

FRP Floating Composite Pier

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.

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.



Template for pre-installation of drilled shafts.



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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 Pre-cast 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.

Services Performed:

- **Fiber Reinforced Plastic Composites**
- **Lightweight Concrete**
- **Pre-cast Concrete**
- **Pre-stressed Concrete**
- **Concrete Durability**
- **Offsite Prefabrication**
- **Constructibility**
- **Design Criteria**
- **Experimental Testing**
- **Concrete Mix Design**

Year of Completion: 2001

Construction Cost: \$10M

Client: Naval Facilities
Engineering Service Center