Honeycomb design concept for floating concrete structures

Prestressed framing system invented by Alfred A. Yee offers many technological and cost advantages

A prestressed concrete honeycomb design for building a wide variety of marine structures is now available for use under a worldwide license held by Global Marine Development Inc. of Newport Beach, Calif.

The innovative framing system, which provides a high-strength and low-weight characteristic, was developed by Alfred A. Yee of Honolulu-based Alfred A. Yee & Associates.

Rebar template cylinder reinforcing assembly.

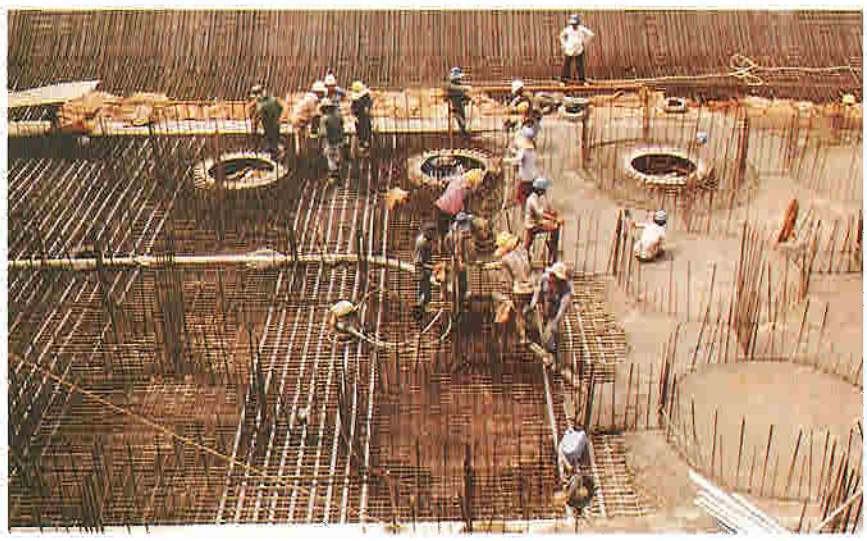
Applications with the concept include offshore drilling rigs; barges; petroleum tanks; floating dry docks, piers and bridges; ocean-going repair and processing vessels; and floating plants.

The system employs a honeycomb sandwich design consisting of vertical cylindrical cells aligned in rows and connected to each other by thin concrete walls with the prestressed slabs forming the top and bottom layers.

Generally, the interconnected web system (to resist the shear) is constructed with reinforced concrete and does not require prestressing. The top and bottom slabs (acting as flanges) can be post-tensioned in one or two directions for economic reasons.

The integration of multiple shear webs with the top and bottom slab results in a structure having extremely high rigidity and hull strength in two directions.

High-magnitude deck loading resistance is accomplished by the close spacing of the multiple shear webs. This concept is well known in the aircraft industry where minimal material and lightness in structure are of paramount importance.



Progressive pouring of the barge's bottom slab.

Advantages of the honeycomb design over other structural framing systems includes:

Economy: The honeycomb system provides the greatest strength and rigidity for the least amount of materials.

Ease of Construction: The design can be built using present well-known construction techniques without the need for new equipment. Further, it permits the use of modular construction techniques and precasting.

Structural Strengths: The design provides exceptional longitudinal and torsional strength for resisting total bending moments and shear.

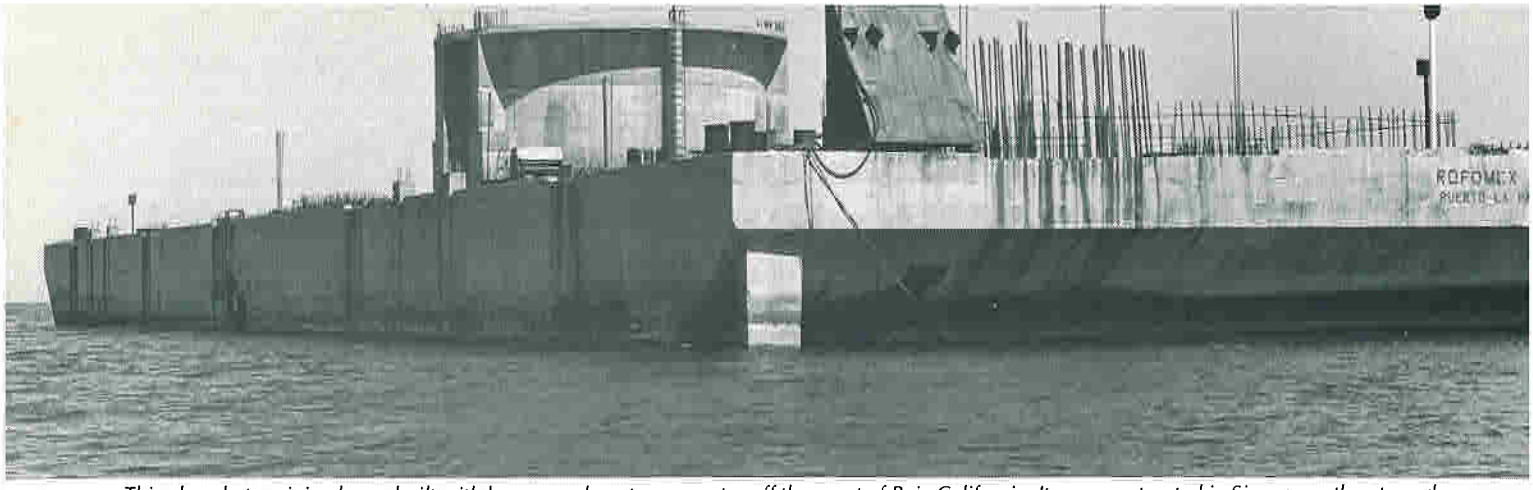
Rigidity: The system provides exceptional rigidity, thus making the structure extremely suitable for a permanent platform such as floating or gravity foundations for self-contained production plants.

Ease of Compartmentation: The honeycomb pattern lends itself toward compartmentalizing, thus providing separate compartments for storage of different liquids such as fuel, chemicals, water, oil, etc., as may be desired or required. Should damage occur, the destabilizing effect is minimal.

Submergence Control: Because of the plurality of cylindrical cells within the tank, a high degree of submergence control is easily achieved when needed. This facilitates trimming and stabilizing the structure for towing, loading and unloading, as well as in grounding and emplacement operations.

Vibration Damping Characteristics: The structure provides excellent damping characteristics to absorb machinery vibrations and noise.

Damage Resistance: The excep-



This phosphate-mining barge built with honeycomb system operates off the coast of Baja California. It was constructed in Singapore, then towed 10,000 miles to its present site.

tional inherent structural strength and plurality of the cylindrical cells offered by the system can localize and contain accidental damage due to collision, explosion or other mishaps and thus prevent uncontrolled sinking, capsizing or leakage.

Safeguard Against Environmental Pollution: Because of the inherent honeycomb structural cell elements and the protective double wall side shell, mass leakage of pollutants into the sea is avoided in case of mishaps, such as the tank being rammed by a ship.

Parallel Construction: The concept allows the cylindrical cells to be prefabricated at the same time slabs are being poured. All this activity can be taking place simultaneously on a noninterference basis.

Not long ago, the honeycomb system was used for the design of a barge platform to accommodate a floating phosphate plant. Fabricated in Singapore, the barge was towed some 10,000 miles to Baja California where it is operated by the Rofomex Co. in Mexico.

The barge, which is 260 ft. long, 110 ft. wide and 24 ft. deep, was constructed in 14 months. It is expected to provide continuous service for 80 years without the need for dry-docking.

Alfred A. Yee & Associates is a division of the architect-engineer Leo A. Daly Co. headquartered in Omaha, Neb. □

Top left: Workers shown forming barge cylinders. Bottom left: Precast circular and star-shaped slabs help form top deck. Top right: Here construction crew pours top deck. Bottom right: Stressing operations at stern of barge.