SIEMENS

CIVIL ENGINEERING AND CONSTRUCTION

SSF Ingenieure

Accelerate bridge planning cycles by up to 30 percent

Product

NX

Business challenges

Optimize transportation infrastructure planning processes

Master freeform geometry design

Incorporate construction phases

Keys to success

Build a comprehensive 4D digital twin as part of the BIM process

Import terrain data via LandXML

Use Siemens solutions for associative drawing creation

Results

Accelerated bridge planning cycles by up to 30 percent

Used NX to leverage 3D modeling and improve transportation infrastructure design

Eliminated time consuming multi-software work

SSF uses NX to leverage 3D modeling and improve transportation infrastructure design

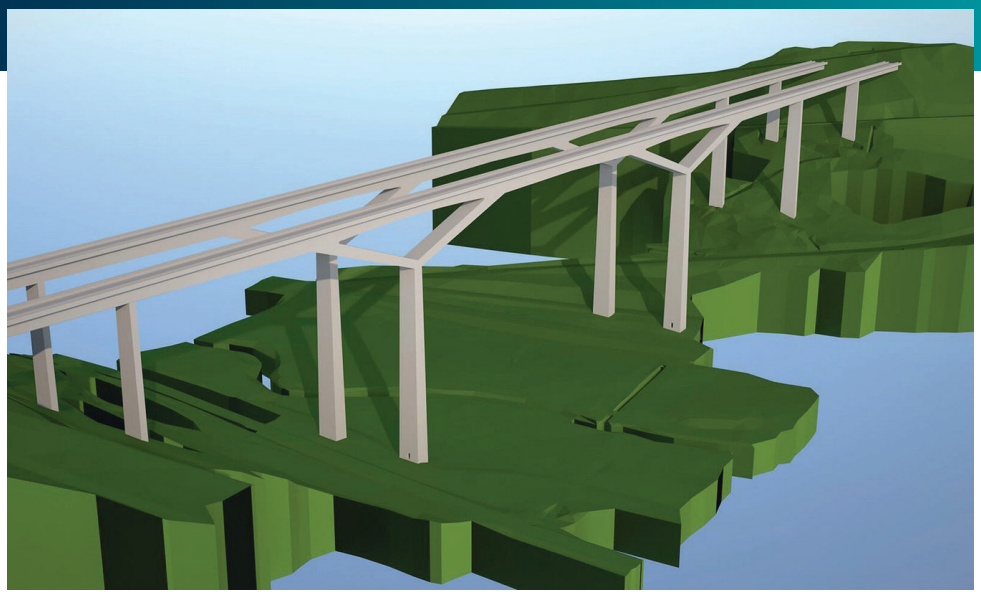
Bridging the gaps

The movement of people, goods and services is a core prerequisite for the economic and cultural development of mankind and civilization. Although electronic media and digitalization have made it easy to exchange information over any distance, land transport continues to play a vital role in linking communities to each other. Traffic is increasing around the world. Both road and rail networks are permanently extended to reduce congestion, bypass residential areas and provide climate-friendly alternatives for short-distance flights. Today's society needs dynamic transport connections because transport is a key component for growth and globalization.

The dual bridges across the Fils Valley in southern Germany are part of the Stuttgart to Ulm segment of the European high-speed line linking Paris, Munich, Vienna, Bratislava and Budapest.

"We could not have created this bridge using 2D design methods or other 3D CAD tools."

Thomas Hehne
Design Group Manager
SSF Ingenieure



SSF Ingenieure used NX for project planning and designing large and complex traffic infrastructure projects.

"Using NX for all design work boosted our efficiency and eliminated a notorious source of error."

Volker Wehrmann
Design Engineer
SSF Ingenieure

Roads and railroad lines pass through tunnels and over bridges to overcome natural obstacles such as mountains, rivers and valleys to increase capacity in places with limited space or to avoid level crossings by grade separation. Automobiles and trains need direct routes without huge detours or steep inclines to be fast and efficient.

In 1971, structural engineers planning the bearing structures of bridges founded SSF Ingenieure AG (SSF). This group of civil engineers based in Munich, Germany owes its growth to a combination of its employees' enthusiasm for engineering and its openness to new technologies and developments. More than 50 years later, SSF employs 300 engineers in six locations throughout Germany and acts as a general planner for large and complex infrastructure construction projects. With 150 designs per year, bridges still take center stage in SSF's engineering theater. They come in various shapes, sizes and construction techniques.

A high-speed landmark rail bridge

Among the landmarks in SSF's portfolio is the Fils Valley rail bridge, which is comprised of dual bridges in southern Germany that bridge a valley between two tunnels. They are part of the Stuttgart to Ulm segment of the European high-speed line linking Paris, Munich, Vienna, Bratislava and Budapest. When the line opens in December 2022, trains will cross the 485 meters (1.519 feet) long and 85 meters (279 feet) tall bridge at 250 kilometers per hour (155 miles per hour).

The semi-integral bridges are supported by slim, Y-shaped piers with flat-angle struts that were concreted and seamlessly connected to the beams at the end of the construction process.

The semi-integral bridges are supported by slim, Y-shaped piers with flat-angle struts. The high speed, the mass of the trains and the difficult topographical and geotechnical situation created challenging requirements for planning, process engineering and construction. Engineers built the reinforced concrete box structure using a formwork carriage and 80 meters (262 feet) tall auxiliary supports. They concreted the struts of the piers and seamlessly connected them to the beams.

The Fils Valley rail bridge is a pilot project of Germany's Federal Ministry of Transport and Digital Infrastructure (BMVI) using building information modeling (BIM) in accordance with the International Organization for Standardization (ISO) 19650. It involves a 4D construction sequence visualization, creating the comprehensive digital twin of the structure and the building process. With time as the fourth dimension, engineers can simulate and monitor the construction phases using the 3D models of all components and the environing landscape. The models were also required to be linked to the 2D plans on every level down to individual components and the ministry's plan management platform.

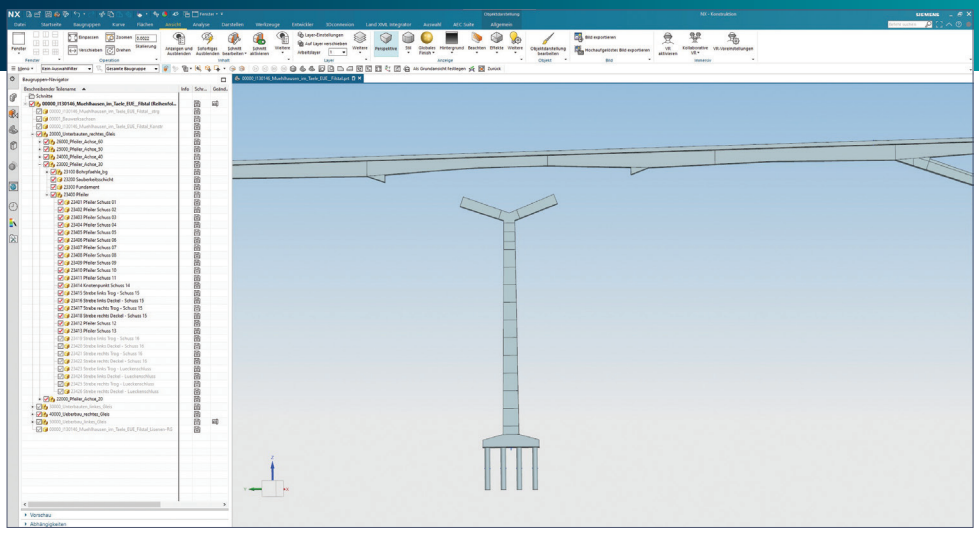
3D bridge modeling using NX

To fulfill all customer and supplier requirements, SSF engineers use various software products. They design some tunnels and all bridges using computer-aided design (CAD) with 3D modeling. They replaced 2D drawings in 2008 and now use NX™ software, which is part of the Xcelerator portfolio, the comprehensive and integrated portfolio of software and services from Siemens Digital Industries Software.

"3D modeling using NX can be 20 to 30 percent faster than 2D drawing," says Thomas Hehne, an SSF design group manager. "It helps avoid collisions and eliminates rework, resulting in designs that are right the first time and eliminating on-site issues."

"Using NX helps everyone save their designs and walk over to the conference room or start an online meeting session. By the time the meeting commences, there is a comprehensive digital twin of the overall project and its current development status."

Jirina Triner
Design Engineer
SSF Ingenieure



SSF engineers used NX to design the bridge in all of its construction stages.

The sheer size of structures such as the Fils Valley rail bridge leads to large assemblies. "Using NX allows us to change between various levels of detail, from rough overviews all the way to the individual nuts and bolts," says Volker Wehrmann, an SSF design engineer. "It also eases collaboration among several internal and external design engineers."

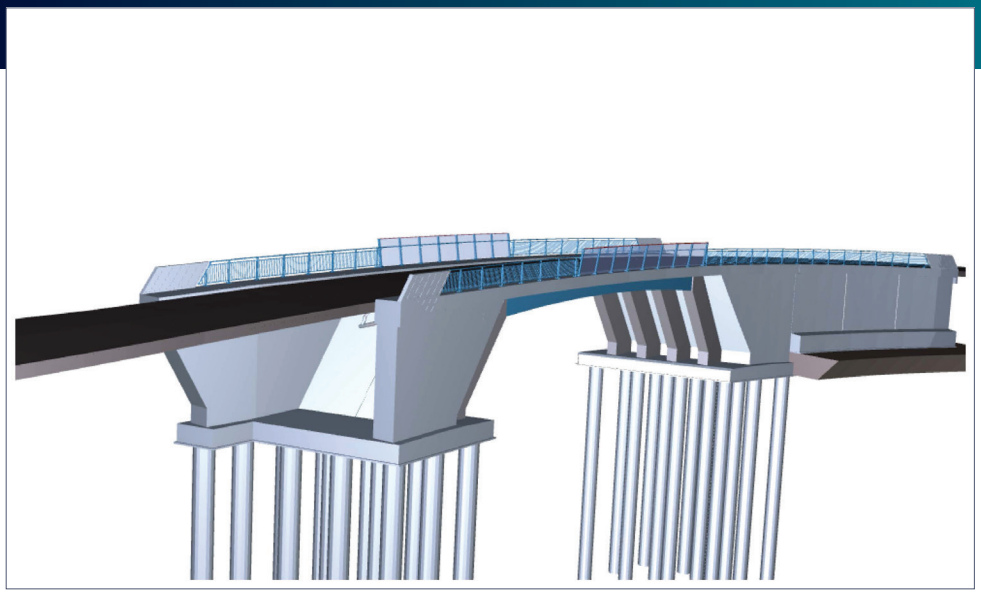
Using NX has considerably reduced the time required for design reviews. These often require several hours if not days of preparation including consolidating data in different file formats originating in different software systems. "Using NX helps everyone save their designs and walk over to the conference room or start an online meeting session," says Jirina Triner, an SSF design engineer. "By the time the meeting commences, there is a comprehensive digital twin of the overall project and its current development status."

Many bridges such as this road bridge crossing a railroad line at Großharthau in eastern Germany feature super-elevated curves and changing gradients.

The line, the cross and the curve

SSF engineers exchange data using the native NX file format not only among themselves but also with leading formwork manufacturers and construction companies. The reason for this is best illustrated using the example of a road bridge crossing a railroad line at Großharthau in eastern Germany. It replaced an older bridge. The bridge was built in a curve to allow traffic to flow during construction and move the road away from nearby houses to reduce the noise.

Modern bridges are hardly ever straight; they feature super elevated curves and changing gradients. "We prefer using NX due to its superior freeform geometry modeling capabilities," says Hehne. "We could not have created this bridge using 2D design methods or other 3D CAD tools." Many other 3D CAD software products can't automatically create Euler spirals that are essential for designing track transition



SSF engineers designed this bridge using NX, taking advantage of the software's freeform geometry modeling capabilities.

curves to prevent sudden changes in lateral acceleration. By contrast, using NX helped engineers combine all elements of geometry.

Integrating the environment

Using NX also enables SSF engineers to perform all design work within a single software environment. This allows them to weave a digital thread covering all disciplines including steel and concrete and also aligning route segments and the surrounding terrain. "We do not need to change between various software systems," says Wehrmann. "Using NX for all design work boosted our efficiency and eliminated a notorious source of error."

Interacting with other stakeholders along the value chain requires exchanging information with the systems they use. While some can process 3D model data in the JT™ data format, an established standard among BIM programs is the platform-neutral Industry Foundation Classes (IFC) file format. It contains a model of a building or facility, including spatial elements, materials and shapes.

SSF engineers use several specialized NX applications required for the construction industry. They import terrain information to NX via LandXML, an XML-based non-proprietary standard for data exchange among the land development, civil engineering and surveying industries. The

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Solutions/Services

NX
siemens.com/nx

Customer's primary business

SSF is a leading German civil engineering company established in 1971. With 300 employees in six locations throughout Germany, the company provides services ranging from the design of technological solutions to the planning of construction phases and the completion of construction projects.
www.ssf-ing.de/en

Customer location

Munich
Germany

Using the ability to import LandXML in NX, SSL engineers created a fully associative, parametric 3D model of the site to process in NX along with the bridge itself.

ability to import LandXML into NX enables them to create and continue to process a fully associative, parametric 3D model of the site. Engineers can use NX to modify this to accommodate the new structure and automatically determine the mass of material that needs to be excavated and moved during the individual phases of a construction project.

Using the AEC alignment capabilities in NX, they create route axes directly from the measurement data in Siemens NX by entering various parameters. The alignment tools supports numerous route planning methods. Many part manufacturers and public examiners who verify the designs still rely on 2D files. SSF engineers use a specialized AEC drafting tool to create construction drawings directly in Siemens NX that conform to the relevant building standards. "These construction drawings are fully associative with the 3D model," says Triner. "Changes to the model or the route information automatically alter the construction drawing."

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