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Dear Readers,

We are pleased to present to you the 15th edition of DSI-Info. The projects shown in this brochure are, once again, good examples of successful applications of our high quality products and systems.

With regards to the DSI organization, we have intensified the focus of our operational structure in our two business areas Construction and Underground, in order to insure that our customers receive the best service and the shortest possible response time.

The Construction business, offering the complete range of products and systems for the construction industry, now consists of the divisions Post-Tensioning and Geotechnics Europe and America as well as the sector "Concrete Accessories". In this new division "Concrete Accessories" we have consolidated all traditional DYWIDAG Formtie Accessories activities together with the products and systems of our newly acquired companies' contec, Germany, Tubus, Portugal, as well as Artéon, Mandelli-Setra and Technique Béton, all in France.

Our Underground business is now structured in Mining America and Mining Asia/Pacific as well as our newly established Tunneling division. This globally operating division has been formed to combine all tunneling activities of the newly acquired companies ALWAG in Austria, DSI-SOPROFINT in Chile and American Commercial in the USA.

By taking these steps, we have adapted our organization to the business volume DSI has achieved during the last few years and have, at the same time, opened up new perspectives for growth, both organically and from strategic acquisitions.

Our Research and Development activities have continued to be successful. This has resulted in a number of new innovative patent applications, further strengthening our technical know-how.

While these developments are going on, you, our clients and business partners, continue to be our principal focus. By being a reliable and trustworthy partner, we will shape the future successfully with you.

Our motivated employees, who are part of the big "DSI-Family", form the basis for all joint activities - because people make the difference.

Join us for an exciting journey – and let yourself be inspired by our high quality systems and solutions!

Yours sincerely

Dipl.-Ing. Eric van Lammeren
CEO

Dipl.-Kfm. Dieter Mayer
CFO



Dipl.-Ing. Eric van Lammeren
Dipl.-Kfm. Dieter Mayer



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Epoxy-Coated Strands post-tension Pedestrian Bridge in the new “Akihabara Crossfield” Complex in Tokyo

Urban Redevelopment, Akihabara, Tokyo, Japan

■ **Akihabara, a district of Tokyo, has changed its visual appearance several times in history. In the past few years, it has become known as “Electric town”, as numerous shops for electronic devices settled there. In the main and side streets of Akihabara, the most modern electronic devices such as mobile phones, digital cameras and DVD players can be found.**

At the beginning of the new millennium, plans for a renewed redevelopment of the Akihabara district were realized. The name of this project, “Akihabara Crossfield”, is symbolic for the main purpose of this redevelopment measure. A new

area is to be created amid the established IT industry featuring research, office and sales areas that serve as an interface with the public and provide adequate facilities for banquets, shows and IT workshops for children. For this purpose, two new multistory buildings, Akihabara Daibiru and Akihabara UDX, were built in the Akihabara district.

To provide a safe connection between the two new high-rise buildings and the railroad station, Kajima Corporation, Japan, had a new 63.8 m long and 8.0 m wide pedestrian bridge built. As regards the architectural design of the bridge, much importance was attached to a slim visual appearance so that the bridge design would harmonize with the IT center.

This objective was achieved by means of a two-span continuous prestressed concrete bridge using ultra high strength concrete. For the bridge construction, the newly developed self-curing technology for artificial lightweight aggregates was applied for the very first time. Thus, low-shrinkage ultra high strength concrete was produced at reasonable cost that could be cast in place with a design strength of 120 N/mm². The high-strength prestressing tendons are 20% stronger than the conventional type. The main girder of the bridge has a square cross-section consisting of an upper floor slab, a web and struts.

Within the framework of the inauguration of the new Akihabara Crossfield Center in March 2006, the bridge was opened to the public.



Completed pedestrian deck

INFO

Owner NTT Urban Development Co. Ltd., Japan, Daibiru Co. Ltd, Japan, Kajima Corp., Japan +++ **General Contractor** Kajima Corp., Japan +++ **Consulting Engineers** Kajima Corp., Japan +++ **Consulting** Sanyu Consultants, Tokyo, Japan

DSI Unit SUMITOMO (SEI) STEEL WIRE CORP., Tokyo, Japan

DSI Scope Supply of 19x0.6" External DYWIDAG Post-Tensioning Tendons type MC with epoxy-coated strands



The World's first Use of a new Bridge Construction Method is in Japan

Katsurajima Viaduct, New Tomei Expressway, Japan

■ The Katsurajima Viaduct was erected at Katsurajima in Okabe-cho, Shizuoka, in only two years as part of the New Tomei Expressway between the Shizuoka Interchange and the Fujieda-Okabe Interchange. The route between the two interchanges is built through mountainous territory with large changes in elevation. Such topography promotes innovative ideas with regard to the chosen bridge construction method, since construction of the piers can be very difficult. For the Katsurajima Viaduct, a slightly modified incremental launching method was chosen.

To maximize the efficiency of incremental launching and to cut costs, the main girder was constructed in stages, with only the core section being launched incrementally. A one-cell box girder cross-section with corrugated steel webs was selected to reduce the weight of the incrementally launched units. After launching, the cross-section was extended to achieve the width required for the bridge slabs. For this purpose, correspondingly wide precast panels were used as permanent formwork that were supported by the ribs and struts added to the hollow box girder. The final bridge deck was cast in place.

The Katsurajima Viaduct was the first bridge in the world to use this construction method.



This method involving a conventional hollow box girder with a corrugated steel web makes it possible to use a smaller bottom slab since the overhang of the bridge deck is supported by ribs and struts. As a result of using a corrugated steel web instead of concrete, the main girder weight is reduced by about 30%.

Only the core section of the main girder is launched incrementally. The overhanging parts of the bridge deck are added later. This reduces the weight during the installation of the girders to about 50% of the conventional weight, which in turn lowers the requirements for the launching nose, jacks and other erection equipment. It also reduces the amount of prestressing steel required for the main girder.

This newly developed method is very efficient due to its lower cost and reduced work load.



INFO

Owner Japan Highway Public Corp., Shizuoka, Japan +++ **General Contractor** JV consisting of Sumitomo Mitsui Construction Co., Ltd. / Chuo P.S. Corp., Ltd., Japan

DSI Unit SUMITOMO (SEI) STEEL WIRE CORP., Tokyo, Japan

DSI Scope Supply of 19x0.6" and 27x0.6" External DYWIDAG Post-Tensioning Tendons type MC with epoxy-coated strands



DYWIDAG Post-Tensioning System incorporated into Korea's largest bridge construction project

Incheon Bridge, Seoul, South Korea



■ The new Incheon bridge, a 12.3 km long toll bridge, is the second link from the »airport island« of Yongjŏng, the location of the international airport, to the mainland and the city of Seoul. The bridge runs in a southeastern direction, thus reducing the traveling time to the international business district of New Songdo City in southern Seoul by 40 minutes. Analyses have shown that this second bridge to link the airport island to the mainland is expected to stimulate economic development so that the economic benefits derived from this project justify the construction cost of nearly USD 1.3 billion.



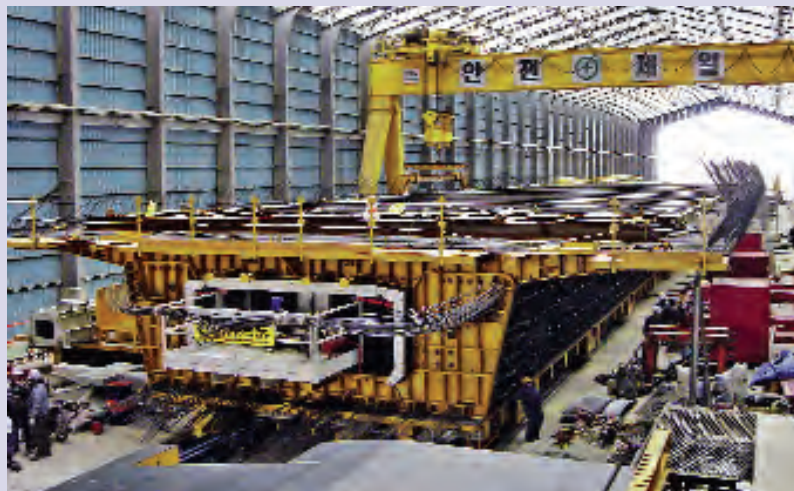
Construction work, which began in June 2005, placed exceptional technical demands on all parties involved in the project. Since the bridge runs over the busy main shipping route to the port of Incheon, a safe solution for the marine traffic was required as well. The decision was made to build an 8.4 km long viaduct that is supplemented by a 1,480 m long stay-cable bridge over the shipping channel. The stay-cable bridge has a vertical clearance of 74 m, a main span length of 800 m and two side spans of 260 m and 80 m each. Thus, the bridge will be the longest stay-cable bridge in Korea and the fifth longest in the world after its scheduled completion in 2009.



The 230.5 m high Y-shaped concrete pylons of the stay-cable bridge rest on drilled cast-in-place foundation columns. The 31.4 m wide bridge deck consists of two parallel prestressed concrete box girders. Each girder supports three lanes in each direction. Concrete box girders in lengths of the individual span widths of 50 m each were prefabricated for the viaduct and lifted onto the bridge piers by means of a heavy lift floating crane. The bridge spans of the two 889 m long approach viaducts were built using the full span precast launching method.



DSI Korea supplied DYWIDAG Threadbars of grade 835/1035 in diameters ranging from 26.5 to 75 mm. The DYWIDAG Post-Tensioning System including comprehensive accessories such as anchors, hex nuts, couplers and protection caps were delivered to the construction site just in time by DSI Korea. As regards the selection of accessories, DSI Korea flexibly met the requirements of the particular site location.



DSI takes pride in having been able to contribute to the success of this outstanding worldclass project by supplying its high-quality DYWIDAG Post-Tensioning System as a member of a highly qualified and competent planning and execution team.

INFO

Owner KODA Development Co., Ltd. (JV consisting of the City of Incheon and AMCE Inc. (UK)) +++ **General Contractor** JV consisting of Samsung, Daelim, Daewoo and others, South Korea +++ **Engineer** Seoyeong Engineering and Chodai Co., Ltd., South Korea +++ **Sub-Contractor** Jinsung and Dongbang Engineering, South Korea

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

DSI Scope Supply of DYWIDAG Threadbars \varnothing 26.5 mm, 32 mm, 40 mm, 75 mm, grade St 835/1035, supply of various anchorage systems and protection caps; rental of equipment; technical assistance



DYWIDAG Post-Tensioning Tendons secure new Office Tower at Singapore's Center

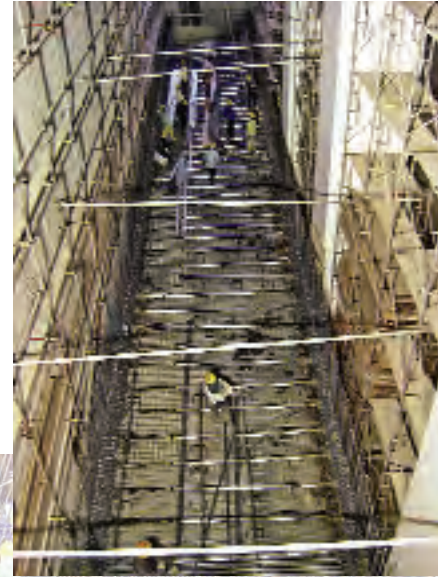
“One Raffles Quay” Prime Office Building, Marina Bay, Singapore

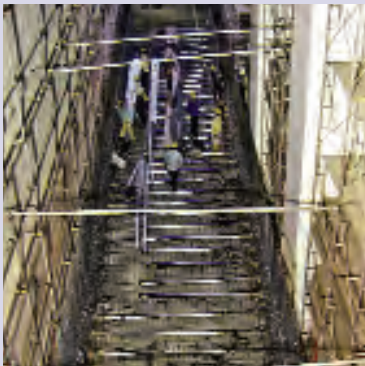
■ A new office-building complex was built at Raffles Quay in Singapore. This complex – One Raffles Quay – is located at the center of Singapore's extended business and financial district. Due to its central position, the building will also accommodate general infrastructure facilities such as an underground air-conditioned retail link leading to Raffles Place MRT station, a hub car park and a district cooling system plant.

This landmark development consists of two towers, a 50 story North Tower and a 29 story South Tower. Both towers are linked by a roofed lobby structure featuring fountains and seats.

Due to the high foundation cost associated with the heavy self weight of floor slabs for ultra high rise buildings, the 50 story North Tower was designed as a composite steel structure.

However, for the column free floor plate of the lower South Tower, a post-tensioned design proved to be more economical. Here, post-tensioned beams span 19.5 m from the central core wall into the perimeter columns, with the maximum height being kept at 900 mm. Those beams were post-tensioned with a combination





of 12x0.6" and 19x0.6" DYWIDAG Post-Tensioning Tendons with MA anchorages.

The centralized cooling system, located in the basement, is large enough to supply cool air to adjacent buildings. The cold water required for operating the cooling system is stored in numerous post-tensioned concrete water tanks built around the basement columns. Both the tanks' 600 mm thick base slab and the 475 mm thick, 12.5 m high walls were post-tensioned using flat DYWIDAG Post-Tensioning Tendons. Post-Tensioning tie beams spanning across the tanks are used to stiffen the otherwise cantilever walls of the tanks. Utraco Structural Systems Pte Ltd., DSI's licensee in Singapore, supplied the DYWIDAG Post-Tensioning Tendons and carried out all post-tensioning operations as a specialist sub-contractor.

INFO

Owner Keppel Land / Cheung Kong (Holdings) Limited / Hongkong Land Limited, Singapore +++ **General Contractor** Obayashi Corporation Pte Ltd, Singapore Office +++ **Engineer** Meinhardt (Singapore) Pte Ltd., Singapore

DSI Unit UTRACO Structural Systems Pte Ltd., Singapore

DSI Scope Supply and Installation of DYWIDAG Post-Tensioning Tendons



Cable vibration dampers secure one of the largest stay cable bridges in Europe

Dr. Franjo Tudjmann Bridge, Dubrovnik, Croatia

■ In May 2002, one of the most outstanding stay cable bridges in Europe was opened to traffic. The Dr. Franjo Tudjmann Bridge near Dubrovnik in Croatia, which has an overall length of 481.4 m, is suspended from the 143 m high pylon by 19 pairs of DYNA Bond® Stay Cables, types DB-P27 and DB-P61.

Especially in winter, the bridge is subjected to extreme storms which are frequent at that coastal location. The winter storms in 2005 and 2006, which were characterized by a large amount of wet snow and wind velocities of up to 110 km/h, led to very high oscillation amplitudes in the stay cables. Amongst other things, these large oscillations can be attributed to wet snow sticking to the cables, adversely changing their aerodynamic characteristics.

As a result, adaptive cable dampers were installed in the spring of 2006 that work according to the principle of magnetorheological (MR) fluid dampers. The electronic control, which was installed in early November 2006, significantly reduces the oscillation amplitudes. Thus, the oscillation behavior of the entire bridge is positively affected, increasing both the service life of the stay cables and traffic safety.

These MR dampers were developed in close cooperation between DSI, Maurer & Söhne GmbH & Co KG, a Munich-based company, and the Swiss research institution for material science and technology, Empa. After one damper had been tested on the Eiland Bridge in Kampen/Netherlands, the dampers found their first use in the Dr. Franjo Tudjmann Bridge.

These novel dampers employ a fluid that has the characteristic to change its fluidity under the influence of a magnetic field. Therefore, coils are arranged in the dampers that produce a magnetic field in an electronically controlled way. The stronger the current, the stronger the magnetic field and hence the damping force. The

strength of the current and thus the damping force are controlled by customized software. The current required is extremely low. Due to its basic friction, the damper also functions in the event of a power failure, albeit with a lesser degree of efficiency. Therefore, it is fail-proof.

Tests on site showed that the dampers, which are installed rectangular to the DYNA Bond® Stay Cables and mounted at about 3.5 m above

the bridge deck, can reduce the oscillation of the cables by a factor of up to 10. The development of these cable vibration dampers is another good example for the successful cooperation between industrial enterprises and research institutions.





INFO

Owner Croatian General Highway Department, Zagreb, Croatia
DSI Unit DSI Group Headquarter Operations, Munich, Germany
DSI Scope Supply and installation of a cable vibration damper system



Excavation for the underground line from Ládvi to Letnany, Prague

Extension of the Prague metro line C to the northern town of Prosek, Czech Republic

Open cut of the Prosek station



Installation of temporary DYWIDAG Multistrand Anchors

■ Prague, a city of 1.2 million inhabitants, has a relatively young metro system that moves more than 1 million passengers per day. The system corresponds to the model common in Eastern Europe: three main lines crossing at three central stations, thereby forming a triangle in the city center.

The first 18.1 km long section of the Prague metro, line C, was opened in 1974. Subsequently, line C was extended to Háje in the south in 1980. Another extension across the river Vltava to Holesovice was completed in 1984. Line C is the underground line closest to the surface and connects the north with Prague's south-east via 15 stations.

On May 24, 2004 the foundation was laid in Prosek for another extension of line C: construction stage IV.C2. This extension of the metro has been designed to provide a fast connection of the northern suburban town of Prosek with its 90,000 inhabitants and the Letnany industrial zone with the old town in Prague. The line runs relatively close to the surface, so that the metro stations can be built using the open-cut and cover method.

The plans for the construction of the new Prosek metro station had already been changed several times at the preliminary stage, thus always providing new challenges for the construction companies involved.

SM7 A.S. is proud to contribute to the successful completion of this challenging project through its own technical know-how and the use of high-quality DSI products. The retaining walls of the excavated sites of the Prosek and Strizkov stations were temporarily tied back using 8,135 m DYWIDAG Multistrand Anchors. SM7 A.S. also supplied high-quality DYWIDAG geotechnical products such as glass fiber anchors and DYWIDAG Bar Anchors for additional single structures as well as technical equipment.



INFO

Owner Prague Public Transit Company Inc. (Dopravní podnik hl. M. Prahy a.s., Praha), Czech Republic +++
Contractor Consortium Metro IV.C2 consisting of Metrostav a.s., Czech Republic, Skanska CZ a.s., Prague, Czech Republic, and Doprastav, Czech Republic +++ **Design Office** Metroprojekt Praha a.s., Prague, Czech Republic
DSI Units SM7 A.S. Prague, Czech Republic / DSI Austria, Elsbethen / Salzburg, Austria
DSI Scope Supply of 8,135 m DYWIDAG Multistrand Anchors and 284 m GEWI® Rock Bolts; technical support







Successful Conversion of a Suspension Bridge into a Cable-Stayed Bridge

Rehabilitation of the Pont de Volonne Bridge, Chateau Arnoux/Volonne, France



■ The bridge across the Durance river near Volonne, Provence/France, which was first opened to traffic in 1846, has a varied history. The original bridge was demolished in the mid-1920s and replaced by a more stable structure that went into service in 1928. The bridge was destroyed in the confusion of the Second World War in 1944, then reconstructed in the following years and reopened in 1949.



More than 150 years after its first construction, the bridge now shows a completely different face. The suspension bridge has been converted into a cable-stayed bridge, and the original structure's last service was to serve as falsework for the central steel box girder of the new bridge.

The two new, 28 m high pylons were constructed directly on the existing bridge piers, with the new pylon crossbeams enclosing the old bridge piers. For this purpose, the tendons to absorb the transversal expansion forces of the new pylons were inserted into the old piers by core drilling through the piers. After completion of the bridge, the old piers projecting beyond the crossbeams were removed flush with the new transverse beams.

To construct the new bridge deck with a main span of 102 m, the steel box girders were welded on top of the old deck. A special challenge of this project was that the DYNA Grip® Stay Cables could initially only be prestressed with a maximum force of about 650 kg per strand due to the low weight of the steel box girders. It was only by the subsequent welding of the outer transverse girders and concreting of the roadway slab that the weight of the new bridge deck was increased to the point where the prestressing force in the cables could be gradually increased to their final values.

To ensure equal forces between the individual strands, the ConTen method was used to apply the last stressing level. After completion of the new bridge in autumn 2006, the old bridge deck was disassembled into individual parts and lowered from the new bridge in segments to pontoons.



Photos reprinted by courtesy of RAZEL-S.A., Orsay, France

INFO

Owner Conseil Général des Alpes de Haute Provence, Direction des Services Techniques Departementaux, Sous Direction des Routes, Subdivision de Chateau-Arnoux, France +++ **General Contractor** Eiffage, France +++ **Contractor** Joint Venture RAZEL/Eiffage, France +++ **Engineer** RAZEL-S.A., Orsay, France +++ **Architect** RAZEL-S.A., Orsay, France

DSI Unit DSI Group Headquarter Operations, Munich, Germany

DSI Scope Supply of 28 t DYNA Grip® Stay Cables (DG-P19, DG-P31); on-site assembly management; technical assistance



GEWI® Tie Rods secure Sheet Piling for Quay Wall, Germany

Relocation and extension of dock 60 in the port of Rostock, Germany

■ **The seaport of Rostock is the only universal port on Germany's Baltic Sea coast. Notably the handling of cargo has grown rapidly in the past few years, such that the port's capacity had to be expanded to achieve additional increases in shipping volume. Therefore, dock 60 was extended to more efficiently handle larger ships, particularly RoRo ships (roll on roll off). In order to extend northern dock 61 at the same time, the landing area of dock 60 was relocated to the south by 80 m. To accomplish this, the quay structure had to be extended by 60 m.**

What made this quay extension project such a challenge was its proximity to the vibration-sensitive Warnow tunnel. To achieve delimitation of the dock in the direction of the tunnel to the south, the quay extension was widened after about 40 m in western direction by 26 m. At the recommendation of project engineering consultants INROS-LACKNER AG, a trapezoidal exit area was constructed on the landside that extends to the south.

For the anchorage of the sheet piling intended for the quay wall, the contractor had to ensure that the tunnel slab of the nearby Warnow tunnel was not put in jeopardy as a result of vibrations caused by heavy hammering operations. A shore enclosure in the form of a mixed sheet

piling was tendered that was to be anchored by means of injection piles. However, an innovative proposal to secure the sheet piling with GEWI® Bar tie rods was executed.

In order not to jeopardize the tunnel slab of the adjacent Warnow tunnel due to vibrations caused by hammering operations, soil exchange drills along the entire sheet piling axis were carried out prior to the driving of the sheet piles. Subsequently, the required sheet piles were vibrated into the soil minimizing the amount of vibration needed.

Installation of walers began coincident with the dredging operations. For this purpose, the contractor chose to weld 78 specially designed



Waling bolts and tie rod connection

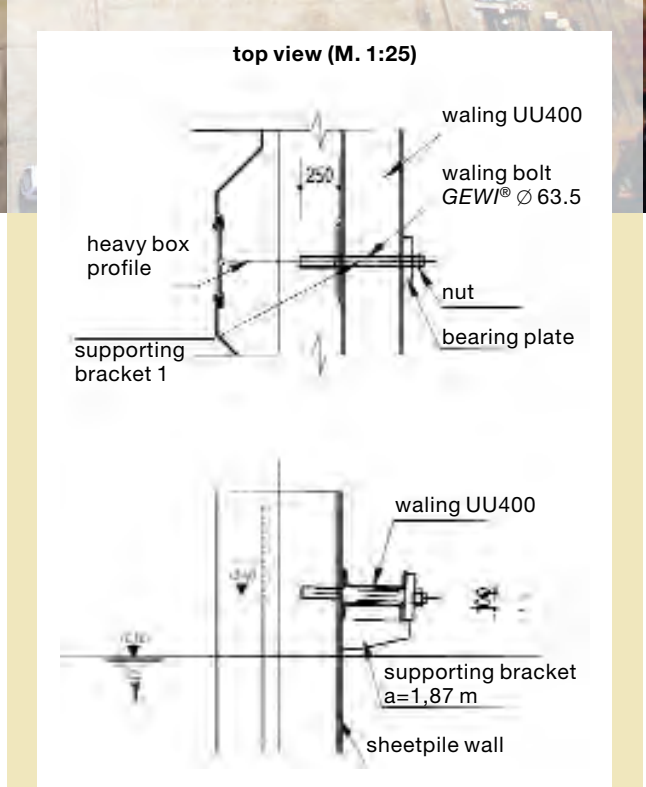
Photos reprinted by courtesy of Vanessa Manthey



Aerial view of dock 60, Rostock, Germany

short 63.5 mm dia. bolts to the walers at an incline to facilitate the short delivery period guaranteed by SUSPA-DSI.

Following partial backfill, tie back walls were erected and the quay walls secured by means of tie rods. To this end, SUSPA-DSI supplied $\varnothing 63.5$ mm GEWI® Tie Rods in lengths varying from 10 to 15 m to the construction site »just in time«. Upon arrival, the rods were assembled to the required lengths of 20-40 m very easily using GEWI® Couplers and installed horizontally in two construction stages. The ball bearings in the rod heads made possible the precise adjustment of the rod inclinations to 3-5°. Thus, movements of the wall caused by the concluding grouting operations could be accommodated without problems. A total of 46 GEWI® Tie Rods now secure the sheet piles of the extended quay wall in dock 60.



INFO

Owner Hafenenwicklungsgesellschaft Rostock mbH, Rostock, Germany +++ **General Contractor** JV Erweiterung LP60 consisting of Bauer Spezialtiefbau GmbH, Schrobenhausen, Germany, and Heinrich Hirdes GmbH, Hamburg, Germany +++ **Engineer** INROS-LACKNER AG, Rostock, Germany

DSI Unit SUSPA-DSI GmbH, LU West Langenfeld, Germany

SUSPA-DSI Scope Supply of 46 pieces GEWI® Tie Rods, $\varnothing 63.5$ mm in lengths varying from 20-40 m including GEWI® couplers, 78 waling bolts made of GEWI® Bars



DYWIDAG Multistrand Tendons secure one of the largest Interstate Bridges in Hungary

Köröshegyi Bridge, M7 Interstate, Hungary



■ The M7 interstate in Hungary is part of the pan-European infrastructure development plan “Helsinki Corridor No 5” that is to link the Adriatic Sea with the East European countries. The corridor leads from Venice to Kiev via Trieste, Ljubljana and Budapest. One of the largest prestressed concrete interstate bridges in Hungary was built as part of the 15 km extension of the M7 interstate between Zamárdi and Balatonszárszó near Köröshegyi.

For years, the EU has been concerned with the development of an integrated, functional traffic infrastructure with the objective of sustained mobility in its increasingly growing economic area. In this connection, Hungary as one of the youngest EU member states has an important transit function due to its geographic position: on one hand, on the way to the East to the former Russian countries, on the other hand, on the way to South-eastern Europe EU candidate states of Croatia, Romania and Bulgaria. In 2003, the Hungarian government decided to expand



Photos reprinted by courtesy of Hídépítő, Budapest, Hungary

its interstate network by 282 km or 50% by 2006. Due to the economic and political importance of a comprehensive Hungarian interstate network, also with regard to the peaceful development of South-eastern Europe, the EU

agreed to bear part of the extension costs. Against the background of balanced seaport politics and its linkage to hinterland traffic, corridor V is an important axis link.

With a length of 1,872 m and a height of 90 m, the bridge near Köröshegyi is a major part of the M7 extension as part of corridor V. Construction of the bridge began in summer of 2004. This route leads from Slovenia to Budapest, passing south of Lake Balaton. Due to its limited construction time of only 2 1/2 years and the high demands with regards to building technology, the bridge was definitely an engineering performance of outstanding importance.

Because of the height of the bridge and the short construction time, the 23.80 m wide deck that will carry two traffic lanes is being built using the prestressed concrete construction method instead of a combination of steel and concrete. The bridge deck rests on 16 piers erected on bored piles in the range of 1.2 to 1.5 m in diameter and depths of 22 to 29 m. The height of the piers varies between 1 m at the edge of the valley and 90 m in the middle of the bridge. The piers were built in 5 m sections using a climbing formwork system.

The 17 bridge spans (60 m + 95 m + 13 x 120 m + 95 m + 60 m) with a span length of up to 120 m were built using the cantilever method and post-tensioned with DYWIDAG Multistrand Tendons. Starting from the piers, each span was built to the right and left in one pour each and then the segments were post-tensioned against each other. A special feature here was a pour section of 11.0 m that requires a travelling formwork hanging from a girder that rests on three piers above the bridge span. This enabled the construction work to be carried out at large heights in a relatively short time span.

INFO

Owner National Motorway Company, Hungary +++ **General Contractor** Viaduct Consortium Hídépítő Rt. - Strabag Rt., Hungary +++ **Engineer** Metróber Kft, Hungary +++ **Design** Hídépítő Rt., Hungary +++ **Consultant** Pont Terv Rt., Hungary

DSI Unit DSI Austria, Elsbethen/Salzburg, Austria

DSI Scope Supply of DYWIDAG Multistrand Tendons (about 1,000 pc. MA 6815 and 3,400 pc. MA 6819, including equipment)

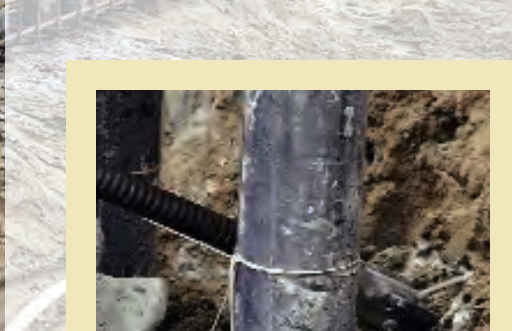
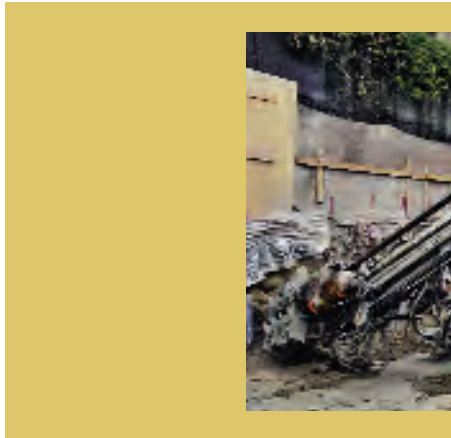


Jet grouting with DYWI® Drill Hollow Bolt Anchors on the Tuscan coast

First-time use of the DYWI® Drill Hollow Bar System for a jet grouting application in Italy

■ For the very first time, the DYWI® Drill System was used in combination with the jet grouting method to extend a shopping mall in Viareggio on the Mediterranean coast, about 30 km from the world famous city of Pisa.

Since the shopping passage is directly situated on the beach promenade of Viareggio, a Tuscan resort in Italy, the ground water level was quickly reached when excavating the soil.



To erect a continuous diaphragm wall inside the excavation, vertical, slightly overlapping jet grouted columns were erected around the planned construction site.

To this end, the diaphragm wall was tied back in the soil using DYWI® Drill Hollow Bolt Anchors. Due to the poor ground conditions, the tie-back operation presented a special challenge. In addition, the anchors had to be very short due to the tightly built structures along the beach promenade. Therefore, very high mantle friction

values had to be achieved during the installation of the DYWI® Drill Hollow Bar Anchors.

The solution to that problem was a combination of the DYWI® Drill Self-Drilling System and the single-phase jet grouting system. The soil was grouted with a pressure of 400 bar during drilling, which resulted in a very large grout body diameter and a very high mantle friction.

Standard DYWI® Drill Hollow Bar Anchors of diameters R32 and R38, which were provided with special couplers and drill bits for that application, were used for the high-pressure jet grouting activities.

The DYWI® Drill Anchors were installed as scheduled and thanks to the jet grouting method, the anchor loads could be transferred into the ground without any problems despite the short anchor length. The close cooperation between DYWIDAG S.P.A., DSI's Italian subsidiary, and the Technical Service Department in Munich, Germany, on one hand and the Italian jet grouting specialists on site on the other hand was the basis for the successful installation of the DYWI® Drill Hollow Bar Anchors in Viareggio, Italy. In addition to the supply of the DYWI® Drill Hollow Bar Anchors through DYWIDAG, DSI's services included technical assistance and supervision of the installation work.





GEWI® Tendons reinforce roof structures

Construction of a new exhibition hall for the Giovannelli plant farm, Pietrasanta (LU), Italy



■ The new **WOODSYSTEM Connection System**, in which wooden trusses are prestressed with **GEWI® Bars**, is ideally suited for the roof structures of large halls, sport stadiums, trade show booths and large tents. **GEWI® Tendons** are ideally suited for this type of reinforcement application. The **WOODSYSTEM** is patented in North America and Europe.

A combination of the **WOODSYSTEM** and **GEWI® Bars** was used to erect the roof of a new plant farm in Pietrasanta located on the Italian coast between La Spezia and Livorno. The hall where plants will be exhibited in the future covers an area of 2,800 m². **DYWIT S.P.A.** supplied about 6.5 t of Ø 32 mm, grade St 500/550 **GEWI® Bars**, including accessories to reinforce the laminated wood roof structure. The maximum span length is 39 m for this project. The new exhibition hall has now been well strengthened to resist the strong winds that frequently occur on that section of the coast.

INFO

Owner Centro Verde Giovannelli Sas, Pietrasanta (LU), Italy +++ **Sub-Contractor** (roof) Woodsystem s.a.s., Moncalieri, Italy +++

Architect Dott. Antonio Rafanelli, Massa Carrara, Italy +++ **Statics** (roof) Dott. Marco Tobaldini, Turin, Italy

DSI Unit DWIT S.P.A., Milan, Italy

DYWIT Scope Supply and installation of about 6.5 t Ø 32 mm, grade St 500/550 **GEWI® Bars**, including accessories



Anchoring the bottom slab of a structure using *GEWI*[®] Plus Piles

A-LAXE Shopping Center in the harbor of Vigo, Galicia, Spain

■ The West Spanish seaport of Vigo located on the Atlantic coast not only accommodates one of Europe's most important fishing harbors, but also a major commercial harbor. An increasing number of cruise ships call at this port as a result of the booming cruise tourism. The administrative authority of the freeport decided to build a large shopping center in the harbor area to increase the port's appeal to the large number of tourists visiting Vigo every year.

The particular nature of the foundation soil located in a land reclamation area in the harbor posed a major technical challenge for this project. The land was reclaimed using a mixture of sand and thixotropic materials. In addition, the tides significantly impair the soil's strength.

Therefore, the large bottom slab of the shopping center had to meet the extreme prevailing loads. Double corrosion protected *GEWI*[®] Plus Piles were used to anchor the bottom slab and to counter hydraulic uplift. The well proven *GEWI*[®] System is predestined for use under difficult framework conditions such as the compression and tension loads on this project. DSC Spain supplied a total of 202 *GEWI*[®] Piles in varying lengths from 4 m to 12 m.



INFO

Owner Consorcio Zona Franca de Vigo, Spain +++ **General Contractor** DRAGADOS, Spain +++ **Architect** Javier Saenz de Oiza, Spain +++ **Technical Consultant** Gescenter Consultant, S.L. y Asociados, Spain +++ **Subcontractor** SONDEOS DEL NORTE, Spain

DSI Unit DYWIDAG Sistemas Constructivos, S.A., Madrid, Spain

DSI Scope Supply of 87 *GEWI*[®] Plus Piles, \varnothing 63.5 mm, grade 670/800 with double corrosion protection, 115 *GEWI*[®] Piles, \varnothing 32-63.5 mm, grade 500/550 with double corrosion protection



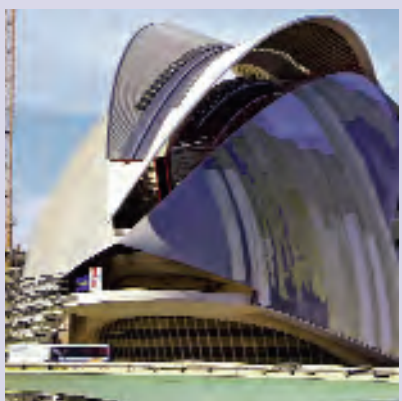
Palau de las Arts Valencia

DYWIDAG Threadbars for the new Opera House in Valencia





■ With “Ciudad de las Artes y de las Ciencias” (City of the Arts and Sciences) star architect Santiago Calatrava, born in Valencia in 1951, has created his most outstanding work in his home city to date. Among his most important works are the expansion of the Milwaukee Art Museum near Chicago, the new opera house in Santa Cruz on Tenerife, the BCE Place Mall in Toronto and the Oriente Train Station in Lisbon. He is also internationally recognized for the bridges he has designed such as the Alameda Bridge in Valencia, the Blackhall Place Bridge in Dublin and the Alamillo Bridge in Sevilla. The latter was built for the World Exhibition in 1992 using DSI Stay Cable Systems.



Following major destruction caused by flooding from the Turia river in 1957, Calatrava’s home city of Valencia diverted the river into a canal outside the city on the spur of the moment. After decades in which the former river bed had become desolate it was decided in the late 1980s to build the new city of the arts and sciences on 35 hectares of desiccated river bed instead of the originally planned expressway. This new cultural center is also a consequence of the ambition of the boomtown of Valencia to regain the importance in Spain that Valencia had already had in the 15th century as Spain’s biggest and most dynamic city.

The 1.2 km long and 200 m wide Ciudad de las Artes y de las Ciencias was designed to illustrate the efficient symbiosis between arts and sciences in Valencia. Since its opening in 2001, more than 6 million visitors have demonstrated that the investment had been justified. The three most essential buildings designed by Santiago Calatrava for that complex comply with his own sculptural design at a high aesthetical level.

The largest of these three structures standing in one row from the west to the east is the new opera house “Palau de las Arts Reina Sofia” that has the shape of a monumental helmet. This 75 m high building was built on 40,000 m². Two symmetrical concrete shells crowned by a steel roof combine the individual structures that otherwise seem to be randomly arranged. With seats for more than 4,000, this is now the largest opera house in the world. The stage of the main hall ranks among the largest of the world with 460 m². In addition, the 166 m² large orchestra pit is the third largest in the world. Also, the artistic management is very impressive – Lorin Maazel conducted the ceremonious opening concerts in early October 2005.

All of these superlatives were also reflected by the architect’s very high demands on the performances of the construction companies involved and the quality of the materials used. DSC supplied DYWIDAG Threadbars for formworks and accessories for this landmark cultural building via PERI.



INFO

General Contractor Acciona Infraestructuras, Dragados, Spain +++ **Architect** Santiago Calatrava, Spain +++
Project Developer Cacsá, Spain
DSI Unit DYWIDAG Sistemas Constructivos, S.A., Madrid, Spain
DSC Scope Supply of DYWIDAG Threadbars for formworks and accessories



Permanent *GEWI*[®] Anchors prevent uplift of new underground railroad station

Citytunnel Project, Malmö, Sweden



Photos reprinted by courtesy of the Citytunnel Project, Malmö, Sweden, of NCC Construction Sverige AB, Malmö, Sweden, and of Brückner Grundbau GmbH, Essen, Germany

■ **The fixed road and railroad connection across the Öresund between Denmark and Sweden including the landmark Öresund bridge was opened in 2000 after a 5-year construction period.**

Since then, rail traffic has significantly increased. Many forecasts project an additional increase of the traffic volume by 40%. Therefore, implementation of previously conducted intensive preliminary studies regarding the expansion of the rail infrastructure in the South of Sweden has become essential. These studies placed particular emphasis on environmental compatibility. After the studies were approved, work on the City tunnel in Malmö, Sweden's third largest city, began in 2004.

The 1.3 billion EUR project essentially includes an 11 km long double-track section from the central railroad station to the Öresund fixed link, 6 km of which are in two parallel tunnels under central Malmö. In addition, the central station is being expanded to include a four-track underground station and changed from a terminus to a transit station. Additional track buildings as well as new railroad stations in Triangeln (subterranean) and Hyllie complete the project.

The new, approximately 1 km long underground station for the central station posed a particular challenge to engineers, since it is located up to 15 m below the ground surface and would »float« in a 12 m deep groundwater lake if the entire structure was not secured against uplift. Therefore, the construction of the station necessitated the building of a »dry excavation«

with anchored diaphragm or slurry walls by the open-cut method. The permeability of the so-called bryozoa limestone, which is located at a depth of about 8 m underneath backfills, requires dewatering by means of wells to lower the water level to 1 m beneath the bottom of the excavation. In order to keep the changes of the hydrological conditions during the entire construction project as small as possible, the withdrawn water is redirected back into the soil via wells.

The bottom and the walls of the structure were concreted in one stage and the permanent uplift anchors are to be installed prior to the completion of the tunnel ceiling. According to the construction schedule, the entire area of 26,000 m² must be completely anchored by spring 2008.





The boreholes are drilled and encased to the final depth (on average 16 to 19 m below the upper surface of the base slab) using drilling equipment for a medium anchor grid of 2 x 3 m. The cleaned boreholes are then grouted with cement grout. After lifting the one-piece permanent GEWI® anchor in place, the external casing is removed and the anchor properly fixed in terms of position and height. As soon as the cement grout has cured, each anchor is subjected to an acceptance inspection using a maximum load of 1,580 kN, which is 1.5 times the service load. The bond length of the anchors is located in the bottom area of the bryozoa limestone, the so-called Limhamn formation, and was fixed at 4 to 5 m after preliminary tests. The anchors installed to date have all passed the acceptance testing with good success.

Before the lowering of the groundwater level is terminated, the anchor heads must be installed, the anchors prestressed to a service load of 1,050 kN, all cavities sealed and the anchor heads embedded in the bottom slab encased in concrete. The service life of the structure is designed for 120 years. Therefore, 20 test anchors are installed in certain accessible structural sections to allow inspection of the uplift anchors on a regular basis.

The opening of this landmark project including the expanded Malmö central station is scheduled for 2011.

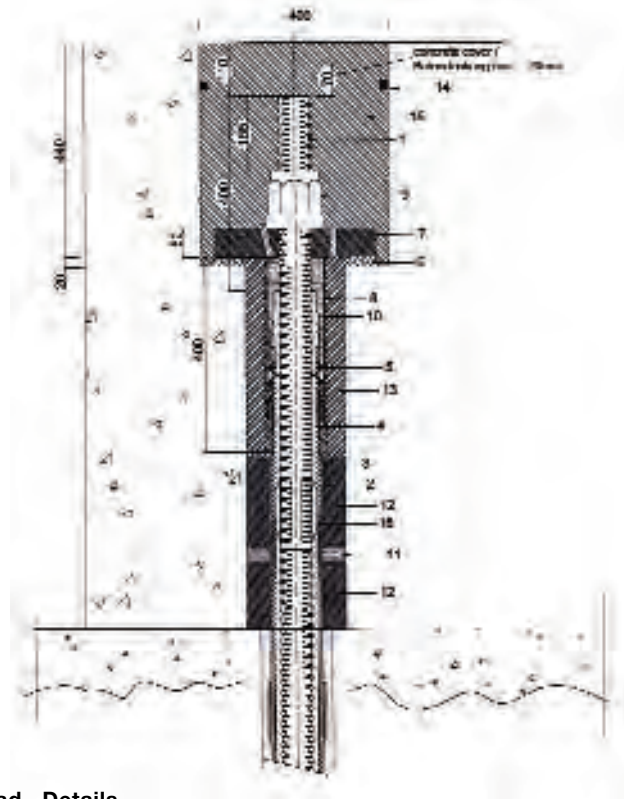
As far as the anchors are concerned, this project is characterized by certain particularities:

- All double-corrosion protected anchors were manufactured by DSI Austria in Salzburg and transported in 22-24 ton shipments to Malmö, a distance of approximately 1,100 km.
- The anchors were manufactured in one piece up to a max. length of 22 m.
- The maximum deviation of straightness was + 10 mm for an anchor length of 22 m.

- Extensive quality certifications/certificates of compliance based on the Z-20.1-17 were required for every anchor batch delivered.
- 100% traceability of every anchor, i.e. every threadbar is consecutively numbered and provided with all supporting documents/certificates required.
- Supporting documents for all materials used, e.g. cement and anticorrosive agents,

with a view to safeguarding drinking water quality.

- Compared to other steel rods or anchors with prestressed concrete strands, the GEWI® steel anchor has the advantage of relatively little bar strain, which in this project means minimal structural deflections in the event of load cases beyond the post-tensioning force.



Anchor head – Details

- | | |
|--|--|
| 1. GEWI®-bar \varnothing 63.5 mm, S 555/700 | 8. Welded-on tube \varnothing 127x4x400 mm |
| 2. Smooth sheathing | 9. Cast nut, 63 T 2163G |
| 3. Corrugated sheathing | 10. Corrosion protection compound |
| 4. Primary grout | 11. Sealing (bentonite) |
| 5. Profile rings | 12. Grout, before stressing |
| 6. Layer of mortar | 13. Grout, after stressing |
| 7. Anchor plate (\varnothing 340, t=60, S355JO) | 14. Sealing tape, Hydrotite |
| | 15. Concrete, grade C 40/50 |
| | 16. Inner spacer |

INFO

Client Citytunnel Project, Malmö, Sweden +++ **Engineers** COWI A/S and SWECO AB, Malmö, Sweden +++ **Owner of Lot E101** NCC Construction Sverige AB, Malmö, Sweden +++ **Diaphragm wall and anchor Subcontractor** Brückner Grundbau, Essen, Germany
DSI Units DSI Austria, Elsbethen / Salzburg, Austria and AAGE Christensen A/S, Valby, Denmark
DSI Scope Supply of 2,700 permanent GEWI® anchors, \varnothing 63.5 mm, grade 555/700 with double corrosion protection in lengths varying from 16 to 22 m and anchor heads; extensive engineering consulting, ongoing acceptance inspections on the construction site; test anchors; installation instruction



Installation of temporary DYWIDAG Multistrand Anchors for slope stabilization in Slovenia

Slope stabilization project »POKRITI VKOP MALEČNIK«, Maribor, Slovenia



■ **SCT d.d, a local Slovenian construction firm, was awarded the contract to extensively stabilize a slope for the »SLIVNICA-PESNICA« interstate section in the village of Malečnik near Maribor on the Drava in the north of Slovenia.**

The contract stipulated that the slope should be stabilized in accordance with the SIA standard of the Swiss Society of Engineers and Architects. The existing soil conditions in that region presented an additional challenge, since the soil at the site to be stabilized is mainly composed of clay dykes.

SCT d.d contacted DSI Munich and asked for their assistance in the installation of the DYWIDAG Multistrand Anchors to be used. A total of 412 temporary DYWIDAG Multistrand Anchors type 4x0.62" in lengths varying from 12-14 m with a load of 450 kN were required.

DSI Munich fabricated the first three multistrand anchors matched to the project's requirements. In cooperation with SCT d.d, DSI Munich employees successfully installed the first DYWIDAG Multistrand Anchors on site. The subsequent testing of the DYWIDAG Multistrand Anchors conducted by DSI at a test load of 675 kN was successful. SCT d.d then installed all further anchors according to the proposal elaborated by DSI Munich to the full satisfaction of the owner.



INFO

Owner DARS, Slovenia +++ **Contractor** SCT d.d, Ljubljana, Slovenia

DSI Unit DSI Group Headquarter Operations, Munich, Germany

DSI Scope Supply of 412 temporary DYWIDAG Multistrand Anchors type 4x0.62"; technical assistance; supply of equipment



Soil nailing systems strong in the UK market

Use of DYWIDAG soil nails to stabilize slopes and through-cuts in the UK



■ **Over the past decade, soil nailing has become a very popular and efficient solution for the stabilization of slopes for railways, highways and housing developments in the UK.**

DSI UK is very closely involved in this development and in the supply of comprehensive high-quality DYWIDAG Soil Nailing Systems to the UK civil engineering and construction industries.

An increasing number of projects involve major works with large numbers of soil nails included in the permanent design.

DYWIDAG Soil Nails are available in two designs: as solid *GEWI*[®] Threadbars or self-drilling *DYWI Drill*[®] Nails. Both alternatives are widely used depending upon the prevailing ground conditions for individual applications.

Generally, solid bars are a regular solution in harder grounds where drilled holes stay open, and self-drilling *DYWI Drill* Nails are normally chosen in softer ground where drilled holes may collapse and the self drilling facility involving simultaneous installation and grouting can be used to advantage.

Below are some examples that illustrate the use of soil nailing systems in outstanding projects in the UK.

Hollow Bars stabilize motorway construction near Porth, South Wales

Use of soil nails to stabilize slopes in the UK

■ **Newly exposed steep side slopes were on the verge of sliding down during construction of a new highway bypass at Porth in South Wales. Therefore, this problem required urgent action by all persons involved.**

Due to their easy and quick installation facilitated by simultaneous installation and grouting, the self-drilling hollow bars supplied by DSI UK were the ideal solution to stabilize the slope section concerned. The quick installation of 746 galvanized hollow bars types R25N, R32N and R32S, which were up to 7 metres long, prevented the slopes from collapsing.



INFO

Owner Highways Agency, Great Britain +++ **General Contractor** Costain, Great Britain +++ **Engineer** Arup, Great Britain +++
Installation Sub-Contractor Systems Geotechnique Ltd., Great Britain

DSI Unit DSI UK, Southam, Warwickshire, Great Britain

DSI Scope Supply of 746 pcs. galvanized hollow bars types R25N, R32N and R32S in lengths varying from 4 to 7 m



Stabilization of slopes with a gradient of up to 60 degrees

Use of Galvanized Hollow Bars to stabilize slopes in the UK

■ **Construction of the TV4 Project is to relieve a major twin rail bottleneck in the Trent Valley at Tamworth in Staffordshire by upgrading the capacity from two tracks to four to cut congestion and allow shorter transit times.**

To increase the capacity and reduce traveling times, additional material was excavated from the embankment and an extra line on either side of the original two tracks was laid. Since some settlements are partly built very close to the railroad line, the resulting 60 degree embankment slopes were secured by a total of 5,000 self-drilling galvanized hollow bars of type MAI R38N in lengths varying from 4 to 11 m.



INFO

Owner Network Rail, Great Britain +++ **General Contractor** Norwest Holst and Balfour Beatty, Great Britain +++
Engineer Scott Wilson, Great Britain +++ **Installation Sub-Contractor** W A Developments, Great Britain
DSI Unit DSI UK, Warwickshire, Great Britain
DSI Scope Supply of 5,000 pcs. galvanized hollow bars type MAI R38N in lengths varying from 4 to 11 m

Slope stabilization using Hollow Bars in Perth, Scotland

Stabilization of slopes in a development area with DYWIDAG Soil Nails



■ **The city of Perth, which is also known as the gateway to the Scottish Highlands, is a popular base for the numerous outdoor recreational activities that are available in the area. To enhance the attractiveness of Perth and encourage more people to settle there, the city council has designated new development areas for both commercial and residential building in the past few years.**

The sloping ground of a large development area near Perth had to be extensively stabilized prior to commencement of a major home construction project.

To this end, DSI UK supplied a total of 800 galvanized hollow bars type R32N for this project. The soil nails were installed in lengths varying from 6 to 12 m by Cementation Foundation Skanska Ltd. within the scope of the construction work.

INFO

Owner City of Perth, Great Britain +++ **General Contractor** I & H Brown Ltd., Great Britain +++ **Engineer** Byland Engineering, Great Britain +++ **Installation Sub-Contractor** Cementation Foundation Skanska Ltd., Great Britain
DSI Unit DSI UK, Southam, Warwickshire, Great Britain
DSI Scope Supply of 800 pcs. galvanized hollow bars type MAI R32N in lengths varying from 6 to 12 m



Winterbourne Railway Cut near Bristol

Use of DYWIDAG Soil Nails to stabilize slopes in the UK

■ An interesting example of the use of DYWIDAG Soil Nails using GEWI® Threadbars was the cut for a railroad line near Winterbourne near Bristol in the UK, where unstable rock faces on both sides of the line were reinforced with galvanized GEWI® Threadbars up to 7 meters long.

For the installation of 1,200 25 mm diameter DYWIDAG Soil Nails, the railroad line had to be temporarily closed so that six drill rigs could be used in the narrow cut.



Photos reprinted by courtesy of CAN Geotechnical Ltd., Great Britain

INFO

Owner Network Rail, Great Britain +++ **General Contractor** GWESPA / A. McAlpine, Great Britain +++
Engineer Tony Gee & Partners, Great Britain +++ **Installation Subcontractor** CAN Geotechnical Ltd., Great Britain
DSI Unit DSI UK, Warwickshire, Great Britain
DSI Scope Supply of 1,200 pcs galvanized DYWIDAG Soil Nails \varnothing 25 mm in lengths varying from 5 to 7 m





DYWIDAG Post-Tensioning Tendons stabilize university building in Beirut

»Charles Hostler« Sports and Cultural Center, American University of Beirut, Lebanon

■ **The American University of Beirut, a private, independent, coeducational, comprehensive university, was founded in 1866 with 16 students. It is chartered by the state of New York. At present, more than 6,900 students from all over the world are studying there.**

The campus has now been expanded by a center for cultural and athletic activities. The principal construction projects include the construction of two new sports buildings that are very interesting from an architectural point of view. One particularity with regards to the construction of the sports buildings is the execution of the slab construction in form of a flat slab with 40 m long post-tensioned tie girders.

The 40 m long girders rest on very slender columns that form the structural frame. The buildings are reinforced by two monolithically erected staircase towers located at the opposite sides of the structures.

DSI's licensee in Lebanon, SOPREL Liban SAL, was awarded the contract to supply, install, stress and grout DYWIDAG Post-Tensioning Tendons. The area of the cantilevered slender columns turned out to be a critical section for the upcoming stressing operations to be carried out on the 40 m long beams.

In order not to compromise the stability of the substructure in that section, the girders were at first supported by a temporary auxiliary frame and subsequently post-tensioned one after the other. Only after completion of the stressing and grouting operations could the loads from the beams be transferred to the columns and the two staircases.

SOPREL Liban SAL successfully completed the tensioning and grouting operations without compromising the building's stability under partly extreme general political conditions.



INFO

Owner American University of Beirut, Lebanon +++ **General Contractor** Karagulla Engineering and Contracting, Beirut, Lebanon +++ **Architect** Vincent James Associates Architects (VJAA), Minneapolis, MN, USA +++ **Technical Consultant** D.G. Joines / SKP, Beirut, Lebanon

DSI Unit SOPREL Liban SAL, Halate, Lebanon

DSI Scope Supply, installation, stressing and grouting of DYWIDAG Post-Tensioning Tendons Type MA 6815, MA 6812 and MA 6809



Use of DYWIDAG Post-Tensioning Systems in one of the world's largest natural gas liquefaction plants

Construction of 8 LNG tanks (Liquified Natural Gas) in Ras Laffan, Qatar

■ **A giant gas field - the North Field - off the north coast of Qatar was discovered in the early 1970s. This gas field is the world's largest natural gas reservoir that is not related to the production of crude oil. The proven reserves in this field are approximately 25 trillion cubic meters. As a result, Qatar has the third largest natural gas reservoir after Russia and Iran and about 15.3% of the world's reserves. The continued substantial investments made by Qatar into the natural gas sector at an early stage in the field's development and the country's excellent position along the shipping routes of the Persian Gulf indicate that Qatar will soon become the largest natural gas supplier in the world.**

The natural gas from the North Field is processed in Ras Laffan, an industrial city located 80 km north of the capital of Doha that was established in 1997. Natural gas is pumped to Ras Laffan via a pipeline at the bottom of the sea. The overall capacity of the gas liquefaction plants in Ras Laffan is to be doubled to an annual capacity of more than 80 million tons of LNG in the next few years. Thus, with more than 300,000 barrels per day, Ras Laffan will become the world's largest gas-to-liquids (GTL) facility producing about one quarter of the world's LNG requirements. The liquefied natural gas is mainly exported to the USA, but also to Asia and Europe.

In 2005, a fourth gas liquefaction plant with an annual capacity of 4.7 million tons was put into operation on the premises of the Ras Laffan LNG Company (RasGas).

By 2010, 7 more gas liquefaction plants with an annual capacity of up to 7.8 million tons each are to be ready for production by RasGas and its sister company Qatar Liquefied Gas Company (Qatar Gas).

Many tanks are required to store the liquefied gas. To prestress these tanks, DSI supplied a total of 3,360 t DYWIDAG Multistrand Tendons for 8 of these new 140,000 m³ tanks from May 2003 to July 2006. The tanks have an outer diameter of 78 m and are about 40 m high. The 80 cm thick walls are horizontally post-tensioned using 19x0.62" DYWIDAG Multistrand Tendons, while 12 strand tendons \varnothing 0.62" were used for the vertical post-tensioning.

High-quality, cryogenic DYWIDAG Post-Tensioning Systems were installed into tanks No. 4, 5 and 6 of the Ras Laffan facility and into tanks No. 1, 2, 3, 4 and 5 of the Qatar Gas II plant for this significant energy supply project.



INFO

Owner Ras Laffan LNG Company Ltd. (II) and Qatar Liquefied Gas Company Ltd. (II), Qatar +++ **General Contractor** Chiyoda, Snamprogetti & Co., W.L.L., Qatar and Chiyoda-Technip Joint Venture, Qatar +++ **Contractor for tanks** Ishikawajima – Harima Heavy Industries Co., Ltd. (IHI), Japan and Consortium Mitsubishi Heavy Industries Ltd. – Vinci Construction Grands Projects +++ **Sub-Contractor for tanks** Kettaneh Construction W.L.L., Qatar

DSI Unit DSI Group Headquarter Operations, Munich, Germany

DSI Scope Supply of 3,360 t DYWIDAG Multistrand Tendons, type MA 12x0.62" and 9x0.62", ring tendons; rental of technical equipment; technical assistance for installation



Use of DYWIDAG Multistrand Tendons for the construction of the first LNG Tanks in Yemen

LNG export terminal, Bal Haf, Yemen



View onto construction site Bal Haf, Yemen

■ Yemen not only has an interesting, partly legendary history, but also large natural gas reservoirs. First plans to exploit the gas fields already existed in the late 1990s. The participation of Korean companies in the investors' group, now trading under the name of YEMEN LNG Company, as well as the worldwide increasing demand for gas led to the realization of these plans in 2005. With USD 3.7 billion, it is the country's largest investment project.

An export terminal for shipping liquefied natural gas particularly to Europe and South Korea is being built in Bal Haf on the busy shipping routes of the Arabian sea. The natural gas is to be transported to the terminal via pipelines from the Marib Block gas fields about 320 km away and liquefied there. Two tanks are being built for the interim storage of this liquefied natural gas (LNG).

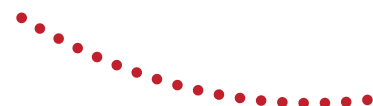
The consortium consisting of TKK, DYWIDAG and DAEWOO began construction of the first two LNG tanks in Yemen in early 2006. Both tanks will have a capacity of 140,000 m³ each, with completion scheduled for late 2008.

Since natural gas only liquefies at temperatures below -161°C, low temperature stability of all materials used in the construction of LNG tanks is extremely important. DSI has already successfully demonstrated the cryogenic suitability of its post-tensioning systems in numerous tests in the past.

DSI's services for the construction of the first two LNG tanks in Yemen included the supply of more than 49,000 m DYWIDAG Multistrand Tendons including anchorages, types MA 6809 and 6819, as well as accessories. In addition, DSI successfully provided evidence for the cryogenic fitness of the GEWI® Thread-

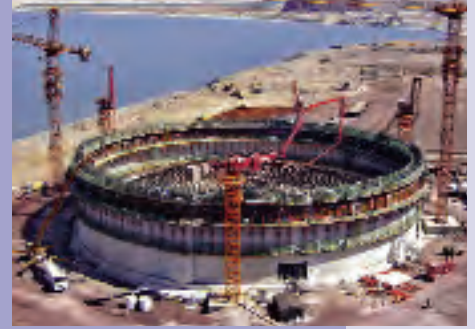


- 1 Cryogenical test at DSI GmbH Unterschleißheim
- 2 Test set-up at DSI GmbH Unterschleißheim
- 3 Test monitoring





Betonierarbeiten der Bodenplatte

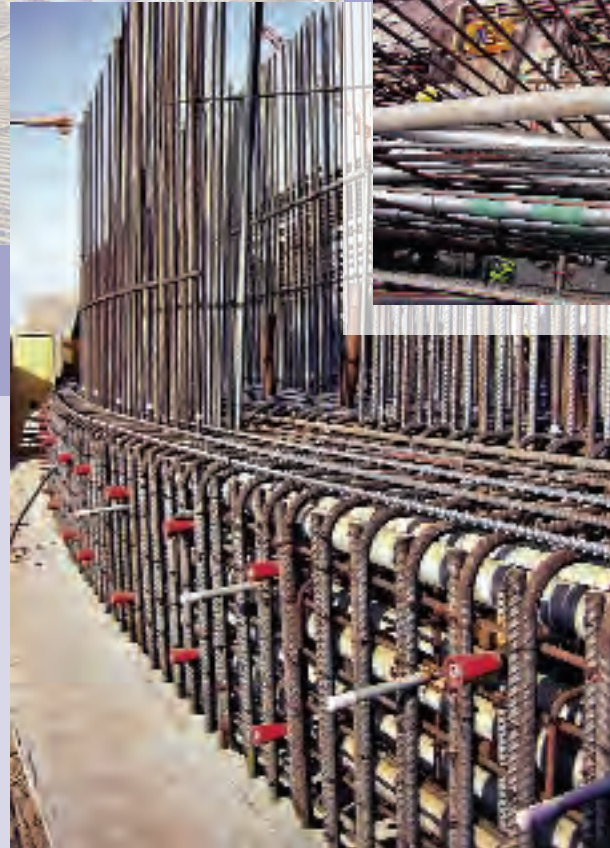


Photos reprinted by courtesy of DYWIDAG International GmbH, Munich, Germany

bars and DYWIDAG Multistrand Anchors in a total of six tests conducted in its Munich testing laboratory.

Floor slabs of LNG tanks require extreme reinforcement. Additional strengthening of the ultimate load of floor slabs is achieved by post-tensioning the reinforcement. Therefore, the strands and reinforcing bars in the floor slabs of the two LNG tanks in Yemen were post-tensioned with 380 high-quality cryogenic DYWIDAG Multistrand Anchors each. For this purpose, DSI additionally supplied specific connection pieces for connecting the anchors to the strands and reinforcing bars.

Furthermore, DSI supplied GEWI® Threadbars including accessories for splices in construction joints. In addition, cryogenic GEWI® Threadbars are also used in access openings. GEWI® Threadbars are predestined for such use, since they can be extended to the length of the opening in the subsequent concreting of access openings, and thus the stability of the wall is ensured.



Reinforcement with DYWIDAG Multistrand Anchors

INFO

Owner YEMEN LNG Company, Yemen +++ **Sub-Contractor for LNG tanks** Consortium consisting of Toyo Kanetsu K.K. (Japan), DYWIDAG International GmbH (Germany) and DAEWOO Engineering & Construction Co., Ltd. (South Korea)

DSI Unit DSI Group Headquarter Operations, Munich, Germany

DSI Scope Supply of about 49,000 m DYWIDAG Multistrand Tendons including anchorages and accessories, 17 t cryogenic GEWI® Threadbars Ø 28 mm grade 500/550, 31 t GEWI® Threadbars Ø 28 mm grade 500/550, 118 t GEWI® Threadbars Ø 32 mm grade 500/550



GEWI® Piles support new addition to University of Toronto Building

Centre for Biological Timing and Cognition (CBTC) at the University of Toronto, Toronto, Ontario, Canada



Computer model of the new building (with permission of the UoT)

■ To establish a comprehensive sleep and biorhythm research centre at the University of Toronto, construction of an additional building became necessary. It was decided to add a three-storey, 2,140 m² building to the Ramsey Wright building on the congested St. George Campus.

The locality chosen for the addition challenged the buildings designers and contractors. Parts of the building are situated over existing mechanical and electrical rooms as well as over loading and delivery areas that had to continue to operate during construction. In addition, vibrations had to be minimized in order not to disturb the ongoing research experiments at the adjacent zoological faculty.

These restraints as well as the restricted site access predestined the use of micropiles. Highly flexible drilling equipment and methods allow DSI GEWI® Piles to be drilled through virtually every ground condition, natural and artificial, with minimal vibration and at any angle. In addition, high-quality small diameter GEWI® Piles (up to 300 mm) are capable of sustaining high compressive loads of up to 5,000 kN. Another advantage of GEWI® Piles is their ability to transfer load via skin friction over the entire bearing length of the pile, thereby avoiding locally high soil pressure concentrations.

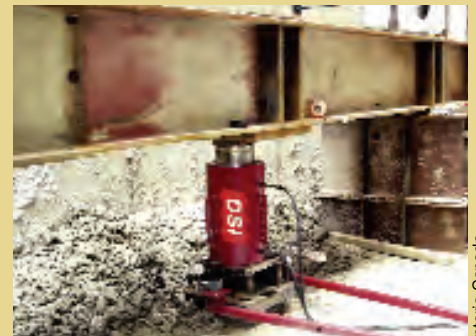
After a test had been successfully conducted, a total of 21 GEWI® Piles with double corrosion protection, consisting of one or two 57 or 63 mm Ø GEWI® Bars with capacities up to 1500 kN each were installed and grouted. Due to the low headroom, the GEWI® Piles were installed in segments and connected with full strength couplers on site. The GEWI® Piles were grouted in drilled holes up to 219 mm Ø an. The average length of the holes was approximately 16 m.

The building will become operational as a Psychology research facility in the summer of 2007.

This project is another example of the flexible and efficient use of GEWI® Piles to support and upgrade historical buildings as well as to expand the use of structures with difficult foundation conditions.



Site layout before construction



Testing of GEWI® Piles



Photos reprinted by courtesy of University of Toronto, Ontario, Canada

INFO

Owner University of Toronto, Toronto, Ontario, Canada +++ **General Contractor** Ellis Don Corporation, Mississauga, Ontario, Canada +++ **Architect** Stantec Architecture, Toronto, Ontario, Canada +++ **Technical Consultant** Halsall Associates Ltd., Toronto, Ontario, Canada +++ **Sub-Contractor** Forages MSE Inc., Ste-Martine, Quebec, Canada +++ **Engineer** Trow Associates Inc., Brampton, Ontario, Canada

DSI Unit DSI Canada Ltd., Eastern Division, Gormley, Canada

DSI Scope Supply of 21 double corrosion protection GEWI® Piles (Nos. 18 & 20) incl. accessories; rental of equipment for testing; technical assistance



World class testing facility built with DYWIDAG post-tensioning systems

New structural laboratory, Polytechnique Montréal, Québec, Canada

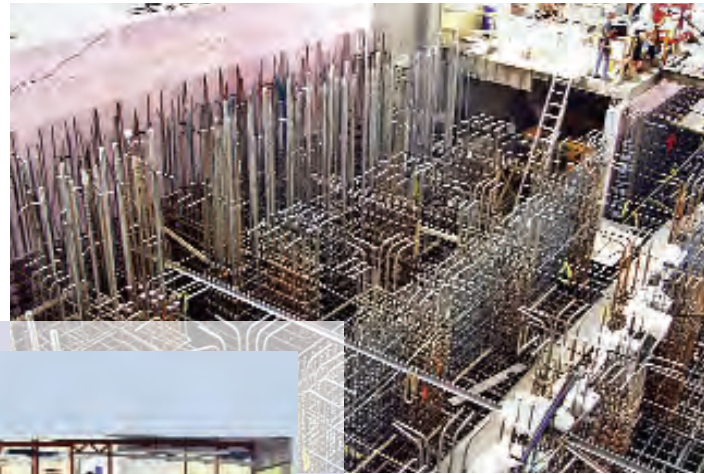
■ Polytechnique Montréal is one of Canada's leading engineering schools and is the largest in Québec in terms of its student population and the scope of its research budgets. Founded in 1873, Polytechnique has 58 research units. Its research activities are among the most active in Canada and account for nearly one-quarter of all university research in engineering in Québec.

The Group for Research in Structural Engineering (GRS) is concerned with research on civil engineering structures including buildings, bridges and dams. It conducts art theoretical, numerical and experimental research on structures and materials. Validation of numerical models and investigation of the structural behavior of large-scale test specimens required high performance Structural testing Facility.

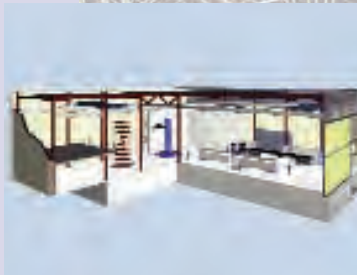
Important subventions granted by the Federal and provincial Governments allowed the construction of this structural facility of international caliber, considered as one of the largest and better equipped in North America.

Expanding on an existing structure, the new structural laboratory totals 1960 m², 1140 m² of which consist of new construction. The principal technical challenge was the construction of a test slab and a reaction wall that will permit the testing of large scale structural elements.

The 1 m deep structural slab, sits on top of a raft slab 0,8 m thick, both heavily pre-stressed with grouted DYWIDAG multi-strand tendons in both directions. The L shaped reaction wall, towering 10 m over the structural slab (14 m overall length), is prestressed horizontally with layers of



Heavy reinforcement in vertical and horizontal directions



3D rendering of new testing facility



Tight space, stringent tolerances, precision execution

grouted DYWIDAG multi-strand tendons and vertically with DYWIDAG post-tensioning bars, stressed at the top. The whole rigid structure is post-tensioned to the rock with DYWIDAG Multi-strand rock anchors.

Civil construction was completed in 2006. Once the high-performance equipment is set up, this facility will be a formidable platform for constant growth and development in the field of structural engineering.

This is another very interesting usage of DYWIDAG post-tensioning, a system that adapts most readily to the most challenging tasks, yet flexible and economic to suit even the most basic needs.

INFO

Owner Polytechnique Montréal, Québec, Canada +++ **PT Contractor** AGF Steel Inc., Longueuil, Québec, Canada +++
Project Manager AXOR, Montréal, Québec, Canada +++ **Consulting Engineers** Dessau-Soprin Inc., Laval, Québec, Canada

DSI Unit DSI Canada Ltd., Eastern Division, Gormley, Canada

DSI Scope Supply of multi-strand MA bonded system (7x0.6" to 19x0.6") for horizontal post-tensioning, Ø 46 mm G150 DYWIDAG bars for bonded vertical post-tensioning, DYWIDAG multi-strand rock anchors (12x0.6" to 19x0.6"); rental of equipment; technical assistance



Lifting of Pier Templates for Stay Cable Bridge using Hydraulic DYWIDAG Lifting System

Golden Ears Bridge across the Fraser River, Langley, Greater Vancouver Area, BC, Canada

■ **The new stay cable bridge across the Fraser River near Vancouver in western Canada is situated in a beautiful landscape. The bridge is named after the nearby mountain chain »Golden Ears«, a local modification of »Golden Aeries«, meaning the nests of the eagles hunting at that section of the coast.**

Construction of the new Golden Ears Bridge started in the summer of 2006. After its scheduled completion in the summer of 2009, the bridge will significantly contribute to improving the traffic situation in the Greater Vancouver Area.

The 968 m continuous hybrid extradosed stay cable bridge with 3 main spans of 242 m each crosses the Fraser River at a structurally critical site. In that area, the Fraser River is considerably

influenced by tide changes with currents in changing directions. The development of pier templates that are resistant to the continuous changing of the flow direction on one hand and that can be anchored in the thick alluvial mud layers of the river on the other hand posed a special technical challenge for this project.

It was decided to rest the 4 pylons on massive concrete pile caps that are 3 m thick, 45 m long and 18 m wide and supported by 12 piles of

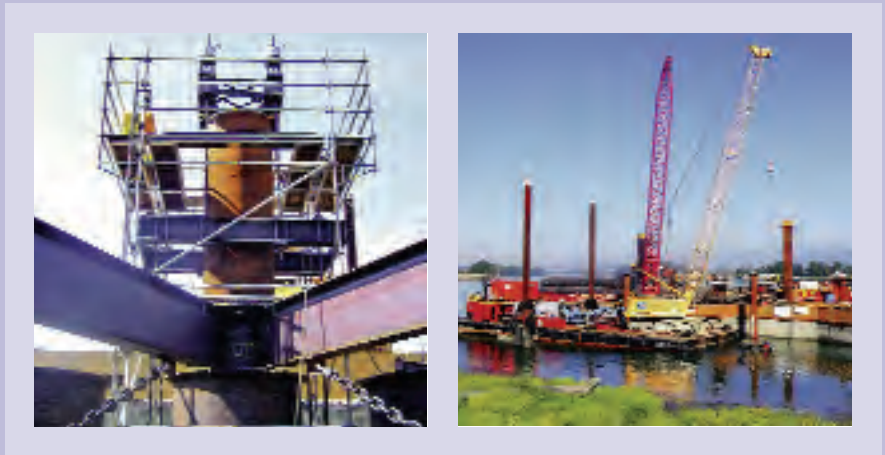


2.5 m diameter and lengths up to 85 m each. To build one of these pile caps, its outer shape (bottom and surrounding walls) was cast as a concrete template structure. That template was floatable and positioned at the required position of the bridge pier. After 6 piles for temporary support had been driven through the template, it needed to be lifted out of the water to its desired elevation. The 1,300 t concrete template had to be lifted simultaneously on all 24 points from its floating position on the water to a level up to 3 m higher to prevent damage to and overloading of the individual load-carrying elements. Therefore, the owner looked for a hydraulic lifting system.

At the proposal of DSI Canada, a lifting system using 24 manually controlled hydraulic hollow jacks was used. A full size test of one lifting unit (pump with control unit and 4 jacks à 110 t) in the DSI plant in Surrey, BC, demonstrated the suitability of that system. Together with the contractor, DSI engineers established detailed procedures for the lifting.

For each of the 6 temporary piles, 4 hydraulic jacks were connected to one pump. An assembling of flow control valves and load lowering valves enabled the pump operator to permanently control and adjust the force and lifting speed for each jack. A technician from DSI Canada supervised the lifting of the first pier template, explaining the exact handling of each section. The manually controlled system was found to be more effective for this project than a computer controlled lifting system.

DSI Canada provided the complete DYWIDAG Lifting System including hardware for this challenging project. In addition, DSI Canada supplied 47 Ø mm DYWIDAG Threadbars with an ultimate load capacity of 1,820 kN that were anchored in the concrete bottom plate to connect it to the 24 lifting points by using the lifting equipment.



INFO

Owner Translink Corporation, BC, Canada +++ **Contractor** Golden Crossing Constructors JV (Main contractor: Bilfinger+Berger, Vancouver, Canada, and CH2MHill) +++ **Engineer** Leonhard Andre and Partner / Buckland & Taylor, Vancouver, BC, Canada
DSI Unit DSI Canada Ltd., Western Division, Surrey, Canada
DSI Scope Development, testing, supply and installation of the hydraulic DYWIDAG Lifting System (6 pumps and 24 jacks incl. hardware); supply of DYWIDAG Threadbars® Ø 47 mm grade 950/1050 and DYWIDAG Threadbars® Ø 63 mm grade 517/690 including hardware



DYWI® Drill Hollow Bar Anchors secure “Electra” Building in San Diego

Conversion of the former “Old SDGE Station B” in downtown San Diego, CA

■ **The historic “Old SDGE Station B” building is located in downtown San Diego. The building was originally built in 1911 to accommodate the boilers and turbines of the San Diego Electrical Railway Company. Later, it became the property of the San Diego Gas & Electric Company under whose name it is still known. A builder applied for the permit to build a new 43-storey high-rise building on that site. However, the historically deemed facade with its neo-classical and Art Deco stylistic elements was to be maintained. Therefore, it was decided to build the new high-rise building within the old facade and to integrate the facade into the new project.**

For this purpose, the SDGE building was entirely gutted inside, and the facade was elaborately stabilized during the construction. In addition, the load capacity of the foundation soil had to be improved in a sustainable manner for the anticipated loads of the new skyscraper. Following its completion in December 2007, the new nostalgic complex will bear the name of “Electra” – in reference to the former owners of the site – and offer about 250 modern, luxurious apartments with a magnificent view of the harbour and the city of San Diego.

Condon-Johnson & Associates Inc., San Diego, was awarded the contract for the excavation, sheeting and shoring work. To increase the load capacity of the foundation soil, DYWI® Drill Hollow Bar Anchors were used.

DYWI® Drill Hollow Bar Anchors can easily be installed on the construction site under confined space conditions using simple and small dimensioned drilling equipment.

The DYWI® Drill Hollow Bar Anchor System offers the following advantages:

- use of small dimensioned drilling equipment.
- No predrilling need under limited space conditions.
- Simultaneous drilling and grouting in a single operation.

For this landmark project that will exceed any other buildings in San Diego after its completion, DSI Long Beach supplied a total of 10,000 ft. DYWI® Drill Hollow Bar Anchors type T76S including hardware accessories such as drill bits and couplers.



INFO

Owner Bosa Development California II, Inc, British Columbia, Canada +++ **Main Contractor** Bosa Development California II, Inc, British Columbia, Canada +++ **Execution** Condon-Johnson & Assoc. Inc., San Diego, CA, USA

DSI Unit DSI USA, BU Geotechnics, USA

DSI Scope Supply of about 10,000 ft DYWI® Drill Hollow Bar Anchors type T76S including hardware accessories such as drill bits and couplers



Replacement of an existing bridge over the Ohio River between Ohio and West Virginia

Pomeroy-Mason Bridge over Ohio river, Pomeroy, Ohio, USA

■ The construction of this new stay cable bridge designed to replace an existing bridge over the Ohio River between Pomeroy, Ohio, and Mason, West Virginia, started in spring 2003. For the Southeast region of Ohio, it is considered a significant milestone in the development and expansion of a safe and efficient transportation system.

Due to its diamond shaped towers and a bridge deck with edge girders and floor beams, it appears more elegant than the old steel truss structure. With spans of 74 + 205 + 74m and a deck width of 23m, the 96 cables range from 19x0.6" to 61x0.6". On this project, the reliable DYNA Grip® Anchorage System is used. The waxed and sheathed strands of each stay cable, which will remain ungrouted inside their common PE pipe, were stressed individually using the Con-Ten method. In addition, the diamond shaped towers were secured using 352 DYWIDAG Bar Tendons, 46mm, gr 835/1030. DSI USA supplied the post-tensioning and stay cable materials, as well as the under-slung form travellers, and assisted in assembling the form travellers.

The side spans were built on false work and the two form travellers allowed simultaneous construction of both cantilever halves of the main span. A challenge on this project was complying with the project specification requirements for air pressure by testing the post-tensioning ducts for leaks before and after pouring the concrete.



INFO

Owner Ohio Department of Transportation - District 10, Marietta, Ohio, USA +++ **Execution** JV Mahan/National, Grove City, Ohio, USA +++ **Consulting Engineers** URS Corporation, Cincinnati, Ohio | Tampa, Florida, USA +++ **Contractor** C. J. Mahan Construction Company, LLC, Grove City, Ohio, USA +++ **Contractor** National Engineering, Strongsville, Ohio, USA +++ **Consultant** Baker Engineering & Energy, Moon Township, PA, USA +++ **Engineering** Janssen & Spaans Engineering, Inc., Indianapolis, USA

DSI Unit DSI USA, BU Post-Tensioning, USA

DSI Scope Supply of 227 t post-tensioning and stay cable materials (96 cables range from 19x0.6" to 61x0.6", DYNA Grip® Anchorages, 352 DYWIDAG Bar Tendons, 46 mm, gr 835/1030), under-slung form travellers; assistance at assembling the form travellers



Interchange secured with DYWIDAG Strand Post-Tensioning Systems

Rebuilding the interchange of I 215 / SR 60 / SR 91 in Riverside, CA, USA



■ Three major freeways meet in Riverside, California east of Los Angeles. Interstate 215 serves as a section of highway 15 on the north-south route as the eastern bypass of Los Angeles, whereas state routes 60 and 91 connect the residential areas in the east of Los Angeles with the city center and the northern quarters.



Traffic on these three freeways has significantly increased in the past 20 years. To facilitate the smooth flow of increased traffic in the future, the Californian Transportation Department decided to significantly expand the interchange in Riverside.

This complex major project, which involved working around the clock for nearly 4 years while maintaining high traffic flows, mainly involved adding HOV (high occupancy vehicle) lanes – lanes that may only be used by vehicles with at least two passengers. In addition, various approach ramps and bridges were rebuilt.

Widening the existing freeways required the construction of retaining walls and noise abatement walls at certain locations. To anchor them safely, DYWIDAG Soil Nails, rock bolts and double-corrosion protected tie backs were delivered just in time by DSI USA from their nearby plant in Long Beach, CA.

The ramp and bridge structures are a combination of cast-in-place and precast concrete construction, representing 60,000 m³ of concrete, 10,000 tons of rebar and 4,100 m of precast girders. Since the traffic interchange is located near the San Andreas fault and hence in a seismic zone, the owner attached great importance to the ramps' stability. A total of 29 individual bridges with span lengths of up to 300 m were prestressed using DYWIDAG Strand Post-Tensioning Systems. DSI supplied, installed, stressed and grouted the entire post-tensioning systems.

A major structural feature of this project are two connector ramps built with concrete cast-in-place on pipe false work rising above the urban surroundings. The upper north-west connector, over 1.6 km in length and 30 m tall, consists of 27 spans. The south-east connector of similar construction is 17 spans, with five frames at 1,060 m built under the north-west connector. From late 2007 on, traffic is once again to flow smoothly through this much improved interchange in Riverside.



INFO

Owner Californian Transportation Department, District No. 8, CA, USA +++ **General Contractor** JV Washington Group / Obayashi, Highland, CA, USA +++ **Sub-Contractor** Drill Tech Drilling & Shoring, CA, USA

DSI Units DSI USA, BU Post-Tensioning, Long Beach, USA; DSI USA, BU Geotechnics, USA

DSI Scope Supply and installation of 1,300 tons of DYWIDAG Strand Tendons, 320 pcs. 27x0.6" tendons type MA, supply of permanent and temporary DYWIDAG Soil Nails, rock bolts and 182 pcs. 3x0.6" double-corrosion protected tie backs



DYWIDAG Soil Nails stabilize excavation of the new Dallas Cowboy stadium

Construction of a new football stadium in Arlington, Texas, USA

■ In early 2005 the Dallas Cowboys and the city of Arlington agreed on the construction of a new football stadium that will become the new home for the successful National Football League team. In addition, the new stadium, with a seating capacity of 75,000 to 100,000, will significantly contribute to the improvement and expansion of the city's infrastructure.

The construction work for the new stadium began in spring 2006. The 650 mio USD complex will accommodate a highly sophisticated stadium with a natural grass field and a retractable roof as well as restaurants, shops and entertainment facilities. Hence, a visit to a football game can be extended to an all-day event. In addition to football games, the stadium with its 200 suites will also be used for other large events such as high school football, College Bowl games, Superbowl games and concerts.

Since the new Dallas Cowboy stadium is 18 m below the current ground level, approximately 570,000 m³ of soil had to be excavated. The excavated material is to be partly used for road construction sites in the vicinity of the city of Arlington and also partly stored for later use on the stadium construction site that covers a total area of 600,000 m².

A total of 8,200 Grade 150 double corrosion protected, epoxy coated DYWIDAG Soil Nails totalling 670 t of prestressing steel were installed in a soil nail wall surrounding the excavation.

The 16-18 m long DYWIDAG Soil Nails stabilize the vertical excavation walls and at the same time tie back the cast in place concrete retaining wall that encloses the entire excavated site.

To flexibly meet the soil nail requirements in line with the progress on the construction site, the DYWIDAG Soil Nails were assembled on site. To this end, DSI USA supplied epoxy coated post-tensioning bars and system accessories. The post-tensioning bars were cut and assembled on the construction site by Craig Olden Co.





An essential advantage of the chosen operational plan was that the DYWIDAG Soil Nails could be fabricated just in time and in the lengths required on the construction site. DSI USA is proud to have made a significant contribution to the success of this important North Texas project. After a scheduled construction time of 3 years, the Dallas Cowboys will move into the new stadium in time for the 2009 football season.



INFO

General Contractor Consortium: Manhattan Construction Company, Rayco Construction and 3i Construction, all Dallas, Texas, USA
 +++ **Contractor** Craig Olden Co., Little Elm, Texas, USA +++ **Architect** HKS Sports & Entertainment Group, Inc., Dallas, Texas, USA +++
Engineer Graham & Associates, Inc., Illinois, USA

DSI Unit DSI USA, BU Geotechnics, Arlington, Texas, USA

DSI Scope Supply of 8,200 double corrosion protected, Grade 150 epoxy coated DYWIDAG Soil Nails (670 t)







New generation of stay-cable bridges incorporating DSI expertise

“Penobscot Narrows Bridge and Observatory Tower“, Bucksport, Maine, USA

■ **Proactive and ground-breaking methods were used for this new stay-cable bridge opened to traffic in autumn 2006 which will raise the standards for future stay-cable bridges around the world.**

The new 646 m long bridge, which has a main span of 354 m and two 128 m high pylons, replaces the previous, very busy 74-year old Waldo Hancock Bridge.

The design and innovative techniques of the new stay-cable bridge were significantly influenced by the owner's particular emphasis on durability (planned service life of the bridge > 100 years) and easy maintenance.

As a result, with the involvement of DSI USA, the following protection systems were combined for the very first time:

- DYNA Grip® Stay Cable anchorages with Epoxy-coated Strands,
- HDPE ducts,
- nitrogen gas protection system,
- DYNA Force Monitoring System.

To enhance the aesthetics of the bridge, the new “cradle system” developed by Figg Bridge Engineers, Inc. was used. The ASCE – American Society of Civil Engineers - gave the Pankow Award to the “cradle system” in April 2007.

In the new “cradle system”, a continuous cable stay runs from the bridge deck, through the cradle in the pylon and back down to the bridge deck. Within the curved portion of the stay, each individual strand of the cable is contained in its own protective tube. By eliminating cable stay anchors formerly required in the pylon, the pylon can be given a more slender and aesthetically pleasing shape.

The DYNA Grip® Stay Cables consist of 61 to 73x0.6" epoxy-coated strands encased in a common sheathing. To protect the stay cables on a permanent basis, DSI developed a system which at the same time allows permanent, easy monitoring and is resistant against the extreme temperature fluctuations in that region.

In this system, DYNA Grip® Stay Cables were inserted into a hermetically sealed HDPE duct and



dried with warm air. Subsequently, pure nitrogen was pumped into the HDPE duct, which eliminated the presence of potentially corrosive elements such as oxygen, chlorides and humidity. Each stay includes a small nitrogen gas reservoir that will feed pressurized gas into the cable in the event of a small leak. Gauges which record fluctuations in pressure and provide the owner with a monitoring system are connected to each stay. The sealing cap covering the strand tail at each anchorage fully encapsulates all anchorage hardware and also incorporates a unique feature: a clear end plate which allows direct visual inspection of the anchor area.

Unique, permanently installed gauges provide data for the DYNA Force System developed by DSI with which the forces in the stay cables can be monitored continuously and cost-efficiently. The DYNA Force System is robust, requires no maintenance, has an accuracy of + 1% and is designed to have a similar service life as the bridge.

The result of the successful cooperation between developers, planners and designers and the Maine Department of Transportation's enthusiasm for innovation is an elegant bridge that will continue to be a landmark well into the 22nd century.



INFO

Owner Maine Department of Transportation, USA +++ **General Contractor** Joint Venture consisting of Cianbro and Reed & Reed, USA
 +++ **Engineer** Figg Bridge Engineers, Inc., Tallahassee, Florida, USA

DSI Unit DSI USA, BU Post-Tensioning, USA

DSI Scope Development and technical assistance; supply of 80 total DYNA Grip® Stay Cables with epoxy-coated strands, development of a pedestal support system for the installation of the cradles into the pylons, installation of HDPE ducts, delivery of 4 form travellers







Seismic retrofit of a historic city hall in California

Reinforcement of the Pasadena City Hall with DYWIDAG Prestressing Systems, Pasadena, CA, USA

■ **Built in 1927 in Spanish Mission Style, the Pasadena City Hall is one of the most beautiful and historically most valuable buildings in Pasadena. So far, the building has survived the region's many earthquakes. However, according to recent studies, the structure would no longer withstand a major earthquake of magnitude 7 or 8.**

As a result, the Pasadena City Council decided on an extensive seismic retrofit and the execution of further reinforcement and restoration measures. The construction project also included the repair of damage caused by previous earthquakes and restoration of the architecturally and historically valuable façade.

The most important part of the reconstruction was the installation of a base isolation system designed to protect the 63 m high structure against seismic activities. To this end, a concrete "moat" was first built around the building. Subsequently, wide strips of ground under the existing basement were excavated and new grade beams were installed under the old slab elevation.

Using more than 1,000 36 mm Ø grade 150 DYWIDAG Threadbars, clamping beams were installed and connected to the existing columns and walls. Next, a total of 44 concrete transfer beams, incorporating two 9x0.6" MA DYWIDAG Multistrand Tendons each, were built and connected to the clamping beams.

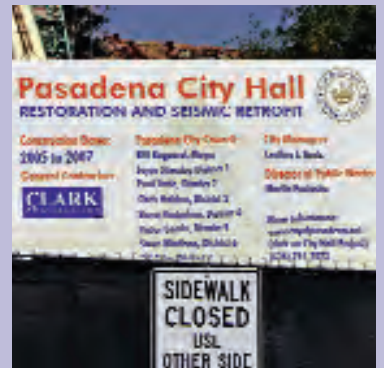
The stressing operations presented a special challenge, since the DYWIDAG Multistrand Tendons in the 44 transfer beams had to be stressed simultaneously in a confined space. DSI USA designed a special trolley to fit in the new moat that could be pushed from one beam to the next. In this way, all beams could be easily stressed and grouted from outside the building.

View of the historic Pasadena City Hall





Detail view of the DYWIDAG Strand Anchors



A total of 240 isolators were placed between the new lower level grade beams and the new post-tensioned transfer beams. Then, the bases of the existing columns and walls were demolished, and the entire weight of the building was transferred onto the isolators.

These isolators now totally support Pasadena City Hall and will dampen the movement of the building during a seismic event.

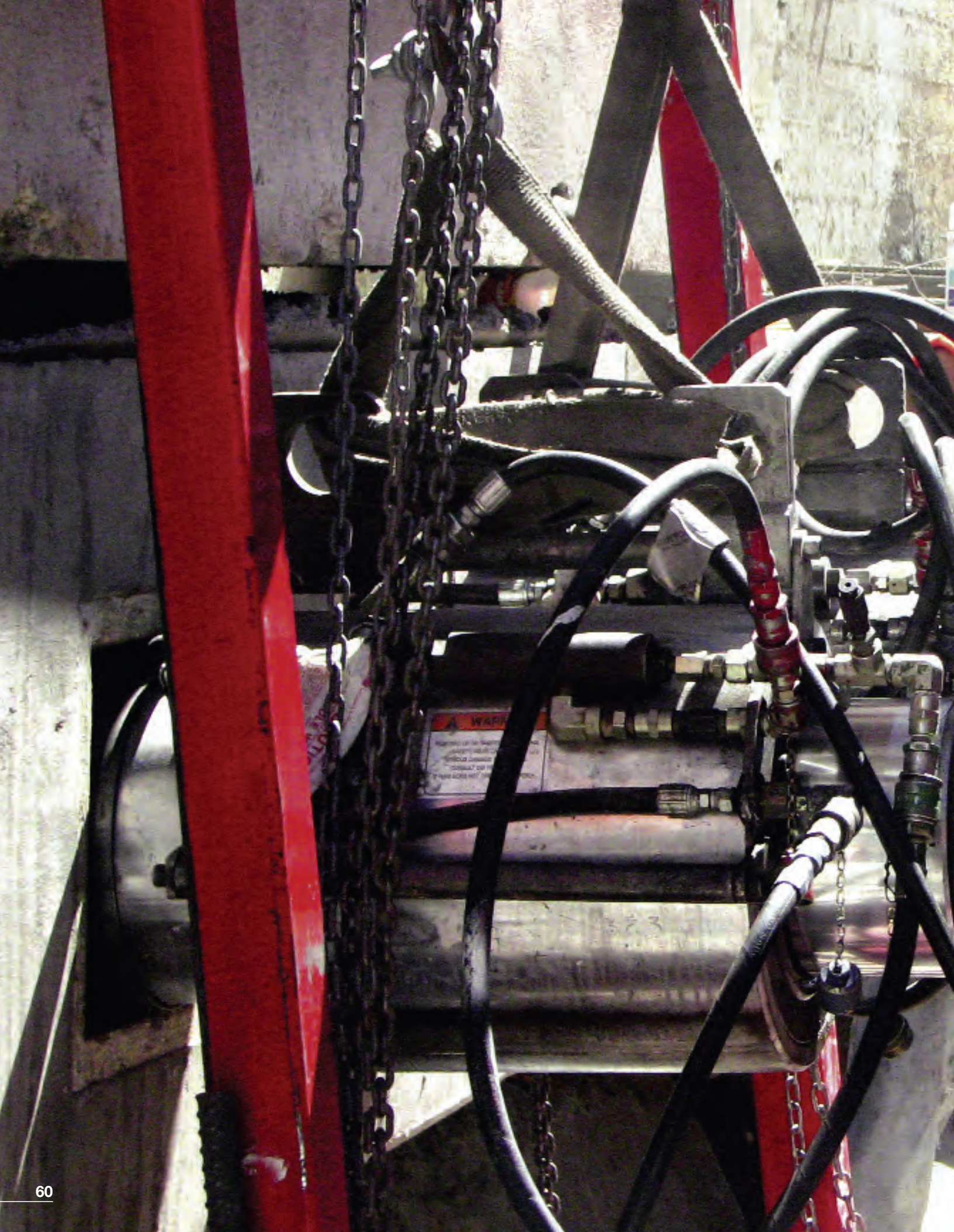
DSI USA is proud to have made a significant contribution to the long-term reinforcement of this historically important building with the utilization of versatile DYWIDAG Threadbar and Multistrand Tensioning Systems. During the one-year construction period, the post-tensioning strand tendons and threadbars were delivered just in time to the construction site by the nearby DSI facility in Long Beach, CA.

INFO

Owner City of Pasadena, CA, USA +++ **General Contractor** Clark Construction Group, Costa Mesa, CA, USA +++ **Architect** Architectural Resources Group, San Francisco, CA, USA +++ **Engineer** Forell/Elsesser Engineers, Inc., San Francisco, CA, USA

DSI Unit DSI USA, BU Post-Tensioning, Long Beach, CA, USA

DSI Scope Supply and Installation of 88 DYWIDAG Multistrand Tendons Type 9x0.6" and 1,074 ea. DYWIDAG Threadbars \varnothing 36mm, grade 150, including accessories; rental of equipment; field and technical services







DYWIDAG Post-Tensioning Systems secure bridge across the Otay River in San Diego County

Expressway bridge across the Otay River, Chula Vista, San Diego County, CA, USA



Installation of a precast concrete segment

■ The first plans for the South Bay Expressway in the southeast of San Diego date back to the year 1959. Since then, what was once the small settlement of Chula Vista located in the southeast of San Diego Bay has developed into the second largest city in the San Diego region with more than 200,000 inhabitants. The new South Bay Expressway

(SR125) now offers a fast north-south connection between highway SR-905, at the Mexican border, and highway SR-54 in Spring Valley. Due to the scarcity of public funds, the South Bay Expressway is the first project in California to be built on the basis of a public private partnership (PPP).

From an engineer's point of view, the most challenging section of this 16 km long toll expressway is the four-lane bridge across the Otay River. The South Bay Expressway operator decided on a precast segmental concrete bridge design in order to complete the construction project in the shortest amount of time possible and in the most economical manner.

The 1,012 m long bridge consists of dual, precast segmental box girder structures. The bridge deck, which rests on a total of 11 pairs of piers, rises 60 m above the valley at its highest point. The end spans are 53.5 m long and the intermediate spans are 90.5 m long.

The box sections are joined at the deck and at pier caps to form the 47.7 m wide roadway. Subsequently, the CIP pier caps were post-tensioned transversely with 8 Type 27x0.6" MA and 4x0.6" FA DYWIDAG Post-Tensioning Tendons each.

About 640 precast concrete segments were produced at Pomeroy Corp., a precast concrete products plant in Perris, California, about 150 km away from the jobsite. The deck overhang of the precast segments was post-tensioned with Type 4x0.6" FA, DYWIDAG Post-Tensioning Tendons and subsequently shipped by flat bed truck to the construction site.

Each of the approximately 80 t, 10 m wide and 4 m high precast concrete segments are lifted in place by means of a gantry truss and temporarily post-tensioned with 36 and 46 mm \varnothing DYWIDAG Threadbars before final longitudinal post-tensioning of each precast segment with Type 12x0.6" and 19x0.6" MA, DYWIDAG Post-Tensioning Tendons.

DSI USA supplied the entire post-tensioning material from its nearby Long Beach factory to close this gap in San Diego's expressway network. Following completion of the Otay River Bridge as well as other numerous CIP post-tensioned concrete box-girder structures supplied and installed by DSI for the contractor, the South-Bay Expressway was opened to traffic in spring 2007.



Installation of precast concrete segments using a gantry truss



Ready concreted pier cap above a pair of piers



Precast concrete segments installed in a pair of piers

INFO

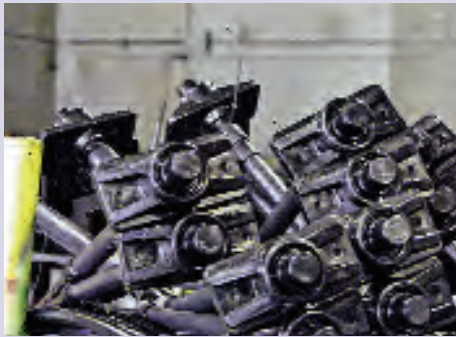
Owner South Bay Expressway, San Diego, CA, USA +++ **Contractor** Otay River Constructors, a joint venture of Washington Group Intl. and Fluor, USA +++ **Engineer** International Bridge Technologies (IBT), USA +++ **Precaster** Pomeroy Corporation, CA, USA

DSI Unit DSI USA, BU Post-Tensioning, Long Beach, CA, USA

DSI Scope Supply of 1600 t DYWIDAG Post-Tensioning Tendons, 5,000 -12,19 & 27x0.6" MA Anchorages and 4x0.6" FA Anchorages, supply of DYWIDAG Threadbars \varnothing 36 mm and 46 mm; rental of equipment; field installation and technical services



Expansion of Florida Monostrand Business



■ **In 2003, DSI established a regional branch in Florida due to the enormous potential for its monostrand business in this area. At the beginning, the focus lay on the booming condominium market including the apartment-to-condominium conversion market. At this time, sales orders destined for the Florida market were being filled from an established production plant near Atlanta, Georgia. Within 1 ½ years, DSI's monostrand business in Florida had grown so large that it was no longer practical to continue supplying materials from Georgia. As a result, a management decision was made to establish a new production facility for DYWIDAG Monostrand Systems in the South of Florida. The centrally located City of Davie was chosen where the new plant went into full production in November 2005.**

Most of Florida's recent high rise condominium housing and hotel construction boom has been in close proximity to the state's extensive coast line. Therefore, a specific and maximum effective corrosion protection of the strand systems is highly required because of the salt water environment. In response to a growing need for more durable systems, DSI introduced the Zero Void® monostrand system to owners, engineers and contractors in the area. This water tight system, which encapsulates the tendons completely in PE, with strong and durable connections and enhanced corrosion protection characteristics, has been successfully installed on several significant new structures along the Florida coast line by business partners who recognize the advantage it brings to their buildings. One of the most significant structures to utilize this new Zero Void® monostrand system is the Marquis building in Miami which, when completed, will rise to a height of 67 floors.

DSI's Florida sales staff was the first to introduce the company's new DYWIDAG Shear System, DSS, to the local market. This system, which consists of headed shear studs welded to a base plate, replaces conventional reinforcing steel bars used for shear reinforcement around columns. Its economic advantages include ease of placement, lighter weight, less congestion

and low cost. Demand for this new DSS Systems in 2005 was so great that it was necessary to double the production capacity after only 6 months on the market.

Around the end of 2006, the condominium market softened but the commercial market has already gained some steam. DSI used this change in the market to address organizational and operational optimization to be able to concentrate even better on the future market. DSI is now well positioned to increase its market share in Florida.

Another potential area of growth is the slab-on-ground market for residential and industrial floors. With the acquisition of Grout Systems Inc. (GSI) in Texas, DSI now has the expertise to penetrate the residential market in Florida.





DYWIDAG Monostrand Tendons secure flat slabs of luxury apartment building

“Europa-by-the-Sea” Condominium, Fort Lauderdale, Florida, USA

■ The new “Europa-by-the-Sea” condominium in Fort Lauderdale owes its name to the elements of Mediterranean style that can be found everywhere within the building and on the premises. The remarkable 15 story building with its simple elegance includes four residences on every floor named after the Mediterranean islands of Ibiza, Mykonos, Santorini and Mallorca. The two penthouses are named after the glamorous cities of St. Tropez and Marbella located on the Mediterranean coast.

All apartments are luxuriously furnished and equipped with sophisticated technology. Furthermore, the 2.75 m high walls provide the rooms with a spacious and unobstructed atmosphere. In addition, the development is arranged so that all units offer sweeping views to the ocean and the beautiful beach of Fort Lauderdale.

All floor slabs were pre-stressed using DYWIDAG Monostrand Systems, which contributed to ensure the simple elegance and lightness of the overall impression of the building while at the same time maintaining the best possible structural strength and stability. The economy and ease of installation of these flexible and high-quality DYWIDAG unbonded Monostrand tendons virtually predestined them for installation and securing of this landmark residential building. To this end, DSI USA supplied 335 km DYWIDAG Monostrands.



INFO

Owner Colonia Development Group, LLC, Fort Lauderdale, FL, USA +++ **General Contractor** Suffolk Construction, West Palm Beach, FL, USA +++ **Engineer** Jenkins & Charland, Inc, FL, USA

DSI Unit DSI USA, BU Monostrand, FL, USA

DSI Scope Supply of 335 km DYWIDAG Monostrand Tendons incl. accessories



Use of DYWIDAG Monostrand Tendons in the Venice of America

W Hotel in Fort Lauderdale, FL, USA

■ Due to its many waterways, Fort Lauderdale is also referred to as the “Venice of America”. Every year it attracts many tourists who fish in its waterways or cruise with their yachts. With its blue waves and golden sand, the beach of Fort Lauderdale is one of the most beautiful regions in Florida. Meanwhile, the city is accelerating its conversion to an elegant and superior coastal resort, leading to a true construction boom of new 5 star hotels.

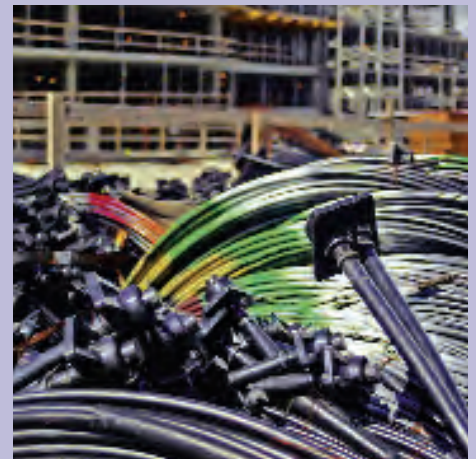
One of those is the new W design hotel of the Starwood Hotels and Resorts Group. “W” is the fastest growing hotel brand in the 5 star hotel business. The new facility consists of two 23-storey high-rise buildings which offer views of the beach and the famous intercoastal waterway from nearly all windows. The west tower accommodates 171 luxurious apartments, whereas the east tower houses the 346 rooms of the W hotel.

All floor slabs of the 23 storeys are stressed with DYWIDAG Monostrand Tendons. This important project once more illustrates the advantages of the DSI strategy to be represented with local facilities all over the world. The investor’s requirements for a construction period as short

as possible could also be met due to the fact that DSI USA was able to supply the approximately 800 km of DYWIDAG Monostrand Tendons just in time, since the DSI plant in Florida is only about 15 km away.

Due to their small size of 0.5" dia., DYWIDAG Unbonded Monostrand Tendons consisting of cold-drawn 7-wire strand tendons are perfectly suited for extremely thin prestressed concrete slabs of 114 mm as they are used in the W hotel. The new W hotel in Fort Lauderdale will open in early 2008.





INFO

Owner Colonia Development Group, LLC, Fort Lauderdale, FL, USA +++ **General Contractor** Hunt Construction Group, Tampa, FL, USA +++ **Sub-Contractor** Baker Concrete, Medley, FL, USA +++ **Engineer** Jenkins & Charland, Inc., FL, USA

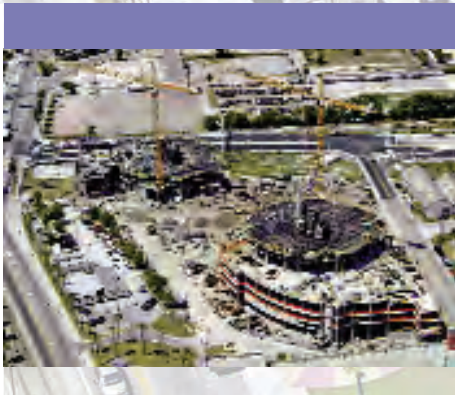
DSI Unit DSI USA, BU Monostrand, FL, USA

DSI Scope Supply of 800 km of DYWIDAG Monostrand Tendons incl. accessories



New residential and retail complex in Tampa

Towers of Channelside, Tampa, Florida, USA



■ The “Towers of Channelside”, a residential and retail complex, is one of the most fascinating projects in Tampa, Florida. The two 29 storey towers accommodate a total of 260 dwelling units, whereas the lower structure connecting both towers houses shops and restaurants. In addition, the project offers sufficient underground parking space to accommodate the needs of the entire facility. The generously dimensioned pool landscape of the

complex adds significantly to the quality of the residential facility.

The “Towers of Channelside” are easily accessible and offer great views of the skyline of Tampa and the blue water of Tampa Bay. The apartments are modern and luxuriously furnished. The floor slabs of both towers were prestressed with a total of 520 km of double-corrosion protected DYWIDAG Monostrand Tendons delivered just in time by DSI from their plant in Davie, Florida.

INFO

Owner Towers of Channelside, LLC, FL, USA +++ **General Contractor** Batson-Cook of Tampa, Inc., Jacksonville, FL, USA +++
Engineer Wilson Structures Consultants, FL, USA

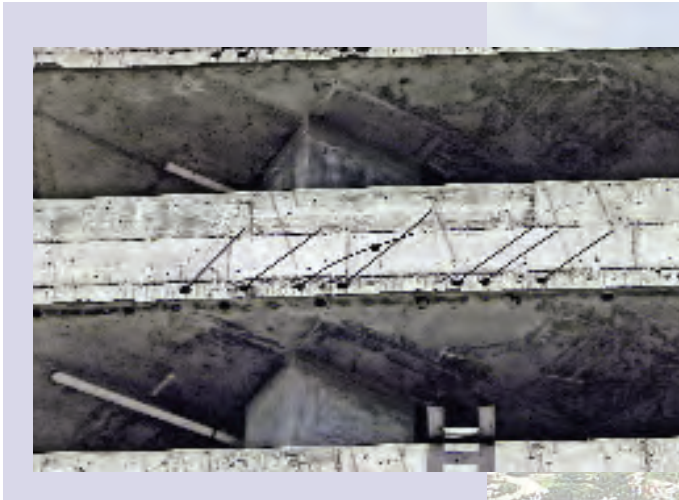
DSI Unit DSI USA, BU Monostrand, FL, USA

DSI Scope Supply of 520 km of DYWIDAG Monostrand Tendons incl. accessories



Spectacular high-rise building in Miami Beach prestressed with DYWIDAG Monostrand Tendons

Marina Blue Apartment and Hotel High-Rise Building, Miami, Florida, USA



■ One of the many high-rise apartment buildings recently built in Miami in connection with the strong demand for residential space is the Marina Blue Building opposite the new cultural center that includes an opera and a museum park in Miami Beach. The completely glazed facade and the slightly characteristic bend make the building stand out from the other multi-storey apartment buildings in the area.

The 191 m high building offers 516 luxuriously equipped apartments on 60 floors. The generously dimensioned balconies offer beautiful views of Downtown Miami and the ocean as well as the cruise ships in the Port of Miami.

All floor slabs of this outstanding building were prestressed using DYWIDAG Monostrand Tendon Systems. For this purpose, DSI USA supplied about 670 km DYWIDAG Monostrand Tendons from the new plant in nearby Davie.



INFO

Owner Hyperion Development Group, LLC, Miami, FL, USA +++ **General Contractor** Soares Da Costa, Miami, FL, USA +++
Engineer Donnell Duquesne & Albaisa P.A., Miami, FL, USA

DSI Unit DSI USA, BU Monostrand, FL, USA

DSI Scope Supply of 670 km of DYWIDAG Monostrand Tendons incl. accessories



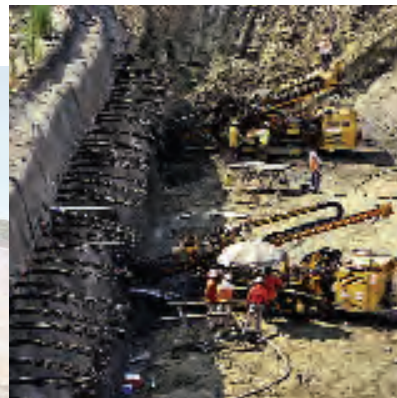




87 m long DYWIDAG Multistrand Anchors secure new building area in California

Whispering Hills development, San Juan Capistrano, CA, USA

■ San Juan Capistrano is one of the oldest settlements in California. Despite its central position between the modern cities of San Diego and Los Angeles, San Juan Capistrano has kept its historic charm. In addition, the 35,000 inhabitants appreciate the high quality of life in the city, which is enhanced by a diversity of cultural events and many opportunities for various sport and leisure-time activities. Furthermore, the metropolitan cities to the north and to the south can be quickly reached via interstate highway 5 located nearby.



Overview of the “Whispering Hills” development area

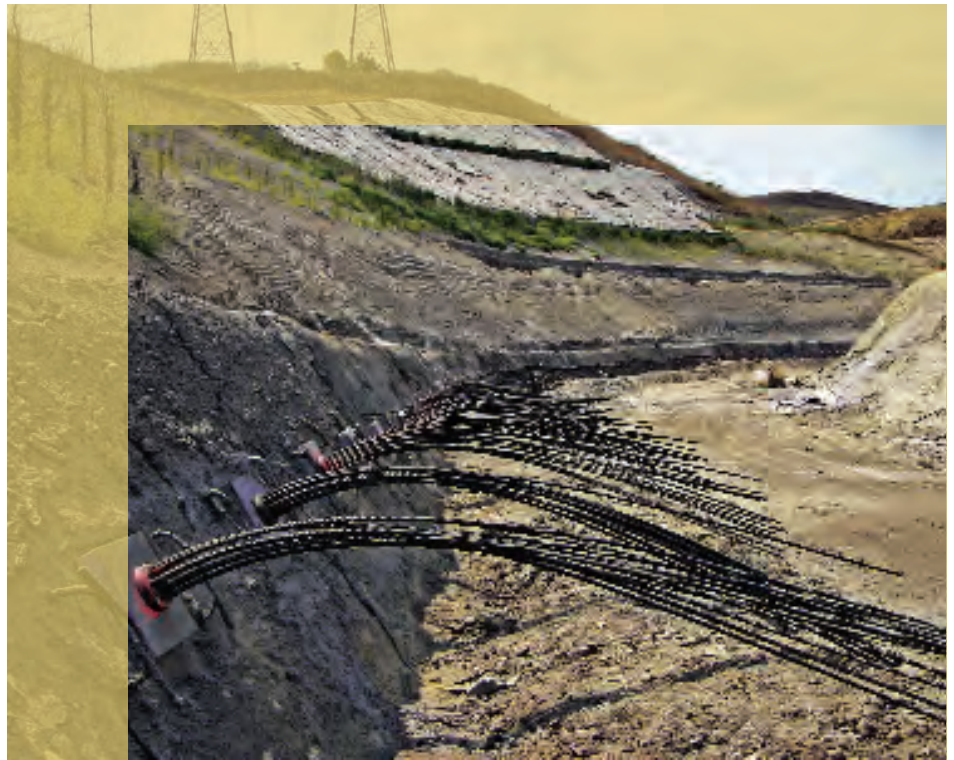


A 1.4 mio. m² site was designated in the urban area of San Juan Capistrano west of La Pata for the development of a new residential area designed to include 175 housing units and various leisure-time facilities as well as a new high school. The many green areas with hiking paths, playing and sporting grounds which are to be created will provide substantial opportunities for recreation.

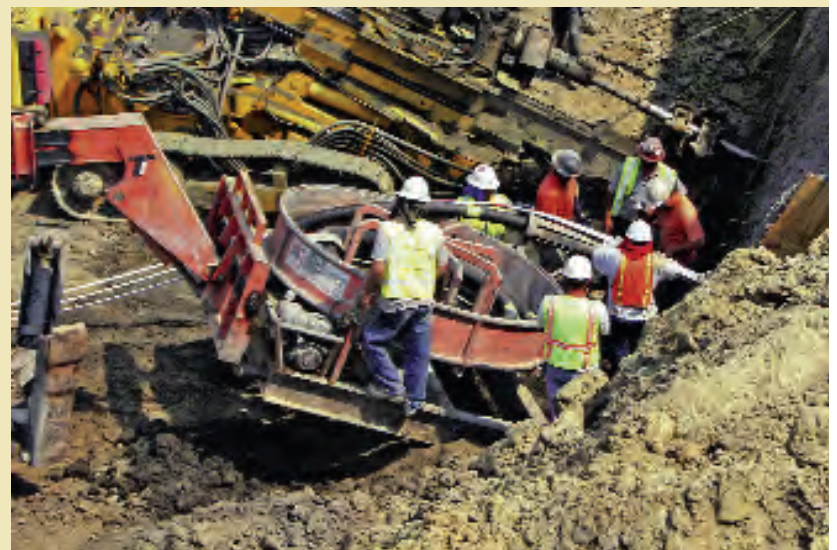
The new development area called Whispering Hills received its name from the scenic coast section of Orange County with its gently sloping hills. To permit construction on the site, an existing slope had to be elaborately stabilized.

Stabilization of the slope required the construction of a comprehensive grade beam system in the designated area. The grade beams were tied back with a total of 492 DYWIDAG Double-Corrosion Protected Multistrand Anchors that had to be installed within a very tight schedule. To this end, DSI Long Beach fabricated a total of 305,000 m into 11 and 12 strand anchors with individual anchor lengths of up to 87.5 m.

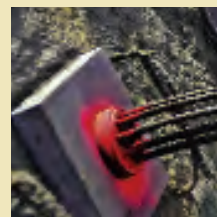
For the installation work, DSI also supplied prestressing jacks and the “EZ Chair”, a new development by DSI America. The “Easy (EZ) Chair” optimizes the fast and safe installation of DYWIDAG Multistrand Anchors.



Retaining wall with installed DYWIDAG Multistrand Anchors



Installing the DYWIDAG Multistrand Anchors using uncoilers



INFO

Owner Whispering Hills, LLC, Irvine, CA, USA +++ **Contractor** Schnabel Foundation Company, USA, and Condon-Johnson & Associates, USA +++ **Engineer** Leighton & Associates, San Diego, CA, USA

DSI Unit DSI USA, BU Geotechnics, Long Beach, CA, USA

DSI Scope Supply of 492 Ø 0.6" DYWIDAG Double Corrosion Protected Multistrand Anchors with 11 and 12 strands; rental of technical equipment



50-70 m long DYWIDAG Multistrand Anchors tie down Gilboa Dam

Stabilization of the Gilboa Dam, Schoharie, NY, USA

■ The Gilboa Dam, constructed in 1926, is located about 50 km southwest of Albany. It is one of several dams in the Hudson Valley that provide New York City with water. As operator of these dams, the NYC Department of Environmental Protection has a long standing commitment to upgrading its dams to modern design criteria. An examination of the dams situated west of the Hudson River revealed that all of them, except for the Gilboa Dam, complied with the current standard of safety and the state standards for existing dams.

As a result, the NYC Department of Environmental Protection decided to carry out initial immediate measures to stabilize the Gilboa Dam at short notice.

Within the scope of these stabilization measures, a debris barrier was erected first, providing clean surfaces for the construction work carried out and relieving the dam of the weight of debris. Subsequently, the capacity of the outlet tunnel for the Schoharie Reservoir was increased by about 200,000 m³ to a total of nearly 2.2 million m³ per day as a result of the widening of the tunnel inlet. To drain additional volumes of water without allowing the dam to be overtopped, four siphons were put in place. As a result, overtoppings are practically unnecessary, thereby significantly decreasing the erosion of the stone dam wall.

Only after the siphon work was completed did the actual reinforcement measures needed to stabilize the dam wall by means of multistrand anchors begin. The dam's owner placed very specific requirements on the double corrosion protected multistrand anchors to be used. For example, the strands in the anchors had to be fully degreased and special water-tight sheathings were specified. DSI met these requirements by providing its DYWIDAG Double Corrosion Protected Multistrand Anchors manufactured in its Toughkenamon facility.

After the contract was awarded, DSI USA supplied four 15 to 20 strand test anchors that were between 12.5 m and 33.5 m long. After the anchors were successfully tested on the construction site and approved, an additional 79 39 to 58 strand DYWIDAG Double Corrosion Protected Multistrand Anchors were manufactured and supplied. 47 anchors were installed vertically across the entire length and height of the dam



wall within the scope of the stabilization project. An additional 32 anchors were installed into the individual layers of the dam wall with inclinations ranging from 45 to 48 degrees on the downstream side. The 35 cm diameter multistrand anchors had to be correctly inserted, grouted and post-tensioned in the borehole, presenting a great challenge for the construction site personnel.

DSI USA supplied a total of 83 Double Corrosion Protected Anchors with 39 to 58 strands which were between 50 m and 70 m long. The challenging prestressing operations were successfully carried out using a 15,000 kN stressing jack that was specially developed by DSI.

Due to the extremely tight schedule, the Gilboa Dam stabilization challenged the organizational and operational abilities of all parties involved. Specific job planning and intensive cooperation between those involved led to the successful completion of this demanding geotechnical construction site.



INFO

Owner City of New York, Department of Environmental Protection, New York, NY, USA +++ **Contractor** Nicholson Construction Co., Cuddy, a Soletanche Bache Co. PA, USA +++ **Engineer** JV Gannett Fleming, Harrisburg, PA, USA / Hazen Sawyer PC, New York City, NY, USA +++ **Consulting Engineers** Freeze & Nichols / EGS Engineering / Donald Bruce, USA

DSI Unit DSI USA, BU Geotechnics, Toughkenamon, PA, USA

DSI Scope Supply of 83 DYWIDAG Double Corrosion Protected Multistrand Anchors with 39 to 58 strands between 50 m to 70 m long; rental of stressing systems and accessories



Construction of the first precast segmental bridge in Pennsylvania uses DYWIDAG Strand Post-Tensioning Tendons

Construction of a new bridge across the Susquehanna River near Harrisburg, PA, USA

■ In the year 2000, 28,000 vehicles per day travelling on the Pennsylvania Turnpike crossed the Susquehanna River near Harrisburg. Since local traffic projections for the region anticipated that this traffic would double by the year 2020, strengthening and expansion or replacement of the existing 55 year old bridge became necessary. The bridge's owner, The Pennsylvania Turnpike Commission, decided to build a new 6-lane bridge north of the existing bridge.

The new bridge consists of twin 1,800 m long by 17 m wide concrete box girder structures with typical span lengths of 45 m. Considering the required geometry and consistent multiple spans, the project was well suited for the precast segmental construction method. One major advantage of the use of precast elements is the much shorter construction time compared to alternative construction methods. In addition, the maintenance costs for precast concrete segmental bridges are significantly lower and the hollow box girders also offer additional space for utility lines.

The precast prestressed concrete segments are supported by a total of 78 piers and two abutments. The bridge's piers consist of two drilled concrete shafts, a solid concrete collar, a hollow concrete collar and a post-tensioned concrete pier cap.

To cast the 1,040 precast segments, each weighing up to 106 tons with a height of 2.5 m and a length of up to 4 m, the contractor set up a

casting yard in close proximity to the bridge. In addition, the precast elements were pre-stressed in transverse direction in the casting yard. Prestressing of the precast concrete segments included installation and stressing of 4x0.6" DYWIDAG Strand Post-Tensioning Tendons anchored in the top slab. In addition, 4 m long 36 mm Ø Grade 150 DYWIDAG Post-Tensioning Bars were installed and stressed at the bottom of the individual elements.

The precast segments were trucked to the construction site for installation. Subsequently, the segments were hoisted onto an erection gantry by a crane, and each 45 m long span was pre-stressed with an average of 8 27x0.6" DYWIDAG External Strand Tendons.

Since construction work on this important project proceeded faster than scheduled, the new bridge was opened to traffic in the spring of 2007.



Photos reprinted by courtesy of Figg Bridge Engineers, Inc., Tallahassee, FL, USA

INFO

Owner Pennsylvania Turnpike Commission, PA, USA +++ **Contractor** Joint Venture Edward Kraemer & Sons and G.A. & F.C. Wagman, Highspire, PA, USA +++ **Engineer** Figg Bridge Engineers, Inc., Tallahassee, FL, USA

DSI Unit DSI USA, BU Post-Tensioning, USA

DSI Scope Supply of 620 pcs. 27x0.6" DYWIDAG Strand Post-Tensioning Tendons, including accessories and 6,400 m of DYWIDAG Post-Tensioning Bars



GSI/DSI Monostrand Post-Tensioning systems are ideal solutions for slab on ground construction on expansive soils

Residential building in Dallas-Fort Worth, Texas, USA

■ **The construction of buildings on expansive soils requires a high degree of quality in foundation slabs. In areas with pronounced rainy seasons and dry seasons, the absorption of available water during wet seasons and loss of moisture during dry seasons in microscopic clay particles can be significant and result in strong volumetric changes of the soil.**

Moisture variations also occur when foundations are constructed over dry soils as moisture naturally moves into the covered dry soil, causing it to swell.

In order to withstand these constant volumetric changes, the slab either needs to be extremely massive or offer the equivalent degree of counter-tension.

The GSI/DSI Unbonded Monostrand-Post-Tensioning system has proven itself to be an effective and very economical solution to these problems.

The GSI/DSI Monostrand-Post-Tensioning system compresses the concrete, creating stresses which resist anticipated tension stresses induced by soil movements.

Furthermore, slabs which have been tensioned with the GSI/DSI Monostrand-Post-Tensioning system conform to the slab on ground design criteria established by the Post-Tensioning Institute (PTI).

There are three main varieties of construction depending on the grade of soil expansion.

A typical post-tensioned foundation on expansive soil consists of a monolithic "ribbed" foundation with a 101.6 mm thick slab, a perimeter beam and interior beams spaced in both directions at 3.05 - 4.58 m maximum centers.

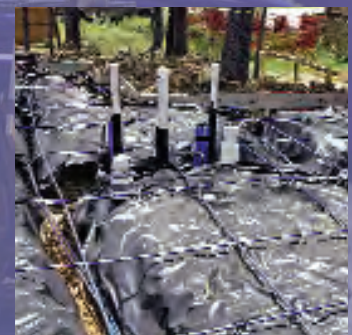
On less expansive soils, a typical post-tensioned foundation consists of a monolithic uniform thickness foundation, sometimes called a "California slab," with a minimum 127 mm thick solid slab with a perimeter beam and no interior beams. The slab can also be constructed without perimeter beam and interior beams, but, in this case, a minimum 190.5 mm thickness of the slab is necessary.

Bonded post-tensioning is accomplished using 12.7 mm GSI/DSI monostrand tendons distributed in both directions, initially stressed to 14.9 t, to provide a residual compressive stress of approximately 345.5 – 689 kPa. The compressive stresses resist the anticipated tension stresses induced by soil movements. This post-tensioning considerably enhances the efficiency and strength of the slab over a typical non-prestressed foundation. Another advantage of prestressing with GSI/DSI monostrands is the

significant cost benefit which is typically achieved by reduction in quantities of concrete, steel and excavation.

The slab-on-ground market is the fastest growing segment in the U.S. monostrand post-tensioning industry. According to PTI, slab-on-ground material shipments have increased on an average of 13% per year over the last decade. Slab-on-ground technique is also pre-eminently suited for the foundations of larger buildings such as apartment buildings, industrial and commercial buildings as well as for use on sports courts or for paving.

What started in Texas in the mid 70's has spread throughout the southern U.S., in key home building states such as California, Nevada, Arizona and Florida, as builders, contractors and engineers discover the inherent benefits of post-tensioning.





GSI and DSI support booming construction activities in Dallas-Fort Worth Metroplex in the USA

■ According to a report published by the George Mason University in Virginia, USA, the Dallas-Fort Worth Metroplex is one of the world's largest metropolitan areas.

Population has increased by more than 50% during the last few years. Currently, approximately 6.2 million people live in this area.

The reason for this growth is the fact that many companies, which were consciously supported by regional loan programs, settled in the area during the last decades. Consequently, approximately 72,000 new jobs were created in 2005 alone.

In addition to the steady growth of the area's economy, the Dallas-Fort Worth Metroplex offers a variety of cultural and recreational activities that add to the region's growing attractiveness.

The constant influx of new people also creates a growing demand for new residential buildings. In 2005 and 2006 alone, some 47,000 new single family homes were built each year and 92% of all available housing was occupied. In 2000, Dallas-Fort Worth had 1.9 million households. According to forecasts, households are likely to nearly double, reaching 3.4 million in 2030.

Consequently, demand for new detached houses continues to be high. Most detached houses in the region are built on concrete slabs without basements. The great demand requires fast, uncomplicated and reliable construction methods.

DSI's and GSI's monostrand Post-Tensioning systems, which are flexible and easy to install are perfectly suited for the fast and efficient post-tensioning of the foundation slabs that are used in those buildings.

In 2006, DSI and GSI delivered monostrand Post-Tensioning systems for installation in approximately 8,500 houses. As a result of the fact that demand is forecast to remain high, DSI has intensified its presence in the region by acquiring the local, well-established companies Grout Systems Inc (GSI) and The Strand Group (TSG).

INFO

DSI Unit Grout Systems Inc. (GSI), BU Monostrands, Ft. Worth, USA
DSI Scope Production and Supply of DSI-/GSI- Monostrand Post-Tensioning Systems



Flat Slab Post-Tensioning of High-Rise Building in Las Vegas using the DYWIDAG Monostrand System

Trump International Condo/Hotel Tower, Las Vegas, NV, USA



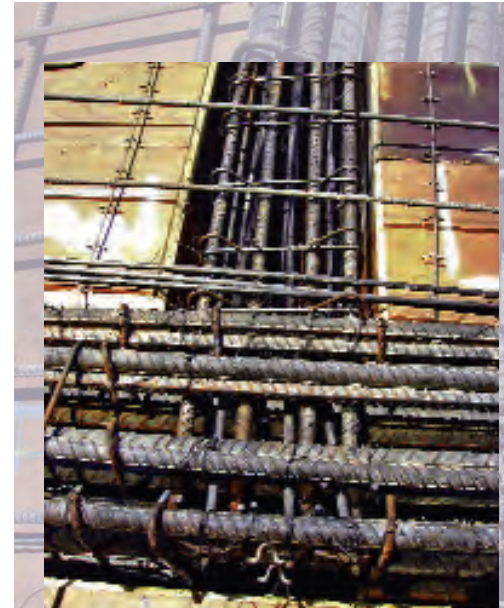
■ **For many years, Las Vegas has been an important market for the use of the DYWIDAG Monostrand Post-Tensioning System. The high-quality DYWIDAG Monostrand System is easily and quickly installed in flat slab construction of many hotels, residential complexes and parking structures.**

Particularly in Las Vegas, investors attach great importance to the fastest possible completion of structures. For example, the new 64-story hotel owned by Donald Trump / Ruffio LLC joint venture was built in only 18 months and incorporated 488 tons of DYWIDAG Monostrand tendons. The 196 m tall building has broken records in Las Vegas. Although the Stratosphere Tower is taller, the Trump Tower is the tallest hotel on the famous Las Vegas Strip. The building includes 1,000 hotel rooms and more than 50 condos and is styled in a fashion similar to its famous brothers in New York. The best known Trump Tower, built in 1983, is situated next to the world famous jeweler Tiffany's on New York's Fifth Avenue.

Also, the new Trump Tower in Las Vegas is very luxurious. The facade, for example, is of 24 carat gold glass. The height of the building reflects the trend that can now be observed in the early 21st century Las Vegas – away from theme hotels to gold glass, gold steel and height.

DSI is proud that the well proven DYWIDAG Monostrand Post-Tensioning System manufactured at DSI's plant in Long Beach south of Los Angeles is perfectly suited for the post-tensioning of flat slabs. DSI USA also supplied 188 tons of Monostrand tendons for the 5-story parking structure of the new Trump Tower. This portion

of the structure incorporated the use of beam and slab construction. The continuous review and further development of DSI Products ensures that DSI can keep pace with their customers' trends without any problems.



INFO

Owner Donald Trump/ Ruffio LLC +++ **Architect** Bergman Walls & Associates Ltd, Las Vegas, USA +++

Sub-Contractor Century Steel Inc., Las Vegas, USA

DSI Unit DSI USA, BU Monostrand, Long Beach, CA, USA

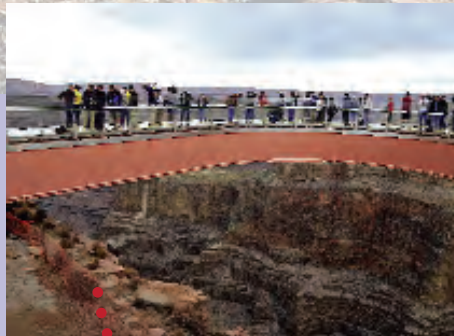
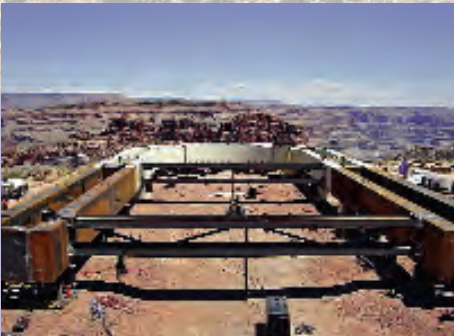
DSI Scope Supply of 676 tons of DYWIDAG Monostrand Post-Tensioning Systems incl. Accessories





DYWIDAG Threadbars secure terrific view over the Grand Canyon

Grand Canyon Skywalk, Grand Canyon West, AZ, USA



Photos reprinted by courtesy of D.J. Scheffler, Inc.,
Pomona, CA, USA and Grand Canyon West

■ **The Grand Canyon Skywalk is the newest tourist attraction in Grand Canyon West, about 200 km east of Las Vegas. This attraction was made possible by entrepreneur David Jin from Las Vegas in cooperation with the Hualapai tribe who owns the land there. The joined forces of the consultants, engineers and contractors involved cooperated to insure the trouble free execution of this spectacular project.**

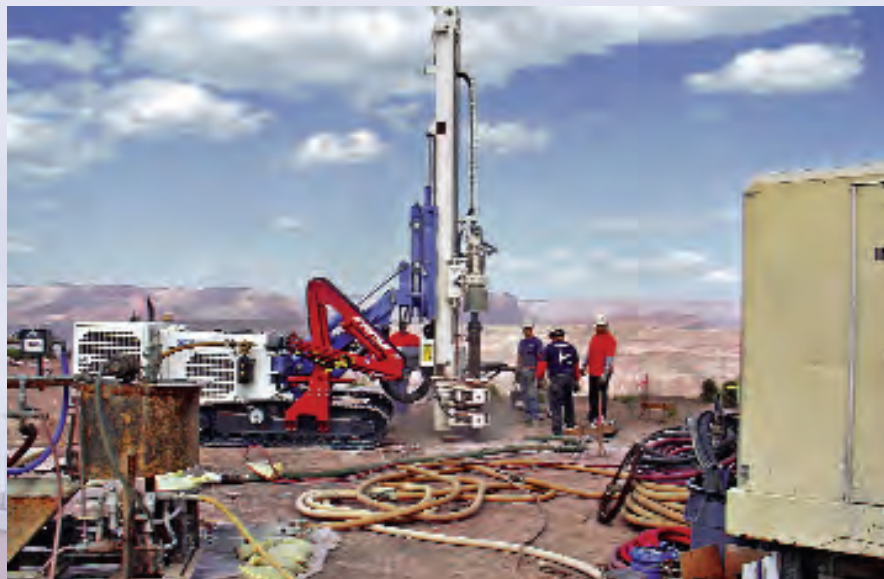
The new Skywalk, a glass-bottom horseshoe-shaped bridge, cantilevers over the edge of the Grand Canyon, 1,200 m above the Colorado River, and protrudes 20 m from the rim at its extremity.

The horseshoe-shaped glass-steel construction is designed for a maximum load of 35,000 t. It withstands wind forces of up to 160 km/h and earthquakes of magnitude 8 within a distance of 75 km.

A special proposal by the D.J.Scheffler construction company resulted in the use of micropiles to anchor the foundations instead of simply drilled foundation piers. The engineers involved welcomed this suggestion since the use of micropiles was also the most economical solution. The high-strength cement grout required for the installation of the micropiles could be directly mixed on site and subjected to local quality control. If concrete piles had been used, significantly larger quantities of ready-mixed concrete would have been necessary. In addition, due to the long transportation route, this concrete would have been about to set at the time of its arrival on the construction site.

Since the bridge was founded in massive original sandstone, micropiles utilizing high strength 65 mm diameter threaded steel bars could be used. For this purpose, DSI supplied 1,370 m grade 150 DYWIDAG Threadbars with an ultimate capacity of 3,470 kN that were pre-assembled to a total of 108 micropiles on site and installed. The giant steel girder for the Skywalk skeleton was welded together on the rim of the canyon and subsequently anchored freely floating above the Grand Canyon in a jack-and-roll action. The steel girder was lifted by means of the DYWIDAG Lifting System with a capacity of 500 t.

The excellent cooperation of all parties involved in this technically very challenging project now allows all visitors who dare to walk onto the glass platform unforgettable views into the Grand Canyon.



INFO

Owner Grand Canyon Resort Corporation, Las Vegas, NV, USA +++ **General Contractor** APCO Construction Company, Las Vegas, NV, USA +++ **Sub-Contractor** D.J.Scheffler, Inc., Pomona, CA, USA +++ **Technical Consultant** Arroyo Engineering, Las Vegas, NV, USA +++ **Architect** M.R.J. & Associates, Las Vegas, NV, USA +++ **Engineer** Lochsa Engineering, Las Vegas, NV, USA

DSI Unit DSI USA, BU Geotechnics, Long Beach, CA, USA

DSI Scope Supply of 1,370 m Ø 65 mm, grade 150 DYWIDAG Threadbars incl. accessories; rental of a 500 t capacity hydraulic lifting system



DYWIDAG Multistrand Anchors stabilize excavation in Philadelphia

New research center (“South Campus Research Facility”) at the Children’s Hospital in Philadelphia, PA, USA

■ Today, the Children’s Hospital of Philadelphia, which was founded in 1855 as the first pediatric hospital in the USA, ranks among the leading facilities for the specific treatment of children worldwide. To continue to live up to its leading position in treatment, research and teaching, one of the largest and most challenging construction projects of the US public health system was begun in 2000.

First of all, construction of an eight-story building was begun. Amongst others, this building accommodates an ultra-modern translational research facility for translating basic science research into real-life treatments and cures.

Poor ground conditions required extensive stabilization of the excavation. The wall formwork was temporarily tied back using 250 DYWIDAG Multistrand Anchors consisting of 2 or 4 strands. Some locations required post-grouting of the multistrand anchors.

DSI USA supplied a total of 24 permanent DYWIDAG Multistrand Anchors with 11 strands each as well as DYWIDAG Post-Tensioning Bars for the permanent vertical anchorage of the foundation. Installation was performed using a 500 ton center hole ram for stressing.

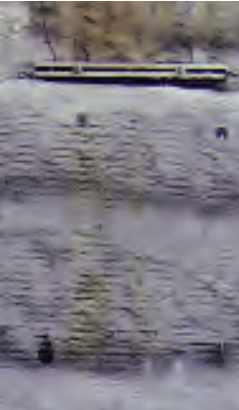
The design of the foundations allows for the possibility of a future expansion of the building to 22 stories in order to accommodate future growth of research activities.



Working on the foundation slab



Excavation including retaining walls



Overview of the excavation

INFO

Owner Children's Hospital of Philadelphia, PA, USA +++ **General Contractor** Turner Construction Company, USA +++
Architect Ballinger, Philadelphia, PA, USA +++ **Engineer** Pennoni Associates Inc., Philadelphia, PA, USA +++
Sub-Contractor A.P. Construction (Scott Creelman), Inc., USA

DSI Unit DSI USA, BU Geotechnics, Toughkenamon, PA, USA

DSI Scope Supply of 250 temporary DYWIDAG Multistrand Anchors with 2 or 4 strands, 24 permanent DYWIDAG Multistrand Anchors with 11 strands, DYWIDAG Post-Tensioning Bars; rental of a 500 ton center hole ram



Construction of arch bridges in Peru

Sicuani and Cirialo Bridges in Cusco, Alcides Carrión bridge in Huancayo, Calicanto bridge in Huánuco, Peru

■ In the past five years, the road network in Peru has been significantly extended. Major roads through the Andes Mountains have been completed at a supra-regional level which connect the districts of Cusco, Apurímac, Ayacucho, Junín and Huánuco.

The development of the road network at a local level poses particular challenges. For example, the traffic flow has to be coordinated with major urban arterial roads or partly be rerouted around the cities. And quite often, geographic hurdles must be overcome.

Therefore, similar situations arose for several new roads. Medium-sized, significant rivers were to be crossed. These rivers had fundamentally similar cross sections, were between 50 and 60 meters wide and were located in very exposed locations. The structural solution required that these two and four lane bridges be architecturally appealing without raising the



Cirialo bridge in Cusco, Peru



Preparation of DYWIDAG Bar Tendons at the Alcides Carrión bridge in Huánuco, Peru



Sicuani bridge in Cusco, Peru



Calicanto bridge in Huánuco, Peru



Alcides Carrión bridge in Huánuco, Peru

level of the roadway. Based on these parameters, four new steel arch bridges were built in various Peruvian cities in 2003-2005. These bridges are characterized both by their impressively compatible designs and their simple and economic method of construction. The construction period for these bridges ranged from 8 to 10 months each.

In 2002, DSI developed an economic solution for anchoring hangers to the bridge deck for the

Bolognesi bridge in Piura, Peru, that was built using similar techniques. This solution was used again. In this method, four DYWIDAG Bar Tendons, which are grouted in individual sheaths, are installed. Each group of four bars includes spacers for preventing wind/rain induced vibrations and individual sets of O-rings at both ends for dampers. The longer hanger bars require a fatigue resistant coupler with the bar ends inside cut at a 45-degree angle and fixed in place with two-component glue.

This efficient bridge construction method is becoming ever more established in Peru. With technical support from DSI Munich, DSI's licensee in Peru, SAMAYCA INGENIEROS S.A.C., develops, installs, stresses and grouts hanger bars coincident with the construction of the bridge deck.

INFO

Owner Sicuani County Department, Lima Ministry for Transportation and Communication, Huancayo Municipal Administration, Huánuco District Authority, all Peru +++ **Engineers** Ph.D. Ing. Víctor Sanchez Moya, Ing. Pedro Lainez Lozada, Ing. José Yeckle, Ing. Moisés Torres, all Lima, Peru

DSI Units DSI Group Headquarter Operations, Munich, Germany, in cooperation with SAMAYCA INGENIEROS S.A.C., Lima, Peru
DSI Scope Technical development and detailing as well as installation of hangers and anchorages; supply of DYWIDAG Bar Tendons \varnothing 36, grade St 835/1035, sheathings, dampers, spacers, couplers, anchors and accessories; rental of equipment

New division “Concrete Accessories”

■ Recently, DSI combined its traditional DYWIDAG formtie business with several newly acquired companies, creating the new business unit “Concrete Accessories”. This unit continues the DSI tradition of providing its customers with quality products and reliable service.

Concrete Accessories offers a broad range of products for the construction industry. The entire product range including the original DYWIDAG formtie system has been produced in DSI’s plant in Haan for many years. From the central warehouse in Haan, a highly motivated team successfully distributes formtie products around the world.

DSI’s product range was considerably widened by the acquisition of strategically important companies in 2006 and 2007. While continuing to act under their well-known names, these companies now closely coordinate their business with DSI’s Concrete Accessories headquarters in Unterschleißheim near Munich.

Mandelli-Setra, a leading manufacturer and major supplier of accessories for the concrete construction industry in France, produces injection molded plastic spacers, dowels, joints and other accessories. Each day, a team of more than 80 employees and sales engineers respond to the specific desires and needs of their customers.

Another French company, **Technique Béton**, which became part of the DSI-group in 2006, is DSI’s specialist for concrete admixtures, mould release agents, special mortars and waterproofing products. High technology concrete is created in modern laboratories with scientific methods, corresponding exactly to the requirements of each structure. Another special are Laroche® products, which are used for concrete spacers.

DSI has also integrated the French company **Artéon** in Gonesse, acquired in 2005, into its Concrete Accessories business unit. For more than 25 years, Artéon has produced a variety of products including high quality Lifting Tools for the precast concrete industry. Artéon’s Lifting

Tools are renowned for ensuring that precast elements and fixing systems can be lifted quickly and safely.

In January 2007, DSI acquired contec in Porta Westfalica, Germany. With more than 25 years’ experience, contec is a leading specialist for innovative sealing solutions and recostal®-formwork in Germany.

TUBUS, the Portuguese market leader for concrete accessories and equipment for the construction industry, joined the new business unit in May 2007. TUBUS is well known for its technical know-how and excellent service. The company’s product range includes formwork, form ties, and scaffolding.

By creating Concrete Accessories, DSI has successfully established another business division. DSI is now able to provide its clients around the world with a full range of Concrete Accessories made to order. The new platform for the exchange of know-how between individual specialists in construction and concrete accessories has created important synergies both domestically and internationally. This forms the basis for stronger R&D activities which will enable DSI to offer new innovative products to its customers.



Fa. Mandelli-Setra, production using injection molding technique, Troyes, France



contec, exterior view, Porta Westfalica, Germany



Technique Béton, laboratory,
Moissy Cramayel, France



contec, production facility, Porta Westfalica, Germany



Technique Béton,
office and production,
Moissy Cramayel, France



Technique Béton, France



DSI consolidates business activities in the expanding tunneling market

■ Consolidation of the existing DSI tunneling activities with the newly acquired companies ALWAG Tunnelausbau Ges.M.B.H. (ALWAG), Austria, and American Commercial Incorporated (ACI), USA

DSI's key focus is on developing, manufacturing and supplying qualitatively high-grade products and systems for the tunneling market. DSI successfully concluded two strategically important acquisitions in September and October 2006 to further strengthen this trade segment.

As a result of the integration of the market leading companies ALWAG and ACI, since December 2006 DSI has combined its global tunneling activities including its Tunneling activities in Australia that serves the Asia Pacific Region, into a new specialist tunneling division with its headquarters located at the offices of ALWAG in Austria. From there, all global tunneling activities of the DSI Group are now being controlled – sustainably enhanced by the two acquisitions.

All R&D activities of DSI Tunneling (DSI, ALWAG and ACI) will now be coordinated by the new

Ground Control Solutions

tunneling division. This will result in more effective service for customers who will undoubtedly benefit from the transfer of technology between DSI companies that have developed an expertise in all aspects of strata control technology.

As a result of the consolidation of its tunneling activities into a new business division, DSI is in a position to provide a full range of strata control products backed with technical support and innovation to global markets.



**AMERICAN
COMMERCIAL
INCORPORATED**





ALWAG

DYWIDAG-SYSTEMS
INTERNATIONAL





Koralmbahn Railway Tunnel, Exploratory Tunnel Paierdorf, Austria



■ **The future railway connection between Graz and Klagenfurt is an important part of the international traffic route “ADRIATIC-BALTIC-AXIS” from Venice in Italy to Gdansk, Poland. The core piece of this railway section is the 32.8 km long Koralm Tunnel, which will go into operation as a double-tube tunnel in 2016. The costs for this project are in the range of 1.8 billion Euros.**

Beginning in 1998, extensive exploratory work has been conducted to obtain information about the geological conditions in the area of the future Koralm Tunnel. A total of 11 km’s of exploratory tunnels will be constructed before work on the final tunnel will start. For the best possible survey, the exploratory program was divided into four separate lots - one in the eastern area and three in the western area.

As part of the exploratory program for the Koralm Tunnel, the Paierdorf lot in Carinthia is being constructed in two stages: first an exploratory shaft with a depth of 125 m, followed by an exploratory tunnel to the east and to the west. Thus, the shaft was constructed to gain access to the future tunnel level. Since July 2005, construction of the 5.1 km long exploratory tunnel has been ongoing. The construction of this largest exploratory section is on schedule and should be completed in 2009. The construction of the tunnel is being affected by difficult and changing ground conditions. In addition, the predicted groundwater inflow has caused problems during excavation.

ALWAG supports the construction of the Paierdorf exploratory tunnel with advanced reinforcement and support products, such as the AT-Casing System and the recently developed AT-Power Set self-drilling Vacuum Tube Spiles. These Vacuum Tube Spiles are used both for reinforcement ahead of the tunnel face and handling of the groundwater through coupled vacuum pumps.

The patented AT-Casing System is being used at the Paierdorf site in terms of the pipe roof system AT-114/T, in combination with the AT-automation unit for pipe roof drilling. The advan-

tages of this system are the fast, safe and efficient drilling of pipe roof umbrellas for the reinforcement ahead of the tunnel face. An experienced technical support team from Alwag is on hand to provide advice to the crews performing the Pipe roof drill installation.



INFO

Owner ÖBB Infrastruktur Bau AG, Austria +++ **General Contractor** ARGE EKT Paierdorf: Swietelsky Tunnelbau GmbH & Co. KG, Austria and Max Bögl Austria GmbH, Austria +++ **Planning Agency** Geoconsult ZT GmbH, Salzburg, Austria +++ **Supervisor** ARGE IGT-3G: IGT Geotechnik & Tunnelbau GmbH, Salzburg, Austria; 3 G - Gruppe Geotechnik Graz ZT GmbH, Graz, Vienna, Austria; Bernard Ingenieure, Hall, Austria +++ **Engineering** Metz & Partner, Baumanagement Ziviltechniker GmbH, Vienna, Austria

DSI Unit ALWAG Tunnelausbau Gesellschaft m.b.H., Pasching/Linz, Austria
ALWAG Scope Supply of IBO R32 Hollow Bar Bolts, Lattice Girders, Lagging Sheets, AT-Power Set self-drilling Vacuum Tube Spiles, AT-89/T and AT-114/T-Casing System, AT-118/DR Drainage System; rental of Rock Drilling Equipment and Injection Flow-Pressure Meter; technical assistance



Reinforcement and Support Systems for Construction of Lainzer Tunnel in Vienna

Lainzer Tunnel, Lot LT 31 Masing, Vienna, Austria

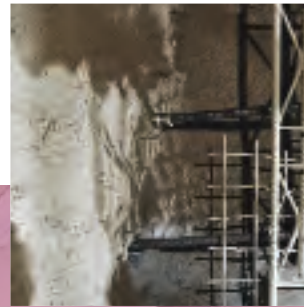
■ **The Lainzer Tunnel is one of the most important projects now under construction as part of the development of the Austrian high-speed Railway System. This section in the west of Vienna will create the connection of the Western to the Southern Austrian Railway Section as well as to the “Donauländebahn”. In addition, the Western Railway Section will be linked to the central switchyard at Wien Kledering. When this project is completed, the single-track connection between the Southern and Western Austrian Railway shall be relieved.**

The projected railway section has a total length of 12.8 km, a 6.5 km portion of which is being constructed as a railway tunnel. Starting from three access shafts, the construction works on the double-track tunnel with twelve safety exits are being accomplished. The lot LT 31 Masing extends from the western area of the Lainzer Straße access shaft to the eastern connection points of the project area. Construction works on the lot LT 31 Masing started in the summer of 2005 with the erection of the site infrastructure, the sinking of the Lainzer Straße shaft started in January 2006. Since October 2006, the construction of the tunnel in eastern direction is in progress. The completion of the Lainzer Tunnel is planned for the end of 2011.

The construction of the Lainzer Tunnel is greatly influenced by difficult ground conditions, as part of the tunnel is excavated in unconsolidated rock formations. To overcome the difficulties of groundwater handling during tunnel construction, the groundwater level is being lowered by intensive pumping through wells, controlled by a sophisticated monitoring system.

ALWAG is the exclusive supplier of reinforcement and support systems for the LT 31 Masing construction site. Special products such as the AT-Drainage System are being used as accompanying arrangements for groundwater handling in critical areas. The accomplishment of the drainage drilling operations is supported by

experienced technicians from the ALWAG supervision team. Lagging sheets and spiles are used for reinforcement ahead of the tunnel face. In particular, the AT-Power Set self-drilling Tube Spiles recently developed by ALWAG are utilized as special reinforcement systems for fast and safe reinforcement ahead of the face.





Drilling works in the sidewall drift (AT-118/DR)



INFO

Owner ÖBB Infrastruktur Bau AG, Austria +++ **General Contractor** ARGE EKT LT-31 - Alpine Mayreder Bau GmbH, Salzburg, Austria and HOCHTIEF Construction AG, Essen, Germany +++ **Planning Agency** PGLT (Planungsgemeinschaft Lainzer Tunnel), Austria +++ **Engineering** IGT Geotechnik & Tunnelbau GmbH, Salzburg, Austria

DSI Unit ALWAG Tunnelausbau Gesellschaft m.b.H., Pasching/Linz, Austria

ALWAG Scope among others: Supply of IBO R32 and R38 Hollow Bar Bolts, Lattice Girders, Lagging Sheets, Rebar Spiles, AT-Power Set self-drilling Tube Spiles, AT-76/DR and AT-118/DR Drainage System; rental of Rock Drilling Equipment and AT-Grout Injection Pumps; technical assistance



Extension of the underground line from Ládví to Letnany in Prague

Extension of the Prague metro line C, Prague, Czech Republic



■ **Prague, a city of 1.2 million inhabitants, has a relatively young metro system that moves more than 1 million passengers per day. The system corresponds to the model common in Eastern Europe: three main lines crossing at three central stations, thereby forming a triangle in the city center. The Prague underground network consists of 51 stations connected by more than 50 km of track that mostly runs underground. The depth of the stations and the route of lines vary significantly. The deepest station, Náměstí Míru, is about 52 m below the surface.**

The first 18.1 km long section of the Prague metro, line C, was opened in 1974. Subsequently, line C was extended to Háje in the south in

1980. Another extension across the river Vltava to Holesovice was completed in 1984. Line C is the underground line closest to the surface and connects the north with Prague's south-east via 15 stations.

On May 24, 2004, the foundation was laid in Prosek for another extension of line C: construction stage IV.C2. This extension of the metro has been designed to provide a fast connection of the northern suburban town of Prosek with its 90,000 inhabitants and the Letnany industrial zone with the old town in Prague. The line runs relatively close to the surface, so that the metro stations can be built using the open-cut and cover method. The New Austrian Tunneling Method (NATM) is being used to drive the 5.5 km long tunnel between the individual stations. One particularly noteworthy aspect of this project is

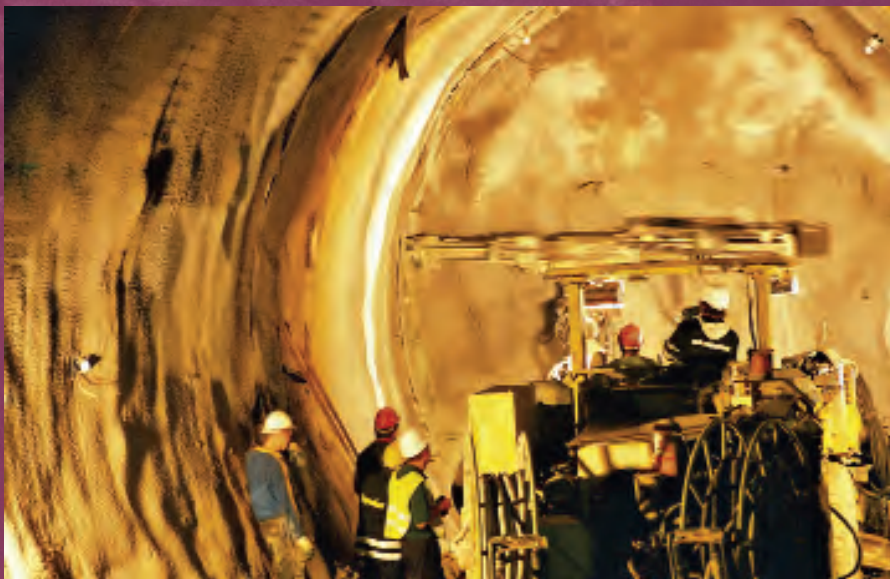
that construction is taking place in an area of former mining activities.

The plans for the construction of the new Prosek metro station had already been changed several times at the preliminary stage.

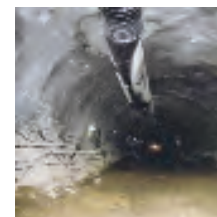
Due to the complex geological conditions, the new tunnel that connects the Prosek and Letnany stations places high demands on the quality of the planning, the construction work and the systems and products used. As regards the construction of the Prosek station, the bottom of the excavated site is located below the water table, and infiltrating ground water must be elaborately drained by artesian wells during construction. The risk of possible settlements in the residential area of Prosek in connection with additional tunneling work to be carried out must be reduced to a minimum. The successful realization of the building project will be a master piece of Czech tunneling engineers.

SM7 A.S. is proud to contribute to the successful completion of this challenging project through its own technical know-how and the use of high-quality DSI products. SM7 A.S. also supplied high-quality DYWIDAG geotechnical products such as glass fiber anchors and DYWIDAG Bar Anchors for additional single structures as well as technical equipment.

For additional stabilization of the elaborate tunnel construction projects, a total of 6,000 m DYWI® Drill Hollow Bar Anchors were delivered to the construction site just in time by SM7 A.S.. After completion of the IV.C2 section, relocation of the provisional bus station and the park & rail site from Ládvi to Letnany is planned. The opening of the three additional stations (Strizkov, Prosek and Letnany) is scheduled for 2008.



Installation of temporary DYWIDAG Multistrand Anchors



INFO

Owner Prague Public Transit Company Inc. (Dopravní podnik hl. M. Prahy a.s., Praha), Czech Republic +++

Contractor Consortium Metro IV.C2 consisting of Metrostav a.s., Czech Republic, Skanska CZ a.s., Prague, Czech Republic, and Doprastav, Czech Republic +++ **Design Office** Metroprojekt Praha a.s., Prague, Czech Republic

DSI Units SM7 A.S., Prague, Czech Republic / DSI Austria, Elsbethen / Salzburg, Austria

DSI Scope Supply of 6,000 m DYWI® Drill Hollow Bolt Anchors; technical support







New service tunnel extended using steel liner plates and innovative grout pumps supplied by ACI

Expansion of the International Airport in Indianapolis, IN, USA

■ **The rapidly increasing number of passengers using Indianapolis's International airport because of its convenient central location has made an expansion of its capacity necessary. In addition to a new tower, the "New Indianapolis Airport" also features an additional passenger terminal including parking spaces and a new roadway to Interstate 70. The expansion project is scheduled for completion in 2008.**

Connection of the new passenger terminal to the existing supply lines posed quite a technical challenge, since a distance of about 1.8 km had to be covered, and one airstrip and several runways had to be crossed. As a result, a decision was made to build a 615 m long tunnel underneath the runways for the supply lines (water, power, communication). Since the airport had to continue to operate during the tunnelling work, while the tunnel was being built, it was vitally important that no settlements occur on the runways during construction work.

Due to the local geological conditions and the location of the tunnel below ground-water level, an earth pressure balance machine ("EPB TBM") was used to drive the tunnel. On the basis of a special proposal made by the engineers involved, the tunnel was lined with sealed, heavy steel liner plates manufactured by American Commercial Incorporated (ACI) instead of the customary concrete segments. For that purpose, the steel liner plates were additionally reinforced with steel braces prior to their installation.

Originally, the service tunnel was planned with a larger diameter to accommodate pedestrians. Due to a special proposal, however, the size of the tunnel was reduced and permanent ventilation and lighting were eliminated. Subsequently, the supply lines were fixed inside of the tunnel structure using aerated concrete. That special solution reduced the originally project costs by about one third.

The relatively small tunnel diameter of 2.60 m, however, rendered the injection of grout mortar to fill the spaces between the steel liner plates and the driven bottom wall very difficult.

However, ACI as the US distributor of Häny grouting systems knew an effective solution to that problem. Due to the small diameter of the tunnel, it was impossible to place the grout mixing and pumping equipment inside of the tunnel. Therefore, the grout had to be produced above ground and pumped over a distance of more than 600 m without exceeding the specified maximum pressure of 2.5 bar at the point of in-

jection. To this end, retarding agents were added to the grout in the mixing machine. A progressive cavity pump with variable speed drive was linked directly into the hydraulic system of the grout pump to always keep the same grout/accelerator ratio at the point of injection, independent of the output of the grout pump.

At the point of injection, a sophisticated control and recording system keeps track of the pressures, flow rates and quantities and controls the pumping equipment on the surface. Thus, an optimum mixing ratio of the two part grout was ensured and the grout was equally spread around the steel liner plates. The recorded data can be transferred to a computer via memory card for subsequent evaluation.

So far, the new service tunnel at the Indianapolis airport is the longest tunnel driven with an EPB machine using steel liner plates. ACI is proud to have contributed to the successful construction of this technically challenging tunnel with its expertise.



INFO

Owner Indianapolis International Airport, Indianapolis, IN, USA +++ **General Contractor** Bowen Engineering Corp., Fishers, IN, USA
+++ **Engineer** Parsons Brinckerhoff, USA +++ **Sub-Contractor** Midwest Mole, Indianapolis, IN, USA

DSI Unit American Commercial Inc. (ACI), Bristol, VA, USA

DSI Scope Supply of sealed, heavy steel line plates, supply of a grout pump plant; rental of equipment; technical assistance



Mining for oil

Greybull Petroleum, Greybull, WY, USA

■ **The method of collecting oil with the help of gravity is not new. It involves driving a long sloping tunnel or “slope” into the ground on a grade of approx. 12% underneath an oil field which is relatively close to the surface. From that slope, numerous holes are drilled upward into the oil field and fitted with proper piping. Gravity then “draws” the oil through these boreholes down into the slope where it is collected and subsequently pumped to the surface.**

Rock Well Petroleum, Inc. is one of the pioneers in the use of this efficient, environment-friendly and cost effective oil production method. The first oil field to be mined with this technique is an old, abandoned oil deposit near Greybull in Wyoming. Conventional oil production using pumps was discontinued years ago because it was inefficient and too expensive. Rock Well Petroleum, Inc. now expects oil production (several hundred barrels of oil per day) via the gravity method to continue for 15 years or more needing only weekly surveillance and adjustments.

In addition, the gravity method is very environmentally friendly, since production has little negative impact on the surface. When the Greybull oil field is completely worked out, the slope will have a length of approximately 1.2 km and a max. depth of about 120 m.



American Commercial Inc. (ACI) developed a solution for the portal of the oil “mine” in Greybull in compliance with Rock Well Petroleum’s requirements. This solution consists of 4-piece grade 50 steel horseshoe ribs with an outside radius of about 5 m. The steel ribs were manufactured and cold-formed at ACI’s Louisville, Kentucky plant. The rib design allows sufficient width for all wheeled equipment and provides ample clearance in the crown or upper section for permanent ventilation tubing. Subsequently, the steel ribs were covered with a heavy (10 ga.) steel planking attached with a simple clip connection to the flange of the rib. The planking consists of two individual side pieces and is jointed at the ribs’ crown. A 20 cm wide closure band at each butt connection of the planking renders the portal water tight. Thus completed, the portal could be covered with loose uniform material salvaged from the excavation.

ACI’s comprehensive technical assistance also included engineering planning services. Investigations had shown that the depth of cover over the slope entrance varies. Therefore, ACI recommended to set a total of 46 steel ribs with spacing that varies from 0.75 to 1.2 m. In addition, ACI added value to this project with innovative ideas regarding the incorporation of materials already on site. e.g. by designing the canopy of the portal itself to set on a wall beam supported by 1.5 m posts.

Rock Well Petroleum, Inc. was highly satisfied with ACI’s technical assistance and dedicated customer service in relation to this project. Therefore, ACI is very confident to assist Rock Well Petroleum, Inc. in the realization of their plans to mine further onshore oil fields on US territory.



INFO

Owner Rock Well Petroleum Inc., Greybull, WY, USA

DSI Unit American Commercial Inc. (ACI), Bristol, VA, USA

DSI Scope Development, manufacture and supply of 46 four-piece steel ribs grade St 50 and supply of steel planking



Growth markets in Mining

■ During the last few years, DSI's mining division has shown very dynamic growth. Its dramatic growth has been based on strong organic growth on the one hand and on growth through strategic acquisitions on the other.

This development has enabled DSI to become a global leader in the development, production and supply of high quality mining products. Furthermore, DSI offers its clients the most comprehensive product range of its kind in the world.

In terms of organisation, the Mining division is part of DSI's Underground division. The Underground division is divided into Mining America, Mining Asia/Pacific and into the newly formed Tunneling division. This structure allows DSI to be represented in all of the world's most important mining markets.

February 2006 – Canada

Acquisition of Ground Control, Canada

The acquisition of Ground Control (Sudbury) Ltd., Ontario, Canada, was another step on the way to DSI's position as market leader for innovative and efficient Mining products and systems.

Ground Control's product range has proved to be a perfect complement for DSI's mining business. One of Ground Control's special features is its resin cartridges, which have been produced and distributed in Canada for many years under the brand name "Ground-Lok".

Ground Control is also very similar to DSI in terms of company philosophy – particularly with regards to its technical customer service. With the help of the highly motivated Ground Control team, the development of new, innovative products for the Canadian Mining market has been significantly intensified.

March 2006 – Mexico

Acquisition of Mexicana de Anclas Mineras in Mexico

On March 3rd, 2006, DSI acquired the company Mexicana de Anclas Mineras in order to further extend their market presence on the Central- and South American mining markets.

Anclas Mineras is the Mexican market leader in the production of mining products for the Underground sector. Additionally, with a strong market position, Anclas Mineras is active in South American markets such as Chile.

The company's strategically favorable location in Guadalajara, offers excellent opportunities for increasing the production and supply of high quality DSI-products for the rapidly expanding hard rock and coal mines in Latin America. Production capacities have already been adapted to the growing export business. Since its acquisition, the company has been operating as DSI-Anclas Mineras.

December 2006- USA

Acquisition of Fasloc, Inc., USA

Premier producer Fasloc has been manufacturing high quality polyester resin cartridges under the brand names Fasloc® and Cableloc® since the 1970's. For decades, Fasloc cartridges have been used successfully for permanently securing a wide variety of anchors in mines located in the eastern US and in Canada.

The Umbrella of Mine Safety



According to Bob Bishop, Chief Operating Officer of DSI's Mining division, "The mining industry is much safer today as a result of the use of roof bolts anchored with resin cartridges pioneered by Fasloc. Fasloc's power of innovation has taken the mining industry another step forward in terms of efficiency and safety."

"We are delighted to become part of the DSI group and look forward to leveraging DSI's

global position and strata control know how to better serve our customers and secure the growth opportunities that exist for the supply of our high quality Fasloc® and Cableloc® resin cartridges through DSI's global network," said Mike Sullivan, President and Chief Operating Officer of Fasloc, Inc.

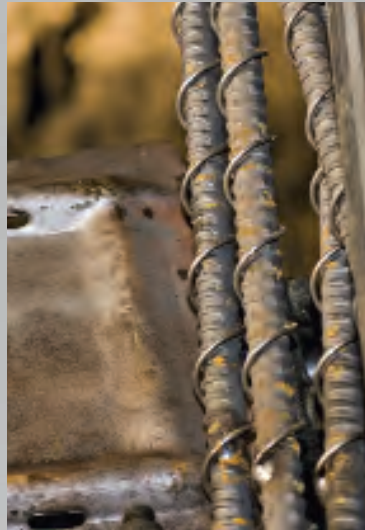
January 2007 – Chile

Acquisition of Soprofin SA in Chile

As a further strategic step towards strengthening their presence in Latin America, DSI acquired the company Soprofin SA in Santiago, Chile, in January 2007. Soprofin is Chile's market leader for the production and supply of products and systems for mining and tunneling. The production of high quality mining and tunneling products is carried out by 120 employees in two production facilities in Quilicura and Santiago de Chile. The company is continuing its successful business as DSI-Soprofin.



DSI Australia assists with the expansion of PT Freeport Indonesia



The photo above shows Derek Hird (Chief Executive Officer) and Dave Martin (Regional Sales Manager) inside the Common Infrastructure Project Tunnel

■ For decades, the Freeport-McMoRan Copper and Gold and PT Freeport Indonesia team has worked to explore, develop and mine one of the world's truly great copper and gold ore zones – the Ertsberg-Grasberg minerals district in the province of Papua.

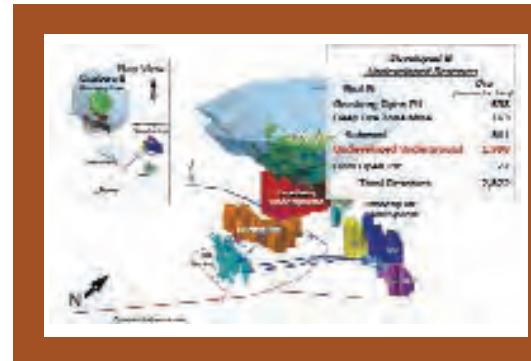
PT Freeport Indonesia currently operates the Grasberg open pit and the Deep Ore Zone (DOZ) underground block cave mine. Production at the Grasberg open pit mine in 2006 averaged 184,200 metric tons of ore per day and production from the DOZ underground mine averaged 45,200 metric tons per day. However, PT Freeport Indonesia are currently expanding the DOZ underground mine to a targeted 80,000 metric tons per day.

In 2006, copper ore grades averaged 0.85% and copper recovery averaged 86.1%. At the same time, gold ore grades averaged 0.85 grams/metric ton and gold recovery rates averaged 80.9%.

Even though the Grasberg open pit has a long reserve life, what makes PT Freeport Indonesia so exciting is what lies beneath the world class open pit reserves: The underground deposits – PT Freeport's "underlying assets".

Access to the wealth of proven undeveloped underground deposits is the key driving force to future production. The Common Infrastructure Project involves the development of tunnels that will provide access to the future underground mines, including Grasberg Underground, Kucing Liar, Mill Level Zone, Deep Mill Level Zone and Big Gossan, for the next 34 years.

DSI Australia has worked closely with PT Freeport on these expansion plans and provided the technical assistance for the ground support selection procedures for the new underground developments. DSI Australia's existing contract with PT Freeport Indonesia has provided the framework for DSI Australia to supply ground support products for the Common Infrastructure Project. These products include thread bar bolts, friction bolts and steel wire mesh.



INFO

Owner PT Freeport Indonesia, Indonesia

DSI Unit DSI Pty. Ltd., Bennetts Green, Australia

DSI Scope technical assistance; future supply contract for threadbar bolts, friction bolts and steel wire mesh



DSI Australia – The innovators in strata reinforcement

■ Innovation is driving the growth of strata reinforcement solutions provider DYWIDAG- Systems International Pty Ltd (DSI).

According to DSI's CEO for mining in Australia, Derek Hird, "innovation is the key for organisations to remain competitive now and in the future. Innovation is about working smarter to meet the diverse needs of our customers."

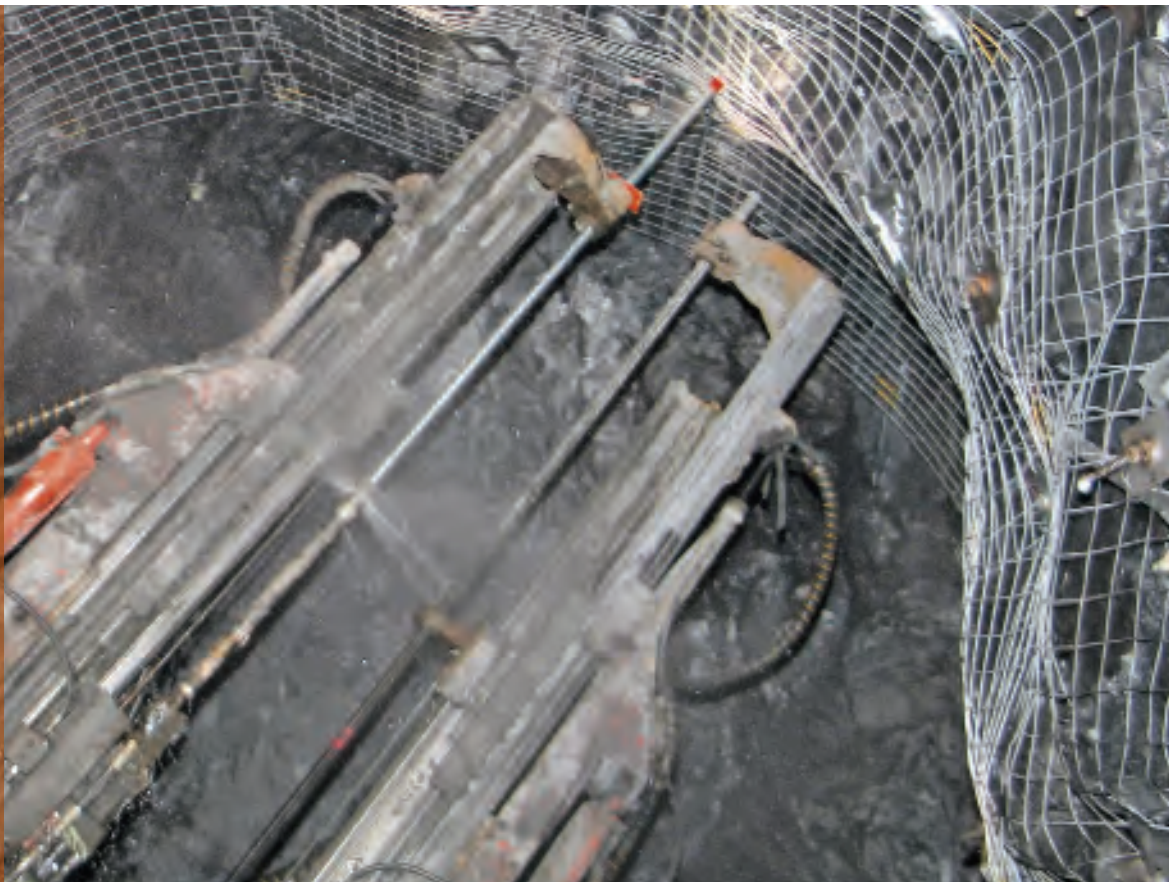
Innovative practices in production have been an important success factor for the organisation and have enabled DSI to respond proactively to new trends and market conditions in order to adapt to clients' needs.

DSI Australia has pioneered the development of a range of new products to further enhance its comprehensive product range. These new products include a single pass resin bolt for the hard rock sector. "Single pass" means that this newly developed bolt is completely installed in only one step. Other examples for DSI Australia's new product range are a high capacity post grouted strand bolt, a post grouted rib bolt, a domed butterfly plate, a resin anchored no tail rib bolt, and an improved load transfer roofbolt.

Innovation involves diversifying into more varied applications.

DSI is expanding into new markets with the launch of steel and sythetic shotcrete fibres to occur in may 2007. This expansion will further enhance the company's ability to supply and service the needs of the underground mining industry.

Innovation at DSI is not limited to the introduction of new products. DSI is introducing what is referred to as lean manufacturing or Enterprise Resource Planning (ERP). DSI has realised early on that the traditional 'batch and 'queue' manufacturing process used for the past 50 years has become outdated and inefficient. With the leaner, more diversified manufacturing measures DSI can fully utilise its resources to deliver superior levels of customer satisfaction to clients.





Corroded Mining Elements replaced with Double Corrosion Protected DSI Rock Bolts

Cannington Mine in Queensland, Australia

■ The Cannington Mine, which is 100% owned by BHP Billiton, is located in northwest Queensland, about 250 km southeast of Mount Isa, Australia, and is the largest and lowest cost producer of silver and lead in the world. For the 2005 financial year, the Cannington mine achieved a production record with 3.4 million tons of ore mined and 3.1 million tons of ore processed.



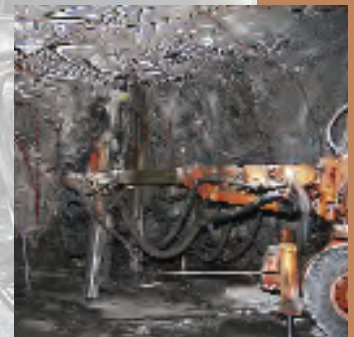
The Cannington mine site operations consists of an underground mine accompanied by a metallurgical processing facility. Both open stope and bench mining methods are used at Cannington. While grinding, sequential flotation and leaching techniques are used to produce high grade marketable lead and zinc concentrates that contain high silver content. In addition, the operation includes a rail loading facility at Yurbi and a modern minerals concentrate handling facility at the Port of Townsville.

In 2006, Cannington mine operators began two simultaneous rehabilitation projects, the decline rehabilitation project and the southern zone rehabilitation project. Both rehabilitation pro-

jects were required due to the corrosion of the installed support elements, which was resulting in an increasing frequency of rock falls that posed a major hazard inside the mine.

The rehabilitation project involved installing new ground support elements in approximately 20 kilometers of underground roadways with a target timeframe for completion of 6 months. The operators of the Cannington mine elected to utilize high-quality DSI Mining Products that can be installed easily and quickly. DSI Australia supplied a large number of double corrosion protected (DCP) rock bolts as well as other high-grade mining products to stabilize the Cannington mine. The DCP bolt developed and supplied

by DSI Australia is essentially a post-grouted expansion shell bolt with a polyethylene sleeve providing corrosion protection. Another significant feature of the DCP bolt is an injection adapter specifically developed by DSI Australia which renders post-grouting significantly faster and therefore more cost-efficient.



INFO

Owner BHP Billiton Ltd., Australia
DSI Unit DSI Pty. Ltd., Bennetts Green, Australia
DSI Scope Supply of double corrosion protected rock bolts







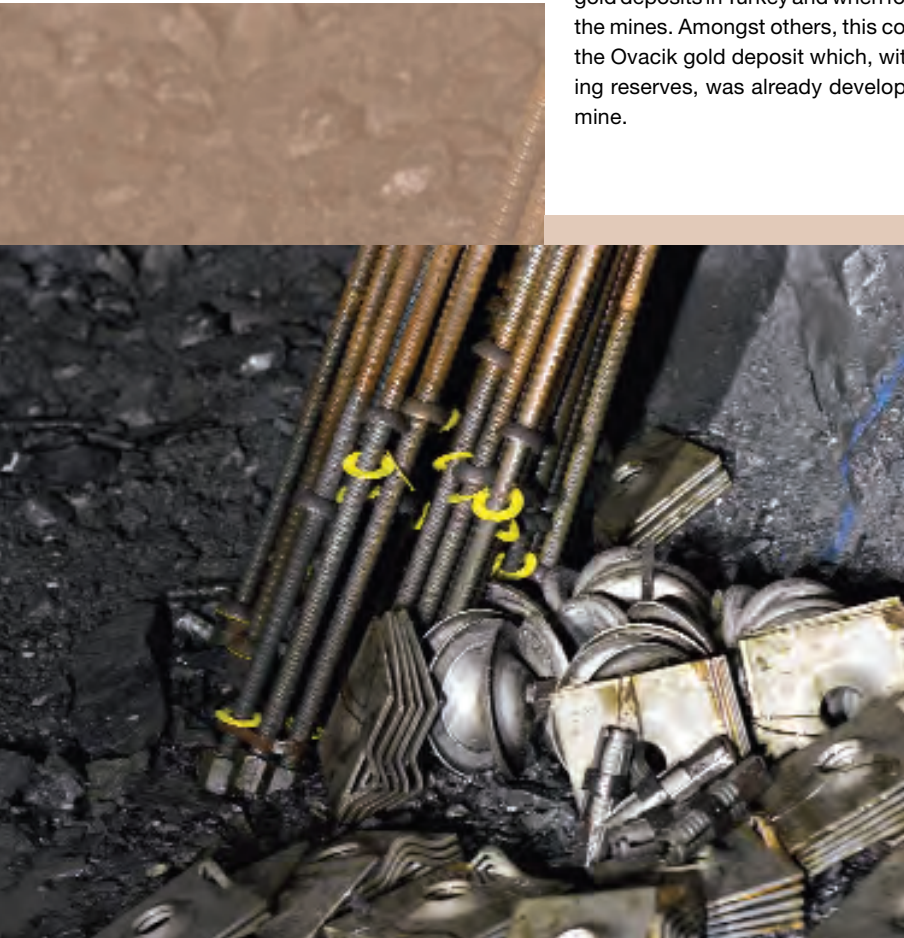
First-time delivery of DSI Australia mining products to Turkey

■ **According to archaeological findings, gold was first mined in Turkey 5,000 years ago. Today Turkey has one of the largest gold processing industries anywhere, with most of the gold, however, being imported. Only recently has gold mining once again increased substantially in Turkey.**

The Turkish mining company Koza Altin Isletmeleri A.S. was established to look for further gold deposits in Turkey and when found, develop the mines. Amongst others, this company owns the Ovacik gold deposit which, with its promising reserves, was already developed as a gold mine.

The Ovacik gold mine is located in West Anatolia about 100 km north of Izmir near the historical city of Pergamon. Extensive examinations revealed that about 2.4 million tons with an ore quality of 10 gram/ton are mineable in the Ovacik mine. Thus, based on current findings, a total of 24 t of gold and 24 t of silver can potentially be produced in this mine.

The Ovacik gold mine operators decided in favor of mining products from Australia. The decisive criteria for this decision were the high quality of the products manufactured by DSI Australia and the fact that DSI could provide the required technical support and after-sales service. Specifically, friction bolts, multistrand anchors and other mining products fabricated by DSI Australia in its Bennets Green plant in New South Wales are used in the Ovacik gold mine.



INFO

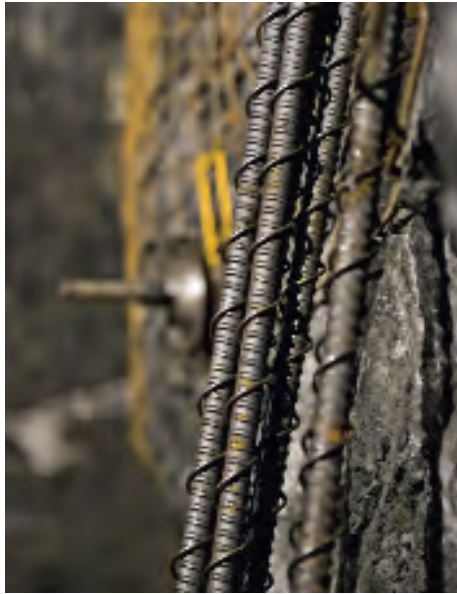
Owner Koza Altin Isletmeleri A.S., Turkey

DSI Unit DSI Pty. Ltd., Bennets Green, Australia

DSI Scope Supply of friction bolts, multistrand anchors and other mining products; technical assistance and after-sales service



DSI Australia supply ground support products to Kazakhstan



The area in which the Voskhod mine is located experiences a strongly continental climate characterized by hot summer weather (+20°C) and extremely cold winters (>-30°C). In these extremely differing climatic conditions, the construction of the box cut and portal presented a great challenge to all parties involved.

The Voskhod deposit consists of one large lens of massive to disseminated chromite with up to nine small pods. It is a totally 'blind' deposit, lying as it does at depths of 98 to 440 m, dipping northeast at 28°.

The mining method is to be sub-level caving using a 20 m level interval. Up-hole drilling and subsequent blasting from extraction levels will be followed by mucking and loading into low profile trucks for the haul to the surface.

The probable reserve, based on the indicated resource, allowing for mining recover losses of 10% and a dilution factor of 18% at zero grade is 18.3 Mt at 40.3% Cr2O3, giving a mine operational life of 14 years. The estimated total lateral development for the life of mine is 36 km.

Central Asia Mining, a joint venture between Byrncut Mining, Australia and Vostokshakhtstroy, a local Kazakh contractor, was awarded the contract to develop the Voskhod mine. DSI Australia developed specialised export packing for the mining products, e.g. friction bolts and DCS bolts, supplied to Central Asia Mining to ensure they arrive in the best possible condition after the long journey to Kazakhstan. The DCS bolt is a specialised double corrosion protection bolt designed to provide long-term corrosion protection.

■ Immediately after acquisition of the Voskhod chrome mine in the Republic of Kazakhstan in 2007, Oriel Resources began with the development of the mine. This operation is scheduled for completion in early 2008 to commence mining of the high grade chrome ore. The ore will then be fed to a dedicated smelter in Russia. As part of this development, DSI Australia is involved in supplying all the ground support products to this operation.



Container load of DSI Mining Products ready for shipment to Kazakhstan in specifically developed export packing



INFO

Owner Oriel Resources, Kazakhstan +++ **Contractor** Central Asia Mining

DSI Unit DSI Pty. Ltd., Bennetts Green, Australia

DSI Scope Supply of the entire range of ground support products for the development of a new mine



New Delivery Contract for the Tasman Coal Mine in New South Wales



Photos reprinted by courtesy of Newcastle Coal Company, NSW, Australia

■ **Development of the new Tasman underground coal mine located in the vicinity of Mount Sugarloaf west of Newcastle began in late 2005. The mine is located in the Hunter Valley Region in New South Wales, Australia, which is known for its rich coal deposits and fine wine. Once the full extraction rate has been achieved, coal will be extracted at an annual rate of up to 750,000 tons per year. According to studies, a total of 12 million tons of thermal coal will be mined from the Fassifern Seam in the Newcastle Coal Measures during the 21 year period that the mine lease will apply.**

Due to the shape and size of the deposit, underground longwall methods are precluded. Consequently, a combination of conventional mining, place changing and pillar reduction methods are proposed. Coal will be produced from underground workings and transported via a conveyor system that will feed directly into a crusher. Crushed coal will then be transported to a nearby site for processing and/or transfer by rail to domestic customers or to the Port of Newcastle for export.

The operator of the Tasman coal mine concluded a contract with DSI Australia for the supply of a high-quality and innovative range of DSI mining products. Thus, DSI Australia will supply all roof support products such as rock bolts, anchors, or resin cartridges, including accessories required for securing the development work at the underground coal mine.

The close vicinity of the Tasman coal mine to DSI's plant in Bennetts Green, NSW allows just in time supply of the entire mining product range, so that customers incur no costs for storage and the operator needs no further space capacities.



INFO

Owner Newcastle Coal Company, NSW, Australia

DSI Unit DSI Pty. Ltd., Bennetts Green, Australia

DSI Scope Contract for supplying the entire product line of mining products such as rock bolts, anchors, or resin cartridges, including accessories, to the Tasman coal mine



First application of OMEGA®-Bolts in Australia



■ The Otter Juan nickel mine is one of the oldest mines in the Kambalda region in Western Australia, about 630 kilometers east of the city of Perth. After it had been shut down temporarily and successfully sold, the highly profitable Otter Juan mine has been operated by Goldfields Mine Management for some years. With operations extending beyond 1,250 m below the surface, it is one of the deepest mines in Western Australia.

The general conditions in the mine render extraction of the pentlandite mineral, which is a nickel sulphide compound and contains about 4% nickel, extremely difficult. The mine has an environment of high stress and a weak talc-chlorite ultramafic hanging wall rock mass. The mined ore is transported to the Kambalda Nickel Concentrator for processing.

The problematic soil conditions in the Otter Juan mine are made more difficult by increased seismic activities. Therefore, Goldfields Mine Management has chosen to use the flexible OMEGA®-Bolt with a load-bearing capacity of 24 tons to stabilize the extraction surfaces. Due to its physical properties, the OMEGA®-Bolt is predestined for use in seismically active mining regions, since it provides a high level of deformability to accommodate ground movement.



Trent Wehr (Regional Sales Manager-WA) and Ray Piotrowski (Kalgoorlie Branch Administrator)

INFO

Owner Goldfields Mine Management, WA, Australia

DSI Unit DSI Pty. Ltd., Bennetts Green, Australia

DSI Scope Supply of OMEGA®-Bolts



DSI Australia signed an exclusive distribution agreement for the supply of shotcrete fibers

■ **DSI Australia has signed an exclusive distribution agreement with Radmix International Pty. Ltd., Australia, for the supply of steel and synthetic fibers for shotcrete application in the mining and tunneling markets.**

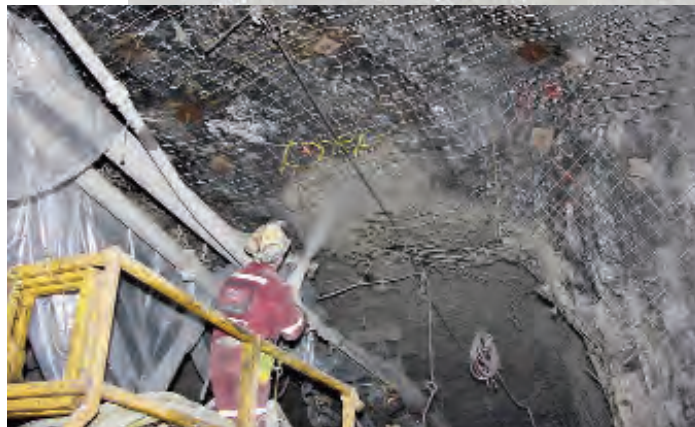
Fiber reinforced shotcrete is typically used in mine and tunnel roadway development as well as for slope stabilization to provide a reinforced surface support.

With shotcrete applications the concrete is pneumatically applied through a hose and is compacted by impact energy. Fibers added to the concrete improve the performance of the shotcrete, hence are playing an increasing role as the reinforcement medium of choice. For a uniform performance of the concrete layer, the fibers are randomly distributed throughout the shotcrete.

Fiber reinforced shotcrete offers customers a product which is easier and safer to apply, cost effective and superior in strength and toughness than other forms of concrete reinforcement such as welded wire mesh. Fiber reinforced shotcrete also achieves higher grades of crack resistance, ductility, energy absorption and impact characteristics than alternative surface support options.

Radmix is one of the world's most efficient and technologically advanced steel and synthetic fiber manufacturers. Radmix combines comprehensive research into the latest reinforcing fiber technology from around the world with in house development of fiber design and production technology. As a result, Radmix stands as one of the few companies worldwide to provide a complete range of fibers and technical expertise at competitive prices.

The addition of shotcrete fibers to the DSI product range fits extremely well with the products DSI is offering to the underground mining market. This fiber product range will further develop the company's position as the global market leader in ground support products and continue to enhance DSI's "one stop shop" approach for ground support products.



INFO

DSI Unit DSI Pty. Ltd., Bennetts Green, Australia

DSI Scope Exclusive distribution of steel and synthetic fibers for shotcrete manufactured by Radmix International Pty. Ltd., Carabooda, WA, Australia



DSI develops innovative Manx Bolt for the Beltana Coal Mine in New South Wales

DSI research and development activities at their customers' service

■ **The Beltana coal mine in the Upper Hunter Valley in New South Wales is owned by the Xstrata Group, a globally diversified metal and mining company and the largest Australian exporter of power station coal. The Beltana long-wall punch mine is considered to be one of the lowest cost high productivity operation of its kind in Australia.**

DSI Australia visits the Beltana coal mine for technical service on a regular basis. During one of those visits, the operators mentioned that tires of mine vehicles were becoming damaged due to the protrusion of rib bolt tails into the roadway. Not only was this a safety issue but it was causing the mine significant costs for tire replacement.

The way the DSI team dealt with their customer's casual remark is a good example of DSI's innovation and dedication to customer service. Returning from their service visit to the mine, DSI took it upon themselves to develop a solution to Beltana's problem via their R&D department in Newcastle, Australia. The solution required a rib bolt system with the following features:

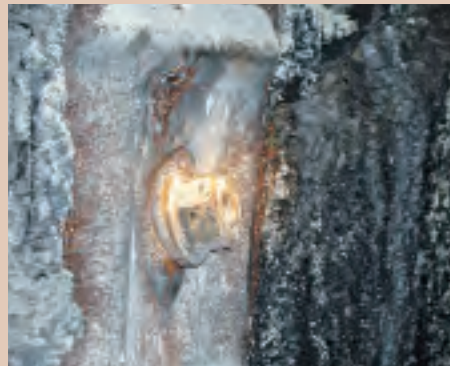
- Low profile with zero or minimum tail.
- Meets or exceeds the support plan specification.
- Easily integrated with the existing rib/roof bolt consumable logistics and installation procedures.

Hence, the Manx Bolt, for which a patent has already been applied, was developed as a new DSI mining product. The Manx Bolt is a resin anchored tensionable rib bolt with a headed drive nut for use in standard 27 mm size holes. The bolt is a 17 mm "D" bar with mixing paddles at the anchor end to ensure optimum bonding of the anchor with the resin during curing. The bolt tail has an M16 thread form. The drive nut is a low profile, 36 mm A/F nut combined with a sleeve and shear pin break out system which ensures that the tail protrudes no more than 45 mm out of the bolt after installation.

By replacing the previous rib bolts with the new DSI Manx Bolts, the problem of slashed tires at the Beltana coal mine was solved to the operators' complete satisfaction.



That's how far the old rib bolts at Beltana mine protruded



Installed new DSI Manx Bolt with domed butterfly plate – maximum 45 mm protrusion

INFO

Owner Xstrata Coal, NSW, Australia

DSI Unit DSI Pty. Ltd., Bennetts Green, Australia

DSI Scope Development and supply of DSI Manx Bolts



Triple winner at the 2006 Hunter Manufacturing Awards Ceremony in Newcastle, Australia

DSI Australia receives awards in three categories

■ Traditionally, a large number of small to large production companies are located in the Hunter region northwest of Sydney that is particularly proud of the long tradition and performance of its manufacturing industry.

Every year, the Hunter Manufacturing Awards Inc. (HMA), a non-profit organization, awards companies for their manufacturing excellence and innovations. Hence, the HMA honors enterprises which make a significant contribution to the region's growth and wealth.

At the awards ceremony held in Newcastle on October 13, 2006, DYWIDAG-Systems International Pty. Ltd. (DSI) was awarded 3 of the much sought-after awards in the category "large companies":

- Innovation in Marketing
- Innovation in Product Design
- Innovation in Manufacturing.

The high commitment of all DSI employees active in Australia is the basis for DSI Australia becoming the worldwide market leader in ground support technology. We congratulate our colleagues on these well-deserved awards.



DSI Australia provides Sponsorship to the Australian Roof Bolting Titles



Scott Kirby from DSI Australia judging the roof bolting competition

■ The Australian Roof Bolting and Coal Shoveling Titles were held on the 4th November 2006 in conjunction with the Blackheath Rhododendron Festival in the Blue Mountains west of Sydney. These are two unique sports that are directly related to the Coal Mining Industry and generally attract a high level of competition wherever they are held.

DSI Australia supported the Australian Roof Bolting Titles by providing the roof bolts and resins used in the competition as well as a financial contribution to the events prize money. Furthermore, representatives from DSI Australia act as judges for the roof bolting competition.

The 54th Australian Roof Bolting Titles 2006 were a great success and generated a great deal of interest with a large number of competitors coming from as far as Queensland and Tasmania to compete in this year's event.







DSI USA Acquires Fasloc, Inc., a Premier Producer of Resin Cartridges in the USA



■ In December 2006, DSI acquired Fasloc Inc., Martinsburg, WV, USA. Fasloc, which emerged as an independent company from the DuPont group in September 2005, is the pioneer and premier producer of resin cartridges in America.

The mining industry is much safer today as a result of the use of roof bolts anchored with resin cartridges pioneered by Fasloc. The installation of anchors with resin cartridges creates stable and secure mine roofs. Resin cartridges consist of two chambers divided by a membrane and containing resin as well as a catalyst. The membrane is ruptured in the borehole during insertion of the bolt, causing the materials to mix. Depending on individual requirements, the material takes between a few seconds and a few minutes to cure, thus securing the bolt in material as solid as stone. The resin causes the bolt to bond with the surrounding strata and creates the necessary tension resistance for a single stable load-bearing surface.

Since its inception in the 1970's, Fasloc's innovation, product improvement, and service have taken the mining industry another step forward in terms of efficiency and safety.

With innovative and flexible polyester resin cartridges under the Fasloc® and Cableloc® brands, Fasloc is the leading manufacturer in this field.

Fasloc's state of the art, fully automated production facilities include eight assembly lines. Here, over 500 different varieties of resin cartridges are produced and immediately packaged for shipment. The production facilities also include well-equipped laboratories for continuous research and development as well as for quality control. Fasloc's production facilities in West Virginia are strategically located to guarantee "just in time"- delivery of products to the American mining region in the Appalachian Mountains and to the Canadian mineral mines near Ontario.

For DSI, the acquisition of Fasloc is another step towards expanding its worldwide mining activities. Resin cartridges perfectly complement DSI's mining product range. Furthermore, DSI's global network offers an existing supply platform for delivering Fasloc's high quality products to mines outside of their home region for better safety.

During the last few years, DSI has successfully expanded its mining division through strong organic growth and strategic acquisitions. In March 2006, DSI acquired the Canadian company "GroundControl", which produces highly regarded resin cartridges in Canada under the brand name of "GROUND-LOK". As a consequence of the integration of both companies and in order to create synergies, FASLOC now also coordinates GroundControl's resin cartridge division.

The purchase of Fasloc strengthens DSI's position as a market leader in the development, production and supply of mining products and systems. With DSI, mine operators have a partner that offers excellent customer service in addition to the largest and most complete product range for securing mines.



Pull Test



Mike Sullivan, CEO Fasloc Inc.





New Delivery Contracts for Coal Mines in the Appalachian Mountains

Coal mines of the James River Coal Company in Kentucky, USA



■ **James River Coal Company mines and sells bituminous, steam and industrial-grade coal through six operating subsidiaries located throughout Eastern Kentucky and Southern Indiana. They are the sixth largest coal producer in Central Appalachia and the third largest in the Illinois Basin and operate the following mines in South East Kentucky:**

- McCoy Elkhorn in Pike County
- Blue Diamond Coal Co. in Perry County
- Bledsoe Coal Co. in Slempp County
- Bell County Coal in Bell County
- Leeco in Perry County

Since the summer of 2006, DSI Mining America has supplied these mines with rebar bolts, cable bolts, plates and other mining products on a regular basis.

The purchasing department of the James River Coal Company attaches great importance to just in time delivery for their mines. Here, the DSI strategy of being close to their customers proves its worth, since DSI could meet their client's exacting demand from their plant in Blairsville, Pennsylvania. James River Coal is extremely pleased with the products and support provided by DSI and looks forward to a long, mutually beneficial relationship.

In early 2007, DSI comprehensively expanded its production capacities at its Blairsville facility in order to be able to supply the numerous coal mines in that region with just in time-delivery.

Photos reprinted by courtesy of James River Coal Company, Richmond, VA, USA



INFO

Owner James River Coal Company, Richmond, VA, USA

DSI Unit DSI Groundsupport Inc., Blairsville, PA, USA

DSI Scope Contract for supplying the entire product line of mining products such as rebar and cable bolts including accessories to six coal mines



DSI Fiberglass Rebars secure gold mine in Canada

■ **The Williams Operating Corporation mine in Ontario, which is both a surface and underground gold mine, ranks among the largest gold producers in Canada.**

The operators of the mine consulted DSI with regard to supporting the working face of a raise because the circumstances regarding gold extraction in such a mine require special measures. The support system should not leave metal debris in the muck during blasting in order not to affect segregation of the gold. DSI therefore recommended the use of fiberglass dowels, which provide the support required and are consumed during the blast to such an extent that the debris is small and inconsequential, thus not interfering with the milling process.

In January 2007, DSI successfully installed 4.23 m long, 22 mm diameter DSI Fiberglass dowels at the Williams Operating Corporation underground mine.

The DSI Fiberglass Rebars were installed as follows:

- The 33 mm diameter, 4.18 m deep holes were predrilled using pneumatic drilling equipment. Depending on the drilling progress, wing bits in lengths varying from 0.6 to 4.18 m were used.
- Subsequently, one 30 mm thick and 60 cm long ultra fast (0-30 seconds) low viscosity resin cartridge was inserted to the toe of the hole. Thereafter, another three 30 mm thick and 60 cm long low viscosity high strength 5-6 minute slow cartridges were inserted in succession and tamped.

■ The DSI Fiberglass dowels were pushed by hand into the prepared holes. For the concluding installation by machines, a special dolly was used for the drilling equipment. An 8-edge dolly with an edge length of 19 mm was welded onto a special adapter. The turning movement led to the fiberglass rebars being fully encapsulated by the resin. This could be visually controlled at the collar of the drilling equipment.

The operators of the Williams Operating Corporation mine were very satisfied with the installation of the fiberglass rebars conducted by DSI and the thus achieved ground support in their raises.



32.5 mm wing bit



45 degree fiberglass end for easy resin penetration



Installed DSI Fiberglass Rebar



Special dolly



INFO

Owner Teck Cominco and Barrick Gold Corporation, Ontario, Canada

DSI Unit DSI Groundsupport Inc., Salt Lake City, UT, USA

DSI Scope Supply and installation of DSI Fiberglass Rebars and resin cartridges; technical assistance



DSI Mining Products Secure Underground Observatory in Canada

Sudbury Neutrino Observatory, Sudbury, Ontario, Canada

■ **The Sudbury Neutrino Observatory (SNO) is a world class scientific facility located 2.000 m underground in what used to be a nickel mine. Thanks to specialist unique location, interfering influences such as cosmic radiance are eliminated. Since 1999, the SNO has provided evidence for neutrinos which are created as a result of certain types of radioactive decay or nuclear reactions such as those in the sun, in nuclear reactors, or when cosmic rays hit atoms.**

The key to SNO's research activities is the 12 m dia. acrylic sphere detector containing 1000 t of heavy water (deuterium oxide D_2O). This water container is surrounded by a stainless steel mesh containing 9.600 light sensors. The light sensors register tiny flashes of light which are

created when neutrinos react with heavy water. In order to protect this process from radioactive influences, the mesh and light sensors are inside a barrel shaped cylinder which is ten stories high and filled with normal water.

During construction of the SNO in the mid-1990's, high quality DSI- mining products were used. The abandoned mine's galleries were extensively supported by unbonded DYWIDAG Permanent Strand Anchors. The fixation and anchorage of the detector inside the cylinder was facilitated by the use of DYWIDAG grade 60 bars.

The most recent phase of the neutrino study has now been completed, as the heavy water has been exhausted and has to be renewed. As further research in the fields of neutrinos, supernovae and "dark matter" is to be carried out, the use of this underground laboratory has been substantially extended.

The expansion, named the SNOLAB, is another example of the use of high quality DSI mining products. Among others, a 5 story complex was supported by a total of 134 \varnothing 2.5 cm St150 DYWIDAG Strand Anchors in order to protect the large adjoining cylinder. The DYWIDAG Strand Anchors were post-tensioned by DSI Mining Canada's personnel.

At the beginning of 2007, new research began in this renowned institute which has already received numerous international science awards.



INFO

Owner Sudbury Neutrino Observatory, Sudbury, Ontario, Canada

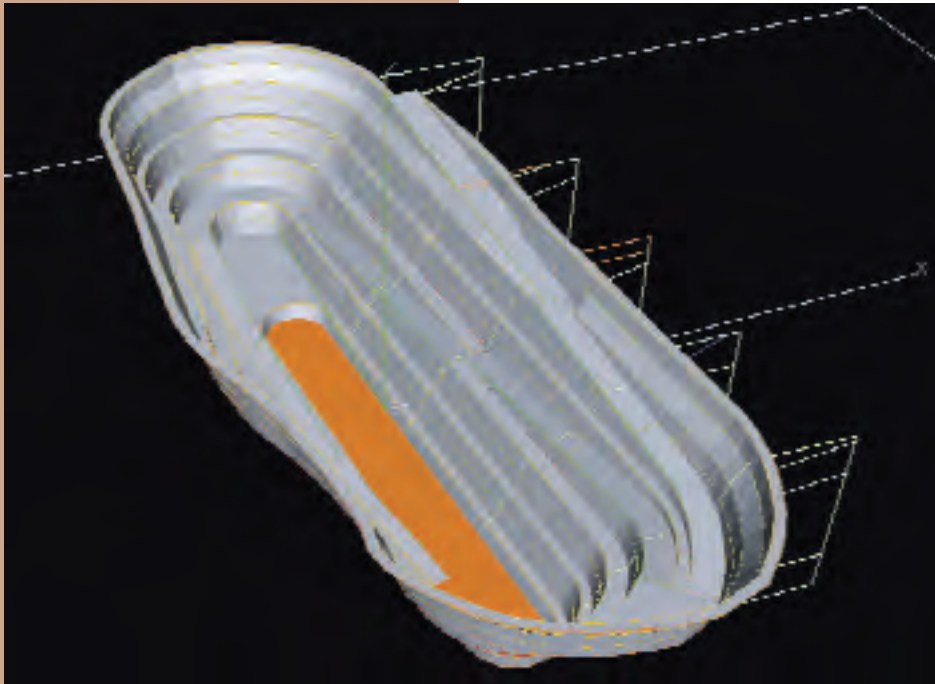
DSI Unit DSI Canada Ltd., Sudbury, Ontario, Canada

DSI Scope Supply and post-tensioning of 134 DYWIDAG Strand Anchors \varnothing 2.5 cm St 150



Cablebolt Systems secure Open Pit Mine in Argentina

Cerro Vanguardia, Province Santa Cruz, Argentina



Rajo Mina Cerro Vanguardia.
Position of the five sections E-0 of the east wall of Pit 0-Dz cb7 South



■ **Mining company Cerro Vanguardia performs its operations in extraction of precious minerals, especially gold and silver, via Open Pit in the province Santa Cruz in southern Argentina.**

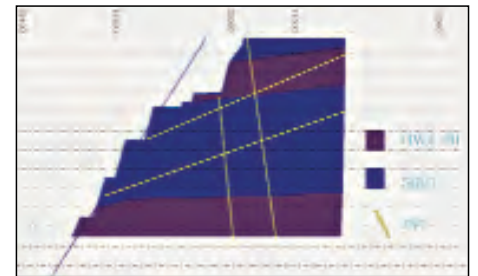
Due to the unstable conditions presented by the Osvaldo Diez mine CB 7 south, west wall, Cerro Vanguardia asked that the Department of Engineering at DSI-Sopofint evaluate the problem and - through its geomechanical engineering services - determine the system of stability control regarding the critical slope and install a system of reinforcement.

In order to design the reinforcement system, the engineers built a conceptual model and determined the principal mechanisms regarding the failure of the wall given the main orientation of its critical slope. To construct the model, they considered the parameters of resistance with respect to the rock mass as well as the in-situ geological conditions.

Using bi-dimensional numeric modeling, the stability both of the bench and the inter-ramp scales was investigated. The team calculated factors of safety and the probability of failure utilizing the Duncan Method, evaluating both the cohesion and friction properties of structures present in the rock mass.

As a result of their evaluation, the engineers recommended the application of the grout cablebolt system over an area of 1.000 square meters to control the instability of the critical slope. Accordingly, 3.700 meters of birdcage cablebolts of different lengths and orientations were installed.

The client showed great satisfaction with the quality of service and professionalism demonstrated by DSI-Sopofint's Department of Engineering.



Geometry, units lithologies and main structures corresponding to section Geotechnics N°5 located in the south

INFO

Owner Cerro Vanguardia, Province Santa Cruz, Argentina

DSI Unit DSI-Sopofint, Santiago de Chile, Chile

DSI Scope Technical evaluation; supply and installation of 3,700 m of cablebolts



Geotechnical Meeting, Hamburg, Germany

September 18-20, 2006



■ In 2006, the annual “DSI European Geotechnical Meeting” of all geotechnical experts from the European DSI companies took place in Hamburg. These regular meetings primarily serve to promote discussion and exchange of ideas regarding the use and further development of the existing DSI Geotechnical Systems and planned new developments from R&D. In addition, these events

provide DSI’s geotechnical experts with an opportunity to openly and actively exchange their expertise.

The 2006 program was complemented by a visit to a construction site located in the free port of Hamburg where the construction of a new wharf provided practical insight into current geotechnical methods.

First Sales Meeting directed by Mike Kelley

■ DSI USA’s Geotechnical Business Unit held its semiannual Sales Meeting at the Long Beach, California Marriott Hotel on December 12th and 13th, 2006.

The meeting’s attendees, who included representatives from the US Mining Business Unit as well as from the recently acquired American Commercial Inc., discussed technical and marketing issues common to all three business units. It was the first such meeting chaired by Mike Kelley, the GT Business Unit’s newly appointed Manager.

Left to Right: Klaus von Waldow, Alex Chen, Mike Kelley, Bernhard Froemel, Lucian Bogdan, Larry DeGraff, Ron Kurta, Joe Li, Shawn Twitchell, Terence Lee, Kerry Allen, Ken Purinton, Mathias Dengler, Herman Wong, Chris Wilkinson, Luis Gomez





From left to right: Mr Weber, Mr Tanaka, Mr Ishii, Mr Lanzinger, Mr Kawai, Mr Matsui, Mr Nuetzel, Dr. Windisch, Mr Reif, Mr Traute, Mr Ito, Mr Tsuchida, Mr Yano, Mr Matsui and Mr Yamada

2006 DYWIDAG Family Tour

October 18-27, 2006

■ Many years ago, Sumitomo (SEI) Steel Wire Corp DSI's licensee in Japan, together with DSI Group HQ Operations in Munich established what is now known as the DYWIDAG Family Tour in Japan. This Family consists of a number of prominent Japanese construction companies who are actively involved with the application of DYWIDAG construction technology in that country. Almost since its inception, DSI has organized a tour for representatives of the Family. This tour, which takes place every two years, is an informative excursion to the most interesting construction sites in Germany and Europe. The participants in the DYWIDAG Family Tour are engineers involved with the planning and execution of bridges and other engineering structures. This tour provides

them with the possibility to exchange experiences and new developments regarding the DYWIDAG Post-Tensioning System based of practical examples.

The 2006 DYWIDAG Family Tour first took the group to Amsterdam, where they visited several bridges built in connection with the extension of a railroad line near Utrecht and several overpasses that are part of the new construction of the A73 interstate near Roermond. Subsequently, the tour proceeded to Germany, where they visited amongst others the construction sites of the new A1 Liesertal bridge in the Eifel region and the Weidatal bridge near Querfurt which is being built in connection with the extension of the A38 interstate. A particular highlight was the visit to the construction site of the new Strelasund crossing on the island of Rügen in North Germany. DSI supplied and installed 3,360 m stay cables including 64 DYNA Grip® Anchorages for this bridge which is one of the largest stay-cable bridges in Germany. In addition, a short trip to the Czech Republic enabled the participants to visit the Nymburk stay-cable bridge and several bridge structures built in the course of the extension of the Dresden-Prague expressway near Ustí nad Labem.

At the end of the DYWIDAG Family Tour, a visit to the DSI Headquarter in Munich with lectures given on prestressed concrete technology was on the agenda. The successful 2006 DYWIDAG Family Tour was completed with a visit to the traditional Munich Hofbraeuhaus.





7th International Workshop on Micropiles (IWM 2006) in Schrobenhausen, Germany

May 4-7, 2006

■ In the year 1994, a group of practitioners and academics established the International Workshop on Micropiles. Since then this group, which has since been renamed the International Society for Micropiles (ISM), regularly meets to exchange information and discuss new developments in technology and research as well as new requirements for micropiles.

Four DSI employees were invited by ISM to contribute with two presentations to this workshop, which was held on the premises of Bauer Spezialtiefbau AG in Schrobenhausen, about 1 hour's drive from Munich.

Kerry Allen representing DSI America and one of the events principal organizers spoke to the participants about the ADSC Geo3 Field Day (ADSC - International Association of Foundation Drilling) that took place in Dallas, Texas, in November 2005. The presentation which dealt with the planning and implementation of the Geo3 Field Day was well received by the delegates. Thereafter, ISM distributed a video about the Geo3 Field Day to all participants.

Florian Stuetzel representing DSI GmbH Munich gave a highly acclaimed presentation on the subject of micropiles employing higher strength steels. Mr. Stuetzel presented the results of extensive empirical and mathematical investigations regarding the challenge of ensuring corrosion protection within the load transfer area at the pile head. As a consequence, he developed construction-site practical solutions for this problem which were integrated into the system development and their approvals. These excellent concepts were well received and further discussed in the course of the workshop.



From left to right: Chris Irvin, DSI UK, Southam, Warwickshire, United Kingdom; Frank Schmidt, DSI GmbH, Munich, Germany; Kerry Allen, DSI America, Chicago, IL, USA; Florian Stuetzel, DSI GmbH, Munich, Germany



Presentation of Kerry Allen



Presentation of Florian Stuetzel



Representatives of Figg Engineers, Cianbro Construction, CTL, Maine DOT, as well as Shahid Islam and Christian Roemschied (both DSI America) during the ceremonious award presentation

Pankow Award 2007

■ Every year, the American Society of Civil Engineers (ASCE), within the scope of its OPAL Gala (“Outstanding Projects and Leaders”), honors outstanding engineering performances which contribute to significantly improving the general quality of life worldwide.

At this event, the “Pankow Award” is presented to organizations that successfully implemented innovations related to design, materials or construction methods in a joint effort.

On April 25, 2007 the “Pankow Award 2007” was given to the “cradle system” developed by Figg Engineers for stay-cable bridges. DSI was involved both in the development of this new “cradle system” and its first practical use for the new Penobscot Narrows stay-cable bridge in the State of Maine, USA (see project article in this DSI Info). For this project, DSI supplied stay cables and anchorage systems perfectly matched to the new “cradle system”. This successful project also qualified for the final round of the “Opal Awards”.

March 14th, 2006 – Bridge Construction Symposium draws record number of participants to Dresden

■ The 16th Dresden Bridge Construction Symposium, with a record participation of more than 1,300 participants, once again proved to be the most important event for those involved with bridges and bridge construction in Germany.

Two of the twelve presentations were dedicated to the “2nd Strelasund Crossing” bridge. With a total length of 2,830 m, this bridge is currently the largest bridge construction site in Germany. The initial presenter, Dipl.-Ing. Volker Kock from DEGES, spoke on the construction project in its entirety, describing the various structures of the 4,100 m long section between the Stralsund by-pass and the Altefaehr slip road on the island of Ruegen.

In another lecture, Dipl.-Ing. Werner Brand from DYWIDAG-Systems International spoke in detail about the first application of strand stay cables in Germany. These cables, which consisted of multiple seven-wire galvanized, waxed and PE-sheathed strands, were used in place of locked coil cables which were the previous standard in Germany. For this reason, an extensive testing program in compliance with the new fib Bulletin 30 was conducted on the stay cables to be



used. The 583 m long so-called “Ziegelgraben Bridge” is the most outstanding structure in this project. The 32 DYNA Grip® DG-P 37 stay cables were supplied and installed by SUSPA-DSI, Langenfeld, Germany.

On the eve of the symposium in the presence of Federal Traffic Minister Wolfgang Tiefensee, the German bridge construction award was presented for the very first time to the valley bridge Wilde Gera and to the La-Ferté Steg. As a contribution to the promotion of the construction culture in Germany, the award will be presented bi-annually in the future.



Presentation of Werner Brand



Batimatec 2007, Algiers, Algeria

May 3-8, 2007

■ In 2007, DSI participated in the international Batimatec trade show in Algiers for the very first time together with its local partner ADD Béton. More than 400 registered exhibitors presented their construction and construction material products to the interested audience at this largest construction trade show in the North African region.

Particularly in the North African region, high revenues from fossil energy carriers and promising economical concepts are the basis for further growth. Therefore, DSI France intends to further enhance its activities in these growth markets with its high-quality products and systems.

Parallel to the Batimatec trade show, the first construction site in the Algiers metropolitan area where DYWIDAG Multistrand Anchors had successfully been installed could be visited.



Joint booth of ADD Béton and DSI, Batimatec, Algiers



Installation of DYWIDAG Multistrand Anchors on site in Algiers

2nd International fib Congress, Naples, Italy

June 5-8, 2006

■ Approximately 900 engineers from all over the world met at the 2nd fib (Fédération Internationale du Béton) Congress to discuss the latest scientific and practical developments and findings in the field of concrete and post-tensioning. Numerous lectures were given within the scope of the congress. Tours designed to explore technically challenging construction projects rounded off the congress program.

In addition, representatives from DSI actively participated in the lectures. Mr. Oswald Nuetzel, head of the Stay-Cable System Unit of DSI GmbH Munich, spoke on the experiences gained in the course of the first ever application of the new fib Stay Cable Recommendation 2005. In this connection, the installation of 2x32 DYNA Grip® Stay Cables in the new Ziegelgraben Bridge from Stralsund to the island of Rügen in North Germany was presented as a practical application. The presentation was well attended and well received by the participants. Mr. Heinz Heiler, former managing director of DSI GmbH, and Prof. Dr. Dieter Jungwirth, former head of the DSI Technical Department, both contributed their technical input to this lecture.

A large exhibition took place concurrent to the congress. Many congress participants visited DSI's booth to learn more about the comprehensive range of products and systems offered by the Company that relate specifically to bridge construction.



From left to right: Mr. Mirek Chvala, Mr. Ron Bonomo, Mr. Matthias Dengler, Mr. Milan Chandoga, Mr. Lubomir Hrnčiar



2006 BIG5 Show, Dubai, United Arab Emirates

October 28-November 1, 2006

Presentation by Oswald Nuetzel at the 2nd fib Congress, Naples/Italy

■ Oswald Nuetzel, technical director of the Stay-Cable Technology Unit of DYWIDAG-Systems International GmbH, lectured on the following subject on the occasion of the 2nd International fib Congress: “Experience gained during the first-ever application of the new fib Stay Cable Recommendation 2005 on the Ziegelgraben Bridge to the Island of Ruegen/Germany”.

Within the scope of the lecture, Mr Nuetzel explicitly presented the experience made with DYNA Grip® Stay Cables in the course of the first-ever application of the new fib recommendations for strand stay cables (Bulletin 30) during the construction of the Ziegelgraben Bridge across the Strelasund.

The presentation was well attended and received by the participants.



■ 2006 marked DSI's second participation in the BIG5 show at the Dubai International Exhibition Center because visitors and decision-makers expressed considerable interest in the company's high quality formtie systems in the previous year.

The BIG5 show, the leading annual trade show covering all aspects of construction, has developed into one of the most important trade shows for the German export economy in the Middle East and the Gulf region. This is demonstrated by the fact that the 2006 BIG5 show is the largest foreign trade show participation ever promoted by the Federal Republic of Germany. More than 320 German exhibitors presented themselves in the “Zabeel” hall which, with an exhibition space of more than 6,000 m², is the largest international pavilion at the Dubai International Exhibition Center.

In addition to its traditional DYWIDAG Formtie Systems, DSI also exhibited products from the newly acquired companies of the Concrete Accessories Unit at this trade show for the very first time. This new unit is the result of the merger of the companies Artéon, Mandelli-Setra and Technique Béton with the DSI Formtie and System Accessories product line. The products and system solutions developed by the new Concrete Accessories Unit struck a chord with the approx. 35,000 trade show visitors. Numerous new and valuable contacts were established.

In connection with the strategic expansion of the Concrete Accessories Unit, DSI plans to considerably enlarge its participation in the BIG5 show in 2007 both with regard to content and its presentation to the outside world.





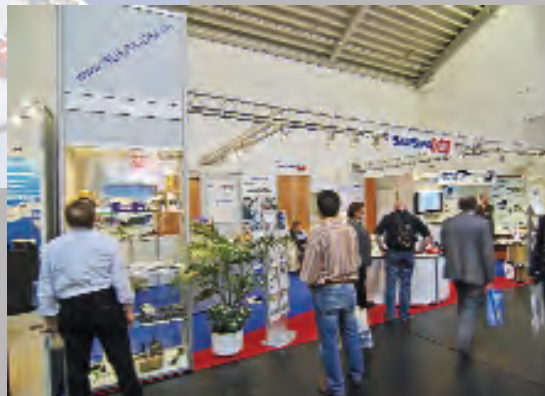
Trade fair bauma, Munich, Germany

April 23-29, 2007

■ The 28th International Trade Fair for Construction Machinery, Building Materials Machinery, Mining Machines, Construction Vehicles and Construction Equipment (bauma) exceeded all records. The current worldwide boom in the construction sector brought approximately 20 % more visitors to bauma in 2007 than three years ago. Approximately 500,000 visitors learned in detail about the products and services of the more than 3,000 exhibitors, who also introduced them to a broad range of innovations and new techniques. 540,000 square meters of completely filled exhibition space made bauma 2007 the largest trade fair ever.

At this globally leading platform held every three years, the DSI Group was represented with displays in four separate booths. The spacious presentation area of DSI displayed the complete product range of the DSI Group, emphasizing “Underground” and “Construction”. The company contec, acquired by DSI in January 2007, exhibited their formwork and sealing systems for buildings at their own booth. Within the theme sector “Tunneling”, the joint booth of ALWAG designed as a tunnel entrance attracted many visitors. Test control units for building material could be viewed at the booth of SUSPA-DSI within the respective theme sector. The Bauma 2007 was a complete success both for its organizers and for DSI.





Imprint

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Printing

Holzer Druck and Medien
Weiler im Allgaeu, Germany

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This publication is published in English (18,000 pcs.) and German (5,000 pcs.).

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