VERBINDET BRÜCKE: A BRIDGE THROUGH THE HEART OF EUROPACITY

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BACKGROUND

The proposed Verbindet Bridge, located in the heart of Berlin, will be a centerpiece for the new Europacity development. The Europacity development spans approximately 40 hectares, and provides access to some of Berlin's main train stations. The aim of redeveloping this district is to establish a high-quality urban space in the center of Berlin, providing new areas for businesses, housing and public space. The area will include pedestrian friendly roads and green spaces with direct links to the newly expanded boulevard of Heidestrasse.

As shown in Figure 1, the proposed bridge will be in the north end of the Europacity district, linking the communities of Moabit and Mitte.

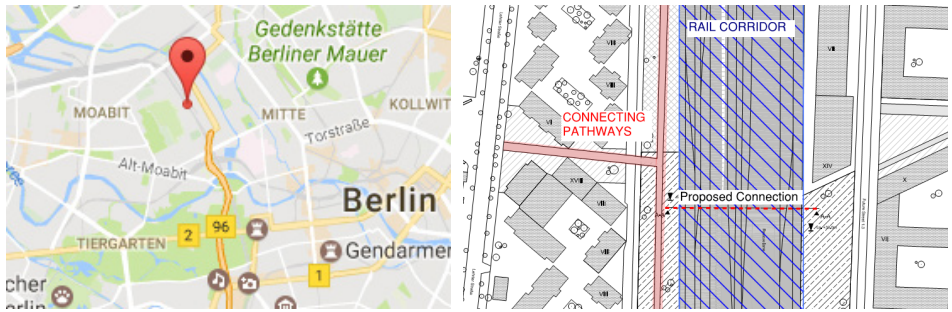

Figure 1: Proposed location for the Verbindet Bridge. a) Bridge location in Google Maps, b) Layout of the area and the proposed connection by Maximillian Schubert

The area surrounding the proposed bridge was originally developed in the 19th Century as part of the railway networks throughout Berlin. During the second world war, the area was severely bombed and became a no-man's land dividing East and West Berlin. The development of new paths, roads and buildings in the area will increase the need for a signature bridge structure that will define both the past and future of the communities surrounding the bridge.

OVERVIEW

The proposed Verbindet bridge is to be a central part of the Europacity development. The structural system that best fits the needs of the community is an extradosed bridge. The proposed bridge consists of a 90.5 m long main span, and seven approach spans with varying lengths. The layout of the proposed bridge is provided in Figure 2, along with some key dimensions.

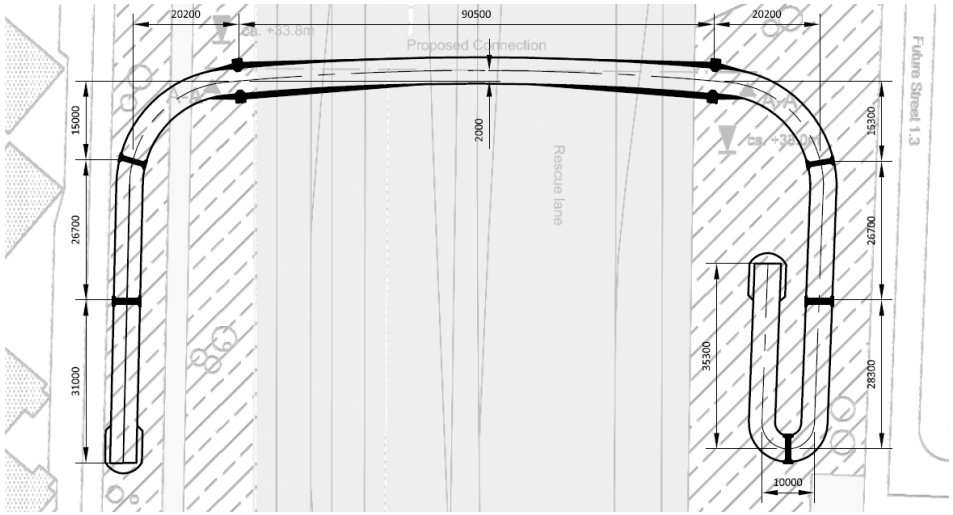

Figure 2: Layout of the proposed bridge.

A cable structure was chosen to span the rail corridor to avoid intermediate supports. An extradosed bridge provides this function while also creating a beautiful structure and centerpiece for the community. The shorter towers, as compared to a traditional cable stay bridge, provide a more appropriate fit for the surrounding parks, paths and buildings.

The bridge is curved in plan to provide smooth and aesthetic approach ramps for pedestrians and cyclists. This curvature pays homage to the history of the area as a hub for trains, which flow seamlessly around all obstacles in the surrounding landscape. The visual product of this curvature is a simple, unimposing ramp for the approaches that leads up to the signature main span.

The elevation view of the main span of the bridge is presented in Figure 3.

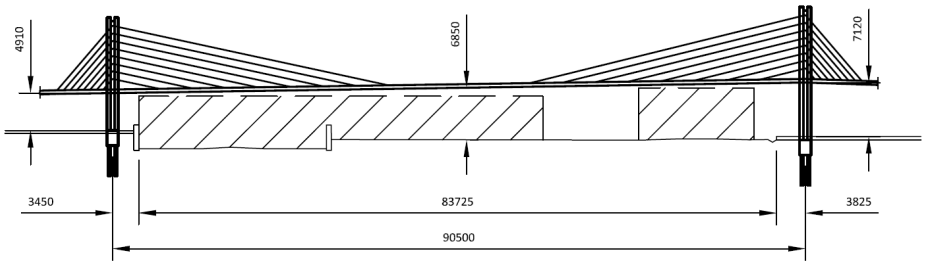

Figure 3: Elevation view of the main span of the proposed bridge. Clearance requirements for trains are shown as dashed regions.

The deck of the main span provides a minimum of 6.2 m clearance above the rail corridor. A 6% ramp gradient is provided along the east and west approaches. The bridge deck runs 4 m above the multi-use path on the west side, providing adequate clearance. The bridge is designed to allow for the installation of high-voltage protection, in accordance with RIZ-ING Elt 2. In addition, the main span towers are positioned more than 3 m away from the edges of the railway corridor to prevent impacts, and to provide better foundation conditions. The proposed foundation includes a concrete footing over concrete piles that extend into the stable sub-soil and bedrock located underneath the peat and sludge.

The overall concept for the main span of the proposed Verbindet bridge is presented in Figures 4 and 5.

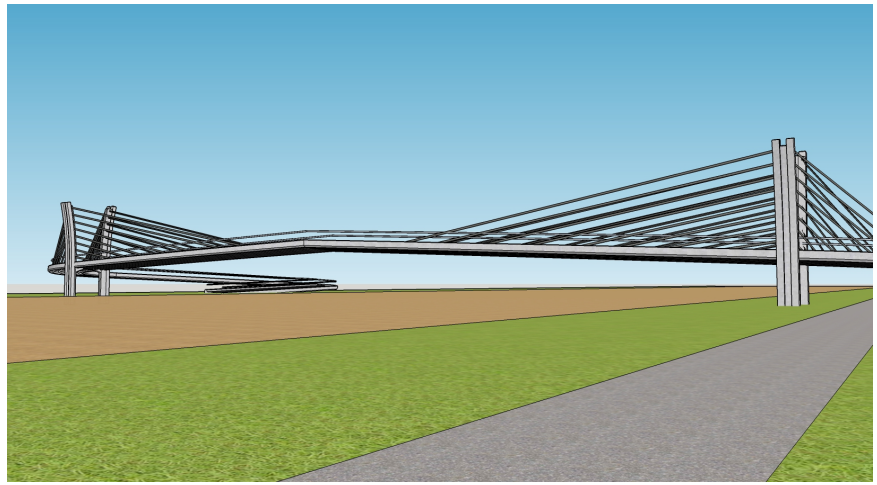

Figure 4: 3D model of the main span of the proposed bridge. View from the west side pedestrian walkway.

Figure 5: 3D model of the main span of the proposed bridge. View from the center of the bridge, looking west.

DESIGN DETAILS

The proposed Verbindet bridge is designed to withstand the loading specified in the Eurocode, and reduce the amount of vibration without the need for any dampers. The cross section of the bridge deck is provided in Figure 6.

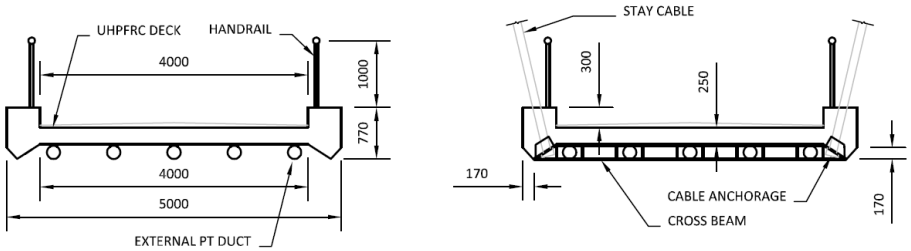

Figure 6: Cross section view of bridge. a) Typical section, b) At cable anchorage.

The full depth of the deck is comprised of Ultra High Performance Fiber Reinforced Concrete (UHPFRC), which provides the stiffness required to reduce vibrations and the compressive strength required to withstand the large compressive forces due to bending and axial compression from the cable stays. The deck is supported with five external, un-bonded post-tensioned steel ducts that increase the lever arm and bending resistance of the bridge deck while reducing the quantity of concrete required. In addition, this arrangement provides access to the tendons and cable stay anchorages for repair and maintenance.

At the cable stay anchorages, a steel beam is incorporated seamlessly along the base of the deck to act as a cross beam and transfer the loading from the stays to the deck. This cross beam has openings for the longitudinal ducts, with vertical stiffeners around each of the openings. The concrete deck is reinforced with steel reinforcement to provide additional bending capacity and prevent cracking. All the steel used for the cross-beam, reinforcement and cable stay anchorage is to be composed of stainless steel to improve the durability of the bridge, and reduce the amount of maintenance work required.

The elevation and plan view of the proposed main span tower is provided in Figure 7. The towers are inclined above the deck to match the geometry of the in-plan curvature of the roadway. The towers are comprised of three sections. The middle portion stops short at the top of each tower, as illustrated in Figure 7. This provides simple and elegant towers, which are one of the main visual components of the bridge.

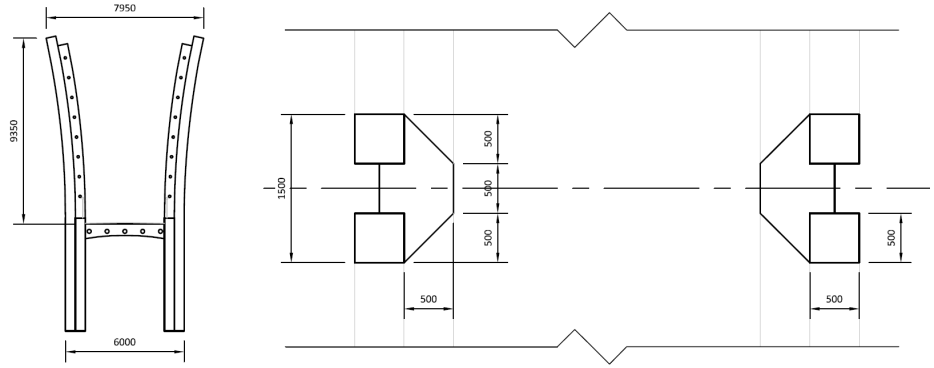

Figure 7: Main span pier legs. a) Elevation view of tower, b) Plan view of tower footprint at deck level.

CONSTRUCTION METHODOLOGY

To reduce the construction time and the environmental impact of the project, the bridge will be constructed using prefabricated segments. The main span towers will be used to install the pre-fabricated deck segments over the rail corridor, without impacting the train schedule. The main span and approach piers will be built using pre-fabricated segments with post-tensioning bars and strands. The approach spans will be built using pre-fabricated deck segments, installed using the span-by-span construction method.

CONCLUSION

The proposed Verbindet bridge will provide a centerpiece for the communities surrounding the new Europacity development, creating an important link between Miabit and Mette. This bridge will provide a new means for pedestrians and cyclists to interact with the parks and buildings in the area. The curved deck and inclined towers will fit seamlessly with the surrounding area, paying homage to the history and future of the region.