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Steel Reinforcement Institute of Australia

INDUSTRY PARTNER

Residential Footing Design and Reinforcement Quality

Scott Munter, Executive Director/CEO, SRIA

Web Site: sria.com.au

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Market Development

The Hub for Steel Reinforcement Knowledge and Support

Quality and Traceability

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Prefabrication

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Digital Detailing

Sustainability

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Technical Notes

TECHNICAL NOTE 1

November 2022

SURFACE CONDITION OF STEEL REINFORCEMENT

The strength and performance of reinforced concrete depends on the reinforcement being adequately bonded into the concrete. While the issue of acceptable corrosion of the bar surface is an area that we receive many technical enquiries about, the contamination of the surface by grease, oil, dirt and formwork release agents is also an area that many Engineers are unclear about.

Clause 17.2.4 of AS 3600[1] states: *"At the time concrete is placed, the surface condition of reinforcement shall be such as not to impair its bond to the concrete or its performance in the member. The presence of millscale or surface rust shall not be cause for rejection of reinforcement under this clause."* Clause C17.2.3.4 of the AS 3600 Commentary[2] also states: *"Rust and millscale has little effect on bond [3,4]. Moderate rusting has been shown to improve bond [5]."*

The bond and anchorage properties of bars and mesh are therefore not detrimentally affected by a light coating of rust which has formed on the steel surface after normal exposure to the atmosphere **Figure 1**. In fact, the light rust on the surface of the bars in **Figure 1** caused by normal exposure to the environment, and which is characterised by a red, orange, or light brown colour, if tightly adhering to the bar, will actually enhance the bond characteristics of the bar [6,7].

Figure 1 Examples of acceptable surface condition of reinforcement

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TECHNICAL NOTE 2

January 2007

SUBSTITUTION OF N12 REBAR IN AS 2870 *RESIDENTIAL SLABS AND FOOTINGS*

A green-slip amendment to AS 2870, issued 22nd November 2002.

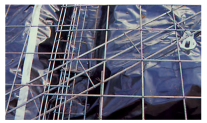
Section 1.9 was completely revised to reference AS 4671 as the Standard for reinforcement in slabs and footings.

As a result of these changes, the old Clause that allowed the substitution of Y12, 400 grade ribbed bar has now been deleted. Further additions to the current rules in Section 1.9 are proposed in the current draft revision of AS 2870 that will further support the use of Class N steel in the standard designs of Section 3.

Only Class N bars as detailed in Section 3 can be used in the standard designs and provide a "deemed to comply" design. If Engineers or Builders choose to specify 10.7 Class L bar they will have to justify its use via Section 4, *Design by Engineering Principles*.

SRIA members will not provide any advice on the substitution of N12 bars with 10.7 Class L bar except to say that L10.7 bars should only be used where specified on the drawings by the Engineer responsible for the design.

SRIA members will not substitute N12 bars with L10.7 bars where N12 has been specified or ordered.



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TECHNICAL NOTE 3

November 2022

BAR CHAIRS for SUPPORT of REINFORCEMENT

AS/NZS 2425 (2015) *Bar chairs in reinforced concrete – Product requirements and test methods*, contains requirements for the sampling and testing of bar chairs to assess their compliance for load-carrying capacity, ability to place and compact concrete around and within the different types of bar chairs, and durability requirements for concrete bar chairs. **Figures 1 to 3** provide examples of plastic, plastic-tipped wire and concrete bar chairs.

With the release of AS/NZS 2425, Engineers now have the ability to specify the required load capacity, spacing and type of bar chairs for each specific project. For concrete bar chairs, the durability of the concrete material used should also be specified by nominating an appropriate chloride permeability from Table 2 in AS/NZS 2425.

Type of bar chair

Plastic (**Figure 1**), plastic-tipped wire (**Figure 2**) or concrete (**Figure 3**) bar chairs may be specified.

Following assessment of the corrosion potential of plastic-tipped wire bar chairs in exposure classification B2, which Table 4.3 of AS 3600 Concrete structures defines as above ground exterior environments within 1 km of the coast, it is now considered that these types of chairs should only be used in exposure classifications A1, A2 and B1. However, if the type of bar chair has not been specified, plastic bar chairs will be provided by default for all projects that are known to be within 1 km of the coast (taken as B2 exposure classification).

For severe exposure environments such as marine, coastal or water-retaining structures, concrete bar chairs are recommended. The reason is that concrete does not bond to plastic and the risk exists that hairline cracking between the concrete and plastic bar chair may provide a direct path for aggressive agents to reach the reinforcement and cause early corrosion. The hydration reaction of the cement in concrete will chemically bond to concrete bar chairs avoiding this potential problem.

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TECHNICAL NOTE 4

November 2007

FABRICATION AND SITE HANDLING OF REINFORCING BARS

1 INTRODUCTION

An Australia/New Zealand Standard AS/NZS 4671 was published in 2001; a replacement for AS 1302; AS 1303 and AS 1304. The Standard formalised the introduction of 500 MPa yield strength steels. Rather than specify the steels by manufacturing process, the new Standard classifies by strength grade and ductility class (Low L, Normal N and Seismic E (NZ only)).

While higher strength steels were introduced, the Standard responded to designers' and builders' requests to maintain weldability and rebend characteristics, which are the cornerstones of Australian concrete construction technology. This has been achieved with only minimal changes in the Welding Standard AS 1554.3[1].

Class N deformed reinforcing bars manufactured to comply with AS/NZS 4671 are high-strength, low-carbon steels. The compliance of both Australian manufactured and imported steel reinforcement is assured by one of two methods.

Firstly, by the Australian Certification Authority for Reinforcing Steels Ltd (ACRS). This is an industry-based, third-party product certification scheme for steel reinforcement and prestressing strand. If the product conforms to the relevant Australian Standards, it is permitted to display the ACRS 'mark' on its tags and other documents.

Alternatively, by compliance with ISO 9000 quality systems which guarantees that consistent processes developed by a company are being followed.

This Technical Note has several objectives:

- Give designers an understanding of reinforcing bar capabilities and limitations.
- Encourage good on-site practices in the handling, placing, rebending and adjusting of reinforcing steel.
- Provide commentary to the mandatory requirements of the Concrete Structures Standard AS 3600:2009[2].

2 TYPES OF REINFORCING BARS AND THEIR IDENTIFICATION

Three types of deformed reinforcing bars complying with AS/NZS 4671 are available in Australia. Two are high-strength, hot-rolled deformed bars of Grade 500N and the third is low-strength Grade 250N.

2.1 Quenched and Self-Tempered Bars (QST) 500N

Most Grade 500N reinforcing bar is a mill heat-treated and tempered product. It is produced in straight lengths in diameters 12 mm, 16 mm, 20 mm, 24 mm, 28 mm, 32 mm and 36 mm.

General identification is by regular-spaced, inclined transverse ribs, two longitudinal ribs and a minimum of two (usually three) longitudinal marks in addition to the longitudinal ribs as, shown in **Figure 1**.

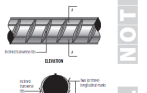

FIGURE 1 *General identification of QST (Straight) 500N Bars*

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TECHNICAL NOTE 5

April 2007

GUIDELINES FOR ECONOMICAL ASSEMBLY OF REINFORCEMENT

1 INTRODUCTION

This Technical Note recommends detailing and fixing practices which will allow some flexibility when placing steel reinforcing bars and fabric.

Steel fixing is the art of assembling reinforcement in its specified position, as shown in the drawings. Reinforcement details which artificially create fixing problems are discussed in this guideline.

Four topics are considered:

- Relieving reinforcement congestion.
- Simplification of fixing without affecting the design intent.
- Reducing the number of reinforcement items to be fixed.
- Detailing to allow for variations in site measurements and to protect the reinforcement against corrosion.

In this guideline the term *assembly of reinforcement* means *bringing together several items of steel in one or more* structural members:

- within or upon formwork close to its final position;
- using on-site cage assembly some distance from the forms, which may require craneage of the assembled steel to the forms; or
- by off-site cage assembly, which will require transportation to the site with subsequent craneage to the forms.

Each assembly method has advantages which depend on site and construction practices. A method suitable for one project may be inappropriate for another. For example, crane locations and capacity, the system of formwork adopted, the method of construction, etc may not be known to the design engineer before the contract is let, so

Engineering analysis of a structure generally applies to it as a whole however each member is individually designed and detailed with its own independent reinforcement. The separate members are then connected by additional reinforcement so that, after the concrete has reached full strength, the complete structure should act as previously analysed.

Throughout this guideline, we have used the term ***Note*** to describe a statement made about a certain topic, and the term ***Hint*** to indicate a recommendation or suggestion about a suitable procedure.

All the information provided in this Guideline is directed towards the construction team that is, the design engineer, the draftsperson, scheduler, steel fixer and inspector.

TECHNICAL NOTE 6

July 2008

DESIGN to AS 3600:2001 of SUSPENDED CONCRETE FLOORS REINFORCED with CLASS L MESH

1 SCOPE

This technical note addresses the design of suspended concrete floors reinforced with low-ductility Class L mesh in accordance with the current edition of the Concrete Structures Standard AS 3600:2001[1]. Changes to the Standard made in two amendments (1 & 2) that concern using Class L mesh as main reinforcement are fully accounted for.

An example of a suspended concrete floor constructed using Class L mesh as multi-purpose main and secondary reinforcement, which comprises reinforced concrete beams and slabs, is shown in **Figure 1**.

Design for serviceability and ultimate strength are addressed. Important aspects of design not directly addressed in AS 3600 are clarified.

FIGURE 1 *Suspended Concrete Floor Construction using Class L Mesh*

2 BUILDING CODE OF AUSTRALIA (BCA)

The two complementary Australian Standards AS 3600:2001 *Concrete structures* and AS/NZS 4671:2001 *Steel reinforcing materials*[2,3] are both given legal status by being referenced in the current Building Code of Australia (BCA)[4]. Designs developed using those Standards comply with the Deemed-to-Satisfy Provisions of the BCA and accordingly fully satisfy its Performance Requirements.

These two Standards define the minimum properties, and design and construction requirements for Class L mesh used as reinforcing steel in suspended concrete floors.

3 AS/NZS 4671:2001

The standard grade of ribbed reinforcing mesh 500L referred to in AS/NZS 4671 has a nominal yield stress, f_{sy}, of 500 MPa and is designated as having low (L) ductility.

Its ductility is characterised by uniform strain, ε_{su}, and tensile-strength-to-yield-stress ratio, f_t/f_{sy}, for which compliance with Appendix A of AS/NZS 4671 must be demonstrated. Minimum lower characteristic values for Class L mesh are $\varepsilon_{su} = 1.5\%$ and $f_t/f_{sy} = 1.03$, on which the design rules in AS 3600 are based. Significantly higher values can be achieved in practice[5]. As well as confirming satisfactory mechanical properties, weld-shear strengths and geometric measurements must also be confirmed.

Cross-sectional areas of commonly-available Class L mesh sizes used in the construction of suspended concrete floors like that in **Figure 1** are given in **Table 1**, where A_{sl} and A_{st} are the cross-sectional areas of the longitudinal and transverse bars, respectively, based on

INSTRUCTIONS: Click on any item in BLUE to go to it, or

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TECHNICAL NOTE 8

November 2022

STRUCTURAL INTEGRITY REINFORCEMENT FOR SLABS

In 2018, based on the lessons learnt from the Christchurch, New Zealand earthquake events in 2011, AS 3600[1] was revised to incorporate many new provisions to safeguard future Australian buildings from seismic events and provide important life safety to the occupants if the buildings are subjected to one of these extreme events.

One simple reinforcement detailing requirement that was incorporated into the Standard was structural integrity reinforcement for both beams and slabs. This nominal amount of reinforcement was found to be very effective at preventing the collapse of slabs following punching shear failures in Christchurch, improving the life safety of the building **Figure 1**. The Newcastle Workers Club is an example of punching shear failure where no structural integrity reinforcement was provided **Figure 2**. The benefits provided by structural integrity reinforcement led the SRIA to include this aspect of detailing on the cover of the 2016 *Guide to Seismic Design and Detailing of Reinforced Concrete Buildings in Australia*, which is also available for free as a pdf copy from the SRIA website. While the Guide includes structural integrity reinforcement, it has come to the attention of the SRIA that the provisions for slabs that were included as Clause 9.2.2 of AS 3600 in 2018, are being misinterpreted. This Technical Note is intended to clarify the intent and requirements of AS 3600 for structural integrity reinforcement for slabs.

Figure 1 Punching shear failure with structural integrity reinforcement preventing collapse of slab, Hotel Grand Chancellor, Christchurch

(photograph courtesy Peter McBean)

Figure 2 Punching shear failure at Newcastle Workers Club during the 1989 Newcastle earthquake – no structural integrity reinforcement to reduce the risk of collapse

(photo courtesy Cultural Collections, the University of Newcastle, Australia)

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TECHNICAL NOTE 9

November 2022

FITMENTS

Fitments are defined in Clause 1.6.3.42 of AS 3600 (2018)[1] as a "*Unit of reinforcement commonly used to restrain from buckling the longitudinal reinforcing bars in beams, columns and piles; carry shear, torsion and diagonal tension; act as hangers for longitudinal reinforcement; or provide confinement to the core concrete.*" A typical fitment is shown in **Figure 1**. While AS 3600 has always adopted the terminology "fitment", they are commonly referred to as either ties, stirrups, ligatures or helix. Note that the term "tie" was redefined in AS 3600 (2009)[2] as a "*tension member in a strut-and-tie model*", and the term helix refers to helical reinforcement, which was introduced in AS 3600 (2009), with the same definition now included in Clause 16.3.50 of AS 3600 (2018). "*reinforcement that is wound in a helical fashion around the main longitudinal reinforcing bars in a column or pile restraining them from buckling and to carry shear, torsion and diagonal tension or around tendons at an anchorage to resist bursting action effects.*"

Two 135° hooks for anchorage

Figure 1
Typical closed fitment

Typically, fitments will be closed fitments as defined in Clause 1.6.3.12 of AS 3600 (2018), "*A unit or multiple units of reinforcement used as an external or internal fitment that form a continuous perimeter around a concrete element with the ends of the fitment anchored into the concrete using a minimum of 135° hooks around a longitudinal bar.*" While a closed fitment would typically resemble the single unit or shape shown in **Figure 1**, the reference to multiple units is to allow for the various options covered in Clause 8.3.2.4 of AS 3600 for the anchorage of shear reinforcement. These include anchorage by a "*hook or cog complying with Clause 13.1.2.7 or by welding of the fitment to a longitudinal bar or by a welded splice, or by lapped splices.*"

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TECHNICAL NOTE 10

March 2025

Mechanical Splices

General

Mechanical couplers are a means to splice reinforcing bars in tension or compression, without the need for lapped splicing of the bars. They can be used to reduce reinforcement congestion and improve structural integrity as they do not rely on the concrete to transfer the stress from one bar to the other. They also improve constructability, allow prefabrication of larger steel reinforcement cages, allow splicing of tension-tie members, connections to previously cast elements, and also assist in repair or retrofit work by allowing connection onto existing reinforcing bars.

In general, the performance requirements for mechanically splicing Ductility Class N bars are covered in Clause 15.2.6 of both AS 3600 and AS 3700.S, or are provided by the state transportation authorities. Generally, if the mechanical splice is providing a full-strength connection (bar-break failure away from the coupler zone) and the longitudinal slip in the connection is less than 0.1 mm, then the mechanical splice is deemed to satisfy the performance requirements. In case the longitudinal slip in the connection is more than 0.1 mm, then the Consulting Engineer should consider the potential detrimental effects of excessive slip during the design process. In addition to this, depending on the project requirements, performance of the mechanical splices under high cycle fatigue loading needs to be reviewed as well. Also, Clause 13.2.3(e) of AS 3600 states that they are the only option for splicing bars larger than 40 mm. They are also specifically referred to in Clause 10.7.5.3 of AS 3600 as a means for splicing column reinforcement.

Specific detailing requirements for end-bearing splices in columns are also covered in Clause 10.7.5.4 of AS 3600: the splice must always be in compression, additional fitments are required above and below the splice and most importantly, the ends of bars are to be held in concentric contact by a clamp.

While end-bearing splices, formed by providing a sleeve around the bar ends to ensure that they remain in contact, are mentioned in Clause 10.7.5.4 of AS 3600, they are typically no longer used and as such, are not covered in this Technical Note. However, they are still found in many historic reinforced concrete structures and when assessing these structures, their locations should be identified and taken into account when determining the capacity of the structure, as they cannot transfer any tensile loads.

While there are many different suppliers of mechanical couplers in the marketplace, they fall into two basic types: threaded couplers (**Figure 1**) and coupling sleeves (**Figure 2**).

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RAFT SLAB DESIGN AND DETAILING - VICTORIAN STRUCTURAL BRANCH COMMITTEE OF ENGINEERS AUSTRALIA 12 JULY 2016

Title	Description	Size
Presentation by Peter Bayetto	Compliance with AS2870-2011 - Recent Failure Investigations and Design by Engineering Principles (rev	23.1 MB
Presentation by Eric Lume	Residential Slabs and Footings Construction Requirements	6.3 MB
Presentation by Scott Munter	Residential Slabs and Footings Reinforcement and Slab Design	7.3 MB

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Reinforcing Bar Classification

All reinforcing bar to comply with:

AS/NZS 4671 Steel for the reinforcement of concrete

AS/NZS 4671 Designation	Yield Stress MPa	Ductility Class	Description	Typical Size mm
S600N	600	N	Hot-rolled Deformed bar	11, 15, 18, 22, 26, 29, 33, 37
D500N	500	N	Hot-rolled Deformed bar	Coil (10-20), Straight (12-40), Special (50)
R250N	250	N	Hot-rolled Plain round	6.5, 10, 12, 16, 20, 24
D250N	250	N	Hot-rolled Deformed bar	12 (pool steel)
D500L	500	L	Cold-rolled Deformed bar	5 - 12
R500L	500	L	Cold-drawn Round rod	5 - 12

- Symbols used

S	Deformed Grade 600 Ductility Class N Bars ie S18
N	Deformed Grade 500 Ductility Class N Bars ie N20
POL	Deformed Grade 250 Ductility Class N Bars ie POL 12
R	Plain Round Grade 250 Ductility Class N Bars ie R10
L	Plain Round Grade 500 Ductility Class L Bars ie L10

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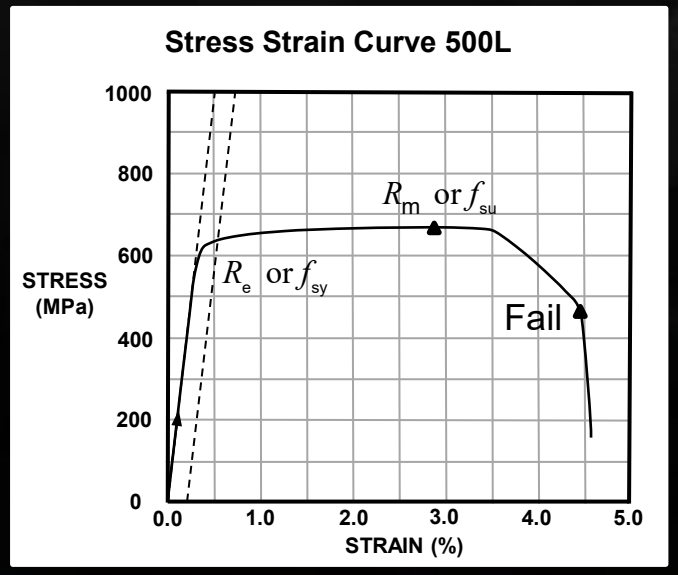
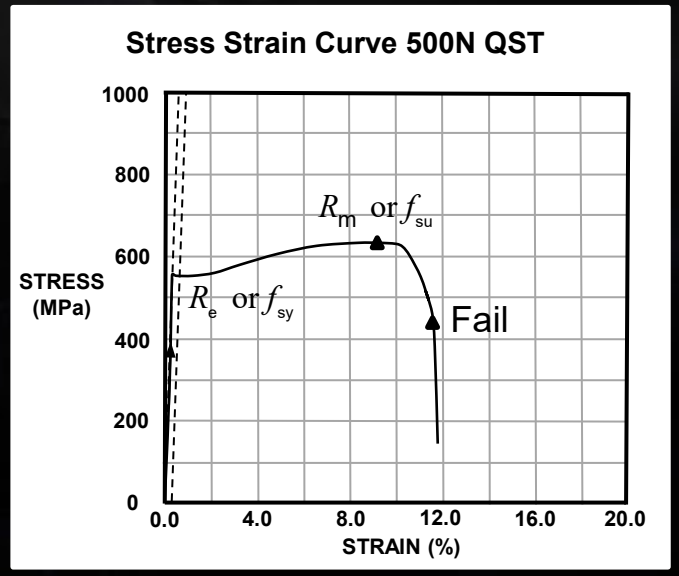
Mechanical Properties

AS/NZS 4671:2019 Steel for the reinforcement of concrete: Table 7.2 (A&B)

Property		250N	500L	500N	600N	750N	Probability of exceedance
Nominal Diameter (mm)		12 (pool steel)	5 to 12	10 to 40	10 to 40	8.2, 9.8 & 13	-
Yield Stress (MPa)	$R_{ek.L}$ $R_{ek.U}$	≥ 250 -	≥ 500 ≤ 750	≥ 500 ≤ 650	≥ 600 ≤ 750	≥ 750 ≤ 900	C_{vL}: P = 0.95 C_{vU}: P = 0.05
Ratio	$(R_m/R_e)_{k.L}$	≥ 1.08	≥ 1.03	≥ 1.08	≥ 1.08	≥ 1.04	C_{vL}: P = 0.90
Uniform Elongation (%)	$A_{gt.k.L}$	≥ 5.0	≥ 1.5	≥ 5.0	≥ 5.0	≥ 4.0	C_{vL}: P = 0.90





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Chemical Composition

Type of analysis	Chemical Composition (%) Max						
	C		P	S	Carbon Equivalence Value for Class		
	500L 500N	600N 750N	All steel grades		500L	500N	600N & 750N
Cast analysis	0.22	0.33	0.050	0.050	0.39	0.44	0.49
Product analysis	0.24	0.35	0.055	0.055	0.41	0.46	0.51

Carbon Equivalence:

$$C_{eq} = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

Correct chemistry allows welding to AS/NZS 1554.3

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Ensuring Quality Reinforcement

JASANZ Accredited Third Party Certification

2025
VALID TO 31 Dec
Australasian Certification Authority for Reinforcing and Structural Steels Ltd

ACRS
PRODUCT CERTIFICATION
www.steelcertification.com

CERTIFICATE OF APPROVAL

Product Conformity Certification

This is to certify that

InfraBuild Steel

InfraBuild

at

22 Kellogg Rd
Rooty Hill NSW Australia 2766

has satisfied the Authority that it complies with the rules of the ACRS Product Certification Scheme and the relevant ACRS Quality and Operations Assessment Procedures. Where appropriate, and as listed below, it has further satisfied the Authority that it manufactures and/or supplies products that conform with the Standards listed below, and is entitled to use the ACRS mark in relation to the products listed on this certificate.

SCOPE OF CERTIFICATION

Reinforcing Bar Manufactured in straight lengths to AS/NZS 4671:2019

Products listed on this Manufactured Product certificate may be relied upon as having the benefit of ACRS Product Scheme certification after any subsequent processing only if cut, or bent, or welded by an ACRS certified processor. For Approval of processed reinforcing bar, refer to the bar processor's ACRS Fabricated Product certificate.

This certificate remains the property of the Authority and is issued subject to the Regulations of the Authority.

CERTIFICATE NUMBER	VERSION	FIRST APPROVAL	ISSUE DATE	EXPIRY DATE
31101	4	01 November 2003	01 January 2025	31 December 2025

SIGNED FOR ACRS

Andrew Wheeler,
Executive Director
AUSTRALASIAN CERTIFICATION AUTHORITY FOR REINFORCING AND STRUCTURAL STEELS LTD | ABN: 40 096 692 545 | PO BOX 1369, CROWS NEST NSW 1585, AUSTRALIA

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Page 1 of 2

Example of a JASANZ Accredited 3rd Party Mill Certificate

Certifies the stock bar, rod and coiled products conform to AS/NZS 4671

Straight Bar Manufactured to AS/NZS 4671:2019
Manufactured Bars listed on the ACRS Certificate, only remain ACRS Certified if cut, or bent, or welded by an ACRS certified processor.

For Approval of processed reinforcing bar, refer to the bar processor's ACRS Fabricated Product certificate.

JASANZ
Joint Accreditation System of Australia and New Zealand

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Ensuring Quality Reinforcement

Need for a JASANZ Accredited Third Party Certificate

Every project should specify one and obtain to guarantee quality

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Ensuring Quality Reinforcement

JASANZ Accredited 3rd Party Processor Certificate

Required by purchasers to prove quality reinforcement delivered to site

2025
VALID TO 31 Dec
Australasian Certification Authority for Reinforcing and Structural Steels Ltd

ACRS PRODUCT CERTIFICATION
www.steelcertification.com

CERTIFICATE OF APPROVAL

Product Conformity Certification

Certificate No: 811021
Ausreo Pty Ltd
at
Gate C, 133/139 Newton Rd
Wetherill Park NSW Australia 2164

AUSREO

Products assessed by ACRS to the following Standards:

- Processing and distribution of Grade 250N and 500N carbon steel bars and welded mesh in accordance with AS/NZS 4671: 2019, and either AS 3600: 2018 Concrete structures and AS 5100.5: 2017 Bridge design – Concrete "material and construction requirements for reinforcing steel", or the "Reinforcement" clauses of NZS 3109 Concrete Construction.
- Threading of reinforcing bar for the application of a Lenton Coupler with equipment, training and maintenance provided by the supplier.

Processed steel reinforcing materials may only be relied upon as having the benefit of ACRS Product Scheme certification when manufactured or processed by ACRS certificate holders.

Approved Company Information

Tag

ausreo.com.au 1300 AUSREO

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Page 2 of 2

ACRS Processor Certificate only available if reinforcement supplied by ACRS Certified Mill

Processing of Grade 250N and 500N carbon steel bars and welded mesh in accordance with AS/NZS 4671 (2019) and either:

- ***AS 3600 (2018) Concrete structures***
- ***AS 5100.5 Bridge design – Concrete***
- ***NZS 3109 Concrete Construction***

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Bending Reinforcement

Clause 17.2.3.2 of AS 3600 – required pin diameters

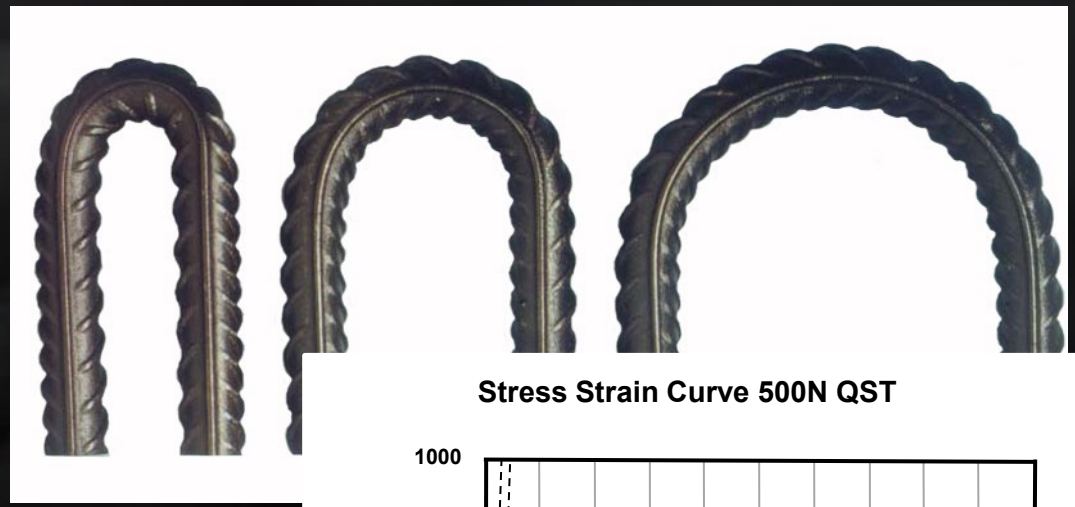
Avoids excessive steel strain and crushing of concrete

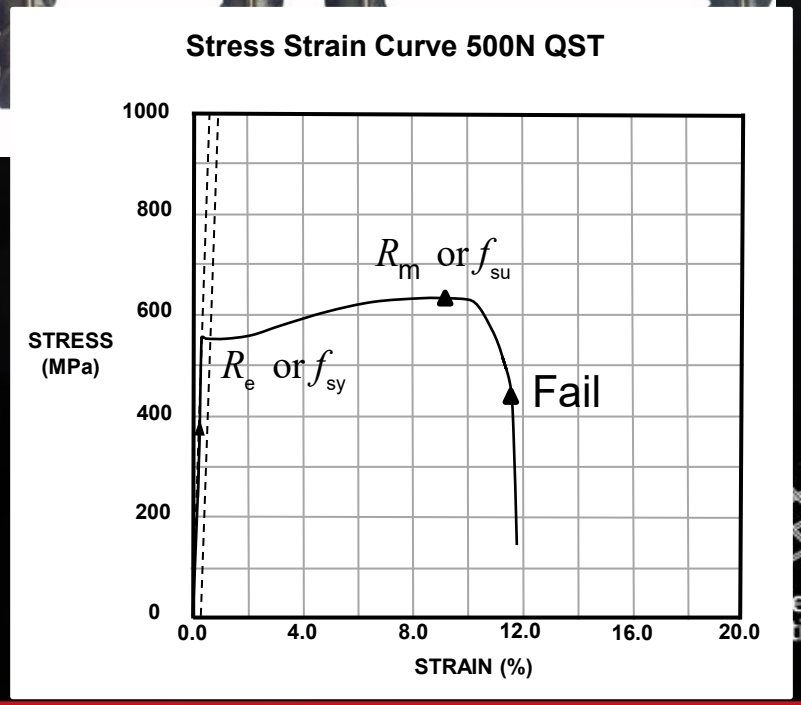
Fitments

500L & R250N	$3d_b$
D500N	$4d_b$

General

D500N	$5d_b$
Galvanised ≤16mm	$5d_b$
Galvanised ≥ 20mm	$8d_b$





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Need for a JASANZ Accredited Third Party Certificate

Every project should specify one and obtain to guarantee quality

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Recent increase in imported mesh product

Steel Reinforcement Institute of Australia

SRIA Industry Warning late 2023

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NON – CONFORMING MESH CAMPAIGN RAISING AWARENESS ON SOCIAL MEDIA

David Chandler OAM • Following — 2w •••

NSW Building Commissioner at NSW Department of Customer Service

#BuildingCommissionNSW will be keeping an eye out. #Engineers #Certifiers #Builders expect check-ups of #OccupationCertificates and on-site. Will be an avoidable tragedy to have to demolish slabs if found. Be assured if counterfiet products are discovered they will be coming out. #BuildingCompliance #Accountability #Licences #Risk

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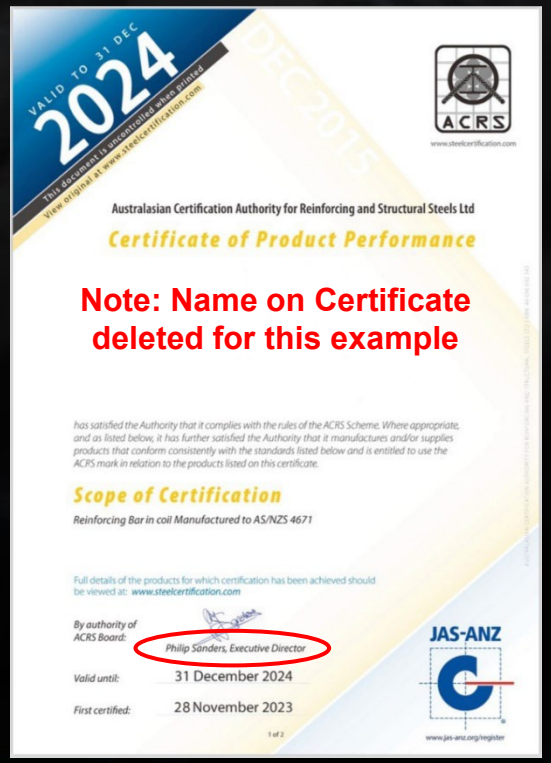
Products found accompanied with false ACRS Certificates

- Always check Certificates on JASANZ website
- This company (logo removed) was a non-Australia producer for >10 years
- Printed copies may have been altered
- SRIA Member's Certificates can be found on SRIA website

Philip Sanders resigned as Executive Director some years prior to this Certificate



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Ensuring Quality Reinforcement

On Site – check that bar markings match the JASANZ 3rd party Certificate

- Bar marking

- ACRS Certificate for imported mesh

2023
VALID TO 31 Dec
Australasian Certification Authority for Reinforcing and Structural Steels Ltd

ACRS PRODUCT CERTIFICATION
www.steelcertification.com

CERTIFICATE OF APPROVAL

Product Conformity Certification

This is to certify that

Tianjin Tiankang Metal Products Co. Ltd

at

Tuanbo,
Jinghai County Tianjin China

has satisfied the Authority that it complies with the rules of the ACRS Product Certification Scheme and the relevant ACRS Quality and Operations Assessment Procedures. Where appropriate, and as listed below, it has further satisfied the Authority that it manufactures and/or supplies products that conform with the standards listed below, and is entitled to use the ACRS mark in relation to the products listed on this certificate.

SCOPE OF CERTIFICATION

Steel Reinforcing Mesh Manufacture to AS/NZS 4671:2019

Mesh approved on this certificate is certified only if manufactured from ACRS approved wire or bar. For approval of wire or bar, please refer to the manufacturer's ACRS certificate.

This certificate remains the property of the Authority and is issued subject to the Regulations of the Authority.

CERTIFICATE NUMBER	VERSION	FIRST APPROVAL	ISSUE DATE	EXPIRY DATE
160802	2	30 November 2016	01 January 2023	31 December 2023

SIGNED FOR ACRS

Andrew Wheeler,
Executive Director
AUSTRALASIAN CERTIFICATION AUTHORITY FOR REINFORCING AND STRUCTURAL STEELS LTD | ABN: 40 096 692 545 | PO BOX 1369, CROWS NEST NSW 1585, AUSTRALIA

PRINTED ON 03/08/2023 FROM ACRS

To check the validity of this certificate please scan the above Static QR Code with the ACRS Cloud App or www.steelcertification.com

Cert. Ref.: 082-01 160802 2

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JAS-ANZ
www.jas-anz.org/register
Accreditation certificate number Z5221212AC

Page 1 of 2

2023
VALID TO 31 Dec
Australasian Certification Authority for Reinforcing and Structural Steels Ltd

ACRS PRODUCT CERTIFICATION
www.steelcertification.com

CERTIFICATE OF APPROVAL

Product Conformity Certification

Certificate No: 160802
Tianjin Tiankang Metal Products Co. Ltd

at

Tuanbo,
Jinghai County Tianjin China

Products assessed by ACRS to the following Standards:

AS/NZS 4671 Grade 500L Mesh
- Square Mesh SL52, SL62, SL63*, SL72, SL81*, SL82, SL92, SL102
- Trench Mesh L8TM, L11TM, L12TM

Non Structural Mesh (NZ): SL41.5, SL51.5

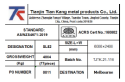
*added July 2023

Approved Company Information

Bar Markings

Tianjin TianKang Industrial Corporation

Tag



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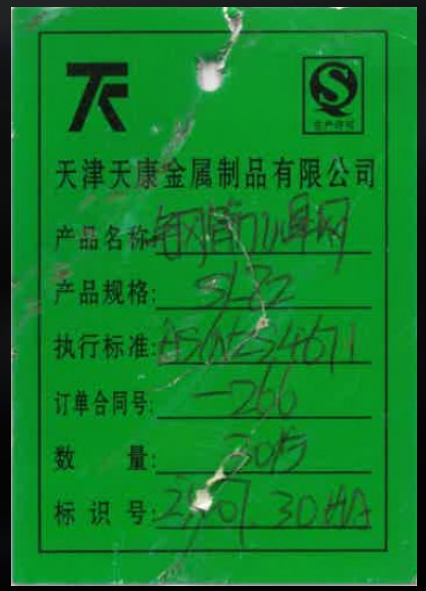
Accreditation certificate number Z5221212AC

Page 2 of 2

Tag on mesh?



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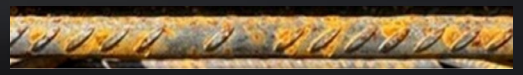
Ensuring Quality Reinforcement

ACRS Certificate updated after questions raised

- Bar marking now matches ‘interim’ 2023/2024 image 
- Always buy from a JASANZ 3rd party accredited mill for traceability

2024
VALID TO 31 Dec
Australasian Certification Authority for Reinforcing and Structural Steels Ltd

PRODUCT CERTIFICATION
www.steelcertification.com

CERTIFICATE OF APPROVAL

Product Conformity Certification

This is to certify that

Tianjin Tiankang Metal Products Co., Ltd.

at

Zhangjia Fangzi Village,
Tuanbo Town, Jinghai County, Tianjin China 301636

has satisfied the Authority that it complies with the rules of the ACRS Product Certification Scheme and the relevant ACRS Quality and Operations Assessment Procedures. Where appropriate, and as listed below, it has further satisfied the Authority that it manufactures and/or supplies products that conform with the Standards listed below, and is entitled to use the ACRS mark in relation to the products listed on this certificate.

SCOPE OF CERTIFICATION

Steel Reinforcing Mesh Manufacture to AS/NZS 4671:2019

Mesh approved on this certificate is certified only if manufactured from ACRS approved wire or bar. For approval of wire or bar, please refer to the manufacturer's ACRS certificate.

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160802	4	30 November 2016	01 January 2024	31 December 2024

SIGNED FOR ACRS

Andrew Wheeler,
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AUSTRALASIAN CERTIFICATION AUTHORITY FOR REINFORCING AND STRUCTURAL STEELS LTD | ABN: 40 096 692 545 | PO BOX 1369, CROWS NEST NSW 1585, AUSTRALIA

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2024
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Australasian Certification Authority for Reinforcing and Structural Steels Ltd

PRODUCT CERTIFICATION
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CERTIFICATE OF APPROVAL

Product Conformity Certification

Certificate No: 160802
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at

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Tuanbo Town, Jinghai County, Tianjin China 301636

Products assessed by ACRS to the following Standards:

AS/NZS 4671 Grade 500L Mesh

- Square Mesh SL52, SL62, SL63, SL72, SL81, SL82, SL92, SL102
- Trench Mesh L8TM, L11TM, L12TM
- Rectangular Mesh RL718, RL818, RL918, RL1018 and RL1218

Non Structural Mesh (NZ): SL41.5, SL51.5

Approved Company Information

Bar Markings 

Tag 

To check the validity of this certificate please scan the above Static QR Code with the ACRS Cloud App or visit www.steelcertification.com

Cert. Ref.: 082-01 160802 4

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Accreditation certificate number Z5221212AC

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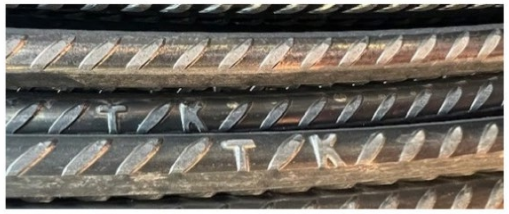
2023 and PRIOR

INTRIM 2023/2024



2024 ONWARDS

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Ensuring Quality Reinforcement

Either:

1. Buy from an SRIA Member – All JASANZ accredited 3rd Party Certified
2. Obtain JASANZ accredited 3rd Party Mill & Processor Certificates
   Check that Certificates are authentic
   (register.jasanz.org/certified-organisations and search for AS/NZS 4671)
3. Ensure tags/bar markings match the Certificate when inspecting

Steel Reinforcement Institute of Australia
1,703 followers
1w • Edited •

⚠️ HOW YOU WEED OUT NON-CONFORMING REBAR AND MESH:

Processors / Suppliers - Ask the Steel Mill for 3rd Party Certification that ...see more

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Surface Condition of Reinforcement

Ensure no loose or flaking rust on surface of bar

- Indicates loss of steel section (or mass) which may affect performance
- Limits on mass provided in Table 7.5 (A) of AS/NZS 4671
- If outside these limits, then non-conforming
- Refer also **SRIA Technical Note 1**

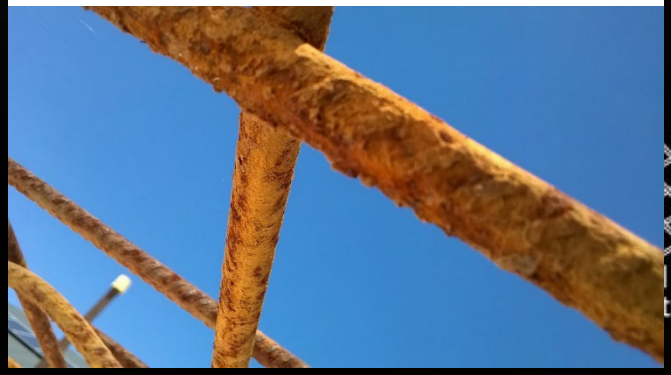
Acceptable – surface corrosion

Unacceptable

Loose and flaking rust

N20 Bar

SL72 Mesh



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Bending Reinforcement on Site

Incorrect Site Practices

Not bending around correct pin diameter

- Site rebending now covered by Clause 17.2.3.2 of AS 3600 (2018) due to poor site practices
- Use of pipes for leverage no longer allowed in AS 3600 due to a lack of control on site
- Refer also SRIA Technical Note 4

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Bending Reinforcement on Site

Recommend bars bent properly by Processor

Take care in approving site bent reinforcement

Bends up to 180
Maximum D16 bar
35 - 63 mm bending roller
Depends on brand and model

Bends of
90, 135 and 180
Max D20 bar
Roller diameter?

Bends
45, 90, 135 & 180
Roller
38, 50 & 62
Max N20 bar

Bends 90
Max N20 bar

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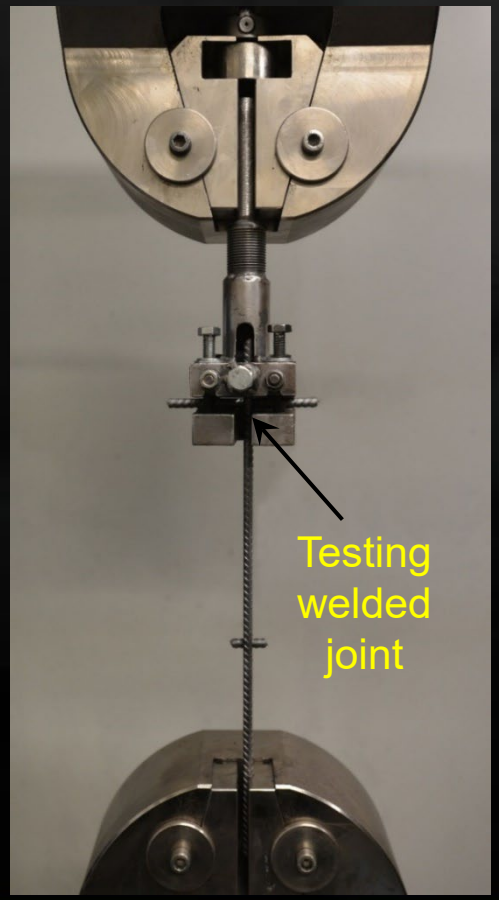
Mesh Processing

Quality of welding and adequate lap are critical

- Each welded joint develops 50% of the bar's yield stress
- Clause 7.2.5 of AS/NZS 4671



- Overlap mesh sheets a minimum of 2 cross-bars

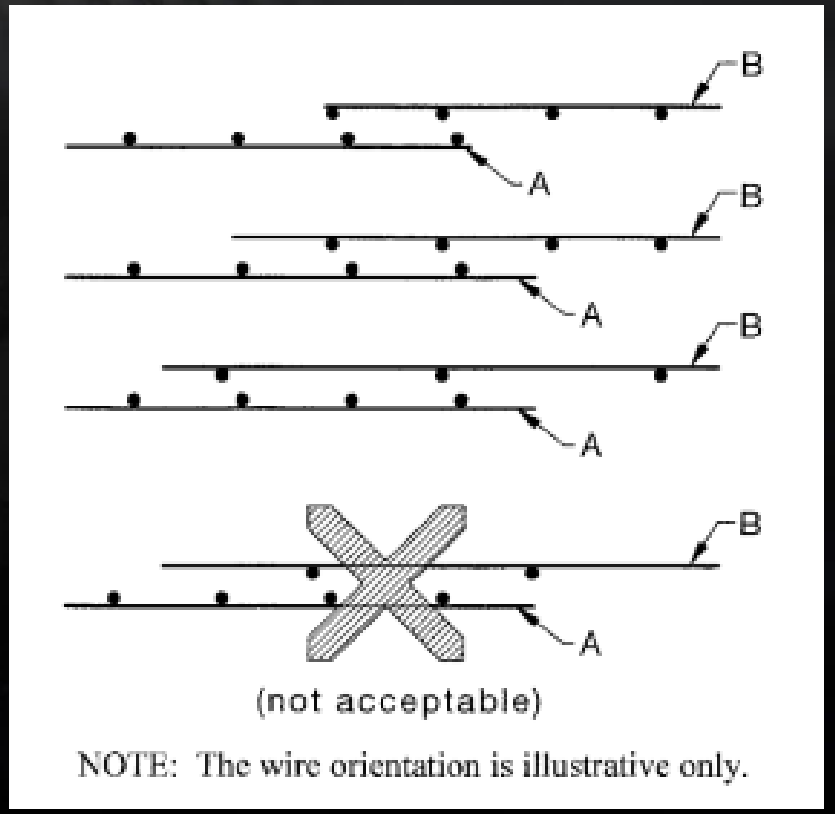


Figure 6.5 of CIA Handbook
Figure 5.1 from AS 2870

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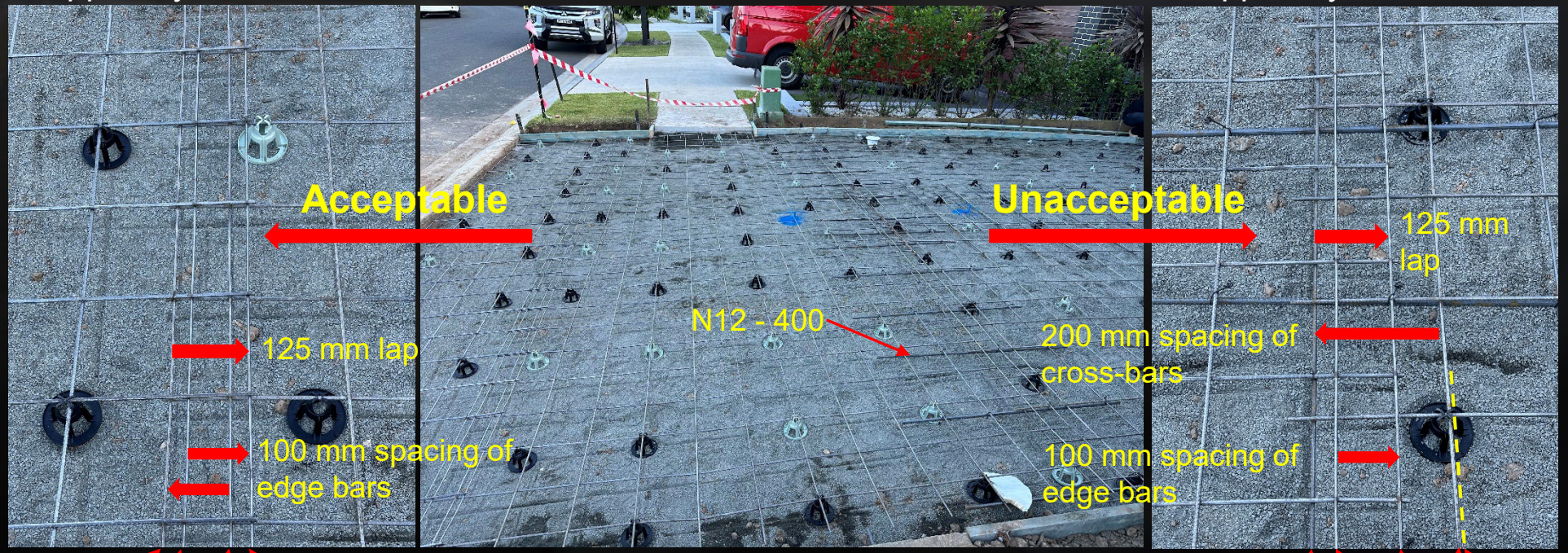
Lapping of Mesh

Overlap mesh sheets a minimum of 2 cross-bars

Lapped by 2 cross-bars

Lapped by 1 cross-bar



Residential Driveway

Note: Concreter on project taught to overlap mesh by 125 mm

Steel Reinforcement Institute of Australia

National Construction Code Requirements

Performance Requirements

H1P1 Structural reliability and resistance

[2019: P2.1.1]

(1) By resisting the actions to which it may reasonably be expected to be subjected, a building or structure, during construction and use, with appropriate degrees of reliability, must—

(a) perform adequately under all reasonably expected design actions; and

(b) withstand extreme or frequently repeated design actions; and

(c) be designed to sustain local damage, with the structural system as a remaining stable and not being damaged to an extent disproportionate to the original local damage; and

(d) avoid causing damage to *other properties*.

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National Construction Code Requirements

NCC Performance requirements

(2) The actions to be considered to satisfy (1) include but are not limited to—

(a) permanent actions (dead loads); and

(b) imposed actions (live loads arising from occupancy and use); and

(c) wind action; and

(d) earthquake action; and

(e) snow action; and

(f) liquid pressure action; and

(g) ground water action; and

(h) rainwater action (including ponding action); and

(i) earth pressure action; and

(j) differential movement; and

(k) time dependent effects (including creep and shrinkage); and

(l) thermal effects; and

(m) ground movement caused by—

(i) swelling, shrinkage or freezing of the subsoil; and

(ii) landslip or subsidence; and

(iii) siteworks associated with the building or structure; and

(n) *construction activity actions*; and

(o) termite actions.

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National Construction Code Requirements

NCC Performance requirements

(3) The structural resistance of materials and forms of construction must be determined using five percentile characteristic material properties with appropriate allowance for—

(a) known construction activities; and

(b) type of material; and

(c) characteristics of the site; and

(d) the degree of accuracy inherent in the methods used to assess the structural behaviour; and

(e) action effects arising from the differential settlement of foundations, and from restrained dimensional changes due to temperature, moisture, shrinkage, creep and similar effects.

H1D1 Deemed-to-Satisfy Provisions

[New for 2022]

(1) Where a *Deemed-to-Satisfy Solution* is proposed, *Performance Requirements* H1P1 and H1P2 are satisfied by complying with H1D2 to H1D11.

(2) Where a *Performance Solution* is proposed, the relevant *Performance Requirements* must be determined in accordance with A2G2(3) and A2G4(3) as applicable.

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AS 2870 Section 1: Scope and General

1.2 APPLICATION

To comply with this Standard:

(a) all sites shall be classified in accordance with Section 2; &

(b) footing system design shall be performed by either:

(i) prescribing a standard design in accordance with Section 3; or

(ii) applying the engineering principles described in Section 4; &

(c) all design and construction shall comply with Sections 5 and 6.

Residential concrete footing system design, detailing and construction should also comply with AS 3600,

except that if in conflict, AS 2870 takes precedence.

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AS 2870: Design Process

1

Residential Building

3

Footing System ("barrier"):

- ***Standard Designs*** **(SECTION 3)**

or

- ***Design by Engineering Principles*** **(SECTION 4)**

2

Foundation:

- **Site classification (Section 2)**

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AS 2870 Section 3: Standard Designs

- DTS Designs - calibrated empirically by observing the real performance and reserve strength of completed buildings.
- Less emphasis on design loads & greater emphasis on foundation movement
- Clause 1.4.2 - design actions are:
  - 1.0 × Foundation movement + 1.0 × Permanent action (DL) + 0.5 × Imposed action (LL)
- Why this design philosophy?
  - Foundation movement is a primary design consideration for footing systems which act as a "*barrier*" to protect the structure they support.
  - Less emphasis given to dead and live loads reduces overall cost of housing nationally.
  - Failure due to overloading poses only a minimal or nonexistent risk to life.
- The minimum requirements will not necessarily result in a defect-free building, as stated in Clause 1.3.1.

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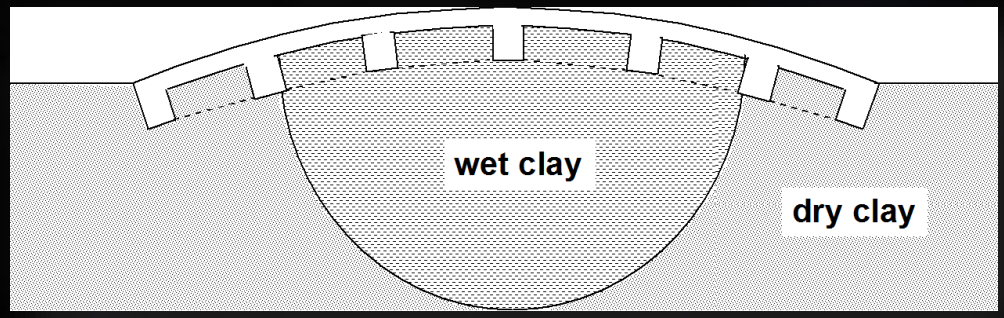
AS 2870 Section 3: Standard Designs

Site class	Type of construction	Edge and internal beams				
		Depth (D) mm	Bottom reinforcement		Top bar reinforcement	Max beam spacing cc m
			Mesh	Bar alternative		
Class A	Clad frame	300	3-L8TM	2N12	-	-
	Articulated masonry veneer	300	3-L8TM	2N12	-	-
	Masonry veneer	300	3-L8TM	2N12	-	-
	Articulated full masonry	400	3-L8TM	2N12	-	-
	Full masonry	500	3-L8TM	2N12	-	-
Class S	Clad frame	300	3-L8TM	2N12	-	-
	Articulated masonry veneer	300	3-L8TM	2N12	-	-
	Masonry veneer	300	3-L11TM	3N12	-	-
	Articulated full masonry	500	3-L11TM	3N12	2N12	-
	Full masonry	700	2x3-L11TM	3N16	2N16	5
Class M	Clad frame	300	3-L11TM	3N12	-	6
	Articulated masonry veneer	400	3-L11TM	3N12	-	6
	Masonry veneer	400	3-L11TM	3N12	-	5
	Articulated full masonry	625	3-L11TM	3N12	2N12	4
	Full masonry	950	2x3-L11TM	3N16	2N16	4
Class M-D	Clad frame	400	3-L11TM	3N12	-	5
	Articulated masonry veneer	400	3-L11TM	3N12	1N12	4
	Masonry veneer	500	3-L12TM	3N12	2N12	4
	Articulated full masonry	650	3-L11TM	2N16	2N16	4
	Full masonry	1050	2x3-L11TM	3N16	3N16	4
Class H1	Clad frame	400	3-L11TM	3N12	-	5
	Articulated masonry veneer	400	3-L11TM	3N12	1N12	4
	Masonry veneer	500	3-L11TM	3N12	3N12	4
	Articulated full masonry	750	2x3-L11TM	3N16	2N16	4
	Full masonry	1050	2x3-L12TM	3N16	3N16	4
Class H1-D	Clad frame	400	3-L11TM	3N12	1N12	4
	Articulated masonry veneer	500	3-L11TM	3N12	2N12	4
	Masonry veneer	650	2x3-L11TM	3N16	1N16	4
	Articulated full masonry	800	2x3-L11TM	3N16	2N16	4
	Full masonry	1100	2x3-L12TM	3N16	3N16	4
Class H2	Clad frame	550	3-L11TM	3N12	2N12	4
	Articulated masonry veneer	600	3-L12TM	3N12	2N12	4
	Masonry veneer	750	2x3-L11TM	3N16	2N16	4
	Articulated full masonry	1000	2x3-L11TM	3N16	2N16	4
	Full masonry	-	-	-	-	-
Class H2-D	Clad frame	550	2x3-L11TM	3N16	2N16	4
	Articulated masonry veneer	700	2x3-L11TM	3N16	2N16	4
	Masonry veneer	750	2x3-L11TM	3N16	2N16	4
	Articulated full masonry	1000	2x3-L11TM	3N16	2N16	4
	Full masonry	-	-	-	-	-

Standard Designs – Figure 3.1 (in part)

- Section 3 Deem-to-comply ‘recipe’ footing system designs cover most sites (except Class E & P)
- Maximum differential footing deflection (i.e. serviceability) is specified for the design of footing & rafts in Table 4.1
- Limits damage depending on sensitivity and type of supported elements e.g. masonry.
- Slabs & footings modelled as beams or rafts supported on a foundation are indeterminate systems.
- Software is an efficient modelling tool and has been used to check Section 3 design models to Section 4 engineering principles.
- One such program is ‘*CORD*’ – Code Orientated Raft Design, a commercial footing design program.



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AS 2870 Section 3: Standard Designs

Standard reinforcement designs satisfy the following criteria (of Section 4):

BENDING STRENGTH (cross-section design): Clause 4.4 (f)

- **$M^* \leq \phi M_u$**
  - M_u = nominal moment capacity calculated in accordance with AS 3600, e.g. f_{sy}=500 MPa
  - ϕ = capacity reduction factor (**NOTE:** ϕ=0.85 for both Class L & N steels in AS 2870)

SHEAR STRENGTH (region design, e.g. punching shear): Clause 4.4 (j)

- **$V^* \leq \phi V_u$**
  - V_u = nominal shear capacity (with or without shear reo) calculated in accordance with AS 3600
  - ϕ = capacity reduction factor (ϕ=0.7 for both Class L & N steels)

DUCTILITY (overall member design): Clause 4.4(i)

- **$M_u \geq 1.2M_{cr}$** (minimum bending strength for multiple crack development)
  - flexural cracking moment, M_{cr} (for f'_c= 20 MPa : sagging f_t = 2.7 MPa; hogging f_t = 1.8 MPa)

NOTE: All standard footing designs developed with:

- ϕ = 0.85 (flexure) or 0.7 (shear) for Ductility Class L & N steels.

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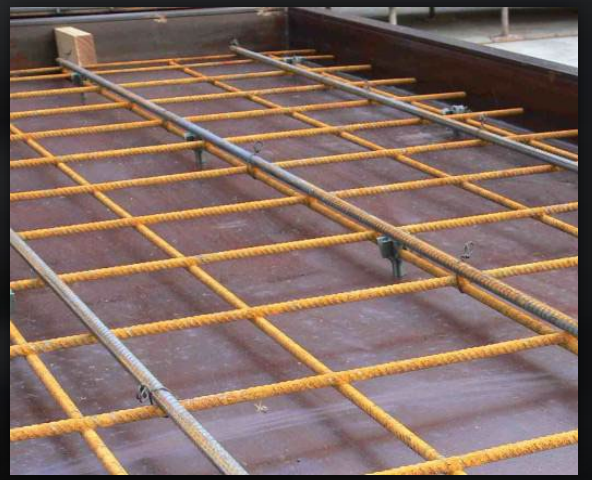
Mixing Ductility Class L & N Steels

If mixing Ductility Class L & N steels together in a single layer, for AS 2870 footing designs they are treated as fully equivalent:

- $\phi = 0.85$ to calculate ϕM_u
  - Moment redistribution is not normally assumed when calculating M^*, which reduces ductility demand on the reinforcing steel
  - No imminent warning requirements
  - Sections normally under-reinforced
  - When calculating nominal moment capacity, M_u, assume all steel is at yield stress, f_{sy} = 500 MPa
- $\phi = 0.7$ to calculate ϕV_u
  - When calculating nominal shear capacity excluding contribution of shear reinforcement, V_{uc}, for example, all fully-anchored Class L & N main bars are fully effective, i.e. use full cross-sectional area.



Class N bars and Class L mesh effectively in a SINGLE LAYER

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AS 2870 Section 3: Standard Designs

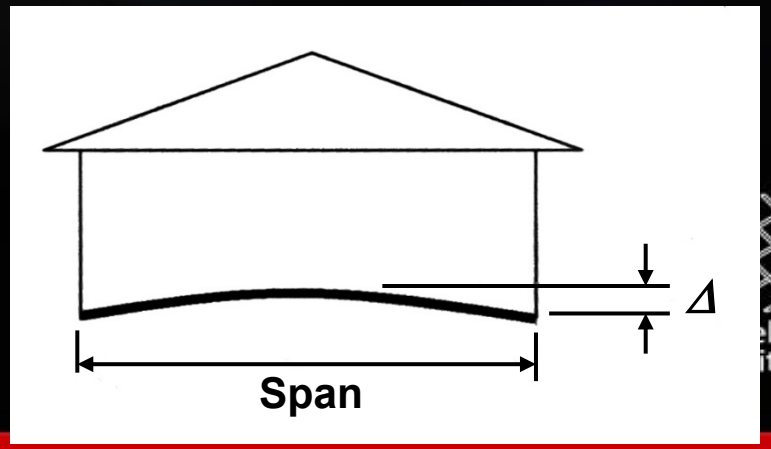
Greatest ductility demand is in Clad or Articulated Masonry Veneer

Maximum Design Differential Footing Deflection for Design of Footings and Rafts (Table 4.1)

Type of construction	Maximum differential deflection, as a function of span, mm	Maximum differential deflection, mm
Clad Frame	L/300	40
Articulated masonry veneer	L/400	30
Masonry veneer	L/600	20
Articulated full masonry	L/800	15
Full masonry	L/2000	10

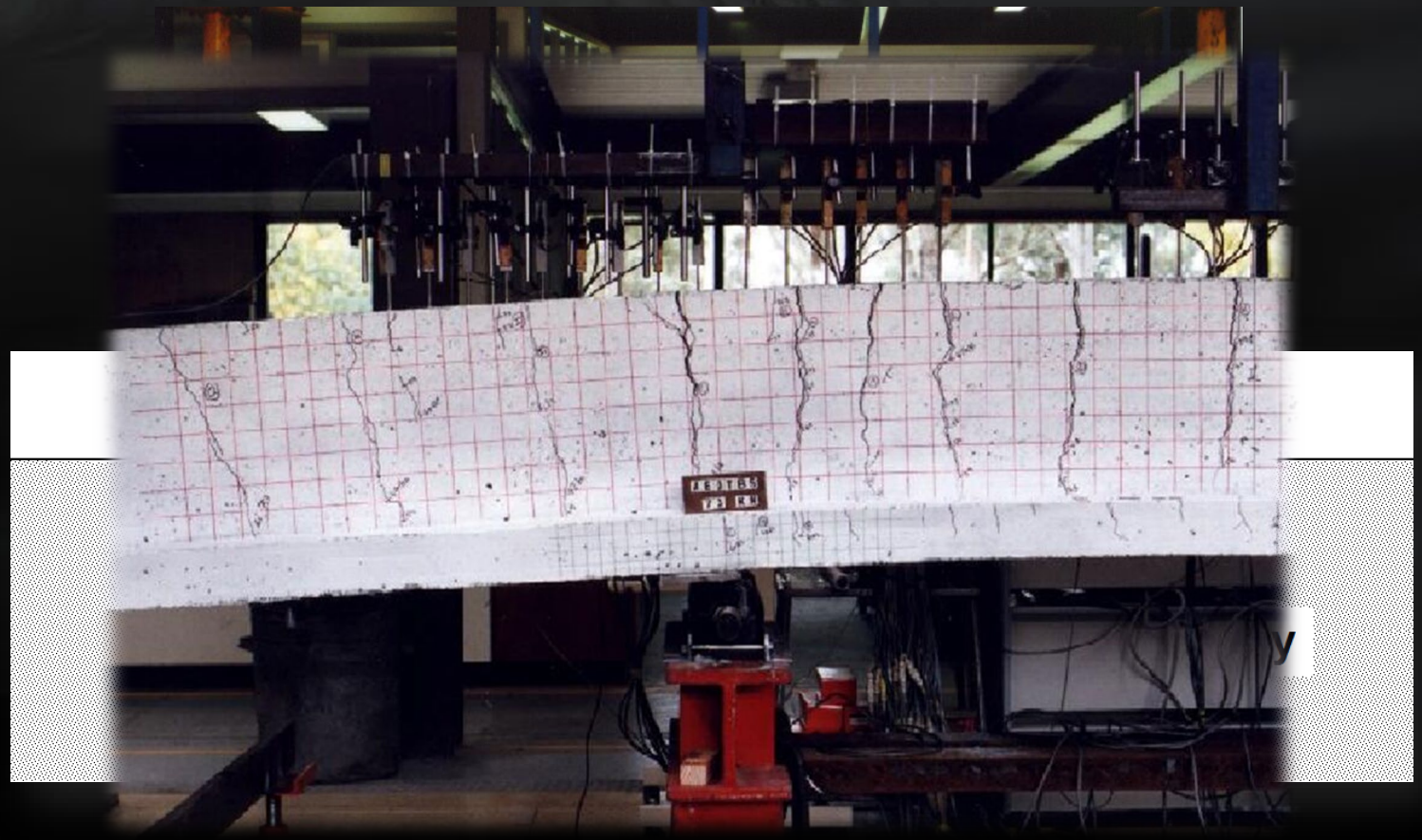
NOTE: Deeper (stiffer) members are required as the design differential deflection reduces.

Their ductility is less, but so is the ductility demand.



AS 2870 Section 3: Standard Designs

These deformations can be accommodated by the ductility of the reinforced-concrete sections incorporating either Class L or N reinforcing steel provided they are designed for multiple cracking.



Steel Reinforcement Institute of Australia

AS 2870 Section 4: Modification of Standard Design

Clause 4.1 GENERAL: *"This Section may be used to extend the range of validity of, or modify, the deemed-to comply designs contained in Section 3…"*

Simplified Method (Clause 4.5)
Design parameters within the following range (Clause 4.5.1)

Design Parameter	Range
y_s	10 mm to 70 mm if H_s > 3 m or 10 mm to 100 mm if H_s < 3 m
Δ	5 mm to 50 mm
Span	5 m to 30 m
Beam spacing	≤ 1.25 values in Figure 3.1 Clause 5.3.9 shall apply at external corners of the building. For Class E sites the beam spacing shall not exceed 5 m.
Beam depth	250 mm to 1200 mm
Minimum depth of any beam	≥ 0.8 max. beam depth
Beam width	110 mm to 400 mm
Design distributed load	≤ 10 kPa
Design edge line load	≤ 25 kN/m

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AS 2870 Section 4: Design by Engineering Principles

Clause 4.5.2: "*…strength shall be provided by the satisfaction of the ductility requirements of Clause 4.4(i)*"

Ductility Requirements & Durability:

- Satisfying the ductility requirement $M_u \geq 1.2M_{cr}$ allows multiple cracks to form over any zone under a high degree of bending.
  - Concrete block elements form between adjacent cracks, spaced approximately *D* apart , providing a mechanism for greater overall member deformation
- Multiple cracking in peak moment regions avoids concentrating the crack width at the first-cracked section.
  - With 3-4 cracks forming in each peak region, more rotation is achieved as demanded by the soil movement, etc., and finer cracks normally maintain durability
  - e.g. 1 crack 0.6 mm wide can be visually a problem, damage finishes or be a corrosion issue, while 3 fine cracks each 0.2 mm wide is good design.
- Class L and N reinforcing steels complying to AS/NZS 4671 have sufficient ductility to ensure adequate deformation capacity.

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AS 2870 Section 4: Design by Engineering Principles

Reinforcement Requirements for Higher Concrete Grade:

- Standard Section 3 footing designs are all based on f'_c = 20MPa and **do not** apply for concrete grades of 32 MPa or greater.
- Higher grade concretes may be required e.g. saline conditions.
- Tensile strength and modulus of elasticity will both increase in proportion to the square root of compressive strength grade, f'_c.

Concrete grade	Modulus of elasticity E MPa	Tensile strength Hogging deformation MPa	Tensile strength Sagging deformation MPa
N20	15000	1.8	2.7
N25	16800	2.0	3.0
N32	19000	2.3	3.4
N40	21200	2.5	3.8

- **If concrete sections remain unchanged, then designers must calculate the steel reinforcement required to satisfy ductility,**

  i.e. $M_u \geq 1.2M_{cr}$.

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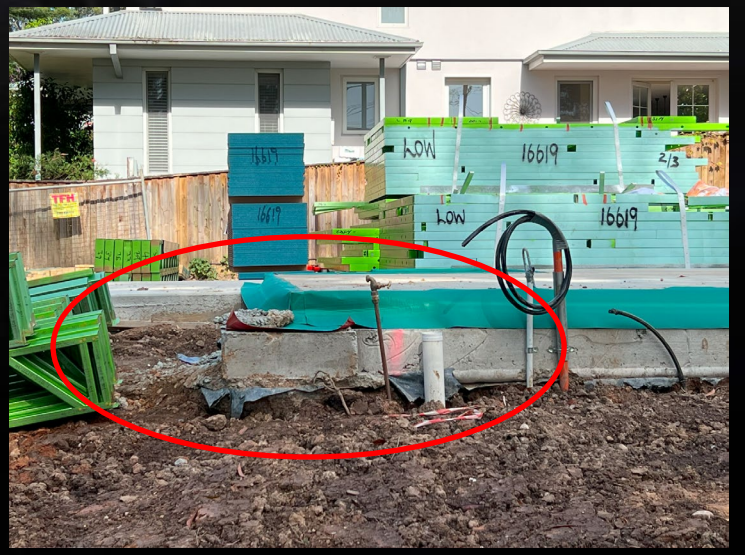
Importance of Site Inspections

- Approval of engineering design & specification requirements.
- Ensure quality materials used
- Site inspection is essential before any concrete placement.
- Take photographs and watch start of a concrete pour if there are concerns.



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Industry Issues Identified with AS 2870

Proposed revision of AS 2870 (2011)

To address problem areas identified since 2011 revision, including:

- Footing performance
- Normal and abnormal sites (weather + zero lot alignments)
- Site classification – impacts of construction
- More guidance for Class P sites
- Guidance for concrete strengths > 25 MPa
- Include high strength reinforcement
- Review reinforcement detailing requirements
- Review plumbing requirements
- Designing for trees (currently informative Appendix)

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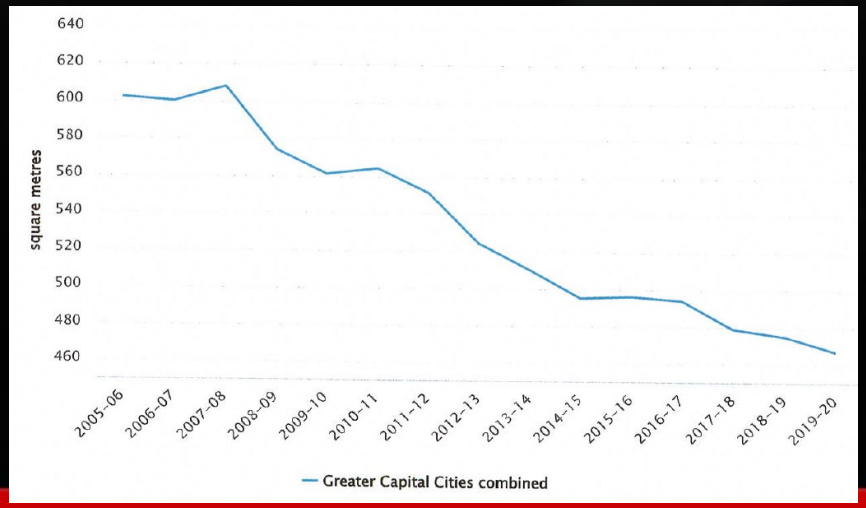
Revision of AS 2870

Normal and Abnormal Sites

- Add new abnormal moisture conditions
- Condition identifying and treating initially desiccated sites
- Zero lot alignment sites
- Smaller lot sizes
- Requirement for trees
- Site classification P
- More guidance for Class P sites



ABS
Released 8-9-2020

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Revision of AS 2870

Site Classification

- Undertaken by suitably qualified people
- More reliable classification in difficult or non-standard conditions
- Currently number of boreholes not specified
- Extent of investigation not covered
- Tree removal during land development (use satellite imagery)
- Basements
- Changes to classification if backfill and drainage not adequate

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Revision of AS 2870

Guidance for Class P Sites

- Currently no guidance provided
- Guidance will provide more standard approach
- Reduce the number of sites outside scope of Standard
- Provide more economical footing designs for Class P sites

Concrete Strengths > 25 MPa

If concrete strength > 25 MPa

- Ductility requirements of Clause 4.4(i) need to be satisfied
- Provide additional Tables to cover 32 MPa and 40 MPa concretes

High Strength Reinforcement

Include use of 600 MPa reinforcement

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Revision of AS 2870

Plumbing Requirements

- Review existing requirements for flexible connections
- Consider encasement for Class E
- Ensure consistency with plumbing Standard

Designing for Trees

- Trees and reduced boundary distances
- Normal and abnormal sites (weather and zero lot alignments)

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Revision of AS 2870

Reinforcement Detailing Requirements

Items to be reviewed and/or included:

- Mesh lapping requirements
- Ensure edge bar located along slab edges
- Bending of reinforcement on site (Tech Note 4)
- Surface condition of reinforcement (Tech Note 1)
- Lap lengths (Tech Note 7)
- Cover set using bar chairs
- Include AS/NZS 2425 reference
- Bar chair spacing (Tech Note 3)

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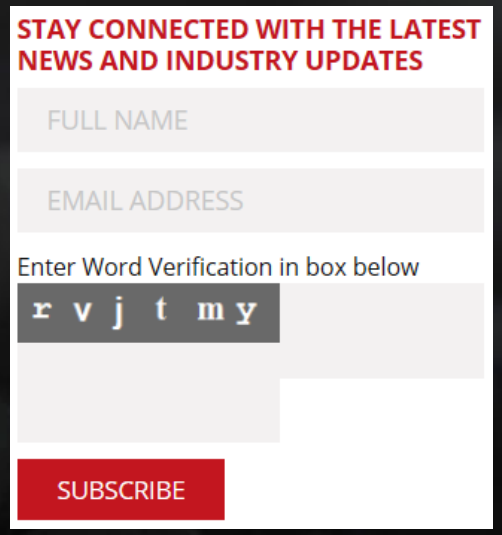

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Residential Slabs and Footings Detailing and Construction Requirements

Eric Lume, National Engineer

Problem or Performance

The most controversial aspect of AS 2870 is almost certainly that some damage may occur even though all parties have fulfilled their obligations competently.

- Some factors unknown even after detailed investigation
- Compromise between cost and reasonably foreseeable actions
- Standard designs not expected to fully resist all actions
- Homeowners may request more conservative design

Clause 1.4.3
The design of footing systems shall consider the following:
(a) Effective drainage of the site
(c) Control, but not prevention, of shrinkage cracking
(d) Control, but not prevention, of cracking due to footing movement
(e) Stiffness and ductility of the footing system
(g) Tolerance of the wall system to movement

Comply with AS 2870 and NCC wherever possible

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Performance – Site Investigation

Number of boreholes required

- Minimum one borehole or pit per building site, or site of extension
- Minimum three boreholes per site if soil known to be highly variable, or $H_s \geq 3.0$ m
- Number across housing subdivision may be reduced if consistent


APPENDIX A – SITE SKETCH

+BH1

APPROXIMATE LOCATION OF PROPOSED DWELLING

GENTLE

BH2+

Site Address:	Logan Reserve
Date:	15/03/2021
Job Number:	

Notes:
1. This site sketch is schematic only and is not to scale.
2. Approximate measurements and locations have been used.
3. Site features in aerial photos may have changed from the time the photo was taken.

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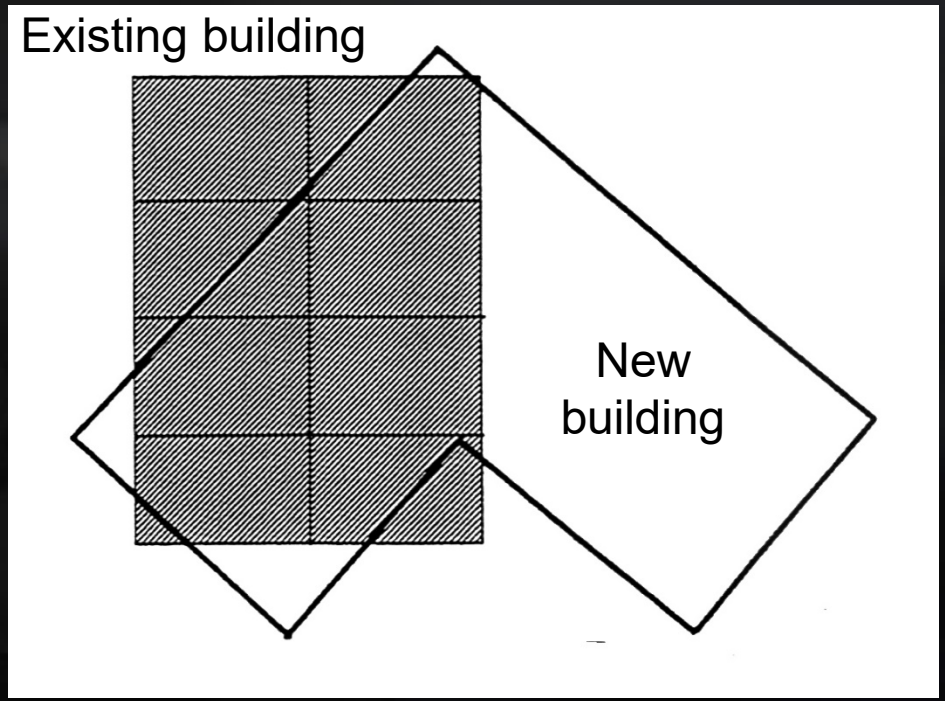
Abnormal Moisture Conditions

- Drains
- Channels
- Ponds
- Dams
- Tanks
- Trees
- Fill
- Urbanisation
- Previous structures
- Onsite wastewater disposal



Previous structure may have changed moisture conditions

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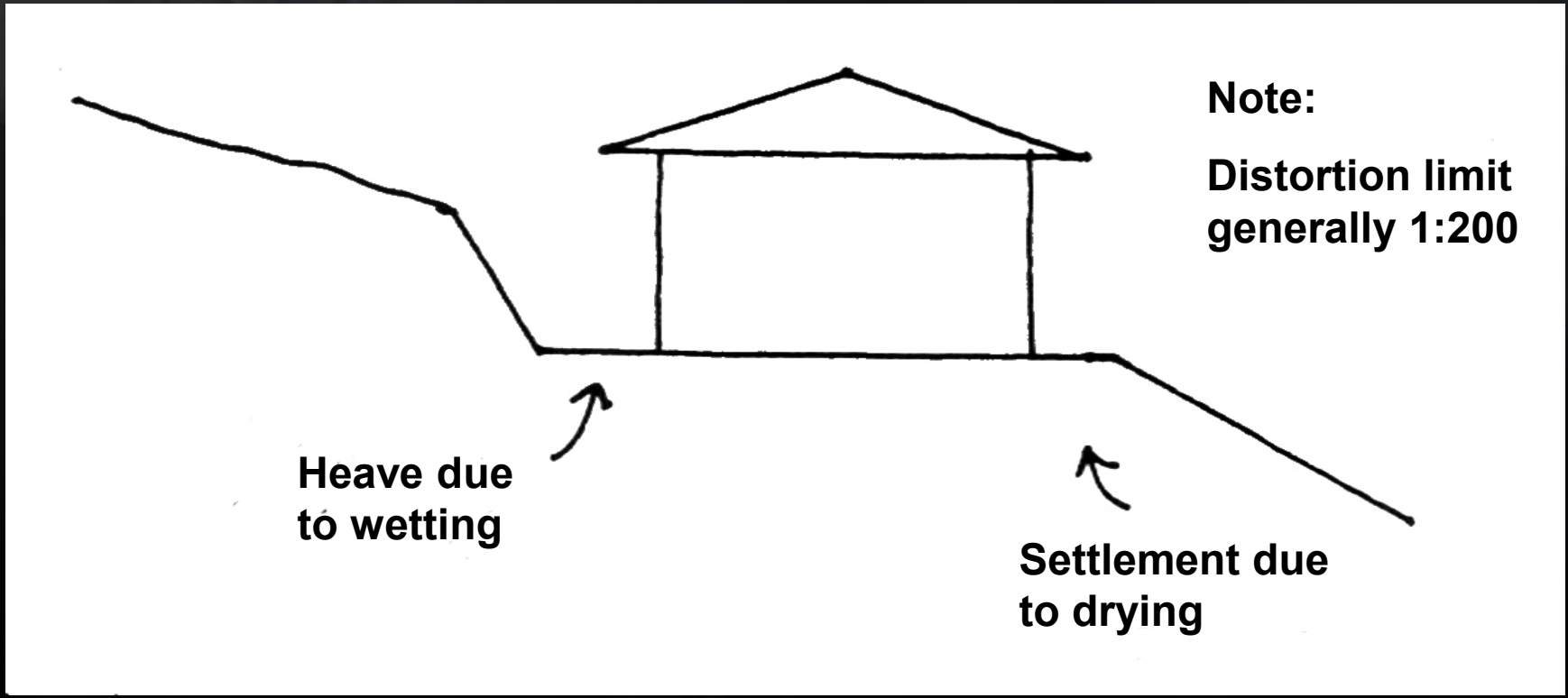
Abnormal Moisture Conditions

Cut and fill



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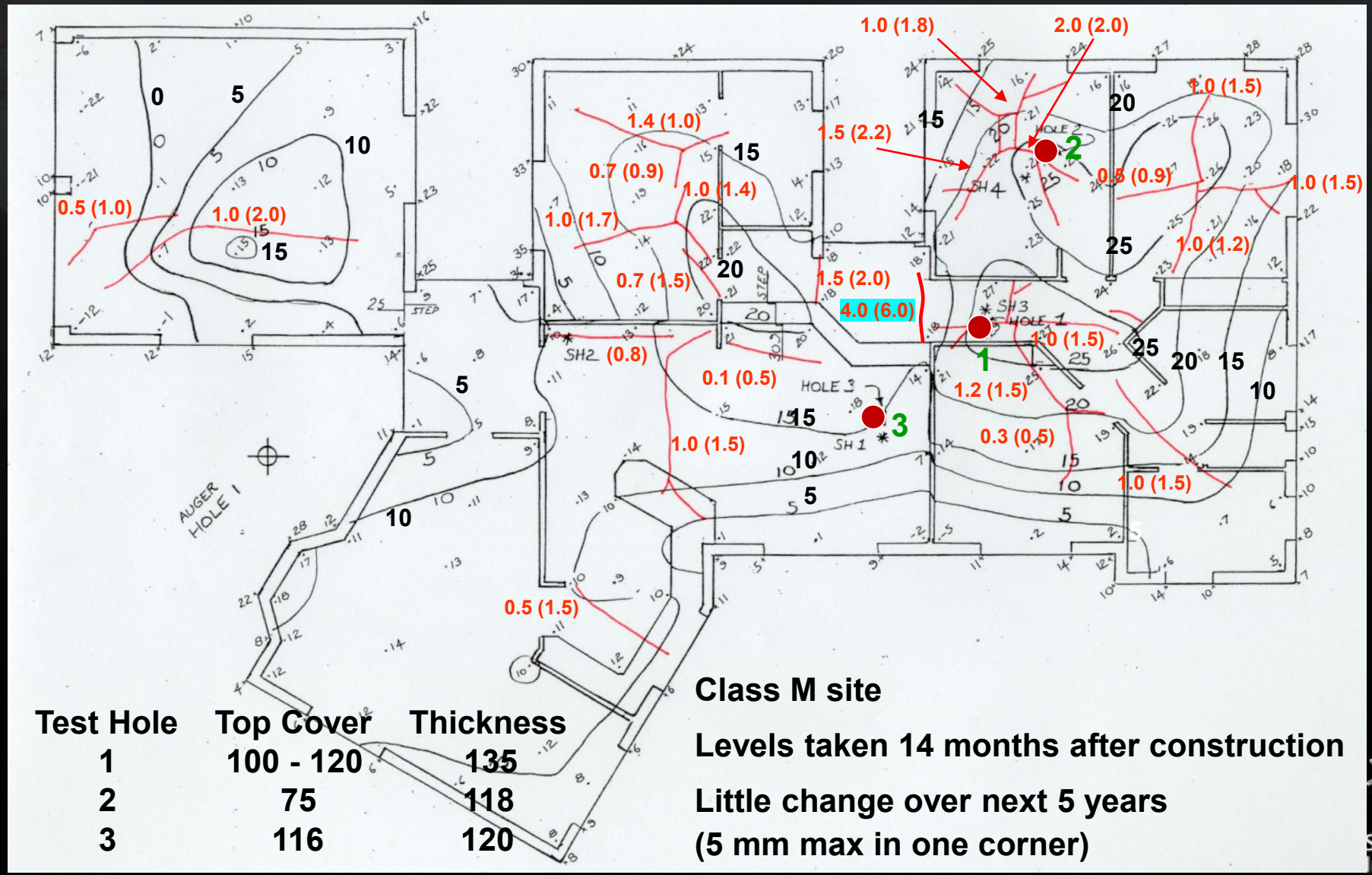
Performance – Average house slab



Test Hole	Top Cover	Thickness
1	100 - 120	135
2	75	118
3	116	120

Class M site

Levels taken 14 months after construction

Little change over next 5 years (5 mm max in one corner)

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Table C2 of AS 2870

Classification of Damage with reference to concrete floors (extract)

Note: Occasional incidence of damage category 2 is expected (Cl 1.3.1)

Description of typical damage	Approx. crack width limit in floor	Change in offset from a 3 m straightedge centred over defect	Damage category
Hairline cracks, insignificant movement of slab from level (Usually no damage – Clause 1.3.1)	< 0.3 mm	< 8 mm	0 Negligible
Fine but noticeable cracks. Slab reasonably level (Low incidence of damage category 1)	< 1.0 mm	< 10 mm	1 Very slight
Cracks noticeable but easily filled. Doors and windows stick slightly (Occasional incidence of Category 2)	< 2.0 mm	< 15 mm	2 Slight

- **How to ensure limits are achieved?**
- **Construct in accordance with Standard**

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Construction in accordance with AS 2870?

Not just about placing concrete

All factors must be considered as contributing to performance

- Classify site correctly
- Select appropriate standard design
- Modify if necessary for site conditions eg rock outcrops, pipes
- Comply with detailing requirements
- Comply with construction requirements
- Unless all requirements satisfied – PERFORMANCE SOLUTION

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Construction in accordance with AS 2870?

Not just about footing/raft design

Walling must also be considered

Articulated Masonry

Section 3 Standard Designs include details for:

- Articulated masonry veneer
- Articulated full masonry

Clause 1.8.1 Articulated full masonry

Full masonry construction incorporating articulation of external and internal walls

Clause 1.8.2 Articulated masonry veneer

Masonry veneer construction incorporating articulation of the masonry veneer.

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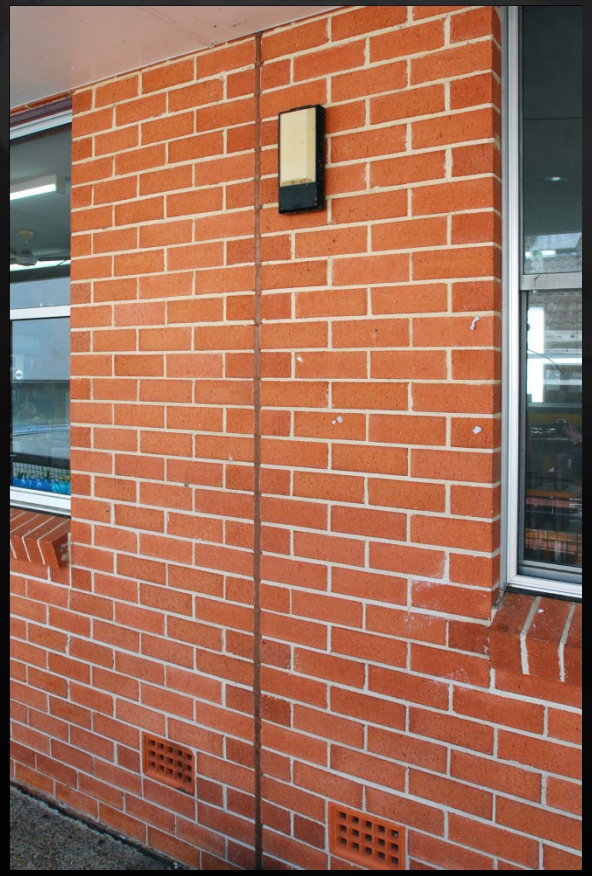
Articulated Masonry

Typical articulation joints



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Articulated Masonry

AS 4773.1 (2015)

Masonry for small buildings

- contains requirements for articulation joints
- called up in NCC (BCA)
- contraction joints included
- expansion joints included

Also refer to:

CCAA TN61

Articulated Walling

www.ccaa.com.au

Referenced in AS 2870

TABLE 13.1

SPACING OF ARTICULATION JOINTS FOR UNREINFORCED MASONRY WALLS

Site class (see Note)	Masonry wall construction and surface finish	Joint spacing, m		
		Up to 4 m high for 10 mm joints	4 m to 8.5 m high for 10 mm joints	4 m to 8.5 m high for 15 mm joints
M, M-D	External face finish masonry	6.0	4.2	6.0
	External rendered and/or painted masonry	5.5	3.9	5.5
	Internal face finish or sheeted masonry	6.0	4.2	6.0
	Internal rendered and/or painted masonry	5.5	3.9	5.5
H1, H1-D	External face finished masonry	5.5	3.9	5.5
	External rendered and/or painted masonry	5.0	3.5	5.0
	Internal face finish or sheeted masonry	5.5	3.9	5.5
	Internal rendered and/or painted masonry	5.0	3.5	5.0
H2, H2-D	External face finished masonry	5.0	3.5	5.0
	External rendered and/or painted masonry	4.5	3.2	4.5
	Internal face finish or sheeted masonry	5.0	3.5	5.0
	Internal rendered and/or painted masonry	4.5	3.2	4.5

NOTE: Site class as defined in AS 2870. For further information and guidance on site classification, see AS 2870.

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Section 5 Detailing Requirements

Drainage

Requirements for rafts and slabs

- Concrete
- Reinforcement
- Vapour barriers and damp-proofing membranes
- Edge rebates
- Recesses in slab panels
- Heating cables and pipes
- Shrinkage cracking control
- Beam continuity in rafts
- Beam layout restrictions

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Section 5 Detailing Requirements

Requirements for Pad and Strip Footings

- Concrete
- Reinforcement
- Stepping of strip footings

Requirements in Aggressive Soils

Additional requirements for Classes M, H1, H2 and E Sites

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Drainage

Avoid water ponding against or near the footing

- Slope ground away from building (50 mm over 1 m width)
- Consider effects of a number of variables such as flooding and landscaping

Avoid water entering the building

For Class 1 buildings, minimum floor height above finished ground or paving level

- 150 mm typically
- 100 mm for sandy, well-drained areas
- 50 mm where adjacent paving slopes away from building
- May be reduced locally (at doorways) if shielded from weather

  (mandatory requirement for level access)

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Vapour Barriers & Damp-proofing Membranes

Materials, properties and installation

- only in AS 2870 (Clause 5.3.3)

NSW and SA

- required to have damp-proofing membrane

Damp-proofing membranes

- Film thickness – 0.2 mm
- High impact resistance – Falling Dart Test
- Resistance to puncture and moisture penetration – CSIRO Test

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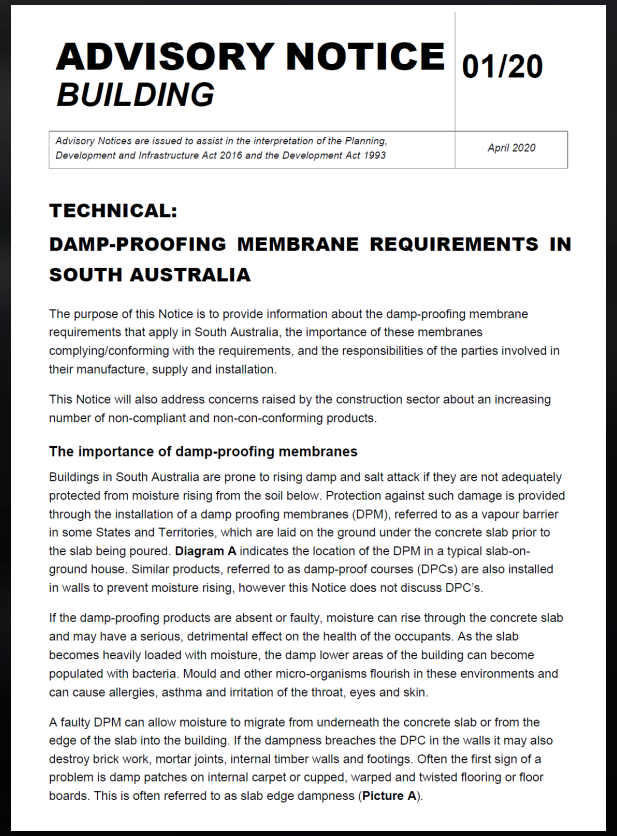
Damp-proofing Membranes

To ensure products meet requirements of NCC

- Obtain evidence of conformity and compliance
- Builders and inspectors should check that material supplied and installed is what has been specified in the plans and specifications
- Check that product is continuously branded as required by NCC
- Refer Advisory Notice Building 01/20
  Department for Infrastructure and Transport, SA



ADVISORY NOTICE 01/20
BUILDING

Advisory Notices are issued to assist in the interpretation of the Planning, Development and Infrastructure Act 2016 and the Development Act 1993 — *April 2020*

TECHNICAL:

DAMP-PROOFING MEMBRANE REQUIREMENTS IN SOUTH AUSTRALIA

The purpose of this Notice is to provide information about the damp-proofing membrane requirements that apply in South Australia, the importance of these membranes complying/conforming with the requirements, and the responsibilities of the parties involved in their manufacture, supply and installation.

This Notice will also address concerns raised by the construction sector about an increasing number of non-compliant and non-con-conforming products.

The importance of damp-proofing membranes

Buildings in South Australia are prone to rising damp and salt attack if they are not adequately protected from moisture rising from the soil below. Protection against such damage is provided through the installation of a damp proofing membranes (DPM), referred to as a vapour barrier in some States and Territories, which are laid on the ground under the concrete slab prior to the slab being poured. **Diagram A** indicates the location of the DPM in a typical slab-on-ground house. Similar products, referred to as damp-proof courses (DPCs) are also installed in walls to prevent moisture rising, however this Notice does not discuss DPC's.

If the damp-proofing products are absent or faulty, moisture can rise through the concrete slab and may have a serious, detrimental effect on the health of the occupants. As the slab becomes heavily loaded with moisture, the damp lower areas of the building can become populated with bacteria. Mould and other micro-organisms flourish in these environments and can cause allergies, asthma and irritation of the throat, eyes and skin.

A faulty DPM can allow moisture to migrate from underneath the concrete slab or from the edge of the slab into the building. If the dampness breaches the DPC in the walls it may also destroy brick work, mortar joints, internal timber walls and footings. Often the first sign of a problem is damp patches on internal carpet or cupped, warped and twisted flooring or floor boards. This is often referred to as slab edge dampness (**Picture A**).

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Slab Edge Dampness - Indicators

- Persistent dampness of the exposed face
- Pungent odours in floor coverings
- Watermark stains on walls
- Mould growth
- External paint blistering/peeling below the DPC
- Delaminating (drummy) render below the DPC

(courtesy New Home Inspections, Melbourne)

(courtesy Visual Landscaping, Adelaide)

(courtesy Visual Landscaping, Adelaide)

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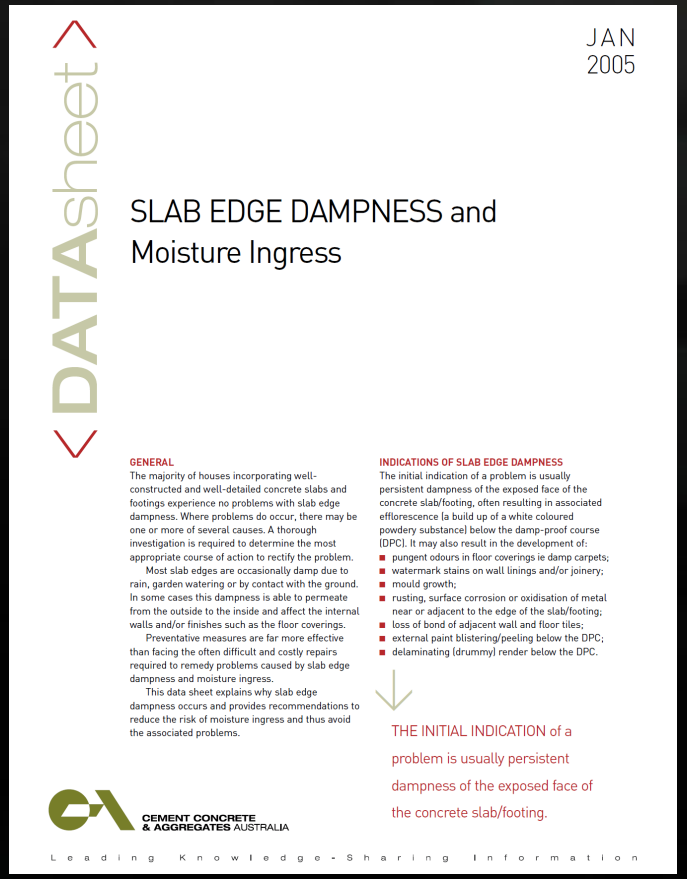
Slab Edge Dampness

Some Resources

1. CCAA Data Sheet - Slab Edge Dampness and Moisture Ingress
2. CIA – Slab Edge Dampness



DATAsheet

JAN 2005

SLAB EDGE DAMPNESS and Moisture Ingress

GENERAL

The majority of houses incorporating well-constructed and well-detailed concrete slabs and footings experience no problems with slab edge dampness. Where problems do occur, there may be one or more of several causes. A thorough investigation is required to determine the most appropriate course of action to rectify the problem.

Most slab edges are occasionally damp due to rain, garden watering or by contact with the ground. In some cases this dampness is able to permeate from the outside to the inside and affect the internal walls and/or finishes such as the floor coverings.

Preventative measures are far more effective than facing the often difficult and costly repairs required to remedy problems caused by slab edge dampness and moisture ingress.

This data sheet explains why slab edge dampness occurs and provides recommendations to reduce the risk of moisture ingress and thus avoid the associated problems.

INDICATIONS OF SLAB EDGE DAMPNESS

The initial indication of a problem is usually persistent dampness of the exposed face of the concrete slab/footing, often resulting in associated efflorescence (a build up of a white coloured powdery substance) below the damp-proof course (DPC). It may also result in the development of:

- pungent odours in floor coverings ie damp carpets;
- watermark stains on wall linings and/or joinery;
- mould growth;
- rusting, surface corrosion or oxidisation of metal near or adjacent to the edge of the slab/footing;
- loss of bond of adjacent wall and floor tiles;
- external paint blistering/peeling below the DPC;
- delaminating (drummy) render below the DPC.

THE INITIAL INDICATION of a problem is usually persistent dampness of the exposed face of the concrete slab/footing.

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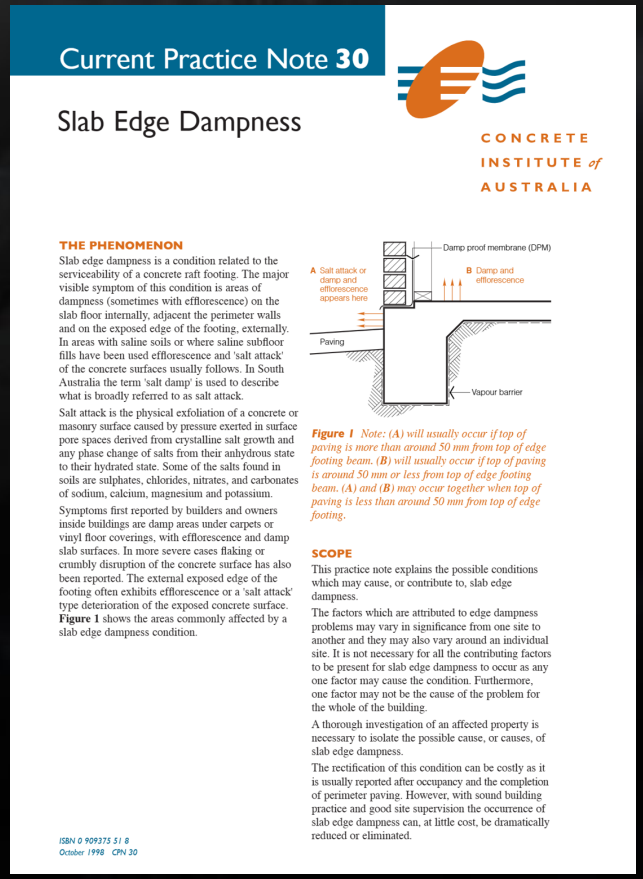
Leading Knowledge-Sharing Information



Current Practice Note 30

Slab Edge Dampness

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THE PHENOMENON

Slab edge dampness is a condition related to the serviceability of a concrete raft footing. The major visible symptom of this condition is areas of dampness (sometimes with efflorescence) on the slab floor internally, adjacent the perimeter walls and on the exposed edge of the footing, externally. In areas with saline soils or where saline subfloor fills have been used efflorescence and 'salt attack' of the concrete surfaces usually follows. In South Australia the term 'salt damp' is used to describe what is broadly referred to as salt attack.

Salt attack is the physical exfoliation of a concrete or masonry surface caused by pressure exerted in surface pore spaces derived from crystalline salt growth and any phase change of salts from their anhydrous state to their hydrated state. Some of the salts found in soils are sulphates, chlorides, nitrates, and carbonates of sodium, calcium, magnesium and potassium.

Symptoms first reported by builders and owners inside buildings are damp areas under carpets or vinyl floor coverings, with efflorescence and damp slab surfaces. In more severe cases flaking or crumbly disruption of the concrete surface has also been reported. The external exposed edge of the footing often exhibits efflorescence or a 'salt attack' type deterioration of the exposed concrete surface. **Figure 1** shows the areas commonly affected by a slab edge dampness condition.

Figure 1 *Note: (**A**) will usually occur if top of paving is more than around 50 mm from top of edge footing beam. (**B**) will usually occur if top of paving is around 50 mm or less from top of edge footing beam. (**A**) and (**B**) may occur together when top of paving is less than around 50 mm from top of edge footing.*

SCOPE

This practice note explains the possible conditions which may cause, or contribute to, slab edge dampness.

The factors which are attributed to edge dampness problems may vary in significance from one site to another and they may also vary around an individual site. It is not necessary for all the contributing factors to be present for slab edge dampness to occur as any one factor may cause the condition. Furthermore, one factor may not be the cause of the problem for the whole of the building.

A thorough investigation of an affected property is necessary to isolate the possible cause, or causes, of slab edge dampness.

The rectification of this condition can be costly as it is usually reported after occupancy and the completion of perimeter paving. However, with sound building practice and good site supervision the occurrence of slab edge dampness can, at little cost, be dramatically reduced or eliminated.

ISBN 0 909375 51 8
October 1998 CPN 30

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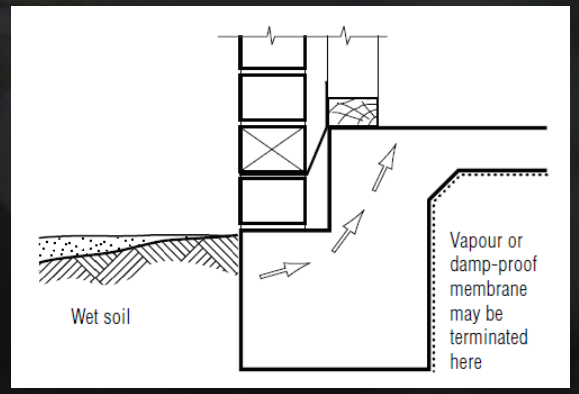
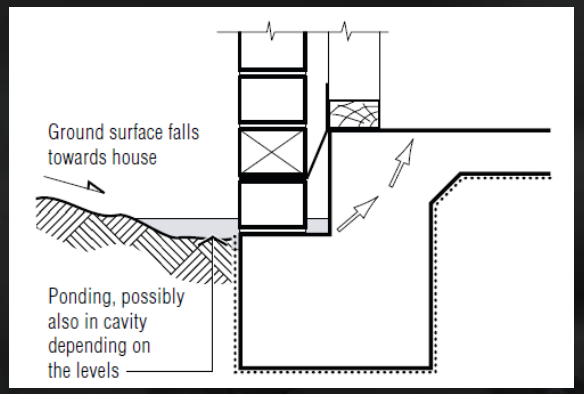
Slab Edge Dampness Causes and Solutions

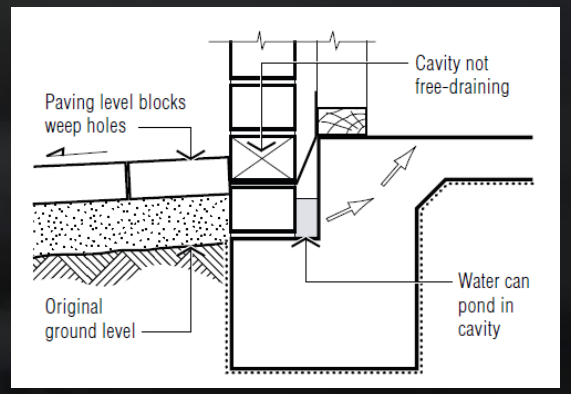
Not Recommended



Slab edge in direct contact with ground

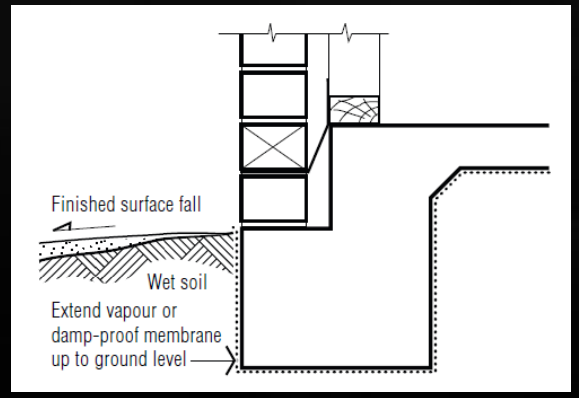


Inadequate drainage

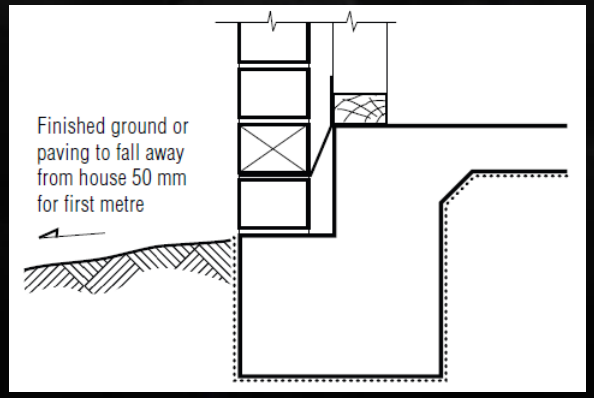


Inadequate cavity drainage

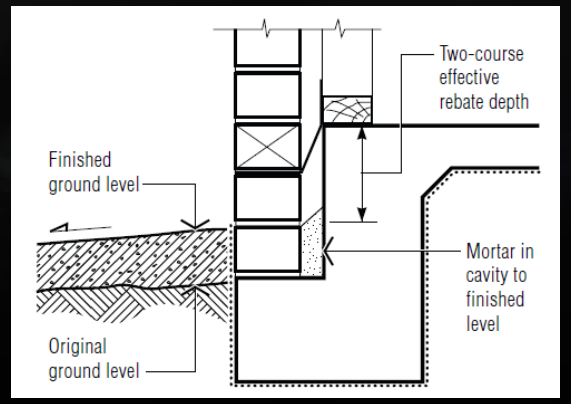
Recommended



Extend vapour barrier to ground level



Free draining cavity and surrounds



Mortar filled cavity to finished ground level

Images from CCAA Data Sheet

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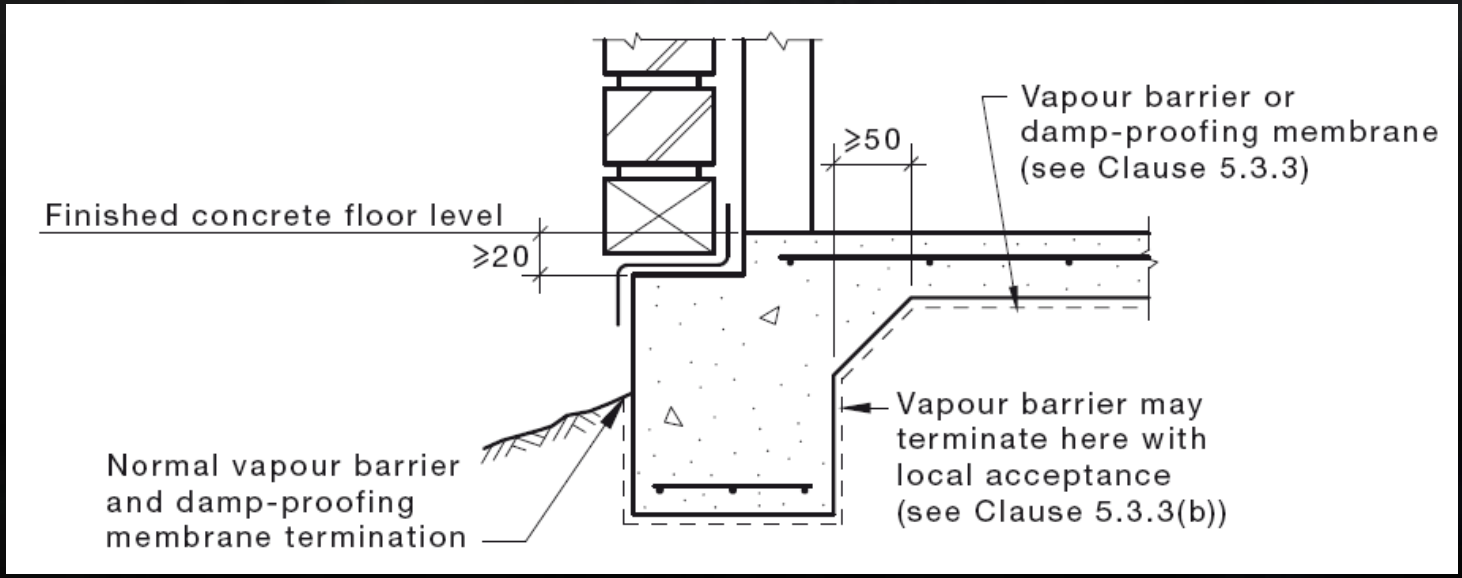
Edge Rebates

- Minimum depth of 20 mm, except for single-leaf masonry
- Requirements for depths > 150 mm
- Where retaining > 450mm of fill – refer Clause 6.4.5



Minimum rebate for cavity masonry or veneer wall

(Figure 5.2(a) from AS 2870 - 2011)

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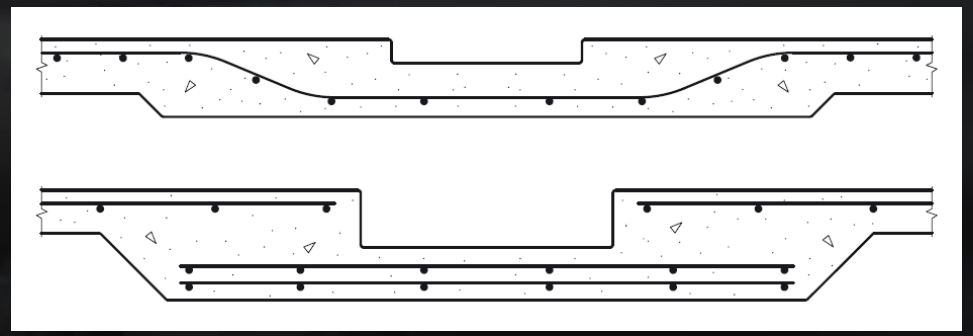
Requirements for Rafts and Slabs

Recesses in slab panels

- Required slab thickness to be maintained
- Continuity of reinforcement to be maintained

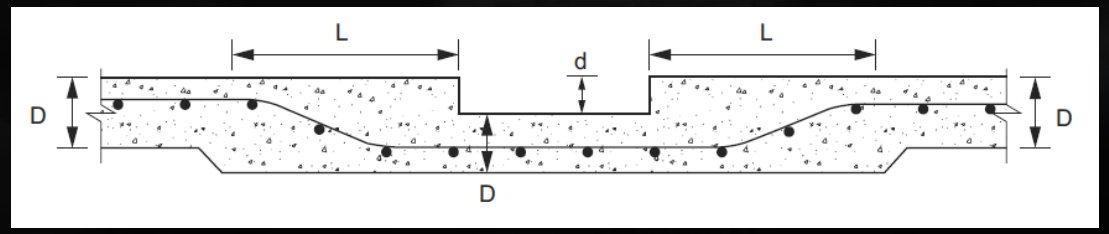
Slab detail at a recess

(Figure 5.3 from AS 2870 - 2011)

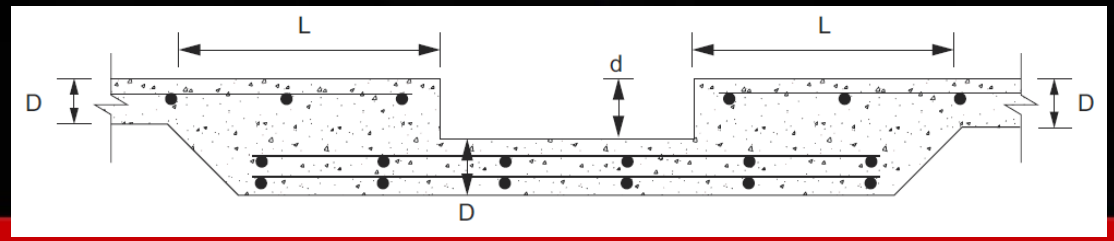


Section 4.2.22 of NCC Housing Provisions Standard

Recess depths (d) less than or equal to nominal slab thickness



Recess depths (d) greater than nominal slab thickness



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Requirements for Rafts and Slabs

Shrinkage cracking control

- Re-entrant corners – 2 x 3-L8TM, 1 x 3-L11TM or 3-N12
- Brittle floor coverings
  - Minimum SL92 mesh or extra layer of slab mesh
  - Use appropriate bedding system
  - Delay placement of brittle finishes

Large tiled areas

Polished concrete

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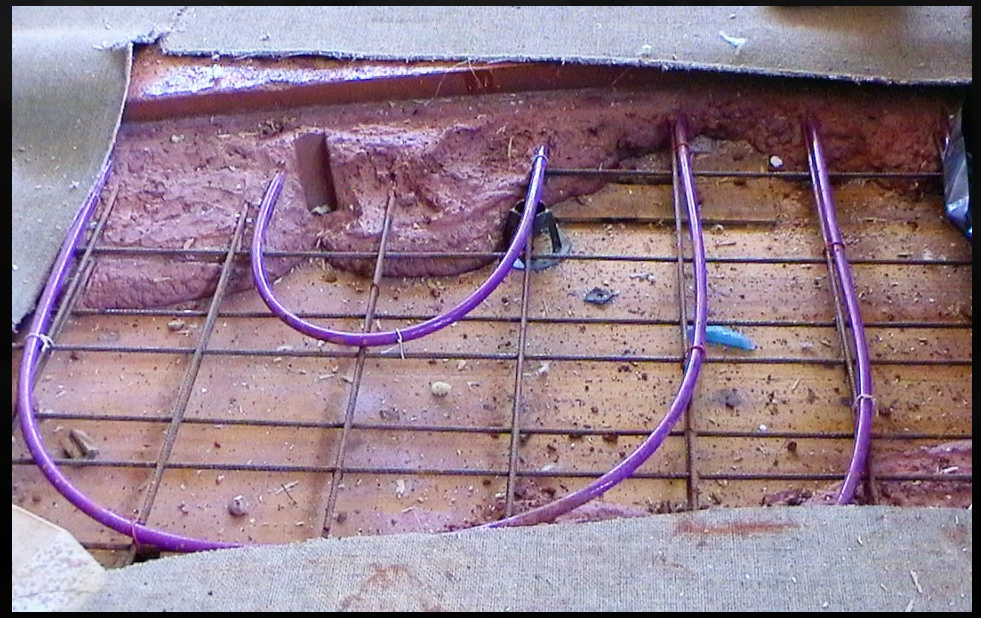
Requirements for Rafts and Slabs

Shrinkage cracking control – floor heating

- Electric systems – no increase in slab thickness or mesh size
- Hydronic systems
  - increase slab thickness by 25 mm
  - increase mesh by one size

Hydronic floor heating system



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Requirements for Rafts and Slabs

Beam continuity in rafts

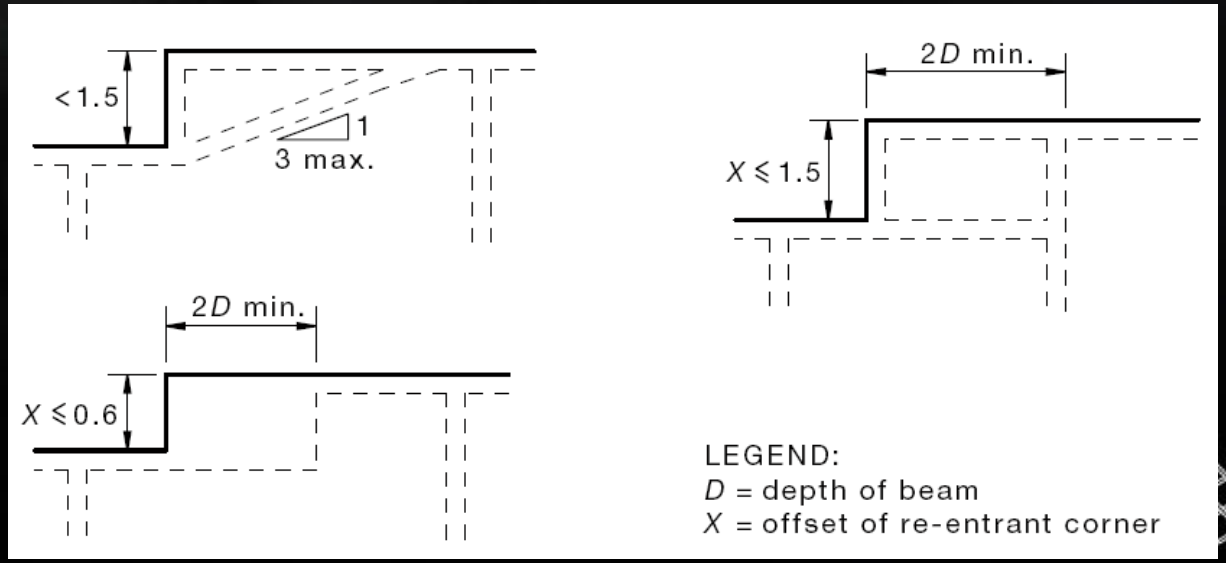
Continuity of internal and external beams must be maintained

- from edge to edge of the slab
- across steps in the slab (Clause 6.4.4 (c) (iii))
- at re-entrant corners
  - provide internal beam
  - if < 1.5 m, refer details in Figure 5.4

Continuity of footing beams

(Figure 5.4 from AS 2870 - 2011)

(dimensions in metres)



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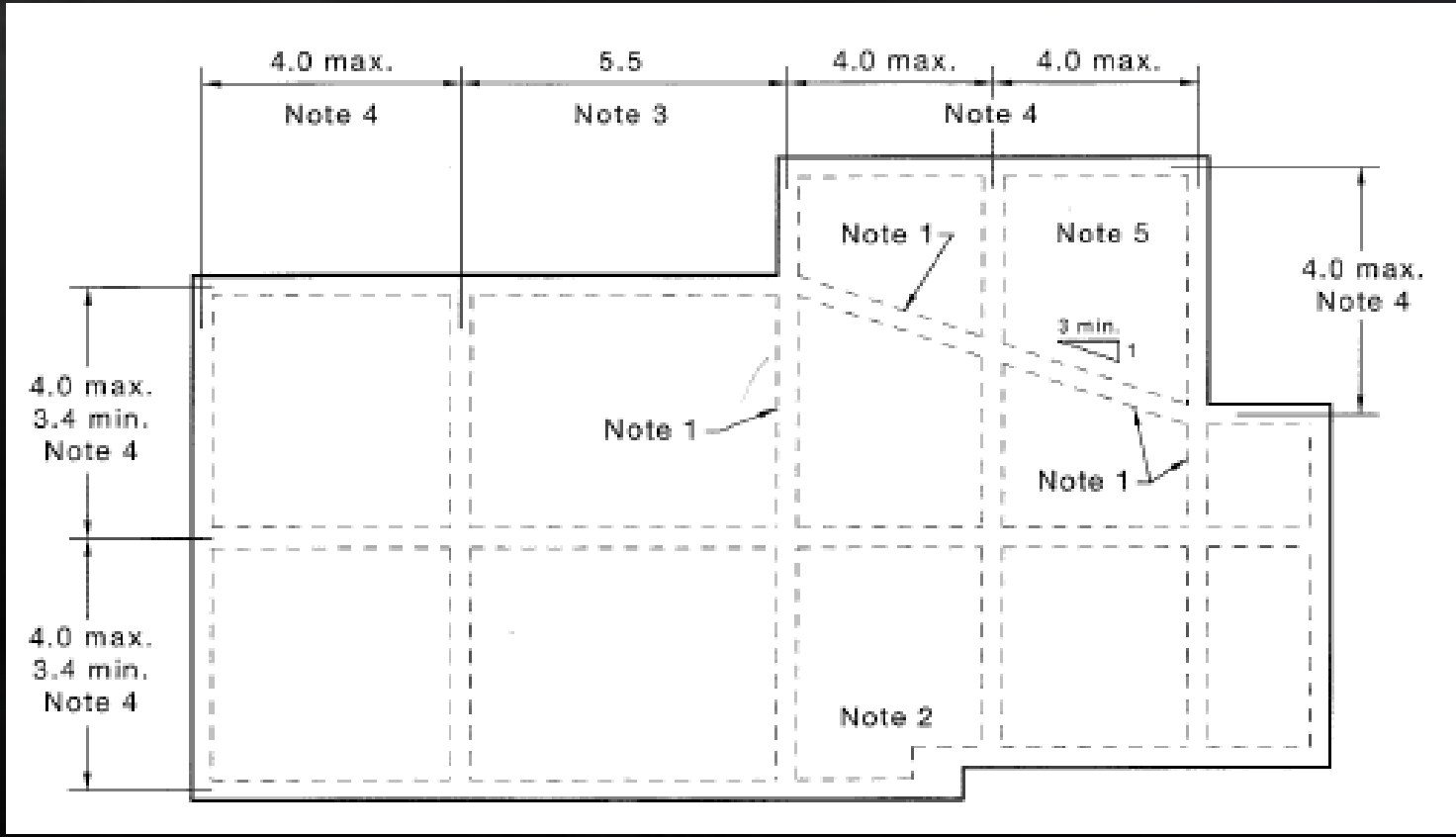
Requirements for Rafts and Slabs

Beam continuity in rafts - Commentary



Arrangement of stiffening beams

(Figure C5.4 from AS 2870 - 2011)

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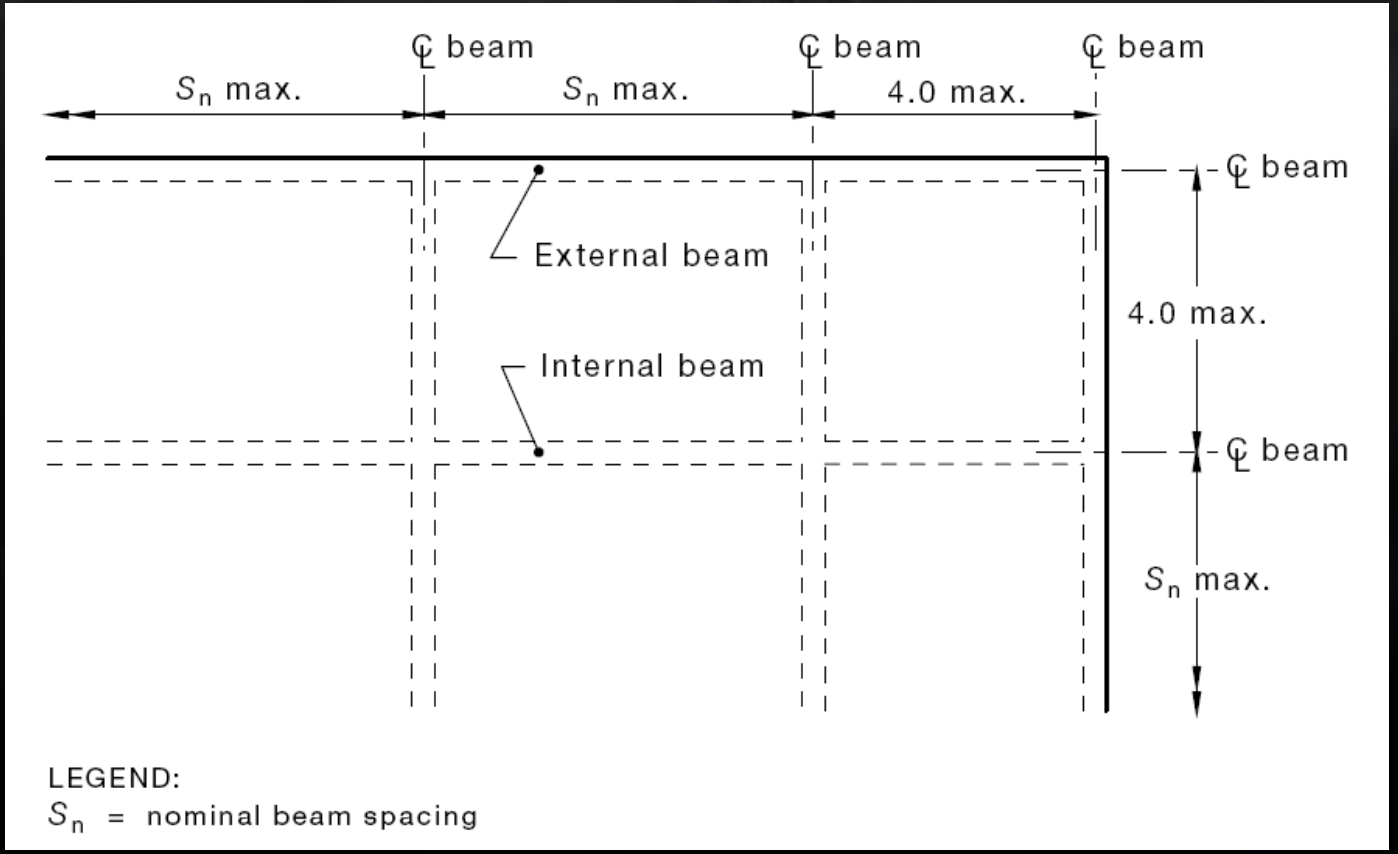
Requirements for rafts and slabs

Beam layout restrictions

Limits placed on spacing of internal beams at external corners

- Controls deflection at external corner



Beam spacing at external corners (Figure 5.5 from AS 2870 - 2011)

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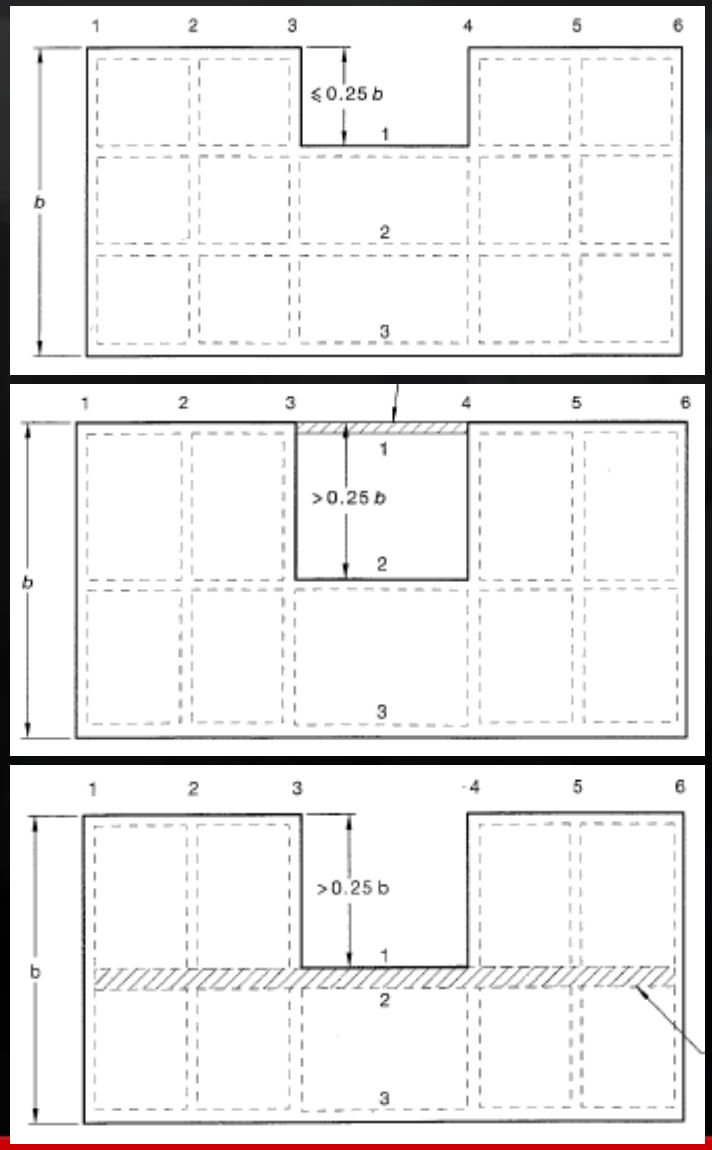
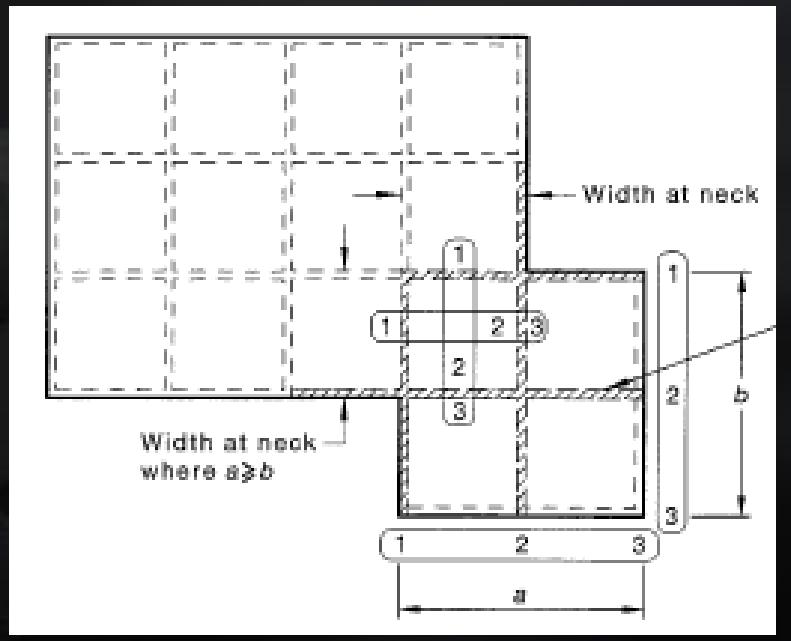
Requirements for Rafts and Slabs

Beam continuity in rafts – maintain stiffness





Arrangement of stiffening beams

(Figure C5.5 from AS 2870 - 2011)

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Requirements for Rafts and Slabs

Beam continuity in rafts – maintain stiffness

Some beams not continuous

Continue internal beam

Internal beam max. 4 m from corners?

Provide additional internal beams

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Requirements for Rafts and Slabs

Beam continuity in rafts – maintain stiffness

Continue edge beam
to next internal beam

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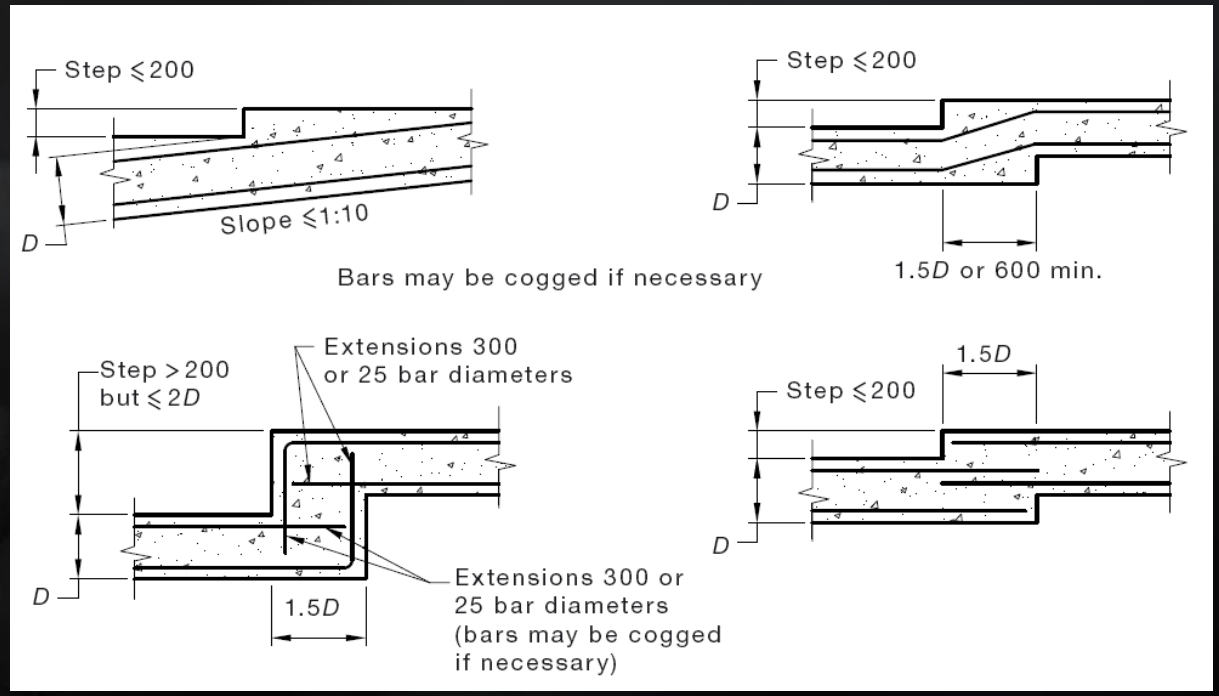
Requirements for Pad and Strip Footings

Concrete – as for rafts and slabs

Reinforcement – covered

Stepping of strip footings



Acceptable methods of stepping strip footings

(Figure 5.6 from AS 2870 - 2011)

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Cover to Reo – May be Difficult to Maintain

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Requirements in Aggressive Soils

Saline and sulphate soils

Western Sydney

Wagga Wagga NSW

Efflorescence is more common sign of soil salinity

Ineffective damp proof course?

Filled above damp proof course?

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Requirements in Aggressive Soils

Requirements in Aggressive Soils – Clause 5.5

Two choices:

1. Isolate the concrete or masonry member from the aggressive soil
2. Use appropriate concrete strength and cover

Isolation of Concrete

Provide damp-proofing membrane up to ground or finished paving level

- Extend membrane from under slab up to ground or paving surface
- Lap membrane from under slab with suitable damp-proofing material (0.5 mm thick) or liquid-applied waterproofing compound applied to face of concrete and extend up to finished ground or paving level

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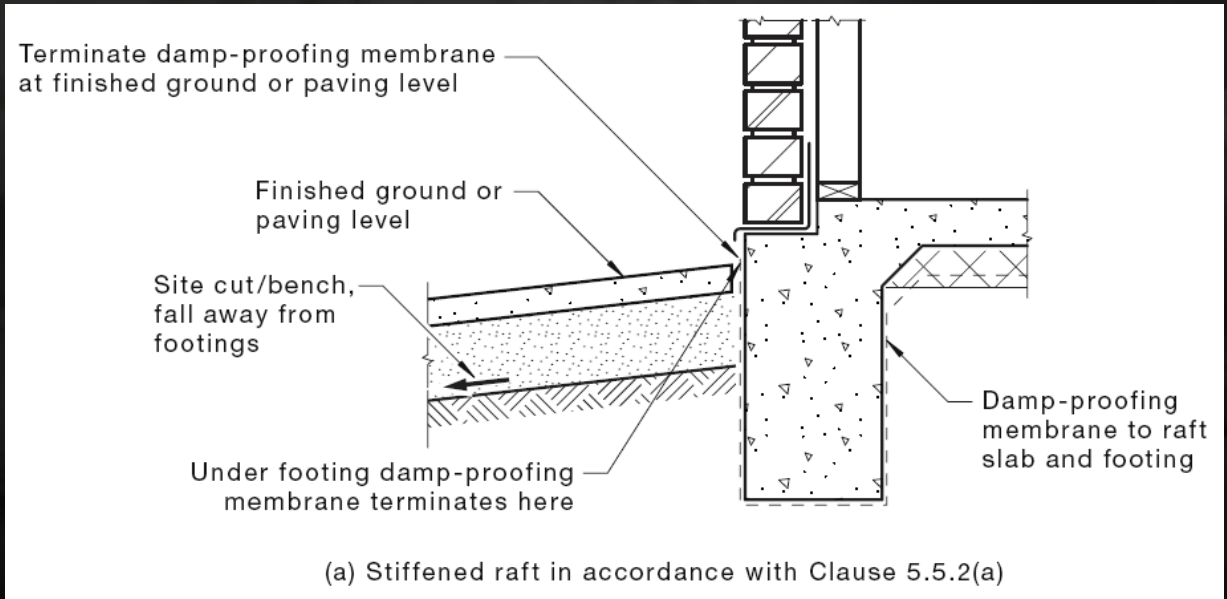
Requirements in Aggressive Soils

Extend membrane from under slab up to finished ground or paving level



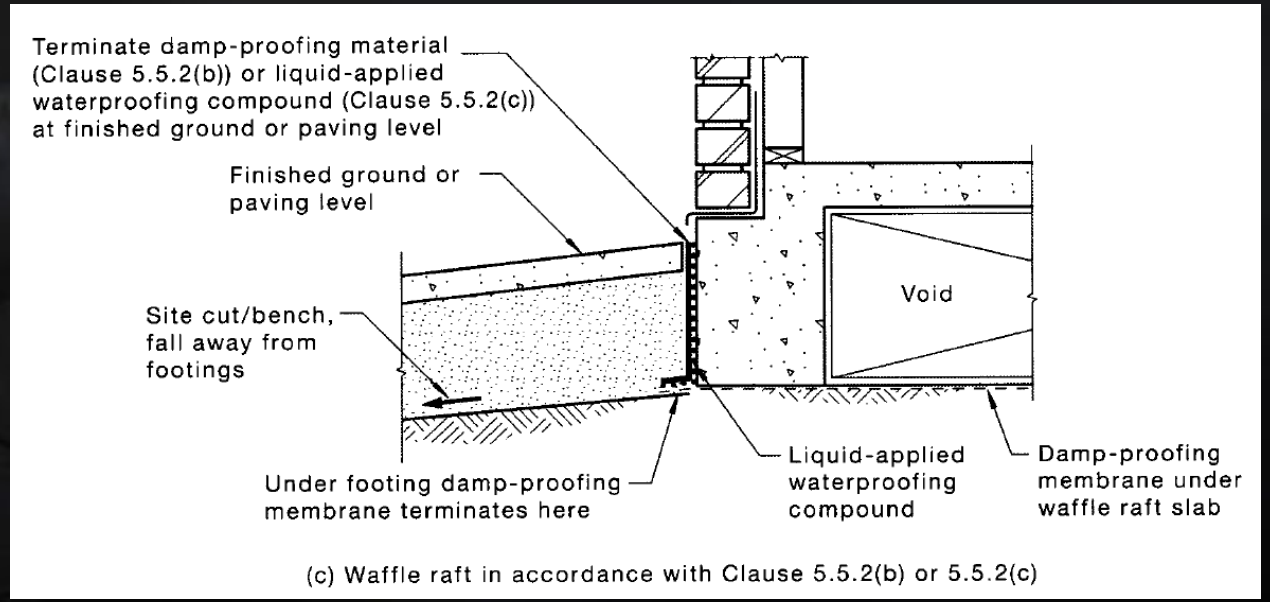


Figure 5.7 Use of damp-proofing membrane for slab protection

(from AS 2870 - 2011)

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Requirements in Aggressive Soils

Some situations may be difficult to comply or rectify

Consider alternate edge treatments to exclude aggressive agents

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Requirements in Aggressive Soils

Appropriate concrete strength and detailing

Step 2 Determine required concrete strength and curing

Minimum design characteristic strength (f_c') and curing requirements for concrete (after Table 5.3 of AS 2870 - 2011)

Exposure classification	Minimum MPa	Minimum initial curing requirement
A1	20	Cure continuously for at least 3 days
A2	25	
B1	32	Cure continuously for at least 7 days
B2	40	
C1	≥50	
C2	≥50	

- **Standard designs only apply to 20 and 25 MPa concrete (Clause 3.1.1 of AS 2870)**
- **For higher strengths, check ductility requirements**

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Requirements in Aggressive Soils

Appropriate concrete strength and detailing

Step 3 Determine minimum reinforcement cover

Minimum reinforcement cover for concrete (after Table 5.4 of AS 2870 - 2011)

Exposure classification	Minimum cover in saline soils (mm)	Minimum cover in sulfate soils (mm)
A1	No change	40
A2	45	50
B1	50	60
B2	55	65
C1	Not applicable to salinity	70
C2	Not applicable to salinity	85

Concrete

- N20, 100 mm slump, 20 mm maximum nominal aggregate size
- In accordance with AS 1379 – ensures quality, not final performance

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Section 6 Construction requirements

Excavations

- If permanent, retain material or batter sides
- If temporary, ensure adequate support of footings is maintained

Construction of slabs

- Filling – controlled and rolled
- Foundations – Natural soil of 50 kPa bearing capacity for slabs
  - Natural soil of 100 kPa bearing capacity for edge footings not tied to a footing slab
  - stepping and sloping of edge beams
  - blinding layer of sand only required for aggressive soils
- Sloping Sites – details of cut and fill
  - stepping of slabs and beams
  - requirements for piers

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Additional requirements for Class M, H1, H2 and E Sites

Masonry detailing – control joints

Variations in foundation material – part of footing on rock

Drainage requirements – avoid water ponding adjacent to or under footings

Plumbing requirements – Clause 5.6.4 (b) and 6.6 (e) (i)

- Penetrations through footings - sleeved
- Flexible joints to drains – highly and extremely reactive sites
  - commence within 1 m of the building perimeter
  - accommodate movement up to y_s in any direction
  - be set at mid-position of their range at time of installation

    ie movement range of 0.5 y_s from the initial setting

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Additional requirements for Class M, H1, H2 and E Sites

Flexible joints to drains (only when passing through footing?)

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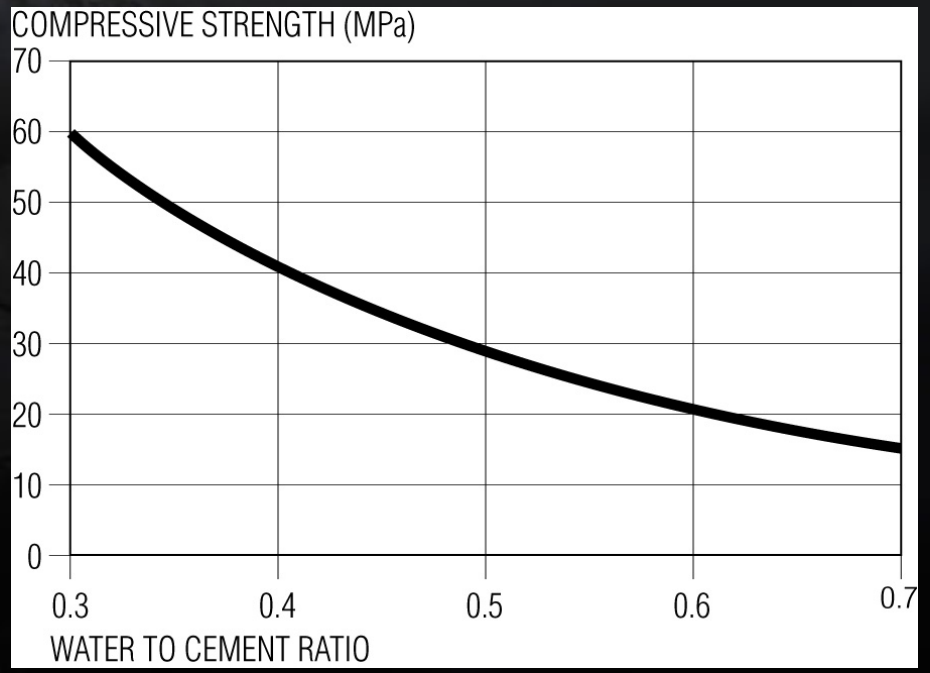
Placing, Compaction and Curing of Concrete

Addition of excess water on-site

Should be avoided - reduces strength



w/c ratio vs strength

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Placing, Compaction and Curing of Concrete

Addition of excess water on-site

- Produces Laitance/efflorescence
- May result in Flaking
- Increases risk of Cracking
  - both plastic and long-term drying shrinkage

Efflorescence

Flaking

Cracking

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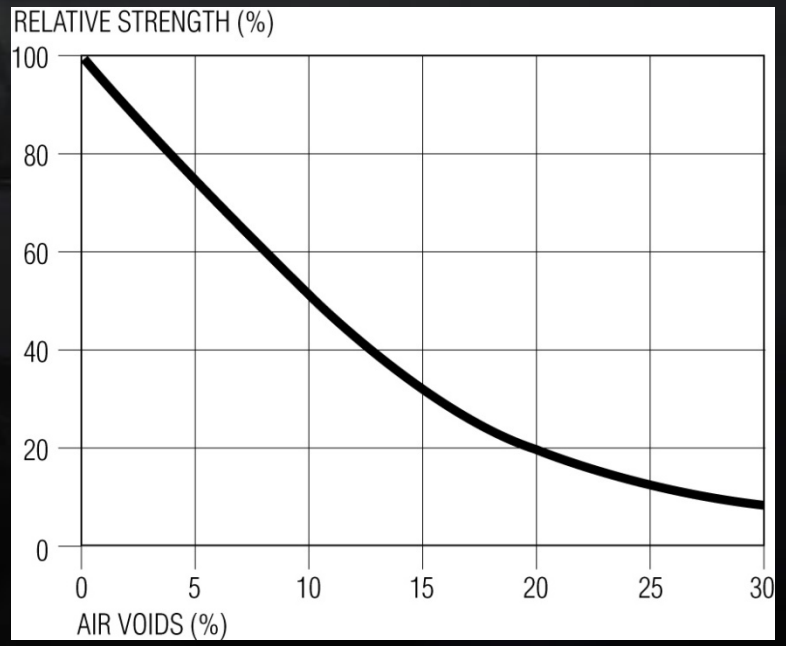
Placing, Compaction and Curing of Concrete

Compaction

Expels entrapped air – improves strength and reduces risk of cracking



Loss of Strength through incomplete compaction

Adequate compaction

- Beams – mechanically vibrate
- Slabs – finishing operations satisfactory for 100 mm thickness

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Placing, Compaction and Curing of Concrete

Compaction

Lack of compaction reduces durability and strength

Increases risk of slab edge dampness

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Placing, Compaction and Curing of Concrete

Curing

- Application of water to or retention of water in concrete
- Improves strength
- Reduces permeability
- Reduces risk of cracking and crack widths

Add water to concrete
(must be continuous)

Retain water in concrete

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Placing, Compaction and Curing of Concrete

Curing

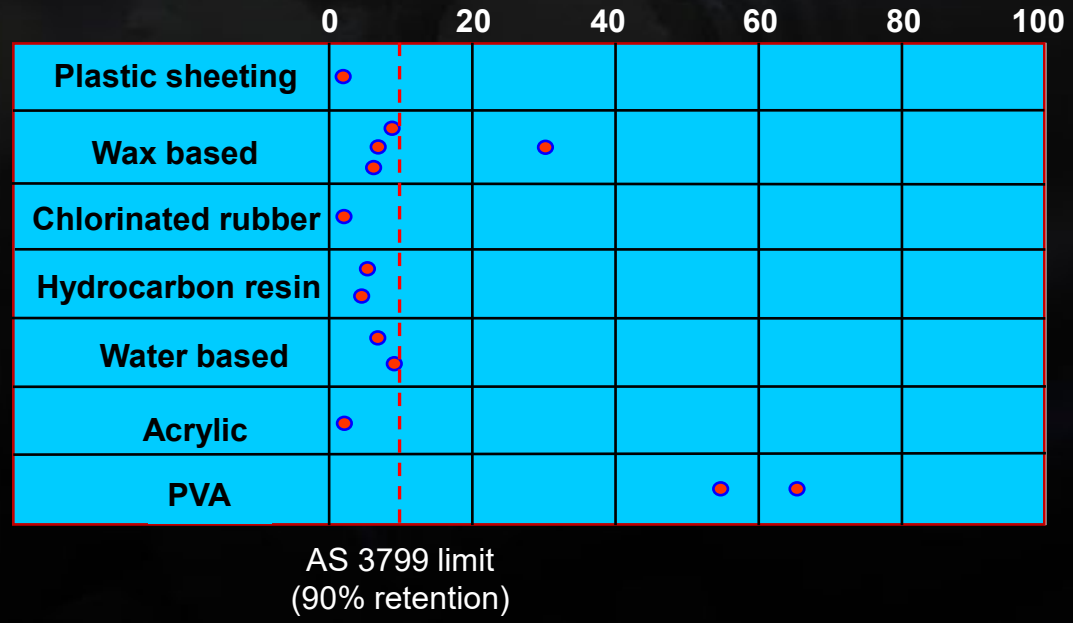
- Important for aggressive soils

  Table 5.3 Curing requirements specified

  Clause 5.5.3(d) Curing methods detailed

- Curing compounds to comply with AS 3799

72 Hour Moisture Loss (as % of untreated sample)



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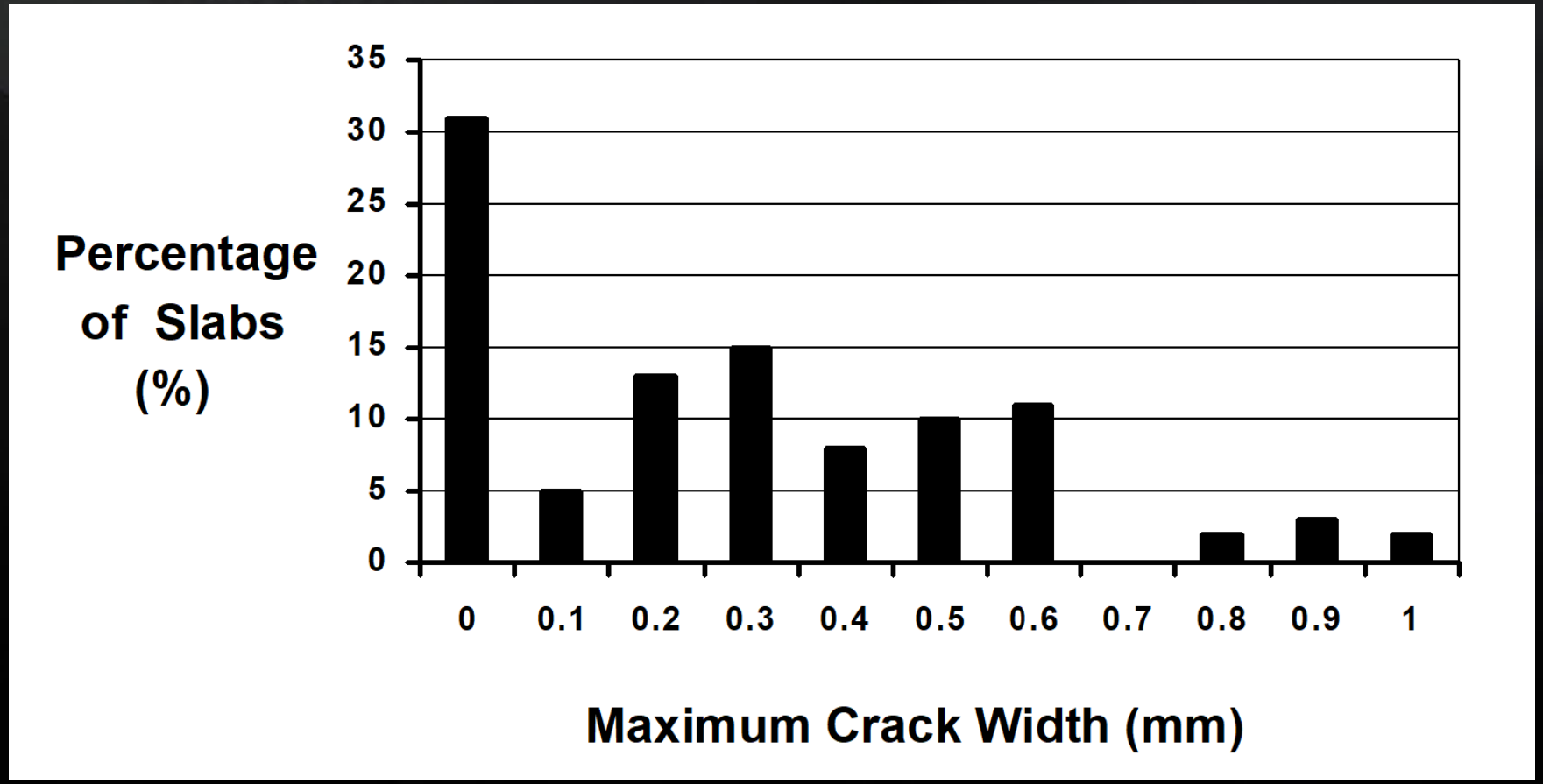
Crack Widths in residential Slabs

Cement and Concrete Association of Australia

Technical Report TR/F129 (December 1996)



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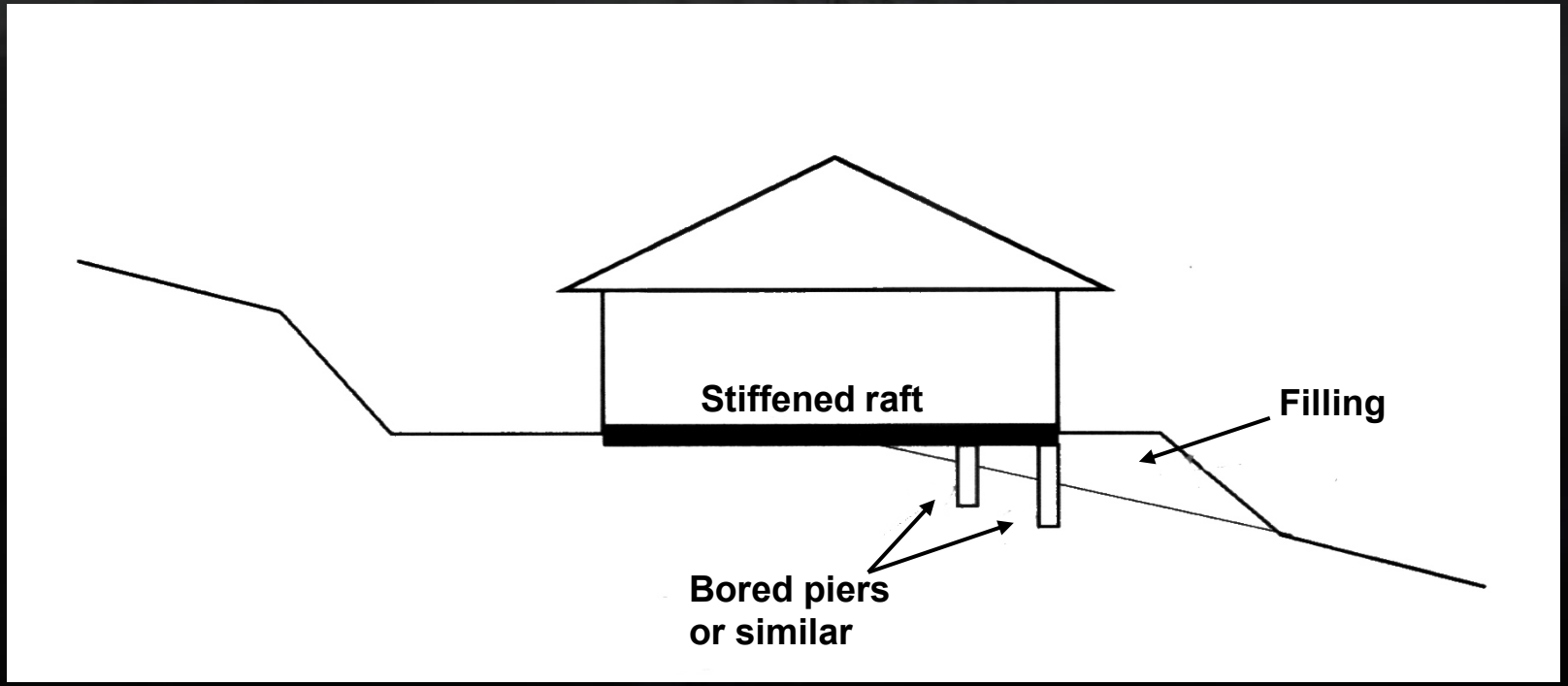
Combined Footing Systems

Is mixed construction allowed? eg deepened footings and stiffened raft

For Class M and H sites, only one standard design shall be used (Clause 3.1.1)



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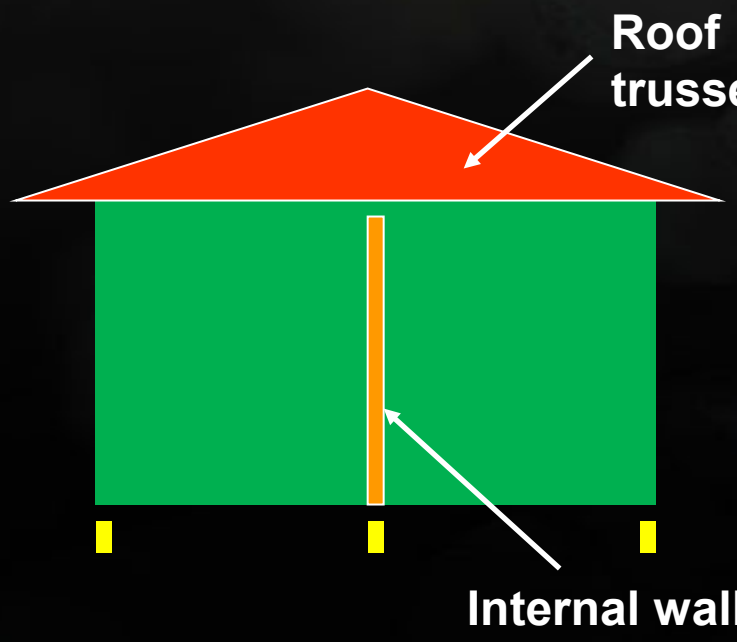
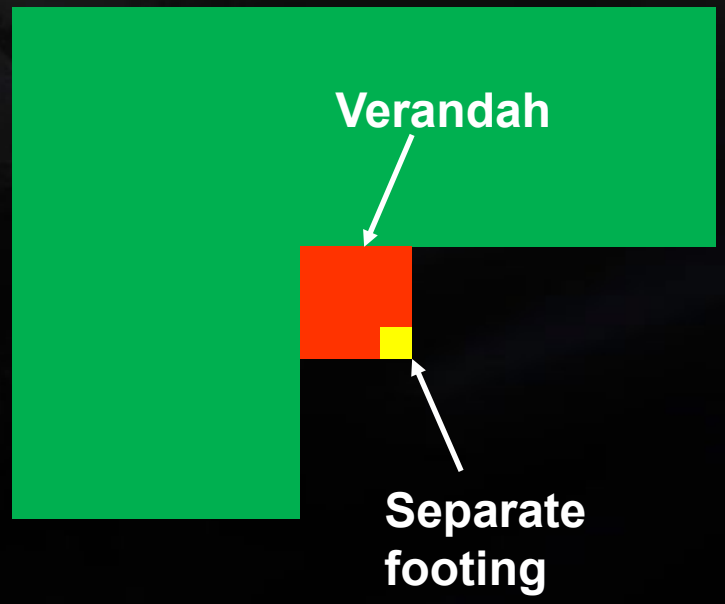
Detailing Issues

Site considerations

- Verandahs
- Trussed roofs
- Maintenance of drainage
- Gardens and watering
- Plumbing leaks





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