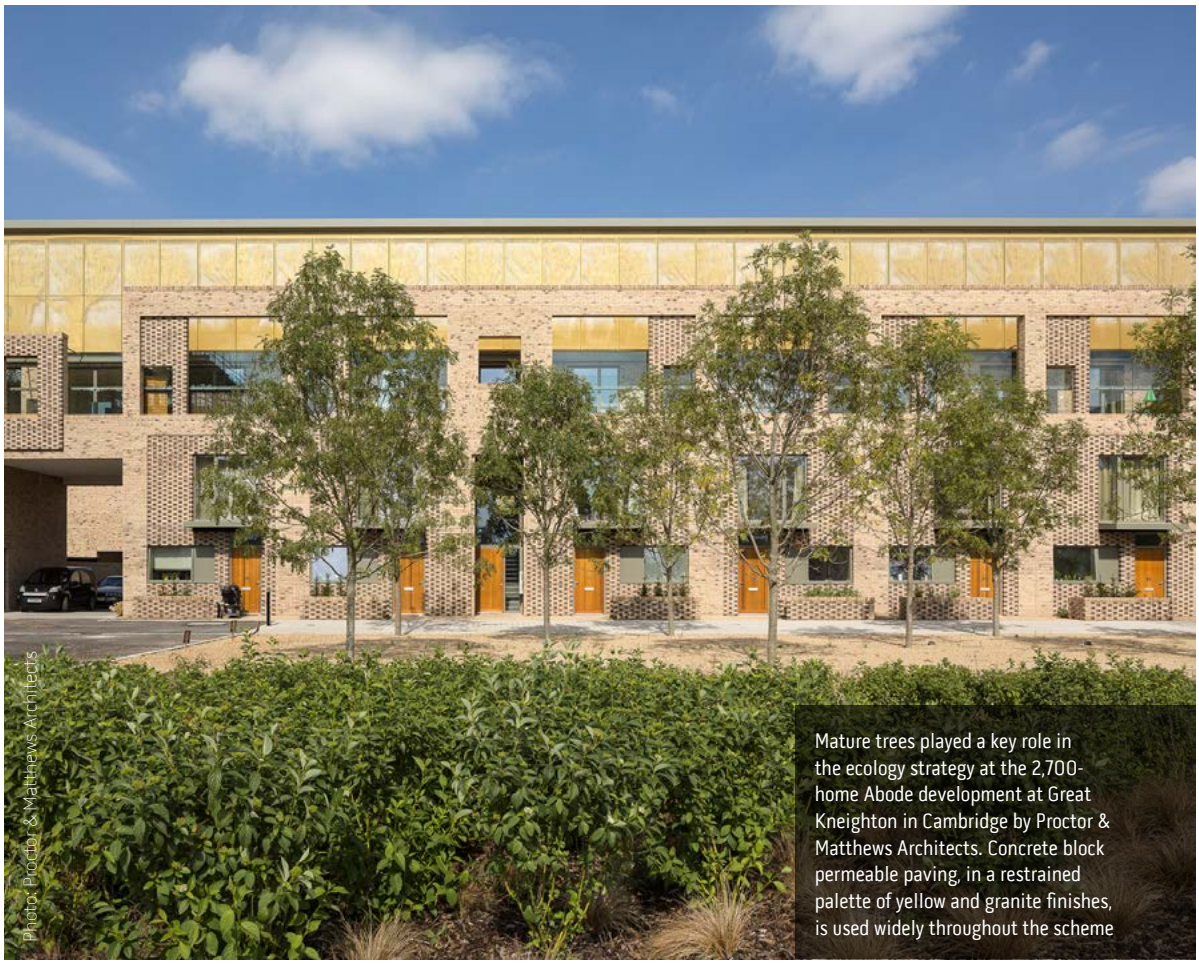

Photo: Proctor & Matthews Architects

Mature trees played a key role in the ecology strategy at the 2,700-home Abode development at Great Kneighton in Cambridge by Proctor & Matthews Architects. Concrete block permeable paving, in a restrained palette of yellow and granite finishes, is used widely throughout the scheme

Designing hard landscaping to support trees

Trees are essential for making our towns and cities liveable, but we have to meet their needs too. Chris Hodson explains how concrete block permeable paving can be used to create durable urban landscapes that support healthy growth

For centuries, trees have contributed to the character of our towns and cities, providing shade from the sun and shelter from rain. Their wider benefits include carbon sequestration and reducing flood risk, as well as mitigating the urban heat island effect with cooling from shading and evapotranspiration. Urban trees support biodiversity and human wellbeing, and research has linked their presence to everything from reducing noise, air and stormwater pollution, to preventing crime, increasing business activity and property values.

The importance of urban trees is recognised in the new National Planning Policy Framework (NPPF) for England, published in December 2024. This sets the standards and guidance that local councils must follow when writing Local Plans and deciding on planning applications. The NPPF states that: "Planning policies and decisions should ensure that new streets are tree-lined and that opportunities are taken to incorporate trees elsewhere in developments."

What trees need

It's not enough to simply include trees in developments. Measures also need to be put in place to nurture and allow them to mature, generally over decades. The NPPF recognises this, requiring that "appropriate measures are in place to secure the long-term maintenance of newly planted trees, and that existing trees are retained wherever possible".

Trees require access to water, nutrients and oxygen through their roots. They also need to be planted in an environment that allows carbon dioxide to escape. Equally important is soil, or a similarly permeable medium, that allows for deep and expansive root growth to ensure stability.

As our urban areas have effectively been sealed up with impermeable materials, this has created problems for street trees, as well as increasing the risk of surface water flooding. Installing permeable surfaces, such as concrete block permeable paving (CBPP), is a straightforward solution that can help to meet long-term tree maintenance requirements, as well as provide the hardstanding required in urban environments.

Photo: Robert Bray Associates

Permeable surfaces are also an important element of sustainable drainage systems (SuDS), which reduce flood risk, remove pollution, support biodiversity and provide amenity. The NPPF requires developments that could have drainage impacts to include SuDS, and the government is considering making them mandatory on all developments.

How CBPP works

Concrete block paving generally combines interlocking high-strength blocks with granular material to form a flexible pavement with minimal movement between blocks. Conventional block paving uses sand for joints and laying courses, and is therefore not permeable. CBPP, however, uses angular aggregate of 2-6.3mm to fill enlarged joints, usually generated by spacer nibs, and as a permeable laying course. This allows rainwater runoff to be collected, attenuated and treated, removing pollutants for a gradual supply of clean water.

CBPP can be applied on top of various permeable structural layers, but typically coarse-graded 4-20mm aggregate is used. This forms voids, making up around 30% of the layer's volume, enabling water attenuation and storage.

The blocks have consistent performance characteristics, making them slip-resistant, safe, strong, durable and reusable. CBPP therefore provides a trafficable surface, while mimicking the dispersed run-off pattern of natural vegetation. It enables water, nutrients and air to reach tree and shrub roots, and CO_2

ABOVE
A community rainpark at Bridget Joyce Square in west London, designed by Robert Bray Associates. Concrete block permeable paving was laid over the existing concrete slab of an adopted street and adjacent parking areas. Rainwater is cleaned, attenuated and conveyed to tree-planted basins as part of a sustainable drainage system

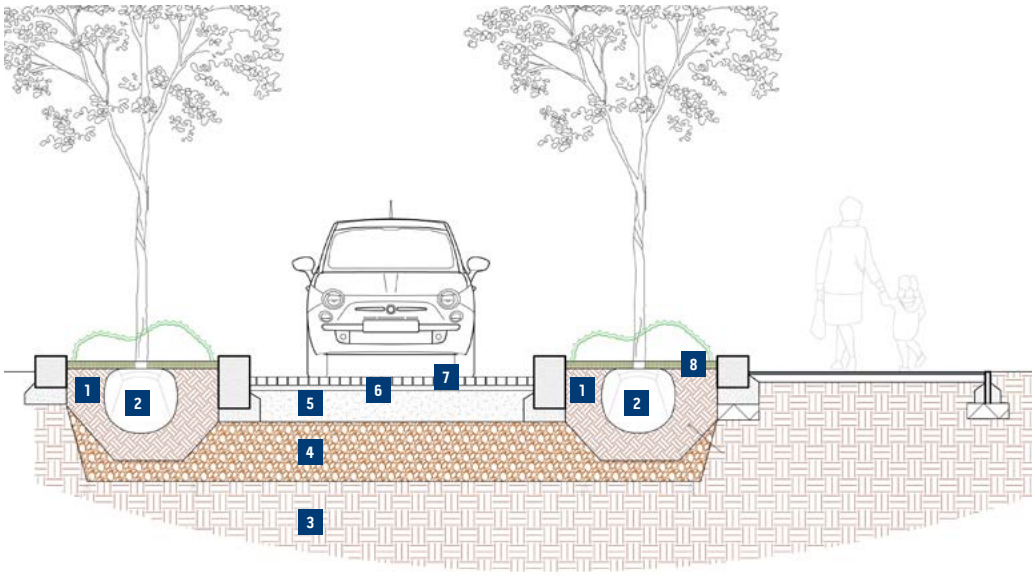

Image: Robert Bray Associates

to escape. Rainfall can be captured over a much wider area for gradual, lateral conveyance to root systems – particularly useful for irrigation in drier summers.

By creating a favourable environment for roots, permeable paving helps to prevent surface damage from upward growth, and facilitates natural expansion into lower levels for stability and longevity.

Alternative profiles and techniques to support urban trees

In addition to the coarse-graded aggregate sub-base described above, alternative structural layers can be included to support trees and green infrastructure, while also providing additional water storage, space for utilities or multifunctional needs.

The ability of CBPP to remove silt is particularly important for protecting many of these alternative systems from clogging.

Tree pits CBPP can be used over and around standard tree pits, enabling irrigation and simple gas exchange, without the need for additional reservoirs or pipes. This also avoids root disruption common with other paving used close to trees, by providing space for tree roots.

Geocellular systems Proprietary permeable sub-base replacement systems can be used instead of the coarse-graded aggregate sub-base. These usually consist of plastic units that form a cellular raft, designed to support anticipated traffic

ABOVE
A tree planting trench with structural soil at Robert Bray Associates' scheme on White Hart Lane, north London (see next page)

1 900mm-deep tree pit backfilled with topsoil

2 Tree root ball

3 Subsoil, ripped (broken up) to depth of 200mm

4 600mm-deep structural soil composed of graded crushed rock and planting soil

5 300mm layer of hydraulically bound coarse-graded aggregate

6 50mm layer of 2-6mm grit

7 Concrete block permeable paving

8 75mm layer of compost mulch

Photo: Robert Bray Associates

ABOVE
Robert Bray Associates' regeneration of White Hart Lane, north London, incorporating a new pocket park with small-element flag concrete block permeable paving. As well as SuDS, it includes new trees with integrated sustenance and protects previously "suffocated" mature trees

loadings. With over 90% void space, geocellular systems can provide water storage and space for soils. They can also improve load distribution beneath paved surfaces, potentially allowing for reduced pavement thickness, and are useful for forming inlets and outlets from the permeable constructions.

Structural soils This system, used widely and successfully in Stockholm, has a load-bearing base of compacted crushed stone or recycled concrete. Selected soils – some incorporating biochar – are then introduced into voids to enable root growth. CBPP, usually laid over a coarse-graded aggregate layer for aeration, provides irrigation and gas exchange, making aeration wells, gulleys and other devices unnecessary.

Retrofit solutions

Mature trees can be protected and their lives extended by replacing impermeable materials around them with permeable surfaces that facilitate hydration and gas exchange.

Hybrid retrofit One approach for introducing SuDS and trees in existing streets is the partial replacement of existing impermeable paving with CBPP to one or both sides, which

avoids utilities and can help to demarcate on-street parking areas. Here, the existing road profile directs water from the impermeable carriageway and also footways onto the CBPP. Correctly specified, CBPP has the capacity to capture all of the rainwater falling directly on it, as well as runoff from surrounding impermeable surfaces, up to twice its own area. Water storage for SuDS and/or sustenance for trees and green infrastructure is achieved with modular geocellular systems or structural soil profiles below the CBPP, and/or rain gardens.

Permeable paving overlays The permeable surface zone can simply be applied as an overlay to impermeable constructions to collect, clean and convey water laterally to raingardens, trees, SuDS features or sewers. This is a low-intervention, low-cost approach to SuDS that reuses existing impermeable road-bases and locks in their embodied carbon.

Specifying CBPP

CBPP can withstand heavy loadings, and is suitable for urban areas where speeds are lower, typically below 30-40mph.

The relevant British standard for the design of permeable paving is BS 7533-13:2009. However, an updated standard, BS 7533-103, is under development and expected to be published for public consultation in June 2025. For guidance on designing SuDS, refer to The SuDS Manual (C753) from CIRIA.

Correct design, detailing and construction of CBPP is key to its long-term performance. This includes:

- preventing soil and mud from entering the base and surface both during and after construction
- ensuring that joints are completely filled and topped-up at construction completion, and avoiding soil and mulch being washed from landscaping onto the CBPP.

Current maintenance regimes for other paving can generally be applied to CBPP, although aggressive mechanical brushing which might dislodge jointing material should be avoided.

Any localised problems will generally be apparent on visual inspection: ponding on the surface indicates that the joints may be blocked, which can be resolved by suction brushing and replacement of jointing material. Damaged or displaced paving units indicate structural issues. In the absence of these indications, no remedial action is necessary.

Chris Hodson is a consultant to MPA Precast and author of its guidance document, *Understanding Permeable Paving*. For case studies and guidance on all aspects of permeable paving and SuDS, go to mpaprecast.org/paving

Photo: Chris Hodson

ABOVE
Hybrid retrofit street enhancements by Robert Bray Associates at White City, London. Concrete block permeable paving has been installed to demarcate on-street parking, providing sustainable drainage and a puddle-free surface. Litter, silt and pollutants are retained on the surface for removal with straightforward cleaning