Canal &
River Trust

HS2

Design Principles
for Waterway Crossings

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Introduction

The Canal & River Trust (the Trust) cares for over 2,000 miles of waterways in England and Wales. The Trust believe that the design and construction of the HS2 line should showcase the very best in contemporary architecture and engineering, creating structures that contribute positively to the multiple layers of transport history that are evident throughout the canal corridor.

The Design Principles have been developed in conjunction with the IWA, with special thanks to the IWA's HS2 liaison members

This document has been produced by Knight Architects and the Canal & River Trust as a general recommended approach to design principles for HS2 bridge and viaduct crossings over Canal & River Trust waterways. It is not intended to serve as a detailed basis of actual design or specification for any particular location, either in the context of HS2 or elsewhere.

Purpose of this document

Fundamentally, there is a concern that HS2 will have an irrevocable, negative impact upon the waterways in its vicinity. This impact can be broadly defined in two key categories which will form the primary sections of this document:

1 - What HS2 will affect

2 - What HS2 will introduce

This document describes a series of general design principles that should be adopted by HS2 Ltd. to guide the development of HS2 design within the corridor of the waterways.

The section 'What HS2 will affect' outlines the qualities and amenities of the waterways which the Trust is tasked with protecting, which will be removed or otherwise adversely affected. HS2 will have a significant impact on the views, character, environment, scale and tranquillity that the users of the waterways currently enjoy. This section describes the key concerns of how HS2 threatens these amenities, and outlines the Trust's requirements as to how they must be protected.

The section 'What HS2 will introduce' addresses the infrastructure that HS2 will introduce to the waterway's environment. The scale, material, quality and character of the new infrastructure will have a crucial relationship with that of the existing waterways. This section outlines the constraints and requirements that HS2 infrastructure must meet, and offers guidance as to how it may best respond to the waterway environment.

Each crossing will be subject to careful individual assessment and consideration to establish the suitability of the design response to the locale. The Trust require that individual bridge designs at each crossing; reflect the character of each area, contribute positively to the waterway environment, and meet our expectations for high quality structures and spaces.

This document includes examples of structures and associated elements that illustrate what is acceptable and what should be avoided in the design of HS2 crossings. These are identified with a green tick or a red cross as appropriate for different waterside environments.

Technical design standards to be applied throughout the United Kingdom are given in the Design Manual of Roads and Bridges (the DMRB).


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Chapter A

What HS2 will affect

A1 Appeal

The waterways are home to a variety of uses including boating, cycling, walking and fishing, as well as providing a rich habitat for wildlife and plants. Of primary concern is the detrimental impact that HS2 may have on these uses and habitats. 50% of the population live within 5 miles of one of the Trust's waterways, enabling approximately 270 million visits per year. It is therefore essential that the waterways remain attractive, welcoming and beautiful places for leisure users to enjoy, and must not be adversely affected where there are HS2 crossings.

It is important to recognise that the HS2 bridges will be primarily experienced by those passing under the structures as opposed to those travelling on them. Passengers on the trains will experience most crossings for a split second through an insulated glass window, yet the users of the waterways travelling slowly by boat, foot or cycle will view them for significantly longer and in a direct and intimate manner, fully experiencing the noise and vibration of passing trains.

Those passing under the bridges can appreciate the full form of the structures within their surrounding context. As such, the users of the waterways should be provided with an environment that welcomes them rather than something that appears threatening or disconnected. This is particularly true for pedestrians and cyclists who generally have much more time to take in the structure and view it at close quarters.

A successful public realm requires the design to embrace considerations beyond the simple physical connection between two points. How the connection is expressed and presented will either encourage or deter public use.

Fig.A1.1 - Characterful locks add to the appeal of the waterways

A2 Views

The waterways are experienced in a dynamic way, by people moving through the landscape as a series of views. HS2 will have an impact on these views throughout its route. In the waterway environment, each crossing must be assessed individually, so as to ensure current views are protected, and the proposed structures are carefully integrated into their setting.

Broadly speaking, urban and rural contexts will have different priorities that must be addressed. Throughout the rural settings of the waterways, there are many expansive views and open vistas. HS2 structures must recognise this, and seek to maintain these distant views, with the structure passing through the landscape as lightly as possible. The crossings should be predominantly recessive (they will not be ‘feature bridges’) and measures to reduce their visual impact should be taken.

In urban environments distant views are often much more limited. Views are primarily at a relatively short range, and the environment is more enclosed. The structure itself becomes the focus, and must be detailed as such. Whilst in rural settings the HS2 structures will be read against a natural backdrop, in urban settings the scene is likely to already comprise of a tapestry of infrastructure. Here, the focus should be on the visual integration of this ‘layer’ of infrastructure with that of the existing.

Subsequent chapters will outline how HS2 structures may be designed to minimise their impact on the existing views.

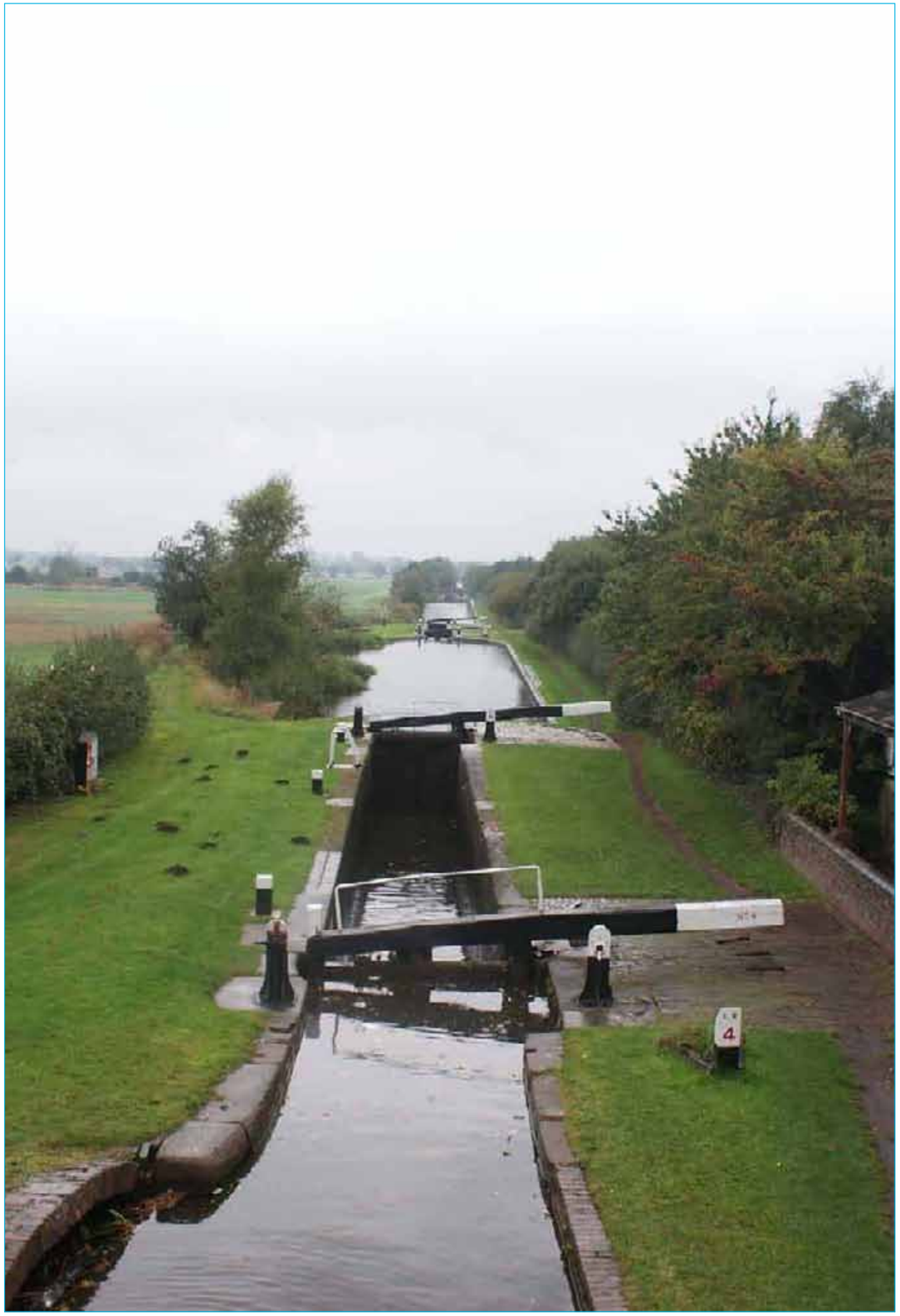

Fig.A2.1 - High-level views permit vistas outside of the waterway environment

A3 Horizon

The characteristic slow horizontal animation of the horizon against the canal is occasionally punctuated by the requirements for roads, rail lines and services to pass above. Routes through these structures should be clearly legible - it is important the pedestrian experience begins and ends where they expect it to and the whole route in between is clearly visible.

Whilst HS2 is typically kept low to minimise the wider visual impact on the landscape, distant views of the horizon are one of the most important aspects of the relatively narrow, linear waterway environment. They give context to the journey, and the landscape through which the canals and rivers pass. They allow progress along the canal, as well as changes in height to be measured.

The impact of screening HS2 from onlookers serves to further narrow the visual envelope of the canal. As such, the long views of the horizon must be protected. As you can see from the illustrations opposite, the vertical alignment of the crossing plays a significant role in the composition of the view at that point. By raising the height of the crossing, those on boats and the towpath can see the progression of their route beyond (Fig.A3.2). This helps to draw the focus beyond the rail bridge, and maintains a welcoming environment. This visual deference, framing the landscape rather than breaching the horizon, ensures that the structures will form a part of the canal environment.

As you can see from Fig.A3.1, where the horizon is obscured by HS2, the structure of the crossing itself becomes the focus, and the view for the user is greatly compromised - appearing both stunted and even claustrophobic, failing to recognise the character of the waterway.

Fig.A3.1 - Crossing obscures views of the horizon

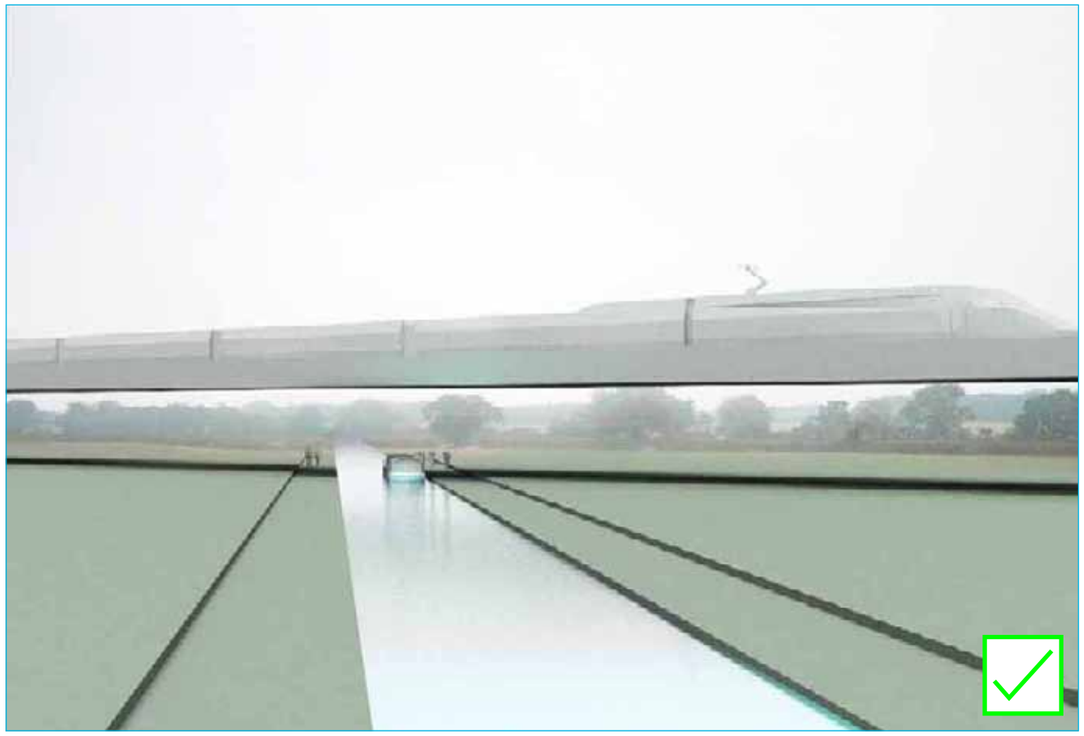

Fig.A3.2 - Crossing permits views of the horizon

A4 Character

A4.01 Sense of Place

It is essential that the railway infrastructure of HS2 should respect the urban and rural fabric of the canals and rivers it crosses so that in time it may become an integral part of them. Whilst a consistency of HS2 structures is desirable in order to achieve a uniform quality of materials, detailing, and a clear ‘route aesthetic’, the bridges will be crossing unique places of great character. Through the creative and elegant use of elevations, piers, soffits, decks, surfacing and lighting, HS2 crossings can be created that are appropriate for their setting.

For example, the characteristics of urban and rural waterway corridors are often different. This distinction needs to be considered and recognised in the HS2 structures with a design philosophy that embraces the distinctiveness of their locale, within the frame of HS2 design.

In order to emphasise this, public realm, landscaping improvements, and opportunities for public art may be carefully and selectively employed. This would need to be carried out with the involvement of local community groups, residents, the Canal and River Trust, and key stakeholders, to ensure that the improvements to the area reflect the aspirations of those who will use it the most.

Fig.A4.1 - Bridges potentially add to the character of the waterways

A5 Scale

The waterways have a specific scale; a scale of size, speed and detail. Physically the canals are detailed at a ‘human’ scale - towpaths widths, furniture, signage, boats and materials all address the users, and as such the environment is welcoming.

The speed of the waterways is also hospitable. Boats, cyclists and pedestrians all broadly share a common speed, which permits a comfortable environment for all. Where HS2 encroaches upon the canal environment, there will be a stark and severe contrast of speeds. This will have an obvious acoustic impact that must be minimised as outlined in section B14.03. In addition to the acoustic effects of contrasting scales, the visual discontinuity must also be addressed. HS2 is detailed for high-speed trains, and as such will likely feel inhospitable to users of the waterways. Structures, material quality, finishes, and detailing that are appropriate for a high-speed rail environment will almost certainly not be appropriate when viewed from a boat or a towpath at 4mph (Fig.A5.1).

Wherever HS2 structures impose upon the visual envelope of the waterways, they must be detailed so as to read as part of the waterway environment. Furthermore, care will need to be taken to ensure the proportions of the structures are considered in the context of the waterway corridor, therefore consideration needs to be given to the aesthetics derived from the relationship between span, deck depth, and pier size.

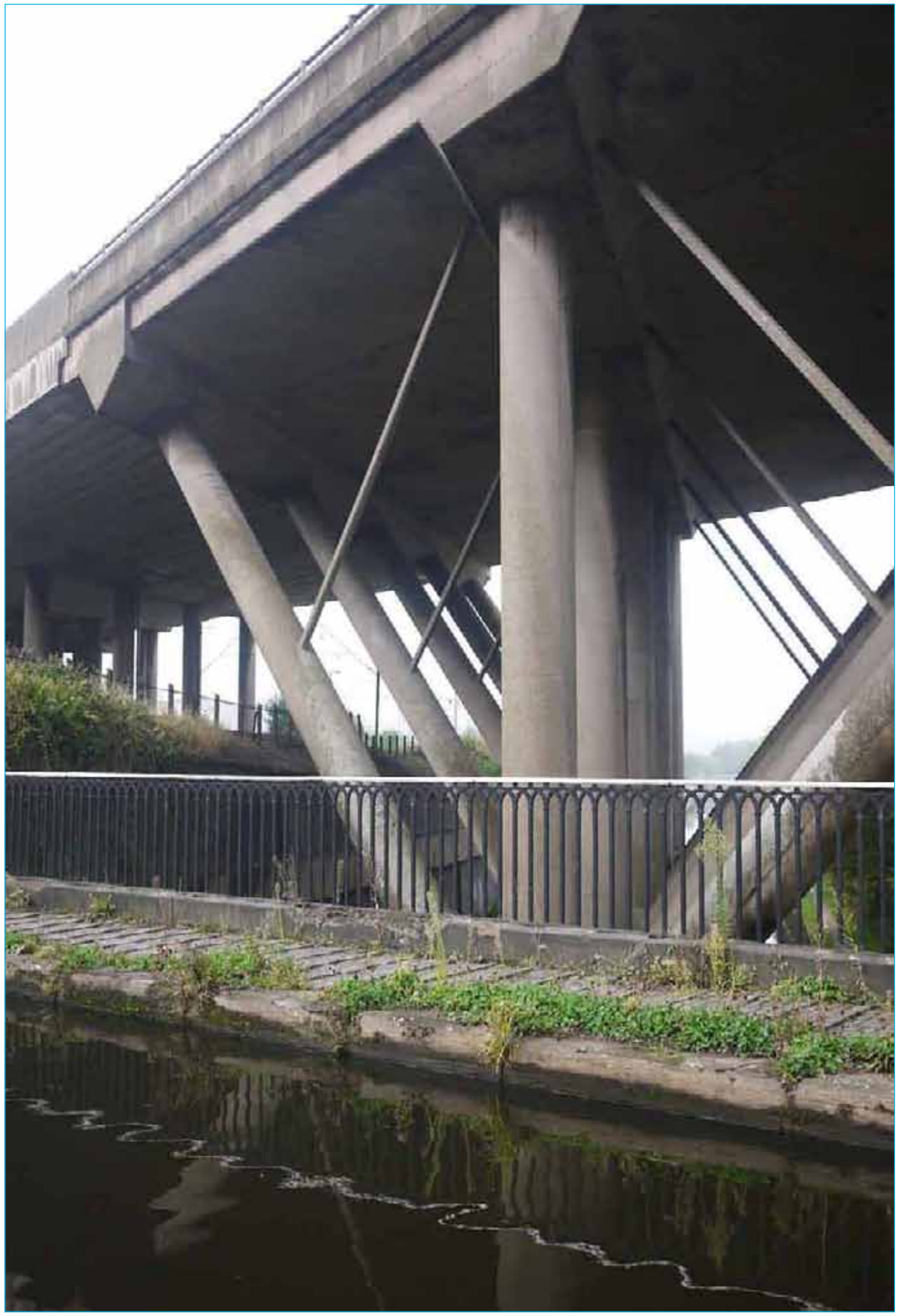

Fig.A5.1 - Modern infrastructure is often at a much larger scale than that of the waterways

A6 Tranquillity

The waterways are a peaceful environment. The tranquillity of the canals in rural areas is one of their primary attractions, and HS2 must be designed to ensure that its impact on the aural envelope of the canal is minimised.

Planting will do very little to minimise the noise of a train passing by, and so other measures must be used to reduce this impact. Even in areas that have -for example- a close proximity to a road, HS2 will bring sudden and sharp sounds that rise above the comparatively consistent background acoustics of a road.

Details of how acoustic screening may be implemented are outlined in section B14.03.

In addition to the acoustics of HS2 whilst in use, construction noise should be kept to an absolute minimum. At locations with moorings, working hours should be restricted in the same way as when in close proximity to a residential area.

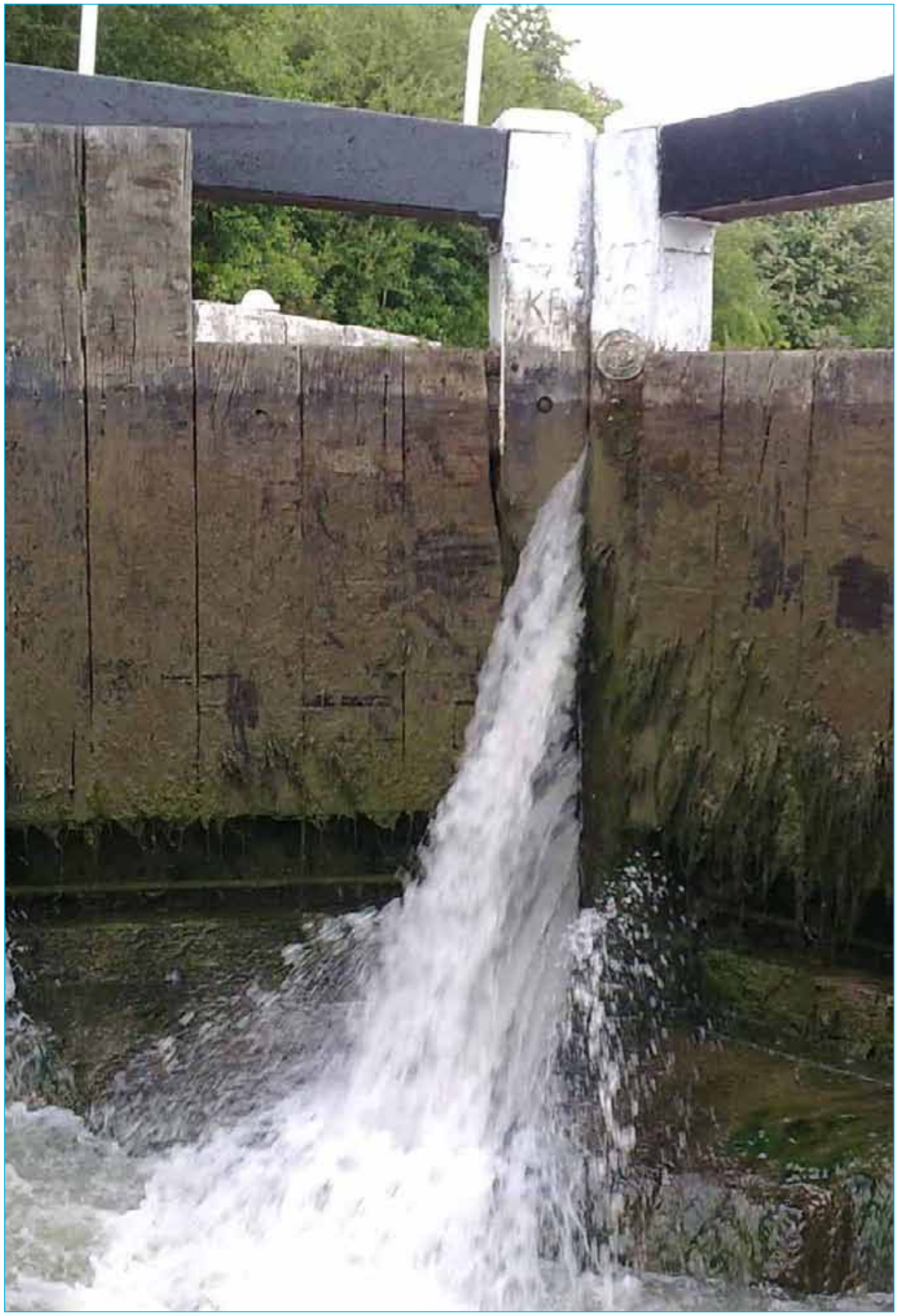

Fig.A6.1 - Tranquillity and characteristic noises add to the appeal of the waterways


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Chapter B

What HS2 will introduce

B1 Quality

Issue

Good design can be difficult to define and this can be particularly true for utilitarian infrastructure such as roads and bridges, however it is very important to consider visual and build quality for these structures because of the very long life span they enjoy. As described in this chapter, it is paramount that consideration is given to aesthetic quality and character in order to avoid poor design that can become an unwelcome addition to the waterway environment.

Response

HS2 should aim to achieve a consistent visual quality that enhances either the urban or rural environment and provides a clear waterway identity. To this end the many diverse elements of the design will be standardised, controlled and coordinated from end to end of the Project so as to ensure a high quality visual appearance. This section will describe the approach to appearance for the many elements that will contribute a unifying aesthetic design to the Project. Individual elements will be guided by applicable design standards. However, they will also be considered in relation to one another and to viewers, whether stationary or moving, so as to ensure the overarching aesthetic objective of an integrated and harmonious visual environment is met.

A consistent design approach should be taken to all waterway works associated with the project in order to ensure visual coherence.

Within the “standardised designs” approach proposed in HS2’s Draft Planning Memorandum, appropriate designs for open and focused waterway crossings should be developed.

Fig.B1.1 - High quality elements stand the test of time

B2 Relationship

Issue

HS2 will introduce a relationship between the high speed rail and the waterways, and careful consideration must be taken to ensure that it a positive one.

The waterways were once a functional and vital piece of infrastructure. As new modes of transport emerged, these were overlaid on the canal and river network, in a manner that was frequently unsympathetic to the waterways. As the logistical usage of the waterways declined, their recreational usage increased. Today, the waterways are a place of relaxation; people choose their characteristic slow-pace and tranquillity as one of retreat from that of an increasingly speedy world.

Response

Slow is a quality that must be protected, and the need to do so has never been more apparent than with the addition of HS2. The relationship between these two layers of infrastructure must allow both to function as positively as possible. With careful consideration, the relationship between the two layers of infrastructures can be harmonious as seen in Fig.B2.2. Yet where a new layer of infrastructure is built without due deference to the last, an uncomfortable and unsightly relationship results, as seen in Fig.B2.1. Structures that recognise and address the canal corridor will become a successful part of its environment.

Fig.B2.1 - Bridge with a poor relationship with the canal below

Fig.B2.2 - Bridge with a positive relationship with the canal below

B3 Horizontal Alignment

Issue

One of the design characteristics which will potentially have the largest detrimental impact on the waterways is that of horizontal alignment. Notwithstanding the pre-existing structural and functional constraints that largely dictate the alignment, it must be considered a matter of primary importance. Simply put, heavily skewed crossings will have a significantly greater impact on the waterway environment than perpendicular crossings, and as such will require a higher degree of consideration in order to achieve an acceptable result.

Response

As shown in Fig.B3.1 and Fig.B3.2 the degree to which HS2 is 'skewed' across the water significantly alters the amount of the waterway environment that is beneath the bridge. A perpendicular arrangement is preferable for the following reasons:

1. It reduces the area underneath the bridge
2. It minimises the footprint of the bridge in the canal corridor
3. It reduces the amount of soffit seen
4. It reduces the overshadowing of the waterway environment
5. It appears to be a more 'considered' and formal arrangement
6. The span is reduced, which in turn reduces the structural depth
7. Unsightly 'left over' spaces are eliminated
8. More vegetation can remain undisturbed

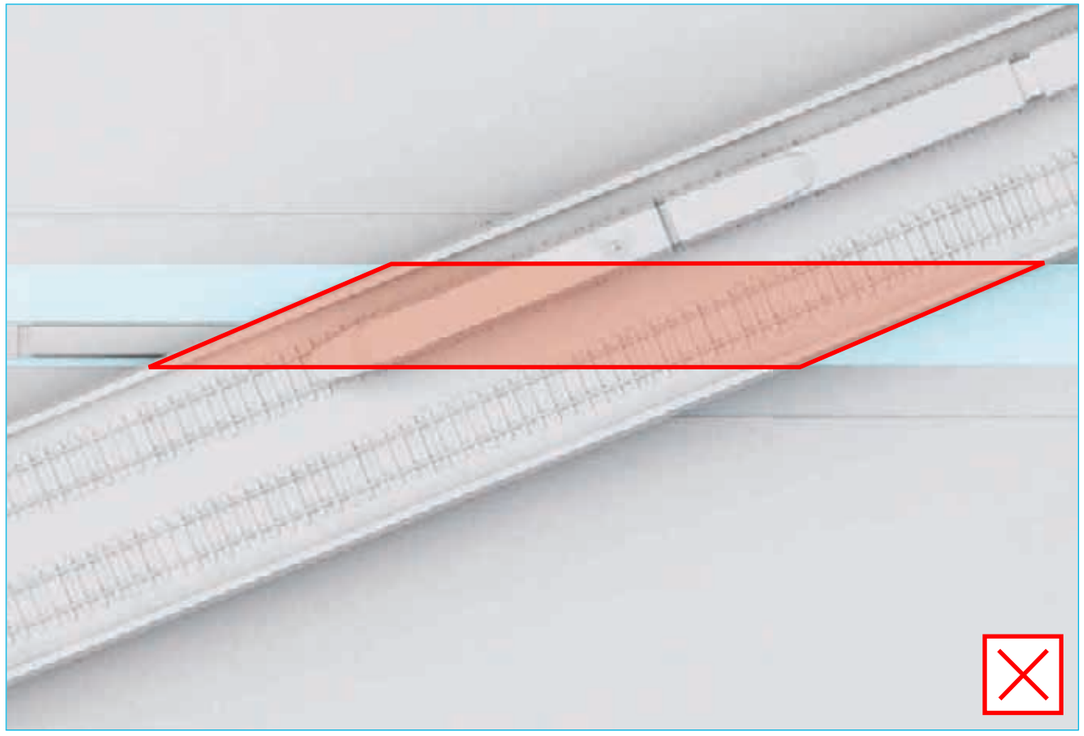


Fig.B3.1 - Heavily skewed crossing increases the 'footprint' of the bridge

Fig.B3.2 - Perpendicular crossing minimises the 'footprint' of the bridge

B4 Vertical Alignment

Issue

Of equal importance to the horizontal alignment is that of the vertical. In addition to the practical considerations of vertical alignment is the aesthetic impact of height. Views along the canal will be greatly impacted by the vertical alignment of HS2 crossings.

Response

B4.01 Clearances

Both the towpaths and the waterways have minimum vertical clearances that are required for the sustainable use of the waterway corridor. Both the canal and the towpath have minimum clearances that must be maintained as defined by the Trust for each individual waterway.

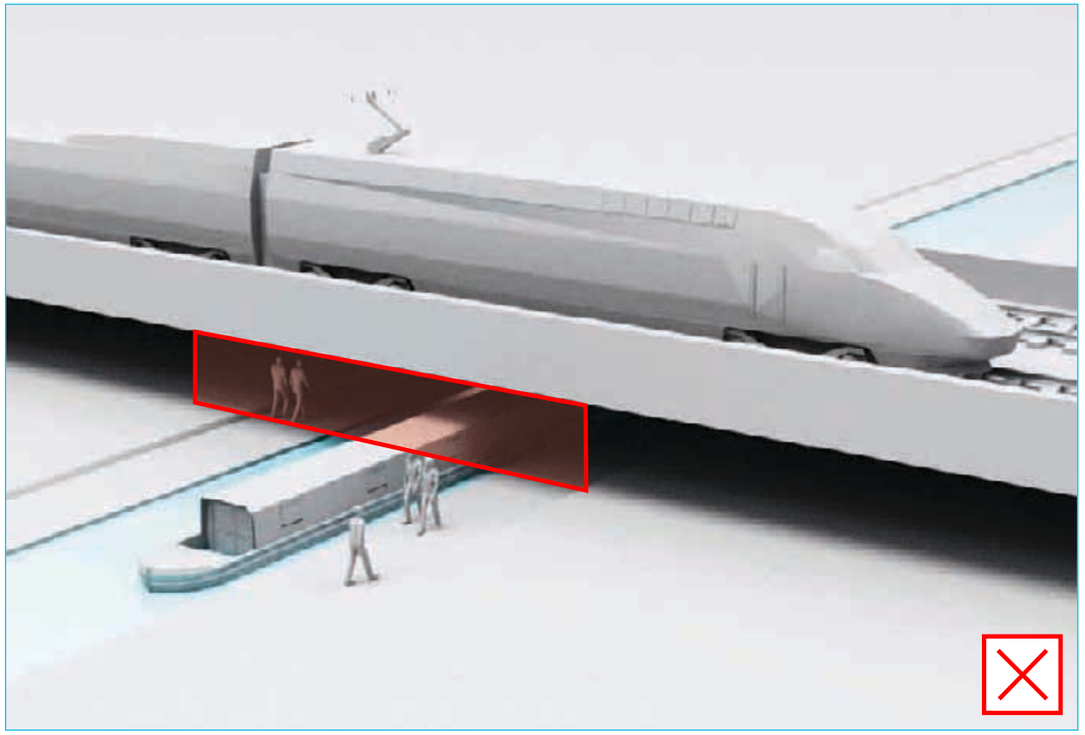


Fig.B4.1 - Low vertical alignment creates dark spaces and a disharmony of scales

B4.02 Height

Each structure must be considered in its own right, as the vertical alignment of narrower, perpendicular crossings will not have as significant an impact on the waterway environment as wide, skewed ones. Generally speaking, however, lower crossings block views and light, and as such will require great attention to reduce their visual impact (Fig.B4.1). Conversely, crossings with a higher vertical alignment will permit more light to penetrate beneath them, and natural vegetation to encroach further underneath the structure (Fig.B4.2). Higher structures also serve to ease the disharmony of scales as discussed in (x.x).

Furthermore, whilst the vertical alignment of the tracks will be largely fixed, there may be instances in which reducing the span (and consequently the structural depth of the deck) would have a significant benefit on views through the crossing. In addition, where a vertical alignment introduces a clear view of the bridge soffit on approach along the towpath, its design must be carefully considered so as to ensure that the soffit appears as a high-quality, well thought out element of the waterway environment.

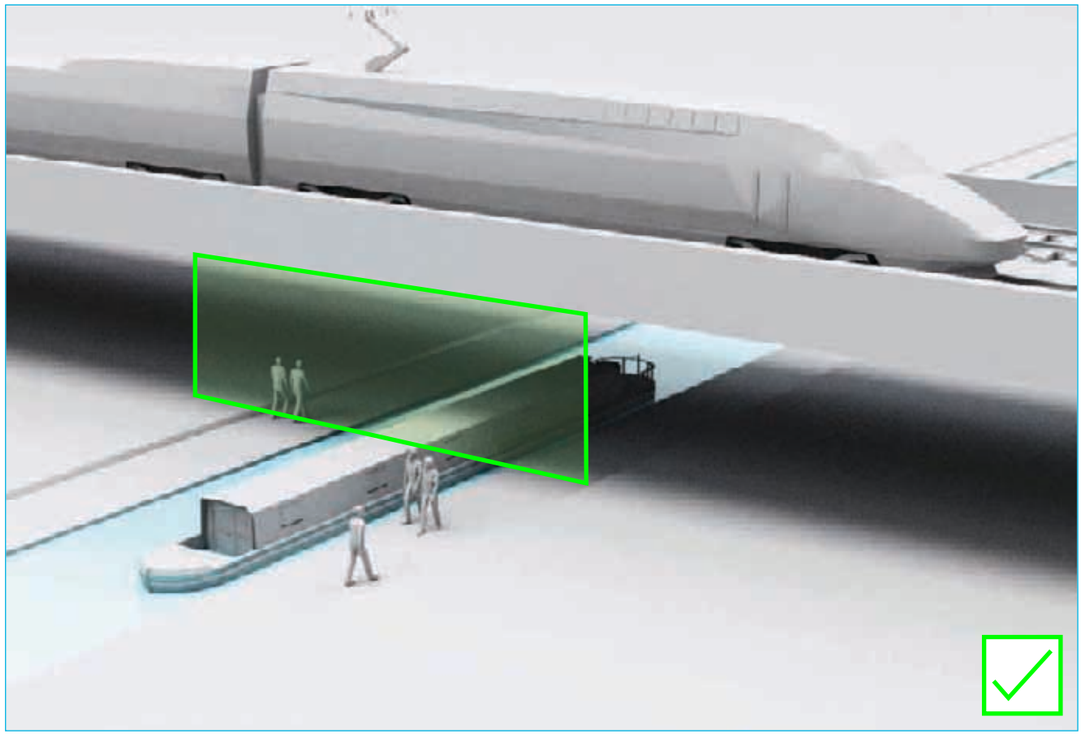


Fig.B4.2 - Higher vertical alignment permits light to enter

B5 Visual Scenarios

Issue

Each crossing will present a different structural challenge, in terms of alignment, span and constraints. The supporting structures to HS2 will impact greatly on the visual environment and quality of the waterway environment and as such their careful selection and implementation is essential.

Response

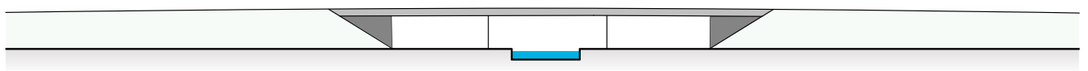
The following pages look at the various options for supporting the waterway spans, which can broadly be categorised as “open scenarios” with wide views across the landscape (where either a viaduct or embankment is used) and “focused scenarios” with narrow, linear views of the canal. Whilst each crossing must be assessed individually, we can identify some broad preferences for each scenario, as highlighted opposite.

“Open” Scenarios: Viaducts

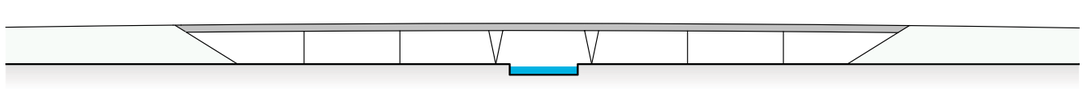
Uniform Viaduct: Standard piers do not address the water and do not suit its requirements.

Waterside Piers: Special piers for the canal crossing identify the span, and address the requirements of the waterways.

“Open” Scenarios: Embankments

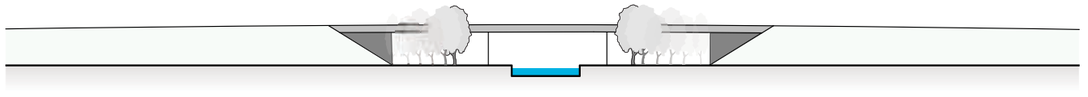


Abutment and Piers: Single backspan and vertical abutment walls curtail open views

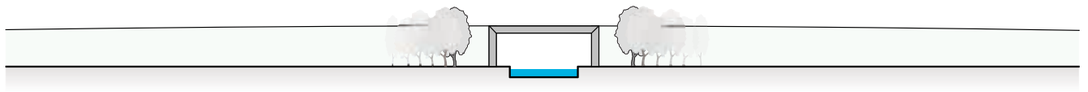


Embankment: Maintaining multiple backspans behind canal span ensures views remain open

“Focused” Scenarios



Abutment and Piers: Piers and vertical abutment walls create enclosed, dead spaces



Embankment: Close, vertical abutments create a ‘picture frame’ span across the canal.

Fig.B5.1 - Typical ‘focused’ scenario with no lateral views

Fig.B5.2 - Typical ‘open’ scenario with lateral views

B5.1 “Focused” Scenarios

Issue

Focused, narrow views are a common characteristic of the waterway environment, and HS2 crossings need to engage with this aesthetic in a positive way. Standard pier arrangements are more suited to open views, and potentially appear cluttered and unresponsive in these ‘closed’ scenarios.

As described previously, analysis of individual crossings needs to be undertaken to determine the most appropriate solution for the landscape. However, generally speaking, where an embankment meets the waterway environment in a ‘focused’ scenario, sloped abutments with intermediate piers (Fig.B5.3) tend to create ‘negative’ spaces between the piers and the abutments. These zones are unusable for planting due to the overshadowing, and worse, can appear as dark and dangerous spaces, that detract from the welcoming waterway environment.

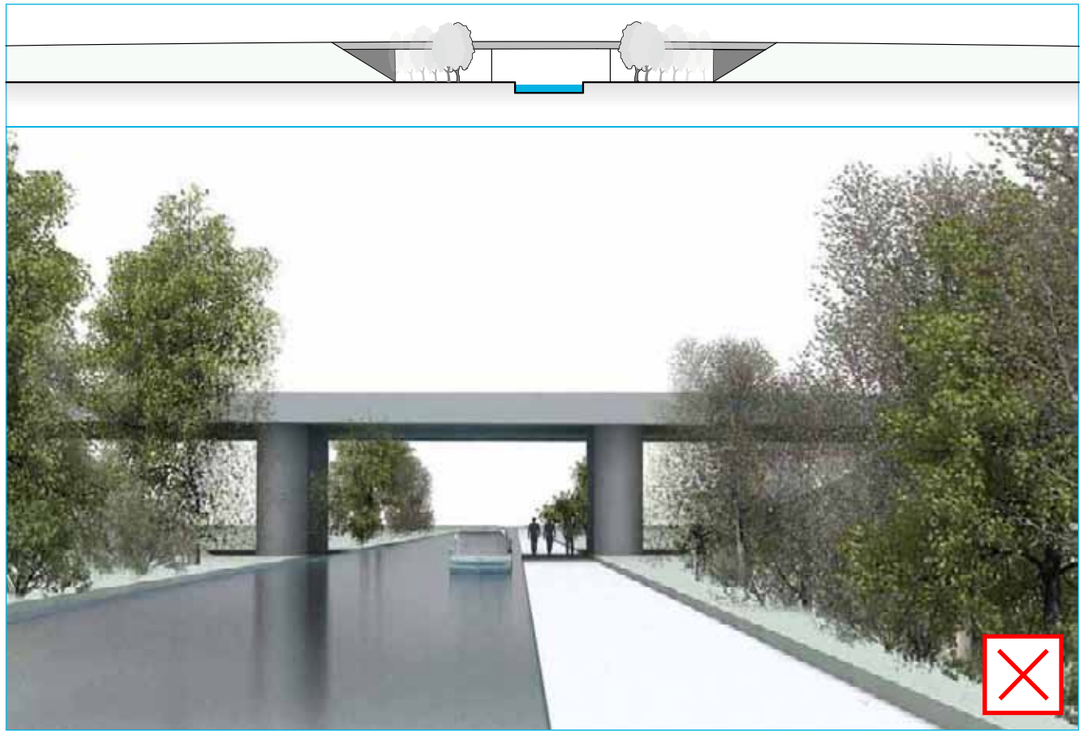


Fig.B5.3 - Pier and back-span arrangement unsuitable for ‘focused’ scenarios

Response

In situations where there is a closed, narrow visual envelope along the canal (usually created by hedgerow and trees) a beam and vertical abutment solution (Fig.B5.4) may be beneficial. Continuing the embankment up to vertical abutment walls creates a ‘frame’, which complements the linear, narrow views at that location, and appears as a comfortable and appropriate component of the waterway environment.

Fig.B5.4 - Framed structure suitable for ‘focused’ scenarios

Fig.B5.5 - Framed structure suits the focused scenario

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.

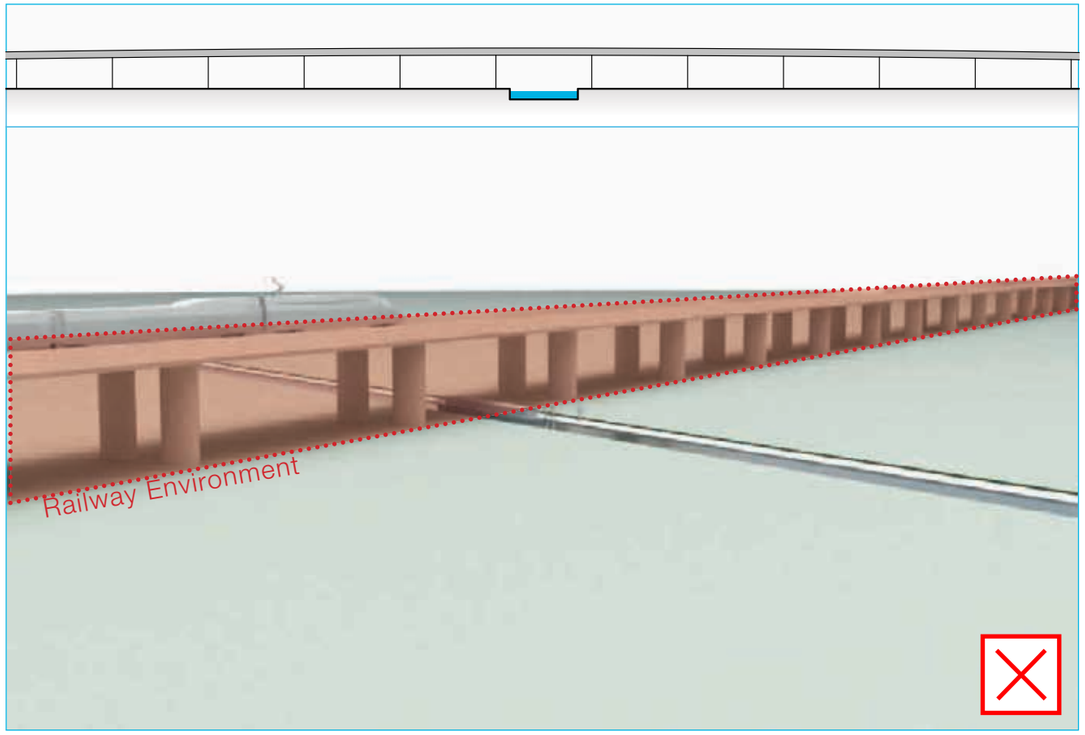


Fig.B5.6 - Unresponsive pier arrangement remains a part of the railway environment

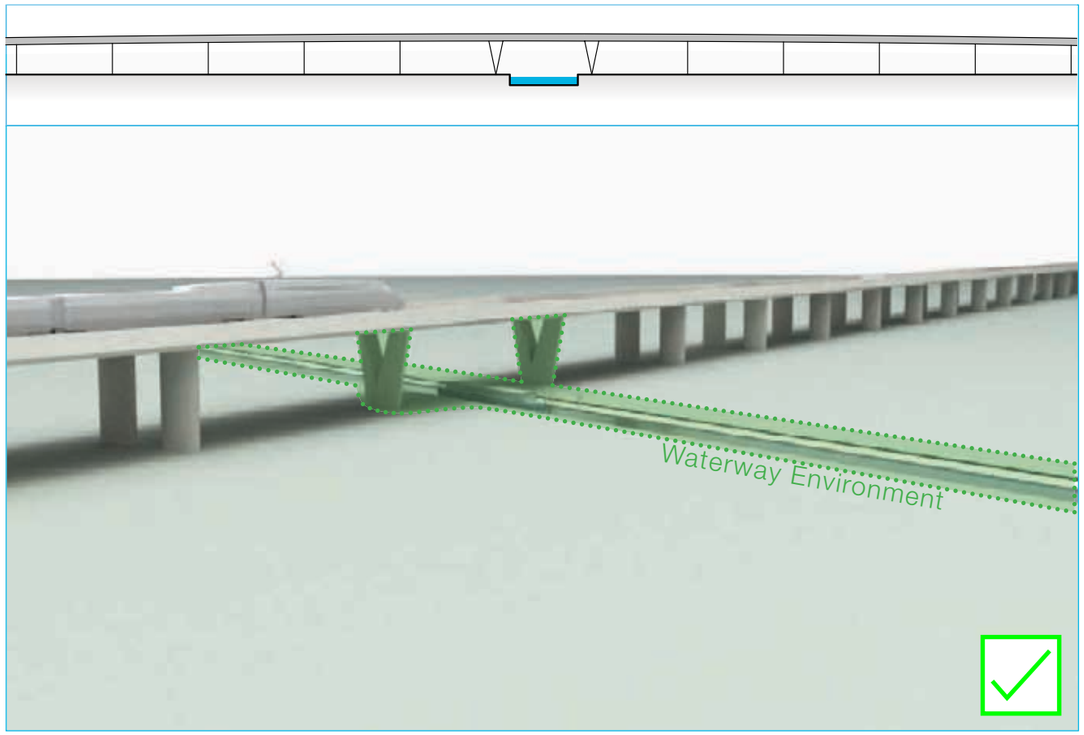


Fig.B5.7 - Piers which respond to the canals become a positive part of the waterway environment

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

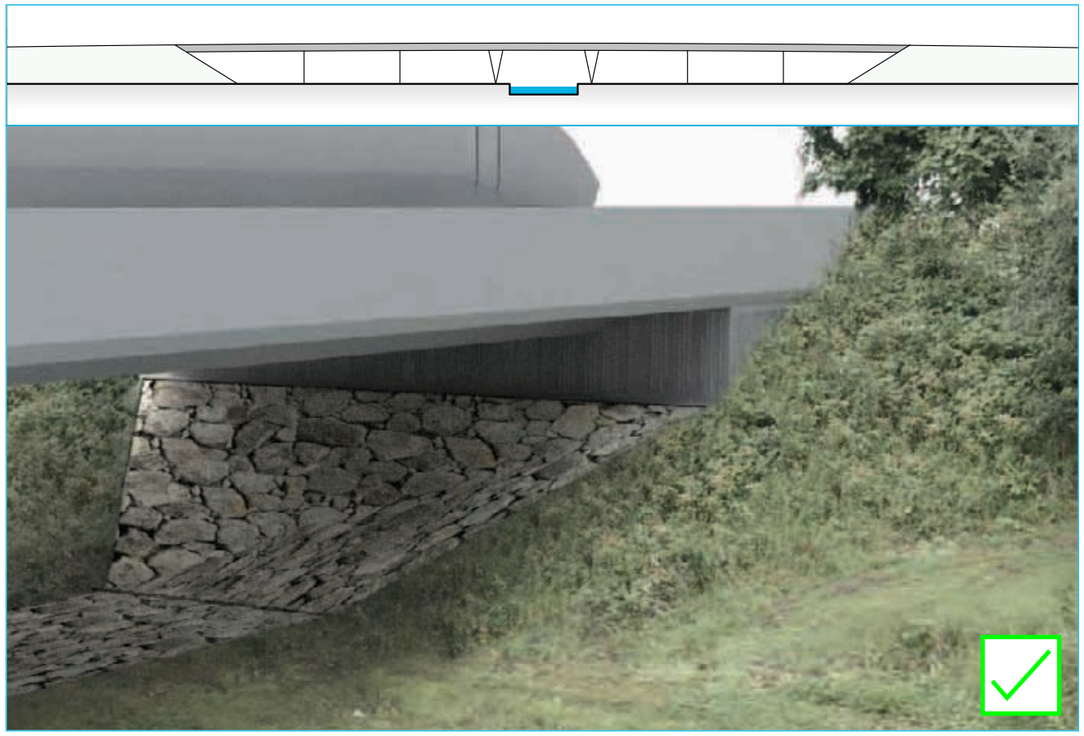


Fig.B5.10 -Sloped abutments with tapered riprap blend well into the landscape

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.

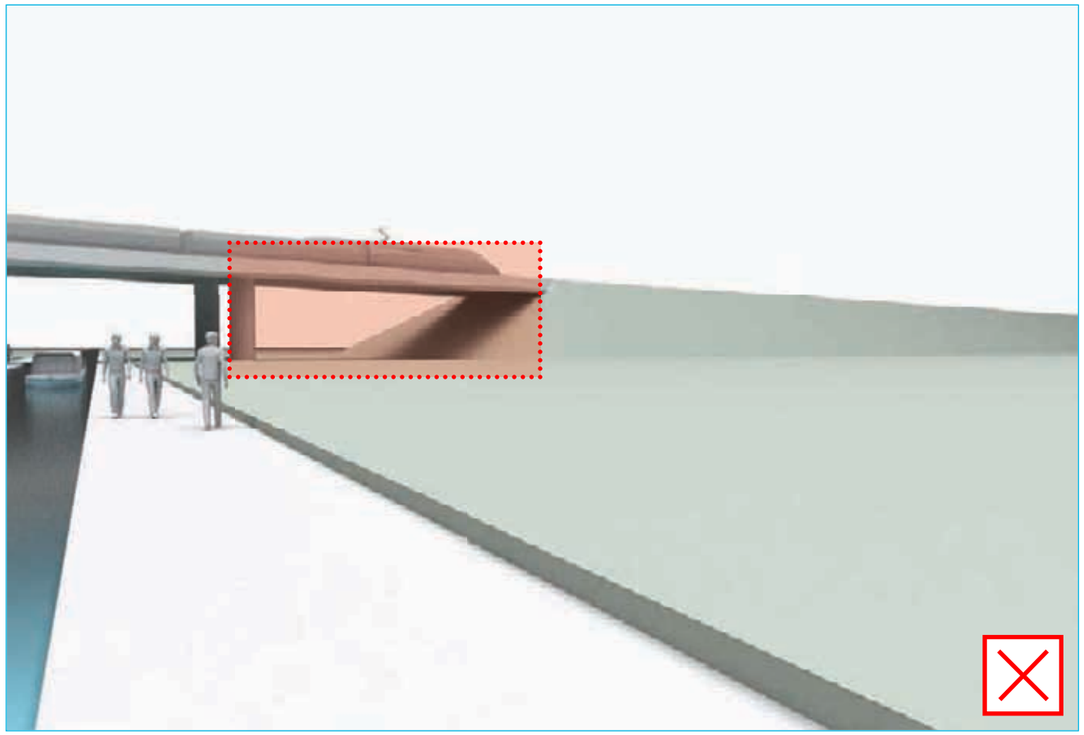


Fig.B5.12 - Single Back-spans and abutments create unsuitable environments

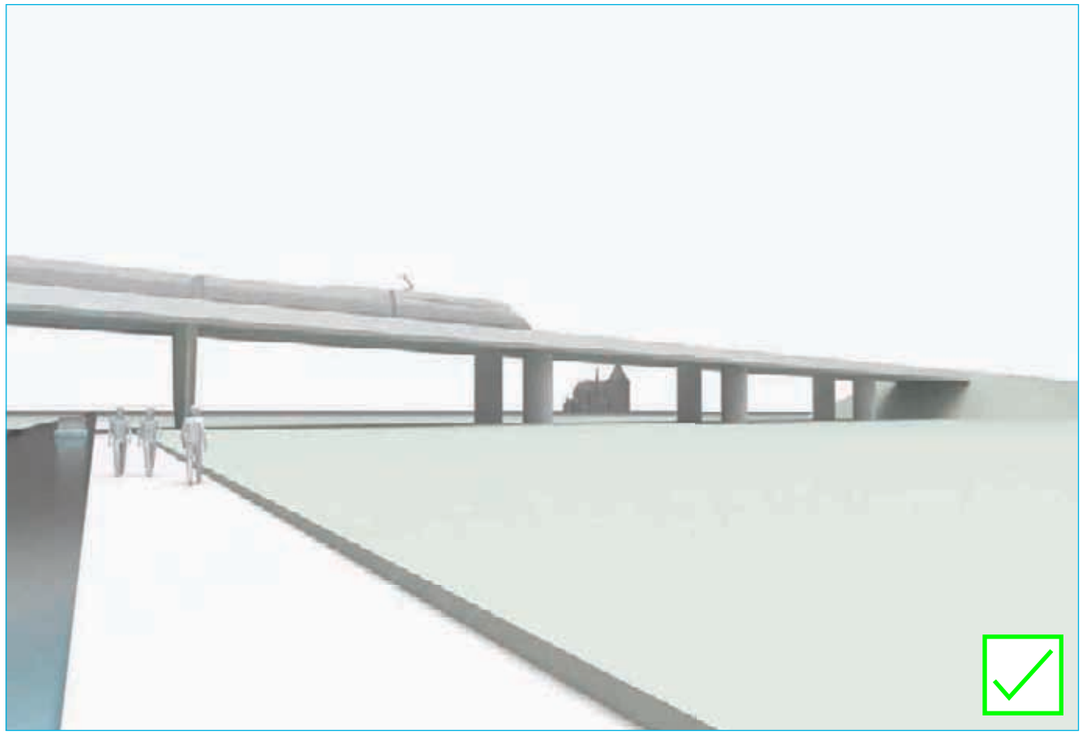


Fig.B5.13 - Multiple spans permit views through

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)

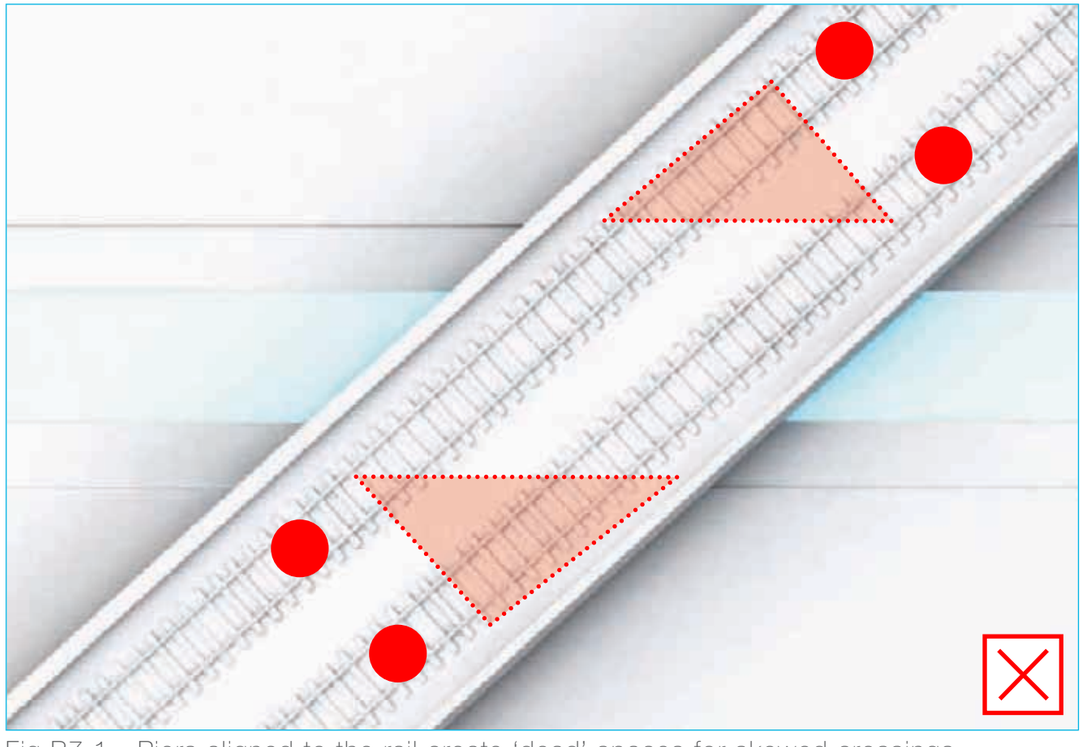


Fig.B7.1 - Piers aligned to the rail create ‘dead’ spaces for skewed crossings

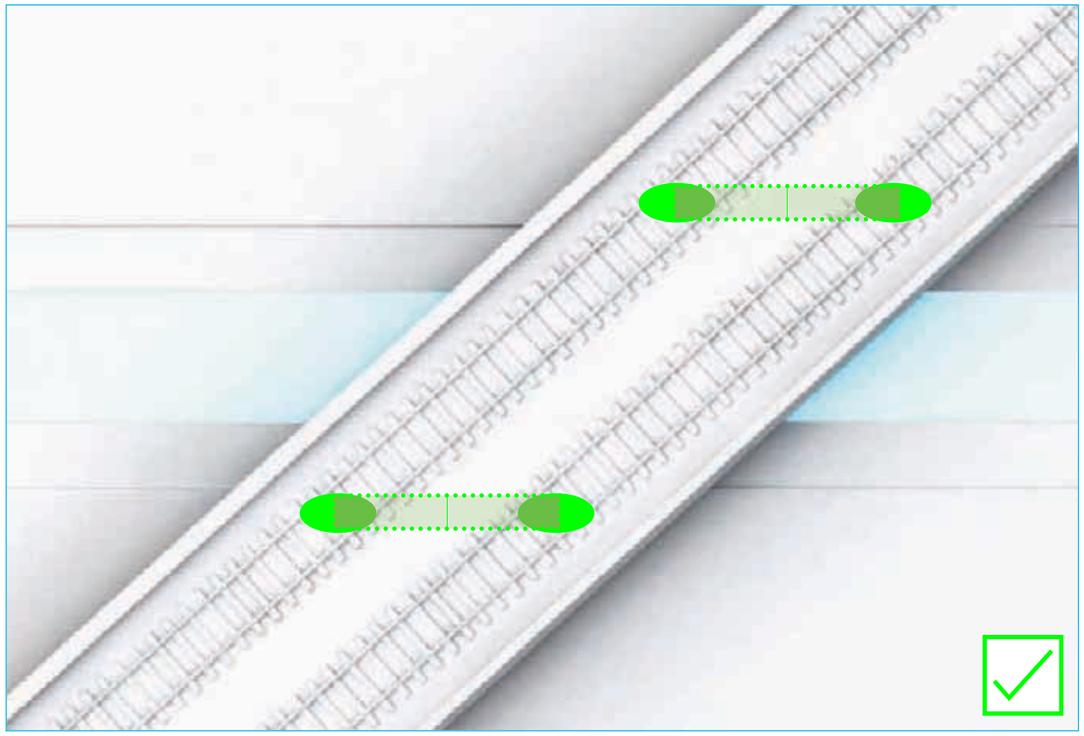


Fig.B7.2 - Piers aligned to the canal do not create ‘dead’ spaces for skewed crossings

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

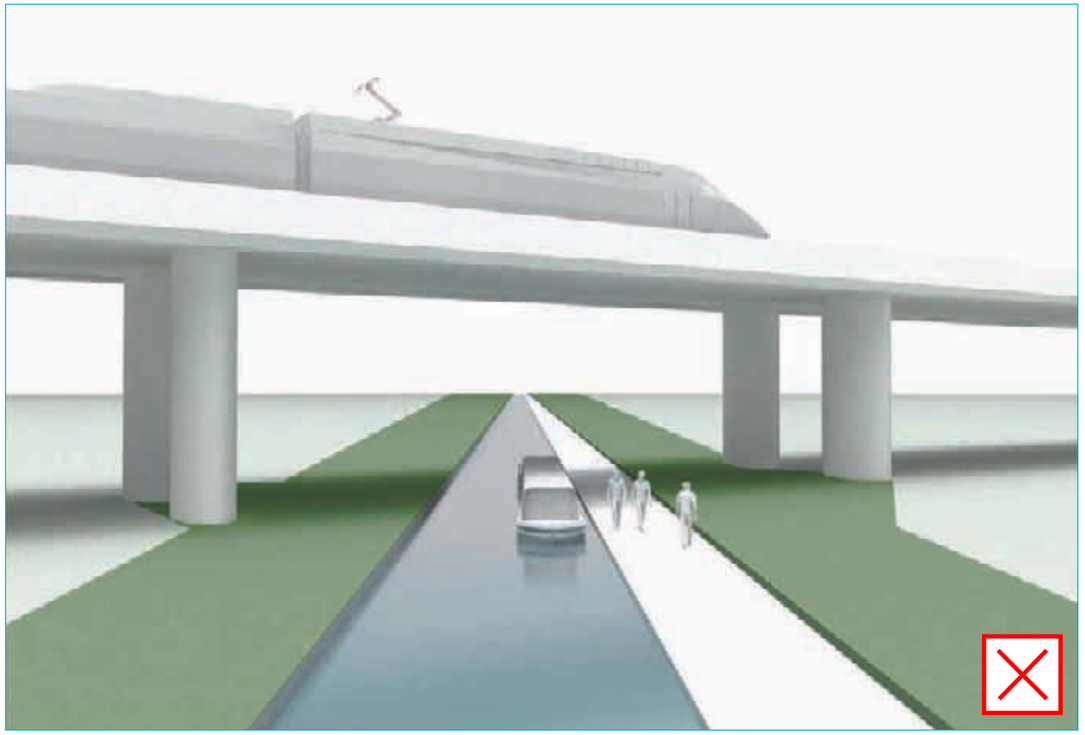


Fig.B7.5 - Piers aligned to the rail create ‘dead’ spaces for skewed crossings

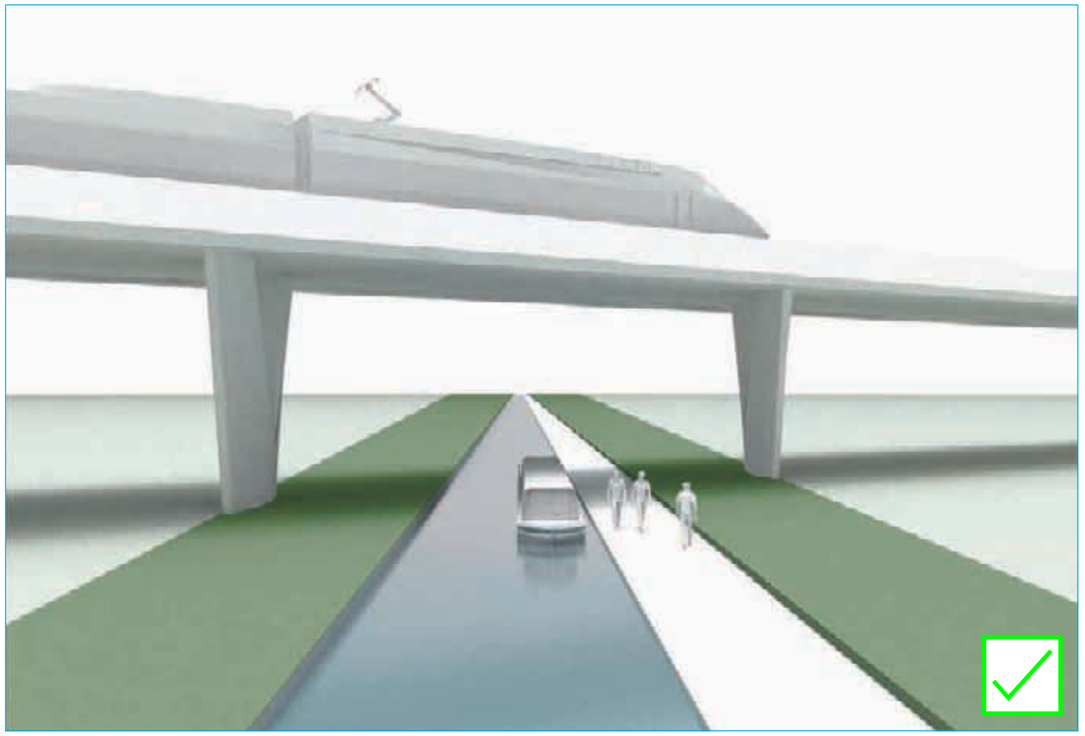


Fig.B7.6 - Piers aligned to the canal do not create ‘dead’ spaces for skewed crossings

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.

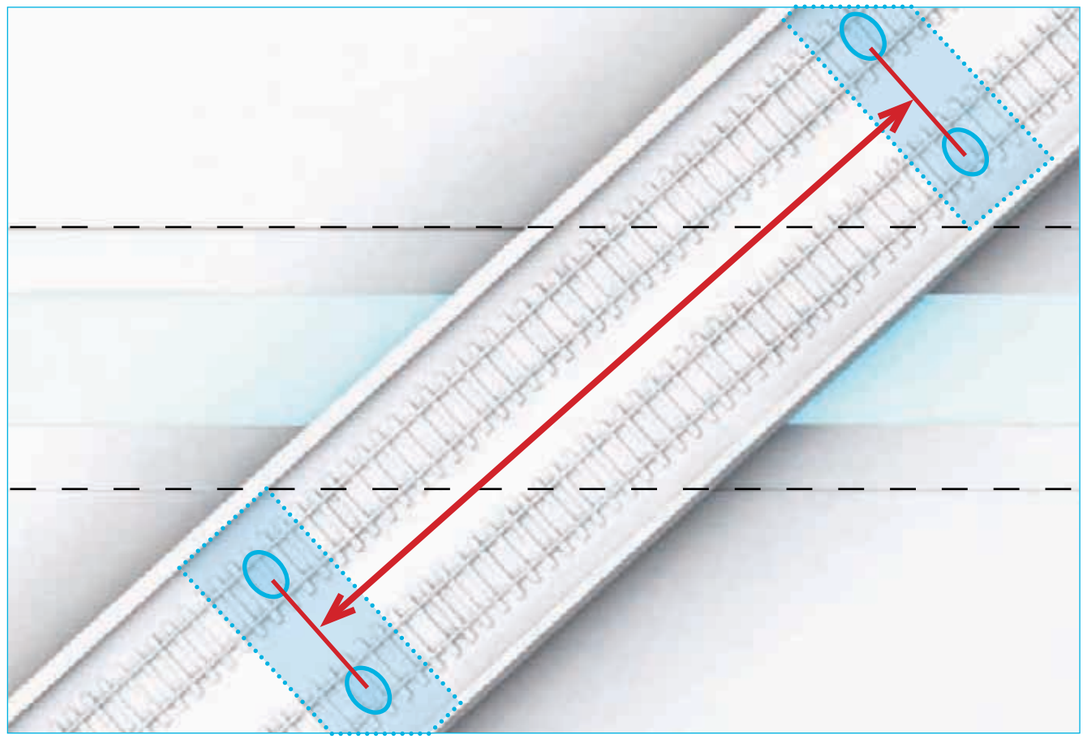


Fig.B8.1 - Piers aligned to the rail increase spans

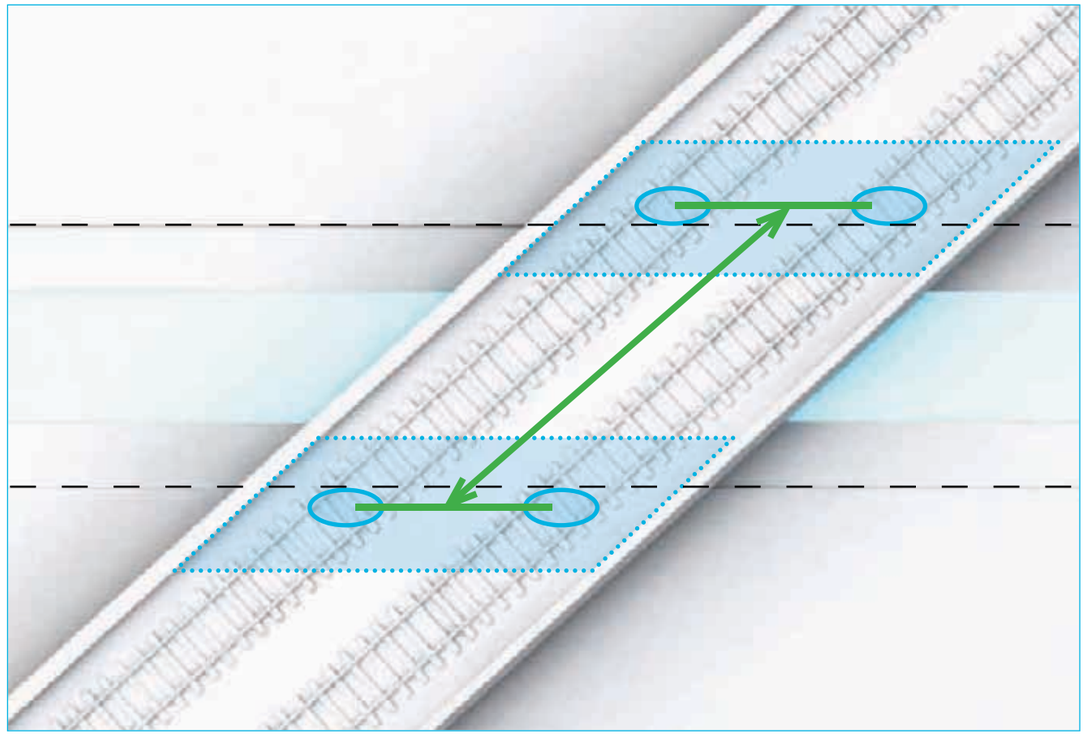


Fig.B8.2 - Piers aligned to the canal reduce spans

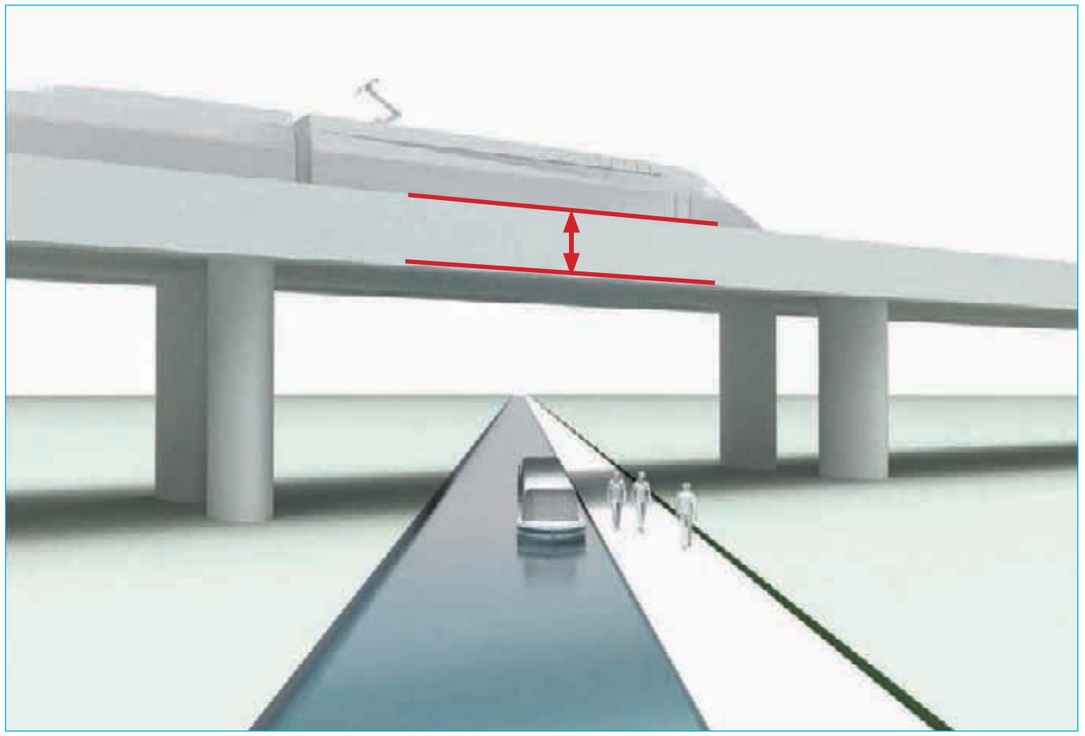


Fig.B8.3 - 'ncreased spans results in increased structural depths

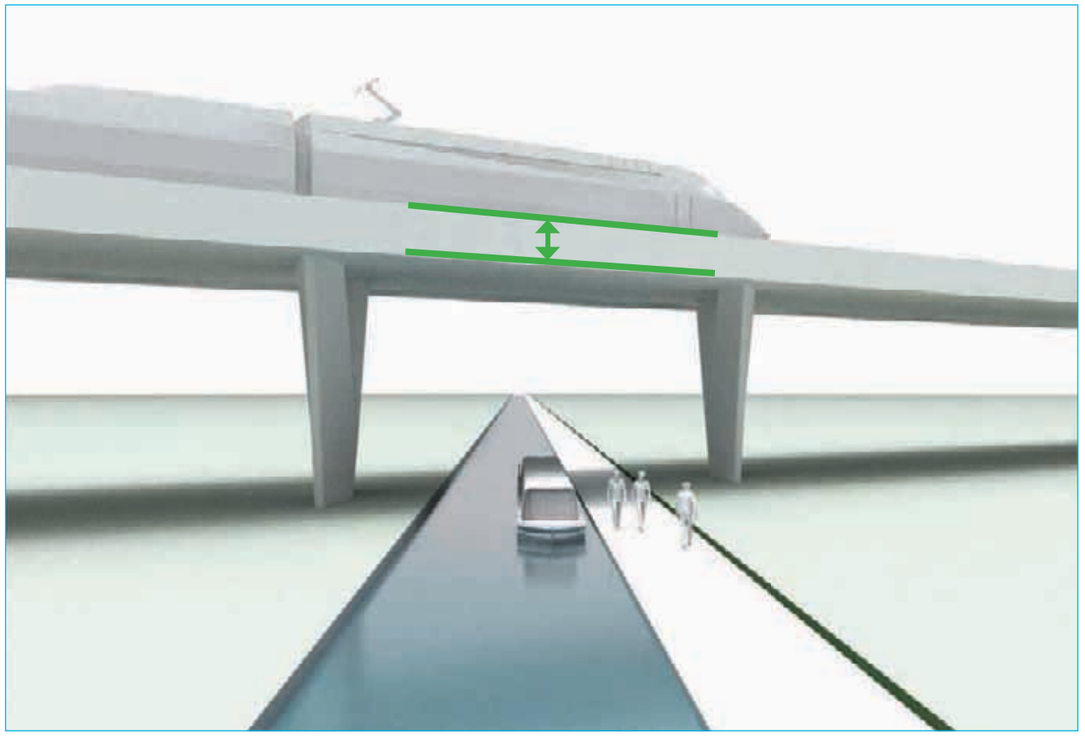


Fig.B8.4 - Reduced spans results in reduced structural depths

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.

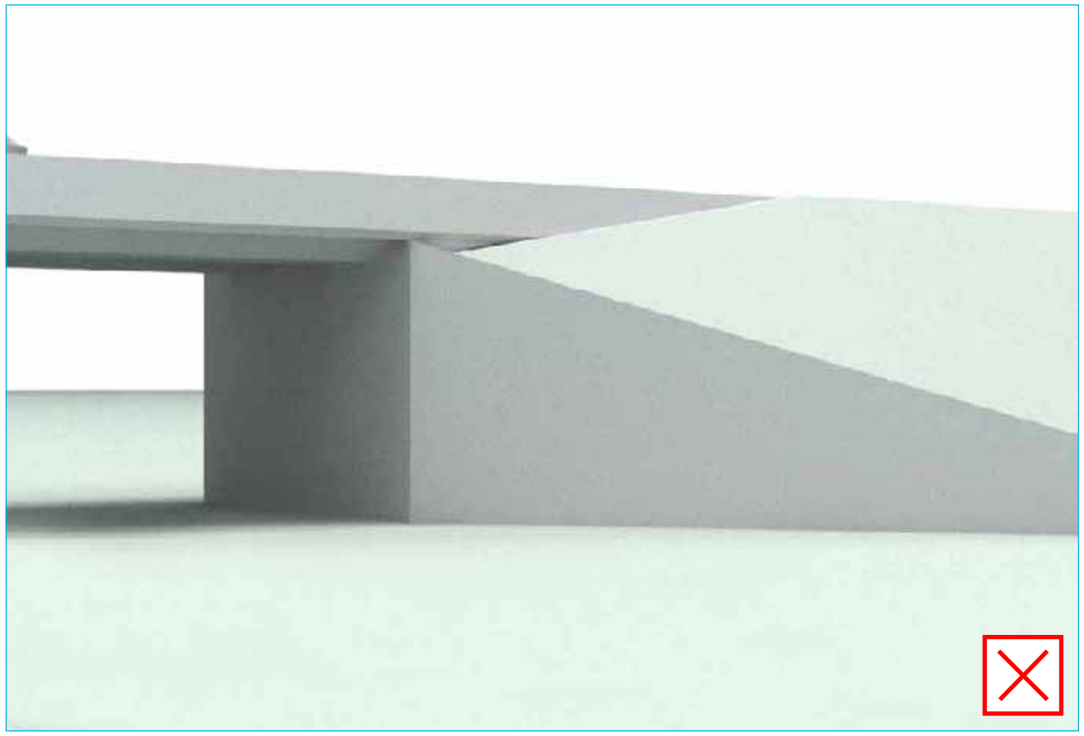


Fig.B9.1 - Wing-walls create excessive areas of unsightly concrete

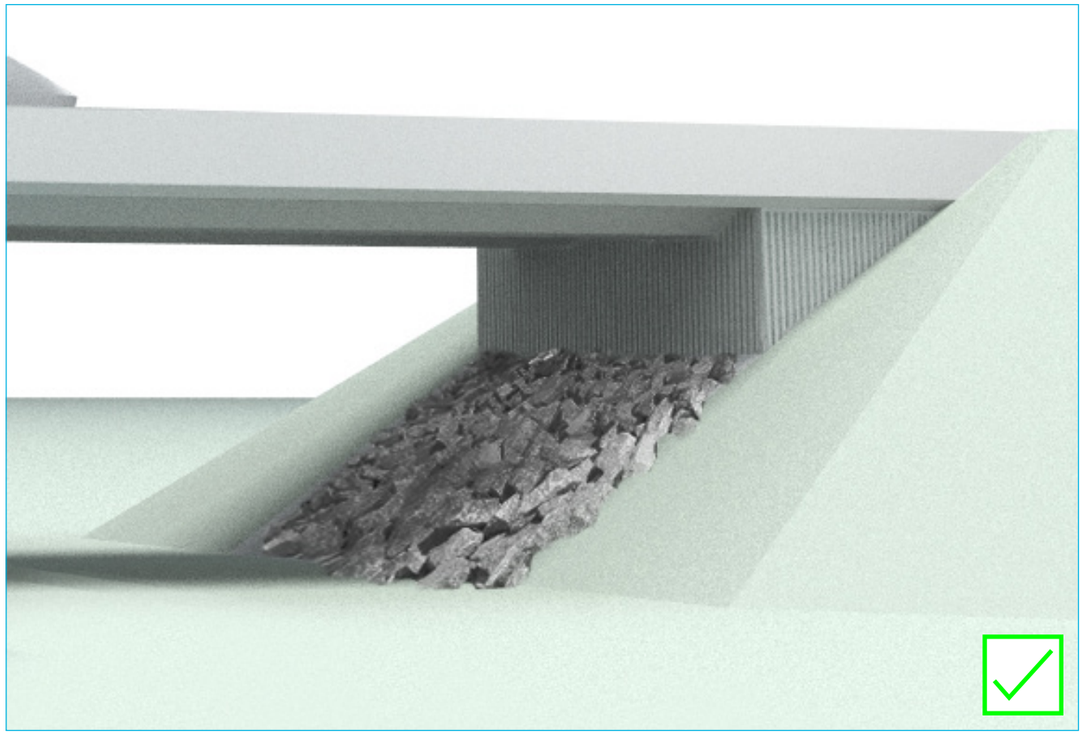


Fig.B9.2 - Riprap and textured concrete with sloped embankments blend well into landscapes

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.

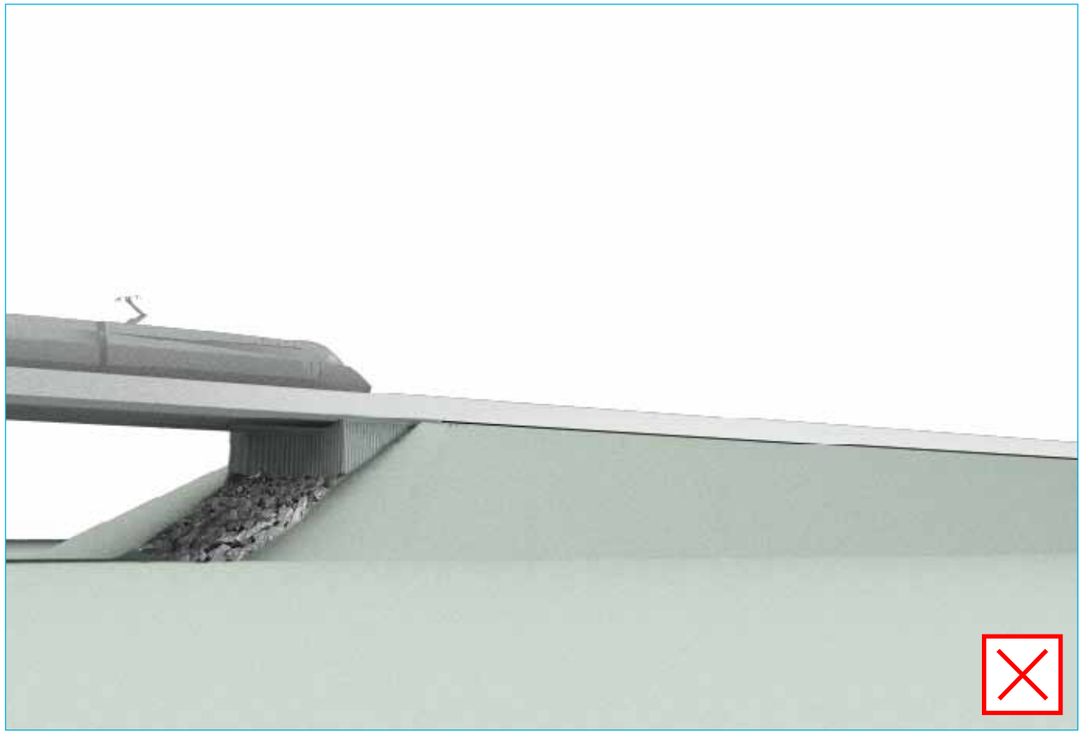


Fig.B10.1 - Hard top edge is obvious against the background of the sky

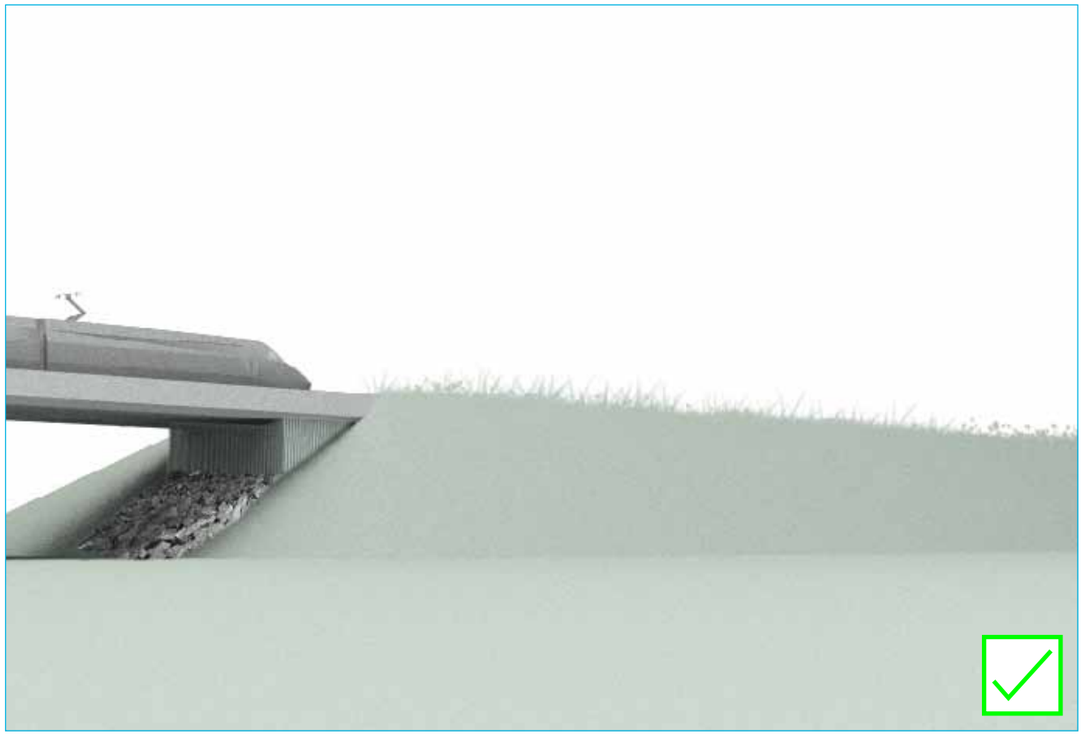


Fig.B10.2 - Soft top edge is blends well into the background of the sky

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

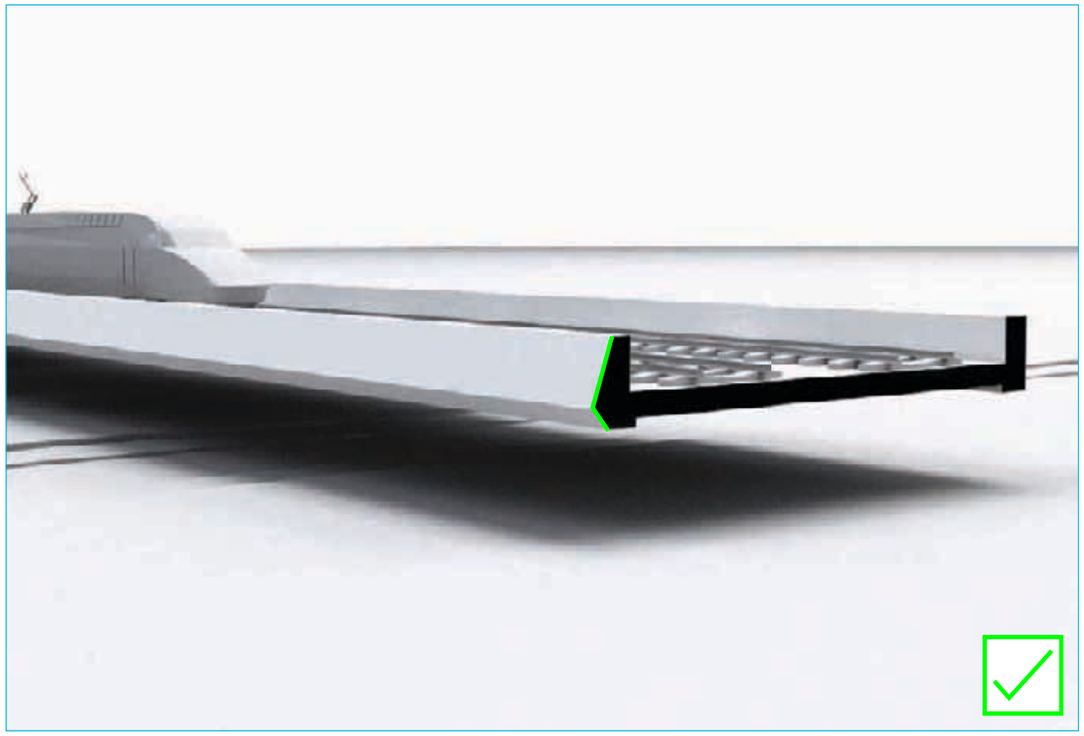


Fig.B11.2 - Chamfered edge condition creates slender appearance

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.

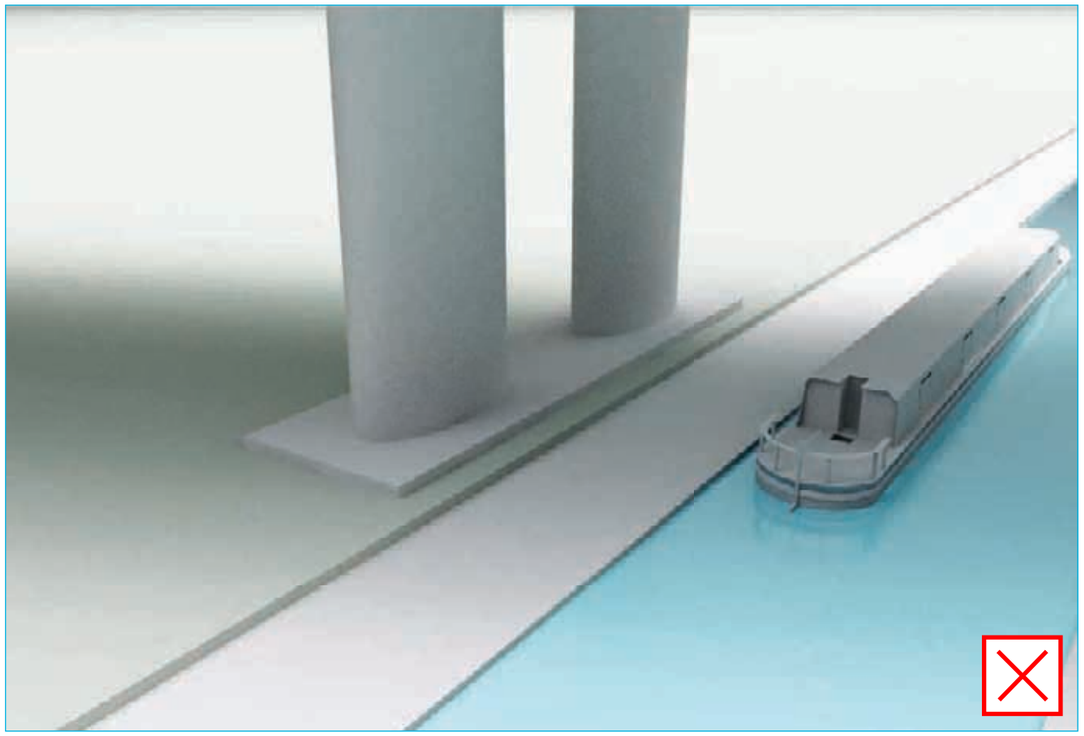


Fig.B12.1 - Visible pile caps are unacceptable

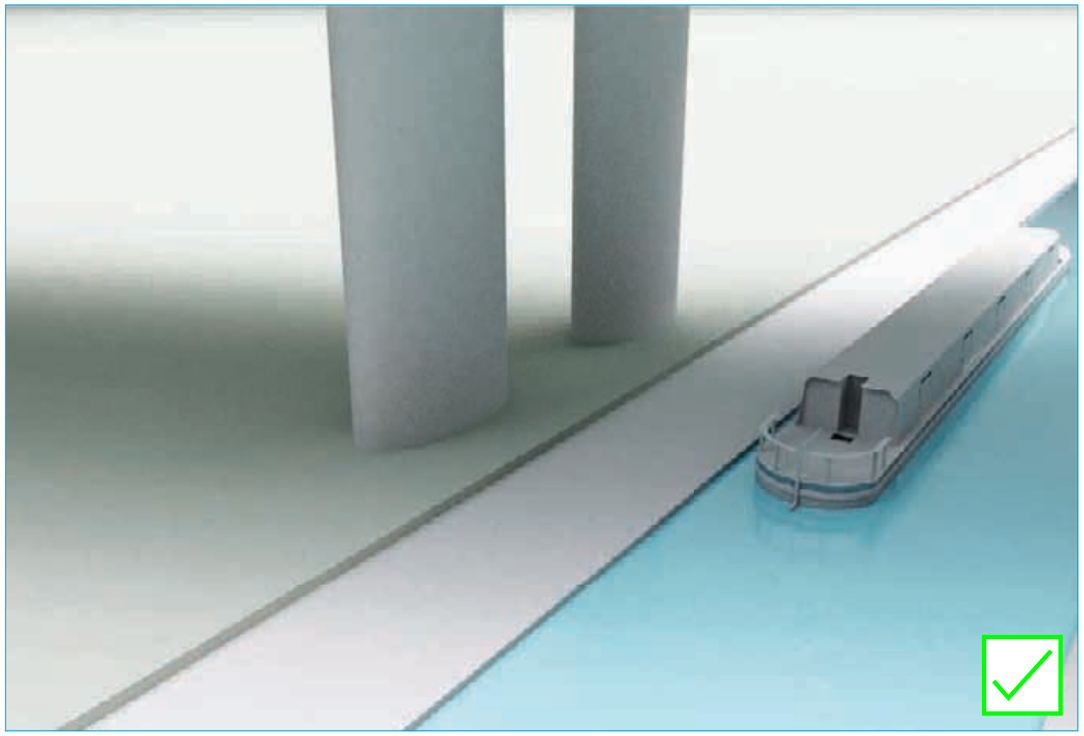


Fig.B12.2 - Piers should spring seamlessly from the ground

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.

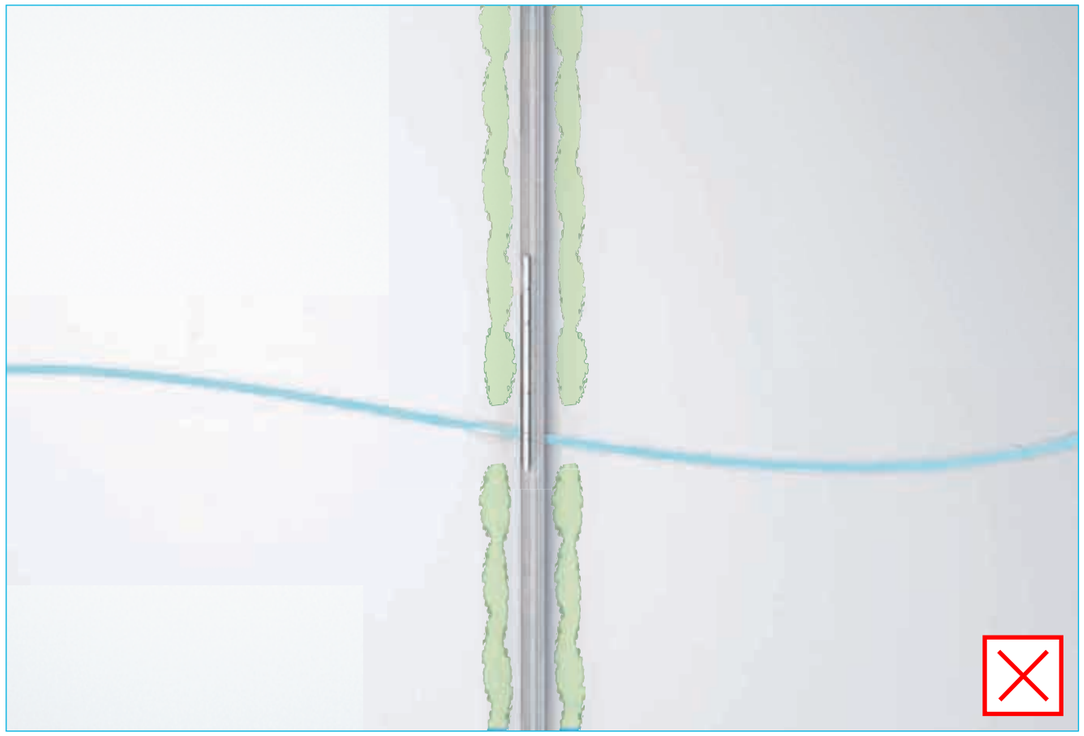


Fig.B13.1 - On-line planting alone is not sufficient

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.

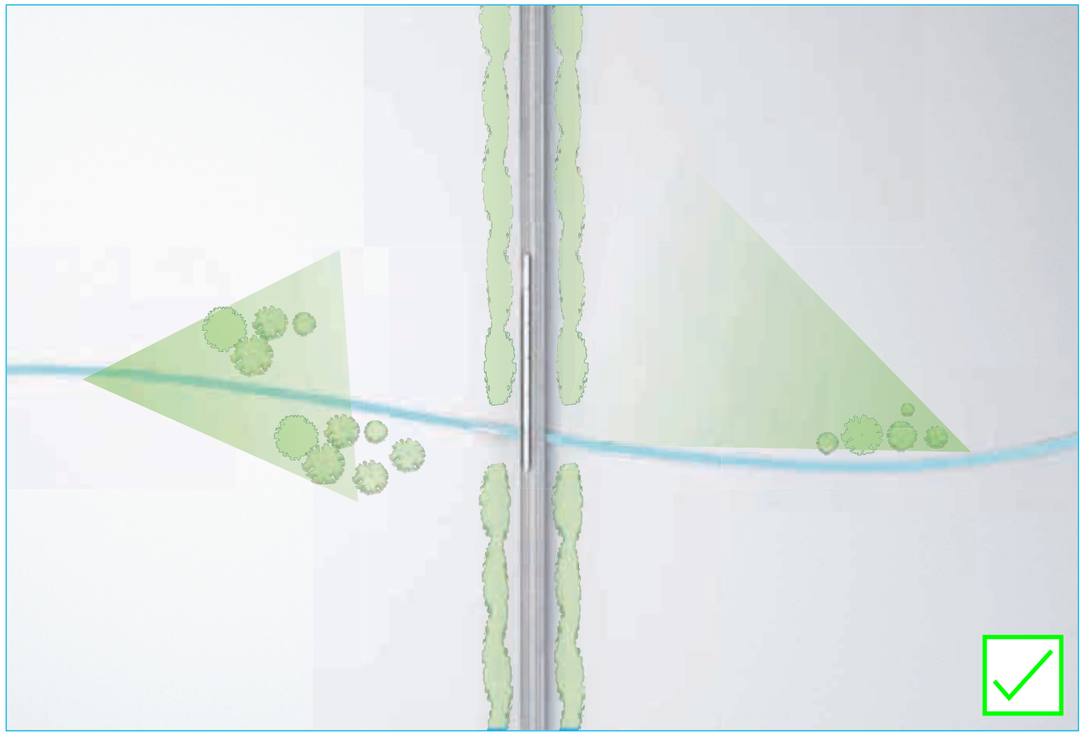


Fig.B13.2 - Strategic off-line planting frames views

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.

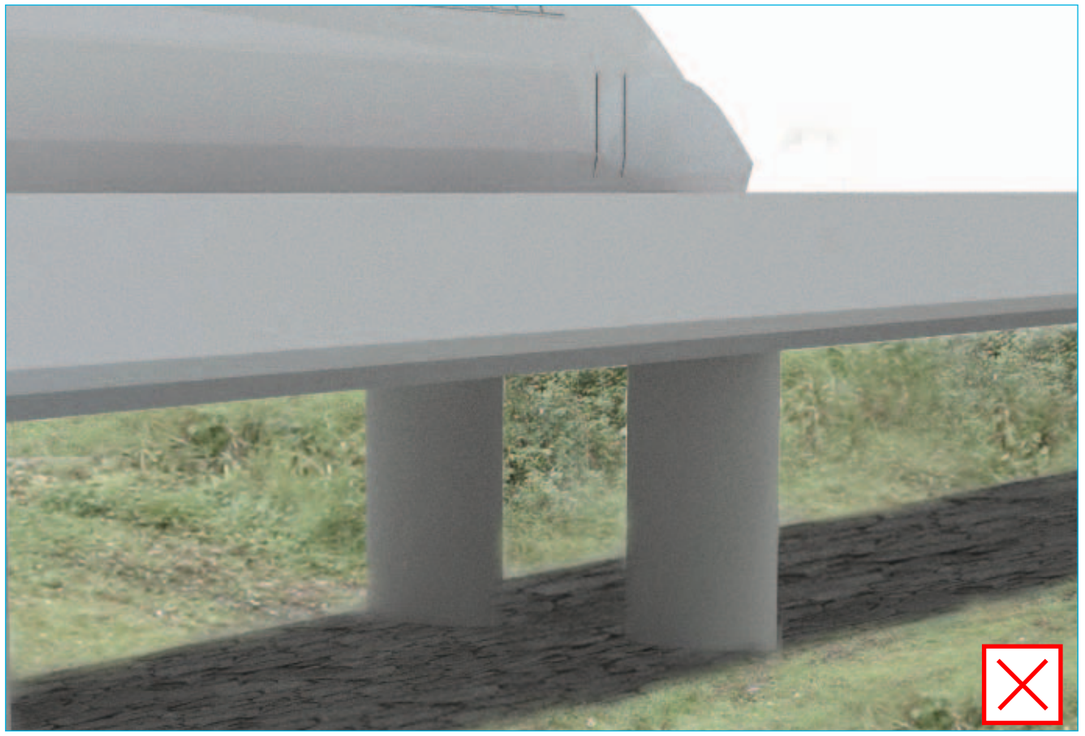


Fig.B13.3 - Large areas of abutment appear unsightly

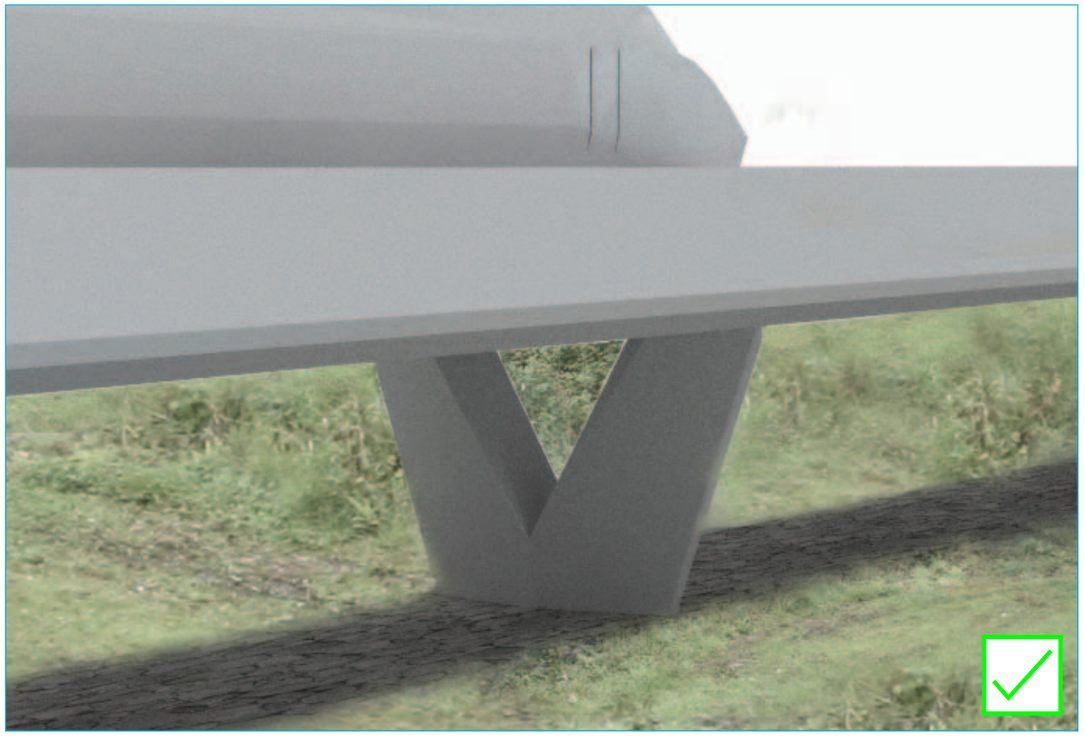


Fig.B13.4 - Permitting natural vegetation to encroach slightly is more suitable

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.

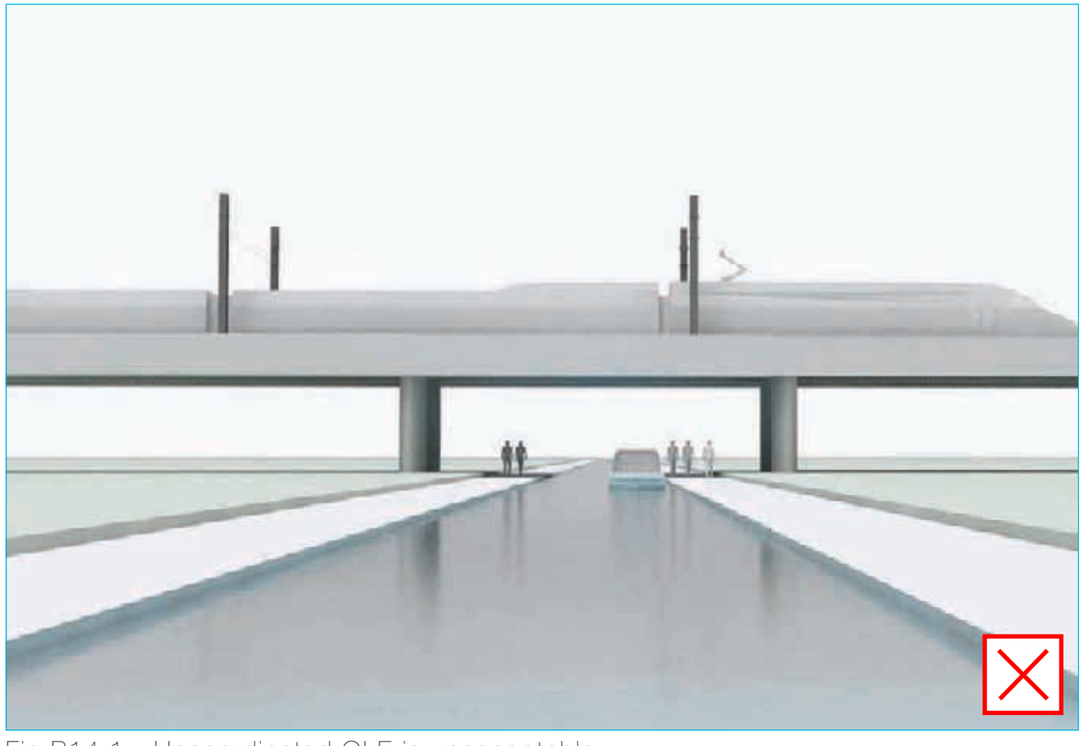


Fig.B14.1 - Uncoordinated OLE is unacceptable

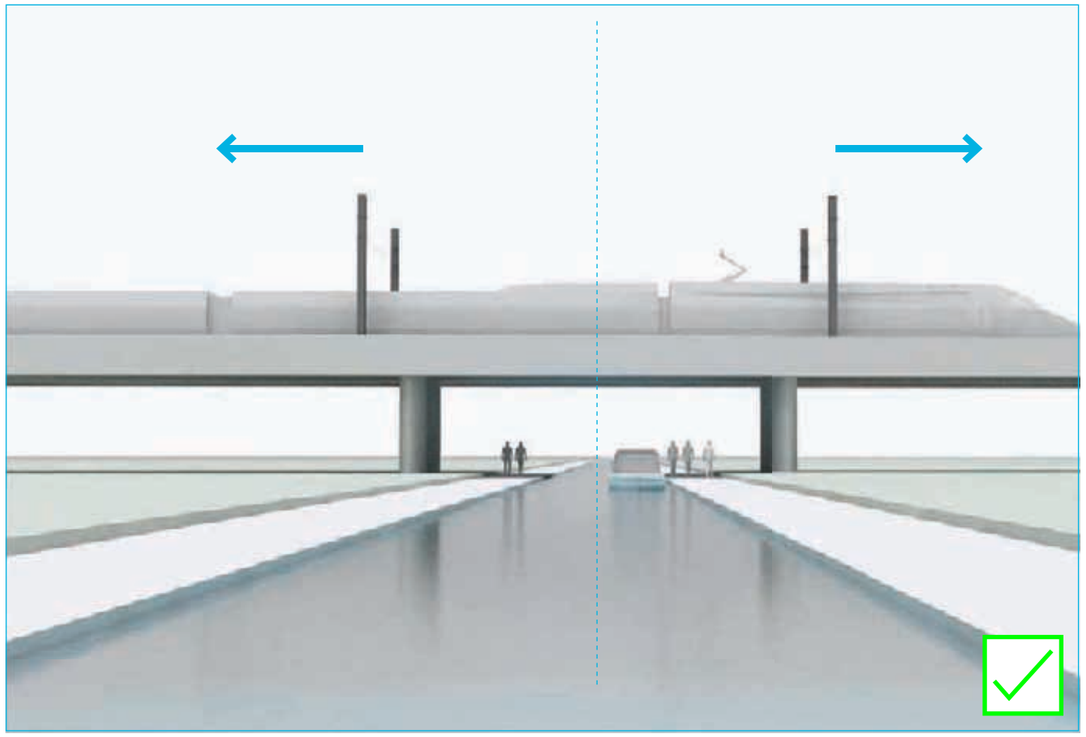


Fig.B14.2 - Well coordinated OLE appears well considered

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.

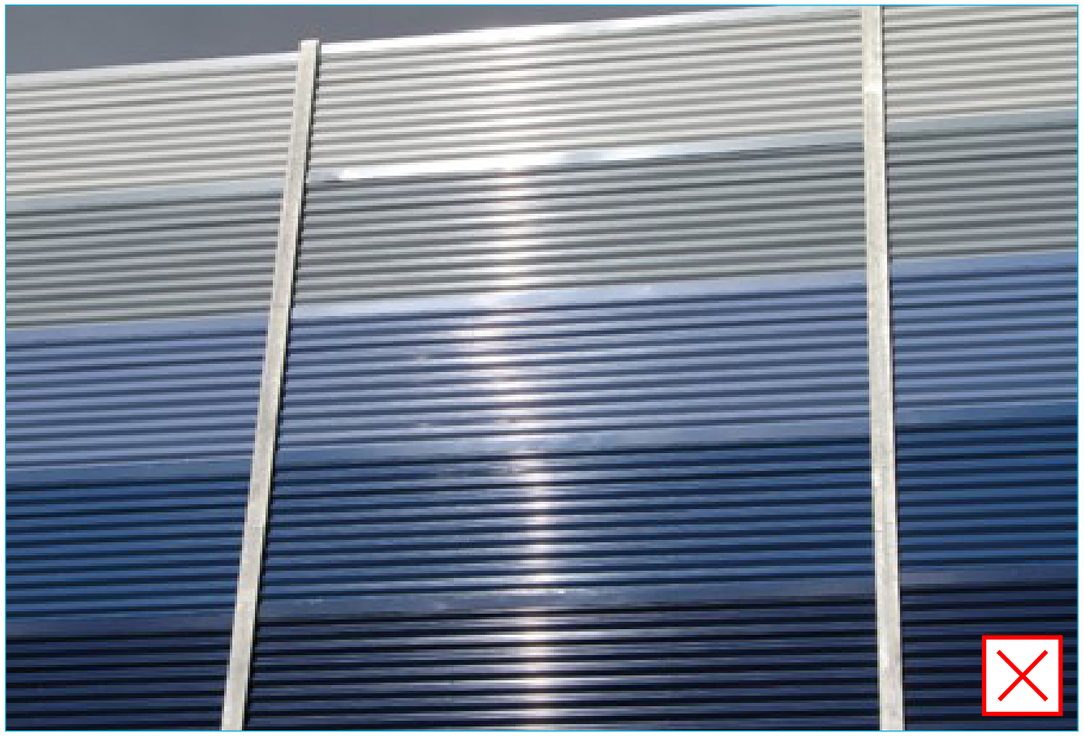


Fig.B14.3 - Opaque, coloured acoustic barriers are overly obtrusive

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.

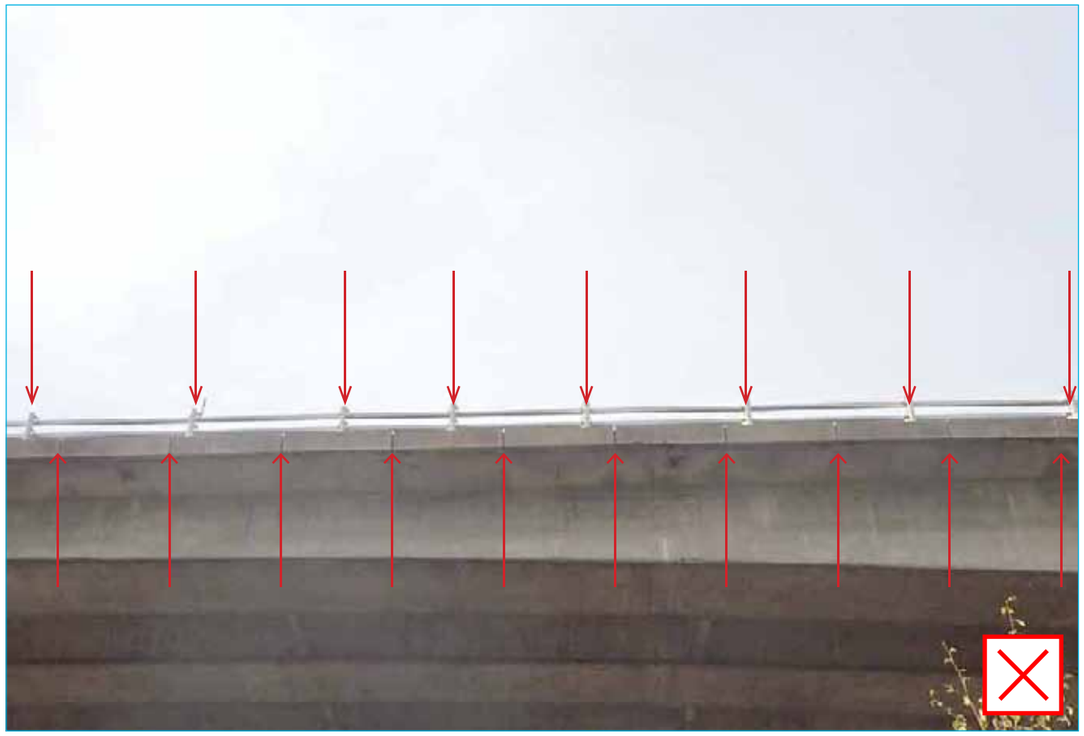


Fig.B16.2 - Poorly coordinated elements appear ill-considered and unsightly

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.

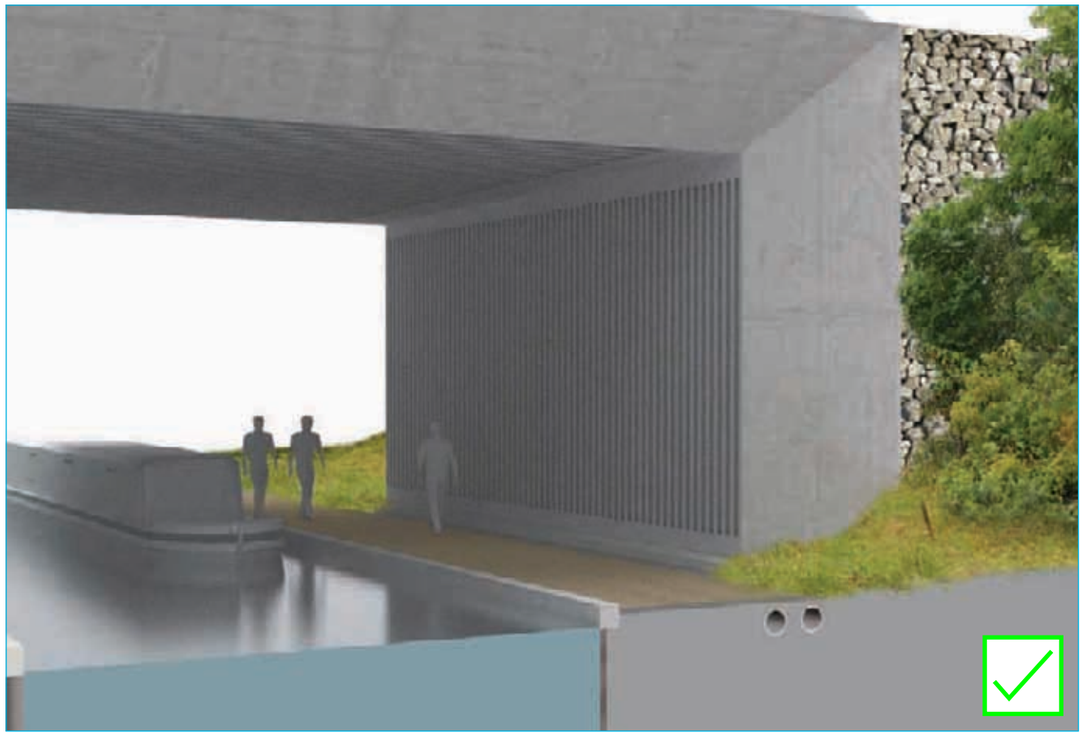


Fig.B17.1 - Typical towpath makeup

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.