4.2
Traditionally certain materials, designs and techniques have been used and have become established. The materials and associated designs shown in this Standard have been proven through use. Other materials and systems are allowed but compliance with the provisions of the New Zealand Building Code must be able to be demonstrated to the satisfaction of the territorial authority.

1.5 Definitions
For the purposes of this Standard the following definitions shall apply:

ADMIXTURE means any substance added to the fundamental components of a plaster mix.

AGGREGATE means particles of rock or mineral fragment used with various cementing materials. The term used in conjunction with plaster usually implies sand, vermiculite or perlite.

BACKGROUND means the surface to which the bond coat is applied to a solid substrate or to the steel mesh or lath in stucco construction.

BACKING means the sheet materials used on timber or steel framed walls.

BOND means the state of adhesion between a plaster coat and its background.

BONDING AGENT means an admixture used to assist the adhesion of the bond coat to the background.

CEMENT means a Portland cement or a blended Portland cement that will set and harden by chemical interaction with water.

COAT means a layer of plaster applied in a single operation. Various types, listed in the usual sequence of application, are defined as follows:

DUBBING OUT COAT means a coat of plaster applied to any hollow sections of a solid substrate to bring the surface to an acceptable plane for the next plaster coat.

BOND COAT means the first coat of coarsely textured plaster applied to a solid substrate to provide adhesion for the second layer of plaster. It is also called “SLUSH COAT”.

SCRATCH COAT is a form of bond coat which provides an initial rough levelling coat on stucco and solid substrates.

FLANKING/RENDER COAT means an intermediate levelling coat of plaster in between bond or scratch coat and finish coat.

BASE COAT means any plaster coat applied prior to application of the finish coat.

FINISH COAT means the final coat of plaster applied over the previous coats and finished within the specified surface tolerances.

CONSISTENCY means the degree of fluidity of a plaster mix.

CORNER BEAD means the casing used to form a corner and to provide reinforcement.

CURE means to provide conditions to ensure satisfactory hydration of Portland cement plaster.

DADO FINISH means the cement, lime and sand mix used as a finish coat where extreme hardness and resistance to water are required in combination with a very smooth surface.

FURRING means spacers used to accurately position steel mesh or lath in the plaster coat.

GROUNDS means pieces of material attached to the background so that their exposed surfaces act as a gauge to determine the position of the finished surface.

LATH or MESH means an applied reinforcement for plaster.

LIGHTWEIGHT CONCRETE means concrete containing lightweight aggregate and having a unit weight not exceeding 1850 kg/m^3.

LIGHTWEIGHT PLASTER means a plaster finish coat which contains exfoliated vermiculite, expanded perlite, polystyrene bead or polystyrene grind.

MODIFIED PLASTER means a plaster which consists of Portland cement, sand and chemical admixtures excluding lime whose solids exceed 5 % by weight of cement.

MOIST CURING means maintenance of a wet atmosphere around the surface of a plaster coat.

POLYSTYRENE BLOCK SUBSTRATE means continuous reinforced concrete wall systems that use expanded polystyrene (E.P.S) blocks as a permanent formwork.

PROPRIETARY MODIFIED PLASTER means a modified plaster that has preblended ingredients for use in accordance with the manufacturer's instructions.

SELF-FURRING means steel mesh or lath shaped in such a way that it is spaced out from the backing without the use of spacer blocks.

SOLID SUBSTRATE means concrete, lightweight concrete, concrete masonry, lightweight concrete masonry or brick walls and concrete ceilings and soffits.

SOLID PLASTER means Portland cement based cementitious mixture of sand, aggregate, lime or other admixture and water.

STUCCO means solid plaster claddings of Portland cement, sand, aggregate (often containing lime or other admixtures), applied on a background of galvanized mesh or lath over rigid or non-rigid backing fixed to light timber or steel framing.

2 GENERAL CONSIDERATIONS

2.1 General requirements of solid plastering

2.1.1 *Scope*
This section of the Standard specifies general requirements of solid plastering relating to workmanship, reinforcement, openings and penetrations, accuracy, air temperature, control joints and plaster finishes.

2.1.2 *Workmanship*
All plastering work shall be performed by people who have the requisite skill and experience. The work shall be carried out in accordance with this Standard.

C2.1.2
Plastering is highly skilled work and the current practice is based on tradition and site experience. A person who can demonstrate acceptable quality of workmanship in all respects of plastering and has successfully completed a recognized plastering trades course will satisfy this requirement.

2.1.3 *Reinforcement of plaster systems*
The following requirements apply:

(a) The reinforcement for stucco on rigid and non-rigid backing as well as for expanded polystyrene blocks shall be galvanized wire mesh or expanded metal. Refer to 3.6.3, 4.3 and 5.3 for details and fixing of reinforcement.

In stucco construction all exterior surfaces to receive metal reinforcement shall have building paper fixed to the background material before the reinforcement is fixed.

(b) Reinforcement is not required for solid substrates except when using expanded polystyrene block or where identified by specific design.

2.1.4 *Openings and penetrations*

2.1.4.1
Openings and penetrations in areas to be plastered shall be formed prior to plastering being started. Weather penetration around door and window openings in exterior claddings shall be prevented by the installation of head, sill and side flashings. Head and sill flashings shall extend horizontally no less than 30 mm beyond each side of the framing to the opening and all flashings shall be installed before plastering commences.

2.1.4.2
Flashing details for head, sill and jambs shall be as given in figures 1(a), (b) and (c).

2.1.4.3
Flashings shall be constructed from type 304 or 316 stainless steel, powder coated aluminium, hot dipped galvanized steel, or galvanized steel with a coating of not less than 400 g/m^2. The forming of the flashings must not compromise the effectiveness of the protective coatings applied. Flashings made from other materials shall be subject to the approval of the territorial authority.

2.1.4.4 *Metal components*
All metal components used in solid plastering work shall be made from one of the materials listed as suitable for flashings given in 2.1.4.3.

2.1.4.5 *Service penetrations*

2.1.4.5.1
All service penetrations through the plaster larger than 150 mm diameter or equivalent area (e.g. meter boxes) shall be fully flashed.

2.1.4.5.2
Small service penetrations, being up to and including 150 mm diameter or equivalent area such as waste pipes, shall be installed so that they are supported as they pass through a framing member (dwang, nogging or similar), slope downhill to the outside and are sealed against moisture penetration. The hole through the framing and the sealing system itself shall allow for thermal expansion and contraction of the penetrating element and sealants shall be protected from direct sunlight which could cause deterioration of the sealant.

2.1.4.5.3
The hole for the penetration shall be at least 15 mm greater in diameter than the pipe or cable to allow sufficient sealant thickness to accommodate movement without failure. Both the opening in the backing and in the cladding must be sealed around the penetration. The sealant must be forced against a backing rod, if necessary, and be protected from the weather on the outside by a close-fitting flange around the pipe or cable.

C2.1.4.5
When using sealants it is essential to ensure the sealant is suitable for the surfaces to which it is attached and to follow the sealant manufacturer's instructions. For contact with Portland cement plaster a neutral-curing silicone should be satisfactory. Plastic or rubber proprietary fittings or sleeves are available for waterproofing small penetrations. See Appendix D for information on alternatives.

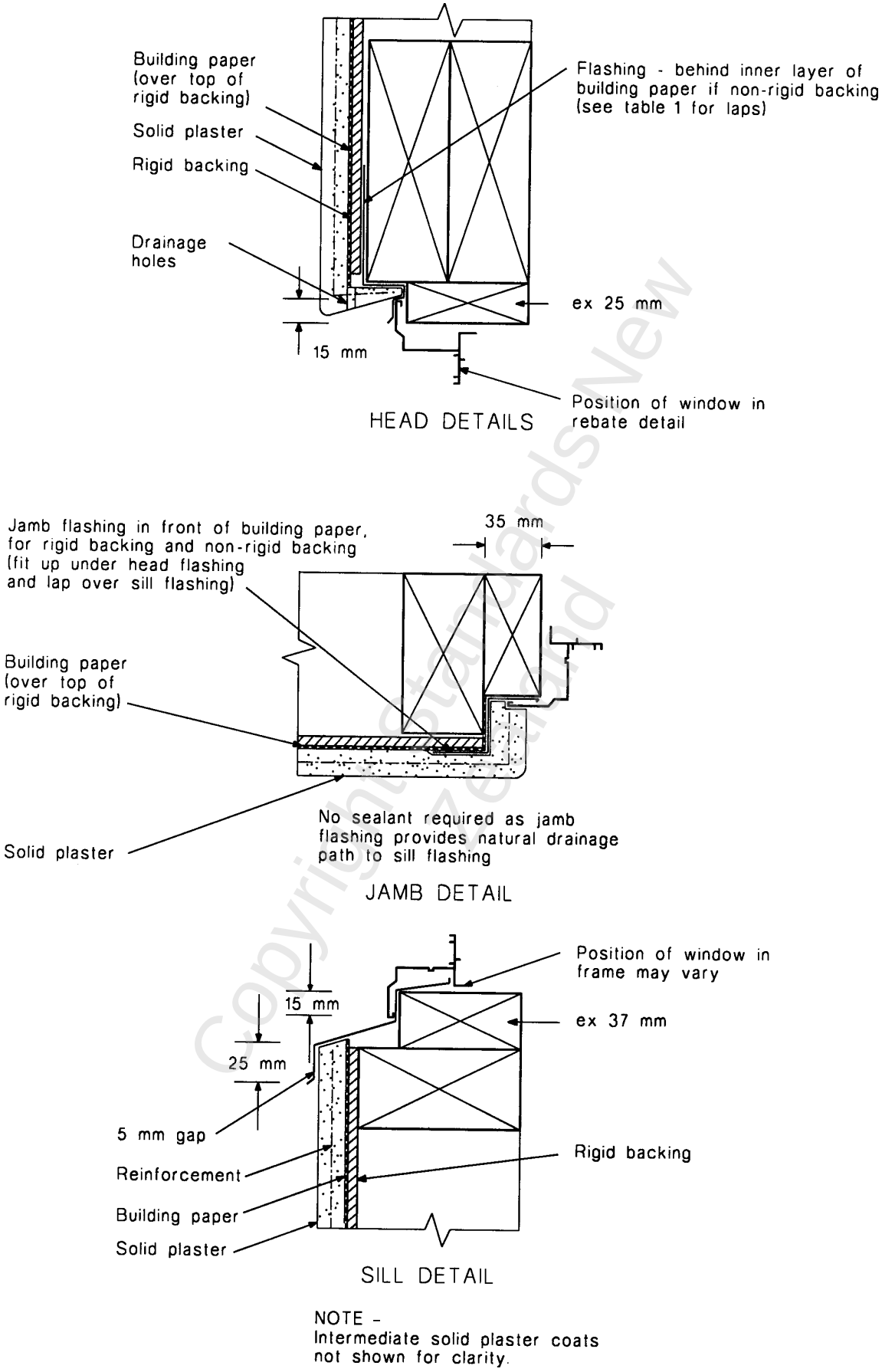


Figure 1(a) – Flashing for metal window frames

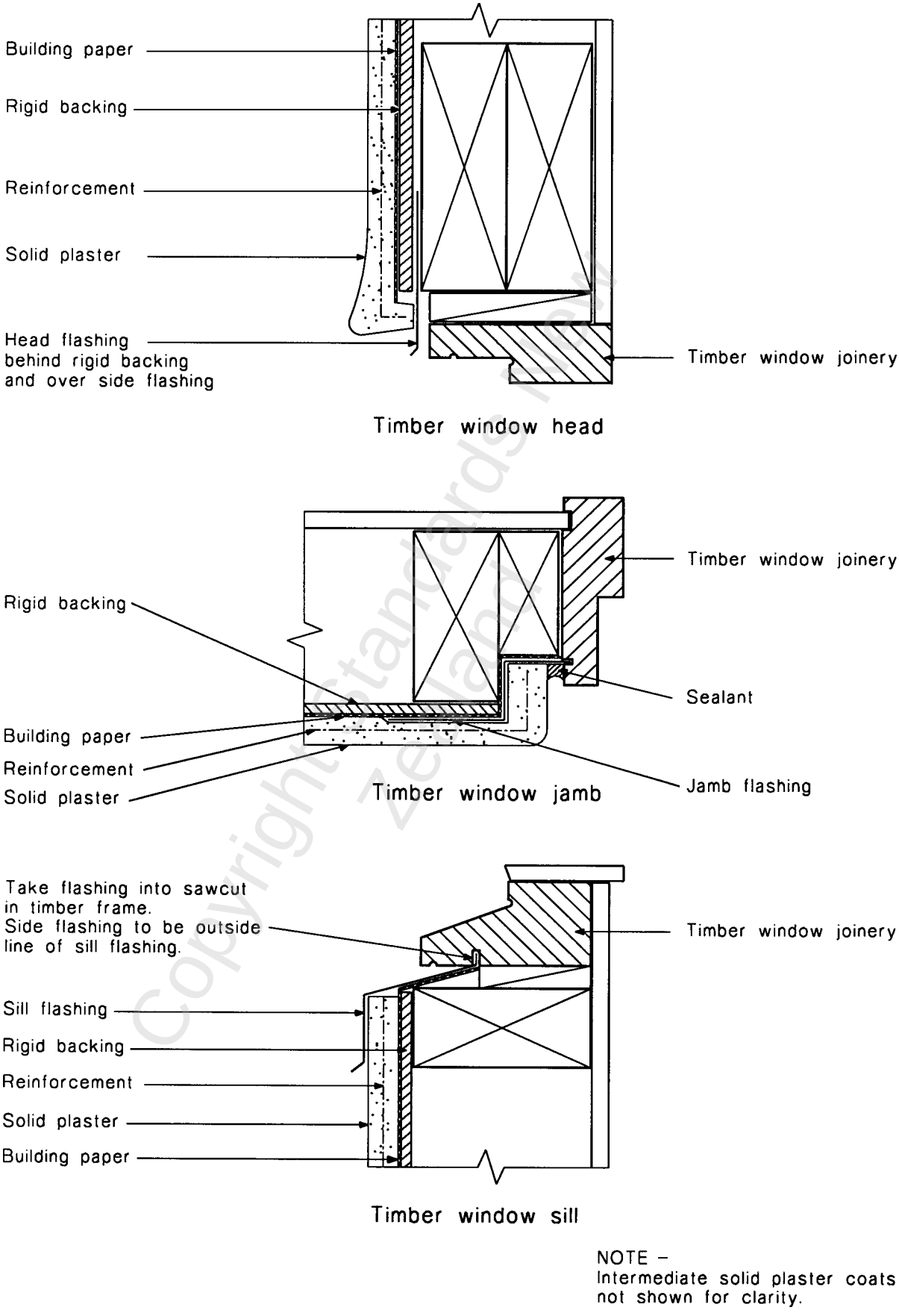


Figure 1(b) – Flashing for timber window frames

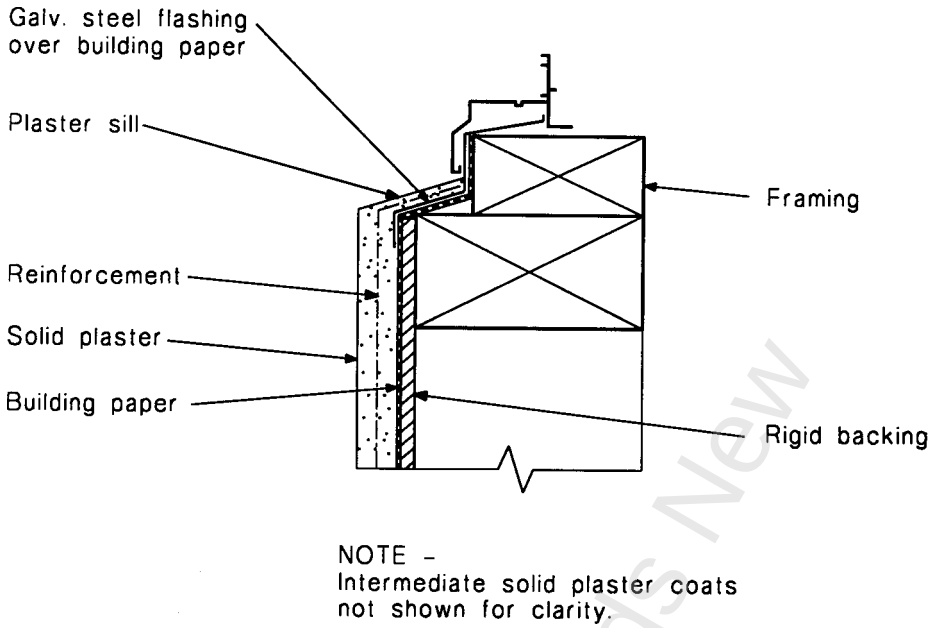


Figure 1(c) – Alternative sill detail

Table for figures 1(a), 1(b) and 1(c)
Table 1 – Laps for flashings

Situation	Order of layer	Required lap
Head of window	Building paper outside flashing	40 mm for extruded flashings 75 mm for folded flashings
	Flashings outside window frame	15 mm
Sill of window	Window sill outside flashing	15 mm
	Flashing outside building paper	40 mm for extruded flashings 75 mm for folded flashings
Jamb of window	Flashing outside building paper	70 mm

2.1.5 *Accuracy*

2.1.5.1
All surfaces, corners, edges, angles and reveals shall be finished to lines and levels shown on the plans and specifications within the flatness tolerances specified in this clause.

2.1.5.2
For all smooth trowelled surfaces, the background shall be brought up to line and level with vertical surfaces plumb and horizontal surfaces level.

2.1.5.3
Smooth trowelled or sponge finished plastered surface shall:

(a) Not deviate more than ±3.0 mm as measured from a 1800 mm long shimmed straight edge;

(b) Have no abrupt deviations of surface.

C2.1.5
The above tolerances do not apply to textured or patterned finishes created with a trowel.

2.1.6 *Surface contaminants*
All surfaces receiving plaster shall be free from any contaminant that will interfere with the ability of the plaster to obtain good adhesion. Contaminants include form-releasing oils, tar and bituminous emulsions, paint of any kind, dust and loose particles, soil and clay.

C2.1.6
Where concrete that forms a solid substrate has been cast against formwork, it is recommended that a chemical release agent be used to facilitate formwork removal. Surface contamination that may arise from oil based release agents must be removed before plaster can be applied.

NZS 3114 Specification for concrete surface finishes *specifies F2 as an appropriate concrete finish to receive plaster.*

2.1.7 *Air temperature*

2.1.7.1 *Cold conditions*
No plastering shall be carried out in air temperatures below 5 ºC or if the temperature is likely to drop below 5 ºC in the 24-hour period following the application of plasterwork.

C2.1.7.1
At low temperatures the hydration process of the strength gain is very slow and overnight frosts may damage the plaster. Surface temperature can be significantly affected by wind speed.

2.1.7.2 *Hot conditions*

2.1.7.2.1
There shall be no plastering in hot dry conditions that cause rapid drying of a pre-wetted substrate or a previous plaster coat with consequential rapid drying of the plaster coat.

2.1.7.2.2
All necessary precautions shall be taken to protect newly completed work against the effects of drying winds, direct sunlight, rain and water run-off for at least 24 hours after application.

C2.1.7.2
The restriction on plastering in hot weather is to prevent a pre-wetted substrate or a previous plaster coat drying quicker than the plaster can be applied. This can lead to poor plaster adhesion and loss of moisture in the plaster mix can cause surface shrinkage cracking.

In hot sunny conditions work should be carried out on the shaded areas of a building. It is good practice to follow the sun and protect the work by shading.

2.1.8 *Adjacent surfaces*

Adjacent surfaces not required to be plastered shall be protected by physical barriers during the whole of the work. The barriers protect the surfaces from the corrosive effects of the plaster, e.g. anodized aluminium discoloration, staining of woodwork, or damage to glazing or other materials.

C2.1.8

An acceptable way of creating physical barriers is to use plastic sheets and/or masking paper and tapes.

2.1.9 *Control joints*

2.1.9.1

Control joints shall be formed in the plaster to coincide with all locations and joints in the structure where movement is likely to occur. They shall be formed at all junctions between dissimilar substrates and at any change in wall cross section or height.

2.1.9.2

On solid substrates in which temperature and humidity movements are unlikely to be significant, the only other essential joints in the plaster will be those dictated by the extent of a day's work.

2.1.9.3

In stucco systems, control joint spacings shall not be greater than 4 m both vertically and horizontally and be located:

(a) Above and below the sides of door and window openings, and

(b) At inter-storey level at the underside of floor joists.

2.1.9.4

Control joints are not required at the sides of windows less than 500 mm wide and less than 0.2 m^2 in area.

2.1.9.5

Galvanized mesh or lath shall not be continuous across control joints.

2.1.9.6

Control joints shall be formed by plastering up to a corrosion resistant jointing bead or flashing or a temporary batten. Alternatively, a neat straight V-groove shall be cut through the bond and flanking coats before they harden. After the flanking coat is cured and dried, this groove shall be filled with a polyurethane, polysulphide or neutral cure silicon type sealant prior to the overall application of the finish coat.

2.1.9.7

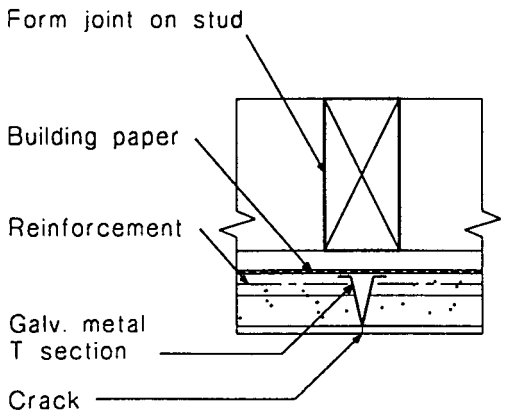
See figure 2 for details of horizontal and vertical control joints.

C2.1.9

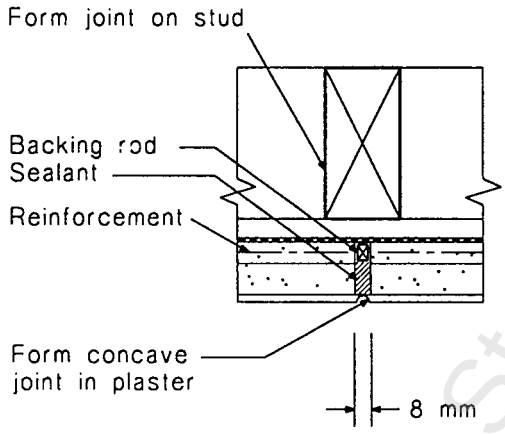
If possible, control joints should be located in a pattern which contributes to the appearance of the structure.

During the development of the Standard, an evaluation of random cracking arising from shrinkage showed that the risk of such cracking was greatly increased by having continuous reinforcement through a control joint. Hence the document's requirements for non-continuous reinforcement.

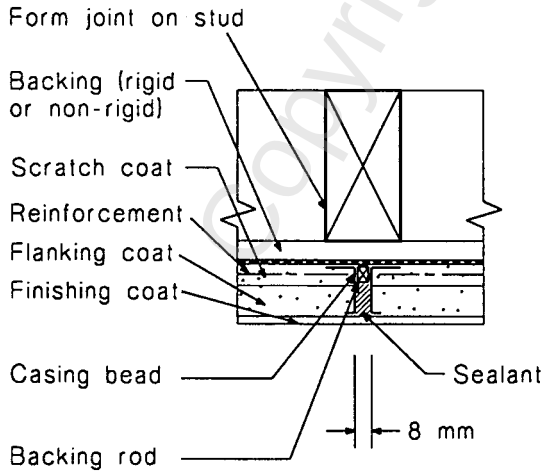
Section 3.8 of the BRANZ "Good Stucco Practice" dated February 1996 gives more details of control joints which comply with the principles illustrated by figure 2.



(a) T-brace moulding

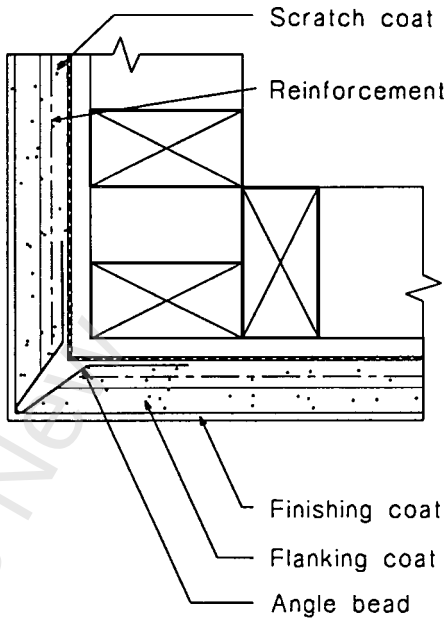


(b) Gap formed or cut in plaster



(c) Casing beads

VERTICAL CONTROL JOINTS



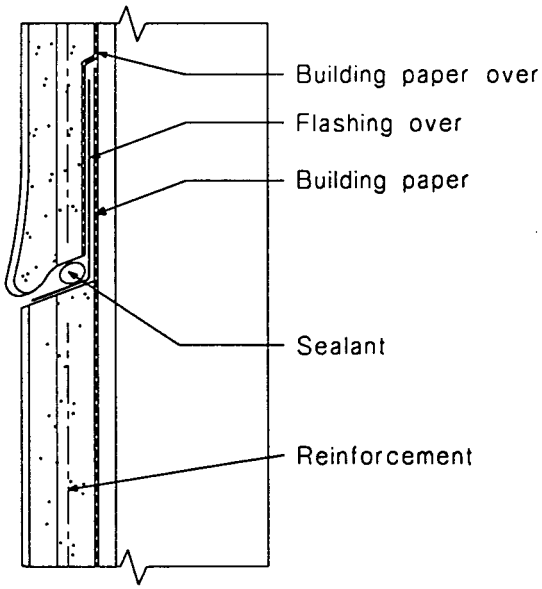
(d) External corner

NOTE –

(1) Angle bead or control joint extrusion must be covered by the finishing coat and must be hot dipped galvanized.

(2) The extrusion must be fixed firmly to a stud behind with galvanized nails.

(3) When an angle bead or control joint extrusion is not used, the reinforcement shall be continuous around the corner.



(e) Horizontal control joint

Figure 2 – Control joints

2.1.10 *Plaster finishes*

2.1.10.1 *Types of finishing coats*

2.1.10.1.1
Plaster finish coats shall be smooth trowelled, medium textured or heavy textured as described in 3.5.2, 4.5.2 and 5.5.2.

C2.1.10.1.1
Texture, as a description of surface appearance, is identified generally with the method and tools used to achieve the finish. Texture can be varied by the size and shape of the aggregate used and the tools employed. See Appendix A for types of finishing coats commonly used.

2.1.10.1.2
For thicknesses of plaster coats refer to tables 4, 6 and 7.

2.1.10.2 *Angle arrises*

2.1.10.2.1
Where no external corner reinforcement or corner bead is specified, arrises shall be removed to form a 45º angle or other desired shape.

2.1.10.2.2
Square arrises shall be softened down by lightly rubbing over with a wet trowel when finishing.

2.1.10.2.3
Plaster thicknesses as specified in tables 4, 6 and 7 shall be maintained at the arrises.

2.1.10.3 *Drip edge*
At the bottom of exterior walls, at the junction with the floor or foundation, a drip edge shall be provided to shed water clear of the adjoining cladding (see figures 3 and 4).

2.2 Materials for solid cement plasters

2.2.1 *Scope*
This clause covers selection of materials for solid plasters.

C2.2.1
Cement-based plaster systems must satisfy important workability requirements during application. These are dependent on the correct mix proportions and the materials used, especially the sand. The finished plaster work must be structurally sound, well adhered, free of cracking and water resistant. The quality of the finished work is very dependent on the correct plaster mix applied in a consistent manner to a properly prepared substrate by a competent tradesperson (see 2.1.2).

2.2.2 *Materials and source*

2.2.2.1
The materials used in the plaster mixes shall be of consistent quality suitable for the intended use, satisfying the grading and compliance requirements of this Standard.

2.2.2.2
The source of materials, including cement, shall not be changed during the course of the work unless it can be shown that alternative materials can continue to meet the requirement of the Standard.

C2.2.2.2
For uniformity of surface colour, it is essential to ensure that the continuity of the supply of all materials is maintained from the original sources.

2.2.2.3 *Cement*
Cement shall meet the requirement of one of the following:

(a) Type GP, GB, HE or SR Portland or Blended cement complying with NZS 3122;

(b) Portland Pozzolan cement complying with NZS 3123;

(c) Portland-limestone filler cement complying with NZS 3125.

White cement shall comply with the performance requirements of NZS 3122.

C2.2.2.3
The cement production Standard NZS 3122 has adopted a coding system to suit eventual integration with overseas Standards.

Within the plastering industry, 3 types of cement from NZS 3122 are likely to be used. These types are also those produced as standard production.

GP General Purpose Portland Cement was Ordinary Portland Cement (OPC).
GB General Purpose Blended Cement was not covered by the previous publication of NZS 3122. It refers to cements that are made up of a mixture of GP cement and other materials such as blastfurnace slag and flyash.
HE High Early Strength Cement was previously designated Rapid Hardening (RH).

It should be noted that there will be colour differences between the different cement types, including NZS 3122 Portland and blended cements *and* NZS 3125 Portland-limestone filler cement.

2.2.2.4 *Sand*

2.2.2.4.1
Sand shall be to correct grading and as defined in 2.2.2.4.4 which shall replace the flow time requirement given in clause 8.1 of NZS 3103. In other respects the sand shall comply with the requirements of NZS 3103.

2.2.2.4.2
Sands for use in any external stucco plaster shall not have a chloride content in excess of 0.05 % by mass of sand.

2.2.2.4.3
Sand sampling shall be carried out in accordance with NZS 3111 section 5 and tested for chloride content in accordance with BS 1881:Part 124 or ASTM C1152.

C2.2.2.4
Sand is the major component of a plaster mix and has a significant effect on it's workability and long term performance. Variations in sand, cleanliness, grading or moisture content affect the strength, density and working properties of the plaster, while variations in colour or moisture content also affect the uniformity of colour of the hardened plaster.

Unwashed beach sand can have chloride contents in the order of 0.03 % to 0.09 % by weight of dry sand.

The corrosion protection of reinforcement by encapsulation in the plaster is significantly affected by the amount of chloride that is contained in the plaster. Accordingly, it is necessary to place chloride limits on the basic materials making up the plaster. The use of chloride based accelerator admixtures has been restricted in 2.2.3.3 in external stucco applications and some restrictions have been placed on the maximum chloride content of the sand. The 0.05 % of mass has been permitted in view of the fact that this Standard specifically requires the plaster surface to be sealed by painting and to be maintained over the life of the system. Where plaster is unprotected, then the chloride limit would be set at a lower level, i.e. 0.03 %.

There are several test methods for chloride content. Two common wet chemical methods are quoted but XRF (X-Ray Fluoroscopy) methods could be used provided an equivalency of performance to the wet chemical methods can be demonstrated.

2.2.2.4.4 *Grading*

Grading for plaster sand for use in all coats except the finishing coat, showing percentage passing shall be as in table 2.

Table 2 – Grading of sand

Sieve size (mm)	4.75	2.36	1.18	0.6	0.3	0.15	0.075	Pan
Min. (ASTM)	100	90	60	35	10	0	0	0
Max. (ASTM)	100	100	90	70	30	5	3	0

The size of sand particle for the finishing coat shall not exceed 1.18 mm.

Sands that do not fully comply with the above mentioned grading table may still be used, given that local usage has shown that the sand has suitable workability and a history of satisfactory performance which has been proved by independent technical assessment to be suitable as plastering sand. (See Appendix B for method of assessment of sand).

C2.2.2.4.4

The sand grading is based upon achieving a structural and weatherproof plaster coating. In areas of New Zealand where manufactured angular sands are used it will be desirable to use lime as an admixture to assist in producing fine particle lubrication of the mix. Generally this grading and particle size will not produce a fine smooth finish.

2.2.3 *Admixtures*

2.2.3.1 *General*

Admixtures used in plaster mixes to improve workability, bond, control setting times and as an aid to curing shall comply with 2.2.3.3 to 2.2.3.5.

C2.2.3.1

Admixtures are a recognized component of plaster systems used to a greater or lesser degree by most tradesmen. Some admixtures are well known and their use may be specified (see below).

2.2.3.2 *Lime*

2.2.3.2.1

Hydrated lime shall comply with AS 1672 and be included in the plaster mix in accordance with table 3.

2.2.3.2.2
Hydrated lime can be added direct in powder form at the time of mixing or as a lime putty. Lime putty is prepared by soaking appropriate batch volumes (table 3) of powdered lime in water for approximately 24 hours, draining off any excess water and then adding the creamy putty material to the plaster mix.

C2.2.3.2
Hydrated lime has very fine plate-like particles that help to "lubricate" the plaster mix improving the workability. This is particularly important when using manufactured angular sands.

Lime putty is generally used in thin finishing plaster coats to overcome the early stiffening of the mix associated with adding powdered hydrated lime directly into a plaster mix.

2.2.3.3 *Chemical admixtures*

2.2.3.3.1
Chemical admixtures, such as water-reducing admixtures, retarding admixtures, accelerating admixtures and air entraining admixtures shall comply with NZS 3113 and AS 1478.

2.2.3.3.2
Dosage rates detailed by the manufacturer shall be accurately determined for the particular plaster mix and volume of plaster mixed to ensure performance requirements set out in NZS 3113 and AS 1478 are achieved.

2.2.3.3.3
The admixture dosage shall be accurately measured and dispensed into the plaster mix.

2.2.3.3.4
Combinations of admixtures shall be used only if the manufacturers can provide performance results showing that the combinations of the proposed admixtures for a specified plaster mix are compatible and their use in the plaster mix will produce plaster of a quality equal to or greater than a fully cured plaster with no admixtures.

2.2.3.3.5
Calcium chloride based accelerators shall not be used in any external plaster systems containing metal reinforcement, unless it can be shown that in combination with the sand the chloride levels in the plaster do not exceed 0.04 % by mass of plaster.

C2.2.3.3
Addition of lime is not recommended with chemical admixtures.

When dosage rates are such as to create a modified plaster the subsequent operations of such a plaster need to follow the manufacturer's instructions. Such applications are not covered in this Standard at present.

2.2.3.4 *Bonding agents*

2.2.3.4.1
Bonding agents for exterior and interior work shall be specially formulated water based emulsions such as:

(a) Styrene butadiene rubber (SBR) emulsions;

(b) Acrylic emulsions.

2.2.3.4.2
Bonding agents formulated with polyvinyl acetate (PVA) shall only be used in an interior, moisture free environment.

2.2.3.4.3
The bonding agent emulsions shall be considered as a part replacement for mixing water and dosed as required by the manufacturer's instructions to ensure increased bond in accordance with the testing requirements of ASTM C631, C932, C952 and C1042 as appropriate.

C2.2.3.4
Emulsions become effective by coalescing which happens only when the mixture dries out. Uncoalesced emulsions can be leached out of the mix by water. Mixes containing an emulsion should therefore be cured by maintaining moist conditions but not by applying free water. They must then be allowed to dry out completely before being exposed to wet service conditions.

Undiluted polymer emulsions should be used on their own with great caution because they may form a plastic skin that will act as a debonding agent. Because PVA is unstable in continuous moist conditions it should be used only for plaster work that will be permanently dry in service.

2.2.3.5 *Oxides/pigments*

2.2.3.5.1
Coloured oxide and pigments shall comply with NZS 3117.

C2.2.3.5.1
It is recommended that sufficient mix is made to complete the total wall or a discrete section.

Rate of curing can alter colour finish.

Pre-coloured cement-based plasters may not provide a uniform coloured finish.

Exterior coloured plaster surfaces will be subject to water staining and a potential for colour fade. Some efflorescence due to the leeching of soluble salts to the surface is also possible, particularly when plaster is applied in winter conditions.

Water staining and efflorescence effects can be reduced with the application of a cement compatible exterior grade clear sealer coat which will also greatly improve the waterproofing of the plaster system. (See 2.6 for suitable coating systems).

2.2.3.5.2 *Dosage rates*
Dosages of mineral oxide shall not exceed 3 % by weight of cement unless it can be shown that greater concentrations do not have a detrimental effect on the plaster. Dosages in excess of 6 % by weight of cement shall not be used.

C2.2.3.5.2
Oxides and pigment dosage rates based on the cement content of the plaster mix should also not exceed the maximum rate stated by the manufacturer, within the guidelines of NZS 3117.

The colour saturation point for most oxides and pigments based on the cement content is generally between 5 % and 8 % by weight. A good depth of colour can be achieved by 3 % to 4 %.

Addition of oxides at the 15 % level has been shown to produce a significant (90 %) loss in strength of the plaster coat.

2.2.3.6 *Synthetic fibres*

2.2.3.6.1
Synthetic fibre type and size shall comply with ASTM C1116 being compatible with cement-based plasters and able to be evenly distributed into the plaster mix.

2.2.3.6.2
Fibres shall be permitted in the plaster coat containing the metal lath reinforcing only if that coat is manually applied.

2.2.3.6.3
The fibres shall be clean, dry and free of any coating that will adversely affect the plaster bond to the fibres.

2.2.3.6.4
The quantities of fibres in the plaster mix shall be as required by the synthetic fibre manufacturer to ensure compliance with ASTM C1116.

C2.2.3.6
The addition of synthetic fibres such as polypropylene or fibreglass to a plaster mix helps to control stresses and reduce the potential for cracking through providing initial additional strengthening as the plaster mix cures. The fibres are not a replacement for the specified metal reinforcement. E-type fibreglass fibres are acceptable, even though their long-term durability will not equal that of AR-type (alkali resistant) fibreglass or polypropylene fibres.

It has been noted that the addition of synthetic fibres reduces the risk of surface plaster cracks in hot, dry conditions.

Fibres should not be used in the first coat of plaster if it is pneumatically applied, as the fibres are likely to prevent the plaster mix from penetrating the openings in the reinforcing. This can result in an inadequate coat thickness and a failure to enclose the reinforcing in plaster.

Fibres are not usually used in the final plaster coat of a system as the fibres would protrude from the surface and produce an unsatisfactory finish.

It is not practicable to give a general specification for weight of fibres per mix as fibre density varies for different types and batching is normally measured by volume. However, the approximate measure of 0.5 litre of fibres to a normal 30-litre mix appears to work satisfactorily.

2.2.3.7 *Lightweight aggregates*

2.2.3.7.1
Expanded perlite and exfoliated vermiculite shall have no dimension greater than 4 mm and shall comply with the relevant sections of NZS 3152 or AS 2758.1.

2.2.3.7.2
Polystyrene grind shall comply with AS 1366.4.

2.2.4 *Stone*
Stones used in roughcast finished coats shall meet the durability requirements as specified in NZS 3121 and shall have no dimension greater than 14 mm.

2.2.5 *Water*
Water shall comply with NZS 3121. Drinkable water supplied by a territorial authority for domestic use is suitable.

2.2.6 *Storage*
Materials shall be stored in dry conditions off the floor or ground on timber battens or dunnage ensuring protection from contamination and degradation.

2.3 Plaster mixes

2.3.1 *Scope*
This clause gives mix proportions for plastering systems covered in the Standard.

2.3.2 *Mixes for plastering*
Plaster mixes, by volume, shall be as detailed in table 3. Plaster on porous solid substrates, as determined from 3.3, require a scratch coat rather than bond coat.

C2.3.2
The finishes are described in Appendix A.

As a general rule, each coat of plaster should be weaker than the preceding one, except that a slightly stronger mix may be used in a thin finish coat.

2.4 Batching and mixing

2.4.1 *Scope*
This clause covers batching and mixing of cement plasters by machine or by hand.

2.4.2 *Batching*

2.4.2.1
The plaster ingredients, water and liquid admixtures shall be batched by volume using accurate gauge boxes or other suitable containers.

2.4.2.2
Pigments and liquid or solid admixtures shall be batched according to the manufacturer's recommendations.

C2.4.2
A shovel is not an adequate or accurate measure.

2.4.3 *Mixing*

2.4.3.1 *General*

2.4.3.1.1
Portland cement plasters shall be thoroughly mixed to provide a uniform consistency throughout the mix.

2.4.3.1.2
Machine mixing shall be used where practicable.

C2.4.3.1
In order to ensure proper intermixing of all materials machine mixing is highly desirable, since the performance of the plaster is influenced by the consistency of the plaster production. Careful hand mixing is possible where small quantities of plaster may be required.

Table 3 – Mixes for plastering

Background	Finish	Bond coat or scratch coat	Flanking coat	Finish coat
Concrete	Dado finish	CS 1:1 1/2	CLS 1:1:6	CLS 1:1:1
	Sponge finish	CS 1:1 1/2	CLS 1:1:6	CLS 1:1:6
	Lightweight plaster	CS 1:1 1/2	CV 1:4	CV 1:4
	Tyrolean	CS 1:1 1/2	CLS 1:1:6	CS 1:3
	Textured & scraped	CS 1:1 1/2	CLS 1:1:6	CLS 1: 1/2 :4
	Combed	CS 1:1 1/2	CLS 1:1:6	CLS 1: 1/2 :4
	Rough cast	CS 1:1 1/2	CLS 1:1:6	CLSA 1:1: 1/2 :3
	Dry dash	CS 1:1 1/2	CLS 1:1:4	– –
Brick & blockwork (unit masonry)	Dado finish	CS 1:1 1/2 -2	CLS 1:1:6	CLS 1:1:1
	Sponge finish	CS 1:1 1/2 -2	CLS 1:1:6	CLS 1:1:6
	Lightweight plaster	CS 1:1	CV 1:4	CV 1:4
	Tyrolean	CS 1:1 1/2 -2	CLS 1:1:6	CS 1:3
	Textured & scraped	CS 1:1 1/2	CLS 1:1:6	CLS 1: 1/2 :4
	Combed	CS 1:1 1/2	CLS 1:1:6	CLS 1: 1/2 :4
	Rough cast	CS 1:1 1/2 -2	CLS 1:1:6	CLSA 1:1: 1/2 :3
	Dry dash	CS 1:1 1/2 -2	CLS 1:1:4	– –
Lightweight concrete & blocks	Dado finish	CS 1:2	CLS 1:1:6	CLS 1:1:1
	Sponge finish	CS 1:2	CLS 1:1:6	CLS 1:1:6
	Lightweight plaster	CS 1:2	CV 1:4	CV 1:4
	Tyrolean	CS 1:2	CLS 1:1:6	CS 1:3
	Textured & scraped	CS 1:1 1/2	CLS 1:1:6	CLS 1: 1/2 :4
	Combed	CS 1:1 1/2	CLS 1:1:6	CLS 1: 1/2 :4
	Rough cast	CS 1:2	CLS 1:1:6	CLSA 1:1: 1/2 :3
	Dry dash	CS 1:2	CLS 1:1:4	– –
Polystyrene blocks	Dado finish	CS 1:1 1/2	CLS 1:1:4	CLS 1:1:6
	Sponge finish	CS 1:1 1/2	CLS 1:1:4	CLS 1:1:6
	Tyrolean	CS 1:1 1/2	CLS 1:1:4	CLS 1:1:6
	Textured & scraped	CLS 1:1:6	CLS 1:1:6	CLS 1: 1/2 :4
	Combed	CLS 1:1:6	CLS 1:1:6	CLS 1: 1/2 :4
	Rough cast	CS 1:1 1/2	CLS 1:1:4	CLS 1:1:6
	Dry dash	CS 1:1 1/2	CLS 1:1:4	– –
Stucco				
Rigid backing & non-rigid backing	Dado finish	CLS 1:1:6	CLS 1:1:6	CLS 1:1:1
	Sponge finish	CLS 1:1:6	CLS 1:1:6	CLS 1:2:9
	Lightweight plaster	CS 1:3	CV 1:4	CV 1:4
	Tyrolean	CLS 1:1:6	CLS 1:1:6	CS 1:3
	Textured & scraped	CLS 1:1:6	CLS 1:1:6	CLS 1: 1/2 :4
	Combed	CLS 1:1:6	CLS 1:1:6	CLS 1: 1/2 :4
	Rough cast	CLS 1:1:6	CLS 1:1:6	CLSA 1:1: 1/2 :3
	Dry dash	CLS 1:1:6	CLS 1:1:4	– –

Key to table

C Portland cement
L Lime or lime putty (see 2.2.3.2)
S Sand
V Exfoliated vermiculite, expanded perlite or polystyrene grind
A Stone

NOTE–

(1) Where admixtures are used in lieu of lime refer to the manufacturer's recommendations.
(2) See also 2.2.3.3.
(3) Surface porosity of the substrate (see 3.3.2) will determine whether a bond coat or scratch coat is used.
(4) Smooth trowel finishes are not recommended because of the potential to highlight fine cracks and minor surface irregularities.
(5) Flanking coat is also referenced as Render coat (see definitions in 1.5).

2.4.3.2 *Machine batching and mixing*

2.4.3.2.1
Three quarters of the required water shall be measured and placed in the mixer, followed by the addition of measured quantities of other ingredients.

2.4.3.2.2
The remaining water shall be progressively added if necessary to ensure that the mixing produces a mixture which is uniform in colour and consistency.

C2.4.3.2
When mixing the plaster the aim is to get uniform consistency using identical proportions of ingredients in each batch.

2.4.3.3 *Mixing time*
For each mix, the mixing time taken shall be established by preparing a trial batch and accurately recording the time taken to produce the required consistency, as described in 2.4.3.2. That mixing time shall be used for all subsequent batches with the same components and mix proportions.

C2.4.3.3
Excessive mixing time when using polymer-based plasticisers causes excessive air entrainment which results in reduced strength and increased shrinkage. (A laboratory study where mixing time was increased from 2 minutes to 15 minutes gave a strength reduction of 50 % and a shrinkage increase of 35 %).

Mixing times are longer if a concrete mixer is used rather than the more efficient paddle mixer. A simple time switch on the mixer is a reliable way of ensuring correct mixing time.

2.4.3.4 *Hand mixing*
Hand mixing shall be done on a smooth non-porous surface. The sand shall be spread out in a 100 mm thick layer. The cement and lime shall then be spread uniformly over the sand. Mix the ingredients thoroughly, until the colour is uniform. Then gradually add the water while mixing until the uniform consistency is achieved.

2.4.3.5 *Re-mixing*

2.4.3.5.1
Re-tempering or re-mixing after the plaster has stiffened shall not be permitted.

2.4.3.5.2
General and blended Portland cement-based plaster which remains unused after 90 minutes, measured from the time of mixing, shall not be used unless a retarding admixture was used at the time of mixing to extend the setting time.

2.4.3.6 *Proprietary plasters*
All pre-mixed materials shall be delivered to the site in sealed packaging, bearing the trade names of the materials, the manufacturers' details and mixing instructions.

C2.4.3.6
This requirement confirms where and how the specified manufactured products are to be used.

2.4.3.7 *Cleaning*
Frequent washing of all mixing equipment and tools shall be undertaken, especially if latex emulsion admixtures are used in the gauging liquid.

C2.4.3.7
Frequently means a minimum of 3 times a day for sand cement mixes and at 45 minutes intervals for mixes with latex admixtures.

2.5 Application and curing of plaster coats

2.5.1 *Scope*
This clause includes application and curing of various types of plaster coats such as bond coats, scratch coats, flanking coats and finish coats.

2.5.2 *General*

2.5.2.1
Each coat of plaster shall be cured to provide moisture for cement hydration while ensuring a controlled rate of drying to resist cracking which could lead to structural failure or water penetration. No plaster coat shall be applied over a preceding coat of plaster until the base plaster has been correctly cured.

2.5.2.2
Mixes containing admixtures shall be cured under conditions recommended by the manufacturer.

2.5.3 *Dubbing-out*

2.5.3.1
All dubbing-out which is necessary to provide a plane background for plasterwork shall be done at least 48 hours before the application of base coats to allow the dubbing-out to dry out. If the dubbing-out thickness needed is greater than 15 mm it shall be built up in 2 or more coats, each not more than 15 mm thick. The mix for dubbing-out shall not be weaker than the flanking coat.

2.5.3.2
Where dubbing out exceeds 30 mm specific design is necessary, which is outside the scope of this Standard.

2.5.4 *Bond coat*

2.5.4.1
Bond coats are required on non-porous solid substrates as determined from 3.3. Bond coat plaster mix shall be applied to the substrate prepared in accordance with 3.2 and 3.3.

2.5.4.2
The bond coat shall be applied by throwing the plaster with force onto the substrate using a scoop or a suitable trowel. The resulting bond coat shall comprise a close rough textured layer of plaster up to 4 mm thick. No attempt must be made to smooth off, level, or pat into place this plaster coat.

C2.5.4.1 and C2.5.4.2
A machine pump designed for the purpose of applying cement-based plaster may also be suitable for applying the bond coat.

2.5.4.3 *Curing of bond coat*
The bond coat shall be cured in accordance with one of the following procedures:

(a) Moist curing shall be provided for 48 hours and then left to dry for 24 hours or until the surface hardness is suitable for the application of the flanking coat.

(b) Where an acrylic bonding agent has been used in the plaster mix, moist curing shall be dispensed with and the plaster coat shall be protected from direct sun and drying wind for at least 16 hours after application. After this curing, the bond coat shall be left to dry for 24 hours or until the surface hardness is suitable for the application of the flanking coat.

(c) Where the flanking coat is to be applied within 24 hours of the application of the bond coat, moist curing required in section (a) or protection in section (b) shall be provided for 12 hours and the coat shall be allowed to dry until the surface hardness is suitable for the application of the flanking coat.

The flanking coat shall then be immediately applied.

If for any practical reason the follow-up of placing the flanking coat does not take place, then the curing regimes of 2.5.4.3(a) and (b) must be reintroduced and the appropriate periods of curing and delay times will apply.

Refer to 2.5.9 for the practical scratch test for determining a suitable hardness and hence strength gain.

C2.5.4.3
In method 2.5.4.3(c) continuity of curing of the bond coat is achieved by the application of the flanking coat which effectively prevents moisture loss from the bond coat.

Note that method 2.5.4.3(c) is not applicable to scratch coats used on stucco construction.

2.5.5 *Scratch coat*

2.5.5.1
A scratch coat as a base coat shall be the base coat for stucco systems or on solid substrates of brickwork or similar absorbent surfaces. The plaster shall be applied to the substrate to the required thickness by trowel application or mechanical means, with sufficient pressure to ensure continuous contact with the solid substrate or stucco background. The finished surface of the scratch coat shall be scratched with a suitable tool to leave grooves approximately 5 mm deep spaced at 15 mm to 20 mm intervals.

C2.5.5.1
The grooves are required to provide key for the flanking coat and also promote closely spaced cracks due to the plaster shrinking during the drying period.

Note also that there are different scratch coat thicknesses for solid substrates and stucco construction.

2.5.5.2 *Curing of scratch coat*
The scratch coat shall be cured in accordance with the following:

(a) On solid substrates the procedures shall be the same as required for a bond coat in 2.5.4.3.

(b) On stucco construction moist curing shall be provided for 48 hours and then left to dry 24 hours or until the surface hardness is suitable for the application of the flanking coat.

Refer to 2.5.9 for the practical scratch test for determining a suitable hardness and hence strength gain.

2.5.6 *Flanking / Render coat*

2.5.6.1
A flanking coat shall be applied to:

(a) A solid substrate that has received either a bond (including dubbing-out coat where required) or scratch coat, and

(b) Scratch coats on rigid and non-rigid backings.

2.5.6.2
Before the application of the flanking coat the surfaces of the bond or the scratch coat shall be thoroughly brushed to remove all loose material and shall be dampened with water to promote good adhesion. There shall be no free-water on the surface at the time of application of the flanking coat.

2.5.6.3
The plaster shall be applied to the substrate 2 mm or 3 mm greater than the required thickness by trowel application or mechanical means, with sufficient pressure to ensure continuous contact with the substrate.

2.5.6.4
The excess plaster shall be struck off with a suitable screed or rule to within ±3 mm over 1800 mm of the required line and level. Ridges in the plasters surface shall be floated out and any hollows filled in with more plaster and then struck off or ruled out flush with the surrounding plaster.

2.5.6.5
The surface of the flanking coat shall be finished to provide a flat compacted surface with an open grained finish such as that achieved with a wooden float.

C2.5.6
Excessive floating should be avoided as floating tends to bring the cement and fine sand to the surface.

2.5.6.6 *Curing of flanking coat*

2.5.6.6.1
The flanking coat shall be moist-cured for a minimum of 48 hours and then allowed to dry slowly for at least a further 72 hours.

2.5.6.6.2
If a bonding agent has been used in the plaster mix, moist-curing shall be dispensed with and the coat shall be protected from direct sun and drying winds for at least 16 hours after application. After curing this coat shall be allowed to dry for at least a further 72 hours. (See Appendix C).

2.5.7 *Finishing coats*

2.5.7.1
A finishing coat shall be applied only to a flanking coat which has been prepared in accordance with 2.5.6 of this Standard. The finishing coats shall be smooth trowelled or medium or heavily textured as described in 2.5.7.3, 2.5.7.4 and 2.5.7.5.

2.5.7.2
For a 2 coat system as described in 3.4 and table 4, a flanking coat shall be applied directly to a scratch coat to form the final coat.

C2.5.7.2
In the 2 coat system, the flanking coat contains sand particles that are larger than those used in standard finish coats. Hence smooth compact surface finishes are not possible with this system. Flanking coat sand should not be changed to a finer particle grading nor additional cement used.

2.5.7.3 *Smooth trowelled finishing coats*
Smooth trowelled finishing coats shall be 2 mm to 3 mm thick.

C2.5.7.3
Examples of finishes in this category are smooth trowelled (dado) and sponge. (See Appendix A).

2.5.7.4 *Medium textured finishing coats*
Medium textured finish coats shall not be greater than 6 mm thick.

C2.5.7.4
Examples of finishes in this category are tyrolean, textured and scraped or combed finish. (See Appendix A).

2.5.7.5 *Heavily textured finishing coats*
Heavily textured finishing coats shall not be greater than 14 mm thick.

C2.5.7.5
Examples of finishes in this category are hand-thrown rough cast and dry-dash. (See Appendix A). A typical pebble dash finish may have a 6 mm coat plus a stone protrusion of 8 mm to give a total finish thickness of 14 mm.

2.5.7.6 *Curing of finish coats*

2.5.7.6.1
The finish coat shall be kept continuously moist for at least 72 hours after application and shall then be allowed to dry.

2.5.7.6.2
If hot or windy conditions prevail during the next 72 hours of drying, the surface shall be occasionally dampened by spraying with water.

2.5.7.6.3
Where a bonding agent has been used in the plaster mix, moist curing as above shall be dispensed with but the surface shall be protected from direct sun and drying wind for at least 16 hours after application and shall then be allowed to dry. (See Appendix C).

C2.5.7.6
Curing of the finish coat is necessary to prevent plastic cracking due to rapid water loss caused by the usually thin (2 mm to 3 mm) coat. Correct curing also aids the development of strength where a hard abrasion resistant surface is required.

In order to prevent shrinkage crazing, it is essential that the finish coat is dried slowly.

2.5.8 *Protection of the finished work*
All finished work shall be protected from mechanical damage or disfigurement immediately after application of the finish coat.

C2.5.8
A degree of protection against marring, staining and efflorescence of finished cement plaster may be obtained by using clear acrylic sealers. These are particularly useful for application to white, pigmented or exposed aggregate plaster finishes.

2.5.9 *Surface hardness or scratch test*
Using a metal coin or nail, scratch the surface of the plaster coat. If the plaster surface powders or crumbles, then the plaster has not reached a suitable strength, prior to proceeding with subsequent plaster coats or surface coatings.

2.6 Surface coatings

2.6.1
Stucco shall be waterproofed by the application of a surface coating.

2.6.2
An alkali resistant water based dispersion coating system having a dry film thickness of between 80 μm and 150 μm (micro metres) is deemed to comply with this requirement.

2.6.3
This shall be achieved with 2 or 3 coats, depending on the product used and the texture of the plaster surface.

2.6.4
The surface coating shall not be applied until:

(a) The surface complies with 2.5.9; and

(b) The painting contractor has determined that the moisture content is at a level suitable for paint application.

C2.6
Uncoated cement plaster systems cannot be assumed to be completely waterproof as the drying process is likely to produce voids and fine shrinkage cracks which, although often not readily visible, permit the entry of water in driving rain conditions. Integral waterproof proprietary admixtures used in flanking and finish coats will assist in reducing water penetration.

Moisture should be controlled firstly by trying to eliminate its entry and secondly by allowing it to dissipate without causing damage to building elements. Plaster which has been proportioned, mixed, applied and cured in accordance with this Standard will provide a high level of resistance to water penetration but, for stucco systems, it is essential to provide a coating.

An acrylic system is called up as the coating needs to prevent the entry of liquid water yet allow the ready transmission of water vapour.

Light coloured finishes are preferable to dark ones as dark colours absorb more heat and increase the likelihood of cracking with changes in temperature.

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High build coatings can be an effective surface finish on plaster and stucco. However, because they generally have lower water vapour permeability than standard acrylic paints, they can retard drying of water which has entered the plaster through leaks and/or cracks. High build systems generally have better crack bridging ability but should not be regarded as a cure for poorly mixed, cured or detailed plaster. Details on the suitability of high build coatings for specific uses can be obtained from specific manufacturers.

A plaster system may require 14 days of drying after the conclusion of curing before the plaster is likely to meet the provisions of 2.6.4(b). Clearly, if there are periods of wet weather, then the time to reach a satisfactory moisture level will be extended, delaying the paint application.

2.7 Maintenance

The completed plaster system shall be regularly maintained to ensure continued resistance to water entry. Maintenance shall include the removal of dirt, mould and other organic deposits, the repair of cracks or other defects, and repainting as necessary to preserve the waterproof finish.

C2.7

Organic deposits, if not removed, can release organic acids which attack cement plaster.

Where a clear coating system is used, as over an oxide coloured plaster (see C2.2.3.5.1) the durability is likely to be less than for a coloured coating system and repainting will need to be performed more frequently.

Cracks in the plaster, which have ceased to move, can be repaired by raking out the crack, removing any loose material and applying fresh plaster. Cracks which are subject to movement (sometimes on a seasonal basis) may be filled with an elastomeric sealant. In such cases it is essential to follow the advice of the sealant manufacturer regarding selection and application of the product.

Very fine cracks can be repaired by applying a very high build paint (coating thickness greater than 300 μm thick) over the crack.

All repair work must be cleaned and coated with a paint system complying with 2.6.

3 SOLID SUBSTRATES

3.1 Scope

3.1.1

This section is applicable to solid substrates and covers surface preparation, assessment of porosity and surface dampening, plaster systems and plaster thickness.

3.1.2

The structural design and construction of all solid substrates including expanded polystyrene block walls are outside the scope of this Standard. These shall comply with all relevant requirements of the New Zealand Building Code including Clauses B1, B2, E2 and E3 and the New Zealand Standards NZS 4210 and NZS 3109.

3.2 Surface preparation

3.2.1 *General*

Good bond between the plaster and the background must be achieved over the total surface area. Surfaces shall be prepared thoroughly as described in 3.2.2.

3.2.2 *Preparation of solid substrate*
The following requirements apply:

(a) All projections and fins that exceed 4 mm in projection or are of a soft friable nature, shall be hacked off.

(b) All other loosely attached material including possible surface contaminants shall be removed.

C(b)
Typical surface contaminants which could interfere with bond are for example paints, oils, greases, adhesives, form release agents, residues of curing compounds, lichen and moss, laitance and lime efflorescence. Various cleaning materials may be used to remove some of these materials, but care must be taken to ensure that no corrosive or bond-inhibiting residues are left on the surface.

(c) The surface shall be inspected for possible material that may subsequently detach from the substrate and such material shall be removed.

C(c)
Typical examples of this could be previously plastered surfaces.

(d) The surface shall be roughened to provide an adequate mechanical key. If the plaster system to be applied is less than 15 mm thick the surface shall be roughened to "coarse sandpaper" texture i.e. 1.0 mm amplitude (the height difference between peaks and troughs). For plaster systems 15 mm or more thick the surface shall be roughened to an amplitude of 3 mm.

C(d)
Surface roughening can be achieved by using surface retarders on formwork during casting or by hand or mechanical scabling, grit blasting or high pressure water jetting.

(e) Where the substrate consists of old brickwork, rake out all of the soft joints to a depth of not less than 10 mm.

(f) Final cleaning shall remove all dust and other debris.

C(f)
This operation is critically important since residual layers of loose material will interfere with the plaster bond and substantially negate the effectiveness of surface roughening. Air jetting and wet hosing are the preferred cleaning methods. Brushing is inadequate unless performed with extreme thoroughness.

3.3 Assessment of porosity and surface dampening

3.3.1 *Scope*
This clause describes how to determine if a substrate is porous or non-porous and gives the requirement of surface dampening.

3.3.2 *Porosity*

3.3.2.1
Solid substrates are defined as non-porous and porous and shall be assessed by determining the ability of the prepared surface to repel or absorb water.

3.3.2.2
The degree of absorption shall be assessed by applying water by brush or a cup to the solid substrate and observing what happens.

3.3.2.3
The surface shall be defined into 2 categories:

(a) If little or no water is absorbed, it is defined as a non-porous surface;

(b) All other surfaces are defined as porous.

Category (a) surfaces shall be pre-wetted by brushing or fog spraying with water and then allow the wet shine to go off before applying a bond coat.

Category (b) surfaces shall be wetted thoroughly and then allowed to become just surface dry before plastering starts.

C3.3.2
The degree of porosity will vary for different surfaces.

On very porous substrates such as lightweight concrete blocks, the partial sealing of the surface to control the aggressive suction can be achieved using a one part of water to one part of bonding agent mix plus cement, applied to the surface and allowed to dry before application of the first plaster coat. Another alternative is to apply a bond coat that includes a bonding agent in proportions recommended by the bonding agent manufacturer.

3.3.3 *Surface dampening*
The background surface shall be dampened and allowed to dry back to a surface-dry condition.

C3.3.3
The purpose of dampening the substrate for cement plaster is to reduce excessive suction and to provide a reservoir of moisture for curing the plaster. Satisfactory dampening is best achieved by overnight soaking, but for low-porosity surfaces a water spray shortly before plastering is acceptable. However, the surface must return to a surface-dry condition before plastering, as complete absence of suction or the presence of free water on the surface will significantly impair the achievement of bond.

3.4 Plaster systems for solid substrates

The plaster system applied to all solid substrates shall consist of 2 or more separate coats as detailed below:

(a) Non-porous	3 coat system:	1 - Bond 2 - Flanking 3 - Finishing
(b) Porous dependent on finish required: Textured finish only	2 coat system:	1 - Scratch 2 - Finishing
Any other finish (Smooth trowelled or dado)	3 coat system:	1 - Scratch 2 - Flanking 3 - Finishing

C3.4
In addition to the above layers it may be necessary to use dubbing out coats to provide a level plane for plasterwork.

Two coat systems do not provide the opportunity to create surface profile tolerances that are visually acceptable in finishes other than those that are of a textured or profiled type.

3.5 Plaster thickness

3.5.1 *Scope*
This clause gives acceptable thickness of plaster coats for porous and non-porous solid substrates.

3.5.2 *Thickness of plaster*
Plaster thickness shall be measured from the face of the solid substrate. The thickness of individual plaster coats shall be as given in table 4.

Table 4 – Thickness of plaster coats for solid substrates

Non-porous substrate	**Bond coat**	**Flanking coat**	**Finish coat** [See note (2)]	**Total thickness**
Concrete – walls: ceilings:	3 to 4 mm 3 to 4 mm	9 to 15 mm 3 to 7 mm	2 to 3 mm 2 to 3 mm	14 to 22 mm 8 to 14 mm
Porous substrate	**Scratch coat**	**Flanking coat**	**Finish coat** [See note (2)]	**Total thickness**
Bricks Concrete blocks Lightweight concrete Lightweight concrete blocks	3 to 4 mm	9 to 15 mm	2 to 3 mm	14 to 22 mm

	Scratch coat	**Textured finish coat**	**Total thickness**
Porous substrate (2 coat textured finish)	5 to 8 mm	10 to 14 mm	15 to 22 mm

NOTE –

(1) Bond coat shall be used for non-porous concrete wall or ceilings and Scratch or Bond coat can be used for porous substrates.

(2) Refer to 2.5.7.4 and 2.5.7.5 for medium and heavily textured finishes and appropriate thicknesses.

(3) Where dubbing-out is necessary to provide a level plane for plasterwork, it shall be executed at least 48 hours prior to the application of bond coats. If the thickness needed is greater than 15 mm it shall be built up in 2 or more coats, each not more than 15 mm thick. The mix for dubbing-out shall not be weaker than the flanking coat.

(4) Flanking coat is also known as Render coat (see definitions in 1.5).

C3.5.2
Smooth trowelled finishes are not recommended because of the potential to highlight fine cracks and minor surface irregularities. (See Appendix A).

3.6 Expanded polystyrene block

3.6.1 *Scope*
This clause gives the requirement for plastering substrates of expanded polystyrene blocks.

C3.6.1
Expanded polystyrene (E.P.S.) represents a special case of solid substrate in that unlike the other solid substrates it requires mechanical fixing and reinforcement.

3.6.2 *Polystyrene blocks*

3.6.2.1
All polystyrene blocks shall be injection moulded from polystyrene beads complying with AS 1366.3 so as to produce accurate dimensionally stable blocks.

3.6.2.2
The maximum thickness of block faces for blocks used for solid plastering shall not exceed 50 mm.

3.6.3 *Plaster systems and method of support*
The following requirements apply:

(a) Where the substrate is expanded polystyrene block the plaster system shall be as described in table 4 for a non-porous substrate.

(b) Provision shall be made to support the plaster systems by mechanical fixings to the concrete core of the block as follows:

(i) Hot dipped galvanized flat head nails 100 mm long x 4 mm diameter with plastic spacers shall be prefixed through the polystyrene block projecting 10 mm from the face of the block before placing the concrete infill.

(ii) The fixings shall be spaced at 250 mm – 300 mm centres each way.

(iii) The fixings shall be within 150 mm of any openings or wall perimeter.

(iv) Metal reinforcement as described in 4.3 shall be attached to polystyrene blocks by tying it with hot-dipped galvanized wire clips to the nails at 250 mm – 300 mm centres each way.

C3.6.3
Modified plaster coatings of a finished thickness of approximately 6 mm are not required to have mechanical fixings or metal reinforcement, but such systems may incorporate non-metallic reinforcement meshes.

Modified plaster coatings are outside the scope of this Standard.

Building paper is not required on polystyrene blocks.

4 STUCCO ON RIGID BACKING

4.1 Scope and general considerations

4.1.1 *Scope*
This clause covers stucco on rigid backings fixed to light framed construction of timber or steel. It deals with materials and fixing, metal reinforcement, plaster systems and plaster thicknesses applicable to rigid backing.

4.1.2 *General considerations*

4.1.2.1
The scratch coat for stucco on rigid backing shall be reinforced with galvanized wire mesh or expanded metal conforming to 4.3.

4.1.2.2
The timber framing supporting the rigid backing shall comply with the provisions of NZS 3604.

4.1.2.3
Where steel framed buildings are to be clad with plaster, the building must come within the scope of clause 1.1.3 of NZS 3604, with steel framing substituted for timber framing. Steel wall framing shall be the subject of specific design in accordance with NZS 4203 and AS/NZS 4600. Steel framed wall deflections shall not exceed the suggested serviceability limits for brittle claddings of NZS 4203, table C2.4.1. The maximum stud and dwang spacing shall be as for timber framing.

4.2 Materials and fixing

4.2.1 *Backing materials and fixing to timber framing*

4.2.1.1 *General*

4.2.1.1.1
Rigid backings shall comprise the following materials:

(a) Plywood;

(b) Fibre cement sheet;

(c) Polystyrene sheet.

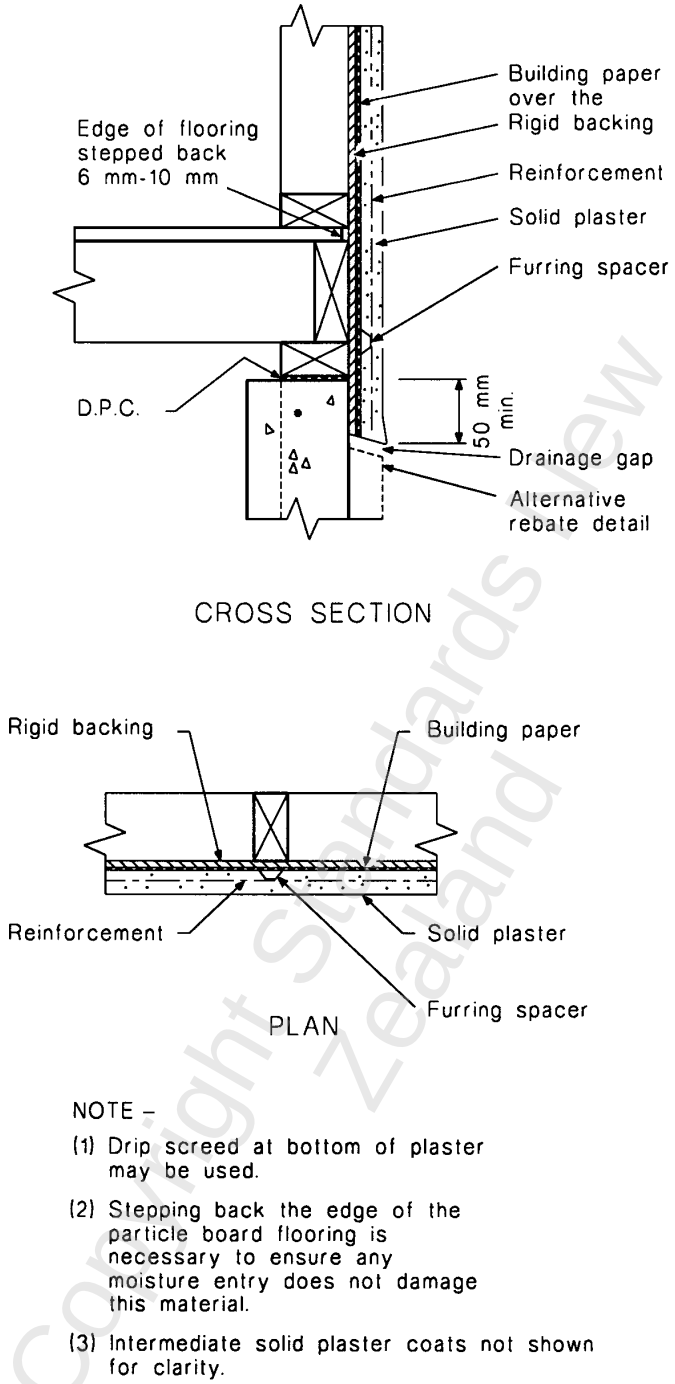
complying with the following clauses.

4.2.1.1.2
Rigid backings shall be overlaid with building paper to provide a slip layer which permits the independent movement of plaster and backing (see figure 3).

4.2.1.1.3
Sheets that become distorted and are more than 5 mm out of plane at the time of plastering as a result of excessive exposure to the weather shall be replaced.

C4.2.1.1
The rigid backings specified in this clause ensure that the backing deflection is limited to a maximum of 5 mm when the plaster is applied. Further they are resistant to deterioration when in contact with moisture and will be durable for not less than 15 years therefore meeting the New Zealand Building Code's durability requirement B2.4.1(b).

Cement plaster systems cannot be assumed to be completely weatherproof and it is necessary to ensure that any moisture entry does not penetrate to the structural framing.



NOTE –

(1) Drip screed at bottom of plaster may be used.

(2) Stepping back the edge of the particle board flooring is necessary to ensure any moisture entry does not damage this material.

(3) Intermediate solid plaster coats not shown for clarity.

Figure 3 – Rigid backing detail

4.2.1.2 *Plywood backings*

4.2.1.2.1 *Specification and thickness*

Plywood backings shall comply with AS/NZS 2269 and be treated to H3 Group B of NZMP 3640. The sheet thickness shall comply with table 5.

C4.2.1.2.1

Vertically fixed sheets need to be thicker as sheet stiffness is lower where the face veneers are parallel to the studs.

Table 5 – Plywood sheet thickness

Plywood sheet thickness (mm)					
Sheets vertical			Sheets horizontal		
Stud spacing (mm)			Stud spacing (mm)		
400	480	600	400	480	600
12	12	15	9	9	12

4.2.1.2.2 *Fixing to timber framing*
Joints between sheets shall have gaps of 3 mm.

All edges of sheets shall be supported and fixings shall be 10 mm from sheet edges.

Sheets shall be nailed at 150 mm centres around the perimeter and at 300 mm centres within the body of the sheet.

Nails shall be hot dipped galvanized, 2.5 mm diameter and have a length of 3 times the sheet thickness but not less than 30 mm.

C4.2.1.2.2
Usually 3.15 mm diameter nails are used to maintain gaps between sheets.

Where the sheet joints are not supported by studs then dwangs or nogs of sufficient width need to be added to allow adequate fixing.

4.2.1.3 *Fibre cement sheet backings*

4.2.1.3.1 *Specification and thickness*
Fibre cement sheet shall comply with NZS/AS 2908.2. It shall have a thickness of no less than 4.5 mm and span no more than 400 mm between stud centres.

C4.2.1.3.1
See Appendix D for information on alternatives.

4.2.1.3.2 *Fixing to timber framing*
Joints between sheets shall have a minimum gap of 3 mm.

All edges of sheets shall be supported and fixings shall be 10 mm from sheet edges.

Sheets shall be nailed at 200 mm centres around the perimeter and at all intermediate framing.

Dwangs shall be provided at a maximum space of 800 mm.

Nails shall be hot dipped galvanized, 2.5 mm diameter and 40 mm in length. Nailing shall be started 50 mm from the corners of sheets.

C4.2.1.3.2
Usually 3.15 mm diameter nails are used to maintain gaps between sheets.

Where the sheet joints are not supported by studs then dwangs or nogs of sufficient width need to be added to allow adequate fixing.

4.2.1.4 *Polystyrene sheet*

4.2.1.4.1 *Specification and thickness*
Expanded or extruded polystyrene sheet manufactured to AS 1366, shall be no less than 20 mm thick when spanning up to 400 mm.

At floor level the bottom edge of the polystyrene shall be supported by a bead, stop or by a rebated concrete foundation or floor slab.

C4.2.1.4.1
30 mm thick polystyrene sheet has been used to span 600 mm. See Appendix D for information on alternatives.

4.2.1.4.2 *Fixing to timber frame*
Sheets shall be nailed at 250 mm centres, ensuring a minimum 35 mm penetration into the frame, around the perimeter and within the body of the sheet where it crosses studs or dwangs.

All edges of sheets shall be supported and fixings shall be 15 mm from sheet edge and between 50 and 75 mm from sheet corners.

Nails shall be hot-dip galvanized, 3.15 mm diameter and 75 mm in length used with 22 mm diameter plastic washers.

C4.2.1.4.2
Because of the thickness of the polystyrene and the plaster a considerable weight of the cladding is supported by cantilever action on the fixings. It is necessary to distribute this load and ensure the fixings are firmly attached to the framing.

Where the sheet joints are not supported by studs then dwangs or nogs of sufficient width need to be added to allow adequate fixing.

4.2.2 *Fixing rigid backing to steel framing*

4.2.2.1
Rigid backings shall be fixed to steel framing in the manner described for timber framing in 4.2.1.2.2 to 4.2.1.4.2 but nails shall be substituted with screws which penetrate no less than 10 mm through the steel studs and are located at the same spacings as specified for nails in timber framing.

4.2.2.2
Screws shall be self-embedding complying with AS 3566. Screws shall be no less than No. 8 (approximately 3 mm diameter excluding the raised thread) and be hot-dipped galvanized or made from type 304 or 316 stainless steel.

C4.2.2
See Appendix D for information on alternatives.

4.2.3 *Building paper*

4.2.3.1
All the exterior surfaces to receive metal reinforcement shall have breather-type building paper fixed over the rigid backing.

4.2.3.2
The building paper shall be free from holes or breaks and comply with NZS 2295. The rolls of building paper shall be run horizontally and lapped not less than 75 mm at joints with the direction of the lap ensuring that water is shed to the outside of the paper with the upper sheet lapped over the lower sheet.

4.3 Metal reinforcement and flashings

4.3.1 *Scope*
This section covers metal reinforcement fixed to the outer face of rigid backing and its installation, accessories and flashings.

4.3.2 *General*
Metal reinforcement shall be used over rigid backing on timber stud or metal stud construction.

C4.3.2
Reinforcement is used to resist shrinkage stresses, to hold the plaster together and to fix to the framing. For the reinforcement to perform these functions it is essential that it is spaced out from the backing and embedded in the plaster.

4.3.3 *Types of reinforcement*
Metal reinforcement for exterior plastering shall be either:

(a) Wire mesh with a mesh size of 15 mm to 50 mm, a minimum wire diameter after galvanizing of 0.9 mm and is hot dipped galvanized in accordance with AS 1650, or

(b) Expanded metal reinforcing manufactured from steel sheet no less than 0.45 mm thick and having not less than 275 g/m^2 (137.5 g/m^2 on each side) of hot dipped galvanizing before cutting and deforming.

C4.3.3
Galvanizing at 275 g/m^2 is adequate to meet a durability of 15 years and even longer depending on the quality of the plaster, location and standard of maintenance. However, it is strongly recommended that 400 g/m^2 be used to meet a greater durability normally expected by building owners.

4.3.4 *Spacing or furring of reinforcement*

4.3.4.1
Metal reinforcement shall be stretched taut and spaced (furred) out from the backing or building paper not less than 6 mm nor more than 9 mm.

4.3.4.2
Spacers for furring the reinforcement shall comprise 50 mm to 60 mm squares of fibre cement sheet or H3 treated plywood. Alternative spacers such as purpose made plastic or galvanized steel spacers are acceptable subject to the approval of the territorial authority.

4.3.4.3
Self-furring reinforcement that meets the requirements of 4.3.3 may be used.

C4.3.4
If the reinforcement is not spaced out from the backing it cannot be embedded in the plaster and hence it becomes ineffective. Further the spacing ensures that the reinforcing is covered to a depth that allows scratching of the bond coat.

Self-furring reinforcement systems with ribs are suitable for use over rigid backings.

Materials for use as spacers for reinforcement mesh need to be compatible with wet plaster, larger than the mesh size, durable and unaffected by moisture.

4.3.5 *Fixing of reinforcement*

4.3.5.1
The reinforcement shall be fixed with hot-dipped galvanized nails or type 304 or 316 stainless steel staples at no more than 150 mm spacing on all vertical and horizontal supports. Laps shall be either lashed with galvanized tie wire not less than 1.2 mm diameter or connected by galvanized clips spaced at not more than 150 mm centres.

4.3.5.2
Where mesh or lath is provided with a predominant feature or strength in one direction, this direction shall be laid across the primary supports.

4.3.5.3
The minimum depth of penetration of nails or staples in timber framing shall not be less than 30 mm.

4.3.5.4
For fixing into steel framing nails shall be replaced with hot-dipped galvanized or type 304 or 316 stainless steel screws which penetrate no less than 10 mm through the steel.

C4.3.5
Pneumatic/air gun stapling equipment should use type 304 or 316 stainless steel staples and not uncoated steel staples. See Appendix D for information on alternatives.

4.3.6 *Continuity of reinforcement*
The following requirements apply:

(a) Continuity of reinforcement shall be maintained by lapping the galvanized wire mesh or expanded metal reinforcement by 100 mm at sides and 150 mm at the ends. Laps at ends of sheets shall be staggered.

(b) Continuity of reinforcement at angles (corners) shall be maintained either by wrapping furred out wire mesh around the angle or by the use of casing bead that must be lapped in accordance with (a) above with adjoining reinforcement.

C4.3.6
See Appendix D for information on alternatives.

4.3.7 *Openings*

4.3.7.1
Where galvanized wire mesh or expanded metal is used as reinforcement over rigid backings on timber or metal framing, the corners of openings which exceed 0.2 m^2 in area shall be provided with additional reinforcing strips of mesh or expanded metal of at least 450 mm x 300 mm fixed diagonally (longer dimension at an angle of 45º) across the corners.

4.3.7.2
Where control joints occur at the sides of an opening, diagonal reinforcing strips across the corners shall be omitted to ensure that there is a complete break in the reinforcing at the control joints.

4.3.8 *Accessories*

4.3.8.1
All plaster accessories such as angle beads, screed beads and plaster stops shall be rigidly attached to the supporting frames and shall be true to line and level.

4.3.8.2
These accessories shall be compatible with and satisfy the durability requirements of the stucco system as a whole.

C4.3.8
Accessories may be attached by galvanized wire tying, nailing or stapling through expanded wings or through holes provided in the accessory.

The use of angle beads produced from ferrous materials is not recommended as surface treatments utilized in the protection of ferrous material are easily damaged during plastering.

4.3.9 *Flashings*

4.3.9.1
Flashings shall meet the requirements of 2.1.4.

4.3.9.2
All flashings must be in place before fixing the metal reinforcement which shall extend over that part of the flashing covered by the plaster.

4.4 Plaster systems for stucco on rigid backings

4.4.1 *Scope*
This clause applies only to stucco on rigid backings.

4.4.2 *Plastering systems*
The plaster system applied to metal reinforcing over a rigid backing shall be a 3-coat work comprising the following:

1 – Scratch coat
2 – Flanking coat and
3 – Finishing coat.

Methods of application and curing of these coats are covered in section 2.

4.5 Plaster thickness for stucco on rigid backings

4.5.1 *Scope*
This clause gives acceptable thickness of plaster coats for stucco on rigid backings.

4.5.2 *Thickness of plaster*
Plaster thickness shall be measured from the face of the backing at a stud position. The thickness of the individual plaster coats for stucco on rigid backings shall be as given in table 6.

C4.5.2
Smooth trowelled finishes are not recommended because of the potential to highlight fine cracks and minor surface irregularities (see Appendix A).

Table 6 – Thickness of plaster coats for rigid backing

Scratch coat	Flanking coat	Finish coat	Minimum thickness	Maximum thickness
9 to 12 mm	6 to 9 mm	2 to 3 mm Smooth [See note (1) below]	21 mm [See note (1) below]	26 mm

NOTE –

(1) Medium and heavily textured surfaces may exceed 2 mm to 3 mm total thickness for a finished plaster coat to achieve the desired finish specified for the size of the aggregate used. See 2.5.7.4 and 2.5.7.5 for appropriate thicknesses.

(2) Flanking coat is also known as Render coat (see definitions in 1.5).

5 STUCCO ON NON-RIGID BACKING

5.1 Scope and general considerations

5.1.1 *Scope*
This section covers specific information related to non-rigid backing where plaster is applied on a background of galvanized mesh or lath over a non-rigid (building paper) backing fixed to battens over a wind barrier over light framed construction of timber or steel. It deals with materials and fixing, metal reinforcement, plaster systems and plaster thicknesses applicable to non-rigid backing.

5.1.2 *General considerations*

5.1.2.1
The timber framing supporting the non-rigid backing shall comply with the provisions of NZS 3604. Walls, however, shall be limited to 2.4 m high for 100 x 50 mm studs spaced at 400 mm centres with 3 rows of dwangs evenly spaced, with top dwang just below eaves level.

5.1.2.2
Stud spacing may be increased to 600 mm where self furring hot dipped galvanized expanded metal with stiffening ribs is used, provided it can be demonstrated to the approval of the territorial authority that its deflection, under normal plaster application, would be no more than 10 mm.

5.1.2.3
Where steel framed buildings are to be clad with plaster, the building must come within the scope of clause 1.1.3 of NZS 3604, with steel framing substituted for timber framing. Steel wall framing shall be the subject of specific design in accordance with NZS 4203 and AS/NZS 4600. Steel framed wall deflections shall not exceed the suggested serviceability limits for brittle claddings of NZS 4203, table C2.4.1. The maximum stud and dwang spacing shall be as for timber framing.

C5.1.2
The 2.4 metre high timber stud restriction may be waived for specific designed timber stud walls which are outside of the scope of this Standard.

5.2 Materials and fixing

5.2.1 *General*

5.2.1.1
A drained cavity shall be provided between the wind barrier (also called cladding underlay or sheathing) on the face of the stud and the non-rigid (building paper) backing to the plaster.

5.2.1.2
Non-rigid backings shall be fixed to the framing in a manner which limits the backing deflection to a maximum of 10 mm when the plaster is applied.

5.2.1.3
The non-rigid backings described in this section are resistant to deterioration when in contact with moisture and will meet the durability requirements of New Zealand Building Code clause B2.3.1(b) for not less than 15 years.

C5.2.1
Stucco systems cannot be assumed to be completely weatherproof and it is necessary to ensure that any moisture entry does not penetrate to the structural framing.

5.2.2 *Wind barrier (Cladding underlay or sheathing)*
Wind barriers (also called cladding underlay or sheathing) shall be fixed to the exterior face of stud framing and shall:

(a) Be heavy weight breather type building paper complying with NZS 2295 for water absorpency and resistance to water penetration, and having a bursting strength of no less than 500 kN/m^2 when tested to BS 3137.

(b) Be run horizontally;

(c) Be lapped not less than 75 mm at joints with the upper sheet lapped over the lower sheet;

(d) Be secured to plates, bearers, and studs;

(e) Extend from the upper side of the top plate to the underside of the bearers or wall plates supporting the ground floor joists;

(f) Be repaired or replaced if punctured or torn, immediately before exterior coverings are fixed.

5.2.3 *Backing materials and fixing*

5.2.3.1
Non-rigid backing shall be heavy weight breather-type building paper complying with 5.2.2(a).

5.2.3.2 *Fixing of non-rigid backing to stud framing*
Non-rigid backings shall be installed in the following manner:

(a) Fix 20 mm thick, H3 of NZMP 3640 treated vertical battens, through the wind barrier, to the studs with 60 x 2.8 mm hot dipped galvanized flat-head nails at maximum 300 mm centres.

(b) Horizontal battens are required at heads and sills of openings and at eaves level. Where horizontal battens are used on dwangs they shall be slightly (about 5 mm) out of horizontal and 50 mm short of vertical battens to prevent water being trapped by the battens (see figure 4).

(c) The non-rigid backing shall be provided with support to keep it taut to limit its deflection no more than 5 mm. This shall be achieved by the use of 75 mm galvanized wire mesh, or by plastic tape or wire at 150 mm centres run over the battens.

(d) Fix the non-rigid backing (building paper) over the outside of the battens on top of a support system in (c) before fixing the reinforcement.

(e) Building paper for the wind barrier and non-rigid backing shall be fixed with sufficient staples to maintain their position until the battens or reinforcement respectively are fixed.

5.2.3.3 *Fixing of non-rigid backing to steel stud framing*

5.2.3.3.1
Non-rigid backings shall be fixed to steel stud framing in the manner described in 5.2.3.2 but flat head nails shall be substituted with screws which penetrate no less than 10 mm through the steel studs and are located at maximum 300 mm centres.

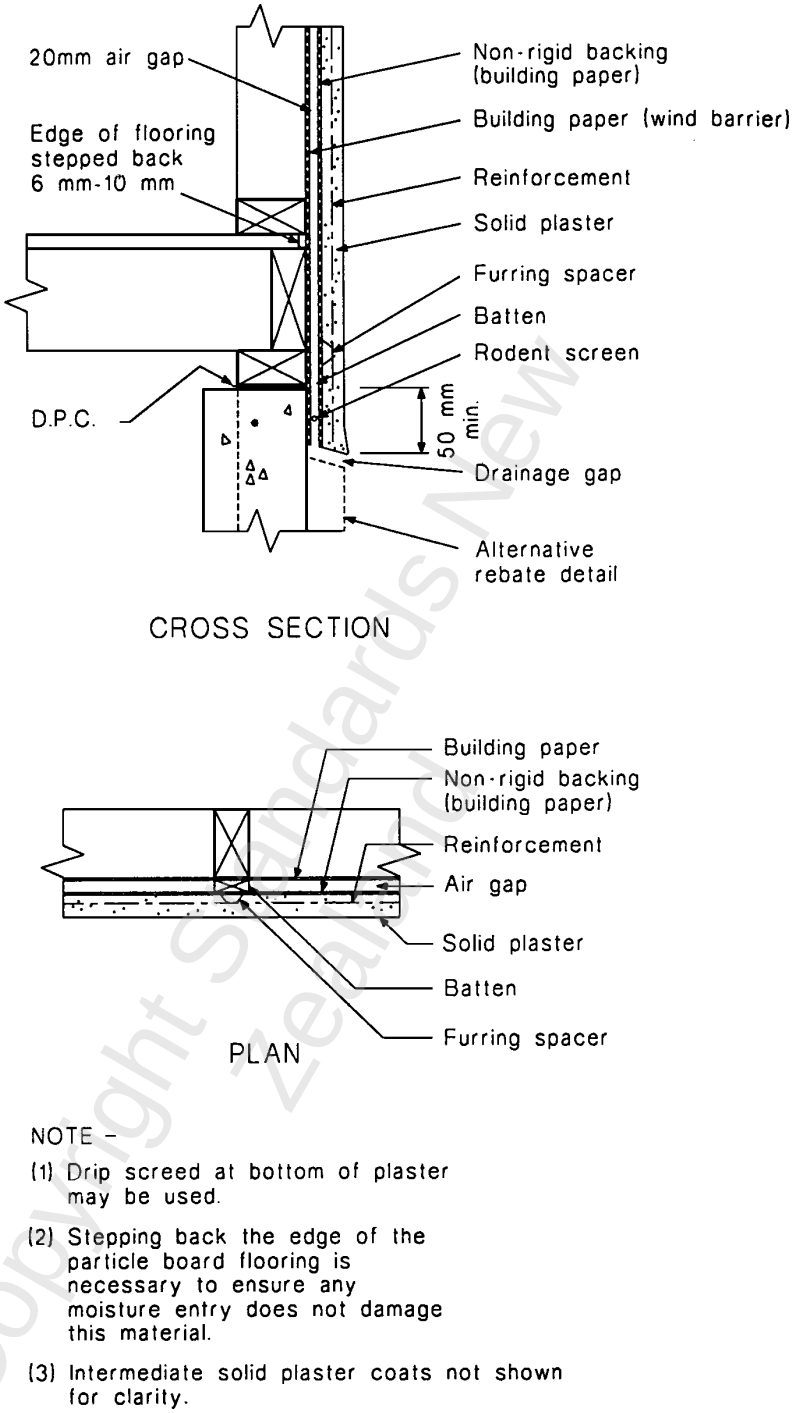
5.2.3.3.2
Screws shall be self-embedding complying with AS 3566. Screws shall be no less than No. 8 (approximately 3 mm diameter excluding the raised thread) and be hot-dipped galvanized or made from type 304 or 316 stainless steel.

C5.2.3.3
See Appendix D for information on alternatives.

5.2.4 *Cavity drainage*
Where non-rigid backing is used the cavity between the backing and the wind barrier shall be ventilated to the outside air with bottom openings which shall serve to drain moisture to the outside (see figure 4). Vermin proof the bottom of the cavity.

5.3 Metal reinforcement and flashings

5.3.1 *Scope*
This clause covers metal reinforcement fixed to the outer face of non-rigid backing and its installation, accessories and flashings.



NOTE –

(1) Drip screed at bottom of plaster may be used.

(2) Stepping back the edge of the particle board flooring is necessary to ensure any moisture entry does not damage this material.

(3) Intermediate solid plaster coats not shown for clarity.

Figure 4 – Non-rigid backing detail

5.3.2 *General*

Metal reinforcement shall be used over non-rigid backing for stucco on timber stud or metal stud construction.

C5.3.2

Reinforcement is used to resist shrinkage stresses, to hold the plaster together and to fix to the framing. For the reinforcement to perform these functions it is essential that it is spaced out from the backing and embedded in the plaster.

5.3.3 *Types of reinforcement*

Metal reinforcement for exterior plastering shall be either:

(a) Wire mesh with a mesh size of 15 mm to 50 mm, a minimum wire diameter after galvanizing of 0.9 mm and is hot dipped galvanized in accordance with AS 1650; or

(b) Expanded metal reinforcing manufactured from steel sheet no less than 0.45 mm thick and having not less than 275 g/m^2 (137.5 g/m^2 on each side) of hot dipped galvanizing before cutting and deforming.

C5.3.3

Galvanizing at 275 g/m^2 is adequate to meet a durability of 15 years and even longer depending on the quality of the plaster, location and standard of maintenance. However, it is strongly recommended that 400 g/m^2 be used to meet a greater durability normally expected by building owners.

5.3.4 *Spacing or furring of reinforcement*

5.3.4.1

Metal reinforcement shall be stretched taut and spaced (furred) out from the backing or building paper not less than 6 mm nor more than 9 mm.

5.3.4.2

Spacers for furring the reinforcement shall comprise 50 mm to 60 mm squares of fibre cement sheet or H3 treated plywood. Alternative spacers such as purpose made plastic or galvanized steel spacers are acceptable subject to the approval of the territorial authority.

5.3.4.3

Self-furring reinforcement materials that meet the requirements of 5.3.3 may be used.

C5.3.4

If the reinforcement is not spaced out from the backing it cannot be embedded in the plaster and hence it becomes ineffective. Further the spacing ensures that the reinforcing is covered to a depth that allows scratching of the bond coat.

Self-furring reinforcement systems with ribs are suitable for use over non-rigid backings.

Materials for use as spacers for reinforcement mesh need to be compatible with wet plaster, larger than the mesh size, durable and unaffected by moisture.

5.3.5 *Fixing of reinforcement*

5.3.5.1

The reinforcement shall be fixed with hot-dipped galvanized nails or type 304 or 316 stainless steel staples at no more than 150 mm spacing on all vertical and horizontal supports. Laps shall be either lashed with galvanized tie wire not less than 1.2 mm diameter or connected by galvanized clips spaced at not more than 150 mm centres.

5.3.5.2

Where mesh or lath is provided with a predominant feature or strength in one direction, this direction shall be laid across the primary supports.

5.3.5.3

The minimum depth of penetration of nails or staples in timber framing shall not be less than 30 mm.

5.3.5.4
For fixing into steel framing nails shall be replaced with hot-dipped galvanized or type 304 or 316 stainless steel screws which penetrate no less than 10 mm through the steel.

C5.3.5
These fixings are important as they support the total weight of the plaster.

Pneumatic/air gun stapling equipment should use type 304 or 316 stainless steel staples and not uncoated steel staples.

See Appendix D for information on alternatives.

5.3.6 *Continuity of reinforcement*
The following requirements apply:

(a) Continuity of reinforcement shall be maintained by lapping the galvanized wire mesh or expanded metal reinforcement by 100 mm at sides and 150 mm at the ends. Laps at ends of sheets shall be staggered.

(b) Continuity of reinforcement at angles (corners) shall be maintained either by wrapping furred out wire mesh around the angle or by the use of casing bead that must be lapped in accordance with (a) above with adjoining reinforcement.

C5.3.6
See Appendix D for information on alternatives.

5.3.7 *Openings*

5.3.7.1
Where galvanized wire mesh or expanded metal is used as reinforcement over non-rigid backings on timber or metal framing, the corners of openings which exceed 0.2 m2 in area shall be provided with additional reinforcing strips of mesh or expanded metal of at least 450 mm x 300 mm fixed diagonally (longer dimension at an angle of 45º) across the corners.

5.3.7.2
Where control joints occur at the sides of an opening, diagonal reinforcing strips across the corners shall be omitted to ensure that there is a complete break in the reinforcing at the control joints.

5.3.8 *Accessories*

5.3.8.1
All plaster accessories such as angle beads, screed beads and plaster stops shall be rigidly attached to the supporting frames and shall be true to line and level.

5.3.8.2
These accessories shall be compatible with, and satisfy the durability requirements of the stucco system as a whole.

C5.3.8
Accessories may be attached by galvanized wire tying, nailing or stapling through expanded wings or through holes provided in the accessory.

The use of angle beads produced from ferrous materials is not recommended as surface treatments utilized in the protection of ferrous material are easily damaged during plastering.

5.3.9 *Flashings*

5.3.9.1
Flashings shall meet the requirements of 2.1.4.

5.3.9.2
All flashings must be in place before fixing the metal reinforcement which shall extend over that part of the flashing covered by the plaster.

5.4 Plaster systems for stucco on non-rigid backing

5.4.1 *Scope*
This clause applies only to plaster on stucco on non-rigid backings.

5.4.2 *Plastering systems*
The plaster system applied to a background of galvanized mesh or lath over a non-rigid backing shall be a 3-coat work comprising the following:

1 – Scratch coat
2 – Flanking coat and
3 – Finishing coat.

Methods of application and curing of these coats are covered in section 2.

5.5 Plaster thickness for stucco on non-rigid backing

5.5.1 *Scope*
This clause gives acceptable thickness of plaster coats for stucco on non-rigid backing.

5.5.2 *Thickness of plaster*
Plaster thickness shall be measured from the face of the backing at a stud position. The thickness of the individual plaster coats for stucco on non-rigid backings shall be as given in table 7.

Table 7 – Thickness of plaster coats for non-rigid backing

Scratch coat	Flanking coat	Finish coat	Thickness	
			Minimum	Maximum
9 to 12 mm	6 to 9 mm	2 to 3 mm Smooth [See note (1) below]	21 mm [See note (1) below]	26 mm

NOTE –

(1) Medium and heavily textured surfaces may exceed 2 mm to 3 mm total thickness for a finished plaster coat to achieve the desired finish specified for the size of the aggregate used. See clauses 2.5.7.4 and 2.5.7.5 for appropriate thicknesses.

(2) Flanking coat is also known as Render coat (see definitions in 1.5).

C5.5.2
Smooth trowelled finishes are not recommended because of the potential to highlight fine cracks and minor surface irregularities. Other examples of finishes are given in Appendix A.

APPENDIX A
TYPES OF FINISHING COAT
(Informative)

A1
The plaster finish coats are to be one of the following finishes.

A2 Smooth trowelled (dado) finish
Cement based plaster is laid on with a trowel, skimmed with a float and trowelled down. The surface is trowelled to a smooth, dense finish as the plaster stiffens. No water is applied during trowelling.

A3 Lightweight plaster finish
Lightweight plaster finish which contains exfoliated vermiculite or expanded perlite is applied with a trowel or sprayed on by pump to achieve either a fine or medium textured finish.

A4 Sponge finish
The plaster is laid on thinly with a trowel, floated up with a wood float and lightly finished with a close cellular sponge in one direction.

A5 Textured and scraped finish
The plaster is applied to a uniform thickness with a laying trowel. As soon as the coat has set, but before it has hardened excessively, the aggregate is exposed by scraping the surface with a straight-edged trowel or joint rule.

A6 Combed finish
The plaster is applied to a uniform thickness and when it has set but not excessively hard a comb is used to scratch the desired effect which may be in a shadow pattern, wavy, circular, or just a vertical effect.

A7 Hand-thrown rough cast finish
The plastic finish mix is thrown onto the surface with a scoop or trowel. No retouching is done.

A8 Machine applied (Tyrolean) finish
The plaster finish mix is machine-applied with either a hand operated “TYROL” machine or is sprayed on using a compressed air hopper gun with variable pressure to achieve either a fine or coarse finish. The “Tyrolean” effect can be pigmented to various pastel colours.

A9 Dry-dash/Pebble-dash finish
The washed, dried aggregate is thrown onto the surface while the flanking coat is still soft.

Commentary
Heavily textured and rough cast finishes have 2 pronounced advantages as compared with the smoother finishes:

(a) They shed water more readily because of the large number of drip points formed on the surface.

(b) They are less prone to crazing and colour variation because of the absence of a cement-rich surface skin.

Smooth finishes are not recommended on the exterior because of the potential to highlight fine cracks and minor surface irregularities.

APPENDIX B
METHOD OF ASSESSMENT OF SAND
(Informative)

B1
The information in this Appendix provides guidance for determining if sand is acceptable for inclusion in plaster cements. The sand must be to the approval of the territorial authority.

B2
Sand may be assessed for suitability by doing the following:

(a) Comparing grading and maximum particle size and if necessary, the clay content as set out in item (c) below.

(b) Making a mix to assess water requirements and workability.

Mix assessment being done as follows:

(i) Weigh out the following amounts of material:

1 kg of cement
5 kg of dry sand
1000 g (ml) of water
200 g (ml) of water
300 g (ml) of water

(ii) Mix the cement and sand to a uniform colour on a non-absorbent surface.

(iii) Mix, in 3 stages, each of the amounts of water (1000 ml, 200 ml and 300 ml) until the mixes reach a consistency suitable for plaster.

If 1000 ml of water is enough the sand is of good quality.

If 1000 + 200 ml is enough the sand is of average quality.

If 1000 + 200 + 300 ml is enough, the quality of the sand is poor; and

If more water than that is required, the quality is very poor.

“Good” and “Average” sands are suitable for use in all plasterwork.

“Poor” sands may be used for interior plaster; and

“Very poor” sands shall not be used.

(iv) Assess the workability of the mix (at plastering consistency) by forming a flattened heap about 100 mm high and 200 mm in diameter on a non-absorbent surface. Place a plasterer’s trowel face down on top of the heap and try to push the trowel down.

A workable plaster will squeeze out from under the trowel and it will be possible to push the trowel to within a few millimetres of the underlying surface. An unworkable mix will “lock up” once the trowel has moved 3 mm to 5 mm and prevent further downward movement of the trowel.

If the mix appears to be workable, pick up some of the plaster on a trowel then tilt the trowel. The plaster should slide off easily. If it clings to the trowel, the mix is too "fatty", an indication of excessive clay content of the sand.

(c) Clay content

Only a small proportion of clay can be tolerated in a plaster sand. Sands with a suspected high content shall be tested prior to use.

Sands with high clay content may generally be recognized as follows:

(i) The fraction that passes a 0.075 mm sieve* can, after being moistened, be rolled into a thread about 3 mm or less in diameter.

(ii) Plaster mixes made with such sands:

Are very "fatty" and tend to cling to a trowel

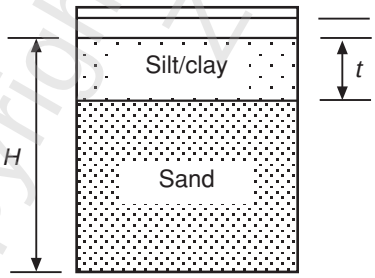
Have a high water requirement.

Specialist advice should be sought if there is any doubt about the content and type of clay in a sand.

*Test sieves are expensive and normally found only in laboratories. For a field test a nylon stocking is an effective substitute. Place a few handfuls of dry sand in the foot of a nylon stocking and tie closed. Shake the sand and collect the dust in a bowl then perform the above test.

B3 Bottle test

An alternative simple test is to take a glass jar with parallel sides, fill to approximately three quarters with sand, add clean water with a teaspoonful of salt to fill the bottle. Seal the top and shake vigorously and allow to stand for 3 hours undisturbed.



t = thickness of settled silt/clay

H = height of sand + silt/clay

$$\% \text{ silt or clay content} = \frac{t}{H} \times 100$$

The following determine the suitability of the sand:

(a) Clay/silt particles will have settled out on the top surface of the sand. If the percentage change is over 5 % the sand should not be used unless more detailed performance tests can confirm its suitability.

(b) If the water remaining is discoloured then there are also organic impurities. These impurities can give significant reduction in strength and extend setting times. If the discolouration is significant the sample should not be used unless more detailed performance tests can confirm its suitability.

APPENDIX C
COMMENTS ON CURING
(Informative)

C1
A sand-cement plaster can achieve satisfactory strength and bond to the substrate only if it is thoroughly cured, i.e., if adequate water is retained in the plaster long enough to ensure advanced hydration of the cement. Conventional methods of curing therefore involve the prevention or substantial retardation of moisture evaporation from the surface and are normally continued for several days after application of the plaster. Curing is particularly important during periods of low humidity and drying winds and in situations exposed to direct sunlight.

Extended curing should be applied if the ambient temperature is low, since the reaction between cement and water is retarded by low temperatures.

C2
Tensile stresses in the plaster, and shear stresses at the plaster-substrate interface, begin to develop only when the plaster is allowed to dry. The maximum shear stress is proportional to the plaster thickness. If it overcomes the adhesion of the plaster, debonding occurs. To minimize this possibility, each coat in a multi-coat plaster system is usually cured and dried individually. This procedure ensures that any cracks caused by excessive tensile stress are very fine, they are not associated with bond failure, and they do not affect the integrity of subsequent coats.

C3
The use of acrylic emulsions in plasters offers a means of eliminating the requirements for extended periods of moist curing. As compared with plain plasters, those containing acrylic emulsions in appropriate quantity have lesser potential drying shrinkage, reduced modulus of elasticity (higher extensibility) and enhanced strength development even in the absence of moist curing. Other advantages associated with the use of acrylic emulsions are a slower rate of water loss in drying conditions, which improves the potential for stress relief by creep, and a considerable improvement in bond to substrates. The combined influence of all these factors is to restrict the magnitudes of tensile stresses in the plaster and shear stresses at interfaces, and so minimize the risk of tensile cracking or bond failure.

In consequence of these features, the normally recommended curing procedures may be altered when dealing with the application of acrylic-modified plasters to any substrate. Acrylic-modified plasters are required only to be protected from direct sun and drying winds for at least 16 hours after application. As a means of ensuring this protection, plaster in exposed situations should not be applied when strong drying winds are anticipated. Nor should it be applied in direct sunlight or to surfaces which will be heated by the sun later in the day. Plastering should be scheduled to start on the shady side of the building and continue round following the sun.

C4
The circumstances prevailing on site will determine the method of curing plaster coats. A plaster coat can lose water by migration into the background or previous coat and by evaporation from its surface. Sufficient water for cement hydration can be maintained by the provision of a wet atmosphere around the surface of the plaster coat. This can be achieved by covering the work with hessian which is kept continually wet. Plastic sheeting can be used to reduce air circulation in the vicinity of newly applied plaster, in which case the plaster coat should be wetted when it has gained sufficient strength to permit this.

C5
In areas where high summer temperatures occur, curing may be assisted by hanging scrim or shade cloth over the plaster to give shade, reduce the effect of drying winds and to retain moisture.

C6

Proprietary sprinkler systems with programmed timers are very useful, especially over weekends when sites may not be attended.

C7

If during the specified curing period, the plaster has changed colour and gone white, it has obviously been allowed to dry prematurely and will fail to reach its required strength. No amount of subsequent wetting will correct the situation and the risk of cracking is high.

APPENDIX D
MATTERS OUTSIDE THE SCOPE OF THIS STANDARD
(Informative)

This Appendix provides information on matters which are outside the scope of this Standard but nevertheless are of relevance to cement plasters. Where cement plaster designs are based on information contained in this Appendix then full details of what is proposed need to be submitted to and approved by the territorial authority.

D1 Sample areas
When required by the specifier, samples of the plaster system or the plaster finish are to be prepared by the plasterer, prior to the work commencing.

CD1
Sample size should be at least 1 m^2 and finished to a standard that can be replicated over the total work area.

D2 Proprietary Plasters
All pre-mixed materials should be delivered to the site in sealed packaging, bearing the trade names of the materials, the manufacturers' details and mixing instructions. Such instructions should be adhered to.

D3 Curing compounds
Cement based finishing coats with or without a bonding agent may be cured by the application to the surface of a clear acrylic emulsion sealer according to the manufacturer's recommendations.

D4 Moulded work
Features to be moulded into plaster, either in situ or precast and subsequently fixed to plaster need to be fully specified, giving patterns, sizes, compositions, fixing details etc.

These should be fixed either mechanically or by using epoxy adhesives according to manufacturer's specification.

D5 Alternatives to what is specified in the Standard

D5.1
Alternatives to this Standard include any one or more of the following:

(a) Different number or thickness of plaster coats;

(b) Different preparation, placement, curing and weathering;

(c) Different thickness of the backings (rigid or non-rigid) materials specified;

(d) Different backing materials;

(e) Different reinforcement materials or fixing details;

(f) Different support conditions or spans for the plaster.

Such designs are outside the scope of this Standard and where the alternatives are proposed full details must be forwarded to the territorial authority for approval.

D5.2
In all cases it is essential that the manufacturer's instructions be followed.

D5.3
Products or plaster systems that have been appraised by suitably qualified people or organizations should be favoured over systems that do not have appraisals. Products or plaster systems that have been appraised and then accredited by the Building Industry Authority must automatically be accepted by territorial authorities as complying with those clauses of the Building Code claimed in the appraisal. In all cases where appraisals are involved the products or systems must be used in strict accordance with the conditions and limitations of the appraisal.

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