# BRIEFING

Interpave
THE PRECAST CONCRETE PAVING AND KERB ASSOCIATION

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# Concrete Block Permeable Paving for Cool Pavements

Concrete block permeable paving (CBPP) is a well-established, multi-functional SuDS technique that simply combines well-drained, safe and attractive surfaces for a wide range of applications with attenuation, storage, pollution treatment and conveyance of rainwater. By its very nature CBPP requires no additional land-take. Its unique capabilities include source control and a gradual flow of clean water to other SuDS features for amenity or biodiversity, to drainage systems or into the ground.

Essentially, CBPP products share the same material and performance characteristics as other precast concrete paving products, being slip resistant, durable, strong and sustainable. Products from Interpave manufacturer members offer a wide choice of shapes, styles, finishes and colours. The differences with CBPP are the enlarged joints filled with angular aggregate and underlying pavement layers of voided material, all to accommodate water whilst still providing the necessary structural performance.

**Albedo and Urban Heat Island Effect**

CBPP products also share the same thermal performance as other concrete paving blocks, notably albedo – helping to reduce the impact of development and the urban heat island effect. The Spanish Cement Association, 2012 (1) says:

*'On average, the albedo of the planet is 0.35. That is to say 35% of all the solar energy is reflected while 65% is absorbed. Asphalt albedo ranges from about 0.05 to 0.20 …. A typical concrete has an albedo of about 0.35 to 0.40 when constructed; these values can decrease to about 0.25 to 0.30 with normal usage. With the incorporation of slag or white cement, a concrete pavement can exhibit albedo readings as high as 0.70 … concrete has a significantly higher albedo than asphalt, either new or old. In fact, concrete usually has a higher albedo than almost every other material that is typical to urban areas, including grass, trees, coloured paint, brick/stone and most roofs'*.

Exposed aggregate and other reflective surfaces to further increase albedo are available from Interpave members. These may also increase luminance, or the amount of light reflected off the paving. For asphalt, luminance is only about 7% whereas block paving achieves between 15% and 30%. This often-overlooked area has implications for street lighting design and safety in terms of contrasting pedestrians against paving at night.

**Conduction and Thermal Storage**

Current thinking on thermal performance is that concrete block pavements behave differently to those surfaced with asphalt, having lower thermal inertia, retaining less heat and releasing it more quickly at night – so avoiding accumulative build-up over days during hot weather. This is particularly the case for CBPP with high albedo mitigating increased surface temperature when dry.

Of course, with CBPP some heat from the pavement also warms the water gradually passing through joints and voids, then to the ground or other SuDS features for evaporative cooling. The amount of heat removed in this way will depend upon the 'dwell time' of water within the pavement, determined by the SuDS design. It can also be increased using orifice flow controls and other measures.

**Evaporation and Convection**

By its very nature, CBPP offers a unique opportunity to create 'cool pavements', enhancing the thermal performance of precast concrete pavements (discussed above) with evaporative cooling from rainwater runoff. Aided by convection, this evaporation occurs both on the block surface and, importantly, within the voided pavement structure containing air, water and water vapour. In addition to cooling, evaporation from CBPP can increase local air humidity and pedestrian comfort.

A 2017 review of cool pavements (2) confirms that: '*Porous pavements allow water to drain through during rainstorm and evaporate during hot, sunny weather. Evaporation keeps the pavement cooler because heat is pulled out from the pavement during hot weather'*. It also recognises that more research is needed to determine the specific performance of various pavement types and scenarios. However, trials have demonstrated tangible 'interception losses', endorsed by SuDS practitioners' experience, of water within CBPP that could only be attributed to significant evaporation.

Of course, the presence of water is key to this process. Following rainfall, water will be absorbed by the paving blocks and the underlying pavement materials to some extent, as well as attenuated within voids. Water storage will generally be a requirement of the SuDS design anyway and flow controls applied to optimise it. However, additional interventions may be considered to retain water in a 'cooling zone' at the base of the pavement during prolonged periods of dry weather, to maintain some evaporative cooling over time. These might include amended flow controls or revised outlet positioning. This 'cooling zone' would be excluded from storage quantities in the SuDS design. Other design measures might include draining planters on the surface into CBPP to utilise excess irrigation for cooling.

**Retrofitted Cool Pavements**
In addition to new CBPP, retrofitting permeable paving, in place of conventional asphalt street surfaces over the original road base, offers real opportunities for cool pavements as well. Techniques such as this are essential to realising the aims of the London Sustainable Drainage Action Plan. CBPP can also be re-used for layout alterations or reinstatements, reducing carbon footprint and whole-of-life costs.

This technology has already been used for temporary overlays to existing London streets to provide a well-drained surface level with the footway during short-term pedestrian trafficking. The Bridget Joyce Square, Australia Road project also provides an exemplar of this approach. Here, the same blocks and 2-6mm grit bedding layer and jointing material as used in CBPP generally are installed over the road base. When applying retrofitted CBPP overlays in future, additional water retention measures could be included to provide enhanced cool pavements.

**References**
(1) Aniceto Zaragoza Ramírez and César Bartolomé Muñoz (2012). **Albedo Effect and Energy Efficiency of Cities**.

(2) Nurul Rezuana Buyung and Abdul Naser Abdul Ghani (2017), AIP Conference Proceedings. **Permeable Pavements and Its Contribution to Cooling Effect of Surrounding Temperature.**

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