ENERPAC APPLICATION INSPIRATION

- **Buildings and Stadiums**
- Bridges and Infrastructure
- Manufacturing
- Power Generation
- Steel and Metal Production
- Oil and Gas, Petrochemical
- Shipbuilding
- Mining

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With more than 50 years of experience, Enerpac has gained unique expertise in delivering hydraulic solutions for the controlled movement and positioning of heavy loads.

This expertise has been acknowledged by the world's leading industrial professionals and has contributed to the successful movement of a number of the most recognizable structures on earth.

In addition to providing the most comprehensive line of globally-supplied, locally supported Heavy Lifting products, Enerpac combines hydraulics, steel fabrication and electronic control with engineering and application knowledge, to design and manufacture solutions that ensure your projects are completed safely and efficiently.

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Repairing the Foundation of a Sinking Apartment Building

Customer: MPL Technology Katowice

Location: Katowice, Poland

Challenge: Underground coal extraction led to the erosion of the ground causing a nearby apartment building to tilt. The apartment's foundation needed to be lifted 61 cm in order to re-level the sinking apartment building.

Solution: 106 custom hydraulic lock-nut jacks were mounted under the foundation of the apartment building. The jacks successfully lifted and leveled the apartment.

Products: CLL-Series, Hydraulic Lock Nut Jacks

Lifting a Historic Building for Renovation

Customer: Bresser

Location: Tbilisi, Georgia

Challenge: Renovation of a historic building in Georgia's capital required the foundation to be repaired after it had sunk into the ground. The 100-year-old building needed to be lifted 3,4 meters onto pylons in order to be renovated.

Solution: A 16-point SyncLift system and 39 hydraulic jacks were used to synchronously lift the building onto pylons. Five and half meter long pylons were driven through the first floor and into the concrete foundation. Mounted on-top of each pylon was a bracket and a double-acting hydraulic jack. Four threaded steel rods were run through each pylon bracket and connected to a structure supporting the foundation of the building. As each jack advanced the top portion of the bracket was lifted, raising the foundation of the building.

The SyncLift system provided the operator the ability to monitor and control every jack from a single touch-screen controller. The foundation of the historic building was successfully lifted and repaired.

Products: EVO-Series, 16-point Synchronous Lifting System, CLRG-Series, Double-Acting Hydraulic Jacks

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The Shanghai Concert Hall Lifting and Moving Project

Location: Shanghai, China

Challenge: The decision to relocate the 74-years old building was made mainly because of noises from neighboring areas. With the city's busiest expressway nearby the aged building has been plagued by noises and exhaust gas. With its south and west walls close to a populated residential complex, daily chaos often burst into the music hall. Although building a new Concert Hall would have been less expensive, the Shanghai City choose to move the entire building to retain the distinctive architecture and acoustics.

Built during Shanghai's early 1900's construction boom, the former Nanking Theatre was Shanghai's first venue for foreign film and was one of the few buildings of its era designed by a Chinese architect. Known for its excellent acoustics, the theatre has been used as a venue for symphony orchestras since 1959. After its relocation and renovation, the old concert hall will again welcome orchestras.

Due to the mixed foundation design and the lack of an integrated frame, the 5800 tons building was extremely difficult to lift and move. For that reason the music hall was put onto a 1800 ton armored concrete tray. The entire Shanghai Concert Hall was lifted in only 6 days to the prescribed height of 1,7 m.

Products: Weigh and Lifting Systems,
with 59x 200 tons Cylinders,
4x Large Hydraulic Pumps,
Central PLC-Control System to control and
monitor all movements.

Repairing the Foundation of a Tilting Silo with Steel Piers

Customer: Earth Contact Products

Location: Garrison, Iowa, USA

Challenge: After several freeze and thaw cycles a crack formed in the silo's foundation. Over time the crack expanded and permitted water to erode the soil under the silo's foundation. The northwest portion of the silo's foundation had settled 4 inches causing the silo to tilt. In order to re-stabilize the foundation, the 680.000 pound silo needed to be lifted, leveled and structurally supported.

Solution: The structural load was transferred from the soil to 18 ECP steel piers. The steel piers were driven to depths of 35 and 50 feet below the silo to the load bearing stratum. After each pier was load tested, custom 25 ton RC-Series hydraulic jacks were attached to a bracket on the top of each steel pier. Powered by a Z-Class hydraulic pump, the hydraulic jacks applied 48.000 pounds of force at each placement to lift the silo 5,1 cm. Once level, the pier cap bolts were tightened and the hydraulic jacks were removed. The silo is now structurally supported by the ECP Steel Piers.

Products: Custom RC-Series Hydraulic Jacks,
Z-Class Electric Pump

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Repairing a Building's Foundation after an Earthquake

Customer: Sync Lift Systems Ltd. New Zealand

Location: Christchurch, New Zealand

Challenge: After a devastating earthquake, a 2800 ton city center building was knocked off its foundation and needed to be lifted and leveled by up to 300 mm.

Solution: An EVO Synchronous Lifting System was used to manage the lifting force and extension of 22 high tonnage double-acting CLRG-Series hydraulic cylinders to safely and accurately lift the foundation and building to the required position. Each cylinder was installed in a steel stool which was connected to the buildings foundation. Draw wire stroke sensors were attached to each of the lifting positions, providing displacement information to maintain synchronous accuracy of all positons to less than 1 mm. Managing the lifting operation from one central control system improved safety and operational productivity.

Products: EVO-Series, Synchronous Lifting System, CLRG-Series, High Tonnage Cylinders

Hydraulic Drive System for Las Vegas Observation Wheel

Customer: Caesars Entertainment

Location: Las Vegas, Nevada

Challenge: Erecting the Las Vegas High Roller Observation Wheel included installing the 28 passenger cabins. To ensure accurate and safe installation, a hydraulic drive system was needed to turn the wheel for correct positioning and placement. The drive system would also be critical in the overall rotation of the wheel, which would serve as the permanent operating system. Enerpac and Schwager Davis Inc., a specialty contractor, worked together to supply a reliable system solution.

Solution: Enerpac and Schwager Davis provided the Mechanization System, a hydraulic drive system that provides the propulsion and normal braking force for the system in normal use, to rotate the wheel. The system consists of a total of eight drive units, each of which has four large tires that provide the traction force to rotate the wheel. One full revolution of the wheel takes approximately 30 minutes. The system is capable of rotating the wheel in both directions.

In addition to rotating the wheel, the drive system was also used for several weeks during construction to rotate the wheel in order to install the large 25 ton passenger cabins.

Products: Custom Hydraulic Drive System

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Enerpac Helps Erect World's Tallest Observation Wheel in Las Vegas

Customer: Caesars Entertainment

Location: Las Vegas, Nevada

Challenge: To help erect the 167,6 m tall Las Vegas High Roller observation wheel including installing the massive rim sections that support 28 observation cabins, each 6,1 m in diameter, each weighing 25 tons and each accommodating up to 40 people. The rim consisted of 28 different sections each weighing a massive 45 tons. The challenge was to lift, assemble and then rotate the huge rim sections so the next section could be assembled, thus allowing the wheel to take shape.

Solution: Working with American Bridge Co. and its consulting engineer Zieman Engineering, Enerpac developed and supplied the Hydraulic Rotating Mechanism (HRM) necessary to assemble and erect the rim sections. The HRM was mounted on a 21,6 m temporary holdback tower and was used to grip, hold and turn the rim while it was being constructed--and safely hold it in place during construction. The HRM consisted of six gripper boxes (three per side of the rim) which were operated by two hydraulic power units and a single computer control station, resulting in a 750-ton gripping, holding and moving capacity.

Products: Custom Hydraulic Rotating Mechanism

Abu Dhabi Airport Hangar: Heavy Lifting of 2000 ton Steel Roofs

Location: Abu Dhabi, UAE

At Abu Dhabi Airport, United Arab Emirates, 3 enormous steel roofs, 2000 ton each, constructed at ground level were lifted 131 feet (40 meters), using Enerpac HSL-Series strand jacks, creating aircraft maintenance hangers. The strand jack system managed by a single operator using the Smart Cylinder Control (SCC) system, delivers confidence by providing complete understanding of the lift operation from a central position.

Enerpac won a challenging and rewarding order from ASI (an Australian based company) for the Abu Dhabi Airport Hangar project. The triple bay hangars are specially designed to be big enough and high enough to house the new Airbus A380 planes. This was a fantastic effort by a team, who worked day and night to meet all deadlines.

Team members emphasized Enerpac's strengths and business reputation to convince ASI that Enerpac had the expertise and product offering to ensure a successful outcome. ASI was impressed by Enerpac's diligence and professionalism.

Products: HSL-Series Heavy Lifting Strand Jacks,
SLPP-Series, Hydraulic Power Packs
Smart Cylinder Control (SCC) System

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Lifting the London Eye

Customer: Mammoet

Location: London, England

Raising the “London Eye” on time to celebrate the new Millenium required an innovative mega crane. Powered by Enerpac HSL-Series strand jacks, the world’s tallest (135 meters) cantilevered observation wheel was successfully lifted, taking its position in the London skyline.

Products: HSL-Series, Heavy Lifting Strand Jacks

Climbing System Lifts U2 Concert Stage

Customer: Stageco (Belgium)

Location: U2 concerts worldwide

The Belgian company Stageco has constructed three gigantic, identical stages for the current U2 360° Tour. What makes this project special, is that high-pressure hydraulics are being used for the first time ever to assemble and dismantle the 230 ton construction - also known as “the claw”. Together with Enerpac, Stageco has developed a unique system, based on Enerpac’s Synchronous Lift System, to raise the modular construction to a height of 30 metres quickly and safely.

Being able to put on bigger and better shows than your competitors gives you a trump card in the entertainment world. Performances and tours by famous artists and bands have to look good, as is demonstrated by the glitz and special effects that are usually the main feature. The stage is crucial, and this is no different in U2’s 360° Tour. For this world tour, set designer Willy Williams and stage architect Mark Fisher came up with “the claw”, a 30 metre high stage construction on four legs, giving spectators all around the stage an unobstructed view of the band.

Products: PLC-Controlled Synchronous Lifting System
16 Lifting Cylinders
16 Locking Cylinders
4 Hydraulic Power Units

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Enerpac helps the Beijing's "Bird's Nest" to stand on its own feet

Location: Bejing, China

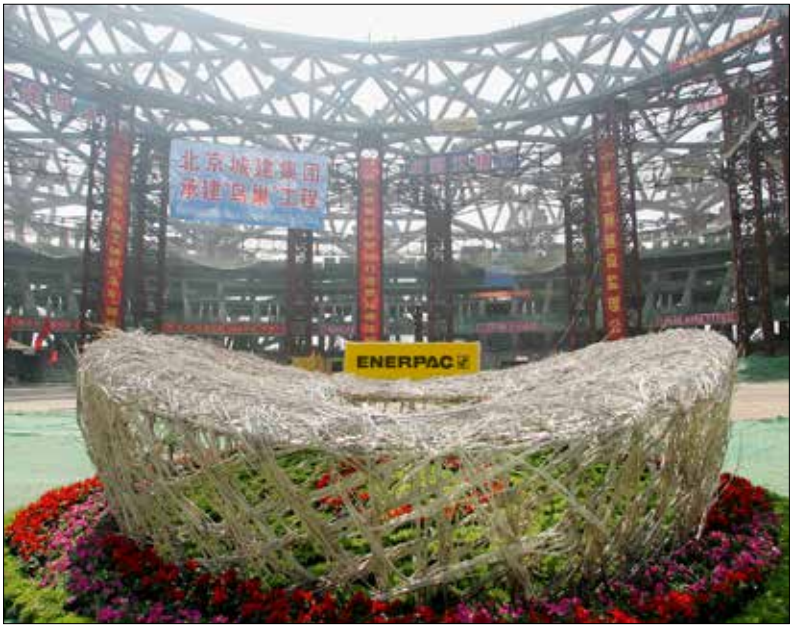
After two years of construction, the main venue for the 2008 Beijing Olympic Games came to a final and most important part of the construction of its steel structure: the dismantling of the temporary support towers.

Due to the extreme high cost of hiring a number of 800-ton cranes for several days in China, a smarter and less expensive solution needed to be found. Key pre-requisites to the entire cutting-operation were safety, control, stability and cost. Enerpac, known from many complex hydraulic applications around the globe was consulted.

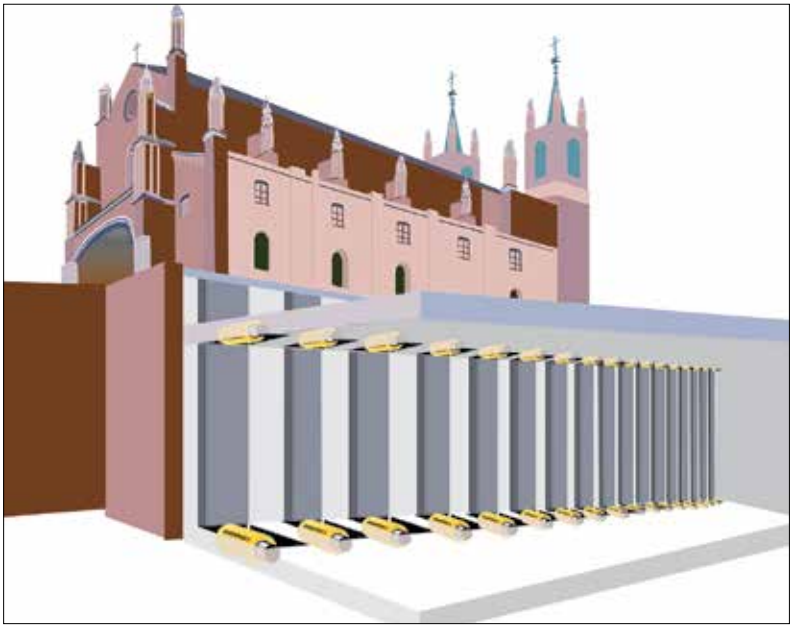
Basically the disconnecting and dismantling process of the temporary supports comes down to synchronically and fully controlled lifting the structure of its supports, cutting the welds, followed by controlled and synchronized stage-lowering to allow the removal of the 50mm think leveling plates that were used during construction.

Stadium key facts:
Gross floor area - 258.000 square meters
Seat capacity - 80.000 (11.000 temporary)
Seats will be added after the 2008 Olympics
Structure - 36 km of unwrapped steel length
Height - 69,2 m above pitch level

Products: The entire configuration including the central computer, satellite computer-controllers, 156 double-acting hydraulic cylinders and 55 electronically controlled hydraulic power units was specified and custom designed by Enerpac. For added safety, control and accuracy, multi-functional valves, load sensors, stroke sensors, shift detection and a digital feedback system were integrated.



Intelligent hydraulics stretch out the Prado museum



Customer: ACS

Location: Madrid, Spain

Spain's prestigious Prado Museum in Madrid, built in 1819 is expanding its exposition room to 16.000 m2. The new exhibition space is partly underground, stretching from the existing Prado buildings to the adjacent 16th century Jerónimo Church.

The Enerpac hydraulic synchronous system measures and monitors any movement of the foundation caused by the load of the surrounding buildings and traffic. In total 34 double-acting lock nut jacks, each with 500 ton lifting capacity and 100 mm stroke (CLRL-5004) are used. Each hydraulic jack is equipped with a positioning sensor to measure movement (plunger travel) and a tilting swivel saddle to compensate for side load caused by non-centered loads. Each group of 17 hydraulic jacks include six Class A 500 ton load cells with an accuracy of 0,1 %.

All hydraulic jacks are powered by one large two-stage electric pump connected with about 2000 m of hydraulic hoses. The PLC control unit includes an emergency stop and extra system safety features to signal voltage and power consumption, pump overload, oil level and temperature.

Products: PLC-Controlled Synchronous Lifting Systems, 34x 500 ton Double-Acting Lock Nut Cylinders

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Positioning the Roof Segments of the Palace of the Arts

Customer: Acciona

Location: Palace of the Arts, Valencia, Spain

Since the advent of hydraulic jacks or lifting cylinders, construction engineers have had the capability to raise and relocate structures, bridges or buildings of almost any size and tonnage – even entire city centres to allow new underground installations such as subways or essential repair work.

In theory there are no limits….. the greater the weight, the more cylinders are employed. But the extend of a straight lift has always been limited to the plunger stroke length of the cylinders used. To lift beyond that limit stage lifting has involved additional holding arrangements to permit the replacement or repositioning of cylinders for the next stage in the lifting operation.

Products: SHS-Series, SyncHoist - Synchronous Load Positioning Systems

Repair 12.000 ton moveable stadium roof

Customer: Millwright & Price Erecting

Location: Miller Park Stadium, Milwaukee, USA

The day after the Milwaukee Brewers finished their final game of the season at Miller Park in September 2006, a different team went into action. This time the coaches were engineers, and the first-string players were millwrights, ironworkers, operating engineers, and laborers.

The task for which they had been preparing was a major repair job on the stadium's movable roof: replacement of the ten bogies (powered carriages) on which the five movable sections of the roof are carried. The 12.000 ton roof is designed in a fan-shape, with each of five movable sections pivoted at its home-plate end and riding on two bogies at its wide (outfield) end 183 metres away.

The 6,7 metres long original-equipment bogies, two at each of the far corners of each fan-shaped roof section, were fitted with pairs of double-flanged wheels to ride on an eight inch-wide circular track approximately 42 metres above ground level. Three-phase power for the bogie drive motors is fed out along each roof section from the home plate pivot end, eliminating any need for sliding contacts.

Products: CLL-Series, High Tonnage Cylinders
PE8000-Series, Electric Pumps

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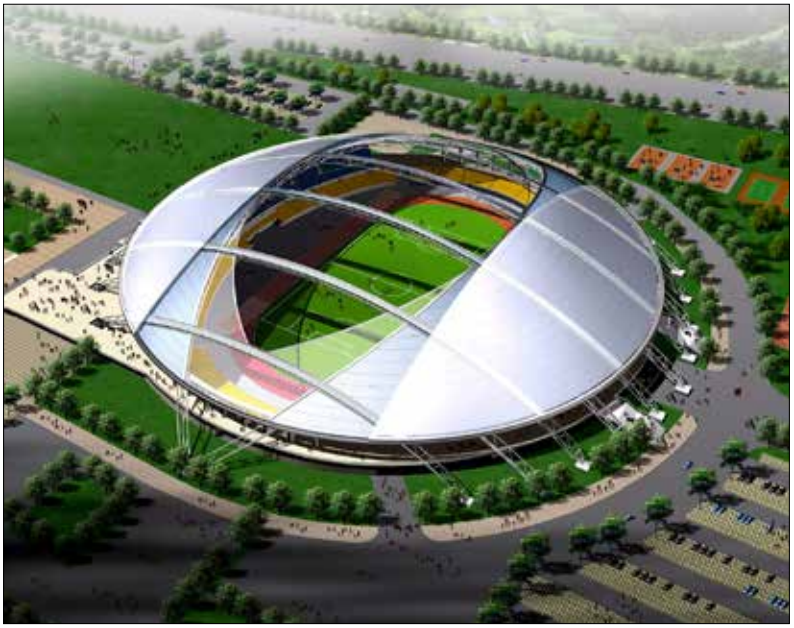
The stadium roof in the Chinese Nantong opens and closes by means of hydraulics

Location: Nantong Stadium, China

The new Nantong stadium in the Chinese Jiangsu province is China's first large stadium with a roof that can be opened and closed. It is exceptional that for the first time in history, the propulsion and stabilisation of the movable roof parts takes place hydraulically. Enerpac signed a contract for the development and installation of the advanced propulsion- and operating system whereby trolleys play an important role.

Below the stadium roof a soccer field, 400 metres of athletics track, and various accommodations are located. The stadium has a total surface of 48.000 m^2. This stadium forms part of a much larger complex with among other things an exhibition centre. In total, said complex takes up a surface of 150.000 m2. With this the complex that is also compared to the Olympic Stadium in Peking is the largest and most functional one in the history of the Jiangsu province. With the construction an investment of 1,1 billion RMB (China Yuan Renminbi) or almost 107 million euro was involved.

Products: 8x Hydraulic Winches
44x Trolleys



Positioning of Olympic Stadium Roof

Customer: Cimolai

Location: OAKA Olympic Stadium, Athens, Greece

Movement of the arches and roof construction is done simultaneously using two Enerpac PLC-controlled hydraulic systems each with four 150 ton pull cylinders with 2 meters stroke.

The suspended ached roof construction, designed by the famous architect Mr. Calatrava will cover about 10.000 m2 of the Olympic Stadium which will seat around 75.000 spectators. The new design is built from glass and metal. The unique architectural and structural design and style makes this a very special project because the existing stadium will be refurbished while the roof and arches are being designed and erected.

The roof-arch construction will be built close to the sides of the stadium and then hydraulically moved into position with a sliding and guiding system. The arches and roof are being constructed in two halves, 70 meters from either side of the stadium. On completion of the steel structure the roof and arches are simultaneously slid into position on Teflon pads along huge reinforced rails.

Products: PLC-Controlled Hydraulic Systems
4x 150 ton Pull Cylinders with 2 meters stroke.

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Stage lifting 300 year windmill

Customer: Bresser / van 't Wout Waddinxveen B.V.

Location: Oranjemolen, Vlissingen, The Netherlands

Challenge: Lifting an entire mill from 1699 with all its fittings by two metres is quite something.

FUNDERINGS- en VIJZELTECHNIEKEN Bresser / van 't Wout Waddinxveen B.V. completed this 700 ton chore in three days with Enerpac hydraulic lifting equipment.. The opportunity was also taken to correct the position of the slightly squint mill. Since then the well-known Oranje mill has been waiting on steel supports for the time that it can once more turn on the reinforced dike.

Heightening the Oranje dike in Vlissingen is one of the final phases on the Delta project. This dike remains still a weak link in the struggle against extremely high water and has to be heightened by two metres in order to protect the Zeeland countryside behind it from flooding. In itself a water management project that presents no special challenges for our Dutch dike builders. That is were there not a typical windmill from 1699 on the dike, a windmill that everybody wants to retain on the dike: the Oranje mill. The Municipality of Vlissingen had as owner two options: take the mill apart and reconstruct it from scratch after heightening the dike, or lift the mill in situ to the required height. Practical considerations and the desire to keep the mill that still operates on a daily basis resulted in adopting the latter option.

Products: Hollow Plunger Cylinders
Split-Flow Pumps

Positioning Structural Steel for the Roof of the Mercedes-Benz Stadium

Customer: Derr & Isbell Construction

Location: Atlanta, GA, USA

Challenge: Working with the roof's structural steel is very difficult, and requires precise lifting to ensure accurate placement. Additionally, the steel is extremely heavy at approximately 850.000 pounds, requiring a lifting solution that will not only accurately lift the steel but also safely.

Solution: Derr & Isbell Construction engineers on the project turned to Enerpac for a solution. Enerpac recommended using its SyncHoist System, a unique below-the-hook lifting solution for positioning of heavy loads in crane applications. Using just one crane, the SyncHoist System allows operators to easily position loads while ensuring complete safety, speed and control.

To accurately lift and position the structural steel for the stadium's roof, the SyncHoist System employed two cylinders located between the hook and one of the two spreader beams, making the side load adjustable. The other two cylinders were located between the other spreader beam and the load, which allowed that side of the lift to be adjustable as well. This design allowed operators to completely control the load throughout the entire lift.

Products: SHS-Series, SyncHoist System

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Buildings and Stadiums

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