Owner Federal service for road construction North Rhine-Westphalia (NRW), Germany +++ **Main Contractor** Consortium Rheinbrücke Wesel , consisting of Hermann Kirchner Hoch-und Ingenieurbau GmbH, Bad Hersfeld, Germany and Donges Stahlbau GmbH, Darmstadt, Germany +++ **Design** Schüßler-Plan Ingenieurgesellschaft mbH, Berlin, Germany
DSI Units DSI GmbH, Langenfeld, Germany, and DSI GmbH, Technical Service, Unterschleissheim, Germany
DSI Scope Supply and installation of 330t of SUSPA Bonded Strand Tendons, 90t of SUSPA Unbonded Strand Tendons, 90t of "Draht Ex 66" SUSPA Wire Tendons for external post-tensioning, DYWIDAG Bar Tendons, 700t of DYNA Grip ® Stay Cables with 60 anchorages DG-P 37 and 84 anchorages DG-P 55; technical processing of stay cables and realization of tests for individual approval

DYNA Grip ® Stay Cable Systems Used for Stay Cable Bridge in Germany

Wesel Lower Rhine Bridge, Germany

The Rhine Bridge near Wesel, approximately 50km north-west of Essen, has always been an important part of the local traffic system. Consequently, the bridge, which was destroyed during the war, was reconstructed in 1953 on its old foundations in order to re-establish the Rhine crossing in this area. It was recognized at the time that the new bridge was only a temporary solution to allow Federal highway 58 to cross the river. With a volume of approximately 36,000 vehicles per day, the highway has turned into one of the main arterial roads on Lower Rhine. Recurring maintenance work on the narrow, 7.8m wide bridge often caused major traffic obstructions in surrounding towns and cities by creating traffic jams. In order to relieve those towns from a steadily increasing volume of traffic, federal highway 58 has now been relocated. When completed, the new bridge will also solve the problem of the bottleneck at the Rhine crossing.

The new stay cable bridge, with two lanes into each direction and bicycle lanes, is the core of the new Buederich-Wesel bypass. With its 130m high pylon, the architecturally pleasing bridge is clearly visible from the surrounding planes of the Lower Rhine region. Long before its inaugu ration in the summer of 2009, the bridge has already become a regional landmark.

The decision to construct a stay cable bridge as the new Rhine crossing was mainly influenced by inland navigation's demand for an obstruction- free, 300m wide waterway. Stay cable bridges are the most economic solution for large spans such as the ones required in this case. In addition, in the case of the Wesel Lower Rhine Bridge, the alignment of federal highway 58 allows for the construction of a bridge with a single pylon. Furthermore, the bridge deck can be erected using the free cantilever method, which constitutes an additional advantage in view of the importance of minimal disturbance of navigation.

The new Wesel Lower Rhine Bridge is the second stay cable bridge in Germany that is constructed using a stay cable system consisting of parallel strands. DSI developed the DYNA Grip ® system at the end of the 1990s. In Germany, the system was first used on the second Strelasund Crossing between Stralsund and Ruegen. The Strelasund Crossing for which SUSPA-DSI had delivered 150t of DYNA Grip ® stay cables with 64 DYNA Grip ® anchorages was inaugurated on October 20th, 2007 by German chancellor Angela Merkel.
In autumn 2007, SUSPA-DSI started to install the stay cables in the new Wesel Lower Rhine Bridge. The bridge has a total length of approximately 773m and a main span of 335m over the Rhine river. After its completion, the bridge will be the third largest stay cable bridge in Germany.

The deck is divided into two segments. The 396m approach on the left of the Rhine comprising of six spans was constructed by incremental launching using a heavy two- to three cell reinforced concrete box girder. However, the river is spanned by a lightweight steel three cell box girder section that was constructed using the cantilever method.

The concreting of the reinforced concrete deck was carried out in 13 sections. For incremental launching, the cross section was centrically post-tensioned in the floor slab and roadway slab. For this, SUSPA-DSI delivered factoryproduced bonded SUSPA Strand Tendons that could be installed quickly. In addition, the 27.5m wide roadway slab was post-tensioned transversally using factory-produced unbonded SUSPA Monostrand Tendons. Inside the hollow box girder, external “Draht-EX 66” SUSPA Wire Tendons have been installed and aligned following the bending moment diagram. Additionally, DYWIDAG Bar Tendons were used in the final beam and for the incremental launching equipment.

The 130m high pylon is in the shape of an in - verted Y, with the bridge deck running between the two branches. Both transverse branches consist of rectangular box girder sections made from high-strength concrete, with the vertical upper part realized as a steel bond crosssection where the cables are inserted. For future maintenance, an elevator is built into the pylon branch.

The 72 type DG-P 37 and DG-P 55 DYNA Grip ® stay cables are arranged into 12 groups of cables with 6 cables each and are located between the two roadways. Along the free cable length, the cables consist of single corrosion protected parallel stay cable strands that run through a duct. Waxed and PE coated strands consisting of seven galvanized cold-drawn smooth individual wires with circular cross sections are used for this project. Steel Grade ST 1570/17770 N/mm², a grade that is currently used in Germany, is used. The PE duct is ruby red, a color that has already been used on several Rhine bridges. A PE-helix applied on the duct eliminates vibrations of the cables induced by rain and wind. DYNA Grip ® dead end anchors are used in the pylon, and DYNA Grip ® stressing anchors with extra long threads are located in the middle cell of the three-cell deck. The use of DYNA Grip ® Anchorages makes it possible to exchange or inspect individual strands in a cable wherever necessary.

While European Technical Approval (ETA) exists for internal and external post-tensioning tendons, there is still none for stay cables, which is why project specific approval had to be obtained for this structure. The main prerequisite for the approval were two fatigue tests in accordance with fib Bulletin 30 carried out on a strand bundle with 55 strands. The tests were conducted at the institute for material testing at Munich Technical University. 2 million cycles with a stress range of 200 N/mm² were carried out with an upper load of 45% GUTS (ultimate load capacity). In order to simulate tolerances in application and angle rotations of the cable in the structure, anchorages had to be installed with a planned vertical misalignment of 0.6°. After the fatigue tests were completed, ultimate capactiy and elongation at maximum load were determined. The tests met all fib criteria.

The Lower Wesel Rhine Bridge once again shows DSI as a competent partner for construction companies - a partner who is able to cover the complete range of post-tensioning methods and stay cables necessary for bridge construction.

DYWIDAG-Systems International GmbH **Phone:** + 49.89.309050.200 **Fax:** + 49.89.309050.252