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for the world at your feet

FACTORS AFFECTING DECK COATING IN PARKING STRUCTURES

How to Avoid Floor Failure in Multi-Storey Car Parks

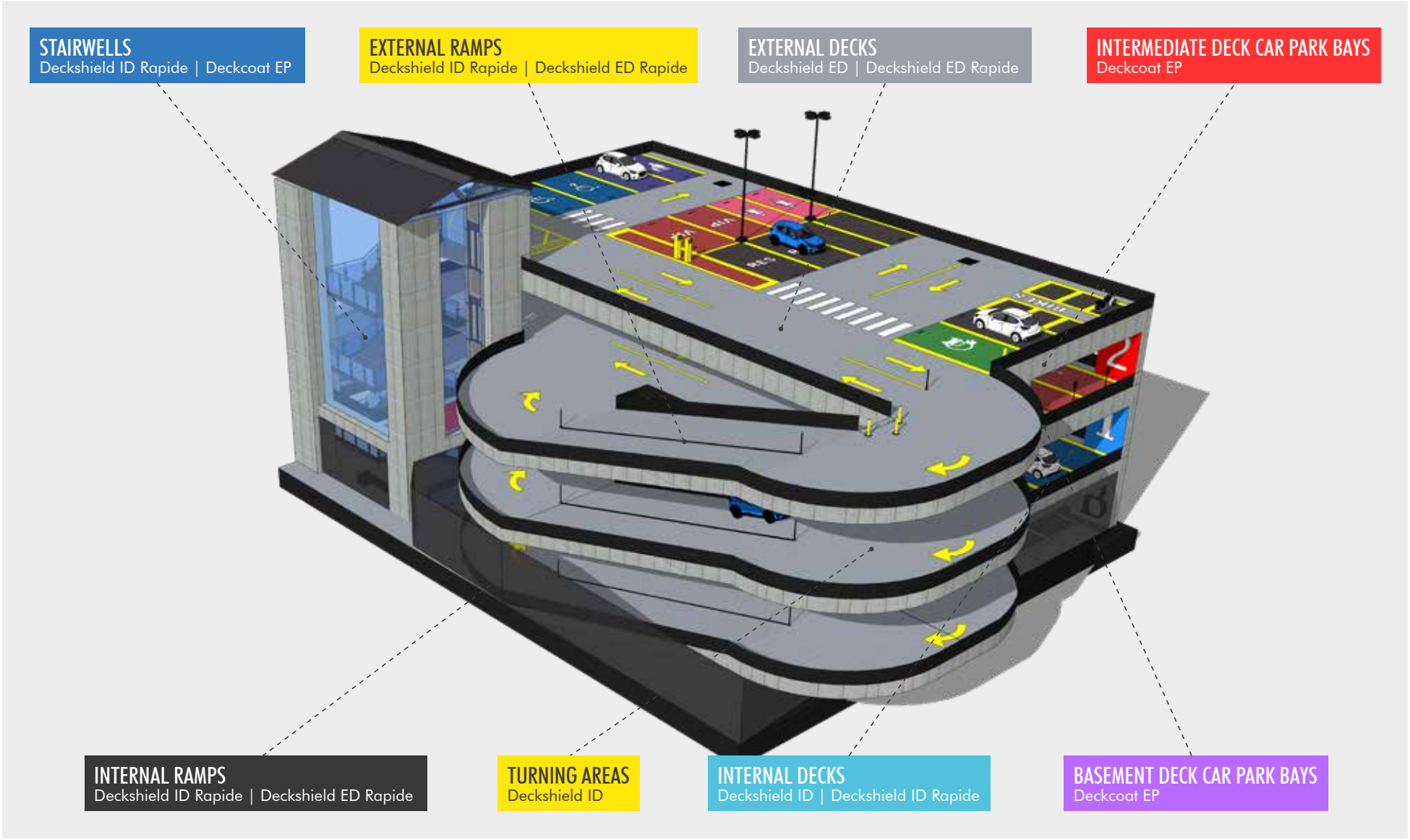
www.flowcreteaustralia.com.au

While car parks are often overlooked in the construction industry, compared to the flashier high-rise skyscrapers and grand new shopping centres, they actually play a vital role in practically every large-scale development in every city and town around the world.

And though they may seem like uncomplicated spaces, there's a lot that needs to be considered to make sure that a multi-storey car park is able to provide a high-quality, effective and long lasting facility.

In particular, floors in car parks are faced with some especially challenging issues. In this eBook we explore these flooring problems and how you can make sure that a car park coating won't just crack and fail when faced with all the traffic, wind, rain, slab movement, chemicals, spillages, and…well, read on to find out exactly what they need to be able to withstand and how to achieve this.

Flowcrete Australia offers specialist epoxy and polyurethane coating systems for all areas of a car park.



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LEAKING TOP DECKS

Car parks often have exposed top decks instead of roofs and so need to be able to cope with large quantities of rainfall. If the water leaks through the top deck into the parking levels below then it can lead to a number of problems, as not only can this cause slippery, unhygienic conditions, but if it gets into the underlying concrete then it can seriously affect the building's structural integrity.

One of the leading causes of water getting through the floor is because the coating has cracked, spoiling what should be a seamless, impervious finish and creating a chink in the concrete's protection that allows liquids to infiltrate the concrete and the interior of the building.

This cracking usually happens because of the way that multi-storey car parks are constructed. Being large structures with few supports (in order to maximise parking space), combined with the inevitable movement of heavy vehicles, it is normal for each level to undergo a lot of flex and movement.

Top decks also experience more thermal movement than the other levels, as the heat from the sun will cause everything to expand, including the building's concrete. If the floor coating doesn't grow and shrink with the concrete, then it will crack.

Needless to say, in climates like Australia and New Zealand it is particularly important to make sure that the punishing sunlight won't damage the floor. This is another reason to apply an elastic, flexible finish that will move with the building.

Flooring systems that are too brittle will inevitably fail when faced with this type of movement, no matter how tough the coating is and how well it can survive direct impacts – these characteristics are redundant if it can't sway and stretch with the building.


P5
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2

UV EXPOSURE

While a clear blue sky seems innocuous enough, UV rays can deteriorate and break down even the hardiest materials given enough time. This means that many buildings will quickly suffer from UV degradation if they're not properly protected. Being constructions that don't typically have roofs, multi-storey car parks are particularly at risk from prolonged exposure to the sun's rays.

This problem is inevitably at its most acute on the uncovered top deck of a car park, which has no respite from the punishing effects of the weather. If the floor on this level is not up to the challenge then its colour could start to fade and the coating could begin to start chalking, cracking or crumbling.

Most epoxy systems will fail in this type of environment and therefore it's best to choose a different type of resin chemistry on the exposed deck than would be used for the other car park levels.

PUMMA, a hybrid system that combines the durability of methyl methacrylate (MMA) with the flexibility of polyurethane, has much better resistance to UV rays and is able to withstand even the most extreme warm weather without losing any of its looks or integrity.

Thanks to its UV stability, the MMA within the floor's formulation effectively acts like a thick layer of factor 50 sunscreen, protecting the floor from the damaging effects of sunlight.

The ability of this type of flooring material to survive UV rays can be tested as part of EN 1504 testing (which is an internationally accepted standard for coatings that protect concrete structures).

The standard includes a test for artificial weathering which involves exposing a sample to 2,000 hours of high temperatures and constant irradiation. To accurately mimic sunlight in a lab, the sample is placed under a UVA 340 lamp for the entire time. After the 2,000 hours is up, a UV resistance deck coating should show no signs of chalking, blistering, peeling or flaking.

IT REALLY IS SUNNIER DOWN SOUTH!

We might joke about the fact that countries like Australia and New Zealand see more sunlight than everywhere else – but this really is true! Due to a combination of factors, including the Earth's orbit, the ozone layer and cleaner air, UV intensities are greater in the southern hemisphere than they are north of the equator.

This makes choosing UV stable floors in these parts of the world all the more important!

3 MOISTURE & MEMBRANES

To fully protect a deck coating and its underlying structure, it's important to guard against liquids seeping into the underlying concrete while simultaneously stopping moisture from inside the concrete rising up into the floor.

Let's start with the issue of water getting into the concrete, which is obviously more of a concern on exposed top decks than elsewhere.

To prevent water ingress, a membrane should always be installed underneath the finish that waterproofs the substrate. To achieve this, many contractors turn to liquid waterproofing membranes, which are applied like paint and when dry form an elastic layer across the concrete. These are often spray applied directly onto the substrate and create a thin, rubber-like coating.

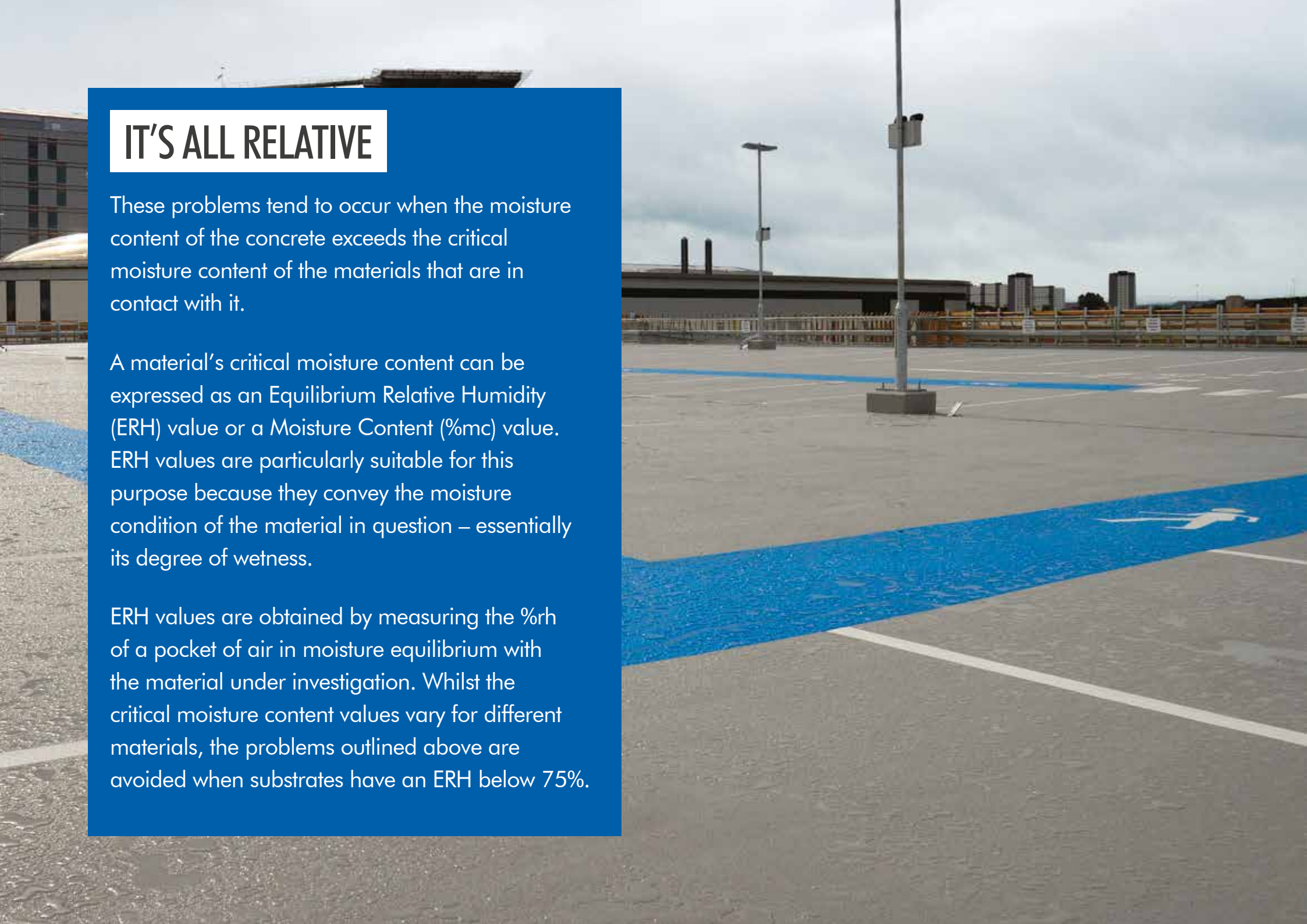
While there are many liquid waterproofing membranes available, choosing the right one for a car park floor requires considering whether it will stand up to the rigours of a car park environment (such as heavy vehicle traffic, impacts, etc.). If the answer to this is no, then not only could the membrane be ineffective, but it could lead to a domino effect of failures within the floor coating.

To help ensure that the membrane ticks both of the above boxes, Deckshield ED Rapide has been designed to include an innovative MMA-based waterproofing membrane. This specialist system for external car park decks incorporates this membrane thanks to its ability to quickly form a robust layer between the floor's primer and coating that stops any liquid in its tracks.

Slightly thicker than traditional, spray-on membranes, this solution is roller applied and thanks to its methyl methacrylate (MMA) formulation cures rapidly and is less affected by cold temperatures or high moisture levels during the application process.

RISING MOISTURE MATTERS

At the other end of the coating system, excessive moisture in the concrete slab can lead to significant damage. This happens because the moisture struggles to escape when it moves out of the substrate and so ends up forcing its way into the coating, causing issues such as adhesion failure and unsightly bubbles.



IT'S ALL RELATIVE

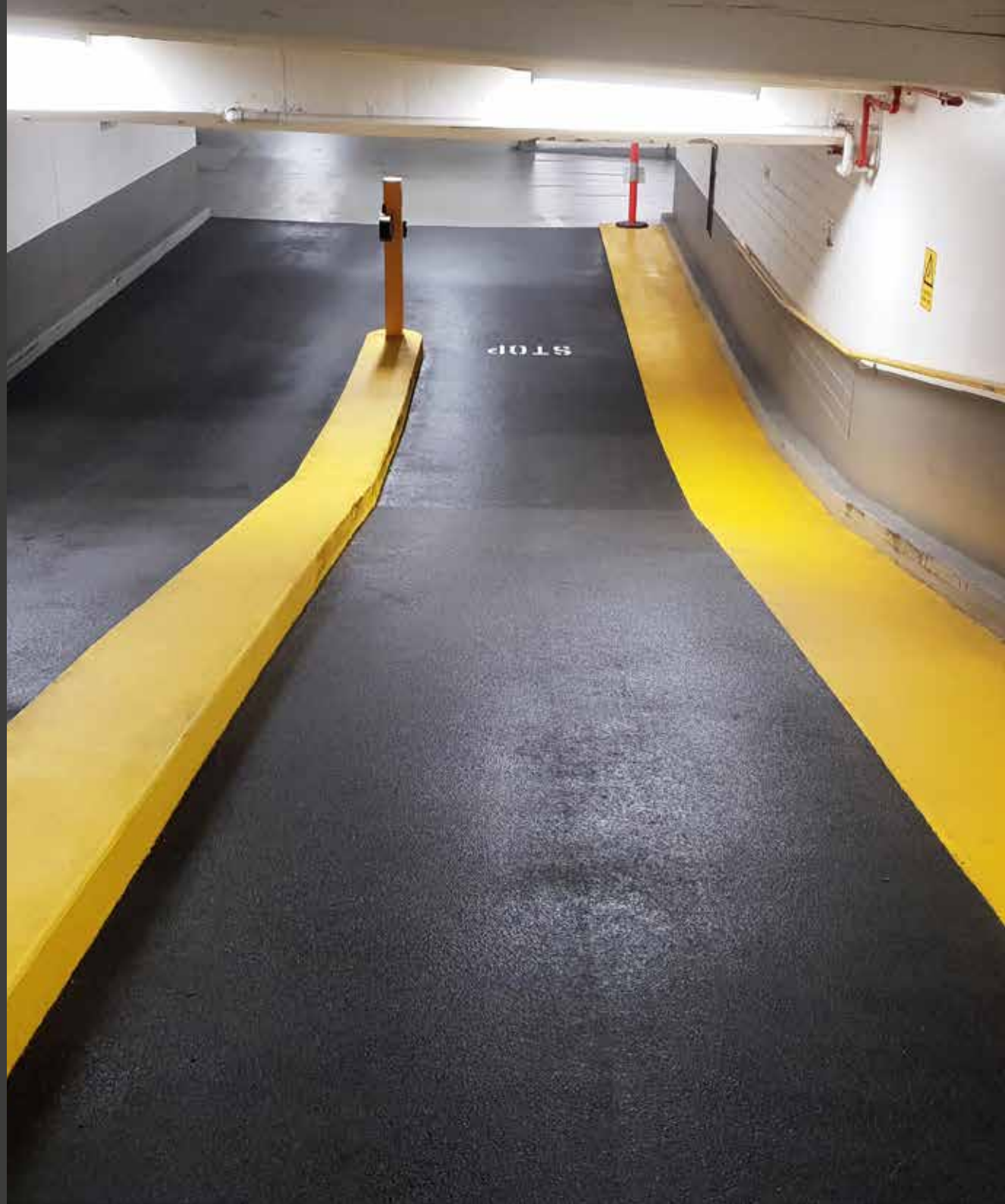
These problems tend to occur when the moisture content of the concrete exceeds the critical moisture content of the materials that are in contact with it.

A material's critical moisture content can be expressed as an Equilibrium Relative Humidity (ERH) value or a Moisture Content (%mc) value. ERH values are particularly suitable for this purpose because they convey the moisture condition of the material in question – essentially its degree of wetness.

ERH values are obtained by measuring the %rh of a pocket of air in moisture equilibrium with the material under investigation. Whilst the critical moisture content values vary for different materials, the problems outlined above are avoided when substrates have an ERH below 75%.

4 SLIP RESISTANCE

Car park deck coatings tailored for slip resistance ensure that vehicles can safely move around. What's more the aggregates – often aluminium oxide or bauxite to provide a much hardier, reliable finish than sand – used to enhance anti-slip properties also strengthen the coating.



Slip resistance is more problematic but also more critical on ramps and tight turning areas.

There are two main types of car park ramp. A connecting ramp vertically links separated parking decks, while parking ramps combine the functions of circulations and storage in spiral or helical car parks. Both types can either be curved or straight, although this has a large impact on the gradient of the ramp and the forces required for a car to move along it.

The challenge in these places stems from the fact that a heavy vehicle making a tight turning motion puts a lot of pressure, mechanical impact, vibration and abrasion through the tyre's small contact area and into the floor. Not only does the car need help with grip in these circumstances, but the floor needs to be able to deal with this intense pressure and abrasion over and over again.

Slip resistance is also all the more crucial on exposed ramps or where rainwater can get into the site, as obviously it's even harder for a car to grip onto a wet surface than a dry one.

Ramps and turning circles are one of the most complex areas of the structure for engineers and architects, as they often need to push for shorter, narrower ramps with low floor to ceiling spaces in order to maximise parking capacity. Temperature changes can also affect the joints on the structure where the ramps connect to the different levels of a multi-storey building.

5 TYRE SQUEAL

We've all heard a tightly turning car when it's accelerating and shivered as that screeching, high-pitched whine echoes around the car park.

This can be a problem for site operators for a variety of reasons, particularly if they want their parking facilities to evoke a high-end environment or if there are residents nearby likely to complain about the noise.

The reason for this din is because of the friction created between a car's tyre and a smooth floor. When combined with the wide-open spaces and concrete walls of a car park it's the perfect recipe for loud, reverberating and annoying noises.

The solution to this problem is to use a trafficable deck coating that has been textured using aluminium oxide or bauxite aggregates. The small bumps and ridges that this creates is ideal for enhancing traction while reducing the contact area between the tyre and the floor, giving the car grip and simultaneously avoiding unpleasant sounds.

Much like with slip resistance and strength, it's especially important to make sure that a multi-storey car park's ramps and tight turning areas have the right flooring profile, as these are the spots most likely to fall victim to tyre squeal.

Durability is an important consideration when it comes to reducing tyre squeal, as if the floor becomes ground down and smooth over time then the required level of traction will also wear away.

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CONCRETE SLAB MOVEMENT

The nature of car parks demands that they are constructed with large clear spans with a minimum number of supporting columns, in order to achieve the maximum number of vehicle parking spaces. This type of construction, when subject to cyclical traffic flow, inevitably leads to the structure being susceptible to a lot of flexing and movement.

A high volume of vehicles traversing a car parking structure over time can lead to dynamic loading, where vibrations impart through the decks into the structure, increasing the risk of movement across all construction, expansion and movement joints within the frame of the structure and decks themselves.

The concrete slab will also be subjected to different types of movement, such as the perpendicular stress of shearing thanks to the inconsistently distributed loads created by cars moving in multiple directions. In addition to this, car parks will also face lateral strain, which is when the slab extends along the longitudinal stress (i.e. the car moving in a straight line) and contracts in the lateral direction. With all these forces pushing and pulling at the concrete, we can see how the slab faces some pretty tough challenges!

The floor coating will also experience these issues and needs to be able to flex with the movement of the cars and the underlying concrete slab without splitting apart. Too rigid and the floor will crack when subjected to the above forces, too thin or weak and the grinding punishment of the cars will erode and wear away at the floor.

This guide has been produced to give an overview of the resin choices available and factors to consider when specifying a resin flooring system within the design of a multi storey car park.

Flowcrete has been successfully manufacturing and supplying flooring material to the car parking industry for over 30 years, securing high profile installations at car parks including The Star Casino, Roselands Shopping Centre, Parklands and Concord Hospital to name a few.

Flowcrete's Deckshield range has been specially formulated for this industry and can play a critical role in protecting the parking structure from the daily abuses faced in this type of facility, while transforming car parks into bright, welcoming and safe environments for visitors.

Detailed recommendations and advice are available from our network of regional technical and sales representatives.

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