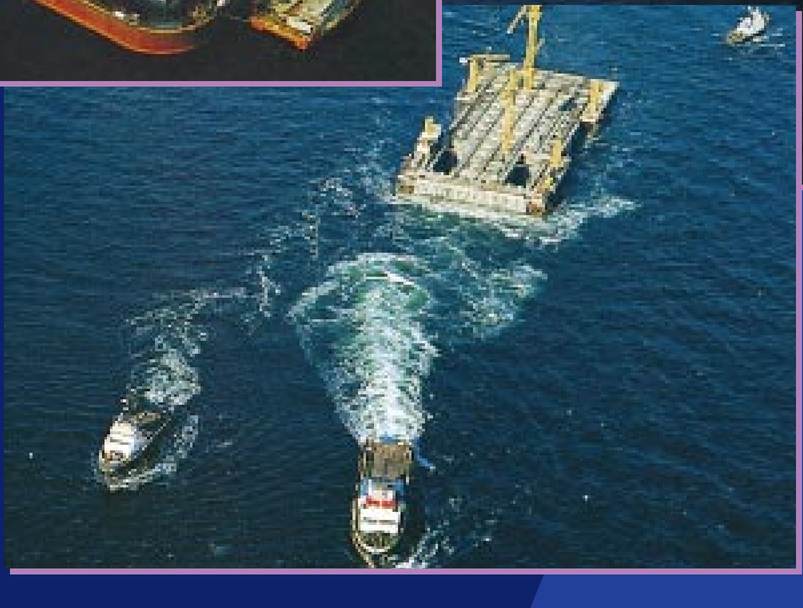
November 1998

Ben C. Gerwick, Inc. NEWS



Ben C. Gerwick, Inc.

NEWS

Published by

Ben C. Gerwick, Inc.
http://www.gerwick.com/

601 Montgomery St., Suite 400
San Francisco, CA 94111
Tel: (415) 398 8972
Fax: (415) 433 8189

112/114 J Street, Suite 200
Sacramento, CA 95814
Tel: (916) 442 8696

for its employees, affiliates and friends.
Please contact the President for permission to reprint articles.

Cover Picture

Great Belt Bridge
in Denmark,
opened in June 1998

Contents

COWI

BUCKLAND & TAYLOR LTD.
Bridge Engineering

COWI Consulting Engineers and Planners AS have bought Canada's leading bridge company, Buckland & Taylor Ltd., which – in addition to its leading position in Canada – also has a solid foot hold in the USA.

Buckland & Taylor was founded in 1970 by Peter G. Buckland and Peter R. Taylor. With a staff of 65 the company specializes in the design of major bridges as well as maintenance and repair projects.

Buckland & Taylor designed and supervised construction for the previous world record cable stayed bridge, Alex Fraser Bridge in Vancouver. In 1991 this bridge was passed by the present record span bridge, Pont de Normandie, for which the steel box girder and cable suspension system was designed by COWI.

The acquisition of Buckland & Taylor is a step in the fulfillment of COWI's global strategy to be one of the leading bridge designers in the world. A previous step was made about 10 years ago, when COWI bought the majority of Ben C. Gerwick, Inc.

New Publications and Presentations

FIB Symposium, 1999, Prague;
Precast concrete applications for navigation dams and marine bridge piers,
by Paul E. Bach.

Scandinavia-America Foundation, U.C. Berkeley, February 1998;
World Bridges in Scandinavia
by Paul E. Bach

Precast Concrete Manufacturers of California, Sacramento Seminar, September 1998;
Ductility of Prestressed Piles
by George C. Fotinos

ACI Conference (Los Angeles) October 1998;
Seismic Design of the Underwater World Aquarium
by George C. Fotinos

George C. Fotinos was awarded *Life Membership to the American Society of Civil Engineers in September 1998*

DFI - Geosystems for Future Transportation Systems, October 1998;
Micropile Foundation Retrofit Design for the Richmond-San Rafael Bridge
by Patrick E. Durnal

Innovative Bridge Retrofit

Precast Concrete Jackets

As part of the seismic retrofit design of the Richmond – San Rafael Bridge, Ben C. Gerwick, Inc. developed a concept of using precast concrete jackets to strengthen the existing concrete piers. Unlike steel jackets, concrete jackets can be designed to resist corrosion in the aggressive tidal-splash zone for the remaining 100-year life expectancy of the bridge. A concrete mix with a low water-cement ratio, fly ash, and moderate amounts of an active pozzolan will be specified to allow the jackets to be constructed using a 2.5-inch minimum concrete cover with un-coated reinforcement. The concrete in the splash and tidal zone will receive a polyurea coating. This reduced cover impedes micro cracking and reduces the weight of the jackets.

The concrete jackets will be match-cast horizontally in approximately 10-foot tall segments and placed around the existing shafts, spandrel beam and diaphragm wall in two halves, connected by transverse HS rods. HS rods will also connect the precast segments vertically.

Two-thirds of the precast concrete jackets will be submerged under water when placed in their final position. The precast jacket concept allows for a high degree of offsite prefabrication followed by in the wet erection with minimal use of divers.

The existing shafts are cleaned as necessary by high-pressure jets before placing the precast jackets. An erection frame is placed on top of the existing shafts that allows two precast segments to be placed on each side of the concrete substructure above water. HS rods are used to connect the segments on the outside of the shafts.

Richmond-San Rafael Bridge – precast concrete jackets retrofit

The segments are then lowered down making room for the next two segments to be placed. Prior to joining the segments an epoxy coating is placed on top of the match-cast surfaces. This can be done above water. The next two segments are then placed and bolted together on the outside of the shafts. Vertical HS rods are then placed in ducts and connected to the first segments through couplers. The vertical HS rods are then pre-stressed.

More segments can now be placed, bolted and stressed together until the entire precast concrete jacket is lowered to its final position. All this work can be accommodated without the use of divers. The last items to be installed are the HS rods on the inside of the existing shafts, some of these penetrating the diaphragm wall below water. Divers will be required to assist in coring the holes through the four-foot thick diaphragm wall. Oversized preformed holes in the precast jackets will guide the coring equipment. Installation of guide rails on the precast jackets before they are lowered into the water can also facilitate the underwater coring operation.

Construction is scheduled to start in 1999.

Thomas Dahlgren

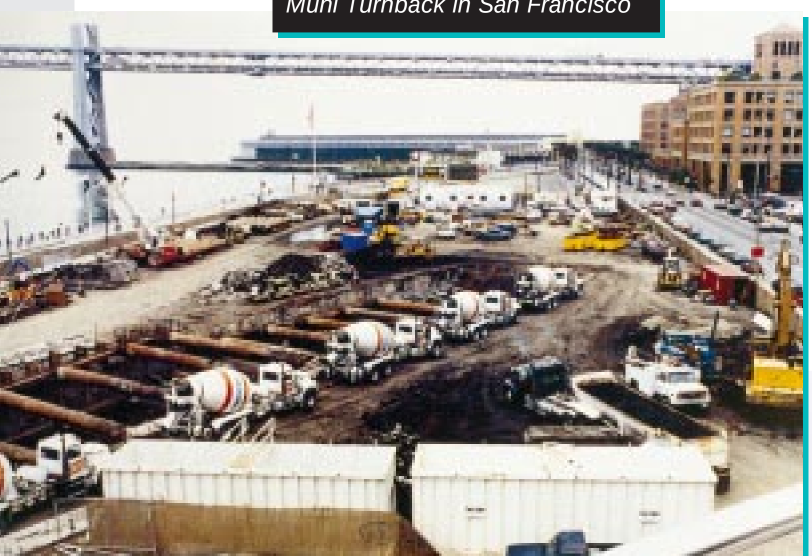
Specialty Consultant Services

Heavy Civil Engineering Projects

Port of Los Angeles new Pier 400 project

Key individuals from Ben C. Gerwick, Inc. are frequently requested to serve as specialist consultants and / or as members of Technical Advisory Boards / Technical Review Committees. This has led to meaningful if limited roles in a wide range of projects, both domestic and international, which in turn have broadened the experience within the company.

The ASCE annually selects the Outstanding Civil Engineering Projects for the year. We are proud that our firm has participated as a member of the TRC for the San Francisco Muni Turnback which was designed by Bechtel with the assistance

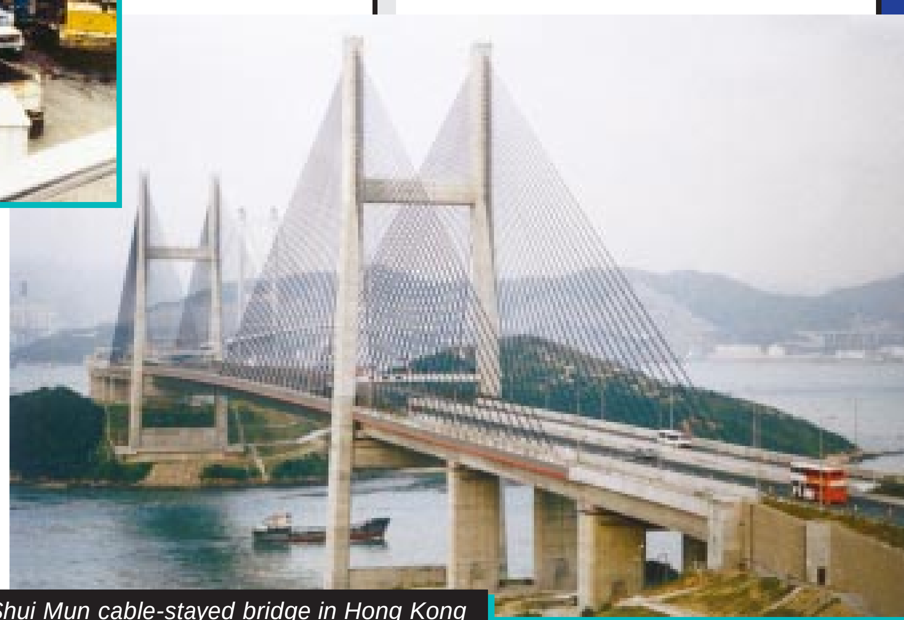


Muni Turnback in San Francisco

of Dames and Moore. This project was selected by ASCE for the Grand Conceptor Award for 1998.

In addition, there were seven projects selected for the Grand Award. Personnel from our firm participated in two of these; the Kap Shui Mun cable-stayed bridge in Hong Kong, designed by Greiner Corp. with Leonhardt and Andrea, for whom our client was the Hong Kong Highway Department, and the Confederation Bridge, also known as the Prince Edward Island Bridge, in Eastern Canada, where we were involved with the design consultant, JMI-Stanley and the Strait Crossing Joint Venture, consisting of SCI (Canada), Morrison Knudsen (USA), GTM (France) and Ballast Nedham (Netherlands).

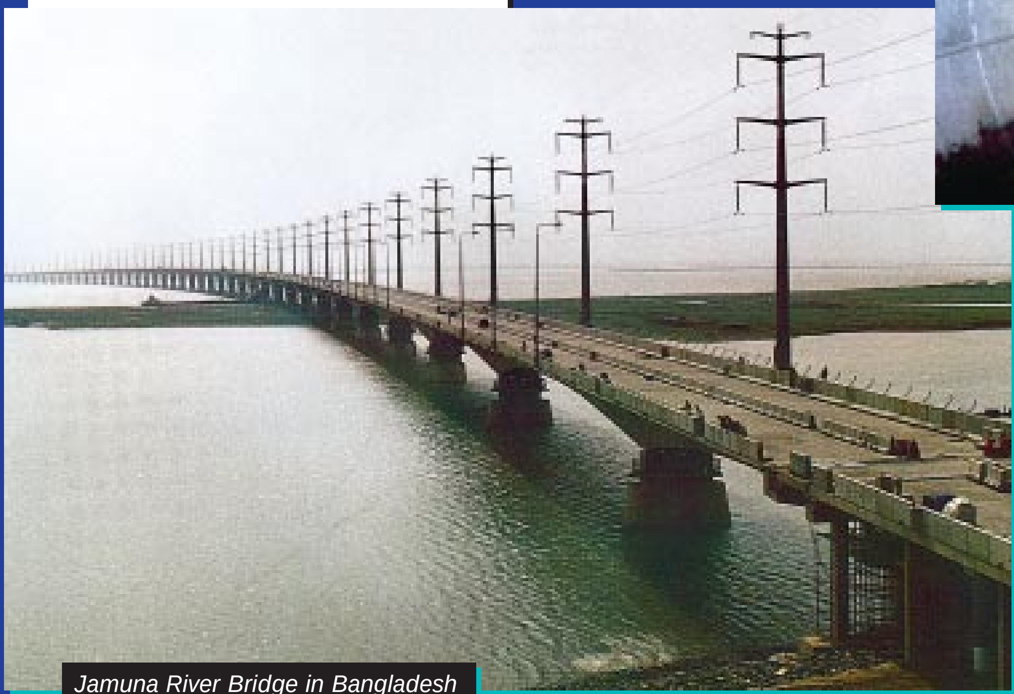
As specialist consultants or as members of review boards or committees, the range of expertise required varies widely. The work has included durability of concrete on such projects as the tunnel liners for the Channel and Great Belt Tunnels, to underwater shaft



Kap Shui Mun cable-stayed bridge in Hong Kong excavation for outfall risers in the ocean and intakes in existing reservoirs. Other projects have included the Port of Los Angeles new Pier 400 project, the Hibernia ice-berg resistant offshore platform, and a number of bridges including the seismic retrofit of the bridges across San Francisco and San Diego Bays, the Jamuna

Confederation Bridge in Eastern Canada

English Channel Tunnel



Jamuna River Bridge in Bangladesh

River Bridge in Bangladesh, the Woodrow Wilson Bridge in Washington DC and the Fehmarn Crossing between Denmark and Germany.

Some of these projects have been previously presented in the BCG News, others will be in future issues. We are indeed grateful for the opportunities which have been afforded us to participate by Owners, Consulting Engineers and Contractors.

Ben C. Gerwick

Hibernia ice-berg resistant offshore platform in Newfoundland

Port of Port Arthur

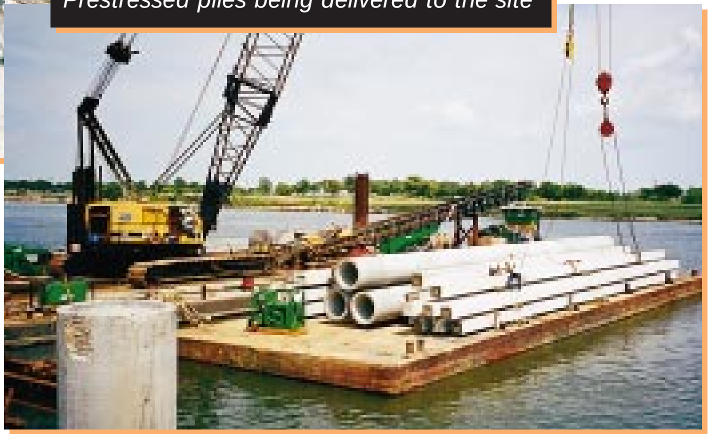
Installation of Concrete Cylinder Piles

For the expansion of the new 1,700 foot long marginal wharf at the Port of Port Arthur, Port Arthur, Texas, 54 inch diameter prestressed concrete cylinder piles are being installed along the back row of the new wharf. These cylinder piles provide support for the container crane and provide lateral resistance to berthing and mooring forces from the ships at berth. The use of the vertical cylinder piles eliminates the need for any batter piles, thus resulting in a structure that is both simple to build and economical.

The cylinder piles are driven into a marine clay layer to depths up to 138 feet below sea level. The wharf contractor, Misener Marine Construction of Tampa, Florida, is using a Vulcan 0-20 air/steam hammer to drive the piles to grade. A total of 89 cylinder piles are required for the project.

The piles are manufactured at Gulf Coast Prestress in Pass Christian, Mississippi and barged to the site. The piles are manufactured in 16 feet lengths using the spinning method of fabrication. The 16 feet length cylinders are then prestressed together with 32-1/2 inch diameter low-relaxation prestressing strands to form cylinder piles up to 148 feet long. The effective prestress in the piles is 1,200 psi. Minimum concrete strength is 7,000 psi at 28 days. The longest cylinder pile weighs 62 tons.

Prestressed piles being delivered to the site



In addition to the cylinder piles, 20 inch square and 24 inch square prestressed piles are being installed in all other rows of the wharf. A total of 490 of these smaller piles are required for the project.

The construction cost of the Phase II contract is $ 27,295,000 and includes backland improvements. McCarthy Brothers is the General Contractor. The wharf contract is $ 11,363,000. On a square foot basis the wharf cost is $ 92/sf.

George C. Fotinos

Offsite Prefabrication

Assessment of Concrete Technologies for Inland Waterways

Tremie concrete production with a floating batch plant and transit mixers

The U.S. Army Corps of Engineers has initiated several major lock and dam developments using 'in-the-wet' or 'offsite prefabrication' construction methods. These innovative methods utilize precast concrete modules into which underwater tremie concrete is placed without the use of conventional cofferdams. Studies have shown that the offsite prefabrication construction methods will not only lead to substantial savings in cost and construction time, but will also minimize adverse effects on river traffic during construction.

As part of the Corps of Engineers' innovative construction initiative, the U.S. Army Engineers Waterways Experiment Station (WES) launched a comprehensive research program on various offsite prefabrication construction technologies. As a part of the WES's research effort, Ben C. Gerwick, Inc. has been undertaking special assignments to perform studies on three technical subjects:

Assessment of floating crane equipment and lift-in techniques for transporting and installing large precast concrete segments — the study evaluates the cost, performance, suitability and availability of various overwater lifting equipment. The study also identifies and classifies the types of precast concrete segments for lift-in construction in terms of their sizes, weights, configurations, and general characteristics for transportation and installation.

Assessment of underwater concrete construction technologies — this investigation reviews the performance requirements of tremie concrete, production and placement methods and procedures.

Review of prestressing concrete technology — historically, prestressed concrete has only had a limited use in inland waterways navigation structures. With offsite prefabrication construction methods it is perceived that the use of prestressing will increase. The relevant subjects include; the design criteria for the ultimate strength requirements, serviceability requirements, fatigue strength requirements, and durability for offshore structures.

Lift-in construction with a jack-up barge

These special projects will further the transfer of marine construction technologies to the inland waterways. Publication of the study reports will also help to disseminate the special marine construction techniques and experience within the engineering and construction communities.

Sam Yao

Great Belt Bridge Opening

Improving the European Transportation System

An important step to improve the northern European transportation network was the opening in June, 1998 of the last phase of the USD 4 billion Great Belt fixed link in Denmark. The 18 km wide Great Belt is divided into two channels, east and west, by the island of Sprogo. The link consists of three major structures: A bored railway tunnel, opened in 1997, the now opened high level motorway bridge across the east channel, and a low-level bridge for rail and motorway across the west channel, also opened in 1997.

Casting of caissons and bridge piers

Pylon construction by climbing forms

The high level Eastern Bridge spans the international shipping route between the Baltic and the North Sea. It has a suspension main span of 1,624 m. The design was developed by the CBR joint venture of COWI, B. Hojlund Rasmussen and Ramboll & Hannemann, with support from Ben C. Gerwick, Inc. for constructibility for deep water foundations.

Rising 254 m above sea level, both pylons of the suspension bridge are located in water depth of 20 m. After excavation of a deep layer of soft till, a trimmed bed of crushed stone was placed and compacted.

Cellular 78 x 35 m caissons, 20 m high, and weighing 30,000 tonnes, were cast in a dry dock 20 km from the bridge site. The caisson was equipped with 0.5 m high skirts, which penetrated into the stone bed. Full contact between the stone bed and the caisson was secured by grouting.

The two anchor block structures are located at a water depth of 10 m. They were designed to resist inclined cable forces of 60,000 t. Excavation down to 25 m below sea level was done as a wedge shaped foundation base to provide shear resistance to the large horizontal loading. Artificial islands were constructed around the anchor blocks in order to ease the water flow around the large structures and to provide protection against ship impact.

Paul E. Bach