Crack -Bridging Car Park Flooring
Is it What it is Cracked Up to Be?

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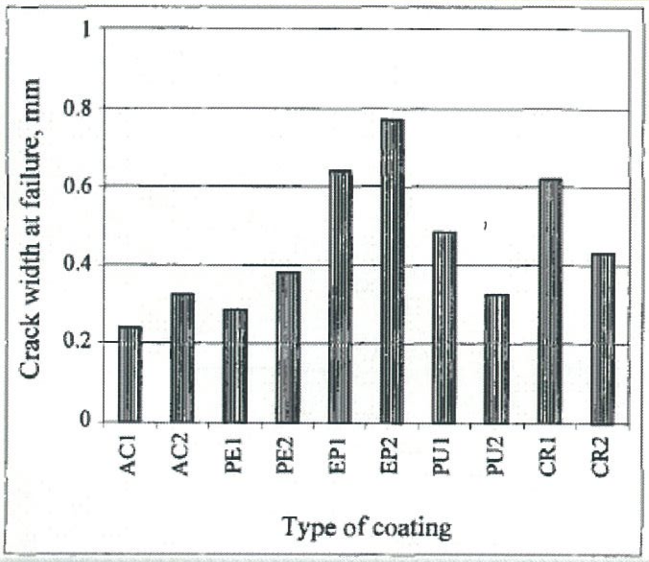
Polyurethane (PU) vs. Epoxy in Crack-Bridging Ability (CBA) on concrete or screeds

There is a common misconception that PU coatings with higher elongation will outperform epoxy in bridging cracks on concrete. While it may be true in some individual cases, it is not necessarily true in actual practice.



According to published data comparing the CBA of 5 types of commercial organic coatings commonly used for concrete coating and protection, two commercial epoxy coatings came out as best in CBA, topping polyurethane (PU), acrylic, polymer emulsion and chlorinated rubber coatings.[1] According to this study, two suppliers from each of the 5 types of coatings were selected. The two epoxy samples were the best of the ten in CBA followed by a chlorinated rubber. The two PU coatings ranked fourth and seventh respectively.

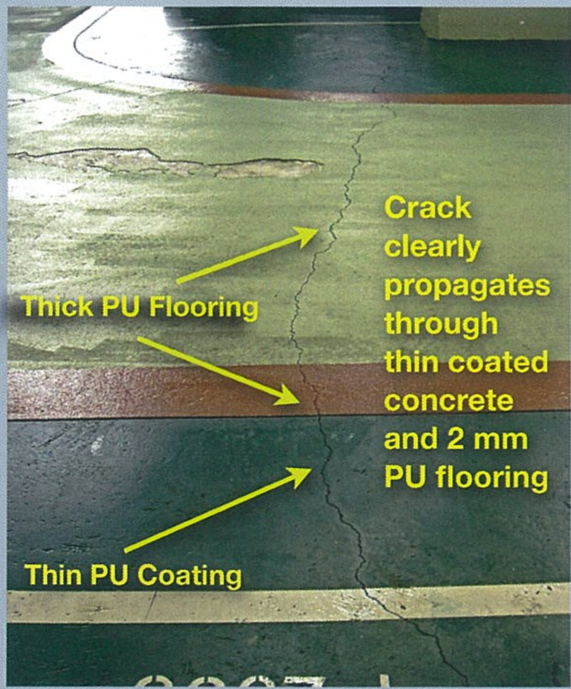
Table 1 – Description of the selected coating

Coating type	Generic type	Coverage rate, m^2/l
Acrylic, AC1	Modified acrylic resin	8.6
Acrylic, AC2	Solvent-based acrylic resin	12.0
Polymer emulsion, PE1	Copolymer emulsion	12.0
Polymer emulsion, PE2	Copolymer emulsion	0.9
Epoxy resin, EP1	Two-component polyamide-cured epoxy resin	6.6
Epoxy resin, EP2	Two-component polyamide-cured epoxy resin	12.0
Polyurethane, PU1	Two-component polyurethane, isocyanate-cured acrylic resin	9.4
Polyurethane, PU2	Two-component polyurethane, isocyanate-cured acrylic resin	12.0
Chlorinated rubber, CR1	Chlorinated rubber	5.1
Chlorinated rubber, CR2	Chlorinated rubber	6.8

Crack-Bridging Ability (CBA) of selected coatings (from Ref.1)

[1] **Almusallam A., F. M. Khan,. and M. Maslehuddin**, "Performance of concrete coatings under varying exposure conditions" *Materials & Structures* **35** (2002) 487-494

The results may seem surprising at first glance. But one must understand that the CBA of a resin coating on concrete is a complex function of a number of parameters. According to **Delucchi** *et al.* [2] , a coating's ability to bridge cracks depends on both intrinsic as well as extrinsic parameters ranging from coating structure, mechanical properties, thickness, adhesion to concrete and propagation rate of the cracks, etc. In their investigation, they have found that in determining CBA, the tensile strength of a coating plays a more important role than elongation, and their results also show a power law relationship between tensile strength and CBA of a coating. [2]



Crack through PU flooring

In a more recent paper, **Delucchi** *et al.* [3] have found that the CBA of a hard and soft (~330% elongation at break) coating are indistinguishable at coating thickness around 0.3 mm. The difference is only more pronounce as the coating thickness is increased to 0.6 mm, 0.9 mm and 1.2 mm. The researchers explained that for thicker coatings, the coating molecules are able "to reorient themselves, by moving into the free volume spaces within the film, in the same direction of the applied stress." [3] This reorientation of molecules contributes to CBA.

PU floor fails under heavy traffic near car park entrance.

PU floor failure requiring extensive and frequent repairs

PU floor failure due to wear and tear at a basement car park

[2] **Delucchi M., A. Barbucci, T. Temtchendo, T. Poggio and G. Cerisola**, "Study of the crack-bridging ability of organic coatings for concrete: analysis of the mechanical behaviour of unsupported and supported films" *Progress in Organic Coatings*, **44** (2002) 261-269

[3] **Delucchi M., A. Barbucci and G. Cerisola**, "Crack-bridging ability of organic coatings for concrete: influence of the method of concrete cracking, thickness and nature of the coating" *Progress in Organic Coatings*, **49** (2004) 336–341

Here In Hong Kong

Most of Hong Kong's car parks are covered, not exposed outdoor decks. Resin flooring failure due to weather elements is normally not a design concern. Crack-bridging flooring is more important for exposed car park decks more commonly found overseas where temperature can vary by 10-20ºC within a day and as much as 50-70ºC throughout the year. Such conditions are not found in Hong Kong's covered car parks. .

PU or flexible floorings in Hong Kong fail characteristically by wear and peeling off (adhesive failure) from the floor screed in patches. Once small pieces of the coating come off, the process will be accelerated by further wear and tear by the tires. The vulcanized rubber tires create tremendous tearing and stretching action on the floor.

Flooring with high tensile strength will be better able to withstand this type of damage.

PU may also show excessive abrasive wear that is commonly seen in car park driveways and entrance/exit where sharp turning occurs.

Typical PU flooring failure in Hong Kong where the resilience of the PU coating is no match for the rubber tires.

In summary, the CBA of a coating is not a simple function of material flexibility or elongation. Many flexible PU crack-bridging systems, indoor and outdoor, have failed in Hong Kong as we have shown in our case photos partly due to this misconception by specifiers. It has been proven that a well formulated epoxy systems with high tensile strength and balanced flexibility exhibit good CBA and excellent durability in heavy traffic car parks. Epoxy flooring has been the proven choice for specifiers at numerous car parks in Hong Kong over the past ten years. For exposed outdoor decks, a combination of epoxy and PU can be used to create a UV-resistant, crack-bridging as well as hard wearing and durable flooring system.

For enquiry or comment, please contact us at info@chematco.com

Note: All case photos shown are taken in Hong Kong unretouched except for color correction.