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The British Cementitious Paving Association




MOTORWAY BARRIERS: THE CONCRETE BENEFITS

DEFINITIVE INDUSTRY GUIDANCE

First published: 2020
Reference: BP/66

Britpave
Britpave, the British Cementitious Paving Association, forwards the better and greater use of concrete and in-situ cementitious infrastructure solutions. Members include major contractors, and sub-contractors, specialist equipment and material suppliers, consulting engineers and interested trade associations. Together, Britpave provides a single voice for the in-situ cementitious infrastructure sector.
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Concrete Barriers: The Default Option

Since 2005, concrete central barriers have been the default option for motorways managed by Highways England (HE) where the average annual daily traffic level of 25,000 vehicles per day and where the central reserve width is less than 10m. The policy was instigated by HE's predecessor, the Highways Agency, whose Interim Advice Note 60/05 called for steel barriers to be replaced as they reached the end of their 20-year life.

Of the 3,602 miles of motorways managed by HE, 1,498 miles have concrete barriers and by 2020 a further 195 miles will have concrete barriers installed (1) as the programme to replace the ageing existing steel barriers continues.

The Benefits

There are a number of reasons why concrete barriers have become the default option. These include:

Saving lives

Tested to meet the requirements of the European safety barrier standard EN 1317 (CEN 2010), concrete step barriers (CSB) are able to contain errant 4x4 cars, light vans, buses, coaches and lorries of up to 13.5 tonnes. Traditional steel barriers are only designed to contain up to 1.5 tonnes. The high containment level of concrete barriers is key to minimising the risk of that most fatal of motorway accidents: the crossover. This is where the central barrier is not strong enough to prevent a vehicle from crashing through and crossing over into the face of on-coming traffic.

CSB has a narrow working width and is designed not to deform under impact. It reduces the accident severity as some of the impact energy is absorbed by the vehicle wheels and suspension system in advance of the vehicle body impacting the barrier wall.

Due to the absence of support posts, concrete safety barriers have a limited risk of impact injuries to motorcyclists. Steel wire-rope barriers and steel barriers fixed to steel posts are particularly dangerous for motorcyclists with the potential for decapitation and severance of limbs.

The maintenance-free, long-term performance of up to 50 years means that concrete barriers rarely need repairing or replacing even after a vehicle impact. Removing the need for road workers to be present on dangerous, live motorways would significantly advance Highways England's objective of 'Aim for Zero' road worker death or injuries.

Whole life cost

With a performance life of at least 50 years, compared to 20 years for steel barriers, concrete barriers offer significant whole life cost benefits. These costs are further underlined by concrete barriers being virtually maintenance-free, even after severe vehicle impacts.

In addition to the construction cost savings, the ability of concrete barriers to contain vehicles and so minimise the possibility of crossover accidents minimises a significant range of costs. These include the accident, recovery, barrier repair, traffic management and congestion costs associated with motorway crashes.

A number of cost studies have underlined the whole life cost advantages of concrete barriers. A Britpave study of basic barrier costs comparing surface mounted concrete step barrier, untensioned double-sided corrugated steel beam barrier and untensioned single-sided corrugated steel beam barrier found that the concrete barrier offered the higher H2 vehicle safety containment for a similar price against the lower N2 steel barriers(2). A Transport Research Laboratory comparing concrete and steel barriers also concluded that concrete barriers offered the best whole life cost(3). As did a Swedish study that concluded: "The calculation results show that concrete barriers generate the lower life-cycle cost compared to cable and w-beam barriers. The result is mainly due to the fact that the concrete barriers generate the lowest maintenance and socio-economic costs among the barriers types studied. The underlying factor for this is that concrete barrier require limited maintenance, which in turn results in limited traffic disturbances and, consequently, lower socio-economic costs"(4).

Minimum land take

Concrete barriers require less land than all other competing barrier solutions. Concrete step barriers with containment levels N2 and H2 have a working width of just W1 (0.6 metres) and W2 (0.8 metres) respectively.

At 900mm high with an overall base of 542mm, concrete barriers are far narrower than two parallel rows of steel barriers. Yet they provide a higher containment level and are design to last for twice as long. The reduced working widths of concrete barriers enables the maximum number of traffic lanes. This is especially valuable for motorway lane expansion projects. Due to the robustness of the concrete barrier only one row is necessary to separate and protect vehicles from both carriageways.

Sustainability

Concrete barriers provide a long-term sustainable construction solution. Both recycled aggregates and cement replacement materials can be used and the barrier may be fully recycled at the end of use. The fact that concrete barriers offer a maintenance-free performance life of 50 years negates the CO2 emissions related to routine repairs, traffic management and traffic congestion.

In terms of embodied CO2 levels, concrete motorway barriers far out-perform steel barriers. The average embodied CO2 in a surface-mounted concrete step barrier can be as low as 19% of a similarly performing H2 containment steel barrier over a 50 year period(5).

Continued innovation

In-situ concrete barriers are constructed using the slipform technique. The barriers may be embedded or surface mounted, reinforced or non-reinforced and there are number different available profiles.

Slipforming barriers is a high-output automated process. A typical concrete step barrier can be slipformed at a rate of 400 - 600 linear metres per eight hour shift. Continued development in slipform pavers enable higher accuracy and efficiency.

Concrete barriers may be surface mounted or embedded with foundations. Surface mounted offers particular benefits of reduced construction times and reduced costs. In addition to speed of construction, slipformed concrete barriers offer a finish without joints, reduced labour costs, long-term performance and minimum maintenance.

A wide range of concrete barriers for different road scenarios has been developed:

- Standard concrete barrier
  Double-sided central reservation barrier that can be surface mounted
- Dual concrete barrier
  Dual row of barrier to protect lighting columns or address different carriageway levels
- Wide and trough wide barrier
  Developed to provide a terminal between structures and allow signs, lighting columns and gantry supports to be affixed
- Variable barriers
  Different variable heights accommodate any carriageway height differences.

Continued innovation in concrete barrier systems has seen the introduction of corrosion-resistant reinforcement, new proven transitions between different barrier systems, and barrier overlay systems where existing concrete barriers can be strengthened by slipforming over the existing barrier creating a new higher and wider barrier.

Summary

Given the wide range of performance, whole life cost and sustainability benefits it is little wonder that concrete barriers are the default option for motorway and trunk roads where the average annual daily traffic level is 25,000 vehicles per day.

As traffic continues to increase, their success in minimising the risk of crossover accidents over a 50 year service life means that, in addition to the road network managed by Highways England, concrete barriers should be considered for busy roads managed by local highway authorities.

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1. Highways England, Freedom of Information request, 27th October 2017
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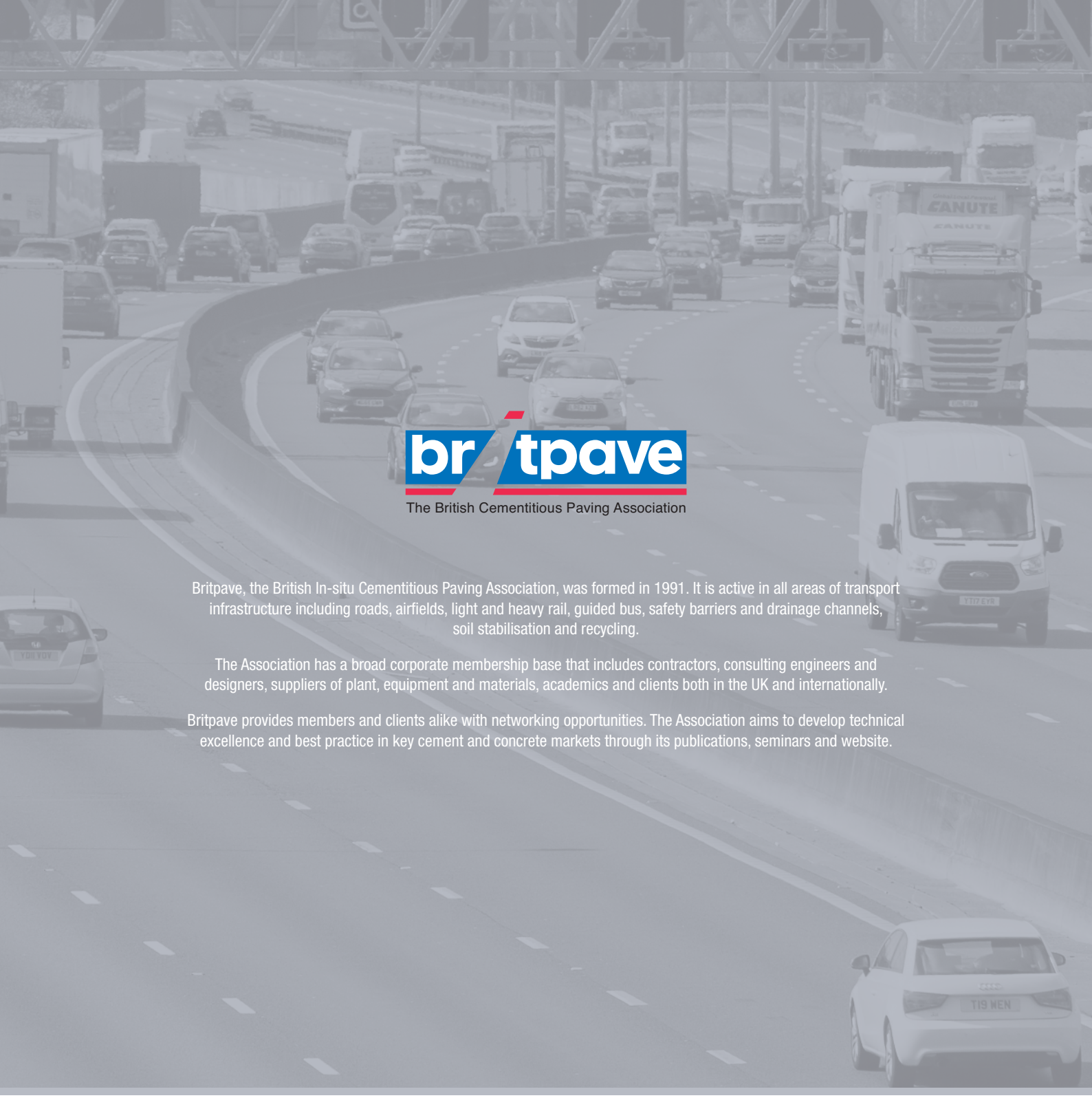

The British Cementitious Paving Association

Britpave, the British In-situ Cementitious Paving Association, was formed in 1991. It is active in all areas of transport infrastructure including roads, airfields, light and heavy rail, guided bus, safety barriers and drainage channels, soil stabilisation and recycling.

The Association has a broad corporate membership base that includes contractors, consulting engineers and designers, suppliers of plant, equipment and materials, academics and clients both in the UK and internationally.

Britpave provides members and clients alike with networking opportunities. The Association aims to develop technical excellence and best practice in key cement and concrete markets through its publications, seminars and website.

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BP/66. First published 2020.
Published by Britpave. Indigo House, Unit 10, Mulberry Business Park, Fishponds Road, Wokingham, Berkshire RG41 2GY
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MBL31258-1