March 2001

Ben C. Gerwick, Inc.

NEWS

Ben C. Gerwick, Inc. NEWS

President's Memo

Ben C. Gerwick, Inc. is a leader in engineering of deep-foundation structures, including new design and repairs and upgrading of concrete structures and complex bridges. The company specializes in construction and concrete technology problems encountered in harsh marine environments, difficult soils and earthquake prone areas.

The current issue of Ben C. Gerwick, Inc. illustrates such skills. In addition you may read about innovative ways to improve the economy, schedule, constructibility, durability and construction tolerances of marine structures.

Read how piled decks for new marine airport runways, under-water seismic upgrading of bridge footings, pre-cast concrete bridge footings, lock wall repairs and new approach walls and novel applications of composite materials for a navy pier all depend upon innovative use of off-site prefabrication, "in-the-wet" construction with either floating means or crane barges and offshore joining techniques.

Finally, you will appreciate that the additional benefits to off-site prefabrication often include significantly increased redundancy to construction schedules, considerably less disruption to vehicular and vessel traffic during construction and considerably less environmental impact. We have much of which to be proud.

Paul E. Bach

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for its employees, affiliates and friends.

Cover Picture
Renovation on the Upper Mississippi River at Clarksville, Missouri.

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Ben C. Gerwick, Inc. is an internationally known civil/structural consulting firm located in San Francisco specialized in the construction of major marine structures for more than 70 years, first as a heavy construction company, and since 1971 as consulting engineers.

In 1989, Ben C. Gerwick, Inc. joined COWI Consulting Engineers and Planners AS, an engineering company with headquarters in Denmark, founded in 1930. The parent company of Ben C. Gerwick, Inc. operates from 25 offices and employs more than 2,100 people worldwide. The firms augment one another's strengths and share resources to benefit their clients.

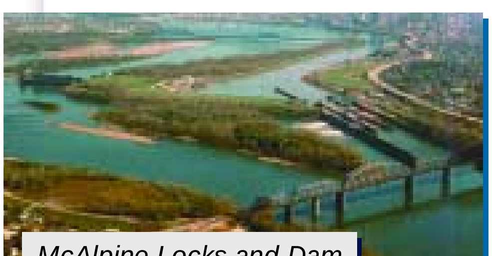
McAlpine Locks Approach Walls

Ohio River — Offsite Prefabrication

Ben C. Gerwick, Inc. has teamed with Horner & Shifrin, Inc., St. Louis, to design new upstream and downstream approach walls at McAlpine Locks and Dam on the Ohio River for the US Army Corps of Engineers.

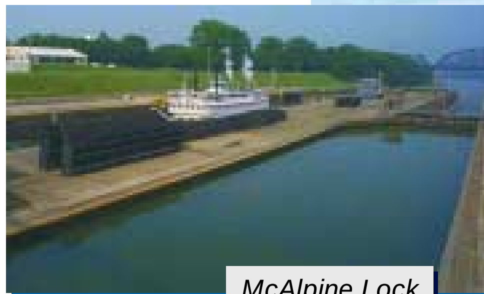
The client sought Ben C. Gerwick, Inc.'s expertise in off-site prefabrication and innovative "in-the-wet" construction methods to develop a preliminary design that would minimize underwater construction activities, as well as the number and sizes of beams and drilled shafts.

The McAlpine approach wall structures will consist of a sheet pile end cell, piers and precast post-tensioned concrete box wall beams supported by the end cell, the piers and the end of the lock wall. Each upstream approach wall span will consist of precast box beams (77 feet long) stacked one on top of the other. Each downstream approach wall span will consist of stacked beams (86 feet long). Each of the upstream and downstream piers has three 6 feet diameter, or three 5 feet diameter drilled shafts, respectively, supporting a pier cap and buttress.


McAlpine Locks and Dam

The drilled shafts will be stabbed into rock, with horizontal alignment provided by a steel template. A rock socket will be drilled within the shaft, cleaned out, a reinforcing cage inserted, then back filled with tremie concrete. Each drilled shaft is fitted with a pre-cast concrete collar that seals to the shaft casing.

The precast pile cap shell is then positioned by crane and lowered to the proper elevation. The weight of the pile cap shell will push the collars down with it. Once the pile cap shell is positioned it can be temporarily supported from beams placed on top of the pile casings. The annuli between the drilled shafts and the shell bottom slab are then grouted. Once the grout has reached design strength, the shell can be dewatered, and the temporary supports removed. Then construction of the reinforced pile cap can proceed in the dry.


McAlpine Lock


Inserting auger in drilled shaft casing

On completion of the pile cap, the precast concrete box beams (constructed offsite) can be barged to the site, and positioned atop the pile caps by crane. The weight of the heavier (upstream wall) box beams is 530 kips each. The pier cap and buttress piers are notched to accept the precast concrete box beams, which are supported both vertically and laterally by elastomeric bearings.

Construction of the pier buttresses will proceed concurrently with placement of the box beams, with the ends of the box beams acting as partial forms for the pier buttresses. The pier buttress rises from the pier cap up to the top of wall elevation and provides lateral resistance.

This "in-the-wet" method of construction will provide better quality control of the precast elements offsite, reduce onsite labor costs and minimize disruption to ongoing barge traffic using the existing lock.


Robert J. Filgas, P.E.

Engineering Standards
For Marine Oil Terminals

The California State Lands Commission (SLC) formed the Marine Facilities Division (MFD) in 1990 to oversee the more than sixty existing marine oil terminals in California. The creation of the MFD was a result of the passing of the Lempert-Keene-Seastrand Oil Spill Prevention and Response Act of 1990. The Act, in short, requires the SLC to adopt rules and regulations that minimize the possibility of a discharge of oil.

No engineering standards currently exist that would help the SLC meet the goals of this new Act. As a result, the SLC engaged Ben C. Gerwick, Inc. (in a Joint Venture with Han-Padron Associates) to help them develop practicable state-of-the-art engineering design and maintenance regulations that each oil terminal will be subjected to in the future.

One of the major concerns is the ability of the existing facilities to sustain a seismic event without causing a major oil spill. All of the sixty marine oil terminals in California were built before today's much stricter seismic design codes. In fact, about 40% of the existing terminals were built before 1940 and about 90% of the facilities were built before 1970. The seismic design criteria developed by the JV is based on the latest knowledge in performance based seismic design that assures the capacity of the existing facility is fully utilized, which in turn will reduce an eventual retrofit cost.

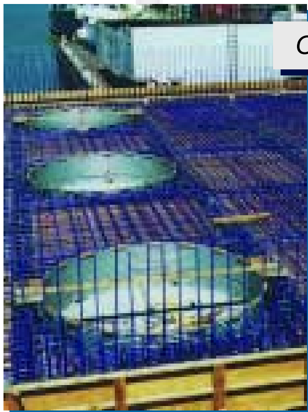
Another concern is the size of the oil carrying vessels, which in general have become larger over the years. In many cases the marine oil terminals were not built directly to berth such vessels. The new engineering regulations therefore include requirements for mooring and berthing evaluations that justify the size of the vessel that berth at the facility.

The State Lands Commission hopes to implement these requirements as regulations in 2002.

Thomas Dahlgren, P.E.

Float-In Cofferdams

For the New Carquinez Bridge



Performing work over water has always been more difficult and costly than performing the same work on land. And when the work is performed below water, the difficulties and cost difference can increase geometrically with the depth at which the work is performed. The key to performing marine construction work efficiently is to minimize work over water, and perform as much of the work as possible on land. The use of float-in cofferdams to construct marine bridge foundations has been a successful application of this principle. Ben C. Gerwick, Inc. first proposed the use of this concept four years ago on the Bath-Woolwich Bridge in Maine. Recently, Caltrans has recognized the schedule and cost advantages of this construction method and has applied it to the design of the main tower foundations for their new suspension bridge across Carquinez Strait at the north end of San Francisco Bay.

The contract for the new bridge was awarded in early 2000 to a Joint Venture of FCI Constructors, Inc./Cleveland Bridge California, Inc. Shortly after the contract award, the Joint Venture selected Ben C. Gerwick, Inc. to modify Caltran's float-in cofferdam concept and further reduce the need for onsite work.

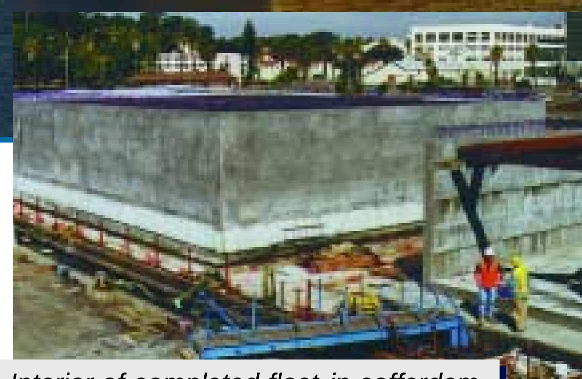
Six 3-m diameter drilled shafts will support each of the four main tower legs for the new bridge. The tops of the drilled shafts will be capped by 5.14 m deep footings, 18m by 20 m in plan. The bottom elevation of the footings is set at 2.34 m below mean sea level. The original design provided by Caltrans envisioned casting the footing shells offsite, floating the shells to the bridge and landing them on pre-installed erection frames (or falsework). The intended concept was to use the footing shells as temporary cofferdams and as templates for the installation of drill shaft casings.

Ben C. Gerwick and the Joint Venture modified the original concept by designing a temporary support system that allowed the float-in cofferdams to be landed directly on the pre-installed drill shaft casings rather than on a separate falsework system. The modified design offered the following significant advantages:

1) Early start for the drilled shaft installation (an activity on the critical path) by allowing casing installation to commence before completion of the float-in cofferdam.
2) Shorter construction schedule by allowing casing installation to run independently of and concurrently with cofferdam fabrication.
3) Lower construction cost by eliminating the need for erection frame or any other temporary falsework support for the float-in cofferdam.

Casting float-in cofferdams on deck of barge

Float-in cofferdams at dock side



Interior of completed float-in cofferdam

Robert Bittner, P.E.

FRP Composite Floating Pier

Development of Advanced Concepts and Material Uses

As a subconsultant to BERGER/ABAM, Ben C. Gerwick, Inc. is currently working with the Naval Facilities Engineering Service Center (NFESC) in an effort to develop new structural concepts for Navy pier construction by using lightweight concrete and fiber reinforced plastic (FRP) composites. The essential requirements for the new pier concepts include cost competitiveness, durability, modularity, and service enhancement. The new Navy pier should have an initial cost comparable with conventional construction and a 75-year maintenance-free service life. It should also be modular in order to facilitate offsite prefabrication and future modification.

Finishing of self compacting

The first phase of the project focuses on assessment of overall concepts in terms of functional utility, constructibility and cost. The study also establishes general FRP/ lightweight concrete design criteria, anchorage/mooring system, lightweight concrete technology and durability evaluation. The initial investigation concludes that a carbon fiber-reinforced/prestressed, lightweight concrete, double-deck, floating pier has substantial advantages over conventional piers. The offsite prefabrication of the floating pier allows the least amount of work and time span for onsite/over-water construction. The floating double deck pier system enhances modularity and improves efficient layout of utility systems. The use of FRP materials for reinforcement, hardware and utility components further improves durability of the pier structure.

As a follow-up to the first phase investigation, experimental tests were conducted. Gerwick was asked to develop self-compacting lightweight concrete. This is new technology that requires a trial-and-error process. Numerous trial batch tests were conducted to develop a suitable concrete mix. After the concrete was verified in two small-scale constructibility tests for homogeneity, flowability and self-compaction, the mix was used to fabricate large-load test specimens at the Pomeroy Precast Plant. Workability of the concrete was found to be very sensitive to production variables, such as the type of batch plant (mixing efficiency), batch size, moisture in the aggregates and type and amount of admixtures used. As the mix proportions were adjusted during the construction, the quality of the concrete improved. An important lesson from this experiment is that successful full-scale production of self-compacting, lightweight concrete requires both trial batching with actual production equipment and materials, and good quality control of the production/placement operations.

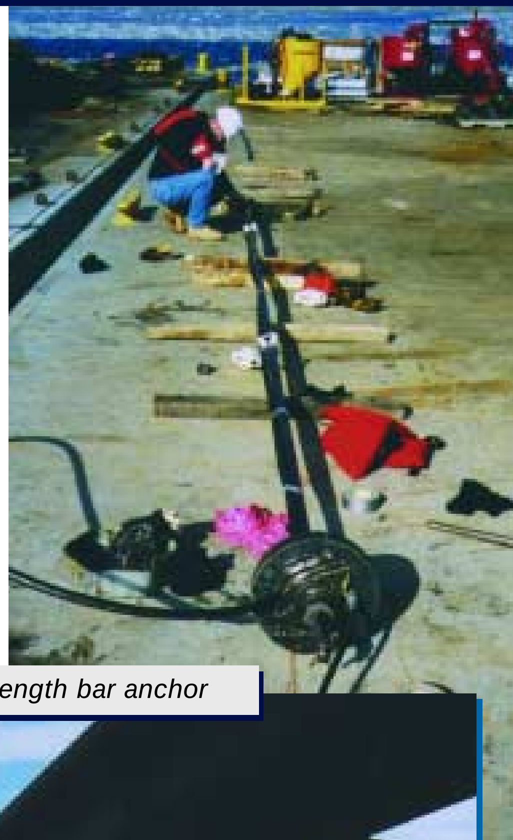
Test to verify flowability, homogeneity, and self compaction

Sam Yao, Ph.D., P.E.

Value Engineering

For the I-40 Mississippi River Bridge

In December 1999, Ben C. Gerwick, Inc. developed an alternative "in-the-wet" design to eliminate the 80-foot deep cofferdams required to retrofit the pile caps on the I-40 Mississippi River Bridge at Memphis, Tennessee. The concept, which significantly reduced the cost and risk associated with the in-river construction, was presented to the successful bidder, Massman Construction Co., the same month. With their first hand knowledge as the original builder of the bridge, they fully appreciated the difficulties associated with constructing the deep cofferdams and elected to pursue acceptance of a value engineering cost saving proposal.



High-strength bar anchor

Overwater spans

After Massman successfully obtained a contract amendment to include provisions for value engineering, Gerwick and Massman worked jointly to develop a proposal for submission to the Tennessee Department of Transportation.

The value engineering concept utilized an alternative strut and tie mechanism to reduce the flexural demand on the pile caps, eliminating the need for additional top mats of horizontal reinforcement. Vertical prestressed bar reinforcement that could be installed using underwater drilling equipment and grouting techniques was designed to create composite action between the pile caps and deep tremie seals. The increased section depth reduced flexural tension stresses under earthquake demands to values well below that normally required to cause concrete cracking, making horizontal reinforcement unnecessary.

While Gerwick completed the engineering, Massman obtained core samples of the pile cap and tremie seal concrete to validate the adequacy of the design assumptions. As it turned out, the tremie seal concrete had higher average compressive strengths than the piles caps, approaching 12,000 psi. The seals proved to be sound and homogeneous with only minor traces of laitance, which were shown not to be detrimental to the design or safety of the bridge.

The Owner approved our value engineering proposal in August last year. The net savings of approximately $4 Million will be split equally between the Owner and Contractor.

Foundation drilling operations

Both Gerwick's engineering effort and the cost of Massman's core sampling were performed at risk, so it was welcome news when the Owner and Designer of Record accepted our innovative alternative construction technique that benefited all.

John Vincent, P.E.

Lock 24 Renovation

Renovation on the Upper Mississippi River

The Svedrup/Gerwick Joint Venture has completed the design for the renovation of Lock 24 on the Upper Missippi River. The lock requires extensive rehabilitation in order to repair deterioration from such sources as alkali silica reaction, freeze thaw damage, abrasion and impact. Key aspects of the renovation include:

Lock 24

a) demolition of large areas of deteriorated concrete;
b) the use of precast concrete panels to reface the lock;
c) provision of new maintenance bulkhead slots on the downstream end of the lock;
d) work on the auxiliary lock bay;
e) general civil upgrades to the service areas of the lock;
f) removal and replacement of various lock appurtenances;
g) rewiring of the lock.

Lock 24 at Clarksville, Missouri was designed and constructed in the 1930s. The lock chamber is 600' long, 110' wide and has a nominal lift of 15 feet between the lower and upper pools. The lock walls are made up of a series of mostly unreinforced, concrete gravity retaining walls (monoliths). In the early 1980s, as the auxiliary gate was deteriorating, a sheet pile and rock dam was constructed, upstream of the auxiliary gate. In March, 2000, the COE installed new upper and lower miter gates in the main lock chamber.

In areas of the walls that are too close to buildings or equipment for blasting, other concrete removal techniques are used. The walls are rebuilt using a combination of cast-in-place concrete and precast concrete panels for the exposed surfaces. Drilled and grouted anchors and cast-in-place concrete are used to tie the new precast panels to remaining portions of the existing concrete walls. To accomplish this work, the lock chamber is dewatered, allowing construction activity in the dry.

To avoid halting traffic on the river, construction activities which require shutting down the lock will only be allowed during the winter closure periods of up to 90 days. As part of the design effort, a constructability study was performed and a construction schedule was developed. The COE has allocated the winter closures of 2001-2002, 2002-2003, and 2003-2004 for the rehabilitation.

Dale Berner, Ph.D., P.E.,
Gerry Stauder, P.E.
Jeff Stamper, P.E

New Publications and Presentations

American Society of Civil Engineers National Convention
Seattle, WA
October 20, 2000
"The Tsing Ma Suspension Bridge"
By Ben C. Gerwick, Jr., P.E.

Oresund Link Immersed Tunnel Conference
Copenhagen, Denmark
April 2000
"Prefabrication of Tunnel Elements," Paper D2
"Contractor-Designer Teamwork, The Key Element of Success in Design Built," Paper D3
By Robert Bittner, P.E.

American Society of Civil Engineers National Convention
Seattle, WA
October 20, 2000
The ASCE Construction Division honored Ben C. Gerwick, Jr., "The worldwide authority on offshore structures, pioneering the development and application of large diameter tubular piling, and the offsite prefabrication and installation of large foundation substructures," with the Distinguished Constructor Award.

SEAONC
San Francisco, CA
September 27, 2000
"Innovative Marine/Inland Waterways: Construction Techniques"
By Dale Berner, Ph.D., P.E.

Swedish and Danish Chamber of Commerce
San Francisco, CA
October 2000
"Opening of the Oresund Fixed Link".
By Niels Gimsing and Paul E. Bach

Profile:

Dale Berner, Ph.D., P.E.

As Vice President, Dale Berner is in charge of engineering for the design and rehabilitation of concrete structures in the marine/aquatic environment, including bridge foundations, dams, locks, wharves, offshore platforms and cooling water intake structures at Ben C. Gerwick, Inc. Since joining the firm in 1983, he has provided expertise in the areas of: construction engineering, high-strength concrete, concrete mix designs, cathodic protection, underwater concrete protection and underwater concrete repair techniques. In addition to his other responsibilities, he has been the Design Manager for the final design of the Olmsted Dam on the Ohio River since 1996.

He graduated with a Ph.D. in Civil Engineering from the University of California, Berkeley, in 1984.