footbridge
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creatingexperience

Footbridge designs for Spain

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Site 1: Riaño

Site 2: Zamora

Site 3: Seville

Site 4: Zorrotzaurre (Bilbao)

For the Footbridge Conference Madrid 2022 it was possible to submit footbridge designs for four different sites in Spain. This was not a design competition but an opportunity for anyone, especially students and young designers, to submit a footbridge proposal, present it at the conference and get comments and critiques from other participants in the conference

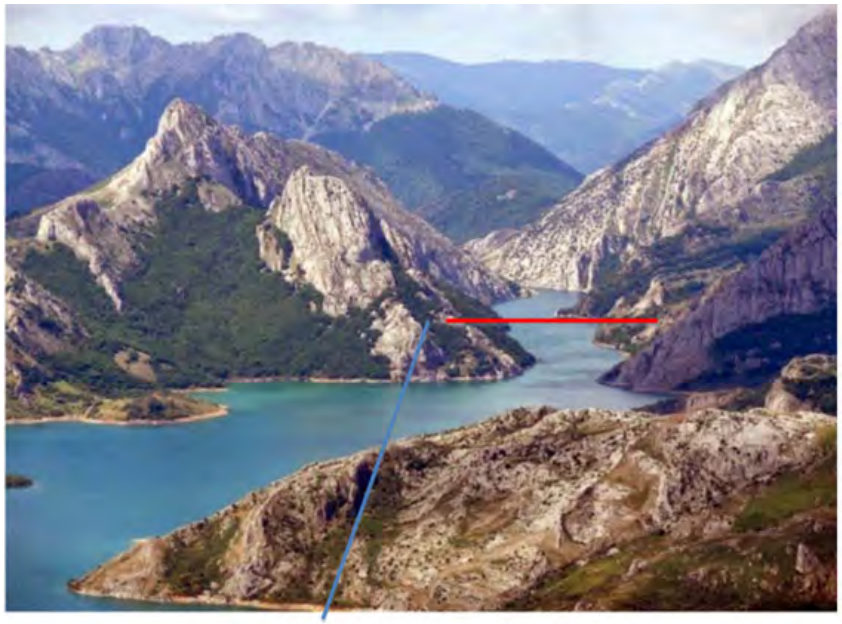
Site 1: Riaño

When the Riaño reservoir was filled in 1987, the network of roads and paths in the area was interrupted. Since that time there has been the idea of building a footbridge to connect Riaño again with the Tendeña valley.

To do so, it would be necessary to give continuity to the current paths to reach the gorge crossing where a footbridge with an important span would be needed.

Existing paths, path extensions and new footbridge

General location of the footbridge



View of the elevation of a possible site for the footbridge

Plan view of a possible site for the footbridge

Close view of the elevation. The design team has to select the exact location, span and elevation

DESIGN REQUIREMENTS

The footbridge must connect the two sides of the gorge. Due to restrictions from the owner of the reservoir a minimum height under deck of 25 m must be respected in order to allow small vessels to pass underneath. The existing footpaths and how to continue them until the position from which the deck of the footbridge will be built need to be considered.
The footbridge will be for pedestrian and cyclist use, and the width and the precise location on the ground plan and the elevation are of free choice.

Site 1: Riaño

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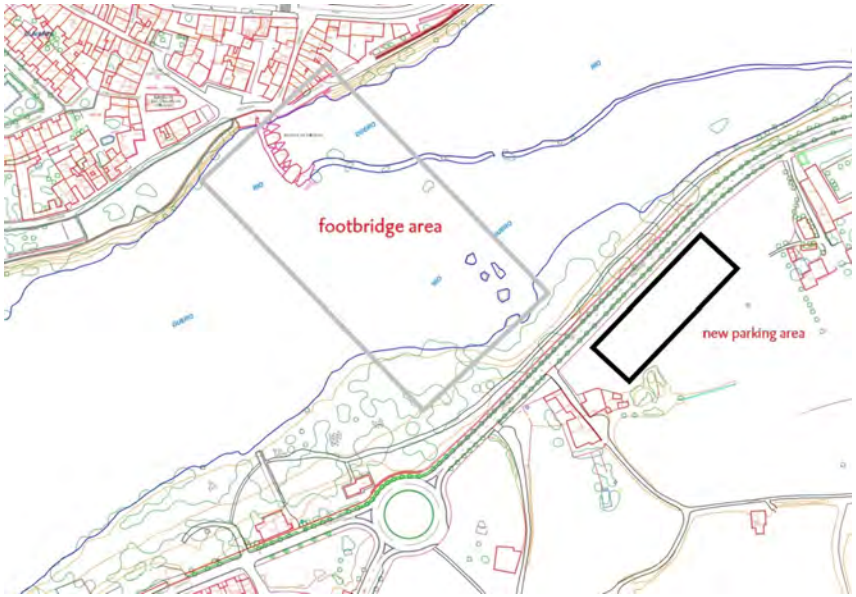
Site 2: Zamora

The historic centre of Zamora is very compact, as befits a city with a medieval layout. The old city is located on the right bank of the Duero River.

View of the Duero River as it passes through Zamora



Location of the new parking area

To avoid the presence of buses and tourist vehicles within the historical area, it has been decided to build a car park on the left bank of the river, and a pedestrian and bicycle bridge that allows access on foot or by bicycle in the monumental area of Zamora.

In order to reduce the cost and take advantage of part of the hydraulic heritage, it has been decided to use the water flour mills.

Water flour mills located on the right bank of the river

DESIGN REQUIREMENTS

The footbridge will therefore connect the two banks of the Duero river. The river is not navigable and therefore the only condition is that there is a 0.50 m vertical clearance over the maximum water level during river flooding.
In order to reduce the cost and take advantage of part of the hydraulic heritage, it has been decided to use the water flour mills platforms as a part of the footbridge.
As it can be seen there are remains of the piers of an old bridge that may or may not be used to support part of the footbridge.

Piers of an old bridge

The footbridge will be for pedestrian and cyclist use, and the width and the precise location on the ground plan and the elevation are of free choice.
The bridge is located in an area of fillings and the planned foundations will be made of piles and will be about 30 m deep.

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Site 3: Seville

For the purpose of the Universal Exhibition held in Seville in 1992, a series of emblematic bridges were built over the Guadalquivir River channel. This channel is isolated by a lock from the natural river, keeping the water at a constant level.

One of these bridges is the Alamillo Bridge, which is the most upstream of the bridges that were built in 1992.
The Alamillo Bridge has in the central part of its section a space for pedestrians that connect both banks at a high level.

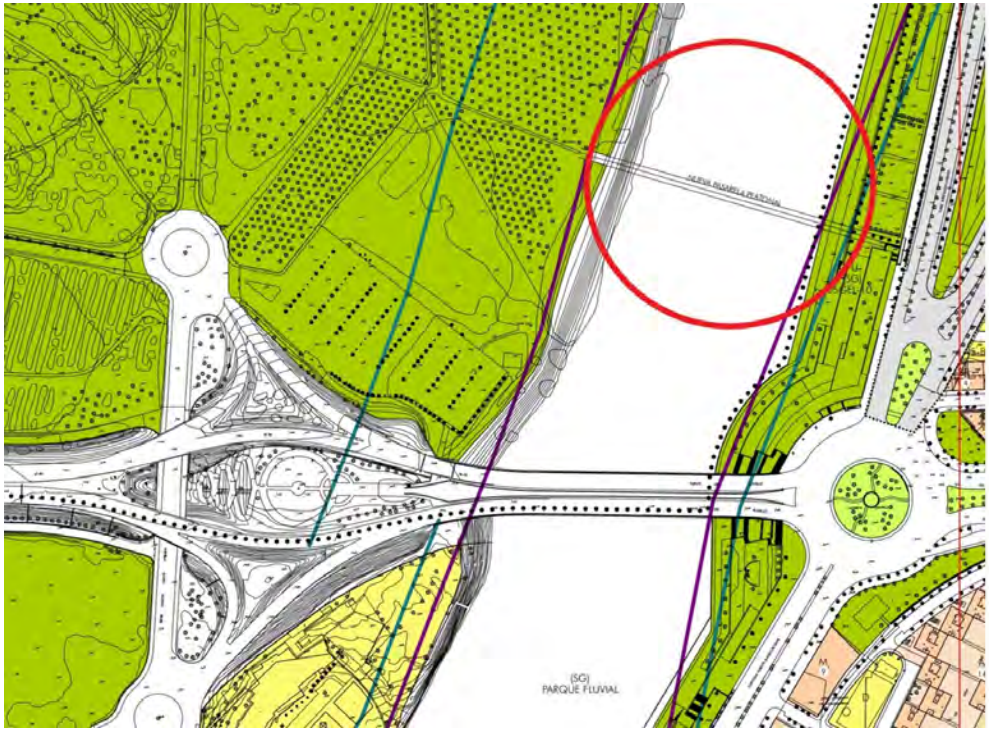
View of the Alamillo Bridge

Central pedestrian path of the Alamillo Bridge

Therefore, there is no pedestrian and cyclist connection between the two banks at the level of the riverside walks.

NEW FOOTBRIDGE OVER GUADALQUIVIR CHANNEL IN SEVILLE

For this reason, the planning includes the construction of a footbridge upstream of the Alamillo Bridge to serve as a pedestrian and bicycle connection between the two banks.



Planning with the new footbridge

DESIGN REQUIREMENTS

The footbridge will therefore connect the two banks of the Guadalquivir canal. There are no vertical restrictions.
The footbridge will be for pedestrian and cyclist use, and the width and the precise location on the ground plan and the elevation are of free choice.
The bridge is located in an area of fillings and the planned foundations will be made of piles and will be about 35 m deep.

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Site 4: Zorrotzaurre (Bilbao)

Site 4: Zorrotzaurre (Bilbao)

Zorrotzaurre is an island where a large number of industries from the Bilbao estuary were concentrated. The recovery of the estuary for the city began in the 1980s with the gradual withdrawal of industry and the construction of cultural facilities, including the Guggenheim Museum.
The island of Zorrotzaurre is located downstream from the city and is therefore one of the last actions for the recovery of this part of Bilbao.

Zorrotzaurre masterplan

Frank Gehry Bridge location

Zorrotzaurre's masterplan includes the definition of a new development and the opening of the so-called Deusto Canal, which is the right branch of the River Nervión. The development project includes the construction of two bridges at the ends of the island. The Frank Gehry Bridge (the one furthest upstream) and the San Ignacio Bridge (located at the opposite end of the island). The first one was opened to traffic in 2015 and the second one is currently under construction.

Frank Gehry Bridge

San Ignacio Bridge location

San Ignacio Bridge

ZORROTZAURRE NEW FOOTBRIDGE

The central area of the island is the last to be developed and the construction of a footbridge for pedestrians and cyclists is planned to shorten the crossing, which is the object of this competition.

General location of the competition footbridge

DESIGN REQUIREMENTS

The footbridge will therefore connect the two banks of the Deusto canal. The channel is not navigable and therefore the only condition is that there is a 0.50 m vertical clearance over the maximum water level during river flooding
The footbridge will be for pedestrian and cyclist use. The width and the precise location on the ground plan and the elevation are of free choice.
The bridge is located in an area of fillings and the planned foundations will be made of piles and will be about 25 m deep.

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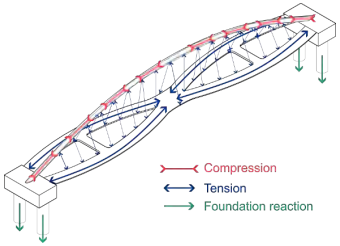
PASARELA DE LA CADENA | CHAIN-LINK FOOTBRIDGE.

Katebegi (chainlink) is derived from the Basque words “kate” meaning chain and “begi” meaning eye. The bridge pays tribute to Zorrotzaurre’s industrial past, where internationally renowned company Vicinay produced marine chains for ships and offshore platforms for over 60 years. As Zorrotzaurre looks forward to becoming Bilbao’s technology district, the proposed footbridge is inspired by the chain-link form linking this future of the river while paying tribute to its past.

The chain-link form is invoked in the plan form of the footbridge, with two 3m wide decks following circumferential segments with opposing radii that intersect across the canal. Each loop is connected by intermediate passages that evoke the links of a mooring stud chain. The arch and its reflection on the canal further emphasise this form, physically connecting Zorrotzaurre with la Ribera, while commemorating its past.

Structurally, the bridge is designed as a bowstring arch, ensuring that the clearance constraint is satisfied by shifting the structural loadbearing elements above the bridge deck. The loads from the decks are transferred to the arch through the hangers, with the arch working in compression and transmitting the loads to the abutments. The abutment reactions are resolved into two components; (1) vertical loads that are transferred to the piled foundations, and (2) the lateral component, which is resisted by the deck in tension, thus closing the loop.



The rise of the arch is 10 m and corresponds to a rise to span ratio of 1/8, which has been designed using graphic statics accounting for the deck permanent loads. The section of the arch is designed as a circular profile with 1 m diameter swept along the arch profile, carefully designed to mitigate buckling of the arch. The curvature of the decks, coupled with the eccentric connection of the hangers, generates considerable torsional moments in the deck. This is thus designed as a trapezoidal box to resist this torsion. The hangers are spaced at 4 m along the span of the footbridge, joining the arch to the inner-face of the decks, except at midspan where the hangers are displaced to the outer edges, to provide torsional restraint.

The construction sequence starts by excavating and casting the foundations behind the banks on both sides of the canal, and the installation of the bearings. The assembly of the bridge can commence simultaneously on the island-side of the canal, minimising the impact on the recently completed riverside walk on the right-side of the canal. The trapezoidal deck-segments shall be fabricated off-site and transported to Zorrotzaurre. The presence of the two existing bridges at either end of the Deusto canal restricts the segments to be either transported by road or shipped down the Nervión river and transported across the island. Once on site, the segments will be placed on props reproducing the profile of the footbridge, with the required precamber, and shall be welded together. An analogue process will be followed to construct the arch. Once the arch and the deck have been built, hangers will be installed and prestressed. At this point, the structure will have already achieved its permanent structural form as a tied arch. A mobile crane located on Zorrotzaurre will lift one end of the structure onto a barge, that will guide the bridge across the canal into its final position. Mobile cranes at either side of the canal will lift the entire structure into its final position, where it shall be fixed onto the bearings. The construction will then be completed with the installation of handrails, wearing course and lighting.

Javier Cañada Pérez-Sala & Luke Lapira