Bentley
Advancing Infrastructure

CASE STUDY

Zumelegui Viaduct in Elorrio Helps Improve Connectivity for Spain's Basque Country Provincial Capitals

OpenBridge® Streamlines Design and Construction Workflows to Keep the Project on Schedule

FASTER, CLEANER, AND SAFER TRANSPORT

As part of the European Union's efforts to improve connectivity between the provincial capitals of Spain's Basque Country, as well as accelerate passenger and cargo transport between Spain and France, Spain's Administration of Infrastructure (ADIF) is delivering the Vitoria-Bilbao-San Sebastian high-speed rail line. The initiative includes building a tunnel and four viaducts, including the Zumelegui viaduct, along the three-kilometer segment running through Elorrio in Vizcaya. K2 Estudio de Ingeniería (K2) is helping to construct the 481-meter-long viaduct considered one of the few examples of the use of a balanced cantilever construction method in high-speed railway bridges.

K2 engineers explained that this project is part of a new high-speed railway to reduce the traffic of vehicles that travel every day between the provincial capitals of the Basque Country, as well as uniting these capitals with the rest of the cities of Spain, with a fast, clean, and safe means of transportation. The new line will help travelers who currently use private vehicles or highway transportation so that, upon completion, it will cut roadway traffic and eliminate thousands of metric tons of carbon emissions.

ADDRESSING SITE AND STRUCTURAL CHALLENGES

Situated at a high elevation amid mountainous terrain, the Elorrio area is comprised of severe slopes that presented challenges in designing and constructing an optimal bridge structure. Accommodating the orography required the team to design a long-span bridge deck divided into seven spans, rigidly connected to four central piers, with pier heights reaching 71 meters. To optimize the structural integrity of the design, K2 wanted to use the balanced cantilever construction method. However, the site constraints presented difficulties executing the construction sequence. The team had to consider the impact of the construction sequence when using the balanced cantilever construction method, which led to the challenge of representing the different stages adjusted to the reality of the site.

In addition, the team needed to ensure structural integrity and control the geometry. They explained that another critical aspect was to carry out the deflection calculation and to decide the camber curve so that a geometrical control procedure could be defined. To construct the complex bridge structure amid the unfavorable environment while meeting the client's schedule demands, K2 needed comprehensive and intelligent bridge design and analysis technology.

OPENBRIDGE OFFERS FLEXIBLE MODELING AND ANALYSIS

K2 selected OpenBridge to perform 3D modeling and structural analysis, validating the cantilever method as the most optimal design and construction solution. Working an integrated 3D design environment, the team was able to model and evaluate the bridge structure's behavior under varying forces and loads and visualize the construction sequencing.

Based on their digital assessments, K2 determined the appropriate devices to support horizontal structural integrity, longitudinal displacement, and braking and seismic forces. The software provided flexibility, intelligence, and automation to streamline the construction sequence and adapt to client changes. OpenBridge allowed the team to design and analyze the complex bridge.

PROJECT SUMMARY

ORGANIZATION
K2 Estudio de Ingeniería S.L.

SOLUTION
Bridges and Tunnels

LOCATION
Elorrio, Vizcaya, Spain

PROJECT OBJECTIVES
- To design and construct a 481-meter-long viaduct along the Elorrio section of the Vitoria-Bilbao-San Sebastian high-speed railway line.
- To establish a flexible, digital 3D modeling and analysis environment.

PROJECT PLAYBOOK
OpenBridge

FAST FACTS

- The Zumelegui viaduct is one of four viaducts along Spain's new Vitoria-Bilbao-San Sebastian Elorrio high-speed railway that will reduce traffic and improve connectivity for the Basque Country.
- The viaduct spans 481 meters amid mountainous terrain and is an example of the balanced cantilever construction method in high-speed railway bridges.
- K2 utilized OpenBridge to perform 3D bridge modeling and structural analysis.

ROI

- OpenBridge saved 1,000 work hours and mitigated potential costly and time-consuming on-site errors.

"Bentley's OpenBridge was the tool that let us design and analyze a complex bridge with a challenging construction sequence and geometry control procedure like this."

– Pablo Grandío Noche, Project Engineer and Bridge Engineer, K2 Estudio de Ingeniería S.L.

DIGITALIZATION OPTIMIZES DESIGN AND CONSTRUCTION

The engineering team explained that it is not easy to estimate the total savings of a project that could not have been done without the capacities of software like OpenBridge. Bentley's 3D bridge modeling and analysis application enabled the team to perform clash detection to anticipate and avoid issues, improving design accuracy and mitigating potentially costly and time-consuming errors on site. The digital solution saved 1,000 work hours, reduced material costs, and improved quality of deliverables.

Working in an open digital platform was key to keeping the project on schedule, enabling K2 to quickly implement client-imposed modifications. It was key that K2 be able to rapidly adapt to all possible changes when assisting with the construction of such a complex structure. Without the flexible and robust features of OpenBridge, the team could not have completed the project.

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