



## Protection and Repair of Multi-Storey and Underground Car Parks

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# Multi-Storey and Underground Car Parks

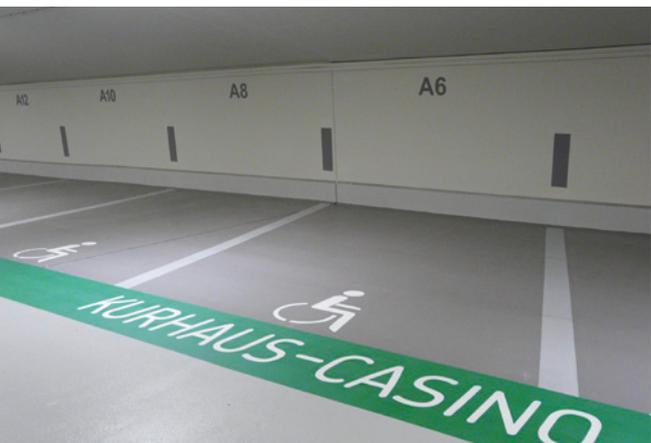
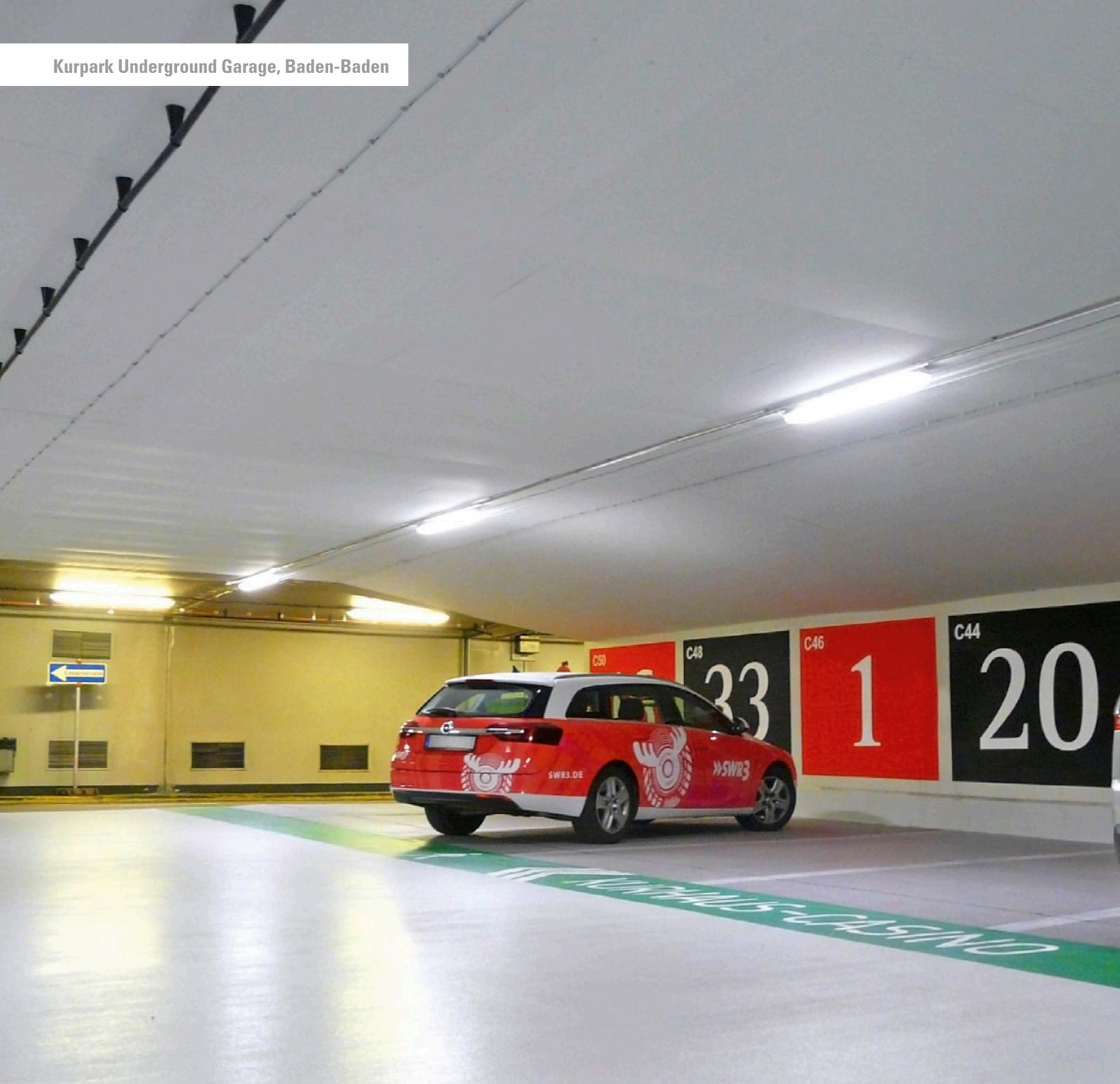
## Solutions for concrete protection and improved user-friendliness

When considering constructing a new or repairing and refurbishing an existing car parking facility, planning professionals will have a number of objectives in mind. Among the most important of these is to protect the reinforced concrete from chloride attack and to seal all cracks and joints so that they are watertight. It will also be desirable to keep the car park light, bright and user-friendly.

Clients will be especially keen on a solution offering robust durability. In the case of refurb jobs, this will go hand-in-hand with the need for minimal downtime and lockout periods so that the car park can be put back into service as quickly as possible.

The variety and sometimes also the disparity of design and technical requirements mean that such undertakings can rarely be approached using off-the-shelf concepts. It is much more the case, in fact, that virtually every multi-storey and underground car park project requires properly customised, detailed planning. And this is where the smart products, solutions and expertise of MC-Bauchemie can make such a difference – BE SURE. BUILD SURE.

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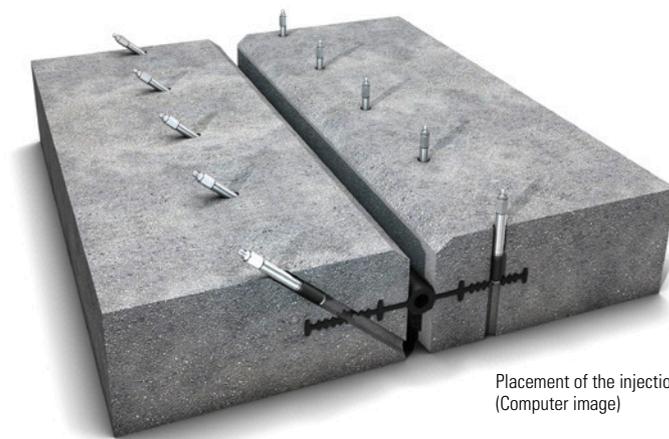


Injection of the deck joints

## Waterproofing of deck joints with injection technology

Implemented in several construction phases during ongoing operations, this elaborate project is a prime example of how a car park structure can be successfully upgraded. The underground Kurpark (spa) car park is located directly below the health clinic and convalescence garden. It provides users with quick, easy and sheltered access to the Baden-Baden casino. Following its upgrade, the car park now offers some 550 spacious, brightly lit bays.

The specifications were extremely extensive, encompassing everything from refurbishment and sealing of the deck-to-wall joints and the complete repair of the concrete base with an increase in the concrete cover, to a new surface coating for the access lanes and parking bays. The final result was to be a parking facility offering a friendly and open welcome in a design matching that of the casino.



Placement of the injection packers  
(Computer image)

### Durable and highly resilient joint waterproofing

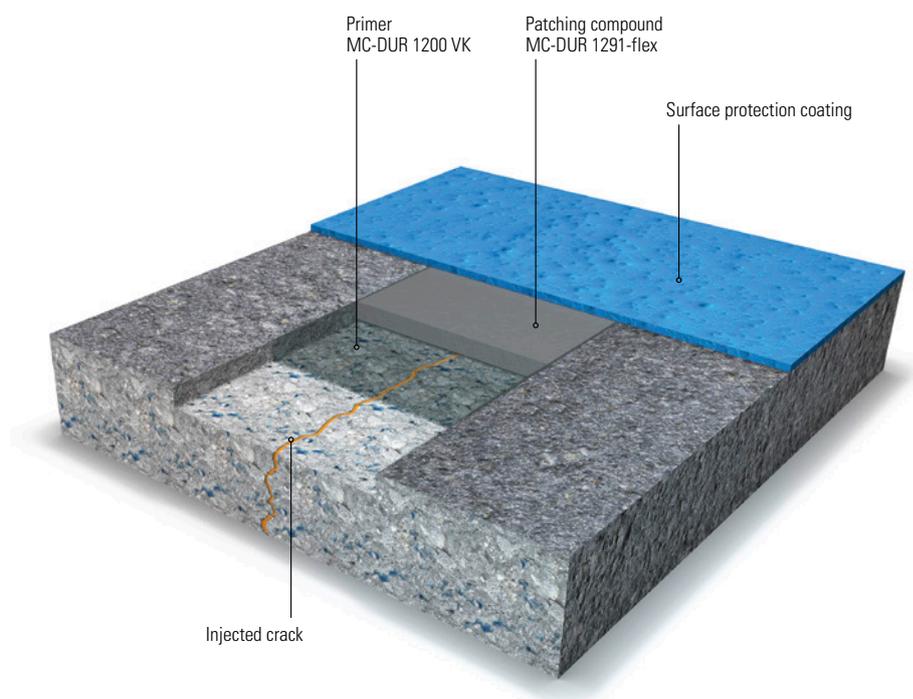
Offering proven long-term resistance and groundwater compatibility, **MC-Injekt GL-95 TX** delivers wherever direct access to the outer surface of the component being sealed is not possible. It is used as a waterproofing injection for the subsequent sealing of construction gaps, such as joints.

Offering permanent flexibility, the soft-elastic acrylate-based injection resin offers good resistance to freeze-thaw cycling. It was used to seal around 500 metres of joints in the underground car park.

## Crack Patching to Seal Deck Slabs

The sealing of cracks in deck slabs consistently places high demands on the systems used, as illustrated by the multi-storey car park serving the Riem Arcaden shopping mall. Since its commissioning in 2006, extensive work has been constantly necessary to seal the cracks that have appeared, and all without any lasting success: Covering an area of about 55,000 m<sup>2</sup> and with a thickness of 1 metre virtually throughout, the deck slab was regularly beset with the occurrence of water-bearing cracks.

The concrete tank construction was finally waterproofed with the aid of MC's crack patching system. The work was carried out in two sections, with the cracks being initially injected and patched over a total length of more than 2,000 metre. This was followed by application of an elasticised, mechanically highly resilient coating system over the entire area of 34,000 m<sup>2</sup>.



### MC crack patching to prevent water upsurge

The system is used for coating and repair of trafficked deck surfaces in underground car parks. The patch system is applied after milling a strip / groove left and right of the crack with a width of approx. 10 cm and a depth of 3-5 mm.

The crack repair patch comprises the primer **MC-DUR 1200 VK** and a layer of the flexible, crack-bridging synthetic resin **MC-DUR 1291 flex**. This is then covered and concealed by the top coat.



This innovative procedure fulfilled the KIWA functional test in June 2016 without any reservations, thus validating the water-tightness of the system.



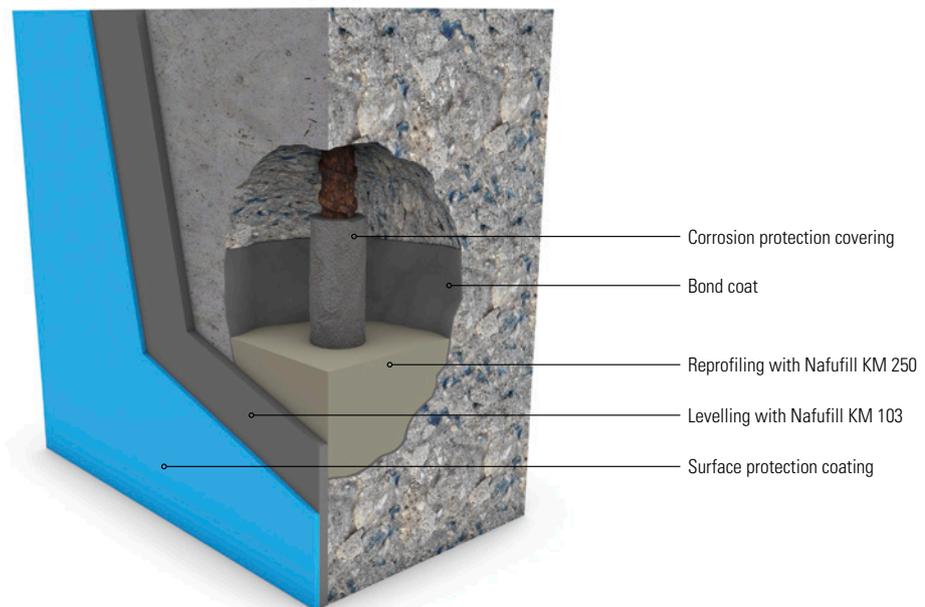
*Crack patch prior to top-coating*



## Structural Refurbishment with Concrete Replacement

The multi-storey car park serving the Allianz Arena in Munich is regarded as the largest of its kind in Europe. Due to the heavy use of the approximately 10,000 parking bays, even in the winter months, the four-storey structure suffered high levels of chloride ingress through to its core. As a result, the reinforced concrete was so badly damaged, especially at the columns, that it had to be partially replaced to depths extending behind the steel reinforcement.

For the reprofiling of 400 columns, the planning engineers opted for the structurally strengthening concrete replacement Nafufill KM 250.



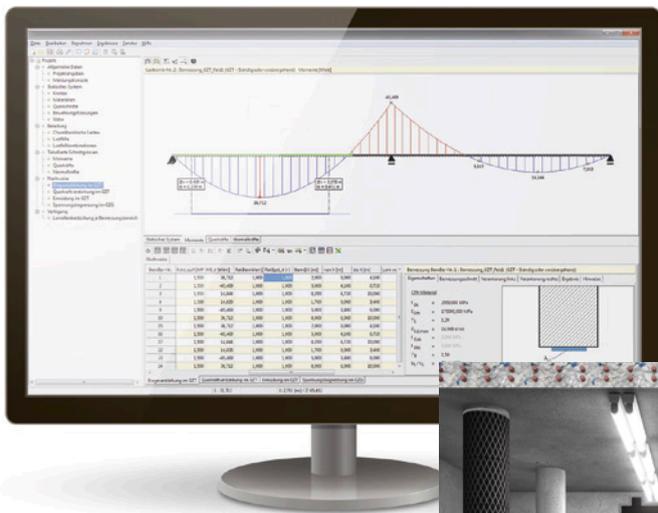
### Repair of concrete elements with reinstatement of load-bearing capacity

**Nafufill KM 250** verifiably fulfils all concrete-related technological requirements pertaining to corrosion inhibition, bonding and reinforcement fire protection. Nafufill KM 250 adds structural strength, is flame-retarding and fire-resistant and is used on interior and exterior building components both to reprofile spalled areas and to increase concrete cover. It is also approved as an embedding mortar for cathodic protection anodes.

- R4 concrete replacement certified to EN 1504 Part 3
- Fire-retardant to DIN 4102-2
- Fire resistance rating F 120
- Non-combustible to EN 13501-1, Material Class A1
- Structurally strengthening
- Resistant to extreme temperatures, freeze-thaw cycling and de-icing salts
- Electrically conductive
- High resistance to carbonation

# Structural Refurbishment with CFRP Straps and Sheets

A total of 15,500 metres of MC-DUR CFK (CFRP) straps were used for the structural refurbishment of the parking deck in Eching, Germany. The CFRP straps were dimensioned for fully code-compliant crack width limitation and glued in milled slots using MC-DUR 1280 as the adhesive.



*The Lasoft 4.0 structural analysis and design program for the calculation of bonded reinforcement assists engineers in devising systems that utilise MC-DUR CFRP straps and MC-DUR CF sheets in structural refurbishment campaigns.*

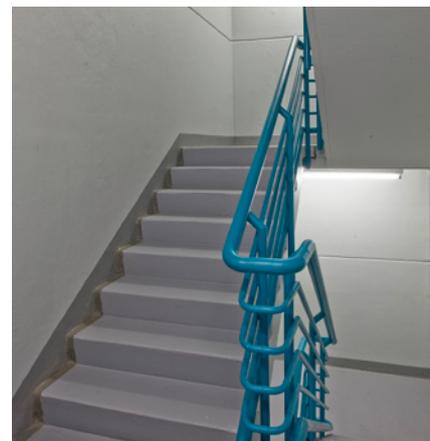
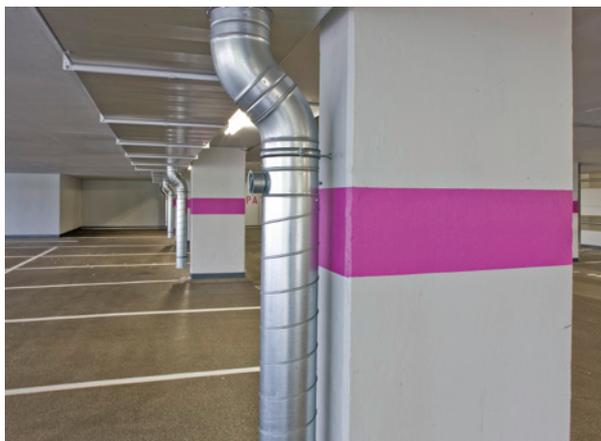
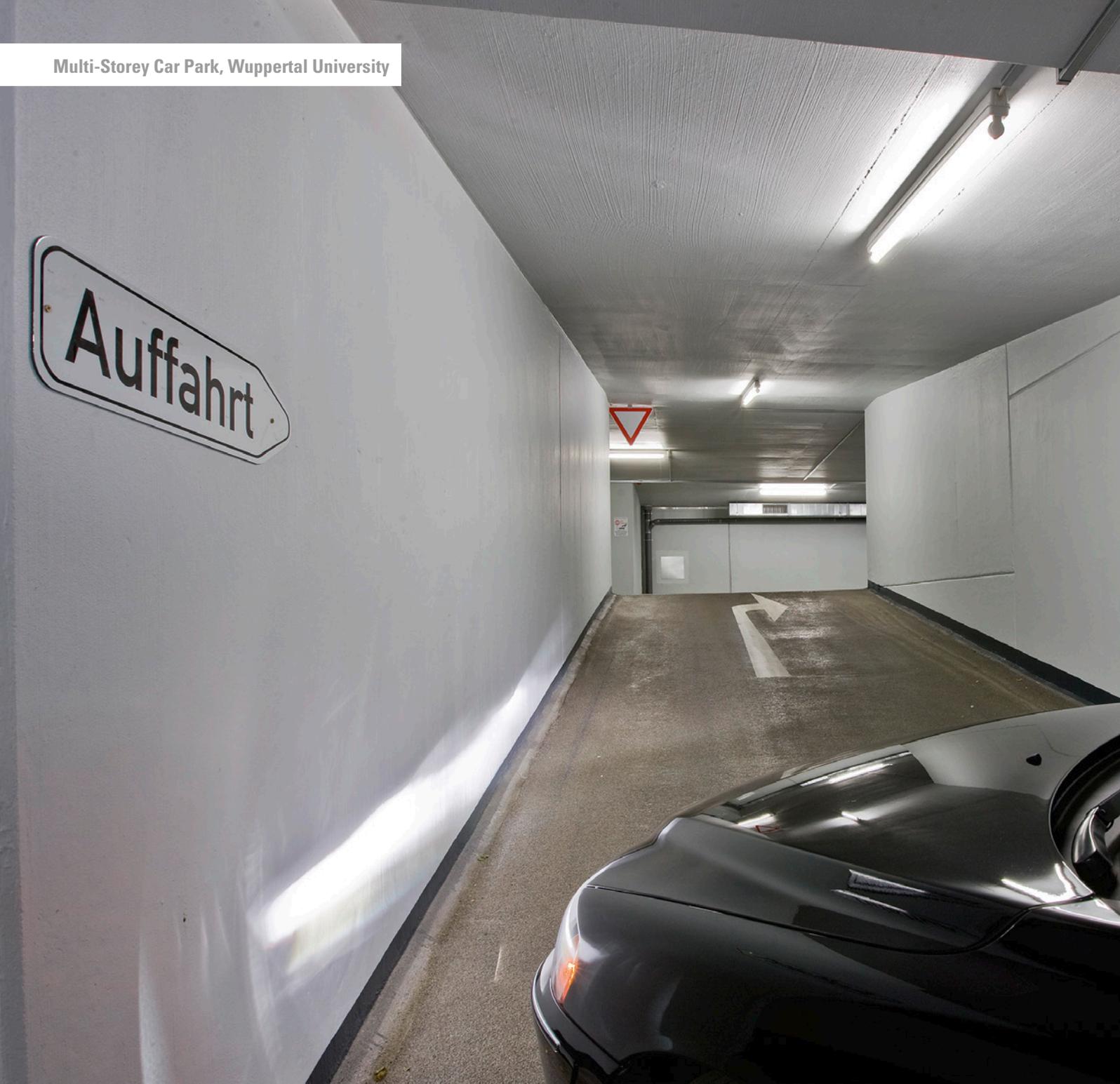


## Structural refurbishment of load-bearing concrete components

Carbon fibre reinforced plastics (CFRP) have long proven to be indispensable to the construction industry. For many years now, CFRP in the form of retrofitted, adhesive-bonded tensile straps or CF sheets and bandages have been used to restore and increase the load-bearing capacity of structural components. **MC-DUR CFK** system can be used for the following refurbishment applications on reinforced concrete components as per approvals issued under the German DAfStb code of practice "Strengthening of concrete components with bonded reinforcement":

- Flexural reinforcement with surface-bonded CFRP straps, CF sheets, steel straps
- Flexural reinforcement with CFRP straps adhesive-bonded in slots
- Shear reinforcement with surface-bonded CF sheets and steel straps
- Column reinforcement by bandaging with CF sheets





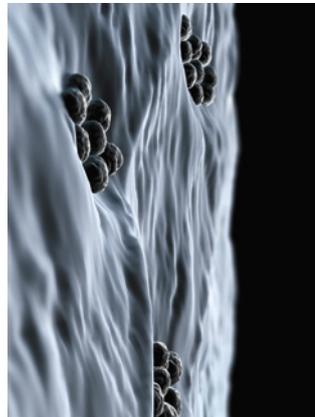
## Surface Protection Product Range for Colour Coating, with Additional Graffiti Protection

More than 200 t of Nafufill repair mortar and 10,000 m<sup>2</sup> of MC-DUR 1200 VK floor coating were used for the extensive renovation of deck, wall and ceiling areas in the multi-storey car park serving the University of Wuppertal. The final coating of the wall surfaces was designed to serve two purposes: protection of the building fabric and provision of durable colour wayfinding guidance for the car park users.

The solution selected was a surface protection system in the high-performance class. In addition to excellent concrete safeguarding properties, it has durable aesthetic qualities, with the special surface provided minimising soil and dirt adhesion while also facilitating the removal of graffiti.

### Attachment of soil particles

*Conventional dispersion paint*



*MC-Color Flair vision*



### Surface protection with added value

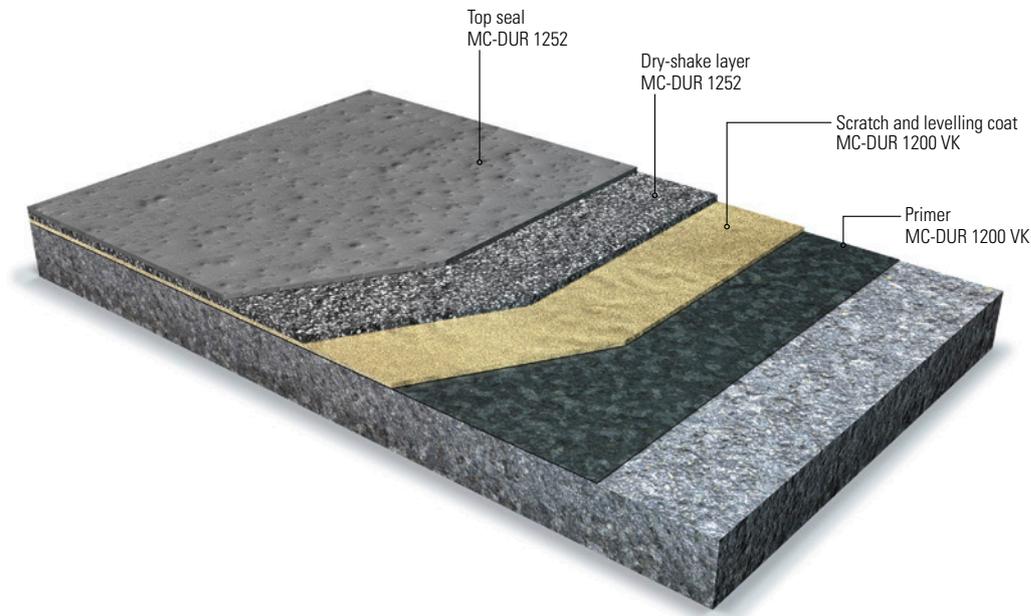
**MC-Color Flair vision** is a two-component aqueous, pigmented, hydrophobic polyurethane-polymer combination with exceptional colour stability and integrated Easy-to-Clean technology. The surface protection system is open to water vapour diffusion, inhibits carbonation and protects the concrete from freeze-thaw cycling and the effects of de-icing salts.

Graffiti disfigurement can be quickly removed with the system detergent **MC-Cleaner G**.

- Wall coatings available in virtually all colours and designs
- Surface protection coating
- Graffiti repellent
- Graffiti removal made easy
- Improved cleanability

## Deck Coating on 90,000 m<sup>2</sup>

One of the specifications underlying the construction of multi-storey car park 3 in the Zurich-Kloten airport complex involved the provision of a colourful design for the deck areas. However, not only was it necessary to meet OS 8 specifications, the trafficability of the entire system also had to be validated. For this purpose, test criteria based on the approval principles issued by the DIBt (German Institute of Building Technology) for coatings were applied. The system employed withstood 100,000 trafficking cycles with Vulkollan tyres without incurring any damage. The epoxy resin coating system MC-DUR 1252 provided the pigmented concrete protection for the parking decks.



### Functional aesthetics

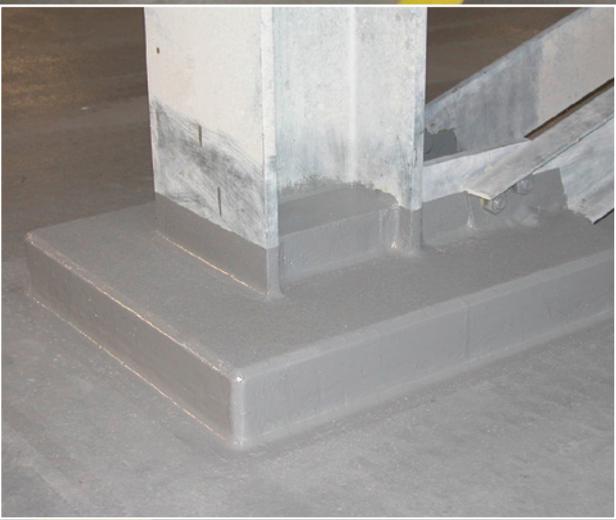
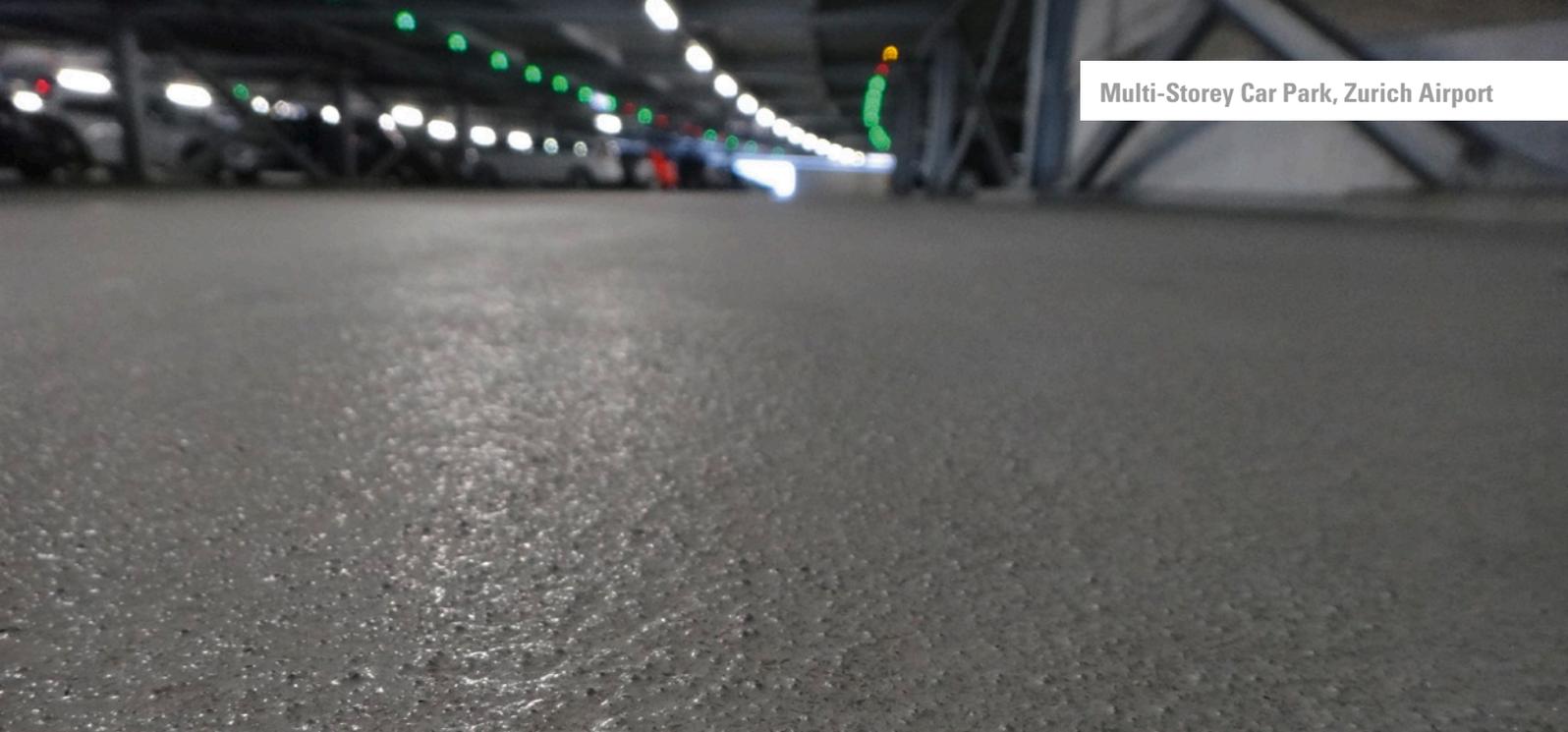
**MC-DUR 1252** is a floor coating suitable for virtually all areas of an underground or multi-storey car park. The high wear resistance of this system has been both confirmed by a neutral body in extensive trafficability tests, and – in particular – thoroughly proven in practice. The impermeability of MC-DUR 1252 ensures permanent protection of the reinforced concrete structure against chloride attack. And as a further assurance, it also carries a fire rating confirming it as a fire retardant.

The coating system offers performance features beyond the requirements of grade OS 8 systems:

- Flexibilised epoxy resin
- Compensation of shrinkage cracks up to 0.15 mm
- Chemical resistance to BPG\* groups 3, 10, 11
- Response to freeze-thaw cycling with and without the influence of de-icing salt: "0"
- Layer thickness: min. 4 mm
- Trafficability according to the approval principles governing coatings for concrete in LAU\*\* facilities

\* Construction and Test Regulations of the German Institute for Structural Engineering (DIBT)

\*\* Facilities which store, bottle, or process substances hazardous to water





*Entrance and exit stress zones*

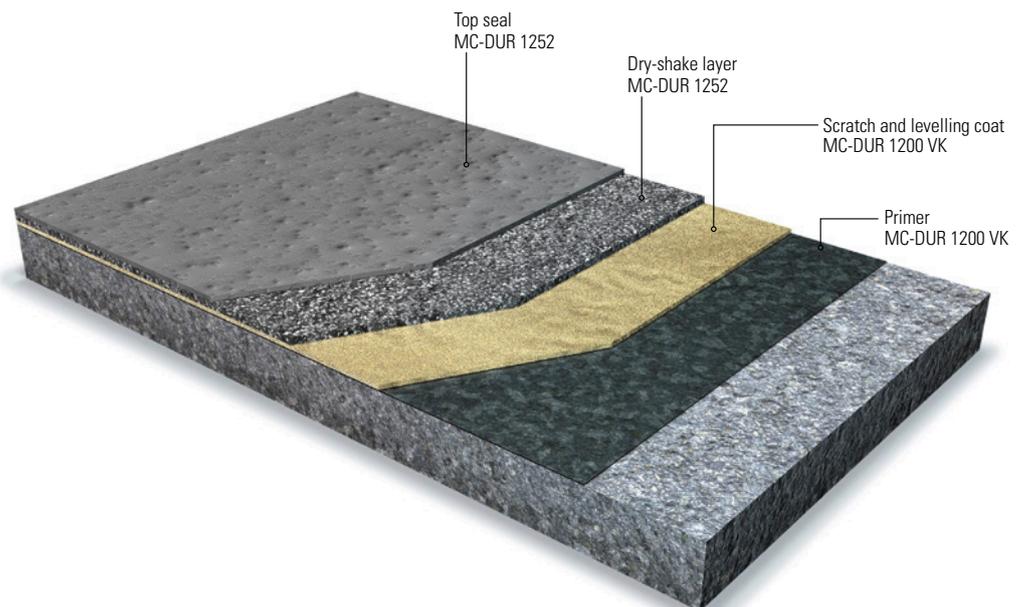


*Particularly exposed to de-icing salt attack*

## Long-Term Protection on Exposed Decking

The 2,000 m<sup>2</sup> open parking deck of the Johanniter hospital in Oberhausen is one of the most frequented areas of the multi-storey car park. Since the repair campaign was to concentrate on ensuring wear resistance, a grade OS 11 system had to be ruled out. Such systems are usually unsuitable for guaranteeing long-term integrity in heavily trafficked zones.

With MC-DUR 1252, the decision was made in favour of a rigid OS 8 system with crack-bridging of up to 0.15 mm for static cracks – already a proven solution offering long service lifetimes. In addition, grade OS 8 systems can be readily combined with crack patching repairs (see project example on pages 6/7).



### Wear-resistant deck coating

For the surface protection of weather-exposed parking decks, the regulations recommend crack-bridging coatings such as the OS 11 system. By definition, these systems are coatings for trafficked surfaces with increased dynamic crack bridging of at least 0.3 mm.

However, experience shows that these soft or flexible coating materials exhibit disadvantages in terms of their wear behaviour. Especially in areas subjected to high mechanical stress, such as curves, ramps or spirals, the first signs of wear can often be observed after only a short period of use.

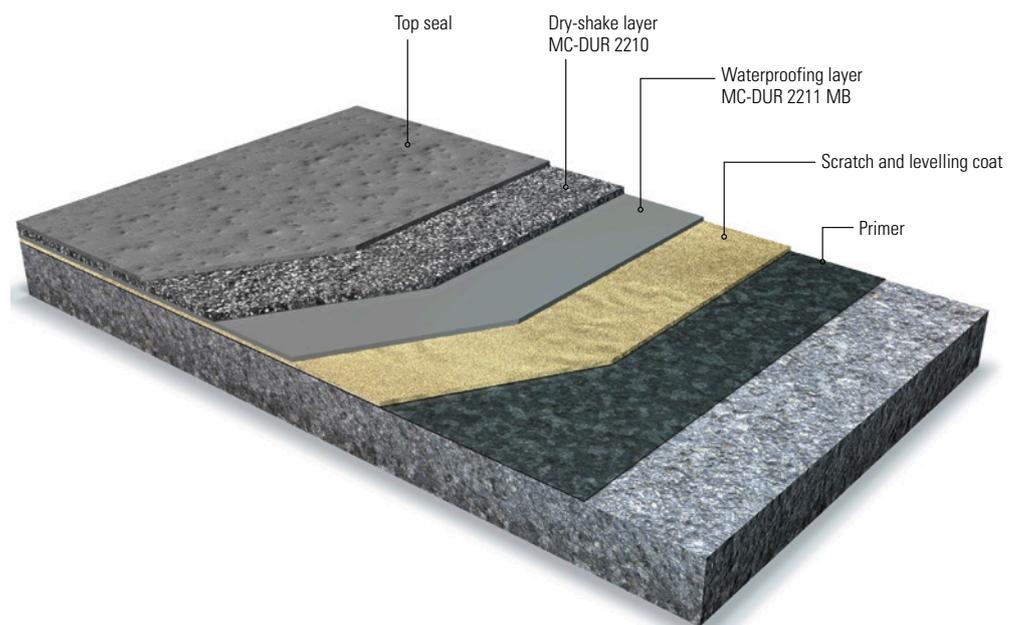
For the open deck, the client chose an OS 8-tested system validated in trafficability tests with no signs of damage.



## Crack-Bridging Coating

Due to existing crack widths and propagation changes thereto, the decision taken with respect to the 4,500 m<sup>2</sup> of weather-exposed parking deck serving the REWE supermarket in Netphen was to apply a grade OS 11a crack-bridging coating. The UV-resistant reaction resin MC-Floor TopSpeed was used as the final sealant to enhance the abrasion resistance of the system.

Even the bad weather conditions that set in during the final phase of the coating work did not have any negative effects on the outcome – thanks to the weather-independent application properties of MC-Floor TopSpeed as the top seal. As a result, the job was completed right on schedule.



### OS 11a coating system: Enhanced crack-bridging capability

Crack-bridging, trafficable surface protection systems are required wherever the risk of cracking arises. They are also indispensable where existing cracks show significant width variation due to temperature and load changes.

The two-layer OS 11a system offers a higher degree of wear resistance compared to the OS 11b single-layer system.

The soft floating layer provides the crack-bridging function, while the wear layer absorbs the mechanical stress caused by traffic.

The final coat of sealant improves deck cleanability and better binds the dry-shake grit (ensuring a better grip).

## High-Performance Coating with Rapid Completion Times

“TopSpeed” means accelerated curing, quickly leading to high resistance, resilience and durability. All the system components use ambient moisture to **boost the curing process**.

This modified combination reaction produces **exceptional adhesion** on all common concrete and screed substrates, while ensuring **outstanding wear and scratch resistance**.

### Kaufland multi-storey car park, Dresden:

It was not just the cold ambient temperatures of only 6 °C in November 2013 that posed a challenge for the repair measures and product systems in question; the job time was also limited to a period from Saturday 10:00 p.m. to Monday 7:00 a.m., with the ramp then needing to be reopened to traffic – a tough task, but one that was reliably resolved with the MC-Floor TopSpeed system employed.

**Kinetic Boost Technology®**

+

+

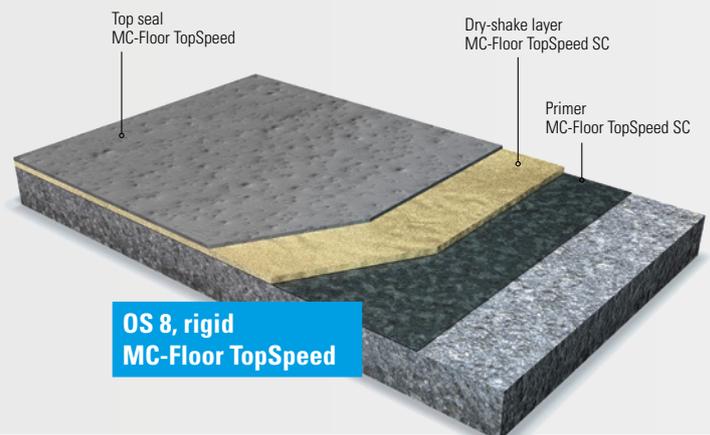


- No enclosure or heating required, even under adverse ambient conditions
- Complete coating build-up within one day
- Fewer journeys to and from site

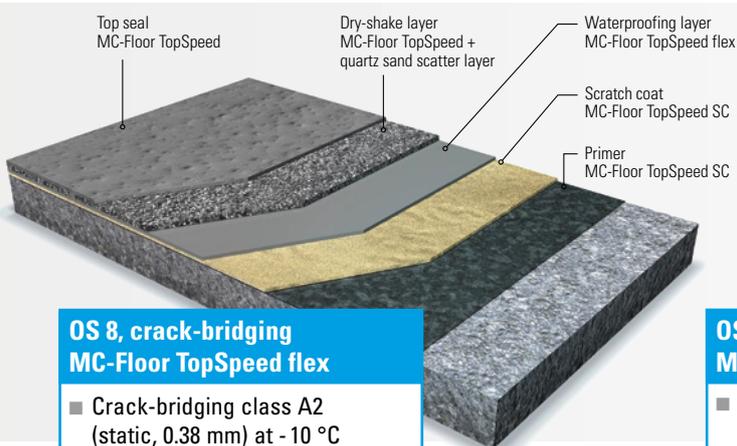
### Individual crack-bridging requirements

The roller coating **MC-Floor TopSpeed** matched up with **MC-Floor TopSpeed flex**, **MC-Floor TopSpeed flex plus** and **MC-Floor TopSpeed SC** creates verified grade OS 8 and grade OS 10 surface protection systems. Depending on crack-bridging requirements, crack width changes can be accommodated through dynamic mechanisms.

The combination of crack-bridging and high mechanical wear resistance is of huge benefit for deck coating projects.

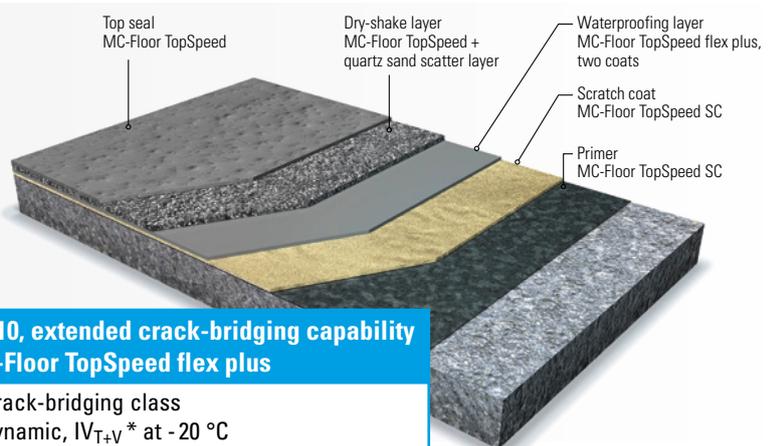


# Fast. Durable. Reliable.



## OS 8, crack-bridging MC-Floor TopSpeed flex

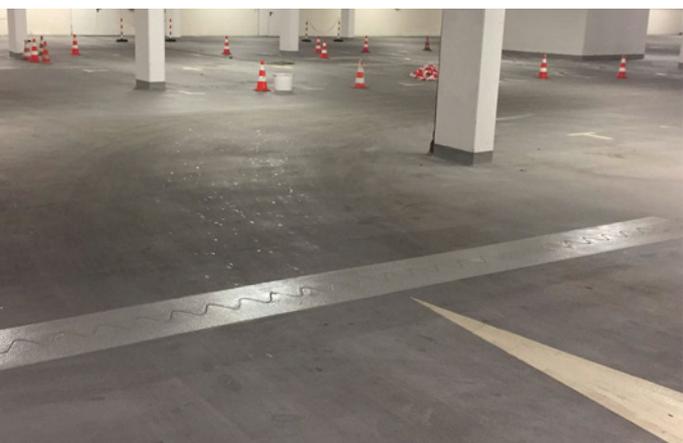
- Crack-bridging class A2 (static, 0.38 mm) at -10 °C
- Crack-bridging class B2 (dynamic, 0.15 mm) at -10 °C



## OS 10, extended crack-bridging capability MC-Floor TopSpeed flex plus

- Crack-bridging class dynamic,  $IV_{T+V}$  \* at -20 °C

\*per TL/TP BEL-B 3



*Installing the joint connection profile  
MC-Floor Connect CP*

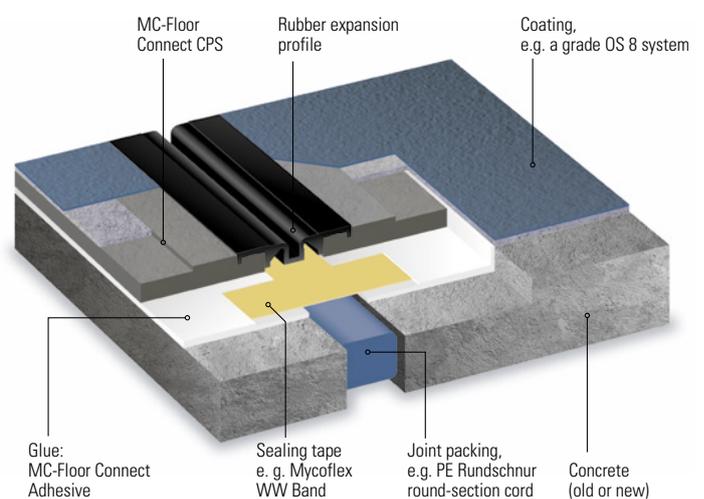
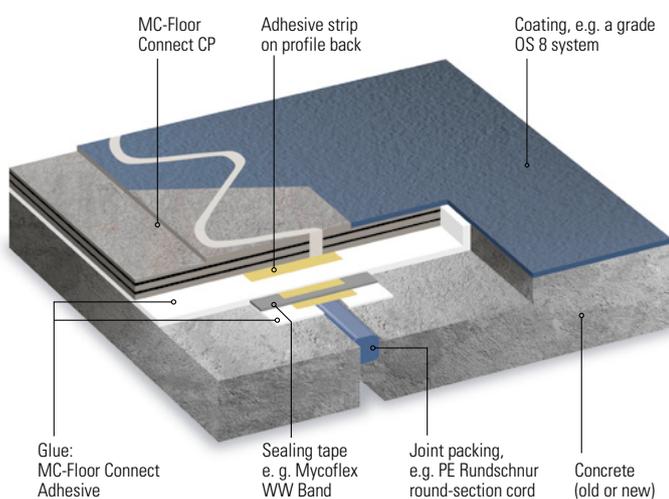


*Gluing the rubber expansion element  
into the joint profile MC-Floor Connect CPS*

# Flush Joint Transitions as a Durable Solution to Traffic Rumble

Heavily damaged joint transitions on trafficked surfaces are not only annoying and noisy; the resulting vibrations are also inevitably transmitted to the structure to cause further possible damage.

In order to solve this problem, the joints between the worn-out trafficked surfaces of the Barmenia employee car park in Wuppertal were resealed in 2016 using the MC-Floor Connect CP system. The profiles were incorporated into the old coating and then colour-matched and overcoated to produce a flush, vibration-free and “inaudible” surface.



## MC-Floor Connect CP

The car park jointing profile system, optimised to combat the mechanical stress caused by pneumatic tyres



## MC-Floor Connect CPS

The 2D car park profile optimised for horizontal and vertical joint movements.



## The silent joint revolution

Whether in commercial facilities or private homes, the constant noise and vibration caused by wheeled vehicles travelling over uneven floor joints in multi-storey or underground car parks have an inevitably adverse affect on structural integrity.

But now, with **MC-Floor Connect** joint profiles, you have at your disposal a durable, permanent solution to such problems.

MC-Floor Connect CP and CPS joint profiles are seamlessly integrated in the substrate to create a flush yet rugged transition for a truly vibration-free effect.

- Quiet, vibration-free transit of rolling traffic
- Short installation times
- “Invisible” integration in existing substrates and coverings
- Resistant to de-icing salts

## Wall Surfaces

### Grade OS 2 surface protection system

#### Requirements

- Preventive protection of weather-exposed concrete components with sufficient water drainage zone of de-icing salts.

#### Properties

- Self-wetting copolymer dispersion
- Reduction in water absorption
- Resistant to extreme temperatures, freeze-thaw cycling and de-icing salts

#### System structure

- Hydrophobic agent: **Emcephob WM**
- High-grade finish: **MC-Color Flair pure**

### Grade OS 4 surface protection system

#### Requirements

- Elevated protection of concrete components with enhanced water-proofing, including in the spray and splash zone of de-icing salts.

#### Properties

- Self-wetting copolymer dispersion
- Standard measure according to corrosion protection principles W and C for crack-free substrates
- Carbonation-inhibiting
- Resistant to extreme temperatures, freeze-thaw cycling and de-icing salts

#### System structure

- Fine filler: **Nafufill KM 103**
- High-grade finish: **MC-Color Flair pure**

### Grade OS 4 surface protection system

#### Requirements

- Very high protection of concrete components with enhanced water-proofing, including in the spray and splash zone of de-icing salts.

#### Properties

- Highly wetted, aqueous 2-component PU-polymer combination
- Integrated Easy-to-Clean technology (graffiti protection and residue-free removal of microbe growth), carbonation-inhibiting and chloride-proof
- Resistant to extreme temperatures, freeze-thaw cycling and de-icing salts

#### System structure

- Fine filler: **Nafufill KM 103**
- High-grade finish: **MC-Color Flair vision**

### Grade OS 5b surface protection system

#### Requirements

- Protection of foundation substrates
- Protection of weather-exposed concrete components with surface-zone cracking

#### Properties

- Polymer-cement mixture
- Chloride-proof and carbonation-inhibiting
- Crack-bridging class B 3.1 (-20 °C)
- MC-Color Flex pure for colour finish
- Resistant to freeze-thaw cycling, de-icing salts and root damage
- Requires no curing

#### System structure

- Priming filler: **Zentrifix F92**
- High-grade finish: **Zentrifix F92**

## Deck Substrates

### Grade OS 8 surface protection system

#### Requirements

- Resistant to high shear and transverse forces
- Accompanying crack treatment
- Danger of rising damp

#### Properties

- Rigid coating
- High mechanical resilience
- Easy application
- Tested resistant to rising damp
- Fire rating B<sub>fl</sub>-s1

#### System structure

- Priming filler: **MC-DUR 1320 VK**  
(1,5:1 with QS 0,1 – 0,3 mm)
- Generous scatter layer of quartz sand
- Top seal: **MC-DUR 1322**

### Grade OS 8 surface protection system

#### Requirements

- Resistant to high shear and transverse forces
- Long service life
- Accompanying crack treatment
- Danger of rising damp

#### Properties

- Rigid coating
- Durability and abrasion resistance due to multi-layer structure, giving high mechanical resilience
- Tested resistant to rising damp
- Fire rating B<sub>fl</sub>-s1
- Compensation of shrinkage cracks, static up to 0.15 mm

#### System structure

- Primer: **MC-DUR 1200 VK**
- Scratch coat: **MC-DUR 1200 VK**  
(1:1 with QS 0,1 – 0,3 mm)
- Dry-shake layer: **MC-DUR 1252**  
(1:0,5 with QS 0,1 – 0,3 mm)
- Generous scatter layer of quartz sand
- Top seal: **MC-DUR 1252**

### Grade OS 8 surface protection system



#### Requirements

- Resistant to high shear and transverse forces
- Fast application
- Danger of rising damp
- Weather-exposed areas
- Accompanying crack treatment
- UV-stable
- Application under adverse ambient conditions

#### Properties

- Rigid coating
- Very high mechanical resilience
- Very good cleanability to EN 11998
- Very short overworking times and rapid curing to final strength
- Totally resistant to UV and yellowing
- Open to water vapour diffusion
- Fire rating B<sub>fl</sub>-s1

#### System structure

- Grundierung: **MC-Floor TopSpeed SC**
- Dry-shake layer: **MC-Floor TopSpeed SC**  
(1:1 with QS 0,1 – 0,3 mm)
- Generous scatter layer of quartz sand
- Top seal: **MC-Floor TopSpeed**

## Deck Substrates

### Grade OS 8 surface protection system



#### Requirements

- Resistant to high shear and transverse forces
- Compensation of static crack movements
- Fast application
- Danger of rising damp
- Weather-exposed areas
- UV-stable
- Application under adverse ambient conditions

#### Properties

- Static crack bridging (class A2, 0.38 mm, at -10 °C)
- Dynamic crack bridging (class B2, 0.15 mm, at -10 °C)
- High mechanical resilience
- Very good cleanability to EN 11998
- Very short overworking times and rapid curing to final strength
- Totally resistant to UV and yellowing
- Fire rating B<sub>fl</sub>-s1

#### System structure

- Primer: **MC-Floor TopSpeed SC**
- Scratch coat: **MC-Floor TopSpeed SC** (1:1 with QS 0,1 – 0,3 mm)
- Waterproofing layer: **MC-Floor TopSpeed flex**
- Dry-shake layer: **MC-Floor TopSpeed**
- Generous scatter layer of quartz sand
- Top seal: **MC-Floor TopSpeed**

### Grade OS 10 surface protection system



#### Requirements

- Resistant to high shear and transverse forces
- High crack-bridging requirement
- Extreme temperature changes / frost
- Weather-exposed areas
- Fast application
- Danger of rising damp
- Weather-exposed areas
- UV-stable
- Application under adverse ambient conditions

#### Properties

- Flexible waterproofing layer with very high crack-bridging capability (dynamic, class IV<sub>T+V</sub>, at -20 °C, per TL/TP BEL-B 3)
- Assured adhesion within the multi-layer system
- Very high mechanical resilience
- Very good cleanability to EN 11998
- Very short overworking times and rapid curing to final strength
- Totally resistant to UV and yellowing
- Fire rating B<sub>fl</sub>-s1

#### System structure

- Primer: **MC-Floor TopSpeed SC**
- Scratch coat: **MC-Floor TopSpeed SC** (1:1 with QS 0,1 – 0,3 mm)
- Waterproofing layer: **MC-Floor TopSpeed flex plus** zweischichtig
- Dry-shake layer: **MC-Floor TopSpeed**
- Generous scatter layer of quartz sand
- Top seal: **MC-Floor TopSpeed**

## Grade OS 10 surface protection system

### Requirements

- Resistant to high shear and transverse forces
- High crack-bridging requirement
- Extreme temperature changes / frost
- Weather-exposed areas

### Properties

- Flexible waterproofing layer with very high crack-bridging capability (dynamic, class IV<sub>T+V</sub>, at -20 °C, per TL/TP BEL-B 3)
- Assured adhesion within the multi-layer system

### System structure

- Primer:  
**MC-DUR 1200 VK**
- Scratch coat:  
**MC-DUR 1200 VK**  
(1:1 with QS 0,1 – 0,3 mm)
- Waterproofing layer:  
**MC-FLEX 2299**
- Dry-shake layer:  
**MC-DUR 2210**  
(1:0,1 with QS 0,1 – 0,3 mm)
- Generous scatter layer of quartz sand
- Top seal:  
**MC-DUR 1252** or  
**MC-Floor Topspeed**

## Grade OS 11a surface protection system

### Requirements

- Crack-bridging requirement
- Temperature changes / frost possible
- Resistant to moderate shear and transverse forces

### Properties

- Flexible two-coat layer with high crack-bridging capability
- Assured bonding within the multi-layer system
- Fire rating B<sub>fl</sub>-s1

### System structure

- Primer:  
**MC-DUR 1320 VK**
- Scratch coat:  
**MC-DUR 1320 VK**  
(1:1 with QS 0,1 – 0,3 mm)
- Waterproofing layer:  
**MC-DUR 2211 MB**
- Dry-shake layer:  
**MC-DUR 2210**  
(1:0,25 with QS 0,1 – 0,3 mm)
- Generous scatter layer of quartz sand
- Top seal:  
**MC-DUR 1322**

## Grade OS 11b surface protection system

### Requirements

- Crack-bridging requirement
- Temperature changes / frost possible
- Resistant to minor shear and transverse forces

### Properties

- Flexible one-coat layer with high crack-bridging capability
- Fire rating B<sub>fl</sub>-s1

### System structure

- Primer:  
**MC-DUR 1320 VK**
- Scratch coat:  
**MC-DUR 1320 VK**  
(1:1 with QS 0,1 – 0,3 mm)
- Wear layer:  
**MC-DUR 2211 MB**  
(1:0,3 with QS 0,1 – 0,3 mm)
- Generous scatter layer of quartz sand
- Top seal:  
**MC-DUR 1322**

## System Solutions for Car Parks

- Injection Technology
- Concrete Repair
- Structural Refurbishment
- Deck Coating
- Joint Repair
- Surface Protection

MC-Bauchemie Müller GmbH & Co. KG  
Infrastructure, Industry & Buildings  
Am Kruppwald 1-8  
46238 Bottrop / Germany

Phone: +49 2041 101-190  
Fax: +49 2041 101-188

IN@mc-bauchemie.com  
www.mc-bauchemie.com



BE SURE. BUILD SURE.

Contact details:

