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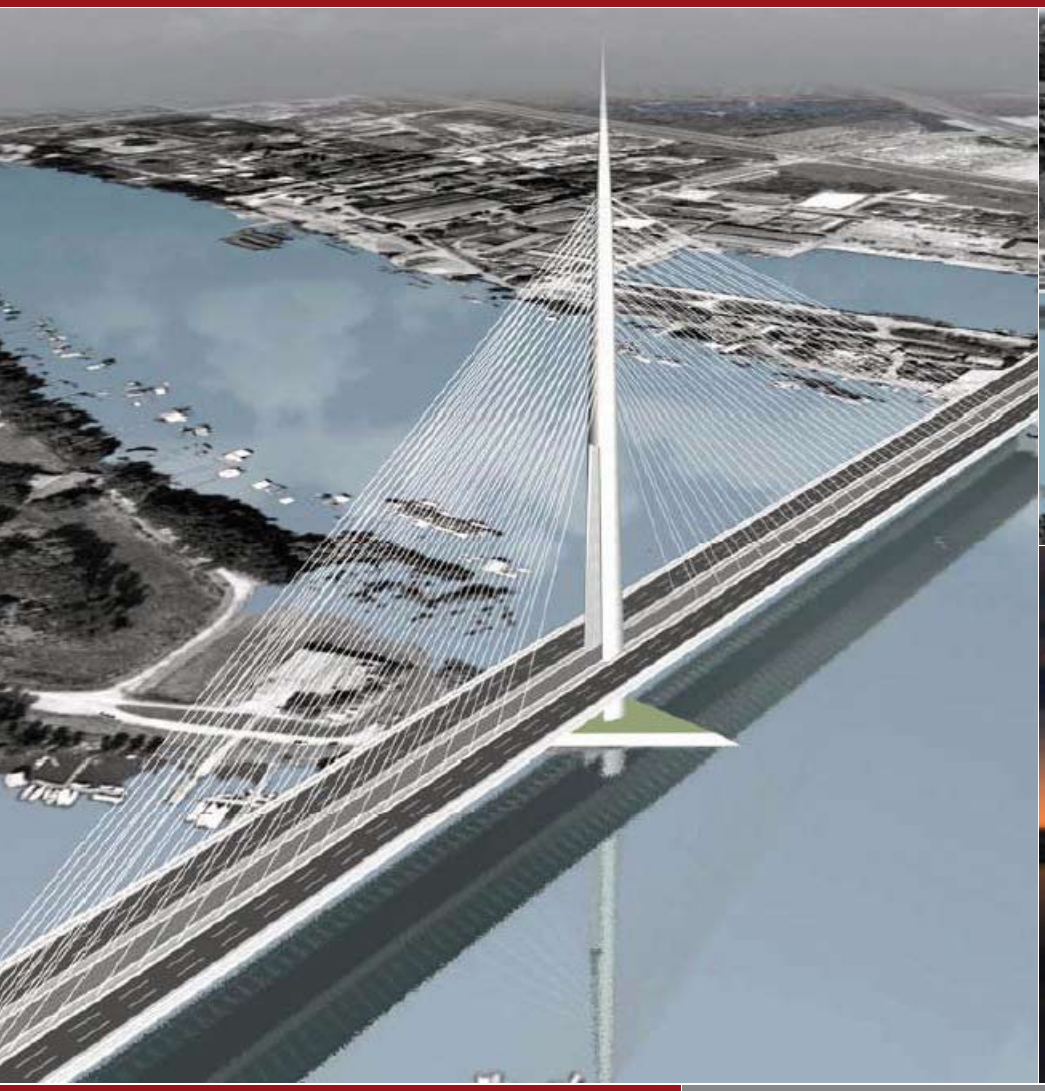

Sava Bridge, Belgrade/Serbia

LAP Beratende Ingenieure VBI GmbH, Stuttgart/Germany

Function and Design – XXL

The Sava Bridge in Belgrade represents a daily obstacle to movement for the people of the city. But that will soon change with the construction of a new cable-stayed bridge over the river. The engineers carrying out the detailed planning, Leonhardt, Andrä and Partner, are using Allplan Engineering to carry out this prestigious project.

Belgrade lies at the confluence of the Danube and Sava rivers. For years, expansion of the northern suburbs of the city has been hindered by the limited capacity of the three existing bridges over the Sava: the Brankov most, Savski most, and Gazela. In order to expand the capacity of the transport network, a fourth bridge is currently being built over the Sava. This will link the district of New Belgrade on the northern bank with the city centre on the southern bank. Together with the feeder roads, this project forms a part of the first section of the Municipal Inner Semi Ring Road, leading from New Belgrade to Pancevo.

Symbol of an up-and-coming city

But Belgrade will be getting more than just an additional traffic artery. With a total length of 964 meters, a structural height of 4.75 meters, a width of 45 meters and around 43,380 square meters of surface area, the new bridge will be the largest river crossing in the Balkan region. Its 200-metre high pylon, located on the northern tip of the Sava island Ada Ciganlija, serves as the main support, and will become a focus of attention as a highly visible symbol of the city. Leonhardt, Andrä and Partner have been able to secure the services of consultant engineers VBI GmbH (LAP-Consult) as operational engineers for the detailed planning of the bridge from the upper edge of the foundation. This Stuttgart agency, which specializes in the planning of load-bearing structures for engineering projects, works with Allplan Engineering and has already, set its seal on a large number of bridge projects. These include the Kehl-Strasbourg pedestrian bridge, which is also a cable-stayed structure. The project is a complex one, and not only because of the dimensions involved. In order to ensure uninterrupted shipping movements during the construction period, the main section spanning the Sava must be erected in the river without temporary supports. In addition, construction will be going ahead on different sections simultaneously. The side section, for example, will be erected parallel to the main bridge, yet independently of it. The teams, from Serbia, Germany, Austria, Hungary, Slovenia, Switzerland, France, Great Britain, Denmark, and China, will be under time pressure. The schedule calls for the new bridge to be handed over to the people of Belgrade after a construction period of just three years.

Tried and trusted support from Allplan Engineering

Distributing the main load of a bridge of this size onto only one pylon is a major challenge, even for experienced structural engineers. And all the more as this pylon will be placed offset from the centre of the bridge; in other words, with an asymmetric or “one-legged” design.

In order to master the crossing of the Sava without auxiliary columns while at the same time saving on weight and therefore costs, the engineers opted for a steel hollow box design, in cantilever format, for the 376 meter length of the main section. By contrast, the planners achieved the even distribution of the weight over the 250 meter long retention area by using a prestressed concrete construction, which will be created using what is referred to as the incremental launching technique. This involves individual bridge sections, referred to as the “increments”, being produced in a fixed-location formwork. Once a section is ready, it is pushed over the columns, together with the sections which have been produced previously, and the next increment unit is cast in the same formwork mould. The side section, which is 358 meters long, will also be erected using this technique. Starting from axis 1, it will be pushed piece by piece in the direction of the centre of the bridge.

As has already been the case with earlier projects, LAP Consultants have benefited in particular from the reinforcement model integrated in Allplan Engineering. This solution, designed for interactive formwork and reinforcement planning, is particularly useful in building projects with complex geometries and reinforcement arrangements – perfectly suited, then, for the Sava Bridge project.

2D and 3D planning in combination

Depending on the specific need, the engineers have combined 2D and 3D planning, a classic example of hybrid working. “For the typical standard tasks in the planning of bridges, 2D planning is entirely sufficient, but more complex points are nowadays being planned increasingly in 3D,” states Steffen Kühn, structural designer at Leonhardt, Andrä and Partner. Formwork and tendon stress planning, for example, have been carried out in 2D, while 3D planning is used for the reinforcement, which may initially be

somewhat more elaborate and onerous, but is more efficient. Whenever and wherever sections and views were required, these could be derived at the desired location directly from the reinforcement model, a major advantage with regard to precise, realistic plans and the rapid implementation of alterations.
Other important areas with regard to the use of 3D included the reinforcement planning of the very complicated intersection area between the superstructure and the pylon, and the planning of the anchoring of the 80 steel cables connecting the bridge decks of the main and retention areas to the pylon. Thanks to three-dimensional planning, the runs of the cables and their anchoring points could be precisely determined and visualized.
The great strength of reinforcement planning in 3D lies in particular in the possibility of testing out variants: “When working with complicated geometrical conditions in conjunction with high reinforcement levels, complex reinforcement patterns often arise, which can be produced and also optimized considerably faster using 3D planning together with the 3D animation. But even with simple reinforcement planning, working in 3D is still worthwhile, especially when amendments are made, as an adaptation in the 3D model no longer has to be carried out manually in all the sectional views. Allplan Engineering provides a significant advantage in such situations in comparison with 2D solutions,” explains Steffen Kühn.

Smooth data exchange

Allplan Engineering also provides excellent service with regard to co-operation with the partner CHP from Freiburg in Germany, which is assisting with planning peaks under the overall supervision of LAP Consultant. “Because CHP also use Allplan to produce reinforcement planning in 3D, the data exchange takes place without any loss of quality or detail. And the transfer into other data formats is very largely free of any difficulties too,” confirms Steffen Kühn happily. There is still a lot to be done before the day in October 2012 when the first cars, light rail trains, motorcycles, and pedestrians are scheduled to begin using the new bridge, and a good part of this work will be planned using Allplan Engineering. This prestigious structure will then be bringing people together for the next century – at least.