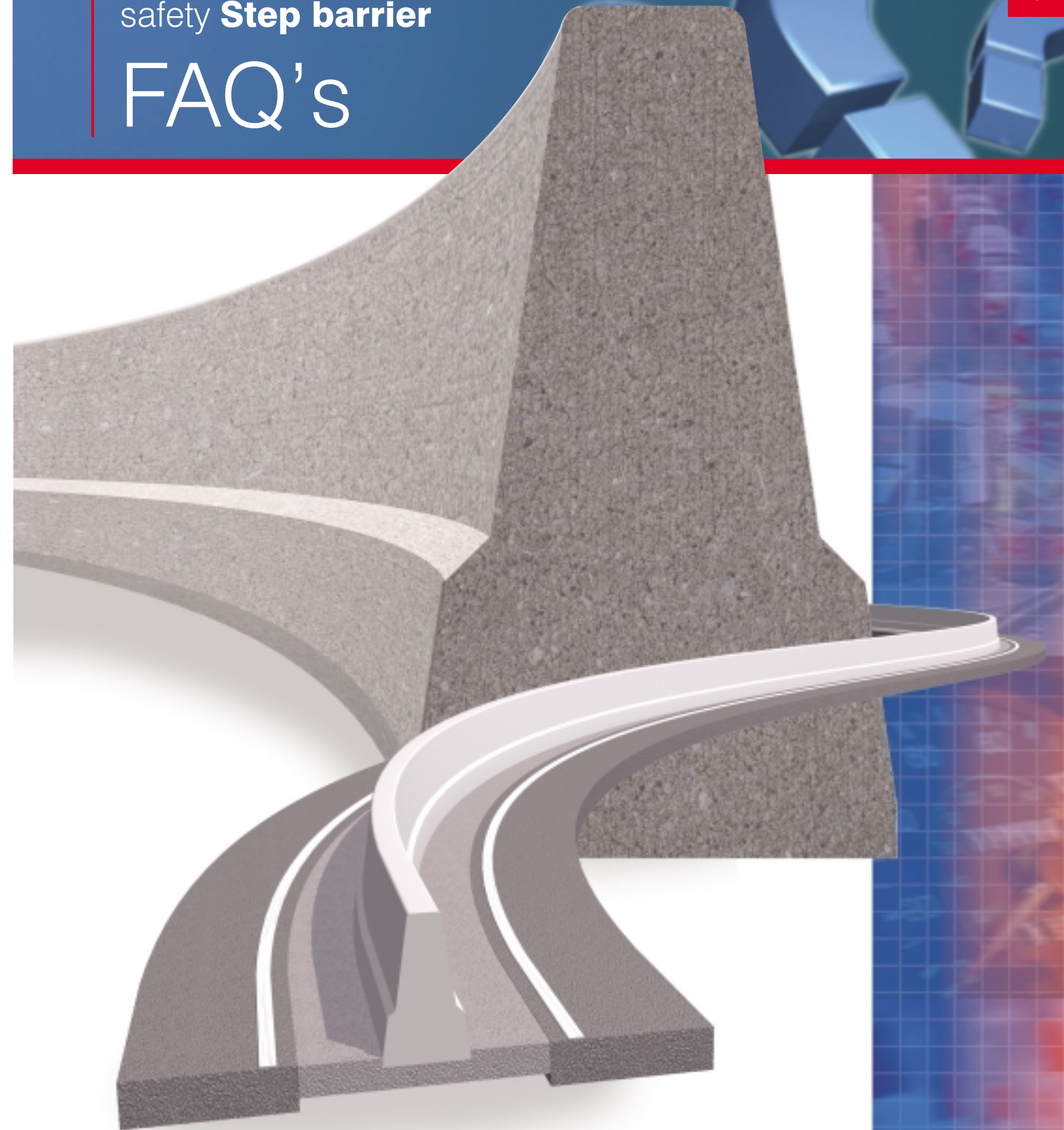


New in-situ concrete safety **Step barrier**

FAQ's



Britpave, the British In-situ Concrete 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 and aims to develop technical excellence and best practice in key cement and concrete markets through its publications, seminars and website.

Britpave acknowledges financial support from The Concrete Centre in the production of this publication. www.concretecentre.com

Frequently Asked Questions

Bifurcation

Can a single concrete barrier bifurcate into two?

Yes. Full details are provided on Britpave drawing CSB/40. Such bifurcation is used to allow a single barrier to split and run either side of bridge piers or sign gantries. It also serves to allow for two lines of barrier where adjacent carriageways are found at different levels and each pavement requires its own barrier. Bifurcation provides the basis of transition from standard width Step barrier to wide Step barrier. The length of the bifurcation section is typically around 4 linear metres and it is normally cast in-situ using fixed formwork either before or after the slipforming of adjacent barrier.

Bridges

How much impact load will be imparted into the barrier foundation, presumably at Ultimate Limit State (ULS) as opposed to H2 containment, and how does the impact load disperse through the barrier upon impact?

The only available information in terms of applied impact force on the barrier and the duration thereof is provided in terms of deceleration values. By using the force = mass x deceleration equation, this force is quite large. It is however not correct to assume that this force will be directly imparted onto the bridge bearings for example. This is because impact forces are resisted/absorbed in part by the mass of the structure in question and any local deformations that take place (energy absorption). A further query is the ULS capacity of the barrier which would not be tested by impact testing but could be done by applying a static horizontal load to the barrier and monitoring at what point it fails by crack formation or deflection - this would provide relevant information about the magnitude of lateral load that may be imparted on the bearings.

In the interim, it is important to point out that both HVCB and in-situ parapet are concrete barriers currently built on bridges. Both of these are more rigidly fixed into the bridge deck than the Step barrier as HVCB has much deeper embedment and in-situ parapet is fixed by steel reinforcement into the deck structure. The vertical impact face of these barriers will result in a larger impact force being transmitted to the bridge when compared to the more sloping Step barrier's impact face. We would therefore suggest that on this basis, Step barrier poses no additional risk above current VCB barrier risk to the structure or its bearings.

In terms of the barrier's ability to resist a static horizontal load, this load is reasonably applied 400mm above the pavement surface. The resistance to this overturning force is offered by the barrier's mass which can reasonably be assumed to be no more than 30m in length (there will usually be bridge joints which will set this dimension). Similarly, we can conservatively assume that a contact adhesion between the foundation and the barrier develops with a limit of 0.2 MPa over a length of say 6.0m local to the point of force application. Setting overturning moments equal to resistant moments, the lateral static applied force equates to 340kN. This value is less than the 500kN force referenced in Table 4 of BD60/04. We would therefore recommend that as long as the bridge structure satisfies the 500kN impact force to BD60/04, it will perform adequately and the concrete barrier does not require this impact force to be increased.

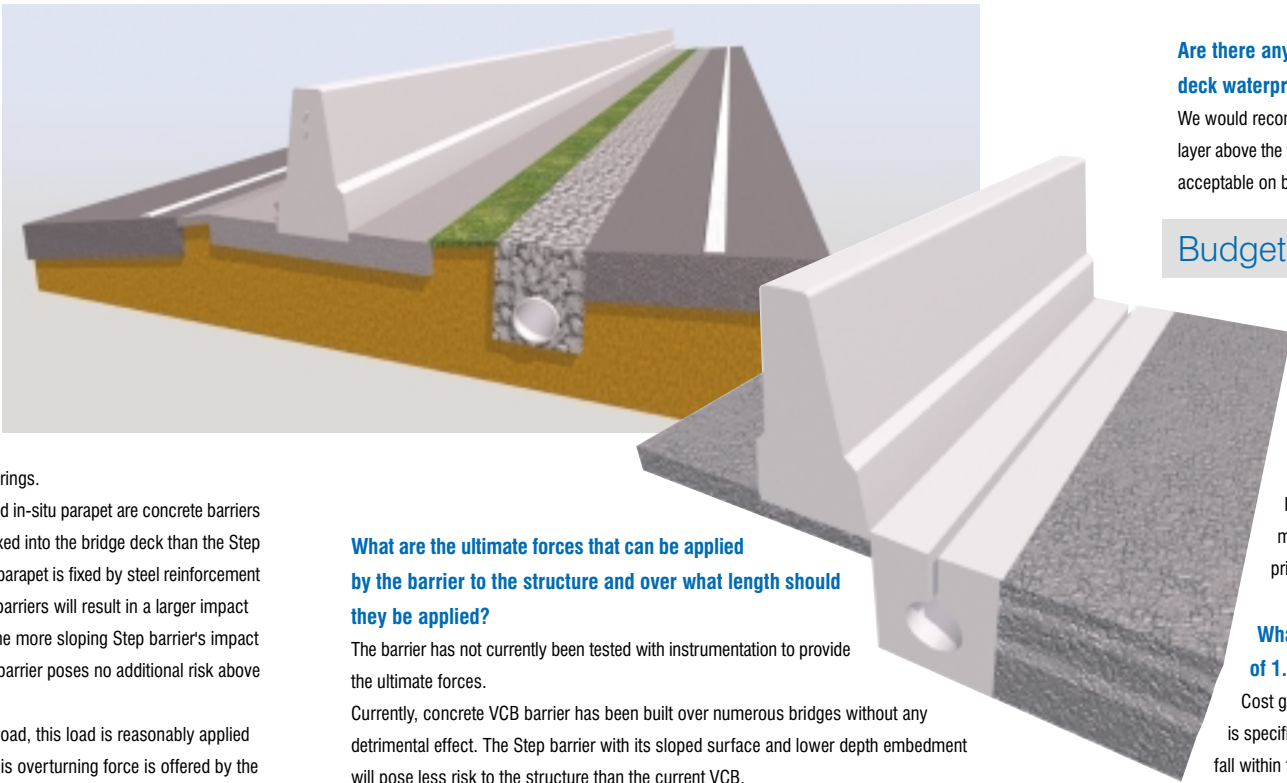
Can Step barrier accommodate a bridge featuring an existing leaf pier 1.0m wide where currently an existing mounted bracket for OBB steel fence is provided? The leaf pier has been designed to resist vehicular impact loading. Can the Step barriers be aligned to finish flush with the pier faces? What would be the clearance, if any, setback and working width in relation to the pier?

Step barrier can tie into the pier - a simple isolation joint between the two items with the traffic

face of the barrier blending to the traffic face of the pier over say 3lm. Current advice is that OBB is tied into the pier, so Step barrier could tie in likewise. Alternatively the barrier bifurcates like steel and runs in front of the pier. Working width is W2 and minimum set back as scheduled in IRRRS is 600mm adjacent to structures. Traffic face is measured from the point where the base of the barrier meets the pavement.

If currently available designs prevent the use of a concrete barrier across a particular bridge how can the requirements of IAN 60/05 be met?

Highways Agency SSR team have confirmed that steel barrier can be provided at this location as would previously have been the case prior to the issuing of IAN 60/05. Either side of the bridge concrete barrier must be provided for the remainder of the scheme. A departure from standard must be sought as per the guidelines provided in IAN 60/05 Britpave is currently working with the Agency to provide expansion joint details and steel profile Step barrier to assist in this area.



What are the ultimate forces that can be applied by the barrier to the structure and over what length should they be applied?

The barrier has not currently been tested with instrumentation to provide the ultimate forces. Currently, concrete VCB barrier has been built over numerous bridges without any detrimental effect. The Step barrier with its sloped surface and lower depth embedment will pose less risk to the structure than the current VCB. We would therefore recommend that, in the interim, as long as the bridge structure satisfies the 500kN impact force to BD60/04, it will perform adequately and the concrete barrier does not require this impact force to be increased.

With reference to the ultimate forces that can be applied by the barrier to the structure. Are they just applied locally or do they act globally as well? For example what forces would be applied to supports and bearings as opposed to the local forces that are applied to the structure?

The ability of the forces applied to the barrier to be transmitted to the bridge bearings for example is a function of the bridge's structure which would be site specific. It is intended to apply a 'static' horizontal load to a section of barrier to determine its resistance at failure - see other FAQ's.

How is the articulation of the bridge accommodated i.e. how is provision made for translation and rotation at joints and supports?

A standard joint detail is being developed which would be capable of handling +15mm, -15mm of translational movement as well as rotation. This detail will satisfy most common bridge decks up to 25m in span based on a 50 year thermal return period. It is recommended that above this span, site specific designs should be considered.

Is there any guidance on the stiffening effect the concrete barrier would have on the structure i.e. is it known how this affects the load paths within the bridge deck and also the local loads adjacent to the barrier?

We do not have any guidance in regard to this question. We are aware of the stiffening effect but do not know its magnitude. It is worth mentioning that concrete barrier has been built over many bridges without detrimental signs to the bridge structure. We believe that the high stresses are taken up by means of sheer deformation along the contact between the concrete barrier base and the bridge structure. The Step barrier with its much reduced foundation depth will offer less resistance to the sheer deformation than the current VCB and HVCB.

How is the barrier to be connected to the bridge in the central reserve (often there is a small, raised concrete plinth in the central reserve to stiffen the deck locally or to provide kerbs for drainage)?

The barrier requires 60mm embedment with a bound foundation material below. The bridge is clearly a suitable foundation. Placing a 60mm thick asphalt surfacing of 500mm width to either side of the barrier would be an acceptable solution or planing out the concrete to a depth of 60mm would also be acceptable. We would suggest that in this instance, an appropriate detail can be developed for each situation that satisfies the embedment requirements.

Are there any details to show how the barrier is to be supported and the bridge deck waterproofing to be maintained?

We would recommend that the barrier be placed directly on top of the red sand asphalt marker layer above the waterproofing. A drawing detail will be developed if concrete barrier is considered acceptable on bridges by the HA.

Budget

What is the budget cost for slipformed Step barrier (H2) containment?

Budget cost for H2 Step barrier is £50 per metre. Market forces and size of market place may see this price fall.

What is the budget cost of Step barrier based on say a minimum length of 1.5km?

Cost guidelines are included within the website and CD ROM but no specific quantity is specified. Of course quantity will affect price. A single length in excess of 1.5km would fall within the general guideline price of £50 per linear metre.

What is the likely budget cost of wide Step barrier?

Approximately £75 per linear metre.

Construction

How do we ensure that asphalt surfaces adjacent to the barrier are not stained by concrete during the construction process?

Ideally construct barrier in advance of adjacent wearing course. If barrier is to be constructed against completed wearing course then appropriate follow-on cleaning operations should be identified and included within appropriate method statements. The attendance of a suction sweeper will be required at all times.



Barrier paving in the Netherlands

Can the barrier be embedded deeper than the specified 60mm to suit construction or programme demands?

Yes, provided the overall height of the barrier is not compromised. In certain circumstances it will prove more economical to site the barrier on road base increasing the depth of the barrier base but avoiding a regulating foundation layer.

Crossovers

What about crossover areas for major maintenance?

It is more economic to remove and replace a section of concrete barrier during future maintenance than to forward plan for future requirements.

Design Life

What is the design life of concrete Step barrier?

Concrete Step barrier is designed to provide a 50 year maintenance free life.

Drainage

Will the use of concrete Step barrier require the provision of additional drainage systems?

No, concrete Step barrier can make use of existing drainage systems. The animations provided on our website assist in understanding how different drainage systems can be accommodated with concrete Step barrier. In-situ slotted linear drainage channel, conventional gully pot systems or surface water channel as detailed in the Manual of Contract Documents for Highways Works, Highway Construction Details, may be constructed directly adjacent to concrete Step barrier. The use of granular drainage directly in front of concrete Step barrier is not permitted.

Can Step barrier be used as a kerb?

Yes, by relocating the outfall grates to the base of the barrier it will act as a kerb line. This is likely to prove the most economic drainage system.

Emergency

At what intervals should ECPs be provided?

HA has indicated that designers should look at alternative means of providing emergency crossing points such as slip roads, service roads, frequency of junctions, stopping access to motorway in emergency situations and to turning vehicles around within the confines of the carriageway. In reality emergency vehicles cannot safely use any crossing point unless traffic on both carriageways is at a standstill. Information from the network suggests that ECPs are hardly ever used. The idea that steel barrier can simply be removed by emergency services and an ECP created almost anywhere is misleading and incorrect - almost all medians serviced by steel barrier could not be trafficked by most motor vehicles.

What design of ECP is available?

Designs for emergency cross-over points are being developed now. They will most likely take the form of a section of H2 W2 containment steel barrier that can be quickly unbolted and moved by hand. The basic principle will be similar to existing approved gated products. This detail will be available in advance of construction demand. For now designers should identify where emergency crossing points are required and indicate these on project drawings. The type and design should as approved by HA.

Future Overlays

Will the use of concrete barrier preclude overlays as a maintenance treatment?

This matter is being discussed, but the current specification dictates the minimum height above pavement level that the barrier must provide.

How is future re-surfacing of the adjacent carriageway accommodated?

Inlay may have to be considered rather than overlay and certainly where overlays are imminent this procedure should be carried out before barrier is installed. It may be permissible to increase the base thickness of the barrier and therefore the height to allow for future overlays and guidance in this regard will be provided in due course.

Hardening

Does the use of concrete barrier dictate that medians must be hardened?

No. The median between pavement and barrier traffic face must be hardened as must the barrier foundation and a 500mm wide restraint strip behind the barrier - see Design section of this website and drawings. The decision to harden the entire median is dependent on the width of the median, existing services and required drainage. The HA view is that in order to minimise maintenance, hardening of the central reserve is the preferred option.

What are the foundation requirements for the concrete safety barrier?

Foundation requirements are detailed in the Britpave drawings. The barrier must be sited on a minimum 150mm thick bound base - either Gen 3 concrete or road base.

Height of Barrier

What is the height of Step barrier above road level?

As detailed within the Britpave product drawings the nominal height of Step barrier above adjacent pavement is 900mm. This increases to a maximum of 1200mm in the case of Variable Profile Step barrier when a single barrier services two adjacent pavements at different levels.

High Containment Step

Are there plans for high containment - H4a, Step barrier?

Yes. Britpave and the Highways Agency are hoping to work with the Dutch Transport Ministry on developing a high containment barrier system. Until then transition details are contained in the Britpave drawings that allow approved Higher Vertical Concrete Barrier (HVCB) to be used.

Implementation of IAN 60/05

Is there a point in a design process where we have reached such a stage where this guidance does not apply?

The instruction is clear and specifies immediate effect. Paragraph 4 specifically states that it applies to all schemes and future schemes including those in preparation providing implementation will not result in significant delay or additional expense. Any scheme that does not include concrete barrier to the median will, in accordance with paragraph 6, require a fully justified departure from standard and reports from industry suggest that such applications will be carefully scrutinised. In almost all cases change to concrete barrier will not require extensive design changes and therefore it would be suprising if any scheme at design stage could not meet the new standard.

Industry Capability

Sub-contractor availability

Industry has the capacity to meet demand. A single Slipform paver can produce in excess of 300lm of barrier per 8 hour shift. There are currently over 20 Slipform pavers in the UK. Following the HA announcement, existing specialist contractors are looking to expand.

Lighting

Lighting columns

These are already catered for in the Britpave suite of drawings - see drawing reference CSB 11. A detail that allows incorporation of lighting columns and traffic signs within a standard width barrier is being worked on.

How are lighting columns accommodated within Step barrier systems?

The use of widened barrier profiles and twin parallel lengths of concrete barrier to accommodate lighting columns are proven with extensive use on the M25 motorway. A widened version of Step barrier is included in the Britpave suite of drawings - see drawing reference CSB 11. The lighting columns are simply bolted to the top of the barrier. Specific holding down details are dependent upon column and lamp type. The barrier's ability to act as a foundation for the lighting column is a function of the lamp type and column. Alternatively two runs of parallel barriers with lighting columns planted in the gap between may be adopted.

What details exists regarding steel cover plates around lighting columns?

These are currently being developed. The preferred current option is to fix lighting columns on top of wide barrier.

Location

Should the barrier be sited along the centre of the median or offset towards one carriageway?

The alignment of the concrete barrier is dependent on the same factors that dictate the alignment of steel barrier systems. Alignment of existing drainage systems, services, lighting columns and traffic signs will influence the alignment of concrete barrier. Like steel it may be sensible to locate the concrete barrier away from services and granular drains.

Does the width of the median affect the type of barrier provided?

The advice note is clear. H2 concrete barrier must be provided in all instances. Like steel barrier, alignment of the barrier within the median is affected by a number of factors including: location of drainage, location of services, width of median, lines of sight and level difference between carriageways.

As a general guide the alignment of steel barrier follows very similar rules to the alignment of steel barrier. A series of animations has been produced to assist designers in this regard. Please visit www.concretebarrier.org.uk for more details.



Maintenance

Will snow or debris collect around concrete barriers?

No adverse comments have been received from M25 maintenance teams. We do not know of any comments received by TRL when investigating the performance of concrete barriers compared to steel barrier systems around the M25 motorway.



What about the effect of de-icing salts?

The barrier is spray cured and there is no necessity to apply Silane. The air entrainment and high strength concrete provide a barrier highly resistant to salt and frost attack.

Noise

What effect will concrete barrier have on noise in urban areas?

We are currently undertaking some research in this area but indications are that concrete barrier will be neutral or even positive in terms of noise reduction.

Operation on Network

Have the Police or Highway Management Teams made any adverse comments regarding the adoption of concrete barrier?

No. What should be noted is that on the M25 the HA commissioned TRL report identifies that there are 70% less accidents where concrete barrier is provided and that there have been no crossover accidents associated with concrete barrier.

Outputs

Typical and potential outputs are provided on the website and CD ROM. A single paver and crew should always attain productivity of 34lm per hour and experience suggests on larger schemes this output will peak at 78lm per hour.

Paver Set Up

Do slipform paving machines straddle the median?

No. They typically operate to one side. They can, if specifically required, be setup to straddle the median.

What is the paver width?

This varies from machine to machine and from contractor to contractor. Barrier can be constructed within a single lane closure.

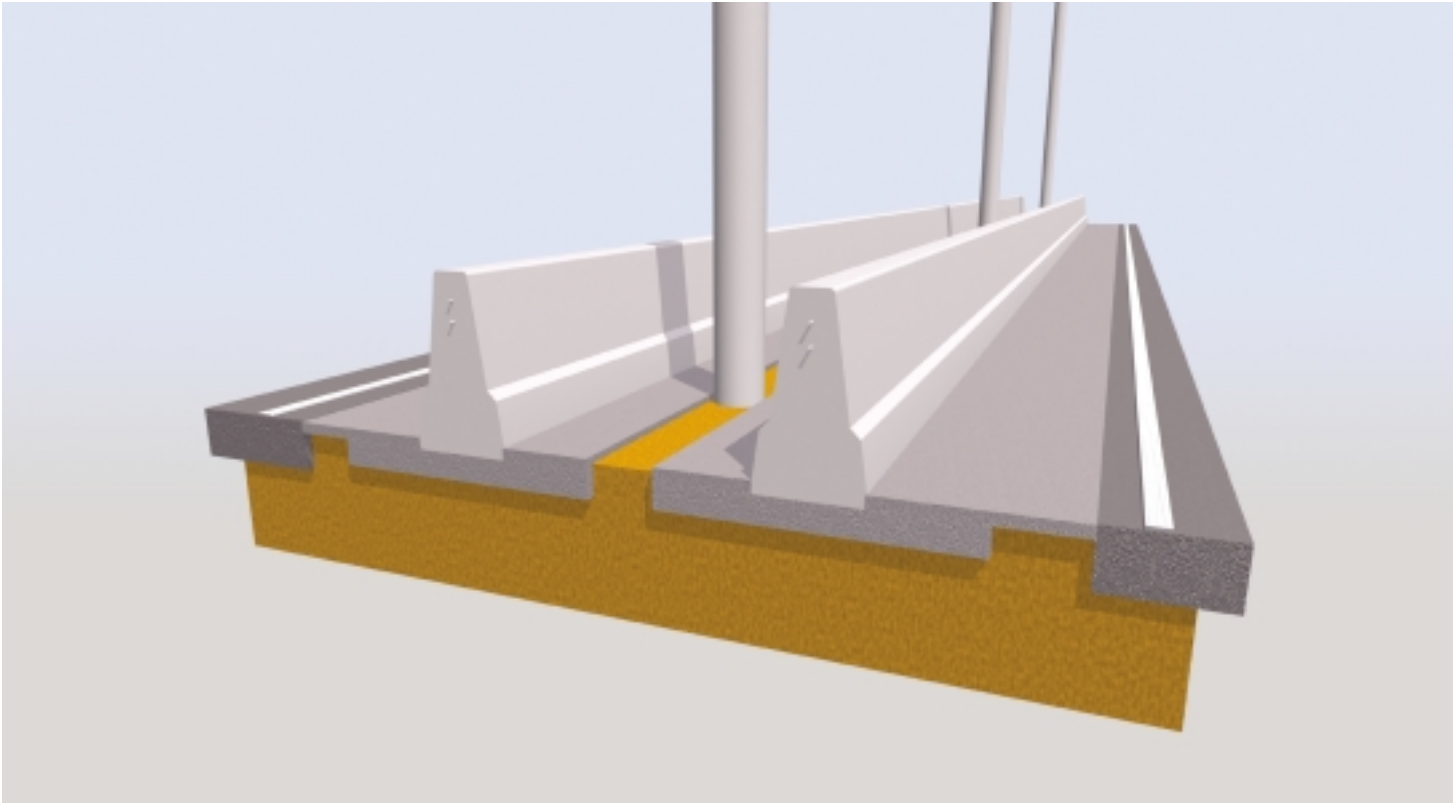
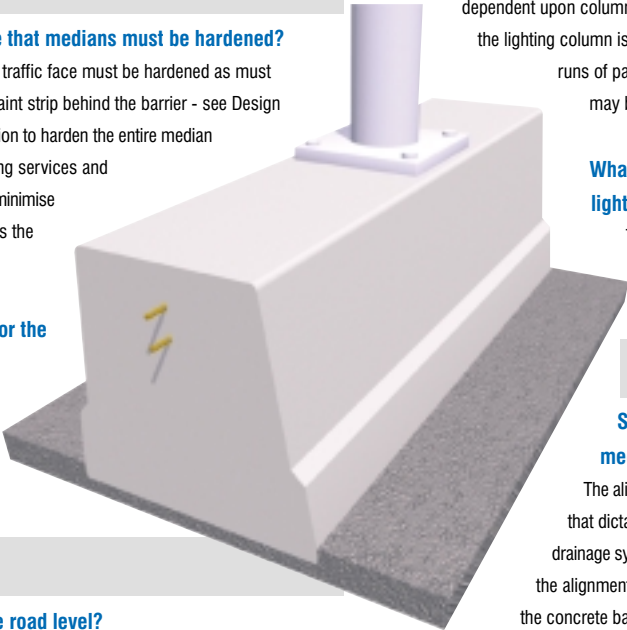
What traffic management is required to construct concrete Step barrier in the median?

This varies from machine to machine and from contractor to contractor. Barrier can be constructed within a single lane closure.

Performance

Has there been any experience on M25 of vehicles striking the barrier and demolishing lighting columns?

No such accidents have been recorded.



Profiles & Tolerance

What is the typical safety barrier cross section that meets the requirements of IAN 60/05?

The Step barrier cross section and all associated specifications, tolerances and construction details are provided in the Britpave suite of drawings for this product. They are specifically referred to in the HA letter of product approval. They are available on the Britpave CD ROM as both Auto CAD and PDF downloads. You may obtain a CD ROM directly from Britpave either via the website www.concretebarrier.org.uk or by telephoning the Britpave office - 01276 33160.

Repairs

Accident damage repairs

Concrete barrier would be repaired in line with standard industry practice. However it must be noted that any repair is highly unlikely. In over 10 years of service no concrete barrier in the UK has been damaged and repaired.

Services

Is it necessary to relocate or renew existing services when constructing concrete barrier in the median?

In most cases no. The alignment of the barrier must be considered having regard to the location of existing services. The minimal embedment and 150mm thick foundation means that the depth of excavation required for concrete barrier is considerably less than the depth of a driven steel barrier post.

Set Back

Drawing CSB/16 details 1300mm minimum set back from edge of pavement should this not read set back as detailed in IRRRS?

Britpave drawings require amendment. Set back is as provided for in IRRRS nominally 1200mm, minimum 600mm. Revised drawings will be available shortly and available as PDF downloads direct from the website.

What is the set back for Step barrier?

Set back - this is the distance from the edge of the trafficked carriageway - traffic side of white line, to traffic face of barrier. Standard set back for Step barrier is 1200mm but as detailed in IRRRS this may be reduced to 600mm if required where the barrier protects structures.

Set Out

Is Step barrier higher than steel barrier?

Yes, except for DROBB.

Signs

Signs in central reserve

Like lighting columns, traffic signs can be bolted to top of Step barrier. Britpave, with input from HA, is currently working on a steel cover plate detail that will allow lighting columns and larger traffic signs to be incorporated within standard width barrier. Like ECPs this information will be available in advance of construction.

Temporary signs in central reserve

This would be a matter for TM contractors. They should provide method statements and risk assessments. If they believe that possible incorporation of fixing points should be discussed we would be pleased to assist. We would suggest that they look towards a clamping system to which signs are fixed.

Can permanent road signs be mounted on Step barrier systems?

Yes, as with the lighting columns, drilling and fixing would be appropriate.

How do you fix temporary road signs to concrete barrier?

A simple clamping device can be used.

How are matrix signs accommodated?

If the location of the matrix sign occurs within a length of Wide Profile Step barrier then like lighting columns the sign can be simply bolted to the surface of the barrier - see drawing CSB/11.

Alternatively where standard width Step barrier is provided the barrier can be widened locally - following the guidelines set out in the Britpave bifurcation drawing, to provide a 1 metre long section of Wide Profile barrier to which the signs can be bolted.

Alternatively where standard width Step barrier is provided the barrier can bifurcate and the sign sited between the two lengths of barrier.



Specification

Is any special concrete required?

Yes. Full details are available within the specification. The mix is air entrained, incorporates polypropylene fibres and has a low workability.

Is the galvanised cable (wire rope) tensioned?

Yes. It is primarily to stop it moving within the concrete during placement prior to initial set

Are there joints in Step barrier?

Yes, but only contraction joints as detailed in the product specification.

What about the surface finish. Will there be follow-up gangs performing finishing tasks?

No. The carefully designed mix means the virtual elimination of manual finishing.

Surveys

Will the adoption of concrete barrier rather than steel barrier require additional central reservation surveys to locate and identify such items as manholes, services, French drains, bridge piers, matrix signs etc?

There should be no need to undertake surveys over and above those surveys that are required for median served by steel barrier. The location and effect on drainage and services for concrete barrier follows the same principles as steel barrier.

Terminations & Transitions

Are there standard details for when the concrete barrier ends and typical OBB/TCB fencing starts?

Rigid barriers may not be directly connected to TCB, they must be connected via OBB. Connection details are included within the Britpave drawings for connection to both single sided and double sided OBB. These details are approved for use by the Highways Agency. Also included are transitions to HVCB and simple termination tapers where the barrier does not connect to another system.

Time from Construction to Trafficking

What is the delay between paving Step barrier and opening the road to traffic?

In theory as soon as 35MPa compressive strength is achieved. This will be between 36 and 48 hours or with the use of special cement 24 hours. The mass of concrete will be effective as a barrier at initial set with higher strength merely providing resilience to impact damage.

Traffic Management

Currently it is not uncommon for TM operatives to run from the hard shoulder with traffic signs across live lanes to the median seeking sanctuary between runs of steel barrier. A single concrete barrier does not allow this, what would Britpave recommend?

We would suggest that this dangerous practice should be outlawed regardless of the type of median safety fence. For concrete barrier, truck mounted crash cushions and mobile lane closures should be used to set up lane closure TM. It is worth noting that as concrete barrier is designed to be maintenance-free, the number of required adjacent lane closures will be significantly reduced as compared to steel barrier systems.

Variable Profile Barrier

Is there a maximum level difference between the two adjacent carriageways?

The maximum level difference currently allowed for in the drawings with a single barrier is 300mm. It is technically possible to provide a single barrier in excess of this limit. Currently HA has certified H2 containment at up to 100mm of level variation and N2 containment between 100mm and 300mm. Therefore current specifications require bifurcation of the single barrier into two where level variation exceeds 100mm. Barrier bifurcation details are provided in the Britpave suite of drawings.

Above 100mm of level difference between adjacent carriageways Step barrier is only certified with N2 containment. How can the requirements of IAN 60/05 be provided?

The maximum level difference currently allowed for in the drawings with a single barrier is 300mm. It is technically possible to provide a single barrier in excess of this limit. Currently HA has certified H2 containment at up to 100mm of level difference and N2 containment between 100mm and 300mm. Therefore current specifications require bifurcation of the single barrier into two where level difference exceeds 100mm. Barrier bifurcation details are provided in the Britpave suite of drawings.

Verge

Is it likely that Step barrier will be installed in the verge as well as the central reservation?

Possibly where there is a requirement for containment above N2 - say where DROBB is typically provided to protect structures such as sign gantry bases.

Working Width

What is the working width of Step barrier?

Working width - this is the dynamic working space of the barrier. For concrete Step barrier this is classified as W2 at H2 containment and W1 at N2 containment. W1 represents a working width less than and equal to 600mm and W2 a working width less than and equal to 800mm measured from the traffic face of the barrier. Working width and containment are confirmed in the Highways Agency letter of product approval dated 19th August 2004, copy available from Britpave CD ROM.

How close to an obstruction can machine laid Step barrier be constructed?

For practical reasons the barrier may be machine laid wherever a distance from centre line of barrier to the structure of 650mm or more is provided. If due to set back and working width this distance needs to be reduced then the barrier immediately adjacent to the structure must be cast in-situ using fixed formwork.

What is the minimum distance that a concrete Step barrier can be constructed relative to a bridge pier?

The position of a barrier in relation to a structure is dictated by a number of factors. For concrete Step barrier the distance from the centre line of the barrier to the structure's face is 329mm for N2 containment and 529mm for H2 containment.

Concrete barrier provides a lower working width than any steel barrier and therefore on any given project where concrete barrier is being provided in lieu of steel barrier there can be no reduction in performance, clearance or working width.

