Concrete Basics

Presenters:
- Rob Mountford
- John Kilby

October 2020

Brought to you by Resene

CEMENT CONCRETE & AGGREGATES AUSTRALIA

www.ccaa.com.au

Concrete Materials

CONCRETE is made by mixing:

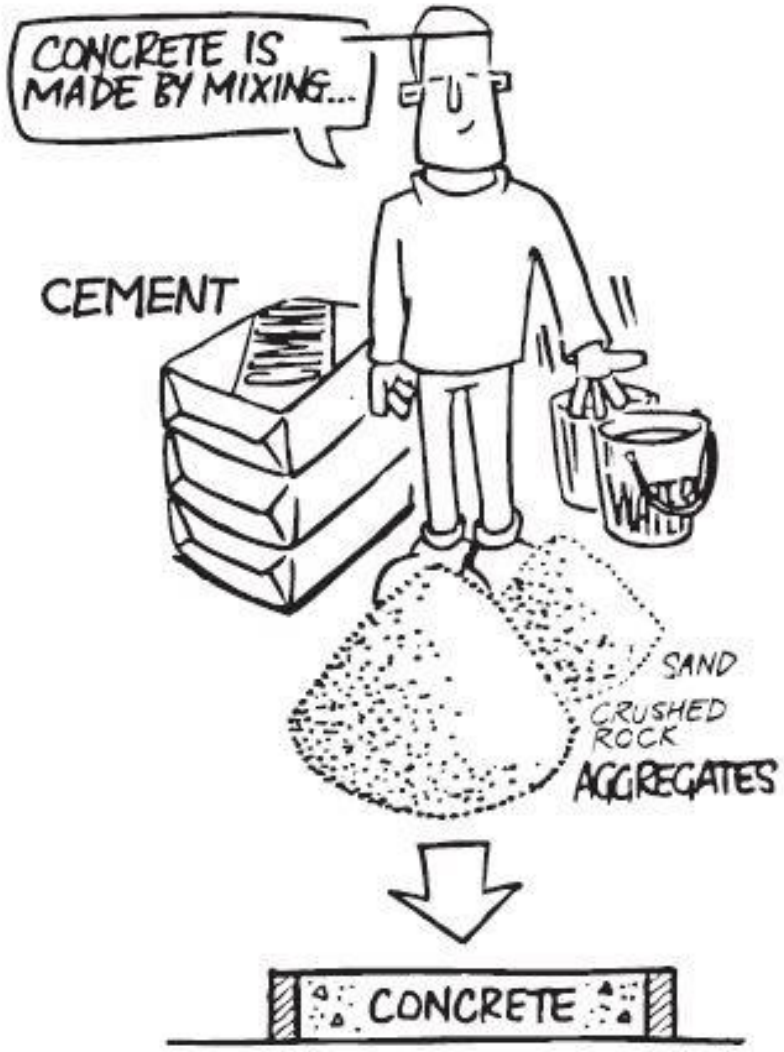
- CEMENT
- WATER
- COARSE AND FINE AGGREGATES
- ADMIXTURES (if required).

The aim is to mix these materials in measured amounts to make concrete that is easy to:

- TRANSPORT
- PLACE
- COMPACT
- FINISH

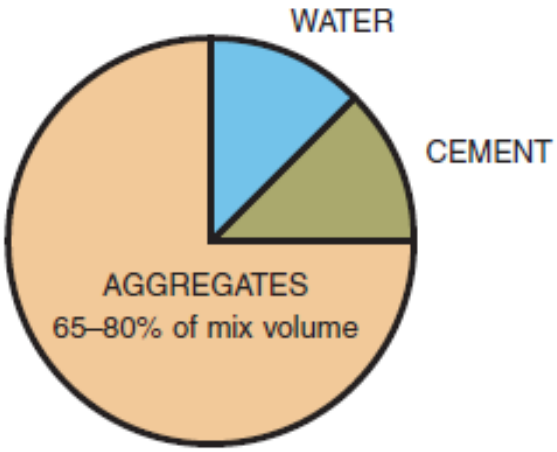
and which will set, and harden, to give a strong and durable product.

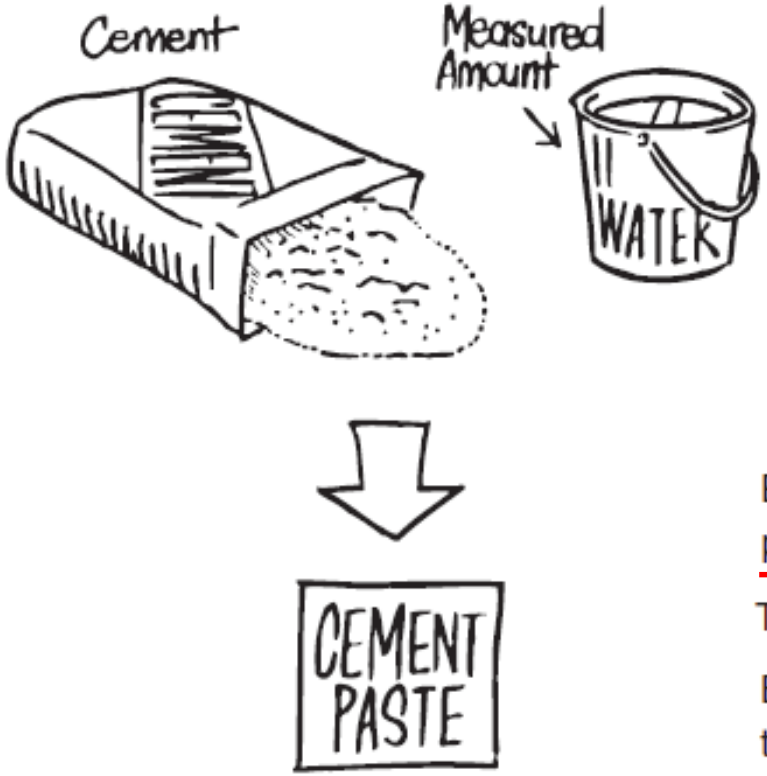
The relative amount of each material (ie cement, water and aggregates) affects the properties of concrete.



CEMENT The cement powder, when mixed with water, forms a paste.

This paste acts like glue and holds or bonds the aggregates together.





Six major types of cement are sold in Australia:

Type GP	(General Purpose Portland cement)
Type GB	(General Purpose Blended cement)
Type HE	(High Early Strength cement)
Type LH	(Low Heat cement)
Type SR	(Sulfate Resisting cement)
Type SL	(Shrinkage Limited cement)

Each type of cement will produce concrete with different properties.

The most commonly used are Type GP and Type GB.

Blended cements contain portland cement and more than 5% of either fly ash, ground slag, amorphous silica (eg silica fume), or a combination of these.

AGGREGATES Aggregates are of two basic types:

COARSE: crushed rock, gravel or screenings.

FINE: fine and coarse sands and crusher fines.
Sand should be concreting sand and not brickies sand or plasterers sand.

Aggregates should be:

STRONG and HARD so as to give a strong final concrete – crumbly or flakey rock such as sandstone should not be used.

DURABLE to stand up to wear and tear and weathering.

CHEMICALLY INACTIVE so that the aggregates don't react with the cement.

CLEAN since dirt or clay sticking to the aggregates will weaken the bond between paste and aggregates.

GRADED be of a range of sizes so that they fit together well to give a strong and dense concrete.

Rounded aggregates give a more workable mix.
Angular aggregates make concrete harder to place, work and compact, but can make concrete stronger.

WATER Water is mixed with the cement powder to form a paste which holds the aggregates together like glue.

Water must be clean, fresh and free from any dirt, unwanted chemicals or rubbish that may affect concrete.

Many concrete plants now use recycled water.

Always check bore water before use.

Don't use sea water in reinforced concrete as it may rust the reinforcing steel.

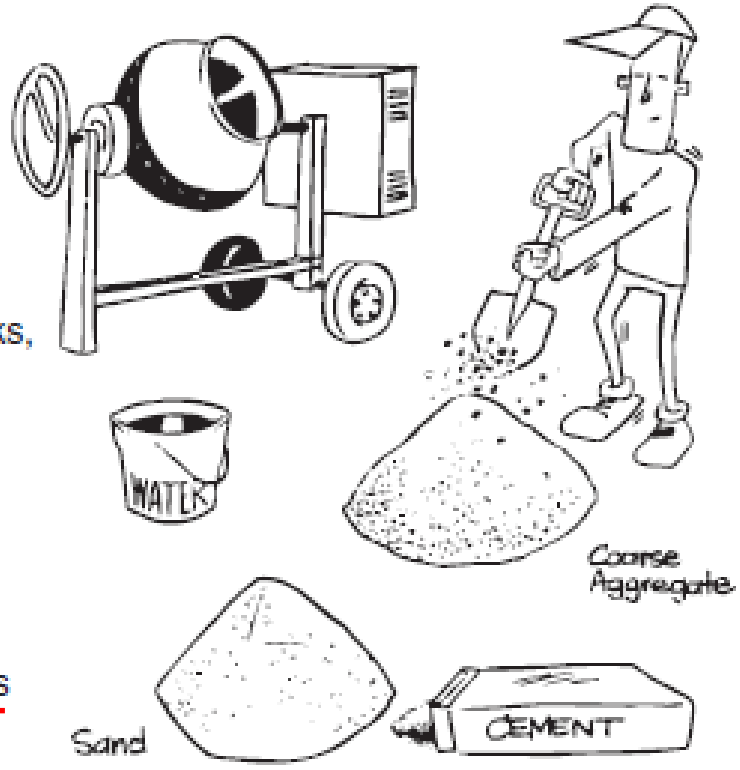
ADMIXTURES Admixtures are mixed into the concrete to change or alter its properties, ie the time concrete takes to set and harden, or its workability.

Proportioning and Mixing

A CONCRETE MIX is designed to produce concrete that can be easily placed at the lowest cost.

The concrete must be workable and cohesive when plastic, then set and harden to give strong and durable concrete.

The mix design must consider the environment that the concrete will be in; ie exposure to sea water, trucks, cars, forklifts, foot traffic or extremes of hot and cold.



PROPORTIONING Concrete is a mixture of cement, water, coarse and fine aggregates and (possibly) admixtures.

The proportions of each material in the mixture affects the properties of the plastic and hardened concrete.

These proportions are best measured by weight. Measurement by volume is not as accurate, but is satisfactory for minor projects.

TYPE OF CEMENT Different types of cement will affect concrete properties, eg how quickly or slowly concrete gains strength.

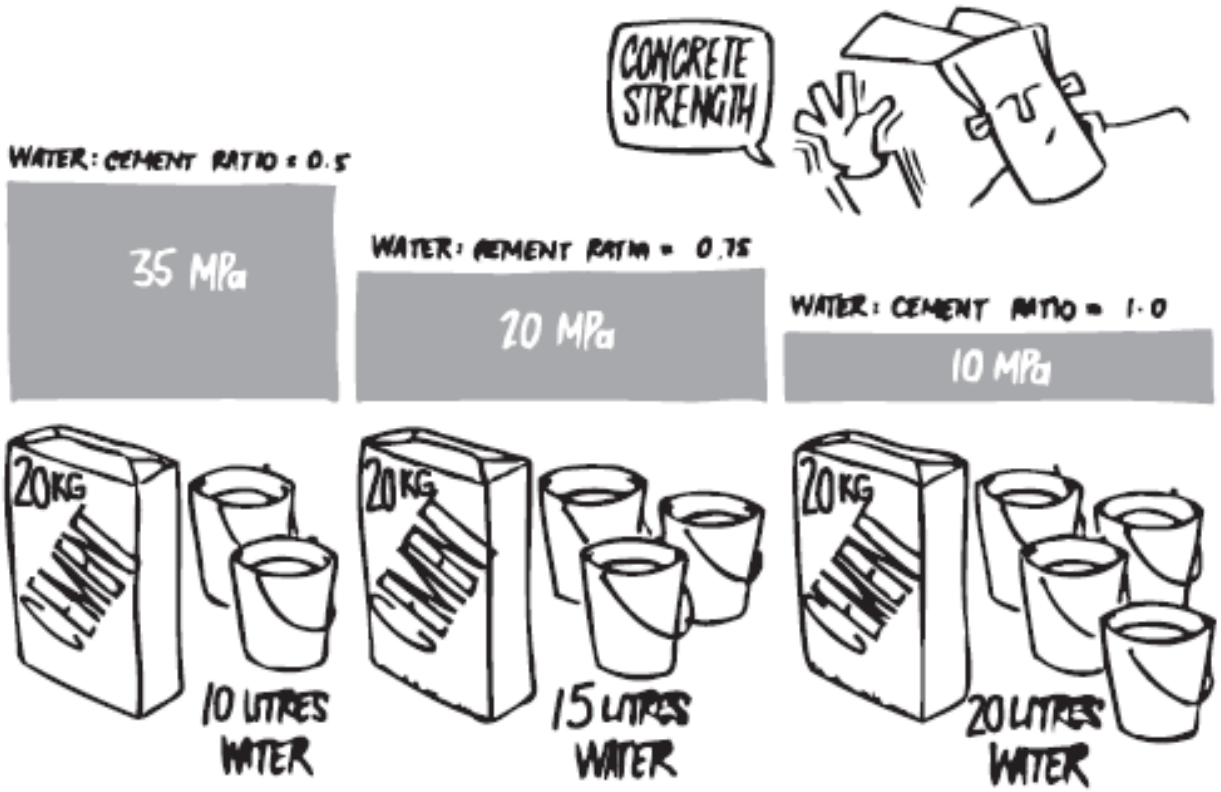
THE WATER TO CEMENT RATIO Too much water and not enough cement means concrete will be weaker and less durable.

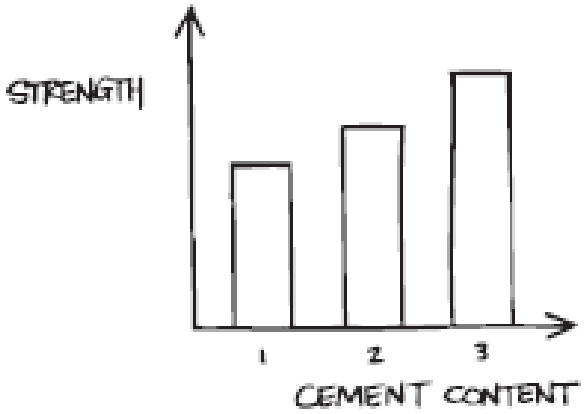
The water to cement ratio (W/C) is the weight of the water divided by the weight of cement.

$$W/C = \frac{\text{Water}}{\text{Cement}} \quad \text{eg} \quad \frac{20 \text{ litres}}{40 \text{ kg}} = 0.5$$

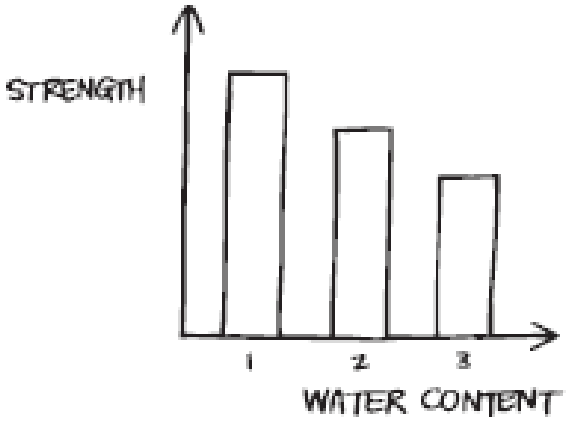
Note: 1 litre of water weighs 1 kilogram

The lower the ratio, the stronger the concrete.

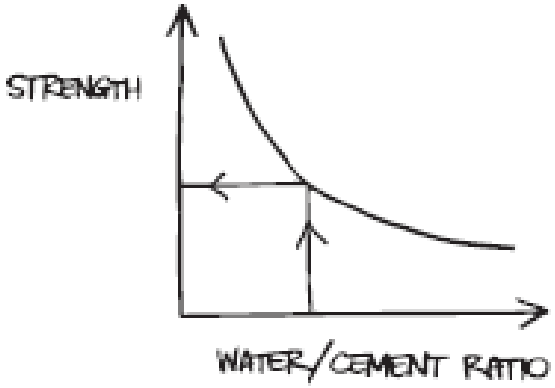




CEMENT CONTENT As the cement content increases, so does strength and durability. Therefore, to increase the strength, increase the cement content of a mix.

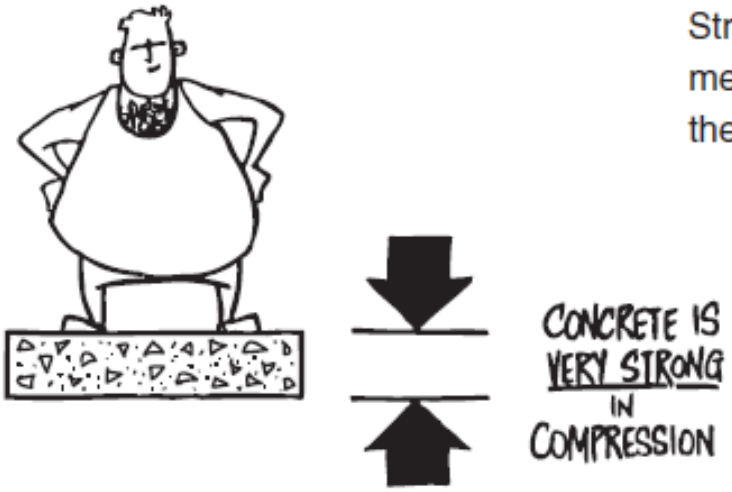


WATER CONTENT Adding MORE WATER to a mix gives a WEAKER hardened concrete. Always use as little water as possible, only enough to make the mix workable.



WATER TO CEMENT RATIO As the Water to Cement ratio INCREASES, the strength and durability of hardened concrete DECREASES. To increase the strength and durability of concrete, decrease the Water/Cement ratio.

Concrete Properties



Strength of concrete in the hardened state is usually measured by the COMPRESSIVE STRENGTH using the Compression Test.

Strength and Durability are affected by:

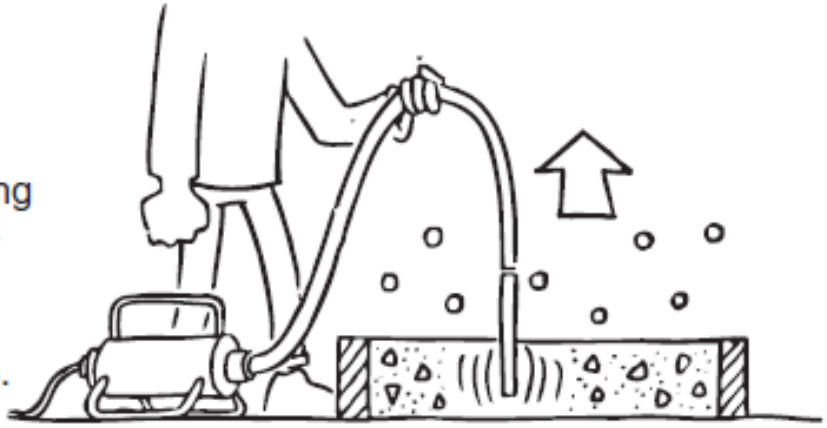
COMPACTION Compaction is removing the air from concrete. Proper compaction results in concrete with an increased density which is stronger and more durable.

CURING Curing is keeping concrete continuously damp for a period, to allow it to reach maximum strength. Longer curing will give more-durable concrete.

Compacting

WHAT IS COMPACTION? Compaction is the shaking or vibrating of the concrete to liquify it and expel any trapped air.

The concrete settles, filling all the space in the forms.



- As you shake & vibrate the concrete the AIR is pushed out.

WHEN TO COMPACT Compaction must be done as concrete is placed, while it is still plastic. Never let concrete dry out and stiffen because it will be too difficult to compact.

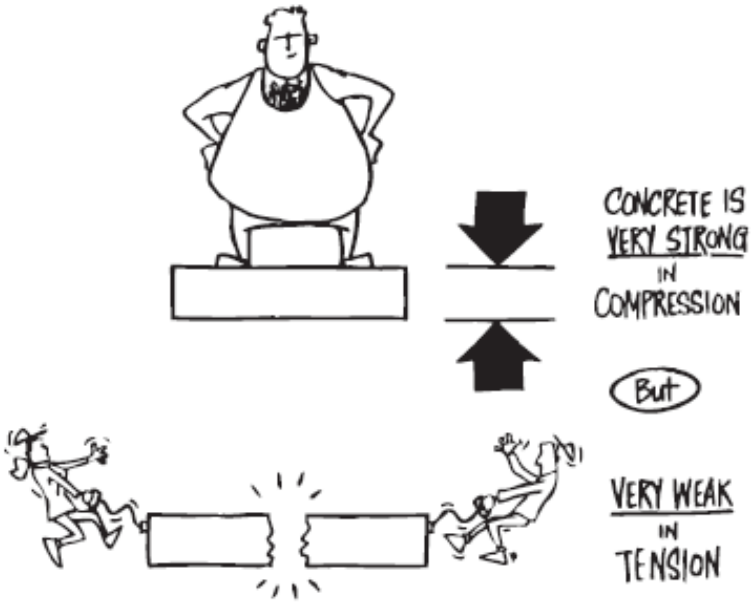
WHY COMPACT Properly compacted concrete is more dense, strong and durable. Off-form finishes will also be better.

The steel found in many concrete structures is called REINFORCEMENT.

Reinforcement helps concrete resist TENSILE and SHEAR forces, and helps control CRACKING in concrete.

CONCRETE PROPERTIES

Normal Concrete:	Reinforced Concrete:
HIGH compressive strength	VERY HIGH compressive strength
VERY LOW tensile strength	VERY HIGH tensile strength
VERY LOW shear strength	VERY HIGH shear strength



WHY USE REINFORCEMENT?

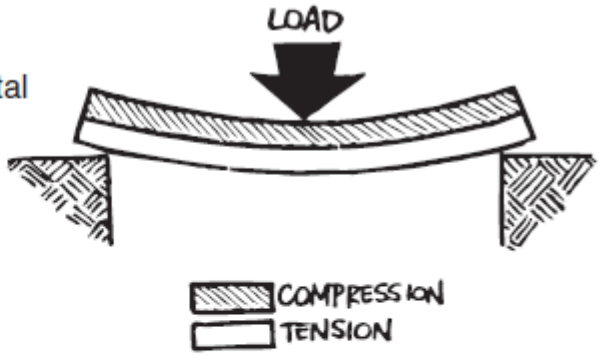
As a load is applied, compressive, tensile and shear forces will act on the concrete. Concrete naturally resists compression (squashing) very well, but is relatively weak in tension (stretching).

Horizontal and/or vertical reinforcement is used in all types of concrete structures where tensile or shear forces may crack or break the concrete. HORIZONTAL reinforcement helps resist tension forces. VERTICAL reinforcement helps resist shear forces.

Below are some examples of reinforcement use:

In a SUSPENDED (off-the-ground) concrete slab, horizontal reinforcement resists tension while vertical reinforcement (in say supporting beams) resists shear forces.

In a SLAB-ON-GROUND, reinforcement increases the tensile strength and helps control the width of shrinkage cracks.

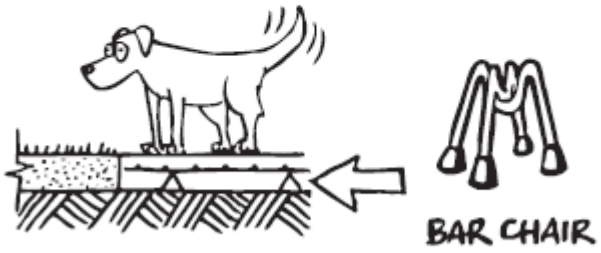


Reinforcement does not prevent cracks but controls their width.

Another benefit is that it reduces the number of control joints required. It is particularly beneficial in odd-shaped slabs.

REINFORCEMENT POSITION

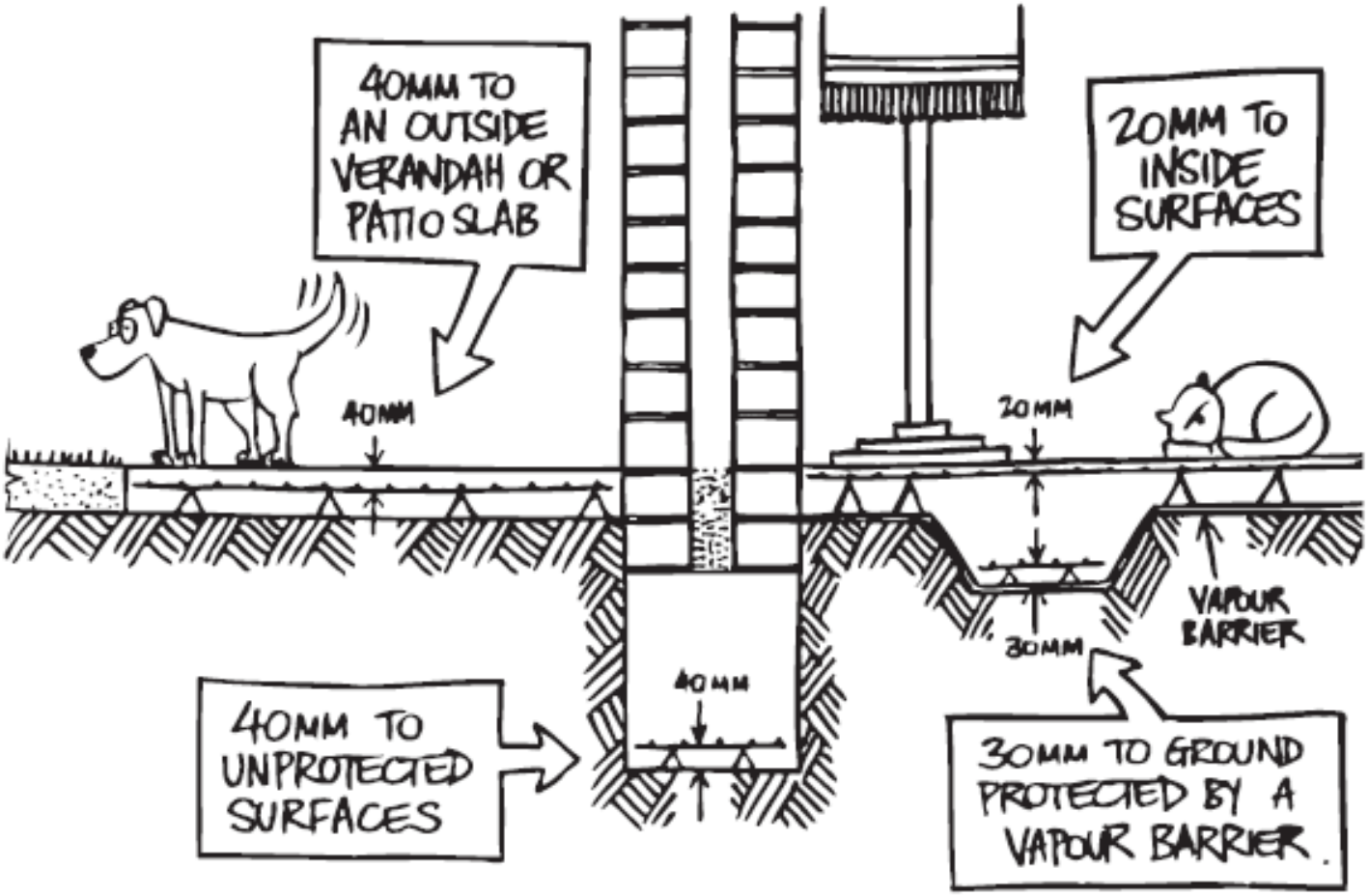
The position of reinforcement will be shown in the plans. Reinforcement must be fixed in the right position to best resist compressive, tensile and shear forces and help control cracking.



The reinforcement in trenches and slabs rests on BAR CHAIRS and must be securely fixed to the bar chairs so it won't move when concrete is placed around it.

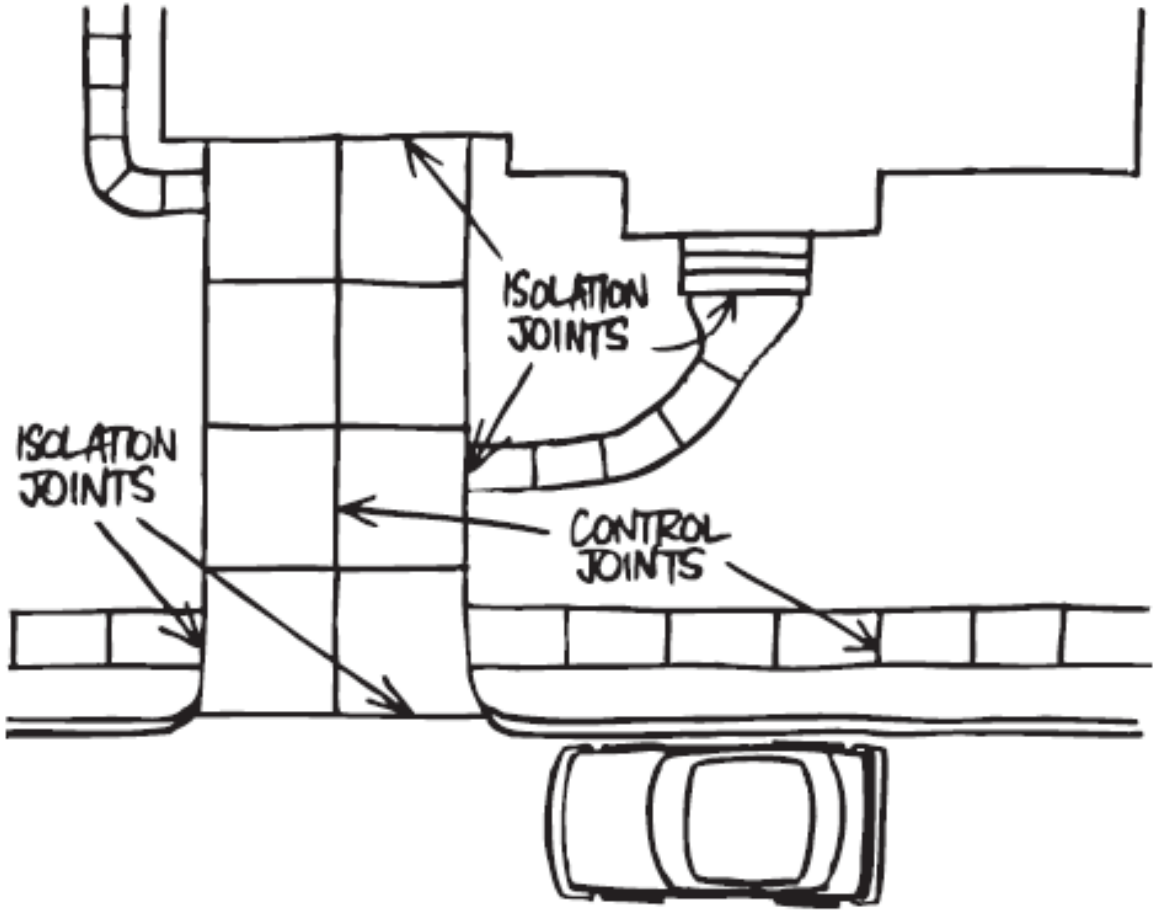
Concrete Cover The reinforcement must be placed so there is enough concrete covering it to protect it from rusting.

Typical covers are shown in the diagram below. Both the concrete cover and strength should be shown in the plans.



Joints

WHAT ARE JOINTS? Joints are PLANNED BREAKS in concrete which allow it to move and thus prevent random cracking.

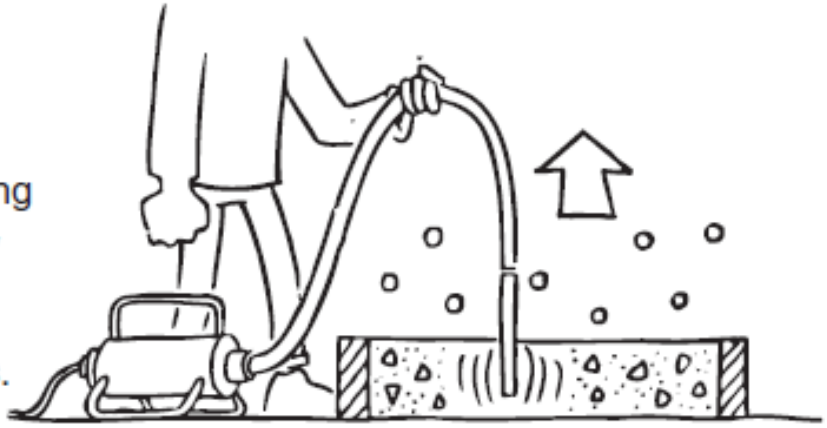


Concrete Floor Slabs

Compacting

WHAT IS COMPACTION? Compaction is the shaking or vibrating of the concrete to liquify it and expel any trapped air.

The concrete settles, filling all the space in the forms.



- As you shake & vibrate the concrete the AIR is pushed out.

WHEN TO COMPACT Compaction must be done as concrete is placed, while it is still plastic. Never let concrete dry out and stiffen because it will be too difficult to compact.

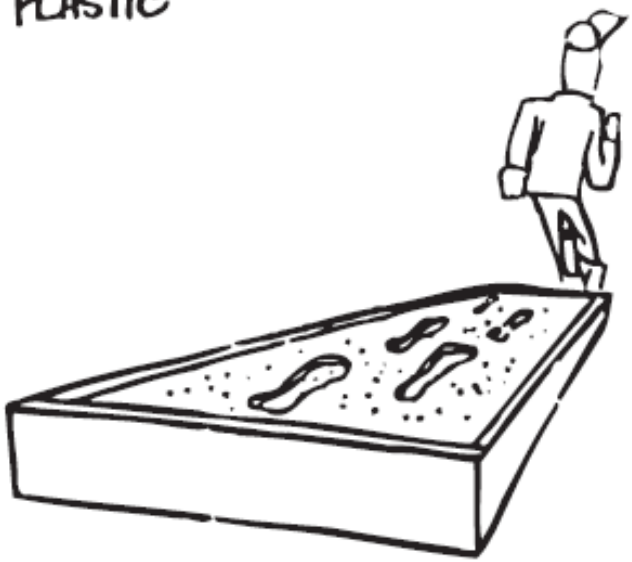
WHY COMPACT Properly compacted concrete is more dense, strong and durable. Off-form finishes will also be better.

PLASTIC

PLASTIC STATE When the concrete is first mixed it is like 'bread dough'. It is soft and can be worked or moulded into different shapes. In this state concrete is called PLASTIC. Concrete is plastic during placing and compaction.

The most important properties of plastic concrete are workability and cohesiveness.

A worker will sink into plastic concrete.



SETTING

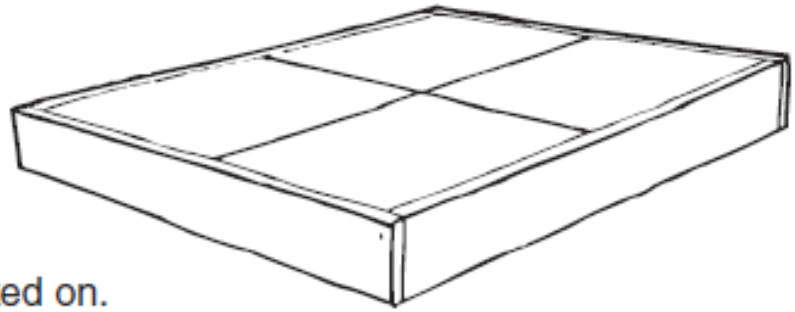
SETTING STATE Concrete then begins to stiffen. The stiffening of concrete, when it is no longer soft, is called SETTING. Setting takes place after compaction and during finishing.

Concrete that is sloppy or wet may be easy to place but will be more difficult to finish.

A worker leaves footprints in setting concrete.

HARDENED STATE After concrete has set it begins to gain strength and harden. The properties of hardened concrete are strength and durability.

Hardened concrete will have no footprints on it if walked on.

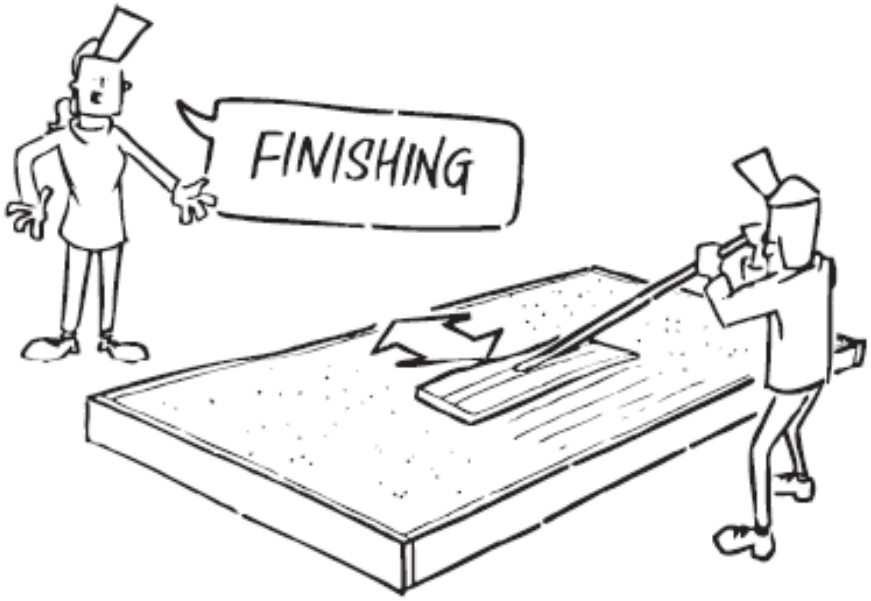


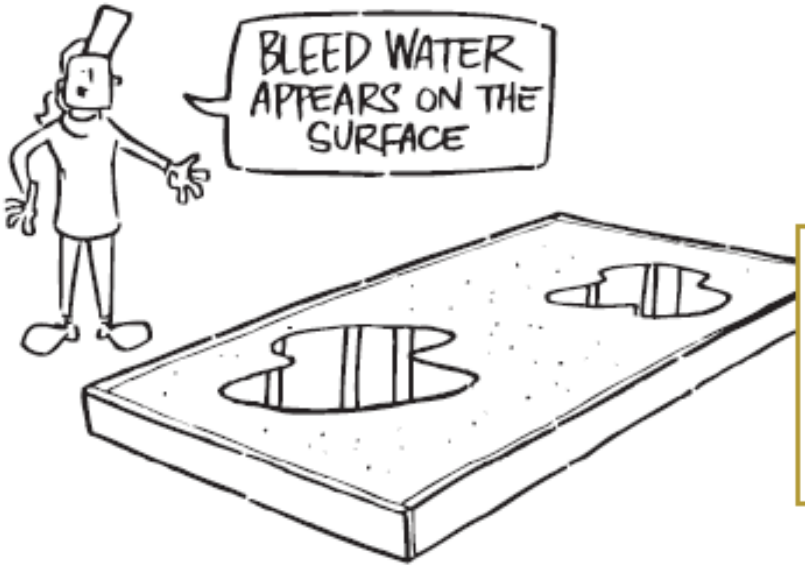
Finishing

WHAT IS FINISHING? Finishing is screeding, floating and/or trowelling the concrete surface to densify and further compact the surface layer of concrete, as well as giving it the look you want.

Finishing takes place in two stages:

INITIAL and
FINAL finishing.





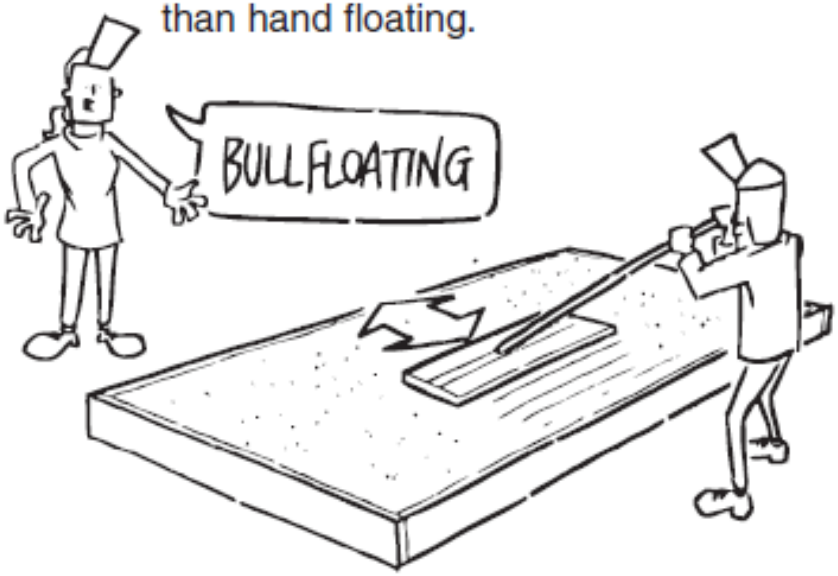
No final finishing can begin while bleed water is present. Mixing bleed water with the surface paste will weaken it, possibly resulting in a dusty surface.

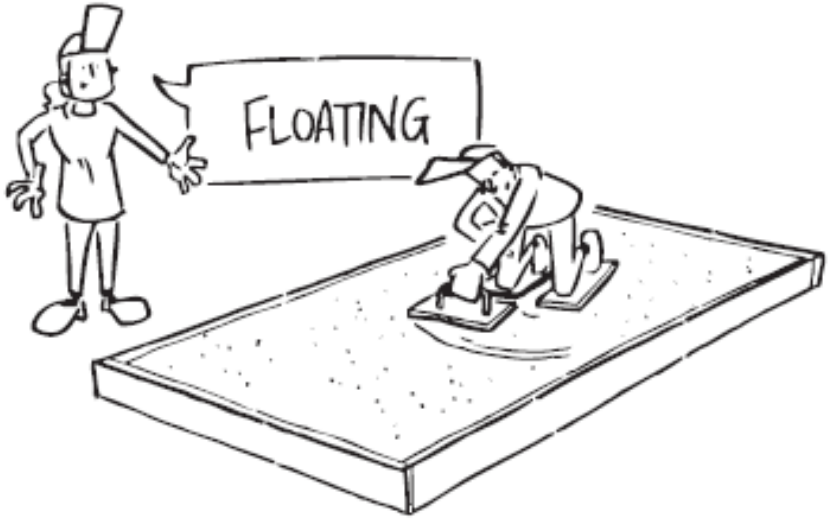
FLOATING There may be two stages in floating:

The BULLFLOAT, which is part of the initial finishing.
The POWER or HAND FLOAT which is part of the final finishing.

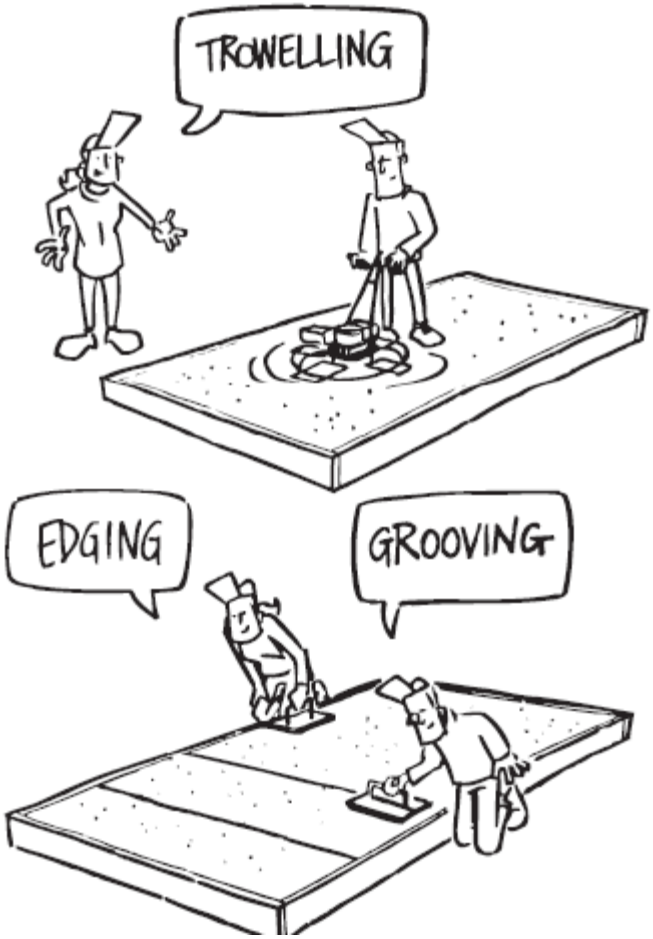
Floating helps compact and level the surface and close minor cracks.

Floating can be done by hand or with a power float. Power floating leaves a better finish than hand floating.





FINAL FINISHING This involves floating, trowelling, edging, jointing or patterning the concrete. Special finishes such as brooming, colouring or patterned finishes can be applied to the surface.



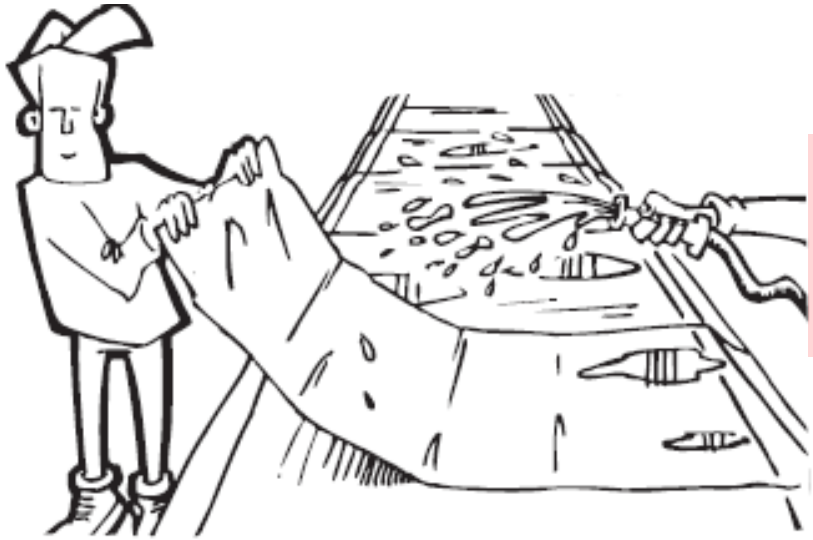
Trowelling Trowelling leaves a dense, hard, smooth and durable surface.

The surface should be trowelled TWICE. A well trowelled surface will be very smooth and can be slippery when wet. Trowelling can be done by hand or power trowel.

Edging and Grooving All the edges of a slab should be finished with a special edging tool. This gives a neater and stronger edge, less prone to chipping. Joints should be planned before placing and are usually formed into the concrete during finishing.

Once any surface has been finished the concrete MUST be cured.

Curing



WHAT IS CURING? Curing means to keep concrete MOIST for some time (typically 3–7 days).

By keeping concrete moist the bond between the paste and the aggregates gets stronger. Concrete doesn't harden properly if it is left to dry out quickly.

WHEN TO CURE Curing is commenced just after finishing the concrete surface.

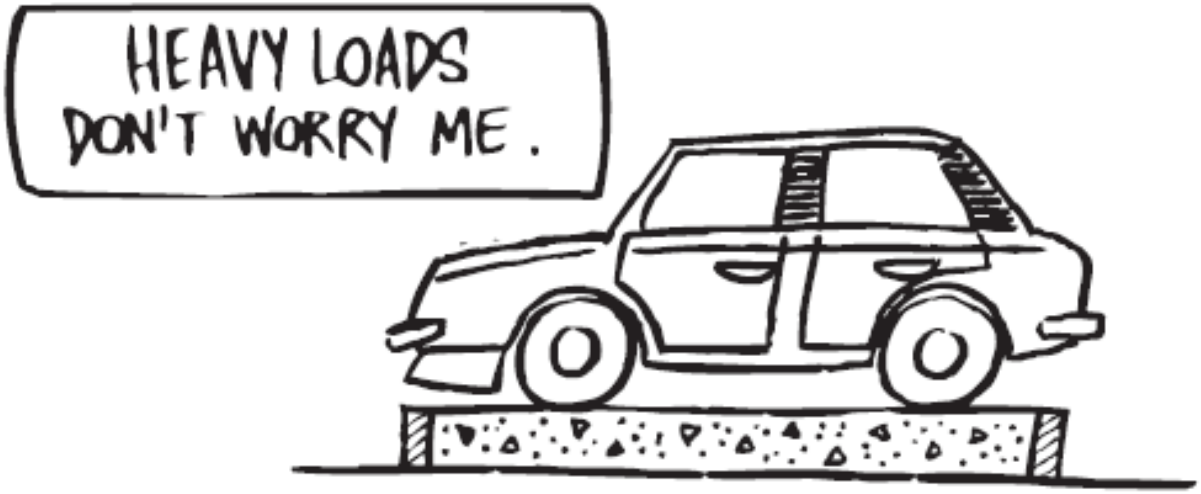
Precautions When curing leave the formwork in place to help reduce moisture loss. In hot weather (above 30°C), or during high winds and low humidity, concrete can dry out quickly. In these conditions take extra care with curing.

WHY CURE Concrete that is cured is:

LESS LIKELY TO CRACK.
STRONGER.
MORE DURABLE.

Cured concrete has a surface that wears better, lasts longer and better protects the steel reinforcement.

Properly cured concrete is stronger and can carry more weight without breaking.



HOW TO CURE The most common ways of curing are:

APPLYING EXTRA WATER to the surface of the concrete, or
REDUCING the rate of moisture loss from the concrete.

Applying extra water

The simplest method of APPLYING WATER is to put a continuous fine, misty spray of water over the concrete.

BEWARE: The spray must be a very fine mist or else it will damage the surface of the concrete.

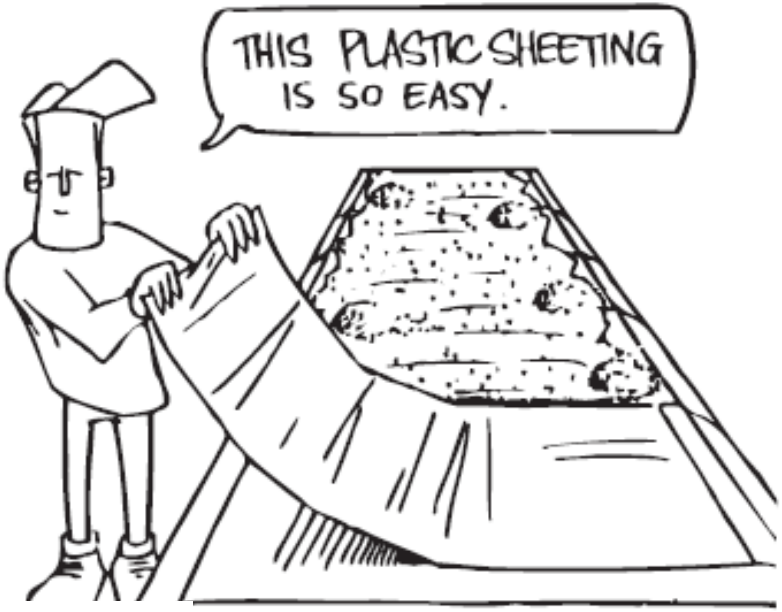
Concrete will dry out more quickly in hot weather. Keep the concrete continuously moist.

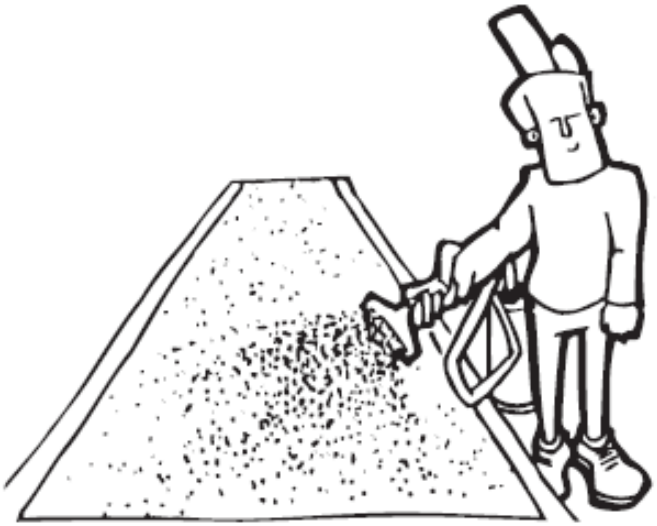
> ***It is most important to keep the concrete moist at all times. Hosing in the morning and again at night and letting the concrete dry out in between is no good.***

Reducing moisture loss

Another way to cure concrete is to cover with PLASTIC SHEETS to slow down moisture loss.

This method is easy and inexpensive. The only problem is that the sheets may cause concrete to become darker in places. To avoid this keep concrete EVENLY moist.





Concrete may also be cured by applying a CURING COMPOUND which slows moisture loss. This should be applied soon after finishing. Always follow the manufacturer's instructions carefully. Curing compounds may be sprayed, rolled or brushed on.

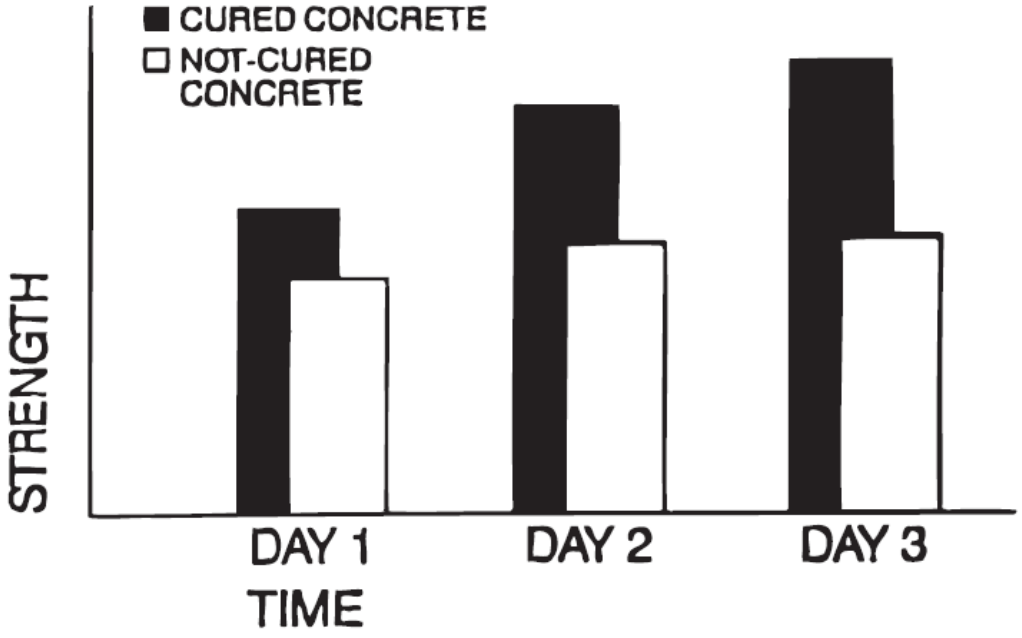
BEWARE: Some types of curing compounds may later make it harder or impossible to apply a surface finish such as paint to concrete, or to stick down floor coverings. When using a curing compound, check with the supplier to ensure compatibility with surface coatings or adhesives for future overlay finishes such as vinyl or tiles.

HOW LONG TO CURE Concrete keeps getting HARDER AND STRONGER over TIME.

Household concrete jobs MUST be cured for at least 3 DAYS.

For better strength and durability, cure concrete for 7 DAYS.

The LONGER concrete is cured, the closer it will be to its best possible strength and durability.



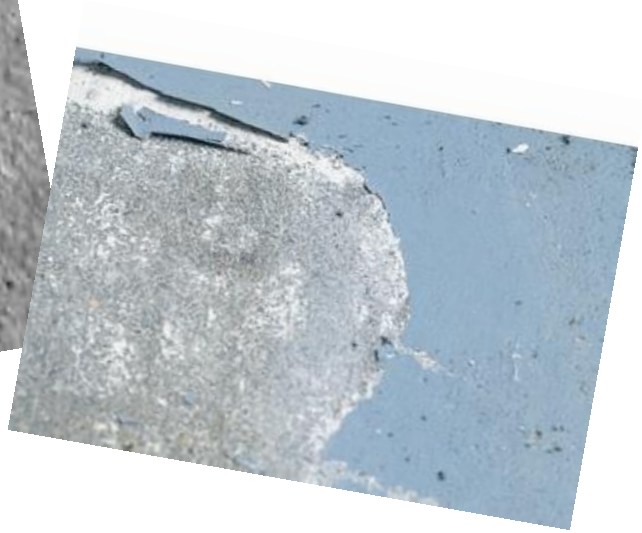
What is 28 days "cure time"? ….we say it all the time

Floor Slab Preparation

Laitance

Laitance is a weak non-durable layer of material containing cement and fines from aggregates**. It is brought by bleeding water to the top of over-wet concrete at the time of pouring.** Unlike efflorescence it is virtually invisible to the untrained eye. The amount of laitance is generally increased by over-working or over-manipulating the surfaces of the concrete by finishing staff. The layer is not adhered well to the concrete proper, and must be removed prior to coating.

Laitance on concrete



Efflorescence

Efflorescence is white crystalline or powdery deposit on the surface of concrete. It is a result of lime (or calcium hydroxide) leaching out of a permeable concrete mass over time, which reacts with carbon dioxide and airborne acid pollutants.

The source of the efflorescence (water ingress), into concrete needs to be identified and plugged, prior to any surface preparation and coating operations. Efflorescence is preferably removed as for laitance.

Plastic sheet method test for excessive moisture

Tape a plastic sheet (45 x 45cm) onto the concrete surface being tested; ensuring an airtight seal between the concrete and the plastic is formed. After 24 hours remove the plastic sheet. Concrete can be coated if no moisture / condensation is present on the underside face of the sheet, or if concrete has not darkened (compared to adjacent concrete). If moisture is present, re-test after another 14 days.

Relevant standard – Moisture Test. ASTM D4263 “Plastic Sheet Method” test.

Acid Etching Concrete
(no longer recommended)

Acid etching concrete is a traditional method of preparing a surface prior to coating by applying diluted hydrochloric acid that reacts with the concretes and is washed off the surface.
Acid etching removes laitance but cannot remove curing compounds or many of the contaminants found in industrial settings, such as oily deposits and water-insoluble materials, any of which can interfere with the adhesion of a coating. Improper surface preparation can result in poor bond and lack of coating adhesion

Acid Etch issues:

- Results are inconsistent
- Only removes laitance, not curing compounds
- Only creates minimal profile in surface
- Can damage Slab
- Hydrochloric Acid is harmful

Following is a pictorial presentation of the process followed.

Selected floor area

Diamond grinding

Vacuuming of dust

Concrete Grinding Features & Advantages

- Removes the top few millimeters of the concrete surface.
- Levels concrete to eliminate tripping hazards caused by uneven alignment or settling of concrete slabs.
- Removes old floor coverings and adhesives such as: VCT tile, carpet adhesive, sheet vinyl, wax stains, epoxy and urethane coatings, mastic glues, mortar beds and more.
- Preps floors for stains, epoxy or acrylic overlays, carpet adhesives, urethane or any new floor covering.
- Removes uneven or rough spots, excess grout, humps and surface indentations from any concrete slab.
- Levels unevenly poured slabs.

Coating Options – Concrete Floors

As a “rule of thumb” Garage & Commercial Floors require 2 pack Epoxy/Urethane systems

	SINGLE PACK PIGMENTED: **Topcoat Options:** **Resene Walk-on** **Resene Lumbersider**	**SINGLE PACK CLEAR:** **Topcoat Options:** **Resene Walk-on Clear** **Resene Concrete Wax**	**2 PACK PIGMENTED:** **Topcoat Options:** **Resene Aquapoxy** **Resene Armourcote 510** **Resene Uracryl**	**2 PACK CLEAR:** **Topcoat Options:** **Resene Uracryl**
Residential Floor	✓	✓	✓	✓
Garage Floor	✗	✗	✓	✓
Commercial Warehouse Floor	✗	✗	✓	✓

Aquapoxy kit & roller

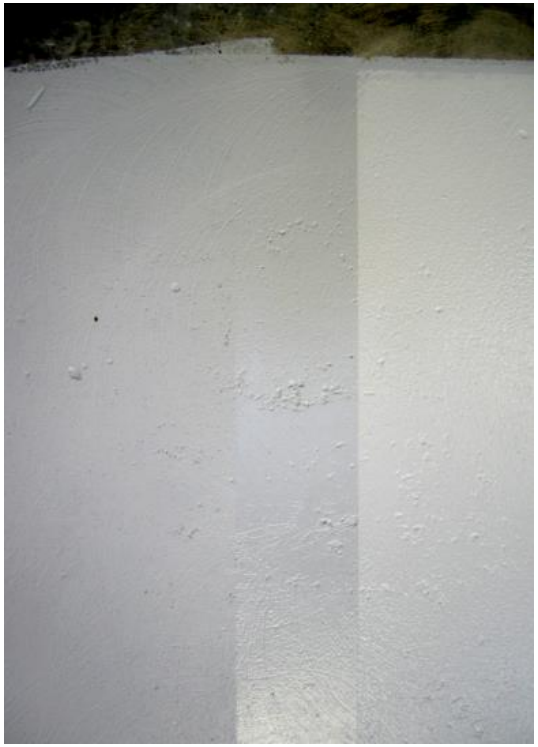
1st coat mixed and thinned

Application of 1st coat

1st coat dry

2nd coat application

1st coat / 2nd coat / 3rd coat



Common Problem – Hot tyre pick up

Hot tyre pick up is the most common Residential Garage floor issue. Providing the correct coating has been selected & applied (ie Epoxy) the issue will relate to poor preparation of the surface and/or the failure to remove all grinding dust prior to application.

Hot tyre pick up occurs due to:

- Poor surface prep – 180grit “sandpaper profile” needs to be achieved through grinding
- Failure to remove all grinding dust prior to coating
- Failure to follow manufacturers instructions
- Incorrect coating used – coating should be Epoxy type

Concrete Precast & Tilt Slab

Precast and Tilt Slab Concrete

Precast concrete is typically produced off-site and is delivered to the construction site and placed in position.

Precast panels are typically smoother and have a better finish than in-situ concrete.

Tilt slab is concrete that is poured directly onto the floor slab of a building (using a similar process to pre-cast concrete). It is a method that it often used for light commercial buildings and warehousing. Typically the height of the slab will be about 2-3 storeys high (10-12 metres).

The weight and size will be limited by the ability of a mobile crane to lift them into position. Both precast and in-situ concrete are poured into moulds that determine their final shape. In order for the concrete to come away from the mould easily, builders liberally apply form oils or release agents to the moulds that allow them to be removed easily, just as you would when making a cake or muffin!

Precast and Tilt Slab Concrete

Precast panel form works in factory

Pouring over mould

Spraying form oil/release agent

Tilt Slab panels on site

Colour variance

Highly detailed finishes

Can require detailed formwork and robust form oils/release agents, or a high level of honing and polishing

Common Problem – Release Agents/Forms oils

Failure to fully remove Release agents/Form oils from a surface prior to coating is the most common factor in coating failure on precast/tiltslab panels. Release agents & form oils allow for the panels to be successfully removed from their moulds much like removing a cake from it's baking dish. Given that their purpose is to minimise adhesion paint coatings won't stick to them either

Release agents/Form oils

- Need to be degreased from surface
- Waterblasting alone will not remove them
- Specific primers should be used eg Resene Concrete Seal 3in1

Insitu Concrete

As mentioned, in-situ concrete is poured on site, typically into formwork (basically a mould that determines its shape. These are usually made from timber or plywood).

Typically the end finish will vary and will not be as smooth as precast concrete. This will not impact on its performance, however if the concrete is to be painted it may need plastering or remedial work to bring it up to the agreed standard.

Alternatively (and this is a very common commercial practice) a high build textured coating such as Resene X-400 or Resene Sandtex (Standard or Superfine) will be applied to help disguise surface imperfections..

In-situ Concrete

FORM RELEASE AGENT

Form Oil should be applied to the inside of the formwork to stop it sticking to the concrete and thus make removal easier. Coat BEFORE the reinforcement is put in place.

Timber board finish is popular

commonly has varying colours and can also have surface defects and "bugholes"

Levels of Finish

Concrete 'Levels of Finish'
Specifiers use the levels of finish for concrete in the same way they do for GIB® board; to reflect the quality of the surface that is required to be achieved. In the main it is used for commercial and industrial projects as distinct to residential.

Concrete is increasingly being used on new homes, often as a feature. The architect or specifier will generally specify a high quality finish for the concrete with either a clear finish or coating system specified that highlights the concrete patina and colour.
The levels of finish for concrete are important and designated as the F standard.

F1 – No finish at all, usually foundations or walls that are to be backfilled.

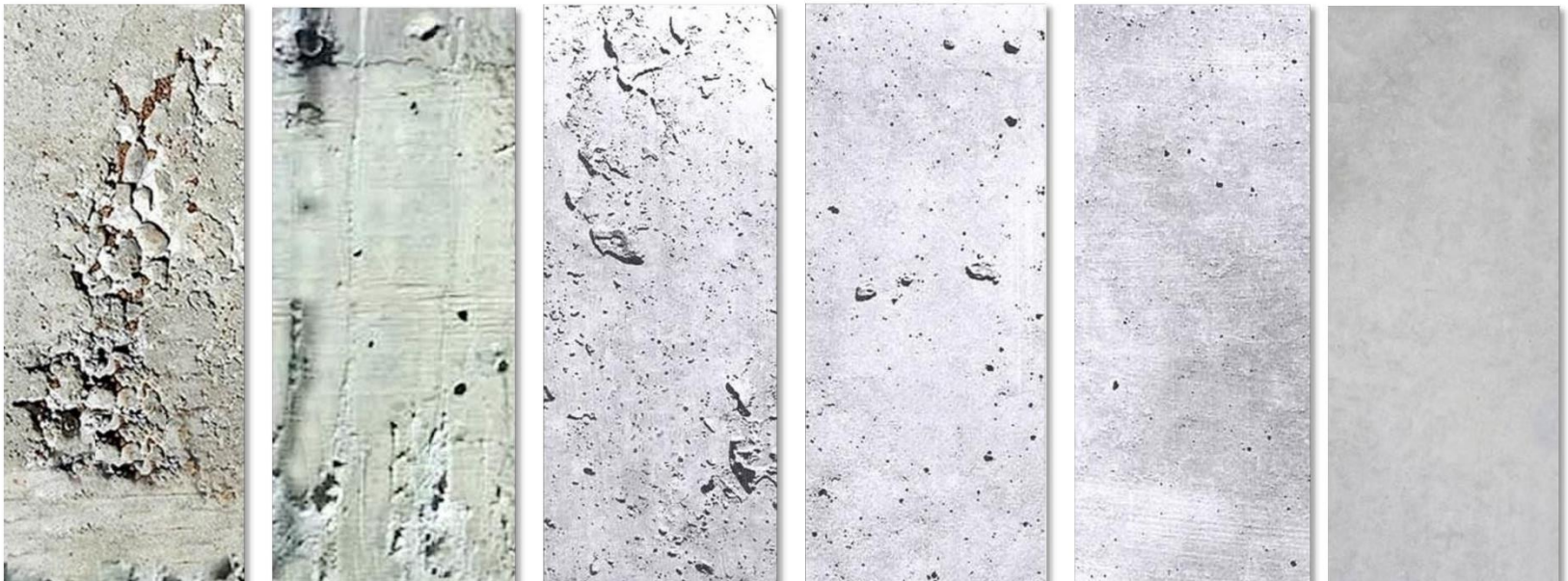
F2 – Concrete that requires plastering before painting.

F3 – Generally smooth surface, but with surface imperfections, used where it is not subject to close scrutiny. Typically associated with structural concrete in areas that are not highly visible.

F4 – Smooth and of a high standard, few surface defects.

F5 – Better than F4, virtually no defects, bug holes etc.

F6 – Very high finish, perfect, no bug holes or surface imperfections, includes G.R.C. (Glass Reinforced Concrete). Concrete used in highly visible areas.



Most concrete specified in New Zealand and Australia is F4 with some F5. The problems arise on a construction project when an architect specifies F5 and the construction firm delivers F3 or F4.

In such situations they either:

Reduce the cost of the concrete to the owner (discount off).

Plaster to achieve the desired level of finish or alternatively ‘bag’ the surface using a cement slurry. (Bagging is definitely not considered a premium solution).

Use a textured or high build paint to disguise the imperfections.

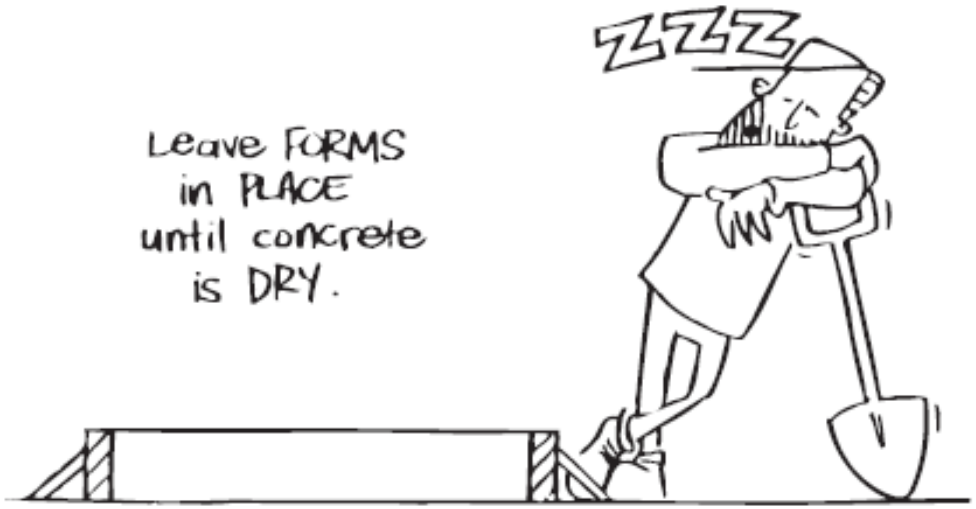
REMOVAL TIMES

Formwork may be left in place to help curing.

Removal time will vary according to the weather,

In cold weather, concrete will take longer to gain strength than in warm weather, removal times will therefore be longer.

In mild conditions (around 20°C) 7 days is long enough to leave the forms in place, unless the concrete is suspended when other considerations apply.



Formwork Removal

Formed Finish	Classification	Hot Conditions > 20°	Average Conditions ≤ 20° > 12°	Cold Conditions ≤ 12° > 5°
Beam and slab **soffits**	Forms	4 days	6 days	8 days
	Supporting members (shores or backprops)	12 days	18 days	24 days
Vertical faces	Finishes F6, F5, F4	1 day	2 days	3 days
	Finishes F3, F2, F1	9 hours	12 hours	18 hours
	A minimum of 2 days applied to the stripping of vertical faces where frost damage is likely.			

Table 5.3 NZS 3109 – minimum formwork stripping times for in situ concrete

Coating Options – Exterior Walls

The Industry is guided by the CCANZ Code of Practice for weathertight Concrete and Concrete Masonry construction

Cement & Concrete Association of New Zealand

January 2014

CCANZ
CONCRETE ANSWERS

CCANZ CP 01:2014

Code of Practice for Weathertight Concrete and Concrete Masonry Construction

Coating Options – Precast & Insitu concrete

Weathertight Precast & insitu concrete does not require coating

4.5 Weathertight concrete

This section specifies weathertight concrete used to construct either:

i) An Insitu Concrete Wall type B1 or B3, or

ii) A Precast Concrete Wall type C1 or C3.

CCANZ CP 01:2014

Code of Practice for Weathertight Concrete and Concrete Masonry Construction

The use of weathertight concrete will provide weathertightness without the need for exterior plaster or coating. Weathertight concrete limits moisture ingress to inconsequential amounts insufficient to cause undue dampness inside the building or damage to building elements.

Weathertight concrete shall:

a) Have a minimum specified 28 day concrete strength of 30 MPa,

b) Have a water/cementitious (w/c) ratio (by weight) no greater than 0.50,

c) Be designed and constructed in accordance with section 2.1, 3.3 and 3.4.

COMMENT:

Weathertight concrete will not prevent the passage of water vapour. Silane or siloxane sealers can be used to further protect and enhance water repellent properties. AS 1478.1 Appendix F covers permeability reducing admixtures.

The requirements of 4.5, c) are to ensure that weathertight concrete is designed and constructed correctly:

- Properly compacted concrete from a well designed mix will be weathertight, but areas of poor compaction, large cracks or poor joints will compromise weathertightness of otherwise sound construction.
- Precast concrete wall panels must be designed to withstand handling and erection without cracking.
- In situ wall construction requires consideration of shrinkage and flexural cracks.

Coating Options – Precast & Insitu concrete

Coating guide from CCANZ Code of Practice

CCANZ CP 01:2014

Code of Practice for Weathertight Concrete and Concrete Masonry Construction

1.1.2.1 Wall weathertightness systems

Exterior finishes for wall construction types as specified in section 1.1.2 shall be as shown in Table 1.

Table 1	Section references of acceptable wall weathertightness systems								
Wall type	Weathertightness system								
	EIFS	Plaster systems			Masonry veneer[1]	Coating systems			Weathertight concrete[3]
		Polymer based plaster	Polymer modified cement plaster	3 coat solid plaster		Pigmented standard or elastomeric high build acrylic (≥180µm)	Pigmented acrylic (≥80µm)	Clear coating[2]	
Masonry	4.1	4.2	4.2	4.2	3.2.9 & 4.6	4.3.2	n/a[4]	4.4	n/a
Wall Construction Type	A2	A1/ A3	A1/ A3	A1/ A3	A4	A1/ A3		A1/ A3	
Insitu	4.1	4.2	4.2	n/a	n/a	4.3	4.3	4.4	4.5
Wall Construction Type	B2	B1/ B3	B1/ B3			B1/ B3	B1/ B3	B1/ B3	B1/ B3
Precast	4.1	4.2	4.2	n/a	n/a	4.3	4.3	4.4	4.5
Wall Construction Type	C2	C1/ C3	C1/ C3			C1/ C3	C1/ C3	C1/ C3	C1/ C3

NOTES:

1. Masonry veneer on concrete masonry construction requires a clear cavity of at least 40 mm.
2. Acceptability of clear coatings is specified in section 4.4.2.
3. Weathertight concrete, as specified in section 4.5, will meet NZBC Clause E2 without the need for a coating.
4. n/a stands for not acceptable.

Coating Options – Precast & Insitu concrete

Standard pigmented coatings greater than 80 microns DFT are acceptable
Clear coatings do not need to meet permeability requirements

	Coating systems		
	Pigmented standard or elastomeric high build acrylic (≥180µm)	**Pigmented acrylic (≥80µm)**	**Clear coating[2]**
Masonry	4.3.2	n/a[4]	4.4
Wall Construction Type	A1/ A3		A1/ A3
Insitu	4.3	4.3	4.4
Wall Construction Type	B1/ B3	B1/ B3	B1/ B3
Precast	4.3	4.3	4.4
Wall Construction Type	C1/ C3	C1/ C3	C1/ C3

Insitu & Precast

(weathertight construction)

Pigmented coating

- 4.3 - Pigmented acrylic (non-high build) is satisfactory (pigmented high builds ok also) providing it is no less than:

>80 microns DFT

Minimum 2 coats applied

(pigmented acrylic - Resene Lumbersider, Sonyx 101)
(high build acrylic – Resene X-200, X300E, X-400)

Clear Coating

- 4.4 - Not required to meet the permeability requirements of AS/NZS4456.16 as uncoated substrate is deemed weathertight itself.

- Standard clear coatings or sealers are acceptable

(Resene Concrete Clear , Uracryl 400 clear, Uracryl GraffitiShield clear, Aquapel etc)

Coating Options – Precast & Insitu concrete

Standard coatings greater than 80 microns DFT are acceptable

4.3 Pigmented coating system

CCANZ CP 01:2014

Code of Practice for Weathertight Concrete and Concrete Masonry Construction

This section specifies pigmented coating systems applied directly to either:

a) A Concrete Masonry Wall type A1 or A3, or
b) An Insitu Concrete Wall type B1 or B3, or
c) A Precast Concrete Wall type C1 or C3.

Concrete walls shall be sufficiently dry to give a relative humidity reading of less than 70% at the time of coating application.

The substrate shall be free of contaminants prior to the application of the coating system.

COMMENT:
If a release agent has been used, make sure that no contaminants remain on the concrete surface.

4.3.1 Pigmented acrylic coating

Pigmented acrylic coatings for exterior use shall have a Dry Film Thickness of at least 80 µm. No less than two coats shall be applied.

Pigmented acrylic coatings shall not be applied to concrete masonry walls.

COMMENT:
Pigmented acrylic coatings are suitable for concrete precast and concrete insitu walls.

4.3.2 Pigmented standard or elastomeric high build acrylic coating

Pigmented standard or elastomeric high build acrylic coatings for exterior use shall have a dry film thickness of at least 180 µm. No less than two coats shall be applied.

COMMENT:
Pigmented standard or elastomeric high build acrylic coatings are suitable for concrete masonry walls, concrete precast and concrete insitu walls.

Coating Options – Precast & Insitu concrete

Standard coatings greater than 80 microns DFT are acceptable

	HIGH BUILD ACRYLIC Pigmented standard or elastomeric High Build acrylic coating >180 microns DFT Topcoat options: Resene X-200 Resene X-300E Resene X-400	PIGMENTED ACRYLIC Pigmented Acrylic >80microns DFT (min 2 coats) Topcoat options: Resene Lumbersider Resene Sonyx 101	CLEAR COAT HIGH BUILD Clear Coat High Build Meets: AS/NZS4456.16 Permeability requirements: Topcoat options: Resene XC-700	CLEAR COAT STANDARD Clear Coat or Sealer Standard: Not suitable where weathertight coating is required. Topcoat options: Resene Concrete Clear Resene Uracryl Clear Resene GraffitiShield Resene Aquapel
Masonry	✓	✗	✓	✗
Non-Weathertight Insitu	✓	✗	✓	✗
Weathertight Insitu	✓	✓	Not required	✓
Weathertight Precast	✓	✓	Not required	✓

Masonry Blocks

1.1.2.1 Wall weathertightness systems

Exterior finishes for wall construction types as specified in section 1.1.2 shall be as shown in Table 1.

Table 1	Section references of acceptable wall weathertightness systems								
Wall type	**Weathertightness system**								
	EIFS	**Plaster systems**			**Masonry veneer[1]**	**Coating systems**			**Weathertight concrete[3]**
		Polymer based plaster	**Polymer modified cement plaster**	**3 coat solid plaster**		**Pigmented standard or elastomeric high build acrylic (≥180µm)**	**Pigmented acrylic (≥80µm)**	**Clear coating[2]**	
Masonry	4.1	4.2	4.2	4.2	3.2.9 & 4.6	4.3.2	n/a[4]	4.4	n/a
Wall Construction Type	A2	A1/ A3	A1/ A3	A1/ A3	A4	A1/ A3		A1/ A3	
Insitu	4.1	4.2	4.2	n/a	n/a	4.3	4.3	4.4	4.5
Wall Construction Type	B2	B1/ B3	B1/ B3			B1/ B3	B1/ B3	B1/ B3	B1/ B3
Precast	4.1	4.2	4.2	n/a	n/a	4.3	4.3	4.4	4.5
Wall Construction Type	C2	C1/ C3	C1/ C3			C1/ C3	C1/ C3	C1/ C3	C1/ C3

NOTES:

1. Masonry veneer on concrete masonry construction requires a clear cavity of at least 40 mm.
2. Acceptability of clear coatings is specified in section 4.4.2.
3. Weathertight concrete, as specified in section 4.5, will meet NZBC Clause E2 without the need for a coating.
4. n/a stands for not acceptable.

Coating Options – Masonry

Pigmented standard or elastomeric high build acrylic coatings for exterior shall have a DFT of at least 180 microns (with no less than 2 coats applied)

	Coating systems		
	Pigmented standard or elastomeric high build acrylic (≥180µm)	Pigmented acrylic (≥80µm)	Clear coating[2]
Masonry Wall Construction Type	4.3.2 A1/ A3	n/a[4]	4.4 A1/ A3
Insitu Wall Construction Type	4.3 B1/ B3	4.3 B1/ B3	4.4 B1/ B3
Precast Wall Construction Type	4.3 C1/ C3	4.3 C1/ C3	4.4 C1/ C3

Pigmented coating

- Pigmented acrylic coatings (non-high build) shall not be applied to concrete masonry walls
- 4.3.2 - Pigmented standard or elastomeric High Build acrylic coating is required, greater than:

>180 microns DFT

(topcoats - Resene X-200, X-300E, X-400)

Clear coating

- Standard clear coatings shall not be applied to masonry walls
- 4.4.2 – must meet the permeability requirements of AS/NZS4456.16 for Masonry

(Resene XC-700 clear high build)

Coating Options – Masonry

Pigmented standard or elastomeric high build acrylic coatings for exterior shall have a DFT of at least 180 microns (with no less than 2 coats applied)

CCANZ CP 01:2014

Code of Practice for Weathertight
Concrete and Concrete Masonry Construction

4.3.1 Pigmented acrylic coating

Pigmented acrylic coatings for exterior use shall have a Dry Film Thickness of at least 80 µm. No less than two coats shall be applied.

Pigmented acrylic coatings shall not be applied to concrete masonry walls.

COMMENT:
Pigmented acrylic coatings are suitable for concrete precast and concrete insitu walls.

4.3.2 Pigmented standard or elastomeric high build acrylic coating

Pigmented standard or elastomeric high build acrylic coatings for exterior use shall have a dry film thickness of at least 180 µm. No less than two coats shall be applied.

COMMENT:
Pigmented standard or elastomeric high build acrylic coatings are suitable for concrete masonry walls, concrete precast and concrete insitu walls.

Coating Options – Masonry

Clear coating systems should comply with section 4.4.2 or 4.4.3 and the coating system should be supplied by a single supplier

CCANZ CP 01:2014

4.4 Clear coating system

This section specifies clear coating systems applied directly to either:

a) A Concrete Masonry Wall type A1 or A3, or
b) An Insitu Concrete Wall type B1 or B3, or
c) A Precast Concrete Wall type C1 or C3.

Clear coating systems complying with section 4.4.2 or 4.4.3 are weathertight.

The coating system shall be supplied by a single supplier who takes responsibility for the system as a whole, encompassing the weathertight coating. The system shall be applied by the coating manufacturer's approved applicator.

Clear coating systems are to be recoated every five years at a minimum or in accordance with the manufacturer's specifications.

The clear coating system shall be designed to prevent water ingress into the pores of the concrete or masonry. The system shall allow the passage of water vapour from the interior to the exterior.

COMMENT:
Clear coatings have been included in this Code of Practice recognising the move to 'minimalist architecture' using unpainted concrete and masonry. Clear coatings do not always have the flexible film-forming ability that acrylic coatings have. Therefore they require a strict maintenance regime and need recoating at shorter intervals.

Coating Options – Masonry

Clear Coatings should be tested for permeability in accordance with AS/NZS 4456.16

Pigmented coatings do not require testing for permeability

CCANZ CP 01:2014

Code of Practice for Weathertight
Concrete and Concrete Masonry Construction

4.4.1 Permeability test

Clear coating system shall be tested for permeability in accordance with AS/NZS 4456.16 except as modified in the following requirements:

a) Standard masonry blocks shall be received and stored for 48 hours in a 20 ± 3°C protected environment prior to the surface coating being applied.
b) The moisture content using a humidity meter shall be measured and recorded and shall be less than 75% before applying the coating.
c) The coating shall be applied to the masonry block in a vertical position in accordance with the manufacturer's specifications and methods and allowed to cure.
d) On completion of curing, the block shall be directly placed in the AS/NZS 4456.16 test rig and testing shall then proceed as stipulated by the test method.
e) The minimum test period shall be two hours.

Coating options - Masonry

	HIGH BUILD ACRYLIC Pigmented standard or elastomeric High Build acrylic coating >180 microns DFT Topcoat options: Resene X-200 Resene X-300E Resene X-400	PIGMENTED ACRYLIC Pigmented Acrylic >80microns DFT (min 2 coats) Topcoat options: Resene Lumbersider Resene Sonyx 101	CLEAR COAT HIGH BUILD Clear Coat High Build Meets: AS/NZS4456.16 Permeability requirements: Topcoat options: Resene XC-700	CLEAR COAT STANDARD Clear Coat or Sealer Standard: Not suitable where weathertight coating is required. Topcoat options: Resene Concrete Clear Resene Uracryl Clear Resene GraffitiShield Resene Aquapel
Masonry	✓	✗	✓	✗
Non-Weathertight Insitu	✓	✗	✓	✗
Weathertight Insitu	✓	✓	Not required	✓
Weathertight Precast	✓	✓	Not required	✓

That’s the end.

Thank you for your attendance.

Resene
the paint the professionals use