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Permeable Paving & Trees in Synergy Martlesham Park and Ride

A case study and re-visit exploring the long-term performance of concrete block permeable paving working in harmony with both new and established trees.

Mineral Products Association

Introduction

This case study starts with our 2003 review of the new Martlesham Park & Ride facility shortly after completion. Then, we report on a re-visit of the project in 2020 by an MPA Precast Paving member, including an interview with the original designer about the use of concrete block permeable paving (CBPP) and the results of permeability trials.

This re-visit provided a clear demonstration of the durability and continuing performance of CBPP over 17 years with minimal maintenance. It also highlighted the ongoing sustenance that CBPP provides for both newly-planted and mature trees, through natural, dispersed irrigation, and essential gas (oxygen/carbon dioxide) exchange, avoiding root disruption to the surface.

Understanding Permeable Paving

With more than 25 years' use on a wide range of project typologies, including adopted roads and even container terminals, CBPP has proven to be a robust, resilient and adaptable sustainable drainage (SuDS) technology. It provides an attractive, safe and puddle-free surface for pedestrians and traffic, combining a structural pavement with integral drainage and no gullies.

The key to CBPP is its permeable surface zone of high-strength concrete blocks with angular aggregate used to fill enlarged joints and as a laying course. It allows water to pass between the blocks while filtering out silt with many pollutants – particularly the 'first flush' following rainfall – and preventing ingress of debris, retained on the surface where it can easily be removed. It can then deliver a gradual flow of clean water for safe SuDS, irrigation, biodiversity, reuse or discharge.

This unique permeable surface works in conjunction with various construction profiles and differentiates the technology from other types of 'pervious' paving. In most CBPP constructed to date, water passes from the surface zone into voids within an underlying coarse grade aggregate permeable sub-base, combining structural support and water storage. Increasingly, however, alternative structural layers are being used to create exciting opportunities for urban trees and green infrastructure, provide additional water storage, accommodate statutory services or meet other requirements.

More information is available in the *'Understanding Permeable Paving'* guide available at www.mpaprecast.org

Martlesham Park and Ride

The Park and Ride facility at Martlesham was one of Suffolk County Council's top priority transport schemes and the third park and ride to be built serving Ipswich, offering sustainable transport alternatives to the car. Designed by Suffolk County Council Environment and Transport, it was also the first large-scale CBPP project to be undertaken by the Authority. Following extensive public consultation, the park and ride scheme formed part of Suffolk County Council and Ipswich Borough Council's Transport Strategy, which included plans for five park and ride schemes around the town aiming to dramatically reduce the level of traffic congestion within Ipswich.

The Martlesham site was chosen for its prime location on the eastern side of town and accessibility to the junction of the Ipswich eastern bypass. This choice followed extensive consultation and a detailed examination at a public enquiry. The location and access advantages of the site outweighed any potential adverse environmental effects that development might have had on the site and surrounding area: the site is part of a designated 'Special Landscape Area' and also part of a 'County Wildlife Site' with areas of acid grassland.

Project Design

The site occupies a total of 3.2ha with space for 530 cars. The key challenge for the project was to mitigate the adverse environmental and landscape effects of the development. This included a terminal building – designed by architects Mouchel with landscape architects The Landscape Partnership – with a green roof for low-impact on the landscape and rainwater attenuation. All the grey and foul water from the terminal building is treated in a reed bed with no public sewer connection needed, making it a completely zero discharge site.

Incorporating SuDS techniques into the overall design reflected the sustainability credentials of the Park and Ride concept. A complete paving solution was also required to create a surface of high industrial strength to withstand heavy vehicles, as well as attractive and accessible pedestrian areas. Overall design objectives included:

- Visually attractive CBPP capable of full infiltration of rainwater to the ground
- Effective car park lighting with minimum impact on surrounding landscape and wildlife habitats, and optimised energy use
- Landscaping with extensive planting of indigenous trees to complement local flora and habitats, and a layout to accommodate the existing trees
- Provision of bat and bird boxes to encourage colonisation within the site.

Completed Project 2003

The project utilised 14,000 m^2 of CBPP for circulation, parking and pedestrian areas. Local conditions allowed for a 'System A' form of construction with total infiltration of surface water to the ground. Here, all rainwater falling on the CBPP, and adjacent impervious areas draining onto it, infiltrates through jointing material, the constructed layers below and eventually into the subgrade. This effectively eliminates the requirement for additional drainage systems whilst also recharging the natural groundwater.

Performance tests carried out at the time at Martlesham Park and Ride, replicated a 20-year in-service lifespan and demonstrated that the stability of the surface would be retained with CBPP construction. In addition to the CBPP, some 1,400 m^2 of impermeable block paving for bus access areas and 1,300 m^2 of flag paving for pedestrian areas were also installed at the project. Since completion, the number of people using the park and ride scheme gradually increased with a high level of regular customers. The local residents were pleased with the new service and have been extremely complimentary about the site design and facilities.

This substantial and impressive example of CBPP forming part of a completely sustainable facility, clearly demonstrates:

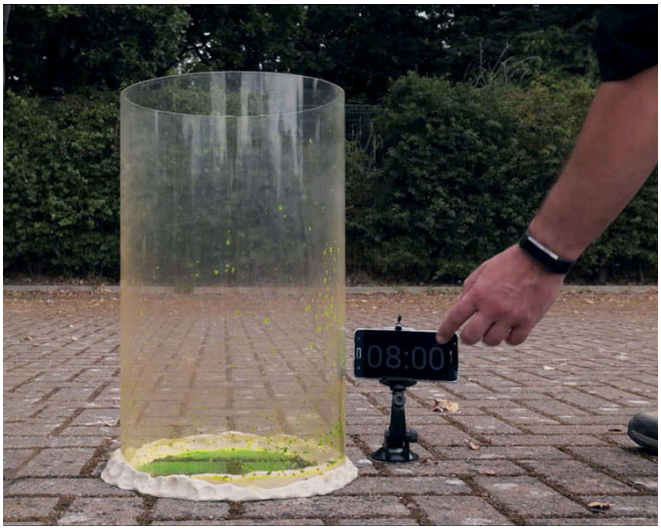
- Elimination of traditional drainage components including pipes, gullies and soakaways
- Potential for total cost savings over other pavement types, including asphalt with traditional drainage
- Maintenance of stability of CBPPs under traffic and in different applications
- Ability for CBPP to replicate original drainage before intervention, therefore minimising impact on the environment
- Compliance with planning guidance and Building Regulations, requiring local infiltration wherever possible.

Project Re-visit 2020

Martlesham Park and Ride was one of three older projects where field tests were undertaken by an MPA Precast member to better understand the effect trafficking, weathering and time have on CBPP systems. To measure the permeability of these existing CBPP pavements, the trials used the American Standard ASTMC1781/C1781M method.

The research demonstrates that all three CBPP sites tested, despite receiving no specific maintenance to improve permeability, still provide infiltration rates that would cope with any likely UK rainfall event.

The Martlesham project was also the subject of a video showing the trials. In this test 10 litres of water in a sealed tube created a head of about 140 millimetres – equivalent to more than a month of heavy rainfall. Here, the surface absorbed the 10 litres of water in 8 minutes and 1 second, equivalent to a rainfall intensity of 1,055mm per hour. The heaviest UK rainfall event in history was 92mm per hour.



The video also includes an illuminating interview with the original project designer about long-term performance and maintenance, and also the benefits of CBPP for trees. Constructed in 2003 and with around 500 car spaces, the 13,000 m^2 of concrete block permeable paving has delivered problem-free performance over 17 years.

The grit-filled joints do have moss in them but, as a porous substance itself, water passes through without problems. The site is surrounded by vegetation, with some tall trees and well-established shrubs. Maintenance has effectively been cosmetic – occasionally sweeping tree debris and vegetation from the surface after storms and leaf fall in the autumn.

Extensive mature trees around and within the site were simply retained as part of the scheme. The CBPP removes pollutants from water passing through, providing treated water sustenance for trees. The roots have continued to grow within the permeable pavement sub-base but – importantly – there have been no visible signs of block rutting or lifting, or roots coming through the surface. The designer's only regret at the time was not to do more with rainwater conveyance and storage within the CBPP and raingardens specifically for tree and green infrastructure sustenance.

17 years after construction there are no issues resulting from tree roots in the CBPP sub-base.

Permeable Paving & Trees in Synergy

Retaining and introducing trees, and other green infrastructure, continues to be a key planning requirement. The December 2024 National Planning Policy Framework (Section 136) requires that: *'Planning policies and decisions should ensure that new streets are tree-lined, that opportunities are taken to incorporate trees elsewhere in developments …, [and] that appropriate measures are in place to secure the long-term maintenance of newly-planted trees, and that existing trees are retained wherever possible'.*

Urban design that enables their sustenance is therefore crucial to nurture and allow trees to mature, enabling them to actually deliver their real potential – including net carbon storage, urban cooling through shading and evapotranspiration, biodiversity and public wellbeing. CBPP offers a straightforward spatial solution to this requirement that can be applied through the planning system.

CBPP provides the same dispersed pattern of run-off transfer to the ground as vegetated surfaces and allows water to reach tree and shrub roots, despite providing a hard surface above. In addition, CBPP also provides essential gas (oxygen/carbon dioxide) exchange for roots without additional reservoirs or pipes, whilst avoiding tree root disruption common with other paved surfaces.

Other MPA Precast Paving case studies highlight innovative CBPP solutions working in synergy with mature and newly-planted trees, within new-build and retrofit settings. They include: structural soils, preparatory tree pits, geocellular systems and impermeable sub-bases. Also, retrofit permeable surface zone overlays, utilising existing road-bases (and their embodied carbon), offer particularly effective street renewal and regeneration solutions.

The CBPP overlay approach, where trees have thrived, is exemplified in the award-winning Bridget Joyce Square, London, shown here (images courtesy of Robert Bray Associates). A case study is available.

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