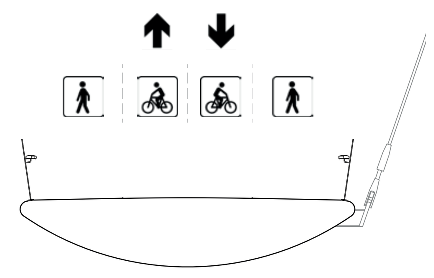
User Access

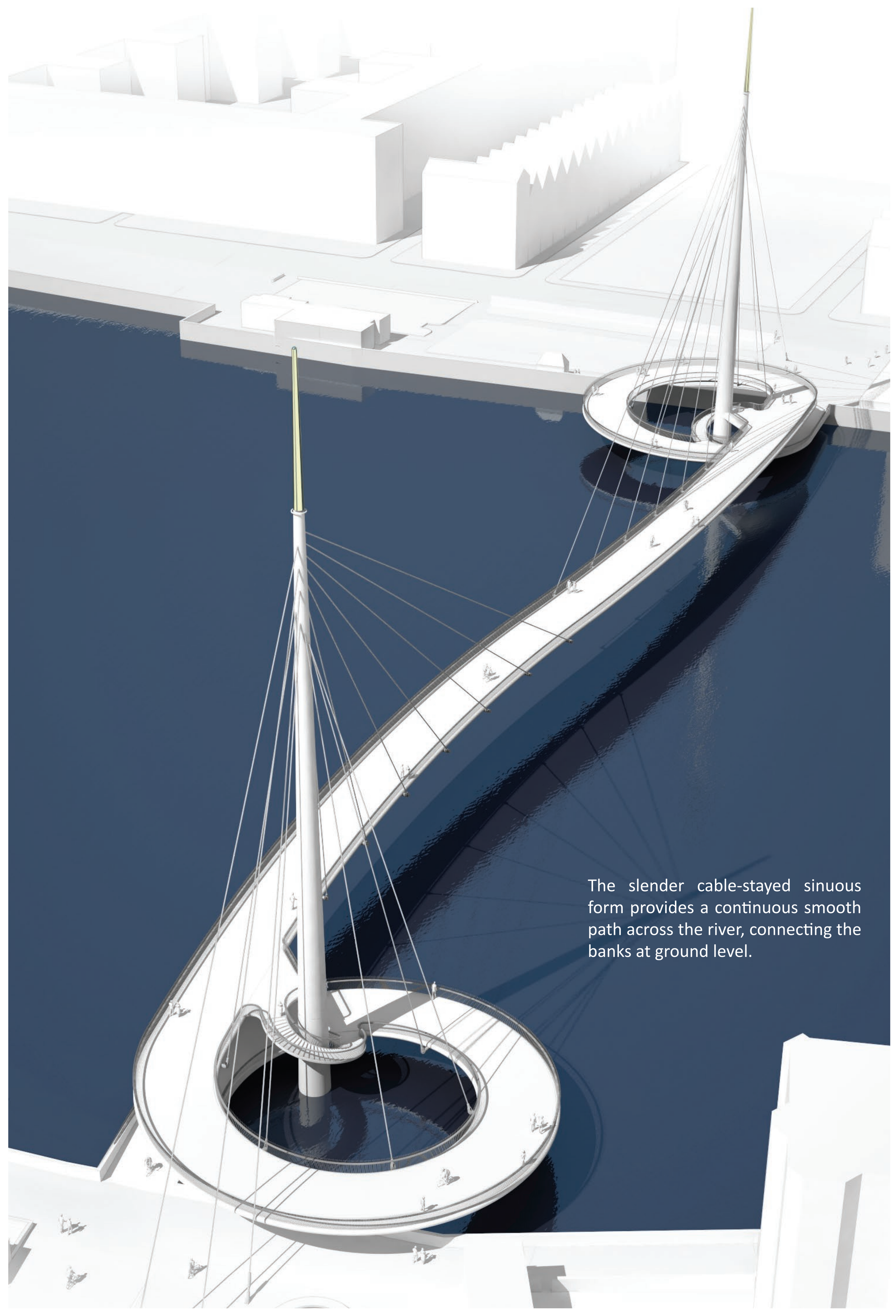
A continuous free surface flows as an uninterrupted path over the entire crossing and provides access for users of all mobilities. Cycle and pedestrian traffic is fully integrated on a single deck. Open visibility for pedestrians and cyclists with a logical system of demarcation placing cyclists in the middle, allows all users to accommodate for one other. The open deck is adaptive to traffic flow demand at different times of day, allowing for the deck to be shared as required.

This system is intuitive and is proven to work in European cities where the predominant means of transport is by foot or bike.

All users of the bridge share a common access landing, a spiral ascent to deck level and the same shared deck which flies over the Thames, irrespective of their mobility or transport mode. The deck provides a ramp of 1:21 gradient for less mobile pedestrians or those sauntering up and taking in the surroundings. Bikes are able to climb the ramp easily, and descend safely.



Where the deck passes close to the mast at its base, there is the option to place a spiral staircase to provide direct accessibility to the upper deck crossing level for pedestrians. This development from the initial proposal improves functionality whilst enhancing the form and concept of the crossing. Should one be required, there is also the option to provide a lift at this point.



Introduction

This bridge linking Nine Elms and Pimlico is an enriching landmark for London, providing seamless pedestrian and cycle access across the Thames and a fitting addition to the city's rich built heritage. The twin masts of the bridge have gilded spires clear over London. Their placement is sensitive to the city, framing open views along the Thames to Battersea power station whilst rising from the buildings and trees of the Thames banks to locate the bridge across the city.

The design concept of the bridge is that the entire crossing span is between the banks of the river, with minimal space required on the banks. The footprint of the bridge in the river channel is also kept to a minimum - just two masts. Access is level from the banks and users are drawn seamlessly onto the bridge.

This proposal sites the bridge between the east end of Pimlico Garden and Nine Elms Lane riverside at the New American Embassy. The concept has the versatility to be readily sited at alternate locations on the Nine Elms reach of the Thames, without demanding land on the banks for ramp or stair access.

NINE ELMS PIMLICO BRIDGE

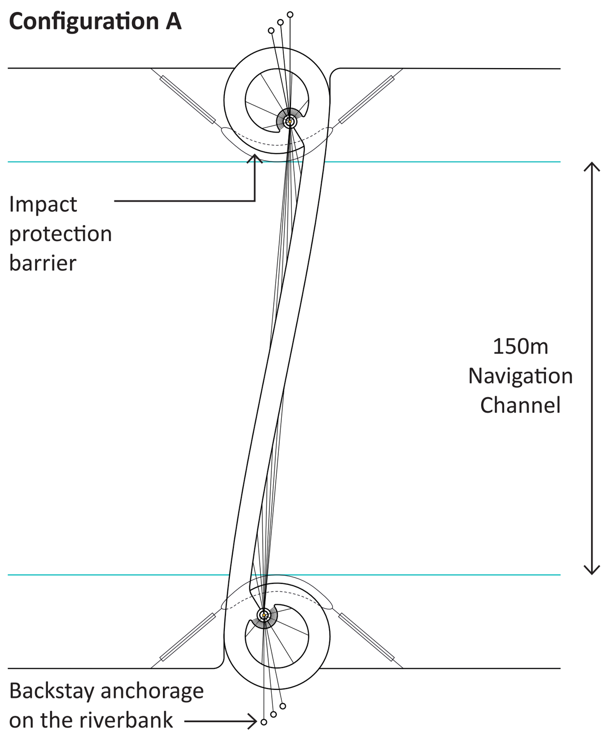
Configuration Options

Our proposal features two options for the configuration of the bridge, addressing specific site conditions at the various location options. The options allow for our bridge to be placed at any crossing location on the Nine Elms reach of the Thames whilst providing full river navigational requirements and keeping all access ramp structure off the river banks. It has been noted that there is a strong desire to minimise the impact of construction on the north bank. Configuration B is the alternative configuration to the detailed solution for site 1. It removes the backstays from the bank entirely, and anchors them to the river wall inside the spiral ramp. This geometry requires a bank to bank distance of at least 234m to provide the 150m navigational channel.

Benefits of alternate B configuration option are:

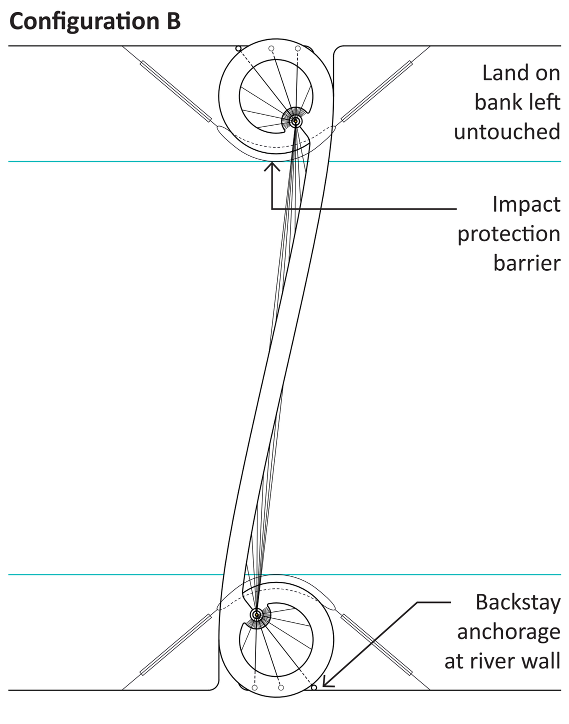
- Minimal impact on riverside sites and neighbours
- No impact on trees from anchorage foundations
- Geometry is adaptable to all other bridge location options without major changes to the structural arrangement.

Configuration A

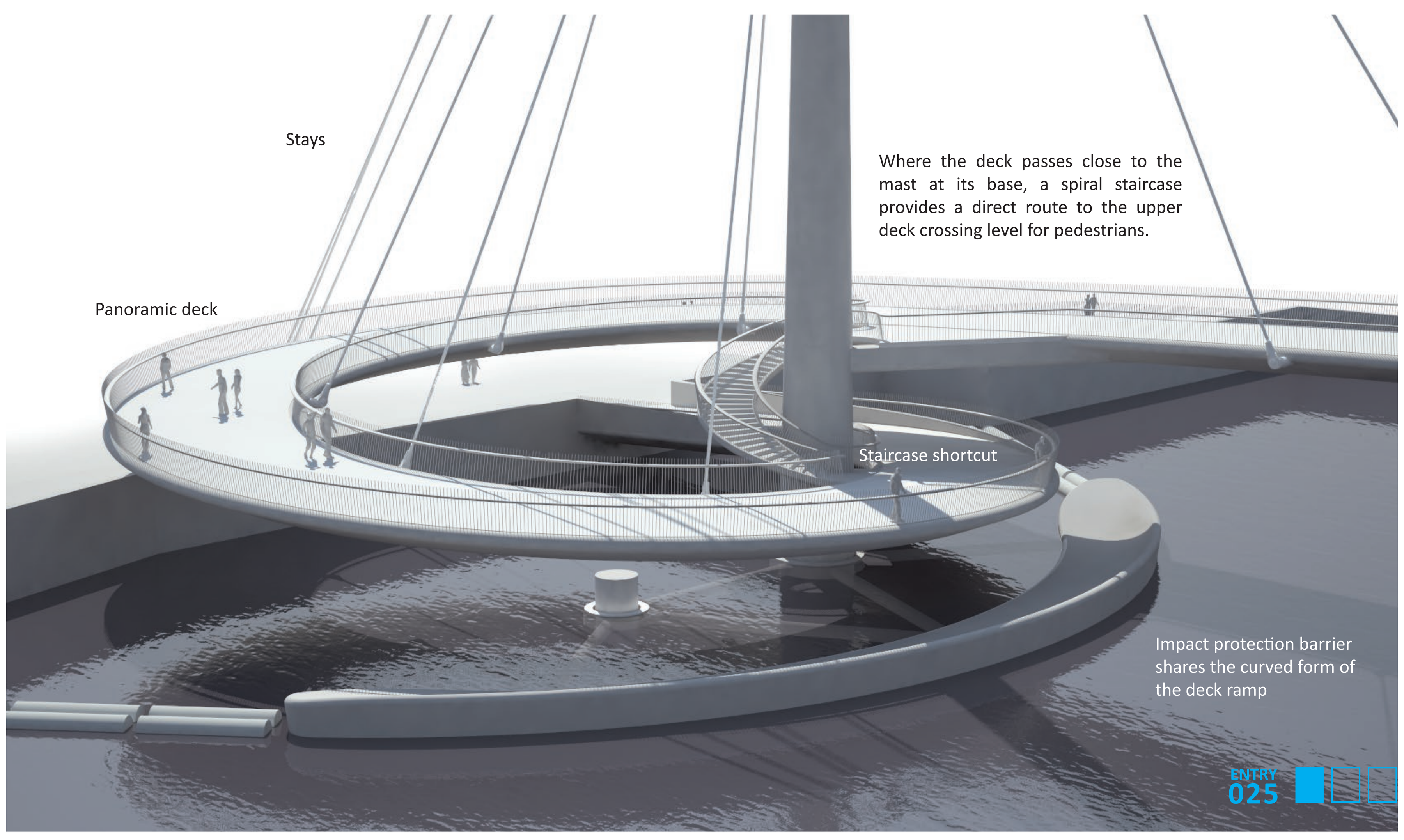


Configuration A relates to site 1, which has the shortest distance between banks. It provides the 150m wide navigation channel with the masts placed in the river closer to the banks than in configuration B. The spiral access ramps suspended over the water and river wall are optimised to be compact and easily navigable. The backstays in this configuration are anchored on the riverbanks.

Configuration B



Configuration B allows for all structure to be between the banks. Backstays are anchored into the rebuilt river walls. There is no structure on the banks at all. Configuration B is of course possible at site 1, however with a reduced navigational channel width.



Superstructure

The slender cable-stayed sinuous form provides a continuous smooth curved path across the river. The deck is supported on one side by cables from the mast, with backstays that minimise intervention on the river-bank and avoid conflicts with trees, buried services and other existing features.

The precast concrete bridge deck, with a high quality smooth finish, provides a 7m wide shared space for cyclists and pedestrians, with a 1:21 gradient to ensure accessibility for all users. Resin bonded grit surfacing is provided to create an attractive non-slip surface.

The deck is a continuous monolithic voided box, with a high torsional stiffness to deal with the eccentric cable stay support. Torsional restraint to the deck is provided at the masts with a stiff integral connection.

The bridge is an integral structure with no bearings and joints, using the curved geometry to accommodate temperature effects.

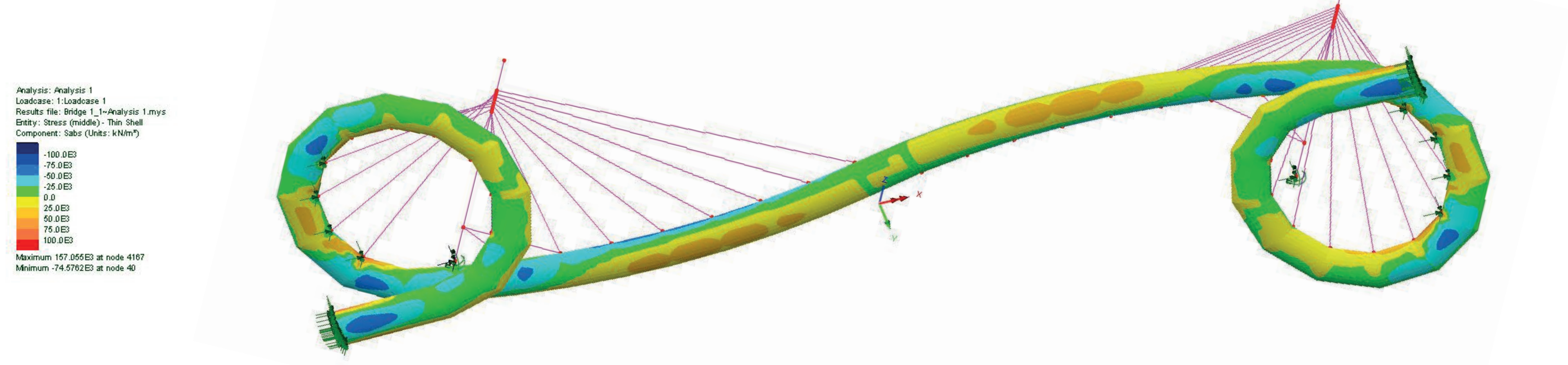
As the spiral ramps provide a relatively flexible longitudinal restraint to the main span, the deck is designed to carry part of the longitudinal load from the inclined cable stays in tension across midspan.

The use of concrete enables a doubly curved soffit to be formed; using sections precast offsite and delivered by river barge. An alternative carbon-fibre composite solution for the deck is also under investigation.

The stays are galvanised locked coil strands at 10m centres in a fan arrangement. The conical mast is fabricated from steel above deck level, and has a special gilded feature tip to locate the bridge in the urban landscape.

The mast location within the spiral ramps is optimised to minimise lateral forces to ensure an economic and efficient design for the structure and foundations.

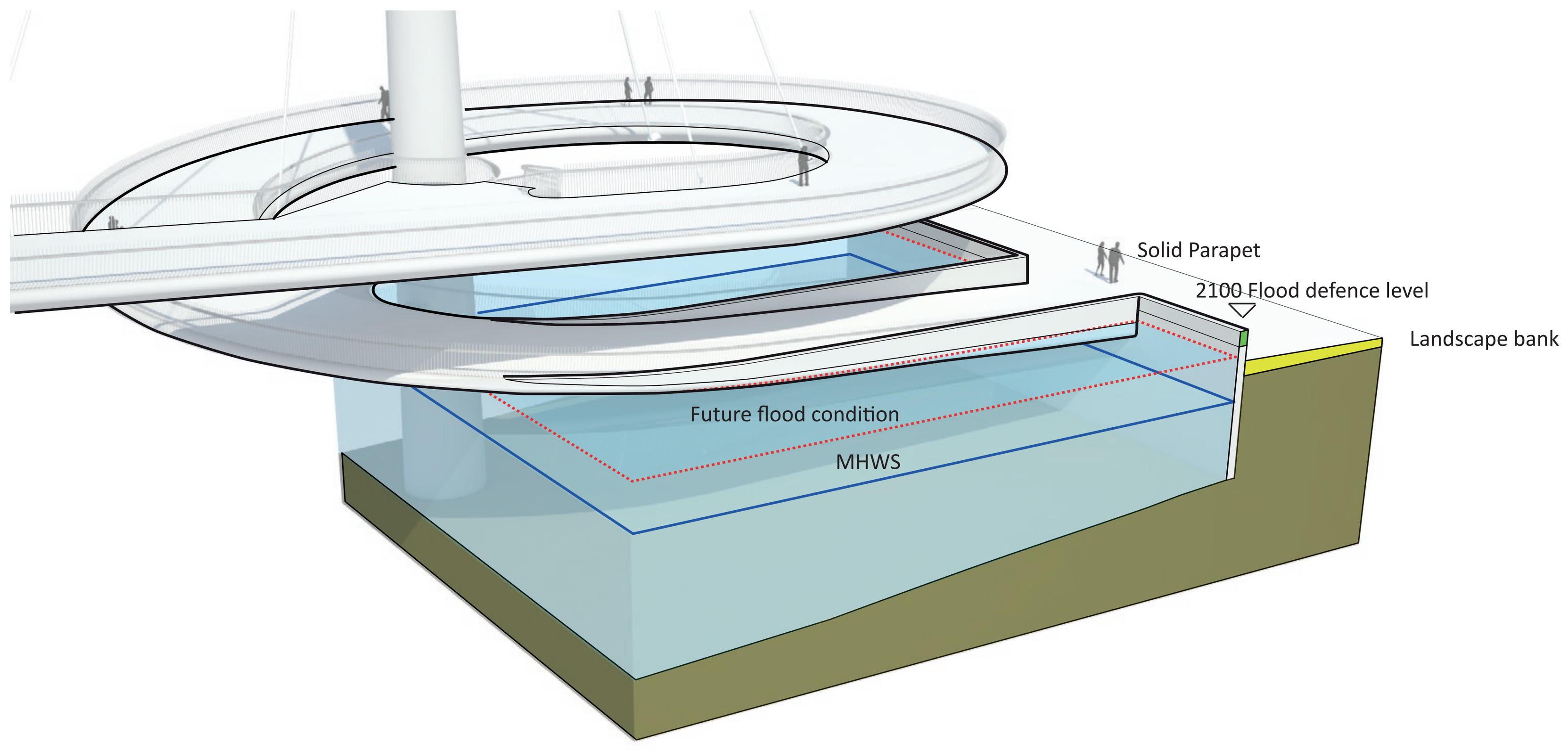
Deck Soffit Dead Load Stress Plot



Flood Defence

As part of the bridge construction, river wall flood defences are raised to a level of 6.35m above ordnance datum in accordance with the EA Thames Estuary 2100 strategy. This remodeling of the river wall allows for level access from the bank and onto the ramps of the bridge deck over river - passing through the river wall. This is done whilst maintaining the flood defence and functionality of the bridge at high water levels.

Initially, previously raised courses of the river wall are removed, down to the new deck level at the base of the bridge. The bank ground level is raised by landscaping of the landing zones up to meet this level, which is necessary for people to be able to stand and look out on the Thames over the new flood defence. The new raised flood wall is integral with the solid parapet wall of the end section of the bridge ramp deck, protecting the bank and base of the deck together from flooding.



Foundations and Substructure

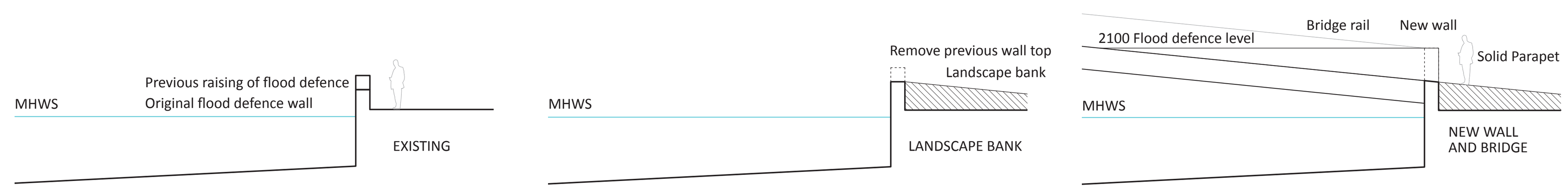
For durability, the masts are concrete up to deck level, with a reinforced concrete pile cap located below the river bed level to avoid scour.

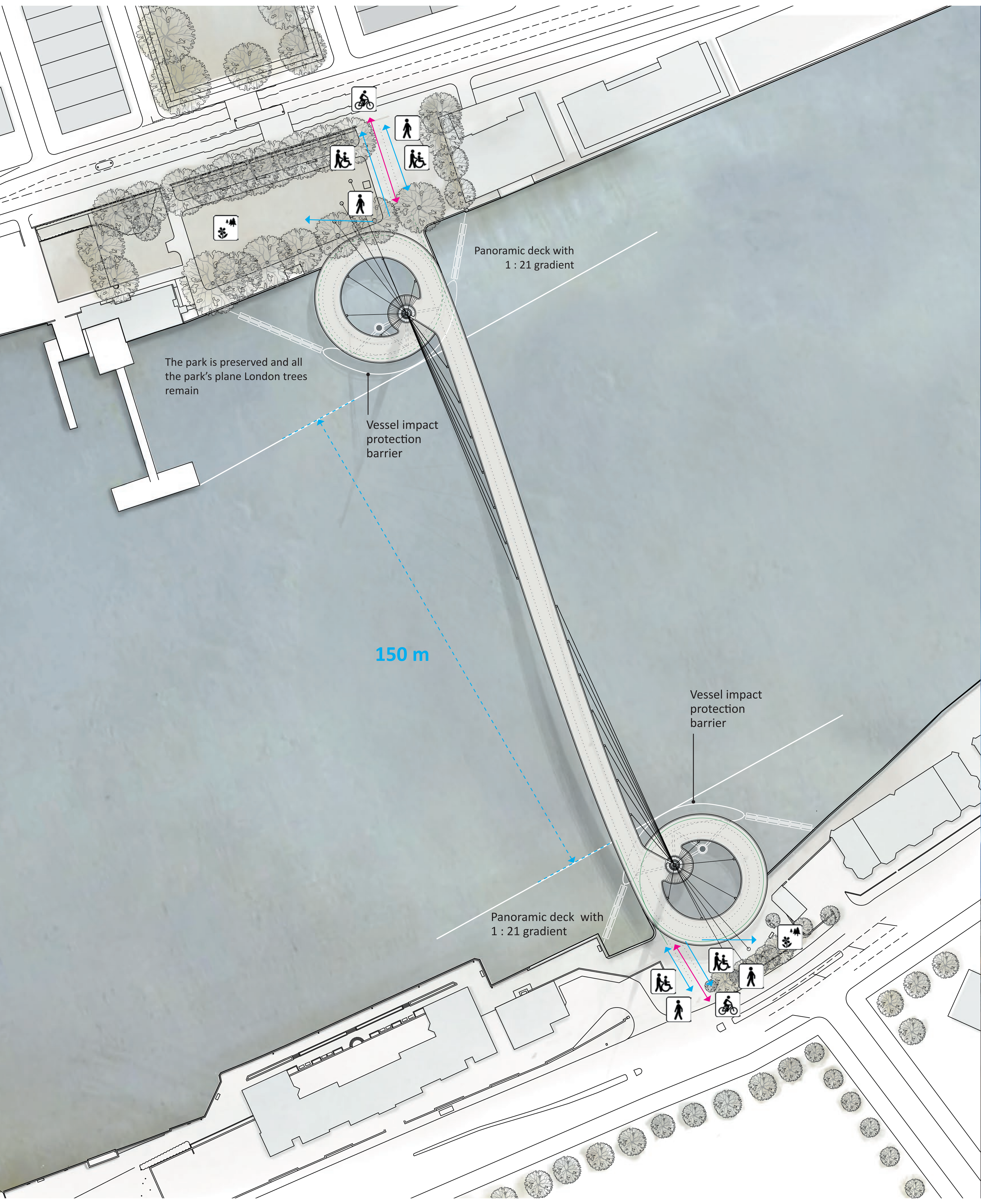
The structure is founded on bored piles curtailed in the London Clay and upper cohesive Lambeth deposits. Pile lengths are limited to remove the need for temporary support fluid below an upper temporary casing. Twelve 1200mm diameter piles are required per mast base.

The masts are restrained by backstay cables anchored to ground. Tension capacity is provided by ground anchors which will be connected by a steel pile cap to minimise construction depth and avoid damage to trees. Consultation with our arboriculturalist propses a ground radar survey to locate major tree roots, before exposing them from the topsoil and threading ground anchors in between.

A bespoke steel grillage pile cap will then be detailed and fabricated to connect the anchorages together and transfer capacity into the backstay cables. This open grillage allows soil to be reintroduced to allow re-growth of the small roots in the topsoil zone. The pile cap will be covered with free-draining granular material to allow continued growth and irrigation of the trees.

New Wall and Flood Defence Levels





Lighting

The bridge is illuminated at a human scale for deck level users, and at a larger scale as a landmark in the city. The deck is lit by ribbons of light glowing from beneath the handrails of the parapet, guiding the path across.

The golden spires are up lit as lanterns high above and can be seen from across the city.

Top Lighting

- visible from far away (100 lux)
- amber LEDs enhance the gold tips
- ultra narrow beam angle of 3 degrees
- seen from all sides
- integrated in slim ring around the top
- little visual impact

Architectural Lighting

- subtle enhancement of pylons
- floodlights mounted around pylons at staircase level
- no visible light sources
- 3000K Ra>80

Handrail Lighting

- ensures S2-S3 lighting class
- illuminates 7m wide surface
- placed at 1m height
- dimensions of light element: max. 60x80mm
- solution with asymmetric lens system
- no tilt
- no visible light sources
- perfect longitudinal uniformity
- 3000K Ra>80

Wayfinding Lights

- integrated in ground
- ride or walk over
- 3000K Ra>80
- max. Ø 50mm

Functional lighting on banks

- urban roadlighting luminaires on cycle path and pedestrian areas
- post top lighting
- ensures S2-S3 lighting class
- high visual comfort
- human scale

Deck Section

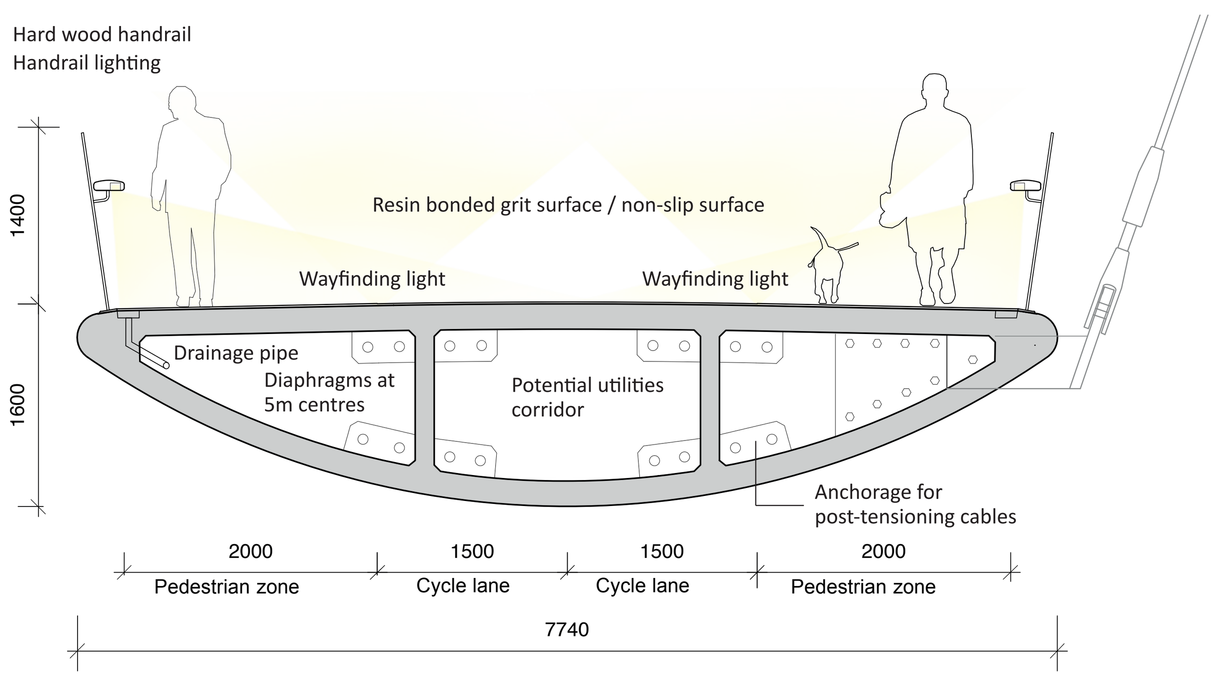
The deck construction is optimised to provide maximum usable deck surface space with the minimum structural width. This minimises the amount of material used in construction and reduces costs. A smaller deck section is more sustainable in terms of embodied energy in material used, its transportation and construction.

Deck Materials

This proposal details a modular high quality concrete deck. Sections are prefabricated with a smooth white surface finish reminiscent of that of stone or marble. Smooth doubly curved surfaces can be cast. Repetitive castings are exploited in the constant ramp geometry and in the symmetrical form of the two sides. This allows for a sustainable and economic solution. The rhythm of precast elements is echoed in the stay arrangement.

There are alternative construction options which should be explored. Carbon fibre composite construction will provide a revolutionary, world first for a bridge of this scale. Technology from yacht building can prefabricate modular elements in composite similar to they would be in concrete. There would be however a substantial saving in weight and transport costs, allowing larger elements to be used in construction.

Steel construction is a viable and proven alternative solution, delivering excellent structural performance.

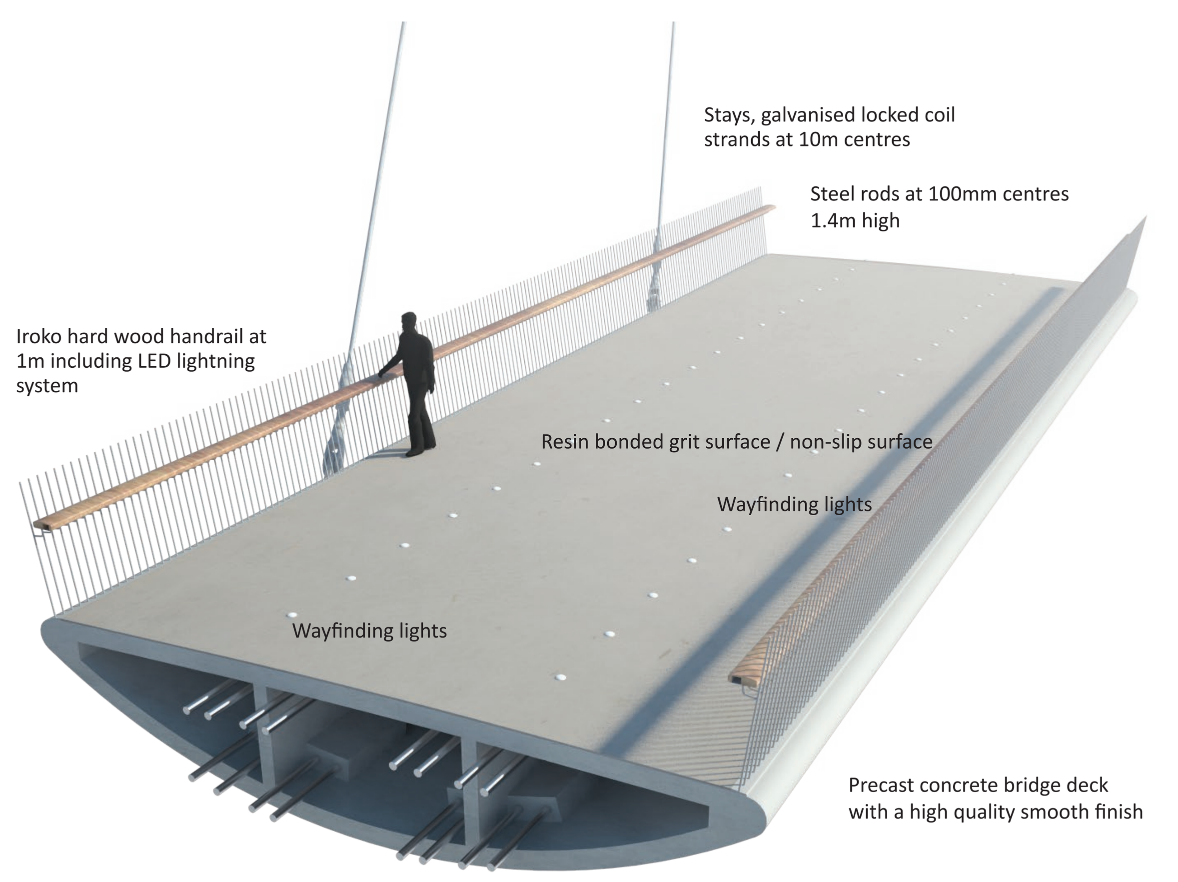


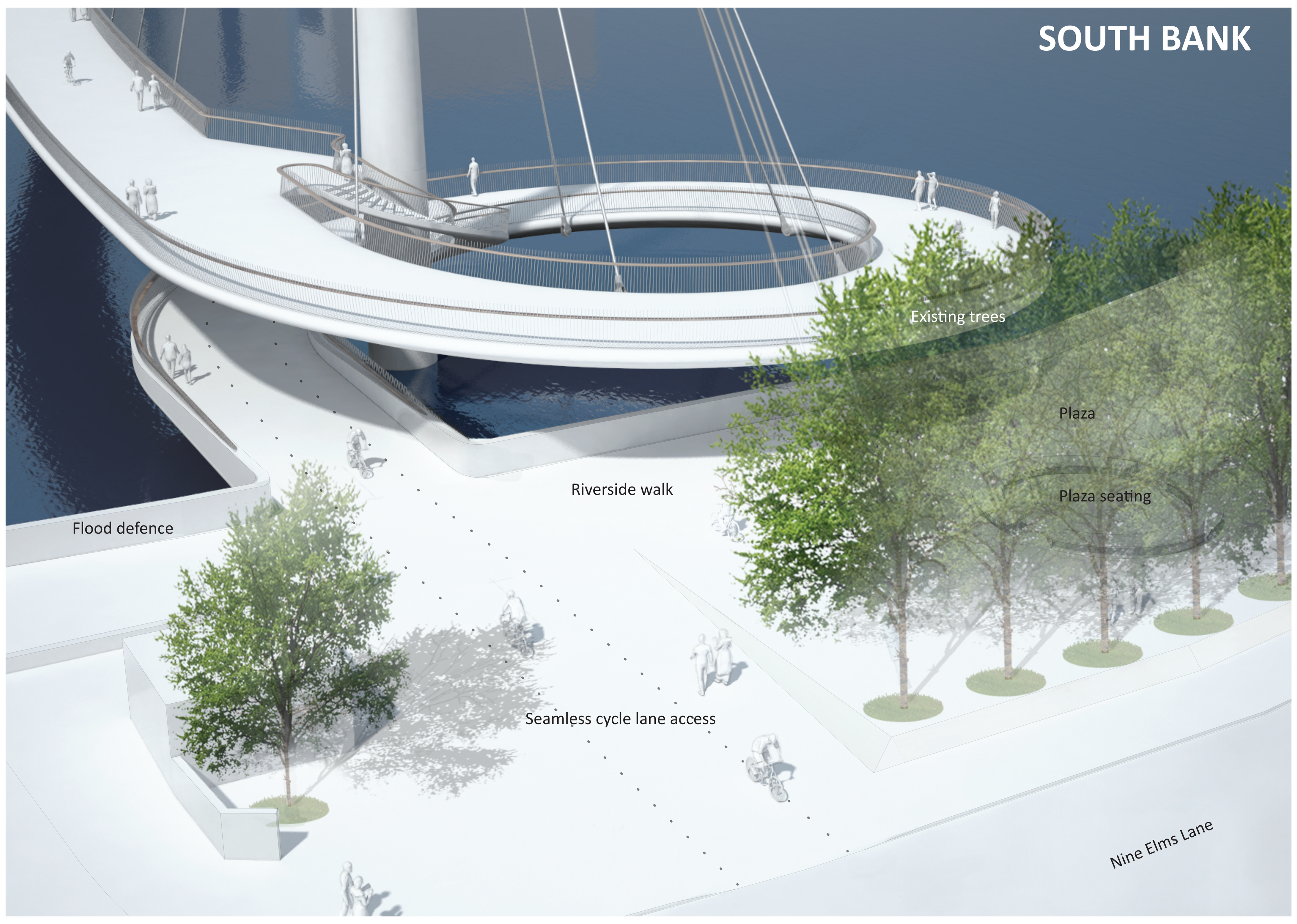
Section 1 : 50

Deck Parapet

The deck parapet is a line of steel rods creating a lightweight and uniform ribbon along the crossing length. The rods support a smooth hardwood handrail for pedestrians along the full length of the bridge and they extend above to meet cycle safety parapet requirements. The parapet rods angle subtly outwards from below the handrail to maximise usable deck space.

Limited wind protection and some wind deflection is provided by the parapet and handrail, but with the opportunity for the provision of increased shielding supported by the parapet if necessary. A windshield along the deck centre line could be provided at maximum mid span exposure if the client deemed it strictly necessary.





Public Realm

Public realm place-making is focused at the bridge ends where the ramps and landings create sheltered and interactive public space. The interaction between the deck ramp and the bank is a place-maker. The transition from the bank onto the bridge ramp is direct and coherent. The strategy for the landing areas is to create open spaces with high visibility for safe, simple, functional access to the bridge. These clear spaces allow both pedestrian and cycle users the time and space to maneuver without visual or physical obstruction. The uncluttered space has a versatility to allow for public life and culture to develop as the bridge is used.

North Bank

The impact on Pimlico Gardens by the bridge landing is kept to a minimum. The direct approach to the bridge follows the existing path across the garden at the east end of the lawn. This path is combined with the eastern remainder of the park to create a clear, open landing for non-congested user access. The eastern end and bankside edge of the park is smoothly landscaped to meet the level of the bridge deck landing and the raised river wall. The majority of the Garden, including all trees, main lawn and Westminster Boating Base operations can remain.

South Bank

The public space at the South bank landing is a hub where the bridge meets the Riverside walk, part of a rejuvinated South Bank promenade. The interaction between the deck ramp and the bank is a place-maker. The transition from the bank onto the bridge ramp is direct and coherent. The two are integrated together as a greater single place as the ramp loops round over the bank, creating shelter over, and views of the public life on the promenade plaza below. Trees along Nine Elms Lane are preserved and supplemented by a new seating area, encouraging habitation of the space.

Dynamic Performance

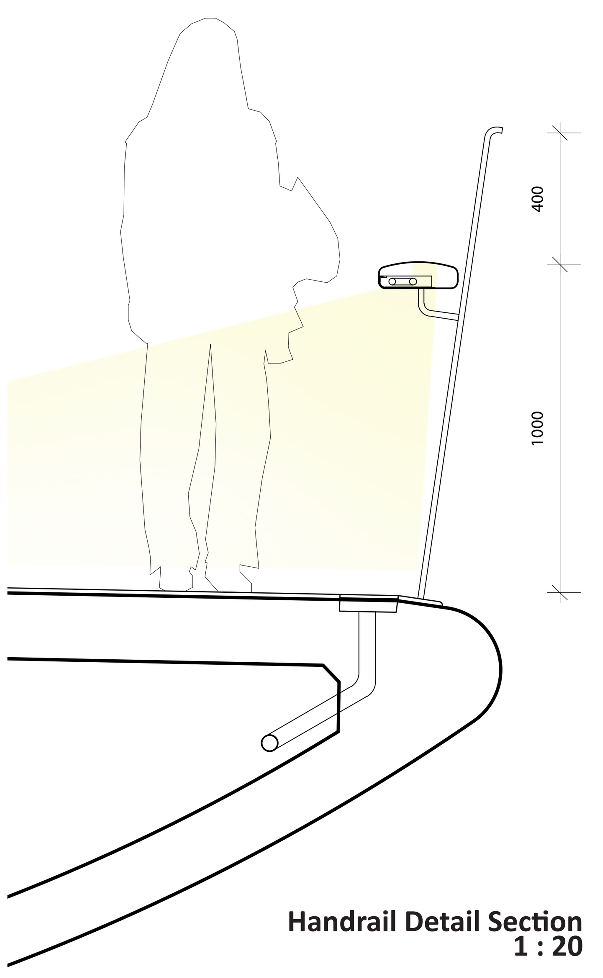
Long cable-supported spans are potentially susceptible to vibrations due to wind and pedestrian excitation. To mitigate these effects it is likely that tuned mass dampers will be installed. These are only required for serviceability conditions and will reduce the displacements and accelerations experienced by users to a comfortable level.

Careful detailing of the section will create a deck section that is not susceptible to wind induced vibrations.

The section will be checked for vortex induced vibrations and gust buffeting effects by modelling in a wind tunnel, and the results will be fed back into the design process.

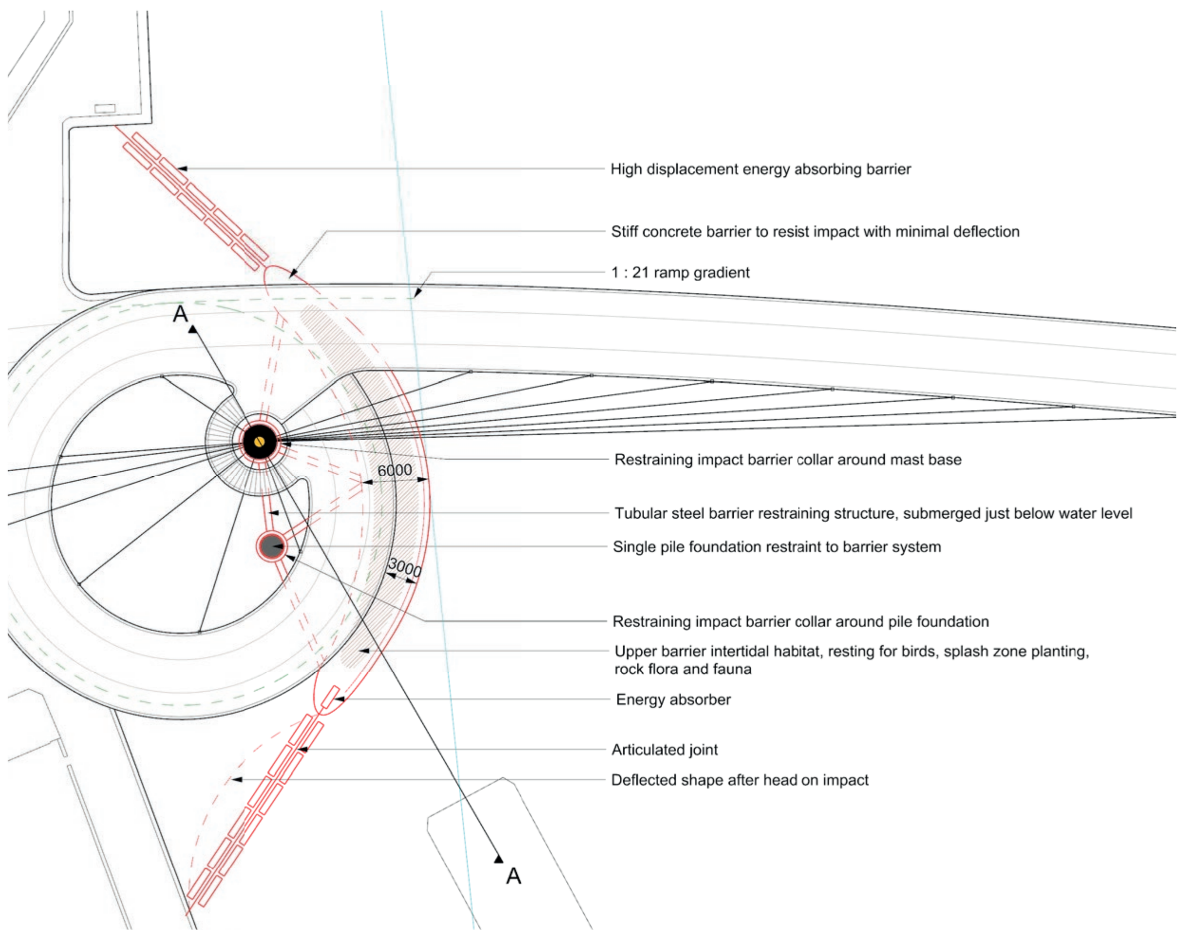
The mast is a tapered circular section. The tapered shape, location and shape of the cable anchorage points at the top of the mast, inhibits the formation of coherent vortices, reducing the impact of the first mode of vibration. If dampers are required, to control amplitudes in the first and higher modes, these will be installed internally and arranged to permit access for inspection and maintenance.

Pedestrian excitation will be modelled using a full time history analysis for moving loads. Accelerations will be limited to ensure the comfort of pedestrian and cycle traffic.



Handrail Detail Section
1 : 20

Vessel Impact Protection and Ecology



A floating barrier encircles the spiral ramps and sits partially submerged at the rivers surface. The crescent arc of the barrier and curved profile share the aesthetic of the deck ramp, so that the structure does not detract from the lines of the bridge itself.

The primary function of the barrier is to protect the bridge ramps and lower superstructure from the impact of a 2500 ton vessel travelling at 12 knots. However, since this stretch of the Thames is an an area of wildlife deficiency, the floating impact protection barrier has the potential to enhance local marine biodiversity in a number of ways.

The upper surface of the barrier can enhance the intertidal ecology by providing vegetated soft sediments or hard substratum for flora and fauna. This provides habitat, feeding and resting areas for birds and invertebrates. A rock habitat could also be incorporated on the barrier to accommodate for encrusting and slow moving intertidal fauna and flora such as macroalgae (seaweed), barnacles, limpets and sea snails. This biodiversity will add to the enjoyment of the riverscape for bridge users.

The underside of the barrier can be cast for give a surface habitat rich for sub tidal organisms.

Section A-A