

A closer look at concrete

Background on concrete

Concrete is a very useful building material made by mixing cement, sand and aggregate (known as metal) with small amounts of water - the wet material is poured into moulds or formwork where it 'sets' and dries to a very hard and durable material.

Concrete is a marvellous material. It is fireproof, has excellent insulation properties is strong and hardly erodes when properly engineered. The Coliseum in Ancient Rome was built around the time Christ lived and is the perfect the example of a concrete building.

Ted Nightingale - the founder of Resene served for many years as President of the NZ Concrete Association. Most of the products he developed in the 1940s and 1950s were to coat concrete or help in its curing - this includes Stipplecote after which the company was formally known.

Concrete will be affected by:

1. Acid attack - caused by rain mixing with pollution in the atmosphere and resulting in acid rain. Over time this will erode concrete and other lime based structures.
2. Extreme cold - when ice forms in cracks containing water the area of the water expands, resulting in spalling (surface breaking) of the concrete.
3. When the steel reinforcing is set too close to the surface, allowing moisture ingress that causes rusting of the reinforcing, this in turn, also causes 'spalling' as the rust occupies a greater volume than the steel reinforcing.
4. Concrete may also crack due to earthquakes or subsoil ground movement, leading to the ingress of water and in particular salt - causing further damage to concrete.

Paint coatings can, in addition to decorating concrete, protect the surface from erosion and greatly increase the useful life of concrete buildings.

Salt staining

We nearly all live close enough to the sea for windblown salt (sodium chloride) to accumulate on surfaces to be painted or repainted. This is not confined to concrete alone, but all exterior surfaces, such as weatherboards and galvanised iron. Salt is water soluble and therefore will stain through waterborne coatings, leaving a whitish stain on the surface, discolouring the paint. Salt is easily washed off smooth surfaces with freshwater but much more difficult if there is lots of surface cracking or if it has a rough texture.

Resene recommend using Resene Sureseal (see Data Sheet D42) on old cementitious surfaces to hold back and prevent any salt stains plus also help bind and reinforce poorly bound cementitious surfaces (including bricks and brickwork).

Satin or semi-gloss?

When it comes to painting (particularly repainting) cementitious surfaces - both Resene Lumbersider (see Data Sheet D34) satin acrylic and Resene Sonyx 101 semi-gloss acrylic (see Data Sheet D30) will perform well. The choice between which of the two to use will necessitate an element of trade-off. Resene Lumbersider is a satin finish (half the sheen level of Resene Sonyx 101) and will disguise imperfect and rough surfaces better than the higher sheen Resene Sonyx 101. However Resene Sonyx 101 is made from a tougher resin and the higher sheen level will be more durable and easily cleaned.

When painting Monotek where the joints are more obvious, rough plaster or blockwork, the lower sheen Resene Lumbersider is generally recommended to help minimise the appearance of surface defects, while for good, smooth concrete, Resene Sonyx 101 is generally the preferred finish.

Flat?

For many years, Resene Zylone 20 flat acrylic (see Data Sheet D37) has been successfully used on the exterior of plastered and concrete buildings. It is surprisingly durable and retains its colour well, and has regularly been used to replicate older style limewashes and other traditional finishes mainly in the Canterbury area.

While today Resene AquaShield mineral effect (see Data Sheet D601) is recommended when a client wants a flat 'aged' and/or classic look, it is worth noting that Resene Zylone 20 flat acrylic is still a good option especially if strong colours (terracottas and reds) are specified. Alternatively, Resene Multishield+ Flat (see Data Sheet D54a) applied over Resene Lumbersider satin acrylic or Resene X-200 waterproofing membrane (see Data Sheet D62) will also impart a flat finish.

Cracks in concrete and plaster

Cracks will form in concrete, plasters and other cementitious surfaces as they cure and as a result of excessive movement, such as the building settling or an earthquake.

Their occurrence is not at all unusual and dealing with them is relatively straightforward. Concrete and plaster 'cure' as water used in the 'wet' mixture dries out, inevitably resulting in the formation of small surface or capillary cracks. They are easily covered by a standard paint system, such as Resene Concrete Primer (see Data Sheet D405) followed by two coats of Resene Sonyx 101 semi-gloss acrylic or Resene Lumbersider satin acrylic.

Hairline cracks are bigger or wider - usually up to 1mm across. This is significant when you consider a layer of Resene Lumbersider is applied at only .035mm or in other words it would take 35 coats of Resene Lumbersider to achieve a paint film that was 1mm high.

Hairline cracking often occurs as the cementitious surface (usually plaster or render) cures, particularly if it is hot and dry as water in the concrete mixture evaporates quicker than it would normally.

Resene Limelock cure and seal (see Data Sheet D809) is designed to slow water evaporation down ensuring a better cure with less surface cracking than would otherwise be the case. You may also have noted builders and plasterers spraying water on fresh plaster and concrete to avoid them drying out too fast.

Resene X-200 waterproofing membrane is ideal for brushing into hairline cracks with three coats easily filling a 1mm crack or alternatively Resene Brushable Crack Filler may be used.

Cracks larger than 1mm may be filled with Resene Brushable Crack Filler (see Data Sheet D811) but multiple coats will be needed. Alternatively a masonry filler or flexible (tube applied) sealant should be recommended. If the crack is likely to move again a flexible sealant should be used, otherwise masonry filler products (such as Resene Jointflex A or Rockcote Multistop Stop) are easier to use and look better.

Efflorescence

Efflorescence is a salt formed when water reacts with lime in concrete, usually when the concrete has a crack that allows water to seep through the material. The dissolved salts react with carbon dioxide in the air and a white deposit forms (efflorescence). This is always indicative of a leak that needs to be fixed and is common on both interiors and exteriors.

The deposit is similar to stalagmites and stalactites (found in limestone caves) and is difficult to remove - good sanding is required and the source of the leak repaired, prior to repainting. The surface must be sealed with Resene Sureseal before painting, because often the cement has been weakened adjacent to the problem.

Form oils and release agents

Form oils and release agents are used when concrete is poured into a precast mould or used with formwork, which is built on site, rather like greasing a cooking tray before putting a cake mixture in. In-situ concrete is then poured into the form (formwork). Form oils and release agents are usually brush applied or sprayed on (a knapsack or garden sprayer is adequate for this) and made from waxes and oils, such as paraffin wax. Invariably residue will be left on the concrete surface when the moulds or formwork is removed and paint will not stick to this residue.

While over time natural weathering will remove these waxes and oils, it can take several months to do so. Waterblasting will not itself remove them. Just as you need to use detergent to wash oil and grease off your clothes at home, detergents need to be used to remove formwork residue.

In most cases Resene Paint Prep and Housewash (see Data Sheet D812), which contains a detergent, will suffice, however some stubborn wax and oil residues may need a stronger product, such as Resene Emulsifiable Solvent Cleaner, a blended solvent and detergent that can be dissolved in water.

Lime burning/leaching

Lime burn results in colour loss and the overall deterioration of the paint film on fresh masonry. Fresh masonry is likely to contain lime minerals, which are highly alkaline. Carbon dioxide in the air slowly neutralises lime. Unless the lime has a chance to neutralise, its alkalinity will actually 'burn' the paint off the surface.

This results in loss of adhesion and/or it can 'burn' through the binder (resin) of ordinary waterborne paints, chemically altering certain pigments in the finished colour and weakening the film's integrity. In effect, the paint will either flake off or be severely discoloured and this is most obvious with darker colours.

Time and moisture are the two necessary components needed to bring down the alkali levels in new concrete/plaster. The Portland Cement Institute and the Gypsum Plaster Association recommend that masonry products, especially stucco, cure for at least 28 days prior to painting. If this is not possible, the painter should apply Resene Limelock followed by a high quality waterborne exterior paint. It is important to understand lime burning or leaching is a surface condition, not a paint problem.

Rust stains on concrete surfaces

(a) Whenever concrete is in close proximity to steelwork, such as nuts and bolts, hand railings etc it is likely that any rust forming will transfer to the concrete surface resulting in unsightly rust stains.

(b) Rust staining may also indicate potentially serious spalling problems occurring within concrete. This is caused by water reaching the embedded steel reinforcing, which causes rust to form. Rusted steel actually expands in volume and the pressure is sufficient to crack and dislodge the adjacent concrete - this is called 'spalling'. Providing the source of rust staining can be treated, the stained area must be sealed with Resene Sureseal before overcoating with the selected topcoat system. If the natural finish of the concrete or plaster is desired (i.e. the client does not wish to paint it), oxalic acid may be used to remove the stain. As this is an acid, extreme care must be taken. A product like C.L.R (Calcium, Lime, Rust) found at most hardware stores is suitable for this purpose.

Light reflective values

The amount of light a colour will absorb or reflect is expressed as a percentage out of 100, with white equating to 100 and black equating to 1.

The darker the colour the more light it absorbs and the hotter the surface will be. Indeed you could easily fry an egg on a roof painted a dark grey or green. How hot a substrate gets is important for two reasons - firstly in hotter climates it is obviously desirable to have the walls of a house reflect heat rather than attract heat. Likewise in cold climates the opposite may apply. Secondly some cementitious substrates, particularly those using timber framing, react badly if they get too hot. They expand and contract too much for the building system to cope with, ultimately resulting in surface cracks. Systems applied over Monotek have a minimum reflectance requirement of 40% while EIFS systems (using expanded polystyrene) from companies such as Rockcote cope better with heat and movement and have a minimum reflectance requirement of 25%.

This typically allows colours tinted from white, pastel and light tone bases but excludes colours from mid tone or deeper. All Resene colour charts reference the light reflectance of each colour or you can look up reflectance values in the swatch library online at www.resene.co.nz/swatches/index.htm.

Waterproofing membranes

Waterproof coatings need to perform the following:

- Act as a water barrier and stop water from getting into the cementitious surface and ultimately into the house (or building).
- Allow water vapour to pass through from inside the house or cladding.
- Have sufficient movement or flexibility in the paint to cope with building movement, such as the settling that occurs as the building ages, earthquakes etc.
- Bridge and fill hairline cracks in plaster.
- Adhere well to cementitious surfaces.

Resene X-200 waterproofing membranes performs these tasks extremely well, looks good, has an extensive colour range and is proven. This product has been used to waterproof Australasian buildings in some of the most extreme (and wet) environments for over 20 years. Resene X-200 contains a 'mini-fibre' that acts like a reinforcing mesh and helps when filling hairline cracks up to 1mm across. We recommend that cracks of this size be 'striped' - basically a first coat is brushed into the worst cracks and then two further coats applied over them and the rest of the surface. It is important that Resene X-200 is forced into cracks and voids for it to work.

What's the big deal about Mediterranean finishes?

Resene was one of the earliest producers of a Mediterranean style finish in New Zealand - only it wasn't realised at the time. The product was Stipplecote and even today companies offer similar cement based paint for plaster and concrete. Essentially to achieve a Mediterranean finish the paint or coating needs to be flat in terms of gloss level and ideally with a hint of texture (often achieved with the brush itself). Some designers also talk about the need for the surface to be chalky and slightly distressed. This comes with age to all paints, so really it is the flat finish that is required.

As a result of this understanding, Resene AquaShield was developed, a product that performs significantly better than other non textured 'Mediterranean' paint finishes. The alternatives are limewashes and so called 'mineral' paints - both nowadays are essentially modified acrylics, usually very cheap to make and very quick to deteriorate once applied. These modified acrylics typically weather quickly, grow mould, hold dirt and road grime, and in the case of limewashes they leach lime, an extremely alkaline material that will etch glass and attack aluminium windows. To repaint an historic building or get a Mediterranean style effect use Resene AquaShield. For a textured effect use Resene Sandtex Standard or Superfine (see Data Sheet D71) applied in a crows foot (criss cross) method, the main difference between the two being the size of the synthetic 'sand' used. This in turn affects the application characteristics and final finish.

A very versatile product, Resene Sandtex Standard will look different depending on how it is applied. When sprayed, either through a hopper gun or powerful airless, Resene Sandtex Standard looks similar to sponge finished plaster. It may also be applied by brush or roller for varying effects - the finish can be as regular or irregular as the customer wants and as high or low build as desired. The key to a good finish is to apply a thinner, anchor coat first and be generous with the product. Resene Sandtex Superfine is ideal for concrete and masonry as its flat finish and texture help hide surface imperfections. Typically it is applied in two coats by brush and roller over a suitable primer, such as Resene Concrete Primer. While it can be brushed using the crow's foot technique Resene Sandtex Standard is typically preferred where brush application is required. Either variant is ideal as a base for metallic finishes.

Waterblasting

Waterblasting is an ideal preparation for most old unpainted cementitious surfaces - although usually it must be used in combination with Resene Moss & Mould Killer. However it does have limitations and some restrictions.

- Avoid using to remove salts from old textured surfaces. Salt needs to be rinsed and washed from the surface - high pressure waterblasting may actually have the opposite effect of forcing salts into the surface rather than off it.
- Avoid using if the surface is old and porous, such as where old limewashes are present, and/or when masonry buildings are being repainted as it may strip the coating completely.
- If the paint is in good condition it should be washed down with Resene Paint Prep and Housewash - a more effective method of removing chalkiness and other contaminants than waterblasting. If the surface is sound, has been treated for moss and mould and paint or other coatings need to be stripped, then waterblasting is ideal. Most home use waterblasters do not operate at very high pressure, usually around 1200 psi (800 kpa), and are generally fine for most situations but at this pressure they are really pressure washers as opposed to true waterblasters. There are a number of house washing companies who will prepare a home for repainting or for maintenance and many painting contractors include waterblasting as part of their service.

Painting over stone-chip panels

Stone-chip panels were (or are) a very popular finish - particularly for spandrel panels on older commercial buildings. Stones or aggregate is laid in the bottom of a mould and concrete is poured in over the top - once the formwork is removed the stones are cleaned to remove any concrete residue to leave a stone chip panel.

Glossary of relevant construction terms

Columns

Columns are upright structural support members, usually square, round, or rectangular, made of reinforced concrete. Columns carry vertical loads (weight). They may be either isolated or attached to a wall. Most often columns are poured in-situ and may require remedial work or a textured coating.

Concrete levels of finish

Levels of finish for concrete may be used the same way as the levels of finish for paperfaced plasterboard to reflect the quality of the surface that is required to be achieved. In the main it is used for commercial projects and industrial projects as distinct to residential. However, as concrete is increasingly being used on new homes, often as a feature, the need to appreciate levels of finish for concrete is increasing as a high quality finish may be specified for the concrete together with a clear sealer, such as Resene Aquapel, to help retain the look of the concrete by deterring mould growth.

The concrete levels of finish are described below:

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 GRC (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 when F5 is specified but contractors only deliver F3 or F4. In such situations they either:

1. Reduce the cost of the concrete to the owner (discount off).
2. Plaster to achieve the desired level.
3. Use a textured or high build paint to disguise the imperfections.

Compressed sheet

Compressed sheet is a fibre-reinforced cement sheet made from sand, cement and cellulose fibre (for added strength) and is used as a cladding material - usually on commercial buildings, however increasingly on residential.

The sheet is designed for use as a substrate for both low and high build coating systems. It has a smooth surface and is fixed in place by screws, these are then filled and sanded back smooth before painting. The joints are left exposed and not filled as they are with Harditex.

Compressed sheet is similar to Titan Board and its replacement Ecoset panels - from a painting perspective they are treated the same. It is often used as a substrate for metallic finishes usually applied over a low to medium build texture, such as Resene Sandtex and Resene Thixalon 5 (see Data Sheet D63).

Construction sealants/sealants

A sealant is a sticky, viscous liquid that is put into a joint, where it stiffens, becomes rubbery and adheres to the sides. There are many types of sealant, the most common types are mastic and elastomeric. Most sealants may not be painted over as they contain plasticisers that will migrate through the paint becoming sticky and trapping dirt, resulting in dark lines on the building.

Sealants are used in both commercial and residential construction - the bigger the gap that needs bridging the more sophisticated (and expensive) the sealant needs to be. As a rule, most commercial sealants should not be painted over. However most sealants used for minor exterior repairs or for minor jointing and gaps, such as around window frames, are paintable once cured, in accordance with the manufacturer's recommendations.

Curing agents

Curing agents are admixtures that are put into concrete to hasten setting and increase the early strength of concrete. This allows faster removal of formwork, surface traffic sooner or in the case of tilt-slab, quicker time to erection. Curing agents are also known as accelerators.

EIFS exterior insulation and finish system

An EIFS system usually consists of boards of rigid and moisture-resistant expanded polystyrene, fixed into place by special nails with plastic washers, then covered with a plaster render system (usually a modified acrylic/plaster system of multiple layers and finished with a paint type coating). This system, supplied by companies like Rockcote, is most commonly used in the residential housing market as it provides good insulation.

Elastomeric

Elastomeric materials are usually polymers or resins (usually polymers) with elastic properties - that is, the ability to stretch and return to their original shape. They may

also be described as having an excellent 'memory' of their original shape when distorted, similar to a rubberband. Elastomeric properties are very useful in paint, as they give the coating the ability to cover over and, expand and contract with, large cracks that are continually moving. Resene Flexicover E (see Data Sheet D64) is an example of an elastomeric type coating.

Formwork

Anything that holds fresh in-situ concrete in place until it hardens, such as plywood shutters, timber planks, steel pan forms and fibreglass moulds is considered formwork. Formwork is usually stripped after 24 hours for vertical surfaces, such as columns and walls. Under soffits of beams or slabs, the forms are either left in place until the concrete has gained sufficient strength or they are removed followed by back propping.

Monotek

Monotek is an exterior fibre cement board with bevelled edges. After fixing to framing, the joints are filled and sanded smooth, a textured coating is then applied to provide a decorative and protective finish and to disguise the joints. The need to hide these joints is the reason why smooth finishes like Resene Lumbersider or products with a high gloss are not recommended. There are very detailed instructions on correct fixing, corners and filling/finishing of this product. Each step must be followed very closely.

In-situ concrete

In-situ concrete is poured on site, typically into formwork. The finish will vary and will generally be less smooth than 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 very commonly, a high build textured coating, such as Resene Thixalon or Resene Sandtex, will be applied to disguise surface imperfections. This is often a cheaper option than plastering and painting.

Masonry filler

A masonry filler is a product used to fill defects and bug-holes in concrete/masonry surfaces to provide a smooth finish where plastering of the whole surface is not possible. These fillers may vary from cement based products, such as plasters, to modified cement/acrylic fillers. Masonry fillers are often used to bring concrete block surfaces up to a smooth finish. This practice, particularly on concrete, is also called 'Bagging' although often this is a simple mix of sand and cement. This treatment may be problematic if the mix dries too quickly.

Pebbledash plaster

Pebbledash plaster is a type of very rough plaster where small graded stones (or pebbles) are literally thrown onto wet plaster. Due to the large surface area it may be both difficult and costly to paint. It is not uncommon to use between 150 and 200 litres on a typical 3-4 bedroom home. This finish was commonly seen in the Hawkes Bay until relatively recently.

Precast concrete

Precast concrete is typically produced off-site and is delivered to the construction site and placed in position. Precast concrete is most commonly used for the spandrels of a building, usually on a high rise. The spandrels are the concrete elements that span

between columns of a high rise, usually with windows placed above them. The columns are usually poured on site and are also referred to as in-situ concrete (poured in place or in-situ). Precast panels are typically smoother and have a better finish than in-situ concrete.

Rebar

Rebar is an abbreviation for reinforcement bar, a steel rod used as reinforcement for concrete that is in a load bearing situation. The steel rods are placed inside the formwork and tied together with metal wire and then the concrete is poured around them. In most environments in New Zealand it is required that the steel rebar has at least a 25mm covering of concrete over it to protect it from corrosion

Spalling

This occurs when the rebar within the concrete (or plaster) corrodes due to cracks and/or weakened (carbonated) concrete or inadequate concrete cover over rebar. As the steel corrodes (rusts) it expands and as concrete has little tensile strength it cracks and ultimately will fall off. This is sometimes also called concrete cancer.

Spandrel panels

Spandrels are the structural panels in a wall, usually under the windowsill on one floor and extending down to the window head (top of a window) of the floor below. They are typically made from reinforced precast concrete.

Stucco

Stucco is derived from an Italian word and literally means 'to stick'. Wet plaster is 'cast' onto the surface in a regular or irregular pattern. In some applications and styles it is literally thrown on. The pattern on the surface of most older New Zealand plaster homes is referred to as stucco. Another example of stucco is the Spanish style. As a rule any plaster finish or render could also be described as stucco.

Tilt slab

Tilt slab is concrete that is poured directly onto the floor slab of a building. It is a method that is often used for light commercial buildings and warehousing. Typically the height of the slab will be about 2-3 stories 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.

When it comes to painting these panels the following system(s) have proven very successful.

- Apply Resene Sureseal to the surface - this performs two functions, firstly it prevents any windblown salt from leaching through and secondly it helps bind any friable or weak areas on the panel, particularly where the stones are attached to the concrete,

which over time become weakened by our 'slightly' acid rain. The Resene Sureseal flows into the resulting cracks and voids and binds the surface back together as it dries.

- Apply Resene X-200, usually in two coats. This will help fill any small cracks and help to prevent the tendency for the stone to loosen and fall out as they age.
- An alternative to Resene X-200 is to use Resene Thixalon 5, which should be recommended if the stones have sharp, pointy edges. Resene X-200 will tend to pull away from these edges making coverage difficult, while Resene Thixalon 5 will cover easily. Resene Thixalon 5 has a higher film build and will help prevent carbon dioxide ingress that contributes to concrete cancer and spalling - a problem that often occurs with older panels.
- A glaze coat, usually Resene Multishield+, will help maintain the look and appearance of the system.

Tyrolean plaster

Tyrolean plaster is similar in many ways to stucco, but is applied using a mechanical applicator that 'throws' the wet plaster on the wall in a regular pattern. A similar system is used for the Resene Resitex range of textured finishes, which are applied using a hopper gun.