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THE FLOATING STABLE PLATFORM: TRANS-  
FERRING NAVY TECHNOLOGY TO CIVILIAN  
APPLICATIONS

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Naval Undersea Center

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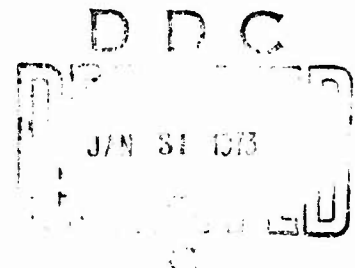


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13 ABSTRACT The Navy has conducted research and development on the concept of using floating stable platforms for combatant missions. Much of the technological data developed is directly applicable to solutions for civilian problem areas, such as offshore floating airports, nuclear power generating plants, construction support bases, industrial sites, trans-shipping terminals, and water processing plants. This report discusses the technology developed by the Navy, and describes several applications when the transfer of this technology to civilian applications can benefit contemporary society.  <b>Details of illustrations in this document may be better studied on microfiche</b>			

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## INTRODUCTION

Just as NASA's Man-in-Space Program developed a technology that provided many beneficial results for the civilian sector, so too the Navy, in its efforts to meet its missions requirements, has acquired a technological expertise that can be directly applied to many civilian matters. The purpose of this report is to show how the Navy met one of its requirements by the conception and design development of the Floating Stable Platform, and how the civilian use of the platform concept and technology can offer solutions for some of the problems facing contemporary society.

## NAVY PROGRAM

The Navy requirement called for a 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 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 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 Undersea Center, there were personnel from the Naval Civil Engineering Laboratory (Port Hueneme, California), the Naval Ships Research and Development 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.

## FLOATING STABLE PLATFORM FEATURES

The modular Floating Stable Platform as conceived by the team is shown in Fig. 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 that is small relative to the total mass of the module.

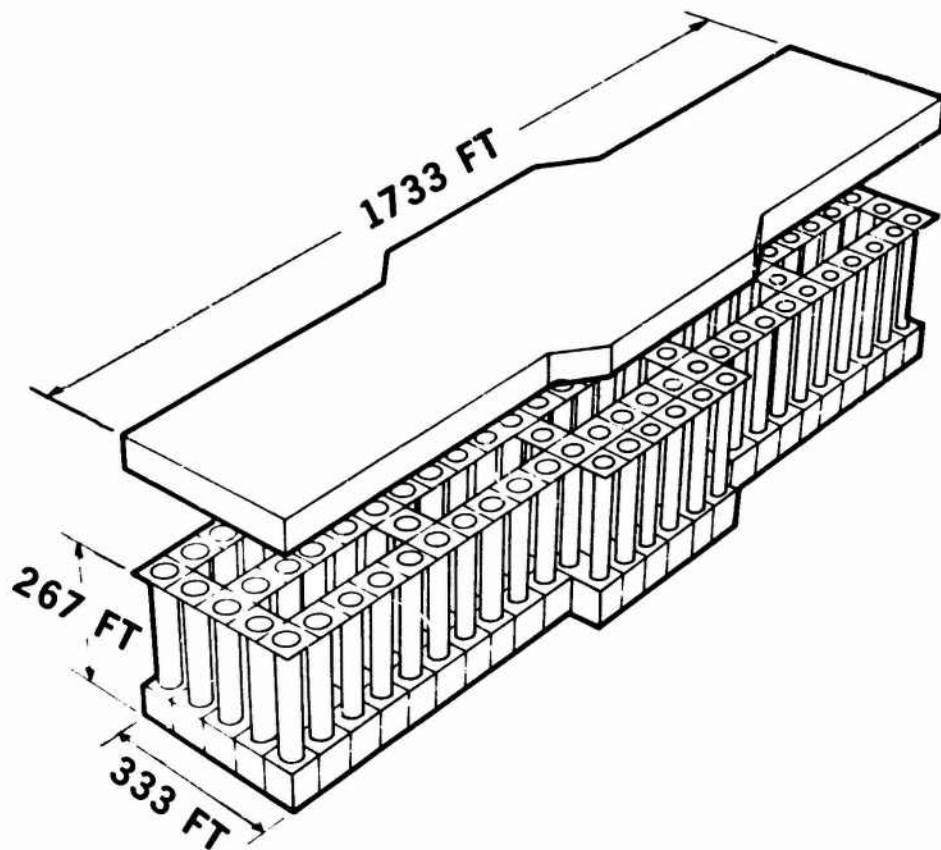


Figure 1. Modular Floating Stable Platform concept.

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 Francisco 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 required.

The hydrodynamic response of a Floating Stable Platform has been demonstrated by testing a model developed by personnel from the Naval Undersea Center. Figure 2 shows



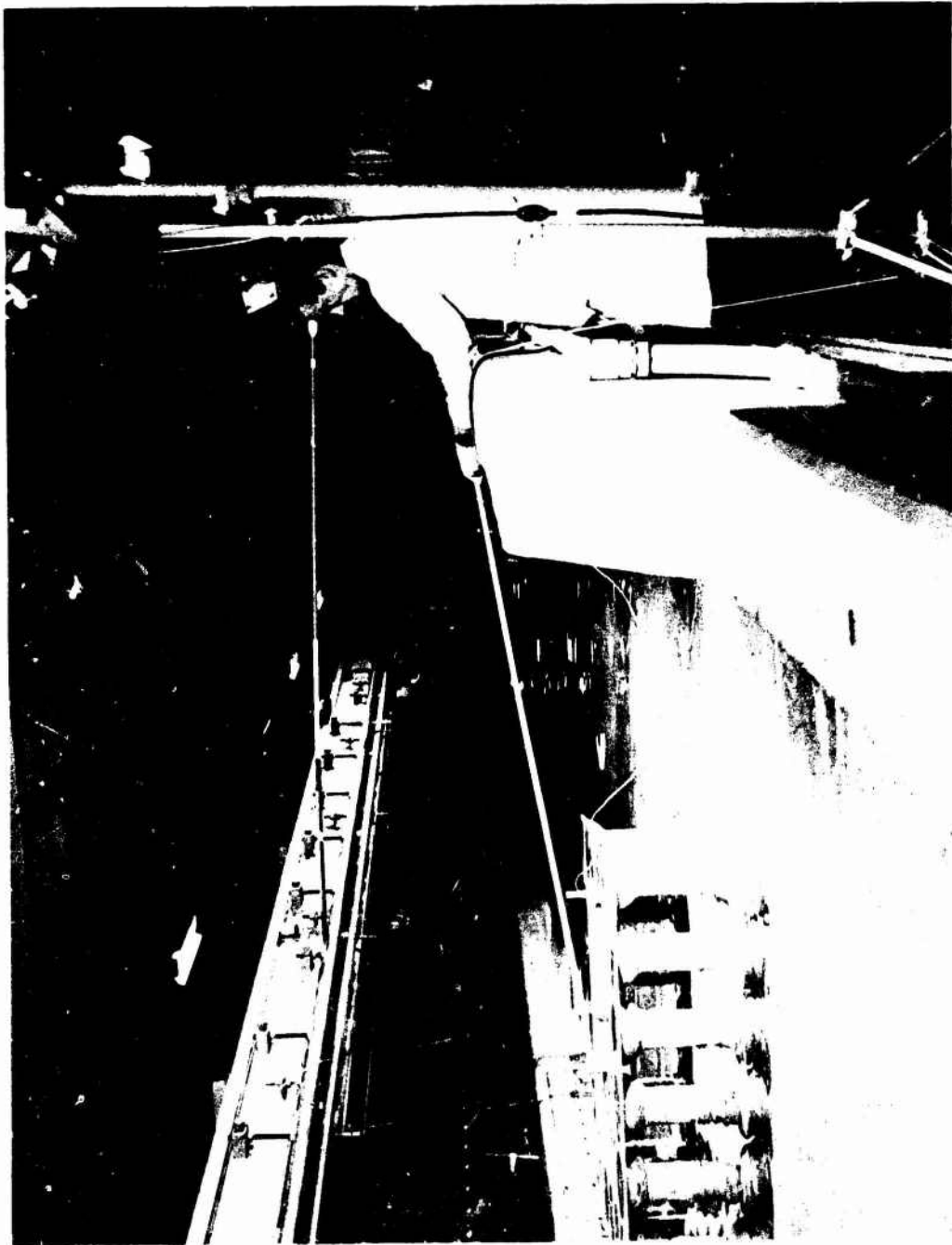


Figure 2. Floating Stable Platform model and individual module.

the model floating in a wave tank as well as an individual module. 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.

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, perhaps never to be used again. 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. 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 3 to 5 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 loss of a requirement for the MOBS platform does not entail the loss of construction expenditures and, 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. Table 1 lists a few of the many contacts the Navy has had with civilian organizations that were interested in data on floating stable platforms. The platform data requested was to be used in connection with airports, power plants, offshore drilling and construction platforms, industrial sites, and exposition sites.



Figure 3. The 1000 x 4000 ft MOBS Platform (artistic concept).

Table 1. Civilian Requests for Data.

Organization	Application
Federal Aviation Agency	Airport
City of San Diego	Airport
Southern California Edison	Power plant
Consolidated Edison of NYC	Power plant
Lockheed Aircraft Company	Power plant
Westinghouse Electric Corporation	Power plant
General Electric Corporation	Power plant
Babcock & Wilcox Company	Power plant
Gulf/Dravo Company	Offshore drilling
Industrial Board of Japan	Industry site
Kawasaki of Japan	Industry site
Hollandse Beton Group, N.V.	Offshore construction
University & State of Hawaii	Exposition site

### CIVILIAN APPLICATION

The remainder of this paper seeks to demonstrate the specific ways in which Navy platform technology can be applied to contemporary civilian tasks and problems. That this sharing of technology will be a mutually beneficial and constructive experience for all sectors of our national life is a fervent hope of the Navy.

One of the obvious applications of floating stable platform technology would be the development of floating airports. The present locations of many of our nation's cities were determined by their proximity to a coastline or a large lake, e.g., San Diego, Los Angeles, San Francisco, Seattle, Chicago, New York, Miami, and Houston. They were centers of commerce during their early days and have continued to be up into the present. That means that now many of these areas are heavily congested, and noise pollution has become a problem of large proportions. Airport siting within city limits has become a matter of public debate. Construction of a floating stable platform as a floating airport answers many of these problems. The floating airport, while still close to the heart of a city, could be placed offshore, where it would be less of a noise or safety threat to the population of the city. Approach and takeoff patterns could be established that either avoided inhabited areas or passed over them only at higher altitudes. What is more, the large tracts of often desirable land which are required for airport construction would be freed for other municipal needs.

Another potential use of floating stable platforms would be to serve as sites for nuclear powered industries. The platform could be used to support a nuclear desalinization plant, and, of course, the source of the water to be desalinated would be the platform's environment, so the expense of getting the seawater to the plant would be eliminated. A similar platform could support a plant to generate electrical power by the nuclear process. In view of our increased needs for fresh water and the impending energy crisis, the

importance of such potential uses for floating platforms is self-evident. Figure 4 shows these applications, among others.

Again, the use of floating stable platforms in offshore locations provides advantages for nuclear plant site selection. These advantages hold for other applications of the floating platform, but are particularly appropriate for the discussion of nuclear power plant site selection because of the sensitivity of the subject among the populace. First, not only do the sites leave valuable "open" or park space untouched, but they are well away from residences. Also, being water-based rather than land-based, the nuclear plant would be virtually unaffected by earthquakes. Because of its proximity to the water, the plant would have ready access to large amounts of cooling water, while affecting the environment with only minimum thermal pollution. The mobility of the floating plant would allow it to be moved to the area of highest demand. Finally, the entire plant could be assembled in a "factory"-shipyard complex rather than the remote area where it is to operate. For maintenance and repair, the plant could be returned to the "factory" as the need arose. The use of this method of supporting and maintaining the plant would significantly reduce facility costs.

Anchored in deep water, a floating stable platform serving as an offshore docking facility allows almost any harbor to receive cargo from deep-draft, large-capacity ships. The ships merely off-load at the platform, and the cargo is transferred to shallow-draft barges or pipelines for movement ashore. The reverse of this procedure is already in operation near Goa, on the southwest coast of India, where small river barges deliver unrefined ore to an offshore platform, from which it is removed periodically by large vessels and transported to processing plants.

A fourth application of the floating stable platform concept is in providing a base for undersea construction. One of the difficulties encountered in undersea construction results from the fact that the surface support ship's cranes, which handle the heavy equipment, are at the mercy of the ship's heave, pitch, and roll response to the weather at the surface. This can have an unfortunate influence on the work being done on the sea floor. The floating stable platform could alleviate this difficulty because of its own stability in varying sea conditions. The heavy equipment could be handled directly from the surface of the platform.

A use for floating stable platforms of the smaller variety would be in situations that required indefinite station-keeping capabilities. Besides agencies like the Coast Guard, industry and research organizations would find the application very helpful in monitoring the weather, gathering oceanographic data, and accomplishing other tasks requiring long-term involvement. Both crew and equipment could better perform their tasks in the stable environment provided by the platform than in a rolling and pitching ship anchored in the North Atlantic or North Pacific.

A sixth potential use for floating stable platforms would be as offshore industrial sites. Because of its growing population density and pollution problems, Japan is particularly interested in this application. Locating the plants offshore, away from residential areas, and with the proper safeguards would provide a cleaner environment and more livable space.

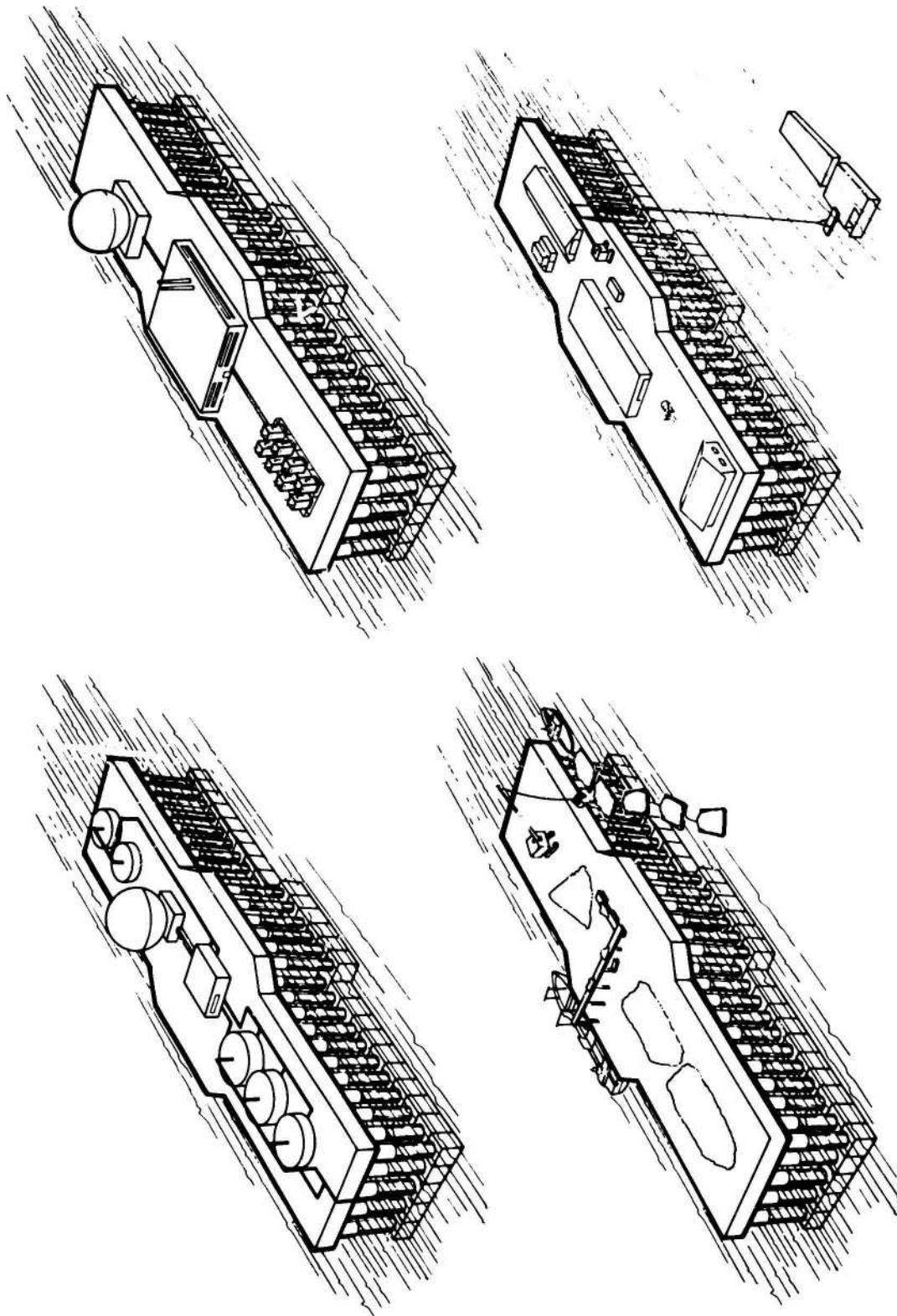


Figure 4. Floating Stable Platform applications.

The final suggested application of the floating stable platform, an exposition site, is perhaps the most exciting. This is true for two reasons: The proposed Hawaii exposition platform may be the first full-scale platform to be actually constructed, and the effort will represent a first attempt at developing the city-on-the-sea concept. The idea began because the State and University of Hawaii were interested in using a floating stable platform as the exposition site for the state's bicentennial celebration planned for 1976-1977. The Navy team working on floating stable platforms has participated in the planning and has made its data available to the exposition planners. A 1/20-scale model has been built from a large number of modules (Fig. 5). The model is now in Kaneohe Bay. This location, can provide a 1/20-scale open-sea environment for testing the model. At this time the model has already undergone hydrodynamic tests, towing tests, and anchoring test, the results of which indicate that the full-scale Hawaii exposition site is indeed feasible.

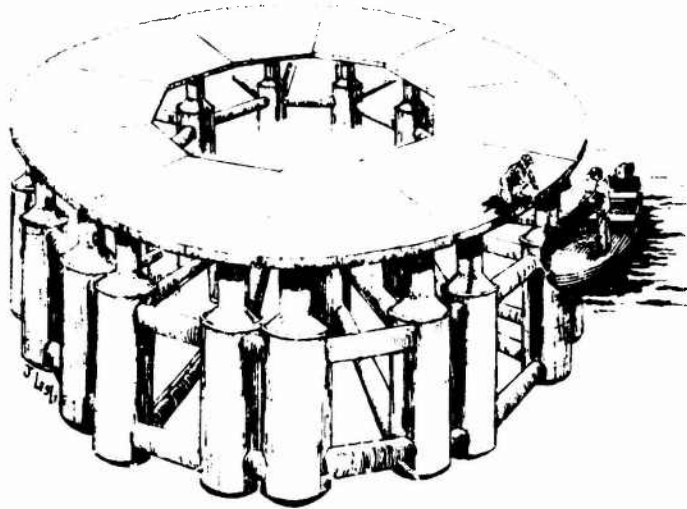


Figure 5. Hawaii exposition site model.

All of the applications described are interesting and feasible, but what of the cost? Buildings constructed of concrete cost, on the average, about \$95.00 per cubic yard of concrete used. The installed cost of the San Francisco Bay Area Rapid Transit System tubes was approximately \$120.00 a cubic yard. Based on these figures, the cost of constructing a floating stable platform is estimated to be about \$150.00 a cubic yard. Thus, a bare platform having surface dimensions of 300 ft by 300 ft and ready for the installation of equipment would cost about six million dollars, or approximately \$62.00 per square foot of plan area. This amount compares quite favorably with the construction costs in many high-value industrial or commercial areas. For example, the \$62.00 per square foot cost for the Hawaii exposition site is much less than the cost per square foot of property in the Waikiki area. So along with being interesting and feasible, the floating stable platforms also offer reasonable construction costs.

## CONCLUSIONS

This paper has reviewed the development of floating stable platforms in response to a Navy requirement. It has also described several potential applications of the floating stable platform concept to needs in the civilian sector. The reader will, no doubt, be able to conceive other applications. In addition to data already published in the literature of such organizations as the Marine Technology Society (MTS), Institute of Electrical & Electronic Engineers (IEEE), or American Society of Mechanical Engineers (ASME), (see Bibliography), copies of the data developed and documented by the Navy engineers are available to United States organizations that have defined specific applications.

It is hoped that this report will stimulate additional ideas for applying the floating stable platform concept to the solution of siting problems of all kinds.



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