Local Presence – Global Competence
Dear customers, partners and other readers,

I am privileged once again to present the new edition of DSI Info.

This edition focuses particularly on the more technically innovative projects DSI has been involved with around the globe over the last 24 months. Some of these are outstanding and we are grateful to the designers and contractors that invited us to participate and supply material and services.

Not all projects in 2009-10 were as photogenic as those featured - some were classical, many highly competitive - but all required the same attention to detail and the high quality and service standards that are associated with DSI’s leadership position in Geotechnics, Post-Tensioning, Tunneling and Mining.

I would like to thank our customers for their continued trust and their business, our suppliers, who remain critical to our success, and our engineers, field force and fabricators who combine to deliver the “DSI way”.

Our world and particularly construction has experienced economically tough times. Some communities and customers have had to cope with the human tragedies, damage and dramatic rescues associated with recent natural disasters.

Our mining customers have had the challenge of responding to ever increasing demand and have had to find ways to go deeper or to extract from lower grade ore. Tough times and technical challenges over history have stimulated engineering to develop to new levels. The industry is in my view more than ready to take advantage of the next expansion.

We at DSI will be there - ready to be a part of the success of those new projects around the world.

I am looking forward to sharing some of your achievements in the following edition of DSI Info.

Alan Bate
Chairman & Group CEO
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The Second Keihan Expressway in Japan is located between Kyoto and Osaka and was constructed as a bypass of an existing national route. The project is one of the largest construction projects in Japan. Since the expressway runs through suburban residential areas, construction had to be carried out as quickly as possible. To meet these requirements, especially efficient construction methods were used for two viaducts located on the new expressway - the viaducts in Nasu-dukuri region and in Aoyama region.

During construction of the viaduct located in Nasu-dukuri, parts of the construction site were used as a casting yard to manufacture unique U-shaped precast girders. In contrast to conventional projects, the precast segments did not consist of a multitude of small precast segments divided longitudinally. The U-shaped precast girders without top slabs were transported to the area below the viaduct. Then, the precast girders were lifted onto the pier near the supports of the erection girder.

As a result, the bending moments acting on the erection girder were reduced by 1/6 in comparison to conventional
span-by-span erection, allowing the weight of the erection girder to be significantly reduced.

The casting cycle for the four girders was set to be equal to their erection cycle so that no storage yard had to be built for the U-shaped girders. Four casting beds and two sets of lifting girders were used to achieve an erection cycle of only two weeks for four girders per span.

For the viaduct in Aoyama region, there was neither enough space for a casting yard, nor was it possible to use the area under the superstructures due to unfavorable topographical conditions. The segments were fabricated in a remote precast yard and transported to the site. The girder was longitudinally divided into several segments, and the completed deck surface of the bridge was used as an assembling point for the segments. The segments were lifted onto the deck and jointed to form girders.

Subsequently, the girders were transported on the deck to the span currently being constructed using the erection girder. The core segment carried the weight of the girder. Special transverse movement devices were used in order to reduce the number of erection girders needed and thus save costs. Similar to the viaduct in Nasu-dukuri, the construction cycle for four girders was two weeks and therefore only half the time needed compared to conventional methods.

For the construction of the two viaducts, Sumitomo supplied the 19x15.2mm Type MC, DYWIDAG Post-Tensioning System with epoxy coated and filled strands that were used for external tendons. Thanks to the unconventional construction methods used, a rate of construction of 2,400m² per month was achieved for both viaducts.
DYWIDAG Multistrand Tendons Stabilize Japan’s Longest Plate Stayed Bridge

In 1994, work began on the Yamba Dam, the largest hydroelectric power project in Japan in terms of value. The structure will dam the Agatsuma River on Japan’s main island, submerging part of the Agatsuma railway line. Consequently, approximately 10.4km of the railway line had to be relocated.

The second Agatsumagawa Bridge is part of this relocation project. The railway bridge, located near the final stop on the Agatsuma Line, curves to the left with a 600m radius, and crosses National Route 145 and the Agatsuma River. One half of the structure consists of prestressed concrete box girders, and the other half is a three-span continuous box girder plate stayed bridge.

The bridge is the first plate stayed bridge in Japan to feature concrete plates with curved surfaces. Its 167m center span makes it the longest bridge of this type in Japan. The main girders have a box girder cross section with rigid ribs, while each main pylon consists of four independent columns - a combination rarely encountered in bridges anywhere in the world.

During the construction of the three-span continuous stayed plate bridge, the cantilever construction method was used to cast 3m long blocks in the center span using a form traveler, while the fixed support method was used to cast 6m long blocks in the side spans. The primary diagonal cables supporting the main girder were installed with a winch and a crawler crane as cantilever construction proceeded. The secondary diagonal cables with a maximum length of 140m and rising gradient of approx. 30% were added after connecting the main girder using two interlocking pushing machines.

Once the concrete plates had been positioned, they were post-tensioned and the temporary supports of the girder were released. Since the primary diagonal cables would be left exposed to the atmosphere for approximately one year, Sumitomo supplied Type 12S15.2MA DYWIDAG Strand Tendons with epoxy coated strands to prevent corrosion. Type 12S15.2MA DYWIDAG Strand Tendons with bare strands were used for the secondary interior diagonal cables which would be grouted at the end.
Fast Transportation from North to South: The New Kyushu Shinkansen High Speed Line in Japan

A few years ago, construction of a new line for the Shinkansen bullet train began on the island of Kyushu in Southern Japan. The line runs from south to north through the entire island, creating a much faster connection to Japan’s main island than previous railway connections.

Construction of the Kagoshima route started in 1991, and the first, 128km long section of the new line from Shinyatsushiro city to the district of Kagoshima was opened in 2004. According to plans, the Kagoshima route will extend for a total of 257km.

A new bridge was constructed for one of the sections. The Ohnogawa Bridge crosses the Ohno River near Uki City, in the centre of Kyushu Island. The new structure is a four-span continuous cable-stayed prestressed concrete bridge. The extradosed bridge has a main span of 113m. The bridge project included the construction of supporting pneumatic caissons and four substructures for cast-in-place reinforced concrete piles.

DSI’s licensee in Japan, Sumitomo, supplied external Type 27S15.2 MC DYWIDAG Tendons with epoxy-coated strands as transverse post-tensioning tendons. These tendons were anchored inside the beams on the main girder side in order to minimize salt damage from the tidal Ohno River. Transverse Post-Tensioning of the deck slabs was carried out using prestressed individual strands.

The main tower saddle sections were prefabricated to ensure high product quality and on-site installation precision; this also helped reduce labor requirements at the construction site. The first trains will cross the new bridge in the spring of 2011.
The Yabegawa Bridge forms part of the Ariake Sea Coastal Road along the Ariake Sea in southern Japan. The three-span, continuous cable-stayed prestressed concrete bridge crossing the Yabe River is 19m wide and features a 261m center span as well as two side spans of 128m each. With a length of 517m, the Yabegawa Bridge is the longest cable-stayed prestressed concrete bridge in Japan.

The Yabegawa Bridge is curved – a feature that is very rare for a bridge this size. The project is characterized by many different technical features. These include an inclined inverted-Y-shape main pylon structure, a trigger-type stopper structure, very deep pneumatic caissons, the use of a massive form traveler for cantilever erection, and the use of an elevator-type movable scaffold for the main pylons.
To improve construction efficiency, the main girders were built using 8m long segments that were positioned using a massive form traveler weighing approximately 300t. Since each segment was 8m long instead of the usual 4m, construction time was shortened by five months at an installation rate of approx. 17 days per segment. In order to establish a reduced cycle time, the cantilever construction method for the segments positioned right and left was also adjusted accordingly, and the support structure was specially designed. 44 to 48 Type SBPR 930/1180, 32mm DYWIDAG Post-Tensioning Bars supplied by Sumitomo were installed per section for cantilever segment alignment and tensioning.

The bridge was erected in an area with very soft clay soil. Therefore, construction of the bridge involved extensive studies and special measures to account for the settling of the main pylon foundations during work on the superstructure. One of these measures consisted in using high-strength external tendons for effective reinforcement against unexpected settlement.

The Type 19S15.7MC 15.7mm DYWIDAG Tendons consisting of epoxy coated and filled strands with HDPE sheathing also served to reinforce the main girder. With a guaranteed tensile strength of 2,250MPa, these strands are the highest strength strands used in post-tensioning worldwide. Compared to the Type 19S15.2 DYWIDAG Strand Post-Tensioning System originally proposed for the bridge, the system used offers approx. 20% more stress resistance and approx. 28% more load resistance.

The stronger external tendons maintain main girder strength against uneven settlement of the main pylon foundations of up to 10cm. The steel used in the high-tensile strands, the performance of the anchoring system, and safety margins provided by the concrete were tested and analyzed to confirm the suitability of the individual components.

The tendons were 269m long in the center span and 131m long in the side spans. There was only little space to insert the 269m tendons inside the girder and to post-tension them. All of the tendons in the side spans were stressed conventionally at the end support using a multi-strand jack. For the tendons in the main span, strands were stressed individually using a monostrand jack due to limited working space. Thanks to this procedure, construction was carried out efficiently. The Yabegawa Bridge was completed in early March 2009, and traffic now flows freely on a 23.8km long section between Omuta City and Okawa City.
Across the Country in Less than Three Hours: Kyongbu High Speed Railway, South Korea

Since the new high speed railway line from Seoul to Busan became operational, travelers can cross South Korea from north to south in less than three hours. The Korea Train Express (KTX), South Korea’s high speed train, is technically modeled after the French TGV and can travel at a speed of more than 300km/h.

Work on the new 430.7km railway line began in 1992 and was finished at the end of 2010. The 1st section between Seoul and Daegu was opened to the public in April 2004, and the final section from Daegu to Busan was completed in December 2010. After completion, the travel time from Seoul to Busan is expected to be shortened to 2h 10min.

Work was carried out on the central and southern sections, at Kimchon Station. This section links the two cities of Kimchon (population 140,000) and Kumi (population 390,000). Construction of this section began in August 2008 and was completed at the end of 2010. Kimchon Station is divided into two sections: a station and a railway extension. The rail extension consists of a 3,780m long hollow box girder bridge with 74 spans that are 50m long each.

For the construction of the hollow box girder bridge, DSI Korea supplied a total of 3,168 Type 22x15.2mm active MA Anchorages and 1,464 external MA Anchorages, thus contributing to a fast and safe completion of construction work. In addition, DSI Korea supplied the stressing equipment necessary for post-tensioning. 8 sets of formwork were operated simultaneously on the job site. With a work cycle of 25 days per span, post-tensioning was successfully completed by May 2010.
DYNA Bond® Stay Cable Bridge for Modern Korean Housing Development

The city of Gimpo near Seoul is located in the province of Gyeonggi, the most populous province of South Korea. As the housing situation in the province is very tight due to the density of population, the government has been funding the construction of new residential developments.

The Gimpo-Yangchon Residential Land Development Project is one of these modern urban developments. The project includes a total of 743 apartments that will considerably enhance living conditions in Gimpo.

The new housing development had to be connected to neighboring districts by the construction of new roads. One of the most important elements of the new road system was the construction of a small stay cable bridge over the new district’s main road designed to connect the development to other districts.

The owner, “The Korea Land & Housing Corporation (LH)” decided to use the DYNA Bond® Stay Cable System as an economic solution for the new stay cable bridge. DSI supplied a total of 16 Type DB-P27 DYNA Bond® Stay Cables and 4 Type DB-P37 DYNA Bond® Stay Cables as well as the special equipment necessary for cable installation.

During installation, the site was supported by a qualified and experienced DSI technician. DSI is pleased to have played a significant role in the construction of a new stay cable bridge that is now a landmark for the new district and visible from afar.
A Symbol for Democracy: The Asian Culture Center in Gwangju, South Korea

The city of Gwangju in south-west Korea is the sixth largest city in the country. Ever since a citizens’ revolt demanding democracy was violently suppressed, the city has been a symbol for democracy, human rights and peace.

Due to the historical importance of Gwangju, the government of South Korea decided to build a new complex for culture and arts in the city in order to strengthen Gwangju’s function as a role model and important culture center in Asia. The Asian Culture Complex is being built on a surface area of approx. 120,000m² around several buildings that symbolize the country’s fight for democracy. One of these buildings is the former headquarters of Jeollanam-do Province.

The Asian Culture Center was designed by Korean architect Kyu Sung Woo. The complex’s oval shape represents a non-hierarchical, democratic form, and the special lighting in the interior of the building, in which daylight plays an important role, symbolizes a strong bond with nature.

The partly subterranean Culture Center will contain institutions such as the Asian Culture Institute, the Asian Artplex for performances, a children’s museum and the Asian Culture Creation Center, an institution that contains ateliers and multimedia labs. The roof of the center will accommodate a park, and the complete building will be built using environmentally friendly construction methods that will allow energy savings of up to 40% in comparison to conventional buildings.

As a total of 10 floors will be underground, the project required an excavation that was particularly deep. Clamshells were used to excavate a slurry wall, which was stabilized by reinforcing bar cages.

The impervious wall was continuously concreted. DSI Korea supplied restressible Type 6x0.6” DYWIDAG Strand Anchors in lengths of 18.5-26.5m with a tensioning force of 70t to support the slurry wall. All in all, over 4,000 DYWIDAG Strand Anchors were successfully installed.
**INFO**

Owner Ministry of Culture, Sports and Tourism, Seoul, Korea +++ Client Daelim Industrial Co. Ltd., Seoul, Korea +++
Subcontractor Betty Construction, Seoul, Korea; E-Kang ENC, Seoul, Korea +++ Consulting Forest of Light, Seoul, Korea

**DSI Unit** DSI Korea Co. Ltd., Seoul, Korea

**DSI Scope** Supply of 4,000 Type 6x0.6” DYWIDAG Restressable Strand Anchors; technical assistance
DYWIDAG Post-Tensioning Systems
Secure North-South Transport in Laos

Just in time for the beginning of the 2009 Southeast Asian Games, the most significant public event to be hosted by Laos in 2009, the new Hinheup Bridge was inaugurated. The new bridge over the Nam Lik River is the principal connection on National Road No.13, which runs North and South through the capital of Vientiane. Connecting Cambodia and China, National Road No.13 is the most important highway in Laos.

The existing 145m long and 5m wide Bailey bridge, which was opened in 1915, only allowed for traffic in one direction at a time. The old steel bridge was severely damaged by three major incidents during its life; the last was in 1981, when a giant flood wave washed away the superstructure. Since then, the old bridge had continued to deteriorate to a stage that was life-threatening to its users. Severe deflection and bouncing of the bridge deck could be seen when heavy vehicles were crossing. During the construction of the new bridge, a 2m long section at the south end of the old structure broke away when a truck heavily loaded with timber tried to cross.

In accordance with a feasibility study carried out by JICA, the bridge was built using the Incremental Launching Method (ILM) in order to meet requirements in terms of capacity and length of the bridge as well as the hydrological pattern of Nam Lik River. Utracon Overseas Pte Ltd, a foreign subsidiary of Utracon Structural Systems Pte Ltd in Singapore, was engaged as the specialist sub-contractor to carry out incremental launching, post-tensioning and other specialist work for the bridge superstructure. Utracon was backed by its commendable track record on previous JICA funded projects in Asia.

In accordance with the JICA’s strict guidelines in terms of environmental friendliness and social sustainability. Hinheup’s natural reserves such as the surrounding rain forest, the encircling mountains and the river with huge stacked stones were all carefully protected. The construction compound was also restricted to just a minimal area.

The new bridge is 195m long and consists of 19 concrete box girder segments in lengths of 7.65m to 11.50m that were concreted in a sequential manner. The bridge deck measures 10.54m in width and is 2.80m deep. Post-tensioning of the concrete box girders was carried out using DYWIDAG Post-Tensioning Systems. Type 12x0.6” DYWIDAG Strand Post-Tensioning Tendons were used for the longitudinal tensioning of the entire bridge. Utracon supplied most of the post-tensioning equipment and performed all of the post-tensioning work for the bridge. Launching was done using a 32m long steel launching nose with two 480t heavy duty hydraulic jacks. Thanks to technical expertise, advanced equipment, precise logistics arrangements, and an experienced workforce, a construction cycle of 11 days per segment was successfully achieved.
Modern Bridge for Modern District: The Marina Bayfront Bridge in Singapore

The Urban Redevelopment Authority and the Land Transport Authority in Singapore are constructing two new bridges that will link Raffles Avenue to the Marina Bay Sands. The Marina Bay Sands is a new urban development that will include hotels, up market shops, first class restaurants, theaters and a congress center.

The first bridge is a pedestrian bridge featuring a unique double helical design and will undoubtedly become a new landmark for Singapore. The second bridge, a 6-lane dual carriageway bridge, is also an elegant structure that runs parallel to the curved pedestrian bridge. The bridge features a 19.8m wide triple cell box girder which was cast in-place using DYWIDAG form travelers. Precast wing slabs are attached to both sides of the box girder for the entire bridge width of 38.6m.

DSI’s licensee in Singapore, Utracon Structural Systems Pte Ltd, was an active participant in the planning and construction of the vehicular bridge. Besides supplying and operating the DYWIDAG form travelers for the casting of the cast in-place box girder, Utracon was also involved in the precast wing slab erection and post-tensioning work.

For the in-place casting of the triple cell box girder, 4 DYWIDAG form travelers were used at each end of the cantilever construction. Each 4.0m long segment was cast in a 10 to 14 day construction cycle, with the longer cycle needed for the forming of in-place diaphragms that had to be cast for some of the segments.

One precast wing slab measures 2.4x8.5m and weighs approximately 30t. A hydraulic truck crane was used for placing the wing slabs. Prior to the casting of the 1.6m wide closure pour and permanent post-tensioning, the wing slabs were temporarily tied back using DYWIDAG THREADBAR®.

The box girders are strengthened by DYWIDAG 12x0.6” and 19x0.6” Internal Post-Tensioning Tendons and 19x0.6” and 27x0.6” External Post-Tensioning Tendons. The installation and stressing of the 10 external tendons was one of the main features of the bridge construction, as the tendons spanned the entire length of the 300m long bridge.

Due to the external tendons’ exceptional length, 2 strand pushers were used for the strand installation process. One pusher was stationed at one end of the tendon, while another pusher was positioned at mid-span. From here, strands were gripped and pushed towards the other end via an opening in the HDPE duct.
During ASFINAG remedial action at the A10 Tauern Motorway, overall structural repair began on the 30 year old “Valley Bridge Larzenbach” structure near Hüttau between the motorway junctions of Bischofshofen and Eben.

Geotechnical work at pier 70, which had become necessary due to landslides, was carried out by PORR Technobau und Umwelt AG.

Although the bridge pier rests on two 9m deep, 5m Ø wells, it slid several centimeters downhill during the past 30 years.

10 St 1670/1860 8 strand Ø 15.7mm Permanent Double Corrosion Protected (DCP) DYWIDAG Strand Anchors and restressable anchor heads were installed in order to stop the pier’s sliding.

Two challenges had to be met during construction work. As the tieback anchoring of the forces in the bridge pier was only possible in very deep strata, Permanent Double Corrosion Protected (DCP) DYWIDAG Strand Anchors with anchor lengths of approx. 80m had to be installed. At this length, the weight of an anchor that had not been pre-grouted is approx. 750kg. The heavy weight of each anchor complicates handling on site and during installation. In addition, installation had to be carried out in very steep terrain that was difficult to access.

Due to these conditions, the anchors were supplied on site on special drums (one drum per anchor). Handling of the compact drums on site was very easy, and the anchors could be transported quickly to the point of installation despite the steep terrain. Installation of the anchors was optimized using a compressed air brake that was specially adjusted to the drums.
After anchor installation and placement of a concrete beam, all of the anchors were equipped with load cells for monitoring anchor forces. Before locking off the anchors, a suitability test was carried out. Due to the extremely long free length of the anchors, an elongation of more than 350mm was to be expected. The stroke of a single jack is not enough to accommodate the anticipated strand elongation.

In addition, re-gripping at each load cycle is very complex and hard to carry out (necessary clearance for wedge set).

Consequently, DSI decided to use special insertion devices in order to be able to couple two Tensa 2,600kN Jacks via a special connecting plate. Thus, a total strand elongation of up to 500mm can be achieved. In combination with a cable winch meter provided by DSI, on-site elongation recordings were eased and the time required for the performance test could be reduced to a reasonable amount.

Stabilization of the pier was successfully completed in November 2009.
During 2009, steps were taken to improve flood protection in the municipalities of Bach and Elbingenalp in the Tyrolean Lech Valley. The construction of the Lech Bridge Bach was an important part of the first section of the B 198 federal road project. The new bridge became necessary because the existing arch bridge built in 1928 was no longer able to guarantee the required drainage volumes at high watermark.

According to project requirements, the supporting structure was to cross the river without any piers in the water, and the elevation of the existing bridge deck was eliminated in the new bridge to allow a level road layout. The new bridge was designed as a stay cable structure with one pylon and blends in well with the surrounding landscape. The main span is supported by six stay cables that fan out from the bridge's center plane. An additional five parallel stay cables anchor the 19m high pylon into the abutment located behind it.

The bridge’s reinforced concrete supporting structure, which was constructed on false work, has a span length of 68m and a width of 11.10m. The upper part of the reinforced concrete pylon is designed as a composite steel hollow box that accommodates the stay cable anchorages.

For the new bridge, DSI supplied the DYNA Grip® stay cable system for 31 to 35 strands. This system permits both the replacement of individual strands and the replacement of complete stay cables.

The strands, which are galvanized, waxed and PE-coated, were installed from the superstructure into the pylon anchorage using a strand pusher. In order to guarantee the uniformity of individual strand forces within one stay cable, the post-tensioning levels, which were adjusted to suit the construction progress, were adjusted using the ConTen method. The newly developed ConTen valve was used in this process. Due to the limited space on site and an ambitious schedule, the installation of all of the stay cables and all of the post-tensioning works were planned and carried out in close cooperation with site management so that the new Lech Bridge was completed on schedule in the autumn of 2009.
Unobstructed Traffic from North to South: The Sarajevo Bypass

The Vc Motorway project is a major European Corridor project that will result in a fast connection from Budapest in Hungary to Ploče on Croatia’s Adriatic coast. The new motorway crosses Bosnia and Herzegovina from north to south.

The Sarajevo Bypass from Zenica to Mostar is a section of this corridor. This section is the most frequently travelled connection from Sarajevo to the south-east of Bosnia and Herzegovina. The new section will significantly relieve traffic on the existing M17 main road and lead to safer and faster travel times. The Sarajevo Bypass is approx. 10km long and includes an approx. 5km long approach road connecting the bypass to Sarajevo.

At present, part of the junction near Sarajevo is under construction. The subproject consists of a total of 12 structures (bridges, viaducts, overpasses and ramps) and has a total length of 3,442m. The junction includes three traffic levels: the highway itself and two viaducts with differing levels.

Each of the structures includes a 600m long curve. Due to the extremely complicated geometry, all of the structures’ spans are constructed classically: span by span on scaffolding.

Type 15x0.62” DYWIDAG Strand Tendons are used for longitudinal prestressing. DSI Headquarter Operations supplied 1,000t of the DYWIDAG Post-Tensioning System, including 15x0.62” MA and R 15x0.62” Anchorages as well as the necessary tensioning equipment.

Construction of this section began in October 2008 and is scheduled to be completed in October 2011.
Ax les Thermes is located in the south-east of France, near Andorra and very close to Spain. The town is situated at an elevation of 720m and is not only popular with skiers, but has been known for its eighty thermal springs for over 2,000 years.

Federal Road No. N20, which runs directly through Ax les Thermes, was at one time the most important connection with Andorra. In order to allow for increasing traffic volume, construction began on a new 5.5km long bypass. The new roadway runs around the upper part of Ax les Thermes.

After forest clearance, work began on the roadway itself. Geological conditions were characterized by fine-grained gneiss granite and granite gneiss. These rock layers called for systematic blasting and an ex-post stabilization of the steep rock face.

Initially, vertical holes were drilled in order to place explosives in the rocky crests. A total of 450,000 m³ of rock were fitted with explosives. The methods used had to be adapted to the construction site’s complicated geometry with its steep gradients. Specialized foundation contractors SEMEN TP and STIPS (ALPHAROC) used a hydraulic excavator named “stork” because of its long arm. The arm is fitted with a drill that makes it possible to...
function in this difficult terrain. An attached compressor assures the drilling equipment’s independence. For additional safety, pits were excavated at the rock face to accommodate spoil and to protect residential buildings below from falling debris.

Once the excavation work, which was carried out by the ROGER MARTIN Company in several steps, was completed, the steep rock faces were stabilized using soil nails. DSI France supplied a total of 51,000m of GEWI® Plus Soil Nails including accessories such as nuts, anchor plates and spacers. In addition, DSI’s French partner SAGGAM supplied more than 8,000m² of mesh for this project.

Due to the fact that the area was difficult to access, a solution had to be found for transporting the pumping supplies and equipment needed for grouting the DYWIDAG Soil Nails that had an average length of 10m. The contractor suggested building a mobile pumping station. A skip was converted into a mobile pumping unit especially for this purpose. Thanks to the conversion of the skip into a mobile grouting machine, all of the installation locations of the soil nails could be reached. The highest soil nail rock wall was 56m tall.

During the two-year construction period, the quick response time of the DSI teams was one of the decisive factors for the rapid construction progress. DSI France is proud to have contributed to the successful completion of this unusual construction project with the flexibility and the technical know-how of its employees.
The Mittlere Ring is one of Munich’s main arterial roads and has long been noted for its very heavy traffic. Some of the bottlenecks of the multi-lane road that circles the city center have previously been eliminated by the addition of new tunnels. Luise-Kiesselbach Square is the last section of this road improvement effort. The square is an important traffic hub in the southwest of the city. Here, motorways A 96 from Lindau and A 95 from Garmisch meet, causing long delays in daily rush-hour traffic.

The 398.5 Million Euro construction project will consist of a 1,500m long, partly two-level tunnel leading to the A 95 motorway, a 400m long underpass as well as a 620m long tunnel in the eastern section. Thanks to convenient approach roads, the extension of the Mittlere Ring will considerably relieve the traffic congestion in this area and improve living conditions for local residents by redirecting traffic underground and creating a new park. Construction work began in October 2007 and is scheduled for completion in 2015.
In order to minimize disturbances for the residents, the new section is primarily being constructed using the cut-and-cover method. Initially, piped vertical boreholes in diameters of 88 to 150cm are drilled to depths of 10-12m. These boreholes are filled with concrete, forming the future side walls of the tunnel. Afterwards, the tunnel ceiling is concreted in sections of approx. 13.5m in length directly onto the soil, which serves as lower formwork. The soil is then excavated from within, starting from the future tunnel exits.

The FLIMU Reinforcing Steel Coupling System was chosen as the most cost effective solution for stabilizing the transition between the drilled piles and the tunnel ceiling because it offsets slightly higher material cost by significantly lower cost of installation labor. In addition, the contractor had already successfully used the FLIMU System supplied by DSI during the reconstruction at Richard-Strauß Road at the north-eastern section of the Mittlere Ring.

Even in areas with minimal working space, the FLIMU System provides a simple, trouble free connection, and only three employees are necessary for installation: one employee to operate the lifting vehicle, and two employees to work the extruder. All in all, DSI supplied approx. 35,000 Ø 28mm extruded coupler splices, approx. 20,000 Ø 32mm extruded coupler splices, and the necessary extruding equipment. Before installation, DSI also carried out tests in original sizes. On-site instructions were given by experienced DSI employees. After the instruction, work could be carried out independently by the construction workers on site.
GEWI® Plus Piles stabilize one of the Largest Automobile Commercial Harbors in the World: Kaiserschleuse Bremerhaven

With a turnover of approx. 2 million vehicles per year, Bremerhaven is one of the world’s largest commercial harbors for cars. Up to now, car carriers depended on the northern lock due to the fact that the 28m wide, 215m long and 9m deep Kaiserschleuse Bremerhaven, which was originally inaugurated in 1897, was too small for modern transport ships that can be up to 240m long.

In order to avoid a detour via the northern lock into Kaiser Harbor and the associated long waiting time, the decision was made to build an up to date, safe lock complex. The new lock is 305m long, 55m wide and 13m deep and suitable for future generations of transport ships that can be up to 270m in length. The new Kaiserschleuse is fitted with innovative lift and slide gates. Costing approx. 233 Million Euros, the project is the largest lock project in Europe.

DSI supplied approx. 770 63.5mm GEWI® Plus Piles, half of which were Double Corrosion Protected, for buoyancy control at the sills, sluice heads and blocks. The buoyancy control anchorages were installed after the excavations had reached their final depths. The GEWI® Plus Piles were installed using mobile work scaffolding, and 640,000m³ of soil were excavated during construction work.

Once the GEWI® Plus Piles were installed, a 1.5m thick underwater concrete floor was constructed. A total of 2,000m of quay walls were realized using the sheet piling method for the Kaiserschleuse. In addition, approx. 750m of sheet piles were driven for the retaining walls of the sluice head excavations.

Construction work proved to be difficult due to the fact that it had to be carried out during high tide and in partly soft clay soil with very low load capacities. Due to the depth of the excavation, the poor soil conditions and the high water pressure, the sheet piles had to be stabilized by up to three waler lines.

Work at the Kaiserschleuse began in 2008 and was successfully completed in the spring of 2010. Thanks to the enlargement of the lock complex, Bremerhaven will be able to maintain and further expand its position as one of the world’s largest commercial harbors for cars.

Owner | Bremenports GmbH & Co. KG, Bremerhaven, Germany
Client | Neidhardt Grundbau GmbH, Hamburg, Germany
Contractor | JV, consisting of Hochtief Construction AG, August Prien Bauunternehmung (GmbH & Co. KG), STRABAG AG and Gustav W. Rogge, all of them Bremen and Bremerhaven, Germany
DSI Unit | DSI GmbH, LU West, Langenfeld, Germany
DSI Scope | Supply of approx. 770 63.5mm GEWI® Plus Piles, half of which were Double Corrosion Protected
Since 1974, municipal and industrial sewage has been treated in a single sewage plant owned by the Eifel-Rur water board (WVER). In 2007, this sewage treatment plant processed approximately 24 mio. m³ of wastewater.

In 2003, the water board decided to modify its process to include the digestion of sewage sludge. Thanks to digestion, the volume of sludge is reduced by approx. 30%, and the sludge is stabilized, which considerably facilitates its disposal. In addition, the sewage plant can cover approx. 70% of its energy demand with gases such as methane, which are created during anaerobic sludge stabilization. Construction began in 2008 and was completed in the first quarter of 2010.

Anaerobic sludge stabilization takes place in three new 6,000 m³ digesters, which can be operated individually or simultaneously. The digesters will produce an annual volume of approx. 5 mio. m³ of gas, which roughly equals the power requirement of 3,000 households and the heat energy necessary for 1,000 households.

An 8m deep excavation was needed for the construction of the digesters. A sheet pile wall was embedded in the excavation in order to make it watertight. The pump and coagulation buildings necessary for the construction of the digester plant were constructed using the cast-in-place method, thus creating a “white tank”.

The three digesters are oval because this shape is ideal for an even mixing of the sludge, which is thoroughly circulated in the three towers. The digesters’ outer shell was post-tensioned using prefabricated SUSPA Systems Tendons. On the whole, DSI Langenfeld supplied 108t of prefabricated SUSPA Tendons with 6-2 to 6-9 strands and the necessary accessories such as anchorages and anchor plates. Thanks to the technical assistance DSI employees provided, tensioning work could be successfully completed on schedule.
Prefabricated DYWIDAG Tendons
Secure Innovative ATS Hybrid Wind Tower

The Dutch companies MECAL Engineering and HURKS BETON have developed a unique concept for very tall hybrid wind towers. Together with the German project developer JUWI, they founded a new company, Advanced Tower Systems B.V., and initiated a pilot project in 2008 in order to present their new concept to the wind energy industry. The pilot project was carried out on a test field of Windtest Grevenbroich GmbH in Grevenbroich near Dusseldorf, Germany.

The Advanced Tower Systems (ATS) Hybrid Tower consists of two parts. The lower part - approximately 74m high - consists of precast concrete elements, and the upper part - approx. 55m high - is a steel tower. Both parts are joined together by means of an adaptor ring. The rotor axis is situated 133m above ground, and the tip of the rotor reaches a maximum height of 180m. The tower is one of the highest wind towers in the world: Usually, conventional steel towers do not exceed heights of 100m.

Some important features distinguish ATS wind turbines from other tower concepts with precast concrete elements. There are two types of concrete precast elements which are cast in what is known as the single mould system. The rounded corner elements have the same geometry over the full height of the tower. The flat and linear segments become smaller at higher levels. The dimensions and the weight of individual concrete elements were chosen in such a way as to allow transportation using conventional trucks.

Tensioning vertical PT Tendons

All of the segments were manufactured from high strength concrete at the HURKS BETON concrete plant near Eindhoven, Netherlands and then transported to the building site in Grevenbroich, Germany on trucks. Assembly of the precast elements on the concrete foundation slab took place at the end of 2008 using a mobile crane. Individual segments were temporarily fixed by bolts at the joints, which were grouted later on.

The precast concrete shaft of the tower was anchored to the foundation by means of prefabricated DYWIDAG Post-Tensioning Tendons. Three type 19x0.6", St 1860N/mm², 15.7mm Ø tendons were installed at each corner of the tower. The stressing anchors were situated at the top of the adaptor ring, and dead-end anchors were cast into the foundation slab. The tendons were preassembled at DSI's plant in Langenfeld and shipped to the job site in Grevenbroich on drums. After the installation of the DYWIDAG Tendons with the aid of a mobile crane, all of the tendons were tensioned and subsequently grouted in order to provide efficient corrosion protection for the post-tensioning strands.

After completion of the steel part of the tower with the aid of a crawler crane at the beginning of 2009, a SIEMENS turbine with a large 93m diameter rotor was installed. The first ATS Tower was connected to the electricity net in Grevenbroich in April 2009 and has been delivering low priced, green energy ever since.

The pilot project has shown that ATS wind towers can be constructed quickly using slender high quality concrete precast elements. Measurements have proven that the SIEMENS turbine placed on the ATS Tower produces almost 20% more energy than the same type of turbines mounted on conventional steel towers, with the hub situated some 30m lower. In addition, the ATS concept provides an economically attractive possibility for generating wind energy at locations with low and moderate wind speed.
DYWIDAG Strand Anchors Stabilize Baden-Wuerttemberg’s Largest Road Construction Project

In the spring of 2008, construction started on a project that is considered the largest and most expensive road construction project of the federal state of Baden-Wuerttemberg, Germany: The 4.1km long ring road around Schwaebisch Gmuend near Stuttgart that has a total cost of approx. 230 Million Euros.

For many years, the B29 federal road, which runs through Schwaebisch Gmuend’s center and is an important connection between Stuttgart and the A7 Motorway near Aalen, has been a traffic bottleneck. The 35,000 vehicles per day using this road cause regular traffic jams and are a continuous nuisance to residents. The new B29 bypass will be located underneath the town for a total length of 2,230m. The tunnel itself is partly constructed by mining techniques and partly by the open cut method. The tunnel tubes are built in three layers from top to bottom.

The western part of the section is being constructed as an impermeable trough structure with a base slab that is up to 2.80m thick. The watertight pit lining is a tied back contiguous bored pile wall, the foundation of which is supported by large bored piles. An open cut tunnel structure is connected to this trough structure.

Construction work in the eastern section was particularly complicated due to the proximity of the Rems river.

Before excavation water could be discharged into the river, it had to be processed in a treatment plant specifically set up for this purpose. In addition, retaining walls were necessary to stabilize the Rems.

DSI supplied 1,362 DYWIDAG Strand Anchors for stabilizing the excavations; 113 of these anchors were Permanent DYWIDAG Strand Anchors with 4, 5 or 7 strands each. Additionally, 1,249 Temporary DYWIDAG Strand Anchors with extended service life and 2 to 7 strands each were used for this project. These semi-permanent anchors were especially developed for an extended temporary service life of up to 4 years. In contrast to Permanent Strand Anchors with double corrosion protection (DCP), those parts of the temporary anchor which are exposed to corrosion are modified to suit higher service life demands.

Completion of the ring road is planned for 2012 – in time to prepare the grounds for Baden-Wuerttemberg’s Garden Festival, which will be held in Schwaebisch Gmuend in 2014.
A Major Project of International Importance: Berlin-Brandenburg International Airport

In the near future, air traffic capacity in and around Berlin will be considerably increased: Berlin-Schoenefeld Airport is being expanded by approximately 970ha to a total area of 1.470ha in order to create the new Berlin-Brandenburg International airport (BBI).

Once completed, the modern international facility located south of Germany’s capital will accommodate all of Berlin’s air traffic. Closure of Tempelhof Airport will be followed by closure of the inner city airport Tegel. The closure of both airports will permanently eliminate the problem of aircraft noise that has long impacted hundreds of thousands of city residents.

The current airport system, which originated at the time of Berlin’s historical division, is no longer able to accommodate increasing passenger volume and spreads over a greater surface than the new BBI airport. In addition, as a result of specially adapted airport infrastructure, wide-bodied aircraft will be able to take off and land in Berlin.

During construction of the modern airport, energy efficiency and regenerative energy systems are of particular importance. BBI will have an initial capacity of 22 to 25 million passengers. It can, however, be expanded to accommodate 40 to 45 million passengers, and will therefore be able to cope with projected increases in future air traffic.

The new airport will include a modern railway network providing fast connections to Berlin’s city center. The connection of the tracks for long-distance and suburban trains to the modern airport’s railway station requires an approximately 3.1km long tunnel, several bridges as well as a 2.5km long depressed exit and entry structure which will accommodate the tracks for the airport express. Excavations for the construction of the depressed structure were achieved by using the open-cut method.

DSI Haan supplied DYWIDAG Form Tie Systems for the construction of the depressed exit and entry structure. DSI supplied approximately 5,000 26.5mm double anchors as well as approximately 4,000 Form Tie systems with Type N water stops. Additionally, the project required the use of steel-plastic cones in diameters of 26.5mm and 20mm.

DSI is pleased to have contributed to this forward-looking large scale project.

Mr. Ralf Lindenberg,
Schulz Baubedarf GmbH Ludwigsfelde
Since the end of 2007, a modern coal-burning power plant has been under construction in the district of Moorburg in southern Hamburg. The plant will replace the Wedel cogeneration plant and supply the south of Hamburg with long-distance heating. The new power plant is being built as a double block plant and will have a capacity of 2 x 820MW after its completion. The completion of the first block is scheduled for 2012, and the second block will be operational in 2013.

The power plant is one of the most modern plants in the world, meeting the latest guidelines for environment protection and fulfilling strict environmental specifications. The volume of cooling water that the plant can take from the Elbe River will depend on the river’s water level. In addition, the owner, Vattenfall, will build a fish bypass system in the town of Geesthacht in order to minimize the plant’s impact on the river’s ecosystem.

The overall contract volume for the power plant is 1.8 Billion Euros. The Moorburg Power Plant is being built in sections. The powerhouse with its 86 to 104m high staircase towers, the boiler house, a coal storage yard, an inlet structure and sprinkler tanks are being built one after another.

During construction, up to 2,400 workers are on site simultaneously. DSI Haan supplied approx. 15,000m of Ø 15mm Form Ties, approx. 15,000 pieces of Type N Water Stops as well as approx. 7,500 pieces of Steel-Plastic Cones for this major project.
Mulde Barrier Lake in Saxony-Anhalt, north of Leipzig, is a former brown coal open pit mine that was flooded in 1975. After the closure of the Goitsche open pit mine, the Mulde River was redirected for a length of 9km and a dam was built without considering the need for fish to transit the area.

In conjunction with a redevelopment in the former open pit area and the planned realization of the European Water Framework Directive, the decision was made to install a fish pass. The new fish pass, which was built as a double slurry wall, helps migrating fish get to the other side of the Mulde Weir.

Construction of the fish pass, designed using the waterproofing method, began in 2009. This method uses waterproof concrete which takes over both the waterproofing and load bearing functions. As waterproof structures cannot be concreted in a single step, concreting had to be carried out in sections using joints.

DSI Porta Westfalica developed the necessary joint details for this structure. By using bentonite coated waterstops – contaflexactiv – and contaseal polymer expanding seals as well as recostal® forming units, the special requirements of the detailed design could be fulfilled completely.

During the construction of the dam’s trough structure, the impermeability of the joint between the old and the new structure was of utmost importance. A clamping flange type detail would not have been suitable for this project. In cooperation with DSI Porta Westfalica, a combination of contec “New to Existing” composite film for fresh concrete and bentonite filled geotextiles was developed and installed.

DSI Porta Westfalica supervised this project from the planning stages to its completion, and the company also provided the detailed plans necessary for construction.
During a fundamental reconstruction in 2009, new locker rooms were built in Berlin Wannsee for Wannsee Stadium. As the old changing rooms were beyond repair, an elliptically shaped new building was designed in its place. The new structure was partly embedded into the ground in order to ensure an optimum adaptation to the surrounding topography.

The locker rooms are also accessible via the sports field below and feature a green roof. In addition, an environmentally friendly ventilating system with heat recovery was installed in the changing and shower rooms. The complicated formwork geometry with strip foundations posed a special challenge. DSI Porta Westfalica performed the detailed design and provided a comprehensive formwork plan for the project. DSI Porta Westfalica’s permanent formwork elements were used for the foundation of the new building’s entrance area.

All in all, 462m² of type FS recostal® foundation formwork was used. The system which was used allows a cantilever concrete height of up to 1.2m without additional reinforcement. An effective forming time of 0.15 h/m² could be achieved thanks to the easy assembly and due to the fact that all necessary components were custom-fitted and that angles and bonding were prepared in advance. Consequently, construction times could be shortened on the whole.
Use of contec Systems for the Construction of KfH Kidney Center in Leipzig

Ever since it was established in 1969, the non-profit organization, KfH, has been committed to assuring better medical care for patients suffering from chronic kidney disorders in Germany. One of the more than 200 kidney centers run by KfH in Germany is located in Leipzig.

Construction at the new kidney center began in 2008. The building’s basement and the connecting passage to the neighboring building were designed and built as a white tank structure. DSI Porta Westfalica supervised the project from the planning stage to its completion and provided the detailed joint plan for the floor slab.

To build the construction joint structure, DSI Porta Westfalica supplied a total of 270m of metal waterstops with active coating. In addition, 103m of recostal® forming units, which were partially key profiled according to DIN 1045-1, were used for the working joints floor/floor and wall/wall. In cooperation with the site manager, a special detail was developed using recostal® DFI elements for the connection of the expansion joints at the transition to the connecting passage. DSI also supplied bentonite coated contaflexactiv crack inducers and waterproof recostal® RSH aktiv starter packs. The expanding seal Waterstop RX® 101 with fixing grid was used for waterproofing the joint wall/ceiling.

The new building will ensure excellent medical care for patients with kidney disorders in the Leipzig area.

Ever since it was established in 1969, the non-profit organization, KfH, has been committed to assuring better medical care for patients suffering from chronic kidney disorders in Germany. One of the more than 200 kidney centers run by KfH in Germany is located in Leipzig.

Construction at the new kidney center began in 2008. The building’s basement and the connecting passage to the neighboring building were designed and built as a white tank structure. DSI Porta Westfalica supervised the project from the planning stage to its completion and provided the detailed joint plan for the floor slab.

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The new building will ensure excellent medical care for patients with kidney disorders in the Leipzig area.
GEWI® Anchors Stabilize Vital Harbor Works on the British Channel Island of Alderney

Located south of Great Britain, Alderney Island is the northernmost island of the Channel Islands. The key lifeline between the island and Great Britain is the Commercial Quay dock, which is located in Braye Harbour.

Comprehensive rehabilitation of the more than 100 year old quay was necessary in order to accommodate vessels measuring 95m in length. In addition, for security reasons, freight and passenger operations will have to be separated in the future. Furthermore, the old quay offered inadequate mooring security for oil tankers and had experienced damage from corrosion.

In May 2008, a specialist team sent by the civil engineering firm Geomarine began cleaning off the existing seabed sand down to sound bedrock. Afterwards, a steel former was placed on the seabed with the help of six divers and filled with concrete up to the level of the underside of the pre-cast concrete blocks. A structural steelwork skeleton was then erected to offer temporary support to blocks.

The new quay wall consists of 842 pre-cast concrete blocks, each weighing 12t, and 2,500m³ of concrete. GEWI® anchors were used to anchor the quay wall to the seabed. The GEWI® anchors were passed through the apertures of the precast block stack and drilled into an 8m rock socket below the seabed prior to being stressed to 120t. Drilling of the rock socket was achieved by using the Down The Hole hammer method, with flush velocity a key factor in ensuring the removal of the drill spoil. It was essential that the adjacent borehole be sealed and grouted before drilling could commence on the next borehole in order to prevent blow-through between boreholes. All in all, 40 No. Ø 63.5mm GEWI® anchors in lengths of 18m were installed, together with 44 No. Ø 63.5mm GEWI® high shear dowels.

The grouting of the anchors required specialized measures to ensure that the boreholes were completely filled. A system of tremie tubes with integrated grout level indicators ensured that the 8m long borehole could be fully grouted. This allowed prestressing of the anchor tendon prior to bonding with the precast concrete segments, ensuring that the prestressing force was permanently transferred to the concrete segment quay wall.

The realization of this project on Alderney Island presented a logistical challenge to everyone involved. Despite the isolated location of the island, delayed shipping, adverse weather conditions and bad conditions for working underwater, work at the new quay wall was successfully completed.
Recently, the main railway line between Dublin and Belfast suffered a major collapse on a viaduct that crosses the Broad Meadow Estuary at Malahide, just north of Dublin. Fortunately, the collapse happened just after a packed commuter train had crossed the old stone viaduct.

The 176m long viaduct was originally built in 1844 as a timber structure, but replaced in 1860 as a masonry pier structure with wrought iron deck sections. In 1966, the deck sections were replaced with post-tensioned concrete sections.

On August 21st 2009, one of the piers collapsed due to heavy scour at its underside, taking with it a 20m deck section. Major rainfalls had resulted in a significant increase in the volume of water flowing through the estuary. Erosion below one of the piers first caused a small breach to appear in the rock causeway. The breach rapidly enlarged itself in the proximity of the failed pier, causing scouring and undermining of the foundation.

The solution was to core through the original stone piers and then to insert 5-6m long, 168mm diameter casings into the rock armor. The silts beneath were immediately grouted in order to ensure that the borehole was sealed down to competent ground below the base of the causeway.

Afterwards, a total of 192 up to 18m long Type R51N DYWI® Drill Micropiles were inserted through the permanent casing and drilled into dense gravel to underpin the original stone piers. At the two piers immediately adjacent to the collapse, 14 Type T76N DYWI® Drill Hollow Bars in lengths of 22m were installed vertically from track level to depths of 22m in order to attain working loads of up to 600kN.

All 11 piers and the abutments at both ends of the viaduct were underpinned with Type R51N DYWI® Drill Micropiles, using 100mm diameter tungsten carbide drill bits. Simultaneous drilling and grouting was employed to ensure that the gravels in the proximity of the bore were fully permeated and any loose soils further consolidated.

The DYWI® Drill Hollow Bar proved to be the ideal solution for working in loose granular soils below the pier footings. The micropiles act solely in compression and were cast into a permanent 6m casing, which was cast into the cored socket of the pier.

The restricted headroom at the underside of the bridge decks necessitated specially modified drill rigs with short stroke drill booms.
New Stress Ribbon Bridge for Historical Spa in Tuscany

The town of Bagni di Lucca (literally: baths of Lucca) is an old thermal spa in Tuscany. A new pedestrian bridge over the Lima River is currently being built as part of the town’s development plan. The bridge has been designed as a stress ribbon structure and fits perfectly into the historical townscape. In addition, this special construction method has many technical and economic advantages.

The 3.20m wide prestressed concrete stress-ribbon structure features an 87m long main span. This pedestrian bridge has a maximum rise of 1.70m under permanent loads and has been designed with a maximum slope of 5% to guarantee the complete accessibility of the link. The cross section consists of a compact 15cm thick concrete ribbon and two 40cm high beams running parallel over the entire bridge length.

The longitudinal bar system consists of two resistant systems: the first one stabilizes the structure during construction, and the second one is used to prestress the completed structure. The suspension cables are made up of two groups of 45x0.6” St 1670/1860 strands that are arranged in a rectangular shape in five layers of nine strands each. The two groups are located in a special channel and positioned at the centre of gravity of the cross section.

DYWIT, Italy was chosen to supply the DYWIDAG Strand Post-Tensioning System for this project. A total of 15t of DYWIDAG Strand Tendons were supplied for the bridge and installed with the assistance of DYWIT employees. The prestressing system is formed by two kinds of tendons: the first consists of 16 four strand tendons that are located at the centre of gravity height of the 15cm thick slab, and the second consists of two tendons with 12 strands each.
The shape of the section and the positioning of the tendons had been studied in detail in order to keep the position of the centre of gravity constant in all construction phases and under service loads.

Work on the structure began with the construction of the two foundation blocks using micro piles. Afterwards, the suspension cables were positioned along with the safety ropes for the workers. Once the precast elements for the bridge deck had been installed, the tendons were prestressed.
After Gioia Tauro and Genoa, La Spezia Harbor on the Ligurian Sea coast is Italy’s third largest commercial harbor. The harbor can accommodate the latest generation container ships and registered more than 1 million container movements in 2007.

In order to accommodate the anticipated increase in the volume of cargo to be handled in the future, Garibaldi Wharf is currently being enlarged. The western side of the wharf will be enlarged to a maximum width of approx. 50m, while the front end will be expanded by 130m. Construction work began in 2008 and is scheduled for completion in 2011.

During the expansion, work was done on a 10m wide sheet pile wall at the front end of the wharf. The sheet pile wall consists of a HZ975/AZ18 main wall and an AZ37-700 anchorage wall.

DYWIT was awarded a contract to supply approx. 4,800m of double corrosion protected Type 63T GEWI® Tie Rods for this project. The tie rods were used to connect a reinforced 4x3m concrete beam to the anchor wall in order to limit deformations while filling the anchor wall. The GEWI® Tie Rods were installed at a spacing of 2.27m and in individual lengths of 27 to 33m. Afterwards, the GEWI® Tie Rods were prestressed to approx. 200kN. With a live load of 40kN/m², the final load after completion amounts to approx. 665kN.
An Exceptional Construction Project: The Wooden Arch Bridge in Sneek, Netherlands

In the northern part of the Netherlands, a quite unique traffic bridge was built over the A7 motorway for the city of Sneek: a wooden arch bridge. The basic design was developed by the architect Hans Achterbosch, who won a competition for innovative bridge structures.

The superstructure consists of two wooden arches carrying a steel deck. The bridge is 32m long, 16m high and 14m wide. The bridge consists of a special type of wood called Accoya®. Thanks to special treatment, the ability of this wood to absorb water is greatly reduced, which is why it is suitable for permanent exterior use. All of the arch segments were manufactured by Schaffitzel Holzindustrie in Germany.

Individual segments were joined together into two separate arches on a building site along the A7 motorway. Afterwards, the arches were positioned using mobile cranes and integrated with the steel deck. Finally, the complete bridge superstructure was transported on a mobile platform and placed in its final position over the motorway. As the weight of the bridge was approximately 400t, a total of six mobile cranes had to be used during the installation.

DSI Netherlands was involved during the final design stage and was thus able to develop a suitable pre-stressing system with special anchors and transition elements for the joints between the arches and the deck. DSI supplied, installed, stressed and grouted all of the strand tendons needed.

Type 15.7mm, 1860N/mm² DYWIDAG Strand Post-Tensioning Tendons were used to absorb tensile forces at the ends of the arches. Tendons with 10 strands were used longitudinally, and transverse tendons had 5 strands each. The anchor plates were exceptionally large in order to transfer pre-stressing forces into the wooden beams. Pre-stressing was carried out in two construction stages - the first one during the assembly of the individual arches and the second one during the integration of the whole bridge superstructure.

The acetyl preservation method used for the wood posed special requirements for the post-tensioning system because direct contact of the wood and pre-stressing steel would have accelerated the corrosion process. Consequently, the strands were double corrosion protected: they were installed in HDPE-tubes, which were injected with cement grout after stressing.

This exceptional bridge has become an important landmark for the city of Sneek. It not only gets the attention of local people, but also the attention of the international community of architects and civil engineers.

Schaffitzel Holzindustrie has already received an order for a similar bridge and is expecting additional projects in the future. DSI is proud to have contributed to the successful completion of this development.
Innovative Solutions for Precast Concrete Viaducts with SPANBETON and DSI

Many viaducts in the Netherlands are built using precast concrete elements. This type of structure is well suited for locations with high traffic volume, limited space and very short construction times. The prefabricated girders are often installed during the night in order to minimize obstruction to traffic.

SPANBETON is a well-known Dutch precast concrete manufacturer that specializes in precast pre-stressed box-girders used primarily for long span viaducts. These girders are integrated into viaducts using transverse post-tensioning tendons. DSI has been co-operating with SPANBETON for more than 40 years and has delivered transverse DYWIDAG Post-Tensioning Tendons for many projects.

The large Ridderster and Vaanplein fly-overs near Rotterdam are among the largest projects executed by SPANBETON and DSI. These projects required the use of up to 1.40m high SKK box-girders for single spans of up to 40 meters.

Motorways are getting wider and wider. That is why the Dutch Ministry of Transport, Public Works and Water Management, the Rijkswaterstaat, started looking for solutions for slender viaducts with even larger spans.
This has been recognized by SPANBETON and DSI as an important challenge.

A special solution has been developed and patented by SPANBETON for viaducts with a minimum of two spans. In what is called the “3P-System”, girders are not only integrated in the transverse direction, but also in the longitudinal direction. For that purpose, external tendons are used within the cross-section of precast box-girders.

Within the last three years, the following three projects were carried out using the “3P-System”:
- viaduct over A2 near Breukelen with three spans of 44, 46 and 45m
- viaduct over A2 near Lage Weide with two spans of 47m each
- viaduct on A50 near Rosmalen with three spans of 35, 53 and 50m

Recently, the “Lage Weide” viaduct has been nominated for the Annual Award of the Dutch Concrete Society.

DSI Netherlands is very proud of the long and successful co-operation with SPANBETON.

The development of the “3P-System” will be very important for improving traffic flow by using slender prefabricated elements for large spans in the future.
During the last few years, road infrastructure development has become one of the main objectives of Poland’s government. Ever since Poland and Ukraine were selected to host the European Football Championship Euro 2012, it has become very hard to find a place in Poland where people are not busy building a new road.

On the west side of Warsaw, the new S8 express road is currently being built. The connection of the planned A2 motorway west of Warsaw to the existing Armii Krajower route will become a part of the northern Warsaw ring road. The S8 budget is approximately 500 Mio. Euros. Work started in February 2008 and was finished at the end of 2010.

The new 10.4km long road section along the S8 will have three 3.5m wide lanes per driving direction. In addition, the road will have 2.5m wide emergency lanes in each direction as well as a 4m wide median strip. Three segments of the road with a total length of 2.6km will be built below ground water level, which is why they have to be stabilized by slurry walls with bottom slabs.

Due to the high ground water level, the non-cohesive soils, the depth of the concrete slab and the slurry wall span, a horizontal diaphragm had to be built before the excavation was carried out. This “plug” was made of 1.6m diameter jet-grouted plugs with an overlap of 0.25m. Depending on excavation depths, plug thickness ranged from 1 to 4m, and they were positioned at depths of up to 17m. Additionally, the excavations were divided into smaller segments, which were closed with jet-grouted facing walls. The palisades used had diameters of 80cm and maximum lengths of 10m.

Until the concrete slabs are in place and can decrease the bending force in the slurry walls, additional temporary support is necessary to withstand the loads during the excavation phase. DSI Poland supplied a total of 1,730 Temporary Strand Anchors (140mm² Type SUSPA-Systems 6-5 GR1570/1770) in total lengths of approximately 21m and with bond lengths of approximately 8-9m. Three injection pipes were installed on every anchor for the grouting process. The anchors fulfilled all the requirements of European Standard EN 1537 in terms of corrosion protection for temporary anchors.

DSI Poland also supplied two complete stressing units with ultra light CFK Hollow-Piston Jacks, 1,175kN – 25kg. Every anchor was stressed and checked according to test method No. 3 of EN 1537. In this method, creep is measured between the 3rd and the 15th minute with constant loads of 0.9P_{0,1k} – 960kN. Seven days after completion of the concrete bottom slab, the anchors were cut off and the holes in the slurry walls were filled with cement grout.
Client GDDKiA, Warsaw, Poland

General Contractor: Joint venture consisting of Budimex Dromex SA, Warsaw, Poland; Strabag Sp. z o.o., Warsaw, Poland; Mostostal Warszawa SA, Warsaw, Poland and Warbud SA, Warsaw, Poland

Contractor: AARSLEFF Sp. z o.o., Warsaw, Poland

Engineers: Joint venture consisting of TPF PLANEGE – Consultores de Engenharia e Gestão S.A., Lisbon, Portugal and E&L Architects Sp. z o.o., Warsaw, Poland

Architects: Arcadis Sp. z o.o., Warsaw, Poland

DSI Unit: DYWIDAG-Systems International Sp. z o.o., Gdansk, Poland

DSI Scope: Supply of 1,730 temporary DYWIDAG Strand Anchors; 2 stressing units; technical assistance
DYWIDAG Systems secure longest Extradosed Bridge in Europe: POVAŽSKÁ BYSTRICA Bridge, Slovakia

The 968m long extradosed bridge No. 206 in Považská Bystrica is the most important element for completing the D1 Slovakian highway between Bratislava and Žilina. The bridge consists of a 30.4m wide single box superstructure supported by eleven piers, seven of which have deviators at intervals of 122m with 8 saddles each to accommodate its extradosed cables.

With this layout, the Považská Bystrica Bridge is by far the longest extradosed bridge in Europe, followed by Puhov Most in Slovenia with four piers and three main spans of 100m.

The bridge was designed by Alfa 04 and Strasky, Husty & Partners, and the general contractor is a consortium of Skanska and Doprastav. The final design and the criteria for the cables were selected from a wide range of different options. In the end, the decision was made to use DSI stay cable systems for the extradosed cables partially because DSI had already been involved in the world’s first extradosed Bridge which was built in Odawara, Japan in 1994 – cf. info box.

The cables consist of 37 0.62” waxed and PE coated galvanized 7-wire strands with a nominal ultimate load of 1860N/mm². The corrosion protected strands are guided through a © 180mm PE pipe and anchored on both sides within the box girder with DYNA Grip® DG-P 37 stressing anchorages.

**Figure 1: DYNA Grip® Stressing Anchorage**
Above the pier, the cables are deviated in a saddle consisting of a saddle pipe and a recess pipe (see Figure 2). At the saddle, the recess pipe is grouted, and different cable forces on both sides of the cables are transmitted reliably to the structure by an anchor groove and pin construction.

The anchorage fatigue and tensile tests, including the wedge-shaped shim plates with an angle of 10mrad underneath the anchorages as well as the leak tightness testing according to fib Bulletin 30, had previously been performed for the design criteria as used for cable stayed bridges. The fatigue tests were performed with two million load cycles at an upper load of 45% GUTS and an axial stress range of 200MPa, while the extradosed cables have maximum service loads of 60% GUTS, but an axial fatigue stress range of less than 30MPa. It is generally known that the stress level only has a minimal influence on the stress range for bare prestressing steels. The correlation between stress range and stress level is described in Smith diagrams. The fatigue behavior of galvanized strands is more favorable than that of bare strands. This is caused by the fact that the zinc layer between the individual wires reduces fretting fatigue. Smith diagrams can be used both for bare strands and for galvanized strands. According to Smith diagrams, the fatigue resistance is decreased only by 10% when increasing the upper stress level from 45% to 60% GUTS. Therefore, no new tests for the cables were required for this bridge.

The extradosed cables were installed using light equipment. First, the PE-sheathing was brought into an inclined position on both sides of the saddle. Then the strands were pushed in using special pushing equipment from one side of the deck through the saddle into the anchorage at the other side of the superstructure.
They were immediately stressed to an initial force with light weight monostrand jacks. Once strand installation had been completed, all strands of one extradosed cable were simultaneously stressed from both ends using the patented ConTen stressing method in two stressing steps. For some of the cables, the individual forces of all 37 strands are monitored using a newly developed EM sensor which is permanently installed at the rear side of the stressing anchorage for long term monitoring. During the stressing operation, the tolerances of the individual strand forces were within the allowed range.

Bridge construction started in the fall of 2008, strand installation for the extradosed cables began in September, 2009 and, due to very fast construction progress, the superstructure was finished in January 2010. The bridge was opened to traffic in the summer of 2010.

Figure 2: Saddle with Anchor Groove and Anchor Pin for Extradosed Tendon
Background

The term ‘extradosed’ was coined by Jacques Mathivat in 1988 to appropriately describe an innovative concept he developed for the Arrêt-Darré Viaduct in France, in which external tendons were placed above the deck instead of within the cross-section as would be the case in a girder bridge. To differentiate these shallow external tendons, which define the uppermost surface of the bridge, from the stay cables found in a cable-stayed bridge, Mathivat called them “extradosed” prestressing. Unfortunately, the design of Mathivat was not used for this viaduct.

The first extradosed bridge was the Odawara Blueway Bridge in Japan. This bridge was completed in 1994. It has span lengths of 73 + 122 + 73m, a width of 13m and a tower height above deck of 10.7m. The relation of pylon height to center span length is 1: 12, which is much smaller than the usual ratio of 1: 5 in conventional stay cable bridges. Thus, the tendon stresses caused by live loads are reduced to nearly one quarter of that of stay cable bridges.

An allowable tendon stress of 0.6fpu was chosen for the Odawara Bridge. High durability of the bridge was achieved by triple corrosion protection of the tendons using new technologies:

- Due to the severe climatic conditions of Japan’s coastal region, the tendons consist of epoxy-coated strands. The strands were installed with a specially developed pushing-in device.
- Glass-fibre reinforced plastic tubes were used as sheathing.
- A special crack-free polymer-cement grout was used as filler.

An inexpensive and space saving anchorage solution was provided by deviator saddles, avoiding troublesome end anchorages at the pylon. The Japanese DYWIDAG licensee Sumitomo Electric Industries Ltd. (SEI) supplied 56 t of epoxy-strands and 64 DYWIDAG MC-anchorages 19x0.6” developed for external tendons, which facilitated an easy and quick exchange of the tendons due to the double sheathing.

Before commencement of material supplies, SEI carried out various tests in co-operation with DSI Munich to check the reliability of the applied materials. This included tests with the epoxy-strand and its anchorage, a tensile test, a test on the system behavior and a pushing-in test for the strands. A large-scale test of the deviator saddles and a fatigue test simulating behavior of the structure under wind load have also been carried out by the owner together with the joint-venture companies.
New Ways for Europe: Pan-European Corridor 5

Pan-European Corridor 5 is a main artery linking Barcelona in Spain with Kiev in Ukraine. The idea of creating traffic corridors across Europe emerged after the end of the Cold War. Since then, modern infrastructure has been developed in order to facilitate the exchange of goods and commodities as well as passenger traffic between Europe and the Balkan States.

Leading from Hungary and Austria to the Port of Koper in southern Slovenia, Highways A1 and A5 in Slovenia form part of European Corridor 5. The connection of the Port of Koper with important Slovenian cities and with surrounding countries is significant because Koper is the second largest harbor on the north-east Adriatic Sea. The harbor makes it possible to connect important cities in Central and Eastern Europe with the Far East and Mediterranean countries. Thanks to the modern motorway connection, goods can be transported faster and more efficiently from Koper to Slovenia and Europe.

DSI Headquarter Operations contributed to a section of Highway A5 from Maribor to Cogetinci near the Hungarian border. Several retaining walls had to be constructed for this section. The retaining walls are up to 350m long and up to 40m high and have gradients ranging from 45° to 68°.

The stabilization of the retaining walls consisted of reinforced concrete grids, vertical concrete girders and piles that were anchored with Electrically Isolated Permanent DYWIDAG Strand Anchors. DSI supplied a total of 850 Type 4x0.62” DYWIDAG Strand Anchors with 3 or 4 strands and Type 7x0.62” DYWIDAG Strand Anchors with 5 strands for five slope stabilization projects.

The strand anchor systems complied with the Slovenian Technical Approval. In addition, DSI supplied the necessary grouting and stressing equipment. Work on this section began in March 2007 and was completed in August 2009.
Spain’s Most Important Engineering Company Relies on DYWIDAG Monostrand Post-Tensioning Systems

IDOM, one of the most important engineering companies in Spain, recently built its new headquarters in Madrid. The new 10 story office building (4 floors of which are taken up by the garage) was constructed from April 2009 to January 2010.

The six office floors were reinforced using unbonded monostrands supplied by DSC. The prestressed floors have a total surface of approx. 12,000m². In total, DSC supplied more than 140t of Y 1860 S7 A=150mm² strand, together with more than 10,500 pieces of stressing, dead end and coupling anchorages complying with European approval ETA-03/0036.

All of the tendons were preassembled at DSC’s warehouse in Madrid and then shipped to the job site just in time. The monostrand tendons were cut to their exact length and the dead ends installed before the tendons were shipped to the job site.

DSC installed the tendons in their exact final position according to ETA-03/0036. The stressing operation, also carried out by DSC’s workers, took place two days after concreting.

A net of water pipes cast in concrete was installed in the post-tensioned floors. Due to concrete core activation, this system, which is known as the TABS system (Thermally Activated Building Structures), reduces air conditioning costs.

Each post-tensioned floor was built in a three week, five day working cycle. The slabs are 40cm thick, and each floor has 2 construction joints.

Owner IDOM, Madrid, Spain
General Contractor Forcimsa Empresa Constructora, S.A., Madrid, Spain
Consulting Engineers IDOM, Madrid, Spain
Consulting IDOM, Madrid, Spain
Engineering Jorge Bernabeu (IDOM) and Juan Carlos Arroyo (Calter), Madrid, Spain (Post-Tensioning)
DSI Unit DYWIDAG Sistemas Constructivos S.A., Madrid, Spain
DSC Scope Supply and installation of 140t Unbonded DYWIDAG Monostrand Tendons
Permanent DYWIDAG Strand Anchors Stabilize Slopes along the Way of St. James in Spain

The village of Trabadelo in the West of the Province of León is part of the famous Way of St. James and is located on the A6 Motorway that links Galicia and Madrid.

Geographically, Trabadelo is located in a hilly landscape with steep, approx. 100 to 150m high slopes. In February 2009, a severe rockslide took place in the area. The highest slope slid exactly at the point where cut-and-cover tunnels secured the A6 Motorway. The rock mass at the slide consisted of slanting slates that had become unstable due to massive rainfalls and construction work at the motorway. After the rockslide, the A6 Motorway had to be closed off immediately along a length of 5km, and traffic had to be detoured to the old Federal Road N-VI.

Following the landslide, immediate stabilization measures had to be carried out in order to extensively secure the slopes. Construction work on this demanding project was successfully carried out within a mere 16 months. Up to 50 construction workers were on-site, working around the clock. The project cost amounted to approx. 35 Million Euros.

The project did not only include extensive slope stabilization, but also the construction of additional access roads to facilitate a continuous monitoring of the entire area. The complete slope was terraced in order to make drainage easier.

In addition, on an area of 2,150m², especially steep slopes were stabilized by anchor walls. 12,300m of active anchorages were installed into the anchor walls and post-tensioned to a load of 120t. DSC supplied 900 Type 8x0.6” Permanent DYWIDAG Strand Anchors as well as the necessary tensioning equipment for this project.

In order to protect the motorway from future rockslides, the existing false tunnels were extended by 3,570m². A total of 6,200m³ of shotcrete and 85,000m² of reinforcing steel were used for the slope stabilization work.

All in all, 510,000m³ of soil were excavated during this project. The Trabadelo section of the A6 Motorway was reopened to traffic in June 2010.
DYWIDAG Strand Anchors for High Speed Train Routes in Spain

Following a large scale extension of Spain’s high speed train network, Acciona, one of the largest construction companies in Spain, was awarded a contract for the extension of the Sotiello-Campomanes section. This 4.3km long section is financed by European funds and forms part of the new connection between Madrid and the province of Asturias in the north of Spain.

The region is located in a mountainous area that once was an impassable barrier between Spain’s center and the province of Asturias. Ever since the 19th century, the construction of a border crossing had been a main focus, and in 1884, the first train route leading over the Pajares Pass was opened. Ever since, the route has remained practically unchanged with its many curves, inclinations and ramps.

The new section is being constructed as a single track along the first, 2.6km long section and as a double track on a length of 1.7km. In addition to two tunnels, the route also includes seven viaducts. Construction work between Sotiello and Campomanes was successfully undertaken between July 2009 and May 2010.

Before construction work started, landslide activities, which were more prevalent during rainy periods, were detected in the Sotiello-Campomanes section. In order to prevent future landslides in the new section, a total of 19 wells were built to drain the affected area. In addition, a pile wall was constructed in the excavation pit for stabilization. Subsequently, the pile wall was secured by four rows of anchors. DSC supplied 310 Type 10x0.6” Permanent DYWIDAG Strand Anchors in lengths of up to 52m with a total length of approx. 10,000m that were installed at a spacing of 1.25m.
DSI Supplies Permanent GEWI® Anchors for Oman’s First Suspension Bridge

Recently, Oman completed the Khor Al Batha Bridge - the country’s first suspension bridge located in the coastal town of Sur. Even before its completion, the country’s only suspension bridge was considered an architectural work of art and a tourist attraction.

Because of its importance for the region’s infrastructure, the bridge was constructed as a traffic structure instead of the pedestrian bridge that had been originally planned. Thanks to the new bridge, the travelling distance between the two villages of Al Ajah and Khor Bath in Sur was reduced by 10km. In addition, the suspension bridge offers visitors an easy and fast connection to the town of Sur via the new Quiryat-Sur motorway.

The 170m long suspension bridge has a main span of 120m, and the 10m wide bridge deck accommodates two traffic lanes and two walkways.

Excavation work was carried out for the construction of the abutments. Excavations had to be deep enough to compensate for possible uplift or subsidence of the surrounding soil. DSI Langenfeld supplied a total of 64 Ø 50mm Double Corrosion Protected (DCP) GEWI® Anchors for the bridge abutments.

The permanent GEWI® Anchors were inserted into pre-drilled boreholes with permanent metal casings that remained in the soil. Afterwards, the boreholes were cement grouted. GEWI® Anchors in lengths of 25m were installed into primary sandstone at the eastern bank. GEWI® Anchors in lengths of 34.5 to 49.8m were used at the western bank, where supporting sandstone prevailed at a depth of 8.5m. Assembly and installation of the GEWI® Anchors was supervised by experienced DSI personnel.

INFO

Owner Ministry of Regional Municipalities & Water Resources, Ruwi, Oman
Contractor STRABAG Oman LLC, Muscat, Oman
Engineers Schlaich Bergermann und Partner, Stuttgart, Germany

DSI Unit DSI GmbH, LU West, Langenfeld, Germany
DSI Scope Supply of 64 Ø 50mm permanent GEWI® Anchors; installation supervision and acceptance testing
Beginning in 2011, Doha will welcome international business partners in a special building: the Qatar National Convention Centre (QNCC). The conference center is being built in the middle of Doha’s Education City, Qatar’s central science and technology park.

In addition to a 40,000m² exhibition space, which is split into 9 halls, and a conference hall seating 4,000 people, the convention center will also contain 52 meeting rooms. The QNCC is being built as an environmentally friendly building, according to internationally recognized LEED certification criteria. For example, approximately 12% of the building’s energy supply is produced by solar cells on the center’s roof.

Thanks to its unusual façade, the congress center has already become a new landmark of the city. As a symbol for the Sidra tree native to Qatar, world famous Japanese architect Arata Isozaki designed a tree-like steel structure for the building’s façade. The Sidra tree is deeply rooted in Qatar’s culture. In the shade of this desert tree, meetings were held by Bedouins and scholars, and its fruit and leaves were used in traditional medicine.

Originally, the owners were going to use traditional construction methods, but then were convinced of the advantages of post-tensioned construction and the DYWIDAG Post-Tensioning System by the structural designer BW Gulf and by QACS.

As a result of the increased spans made possible by prestressed concrete, the architect achieves more freedom in design. Moreover, the dimensions of structural components can be reduced and the required amount of reinforcement is decreased, which leads to savings in construction material and costs. In addition, in prestressed concrete structures, the deflection of the beams and slabs are significantly reduced and cracks in concrete are almost eliminated. This is of utmost importance for the durability of the structure.

The DYWIDAG Strand Post-Tensioning System was used for all 71 beams necessary for this project. With a depth of 1.35m and a width of 45cm, the beams, which were designed by BW Gulf Consulting Engineers, were up to 53m long.

Qatar Australian Construction Systems W.L.L. (QACS), a partner company of DSI, supplied a total of 160 9x0.5” Strand Tendons with 5909 MA Anchorages and Bond End Anchorages. The strand had a total weight of approximately 30t and the tendons were supplied preassembled in corrugated steel duct. The post-tensioning systems were tensioned using a DYWIDAG HoZ 1.700 jack.
Building Material City – Abu Dhabi’s Hub for the Construction Industry

Abu Dhabi now features a modern city within the city: Building Materials City (BMC). The 230,000m² area is centrally positioned on the way to the International Airport and to Abu Dhabi’s trade-fair location and is the United Arab Emirates’ new hub for the construction industry.

By concentrating all of the important construction companies in one place, the country is expecting to create considerable advantages for new construction projects and strong growth for the construction industry as a whole.

The project consists of four different elements that are grouped around a 100,000m² shopping area with 300 retail stores: modern offices that are located in 17 20 story towers, 32 towers accommodating a total of 4,151 apartments, a new 400 room hotel and 15,500 parking spaces. Furthermore, BMC features the Middle East’s first building materials exchange.

BATEC, DSI’s partner company in Abu Dhabi, participated as a subcontractor in this project. The company's scope included the design of the post-tensioned flat slabs as well as the installation, post-tensioning and grouting of the post-tensioning tendons needed for the flat slabs.

For two of the 20 story towers with four lower parking levels each, BATEC constructed approx. 80,000m² of post-tensioned flat slabs. Type FA 3x0.5” and 5x0.5” DYWIDAG Flat Anchorages were used for the flat slabs. All in all, 380t of strand and 4,700 Flat Anchorages were installed in the towers.
Abu Dhabi’s Shining Landmark: The Madinat Zayed Shopping & Gold Centre

The Madinat Zayed Shopping & Gold Centre in the middle of Abu Dhabi is an important city landmark. Built on an area of approx. 55,740m², the center offers its clients more than 220 retail stores and more than 65 leading gold and jewelry shops. The shopping center’s Gold Centre is one of the largest of its kind in the United Arab Emirates. It provides visitors with a wide choice ranging from traditional to modern jewelry in all price categories.

In order to maintain the Gold Centre’s leading role in the future, a comprehensive expansion of Madinat Zayed Shopping Centre was carried out from December 2008 to 2010. The expansion was built on an area of approx. 930m² and includes a hypermarket, a large food court and an amusement center for children.

DSI’s partner company in the UAE, BATEC, was the subcontractor in this project and was responsible for the design of the shopping center’s post-tensioned flat slabs. The company’s scope also included the installation, post-tensioning and grouting of the bonded post-tensioning tendons used in this project. All in all, 135t of strand were installed in the flat slabs.

Al Reef Villas: Abu Dhabi’s New Central Housing Development

From January 2008 to 2010, a major new project was built in Abu Dhabi: The Al Reef Villas, a large scale residential development. The development occupies a total area of one million square meters and is located near Abu Dhabi’s International Airport, only half an hour away from the city center. Al Reef Villas is the United Arab Emirates’ first planned community to concentrate exclusively on middle income buyers.

The project includes more than 2,300 modern urban villas in different sizes and with different architectural themes. In addition, the large scale project, which is designed for approx. 15,000 residents, features a total of 1,800 modern apartments and a four star hotel.

Residents can choose among many retail stores, supermarkets and restaurants, and also profit from community facilities such as a school, a kindergarten, mosques and several recreational and sports facilities.

BATEC, DSI’s partner company in Abu Dhabi, carried out the design for the post-tensioned flat slabs of the residential development as well as the installation, post-tensioning and grouting of the Bonded DYWIDAG Tendons. On the whole, BATEC constructed approx. 300,000m² of post-tensioned flat slabs. 1,500t of strand and 21,000 DYWIDAG Flat Anchorages were installed in the flat slabs.

INFO

Owner Line Investments & Property LLC, Abu Dhabi, UAE
General Contractor Thinet Emirates, Abu Dhabi, UAE
Subcontractor BATEC General Contracting LLC, Abu Dhabi, UAE
Consulting Engineers White Young Emirates Consulting Engineers, Abu Dhabi, UAE

DSI Unit DSI Headquarter Operations, Munich, Germany / BATEC General Contracting LLC, Abu Dhabi, UAE
DSI Scope Supply of Type 3x0.5" and 5x0.5" Flat Anchorages

INFO

Owner Manazel Real Estate Building, Abu Dhabi, UAE
General Contractor Fibrex Construction Group, Abu Dhabi, UAE
Subcontractor BATEC General Contracting LLC, Abu Dhabi, UAE
Architect Crang & Boake Incorporated, Abu Dhabi, UAE

DSI Unit DSI Headquarter Operations, Munich, Germany / BATEC General Contracting LLC, Abu Dhabi, UAE
DSI Scope Supply of 21,000 DYWIDAG Flat Anchorages
Modern Lock Complex for Economic Growth: Tucurui Lock, Brazil

The Tucurui Dam in the federal state of Pará in northern Brazil was the first major hydroelectric power project in the country’s rain forest and produces approximately 8% of Brazil’s total energy. Construction began in 1975, and the dam has been in use since 1984. The construction project had been divided into two phases from the beginning.

The second project phase, which was resumed in 2007 after having been stopped several times, will restore the navigability of the Tocantins River, which had been interrupted by the construction of the dam. A lock complex that was completed in June 2010 was built for this purpose. The lock complex, which extends for a distance of approx. 680km, permits unobstructed shipping traffic between the cities of Belém and Marabá.

The project is of great economic importance for the development of a region that has high economic potential due to its agriculture and the existence of mineral deposits and other natural resources. By bridging a water level difference of about 75m, the new lock complex allows for the quick and easy transport of regional products.

In order to bypass the 75m high dam, a lock complex with two locks was needed. Both locks feature 210m long and 33m wide chambers that are connected by an intermediate 5,463m long and 140m wide channel.

Protendidos DYWIDAG supplied approximately 29,000m of ∅ 32mm St 85/105 DYWIDAG THREADBAR® used for slope stabilization on site. In addition, approx. 6,500m of DYWIDAG THREADBAR® were installed for reinforcing prestressed concrete structures.

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DYWIDAG Post-Tensioning Bars Stabilize Brazil’s largest Hydroelectric Power Project

Considered Brazil’s largest hydroelectric power project, the Estreito Dam is one of the most important components of the Brazilian government’s growth acceleration program. The dam is located on the Tocantins River in northern Brazil, bordering the federal states of Tocantins and Maranhão.

The Estreito Power Plant is a public utility financed with private investments. When fully operational, the plant will generate 1,087MW of power, which is enough electricity to power a city with a population of 5 million. For the reservoir, an area of 400 km² is flooded in two federal states, and the reservoir will have a capacity of 5.4 billion m³ and cover an area of 555 km².

The spillway of the dam has 14 20m long spans. For securing the floodgates, a construction method was chosen that allows the assembly of the gate components while water continues to pass through the spillway. In this method, 26 metallic consoles were used as temporary supports for each floodgate during assembly. The metallic consoles were connected to the pillars using 32mm DYWIDAG THREADBAR® and prestressed.

Protendidos DYWIDAG supplied more than 3,800m of 32mm St 85/105 DYWIDAG THREADBAR® and a total of 1,290 anchorages. They also rented the stressing equipment and provided a full time supervisor for the installation.

Filling of the reservoir started in May 2010, and the first of eight power generating turbines began operating in September 2010. The Estreito Hydroelectric Power Plant is expected to be fully operational by November 2011.
The Pitt River Bridge and its approach roads are part of the Province of British Columbia's Gateway Project, which will dramatically improve the region's traffic flow. The new stay cable bridge over the Pitt River provides up to 16 meters of vertical marine clearance and connects Pitt Meadows and Port Coquitlam in the suburbs of Vancouver.

The 198 Million Canadian Dollars project was jointly funded by the BC Provincial Government and the Canadian Federal Government and built by the general contractor Peter Kiewit Sons Inc. Construction occurred between late 2007 and October 2009. The bridge has a main span of 190m, a width of 40m, and contains three planes of stay cables in two pylons.

DSI Canada Ltd. was awarded a contract to supply the DYNA Grip® Stay Cable System, stressing equipment and technical assistance. Several DSI units were involved in this important infrastructure project: DSI Canada was supported both by DSI USA and by DSI HQ Operations.

DSI supplied a total of 96 stay cables consisting of 64 Type DG-P31 Stay Cables and 32 Type DG-P61 Stay Cables. A total of 306t of Type 0.6” 7 wire galvanized, waxed and HDPE sheathed low relaxation Gr 1860 MPa Strand was supplied. Each stay cable was encased in an HDPE outer sheathing with helical spirals on the outside to mitigate rain-wind vibrations. External viscous dampers were installed on the 24 cables that are longer than 80 meters. Damping for the other 72 cables was provided by elastomeric disks attached to the cables.

Stressing of the stay cables was performed using the DSI Con-Ten Single Strand Stressing System and was carried out in two phases. The first phase was executed after the erection of the steel girders, and the later one occurred after installation of the composite concrete deck. DSI performed calculations to determine the individual strand forces, considering the displacements of the cable anchor points during stressing. The anchorages include a ring nut which allows for a future adjustment of the loads in the stays. Thanks to the DYNA Grip® Stay Cable System, the force of individual strands can be verified and individual strands can be replaced at any time in the future.

Since October 2009, traffic flows freely over the new bridge. Demolition of the two existing swing bridges, which were replaced by the new bridge, took place in summer 2010.
**Owner** British Columbia Provincial Government, Vancouver, Canada

**General Contractor** Peter Kiewit Sons, Inc., Saskatoon, Canada

**Consultant** MMM Group, Thornhill, Canada

**Design** Associated Engineering (B.C.) Ltd., Vancouver, Canada; International Bridge Technologies, Inc., Coquitlam, Canada (Detailed design and construction engineering for main bridge)

**DSI Unit** DSI Canada Ltd., Western Division, Surrey, Canada

**DSI Scope** Supply of 96 Type DG-P31 and DG-P61 DYNA Grip® Stay Cables; rental of equipment and technical assistance
New Landmark for World-Famous Western Event: Elbow River Bridge, Canada

The western Canadian city of Calgary in the province of Alberta now features a new landmark: The Elbow River Bridge. The bridge is an environmentally friendly stay cable bridge that received the Award of Excellence from the consulting engineers of Alberta.

The bridge is designed for cars, bikes and pedestrians and leads over the Elbow River in Stampede Park. Thanks to the new bridge, the south-eastern part of the park is now more closely connected to the surrounding communities, and the communities of Ramsey and Beltline, which are located near the park, are relieved from traffic.

The concept of the Elbow River Bridge is very different from that of conventional bridges: The concrete bridge deck is only supported by two 23m high pylons at the eastern shore of the river and leads over the river without any additional pylons. The deck was built on falsework consisting of eight 44m long steel girders that were removed after the stays were stressed.

DSI Canada was involved in this project from the beginning of the planning stage and closely co-operated with the engineers during construction. The project was characterized by an extremely tight schedule of only nine months. On the one hand, the short construction time resulted from the condition that the new bridge be finished in time for the Calgary Stampede held in early July. With horse shows, rodeos and many other highlights, this world-famous 10 day event commemorates the pioneer era in Canada’s West.

On the other hand, construction had to be finished before the beginning of the snowmelt in order to eliminate eventual bridge damage caused by flood waters. DSI Canada supplied a total of 28 Type DG-P19 DYNA Grip® Stay Cables that were installed in less than two months, thus allowing a safe removal of the falsework before the beginning of the high water period. In addition, DSI also supplied DYWIDAG Strand Post-Tensioning Systems for the completely post-tensioned bridge deck.

Due to the proximity of the bridge abutment to the barns used for the Calgary Stampede, the bridge features a very low cross section.
DYWIDAG Jacks Used for Launching of Athabasca River Bridge, Alberta, Canada

A new bridge has been built across the Athabasca River in Fort McMurray as a part of the ongoing expansion of Athabasca oil and sand developments. The new bridge runs parallel to two existing bridges and doubles the capacity of Highway 63 at its crossing of the Athabasca River.

The superstructure of the 472m long, 30m wide multi-span bridge consists of ten steel plate girders with a composite cast in place concrete deck. Launching all ten girders simultaneously proved to be the most economical solution and offered a schedule advantage. With the total weight of structural steel exceeding 6,000t, this segmental launch was one of the heaviest steel bridge launches ever undertaken in North America.

Detailed planning and design was necessary for aspects of the launch such as the launch nose, launch pad, girder supports, and the pushing assembly. DSI Canada supplied the launching equipment, hydraulic jacks including accessories and the anchorages for this project. During the launch, girders cantilevered the maximum clear span of 76m without the use of temporary supports. An inclined launch nose attached to the leading segment of girders made touch down at the piers. Of the total bridge span, 394m were launched, while the remaining 78m long section was crane-erected.

Lateral guides were positioned at the abutment and at each pier in order to maintain the longitudinal alignment of the girders. At the rear of each girder, a steel sled beam was used for vertical support and to facilitate longitudinal movement. A total of 10 strand jacks were fastened to the rear of the steel sled beams, all of which were simultaneously operated by a single hydraulic power pack. High strength strands were anchored at the abutment and ran along the length of the H-pile through the strand jacks.

During the post-tensioning operation, the jacks gripped the strands, which enabled the longitudinal launch. Each girder sled was tied together with a transverse push beam, which transferred the longitudinal pushing force from the sled beams to the girders. Just before completion, the maximum strand jack force was approximately 4,600kN (10,000,000lbs). The launch was successfully completed on schedule.
DYWIDAG Micropiles secure Skyscraper in Philadelphia, USA

At the end of 2007, construction work began on Philadelphia’s new architectural landmark: Cira Centre South, located between University City and Center City Philadelphia.

The project includes the construction of two modern skyscrapers with offices, condominiums, a four-star hotel and shops, as well as a 2,400 car parking garage. The first phase, which is to be completed by August 2010, includes the construction of a 14-level parking garage using “Green” construction technology. The second phase is not expected to be completed until 2013; this includes the construction of a 47-story tower known as the Walnut Street Tower and a 24-story tower known as the Chestnut Street Tower. All of these were designed by the famous architectural firm of Pelli Clarke Pelli, which also designed Kuala Lumpur’s Petronas Twin Towers.

Cira Centre South is designed to be an extension of the existing 32-story Cira Centre office tower located at Amtrak’s 30th Street Station along the banks of the Schuykill River. When completed in 2005, this tower was the tallest building ever constructed outside of Center City Philadelphia. Both the existing Cira Centre tower and new Cira Centre South parking garage were LEED (Leadership in Energy and Environmental Design) certified. LEED certification is awarded to construction projects that are environmentally friendly and sustainable.

In accordance with the design by consulting engineers Pennoni Associates in Philadelphia, loads had to be transferred to the foundation via individual footings and reinforced strip footings. In order to augment ultimate loads, A.P. Construction reinforced the strip footings by installing more than 400 DYWIDAG Micropiles, using 46mm (1-3/4”) and 65mm (2-1/2”) St 830/1035 (Grade 150) THREADBAR® with respective hardware consisting of hex nuts, couplers and steel bearing plates. DSI supplied over 8,800m (29,000ft) of 46mm (1-3/4”) St 830/1035 (Grade 150) THREADBAR® that were coupled in the field, installed into the center of the tubular piles, and grouted afterwards. Additionally, a total of 2,000m (6,800ft) of 65mm (2-1/2”) St 830/1035 (Grade 150) THREADBAR® were attached to the bottom 20’ of each 46mm (1-3/4”) THREADBAR® center bar to further reinforce the rock socket portion of each Micropile.

As the Micropiles had to be installed within a very aggressive time schedule, DSI had to supply a large portion of the THREADBAR® in less than 30 days. This required continual communication not only with numerous DSI plants throughout North America, but also with the customer. DSI USA would like to thank everyone involved in making this project a success.

DYWIDAG Micropiles secure Skyscraper in Philadelphia, USA
Unrestricted Research thanks to modern Construction Methods: The Mansueto Library in Chicago

In 2007, the University of Chicago’s Regenstein Library had reached its capacity. As the university’s wish was to keep storing its books centrally on campus, the decision was made to build a new library: The Mansueto Library, which will be opened in the spring of 2011.

The building, which is named after a donating married couple, was designed by world-famous Chicago architect Helmut Jahn. It is being built as a four-storey glass and steel dome that will accommodate reading and studying rooms. A five-storey subterranean book vault is located beneath the dome. Thanks to stable temperatures underground, only a minimal amount of energy input is necessary to reach optimum temperatures for conserving the volumes.

The Mansueto Library will be equipped with an automated storage and retrieval system (ASRS) designed to hold up to 3.5 million books and to deliver any of them to the service desk within a mere five minutes. In comparison to most US-American universities that store their books externally, waiting periods of several days can be avoided.

Construction work at Mansueto Library began in September 2008. The oval foundation consists of a slurry wall with a total of 26 panels that touch one another at a slight angle. The construction of the slurry wall was carried out in approximately 2 ½ months, with an average of 3 ½ panels erected per week. The panels’ tops are linked by a cast-in place concrete ring that is approx. 1.5m (5ft) high and approx. 1.7m (5.5ft) wide. This ring will link the dome with the first-floor slab and transfer loads from the dome to the foundation.

Once the slurry wall was finished, the basement was excavated. After completion of the excavation, the perimeter wall was tied back into the surrounding soil using DYWIDAG Strand Anchors that were post-tensioned and grouted. As there are no floor slabs to support the outer wall in the Mansueto Library, a total of 334 permanent DYWIDAG Strand Anchors had to be anchored in the soil at depths of up to 30.5m (100ft) for stabilization. The tiebacks were installed in four levels for a 16.7m (55ft) temporary excavation below grade.

In addition to the required strand anchors, DSI USA also provided the equipment necessary for testing and stressing. Following completion of the excavation, an approx. 61cm (2ft) thick reinforced floor slab was cast in place for the basement floor.

For the next 22 years, the University of Chicago will have enough room for new books thanks to the new library.
New Jersey is currently working on a construction project that will be the state’s second precast segmental bridge. The structure crosses the Shrewsbury River and will ultimately replace the existing 75-year old functionally obsolete and structurally deficient double-leaf bascule bridge. After its completion, the bridge will serve as a central access route to the shore towns of Highland and Sea Bright in Monmouth County and to “Sandy Hook Unit”, a local recreation area.

The bridge structure has an overall length of 482m (1,582ft) and the main span over the navigation channel of the Shrewsbury River measures 71m (233ft). The bridge is being built as two separate, parallel structures with one driving direction each. The eastbound structure is being built first, while parts of the old bridge remain in use.

Unistress Corporation began casting the first segments, which were used for constructing the eastbound pier columns, at their Pittsfield, MA production facility in September 2008. A total of 98 precast segments were produced for the pier columns until September 2009.
The precast segments for the piers were post-tensioned using a total of 120t of epoxy coated DYWIDAG Strand Tendons and approximately 11.5t of 36mm (1-3/8") Ø, St 830/1035 (GR 150) THREADBAR®.

DSI USA supplied all post-tensioning systems for the precast segments and supported the general contractor with engineering services and technical know-how. All in all, DSI supplied more than 615t of 15mm (0.6") Ø DYWIDAG Strand Tendons and more than 81.5t of 36mm (1-3/8")Ø, St 830/1035 (GR 150) THREADBAR®.

According to project specifications, the post-tensioning systems were required to have a very high level of corrosion protection. In response to this requirement, DSI supplied their “System 100” post-tensioning system designed for structures with extended design life. Both type 4x0.6" flat anchorages and type 12x0.6", 15x0.6", 19x0.6" and 27x0.6" anchorages were successfully used for this project.
New Rental Car Facility at Atlanta Airport Guarantees Mobility

During the recent expansion of the Atlanta Airport, a new rental car facility was built. The rental center offers passengers a quick and easy way to rent cars while simultaneously increasing the number of parking spaces in the airport area.

The Consolidated Rental Car Facility (CONRAC) offers space for parking on an area of 185,500m² (1,996,800sq ft) as well as approx. 8,100m² (87,000sq ft) of space for the new rental car facility. The owner requested especially large bays of approx. 18x18m (60x60ft) for the parking decks to provide increased flexibility in use after completion. Due to the size of the bays, the DYWIDAG Monostrand Post-Tensioning System was used.

In comparison to other structural systems, framing systems that utilize the DYWIDAG Monostrand Post-Tensioning System offer the advantage of longer spans with shallower floor system depths. In addition, the durability of the finished structure is increased due to a reduction of cracks in the concrete.

Work was very challenging because the very large floor plates without pour strips had to be subjected to complex analysis. During the analysis, factors such as elastic shortening due to post-tensioning forces, initial shrinkage of the concrete, long-term creep and temperature effects had to be considered.

For post-tensioning the parking decks and the customer service center building, DSI USA supplied approx. 1,330km (4,365,880lf) of unbonded DYWIDAG Strand Tendons with encapsulated anchors. DSI also provided the post-tensioning installation drawings as well as technical assistance on site.
Atlanta’s international airport is expecting to host more than 13 million passengers per year by 2015. In order to adapt capacities to the increase in passenger volume, construction work on a new international terminal began in the summer of 2008. The terminal is scheduled for completion in April 2012. The new Maynard H. Jackson Jr. International Terminal is named after Atlanta’s first African-American mayor. The terminal includes 12 gates and will be linked to international concourse E with its 28 gates via a new public transportation system. In addition, the new terminal will have parking facilities and a new rental car center.

The levels of the new terminal are being built using framework construction, and the beams and girders of the terminal are post-tensioned using monostrand tendons. DSI supplied a total of 441,640m (1,448,951ft) of Unbonded DYWIDAG Monostrand Tendons for the following levels:

- Arrival level: 20,439m² (220,000sq ft), supply of 143,262m (470,021ft) of DYWIDAG Monostrand Tendons,
- Apron level: 20,810m² (224,000sq ft), supply of 136,724m (448,571ft) of DYWIDAG Monostrand Tendons,
- Departure level: 27,406m² (295,000sq ft), supply of 161,654m (530,359ft) of DYWIDAG Monostrand Tendons.

In addition, DSI also provided installation drawings for the assembly of the monostrand tendons as well as technical assistance on site.
Located next to Miami International Airport (MIA), the Miami Intermodal Center (MIC) is a massive ground transportation hub that is currently being developed by the Florida Department of Transportation and scheduled for completion in spring 2010. The complex will provide connectivity to the airport for residents and visitors of Miami-Dade County and the South Florida region. In addition, the transportation hub was created to reduce congestion in the streets around the busy airport.

The first sub-project was the Rental Car Center (RCC), an approx. 315,870m² (3.4 Million ft²) large building that will provide customers arriving through Miami International Airport (MIA) convenient access to approximately 20 participating rental car companies.

The next sub-project will be the construction of Miami Central Station, a rail hub. An automated people mover between the MIC and MIA will also follow the completion of the RCC. The completed center is expected to serve approximately 150,000 commuters and travelers each day.

The MIC rental car facility is a 4 level beam/girder and slab parking structure. Each floor is approx. 16,190m² (174,240ft²) in size and was built in 2009 using the 0.5" Zero Void® Unbonded Monostrand System. The fully encapsulated system provides excellent water tightness and corrosion protection.

The fixed ends were also encapsulated Zero Void® anchorages. On the stressing end, only the tendon tail necessary for prestressing had to be removed once stressed, leaving no bare strand exposed inside the concrete.
Additionally, intermediate Zero Void® Monostrand System couplers were used at construction joint locations where no deck was available to support the remaining length of the tendons for the next pour. The coupler system was installed as a temporary stressing end in the completed section. This anchorage has an exterior thread and can be capped and protected for a long period of time. Once it was time to construct the adjacent pour, a new tendon with an end consisting of a coupler sleeve with interior thread and integrated fixed anchorage was inserted at the “temporary” stressing end, creating a monolithic connection once the adjacent pours had been stressed.

Thanks to this solution, very long tendons could be manufactured in sections and did not have to be rolled up at the construction joints and temporarily stored. More importantly, this procedure also eliminated the need to build support platforms and allowed the contractor to reduce construction time by two months. In addition, the Zero Void® Nail-Less Pocket Former made the use of nails for fastening the anchorage to the edge form unnecessary, which eliminated staining of the concrete surface and reduced installation cost and time.

The Zero Void® Plasma Cutter was used to cut tendon tails after stressing. In contrast to an oxyacetylene torch, the Plasma Cutter only generates a minimal amount of heat during cutting and has no effect on strand and wedge material. The Plasma Cutter quickly cuts the tendon tails to a precise length so the grease caps can be easily installed. The lock-on grease cap allows a tighter connection with the anchorage and a better protection of the wedges.
The 300m (990ft) long David Kreitzer Lake Hodges Bicycle/Pedestrian Bridge in San Diego, California is the world’s longest stress-ribbon bridge. The bridge runs through San Dieguito River Park and offers cyclists a safe alternative to the main highway. As it crosses an environmentally protected lake and its impact on the environment had to be minimized, the pedestrian and bicycle bridge was built as a stress-ribbon bridge.

Complex methods of analysis were needed to represent the nonlinear behavior of the post-tensioning system and the structure’s time-dependent changes. In addition, construction was restricted to the winter months in order not to interfere with the nesting periods of several local bird species. A total of 87 precast concrete elements were needed for the construction of the bridge deck.

Post-tensioning work was performed by DSI USA from a temporary trestle that extended approximately 213m (700ft) from one end of the structure. Initially, approx. 39,000m (128,000ft) Type 19x0.6" DYWIDAG Strand Tendons with MA Anchorages were installed. The primary tendons required for this purpose were prefabricated on site and installed across the open spans using temporary post-tensioning tendons.

Once stressed to a predetermined sag, the precast deck panels were hung into their final position and additional Type 27x0.6" Post-Tensioning Tendons with MA Anchorages were installed in troughs formed in the precast sections.

Following installation, the primary strand tendons were adjusted to the final sag required by the engineer, and final concrete was placed in all troughs and closures. As the concrete cured, the Type 27x0.6" Secondary Tendons were stressed incrementally to control shrinkage. Secondary tendon ducts were fully grouted following completion of stressing.

As one of only six stress-ribbon bridges in North America and one of less than 50 stress-ribbon bridges worldwide, the David Kreitzer Lake Hodges Bicycle Pedestrian Bridge was chosen as a co-winner in the “Non-Highway Bridge” category in PCI’s Design Awards Program.
Owner  San Dieguito River Park, Escondido, CA, USA
Architect  Safdie Rabines Architects, San Diego, CA, USA
General Contractor  Flatiron Construction Corp., San Marcos, CA, USA
Engineering  T.Y. Lin International, San Diego, CA, USA

DSI Unit  DSI USA, BU Post-Tensioning, USA
DSI Scope  Supply of approx. 39,000m of 0.6" Strand Post-Tensioning Tendons and Installation of Type 19x0.6" and 27x0.6"
DYWIDAG Strand Post-Tensioning Tendons with MA Anchorages
The Angeles Crest Highway, a section of Highway 2 linking Los Angeles with San Bernardino, had to be closed after two severe winter storms in 2005 and 2006 because a road section had been washed out. Finding a solution for the re-opening of the mountain pass proved to be very difficult because the local rock mass could not be stabilized and the slide area remained active.

In May 2009, the new Angeles Crest Bridge was re-opened to traffic. After a long break, the pass section once again brought tourists and business to the mountain village of Wrightwood and spares travelers the inconvenience of long detours.

The construction of a cast-in-place bridge was impossible due to the fact that falsework could not be erected on the unstable ground. The decision was made to construct a 63m (208ft) long precast concrete girder bridge instead.

The precast, post-tensioned spliced girder bridge had to be longer than usual because the abutments had to be erected on stable ground both right and left of the active slide area.

Due to space limitations, the precast elements had to be produced off site in individual segments. The precast segments had to be short enough to be transported on the narrow and winding mountain road to the job site. To this end, the 63m (208ft) long girders were divided into three parts: a 28m (92ft) long middle section and two 17m (56ft) long end sections that accommodate the post-tensioning anchorages.

The girder segments were assembled on temporary supports, and closure concrete was placed at the segment joints. Afterwards, approximately 50% of the post-tensioning was applied. Once the girders were set on their abutments, concrete was placed and the final post-tensioning and grouting was completed. For post-tensioning the segments, DSI USA supplied a total of 32,309m (106,000lf) of Type 0.6" DYWIDAG Strand Post-Tensioning Tendons with Type 12x0.6" and 15x0.6" MA Anchorages.

Thanks to the new bridge, snow run-off, debris and eventual future rock slides can now slide off the 75% mountain slope and pass underneath the road without endangering traffic. As the third largest bridge of its kind worldwide, the Angeles Crest Bridge was awarded the American Precast/Prestressed Concrete Institute (PCI) prize in the Best Bridge with Spans More than 47.7m (150ft) category.
New Rental Car Facility at San Jose Airport Stabilized using DYWIDAG Post-Tensioning Systems

The Norman Y. Mineta San Jose International Airport in the center of the city of San Jose, California, is the only commercial airport in Silicon Valley. The airport is located near San Francisco and registered approx. 10.7 million passengers in 2007. In order to be able to accommodate an expected passenger volume of more than 17 million by 2017, the airport is currently being enlarged. In addition, the access roads are being expanded, and a new parking structure and rental car facility are being built opposite the restructured Terminal B.

In addition to 350 customer parking spaces, the Consolidated Rental Car (CONRAC) Facility offers 3,000 spaces for all rental car companies. The center facilitates passengers’ access to rental cars and helps to alleviate traffic congestion around the airport. The CONRAC Facility was completed at the end of June 2010.

The 8-level structure consists of precast, post-tensioned concrete beams and columns, cast-in-place shear walls, and precast double-tee deck panels. In order for the structure to resist lateral forces during seismic events, Unbonded DYWIDAG Multistrand Tendons were installed into the collector beams across the precast element joints and into the shear walls.

DSI USA supplied approx. 89,000m (292,000lf) of extruded and greased strand with PE sheathing as well as Type 19x0.6” and 27x0.6” MA Anchorages. Additionally, DSI USA also provided the equipment necessary for post-tensioning.

Vehicle access to the CONRAC Facility is provided through two helical ramps. These cast-in-place ramps were post-tensioned using approx. 18,630m (61,122ft) of 0.5” Zero Void Monostrand Tendons.

INFO

Owner City of San Jose, CA, USA +++ General Contractor Hensel Phelps, San Jose, CA, USA +++ Consulting Engineers Nakaki Bashaw Group, Irvine, CA, USA +++ Contractor Clark Pacific, West Sacramento, CA, USA +++ Engineering Watry Design, Inc., Redwood City, CA, USA

DSI Unit DSI USA, BU Post-Tensioning, USA

DSI Scope Supply of approx. 89,000m of DYWIDAG Strand Tendons with PE sheathing and Type 19x0.6” and 27x0.6” MA Anchorages; supply of approx. 18,630m of Type 0.5” Zero Void Monostrand Tendons; rental of equipment
DYWIDAG Monostrand for a City within the City: Las Vegas CityCenter

Las Vegas is a city that is continually changing and creating new superlatives. One of these superlatives is CityCenter Las Vegas, which is currently under construction. Framed by the well-known Excalibur Hotel and Casino, the New York New York Hotel and Casino complex and the Bellagio Hotel and Casino, CityCenter Las Vegas is the new city center located directly on the Strip.

Eight famous architectural offices including Pelli Clarke Pelli and Daniel Libeskind have been involved in the project, which is financed by MGM Mirage and Dubai World. The CityCenter is one of the largest privately funded construction projects in the United States.

In addition to four hotels, two towers and a retail and entertainment district, the area will also include an exhibition with works of art by Nancy Rubens, Maya Lin and other artists. The project on the Las Vegas Strip has a surface area of approx. 1,560,500m² (16,797,000ft²).

It is designed as an independent city within the city and will even have its own power plant and fire station in addition to the Strip’s first supermarket. The new complex contains only one casino. The hotels and condominium buildings focus on other core aspects instead.

The impressive large scale project will be completed in 2010. Due to very short construction time, and due to the excellent experiences that have been made with the DYWIDAG Monostrand Systems in the past, four of the new structures contain DYWIDAG Monostrand Systems. In addition, DYWIDAG Strand Post-Tensioning Systems were used for tensioning structurally important girders in the Veer Towers.

DYWIDAG Post-Tensioning Systems are characterized by their quick and easy installation. DSI began supplying monostrand systems in Las Vegas in 1991. Thanks to their technical advantages, high quality and superior service, DYWIDAG Monostrand Systems have been successfully installed in most of Las Vegas’ casino hotels and a large number of parking structures.
The Veer Towers are at the very heart of CityCenter in Las Vegas. What is special about the 37 story luxury condominium towers is their angle of inclination. Each of the towers leans 5 degrees from center in opposite directions. As a reference, the angle of inclination of the world famous Leaning Tower of Pisa is only 3.97 degrees.

Due to the complex statics, the construction of the tower entailed special requirements for all of the companies involved in the project. On level 3, six massive girders had to be cast in place and post-tensioned successively in accordance with construction progress.

A total of 33 type 27x0.6" DYWIDAG Post-Tensioning Tendons were installed in tight quarters in the approx. 2.7x2.7m (9ftx9ft) girders. Each of the six girders had a different size, length, quantity of tendons, and stressing force.

In the first phase, the 27x0.6" Tendons were installed in the six girders. After the concrete had cured, individual tendons were partially post-tensioned.

In phase two, when construction work had reached level 15, the DSI team returned to level 3 in order to slightly increase the post-tensioning force of the DYWIDAG Strand Post-Tensioning Tendons.
The 33 tendons were only post-tensioned to their final post-tensioning force and grouted subsequently once level 25 had been reached. All in all, DSI supplied 33 type 27x0.6" DYWIDAG Post-Tensioning tendons with approximately 16,000m (53,000lf) of type 0.6" strand and approx. 640m (2,100lf) of galvanized 110mm \( \odot \) duct for the condominium towers.

More than a year after the DYWIDAG Strand Post-Tensioning Systems had been installed, the Veer Towers were completed, providing a new slant to the Las Vegas skyline.
Outstanding Living Comfort in Las Vegas’ new Center: Vdara Condo Hotel

The Vdara Condo Hotel is the only hotel in Las Vegas CityCenter to have suites that can be individually owned. A total of 1,543 units and 47 penthouses are located on more than 50 levels.

The modern high rise building is directed towards clients who are either in Las Vegas on business or looking for a suitable retreat. That is why, instead of a casino, the Vdara Hotel offers several meeting rooms, boutiques and a spa.

Together with other buildings in the CityCenter area, the Vdara Condo Hotel has been awarded the internationally recognized LEED certification (Leadership in Energy and Environmental Design) for sustainable methods of construction.

DSI supplied DYWIDAG Monostrand Tendons for post-tensioning the flat slabs. A total of approx. 548km (1,797,773ft) of Unbonded DYWIDAG Monostrand Tendons with standard anchorages was supplied for a surface area of approx. 133,773m² (1,439,925ft²).

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INFO

Owner MGM Mirage Design Group, Las Vegas, Nevada, USA +++ General Contractor Perini Bldg, Co, Las Vegas, Nevada, USA +++
Architect Leo A. Daly, Las Vegas, Nevada, USA +++ Consulting Engineers Desimone, Las Vegas, Nevada, USA +++
Subcontractor Century Steel/Pacific Coast Steel, Las Vegas, Nevada, USA

DSI Unit DSI USA, BU Monostrand, Long Beach, USA
DSI Scope Supply of approx. 548km (1,797,773ft) of Unbonded DYWIDAG Monostrand Tendons
Mandarin Oriental Hotel Las Vegas Relies on High Quality DYWIDAG Monostrand Systems

The Mandarin Oriental Hotel is located directly at the entrance of Las Vegas CityCenter. The 47 story hotel has 392 rooms and suites that were designed by the famous interior designer Adam D. Tihany. Just as the Vdara Condo Hotel owners, the Mandarin Oriental Hotel owners deliberately chose not to include a casino, offering their guests upscale restaurants and a spa instead.

The Mandarin Hotel is one of the six buildings in the CityCenter to have received the internationally recognized LEED certificate (Leadership in Energy and Environmental Design) for sustainable methods of construction. The hotel will exceed regulations for energy efficiency by 34% and features a heat-resistant façade as well as other resource conserving installations.

For the construction of the hotel, DSI supplied approx. 708km (2,323,506ft) of Unbonded DYWIDAG Monostrand Tendons with standard bare anchorages. The monostrand system was used to post-tension flat slabs with a total surface area of approx. 228,683m² (2,461,527ft²).

Unbonded DYWIDAG Monostrand Tendons were also used in the Mandarin Hotel’s modern parking structure. DSI supplied a total of approx. 389km (1,277,092ft) of DYWIDAG Monostrand Tendons for 11 levels with a surface area of approx. 149,113m² (1,605,039ft²).
DYWIDAG Monostrand Tendons Supplied for Harmon Hotel in Las Vegas CityCenter

The Harmon Hotel, which was designed by the world-famous British architect Lord Norman Foster, displays an elegant elliptical curve and stands out with its shimmering, blue and white glass façade. The hotel is part of the Las Vegas CityCenter and will offer its guests a spa as well as several convention rooms in addition to its 400 hotel rooms. It adapts to the general trend in CityCenter, which focuses on recreation and luxurious accommodation instead of casinos. The 28 story Harmon Hotel is scheduled to open at the end of 2010.

Thanks to being constructed with environmentally friendly methods, the Harmon Hotel is another building in Las Vegas CityCenter to have received international LEED certification (Leadership in Energy and Environmental Design).

For post-tensioning a total area of approx. 37,889m² (407,823sq ft), DSI USA supplied approx. 207km (677,613ft) of Unbonded DYWIDAG Monostrand Tendons with standard bare anchorages.

INFO

Owner MGM Mirage Design Group, Las Vegas, Nevada, USA +++ General Contractor Perini Bldg. Co, Las Vegas, Nevada, USA +++ Architect Adamson Associates Inc. (AAI), Las Vegas, Nevada, USA Consultants to AAI Foster + Partners, New York, USA +++ Consulting Engineers Halcrow Yolles, Las Vegas, Nevada, USA +++ Subcontractor Century Steel/ Pacific Coast Steel, Las Vegas, Nevada, USA

DSI Unit DSI USA, BU Monostrand, Long Beach, USA
DSI Scope Supply of approx. 207km (677,613ft) Unbonded DYWIDAG Monostrand Tendons with standard bare anchorages
223,003m² of Post-Tensioned Flat Slabs using DYWIDAG Monostrand Systems - Cosmopolitan Resort & Casino

Directly north of the CityCenter project in Las Vegas, another project is currently under construction: the Cosmopolitan Resort & Casino. In addition to suites and condos, this 3.9 Billion Dollar Resort and Casino includes Nevada’s largest fitness and wellness center. Construction of the structure was completed at the end of 2010.

Occupying a surface area of approx. 13,935m² (150,000ft²), the building offers a 1,800 seat show theater as well as meeting rooms. Due to the fact that the hotel had to be built on a plot of land of only 34,398m² (8.5 acres), which is relatively small by Las Vegas standards, the parking garage is located underground.

Within the scope of this project, a total surface area of approx. 223,003m² (2,400,385ft²) of flat slabs is post-tensioned using Unbonded DYWIDAG Monostrand Systems. All in all, DSI supplied approx. 855km (2,805,415ft) of DYWIDAG Monostrand Tendons with standard bare anchorages. Additionally, approx. 610m (2,000ft) of DSI supplied and installed Galvanized Barrier Cables were included in the parking garage.
Beginning in September 2011, a ride into the city center will be much faster than it used to be for citizens in the south-west of Linz (Austria), thanks to the extension of tram line 3 that is being built from Harter Plateau to Linz main station.

The extension of line 3 is 5.3km long and includes a 1.3km long underground section between Westbrücke and Linz main station. In March 2009, tunnel driving began for the two 1km long, single-track tunnels that are linked to each other via cross-cuts.

The portal near the main station was excavated by the cut-and-cover method. In order to avoid excavation through difficult ground conditions (alternating layers of silt and gravel), the section in the portal area was designed with a 4% decline in order to carry out the major part of the tunnel driving in the schlier layer below the alternating layers of silt and gravel at a depth of 12-17m. Excavation work is carried out as conventional cyclic driving with reinforcement and pre-support ahead of the tunnel face and a fast ring closure. A 20-30 cm thick shotcrete layer with two layers of mesh is applied for the outer lining.

DSI Austria was awarded a contract to supply all ground control products. The scope of ALWAG Systems included forepoling boards and tube spiles as pre-support ahead of the tunnel face. Type R32 IBO-Self-Drilling Anchors are being used for both rock bolting and reinforcement of the tunnel face.

In addition, PANTEX Lattice Girders are used for the immediate support in the excavation area in tunnels and cross-cuts. Thanks to the close communication between the customer and DSI Austria’s employees, the production and supply of PANTEX Lattice Girders could be flexibly adapted to the actual on-site conditions. The ALWAG Systems supplied are contributing to the safe and rapid completion of the tunnel excavation work.
Info

Owner: Linz AG, Linz Linien GmbH, Linz, Austria
Contractor: JV Straßenbahnlinie Harter Plateau, consisting of G. Hinteregger & Söhne, ÖSTU-STETTIN Hoch- und Tiefbau GmbH and DYWIDAG Dyckerhoff & Widmann Gesellschaft m.b.H., all of them Austria
Engineering: Schimetta Consult Ziviltechniker GmbH, IL - Ingenieurbüro Laabmayr & Partner ZT GmbH, Neumann+Steiner ZT GmbH, all of them Austria

DSI Unit: DSI Austria, Pasching/Linz, Austria
DSI Scope: Supply of forepoling boards, tube spiles, PANTEX Lattice Girders and Type R 32 IBO-Self-Drilling Anchors including accessories; injection equipment and technical service on site
ALWAG Systems for the M6 in Hungary

The new M6 Duna Autópálya motorway connection in Hungary runs south from Budapest in the direction of the Croatian border. This important infrastructure project provides an efficient connection of the capital of Budapest with the southern parts of the country. Furthermore, as a part of Trans-European Corridor V, the four-lane M6 motorway is of nationwide importance for the European road network.

The French road construction company COLAS and the Austrian construction company STRABAG formed a consortium to build the new motorway that includes a total of 83 bridge structures and four tunnels. The four tunnels were constructed by STRABAG and are designed as double tunnels with cross-sections of approx. 100m².

534m of tunnel were constructed by the cut-and-cover method and 5,530m were constructed using the New Austrian Tunneling Method (NATM). Tunnel excavation work was carried out without any downtime - up to 120 employees were on site 24/7 in order to comply with the 24 month construction schedule.

DSI Austria supplied all ground control products used for tunnel driving, mainly PANTEX Lattice Girders, IBO-Self-Drilling Anchors and IBO-Spiles.

Later on, the stabilization concept for tunnel driving was modified following a large-scale tunnel collapse, and the contractor STRABAG decided to use the AT-Pipe Umbrella Support System. All in all, 36 pipe umbrellas with individual lengths of 15m each and an overlap of 5m were installed.

The extremely challenging ground conditions required an adaptation of the AT-Pipe Umbrella Support System to the conditions on-site, which could be carried out on shortest notice by the project team from DSI Austria. This procedure ensured the quick and timely completion of this difficult contract section, which guaranteed the opening of the M6 motorway in 2010.
Owner: M6 DUNA AUTÓPÁLYA, Hungary
General Contractor: STRABAG AG, Vienna, Austria

DSI Unit: DSI Austria, Pasching/Linz, Austria
DSI Scope: Supply of the AT-Pipe Umbrella Support System, PANTEX Lattice Girders, IBO-Self-Drilling Anchors including accessories, injection equipment and technical service
DYWI® Drill Hollow Bars Stabilize Fault Zone of a Canadian Mine

The Kidd Mine, operated by Xstrata Copper and situated in North East Ontario, was discovered in 1964 by the Texas Gulf Company. The mine is situated in Canada’s Abitibi Greenstone Belt and started operation in 1966 as an open pit mine that has evolved into an underground mine with four shafts. Kidd Mine is one of the largest volcanogenic massive sulfide ore and base metal deposits in the world.

In addition, Kidd Mine is the world’s deepest producing copper and zinc mine. Currently, the mine is continuing its deepening project in order to reach deposits at depths of up to 3,000m (9,600ft). The construction of a new ore handling system along with the necessary shaft ventilation system and a continuation of the ramp from surface to shaft bottom clean out represent another world record.

Kidd Mine recently experienced two major seismic events of more than 3.2 on the Richter scale at a depth of approximately 2,500m (7,500ft) that affected several levels in the area. The two events were several months apart, yet very similar in strength and location. This underground area is under tremendous pressure because of the depth and geological faults in proximity to the areas being mined.

The mine operators contacted DSI for assistance as their ground support supplier, and both groups worked collaboratively to develop a plan for the unconsolidated areas in the re-hab zone. Although the engineering department is very experienced, they required a new solution to the unique problems that they had encountered. DSI studied the problem and quickly provided a product solution to them.

The solution was to use DYWI® Drill Hollow Bars to provide support in the areas of unconsolidated ground that typically had particles of less than 13cm² (2in²). Type R32 DYWI® Drill Hollow Bars offer an ultimate strength of 280kN and can be installed in lengths of up to 16m (52.5ft) when coupled. In addition, they can be simultaneously drilled and grouted even with the bore hole collapsed.

The plan that Kidd Mine adopted was to have the walls and back cleared of loose rock and debris and then apply a layer of shotcrete approximately 15cm (6in) thick over the existing bolts and screen. Afterwards, regular rebar and resin anchors as well as expandable rock bolts and zero gauge screens were installed. Finally, DSI’s DYWI® Drill Hollow Bars were installed in those areas where the rock had been crushed to the point that the bore hole could not be maintained for regular anchor systems. This product allowed the mine to continue in an otherwise impossible situation.

The hollow bars used in this application had individual lengths of 3m (9.8ft) that were coupled and installed in lengths of 6m (19.7ft), with the sacrificial drill bit acting as a wedge at the toe of the bore hole. Once the DYWI® Drill Hollow Bars had been installed, grout was pumped through the hollow core into the bore hole and surrounding fragmented ground, locking all the pieces into a solid mass. In some cases, a third section of self-drilling hollow bar had to be installed in order to achieve good anchorage in solid ground.

DSI supplied approximately 1,700m (5,577ft) of DYWI® Drill Hollow Bars as well as bearing plates, hex nuts, couplers and other accessories for this project. Experienced DSI employees also provided training to personnel at the mine site on the installation and grouting as well as the tensioning work. DSI was very pleased to be able to offer Kidd Mine a solution that would allow them to continue in a safe work environment.
Safer Mining Follows Agreement on UWA Research

Technology invented at the University of Western Australia to make work conditions safer for underground miners is likely to be used around the world soon, following an agreement that was signed in March 2010.

Through its Office of Industry and Innovation, UWA will collaborate with DSI to further commercialise the High Energy Absorbing (HEA) Mesh internationally.

HEA Mesh, invented by Winthrop Professor Yves Potvin, Director of UWA's Australian Centre of Geomechanics, won the 2008 WA Inventor of the Year “Ready for Market” category. The mesh, made of recycled scrap metal, is easy to install and has high load-bearing capacity.

“The major benefits of this mesh will be to improve mine safety, especially where the ground conditions are rockburst prone and challenging,” Professor Potvin said. “I’d like to thank the staff at UWA’s Office of Industry and Innovation and in particular Project Manager Tom Schnepple, for his work in making today’s agreement with DSI a reality.”

DSI Chairman and Group Chief Executive Officer Alan Bate said: “We are very pleased to be working with the University and Professor Potvin to make this a product in the international mining sector. This agreement is our joint commitment to making this product a proven benefit to DSI’s clients.”

UWA is a leading Australian research university with an international reputation for excellence, innovation and enterprise. Its Office of Industry and Innovation was established in 2001 and is responsible for commercialising UWA’s research outcomes and negotiating industry research contracts.
Today, stay cables are usually stressed using mono jacks. The advantage of stressing with mono jacks lies in their ease of handling because of their light weight and small size. The challenge is to achieve the same force in each strand of a stay cable once tensioning is completed. Tensioning induces a force into the structure that leads to the structure’s deformation. These structural deformations and changes in the sag of the stay cable lead to a reduction of the stressing force in previously stressed strands. Unless special measures are taken, this leads to an uneven state of stress in the individual cable strands.

In 1995, DSI developed the Con-Ten Stressing System for this purpose. Originally, this included a tensioning unit with a first tensioning jack (reference jack) and a second tensioning jack (working jack) connected via a pressure hose and a return hose to form a hydraulically interconnected system. Stressing of the reference strand is initially carried out using only the reference jack. During this procedure, a proximity switch on the reference jack is adjusted. The reference jack remains on the reference strand. The subsequent strand is tensioned using the working jack until the proximity switch of the reference jack interrupts the hydraulic flow to the working jack. This ensures that both strands are equally stressed. By using this technique repeatedly on the remaining strands, all of the strands in a stay cable can be tensioned equally without having to carry out detailed measurements.

The Con-Ten Stressing System has proven itself in many stay cable projects. However, users continually expressed a desire for a system that would be easier, more user-friendly and more economical. In the original Con-Ten system, two equal tensioning jacks and a special electronically operated hydraulic pump were required. The new system only requires one tensioning jack and a slightly modified robust standard Type R 3.0 hydraulic pump. In addition, a common manual hydraulic pump and a mechanical control unit are used. The mechanical control unit is at the core of the new development.

In the case of the new Con-Ten device, the hydraulic system includes a hydraulic pump that is connected to the control unit via a feed line. From here, a connecting hydraulic line leads to the tensioning jack, which is connected to the hydraulic pump via a return line.
The control unit is basically a valve that is driven by the stroke movements of a piston and controls inflow to the tensioning jack. The control unit is positioned on the tensioned reference strand. The tensioning jack is positioned on the strand that is to be tensioned next. As soon as the pressure inside the tensioning jack equals the pressure inside the valve chamber, the tensioning process is interrupted by an automatic closure of the valve. Since the piston area of the tensioning jack equals the piston area of the control unit, both strands contain equal forces after valve closure. All of the strands in a stay cable are successively tensioned using the tensioning jack.

Both Con-Ten Stressing Systems are patented by DSI. The new method has already proven itself in two projects. 7 tensioning units were used during the construction of the Pitt River Bridge, Vancouver, Canada (2008-2009). Two sets of Con-Ten units were used during the construction of the Lech Bridge Bach in Austria (2009). At the moment, 4 tensioning units are being used for the construction site of Povazska Bystrica Bridge in Slovakia (2009-2010). Additional projects are currently underway. The new system will successively replace the previous one.

Advantages of the new generation system:
1. Robust components – suitable for construction sites due to the elimination of electronic components
2. Easy to handle – simple setting of the control unit, light weight
3. Lower equipment cost

DSI Patents for the Con-Ten Stressing System:
- DE 195 36 701 C2
- DE 10 2008 032 881 B3
DYWIDAG-Systems International Pty. Ltd. is the leading producer of Mining Products and Systems in Australia. For quite a number of years, the exportation of high quality mining products from Australia has continually increased, and today, these export activities are an important part of DSI Australia’s business activities. Such activities will be strategically enhanced in the future.

Close cooperation with global mining companies and DSI’s excellent reputation in the Australian mining market are important success factors for DSI’s strong export business. Additionally, DSI Australia, which offers a large product range, is able to offer its clients a complete “one stop shop” solution. The product range includes rock bolts, bar and strand anchors, chemical anchors, resin cartridges, geotextiles and a comprehensive range of accessories.

The growing mining activities in South-Asian countries are especially important for DSI Australia as export markets. Due to the increasing import of special components and the rising number of products and systems destined for export, logistical processes and capacities had to be improved.

At the end of 2009, construction began on a modern import and export facility in Newcastle, NSW. The warehouse occupies an area of more than 1,200m² and was completed after only 10 months of construction. The construction of efficient loading ramps for trucks was especially important because a quick and efficient loading and unloading of trucks contributes significantly to enhancing logistics and minimizing costs.
For many years, DSI Mining Canada has had market leadership in the manufacturing of mining products in Canada. This leading position is a result of the fact that DSI Canada continually evaluates and improves its operations to ensure competitiveness and to remain the supplier of choice for its customers.

In order to create even more cost efficient processes, DSI has standardized the production of rebars. Standardization became possible thanks to an outstanding product: the rebar with break-away pin. When used with a flange or hemispherical nut, this product is both suitable for installation with mechanical equipment as well as light manual machines.

The DSI sales team quickly convinced their customers of the advantages of this rebar, and DSI Canada was in the position to proceed with the rebar auto line. As of today, the complete production can be carried out with a single new machine. This includes turning, threading, nut insertion, drilling, and slashing. The state of the art machine gives DSI Canada the desired capacity they need today and well into the future.

The rebar auto line was commissioned in May 2009 and is located at the new site in Lively near Sudbury, Ontario.

The new manufacturing facility is just a few miles away from the old plant and will be the main manufacturing point of the high volume fabrication.

The other DSI plants in Saskatoon and Rouyn-Noranda will continue to focus on manufacturing specialty products and supplying customized ground support products to the region’s mines. These efficiency improvement measures will help DSI Mining to maintain and extend their market leading position in the future.
Construction, Qatar’s third largest industry, continues to grow at a very fast rate. Especially for high rise buildings and bridges, post-tensioning systems are often used in Qatar as efficient solutions ideal for minimizing construction time.

In Qatar, DSI cooperates with a very capable partner: the DSI licensee Qatar Australian Construction Systems W.L.L. (QACS). Thanks to this successful cooperation, clients in Qatar profit from recent developments in Post-Tensioning.

QACS and DSI also cooperated successfully during TowerTech in Qatar, an international exhibition for high rise buildings and towers in Doha. The event offers a platform for companies active in construction where specialists can exchange information concerning recent developments in their industry. A wide range of products and services as well as new developments were presented during the exhibition.

With the support of DSI Headquarter Operations, DSI’s licensee QACS presented products and systems for Post-Tensioning. DSI was also actively involved in the seminar program with two presentations. Klaus Lanzinger, DSI Headquarters Operations Munich, presented fields of application for DYWIDAG Post-Tensioning Systems in construction to the attending expert public.
Despite the temporary closure of European airspace following the volcano eruption in Iceland, bauma once again proved itself to be one of the world's leading trade fairs. The successful outcome of the exhibition clearly showed that the international construction machinery industry is experiencing a distinct upward tendency after the difficult year 2009.

The DSI Group presented its core business areas at a booth in Hall A2. The interested expert public did not only have the opportunity to inform themselves about DYWIDAG Post-Tensioning and DYWIDAG Geotechnical products and systems: on an area of 128m², DSI also presented recent developments in Concrete Accessories, Mining and Tunneling.

The design model of a completely removable bar anchor according to DIN 4125 and EN 1537 was a special highlight of the DYWIDAG Geotechnical product range. DSI’s Stay Cable business presented a newly developed DYNA Force™ Sensor System allowing a continuous monitoring of forces at the strands.

On the whole, more than 415,000 participants from over 200 countries travelled to Munich for the 29th International Trade Fair for Construction Machinery, Building Material Machines, Mining Machines, Construction Vehicles and Construction Equipment. bauma took place from April 19 to 25 2010 and set new records with 555,000 m² of total area and 3,150 registered exhibitors from 53 countries.

This sensor system is now also successfully used for monitoring permanent anchorages in DYWIDAG Geotechnics. DSI’s contec Systems subsidiary presented the new PREPRUFE® sealing system for the first time during bauma.

Despite the temporary closure of airspace and the resulting decrease of international visits, bauma was a complete success for the DSI Group. DSI is looking forward to participating at the next bauma in Munich from April 15 to 21 2013.
**ITA-AITES Word Tunnel Congress, Vancouver, Canada**

**May 14-20, 2010**

From May 14th to 20th 2010, this year’s World Tunnel Congress and 36th General Assembly in Tunneling took place in Canada's new convention in Vancouver. As has been the practice in previous years, this year’s venue also featured a large number of technical sessions which dealt with topics such as tunneling in soft ground and in hard rock, innovations in mechanized tunneling and tunneling underneath sensitive structures.

The ITACET Foundation, which specializes in education and training in tunneling and underground construction, offered visitors the opportunity to participate in a differentiated training program during the venue. The training program included topics such as shotcrete tunnel linings, tunnel design for deep tunnels in poor rock and innovations in conventional tunneling equipment.

At the DSI booth, current systems by ALWAG Systems and tunneling products from North America were presented to the expert public. DSI will participate in the next World Tunnel Congress, which will take place from May 21st to 26th 2011 in Helsinki, Finland.

**fib Congress, Washington, USA**

**May 29-June 2, 2010**

Every four years, the “fédération internationale du béton” (fib) organizes the international fib Congress and Exhibition. The congress provides the expert public with the opportunity to gain a detailed insight into the global concrete construction industry.

The third international fib Congress took place in Washington D.C. from May 29th to June 2nd, 2010. The congress was carried out simultaneously with the annual convention organized by the Precast/Prestressed Concrete Institute (PCI).

PCI’s Bridge Conference, which included approximately 250 expert participants, also took place at the same time. Attendees could choose from 472 presentations on special topics such as bridge construction, civil engineering, or ultra-high performance concrete.

In co-operation with Jung-Saeng Ahn and Wolfgang Finck, Dr. Glaeser, DSI, contributed to the Congress by presenting a paper titled Recent Developments of Spliced Segmental Girders Using Enhanced Post-Tensioning Systems.

Another DSI representative, Markus Traute, contributed to Marcel Poser’s, Erik Mellier’s and Hans Rudolf Ganz’s presentation as a co-author. The presentation dealt with CE Marked Post-Tensioning Kits.

More than 90 international exhibitors participated at the exhibition. DSI presented new products and systems for bridge construction to the international expert public. DSI will also participate at the next international fib Congress, which will take place in India in 2014.
Imprint

Published by
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Design, Layout and Typesetting
GO2, Karsten Gorissen
Munich, Germany

Picture Editors
NUREG GmbH
Nuremberg, Germany

Printing
Holzer Druck und Medien
Weiler im Allgaeu, Germany

Picture Credits
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This publication is published in English (13,000 pcs.) and German (3,000 pcs.).