

System Solutions for Civil Engineering: Long-Life, Robust and Safe



Civil Engineering Solutions for Energy, Navigation, Connection, Life



To support, connect and protect people

Water is the essence of life. With modern technology man uses water for a better life: Hydroelectric power stations generate renewable electricity, locks make waterways usable, and movable bridges connect places. At the same time, structures protect us against storm tides and floods, or they create living spaces through a regulated water supply. For decades, Rexroth has been the world's leading project partner for automation of such civil engineering structures.

To build structures to last for centuries, and to operate them with utmost availability for decades: Clients, designers and operators of civil engineering projects think long-term. Whether for new construction or modernization of installed systems, they demand that the automation has to be extremely robust to ensure a long service life. The focus is on reliability and availability, because every outage results in enormous costs. Operational safety plays a decisive role. The technology must establish and maintain a safe state, even when there is a power failure. The automation should have a service life, depending on the application, of 20 to 40 years before it is modernized. With such time-frames, the maintenance costs impact far greater than the purchase costs on the actual Total Cost of Ownership.

Rexroth is the world's most experienced automation partner for civil engineering. Our solutions have proven their worth on all continents for decades.



- ◀ Guri Dam, Venezuela
- ◀ Zeltingen Lock, Germany
- ◀ Lowestoft Bridge, United Kingdom
- ◀ Ems Barrier, Germany
(Photo source: Niedersächsischer Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz)

You can find further projects with Rexroth participation in an extensive list of references: R000254

Rexroth automation solutions in civil engineering

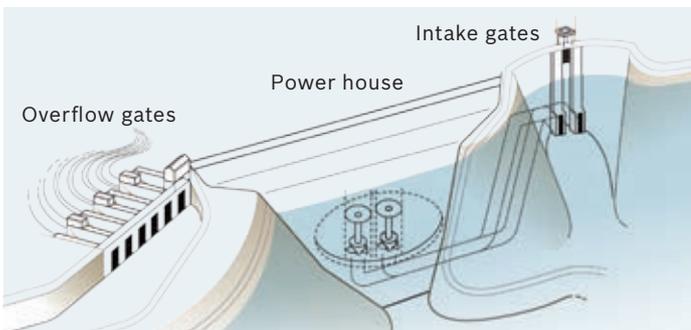
- ▶ **Energy:** Dam equipment
Water turbines
- ▶ **Navigation** Locks
Ship-lifts
- ▶ **Connection:** Movable bridges
Ferry ramps
- ▶ **Life:** Coastal protection
Water treatment plants



Energy: Dams, Weirs and Turbines

Hydroelectric power stations are the world's most important source of renewable energies. Very high construction costs are offset by earnings over decades – when the automation reliably and optimally regulates the water flow. This is exactly what Rexroth guarantees. With safe automation components for turbine control and system solutions for overflow and outlet gates.

◀ **Deriner Dam, Turkey,
with open outlet gates**



Dams are used in a range of applications, from river to medium-pressure and even high-pressure power stations in high mountain regions. Pump-storage power stations are being increasingly used to cover peaks in energy requirements. A number of gates are used to this purpose, and they have to be able to fulfill a wide range of tasks. This places many different demands on the hydraulic drives.

As enormous forces act on the construction, the drives have to be designed to with-stand high loads. For bottom outlet gates for example, pulling and pushing forces are required that can easily exceed several 1,000 kN.



- ▲ **Outlet gate (orifice):**
Cylinder piston diameter
900 mm
Rod diameter 360 mm
Stroke 6,000 mm
Max. pulling and pushing
force 12,000 kN
- ◀ **Power unit for outlet
gate**

Turbine inlet as well as draft tube gates have to be closed and be capable of being driven gently into the end position at speeds of up to 20 m/min. or more.



◀ **Rogun Dam, Tadjikistan:**
 Outlet gate cylinder
 Cylinder piston
 diameter 1,060 mm
 Rod dia. 450 mm
 Stroke 7,600 mm
 Max. pulling force
 16,000 kN,
 Max. pushing force
 12,000 kN

▶ **Deriner Dam, Turkey:**
 Flap gate cylinder
 Cylinder piston diameter
 560 mm
 Rod diameter 250 mm,
 Stroke 5,710 mm,
 Max. pulling force
 4,000 kN
 ▼ Flap gate at overflow

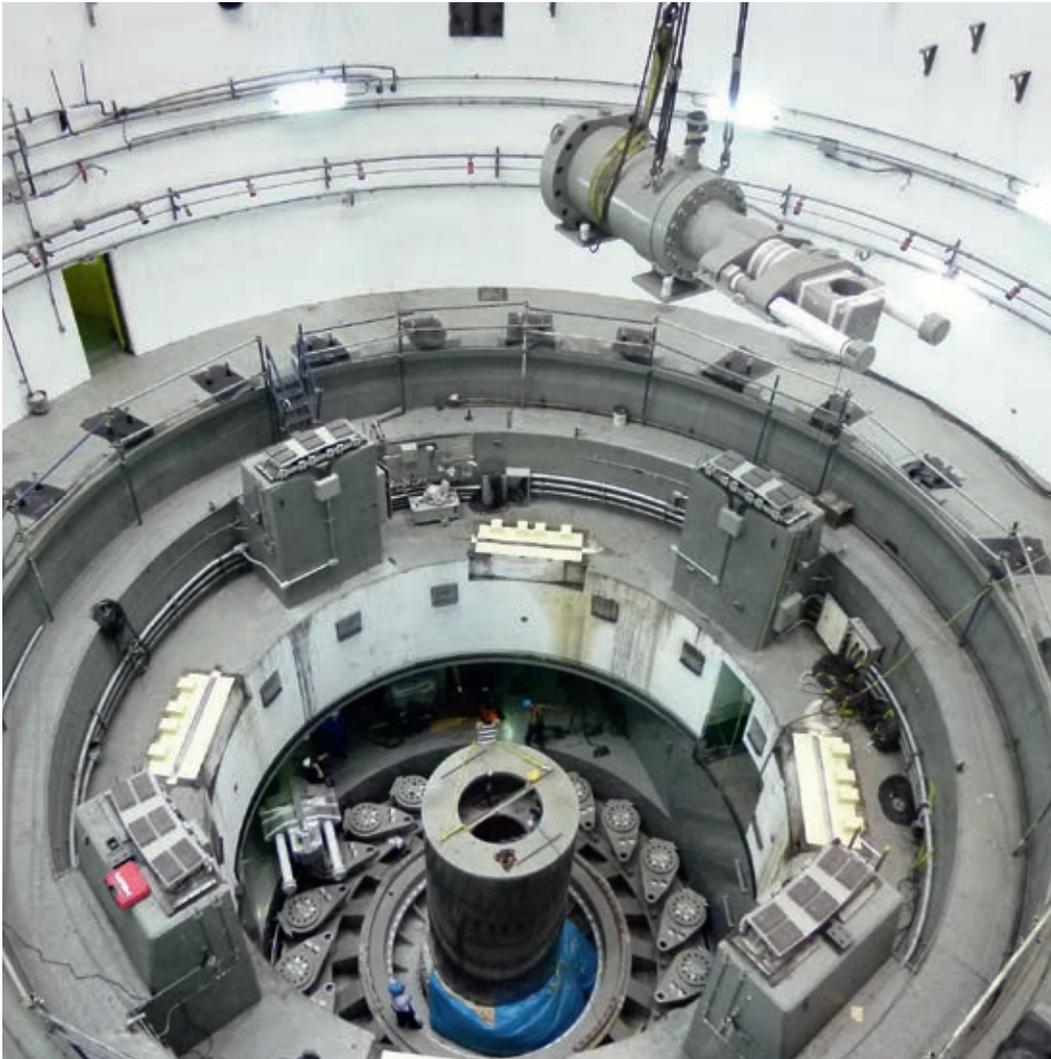


Guri Dam power unit,
 Venezuela





Optimum turbine output through automation: Turbine control requires high positioning accuracy, short response times as well as high dynamics. Regulation of the turbine guide wheel provides optimum efficiency and maximum operational safety.



- ▲ Servomotor for guide vane adjustment
- ◀ Turbine control cylinder Guri Dam, Venezuela

- ▼ Hydraulic power unit for turbine control
- ▼ Manifold for turbine control on the test bench

- Water saving basins in the new 3rd set of locks of the Panama Canal



Navigation: Locks and Canals

Locks and ship elevators make many waterways economically useful. Whether inland or for the connection between seas and oceans, whether for modernizations or new constructions, large-scale projects, or single locks: Work together with the world's most successful system partner for automation of lock systems. Profit from the experience and proven plug & play system solutions – from Rexroth.



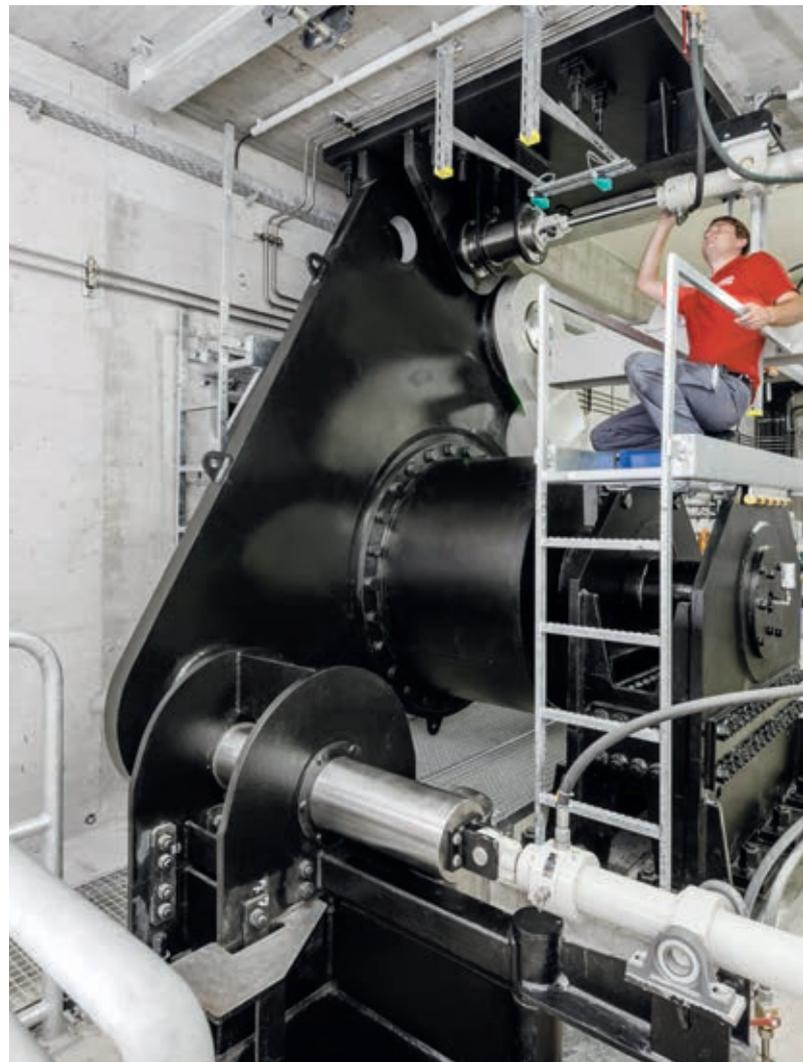
Engineering partner for large-scale projects

Modernization of the Panama Canal is a once-in-a-lifetime project. As the engineering partner for automation, Rexroth has taken on the project planning, design, coordination, installation, and startup. We do this by bundling our resources as a global player. Specialists from different industries and technologies and from several continents are working closely together with their fellow experts on site. This means we relieve a considerable amount of strain from the client.

Water saving basins conserve the environment

The principle of water saving basins, developed in Germany with the collaboration of Rexroth, is being applied in increasing numbers of large-scale projects. Lock chambers are connected to the water saving basins by communicating pipes. Ships are raised by Rexroth drives opening corresponding feed pipes, and water from the saving basins gravity filling the lock chambers. As opposed to existing technology, the water flows back into the basins once lock operation has finished.

The result in figures based on the example of the Panama Canal: Despite considerably larger lock chambers, this technology reduces the fresh water consumption by seven percent compared to the existing locks, thereby helping to conserve the regional water balance.



Moselle Lock Zeltingen, Germany:

- ▲ Drive of the rising segment gate with lock mechanisms
- ◀ Rising gate
- ▶ Hydraulic power unit



In addition to the space-saving, compact design of hydraulic drives, electrohydraulics are also providing considerable saving potentials to system operators with regard to maintenance and repairs.



- ▲ Ship arrester
- ▲ Gripper cylinder
- ▶ Boom cylinder



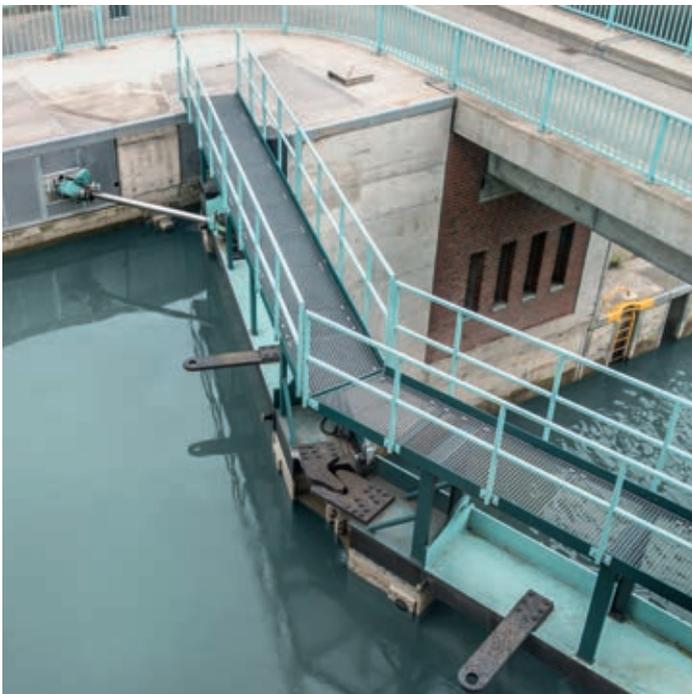
Navigation:

Operate waterways more efficiently with the latest technology



**Dortmund-Ems Canal,
Münster Lock, Germany:**

- ◀ Mitre gate cylinder with cardan bearing
- ▼ Mitre gate drive down-stream
- ▼ Flap gate drive cylinder
- ▶ Culvert drive cylinder and hydraulic power unit







Connection: Movable Bridges and Ferry Ramps

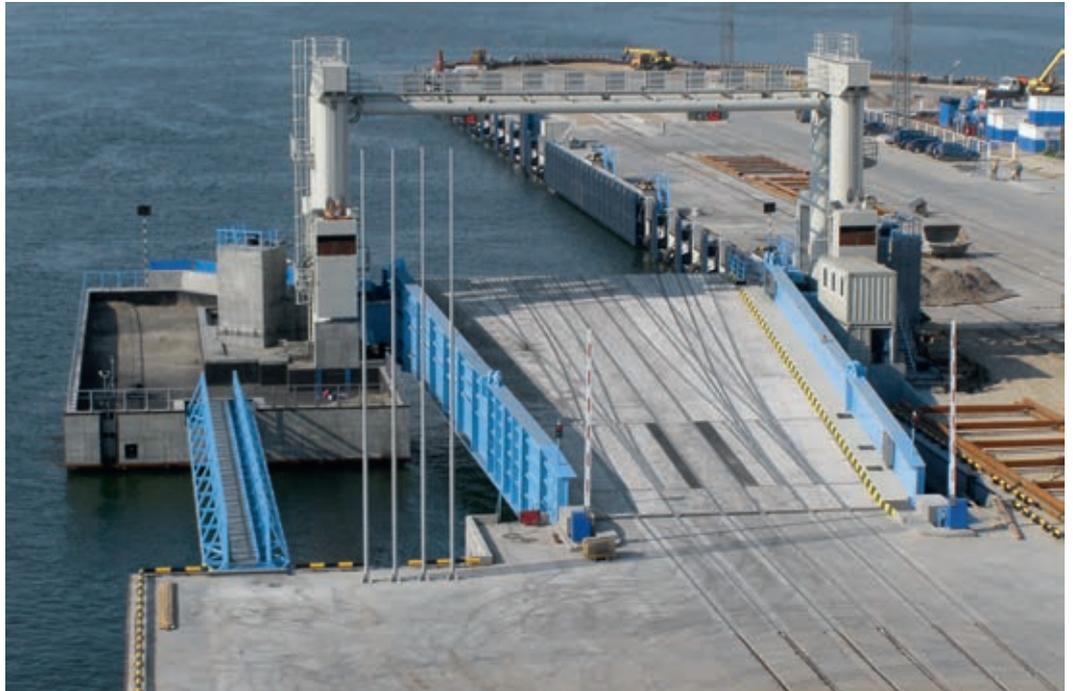
Movable bridges and ferry ramps create connections for overland routes and waterways. But they also place special requirements on the automation: It has to prevent damaging resonance vibrations on bridges and withstand storm waves for ferry ramps.



The roll-on/roll-off ramps or RoRos – permit loading of trains and other vehicles onto ferries, as well as providing safe access for passengers. They actively compensate for the level of the water and the draught of the ferry when the load status changes. Rexroth has developed sophisticated calculation methods for this purpose, which permit pre-determined loading operations regardless of the water level with minimal deviations.

Simulation programs developed by Rexroth not only incorporate the interaction of all drive technology components, but also other factors such as natural oscillations or axial forces caused by wind loads, currents, or extreme swells. These have allowed Rexroth to equip the world’s first storm-proof (typhoon) ferry ramp. Results from simulations have enabled us to design the automation so that it has even withstood the strongest tropical storms over many years.

- ▲ **Bascule Bridge, Lowestoft Bridge, United Kingdom**
- ▶ **Ferry Ramp Baltysk, Russia**
- ▼ **Bascule Bridge, Tower Bridge, London, United Kingdom**





▲ Lift-Bridge,
Oudenaardeburg,
Belgium
◀ Hydraulic power unit

► Solstufe Lehen, Austria
Photo source: Salzburg
AG

Life: Coastal Protection, Reservoirs and Water Treatment Plants

Storm tides and the rise of the sea level pose huge challenges to coastal areas. Rexroth is the engineering partner for coastal protection with its unique experience in realization of a wide range of concepts.



Global climate change is increasingly demanding technical solutions such as barriers to protect the population from storm tides, for coastal protection as well as for control or effective distribution of large quantities of water.

Rexroth is a project partner that has already provided numerous movable barriers along the North Sea coasts and the Mediterranean. They keep the waterways free and usable for shipping, and they can build a protective barrier

when needed. Rexroth system solutions apply extremely high forces for this.

We are incorporating our decades of experience in automation of such systems into numerous ongoing projects. We accompany these projects worldwide from the first idea, through the conception and simulation, right up to realization. Operational reliability is our main focus.



Irrigation systems for better living conditions

Increasing numbers of people as well as agricultural areas in dry regions have to be reliably supplied with water. With its robust and easy to operate automation solutions, Rexroth ensures supply is reliable over even long distances.



- ◀ Ems Barrier, Germany
Photo source:
Niedersächsischer
Landesbetrieb für
Wasserwirtschaft,
Küsten- und Naturschutz
- ▼ Vertical Lift Gate,
Ems Barrier
- ▶ Radial Gate, Ems Barrier

- ▲ Drinking Water Reser-
voir, Ouirgane, Morocco
(AIC Metallurgie)



From the Component up to the System Solution

You are seeking safety and cost effectiveness? Components and system solutions optimized for use in civil engineering have been proving their worth for decades on all continents in every imaginable application.

All civil engineering projects have one thing in common: They require extremely robust, powerful, and low-maintenance automation solutions. Rexroth offers you a globally unique product portfolio for this. We clarify all interfaces, and in our system solutions we match components perfectly to each other.

Through continuous enhancements based on the world's largest number of installed large cylinders in civil engineering and offshore applications, Rexroth has developed the Enduroq industrial surface technology. It covers a wide spectrum of coating processes and materials combinations that give ultimate corrosion resistance in every environment – for hydraulic and electromechanically powered cylinders.



◀ Large hydraulic cylinder
production: Guri Dam,
Venezuela



- ▲ Enduroq 2000/2200: Surface protection with the aid of HVOF technology
- ◀ Tribology
- ▶ CIMS – the position measuring system integrated directly in the cylinder



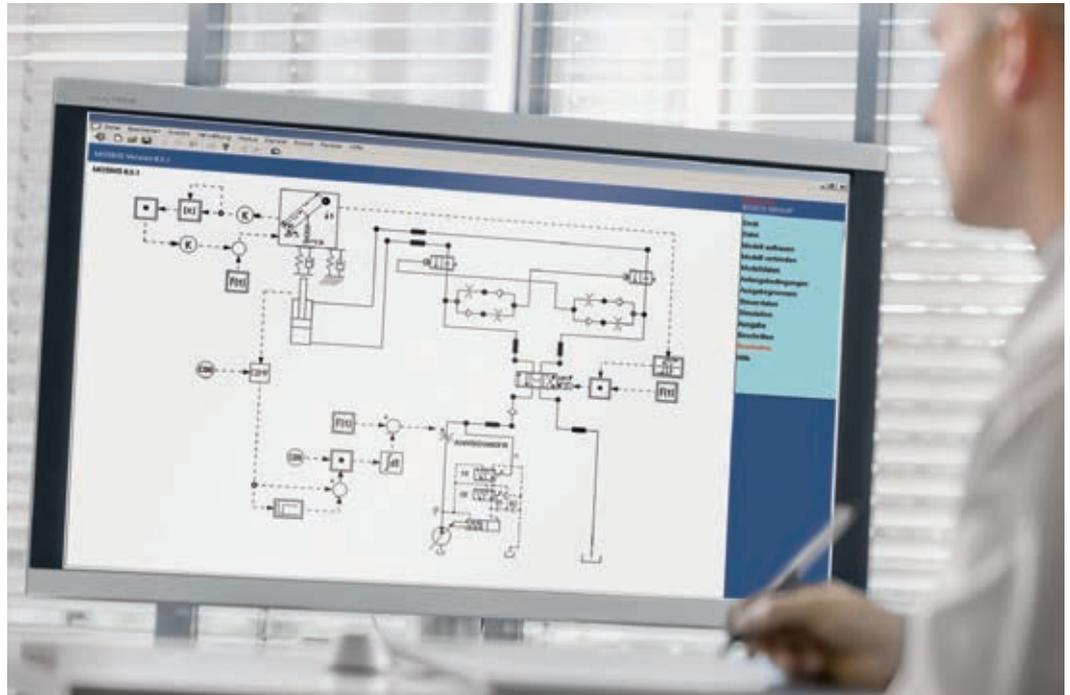
The five most important factors influencing the piston rods of large cylinders as well as the application areas for surface technologies in the context of the piston rod material



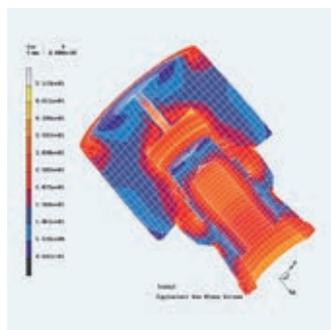
| ▼ Piston rod material | ► Ambient conditions | ▼ Surface technologies | Non or low corrosive, indoor, protected area | Moderate corrosive, outdoor, protected area | High corrosive, outdoor, unprotected area | Very high to extreme corrosive, outdoor, unprotected area in saltwater environment |
|-----------------------|----------------------|------------------------|----------------------------------------------|---------------------------------------------|-------------------------------------------|------------------------------------------------------------------------------------|
| Carbon steel | Chromium | • | | | | |
| Carbon steel | Nickel/chromium | • | | • | | |
| Stainless steel | Chromium | • | | • | • | |
| Carbon steel | Enduroq 2000 | • | | • | • | |
| Carbon steel | Enduroq 2200 | • | | • | • | • |

Extra Efficiency and Safety: Simulation and Visualization

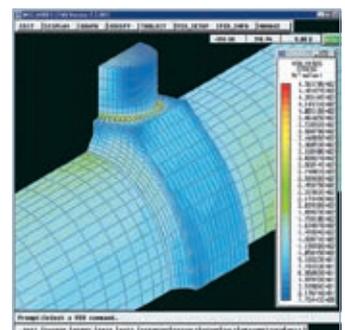
One result of increasing complexity is that the development process of civil engineering projects has to include feasibility studies, so that the correct systems and components are selected. Rexroth caters for this by providing simulations of integrated drive systems, and it evaluates them based on productivity, dynamic drive behavior, and efficiency optimization.



- ▲ **Bascule Bridge, Penemünde, Germany**
wind loads result in high requirements on the stability of the drive technology



- ▲ **Calculation of the system behavior of a mitre gate drive with the aid of simulation tools**
 - ▶ **Structural mechanical calculation of tension distribution in the trunnion of a hydraulic cylinder**
 - ◀ **FEM analysis**



Engineering support: System simulation

Rexroth has reproduced its decades-long extensive knowledge from civil engineering and drive tasks in special simulation programs that are continuously optimized with real data from installed systems. These programs take into account all the special features of fluid technology along with mechanical strength properties and environmental influences such as swells. This means, as early as the conception phase we make realistic statements upon operation of the future solution, are able to highlight potential problems before real implementation, and optimize them for dynamics and energy aspects.

Anywhere, and in particular, wherever external disturbance variables such as wind load, weight, currents or other water powers could affect a structure or system, the vibration behavior of the whole system needs to be considered. These vibration levels may need to be kept within the limits of a non-critical tolerance range by implementing certain modifications. In addition to the benefits, for example, of designing large-scale movable bridges, simulation technology plays a significant part, especially when securing new developments

Operator support: Visualization

Individual and system-specific visualization can be realized according to the type of application and its scope, as well as customer requirements. Visualization permits a centralized display of system status and the monitoring of all relevant system components. By logging all system commands together and all alarm and error messages, potential causes of malfunctions can be swiftly detected and rectified.





System Partner for Turnkey Civil Engineering Solutions

Wherever a civil engineering project comes into being, we are the right partner on site. As a global player with presence in over 80 countries, we always speak your language and know the local conditions. In this way, we give you access to our worldwide experience in applications.



◀ **Radial spillway gates in the La Yesca Dam, Mexico**

Often the details are decisive for success or failure: Is the structure exposed to a humid tropical climate or sub-polar cold? What does this mean for the drive system, what protection is needed? We master such details, because Rexroth has already realized all types of civil engineering projects in all climate zones and on all continents.

For this we make cooperation easy: One contact person who coordinates all Rexroth activities and therefore assists you. Our sector management bundles our worldwide application experience, and produces customized solutions. Rexroth employees from your country or region maintain contact with you and are always nearby. Therefore, we also know the regional technical and regulatory requirements and comply with them. With our extensive range of services, we increase long-term availability with low maintenance costs.



The portfolio for turnkey system solutions:

- ▶ Power units
- ▶ Cylinders
- ▶ Local pipework
- ▶ Electric control systems, including software
- ▶ Visualization
- ▶ Service, maintenance, repair, modernization
- ▶ Training courses

Rexroth Service – Your Key to Higher Productivity

Maximum equipment availability and high efficiency throughout the entire lifecycle of your machines and plants: These are key factors that determine the productivity of your manufacturing processes. Rexroth offers a comprehensive spectrum of services to maximize the availability of your machines. Your benefit: a higher productivity.



Our complete service portfolio is reducing the complexity and costs for maintaining and repairing your production equipment. We guarantee quick access to qualified technicians who solve problems at the root, thanks to their comprehensive knowledge of all drive and control technologies. Besides we ensure fast diagnosis and quick delivery of spare parts while minimizing costs by standardized processes and test procedures. All carried out by uniformly high qualified personnel, covered by our network extended to more than 80 countries.

In addition, we keep your machines fit throughout their entire lifecycle with our preventive/predictive services e.g. fitness checks and oil analysis. Our offer also includes upgrading their efficiency to the latest state of the art as well as analyzing the benefits of modernization/retrofit measures, taking over the implementation in a practical manner – working together with you. Summarized, we combine higher productivity with better energy efficiency and defined safety standards – reducing your total cost of ownership significantly. Rexroth – your one-stop service partner: Just configure our services to your specific needs.



**Spare
Parts**



Repairs



**Field
Service**



**Modern-
ization/
Retrofit**



**Preven-
tive/
Predictive
Services**

Detailed information is available from
www.boschrexroth.com/service



Tough application,
ingenious solution } Exactly



Your advantages

- ✓ Secured availability
- ✓ Increased reliability
- ✓ Improved efficiency
- ✓ Ensured safety
- ✓ Reduced complexity
- ✓ Extended life span

Bosch Rexroth AG

Zum Eisengießer 1
97816 Lohr, Germany
www.boschrexroth.com

Find your local contact person here:

www.boschrexroth.com/contact

The data specified above only serves to describe the product. As our products are constantly being further developed, no statements concerning a certain condition or suitability for a certain application can be derived from our information. The information given does not release the user from the obligation of own judgment and verification. It must be remembered that our products are subject to a natural process of wear and aging.