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As specific events provide a highlight to particular requirements, the concept of applying large, stable floating structures to a variety of military missions and civilian needs is given increased emphasis about every 8 to 10 years. The recent military activity in the Persian Gulf and the frustrating negotiations for continued use of the U.S. bases overseas (particularly in the Philippine Islands) have once again provided such emphasis. In the past, conceptual and technological capabilities have indicated the viability of applying large modular floating structures to replace the past reliance on foreign sites for forward area logistic and tactical support missions; and to provide immediate fully operational capability versus repetitive, expensive, long-term construction. This paper describes

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FLOATING STABLE PLATFORMS: CONCEPTS AND APPLICATIONS

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Introduction

As specific events provide a highlight to particular requirements, the concept of applying large, stable floating structures to a variety of military missions and civilian needs is given increased emphasis about every 8 to 10 years. The recent military activity in the Persian Gulf and the frustrating negotiations for continued use of the U.S. bases overseas (particularly in the Philippine Islands) have once again provided such emphasis. In the past, conceptual and technological capabilities have indicated the viability of applying large modular floating structures to replace the past reliance on foreign sites for forward area logistic and tactical support missions; and to provide immediate fully operational capability versus repetitive, expensive, long-term construction.

This paper's objective is to describe some early work by the U.S. Navy on a mobile ocean basing system (MOBS) concept, and to relate how the Navy concepts and principles could also be applied to current needs. Mr. Dan Hightower will present a companion paper providing an update of current workshops in the United States and reviewing the status of floating structures engineering. He will also prepare a program plan to develop a full-scale demonstration and engineering development validation model.

Requirements

A recurring Navy requirement has called for a transportable (mobile) forward tactical base from which aircraft could be launched for participation in tactical missions and which would provide docking facilities for surface craft engaged in patrol activities. It would also serve as a support and deployment point for personnel involved in the tactical missions. Logistic support requirements for the base, as well as for the missions originating from it, call for runways long enough for large transport aircraft and docking facilities for large ships. A large floating stable platform of modular construction was viewed as the concept which would best meet these Navy requirements.

The project came to be known as the Mobile Ocean Basing System (MOBS). The MOBS team was under the direction of the Office of Naval Research and the Defense Advanced Research Project Agency. The makeup of the team reflected a high level of intra-Navy cooperation. In addition to scientists and engineers from the Naval Ocean Systems Center, there were personnel from the Naval Civil Engineering Laboratory (Port Hueneme, California), the David Taylor Research Center (Carderock, Maryland), and the Naval Postgraduate School (Monterey, California). The team sought to meet the Navy requirement by fully developing the floating stable platform concept.

This concept was originally proposed to provide a major support base to be placed off the coast of Vietnam. Instead, a major base was constructed at great expense at Cam Ranh Bay, and later abandoned to be used by Soviet Russia. If a modular floating stable platform had been applied, the construction would have been accomplished in the continental United States at a great cost savings, and the platform could have been withdrawn at the conclusion of operations, retained for our own re-use, and thus, denied to the Soviets. Similarly, in the Indian Ocean, we could have had an immediate mobile floating "Diego Garcia" base, one that could be used as a bargaining "chip" in negotiations for other overseas bases (Philippines, Iceland, Spain, Greece, Beirut, etc.).

Floating Stable Platform Features

The concept validation model of a modular floating stable platform as conceived by the team is shown in Figure 1. This configuration offers all of the distinctive features which make the floating stable platform concept so attractive. First, there are the stability features that are the result of a small water plane area and a large mass and buoyancy at the base of the platform. Unlike the hull of a displacement-hull vessel (tugboat, destroyer, etc.), which is constantly affected by the surface wave action, the large, buoyant base of the floating stable platform is well below the surface wave action. The deck of the platform is well above the energy of the wave action. The only part of the platform modules subject to the forces of wave or swell action is a narrow segment of the vertical column (small relative to the total mass of the module).

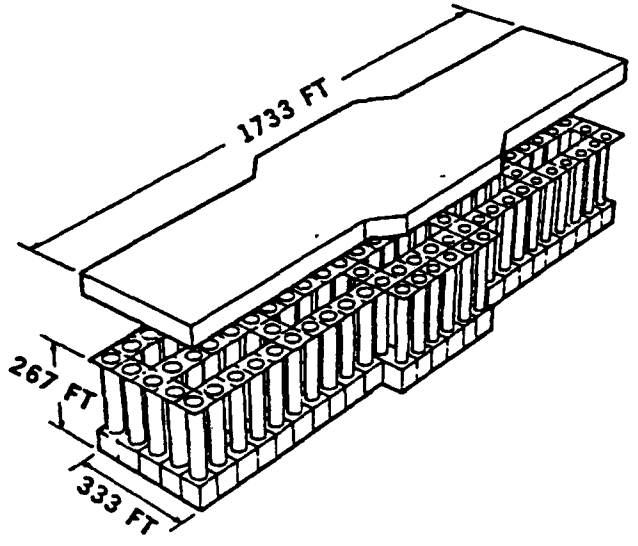

Figure 1. Modular floating stable platform concept.

Second, there are the fabrication and construction features. The modular approach provides for great versatility. The basic module can be easily formed from concrete—a low-cost, malleable material—by means of repetitive forms, such as those used for fabrication of tubes for the San Francisco Bay Area Rapid Transit (BART) or the large aqueduct pipes for the California water system. The tubes (and tube construction methods) for BART, which enabled the transit system to go under San Fransisco Bay, were of particular interest to the team working on the floating platform because the BART tubes are approximately the same length and diameter as the basic module for the floating stable platform. Each BART tube was formed in concrete in a graving dock, the dock flooded, and the tube floated to the appropriate area, ballasted, and lowered into position on the sea floor.

The same type of fabrication methods and materials (repetitive forms and concrete) will be used for the platform modules. Also the modular approach, while standardizing the basic unit, permits a wide range of possible configurations, i.e., the modules can be arranged in many different shapes. Each project could select a configuration which best meets its immediate need. Should that need change, the modular approach allows for easy modification of the configuration or for replacement of individual modules. If one or more modules are damaged due to accidents or attacks, the rest can well support the structure.

The hydrodynamic response of a floating stable platform has been demonstrated by testing a model. Figure 2 shows the model of another float configuration floating in a wave tank. Wave tests were also run on individual modules. In order to determine the model's stability (resistance to pitch, roll, and heave), many wave tank tests have been conducted. All the results indicate that the modularly constructed floating platform operates in an extremely stable condition during all expected sea states.

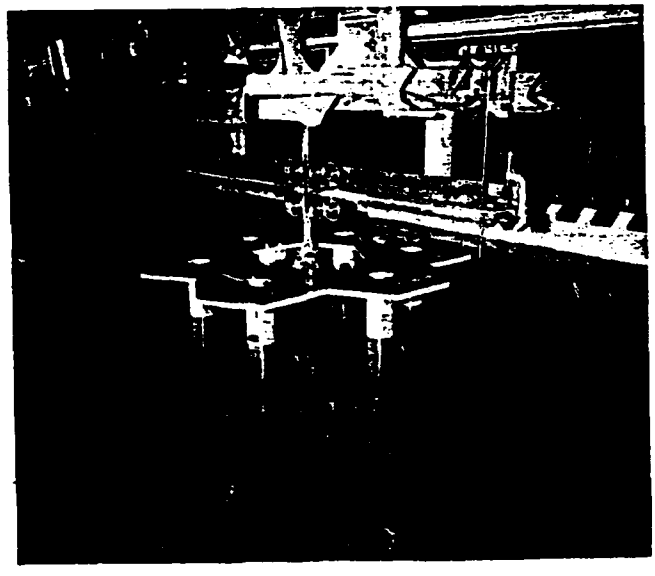

Figure 2. Floating stable platform model.

So the question is, how does the floating stable platform meet the Navy requirement for a floating, forward tactical base, the mobile ocean basing system (MOBS)? It can be shown that, by using the floating stable platform approach, the MOBS platform offers better time, material, and cost trade-offs; better security; and greater versatility than a comparable land base constructed in a forward tactical area. For example, consider a land site installation such as the Cam Ranh Bay base, approximately 180 miles northeast of Saigon, Vietnam. The base had to be designed for the particular location, carved out of the jungle, and maintained in a hostile environment (climatically and politically). When the base was vacated, the mobile equipment was salvaged, but the buildings and runways were

left behind, for use by potential enemies. A multimillion dollar investment was abandoned. The MOBS platform provides an alternative which is not only less costly, but offers advantages unique to the concept.

Figure 3 shows a large MOBS-type platform that could be substituted for a base like that at Cam Ranh Bay or Diego Garcia. First, it would be available faster. The MOBS modules, having been prebuilt in the continental United States (thereby providing civilian jobs in CONUS), could be stockpiled in strategic locations throughout the world. From there the modules could quickly be assembled into the appropriate configuration (which may be changed to meet changing needs), equipped, and placed in position 10 to 50 miles from shore. Once in place and operating, the MOBS platform would not only meet the support and logistic requirements for a forward tactical base, it would be far more secure than the permanent-site base. It would be more secure against infiltration by sappers, against the plundering that can quickly denude permanent sites, and against mortar attacks (the platform is out of attack range, but close enough to support onshore ground forces). Then, when the requirement for that particular base no longer exists, the platform is either removed to a new strategic location or dismantled and stockpiled for future needs. Thus the completion of a requirement for the MOBS platform does not entail the loss of construction expenditures. Overall, the considered use of the floating stable platform concept means a more effective use of military funds. The floating stable platform concept in its military application as MOBS obviously meets the Navy's stated requirements quite successfully.

As a result of pursuing the feasibility studies on the floating stable platform, the Navy has developed a considerable amount of documentation on the technological outputs of the program. This documentation includes information on such things as material trade-off studies, detailed hydrodynamic test data, stability analyses, module construction techniques, and module attachment and configuration techniques. Aware that this technology can have useful applications in the civilian sector, the Navy has encouraged and is presently encouraging its dissemination throughout various scientific, industrial, and governmental communities. Platform data have been requested for use in connection with concepts for airports, power plants, offshore drilling and construction platforms, and industrial, and exposition sites.

Conclusion

Since the U.S. Navy's mobile ocean basing system study and experiments were completed, there have been many concept studies and designs developed for very large floating stable platforms. In a wide variety of applications, in many parts of the world, these large special-purpose platforms have been built, transported over vast distances, and successfully operated to support their basic requirements in various resources and transportation industries. Most of the MOBS-type individual components and procedures have been proven. The time has come to reassess the floating stable platform concepts and determine a plan of action to build a full-scale demonstration model.

Mr. Dan Hightower's paper will describe some current planning efforts to accomplish the goal of building a full-scale demonstration model.

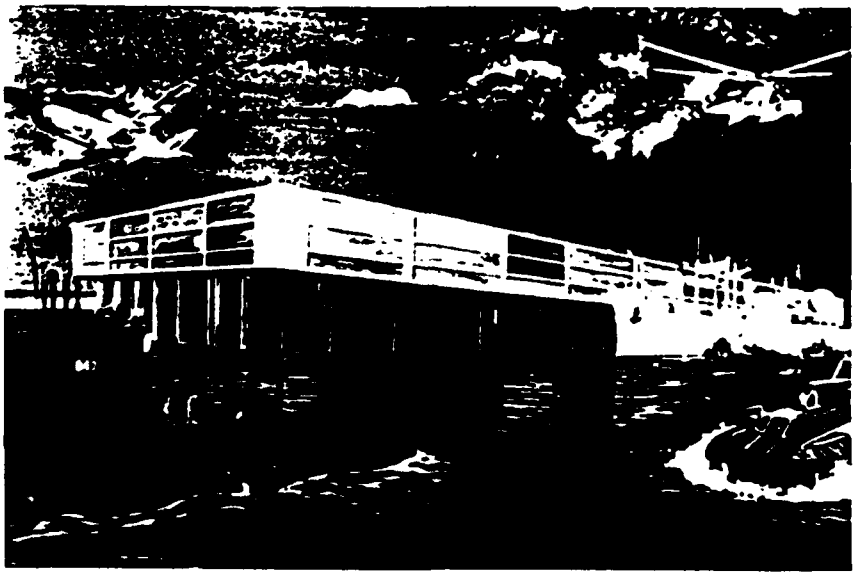

Figure 3. The 1000 × 4000 ft MOBS platform (artistic concept).

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