Shusha Bridge in Azerbaijan (Rendering)

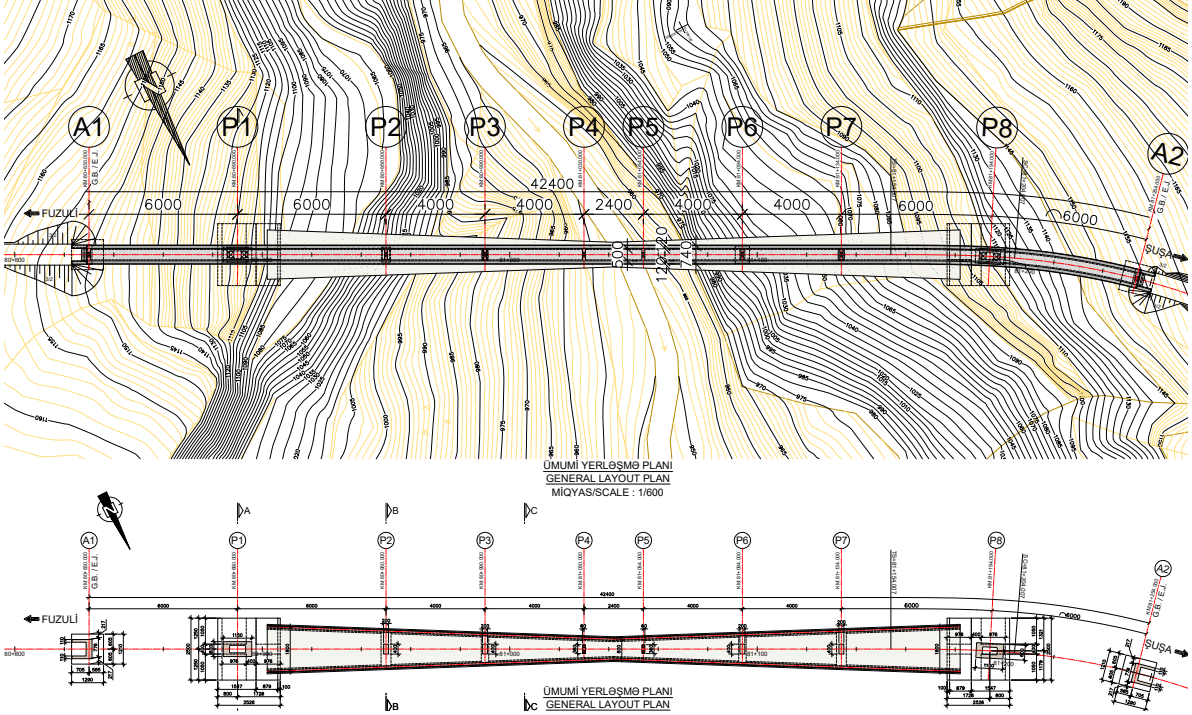
Allplan in practice

SHUSHA BRIDGE: UNIFYING COMPLEXITY AND EFFICIENCY IN INFRASTRUCTURE

A benchmark of design efficiency: Yüksel Proje deploys BIM and Allplan Bridge to overcome unique geometric challenges on the Shusha Bridge project in Azerbaijan.

As part of the Azerbaijan Fuzuli–Shusha Railway project, the Shusha Bridge will serve as a critical component that seamlessly connects the Fuzuli and Shusha regions once completed. Spanning a 200-meter deep valley, the chosen bridge design had to harmonize with the natural landscape while mitigating the challenges of spanning such a deep gorge. In this challenging topographical context, the bridge required a design approach that would balance cost, aesthetics, and structural requirements.

The result was a 50-meter high steel arch bridge with a span of 280 meters, supported by eight columns and an overall length of 424 meters. Yüksel Proje harnessed the capabilities of Building Information Modeling (BIM) to address the intricate engineering demands of this project. By leveraging the advanced software functionalities of Allplan Bridge – from parametric techniques to Python parts and TCL programming – Yüksel Proje was able to ensure precise design, efficient data exchange, and seamless interoperability despite the project's complexity.



General Layout Plan

OPTIMIZED BRIDGE DESIGN

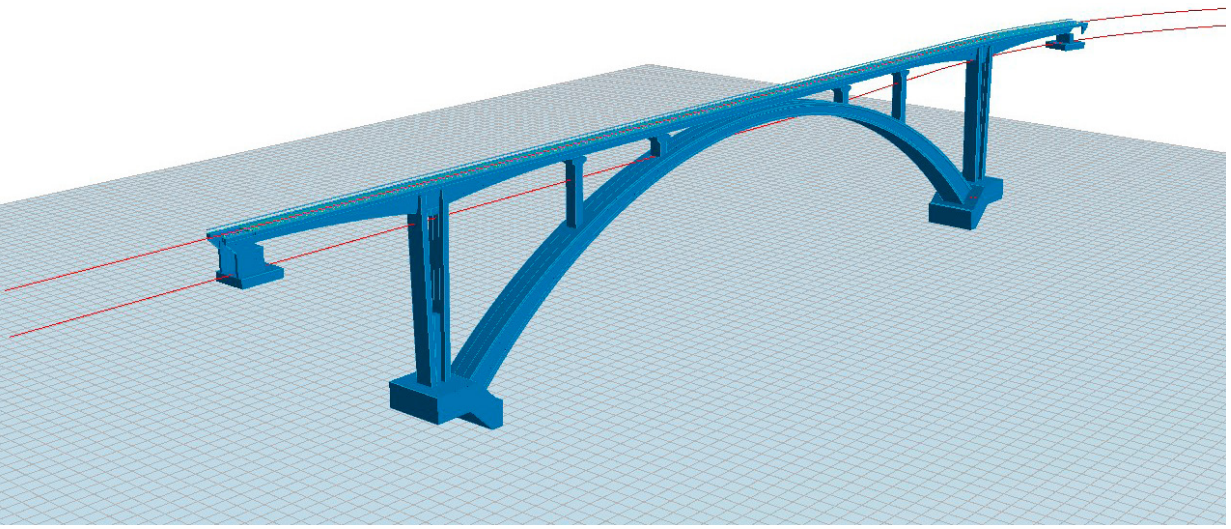
Allplan Bridge played an instrumental role in streamlining the geometry modeling of the Shusha Bridge project, right from the initial stages of design to the final architectural details. The software allowed for the easy specification and manipulation of multiple axes, particularly a main axis and several transversal axes, facilitating a harmonious link between the superstructure and substructure. Through its parametric capabilities, Allplan Bridge made it simple to define and modify the geometry of the bridge by employing a set of interrelated variables. This level of control expedited the evaluation of various design options and captured complex geometrical details with ease.

Furthermore, the software's advanced templating features were pivotal in enhancing efficiency and fostering collaboration among team members. Not only could cross-sections be saved as templates for future projects, but these templates were also extendable to other BIM model components like 3D structural members, project settings, and attributions. The end result was a 3D parametric model that could be effortlessly manipulated for design adjustments, supported by a variation table for controlled input variables. This contributed to an optimized workflow, enabling the project team to swiftly adapt to design changes and ensuring a high level of architectural precision.

STREAMLINED PROCESS WITH AUTOMATION

In terms of workflow automation, Allplan Bridge showcased its versatility by offering partial import and export functionalities, thereby enhancing operational efficiency and reducing the risk of errors. By using the TCL command language, not only could geometrical data be imported or exported in segments, but the same flexibility was extended to other aspects like project settings and material data. This modular approach eliminated redundancy, as exemplified in the treatment of bridge abutments. Initially defined in a general context, the abutments were parameterized using a "free parametric modeling" approach based on Boolean operations applied to a solid prism. These definitions were then saved as templates.

Furthermore, the project benefitted from automating abutment configurations via Excel, showcasing another layer of Allplan Bridge's adaptability. An Excel sheet was employed to establish the abutment variables and generate a corresponding TCL file, which was then partially imported into the model. This allowed for pre-import or post-import adjustments, either directly in the TCL file or within the GUI, providing a streamlined and error-minimized workflow. The result was a highly configurable and adaptable system that supported various aspects of the bridge project from start to finish.



Model view in Allplan Bridge

A DYNAMIC APPROACH TO REINFORCEMENT MODELING

The application of parametric reinforcement modeling in this project capitalized on the features offered by Allplan Bridge, combining both direct and parametric modeling approaches. Direct modeling addressed the unique elements in the project, including reinforcement connections, while parametric modeling was employed for standard components through PythonParts. PythonParts – which are objects made with Python code utilizing Allplan's API – enabled the creation of a wide range of construction elements such as bearings, barriers, and reinforcement, while also automating tasks like section view generation and drawing layout. Specifically, the reinforcement for the bridge's piers was designed as a PythonPart, offering a versatile and adaptable solution for piers of varying heights.

The placement of these PythonParts could be achieved through either direct methods or Allplan Bridge's PythonPart placement function. Utilizing variables, this placement technique established a link between the PythonPart and the bridge's cross-section. Any changes made to the geometry would thus automatically update the reinforcement PythonPart, leading to an integrated, efficient, and effective modeling process. This alignment between the geometrical model and the reinforcement PythonPart ensured a streamlined workflow, minimizing the risk of errors while accommodating the flexibility needed for complex projects.

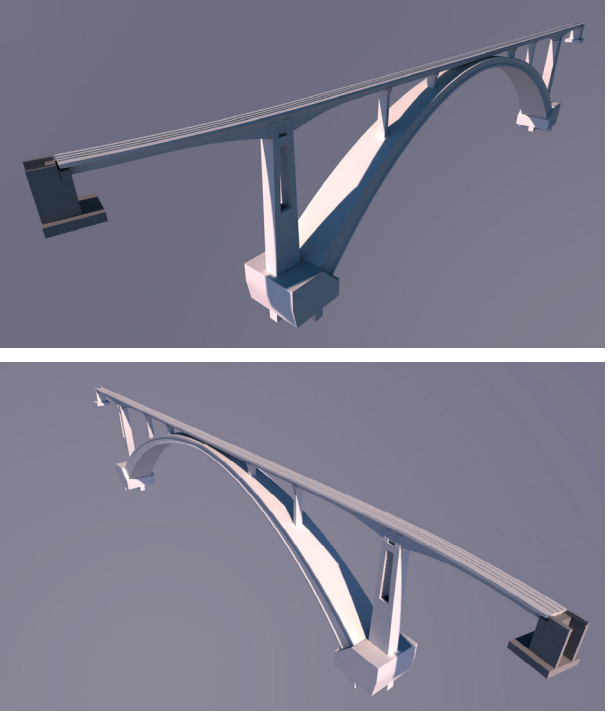
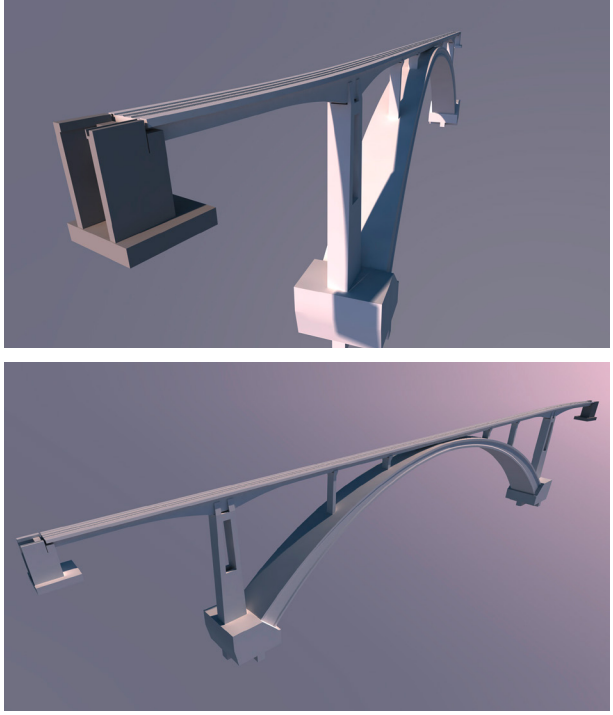
PROJECT INFORMATION AT A GLANCE

- **Focus:** Civil engineering
- **Software used:** Allplan Bridge
- **Client:** Azerbaijan Railways (ADY)
- **Implementation planning:** Yüksel Proje
- **Start of construction:** 2021

SYNCHRONIZING DIVERSE STAKEHOLDERS WITH OPEN BIM

Interoperability was another key element in the project, addressed through an OPEN BIM approach. The intricate interdependencies between different parties involved in the bridge creation process were managed through object-oriented data models such as IFC 4.3. These provided intelligent descriptions of building elements, ensuring seamless and current data exchange between multiple stakeholders. The versatility of Allplan Bridge in this regard was commendable; it not only facilitated the direct assignment of attributes to IFC objects but also enabled the definition of hierarchical trees of spatial elements.

Furthermore, the parametric data structure of the software allowed the architectural model to serve as a basis for generating a structural analysis model. This was crucial for conforming to accepted calculation methods and conducting proof checks, in line with national design codes. While these

Shusha Bridge
Renderings

tasks were often delegated to specialized groups using different software, Allplan Bridge supported a diverse range of data formats and open BIM interfaces. In this project, structural analysis was carried out using MIDAS Civil, facilitated by an online exchange platform, Bimplus, which allowed easy conversion and transfer of the model between different platforms.

ENHANCED VISUALIZATIONS

One of the significant benefits of employing Building Information Modeling (BIM) techniques in the early stages of the project was being able to make use of the model during the bidding phase. This detailed BIM model served as an essential tool for visualizing and comparing design alternatives. Enhanced by powerful rendering capabilities, including those facilitated by Lumion software, the model was crucial in communication with various stakeholders, including clients, authorities, and construction teams. It aided in presenting the project in the most transparent manner, thereby fostering confidence and reducing associated risks. Features such as natural lighting conditions and highly detailed surface designs contributed to the production of photo-realistic videos and presentations.

Additionally, the rendering was further streamlined by the live sync functionality between Allplan and Lumion, which eliminated the need to recreate models in different software platforms. Real-time changes in the Allplan model could be instantly visualized in Lumion, enhancing efficiency and accuracy.

"The complexity of the Shusha Bridge project demanded a sophisticated approach to design and modeling. Thanks to our advanced BIM techniques and parametric modeling, we were able to seamlessly integrate complex geometries and structural elements into a design that is not just functional, but also aesthetically in harmony with the surrounding environment."

Burak Kurtman, Bridge Department Manager at Yüksel Proje

THE CLIENT

Founded in 1978, Yüksel Proje has become a leading name in engineering, design, and construction supervision services, operating in over 30 countries globally. The company has been consistently ascending in the rankings among the world's top design companies and holds a prominent position as one of Türkiye's leading exporters. A testament to their focus on talent, half of Yüksel Proje's workforce is composed of engineers, making human resources their largest investment. With over 1,000 personnel spread across national and international offices and construction sites, the firm has further expanded its footprint by establishing its second R&D Centre in Istanbul in 2020. Over the 45 years since they were founded, Yüksel Proje has earned seven design awards and has been steadfast in their commitment to executing sustainable, environmentally friendly, and life-enhancing projects.

ABOUT ALLPLAN

ALLPLAN is a global provider of BIM design software for the AEC industry. True to our "Design to Build" claim, we cover the entire process from the first concept to final detailed design for the construction site and for prefabrication. Allplan users create deliverables of the highest quality and level of detail thanks to lean workflows. ALLPLAN offers powerful integrated cloud technology to support interdisciplinary collaboration on building and civil engineering projects. Around the world over 600 dedicated employees continue to write the ALLPLAN success story. Headquartered in Munich, Germany, ALLPLAN is part of the Nemetschek Group which is a pioneer for digital transformation in the construction sector.

ALLPLAN GmbH
Konrad-Zuse-Platz 1
81829 Munich
Germany
info@allplan.com
allplan.com

ALLPLAN
A NEMETSCHEK COMPANY