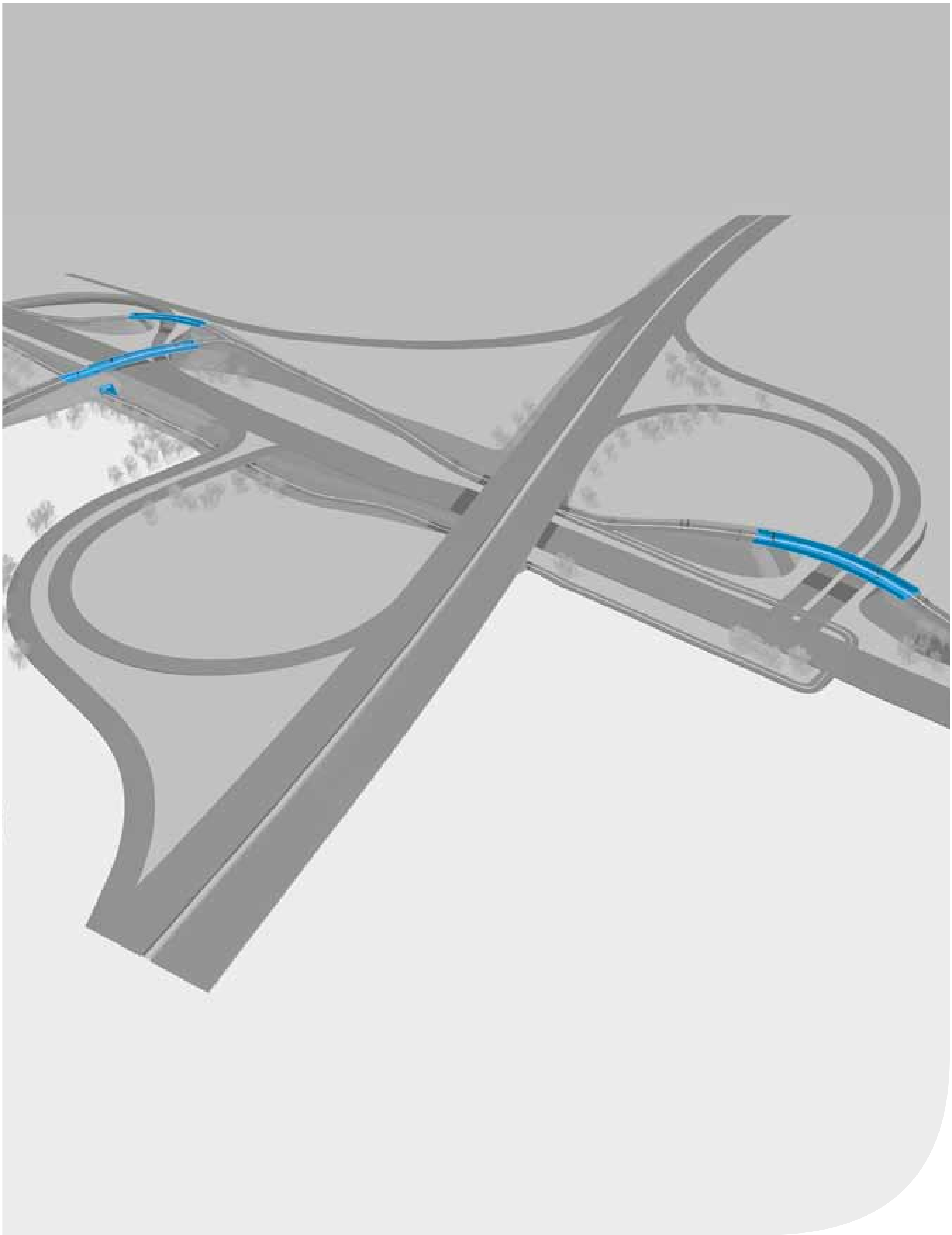
The virtual building site

SSF Ingenieure



The virtual building site

When it comes to research and development, SSF Ingenieure is working on the virtual building site as planning platform for holistic visualisation of a building project. This is based on a real 3D model that contains all the data involved in planning, surveying, building materials and auxiliaries.
In the draft phase of a building project, the 3D model is used for variant studies. Dimensions can be precisely generated resulting in cost estimates exactly to demand. Use of suitable software also makes it possible to produce freeform areas so that there are no restrictions on construction.
Various different views of the model can be generated, collision tests carried out and corresponding plans derived. The model should undergo dynamic updating during the building project and provide various users with relevant data and information at every phase of the project in response to specific enquiries. For example, formwork surfaces can be opened up for process planning, or the system can take on machine control. The accurately dimensioned model acts as communication platform for everyone involved in the project. Critical processes or workflows can be simulated in advance on the virtual model to proceed later without delay on the actual site.
Throughout the entire construction period, the actually provided services are documented on site using mobile IT systems and entered in the virtual building site model. Building progresses are thus recorded and can be used to derive early countermeasures when work starts to deviate from the original planning. The result is a dynamic 4D building site information model that contains not only the geometry and progress in time but also model-related data, such as quality-relevant documents.
The virtual construction can be used as an „as-built" model for the upkeep of a building structure.
This subject is also being examined by the FORBAU research project; SSF Ingenieure is an active member of this research consortium.

Reinforced concrete frame structures FCA Arena Augsburg
This single-section viaduct structure consists of a prestressed frame structure lying in the radius without joints and bearings. The abutments positioned high on the escarpment are founded on bored piles. The superstructure with an arched lower edge merges directly into the greened escarpment without any visible abutments. The cross section was chosen as an asymmetrical V-shape.

The position and height of the prestressing elements had to be adapted precisely to the cross-section contour and swivelled in footprint according to the radius, so that each prestressing element had its own geometry, differing in length and spatial arrangement in the cross-section and development.

Picture credits: **1+3** SSF Ingenieure GmbH / **2** Glass GmbH Bauunternehmung / **4** Florian Schreiber Fotografie for SSF Ingenieure GmbH

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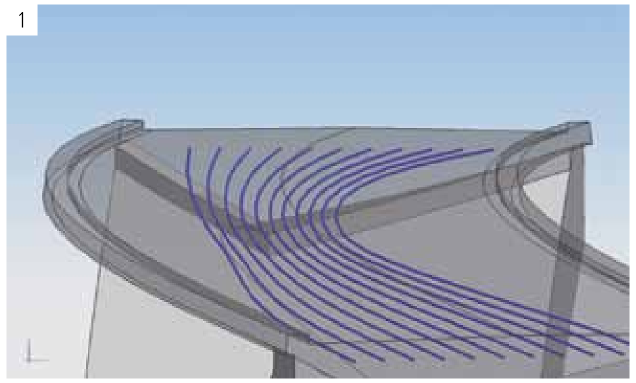
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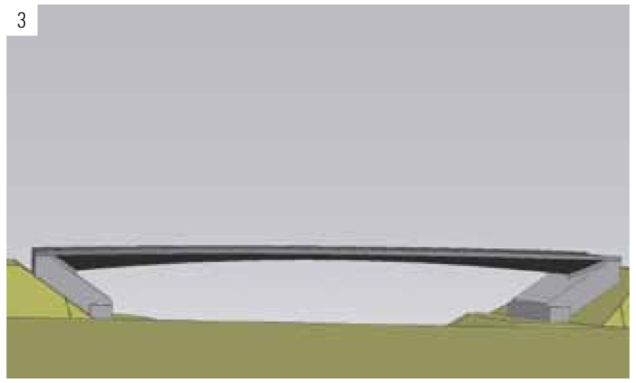
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1+2 Direction of prestressing elements virtuell / real
3+4 Completed bridge construction virtuell / real

Picture credits: SSF Ingenieure GmbH with Lang Hugger Rampp GmbH Architekten

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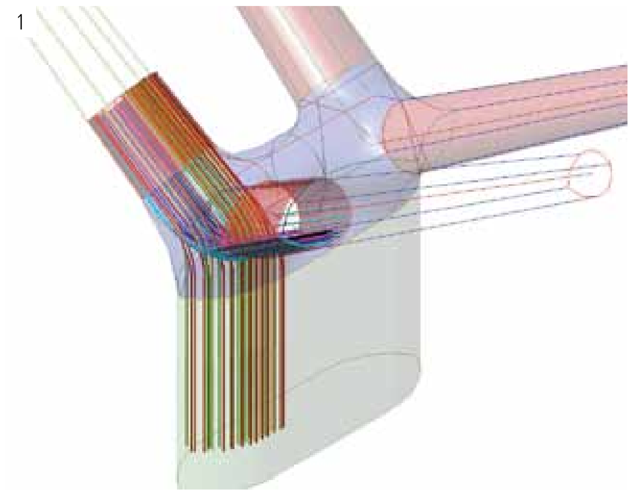
Pillar Strelasund Crossing

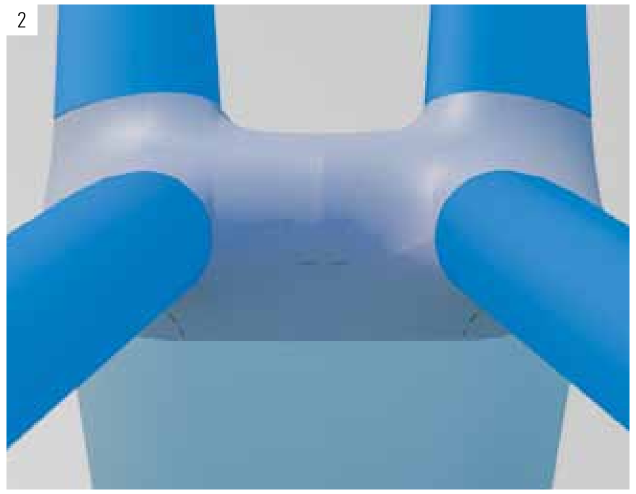
The superstructure is connected deflection-resistant with the reinforced concrete pillars on four V-shaped steel cable stays on either side of the main openings. The formwork and reinforcements for the transitional section of the pillar cable stays were modelled in 3 dimensions. This involved a feasibility check in view of the complicated reinforcement installation and the high level of reinforcement, together with a collision check and definition of the installation sequence for the reinforcement bars interacting from 3 directions. The reinforcement was in practice installed by using corresponding templates.

1



1+2 Formwork and reinforcement virtual
3 Formwork and reinforcement real

2



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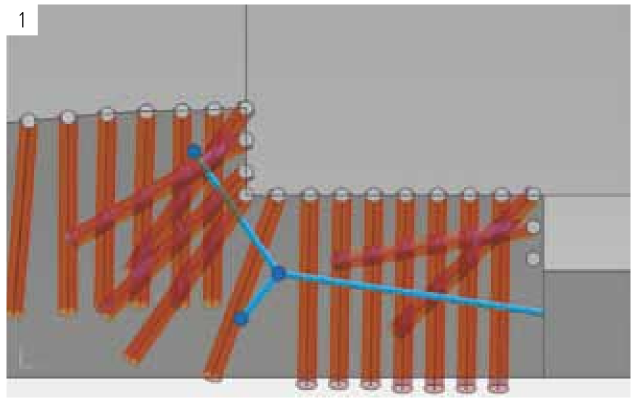

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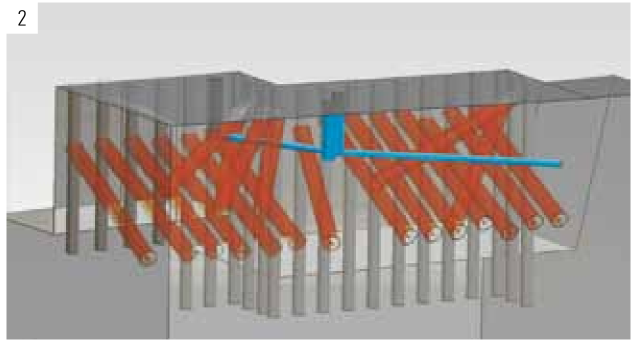
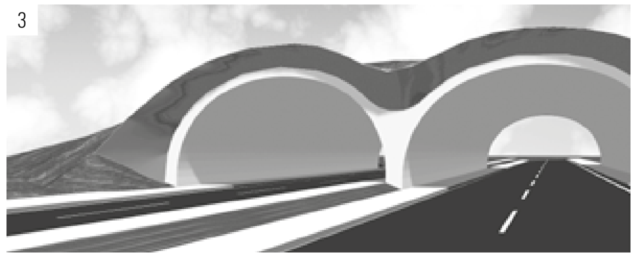


1 Layout of the pit – collisions not visible
2 3D Model – collision clearly evitable

Pit lining for Tuttlingen tunnel

To produce the joint pit for the tunnel and an adjoining retention basin, a protruding corner had to be produced in the bored pile wall, with every single pile anchored. There is a canal with shafts immediately behind the bored pile wall. Minimum clearance of 50 cm to the canal and between the anchors themselves had to be observed when boring the anchors. The horizontal and vertical anchor gradients were stipulated precisely thanks to the 3D collision check.

3



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1 Tunnel portal virtual **2 Tunnel portal** under construction

Tunnel portal Wildlife Crossing Stettenhofen

The tunnel portal for the Wildlife crossing Stettenhofen was modelled in 3 dimensions to define the idea of the draft ready for execution. Any sections could be taken through the 3D model so as to assist planning preparation for the formwork as well as production of the reinforcements.

Picture credits: **1+2+3** SSF Ingenieure GmbH / **4** Max Aichner Bau GmbH & Co. KG

Picture credits: **1+3+4** SSF Ingenieure GmbH / **2** Max Bögl Bauservice GmbH & Co. KG

Bridge on the B299 over the Ludwig-Danube-Main-Canal

A complete simulation of the building site was produced in a digital terrain model as part of the execution planning involved in producing the viaduct structure.

The viaduct structure is a single section structure with VFT® girders with a clothoid footprint. The abutments are founded on bored piles. The superstructure is produced with three straight VFT® box girders and supplementary in-site concrete. The girders measuring 42.50 m had to be driven over the construction site road and lifted into place. Given the pointed
intersection angle, gabion walls had to be produced parallel to the canal, joining the return walls at a pointed angle.
The maximum gradient for driving over the construction road on the sandy ground was 10%. The tree clearance area therefore had to be kept as small as possible. In contrast, simultaneous use of the construction road had to be warranted in order to produce the construction pit for an abutment. Production of the abutment on the other side of the canal entailed banking parts of the canal. Correspondingly, a dam had to be raised in front of the new abutments for ramming in the sheet piling for the new paths in front of the abutments and for moving the drilling machines for producing the piles.

By planning with an exact digital terrain model, it was possible to stake out the crowns of the construction pit precisely in the thickly wooded dam of the canal and use the exact earthwork masses in advance for setting up the building site. The high precision of the model meant that there was no need for a generous buffer.
For workshop planning of the steel girders, the structural camber was applied to the structure in the 3D model for controlling the plate cutting process. This can be ascertained and visualized in all building phases.
In order to organise the building site, it was possible to produce a simulation of the workflows involved on site, starting from excavation through to the sequence of lifting the VFT® girders into place.

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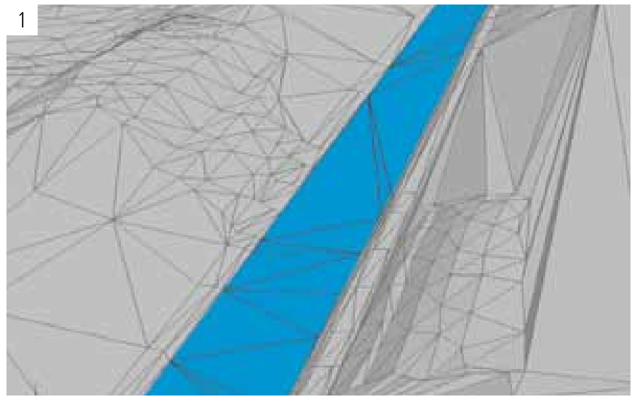

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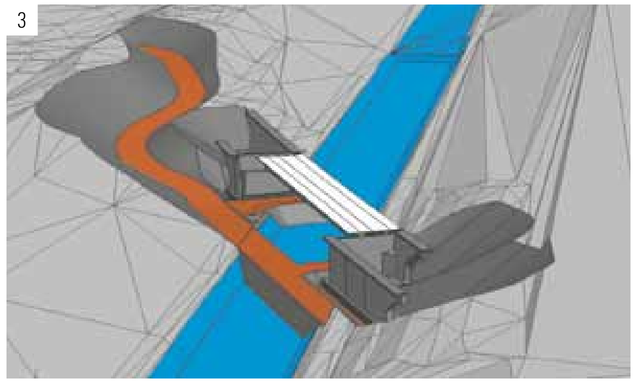

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1 + 2 Terrain virtual / real
3 + 4 one of the construction phases virtual / real

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