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Total Parking Solutions: From Basement to Roof Level Decks

Multi-storey car parks are unique buildings, one in which all elements of the structure are normally exposed to the public. These structures face unique challenges as well as exposure to niche stresses as well as physical and chemical abuse.

This paper aims to assist clients working in the car park sector, from both a construction and facilities management perspective, to correctly assess surface conditions and service requirements in order to make the most appropriate and cost-effective selection of deck waterproof and wearing surface systems for the relevant basement, intermediate or exposed, deck of the structure.

The advice provided, is on the basis that the car park structure and all of its decks are of sufficient structural design and load bearing capacity and free from any structural damage or defects prior to the installation of resin-based deck coating materials.

Lowest Basement Decks

Challenges:

Lowest basement decks can be tricky. Located below or even on grade, basement or lowest level decks are in physical contact with the ground and require horizontal and vertical moisture proofing across basement floor and roof slabs as well as walls in order to

prevent the ingress of water or other corrosive pollutants, such as chlorides or sulphates, into the basement's interior as well as moisture penetration into and through the porous structure of the basement envelope.

If the basement slab is located close to a high water table then different moisture levels below and above the slab will result in moisture vapour transmission and inevitably put pressure upon the underside of the deck coating material, possibly leading to blistering or delamination of the surface.

Below grade basement decks also tend to be very humid environments causing substrates to exhibit higher moisture content than those located on or above ground. The high relative humidity can also lead to problems during the installation of resin-based coatings; resulting in blushing or discolouration of the surface if not formulated to match conditions.

Attributes of Good Car Park Design

- Easy access to car park and bays
- logical traffic flow
- Unimpeded movement
- Light and airy
- Low maintenance
- Safe and secure

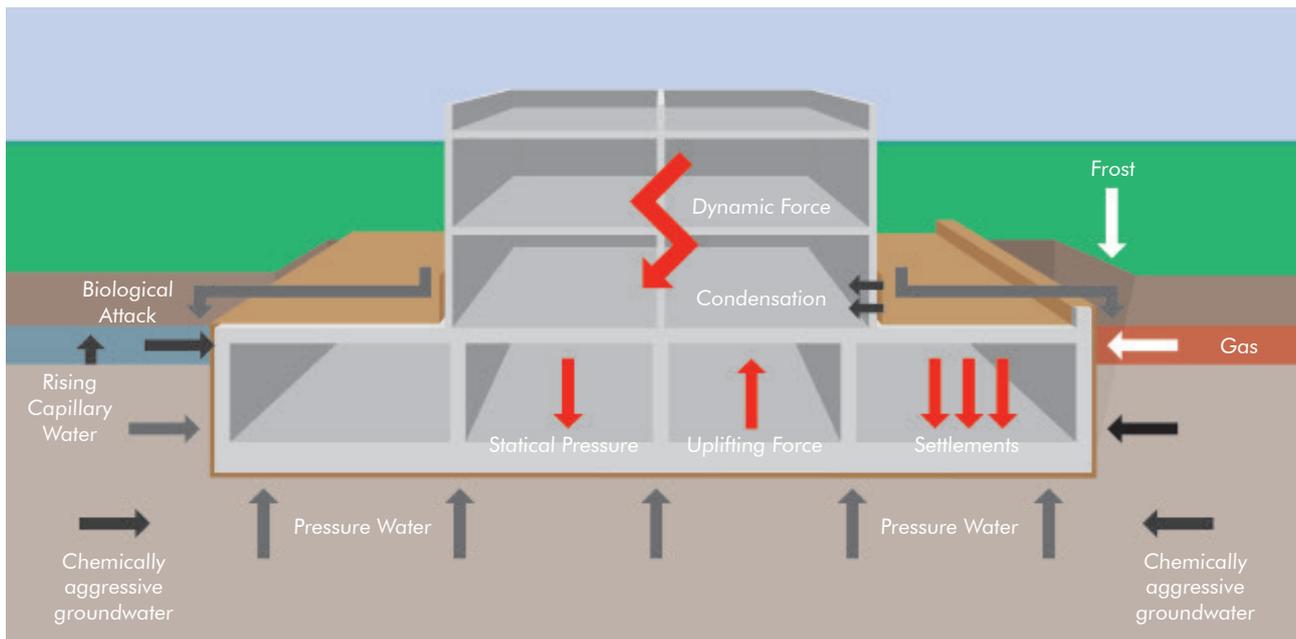


FIGURE 1: Forces Impacting on the Multi Storey Car Park

Solutions:

Protecting basement decks from the effects of groundwater is of utmost importance in order to prevent any lasting or costly structural repair to the car park building. Firstly it must be determined if a secure and intact damp proof membrane (DPM) has already been installed on the negative side of the concrete basement floor slab.

If that is the case and rising moisture is no longer a concern then a DPM on the positive side of the slab is not required. However, in instances where there is no underlying damp-proofing solution or where the membrane has been damaged a positive side DPM, moisture tolerant primer or breathable water-based floor finish will be required to prevent any damage to the final surface.

Positive Side DPM

The installation of a positive side DPM will not only allow moisture vapour to pass through, but will also disperse any moisture vapour across a larger area and therefore prevent any point load pressure from damaging the final surface product over time.

In instances where a suitable DPM has been installed and not damaged, the finishing deck coating material need not be breathable as it will already be protected from any rising moisture by the DPM.

However, take care not to cut corners. It's important to determine not only if rising moisture is present but how much is present, which can be complicated as this tends to change both daily and seasonally. It's always best to consult a car park engineering specialist to understand more about evaluating moisture vapour levels before making any final decision.

Breathable Water-Based Floor Finishes

Resin coatings that offer breathable characteristics are generally water-based. The cross-link density of these systems is such that a certain amount of water vapour can pass safely through the resin material without causing it to de-bond from the damp substrate.

A number of breathable coating materials offer varying amounts of breathability so it is important to understand the limitations of each product before settling on a final coating system.

Advantages of Resin Deck Systems

- Bright and attractive finishes
- Reduces noise from tyre squeal
- Hard wearing and abrasion resistant
- Solvent free
- Can be installed on asphalt substrates
- Fire resistant
- Crack-bridging
- Flexible waterproof membrane

Intermediate Decks

Challenges:

Although intermediate decks of multi-storey car parks are likely to be exposed to the lowest levels of thermal movement, thermal cycling and UV radiation, they are likely to witness the most traffic abuse as vehicles consistently use the intermediate decks to enter and exit the structure.

They are also likely to be subject to the most structural movement, particularly within newly constructed facilities.

Car parks are designed to ensure expansive spans with minimal supporting columns to accommodate the maximum number of vehicles. When subject to cyclical traffic flow, this type of construction often leaves the structure susceptible to 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.

Solutions:

In order to counteract the risk of dynamic loading as well as deliver a chemical, slip and wear

resistant finish in internal decks of multi-storey structures, a range of coating systems can be used.

Polyurethane Coating Systems

Crack-bridging polyurethane materials have been designed to handle the unique structural movement of suspended slab and bridge cracks and therefore offer the necessary flex to move alongside the structure, preventing cracking that may develop in the concrete substrate from reflecting on the surface as well as minimising any long-lasting damage to the structure itself.

Although intermediate decks are generally covered, in certain design schemes, some of the car park may be exposed to some UV light for limited periods of the day. UV resistant polyurethane decking systems offer excellent UV resistance and will protect the finished surface from discolouration or fading.

On top of this, polyurethane surfaces demonstrate excellent chemical resistance and can be tailored to meet individual slip resistance requirements to ensure safety underfoot. They come in a wide variety of colour options and offer the most durable finish for intermediate deck environments.

Epoxy Coating Systems

Solvent free epoxy coating systems are more rigid than polyurethane ones and therefore will not handle structural movement as well.

Epoxy options however do exhibit good chemical resistance and can serve to protect the concrete substrate in areas where significant structural movement is not a concern.

Epoxy coatings also offer excellent resistance to abrasion are easy to clean, hygienic, hard wearing, with excellent impact resistance and mechanical strength. They come in a wide variety of colour options and offer the most durable finish for intermediate deck environments.

Exposed Decks

Challenges:

Exposed decks of multi-storey car parks are the most vulnerable part of the building. These areas have the highest external weathering exposure to the elements and are therefore susceptible to high levels of thermal cycling, thermal movement and UV radiation as well as rain water and air moisture.

Thermal variations will cause the exposed deck substrate to expand and contract, imposing dynamic stresses that will inevitably lead to the early cracking of the concrete substrate whereas ingress of water and chlorides into the premises below could result in long-term damage to the structure.

Solutions:

Roof level parking decks are one of the most challenging waterproofing projects in the construction sector. Firstly, it is important to determine the waterproofing requirements of the final deck coating material. If the decking system itself is required to waterproof the external deck slab, an elastomeric membrane will be required.

On the other hand, if a negative side waterproofing membrane has already been installed in conjunction with the external deck slab, the top coat need not be waterproof, but it must be breathable so as not to trap moisture in the slab.

It is critical that waterproof membranes are not installed both below and above the external deck slab as it will result in moisture becoming trapped between the two membranes. When the temperature of this moisture is raised from exposure to heat from sunlight, vapour pressure will build-up and risk de-bonding of the finishing system.

Polyurethane Coating Systems

By far and away the most suitable material for exposed or external decks is a flexible, elastomeric and waterproof polyurethane deck coating. These materials, whether applied at ground or elevated levels will offer the most robust protection to the external stresses caused by exposure to the elements.

They also exhibit a high level of UV resistance; ensuring that colours remain vibrant and preventing any pigment shift or fading.

Ramps

Challenges:

There are two main types of ramp within the car park; connecting ramps that vertically link separated parking decks and parking ramps, which combine the functions of circulations and storage in spiral or helical car parks. Both types can either be curved or straight, which has a large bearing on any issues concerning gradient.

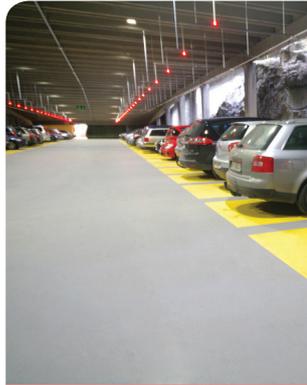
Ramps and turning circles are exposed to high levels of mechanical impact, vibration and abrasion and represent one of the most complex areas of the structure as engineers and architects push for shorter, narrower ramps with low floor to ceiling spaces in order to maximise parking capacity.

Floor Specification Considerations

- Substrate protection
- Chemical resistance to fuels and oils
- Chemical resistance to elements brought in on tyre treads
- UV radiation and exposure
- Slip Resistance
- Frequency of traffic
- Types of vehicles
- Aesthetics
- Ease of cleaning and maintenance
- Environmental stewardship



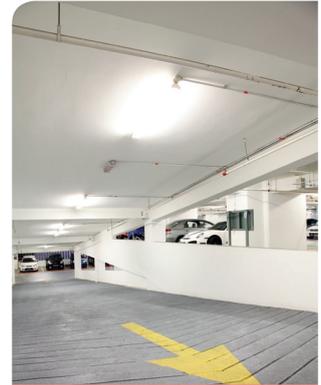
Roof Level Car Park
Deck Systems



Intermediate Level Car
Park Deck Systems



Basement Level Car
Park Deck Systems



Heavy Duty Deck
Systems for Ramps

In some instances, ramps are also partially exposed to external weathering and rainwater and there can be significant movement affecting the joints connecting the ramps to multi-storey decks.

Application of resin materials onto large gradients can also be problematic due to the materials' flowing nature, which is usually advantageous on flat areas.

Solutions:

Ramp areas demand special consideration and treatment. A higher system thickness is recommended as well as systems with a sufficient thixotropic profile to ensure slump-free application.

Heavy Duty Polyurethane Coating Systems

Polyurethane coating systems are best suited to ramps, offering all of the materials inherent

crack-bridging and wear resistance properties, the materials can also be applied at larger thicknesses and can be broadcast with strong aggregates including, aluminium oxide, in order to ensure a strong, textured and anti-slip finish.

Heavy-duty polyurethane coatings are equipped to deal with the heavy load and impact from both pedestrian and vehicular traffic as well as to protect the structure in these vulnerable areas.

This guide has been produced to give an overview of floor specification considerations when selecting suitable moisture-proofing and resin deck coating systems on lowest basement, intermediate and roof level decks of multi-storey parking structures.

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

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