B5.2 "Open" Scenarios: Viaducts

Issue

As the HS2 line approaches a crossing, it is usually at a height above ground level. In many cases, the most appropriate way to deal with this level difference is with an embankment. This serves to blend the rail in with the landscape, and provide opportunities for planting. However, the visual envelope of the waterway corridor may be open, and there may be many views across the landscape towards places of particular beauty, significance or interest. At these locations, it may be more appropriate to create a viaduct which permits views through the structure, protecting the landscape character of the waterway corridor.

Response

In these 'open' scenarios, the piers to either side of the canal corridor significantly impact the waterway environment, and as such they need to become a positive part of it (Fig.B5.7). These 'waterside' piers must satisfy a different set of criteria than those used elsewhere. Unlike those in open countryside, these piers will have a close proximity to pedestrians and other waterway users, and must be held to a higher standard. Furthermore, these piers serve to identify the waterway-span within a viaduct, and enhance the relationship between the rail and the water.

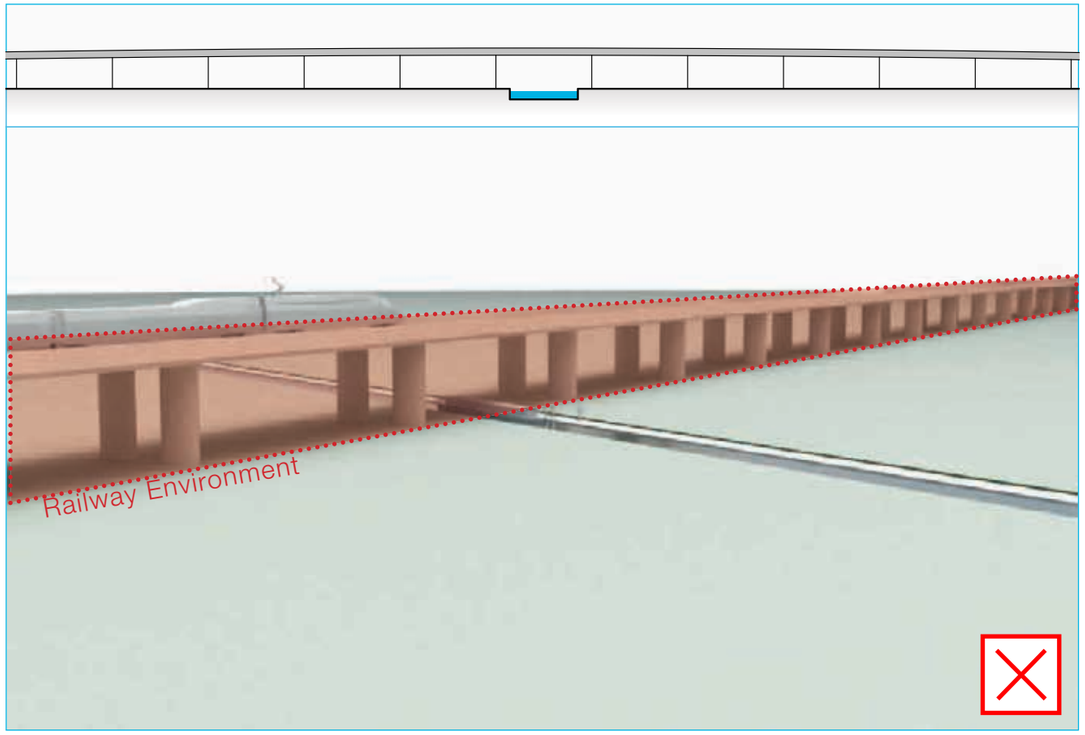

Fig.B5.6 - Unresponsive pier arrangement remains a part of the railway environment

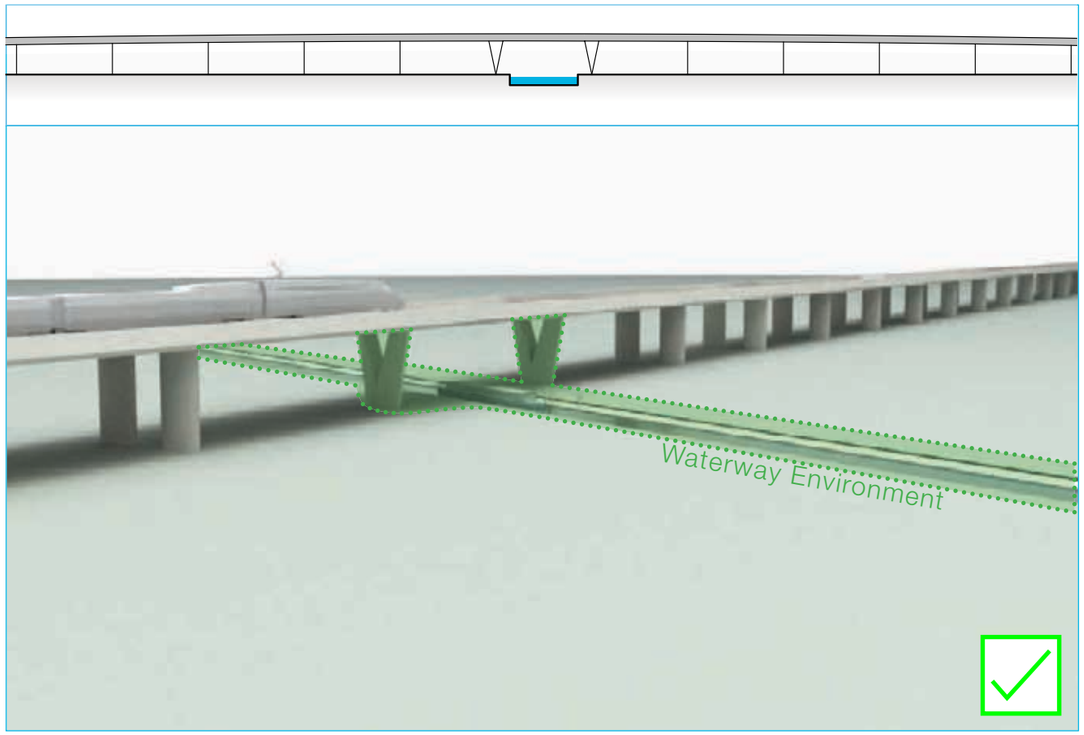

Fig.B5.7 - Piers which respond to the canals become a positive part of the waterway environment

Fig.B5.8 - Viaduct structure suits an open scenario

“Open” Scenarios: Embankments

Issue

Where an embankment solution is selected, the form and position of the abutment is of primary importance

Response

Whilst the deck and piers are identifiable as a family of structures within the landscape, the abutment and embankment should read as a part of the landscape itself. It is therefore important that these elements blend comfortably into the landscape, and do not read as obvious man-made intrusions. Sloped abutment walls with natural stone (riprap) finishes are preferred over vertical concrete abutments (as illustrated in Fig.B5.10)

The location and orientation of the abutments is also of critical importance, and needs to be carefully considered in the context of the wider landscape. Bringing the embankment too close to the canal environment essentially creates a ‘focused’ scenario, in which the other solutions outlined in section 5.1 are more appropriate. In ‘open’ scenarios it is preferable to stop the embankment (with sloped abutment) at least three spans prior to the main waterway span, in order to maintain views through the structures (as illustrated in Fig.B5.11).

Fig.B5.9 - Vertical concrete abutment is an obvious intrusion into the landscape

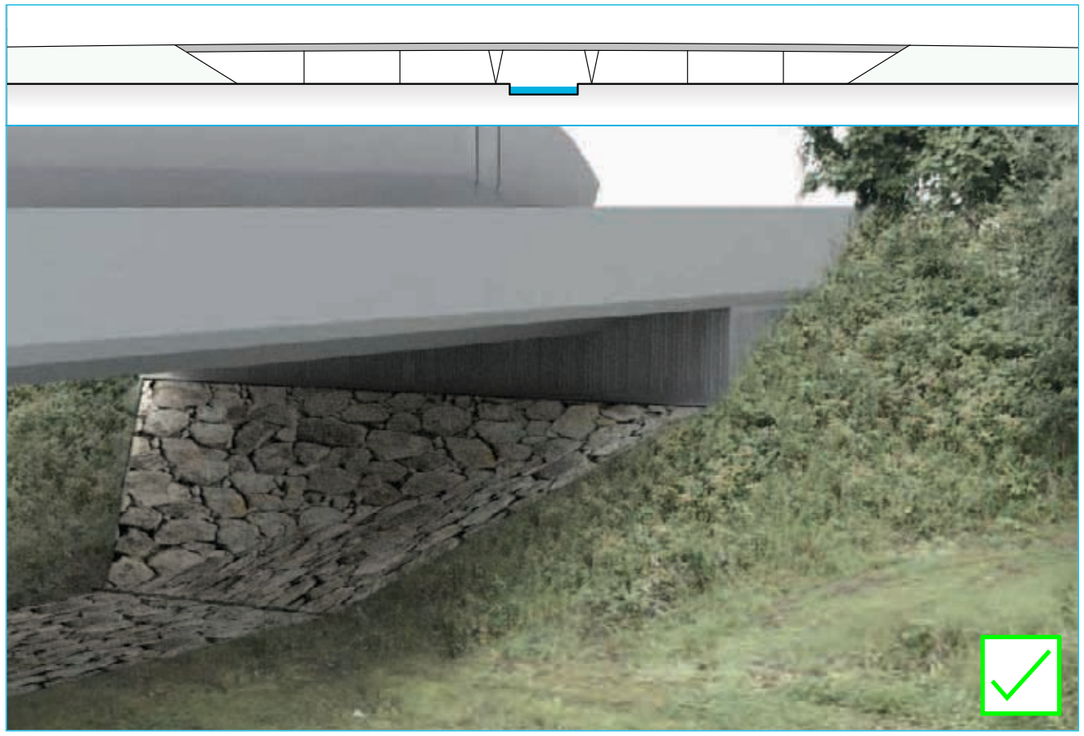

Fig.B5.10 -Sloped abutments with tapered riprap blend well into the landscape

Fig.B5.11 - Sloped abutment face and multiple back-spans reduces negative visual impact and maintains open views

B5.3 Maintaining Views

Issue

As mentioned earlier, a single back-span and pier arrangement (as illustrated in Fig.B5.12) creates an unused ‘dead’ space which is alien to an historic waterway environment, and is to be avoided. Any positive impact of this open space is usually outweighed by the negative impacts of the poor quality of the space beneath, perception of safety and darkness.

Response

In ‘open’ scenarios, providing a single back-span rarely permits views that would otherwise be obstructed. As such, where views are required, several spans are preferable, as they permit wider views (Fig.B5.13), without creating small, uncomfortable spaces between the waterway environment and the abutments, and associated loss of views.

Each location must be assessed on its individual merits, as the clutter of piers associated with viaducts could negatively impact upon the landscape in situations where they are not providing a view through the structure.

Where a viaduct is used, longer spans are preferred, as they increase transparency though the structure. By contrast, the multitude of piers associated with short spans tends to obstruct views.

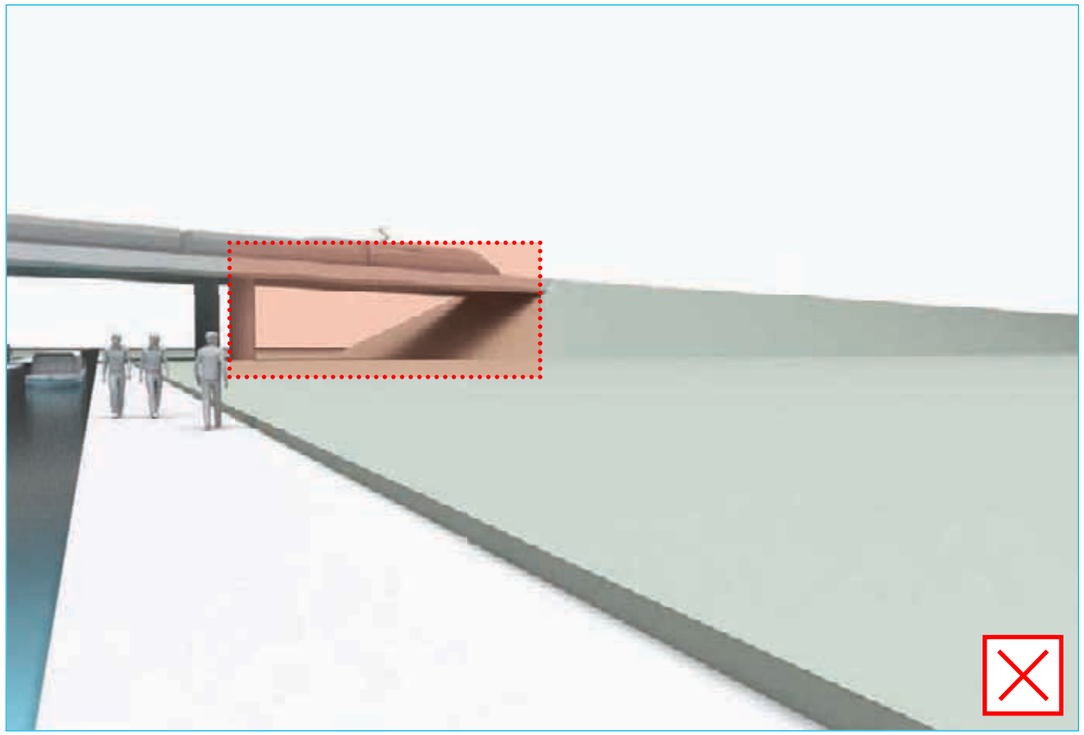

Fig.B5.12 - Single Back-spans and abutments create unsuitable environments

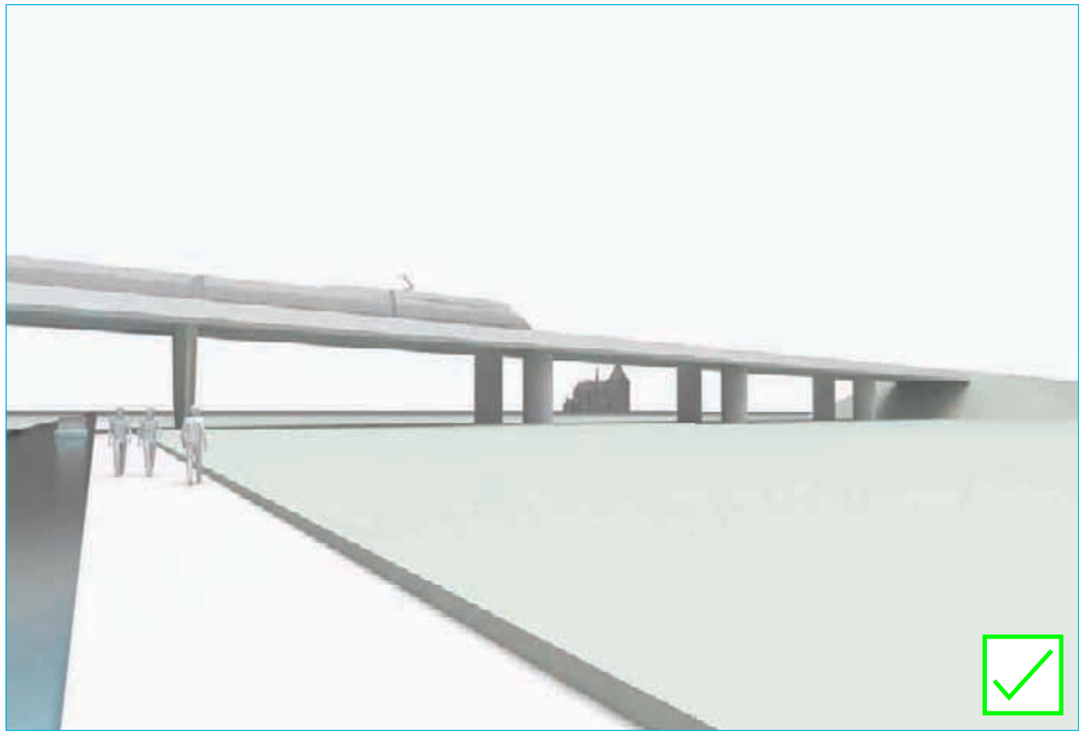

Fig.B5.13 - Multiple spans permit views through

B6 Waterside Piers

Issue

As mentioned earlier, in order to read as a positive part of the waterway environment, the waterside piers must address the canal - in orientation, scale, arrangement and form.

Response

The relationship between the rail and the water is expressed most clearly through the design of the piers. To that end, it is advisable to create a specific pier design for use when crossing the waterways. Fig.B6.1 and Fig.B6.2 illustrate indicative waterside-pier designs which express some of these characteristics. The subtle and considered expression of the ‘waterside piers’ must be tailored towards the canal corridor, and would have a number of significant advantages:

1. They identify the significance of the span
2. They build upon the identity of the waterway, and the relationship to HS2
3. They can be designed to reduce their visual mass as viewed from the towpath
4. They can be detailed at a pedestrian (‘4mph’) scale
5. Surfaces can be detailed so as to not appear too dominant
6. Their design can use light and shadow to reduce their apparent size

The viewing distance for the waterside piers will be very close, and as such the quality of their detailing, service integration, colour, and material finish must be suitable for a high-quality pedestrian environment. The constraints on pier form are also different for those at the waterway span. The objective must be to create as slender profile as possible when viewed in elevation along the canal. Moreover, opportunities to allow light to penetrate should also be taken. In addition, textures and shadow lines should be utilised to reduce the visual weight of the form, and reduce the ‘scale’ of the object to that of a pedestrian environment. As the various crossings will be at different heights above the canal, these piers must be designed in a way that is suitable across the range of their potential heights.

Fig.B6.1 - Waterway piers should be high-quality and slender

Fig.B6.2 - Waterway piers should aim to diminish the railway ‘scale’ a pedestrian one

B7 Pier Alignment

Issue

As illustrated in Fig.B7.1, piers that are positioned relative to the rail alignment bear no relationship to the waterway beneath. This creates an unconformable relationship between rail-and-water, which appears poorly considered.

Response

If the alignment of rail above the waterway is skewed (and as such does not bear any formal relationship to the waterway) the supporting piers must address the canal. As per Fig.B7.2, if the piers are aligned to the canal, the composition of the crossing is more comfortable, creating a series of portals for boats to pass through with positive views along the corridor.

Aligning the piers to the waterway corridor (rather than the rail) has a positive impact for several reasons:

1. ‘Dead’ spaces which are unusable, and even unsafe are removed
2. The span is decreased, in turn decreasing structural depth
3. The piers respond visually to the waterway environment (Fig.B7.6)
4. Less structure is visible from along the canal towpath (Fig.B7.4)

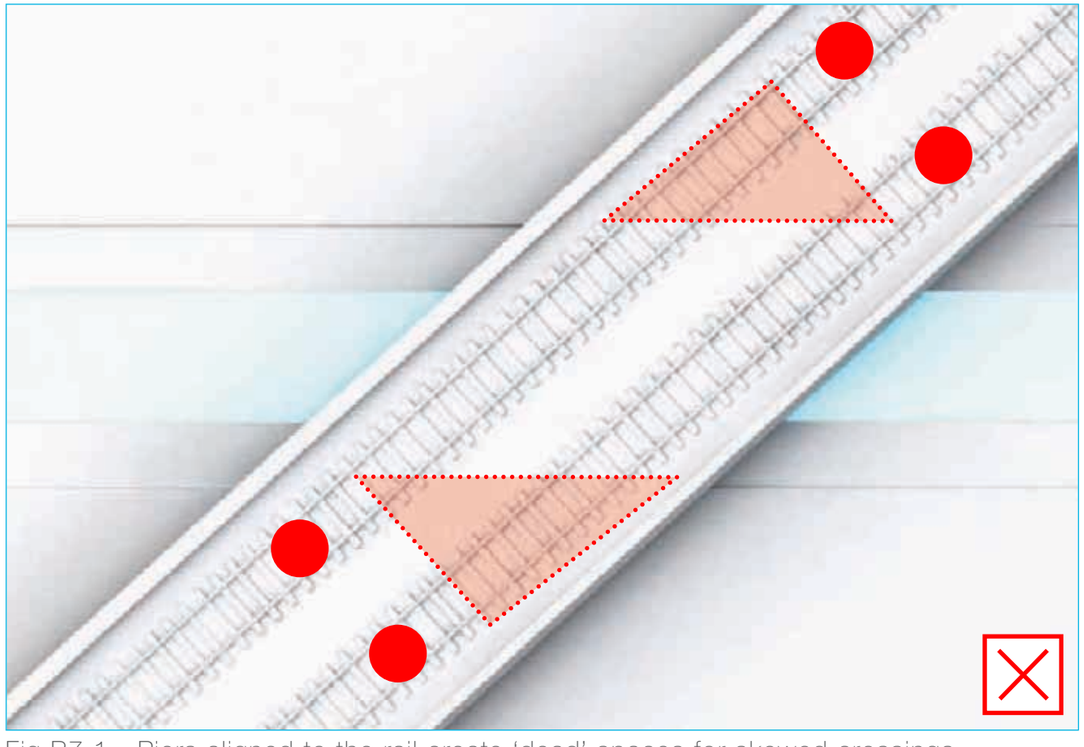

Fig.B7.1 - Piers aligned to the rail create ‘dead’ spaces for skewed crossings

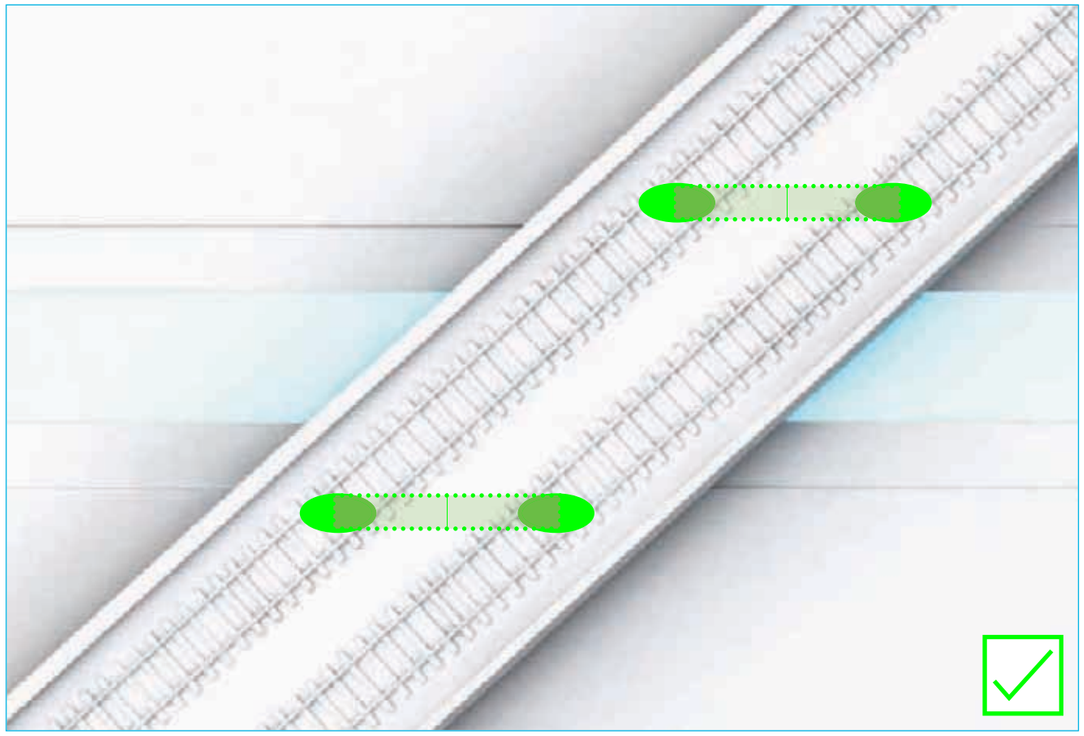

Fig.B7.2 - Piers aligned to the canal do not create ‘dead’ spaces for skewed crossings

Fig.B7.3 - Piers aligned to the rail appear heavy and obtrusive from the towpath

Fig.B7.4 - Piers aligned to the canal appear more slender from the towpath

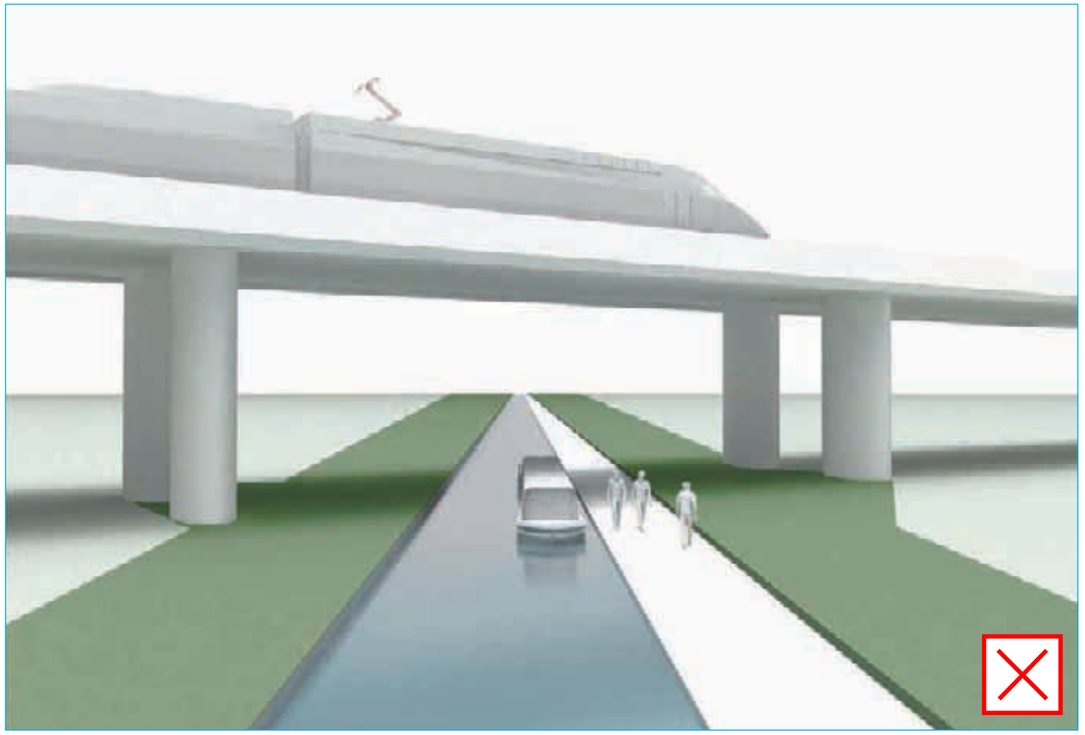

Fig.B7.5 - Piers aligned to the rail create ‘dead’ spaces for skewed crossings

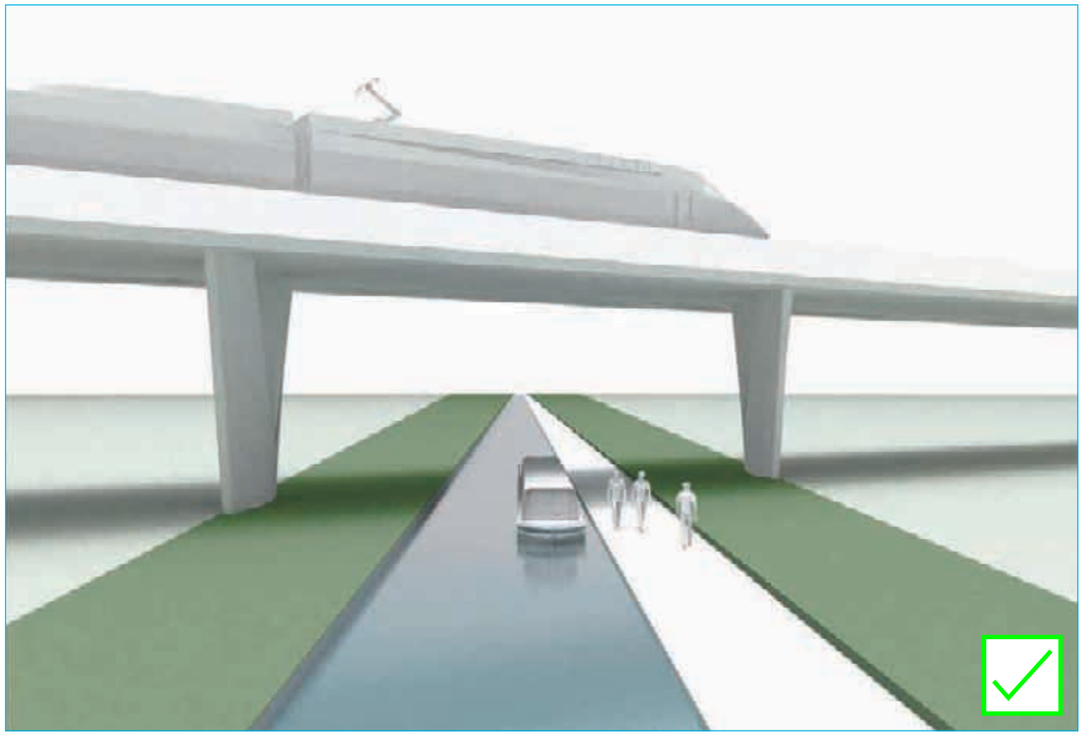

Fig.B7.6 - Piers aligned to the canal do not create ‘dead’ spaces for skewed crossings

B8 Span

Issue

Large spans created by skewed alignments and wide foundation footprints in turn create deep structural cross-sections (Fig.B8.1). This depth tends to obscure views, and does not integrate well into the waterway environment.

Response

For many crossings, achieving a minimum structural depth will prove to be the priority. In these locations, the shortest possible span will need to be sought. This should primarily be done by ensuring the alignment is as perpendicular as possible, with the piers built as close to the waterway boundary as reasonably achievable and (as mentioned previously), aligned to the water. Moreover, there may be exceptional circumstances in which the foundations may be permitted to encroach upon the waterway's land (Fig.B8.2), subject to agreement and approvals from the Trust, and provided that they remain wholly covered upon completion, and properly detailed into the canal infrastructure.

Also to be considered is the minimum widths required for the sustainable use of the waterway corridor. Both the canal and the towpath have minimum widths that must be maintained as defined by the Trust for each individual waterway. Where existing widths are greater than these minimums, the proposed widths must be remain no narrower than existing.

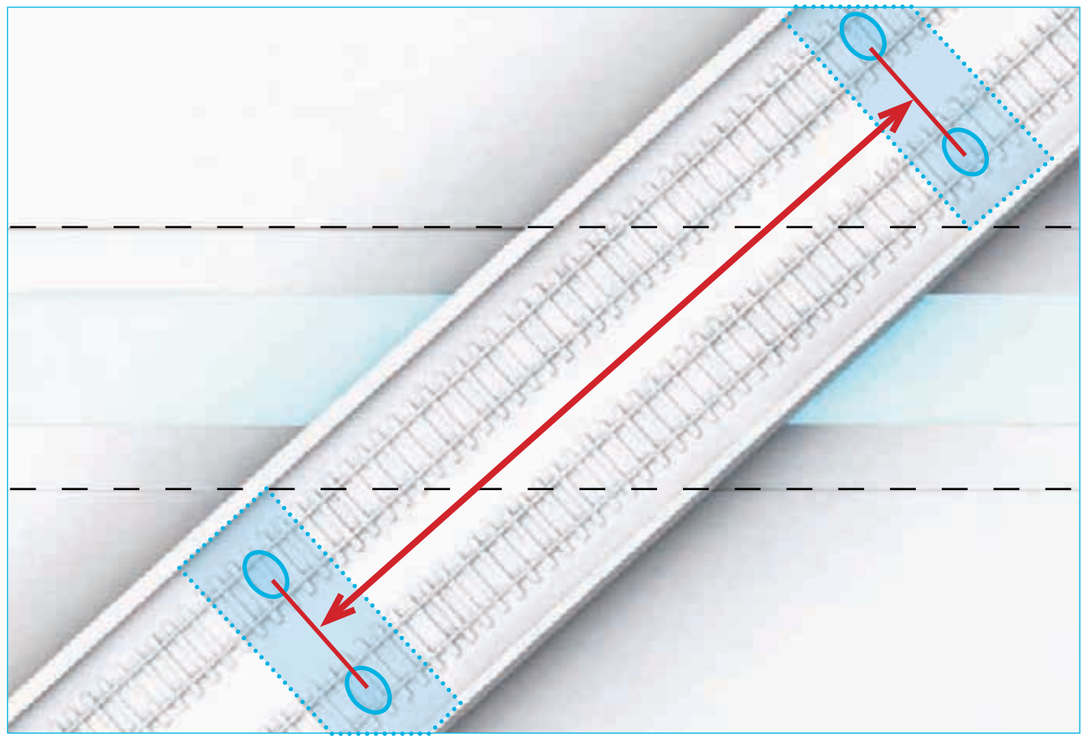

Fig.B8.1 - Piers aligned to the rail increase spans

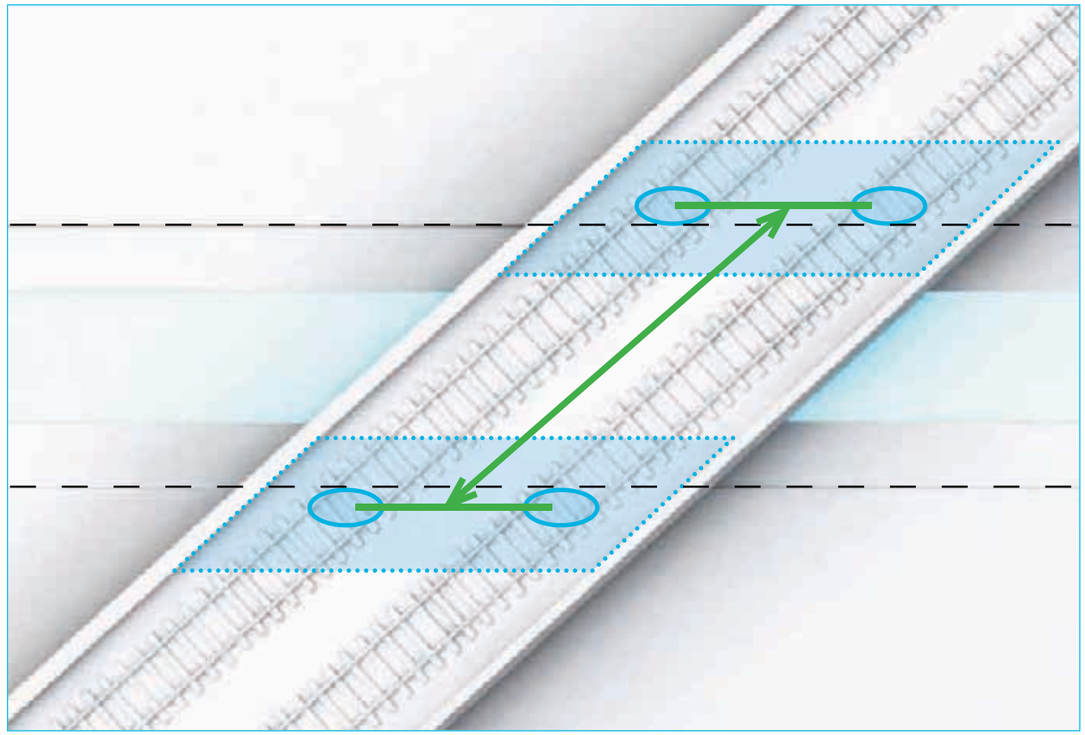

Fig.B8.2 - Piers aligned to the canal reduce spans

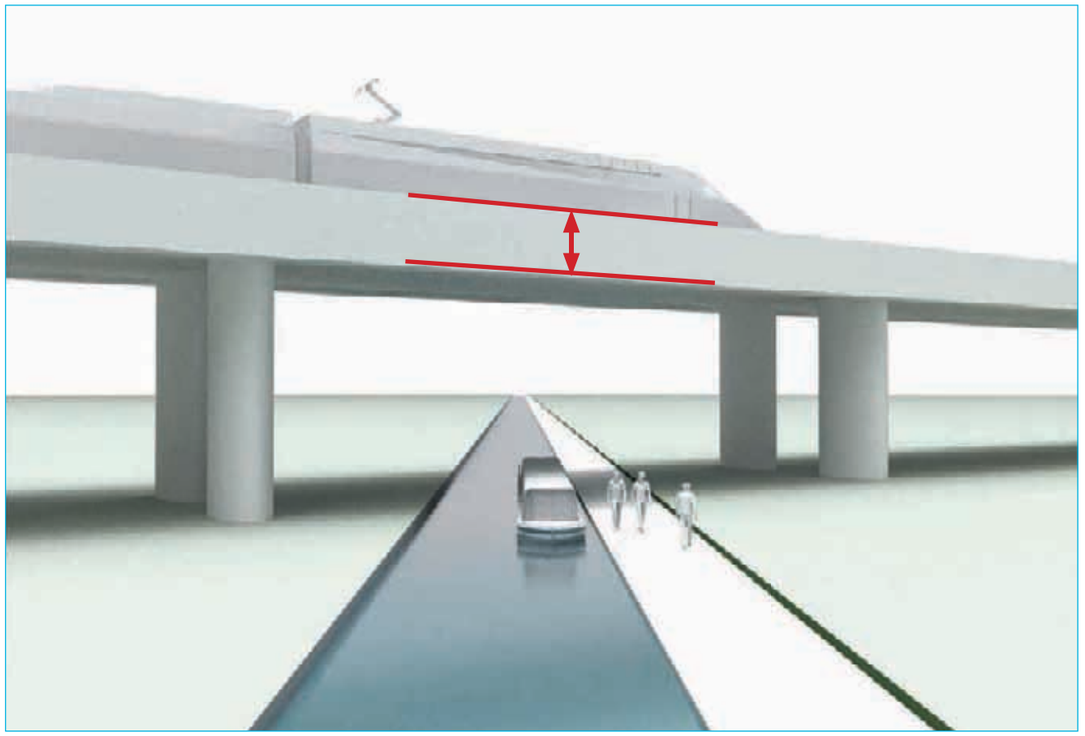

Fig.B8.3 - 'ncreased spans results in increased structural depths

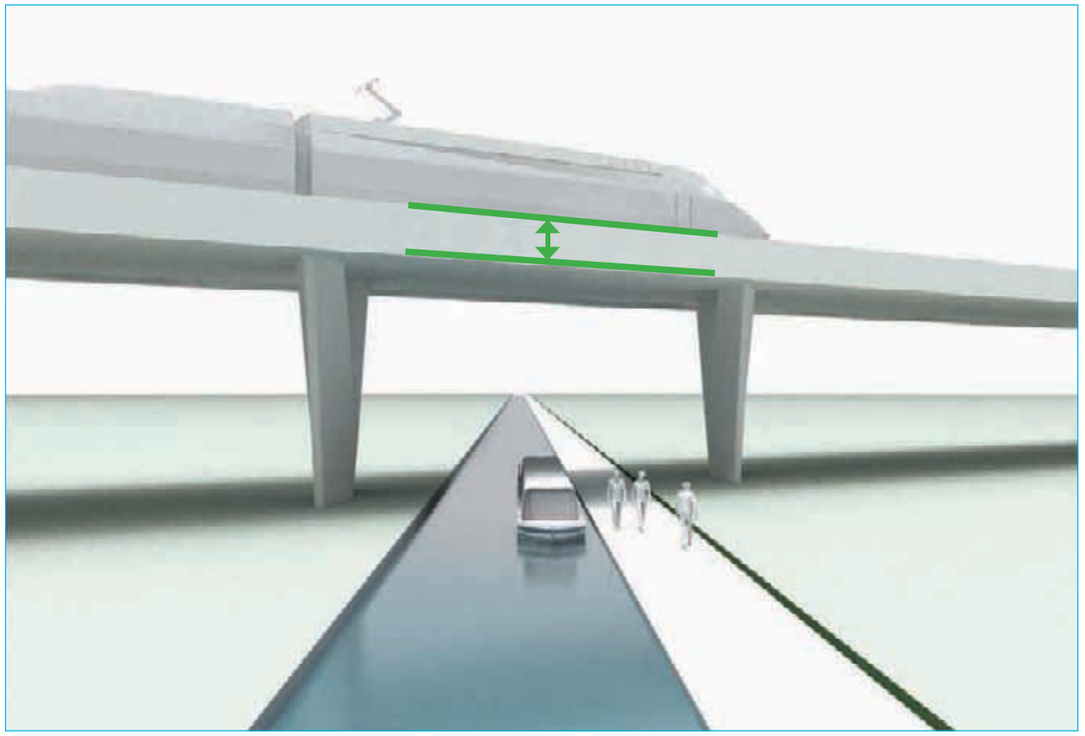

Fig.B8.4 - Reduced spans results in reduced structural depths

B9 Abutments

Issue

Even where abutments are set back from the waterway environment, their significant size will impact upon the appearance of the canals.

Response

B9.01 Wing Walls

Large areas of concrete read as bright, unnatural surfaces, which do not sit comfortably in rural environments and weather poorly. Wing-walls as illustrated in Fig.B9.1 increase the amount of concrete further, and as such are not acceptable.

B9.02 Abutment treatment

Sloped abutments with riprap finishes appear as a softer, more natural element in the landscape and are preferred (Fig.B9.2).

B9.03 Exposed Concrete

Where large areas of exposed concrete are visible from the waterway environment (for example in vertical abutment walls) carefully selected, appropriate textures should be applied in order to break up the surface.

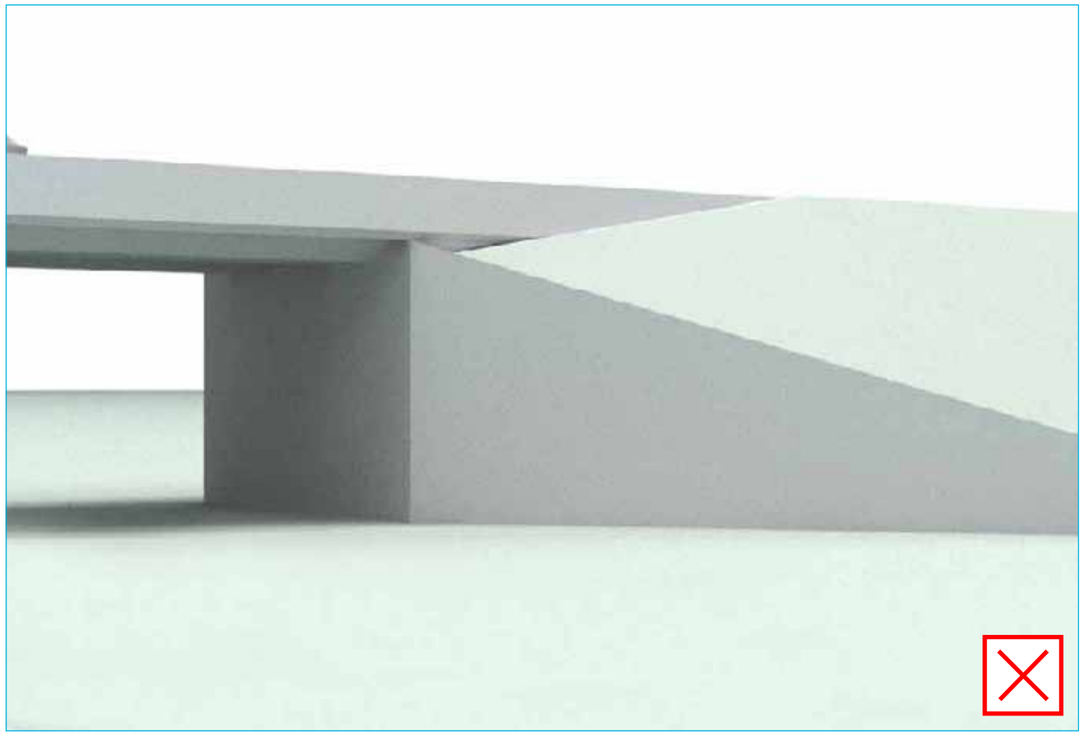

Fig.B9.1 - Wing-walls create excessive areas of unsightly concrete

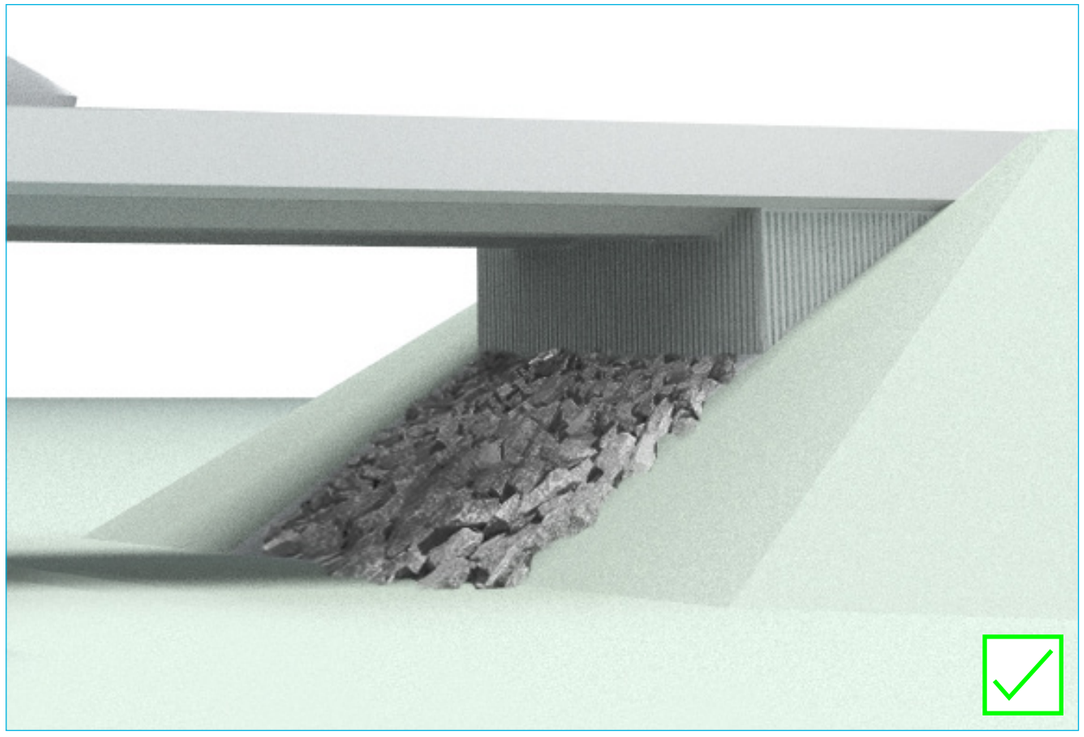

Fig.B9.2 - Riprap and textured concrete with sloped embankments blend well into landscapes

B10 Embankment Edge

Issue

Often, the raised HS2 line will be viewed against the sky, and as such the clean line of a parapet reads as an obvious and severe intervention into a natural setting (Fig.B10.1).

Response

Where an embankment is used, and is visible from the canal, a ‘soft-top edge’ should be created. This natural green edge should be created by carrying the embankment up to the top edge of the parapet (Fig.B10.2)creating a more natural edge to read against the backdrop of the sky.

The slope of the embankment should be shallow enough to ensure that vegetation will naturally grow on its banks, without the need for retaining measures.

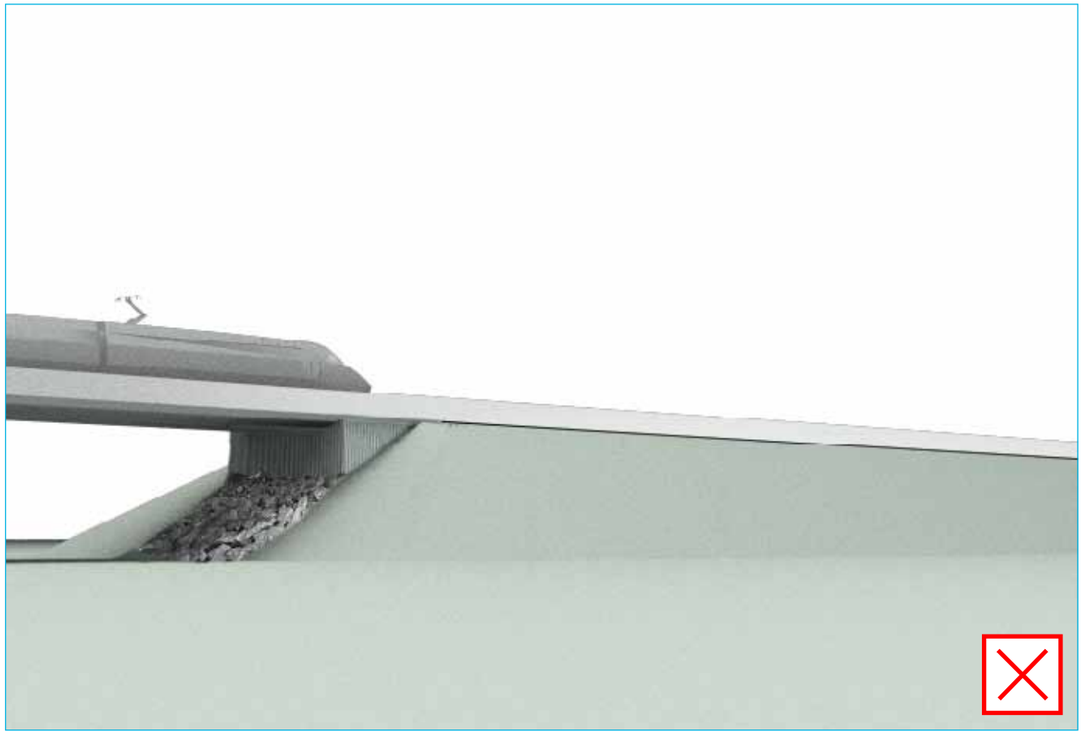

Fig.B10.1 - Hard top edge is obvious against the background of the sky

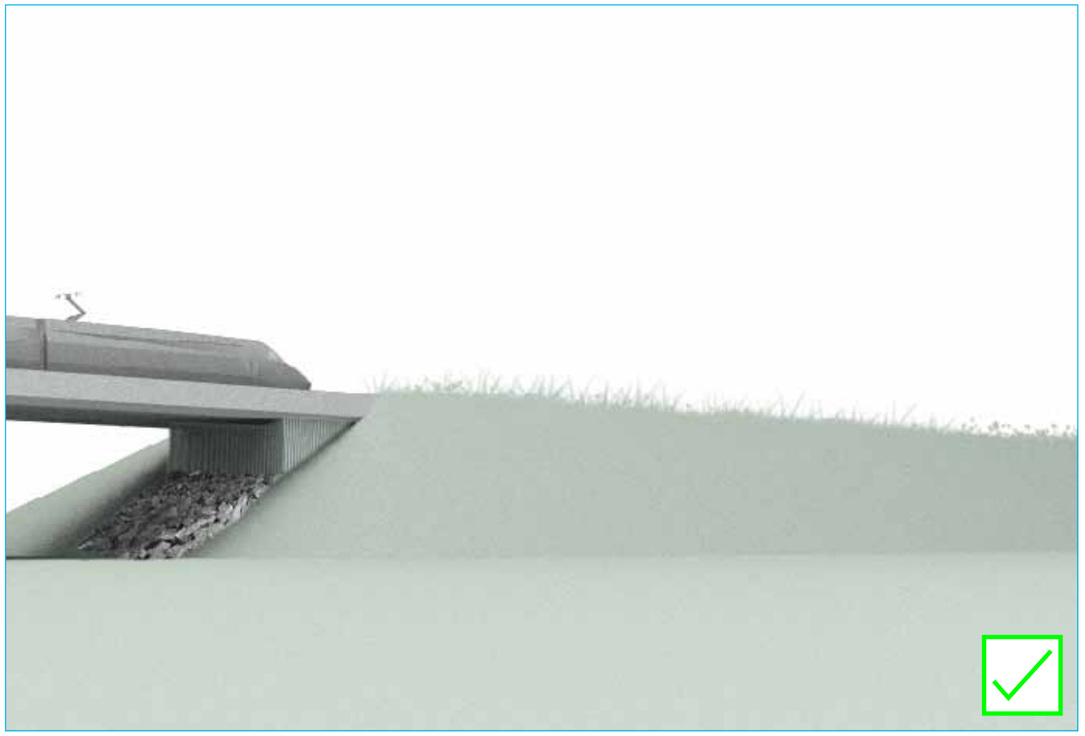

Fig.B10.2 - Soft top edge is blends well into the background of the sky

B11 Parapets

Issue

As illustrated in Fig.B11.1, a vertical, flat edge condition creates a large, heavy and dark profile, which tends to exaggerate the already significant depth of the structures.

Response

B11.01 Edge

By creating a ‘crease’, and inclining the upper face of the parapet, as illustrated in Fig.B11.2, the apparent depth is minimised. The inclined face also catches the light, which brightens the surface and further reduces the visual ‘weight’ of the structure.

B11.02 Cantilevers

Edge cantilevers are required, which will ensure that the deck spine is cast into shadow, reducing apparent depth of the structure. Parapets should also include drip details and other features to ensure that surfaces below are protected from staining. Outer surfaces of parapet string courses should receive a uniform finish that is maintained throughout and is coherent between parapets that are of solid concrete.

B11.03 Detailing

Parapets should be at a consistent height and appearance over each waterway crossing. Parapet junctions elsewhere should be carefully detailed to ensure a visually smooth transition that is visually integrated with the structure and preserves a uniform edge condition.

Fig.B11.1 - Rectilinear edge condition creates heavy appearance

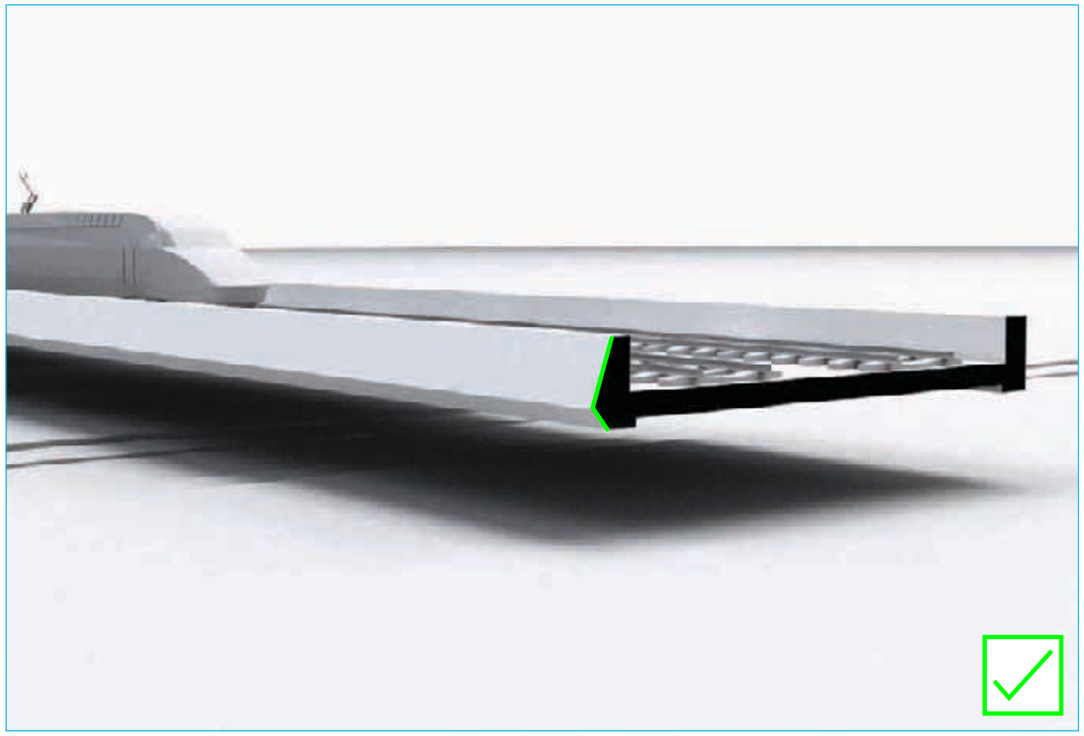

Fig.B11.2 - Chamfered edge condition creates slender appearance

B12 Foundations

Issue

Detailing of the piers will have a significant impact on the perceived quality of the waterway environment. Details that will not be seen from the railway will be very obvious from the perspective of the canal users.

Response

Pile caps and pad foundations should not be visible above ground (Fig.B12.1). Surface finishes should be taken all the way up to the face of the pier or abutment to so that the structure seamlessly touches the ground (Fig.B12.2).

Where the pile cap is in close proximity to the canal wall, the design should be developed with the Trust to consider a holistic design linked to the wash wall.

All works subject to the Trust's approvals and defined in the side agreement.

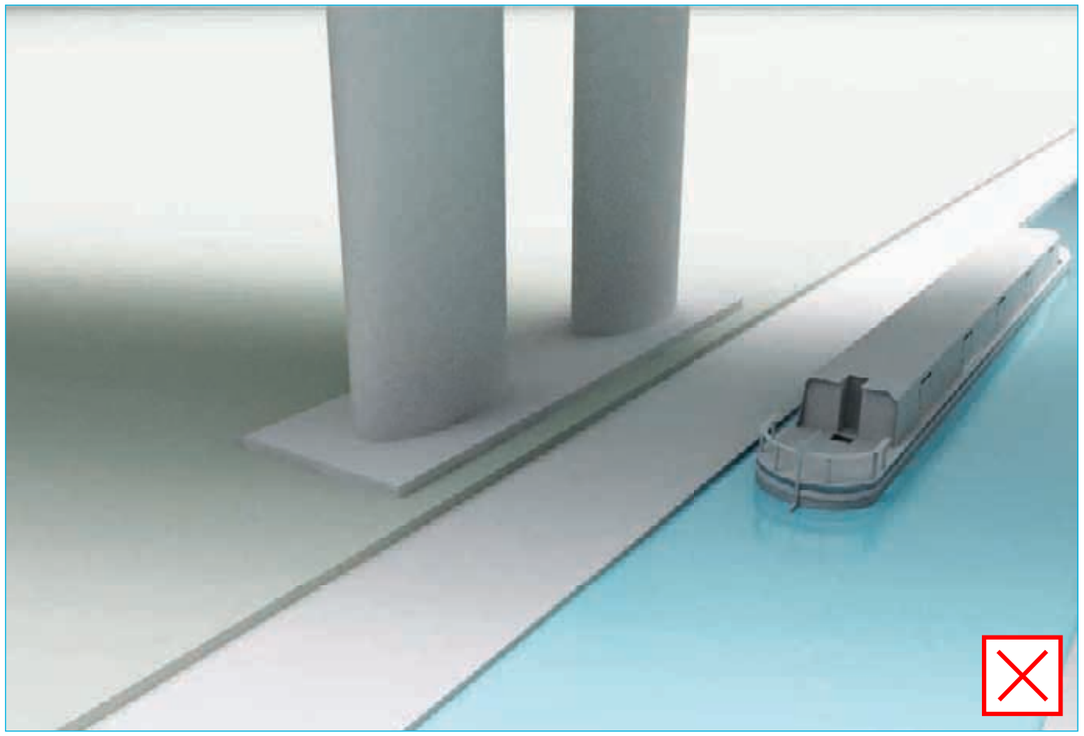

Fig.B12.1 - Visible pile caps are unacceptable

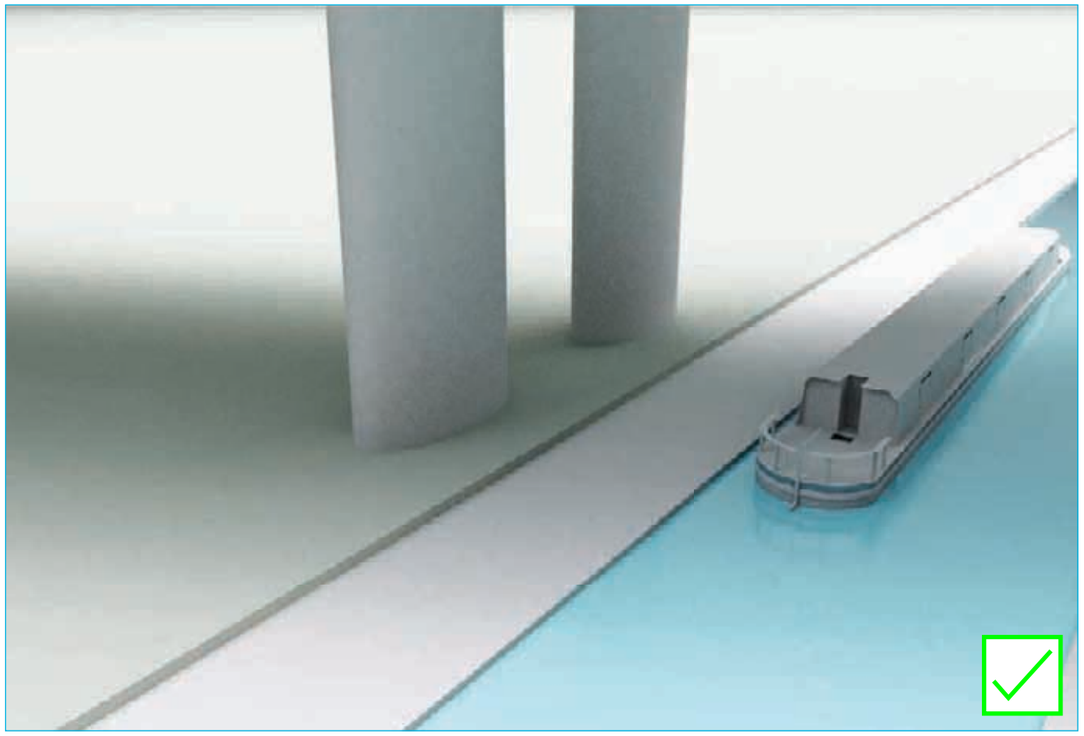

Fig.B12.2 - Piers should spring seamlessly from the ground

B13 Planting

Issue

Planting will significantly alter the visual impact of HS2. Careful planting can serve to hide, frame and even enhance views of the rail, and can ensure that HS2 sits as comfortably as possible in the wider landscape.

Response

B13.01 On-line Planting

Whilst the scheme must introduce a well designed arrangement of on-line planting as illustrated in Fig.B13.1, a linear 'screen' of trees may not appear as a natural component of the landscape, and it is likely that this alone will not be sufficient to reduce the negative visual impact upon the waterway environment.

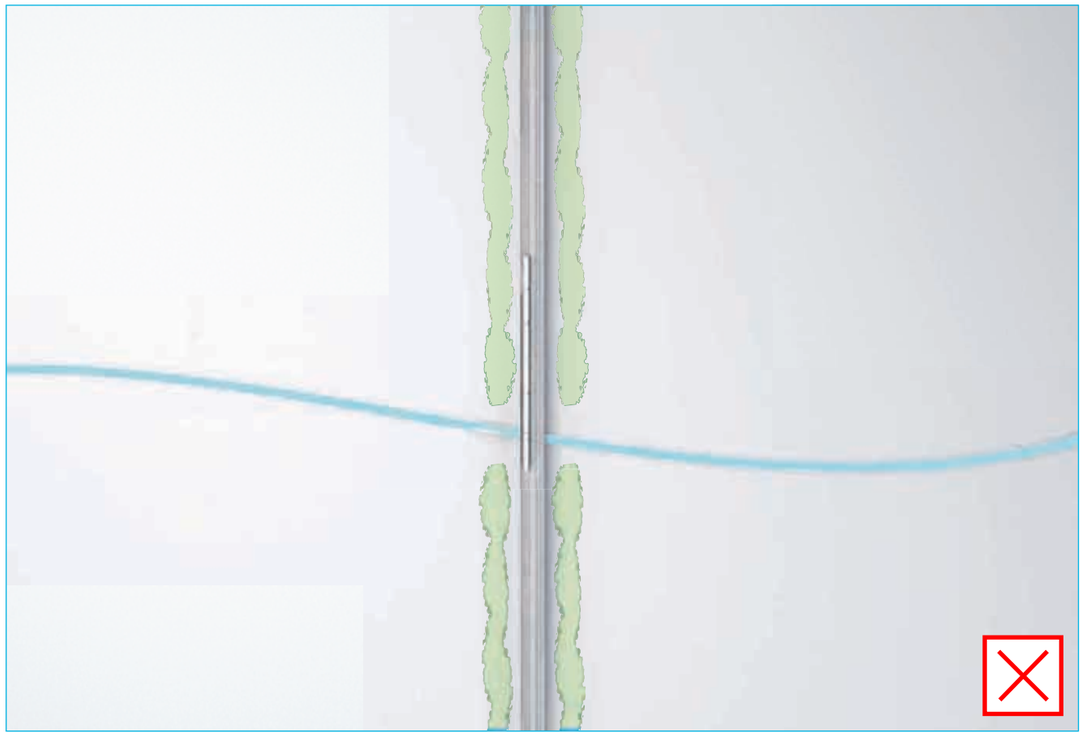

Fig.B13.1 - On-line planting alone is not sufficient

B13.02 Strategic Planting

Over and above the on-line planting that must be provided, it is essential that additional landscaping and planting is carried out at strategic points along the canal's visual envelope. As Fig.B13.2 shows, carefully designed off-line planting can go a long way to screen and compliment the line of HS2 across the landscape. Even small, well placed copses of trees help to frame views, and focus the eye on the canal, and benefit local biodiversity.

Species selection is critical, and must not be simply selected from a generic palette. Local planting strategies must be developed at individual locations, to ensure local appropriateness in terms of habitats and landscape character. Consideration to be given to enhancing the biodiversity of the waterway corridor.

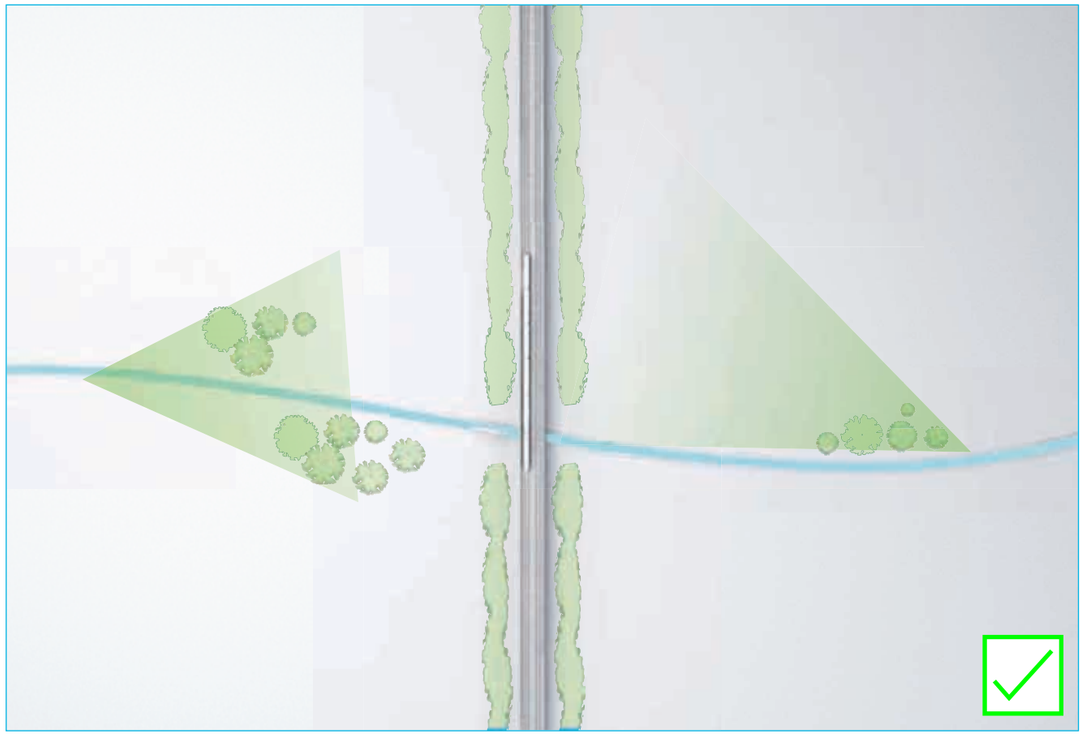

Fig.B13.2 - Strategic off-line planting frames views

B13.03 Below Deck Planting

The width of the HS2 structures will potentially cast the areas below the deck into heavy shadow and prevent natural light and water to penetrate. As a result they prove inhospitable places natural vegetation (Fig.B13.3).

Whilst in urban environments hard landscaping is likely to be an appropriate below-deck solution, in rural settings this is unlikely to be the case. Measures to permit natural vegetation to extend as far as possible underneath the crossings should be taken (Fig.B13.4). These measures could range from reducing the deck width, increasing its height, or possibly providing a split deck so as to create a central light well.

Allowing vegetation to flourish around the structures helps to maintain the continuity of the natural environment.

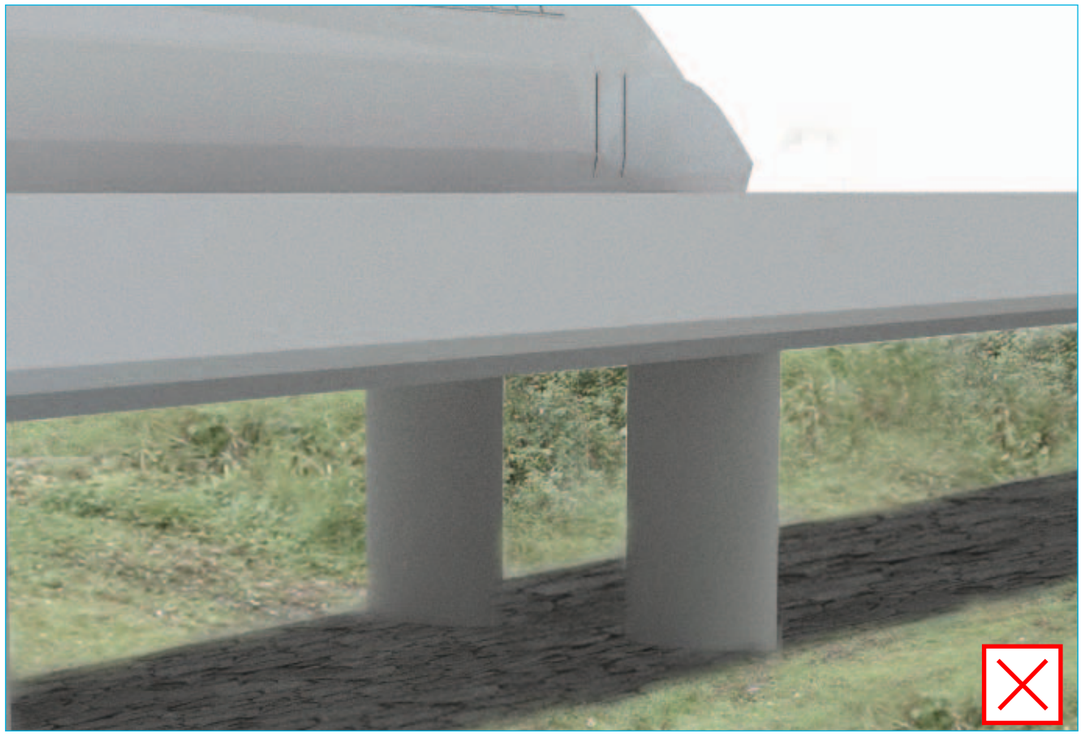

Fig.B13.3 - Large areas of abutment appear unsightly

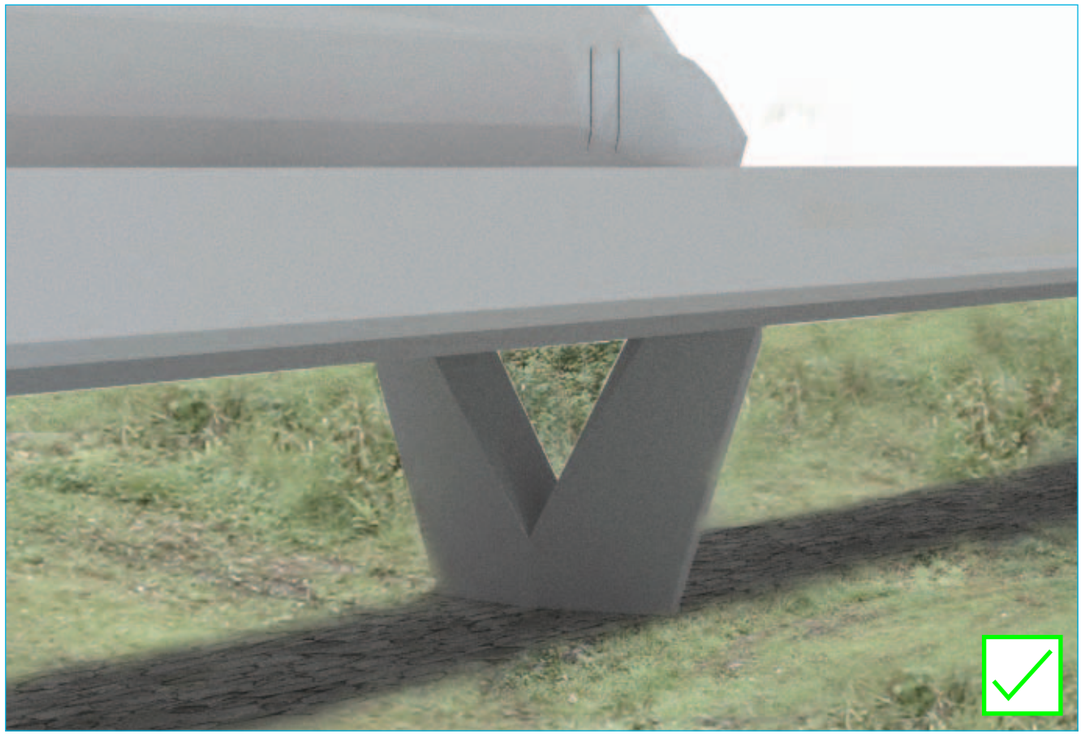

Fig.B13.4 - Permitting natural vegetation to encroach slightly is more suitable

B14 Railway ‘Furniture’

Issue

Over and above the impact of the structural crossing itself, the additional ‘furniture’ elements required for the operation of HS2 will greatly affect the visual environment of the waterways (Fig.B14.1).

Response

Care must be taken to ensure that these elements are considered as integral components of the crossing’s composition. They must appear as coordinated items, so as to minimise their negative visual impact. Simple, elegant design is likely to endure and should not date quickly.

B14.01 OLE Gantries

Where possible, OLE gantry locations should be coordinated in both symmetry and rhythm with the crossings so as to minimise their negative visual impact on the waterway environment. Aligning the railway ‘furniture’ (such as the gantries) with the span, ensures that the crossings appear well considered as shown in Fig.B14.2. Where opportunities are available to hide the gantries from the visual envelope of the waterways, (behind vegetation in ‘focused’ scenarios for example) this would be preferable.

The design and colour of this equipment is required to be consistent, and carefully considered so as to minimise its negative visual impact. It will likely be necessary to improve upon current OLE design standards.

B14.02 Signage and Signalling

Other railway furniture such as signage and signalling should be designed in the same manor; well co-ordinated, minimalist, and where possible located away from waterway crossings. Column mountings should remain inboard of the face of the parapet string course – blisters or similar must not be employed on the parapet face.

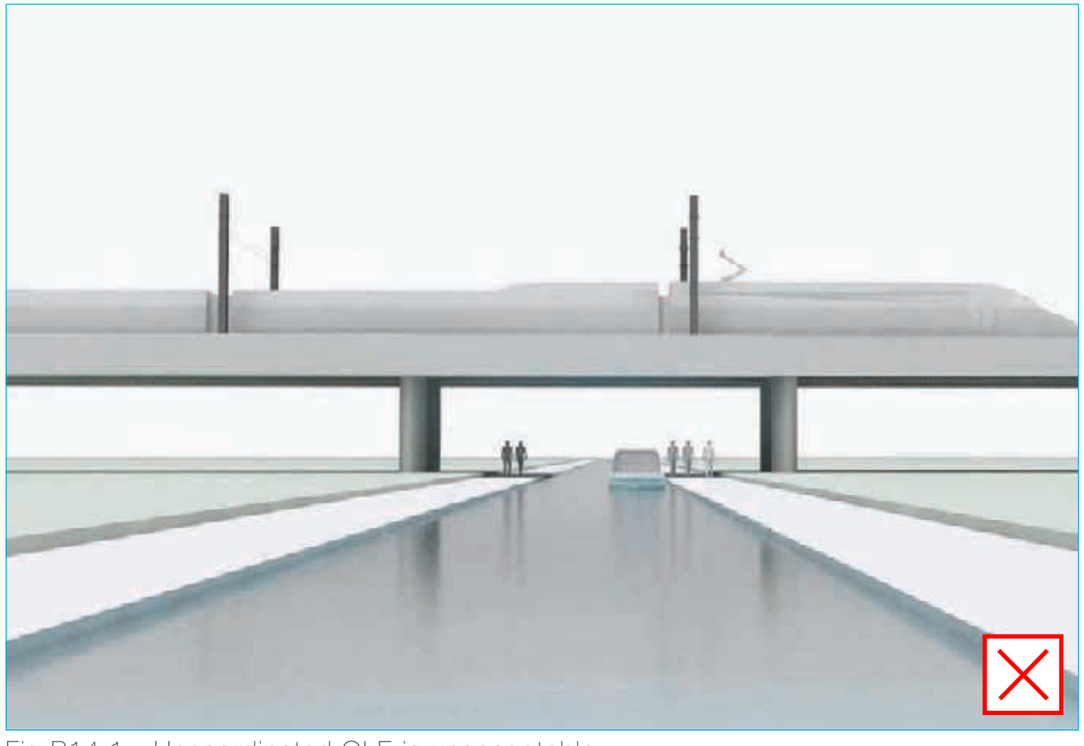

Fig.B14.1 - Uncoordinated OLE is unacceptable

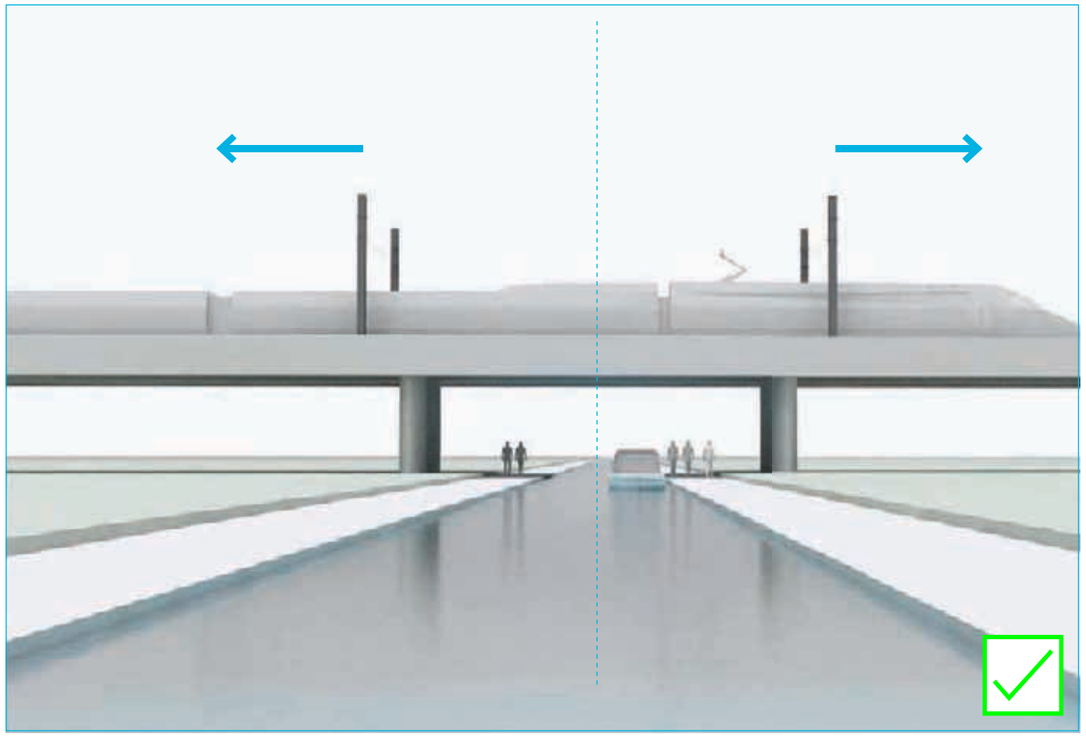

Fig.B14.2 - Well coordinated OLE appears well considered

B14.03 Acoustic Barriers

Crossings must be dealt with on an individual basis, as in certain areas the negative visual impact of the noise barriers themselves may outweigh the benefits of the reduction in noise which they provide (Fig.B14.3).

The design, materials and appearance of the acoustic barriers must be carefully considered to suit the specific landscape setting. Where used, barriers should be carefully designed for robustness, durability and appropriate materials. Acoustic barriers (and any other variant of edge furniture) must be designed within a common language to maintain consistency of appearance. In all cases, it is important that they are designed to suit the particular structure and employ appropriate finishes.

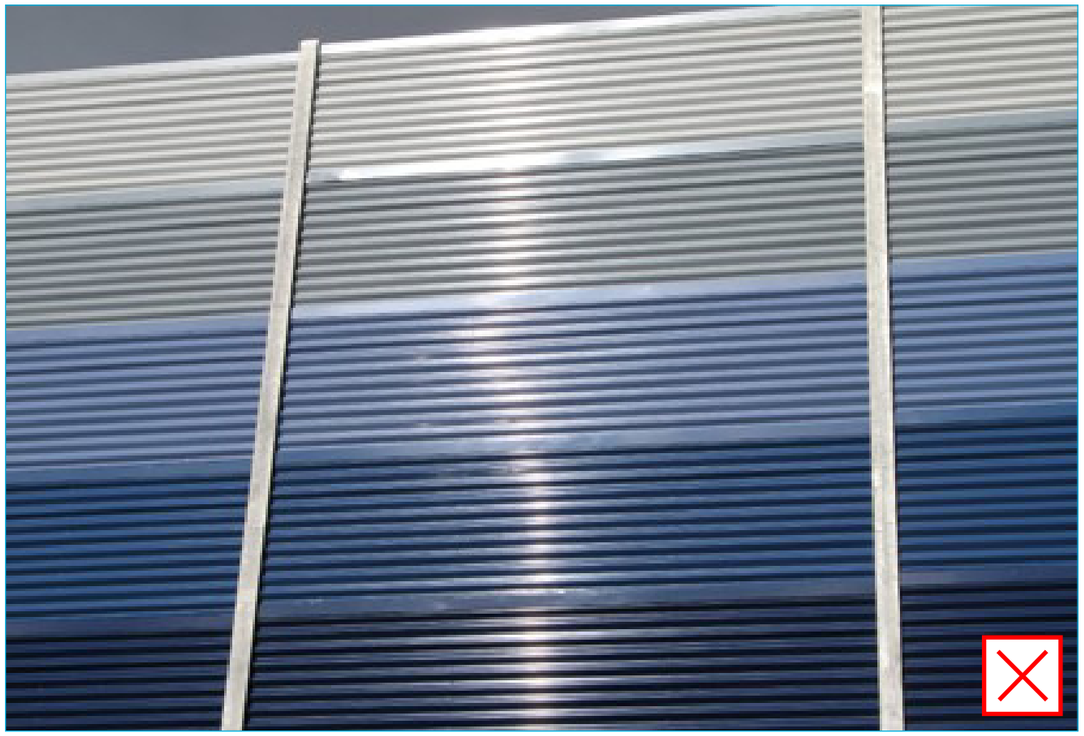

Fig.B14.3 - Opaque, coloured acoustic barriers are overly obtrusive

B14.04 Security Measures

Security measures such as fencing, gates and other items associated with the HS2 line will have a detrimental impact on the enjoyment of the waterways. It is therefore critical that an appropriate waterside fencing system and arrangement is carefully designed and agreed around each individual waterway crossing. The objective must be to minimise the visual impact of the fencing, by locating it discreetly or by selecting an appropriate waterway fencing solution.

B14.05 Other Furniture

Poorly located service boxes and other furniture will negatively impact upon the waterway corridor (Fig.B14.4) and should be located neatly, out of sight.

Fig.B14.4 - Service boxes should not be visible from the waterway environment

B15 Materials

Issue

Whilst along much of the route, HS2's material finishes may be hidden from view, where it crosses the waterways the structures will be viewed at a close distance. The quality of the finishes achieved (both initially and over time) will significantly affect the perceived quality of the surrounding waterway environment (Fig.B15.1).

Response

The quality of the finishes which fall within the visual envelope of the waterways should be commensurate with that of structures in a high-quality pedestrian environment, rather than that of a rural railway one.

Fig.B15.1 - Poor quality, stained concrete is unacceptable

B15.01 Concrete Quality

All visible concrete shall be Class F3. This requires that the resulting finish shall be smooth and of uniform texture and appearance (Fig.B15.2). The formwork lining shall leave no stain on the concrete and shall be so joined and fixed to its backing that it imparts no blemishes. It shall be of the same type and obtained from only one source throughout any one structure. The Contractor shall make good any imperfections in the finish. Internal ties and embedded metal parts shall not be used.

B15.02 Concrete Colour

Patterns and staining from formwork on large areas of exposed concrete should be avoided. Concrete colour should be light grey. Ordinary Portland Cement mixes produce a beige colour that appears unsightly over time. GGBS cements not only provide a considerable reduction in embodied carbon, but also provide a lighter 'greyer' concrete which is more visually appealing, and as such GGBS-based concrete would be a preference.

Fig.B15.2 - Well detailed, uniform concrete creates a high-quality environment

B15.03 Texture

As illustrated in Fig.B15.3, texture may be applied to concrete surfaces. This serves to provide scale and interest, create contrast, and break up large surfaces.

B15.04 Structural Steelwork

Structural steel should be of a consistent design, and used where appropriate. Excessively large steel structures appear unattractive and are not commensurate with the pedestrian environment of the waterways. Subtle patterns can help to make larger steel sections more appropriate for a high-quality pedestrian environment (Fig.B15.4).

B15.05 Steelwork Colour

When a painted finish is to be used it should be selected from a palette of colours that is used throughout the project which have been carefully selected to be compatible with each other, as well as the varied environments in which they will be used. One alternative to painted steel is weathering steel, which offers significant maintenance benefits, as well as producing a finish that blends well with the natural environment (Fig.B15.4).

Fig.B15.3 - Textures and shadow gaps mask joints and reduce visual mass of concrete

Fig.B15.4 - Weathering steel can form a positive element of a pedestrian environment

B16 Detailing

Issue

Where HS2 crosses the waterways the structures will be viewed at a close distance. The quality of the detailing will impact greatly upon the perceived quality of the surrounding waterway environment. Details which fall within the visual envelope of the waterways should be commensurate with that of structures in a high-quality pedestrian environment, rather than that of a rural railway one.

Response

B16.01 Crossheads

Visible crossheads over the top of the piers interfere with the visual continuity of the soffit, and clutter the lines of the structure as shown in Fig.B16.1. It is preferred that they are incorporated within the overall depth of the deck.

Fig.B16.1 - Visible crossheads clutter the view of the soffit

B16.02 Joints

Horizontal construction joints should be avoided, and where possible, piers and columns should be poured full-height. If construction joints are unavoidable, they should be carefully concealed with appropriate detailing. Where movement joints are essential, they should be properly detailed in a similar way, so as to be both carefully concealed, and prevent the passage of moisture. The position of joints and other interfaces should be coordinated between neighbouring elements and generally concealed.

B16.03 Soffit

A high-quality soffit design is essential in order to make the experience of viewing, or passing underneath the HS2 structures as appealing as possible. Plain, continuous soffits are preferred, designed and constructed as an integral element of the crossing.

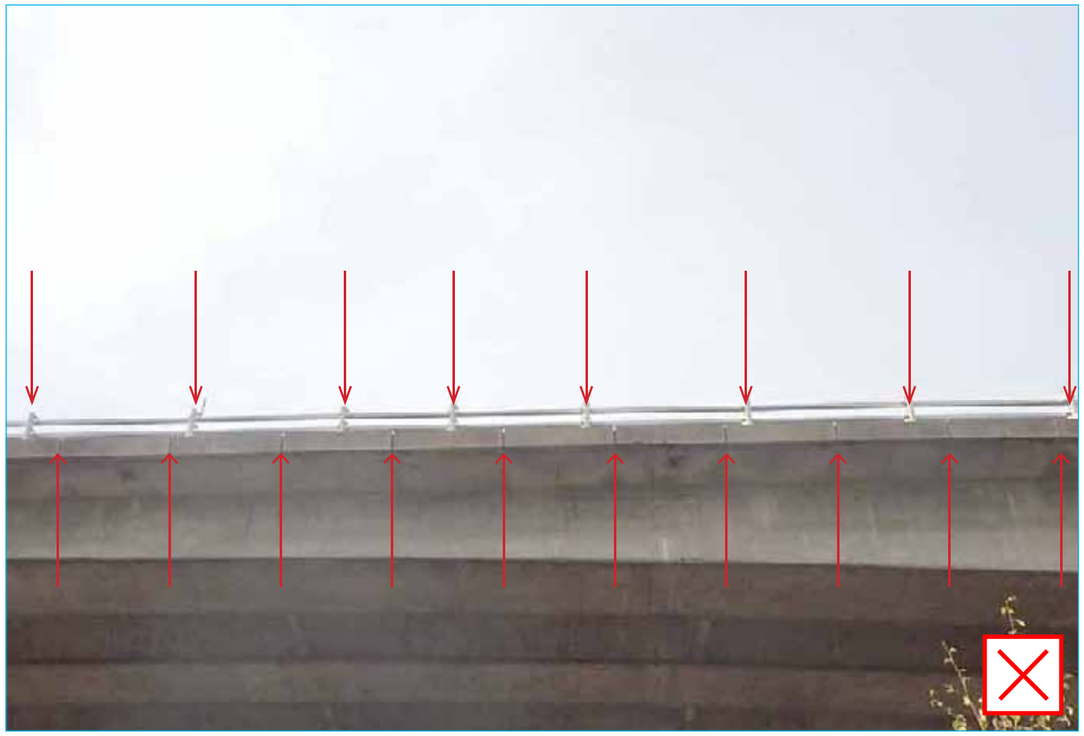

Fig.B16.2 - Poorly coordinated elements appear ill-considered and unsightly

B16.04 Rhythm

Where multiple elements (such as piers or joints) are present, their location should be carefully considered so as to achieve a consistent ‘rhythm’ of elements, poorly co-ordinated elements reduce the apparent quality of the structure (Fig.B16.2).

B16.05 Continuity

Visual continuity of the structure is very important. The eye should be taken seamlessly along the structure with no interruptions such as protrusions, joints, material inconsistencies or ‘kinks’ that would interrupt the line.

B16.06 Drainage

All surface drainage must be dealt with in a closed system that discharges remotely from the structure. If necessary, any below-deck drainage elements such as down-pipes should be located away from pedestrian-facing surfaces, and incorporated smartly into the structures, so as to minimise their negative visual impact (Fig.B16.4). Concrete should be detailed so that free water does not run down the faces, which would lead to staining. Poorly detailed drainage can also lead to leaking onto the towpath, which creates a dangerous and unattractive environment beneath the crossings (Fig.B16.3).

B16.07 Services Integration

All cables, ducts and other services must be concealed from public view along the towpath. Services running vertically must be neatly and carefully detailed so as to integrate them within the structures in a discreet and intentional way. Services running horizontally must be entirely hidden from view, and concealed in the soffit with careful detailing.

B16.08 Birds and Bats

The detailing of all structures must prevent the roosting, perching or nesting of birds or other wildlife. This detailing should be an integral part of the structural design, as opposed to a proprietary roosting-prevention addition, which seldom work, and appear unsightly.

Fig.B16.3 - Poor drainage details impact on the towpath beneath

Fig.B16.4 - Poorly designed drainage appears ill-considered and unsightly

B17 Waterway Elements

Issue

The canals and rivers are well used environments. In addition to the preservation of the waterway's aesthetic, its function must also be protected. The following outlines the practicalities that must be achieved and maintained at HS2 crossings:

Response

B17.01 Towpath

The towpath must continue uninterrupted beneath the crossings. Where a made towpath exists to either side of the crossing, the surface of the new towpath must match that of the existing area.

Where a bridge is to be built over an unmade towpath, formed of earth and natural vegetation, this is unlikely to survive. As such a made towpath must be provided (Fig.B17.1). The extent of this towpath should extend to a point to be determined at each crossing. In certain circumstances it may be appropriate for the made towpath to stop immediately at the face of the bridge crossing, yet in other areas obvious 'tie-in' points may be utilised in order to maintain the continuity of the waterway environment. Refer to the Trusts' HS2 Technical Appendices.

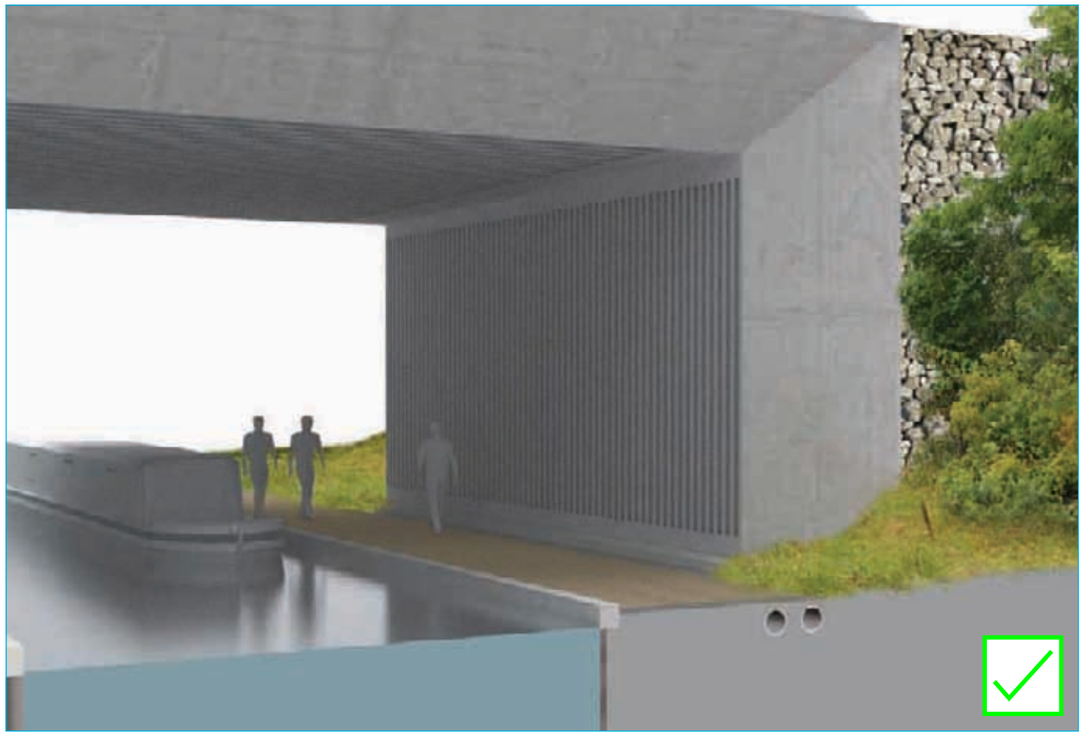

Fig.B17.1 - Typical towpath makeup

B17.02 Ducting

Suitable ducting should be incorporated Into the make-up of the replacement towpath, running along the 'outer edge' of the waterway environment (Fig.B17.1).

B17.03 Moorings

Where HS2 crosses established moorings, alternative moorings must be provided both during construction and in operation. It is likely that the usage of moorings underneath a high-speed crossing will be negatively impacted, and as such in certain locations it may be appropriate to re-locate the moorings elsewhere.

In all locations waterways should be treated as a residential environment, as transient boaters may use sites for residential amenity.

B17.04 Lighting

Wide, low bridges create unattractive and even unsafe areas beneath them. All HS2 bridges across the waterways are to undergo a lighting assessment in order to determine the most appropriate lighting solution for the area. This may range from no lighting at all (and will likely be the case at most rural crossings) through to controlled lighting systems which ensure a safe and enjoyable pedestrian environment is maintained. Moreover, lighting ‘installations’ may be appropriate in certain areas, allowing local artists and communities some interaction with the structures. In all circumstances an appropriate maintenance and management strategy is required.

B17.05 Time on Site

In addition to the leisure uses of the waterways, the canals and rivers also have a residential usage. Construction noise, operation and hours should be controlled in the same way as would be suitable for construction in a residential area.

B17.06 Canal Edge

Installing a bridge over the canal edge limits the headroom required for future piling rigs and edge-maintainance. All works must be in accordance with the Trust’s Third Party Code of Practice.

B17.07 Bridge Signage

Bridges should be identified to canal users with a plaque or similar. The design of these should be developed with the Trust to identify the structure, date of construction etc. There is an opportunity to link with the use of art in the environment.

B17.08 Vandalism

Where possible, measures should be taken to reduce the likelyhood of vandalism, and mitigate the damage done if it occours. Concrete sealants and coatings can be used where deemed appropriate in order to aid its removal.

B17.09 Maintenance Access

HS2 infrastructure will require suitable maintenance and inspection access. This must be carefully integrated into the overall design principles of the crossing structure.

B18 Conclusion

This document set out a series of characteristics which must be maintained throughout the waterway environment, and broadly described the quality which the new crossings must achieve. This document establishes basic design principles which apply throughout the waterway network, and does not look at specific crossings. The design, quality, character, alignment and detail of each crossing must be addressed individually, referencing this document alongside the Trust's technical appendices to the side agreement with HS2.