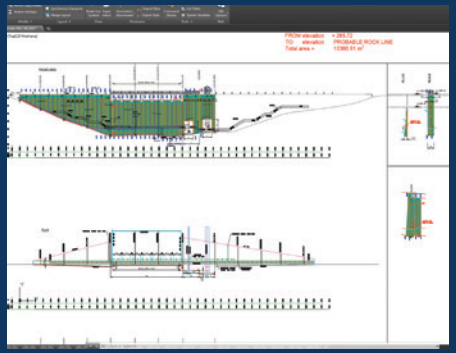
carpi

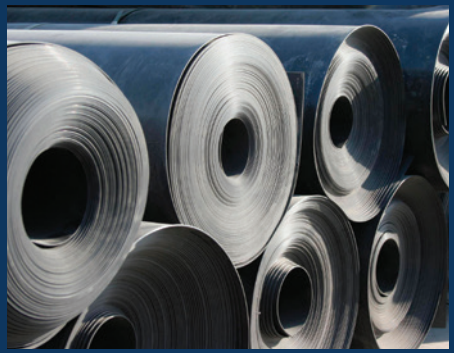
Waterproofing Geosynthetics Contractor since 1963

Construction and maintenance of hydraulic structures

Specialist Waterproofing Contractor since 1963



Design



Supply

Installation

CARPI's mission is to construct, in the dry and underwater, waterproofing systems on all types of hydraulic, civil, underground and environmental protection structures, using synthetic watertight geomembranes.
CARPI provides design, materials and installation.

The CARPI Group, established in 1963, has pioneered new installation techniques that are now patented systems used worldwide for rehabilitation and new construction, and is continuously introducing new techniques and solutions of higher performance to the global market.

Waterproofing Geosynthetics Contractor

carpi

WHO WE ARE

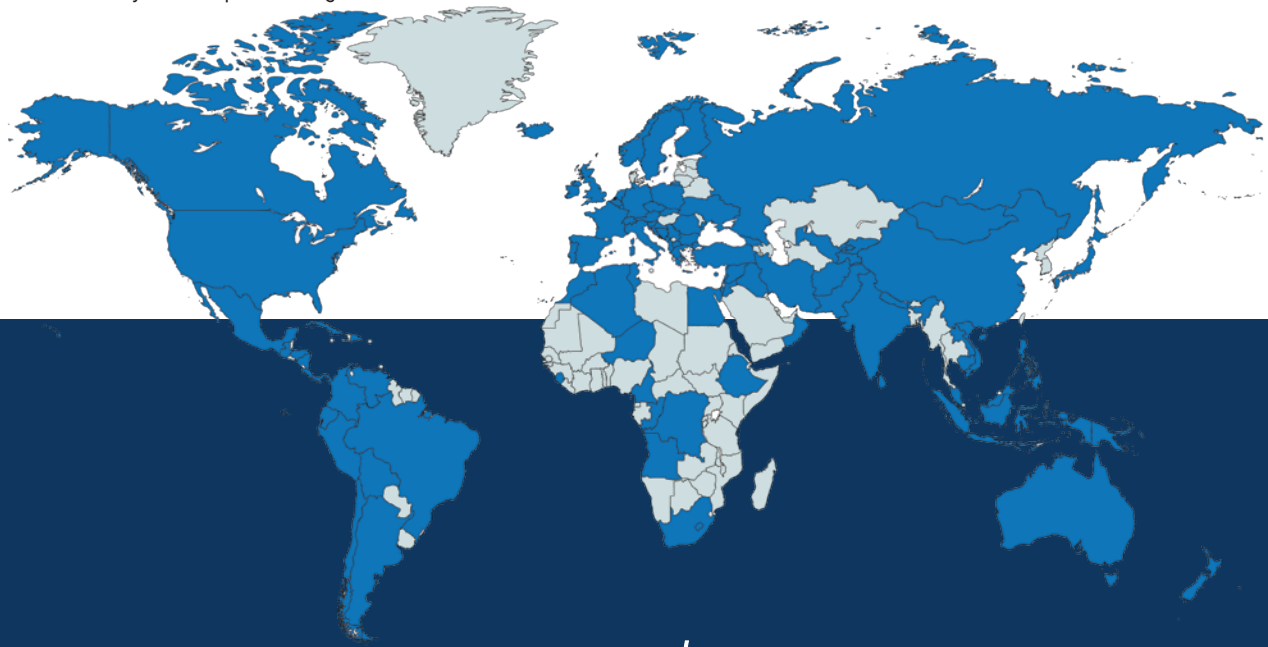
CARPI is a contractor with its own design department and manufacturing capabilities and CARPI is the oldest company in the world dealing with synthetic geomembranes for hydraulic structures.

CARPI HAS THE LONGEST AND LARGEST RECORD IN THE WORLD FOR GEOMEMBRANE INSTALLATIONS IN HYDRAULIC STRUCTURES, WITH GEOMEMBRANE SYSTEMS ON 150+ LARGE DAMS, 50+ CANALS AND HYDRAULIC TUNNELS, AND 30+ RESERVOIRS. (*)

CARPI provides owners and consulting engineers with investigations and recommendations to correct leakage or infiltration problems for almost any type of hydraulic structure. CARPI provides reliable and cost effective solutions, including final design and installation on any project worldwide.

**As of 2016*

CARPI provides design, supply of materials and installation, with **a full and comprehensive warranty.** CARPI has completed more than 1,300 projects worldwide in the most severe environments from the hot and cold temperatures of the mountainous regions to the heat and humidity of the equatorial regions.



Projects and presence

WHAT WE DO

CARPI supplies all the necessary equipment and labour for installations in the dry and underwater at any depth and in any environment.
In an increasingly safety-conscious world, it is a major responsibility of CARPI to provide safe, effective and long-lasting solutions.

CARPI's geomembranes, under the *SIBELON*® trade mark, have successfully performed for over 40 years

TURN-KEY PROJECTS

Waterproofing and protection with SIBELON® geomembranes:

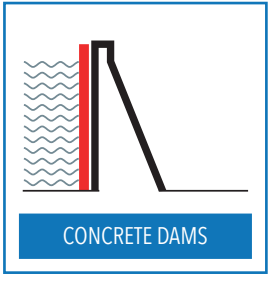
- **Dams, all types** (gravity, buttress, arch, multiple arches, roller compacted concrete (RCC), embankment, cofferdams)
- **Pumped storage, reservoirs, water storage basins, floating covers**
- **Free-flow canals and hydraulic tunnels**
- **Pressure tunnels and shafts**
- **Water supply and sewage systems**
- **Civil works** (foundations and roofing)
- **Highway, railway and metro tunnels**
- **Underground structures** (surge chambers, access shafts to power plants, potable water storage structures)
- **Floating covers to avoid air pollution or liquid evaporation**
- **Synthetic diaphragms against pollutants**

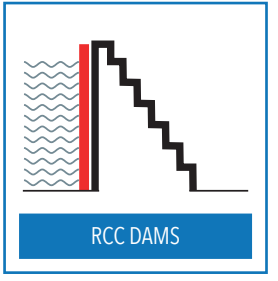
DRY AND UNDERWATER INSTALLATIONS

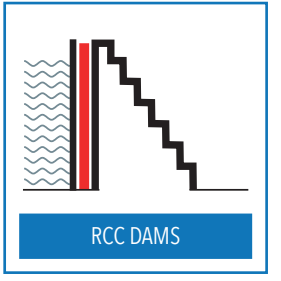
CARPI is the world leader of underwater waterproofing solutions for hydraulic structures. Underwater technologies were developed by CARPI at the beginning of the 1990s. CARPI solutions have been validated by the US Army Corps of Engineers, and applied to many underwater repair projects.

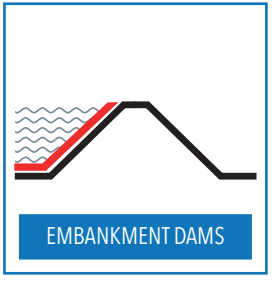
RANGE OF APPLICATIONS

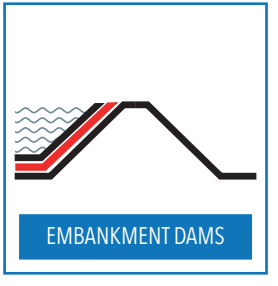
CARPI waterproofing systems stop leakage in hydraulic, civil and environmental protection structures

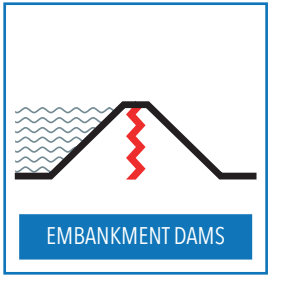


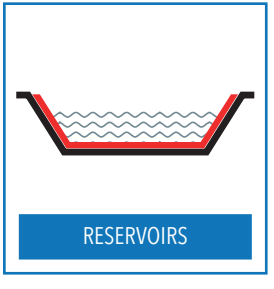


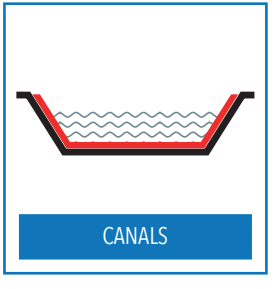


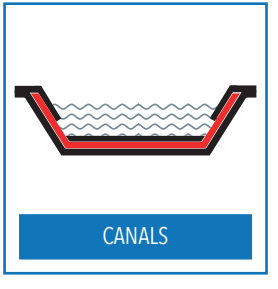


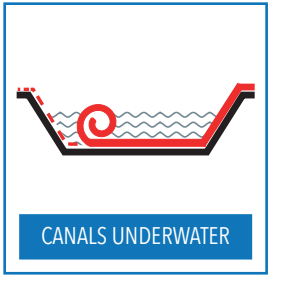






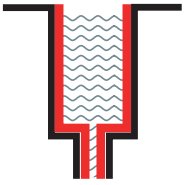




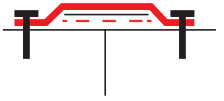


HYDRAULIC TUNNELS

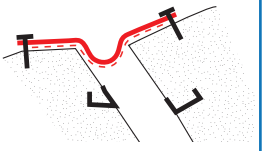
HYDRAULIC TUNNELS



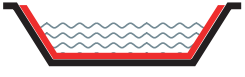
SHAFTS



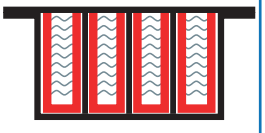
EXTERNAL WATERSTOPS



EXTERNAL WATERSTOPS

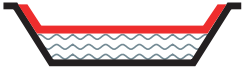


WATER STORAGE

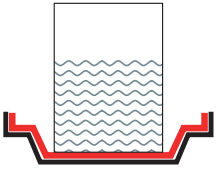


UNDERGROUND WATER STORAGE

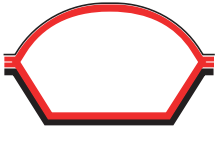
WATER STORAGE



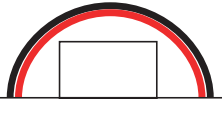
FLOATING COVERS



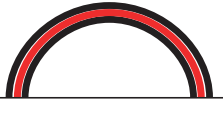
CONTAINMENT



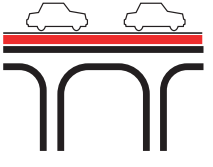
WASTE DISPOSAL



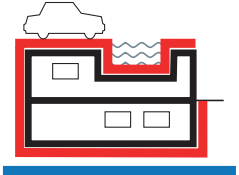
UNDERGROUND STRUCTURES



TRAFFIC TUNNELS



DECK OF BRIDGES



FOUNDATIONS AND ROOFING

CONCRETE DAMS *REHABILITATION*

Full Face/Treatment of Joints and Cracks

Environmental aggression, and in some cases concrete chemistry conditions such as alkali-aggregate reaction (AAR), lead to **water infiltration** with subsequent **cracking and spalling of concrete**, clogging of drains, increased **uplift pressures**, and accelerated further deterioration.

Benefits of *SIBELON*® geomembrane systems:

- Stop water infiltration, bridge joints and large cracks
- Withstand seismic events
- Reduce/prevent uplift pressures
- Provide freeze-thaw protection
- Reduce water content in the dam body, assist in retarding AAR
- Can be installed in the dry and underwater
- Minimum surface preparation
- Documented maintenance free long durability

SIBELON® geomembranes stop water infiltration and give freeze-thaw protection

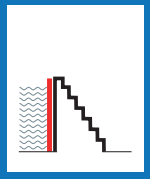
EMBANKMENT DAMS REHABILITATION

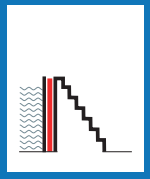
Concrete or bituminous facings of embankment dams **deteriorate** with time and settlement of the dam so that **water infiltration** increases. With age and increased water infiltration, uplift pressures will increase and dangerous **internal erosion** and potential **piping** of the dam may occur.

Benefits of *SIBELON*® geomembrane systems:

- Stop water infiltration
- Provide watertightness even when large settlements occur
- Can withstand seismic events
- Reduce/prevent the formation of uplift pressures
- Avoid the migration of fines in the core
- Prevent internal erosion and piping
- Can be installed in the dry and underwater

SIBELON® geomembranes provide watertightness even in cases of large settlement and seismicity





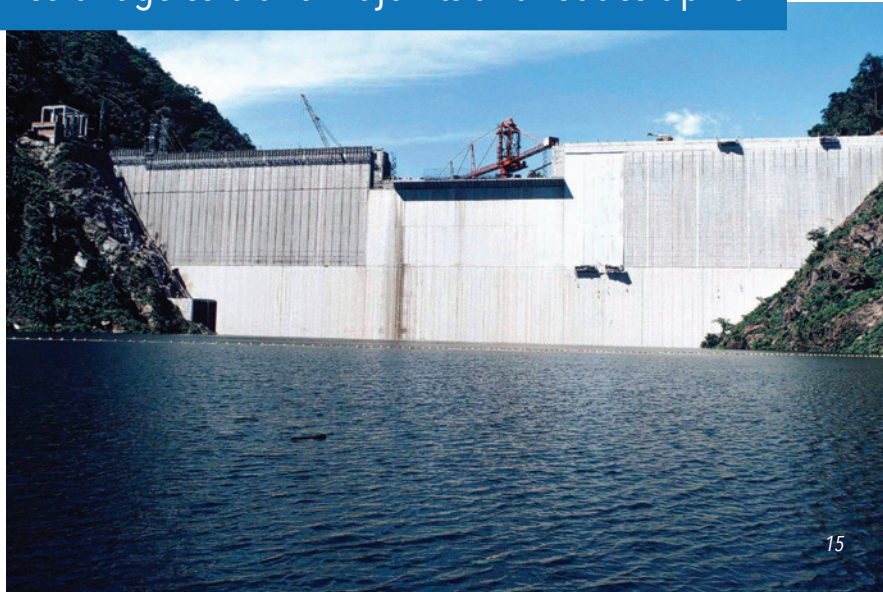
RCC DAMS
NEW CONSTRUCTION

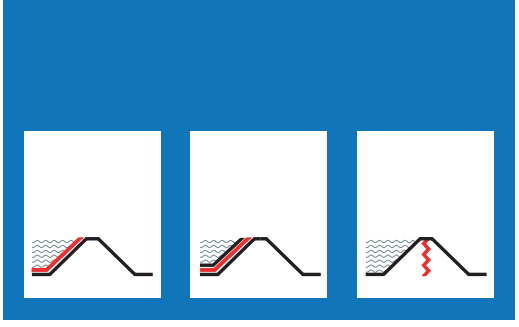
In RCC dams, **leakage** can occur due to possible poor bonding **at the RCC lifts**, inadequate construction at the contact between RCC and conventional concrete appurtenances, or **at vertical induced joints**. The *SIBELON®* geomembrane system is installed to waterproof either the entire upstream face of the RCC dam or construction joints/cracks only. The geomembrane can be left exposed or can be covered.

Benefits of *SIBELON®* geomembrane systems:

- Prevent water infiltration and allow for a face drainage system
- Allow using lower cementitious content in the RCC mix, and aggregates and cement of less stringent properties
- Bridge lift joints and connections with conventional concrete elements
- Face drainage system reduces/prevents the formation of uplift pressures
- Provide freeze-thaw protection to the face
- Make the entire construction procedure easier and more reliable

SIBELON® drained geomembranes bridge cold and lift joints and reduce uplift





EMBANKMENT DAMS, TAILINGS DAMS, COFFERDAMS
NEW CONSTRUCTION

SIBELON® geomembrane facings advantageously **substitute concrete or bituminous concrete facings.** The geomembrane is anchored by geomembrane strips embedded in extruded curbs, or geomembrane bands embedded in trenches, or deep point anchors, or ballast. A geomembrane used as a watertight central core can **substitute clay or bituminous concrete cores.**

Benefits of *SIBELON*® geomembrane systems:

- Provide a watertight barrier withstanding settlement that would cause failure of traditional facings
- Reliable watertight connections between deformable dam body and concrete appurtenances
- Make a project feasible when other suitable materials are not readily available

SIBELON® geomembranes provide watertightness even in cases of large settlement and seismicity

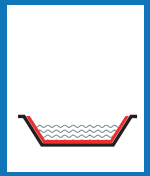
RESERVOIRS, PUMPED STORAGE NEW CONSTRUCTION

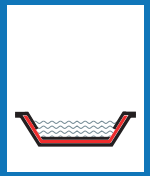
In new reservoirs, *SIBELON*® geomembranes **substitute concrete or bituminous concrete linings**, providing a durable liner. The geomembrane can be left exposed and anchored as described for embankment dams, or be ballasted.

Benefits of *SIBELON*® geomembrane systems:

- Prevent leakage
- Resist differential settlements
- Watertight connections to concrete appurtenances
- Reduce installation time allowing earlier operation
- Protect from deterioration
- Reduce formation of algae, minimise maintenance
- Can be installed on very steep slopes allowing an increased capacity of the reservoir

SIBELON® geomembranes stop leakage, evaporation and contamination





CANALS

Environment and the **dynamic action** of water **deteriorate** canals. Cracking/deterioration of the revetment and of joints allows water infiltration into the surrounding soil and increases surface roughness. The stability of the canal may be undermined, **water flow decreases, water loss** and **vegetation growth** occur.

Benefits of a very smooth *SIBELON*® synthetic geomembrane:

- Stops leakage
- Bridges joints and large cracks
- Protects the canal structure from further deterioration
- Increases the water flow considerably
- Reduces the formation of vegetation and algae
- Minimises maintenance

Documented increase in water flow is up to 90%. If, for structural rehabilitation of old canals, a new concrete layer is required, installing a smooth geomembrane on this new layer allows compensating the reduced cross-section.

SIBELON® geomembranes bridge joints and cracks and increase water flow

SIBELONMAT®

UNDERWATER INSTALLATION IN FLOWING WATER

SIBELONMAT® is a totally new concept for waterproofing canals **without stopping their operation and water flow**. *SIBELONMAT®* consists of two geomembranes connected to form a **watertight double-geomembrane mattress** that is deployed underwater and then filled with a ballasting grout. *SIBELONMAT®* mattresses are connected underwater by watertight zippers pre-attached on the mattress. All installation operations are carried out with remotely operated vehicles (ROVs) or with divers.

Applications:

- Canals
- Embankment dams
- Upstream blankets

Benefits:

- Total watertightness
- No shutdown or outage
- No decrease in water flow

SIBELONMAT® provides watertightness without stopping water flow

UNDERWATER INSTALLATIONS

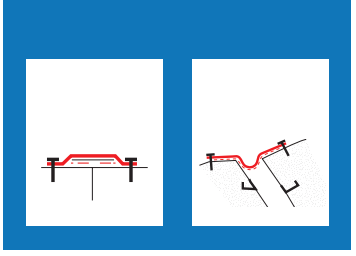
CARPI installs its waterproofing systems underwater.

Benefits:

- Same benefits as the systems installed in the dry
- No shutdown or outage and loss of profit, no significant quantity of water lost, no need to refill the reservoir
- Reduced environmental impact
- No impact on downstream communities, fish hatcheries, recreational areas
- Feasible solution when dewatering is not possible because of project constraints
- Avoid potential problems caused by loading and unloading of the structure

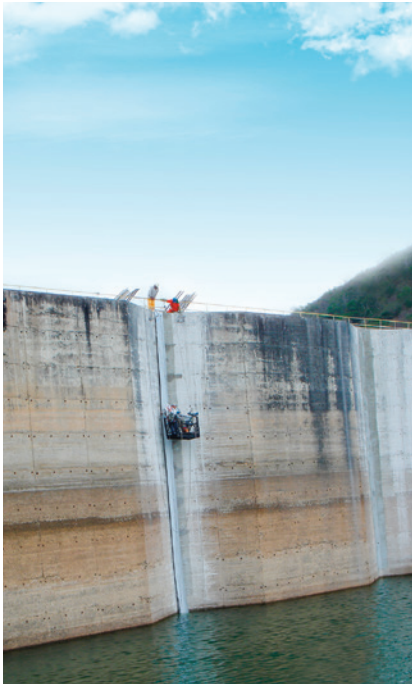
Installation can be performed at any depth, on the entire face of the dam, canal or reservoir, or on more localized critical areas and failing joints or cracks.

Underwater installation does not affect operation and environment



EXTERNAL WATERSTOPS

CARPI external waterstops are designed to resist large joint movements



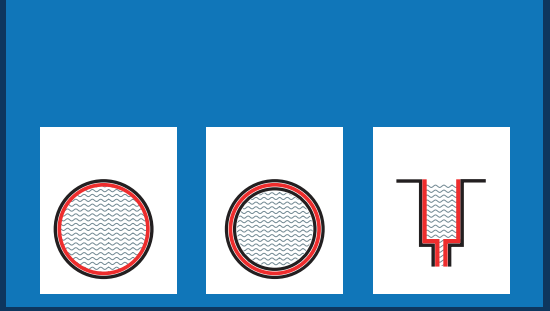
Watertightness at joints is crucial for good performance of dams. Watertightness must be maintained notwithstanding the movements of the joints.

Conventional **embedded waterstops** allow deformation only in the central portion of the bulb, and **cannot withstand large joint movements**.

CARPI external waterstops are designed to provide one single line of defence **capable of resisting** the possible movements with a large factor of safety.

Applications: new construction of RCC dams and CFRDs, dry and underwater rehabilitation of RCC dams, CFRDs, concrete dams.

CARPI external waterstops are installed both in the dry and underwater



HYDRAULIC TUNNELS AND SHAFTS

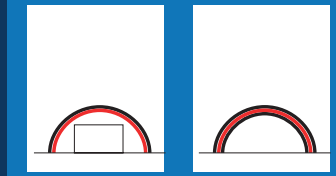
Hydraulic tunnels can be subject to high hydrostatic heads and water velocities that may cause severe **deterioration of the concrete**. Cracking and spalling will allow seepage of water through the structure and **undermine stability**. Increased **roughness** will reduce the water flow.

Benefits of a very smooth synthetic *SIBELON*® geomembrane:

- Stops leakages
- Minimises head loss across the length of the tunnel, ensuring efficient transportation of water
- Provides watertightness even in cracked structures
- Protects the structure from further deterioration
- Increases the water flow considerably
- Reduces the accumulation of sediments
- Minimises future maintenance

When used for rehabilitation, the *SIBELON*® geomembrane is left exposed even with water velocities of several metres/second. When used in new construction, the *SIBELON*® geomembrane is sandwiched between the excavation line and the inner layer of concrete. In this configuration, the concrete provides structural stability while the geomembrane provides watertightness. The CARPI lining system is also very useful to protect ground water in the case of leaking waste water tunnels.

SIBELON® geomembranes stop seepage, increase water flow and minimise maintenance



TRAFFIC TUNNELS UNDERGROUND STRUCTURES

Highway, metro and railway tunnels, underground structures (power plants, car parks, basements, potable water storage structures) must be protected from **water infiltration**, which induces **damage** to electrical systems, **spalling of concrete**, formation of **ice stalactites**, etc.

SIBELON® geomembranes avoid water infiltration and damage to the structure

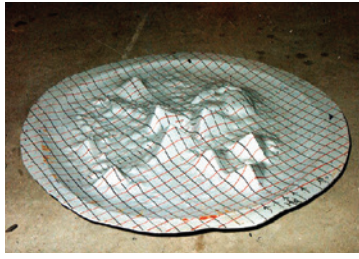
Benefits of a *SIBELON*® geomembrane system:

- Provides watertightness
- Prevents damage to electrical and electronic services
- Creates a barrier to infiltration of gases or hazardous chemicals from the surrounding ground
- When combined with a drainage system, controls the negative effects of pressure on the structure

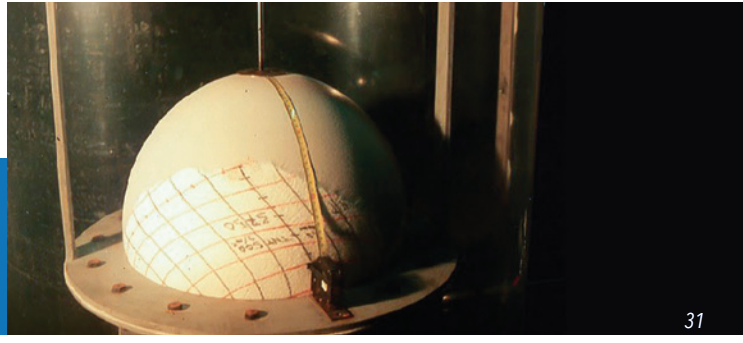
DESIGN, RESEARCH AND DEVELOPMENT

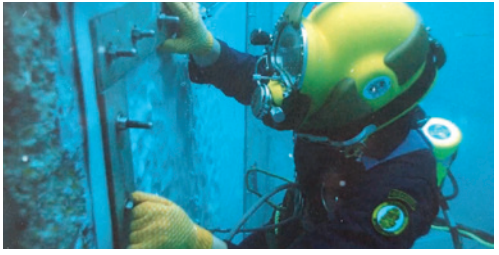
CARPI is constantly improving materials, system technologies and installation techniques. CARPI's laboratories perform large scale tests simulating real-life stress conditions in hydraulic vessels for resistance to puncture, burst, and differential settlement. Equipment includes test apparatus for resistance to seismic events, drainage capability, and friction coefficients. Accelerated aging tests are carried out in independent laboratories.

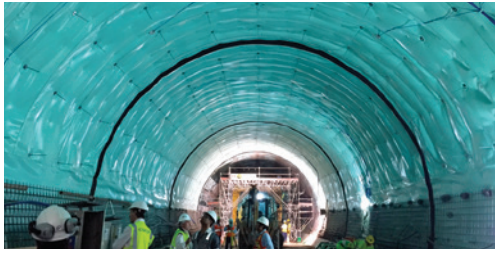
CARPI's materials and systems have been extensively researched by:
TUM – Technical University of Munich
USACE – US Army Corps of Engineers
IREQ – Research Institute of Hydro Québec



CARPI provides innovative and cost-effective patented solutions







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