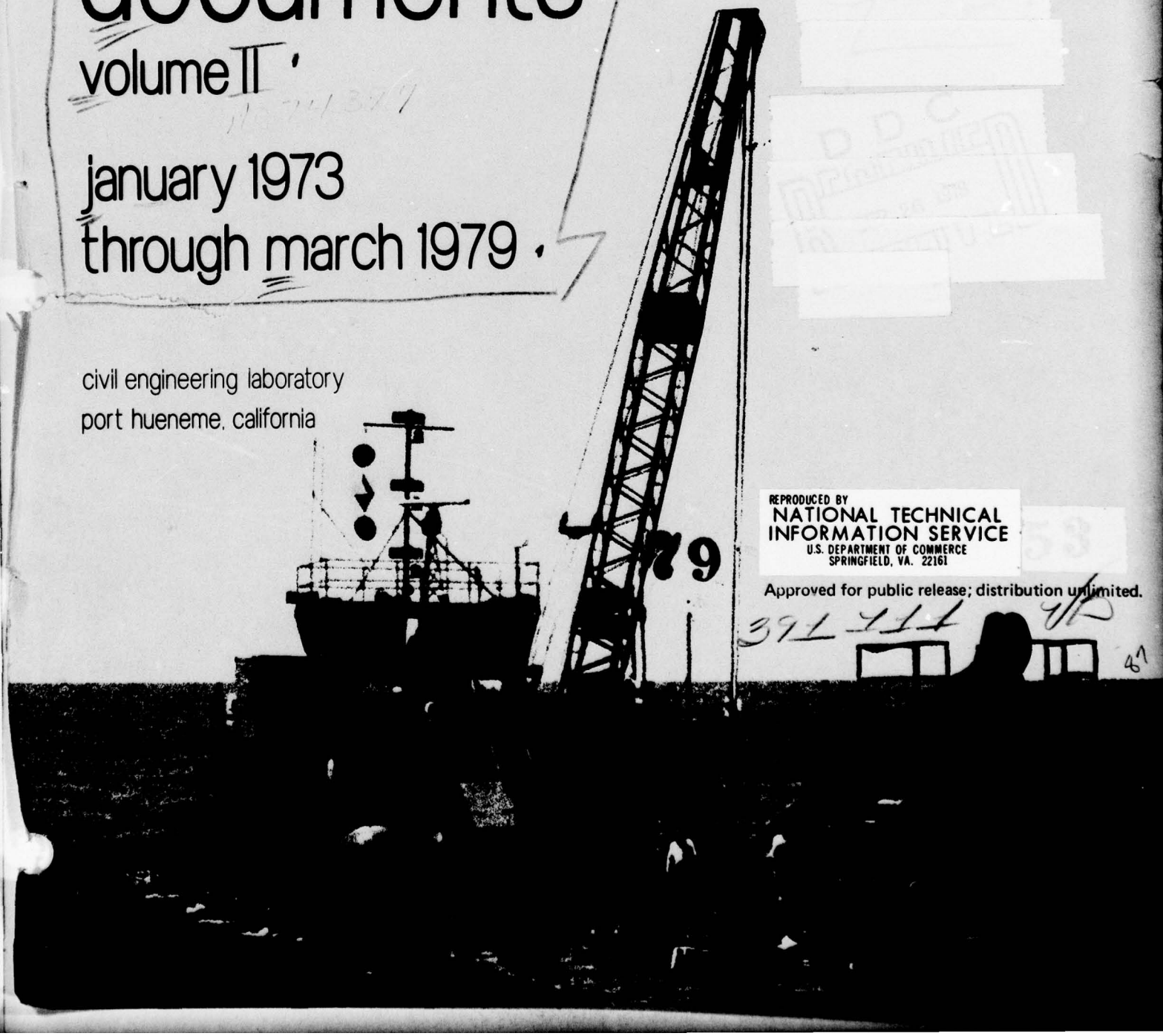
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guide to technical documents

volume II

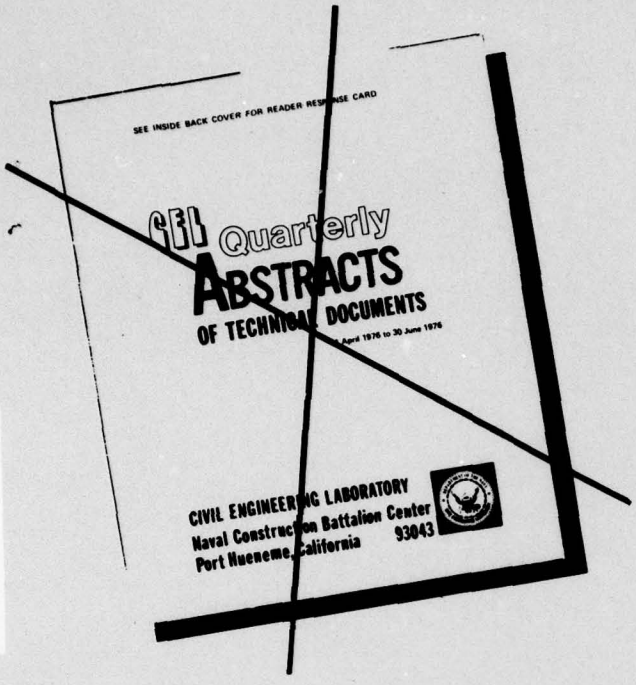
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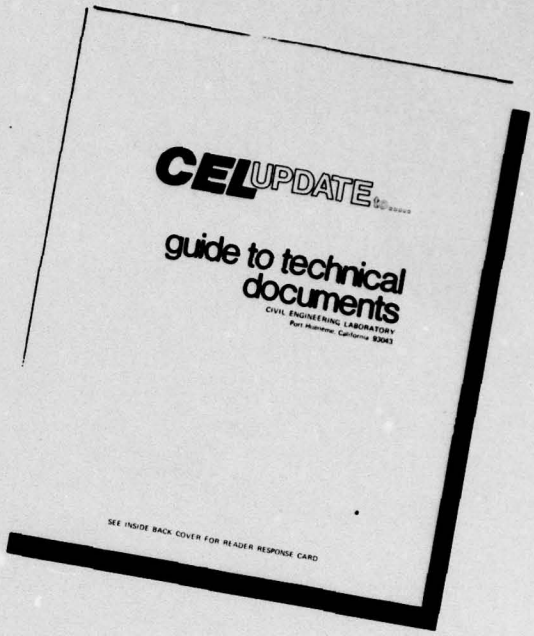
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ABSTRACT

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TECHNICAL REPORTS

R-775
Lobster and FMS: Devices for Monitoring Long-Term Seafloor Foundation Behavior, Sep 1972, H. G. Herrmann, K. Rocker, Jr., AD750258

The report describes the development and evaluation of two devices for monitoring long-term seafloor foundation settlement and tilting. The lobster long-term ocean bottom settlement test for engineering research is an instrumented foundation used as a test device, whereas the FMS (foundation monitor system) is an instrument that can be attached to any seafloor foundation to be monitored. Data and preliminary analyses are presented from successful foundation deployments for periods of up to 1 year at water depths of 4, 120, 600, and 1,200 feet in the Santa Barbara Channel area of the Pacific Ocean. The analysis presented includes data from an extensive laboratory program of core analysis and consolidation testing.

R-776
Zinc Inorganic Silicate Coatings: Five Years' Marine Atmospheric Exposure, Nov 1972, C. V. Brouillette, A. F. Curry, AD905719L

Ten zinc inorganic silicate coatings were exposed for 5 years at the three atmospheric environmental test sites of the Naval Civil Engineering Laboratory. These test sites are Kwajalein, Marshall Islands, Kaneohe, Hawaii (both tropical environments), and Port Hueneme, California. The zinc inorganic silicate coatings were exposed with and without topcoats. It was found that, in general, postcuring and superior self-curing zinc inorganic silicate coatings without topcoats will give long-term protection to steel. A compatible topcoat will improve the protective properties, especially of an inferior zinc inorganic silicate coating. Compatible vinyl, epoxy, or alkyd-coatings are effective topcoats for the zinc inorganic silicate coatings.

R-777
Deterioration of Guy Lines, Oct 1972, R. W. Drisko, AD905721L

The Naval Civil Engineering Laboratory was requested by the Naval Facilities Engineering Command to investigate the deterioration of guy lines and the use of protective coatings in the control of this deterioration. Seven protective coatings were applied to galvanized steel specimens, which were then exposed to accelerated weathering in a salt spray cabinet. Coated specimens performed much better than uncoated controls, and initially coated specimens performed much better than corresponding later-coated specimens. Data on the weathering, tensile strength, and maintenance procedures associated with fiber glass-reinforced plastic guy rods were obtained from a limited survey of field activities. It was determined that plastic guy rods deteriorate more rapidly in tropical than in milder climates, and that they generally retain most of their tensile strength up to 10 years, even though their protective coatings are badly deteriorated. For both metal wire ropes and plastic guy rods, it appears usually to be more economical to replace guys instead of recoating or attempting corrective maintenance of the original guy.

R-778
Operational Evaluation of NEMO (Naval Experimental Manned Observatory), An Acrylic-Hulled Submersible, Nov 1972, P. K. Rockwell, H. H. Migliore, AD753190

The operational evaluation of NEMO (Naval Experimental Manned Observatory), an acrylic-hulled subersible, is reported. The objectives of the program were to determine the benefits of the panoramic visibility afforded by transparent acrylic plastic hull, to evaluate the overall design and modes of operation of NEMO, and to judge the potential application of NEMO-type vehicles to the Navy's oceanographic and ocean engineering needs.

R-779
Buoyancy Transport Vehicle (BTV) - A Technical Evaluation, Nov 1972, L. W. Hallanger, AD753195

The potential utility of the buoyancy transport vehicle (BTV) as a tool for diver construction work was evaluated. The BTV consists of a spherical variable-buoyancy tank surrounded by an aluminum pipe frame which supports the load-lifting hook, ballasting subsystem, and propulsion subsystem. It is roughly 6 by 8 by 6 feet high, has an 850-foot operating depth, a 1,000-pound payload capacity, an air weight of 1,800 pounds, and normally requires a two-man operating crew. The test program included determining basic vehicle performance plus load-handling and load-placement capabilities. Surface support and maintenance requirements were also considered. The test results indicate the buoyancy transport vehicle to be effective for use in construction and salvage jobs where the diver must move large loads and precisely position them on the ocean bottom.

R-780
Determination of Blast Leakage Pressures and Fragment Velocity for Fully Vented and Partially Vented Protective Cubicles, Nov 1972, J. M. Ferritto, AD905720

Blast leakage pressures acting on a structure surrounding a protective cubicle were experimentally determined in a one-third scale model test. Nineteen pressure transducers were used to record the blast environment within the cubicle and on the surrounding structure. Variations in venting area were tested. Results indicate that the pressures can be sufficiently high to cause damage to conventional construction. However, the pressures can be reduced to safe levels by restricting the venting. The velocity of secondary fragments produced from the breakup of simulated processing equipment subjected to the blast of full-size 81-mm mortars was determined. Photographic coverage and calculation of fragment penetration in backstops indicate heavy secondary fragments are capable of traveling considerable distances.

R-781 - Classified report, Dec 1972, AD523803L

R-782 - Classified report, Jan 1973, AD524141L

R-783
Tunnel Ventilation and Heat Control in Undersnow Camps -Byrd Station, Antarctica, Feb 1973, C. R. Hoffman, AD757675

Antartic stations located in tunnels beneath the snow surface, such as the South Pole Station and the recently closed Byrd Station, are of limited useful life because of snow deformation in the tunnel walls and roof. This deformation accelerates as snow temperature increases, which makes the control of heat gain very important. Studies of temperature control methods in snow tunnels were conducted at Byrd Station from December 1965 to October 1971 and demonstrated that the use of large-diameter gravity ventilation ducts from the tunnel to the surface is an effective method for venting unwanted heat when surface air temperatures are lower than the desired tunnel temperature. When surface air temperatures are too warm, large volumes of supplemental cooling air can be obtained from specially constructed systems utilizing the heat sink represented by the surrounding snowfield.

Byrd Station tunnel temperatures are evaluated during use of different ventilating methods. Design considerations are presented for construction of the supplemental cooling system and for fabrication of ventilator caps found effective in preventing the ingestion of windborne surface snow.

R-784
Zinc-Rich Organic Systems Exposed Five Years to a Marine Atmosphere, Mar 1973, C. V. Brouillette, AD759683

Zinc-rich organic primers, with and without topcoats, were exposed for 5 yrs in the tropical marine atmospheric

environment of Kwajalein, Marshall Islands, Kaneohe, Hawaii, and Port Hueneme, California. Satisfactory protection to steel test panels was given by two- and three-package zinc-rich epoxy primers, and a zinc-filled modified saran coating. An alkyd enamel was found to be a very good topcoat when applied directly over the zinc-rich primer. A silicone alkyd was found to give outstanding protection as a topcoat. A modified saran containing 3.1 to 5.3 lb of zinc dust per gallon, with or without a modified saran topcoat, gave excellent protection to the steel test specimens. Extreme care should be exercised when mixing the zinc-rich primers to insure complete dispersal of the zinc dust pigmentation. Zinc-rich epoxy primers are recommended for replacing primers containing toxic lead oxide or chromate pigmentation. The degree of protection of metal substrates by coating systems exposed to severe tropical marine atmospheric environments for 3 to 5 yr can be used as the criterion for predicting good to superior performance by coatings.

R-785
Hydrostatic Loading of Concrete Spherical Hulls Reinforced With Steel Liners, Apr 1973, H. H. Haynes, G. L. Page, R. J. Ross, AD759684

Nine model concrete spheres reinforced with steel liners located on the inside, outside, or both inside and outside were tested to failure under hydrostatic loading. The quantity of reinforcement varied from 1.8 to 23.9% by area, for this range of reinforcement, the spheres showed increases in failure pressure from 0 to 374% over that of unreinforced concrete spheres (2,810 psi). Using a nominal 12% reinforcement, it was found that the best reinforcing method was to place liners on both the inside and outside of the wall.

R-786
Performance of Ten Generic Coatings During 15 Years of Exposure, Apr 1973, C. V. Brouillette, A. F. Curry, AD762408

Performance is reported on ten generic types of protective coatings for steel exposed in two tropical and one subtropical marine atmospheric environments for periods up to 15 yr. Zinc-rich coatings without topcoats and a modified phenolic system demonstrated long term protection of steel. Aluminum pigmentation in the topcoat was found to improve the performance of the protective system. Very good protection for a minimum of 4 yr was demonstrated by (1) vinyls with strontium chromate or red lead pigmentation in the primer (2) a coal-tar epoxy, (3) a mica-filled asphalt emulsion, (4) a modified phenolic mastic, (5) an aluminum-pigmented coal-tar epoxy and (6) zinc-rich coatings.

R-787
Rotating Acoustic Stereo Scanner for Positioning Loads Onto the Seafloor, Preliminary Observations on an Experimental Model, Apr 1973, R. D. Hitchcock, AD762409

An experimental model of a rotating acoustic stereo scanner (RASS) was tested in water depths to 115 ft to obtain pairs of sonar images and to determine the feasibility of using these stereo-image pairs to triangulate the positions of artificial sonar targets located at unknown elevations and radial distances. A high-resolution, side-looking sonar transducer with a maximum range of 80 ft was mounted on a hydraulically driven, rotating table attached to the top of a bottom-resting tripod. Target recognition was performed manually on shore. It was determined that the best type of artificial target for acoustic triangulation is a triangular-shaped triplane having dimensions on the order of 1 ft. An angular scanning rate of 2.0 deg/sec produced images which presumably could be recognized electronically by Fourier transform techniques. Rotational scanning and acoustic triangulation could be completed within 100 sec. Real-time production of a three-dimensional illusion was not achieved with same-side rotational scanning. However, parallax data were obtained on artificial sonar targets, and the data were used to calculate the targets' ranges and elevations within 2% and their bearings within 0.5 deg. Suitable processing of such data would produce stereo-image pairs capable of generating a three-dimensional picture to the eye.

R-788
Deformation Behavior and Fracture Mechanisms of Rocks, May 1973, T. K. Lew, AD762410

A study was conducted to determine from the literature what is known about the deformation behavior and fracture mechanisms of intact, fractured, and jointed rocks. The literature indicates the following. The mechanical properties of an intact rock are not unique, rather they vary with mineral composition, grain size, state of stress, and strain rate. Deformation behavior and fracture mechanisms of an intact rock are characterized by crack growth and deformation of the constituent grains. Dilatancy of an intact rock under compression is associated with shear stress. Fractured rock can still carry load. Deformation of a fractured rock tends to concentrate along the major discontinuities. Furthermore, deformation of a jointed material is characterized by slip along joints, interlocking of the intact blocks, and fracturing of the intact blocks. Under a given state of stress, the stiffness and the strength of a fractured or jointed rock are generally lower than those for the intact rock.

R-789
Effect of Backpacking and Internal Pressurization on Stresses Transmitted to Buried Cylinders, May 1973, S. K. Takahashi, AD764058

Various aspects of the behavior of buried cylinders associated with backpacking, internal pressurization, and slippage at the interface are considered. Parametric curves are presented for horizontally and vertically buried cylinders with and without backpacking. Four configurations of statically loaded, horizontally buried cylinders were considered: (1) no backpacking, (2) rectangular backpacking placed above the cylinder, (3) backpacking placed around the top half of the cylinder, and (4) backpacking placed completely around the cylinder. The cylinder without backpacking received the most vertical load, and the cylinder with backpacking completely around it received the least. When interface slippage was allowed the circumferential stresses were nearly uniform at the crown, the springline, and the invert; for no slippage, the maximum compressive circumferential stresses occurred at the springline. Internal pressurization reduced compressive stresses and, hence, decreased the chances of buckling. Dynamic runs were made for the first two configurations using a finite element program for nonlinear material properties. Reasonable values of velocities and accelerations can be predicted, but parts of the program need to be modified for problems where a low modulus elasto-plastic material is adjacent to a high modulus material.

R-790
Influence of Compressive Strength and Wall Thickness on Behavior of Concrete Cylindrical Hulls Under Hydrostatic Loading, Jun 1973, N. D. Albertsen, AD764054

Sixteen unreinforced, cylindrical concrete hull models of 16-inch outside diameter were subjected to external hydrostatic loading to determine the effect of concrete strength and wall thickness on implosion and strain behavior. The test results showed that an increase in concrete strength of 70% produced an average increase in implosion pressure of 87%, while increases in hull wall thickness by factors of 2 and 6 produced increases in implosion pressure by factors of approximately 2 and 11, respectively. Changes in concrete strength had little effect on strain behavior; however, strain magnitudes generally increased with increasing wall thickness when comparisons were made at a constant percentage of P(IM). Design recommendations are presented to aid in the design of cylindrical concrete hulls for underwater use.

R-791
Direct Embedment Vibratory Anchor, Jun 1973, R. M. Beard, AD766103

A direct embedment anchor driven by vibration was developed for use in deep ocean mooring systems. The report describes the second generation anchor and the modifications required to evolve it from the prototype. Procedures for selecting anchor fluke size for different sediment conditions through estimations of anchor penetration and short-term holding capacity are given. Based on test results, the vibratory anchor can provide between 25,000 and 40,000 pounds of short-term holding capacity in a range of seafloor conditions. Operational experience indicates that the anchor will be limited to deployment from anchored or dynamically positioned work platforms.

R-792
Asphalt Emulsion Slurry Seals Modified With Additives, Jun 1973, R. W. Drisko, AD914078

Eighteen different materials, including 14 water emulsions, three sizes of ground rubber tread, and portland cement, were tested as additives to a standard slurry seal formulation. Most of the additives increased the cohesive strength, the resistance to abrasion, and the resistance to cracking along the edges of painted slurry seal stripes. The economic advantages of these additives can only be determined by in-service testing.

R-793
Arching in Soils With Cohesion and Intergranular Friction, Jul 1973, R. N. Murtha, AD766100

This study was initiated to determine the feasibility of burying protective structures in a soil possessing both cohesion and intergranular friction. Idealized small-scale structures were buried in a compacted "mixed" soil, and static overpressures up to 150 psi were applied to the surface. Seven laboratory tests were conducted in which footing area, depth of soil cover, and overpressure magnitude were the major variables. Measurements were made to determine the soil strain, soil and structure displacement, radial soil stress, and the load reaching the structure. It was found that these soils have arching characteristics similar to those in cohesive soils and to those in granular soils. Arching decreases with increasing load from essentially 100% to a value that is dependent upon the existing intergranular friction.

R-794
Large, High-Pressure Vessels for Simulating the Deep Ocean, Jul 1973, J. R. Maison, AD776575

The current capabilities and limitations in the design and fabrication of large, high-pressure ocean simulators are reviewed. Test chambers up to 20 feet in diameter, 60 feet in length, rated to 30,000 psig (RDT&E tanks) and 75 feet in diameter, 600 feet in length, rated to 40,000 psig (fleet support chambers) are considered. Of the concepts considered feasible for fabricating the simulators, wire-wound construction was found to produce the lowest cost chambers. The core material upon which the wire is wound should be either high-strength steel for the RDT&E tanks or high-strength concrete for the fleet support chamber. Steel cores are limited in size by billet weight and forging press capacity but are unlimited in pressure up to the maximum considered. Concrete cores are unlimited in size, but are constrained to a maximum pressure of about 4,000 psig. An RDT&E program in support of wire-wound construction is included.

R-795
Cursory Structural Analysis of Building 26, San Diego Naval Hospital, Jul 1973, S. K. Takahashi, AD896813L

Building 26 of the Naval Hospital complex in San Diego was analyzed to determine its capability to resist future earthquakes. Current building codes and guides were reviewed to ascertain recent changes that would affect the structural integrity of the building. It was found that certain details of the beams, columns, and slabs do not satisfy the current ACI code. A three-dimensional computer code, called TABS, was utilized to obtain mode shapes and frequencies; rotation and lateral deflections of the floors; axial forces, moments, and shear in the columns; end moments in the beams; and shear forces in the slab. Subsurface soil information to bed-rock needs to be obtained to permit determination of the soil motion at the structure; geological explorations need to be conducted to determine the distance of the structure from the nearest active earthquake fault; and computer analyses of units B and C should be performed to determine the adequacy of the building to safely resist large earthquakes.

R-796
Development of a Quick Camp System for Seabees, September 1973, R. H. Seabold, AD768278

Quick camp modules are standard 8 x 8 x 20-foot shipping containers outfitted for living. They serve as habitats in the field, as temporary storage facilities when not deployed, and as cargo containers in transit. They can be transported by ships, trucks, rail cars, and aircraft, including helicopters. The facilities include berthing, messing, sanitation, administration, medical treatment, shop, laundry, recreation, and storage. The system includes structural, electrical, air treatment, and water purification and distribution subsystems. User needs and the environment were studied, a concept was formulated, and the first cycle of system analysis was performed. A contractor designed the entire system and fabricated three selected first-generation prototype modules: camp utilities, kitchen, and all purpose. Cost-effectiveness studies were performed in specific areas for making major design decisions and in general to determine the economic feasibility of the system. Structural, environmental, electrical, and operational tests were conducted and evaluated. As a result, input data for the second cycle of system analysis were generated.

R-797
Ice-Engineering - Summary of Elastic Properties Research and Introduction to Viscoelastic and Nonlinear Analysis of Saline Ice, Aug 1973, M. G. Katona, K. D. Vaudrey, AD768279

Increasing operational use on ice areas in polar regions has heightened the requirement for improved knowledge and techniques to analyze the behavior of sea ice. Previous studies on plastic behavior are reviewed with emphasis placed on plate analysis. Classical plate theory and the finite element method are compared in analyzing ice plates, with special attention given to sea-ice airfields. Since elastic analysis is not totally representative of actual ice behavior, a general formulation is presented which gives the assumptions and procedures for both viscoelastic and nonlinear domains of sea-ice behavior. A laboratory program is being initiated to determine material properties that are necessary to extend sea-ice analysis into the inelastic range.

R-798
Buried Fuel Capsule: Comparison of Three-Dimensional Computer Data With Experimental Data, S. K. Takahashi, Sep 1973, AD772537

Static and dynamic three-dimensional finite-element computer structural analyses were performed on buried, horizontal fuel capsules for correlation with field and laboratory experimental test data. The structures were 12- and 36-inch-diameter steel capsules with hemispherical ends. Static and dynamic deformations and strains were calculated by a linear elastic computer program using one quadrant of the soil-structure medium. The computer results compared favorably with the experimental data. Stresses, such as the longitudinal stress at the springing line, which are unobtainable with a two-dimensional computer code, were also determined and evaluated.

R-799
Interim Design Guidelines for Seafloor Footing Foundations, Oct 1974, H. G. Herrmann, P. J. Valent, AD773090

The report summarizes interim procedures for designing seafloor footing foundations. Methods for determining foundation loads including the estimation of drag forces and seismic loadings are summarized. General requirements for site surveys and evaluation of the engineering properties of the soil profile are outlined. Detailed procedures for predicting bearing capacity, resistance to lateral loads, and footing settlement are included along with an example design problem. These procedures are considered adequate for designing all but manned installations.

R-800
Development of a Hydrazine Gas-Generation System for the Large Object Salvage System (LOSS), Dec 1973, K. W. Tate, AD774467

This report describes the development and testing of a self-contained hydrazine-fueled, underwater gas-generation system designed to provide large volumns of noncondensable gas for a salvage buoyancy application. This system is capable of generating sufficient gas to displace 200 long tons of seawater at a depth of 850 feet. The catalytic decomposition of monopropellant hydrazine is used to produce hydrogen and nitrogen gases which serve as the buoyancy media. The hydrazine gas generation system was mated with the LOSS (Large Object Salvage System) pontoon and successfully tested in a shallow water demonstration of the integral lift system. In this demonstration, a 74-long-ton object was salvaged from a depth of 90 feet. The success of this in situ test demonstrated the suitability and practicality of using monopropellant hydrazine to produce large volumes of buoyancy gas.

R-801
Design Criteria for Power Sources Supplying Underwater Hydraulic Tools, Dec 1973, G. L. Liffick, S. A. Black. AD774478

The Naval Civil Engineering Laboratory is developing hydraulic power sources for underwater hydraulic tools. Hydraulic power sources driven by diesel and gasoline engines and electric motors have been successfully developed and evaluated. The operational testing was conducted by divers using hydraulic tools to work underwater. The criteria for selecting a particular hydraulic circuit and the components for an underwater hydraulic power source are different from those used for designing a hydraulic power source for surface tools. The appraisal given in the report of the relative merits of different hydraulic circuits and components is based on experience gained during NCEL's power source evaluation program.

R-802
Control of Algal Growth on Paints at Tropical Locations, Dec 1973, R. W. Drisko, J. B. Crilly, AD774481

Fourteen biocides and two paint pigments were given a laboratory screening test for use in paints to control algal growths in tropical environments. The twelve most promising of these were formulated into paints that were applied as test sections on an exterior concrete wall at Guam. After 26 months of tropical exposure, ratings of the resistance to algal growth were made. These ratings were consistent with the earlier laboratory screening tests. Duplicated paints had quite similar field performance ratings. Control paints without biocides had the most growth, and paints with a low level of biocide had more growth than the same paints with a higher level of biocide. Of the ten biocides incorporated into polyvinyl acetate paints, tributyltin oxide performed the best and completely inhibited algal growth at 0.1% concentration. The second best biocide was the phenylmercuric oleate standard. Barium metaborate paint pigment in two different acrylic paints also completely inhibited algal growth.

R-803
Ice Engineering: Viscoelastic Finite Element Formulation, Jan 1974, M. G. Katona, AD774482

The most efficient design, construction, and use of polar-ice-shelf facilities for operation and parking of aircraft, cargo storage, and other purposes depends on a thorough and correct engineering analysis of the structural integrity of the sea-ice layer. The viscoelastic finite element analysis technique and computer program developed in this investigation have proven to be an accurate, versatile, and powerful tool for solving a wide class of boundary value problems, including (1) arbitrary axisymmetric and plane strain geometries subjected to quasi-static, symmetric loading, and (2) layered half-space systems resting on a fluid foundation with arbitrary surface loading, such as sea-ice sheets subjected to aircraft loading. The viscoelastic model includes independent bulk and shear relaxation functions characterized by exponential series.

R-804
Portable Powered Hose Reel, Jan 1974, A. L. Scott, AD774081

The size of the hose reel presently used by Naval amphibious construction battalions to store and deploy the 5,000 feet of 6-inch-diameter buoyant fuel line restricts system mobility. The requirements and specifications for a portable powered hose reel that can be transported by truck or aircraft were developed by NCEL, and a prototype unit was designed and built under an NCEL contract. This reel has seven interchangeable hose drums, each capable of holding about 750 feet of 6-inch-diameter hose, and a base unit with a diesel-engine-driven hydraulic power system, a stress-wire drum with level-wind device capable of holding 5,000 feet of 1/2-inch steel cable stress wire, and a self-contained device for changing hose drums. Unlike the present reel, the hose can be deployed from the beach or from an LCM-8. Tests indicate that the prototype hose reel is rugged and mechanically satisfactory, and it is potentially capable of increasing the versatility of the amphibious construction battalions in deploying the buoyant fuel system.

R-805
Long-Term Deep-Ocean Test of Concrete Spherical Structures. Part I: Fabrication, Emplacement, and Initial Inspections, Mar 1974, H. H. Haynes, AD777079

This report summarizes the fabrication, emplacement and inspections during the first 1.2 years of submergence of eighteen 66-inch-OD concrete spheres. The spheres are located 4 miles south of Santa Cruz Island, California, in depths of water from 1,840 to 5,075 feet. The purpose of the test is to collect data on time-dependent failure, permeability and durability of concrete pressure-resistant structures. Findings from the inspections showed that two spheres located at depths of 3,725 and 4,330 feet had imploded and that the quantity of seawater which permeated through the concrete for phenolic-coated spheres was about 0.8 cu ft and for uncoated spheres, it was about 1.6 cu ft. This test program is planned to continue through 1981 (total of 10 years).

R-806
High-Power Electromechanical Cable Connectors for Deep Ocean Applications, Apr 1974, J. F. McCartney, J. V. Wilson, AD777084

There are two basic connector configurations: one for mating underwater (wet) and one for mating in air (dry). Both are designed for 360 kW, 60 Hertz, 4,160/2,400 VAC power at depths to 6,000 feet, with a mechanical strength of 50,000 pounds. The wet connector is capable of repeated underwater mating by divers,remotely operated actuators, or submersibles with manipulators. Increased performance in depth, strength, or power would require a simple extension of the design, although any significant increase in transmission voltage levels would require further development. These connectors were evaluated in a series of pressure-vessel and open-sea tests to depths of 6,000 feet. The

final configuration performed with no electrical or mechanical degradation after 33 matings at depth. Sustained immersion and power tests for one year at 600 feet and in the tidal zone confirmed the endurance of the designs. This development is the first demonstration of a capability for underwater mating of major electrical/mechanical components of sea-floor structures.

R-807
Protective Construction Against Blast and Fragments From Conventional Weapons: Analytical Procedures for Computing Probability of Survival of Targets, Oct 1974, J. M. Ferritto, ADB000417L

The Naval Civil Engineering Laboratory was tasked by the Marine Corps Development and Education Command to study expedient combat protective construction. Marine Corps operation is intended to be limited to brief stays during which the assigned task is accomplished, possibly under enemy fire, and the units are either removed or replaced with permanent forces. Protection is required primarily against near misses, and the structures must be quickly erected and easily relocated. This report presents methods for the comparison and evaluation of alternate protective concepts. A series of computer programs has been assembled to compute lethal areas and probabilities of survial for surface targets with protective shielding against the effects of conventional weapons. The approach is three-dimensional and allows weapons to impact at any azimuth and burst height around the target. The effect of one weapon on several similar targets may also be studied. A comparative analysis of protective systems for a fuel bag and a bunker is given to illustrate the procedure.

R-808
Ground Motions From Pacific Cratering Experiments, 1,000-Pound Explosive Shots, Jan 1975, J. M. Ferritto, J. B. Forrest, ADB002855L

This report presents data from four instrumented 1,000-pound spherical TNT shots detonated at the Eniwetok proving ground as part of the Pacific Cratering Experiments (PACE). In two tests the charge was tangent to and above the ground; and in two tests the charge was half-buried in the ground. A discussion of the site material properties is presented. The data are compared with previous nuclear test data and with event middle gust data. A supplement to this report contains the data plots for all the shots.

R-808S
Ground Motions From Pacific Cratering Experiments, 1,000-Pound Explosive Shots; Data Supplement, Jan 1975, J. M. Ferritto, J. B. Forrest, ADB002856L

This report contains the data plots for four instrumented 1,000-pound spherical TNT shots detonated at the Eniwetok proving ground as part of the Pacific Cratering Experiments (PACE). In two tests the charge was tangent to and above the ground; and in two tests the charge was half-buried in the ground. Discussion is presented and data are compared in TR-808.

R-809
Influence of Soil-Rock Interface on Dynamic Response of Buried Cylinders, May 1974, R. N. Murtha, AD780343

The study was initiated to determine the influence of an underlying rock interface on the response of buried cylinders blast loading. Static and dynamic tests were conducted on eight different 6-inch-diameter steel cylinders buried horizontally in a dense, dry sand. The major variables were the cylinder thickness and the location of the concrete bottom. Measurements were made of hoop strain, vertical diameter changes, and accelerations of the cylinder; free-field stress, strain, and acceleration of the soil; and surface overpressure.

R-810
Biodeterioration and Fouling of Materials - Five Years at Depth of 120 Feet, May 1974, J. S. Muraoka, AD781638

The study was conducted to obtain additional information on fouling attachment and biodeterioration of materials exposed in a shallow, open-ocean environment (not in harbors or protected bays). The materials were exposed on the seafloor at a depth of 120 feet for a period of up to 5 years in water off the coast of Port Hueneme, California. For comparison, control items on certain plastics were maintained under laboratory conditions. No attempt was made to classify all the fouling organisms which accumulated on the test panels.

R-811
Ice Engineering - Quantification of Subsurface Ice Thickening Techniques, May 1974, J. L. Barthelemy, AD781640

Because of the extreme conditions and the lack of readily available building materials in Polar regions, construction by conventional means is often unfeasible. Methods involving the localized freezing of seawater into useful structures at coastal Polar locations are being developed. One technique previously developed and tested is surface flooding. An alternate method involves subsurface thickening by short-circuiting the insulating property of an existing ice sheet. Especially promising are natural-convection heat exchangers called freezing cells. These devices are simply constructed, self-powered and easily installed. Their performance and ice production capabilities are described by a series of equations. Presented in generalized (dimensionless) form so as to be applicable to a system of any size.

R-812
Caulking Compounds for Application at Low Temperatures, Jun 1974, C. R. Hoffman, AD920678L

Experience in polar climates has demonstrated the difficulty of applying caulking and sealing compounds at low temperatures due to loss of extrudability. Also, it has been found that caulking compounds kept warm for ease of application still fail to adhere to cold surfaces. Caulking compounds available commercially for general construction applications were reviewed for possible cold weather application, and cold chamber and Antarctic field were conducted on eight products of three basic types considered most suitable. The results of these tests showed that butyl rubber and polysulfide-based compounds become too stiff to extrude from hand caulking guns at temperature near 15F. Some silicone compounds, however, can be applied and cured well at temperatures to -45F.

R-813
Stereoscopic Mapping of the Seafloor by a Towed Two-Fish Side-Scan Sonar System, Jun 1974, R. D. Hitchcock, AD781639

Sea trials were conducted to test the concept of constructing a seafloor contour map by interfacing a manual stereo-sonar plotter with a digital computer. The at-sea work used a pair of 100-kHz, side-scan, sonar fish towed at a lateral separation of 42 feet. Real-time data on near-bottom scanning contained mutual interference effects which prevented the stereoscopic fusing of corresponding sonar images. System component errors were obtainable with repeated scannings of an artificial target array.

R-814
Experimental Hose Line for Fuel Transport Over Deep Snow, Jun 1974, C. R. Hoffman, AD782582

Resupply of the inland Antarctic stations requires the transport of more than 3,000,000 gallons of aircraft and diesel fuel from storage at McMurdo Station to the Williams Field air facility 3.5 miles away. In November 1971, the Naval Civil Engineering Laboratory constructed in this area an experimental 2,000-ft-long elevated hose line supported from wooden towers and a wire-rope messenger cable to evaluate the feasibility of constructing and maintaining a per-

manent hose or pipeline compatible with the movement and snow accumulation on the McMurdo ice shelf. More than a year's observations of the system showed compression of the ice shelf averaged 26 ft per 1,000 ft, which was greater than previously observed. Too, annual snow accumulation in localized areas was extremely variable, ranging between 4 and 46 in. The system was constructed and maintained without difficulty. But use of this design is recommended only in areas of little ice shelf compression and snow accumulation.

R-815
A Survey of Techniques for the Analysis and Design of Submerged Mooring Systems, Aug 1974, N. D. Albertsen, AD786487

Techniques useful for the design and analysis of moored cable systems are presented. Included are compilations of information describing computer programs for steady-state and dynamic analyses and methods for the analysis and suppression of cable strumming. It was found that the steady-state analysis of complex redundant structures and the dynamic analysis of simple structures are now possible. However, experimental data are required to validate the analysis procedures and related computer programs. In addition, it was found that procedures still need to be developed to reliably predict, describe, and suppress cable strumming in long cables exposed to oceanic conditions.

R-816
Soil/Structure Interaction: Horizontal Cylinders, Oct 1974, T. K. Lew, ADA002216

This study was undertaken (1) to investigate analytically the influence of the relative stiffness between a buried cylinder and the surrounding medium on cylinder deflections, thrusts, and moments; (2) to develop design curves from the results of the analysis; and (3) to demonstrate the validity of the design curves by comparison with experimental results from different sources.

R-817
Seafloor Construction Experiment, SEACON I - An Integrated Evaluation of Seafloor Construction Equipment and Techniques, Feb 1975, T. Kretschmer et al., ADA009097

A series of interrelated seafloor engineering experiments was conducted in 600 ft of water on the seafloor 7 miles south of Santa Barbara, Calif., between July 1969 and August 1972. The experiments involved the evaluation of equipment and techniques by the Civil Engineering Laboratory (CEL) at Port Hueneme, Calif. The Navy seafloor construction experiment (SEACON) demonstrated a capability to construct operating facilities at the bottom of the ocean and pointed up deficient areas in the state of the art. The focal point of the SEACON I experiments was the construction and evaluation of an unmanned, one-atmosphere concrete structure placed at the 600-ft site. Experimental evaluations of hardware and techniques for site selection and investigation, seafloor construction, and structural and electrical elements were coordinated with the year-long seafloor testing of the concrete structure. After 314 days on the seafloor the SEACON I structure was successfully refloated and towed back to Port Hueneme where analysis of its performance was made.

R-818
Fiberglass-Reinforced-Polyester Laminate for Use in Protective Structures, Jan 1975, G. Warren, ADA004954

This report presents the testing and behavioral study program leading to the development of structural design criteria for a fiberglass-reinforced-polyester (GRP) laminate. The Marine Corps is to employ GRP modules as reusable elements for rapid construction of temporary protection for military ground targets against conventional weapon threats. The objective of the test program was to determine and evaluate the mechanical characteristics of the GRP through a series of flexural, tensile, compressive, and shear tests. In addition, more efficient uses of the structural strength of the GRP were investigated whereby the GRP laminate sheets were employed as facings of sandwich plates. Because of its superior ballistic resistance, the GRP was selected for the Marine Corps protective construction program; however, the laminate is inherently weak in compression and is highly susceptible to creep, localized buckling, and moisture. The established criteria will provide design guidance for GRP structural components of protective structures.

R-819
Snow Road Construction by Layered Compaction - Construction and Maintenance Guide, Apr 1975, J. L. Barthelemy, ADA011811

The use of rubber-tired vehicles in polar regions greatly speeds the movement of cargo and personnel. However, in areas of perennial snow, roads must be provided. Heavy-haul, wheeled transportation equipment, in particular, requires high-strength snow roads while operating on deep snow fields. Specially processed, elevated snow roads can provide dependable service for 2 years or more. This construction guide outlines those procedures necessary to build and preserve snow roads by means of layered compaction, the simplest and most rapid technique developed by CEL. In this process, the roadbed is built up to a desired elevation by successive compaction of 4-in. layers of snow. A modified rotary snowplow is used to gather, process and deposit the construction material.

R-820
Nuclear Shock Wave Propagation Through Air Entrainment Systems of Hardened Facilities, Apr 1975, R. H. Fashbaugh, A. Widawsky, D. Pal, ADA011812

An analytical study was undertaken to develop the capability of predicting nuclear shock wave propagation through air entrainment systems of hardened facilities. All solutions presented in this report are one-dimensional. Two finite-difference schemes for approximating the hyperbolic partial differential equations of fluid dynamics are used: the pseudo-viscosity scheme in a variable area Lagrange formulation, and the Lax-Wendroff two-step scheme in an Eulerian formulation. Shock wave attenuation due to viscous losses at ducting walls is included. A comparison of the results of the analysis with shock tube experimental data shows both formulations to be adequate. The Eulerian formulation is approximate for constant area ducts only and is limited to air temperatures below 1,000°K. The Lagrange formulation is appropriate for constant or limited variable area ducts or a complete air entrainment system configuration. The Lagrange formulation has the capability of a simple exponential decay shock wave input to temperatures of 1,000°K or a 1-Mt nuclear shock wave input to temperatures of 24,000°K.

R-821
Plastic-Coated Rigid Electrical Conduits for Use at Naval Shore Facilities, Apr 1975, E. S. Matsui, ADB004842L

The Civil Engineering Laboratory was requested by NAVFAC to investigate the performance of various plastic-coated rigid electrical conduits and their patching compounds exposed to a corrosive marine atmospheric environment. Five plastic-coated rigid conduits (Galvite, Korkap, Plast-Bond, Occal-40, and Scotchkote) and one glavanized rigid conduit, together with their fittings and patching compounds, were selected for this test program. The conduits were exposed to tropical and subtropical marine atmospheric environments for a period of 3-1/2 years. Although performance varied considerably among the plastic-coated conduits tested, all plastic-coated conduits provided better protection than the galvanized test standard. Korkap, including the patching compound, is outstanding in performance and proved superior to the other plastic-coating conduits.

R-822
Penetration of Projectiles into Seafloor Soils, May 1975, D. G. True, ADA011808

This report presents Laboratory model tests and field tests of a study conducted on projectile penetration into seafloor soils. Existing relationships for predicting penetration behavior are considered, and new relationships are developed to account for observed test results. The derived relationships incorporate conventional soil engineering properties with special modifications to account for the effects of velocity, penetrator shape, and penetration depth on penetration resistance. These relationships are shown to compare favorably with previously available methods for predicting penetration depths where soil properties are known. Recommendations are presented for the evaluation of constraints in the relationships. A calculation procedure is presented for solving the penetrator equations of motion by hand or with the aid of a small computer. An example problem is solved by hand to illustrate the use of the proposed relationships in the calculation procedure. Recommendations are made for use of results in preliminary and detailed engineering work.

R-823
Explosive Tests of Blast Cell, Naval Torpedo Station, Bangor Annex, May 1975, J. M. Ferritto, ADA014201

Blast tests were conducted in blast cells of a typical munitions facility. High-speed camera coverage was made, and pressure measurements were taken. Observed damage was compared with theoretical predictions based on NAVFAC P-397, "Structures to Resist the Effects of Accidental Explosions." The tests indicate that blast pressures will leak out around the blast doors and be of high enough level to cause injury to personnel nearby. Debris nets, if properly fastened, can serve to prevent roofing and ceiling from being blown down. Conventional, corrugated, cement-asbestos roofing can withstand up to 6-psi dynamic overpressure.

R-824
Hand-Held Hydraulic Rock Drill and Seafloor Fasteners for Use by Divers, Aug 1975, R. L. Brackett, A. M. Parisi, ADA014202

Underwater construction operations require an improved diver-operable rock drill and efficient and reliable seafloor rock fasteners. An experimental hydraulically powered rock drill was fabricated from commercially available components. The results from the shallow-water testing of this drill were used to design a prototype underwater rock drill capable of operating to ocean depths of 120 feet. Testing of the prototype rock drill revealed that it either met or exceeded initial performance requirements. Four brands of expansion-type rock bolts were investigated for use as seafloor rock fasteners. Also, a new type of rock bolt was developed for use in coral seafloors. Results of short- and long-term tests are presented along with a summary of important design parameters.

R-825 – Classified report, Sep 1975, ADC004138L

R-826
Lift System for Elevated Causeways, Nov 1975, C. L. Skaalen, ADA018952

A new type of lift system using hydraulic chain jacks was developed for elevating causeways. Tests were conducted to evaluate the lift hardware and to determine the feasibility and practicability of elevating a causeway section in the surf zone on an open beach with this system. Ammi unit-hull pontoons measuring 28x90x5 feet were used as test-bed pontoons. Two independent tests were performed. In the Phase I tests the developed elevating components were evaluated, and techniques and procedures for system operation were determined. In the Phase II tests the effects of dynamic loads on the shock-absorbing hardware of the lift system were evaluated, and elevating procedures for elevating several causeway sections were established. Logistics and time requirements for a complete, elevated, shorefast pier were derived from these tests. Elevating procedures were refined and documented for elevating pontoons within the surf-zone environment. The 55-ton Ammi pontoon was elevated 13 ft above mean water level in surf up to 7 ft high. Higher surf can be tolerated with this system without seriously degrading the operational effectiveness. Future tests will utilize NL pontoons in an operational test involving eight causeway sections for which spudwells have been successfully designed and tested.

R-827
Coating Research: Tensile Testing Procedure and Its Application, Nov 1975, E. S. Matsui, ADB008312L

A procedure for determining the tensile properties of free paint films is discussed. The results obtained were statistically treated to determine the validity of the procedure and to determine if there is correlation between tensile properties defined in laboratory tests and corrosion protection found in field exposure of the coating systems. The statistical analysis revealed that: (1) the free-film test method described here is precise enough to differentiate both tensile strengths and elongations among several coating systems, (2) primers have a profound effect on the tensile properties of the finish coatings, and (3) no direct correlation existed between tensile properties and corrosion protection of the coating systems after 1 year of field exposure in an extremely corrosive marine environment.

R-828
Blast Environment From Fully and Partially Vented Explosions in Cubicles, Nov 1975, W. A. Keenan, J. E. Tancreto, ADA019026

Charges of cast cylinders of composition B explosive were detonated inside several small-scale 3- and 4-wall cubicles of different shape and size to establish methods and criteria for predicting the blast environment (positive and negative pressures, durations, and impulses) in and around cubicles containing fully and partially vented explosions. The blast environment was measured (1) inside the cubicle and (2) outside the cubicle behind the front wall, sidewalls, and rear wall at scaled distances. The blast environment was found to depend on the charge-to-volume ratio, scaled degree of venting, scaled vent area, and scaled distance. Design charts are presented for calculating the pressure-time loading in and around a cubicle for a wide range of these parameters. The procedures offer, for the first time, a rational procedure for tailoring the cubicle configuration and dimensions to the site requirements since it relates blast environment to cubicle parameters and charge weight. Some of the 3-wall cubicles had roofs and some did not. Adding a roof did not substantially reduce the blast environment at large-scaled distances. The greatest benefit from the roof was in the area close to the cubicle where the roof dramatically reduced the blast environment behind the backwall. Criteria is proposed for design loading in and around fully and partially vented cubicles.

R-829
Development and Evaluation of a Motion Compensating Lift System for Deep Ocean Construction, Dec 1975, L. W. Hallanger, R. L. Brackett, ADA019027

A system to raise and lower loads in the deep ocean while providing lift-line tension control and payload motion control was designed, fabricated, and tested. Design parameters included a maximum wet payload weight of 40,000 lb at a maximum operating depth of 6,000 ft through sea conditions state 4 when the system is mounted on an ARS-type vessel. A load-handling system of this type allows soft landing of a payload on the seafloor. In addition, the reduction in the dynamic tensions in the lift line allows the use of smaller lines for a given payload weight, greater payload capacity for a specified line size, or a greater depth capability for a given line size. The concept selected for development, called a "boom bobber", incorporated a boom pivoted at one

end and supported by a relatively soft passive fluid spring. This spring decouples the payload from the motion of the support platform. At-sea testing included determination of system performance for two payloads of 12,000 and 40,000 lb wet weight. Cable tensions and time-correlated motions of the ship, lift system, and payload were recorded. Data obtained were sufficient to prove the promise of the basic concept, even though both at-sea test series ended with specific component failures.

R-830
Fiberglass Reinforced Plastic Pipe for Naval Aviation Fuel Distribution Systems, Dec 1975, R. L. Alumbaugh, E. S. Matsui, T. R. Tree, ADB009553L

The Civil Engineering Laboratory, Naval Construction Battalion Center, has investigated fiberglass reinforced plastic (FRP) pipe as a substitute for conventional metal piping for buried aviation fuel distribution lines. Three commercially available fiberglass reinforced epoxy pipe systems were selected and investigated to determine (1) the effect of current and future aviation fuels on the strength of the FRP pipe (change in ultimate stress), (2) if contamination of the fuel would result from contact of the fuel with the interior surfaces of the pipe system, (3) if FRP pipe systems could withstand hydrostatic pressures up to 600 psi, and (4) if FRP pipe systems could withstand surge pressures up to 400 psi. Contact of current (JP-5) and future (JP-7) fuels with the FRP pipes did not cause any significant contamination of the fuels. The pipe should be able to withstand surge pressures of 350 to 400 psi.

R-831
Snow-Road Construction - A Summary of Technology From Past to Present, Dec 1975, J. L. Barthelemy, ADA021868

During 1947, Naval Construction Forces built a compacted-snow airstrip on the Ross Ice Shelf in Antarctica. Research methods since then have improved the use of snow as a construction material. Snow-compaction techniques and equipment initially developed by the Civil Engineering Laboratory (CEL) for runway construction have been used to build durable, high-strength roads. At the present time, properly constructed and routinely maintained roads built from specially processed snow can support passenger vehicles, pickups, vans, trucks, and tractor-trailer combinations fitted with flotation tires at gross weights up to 75,000 lb. Two methods of construction developed by CEL are recommended: (1) layered-compaction and (2) depth-processing. In layered-compaction, the most recently perfected technique, a snow pavement is elevated to a desired height by compacting successive 4-in. layers, using a rotary snowplow to gather, process, and deposit the snow material. The alternative method requires depth-processing, using snow mixers to pulverize material placed on the roadway. This final report documents the evolution of vehicle road systems on snow and presents a synoptic overview, summarizing all aspects of snow-road technology, from theoretical considerations to historical development and recommended procedures.

R-832
Protection of Existing Fuel Lines Under Piers at Point Loma Annex -Condition After 3 Years of Exposure, Proj. Dec 1975, E. S. Matsui, ADB009723L

Fourteen protective coating systems, including a Government specification paint and a tape system, were applied to the fuel lines under a pier at Point Loma for in-service field testing. Nine coating systems were removed after 9 months of exposure, and the remaining 5 systems were exposed for 3 years. Denso Tape, a grease-impregnated tape, gave the best protection against corrosion, and the Government specification coating system, MIL-P-24441, was second best among the coating systems tested. However, Denso Tape is susceptible to deterioration where fuel leaks are present.

R-833
Deep-Underground, Lined, Horizontal, Circular Openings in Rock, Feb 1976, T. K. Lew, ADA021867

The objective of the study is to develop design and analysis procedures for deep-underground hardened protective facilities in rock by considering the relative stiffness between the liner and surrounding rock and by taking advantage of the load-carrying capability of the rock mass. Accordingly, design considerations such as loading, mechanical properties of the rock mass, material properties of the liner materials, configuration of the facility, and excavation procedure are presented. Design concepts that transfer most of the applied load to the rock are presented. Detailed step-by-step design procedures, which consider rock/liner interaction are presented for rock openings with liners made from a single material, reinforced concrete liners, steel/concrete/steel composite liners, and backpacked liners are propounded. Although the proposed design procedures were developed for hardened protective facilities, they can also be used for the design of other tunnels deep underground in rock.

R-834
Corrosion of Metals and Alloys in the Deep Ocean, Feb 1976, F. M. Reinhart, ADA021279

Between 1960 and 1970, about 20,000 specimens of 475 alloys were exposed in the seawater in the Pacific Ocean in order to conduct a program on the effects of deep-ocean environments on materials. The test specimens included steels, cast irons, stainless steels, copper, nickel, aluminum, titanium, miscellaneous alloys, and wire ropes. They were exposed at the surface and at nominal depths of 2,500 and 6,000 ft for periods of time varying from 123 to 1,064 days. The results of their corrosion behavior have been issued in 15 Civil Engineering Laboratory reports; other Navy Department reports from Naval Air Development Center, Naval Ship Research and Development Center (Annapolis) and Naval Underwater Ordnance Center; and from nongovernment participants. Very little of this information is available in the open literature. Therefore, this information has been compiled, analyzed, and evaluated in this report.

R-835
Solar Heating of Buildings and Domestic Hot Water, Jan 1976, E. J. Beck, R. L. Field, ADA054601

The purpose of this document is to provide guidance in the design and cost analysis of solar heating systems for buildings and domestic hot water (DHW). The nature of solar radiation, several types of solar systems, storage devices, and architectural considerations are among topics included. Calculation methods are included for determining collector size, storage size, simplified building and DHW loads, value of fuel saved, and saving-investment ratios. The calculation procedure is based on parametric curves for "fraction of heating load supplied by solar energy" and several "rules of thumb" for design. A series of 11 worksheets is used to enable the engineer with no prior experience with solar systems to accomplish a complete design and cost analysis. With this information he can prepare bidding and specification documents for the job. Tables of solar insolation at various Navy stations, typical building heat loads, collector prices by type, and storage tank prices are included. Two example problems are worked for tube-in-sheet collectors: one for space and DHW heating for a single dwelling, and the other DHW supply for a dispensary. Neither was found to be cost effective when competing against present day prices for natural gas. A directory of manufacturers and bibliography is also included.

R-836
Stainless Steel Flake Pigmented Coating Systems Exposed to Marine Atmosphere, Feb 1976, E. S. Matsui, ADB009960L

Fifteen protective coating systems containing stainless steel flake pigmentation in the finish coat were applied to sandblasted steel specimens, together with a control system, and exposed 5 years in three marine atmospheric test sites,

two of which are tropical. Of the 15 systems tested, chlorinated rubber over a zinc/organic-silicate primer gave the best protection for 5 years at all test sites. Also, the result of this work indicates that superior performance of stainless steel pigmented coatings depends to a great extent on use of a superior primer.

R-837
CEL 20K Propellant-Actuated Anchor, Mar 1976, R. J. Taylor, ADA022446

A propellant-actuated anchor (CEL 20K) has been designed to function in seafloors from soft clay to competent basalt, yielding a minimum long-term holding capacity of 20,000 lb in water depths of 50 to 20,000 ft. Thirty-six individual tests of the anchor are described in detail, demonstrating that the anchor functions satisfactorily in a wide variety of situations. Generalized and specific applications are given along with alternative installation and recovery schemes for the anchor.

R-838
Dynamic Response of a Horizontally Buried Cylinder Above a Soil/Rock Interface – Results of a Finite Element Analysis, Mar 1976, R. N. Murtha, ADA024052

Static and dynamic two-dimensional finite element computer structural analyses were performed on cylinders, horizontally buried above a rigid concrete bottom (simulating a soil/rock interface), for correlation and laboratory experimental test data. Both linear and nonlinear constitutive models were used to mathematically describe the behavior of the soil medium. A mesh parameter study was performed to optimize mesh size and time increment without degradation of the results. The computer results compared favorably with the experimental data. The reflection of a dynamically applied surface load from the rigid bottom caused soil stress increases of more than twice the incident stress level. These increases were transmitted directly to the cylinder in the form of increased thrusts and moments.

R-839
Stress Analysis of Navy VLF Antenna Insulators, Apr 1976, G. E. Warren, ADA024054

The stresses in high-voltage porcelain insulators that support as well as insulate Navy VLF communication antenna towers up to 1,500 ft (460 m) in height were photoelastically studied. These insulators have been plagued with structural and electrical problems since installation. Therefore, the Navy has begun a program to install insulators entailing new design configurations. The objective of this stress analysis program was (1) to analyze the old insulators using photoelastic coatings applied before removal of the tower load in an attempt to correlate the electrical problems with structural weaknesses, and (2) to predict the structural behavior of the new insulator configurations using three-dimensional photoelasticity with finite element theory comparison. The insulator problems, modeling techniques, as well as stress behavior of the structural models, are given.

R-840
Techniques and Equipment for Routine Destruction of Classified Material, Apr 1976, P. L. Stone, E. R. Durlak, ADB011919L

This report summarizes a continued investigation and development effort for improving techniques and equipment used for routing destruction of DOD classified material. Incineration in controlled-air units is discussed, stressing selection and procurement of equipment that will most likely achieve satisfactory destruction results. More recent work in two areas is emphasized. The first is an investigation of techniques for routine destruction of small quantities of microfiche and film. The second is the final development and testing of the CEL Composite Pulverizer, a two-stage system that can destroy most intact burn bags with a system horsepower and at a capital cost much lower than commercially available equipment.

R-841
A Modular Floor System for Use With Relocatable Buildings, Apr 1976, J. M. Ferritto, P. Springston, ADA026191

The Navy Advanced Base Functional Component Program utilizes many prefabricated buildings intended to be quickly emplaced and relocated. These buildings have usually had concrete slabs for floors; however, this requires skilled craftsmen and concrete batching facilities and results in floors which are not relocatable. This report describes the development of two modular relocatable floor systems - a system on-grade for heavy warehouse loads and a raised floor system for administrative buildings. The relocatable floor systems are generally less expensive per application, do not require highly skilled craftsmen, and are erected in less time than conventional concrete slabs.

R-842
Scattered-Light Photoelastic Analyses of Tunnel Intersections and a VLF Hollow-Post Insulator, Apr 1976, G. Warren, ADA026198

A scattered-light photoelastic stress analysis was performed on models of a VLF hollow-post insulator and a tunnel intersection configuration. A scattered-light polariscope was designed and fabricated in order to perform the analysis. Stress concentrations were found to be more than two times the applied loading in the insulator model and four times the applied loading in the tunnel intersection model. Except for special instances, the conventional three-dimensional photoelastic technique is still more practical for photoelastic applications in small laboratory studies.

R-843
Interim Field Guide to Nearshore Underwater Explosive Excavation, Jun 1976, L. W. Hallanger, ADA028618

This field guide is designed to provide the Ocean Facilities Engineering personnel of the Naval Construction Forces with the information necessary to successfully conduct underwater explosive excavation projects in rock and coral with primary emphasis placed on techniques suitable for cable and pipeline route preparation. It is not intended to replace the training provided by competent instructors, but rather to provide guidance and information for trained personnel and assistance to instructors. Information has been compiled from a wide range of sources covering explosives, equipment, and techniques suitable for use in underwater explosive excavation projects.

R-844
Wave Forces on Submerged Pipelines – A Review With Design Aids, Jul 1976, D. A. Davis, J. B. Ciani, ADA028620

The literature on the subject of wave forces on pipelines is reviewed. Interim design procedures, which include force equations incorporating inertia, drag and lift components, are presented. Also presented are design aids for determining appropriate values of force coefficients. Three classes of pipeline problems are addressed: (1) pipelines remote from the seafloor, (2) pipelines in contact with the seafloor, and (3) pipelines near enough to the seafloor to be influenced by the boundary effects. It is recommended that these design procedures and aids be used until more data are available. Recommendations for future tests are also made.

R-845
Ice Engineering – A Heat Sink Method for Subsurface Ice Thickening, Jul 1976, J. L. Barthelemy, ADA028619

Ice sheets are being used as runways and as roadbeds for aircraft and heavy-haul transportation vehicles in the Arctic and Antarctic. Thin ice often makes operations on the ice sheets costly and dangerous. The Civil Engineering Laboratory has developed methods of freezing seawater at coastal polar locations to thicken natural ice formations into useful platform foundations. This report documents the process of thickening ice by the use of freezing cells to

accelerate ice growth on the underside of an ice sheet. The freezing cell described in this report is driven by density differences: liquid above is cooled by the air, and liquid below is warmed by the seawater medium.

R-846
Effects of Pavement Roughness on Naval Air Operations, Aug 1976, J. M. Ferritto, J. B. Forrest, ADA033558

A review of the problem of airfield roughness has been made. Either as a result of bad construction methods or, more generally, gradual deterioration, variations that impair the performance of aircraft during ground operations may occur in pavement surface elevations. Although no general standards for evaluating roughness have been accepted, use of the level of 0.4 g maximum peak vertical acceleration response of aircraft in ground operational mode is recommended. A computer program using aircraft characteristics and runway profile is described for use in evaluating the Navy's problems in roughness. Rough pavements do not appear to be a widespread problem for Naval air operations. However, several problem areas are noted. Specific repair may be evaluated using the computer program. It is not presently recommended that the roughness evaluation procedures be incorporated into runway condition surveys.

R-847
An Earthquake Analysis of the Liquefaction Potential at the Naval Air Station, North Island, Sep 1976, J. Forrest, J. Ferritto, ADA033493

The loss of strength experienced by saturated cohesionless soils during earthquake or shock loading is generally referred to as liquefaction. The hazard potential existing at Naval Air Station, North Island, Calif., due to this phenomenon is evaluated herein, including both a statistical evaluation of potential earthquake levels and an appraisal of the magnitudes of damage. Knowledge of the in-situ soils was used in conjunction with earthquake-response predictions in the most recent state-of-the-art prediction procedures. Problems encountered in making liquefaction evaluations are discussed in some detail. These problems include predicting the magnitude and recurrence rates (frequency) of ground motions to be expected, determining the true nature of the subsurface soils, and finally evaluating the effect of the applied ground motions on these subsurface soils. This report concludes that although most of North Island is underlain by natural sands which should be fairly resistant to liquefaction, limited regions with very high liquefaction potential exist. These regions would be expected to liquefy under earthquake levels used for engineering analysis, and present a high damage potential to such critical structures as the carrier docking facilities, aviation fuel tank farms, and service lines.

R-848
Seafloor Construction Experiment, SEACON II - An Instrumented Tri-Moor for Evaluating Undersea Cable Structure Technology, Dec 1976, T. R. Kretschmer, G. A. Edgerton, N. D. Albertsen, ADA040278

SEACON II is a major undersea construction experiment whose major goal was the measurement of a complex, three-dimensional cable structure's steady-state response to ocean currents, and the use of these measurements to validate analytical design models. A secondary goal was to provide a demonstration and critical evaluation of recent developments in ocean engineering technology required to site, design, implant, and operate large, fixed subsea cable structures. The SEACON II structure consisted of a delta-shaped module tethered by three mooring legs in 2,900 ft of water. The top of the structure was positioned approximately 500 ft below the surface. The mooring legs were 4,080 ft long, with each arm of the delta 1,000 ft long. Experimental explosive anchors embedded two of the legs, while a 12,500-lb clump anchor containing a radioisotope thermoelectric generator held the third leg. The entire structure was heavily instrumented in order to collect current profile data and position data. These data were used to validate the computer program DESADE. It was found that the program is capable of predicting the steady-state response of complex, submerged cable systems if the drag coefficient for the cables and the current regime are properly modeled.

R-849
Portable Hydraulic Bandsaw for Use by Divers, Dec 1976, P. K. Rockwell, ADA035904

Seafloor cable repair operations generally require several cable cuts that have been time consuming and difficult for divers to perform. A hand-held hydraulic bandsaw was developed at CEL by modifying a commercially available electric model. The experimental bandsaw was tested underwater and found to perform well, cutting 3-1/2-in.-diam double-armored coaxial cable in 1.5 min. The saw was redesigned to be more comfortable to operate and more compatible with seawater use. The prototype saw has been shown to be extremely effective, both underwater and on land; it has cut materials such as SD list 5 and SD list 1 coaxial cable, SG cable, pipe, reinforcing bar, stainless steel rod, tool steel, synthetic line, grapnel line, and structural aluminum.

R-850
Harbor Screening Tests of Marine Borer Inhibitors – Final Report, Dec 1976, T. Roe, ADA036158

The Civil Engineering Laboratory exposed wood panels impregnated with various materials to determine the resistance of these panels to attack by marine borers. This report lists the results of harbor tests of panels which underwent exposure from January 1967 through 1971 at Pearl Harbor and 1976 at Port Hueneme. When impregnated into wood test panels, creosote and 70-30 creosote/coal-tar solution are about equally effective against Martesia and teredinid attack, but the addition of certain organic and organometallic compounds to creosote or creosote/ coal-tar solution produces a preservative superior to either solution alone. Certain creosote-free treatments which contain a combination of one material specifically toxic to Limnoria and another material specifically toxic to teredines are superior to creosote or creosote/coal-tar solutions in preventing marine borer attack.

R-851
An Ice Excavation Machine, Feb 1977, K. D. Vaudrey, ADA037951

A review of operational requirements indicates a continuing need for equipment to excavate ice to facilitate polar construction. A 30-hp ladder-type trencher was selected and procured for its low ground pressure and versatility. The chain was outfitted with specially designed conical ice teeth, and a rotating ice chipper drum was designed and fabricated for the backhoe arm. Both modifications, along with a off-the-shelf hydraulic impactor attachment, were evaluated during a field test program after undergoing shakedown performance tests in the laboratory. A similar, but larger machine with identical teeth, procured under a separate task, was observed during an extended Antarctic ice-trenching operation. The CEL-designed conical teeth made both ice excavation machines very efficient trenchers, cutting over 3,000 lineal ft (900 m) of ice with an average specific energy of only 220 in.-lb/cu in. (1,500 kPa). Both backhoe attachments were effective for special applications, such as ice hammock removal and deadman anchor emplacement.

R-852-I
Container Off-Loading and Transfer System (COTS) - Advanced Development Tests of Elevated Causeway System, Vol. 1 - Summary, Mar 1977, R. C. Towne, ADA039821

A two-phase advanced development test program was conducted to evaluate the installation, operation, and demobilization of the elevated causeway system. In particular, the program was to determine (a) the structural adequacy and operational capability of the elevated causeway

with spudwells mounted internally or externally to NL pontoon sections, (b) the adequacy of the elevating mechanisms to raise, secure, and interface with NL pontoon sections, (c) the practicability of transporting fenders to the site and installing them on the elevated pier, (d) the capabilities of the fenders to function as intended, (e) the capability of the elevated causeway to perform the container off-loading functions, including truck/trailer trafficability and turnaround, and (f) the practicability of expanding the cargo-unloading platform (pierhead). Also tested during Phase II was the Lo/Ro concept which delivers containers deck-loaded on a causeway ferry; the ferry is beached, and the containers are off-loaded with commercial container handlers. The Phase I laboratory tests were conducted at an open-ocean beach site at Point Mugu, Calif. The Phase II tests were conducted by military operators in conjunction with laboratory personnel at an open-ocean beach training site at Coronado, Calif. The results of the tests verified the practicability of all elevated causeway elements to perform their individual concept functions. Crane container-handling rates of up to 20 per hour were attained.

R-852-II
Container Off-Loading and Transfer System (COTS), Advanced Development Tests of Elevated Causeway System, Vol. II: Elevated Causeway Installation and Retrieval, Nov 1977, C. I. Skaalen, A. B. Rausch, ADA050262

A two-phase advanced development test program was conducted to evaluate the installation, operation, and demobilization of an elevated causeway system. This volume details the portion of the program dealing with the pier installation and retrieval. Pier installation and retrieval methods, lift system, pile positioning, driving and pulling techniques, site and elevated causeway surveys and survey methods, and utilization of associated lift system equipment are covered. A human engineering study was made of both the elevated causeway system hardware and the associated operational procedures. The results of the tests verified the practicality of the elevating mechanisms to perform their functions; however, some modifications concerned with improving construction methodology were deemed desirable. The recommended improvements are noted in the report.

R-852-III
Container Off-Loading and Transfer System (COTS), Advanced Development Tests of Elevated Causeway System, Vol. III: The Elevated Causeway Structure, Oct 1977, B. R. Karrh, ADA04928

This report documents the conversion of the U.S. Navy's floating causeway into an elevated structure. The construction of elevated causeway units for development tests is described. Design and testing of modular exterior and interior spudwells for the elevated causeway units is reported. The development and test of a device for connecting floating causeway sections side-to-side to make an expanded platform, floating or elevated, is related. The connection of the causeway structure to supporting piles is examined with respect to manpower and time constraints. These structural features and components were integrated to assist in the construction and testing of an elevated causeway structure.

Analyses and tests of the elevated structure to ascertain the operating capabilities and limitations are described. A structural analysis technique was formulated for the unique modular causeway structure. To compute stresses due to single and combination loads, graphical solutions are presented. A failure analysis of the structure was made to determine operational safety factors. Structural aspects of an elevated crane platform and the impact of the 40-ft (12.2-m) container on the elevated causeway system are discussed.

R-852-IV
Container Off-Loading and Transfer System (COTS), Advanced Development Tests of Elevated Causeway System, Vol. IV: Fender System and Lighterage Motions, Jul 1977, D. A. Davis, ADA043430

The design, fabrication, and testing of a boat fender, which is compatible with a transportable elevated causeway system for unloading container-bearing lighterage, are described. The pile-restrained, floating fender is comprised of a standard 1x15 string of Navy NL pontoons faced with commercially available foam-filled cushions. Each fender unit has an overall length of 90.0 ft (27.4 m), a breadth of 11.0 ft (3.4 m), and a depth of 5.0 ft (1.5 m). Tests of the fender, made in conjunction with tests of the elevated causeway system, indicate that the fender can absorb the berthing impact from a fully loaded 1610 Class Navy Landing Craft, Utility (LCU) having a normal impact velocity of 2 kt (1.0 m/sec). Wave-induced motions of container lighterage at the Phase II site were small and had an inconsequential effect on cargo unloading.

R-852-V
Container Off-Loading and Transfer System (COTS), Advanced Development Tests of Elevated Causeway System, Vol. V: Container-Handling Operations, Jun 1977, J. J. Traffalis, J. J. Hromadik, M. J. Wolfe, R. A. Bliss, ADA042164

A two-phase advanced development test program was conducted to evaluate the elevated causeway system installation, operations, and demobilization. This volume covers the container-handling operations of the Phase II tests (no containers were handled during Phase I) and provides container transfer rates and operational data pertinent to container-handling cranes, containers, spreader bars, lighters, truck/ trailers, pontoon deck reinforcement, turntable, beach transition ramp, beach matting, and air bearing transporter. Also tested during Phase II, and reported in this volume, was the Lo/Ro concept which delivers containers deck-loaded on a causeway ferry; the ferry is beached and containers are off-loaded with commercial container handlers.

Under the ideal sea conditions at the Coronado test site, crane-container handling rates of 20 containers per hour were attained, but the overall productivity was degraded to 15.4 containers per hour with a causeway ferry because of truck/trailer movement on the causeway which could not keep up with the crane operation. A rate of 14 containers per hour was attained with the LCU. Time to unload containers during the Lo/Ro tests varied from an average of 1.6 min per container on the first section (nearest shore) to 2.4 min per container on the third section.

R-853
Preliminary Selection of Anchor Systems for OTEC, Mar 1977, J. M. Atturio, P. J. Valent, R. J. Taylor, ADB018106L

Anchor systems capable of mooring the proposed Ocean Thermal Energy Conversion (OTEC) power plant are described and compared. The comparison is made for two environments: the first, typical of the deep ocean between ±20° latitude; the second, typical of the Gulf Stream. Deadweight anchors with cutting edges were selected as the best choice for anchoring OTEC in the deep ocean. The deadweight required could reach 40 m on a side by 4 m high with 4-m-deep cutting edges and could weigh 18 MN (4×10^6 lb) submerged. For the Gulf Stream environment a deadweight anchor offers only slight advantage over a pile anchor group using large-diameter steel-pile shells grouted into the seafloor. On rock seafloors the advantage is with pile anchor groups, but considerable technical development is required before such an anchorage is attainable. Deadweights to moor OTEC in the Gulf Stream could reach 76 m on a side by 7.6 m high and could weigh 600 MN (133×10^6 lb) submerged.

R-854-I
A Finite Element Head Injury Model, Vol. I: Theory, Development, and Results, Jul 1977, T. A. Shugar, ADA043605

The results of a head injury model development program are presented, including a description of the resulting model's features and its capabilities for simulating direct and indirect impact forces. The model's validity is discussed in terms of level of confidence and verification. Skull bone response and brain response are presented for a variety of dynamic simulations. Over 75 dynamic and static computer runs have been executed in its development. The basic features of the model are described, including recognizable skull geometry, linear elastic and linear viscoelastic behavior, and a capability for specifying arbitrary impact loads and boundary conditions. A special modification of the isoparametric element is shown to be particularly suited to simulation of the dynamic response of nearly incompressible brain matter.

A preprocessor enables automatic mesh generation of a skull model consistent with a prescribed set of geometrical data supplied by the user. Either complete three-dimensional skulls or skulls symmetrical with respect to the midsagittal plane can be specified in the mesh generation process. Additionally, scale factors can be prescribed which modify existing skull meshes and achieve parametric control on size and shape. A postprocessor facilitates the reduction of the large amount of data that is typical of a head impact simulation. The scope and limitations imposed by the assumption of linearity are discussed. The results demonstrate that while some minor changes appear indicated, the model predictions yield useful insight into the mechanical causes of skull and brain injury.

Volume I of this report also contains Appendix A, a clinical description of head injury. Volume II contains Appendixes B through G covering the computer programs for skull modeling.

R-854-II
A Finite Element Head Injury Model, Vol. II: Computer Program Documentation, Jul 1977, T. A. Shugar, ADA043582

Volume II contains necessary information and documentation for executing the HIM computer program. Documentation includes a user's manual, a flow chart, CDC 6600 control cards, sample input data, and a FORTRAN IV source code listing of the HIM program. In addition, listings are provided for a preprocessor (skull mesh generator), a bandwidth minimizer, and a subroutine for an improved finite element for simulating the load-deformation response of the skull.

R-855
Expendable Doppler Penetrometer: A Performance Evaluation, Jul 1977, R. M. Beard, ADA043912

An expendable penetrometer using the Doppler principle has been developed to expediently test seafloor soils to a depth of 9 m (30 ft) at water depths to 6,000 m (20,000 ft). The velocity of the penetrometer is measured as it penetrates seafloor soils. From the velocity record, soil penetrability and an estimate of the undrained shear strength profile can be calculated. The penetrometer has a mass of 173 kg (12 slugs), is 2.9 m (9.5 ft) long, is 90 mm (3.5 in.) in diameter, and is easily deployed from a ship. This report presents data from 11 tests at four locations off the southern California coast. Undrained shear strength profiles determined from penetrometer data are compared to other types of in-situ data and core data. It is concluded that the expendable Doppler penetrometer is reliable and simple to use and that reasonable estimates (+30% of actual values) of undrained shear strength profiles can be obtained even though the analyzed phenomenon is complex. This tool will be of particular value in surveying potential embedment anchor or foundation locations and can, for some cases, provide information sufficient for design purposes.

R-856
Efficiency Study of Implicit and Explicit Time Integration Operators for Finite Element Applications, Jul 1977, M. G. Katona, R. Thompson, J. Smith, ADA043968

Direct integration techniques (step-by-step) are widely used for the time integration of discretized equations of motion that result from applying numerical techniques such as the finite element method to structural dynamic problems. The integration methods are commonly classified in two groups: (1) explicit methods, which are computationally fast per step but are limited to relatively small time steps due to numerical instability, and (2) implicit methods, which are computationally slower per step but are often capable of utilizing significantly larger time steps with comparable accuracy. In many, if not most, problems it is not obvious which integration method is more efficient. In this study the Newmark Beta-Method is examined for stability, accuracy, and efficiency, where Beta = 0 provides an explicit algorithm, while Beta $\neq$ 0 provides an implicit algorithm. Both algorithms are used in the same finite element program to solve a soil-structure boundary value problem composed of a cylindrical steel shell encased in a relatively soft rock-like material and subjected to a surface blast loading. For this problem with linear system properties, the implicit method was significantly more efficient as measured by computer time. For nonlinear systems, the two methods are approximately equivalent in efficiency. A combined explicit-implicit integration technique is proposed for these types of interaction problems with two or more materials. The combined explicit-implicit algorithm employs explicit integration in the soft material and implicit integration in the stiff material with a potential increase in efficiency by an order of magnitude over either method applied individually.

R-857
Corrosion Protection of Existing Utility Lines Under Piers and Wharves: Results of 3 Years of Marine Atmospheric Exposure, Dec 1977, E. S. Matsui, ADA050883

Most utility lines under piers and wharves are made of iron or galvanized steel which become badly corroded when exposed to severe marine environment. The problem is compounded because of the difficulty of preparing good surfaces of these lines before coating because of their location and shape. CEL is investigating new and improved coating systems that can tolerate minimum surface preparation, extend the service life, and reduce the maintenance cost. Various coating systems were subjected to 3 yr of in-service and atmospheric exposure tests. Of these systems, the grease-impregnated tape, Denso tape, was found to provide the best protection against corrosion attack under piers.

R-858
Project TRASH: Total Refuse Advanced Systems Handling, Dec 1977, C. J. Ward, W. V. Miller, ADA050882

Preliminary and conceptual designs of alternative approaches to a small-scale solid waste transfer/resource recovery station were developed. Equipment components and processes were examined, and their life-cycle costs were compared. Selected modules were combined to process two types of solid waste: (1) completely mixed waste and (2) waste from which most glass and metals had been source-segregated. All system designs were ranked according to life-cycle cost. A solid waste two-component source-segregation experiment was then conducted to resolve questions of workability and to quantify the associated effectiveness and cost factors. In addition, a computer program was developed to aid in the economic analysis of proposed changes in waste practices, such as implementation of source segregation, resource recovery, and transfer station operations.

R-859
OTEC Anchors: Selection and Plan for Development, Dec 1977, P. J. Valent, J. M. Atturio, ADA049552

Anchor systems capable of maintaining the Ocean Thermal Energy Conversion (OTEC) power plants on station were identified and compared. Deadweight anchors with base shear keys were selected as the best choice for the more common ocean environments. Concepts for transporting and lowering the required deadweight anchor systems to the seafloor site are described and their limitations noted. The attractiveness - and technical feasibility - of using a free-fall-emplaced deadweight anchor installation is highlighted. Pile anchors attached to a common frame (template) were selected as the better choice on the hard (rock) seafloors often found in the high-energy, shallow-water areas of the Gulf Stream. Further development of the pile anchor system for OTEC, however, is probably not necessary because it is expected that such hard seafloor anchor sites are best avoided by OTEC plants. A plan for development of the free-fall-emplaced deadweight anchor is presented and a plan for implementation recommended. The development plan includes evaluation of the hydrodynamic stability of the free-falling anchor, development of the soil-penetration/anchor-deceleration inter-relationship, assembly of a structural analysis and design technique for the anchor, and finally a demonstration of a near prototype size OTEC free-fall deadweight anchor in early 1980.

R-860
Ice Engineering: Study of Related Properties of Floating Sea-Ice Sheets and Summary of Elastic and Viscoelastic Analyses, Dec 1977, K. D. Vaudrey, ADA051184

This report summarizes approximately 12 yr of research effort by the Civil Engineering Laboratory for developing engineering data and analytical capability for calculating operational bearing capacity of sea-ice sheets. The objectives of the report are: (1) to summarize the CEL elastic and viscoelastic experimental programs; (2) to review the two CEL-developed finite-element techniques for analyzing the structural behavior of the material; and (3) to present bearing capacity limits for both short- and long-term ice-sheet operations.

At the outset of this research program little engineering data and only limited analytical techniques were available to assist the practitioner in evaluating ice-sheet bearing strength. Though much still remains to be learned, it is now possible to make qualitative engineering predictions on bearing strength as a result of the comprehensive laboratory and field research program directed at defining the tensile strength, compressive strength, flexural strength, elastic modulus, creep behavior, and their relationship to temperature and salinity. Bearing strength analysis, using the CEL-developed finite-element computer codes, can now be based on the material properties corresponding to the actual temperature and salinity gradient existing across the vertical profile of the ice plate.

R-861
Exploratory Development of Structures for Tactical Container-Shelter System (TACOSS) Units XI and XII, Dec 1977, R. H. Seabold, ADA053505

Structures for two types of container-shelters were developed for use as part of the Tactical Container-Shelter System (TACOSS). Both types are to serve as 8 x 8 x 20-ft (2.438 x 2.438 x 6.096-m) intermodal shipping containers and as portable shelters. TACOSS XI has removable side panels and telescoping corner posts. Cargo handling can take place through the personnel door and through both sides with any number of side panels removed. In the extended configuration, the roof can be extended upward by means of the telescoping corner posts to obtain a 10-ft (3.048-m) clear ceiling height, and closure panels can be inserted to increase the wall height. In the complexed configuration, side panels are removed and units can be coupled together to form shelters of any length, depending on the number of units used. The units also can be extended and complexed simultaneously to form shelters about 20 ft (6.096 m) wide, with a 10-ft (3.048-m) clear ceiling height, and of any length in increments of 8 ft (2.438 m). TACOSS XII has a detachable pallet base. In the pallet configuration, the entire upper structure is lifted away in one piece and stored elsewhere. The floor of the structure in this configuration serves as an 8 x 20-ft (2.438 x 6.096-m) pallet for ordinary cargo, for a large equipment base, or for a floor of a prefabricated building module. Cargo handling can take place from both sides and both ends. Both types were designed, analyzed, fabricated, and tested. Two experimental models of type XI and one of type XII were fabricated and tested. Neither type fully qualified as a container due to lack of weatherproofness and qualification as shelters was not fully validated due to the cancellation of drop and rain tests, but both concepts were found to be feasible. The operating principles work and need not be changed. The payload, tare weight, dimensional, and residual deflection requirements can be met for all configurations of use and all modes of transportation.

R-862
Development and Testing of an Experimental Heavy Duty Hydraulic Rock Drill for Use by Divers, Dec 1977, R. L. Brackett, W. Tausig, ADB026721L

Underwater construction operations often require drilling holes in seafloor rock and coral for the placement of explosive charges or the installation of seafloor fasteners. To meet this need an experimental hydraulically powered rock drill was developed by combining a commercially available concrete breaker and a hydraulic motor coupled to the tool chuck to provide rotational indexing. Three types of concrete breakers were tested for possible rock drill candidates. The selected breaker was used to build the prototype underwater rock drill, capable of operating to ocean depths of 120 ft. Tests with the rock drill show it is capable of drilling up to 2-in.-diameter holes at a rate of 3 in./min in 17,000 psi granite. In addition, a stabilizing chassis with an articulated positioning arm was designed and fabricated to provide accurate drill positioning. The stabilizing chassis enables underwater construction divers to drill holes up to 4 in. in diameter by 15 ft deep with improved penetration rates.

R-863
Effectiveness of Over-Rust Primers for Naval Shore Facilities, Jan 1978, E. S. Matsui, ADA053557

Various over-rust primers topcoated with government specification paint TT-E-489D were applied over brush-off sandblasted and wire-brushed rusted steel specimens and were exposed 5 yr at three Civil Engineering Laboratory (CEL) marine atmospheric test sites. The performance of the coating system at the CEL test sites was compared with that of the government specification test standard coated over sandblasted, brush-off sandblasted, and wire-brushed steel specimens. The results indicate that a coating system using a superior over-rust primer can provide protection comparable to that of the test standard applied over the sandblasted steel specimens. However, most of the over-rust primers tested provided less protection than the test standard. A test standard coated with a wash primer (Formula 117) provided poorer protection than the same coating system without the wash primer when applied over the rusted steel specimens. Estimating anticipated durability of coating system at one site from data obtained from another site by a regression analysis is also illustrated.

R-864
Operating Cost Evaluation of Sulfur Dioxide Removal Systems for Boiler Applications, Apr 1978, J. M. Slaminski, ADA054767

Seven commercial processes for extracting sulfur dioxide from steam or steam-electric generating plants are analytically compared. The operation and economics of lime and limestone slurry scrubbing, dilute and concentrated double alkali, and dilute sulfuric acid processes with

gypsum disposal products are contrasted with sodium sulfite/bisulfite and activated char sulfur recovery systems. Each process is critically analyzed to yield system flows and operating expenses (including equipment power consumption, product disposal costs or credits, reagent requirements and operating and maintenance costs). The laws for scaling these results to any given plant capacity and coal sulfur content are developed and parametrically graphed. This information is a valuable guide for the Navy or utility engineer to perform accurate system evaluations.

R-865
Nansen Drift Station Project - Remote Sea-Ice Runway Construction, Apr 1978, J. L. Barthelemy, ADA054720

In the past, surface-flooding activities have been confined to areas near major military logistic centers. As a result, techniques developed for sea-ice runway construction relied extensively upon the use of heavy equipment to clear snow and position large stationary pumping equipment. At remote sites, such as that planned for the proposed Nansen Drift Station, requirements are different. Construction crews will be severely restricted as to their size and number of support equipment available, and they may be required to work concurrently at a number of scattered locations. A field-test program conducted by the Civil Engineering Laboratory at Barrow, Alaska, during March 1977 added a new dimension to surface-flooding technology. The exercises demonstrated the feasibility and capability of using small, lightweight pumps to prepare sections of a sea-ice runway. The water-handling equipment included two modified, highly portable, centrifugally driven trash pumps that had undergone preliminary low-temperature testing in the cold-chamber facilities at CEL.

R-866
A Viscoelastic-Plastic Constitutive Model With a Finite Element Solution Methodology, Jun 1978, M. Katona, ADA057684

A textbook style development of viscoplasticity is presented. For completeness, the report also includes a detailed review of plasticity and viscoelasticity. The combination of plasticity and viscoelasticity is the basis for the so-called "viscoelastic-plastic" model developed herein. Other combo-viscoplastic models are also introduced. Each constitutive model is introduced with conceptual one-dimensional stress-strain models and then generalized for multidimensional stress space. Furthermore, each model is cast in an incremental form appropriate for numerical solution techniques. Finite element algorithms are outlined for incorporating these nonlinear constitutive models into boundary value problems. In particular, tangent stiffness and initial strain methods are discussed. The viscoelastic-plastic model is compared to experimental data for plexiglas and sea-ice to illustrate the versatility of the model in replicating nonlinear creep and flow of these materials. Moreover, the identification of the model parameters are shown to be no more difficult than the identification of parameters for the classical theories of plasticity and viscoelasticity.

R-867
A Probabilistic Procedure for Estimating Seismic Loading Based on Historic and Geologic Data, Aug 1978, J. M. Ferritto, ADA060204

This report describes a procedure for estimating site ground motion based on the historic data base of earthquakes adjusted to incorporate fault slip data. Procedures are given for determining site acceleration magnitude and duration for various confidence levels. Seismic risk analysis techniques are discussed. The report contains background material required for an understanding of the procedure.

R-868
Corrosion and Biofouling of OTEC System Surfaces - Design Factors, Nov 1978, J. F. Jenkins, ADA066115

Biofouling and corrosion of Ocean Thermal Energy Conversion (OTEC) plants are critical factors in the economic feasibility of the OTEC concept. As the mission and operating requirements of an OTEC plant are significantly different than those for any existing facility, many unique materials and design problems must be addressed. This report identifies factors that influence biofouling and corrosion, recommends specific design features where appropriate, and identifies items requiring further investigation.

R-869
Long-Term, Deep-Ocean Test of Concrete Spherical Structures - Results After 6 Years, Jan 1979, H. H. Haynes, R. S. Highberg, AD

In 1971, a long-term, deep-ocean test was started on eighteen concrete spheres, 66 inches (1,676 mm) in outside diameter by 4.12 inches (105 mm) in wall thickness. The spheres were placed in the ocean at depths from 1,840 to 5,075 feet (560 to 1,547 m). Over a 6.4-year period, yearly inspections of the spheres by submersibles have provided data on time-dependent failure and permeability. After 5.3 years, three of the spheres were retrieved from the ocean for laboratory testing. Data on concrete compressive strength gain, short-term implosion strength of the three retrieved spheres, and permeability and durability of the concrete were obtained. This report summarizes the findings from the laboratory and ocean tests.

TECHNICAL NOTES

N-1251
Vibratory Emplacement of Small Piles, Dec 1972, D. T. Gordon, R. S. Chapler, AD906997

An experimental study was conducted to evaluate vibratory emplacement techniques for small piles. A vibratory pile driving system utilizing a hydraulic piston actuator was designed, assembled, and tested. The general effects of driving frequency, surcharge, driver power, and tip driving were evaluated. Tests were conducted to compare the vibratory driving with impact driving.

Although rapid penetration rates were achieved with the vibratory system, this advantage was minimized due to the short total driving time. Therefore, it was concluded that a small vibratory pile driver must compete with impact hammers in size, portability, and efficiency. A large system surcharge appeared to be an inefficient method of achieving penetration in difficult terrain. Instead, it was recommended that a linkage be designed to provide rapid impact capability for the actuator in difficult conditions.

A small, self powered, hydraulic system of this type could perform several construction site tasks. The vibratory capability could be used to rapidly emplace or extract piles, stakes, and ground anchors. The rapid impact mode could be used to penetrate difficult soils and to carry out various demolition tasks.

N-1252
Materials for Leak-Proofing Navy Oil Tankers, Dec 1972, H. P. Vind, AD754746

All seagoing tankers leak to some extent. Oil or other liquid cargo leaks out to pollute the ocean, and seawater leaks in to pollute the cargo. If a tanker runs aground or collides with another ship, it may be filled with seawater and spill its entire cargo into the sea.

At the request of the Navy's Supervisor of Salvage (SUPSALV), the Naval Civil Engineering Laboratory explored the concept that Navy oil tankers might be made self-sealing or leak-proof. Letters were sent to 160 firms, and a news release was sent to several trade journals in search of materials which might be used to prevent or retard the escape of oil from tankers. Many responses were obtained.

Some of the promising materials proposed for the purpose are elastomeric sealants for riveted joint construction, rubberized magnetic patches and shingles, gelling and emulsifying agents for thickening oil, rubberized fabric skirts and liners, and reticulated polyurethane foam baffles. It is planned to investigate all of these materials in greater detail in FY73, and laboratory tests will be undertaken at NCEL to evaluate the probable effectiveness of magnetic rubberized shingles and reticulated polyurethane foam in retarding oil leaks from tankers. Continued search for new materials is also planned for FY73.

N-1252S
Materials for Leak-Proofing Navy Oil Tankers, Jul 1973, H. P. Vind, C. W. Mathews, AD765568

A previous report (TN-1252) describes numerous concepts for leak-proofing Navy oil tankers (oilers). This report is a brief supplement to it. Described are magnetic patches, portable oil transfer and storage system, foam baffles, and bottom seals.

N-1253
Inspection of Experimental Marine Piling, Dec 1972, H. Hochman, AD753194

The 54 cooperative piles at Coco Solo, Canal Zone, and the 267 cooperative and NCEL experimental piles at Pearl Harbor, Hawaii, were inspected during the periods Feb 22 to 25 and Mar 17 to 24, 1972, respectively. After 9 years of exposure at Coco Solo, 11 of the 12 piles treated with 70/30 creosote-coal tar showed borer attack of varying degrees of severity. Only minor attack was noted on 7 of the 18 dual-treated piles. Six of the 12 piles treated with 70/30 creosote-coal tar showed light borer attack at Pearl Harbor, but only trace attack was noted on 5 of the 18 dual-treated piles. The major attacking organisms in both sites was Martesia. After 5 to 8 years of exO posure in Pearl Harbor, 60 of the 201 NCEL piles have shown evidence of borer attack The degree of attack varies from a single abortive Martesia hole to light Limnoria and Martesia attack. Here, too, Martesia attack was more usual than was that of Limnoria. The use of dual-treated piles for bearing purposes is recommended.

N-1254
The Measurement of the Intertial Properties of Routinely Installed Naval Shore Based Equipment, Jan 1973, D. Pal, H. A. Gaberson, AD757704

The problem of measuring the mass properties of small shore-based equipment is discussed. Equipment designed and tested for center of gravity and moment of inertia measurement is described. Typical results of actual measurements are presented. The Trifilar pendulum method of moment of inertia measurement is analyzed in detail. A theoretical error analysis is presented and substantiated with experimental results.

N-1255
Application of Fluidic Concepts to Hydraulic Control Systems, Dec 1972, R. H. Fashbaugh, E. R. Durlak, AD906998

A survey is presented of the experimental work that has been done in the area of hydraulic fluidics. The importance of Reynolds number is shown when comparing the performance of a fluidic element with hydraulic oil or air as the working fluid. The results of testing all-hydraulic fluidic actuator control systems conducted at General Electric Company and at the Naval Ship Research and Development Center support the premise that hydraulic fluidic elements are useful in improving all-hydraulic servo-actuator control. A small-scale test conducted at NCEL with pneumatic fluidic elements showed that a pneumatic actuator can be powered directly by a fluidic amplifier cascade at the lower power levels.

N-1256
An Experimental Investigation for Determining Susceptibility Limits and Techniques for Desensitization of Solid State Electronic Equipment to Power Line Transients, Apr 1973, M. N. Smith AD762403

Government and commercial facilities are becoming more operationally dependent on sensitive and complex electronics systems. These systems require precise and continuous supply of electric power for trouble-free operation. Desensitization of sensitive electronic equipment to power supply abnormalities is one approach toward achieving increased operational reliability. This report covers the results of an experimental investigation to determine the susceptibility limits of a selected solid state electronic test unit and to evaluate techniques for desensitizing the unit to a variety of typical power line transients. It was concluded that when sensitive electronic systems are being developed, susceptibility tests should be performed to provide design criteria for desensitizing the equipment on a cost effective basis.

N-1257
Cargo Transfer at Sea - The Pendulation of Loads Suspended From Shipboard Cranes, Dec 1972, H. S. Zwibel, D. A. Davis, AD754747

A theory has been developed which could aid Navy materials-handling specialists in their effort to evaluate load transfer systems for a modular port facility. Theory predicts the horizontal response of an unrestrained, wire-suspended load in regular and random seas. The line length is allowed to vary with time; hence the resulting load response in random seas is characterized as a nonstationary random process. The analysis is used to predict the motion

of a load freely suspended from the boom of a Navy 100-ton floating crane. The results from the analysis and from full-scale tests at sea confirm the fact that motion of unrestrained loads is a serious problem in even moderate sea states. Taglines or other means of restraint will be required from inception through completion of each load transfer.

N-1258
OSDOC II Engineering Tests - Coronado, Dec 1972, R. C. Towne, J. J. Traffalis, D. A. Davis, D. B. Jones, R. Billie, H. S. Zwibel, AD907010L

The Coronado engineering tests were conducted for purposes of evaluating the equipment capabilities and limitations of the NCEL concept. This concept evaluation included off loading 8 x 8 20-ft containers from a simulated non-self-sustaining containership and transporting the containers ship-to-shore in a roll-off mode via a pontoon causeway ferry shuttle, and across hardened beaches to a stabilized storage area. Available inventory equipment and techniques were used in these tests, such as a Navy floating YD-type crane, standard NL pontoons, Marine Corps truck/trailers, and MO-MAT and ON-FAST beach hardening. The tests were conducted in two phases: first, in the San Diego harbor to familiarize the operators with the concept and procedures and second, in the open sea to evaluate the equipment concept. The results of the evaluation demonstrated the feasibility of the concept and the ability of the available inventory equipment to off-load containers from ship-to-shore in wave/swell conditions in excess of original estimates for the equipment. Also apparent was the ability of the equipment operators to perform the concept functions with a minimum of special training and guidance beyond their normal training. The concept of a floating crane/ causeway ferry shuttle is recommended for the joint service OSDOC II exercise.

N-1259
Thin Film Protective Polymers from Amines, Jan 1973, C. V. Brouillette, AD757706

Amino compounds were applied to steel test specimens, by direct application and also from solution, and subjected to ultraviolet radiation to produce photo-oxidative polymerization on the surface of the steel. Thin film polymers were produced on the steel in many instances. The more adherent of these films appeared to resist wetting by tap water and were corrosion resisting.

N-1260
Magnetic Pigmentation in Paint, Jan 1973, C. V. Brouillette, AD757707

Several catalytically cured coatings can be applied to wet steel surfaces, but cannot be applied to steel surfaces completely immersed in seawater. The concept of using magnetic particles as part of the pigmentation and applying to paint under water to magnetized steel was investigated. Promising results were obtained from a magnetically pigmented epoxy and coal-tar epoxy. However, methods for inducing a stronger magnetic charge on the steel substrate are necessary. It is recommended that additional coatings, types of magnetic particles, and methods to produce stronger magnetic charge on the steel substrate be investigated.

N-1261
An Earth Heat Sink Concept for Underground Power Sources, Feb 1973, S. C. Garg, AD757708

The possibility of using an earth heat sink to absorb the waste heat from an underground power plant operating in a closed cycle was investigated. Preliminary calculations based upon a transient heat conduction analysis were carried out to determine the order of magnitude of dimensions of the required heat sink. The calculations have shown that earth heat sinks may be practical and that they should be considered along with other methods of heat dissipation for underground power plants operating on a closed cycle basis over limited durations in time.

N-1262
Evaluation of Three Diver-Installed Fastener Systems, Apr 1973, G. L. Liffick, G. S. Guthrie, AD769672

Many salvage operations require the attachment of lifting points by divers. As part of the Navy-MAKAI dive series in late 1971 both threaded and power velocity attachment systems were evaluated for diver use. One-half-in.-diam eyebolts installed in diver-drilled and topped holes in 1-in. steel plate had an average ultimate pullout strength of 21,500 lb and required 7.8 min to install. Diver-installed power velocity studs and 1/2-in.-diam eyenuts had an average ultimate pullout strength of 20,000 lb in 1-in.-thick steel plate and required 1.4 min to install. Simple padeyes attached with three threaded fasteners were 2.1 times stronger than the single fasteners.

N-1263
Effect of Bottom Sediment Containing Hydrogen Sulfide on Materials; Part I, Mar 1973, J. S. Muraoka, AD759673

Plastic, synthetic ropes, natural fiber ropes, electrical cable, insulations, and a wood panel were partially exposed in the black, bottom sediment of Port Hueneme harbor to determine the effect of hydrogen sulfide on materials. After 1 year of exposure, the materials were recovered and examined for fouling and biodeterioration. In addition, hardness and moisture absorption tests were conducted on the plastic panels while tensile strength tests were conducted on rope specimens.

N-1264
Expansive Cement Concretes for Naval Construction, Mar 1973, J. R. Keeton, AD757715

Expansion and subsequent shrinkage characteristics of shrinkage-compensating concrete were determined in mesh-reinforced prisms as well as in "standard" Rubin bars. The maximum aggregate size was 3/8 in. The specimens were cured in fog for 14 days and then subjected to drying in either 25% or 50% relative humidity (both at 73F). Although mixes were made with several different cement contents, most of the specimens were made with 7.5 sacks of cement per cubic yard. For comparison purposes, similar mixes were made with portland cement.

N-1265
Primers for Automobile Refinishing, Mar 1973, C. V. Brouillette, AD757709

The investigation compared various primers and finish coats and showed that gloss retention was improved by use of a quick-drying primer coating, MIL-C-8585A. A silicone-alkyd finish coat, MIL-C-46141, was found preferable to the specified alkyd enamel finish, TT-E-489F. A regularly scheduled washing and waxing is necessary to maintain a continued desirable aesthetic appearance.

N-1266
Polytoroidal Tunneling Thruster for Specialized Navy Applications, Feb 1973, D. E. Williams, A. Gaberson, AD757710

The report introduced an application of vermiculating or worm-like motion, a motion in which a longitudinal wave traverse one of the contacting surfaces in the direction of motion. The high force tunneling thruster was selected as the most promising of several applications. A model polytroidal thruster using small tire inner tubes as toroidal bladders to operate within a transparent cylinder was fabricated and tested. The use of a transparent cylinder permitted direct observation of the distensions of the inflating and deflating rubber toroids. By positioning the

cylinder vertically, thrust loads in the form of dead weights were used for testing. Observation of bladder distortions during operation provided qualitative data.

N-1267
Analysis of Hydrophone Support Structure After 52-1/2 Months Exposure at a Depth of 5,270 Feet in the Barking Sands Test Range, Kauai, Hawaii, Mar 1973, J. F. Jenkins, AD759674

The condition of the support structure for hydrophone 4-7 of the Barking Sands Test Range, Kauai, Hawaii was analyzed after 52-1/2 months of exposure to seawater at a depth of 5,270 feet. The types and severity of corrosion on the various structural components are described and analyzed. Prediction of the additional lifetime to be expected from similar structures at this location is made. Recommendations for extending the useful lifetimes of similar structures at this site are made.

N-1268
Liquid Film Smoke Scrubber; a Feasibility Study, Feb 1973, T. T. Fu, AD908619

A liquid film smoke scrubbing concept is described. The feasibility of this concept was studied experimentally using the high expansion foam generators on hand to produce the liquid films and JP-4 fuel fires to produce the smoke. The experiments were conducted in a 5 x 7-ft fire test wind tunnel. Test results show that the scrubbing action took place mostly at the bubble films which substantiates the validity of the basic concept. Due to the limitations of the present experimental setup, only about 50% scrubbing efficiency could be obtained and the system suffered from excessive foam accumulations. Based on analyses and test results, it was concluded that these deficiencies can be greatly improved after the following developments are made: (1) a method for producing small size foam bubbles with high expansion ratios; and (2) a smoke resistant and fast draining high expansion foam concentrate formulation. Because of the simple construction and the extraordinary large surface contact obtainable, this method is potentially economical and effective in pollution control.

N-1269
Feasibility Study for Employing Cryogenic Liquids in Salvage Buoyancy Systems at Deep Depths, Apr 1973, K. W. Tate, M. E. Hollan, AD759675

An analytical heat transfer model has been developed to predict the behavior of cryogenic liquid for possible application in ship salvage buoyancy devices at extreme ocean depths. The gasification of cryogenic liquids to produce a buoyancy gas offers a considerable propellant cost savings over other chemical gas generating methods currently being considered for large lifts at deep depths. Computations using the heat transfer model for several simulated missions indicate that the use of cryogenic liquids appears feasible for deep salvage operations because the acceptable heat loss rates from underwater dewars can be significantly higher than those normally accepted for surface dewars.

N-1270
Evaluation of a Straddle-Lift Vehicle as a Container Handler/Transporter for Amphibious Operations, Mar 1973, M. J. Wolfe, AD759676

The landing craft retriever unit (LCRU) at the U.S. Naval Amphibious Base, Coronado, California, was used as a test vehicle to evaluate the straddle lift concept of container handling for amphibious operations. The LCRU was used to load and unload a beached LCM-6 landing craft. The cargo was an 8 x8 x 20-ft Marine van container loaded to 22.4 tons gross. In addition, the LCRU was used to haul the container up various sand slopes and across unimproved terrain, and to load the container onto a trailer.

N-1271
Preliminary Analyses of Possible Factors Associated With Asphaltic Concrete Airfield Pavement Defects, Apr 1973, H. Tomita, AD762404

Aircraft traffic parameters, natural environment, and asphaltic concrete pavement properties and defect density values for 11 Naval and Marine Corps airfields were compiled for preliminary statistical analyses. The purpose of the analyses, which involved correlation and regression, was to determine what traffic, environment, and pavement factors were significantly associated with the various defects. Results of the analyses indicated that most of the factors are not significantly associated with pavement defects. Many of the factors appeared to be related to pavement defects in a manner opposite to what is considered logical from a physical or engineering standpoint.

N-1272
Development, Installation, and Test of an Automatic Fire Protection System for a Navy Manned Hyperbaric Chamber, T. T. Fu, A. Widawsky, AD772514

An automatic fire protection system was developed, installed in a Navy manned hyperbaric chamber, and tested. All design requirements were met or exceeded. The major elements in the automatic fire protection system are four infrared detectors, 14 spray nozzles, a water supply tank, a hand line within the chamber, and two submersible pumps. Water spray is delivered to the chamber in less that 1.6 sec after the appearance of a simulated flame. Surfaces which might support combustible material receive a water delivery rate of 2-3 gal per min per sq ft.

N-1273
A Study of Electrical Safety in Naval Hospitals, Apr 1973, J. L. Brooks, AD911293L

The study of the possible hazards associated with the use of electronic, diagnostic and monitoring equipment in Naval hospitals was conducted by NCEL under the sponsorship of the Naval Facilities Engineering Command. The investigation revealed that recent advances in medical procedures coupled with the ever increasing use of electronic equipment and devices do, in fact, present electrical hazards which are unique to hospitals. It is possible, in certain circumstances, for patient electrocution to occur using perfectly "good" equipment. The hazard that can result in electrocution has been termed microshock because the currents and voltages involved are extremely small, and in normal circumstances, would be negligible. The patients, who are susceptible to this hazard have been termed electrically susceptible patients; and the areas of the hospital where this hazard is likely to exist have been termed electrically susceptible patient areas.

N-1274
Lighting Systems for SEABEE Construction Sites, May 1973, A. L. Scott, AD762405

A commercial floodlight trailer was procured with a 35-ft tower and four high-intensity lights to determine its capability compared to that of the standard Navy floodlight trailer, and to compare light output and durability of various types of light sources. It was found that metallic-vapor-arc-type lamps on a tower at least 30 ft high will produce the most effective lighting for SEABEE construction sites.

N-1275
A Multi-Component Platform Construction System for Use on all Types of Marginal Terrain, May 1973, D. T. Gordon, E. R. Durlak, AD764057

An initial development study was completed for a versatile platform construction system to be used by the Marine Corps in any type of marginal terrain that might be encountered: marshes, drifting sand, frozen soil, etc. These

platforms would be used as foundations for artillery emplacements, helicopter or VTOL pads, and various shelters. For construction at remote sites, all components of the system must be lightweight, easily handled by two men, and capable of rapid assembly without bolts or special tools. A system composed of sealed box beams covered by interconnecting decking panels was selected for development. Both the beam and panel components would provide buoyant support on low bearing terrain. The beam substructure could be used to elevate the platforms over uncleared sites.

N-1276
Investigation of the Seafloor Preconsolidating Foundation Concept, May 1973, P. J. Valent, D. A. Raecke, H. G. Herrmann, AD762406

The report describes the performance of submerged model preconsolidating footings. The preconsolidation concept applied to seafloor footings can reduce the subsequent structure settlement by 80 to 90% load capacity. Projected energy requirements of the pump system are compatible with the existing state-of-the-art. The concept will be useful for supporting sensitive and/or heavy structures on soft seafloor sediments.

N-1277
In-Place Application and Performance of Maintenance Coating on Naval Steel Sheet Piling, May 1973, C. V. Brouillette, R. W. Drisko, AD764053

Several materials and application procedures were investigated for use in the in-place maintenance painting of steel piling. Coatings designed for application to dry sandblasted piling above the waterline have performed well for 3 years. Coatings designed for application between tides, so that they are wetted with seawater almost immediately after application, or for application underwater, have performed well for 2 years. Application above water was accomplished by conventional spraying. Part of the application between tides and a few feet below mean low water was accomplished by a special cofferdam designed for use on steel sheet piling. A quick replacement modification of the cofferdam reduced the time for installation from 90 min to 30 min and rendered to cofferdam operationally safe. Coatings applied below water were specially formulated for underwater brush application and successfully applied.

N-1278
Stainless Steel Flake Pigmented Coating Systems, May 1973, C. V. Brouillette, E. S. Matsui, AD912142L

Fifteen protective coating systems containing stainless steel flake pigmentation in the finish coat were applied to sandblasted steel specimens and exposed 3 years in three marine atmospheric test sites, two of these being tropical. Except for a stainless steel flake pigmented chlorinated rubber finish over a self-cured zinc inorganic silicate primer, none of these protective coatings demonstrated superiority over the government specification alkyd control system during the 3 years.

N-1279
Analysis of Soil Stabilization Systems for Marine Corps Use, May 1973, D. J. Lambiotte, AD912815L

Relative merits of selected soil stabilization systems for use by Marine Corps engineers in meeting increased Marine mobility requirements were established. System merits were based on analyses of system feasibility, material costs, and relative logistic burden. Analysis procedures included definition of a range of Marine Corps requirements for stabilization systems to be emplaced over a wide range of soil types. The analysis was structured to address technology, human factors, tactical and environmental constraints. Study results indicated several stabilization systems with a wide range of utility, but none met all Marine Corps requirements. General areas in which system improvements are needed were identified.

N-1280
A Computer Model for Predicting the Load-Deflection Response of Expedient Soil Surfacing, Jul 1973, J. B. Forrest, T. K. Lew, AD765569

The report deals with the use of a finite element code for predicting the response of expediently surfaced soils to applied loading. A laboratory testing procedure is described which was used to characterize the response of a particular soil, in this case a beach sand, and a fiberglass reinforced polyester surfacing material. Field loading tests were conducted using an 8-in. diam steel plate, and the deflections were compared to those obtained using the analytical computer program. The finite element program proved to be capable of predicting the behavior of this type of stabilized soil system.

N-1281
Design Considerations for Seafloor Foundations on Rock, Jun 1973, P. J. Valent, AD762407

Many potential seafloor structure locations consist of exposed rock or rock with a thin sediment cover. The design of a fixed, bottom-resting structure in such an environment poses a substantial problem because of the unevenness of the bearing surface and the usual accompanying strong currents. The report identifies probable locations of exposed and "near-surface" seafloor rock; describes the rock surface microrelief or roughness and the rock mass integrity; and examines and criticizes rock foundation concepts.

N-1282
Propellant-Actuated Deep Water Anchor, Aug 1973, R. J. Taylor, R. M. Beard, AD765570

A propellant-actuated deep water anchor is being developed to moor deep ocean surface and subsurface structures. The anchor is designed to have a long-term holding capacity of 20,000 lb and function in seafloors ranging from very soft sediments to hard rock (basalt) in water depths to 20,000 ft. The anchor has been designed, fabricated and tested on land. Deep water use of this anchor requires that it be expendable; therefore, surplus ammunition components are used in the launching system (e.g., gun barrel, cartridge, primer), and a simplified structural shape is used for the reaction vessel. Three anchor flukes (one for rock and coral, one for sand and stiff clay, and one for soft clay) were designed to satsify the realm of seafloor anchoring possibilities.

N-1283
Engineering Properties of Some North Pacific and Bering Sea Soils, Aug 1973, H. J. Lee, AD768280

During leg 19 of the deep sea drilling project, the DV GLOMAR Challenger obtained seafloor soil samples from the Bering Sea and North Pacific Ocean. These were tested for engineering properties including vane shear strength and compressibility. The results were analyzed and corrected for the significant disturbance introduced during sampling. Since the correction procedures used are based on a number of assumptions, the corrected results are approximately within perhaps 50% of the correct properties. These estimated engineering properties appear to follow the same trend as land soils and can be correlated with index properties obtained from totally remolded samples. This report represents one phase of a project to investigate seafloor soils on a worldwide basis. Eventually a final report summarizing all of the individual phases will be prepared.

N-1284
Analysis of the Condition of ECHO Tower, Azores Fixed Acoustic Range, After One Year at 1,500 Feet of Depth, May 1973, J. F. Jenkins, AD764056

The condition of ECHO tower after a 1-yr exposure to seawater at a depth of 1,500 ft was analyzed immediately after removal. After 5 days exposure near the surface and

after removal from the sea, the only areas of critical corrosion were several pits found on the antennas. These pits were recoated, but failure of the repair coatings could result in tube penetration in as little as 1 year of additional exposure. Recommendations for modification of existing towers to increase their useful life, as well as that of future designs, are given.

N-1285
Analysis of a Dual Mode Desalination System for Naval Bases, May 1973, E. E. Cooper, AD764055

A study was performed to determine the technical and economic feasibility of a dual mode desalination device, combining a reverse osmosis unit and a multistage flash distillation unit. The function of the reverse osmosis unit would be to remove sufficient amounts of scaling salts from intake seawater to allow scale-free operation of the flash distillation unit at temperatures up to 350F. A review of membrane technology revealed that at 600-800 psi, specially blended, open-cellulose acetate membranes or an ion exchange membrane can reject the necessary percentage of scaling salts with sufficient water flux to feed the flash distillation unit. Thus the dual mode desalination appears technically feasible. An economic evaluation of the dual mode device, however, reveals that the cost of its product water would be higher than that from a conventional 250F flash distillation unit.

N-1286
Deep-Ocean Pile Emplacement Systems: Concept Evaluation and Preliminary Design, Aug 1973, D. A. Raecke, AD767323

A previous review of the state-of-the art of seafloor pile emplacement indicated that three types of mechanical systems could be developed for deep-ocean seafloor pile emplacement. The systems are: vibratory drivers, screw piles, and jack-in piles. Conceptual design for multiple-pile emplacement conceptual design for multiple-pile emplacement systems using each of these mechanical systems were developed and compared. The comparison showed that screw-piles would be the most effective in meeting the given operating requirements. A preliminary design for a pilot-model screw-pile emplacement system is presented.

N-1287
Test and Evaluation of Low Velocity Powder Actuated Tools, Jul 1973, R. N. Bibbens, AD912748L

NCEL conducted an investigation, test and evaluation of commercially available low velocity, powder-actuated tools for potential use by the Naval construction forces. Tool requirements were investigated, an industry search of available tools was completed, and candidate tools were selected for test and evaluation. Nine models of tools were tested and evaluated at NCEL for performance, safety, and reliability. Two models of low velocity tools were recommended for inclusion in the SEABEE allowance, whereas the existing high velocity tools were recommended to be deleted. Other recommendations were made regarding tool applications, safety, maintenance, and training.

N-1288
Snap Loads in Lifting and Mooring Cable Systems Induced by Surface Wave Conditions, Sep 1973, F. C. Liu, AD772515

The emplacement and recovery of large deep ocean cable systems containing in-line packages require a knowledge of the dynamic tension and motions of the system under the influence of surface ship motions, subsurface ocean currents and other external loads. A two-dimensional lumped mass model was developed to simulate simply connected cables and in-line packages. Cable tensions and mass point position and velocity are determined by a finite difference method using a predictor-corrector technique. The resulting computer program is applicable to single payload lowering, cable laying, deep sea mooring and deployment of large undersea cable structures.

N-1289
Electrical Resistance Measurement of Conductive Flooring, Jun 1973, P. J. Hearst, AD765571

Methods for measuring the electrical resistance of conductive flooring at hospitals and ordnance activities are discussed. It is recommended that the method of the National Fire Protection Association Standard 56A be used, with minor modifications, for all Navy conductive flooring measurements.

N-1290
Investigation of Water Emulsion Epoxies, Aug 1973, R. W. Drisko, J. B. Crilly, AD913727L

Three water emulsion epoxies (two polyamide cured and one polyamine cured), a low solvent epoxy, a regular solvent epoxy, and a specification alkyd system were applied to sandblasted steel test panels and to steel panels with weathered alkyd paints on them. After curing, the bonding strengths of the test panels were determined. The polyamine cured water emulsion epoxy had very little bonding strength and was readily torn from the panels. The alkyd system had much lower bonding strengths than the epoxy systems. The regular solvent epoxy specimens generally gave a slightly greater bonding strength result than the polyamide cured water emulsion epoxies and much greater bonding strength results than the low solvent epoxy. Bonding of coating systems was greater on weathered paint than on sandblasted steel substrates. No incompatibility with the weathered alkyd paint was noted. Test panels with these coating systems are under tropical field exposure at Kwajalein. Coating performances will later be compared with bonding strengths.

N-1291
Zinc-Rich Coatings for Aluminum in Seawater, Aug 1973, C. V. Brouillette, AD915753L

Aluminum 6061-T6 coated test panels were prepared for exposure in the harbor water at Port Hueneme, California. Surface preparation of most of the panels was by a light sandblast before application of selected coatings, but one series was merely washed clean with water and then with mineral spirits, and another was treated wiht alodine 1200S before the coatings were applied. Zinc-rich primers of various types were used, topcoated with epoxy vinyl or coal-tar epoxy systems. After 3 years of exposure coatings over the Alodine 1200S gave good to excellent protection comparable to that over the zinc inorganic silicates. The topcoated zinc-rich organic primers were slightly inferior to the zinc inorganic silicates. Several coating systems gave excellent protection during the 3 years of harbor exposure and indicated a protective potential for several years more.

N-1292
Vibratory Locomotion. Jul 1973, H. A. Gaberson, P. L. Stone, AD767634

A new method for accomplishing land locomotion by vibrating a mass attached to a skid has been developed. The mass oscillates in an inclined direction, upward and forward, downward and backward. On the up-forward stroke it lifts the skid and pulls it forward; on the down-backward stroke it pushes the skid into the ground and the increased friction inhibits backslide. The report presents the essentials of the theory of operation, design chart, and reports on experiments with test skids.

N-1293
Multicomponent Evaluation Test of Harbor Oil Spill Recovery System, Jun 1973, D. J. Graham, AD912765

Development work performed by other governmental agencies does not evaluate and recommend equipment for operation use in oil spills. An urgent current need exists

within the Navy for a systematic evaluation of available oil spill recovery components individually and in combination as an oil recovery system for Naval harbors. This report and a companion narrated 16-mm film summarize results of the initial project under a continuing NAVFAC program to fill this Navy need. The main emphasis of this program currently underway at NCEL is a comparative evaluation of oil spill containment booms, skimmers, and related equipment resulting in the recommendation of a harbor oil spill recovery system for Navy use.

N-1294
Smoke Detection in Hyperbaric Chambers – An Experimental Study, Jul 1973, T. T. Fu, AD912750

The feasibility of smoke detection for manned hyperbaric chambers by measuring the total hydrocarbon content in the chamber gas and by water condensation on smoke particles was studied. A Beckman 400 hydrocarbon analyzer and an Environment/One incipient fire detector were used for this study. Tests were conducted during a typical 1,000 FSW dive at the Navy experimental diving unit and with simulated dives in both compressed air and helium to 210 FSW using the 2.5 cu ft pressure vessel at NCEL. The results show that the Beckman 400 hydrocarbon analyzer method is inconvenient to use and the Environment/One detector performed satisfactorily after modification.

N-1295
In-Situ Strength of Seafloor Soil Determined From Tests on Partially Disturbed Cores, Aug 1973, H. J. Lee, AD767635

The major obstacle to rational design of seafloor foundations and anchors has been a lack of good quality information on the bottom sediment engineering properties. Considerable engineering property data have been obtained through laboratory testing of core samples, but most of these data are of questionable validity because of sample disturbance factor. To improve the usability and credibility of laboratory test data, an experimental investigation was undertaken to determine the extent of disturbance involved in seafloor soil sampling and handling. In-situ tests were performed and related to comparable laboratory tests. The soils tested were from the Santa Barbara Channel with a terrigenous (land derived) origin. A technique based on earlier work was developed for predicting in-situ shear strength on the basis of laboratory test results. Various disturbance mechanisms including sampling, vibration, long-term nonrefrigerated storage, and water and air expansion were investigated and analyzed quantitatively. Strength reductions varying between 15 and 50% were observed to result from these disturbances. The in-situ strength prediction procedure appears to be capable of compensating for all forms of disturbance except for those developing as a result of gas expansion.

N-1296
Engineering Properties of a Pelagic Clay, Aug 1973, H. J. Lee, AD768291

Pelagic clay is a common ocean soil type covering over 30 % of the seafloor. Two high quality box core samples of pelagic clay were obtained and subjected to index and engineering property testing. The results of tests on both cores were similar, indicating little areal variability. The shear strength near the soil-water interface was about 1 psi, a relatively high value, and the soil was found to be virtually incompressible up to a compressive stress of about 4 psi. When remolded, the strength of the soil was significantly decreased, by as much as a factor of six. The soil was also found to be very compressible beyond a stress of 4 psi. A technique was developed for using triaxial test results to derive shear strengths below the level of sampling. The resulting strength profile indicates a very gradual increase of strength with depth. Implications regarding the use of direct embedment anchors are discussed.

N-1297
Mobile Ocean Basing Systems: The Concrete Semi-Submersible Platform, Jul 1973, D. A. Davis, AD766101

A study was made to investigate the feasibility of substituting concrete for steel as the primary construction material in a self-propelled semi-submersible platform. Of the configurations considered, 11 were determined to meet all of the study design criteria. It is concluded that the concept is feasible provided that: a deck not exceeding 375 lb/sq ft dead weight is used, an underneath deck clearance of 30 to 40 ft above the mean water surface is acceptable, and columns and hulls (up to 60 ft in outside diameter) having a wall thickness not exceeding 2 ft are acceptable from considerations of formability and strength. The construction, assembly, launch and testing of a 1/10 scale model, twin-hull semi-submersible platform is also described. The model was constructed to verify the findings of the self-propelled platform feasibility study, to demonstrate the feasibility of assembling available concrete products into a platform, to evaluate construction techniques, and to study means of linking platform modules together to form large platforms.

N-1298
1973 Inspection of Experimental Marine Piling, Jul 1973, H. Hochman, AD767636

The cooperative and NCEL experimental piles in Pearl Harbor, Hawaii and the cooperative piles in Coco Solo, Canal Zone, were inspected in January and March 1973, respectively. Of the 120 piles that were inadvertently removed from test in August 1972 at Pearl Harbor, about half were redriven in May 1973. They showed that Martesia attack was greatest at the intertidal zone and that Limnoria attack was frequently greatest at the mud line. Cupro-nickel sheathing was severely corroded with large perforations at about the mid-exposure zone.

N-1299
Test and Evaluation of an 80,000-GPD Reverse Osmosis Seawater Desalination Plant Mounted on a AMMI Pontoon, Jan 1974, C. K. Smith, R. S. Chapler, AD774473

An 80,000/gpd reverse osmosis (RO) seawater desalination plant installed on an AMMI pontoon was constructed. It was tested to determine the performance and structural integrity of the plant. Based on experience with this and other desalination plants, a number of recommendations are made with regard to design of future reverse osmosis plants for military use.

N-1300
Rapid-Hardening Concrete for Repairing Navy Concrete Structures in Any Geographic Region, Aug 1973, W. R. Lorman, AD916102L

Concrete mixtures, consisting of common accelerators (either generic of proprietary) and seawater, were investigated in the laboratory to determine their compressive strength and also their strength of bond to old concrete. The various constituents were stored in the atmosphere at temperatures of 33, 63, and 93F, and the concretes were mixed in the atmosphere at these temperatures. The cylindrical test specimens were cured and tested at these temperatures in the atmosphere and in seawater pressurized to simulate a hydrostatic head of 60 ft. Strength tests were made at ages 1 hr, 4 hrs, 24 hr, and 7 days. Correlation of the strength data with logistic and economic factors showed that rapid-hardening concretes, having adequate compressive and bond strengths and costing less that similar concretes incorporating proprietary accelerators, can be produced by using either calcium chloride (4.0% for low slump concrete and 6.5% for high slump) or calcium nitrate (6.5% for either low or high slump). The recommended concrete mixtures, intended for placement either in the atmosphere or in harbor waters at any depth to 60 ft, may be used by SEABEES in restoring damaged or deteriorated Navy concrete structures situated either ashore or underwater in any geographic region.

N-1301 – Classified report, Apr 1974, AD532004

N-1302
Thermal Conductivity Measurements of Cryogenic Insulations at High Pressures, Jan 1974, K. W. Tate, R. C. Westphal, AD774470

A special test apparatus was developed to measure apparent thermal conductivity of powder insulations at cryogenic temperatures and high interstitial gas pressures. The test apparatus consisted of two concentric cylinders, with the test insulation contained in the annulus between the two cylinders. Thermal conductivity measurements were based on the radial heat flow from the outer cylinder to the inner cylinder. Tests were conducted at pressures from 14.7 to 5,000 psia and a nominal temperature difference of 200 to 520R. Four common loose-fill, powder-type insulations were tested: vermiculity, diatomaceous earth, and two grades of perlite. Test results indicated that for all four insulations tested, apparent thermal conductivity was only weakly dependent on the interstitial gas pressure for pressures above 2,000 psia.

N-1303
State of the Art of Electromechanical Cables, Aug 1973, J. R. Padilla, M. C. Hironaka, AD772516

A state-of-the-art study was made of submarine electromechanical cable technology. These are ocean cables which include electrical cables with special strain members. The purpose of the study was to define areas of deficiencies so that development programs could be initiated in selected areas. The approach included a literature search, and extensive interviews with electro-mechanical cable manufacturers and electro-mechanical cable users. Engineers and scientists of various disciplines from the NCEL participated in the study. Areas of study include: mechanical properties, electrical properties, handling, terminations and hardware, maintenance and repair, manufacturing, and history of electro-mechanical cable development.

N-1304
Technical Investigation Supporting a 2-kW(E) RTG, Final Design, Aug 1973, J. F. McCartney, J. R. Padilla, M. C. Hironaka, T. R. Kretschmer, P. J. Valent, AD912816L

Comprehensive analyses have been made of the following ocean engineering aspects to aid the final design of an undersea 2 kW(E) radioisotope thermoelectric generator (RTG): (1) sea operations including transport of the RTG, installation in the deep ocean, and recovery; (2) seafloor foundation design definition; (3) support structure design definition; and (4) electrical power and instrumentation connection requirements. The basis for these analyses was provided by defining three hypothetical missions that included a range of representative mission locations and oceanographic requirements. The analyses have defined practical methods for transporting, installing, and recovering the power unit to depths of 15,000 ft with relatively small size ships operating in seas up to state 3. Lightweight foundations and support structures are a definite requirement, and conceptual designs have been provided. Electrical power connections can be made reliable by using modified commercially available hardware and by minimizing the number of connectors exposed to the undersea environment. Several development and test areas have been recommended for investigation prior to fabrication of the prototype power unit.

N-1305
Snow Road Construction Technique by Layered Compaction of Snowblower Processed Snow, Aug 1973, M. W. Thomas, K. D. Vaudrey, AD767637

Elevated high-strength snow roads are constructed over the deep snowfields in Antarctica between McMurdo Station and the Williams Field complex to move cargo and personnel in rubber-tired vehicles. The purpose of this experiment was to simplify the existing techniques developed by NCEL for constructing these snow roads. To achieve this objective, new cutter-heads were installed on the ski-mounted snowblower. The pulverized snow was deposited and spread in 4-in. layers, which were compacted by walking the area with LGP D-8 tractors. This modified procedure is described as it was performed in the field, followed by a recommended outline for future snow road construction. This new method eliminates the special ski-mounted snow mixers, a savings of both costly equipment and construction time. Test results show that the experimental snow road densities and shear strengths compare favorably with those of previous roads built by pulvimixing. The experimental test section held up under 2 months of wheeled traffic, prov that snow roads built by the new construction technique ill give satisfactory service.

N-1306
Earth Heat Sinks for Underground Power Sources, Aug 1973, S. C. Garg, AD768292

The cost effectiveness of earth heat sinks for underground power plants operating in a closed cycle over limited durations in time was determined through a transient heat conduction analysis. A comparison of heat absorption capacity of earth heat sinks per cubic foot volume with the capacities of stored water and stored ice heat sinks was carried out for a specific set of operating conditions. The comparison has shown that the cost of an earth heat sink using select backfill is approximately 6 and 14% of the cost of a stored ice heat sink, and approximately 10 and 23% of the cost of a stored water heat sink at sites with full and zero water tables, respectively. The overall volume of the earth heat sink was estimated to be 0.8 and 1.5 times the volumes of stored water and stored ice heat sinks, respectively. It is recommended that earth should be considered as an alternative waste heat sink for limited duration, closed cycle underground power systems because of its simplicity at lower cost.

N-1307
Preliminary Investigation of Structural Damage from Point Mugu, California, Earthquake of 21 February 1973, Aug 1973, S. K. Takahashi, W. E. Schniete, AD768293

The report contains information and photographs obtained during a preliminary investigation of structural damage caused by the Point Mugu, California, earthquake of 21 February 1973. The earthquake was rated at 5.9 on the Richter scale and caused widely scattered minor damage to residential buildings, damage to numerous stores with perishable and fragile goods, and resulted in unsafe conditions in many older unreinforced structures. Structural damage also occurred at the U.S. Naval Missile Center at Point Mugu. Damage to a three-story barracks, to a two-story headquarters building, to an airfield hangar and to other facilities are described.

TN-1308
Compressive Strength of 67-Year Old Concrete Submerged in Seawater, Oct 1973, H. H. Haynes, P. C. Zubiate, AD772527

Core specimens were obtained from six concrete blocks submerged partly or totally in seawater for 67 years off the Los Angeles Harbor breakwater. The compressive strengths of the concrete were compared with strengths of 40 years earlier. It was found that two blocks increased in strength, three remained the same, and one decreased. The blocks still showed fairly sharp edges and original form marks. Rock boring mollusks were found on the surface of the blocks, but they did not damage the concrete.

N-1309
Evaluation of Low Voltage Switchgear for Ship-to-Shore Power, Nov 1973, K. W. Lucci, AD917010L

Operational problems have been encountered with molded case circuit breakers employed for shore-to-ship electrical

service at Naval shore facilities. These operational problems were attributed to nuisance tripping of the breakers at less than rated current and the breakers becoming inoperative due to excessive corrosion within months after installation. The Naval Civil Engineering Laboratory was therefore tasked to conduct an evaluation of low voltage switchgear for shore-to-ship electrical service. Tests included time versus current tests in the 400-700 ampere range at 40C, 50C, 60C, and 70C ambient temperatures. Salt-fog environmental tests were also conducted in accordance with a modified form of MIL-STD-810B.

N-1310
Development of Sea-Ice Strain Transducer, Nov 1973, K. D. Vaudrey, AD773066

The development program for a sea-ice strain transducer is described, starting with a set of general criteria. Four different transducers were designed, fabricated, and tested to evaluate their mechanical and electrical integrity, applicability to ice testing, and ease of fabrication. Other commercially available embedment gages were discussed as possible future generations of sea-ice strain transducers.

N-1311
Protection of Existing Fuel Lines Under Piers at Point Loma Annex, Sep 1973, E. S. Matsui, R. W. Drisko, AD916101L

Fourteen protective coating systems, including a government specification paint and a tape system, were applied to the fuel lines under a pier at Point Loma for in-service field test. After 18 months of exposure, the government specification coating system (MIL-P-24441) was performing better than or at least as good as most of the other coating systems under evaluation. DENSO tape, a grease impregnated tape, was providing the best protection against corrosion, but it is susceptible to deterioration where fuel leaks.

N-1312
Practical Application and Effectiveness of Commercially Available Pulse Voltage Transient Suppressors, Dec 1973, M. N. Smith, AD773074

Most utility power distribution systems at one time or another have random and periodic impulse voltage transients propagated throughout the system. In many cases these transients cause malfunction and physical damage to critical loads. It is possible to reduce the peak voltage levels of many types of transients to a level that most critical loads can tolerate. The report covers the results of test and evaluation of five types of commercially available impulse voltage transient suppressors. It was concluded that no one type suppressor tested meets all the requirements to completely protect critical loads, but some do effectively meet some of these requirements on a cost effective basis.

N-1313
Impact and Operational Tests of the Container Hopper, Nov 1973, M. J. Wolfe, S. K. Wang, AD774469

The container hopper is designed to attenuate the swinging motions of a maritime van container suspended from a floating crane and then guide the container directly onto a truck trailer. It was developed under the auspices of the Marine Corps Development and Education Command and the Naval Facilities Engineering Command. There were two major phases in the development of the hopper. The first consisted of impact tests on one of the hopper shock absorbers. The second phase was a fully operational evaluation of the hopper during the OSDOC II (offshore discharge of containership II) exercise in which a containership anchored 1 mile off the Virginia coast was unloaded with a floating crane. The crane lowered containers through the hopper onto flatbed semi-trailers, MILVAN chassis, and tandem rigs. Like the crane, the hopper and trucks were on a floating platform. Loading times as short as 1 minute were achieved.

N-1314
A Fluidic System for Mixing Two Fluids - Final Study, Dec 1973, D. Pal, AD774486

The development of a double leg elbow proportional fluid amplifier to handle 5.85 gpm of water flow rate is described in detail. The amplifier has linear output flow characteristics with a gain of 50 and can switch flow from one output to the other completely. Based upon the experimental results, analytical expressions are developed which clearly show the effects of the active and passive legs flow parameters, the control flow and the size and location of the output ports on amplifier's performance and they can be used in designing an amplifier of a desired flow capacity. Analytical expressions to predict the performance of the amplifier are also given. A mixing element comprised of two double leg elbow amplifiers stacked together to mix two fluids was designed and tested successfully.

N-1315
Preliminary Development of an Electrochemical Heat Source for Military Diver Heating, Nov 1973, S. A. Black, L. W. Tucker, H. P. Vind, R. D. Hitchcock, AD773065

A bench model of an experimental self-contained source for heating divers was developed and tested. The heater provides 2,000 watts of thermal energy for 8 hours delivered by hot water to the diver tubing suit. Heat is produced by reacting magnesium alloys with seawater. Theoretical and experimental determination of the characteristics of the heat source are presented together with the physical arrangement of the bench-tested heater. The reaction of magnesium plates in seawater was found to provide sufficient heat when the magnesium anode is placed in close proximity to and electrically shorted to a cathodic material such as an iron plate. Controlled heat output is provided by mechanically varying the distance between anode and cathode plates. The single most important factor controlling the reaction rate was found to be the pH of the electrolyte. The effects of other cell operating parameters are discussed as is the feasibility of fabricating a heat cell from a mixture of powdered magnesium and iron. It is concluded that the reaction of magnesium alloys with seawater can provide sufficient reliable and safe heat for operational missions to 1,000-foot depths. Refinements necessary are delineated.

N-1316
Evaulation of Multi-Tap Connectors for Use in Navy Underground Electrical Distribution Systems, Nov 1973, W. R. Haack, AD916353L

Many multiple connections are utilized in secondary underground electrical distribution systems at Navy shore activities. These connections are very often hand taped, and as such are bulky, unreliable, and require much skill and time to install. Multi-tap feeder connectors have been developed to alleviate these problems. Connectors of nine manufacturers were tested and evaluated for Navy use. The results of this evaluation show that multi-tap feeder connectors are generally superior to hand splices. Connectors with heat shrink insulating sleeves are unsuitable for use in hot climates, while those with force fit insulating sleeves manufactured by Burndy and Penn Union are unsuitable for use in areas where they might be compressed by ice. ESNA's "secondary distribution connector," type 26; FARGO's "underground insulated secondary connector," type 26: FARGO's type GU and Raychem Thermofit boot were not recommended for use in Navy underground electrical power distribution systems.

N-1317
Improved Transition Ramps for McMurdo Station, Antarctica, Nov 1973, F. W. Brier, AD773064

Wheeled vehicle travel between McMurdo Station and Williams Field is via a processed snow road on the Ross Ice Shelf or on an annual sea ice road cross McMurdo Sound. The critical areas of construction and maintenance on the Mc-

Murdo road system are at points of transition from one road material to another material. Three transition conditions exist in the road system: annual sea ice to snow, snow to land, and annual sea ice to land. Each of the three transition zones has different construction and maintenance problems. These problems were reviewed and field tests were conducted on various types of surfacing materials at Port Hueneme, California, and McMurdo Station, Antarctica. The field tests showed AM2 aluminum planking was more durable than MO-MAT, but MO-MAT has sufficient strength to support vehicular traffic when it is properly anchored. The field tests also indicated that when placed on sea ice AM2 aluminum planking and MO-MAT must be insulated to prevent surface melting of the ice.

N-1318
Polytoroidal Tunneling Thruster for Specialized Navy Applications; A Development Study, Jan 1974, D. Pal, H. A. Gaberson, AD774468

Practical applications of vermiculating or worm-like motion were investigated. The bladder technology required in studying the practical applications was investigated by conducting an extensive industrial search which revealed that the required bladders have to be custom made. Based upon the vermiculating motion concept a scale model of a 24-in. diam tunneling thruster was designed and built using bicycle inner tubes as braking toroids; the thrust and locomotion to the system was provided by four double-acting pneumatic cylinders. The thruster operated satisfactorily when tested inside concrete pipe positioned vertically. A preliminary design of a tunneling thruster capable of operating in a 8-ft-diam tunnel is given. Other potential applications of the concept are discussed.

N-1319
Polymer-Strengthened Concrete for Military Facilities, Dec 1973, J. R. Keeton, R. L. Alumbaugh, AD773073

Mixtures of polymer-cement-mortar and polymer-cement-concrete were formulated with (1) epoxy, polyester, and epoxy-acrylate resins; (2) acrylic, vinylacetate, styrene-butadiene, and polyvinylidene chloride latices in varying proportions in relation to the weight of the cement. Both Type 3 Portland and regulated set cements were used. Curing methods included low pressure steam, high pressure steam, dry heat, and ambient laboratory air. Compressive strength of concrete with and without polymers were studied.

N-1320
Monitoring Program for New South Pole Station, Nov 1973, F. W. Brier, AD773072

Adverse climate, natural processes, and remote location necessitate consideration of environmental factors for design, construction, and maintenance of polar camps and stations that differ distinctly from those for temperate climates. During the past decade many of these factors have been encountered in the Arctic and Antarctic, but few have been sufficiently defined to permit engineering application in planning, building, and operating polar facilities. The new South Pole Station provides a unique opportunity for monitoring environmental factors affecting inland ice cap stations. Data collected during and after construction of this station will be beneficial in advancing design concepts for future stations on polar ice caps. A monitor program has been developed to obtain data on four parameters affecting stations constructed on permanent snow fields: deformation, bearing pressure, temperature, and snow accumulation.

N-1321
End Connectors for Glass Reinforced Plastic (GRP) Antenna Guy Rods, Jan 1974, H. P. Vind, R. W. Drisko, AD916357

Previous studies at the Naval Civil Engineering Laboratory (NCEL) and the National Bureau of Standards (NBS) indicated that end connectors are the weakest part of guy rods made of glass-fiber reinforced plastic (GRP). Most of the GRP rods maintained by the Navy are terminated by fittings which were actually designed for steel wire rope and have a short shank. A similar fitting with a longer shank intended specifically for GRP guy rods was designed by the Navy in 1961, but the fitting was never produced. In FY73 NAVFAC requested NCEL to find an improved end connector for GRP guy rods for antennae. Several field installable end connectors were found that are quite suitable for repair purposes. However, neither the field installable connectors nor the factory installed type now in use hold to the full break-strength potential of the guy rods. Five sets of the connectors designed for the Navy 12 years previously were fabricated in the NCEL machine shop. They were installed on NUPLAGLAS rods and tested to failure. There were no pull-outs and all of the terminations held until the rods broke at a distance away from the connectors.

N-1322
Removal of Oil in Ground at Transmitter Site, NAVCOMSTA, Greece, Nov 1973, T. B. O'Neill, J. S. Williams, AD773945

The report describes the problem caused by the accumulation of diesel fuel in the ground adjacent to leaking storage tanks at the transmitter site, NAVCOM Station, Greece. The on-site survey account describes the data collection techniques employed and gives values of physical measurements made. Chemical and biological analyses were made later and the results of the analyses are used to develop a hypothesis regarding the extent and magnitude of the oil contamination. Recommendations are made to recover free oil from the area by pumping from collection pits and to restore the soil to an oil-free condition by bacterial seeding.

N-1323
Underwater Site Surveying for Cable Installations, Jan 1974, J. B. Ciani, M. C. Hironaka, AD916982

This study was performed to determine significant properties of nearshore and inshore underwater sites for submarine cable installation, the measurement accuracies required, and the hardware and techniques required to obtain data. The hazards to cables and the causes of cable failures are examined. It was found that all significant accuracies. Equipment is recommended that will perform to the required accuracies. It is recommended that: (1) this equipment be assembled into a site survey kit and evaluated; (2) the utility and accuracy of sonic methods of seafloor and subbottom topographic survey in the surf zone be determined; and (3) supplementary procedures be developed for the surf zone where sonic methods cannot be used.

N-1324
Soil Mechanics and the Advanced Computer Codes, Apr 1974, J. B. Forrest, AD777051

The report discusses some of the more complex soil models available for input to advanced computer codes. It provides a brief overview of the impact of recent computer code advances upon development within the field of soil mechanics. Two different types of models are discussed: (1) variable moduli models based upon incremental elasticity and (2) elastic-plastic models in which plastic yielding conditions are superimposed upon elastic behavior. The difficulties involved in using experimental data to fit a soil model are considered briefly and the major requirements for acceptable soil constitutive model are presented. The report concludes that the most fruitful avenue of pursuit for future soil-structure interaction studies will involve a versatile form of the variable moduli model.

N-1325
Shrinkable Splice Covers for Underground Distribution Cables, Dec 1973, P. J. Hearst, AD916969L

Three different heat-shrinkable tubing splice covers, an elastic tubing splice cover, and a vulcanized splice

cover were evaluated for use on splices of 600-volt underground distribution cables. Two of the heat-shrinkable splice covers and the vulcanized splice cover gave good performance, but the latter was much more costly. The results of this investigation indicate that commercially available heat-shrinkable tubing should provide effective and inexpensive protection as a splice cover at Navy activities. The possible use of heat-shrinkable tubing for high voltage shielded cable and for flexible ship-to-shore cable is discussed.

N-1326
Gloss Latex Enamels, Jan 1974, J. B. Crilly, AD774485

Eight latex enamels were exposed on wood specimens at Port Hueneme and Kwajalein. Of these, one system was found to be better than the others and better than the comparison standard after 1 year of exposure at Kwajalein.

N-1327
Power Line Transient Source and Direction of Propagation Detector. Feb 1974, K. T. Huang, AD777050

The report describes a newly developed power line transient source detector which can locate a transient source in an electrical power system by showing the direction of propagation of the transient along the power line. The advantages of using this detector are: (1) the detector does not disturb the normal operation of the power system, and (2) it is light in weight, small in size, easy to operate, and reasonable in cost.

N-1328
Experimental Development of Potable Water Supply for New South Pole Station, Feb 1974, J. S. Williams, AD777037

Background information about the water supply in polar regions and the development of the Rodriguez Well in Greenland are presented. The design concept of using waste heat from the diesel generators, procurement and fabrication of equipment, and the installation and operation of an experimental well at Old South Pole Station are described in detail. Problems encountered during the experiment were not serious, and the recommended changes are listed as part of the overall recommendation to construct a Rodriguez Well for the water supply at the New South Pole Station.

N-1329
Crash Rescue and Fire Fighting for Expeditionary Airfields – Concept Development, Feb 1974, T. T. Fu, AD918221L

The requirements for crash rescue and fire fighting for Marine V/STOL expeditionary airfields have been developed. The results show that much less support than that of an average airfield is feasible. The runway for V/STOL aircraft is intrinsically short, and emergency landing sites are likely to be some distance from the runway. Helicopter rescue is, therefore, essential. A utility truck carrying a skid-mounted AFFF/PKP twin-agent fire-control unit is suitable for use on runways and adjacent areas. For gear-up landings, runway wetting is proposed as a substitute for conventional foaming. Interim and midrange recommendations have been made.

N-1330
Field Evaluation of Open Sea Oil Spill Recovery Equipment, Feb 1974, D. J. Graham, AD916968L

Deployment tests of two types of oil containment booms and two oil skimmers were conducted off Port Hueneme, California, utilizing the USNS GEAR as a primary tow vessel and command center. No oil was used but much valuable information was obtained regarding deployment techniques and the seaworthiness of booms and towed skimmers during procedures simulating oil recovery operations. Primary conclusions were: (1) the floats of oil containment booms must have sufficient volume and waterplane area for adequate heave response in the open sea; (2) oil skimmers must have on-board storage for collected oil; (3) oil skimmers must have on-board propulsion to maintain station during the low speed sweeps necessary for oil recovery; and (4) an operable towing configuration for oil recovery can be achieved using an ARS-class salvage vessel such as USNS GEAR and its on-board motor launch. A narrated film of the tests reported in this document was assembled which illustrates the deployed equipment for high seas recovery of oil spills and the response of the booms and skimmers to the seaway.

N-1331
The Coanda-Effect Oil-Water Separator: A Feasibility Study, Feb 1974, D. Pal, AD774080

An experimental investigation which establishes the feasibility of using the coanda-effect in developing an oil-water separation is described. Tests conducted on an experimental model with an oil-water mixture containing 6% oil showed that the oil content in the effluent can be reduced to less than 3%. A three-stage separator has produced effluent in the range of 1%. Conceptual designs of a practical separator are discussed. The space requirements for a coanda-effect separator when compared with typical parallel-plate type separators of the same capacity is considerably smaller. Analytical expressions useful in designing a coanda-effect separator of a given size are also given.

N-1332
Equipment for Destruction of Classified Naval Materials, Mar 1974, R. S. Chapler, P. L. Stone, AD918222L

Many shore facilities have experienced difficulty in selecting equipment for routine destruction of classified material. To assist in the selection process, NCEL has tested a controlled-air incinerator and one mechanical destructor. Other equipment has been evaluated in operation tests or by discussions with users. The results of this testing and evaluation are presented.

N-1333
Substitution of JP-5 Aviation Fuel for DF-2 Diesel Under Field Conditions, Feb 1974, J. S. Williams, AD777047

The report covers the work done to determine whether JP-5 aviation turbine fuel is a suitable substitute for DF-2 diesel fuel in the heavy equipment of the Naval Construction Force when such equipment is deployed on a large construction project.

N-1334
Short-Term Engineering Behavior of a Deep-Sea Calcareous Sediment, Mar 1974, P. J. Valent, AD777052

The engineering index parameters, primary consolidation properties, and effective-stress strength properties of a deep-sea calcareous sediment are reported. This short-term engineering property description of the sediment is the first stage of an in-depth study of creep behavior of this sediment during consolidation and shear. The calcareous sediment sample has been classified as an inorganic silt, according to the unifield soil classification system. The compression index, C(C), is 0.80; empirical correlations from terrestrial engineering between C(C) and other, easily and rapidly-measured index parameters may be in error by 30%. The effective angle of internal friction, ϕ, of the sediment, when normally consolidated, is 0.65 rad (37 deg). No significant crushing of the hollow foraminifera tests (shells) comprising the coarse-size fraction of the sediment was noted in the consolidation tests up to stresses of 1530 kPa (32,000 psf). It was demonstrated, however, that this coarse-size fraction does undergo significant crushing if the material finer than 0.043 mm is removed, suggesting that the fine-size fraction acts to distribute load on the coarse-size, test (shell) surfaces.

N-1335
Trenching on Shore and in The Ocean in Arctic Regions: State-of-The-Art Survey, Mar 1974, M. C. Hironaka, AD777046

The objective of this study was to identify present techniques, procedures, and equipment that could be used for developing trenches for cables and pipelines in sea-to-shore installations in Arctic regions. In pursuing this objective, a literature search was performed. Factors influencing Polar trenching operations include: (1) materials to be trenched, (2) properties of permafrost and frozen ground, (3) depth to permafrost or frozen ground, (4) seafloor ice scoring, (5) oceanographic factors, and (6) seasonal effects. For sea-to-shore cable and pipeline installations, present trenching methods have some limitations; thus, it is recommended that a trenching device capable of operating on land, through the surf zone, and in deep water be developed to trench through all material including rock and which uses high pressure water jetting, normal water jetting, and suction dredging techniques.

N-1336
An Evaluation of Modular Advance Base Electrical Distribution Components and Systems, Apr 1974, K. W. Lucci, AD918951L

Modular or containerized advance bases, such as Quick Camp, TACOSS, and Bare Base, require electrical distribution systems which are not only highly reliable and safe, but also lightweight, compact, and durable. Electrical distribution components, such as power cables, connectors, cable splice kits, ground fault interrupters, panelboards and branch protection devices, were evaluated for advance base suitability. Four-conductor, type G, round, portable power cables, with 90 C rated jacket and conductor insulation, were recommended because of superior durability and current carrying characteristics. The newly designed Bendix Class L connector system which meets MIL-C-22922D proved to be superior to the other connectors evaluated because of exceptional durability and resistance to salt-fog environments. Heat shrinkable splice kits are recommended for making quick temporary cable repairs in the field. Ground fault interrupters are recommended for providing electrically safe operation of electrical appliances and tools.

N-1337
Oil Contaminated Beach Cleanup, Apr 1974, J. J. Der, E. Ghormley, AD778329

A review of representative oil spill incidents supplemented by personal and telephone interviews with persons involved in beach cleanup operations as on-scene coordinators or as cleanup operators has been made to evaluate cleanup methods suitable for future operations. The selection of procedure and equipment for beach cleanup was found to depend on the amount of oil, the characteristics of the oil as it hits the beach, and the type of beach contaminated. The most effective beach cleanup procedures and equipment have been identified and tabulated in terms of selected beach classifications. Recommendations for future work to remove deficiencies of existing techniques are included.

N-1338
Evaluation of Enzyme-Catalyzed Cleaning Compounds for Use at Naval Activities, Apr 1974, E. S. Matsui, AD918952L

Effectiveness of five commercially available enzyme-catalyzed cleaning compounds for treatment of grease traps were investigated. Laboratory tests showed wide variation in the effectiveness of these cleaning compounds simulated drain tests.

N-1338S
Evaluation of Enzyme-Catalyzed Cleaning Compounds for Use at Naval Activities; GSA Stock Item and Proprietary Cleaning Compounds, Feb 1976, E. S. Matsui, ADB009984L

This report presents additional data on evaluation of the enzyme-catalyzed cleaning compounds, MAPCO-ZYME 216, GSA stock item 7930-855, and Keep-Kleen, to supplement CEL Technical Note N-1338. The test results indicated that the MAPCO-ZYME is safe, economical, and performs as well as or better than GSA stock item 7930-855.

N-1339
Modification of a Pneumatic Track Drill for Underwater Use by Divers, Apr 1974, G. L. Page, AD778333

The Navy relies on explosive excavation techniques for channel deepening and the emplacement of underwater pipelines in rocky bottoms. Effective use of these explosives requires that they be placed in holes drilled into the rock. Although Navy-issued self-propelled track drills offer an advantageous method of drilling these holes, they have quickly failed when used under water. Under sponsorship of the Naval Facilities Engineering Command, NCEL has successfully modified a Navy issue Worthington model 1290D track drill for underwater use to depths of 120 feet. The main modifications include sealing and pressure equalizing the hydraulic system, sealing to the extent possible the pneumatic system, repositioning the controls for better diver operator visibility, and improved lubrication of the pneumatic components. This report describes these modifications, the test program, and suggests further improvements.

N-1340
Analysis of Scale Control in Fluidized-Bed Heat Exchangers, Apr 1974, B. E. Swaidan, E. E. Cooper, AD778334

An experimental study was made to determine the scale control effectiveness of fluidized-bed heat exchangers in vertically oriented heat exchangers. The purpose of the granular solids is to enhance the deposition of any precipitating salts on the granular solids which present a large surface area in the solution. A further purpose was to investigate whether the mild scouring action produced by the granular solids would eliminate and prevent the formation of actual scale and its buildup on the heat exchanger surface on the bed particles themselves. The favorable results of this study revealed that scale and its buildup can be eliminated by utilizing the fluidized-bed technique for temperatures above 240F.

N-1341
Ferro-Cement Construction Panels, Apr 1974, H. H. Haynes, G. S. Guthrie, AD781644

Two designs of multipurpose ferro-cement construction panels were evaluated as to their versatility for military applications and their strength under flexural loads. The recommended panel design has a thickness of 1/2 in., width of 12 in., length of 8 ft, cross section of a modified channel, and weight of 86 lb. Ultimate load carrying ability of the panel under single point flexure was 1,545 lb which corresponded to an ultimate flexural stress of 4,300 psi for the ferro-cement material. Tests on the corrosion resistance of ferro-cement were also conducted in a salt spray chamber for up to 6 months. Visual observation of the panel surfaces showed rust stains that indicated substantial corrosion of the steel reinforcement; however, the average ultimate strength of the specimens was not significantly reduced.

N-1342
Hydraulic Pressure Intensifiers for Use by Working Divers, May 1974, A. M. Parisi, R. L. Brackett, AD781677

The need for a reliable high pressure (10,000 psi) source of hydraulic power for use by divers has led to the evaluation and modification of two commercially available hydraulic pressure intensifiers. The operation of the internal mechanism of the intensifiers as well as the modifications made to each are described. Tests of both intensifiers on land and underwater as well as necessary refinements to each system are delineated. Results indicate that the intensifier concept is suitable for underwater use

by divers. Designs suitable for field use which keep operation simple and the hardware rugged yet lightweight are required.

N-1343
Standardized Hardware for Oil Spill Containment Booms, Jun 1974, F. J. Campbell, AD781645

The report describes the design, development, and testing of standardized hardware for use with existing and new Navy oil spill containment booms. This hardware, which consists of boom connector, a towing assembly, and a boom-bulkhead attachment, can be used to quickly interconnect and deploy oil booms of a wide variety of manufacturers.

N-1344
Anchoring in Snow, Ice, and Permafrost, Jun 1974, M. C. Hironaka, AD782580

The objective of the study was to identify present techniques, procedures, and equipment being used for anchoring in snow, ice, frozen ground, and permafrost in Arctic regions. Anchoring effectiveness depends on the properties of these materials; therefore, it is necessary to identify the properties of these materials in conjunction with the techniques, procedures, and equipment that are used for anchoring in such material. Based on findings, recommendations for future research and development of anchors and systems for use in such materials are offered.

N-1345
Development of the CEL Salvage Remote Assist and Lift Device, Jul 1974, J. Bayles, AD782503

This report discusses the need for and development of a diver's lift assist device as a part of the Navy's Salvage Forces Program. The device discussed in this report combines the best features of the Hunley-Wischhoefer remote recovery system and the family of commercially available diver's lift assist devices. Features of the unit include buoyancy variability, inflatability, messenger capability, and reliability. It is designed to be simple, safe, and economical. A water brake designed for the device proved quite effective as a safety feature in slowing the rate of ascent through the water column. The assembly was successfully tested in the laboratory and at sea and has been forwarded to the harbor clearance unit in Hawaii for in-service evaluation.

N-1346
Evaluation of a Synthetic Surfacing System for the Marine Corps, Jul 1974, D. F. Griffin, AD922769L

This report describes two synthetic soil-surfacing systems that apply polyester resin, promoter, and catalyst to fiberglass matting on the soil surface to improve trafficability and decrease permeability. Part 1 of this report is a discussion of a manual spraying unit; Part 2 presents information on the performance of a trailer-mounted successor to the manual spray unit. Personnel using these systems require training in the use of applicators and chemical agents, but under the careful supervision of a well-trained operator, application of these synthetic surfacing systems is a low-risk operation. The fiberglass-polyester system applied by either the manual or the trailer-mounted unit has proved effective in improving trafficability and decreasing permeability in field trials. For best performance, the soil surface should be smooth and firm and the in-situ soil density should be high; the fiberglass matting should be free from wrinkles and well anchored on the edges; and the speed of vehicular traffic should be relatively slow to prevent the wheels from overtaking standing waves that may form in the resin-fiberglass system. The resin cures in 30 min to 1 hr and can be applied by the trailer-mounted unit at the rate of 2,000 sq ft/hr for a 1-lb/sq-ft system. Several types of applications are described.

N-1347
Development, Test, and Evaluation of a Underwater Grout-Dispensing System for Use by Divers, Jul 1974, A. M. Parisi, R. L. Brackett, AD786350

Diver-installed seafloor fasteners are used extensively to stabilize oceanographic cables and to secure structures to rocky areas of the ocean bottom. As part of a program aimed at improving the quality of these seafloor fasteners, an experimental diver-operated grout-dispensing system was developed to be used in conjunction with various groutable fasteners. The experimental grout dispenser consists of a low-speed, high-torque hydraulic motor coupled to a progressing cavity grout pump and underwater exchangeable hoppers which allow continuous pumping of premixed grout a 3 gpm and 80 psi over ambient pressure.

N-1348
Bargeships in Amphibious Logistics – Coronado LASH Barge Tests, Jul 1974, B. R. Karrh, AD782583

The advent of barge-carrying ships provides a new transport capability that may influence military logistics in ports and over undeveloped beaches. To explore military applications of these new floating containers, LASH barges were used to perform a variety of sea tests at Coronado, Calif. Existing Fleet assets were used to conduct tests related to (1) barge towing, handling, and maneuvering; (2) barge marshalling (clustering) at sea; (3) cargo handling from barges at sea; and (4) helicopter/barge interaction. The tests demonstrated that cargo barges from commercial barge-carrying ships can be handled and unloaded by the amphibious forces.

N-1349
Application of Fluidic Concepts to Hydraulic Control Systems, Jul 1974, R. H. Fashbaugh, E. R. Durlak, AD782508

This is the first of a two part test program to determine the feasibility of using fluidic concepts to develop a fluidic control unit that will detect and correct angular variations in position such as those experienced by a bulldozer blade during operation. The hydraulic proximity sensor is a key component in the control unit. Experimental test results are presented showing the evaluation of a fluidic proximity sensor using hydraulic oil as the working fluid. The sensor was designed by scaling a pneumatic proximity sensor using a constant value of Reynolds number as the scaling parameter. Test results show that the hydraulic proximity sensor will detect the distance of an object from the sensor by relating that distance to a pressure signal. The performance characteristics of the hydraulic sensor correlated well with those of the pneumatic sensor. The sensor jet force variation with distance was also determined.

N-1350
Holographic Interferometry Survey for Engineering Measurement Applications, Aug 1974, G. Warren, AD786346

Several methods of holographic interferometry are presently available for engineering applications to problems concerning physical measurement. These methods include static and dynamic deformation analysis, holographic photoelasticity, and contouring. The techniques can be used to analyze structural components, to determine material properties, to detect material flaws, and to describe geometrically complex shapes. Example applications, beneficial characteristics, critical aspects, and equipment descriptions are presented and discussed.

N-1351
Flexible Breakwaters, Sep 1974, D. B. Jones, AD786369

Several apparent advantages related to logistics are noted for a floating blanket type of transportable breakwater. However, thin surface covers are not very effective as wave barriers. (The known data on water-wave damping by

shallow-draft barriers of many kinds are reviewed, and the data are reproduced in the Appendix.) To more fully examine the potential of thin, flexible barriers, a supplementary process for reducing wave energy that has not been exploited heretofore – dissipation in a viscoelastic solid – is investigated; the linear theory is used to derive a formula which relates energy dissipation in an impervious viscoelastic blanket to wave height reduction. Numerical results for a high-damping rubber indicate that energy dissipation in a thin surface cover cannot satisfactorily supplement other processes and mechanisms if the wave period is greater than 2 or 3 sec.

N-1352
Reinforced Plastics Laminates Panels – Physical Tests and Surface Examination of Panels Eemoved After Five Years of Exposure, Sep 1974, T. Roe, R. L. Alumbaugh, AD786349

Sets of coated and uncoated glass-reinforced epoxy and thermosetting polyester laminate panels have been exposed to the atmosphere at Port Hueneme and China Lake, Calif, and at Kwajalein, Marshall Islands. A fourth set was maintained at CEL as a control. Results of physical tests performed on the panels exposed at the three field locations for all periods up to five years, and the results from the same tests on the control panels are reported. Comparisons of the mean and standard deviations of the tensile strength, compressive strength, flexural strength, and flexural modulus of elasticity are presented. Also, panels exposed at the three sites for five years together with the control panels stored for that length of time were examined visually: their surface condition is reported. Weather data from the test sites for the entire test period are presented. Based on an analysis of the data obtained from the physical tests of the exposed panels, the general-purpose polyester laminate performed better than the general-purpose epxoy laminate; gel coats are superior to spray-on coatings; and coated panels were superior to uncoated panels.

N-1353
The Fate of Spilled Navy Distillate Fuel, Sep 1974, P. J. Hearst, ADA002256

Laboratory weathering studies of four Navy distillate fuels on salt water showed that in thick films (5 mm) the major portions of the oils did not evaporate in one week. These fuels are thus relatively persistent oils. The physical properties did not change markedly and the thick emulsion, or mousse, obtained with Navy special fuel oil was not obtained with the distillate fuels. Very thin films (0.1 mm) evaporated much more rapidly, leaving residues of about 5%, whereas Navy special fuel oil left residues of 65%. The weathering characteristics are related to the distillation range as shown by gas chromatographic comparisons.

N-1354
Test and Evaluation of Hoses and Connectors for Ship-to-Shore Wastewater Transfer, Sep 1974, F. J. Campbell, AD786336

Hose and hose connector components that are applicable for use in ship-to-shore sewage transfer operations are identified, and the results of field and laboratory tests are presented. Hose clamping and mounting procedures are evaluated and hose/connector system tensile strengths are established. An experimental plastic hose, an experimental rubber, quick-disconnect bronze connectors, and 3/4-inch wide band-type clamping material were found to be the best-suited material of those tested for waste transfer operations.

N-1355
Fracture-Fatigue Analysis of Experimental Diving Unit Complex 6, Sep 1974, J. R. Maison, ADA002199

The Navy Experimental Diving Unit Complex 6 was analyzed for fracture and fatigue resistance. The fracture analysis was performed using three different methods: (1) the Naval Research Laboratory FAD diagram, (2) Linear Elastic Fracture Mechanics (LEFM) with KID data derived from Charpy V tests, and with KID data derived from instrumented Charpy V-notch tests of precracked specimens, and (3) the Pressure Vessel Research Committee (PVRC)-modified LEFM method with KID data. The fatigue analysis was performed using two methods: the LEFM crack growth model, and the ASME-approved stress-cycle (S-N) approach.

N-1356
Removing Rubber From Airport Runways, Sep 1974, H. P. Vind, C. W. Mathews, ADB000410L

The Navy has special problems with the rapid build-up of rubber on training runways because of the requirement for sudden braking to simulate ship-board landings. Various proprietary chemical agents for removing rubber deposits from runways for aircraft were tested to ascertain their compatibility with runway joint sealers and epoxy patches. Comparisons were made of how effectively rubber was removed by the various agents, and by water blasting and mechanical abrasion. Agents formulated as carbon removing compound, MIL-C-25107A, caused epoxy patches to crumble, but the newer rubber removers did not harm properly made patches. The rubber removers may soften joint seals but they did not seem to harm them. In performance tests on small areas of runways, those rubber removers which had the least tendency to spread were the most effective. The rubber deposits are removed from runways a little more thoroughly by water blasting than by the chemical rubber removers; water blasting does slightly abrade the runway, but the damage appears to be inconsequential. Water blasting is recommended for cleaning areas larger than 100,000 sq ft. Because of the cost of moving the heavy equipment to the runway, chemical agents are recommended for smaller areas, or where water-blasting equipment is not available (e.g., overseas). Floor sanding machines are too small and slow for removing rubber except perhaps for use on small patches.

N-1357
Low Profile Concrete Mixer, Oct 1974, A. L. Scott, AD786357

The requirements and specifications for a low-profile, diesel-engine-powered concrete mixer were developed, and a prototype unit was designed and built. The unit can be loaded into a C-130 or a C-1238 aircraft without dismantling, is stable when towed, has a water meter instead of a water tank, has a hydraulic system to replace the cable hoist, and has a hydraulic vibrator instead of shaker cams. The unit has performed well under tests and during in-service tests to data.

N-1358
Diver Work Systems, Oct 1974, R. N. Cordy, ADA002217

For the past 7 years, the Civil Engineering Laboratory (CEL) has conducted research and development on diver work systems in support of Navy seafloor construction and ship salvage. Under the sponsorship of the Naval Facilities Engineering Command and the Naval Ship Systems Command the program has progressed from the evaluation of unpowered hand tools through pneumatic and hydraulic powered tools, and diver-operated work vehicles. The current program is investigating controlled methods of excavating rock underwater. These investigations have shown that oil-hydraulic-powered equipment is best for most underwater work. Systems using seawater as a hydraulic fluid offer many potential advantages; however, successful development of a practical seawater-powered motor has not yet been achieved. A variety of operational oil hydraulic power sources and compatible tools have been developed and delivered to operational Navy units.

N-1359
Heat Transfer Design and Proof Tests of a Radioisotope Thermoelectric Generator, Nov 1974, E. J. Beck, ADA002218

The object was to design, build, and test the heat rejection portions of a large 2-kW(E) radioisotope thermoelectric generator (RTG). The design was optimized to produce the lowest practicable temperatures at the cold junction of a large number of thermoelectric heat-to-electricity conversion elements. The geometry was largely defined by the size, shape, and required number of thermoelectric elements and by their deployment at the upper end of a large pressure-resistant hull. The work showed the capability of the 12-finned convectors to maintain a temperature below 90F at the inner face of the convectors, both when the unit was vertical and when tilted 60 deg from the vertical. The solid copper showed no signs of corrosion; the potential corrosion problem is discussed in some detail in the report, as are related problems of flow, protection, and possible fouling from marine growth.

N-1360
Sea Cache: A Mobile Petroleum, Oils, Lubricants (POL) Seafloor Storage and Supply System for Advanced Bases, Nov 1974, N. D. Albertsen, H. H. Haynes, ADA004936

The structural and operational characteristics of a mobile POL (petroleum, oils, lubricants) logistics system are presented. The system, called Sea Cache, is based on using large (224 ft long x 64 ft high) prestressed concrete structures to transport and store up to 27,000 barrels of POL product. Transport of the POL field structures is by surface tow, and storage is on the seafloor in water depths to 600 ft. The system can operate in conjunction with military forces at advanced bases where the seafloor structure is emptied via pipeline to the beach. In this manner, many of the hazards associated with on-land storage of POL are avoided. The structural and operational analyses show that this system is feasible and is a logical approach to meeting the military's advanced base POL requirements of today and of the future.

N-1361
Test and Evaluation of Underwater Mateable Hydraulic Quick Disconnects for Use in Diver Tool Systems, Nov 1974, R. L. Brackett, A. M. Parisi, ADA002219

The Civil Engineering Laboratory has been investigating hardware and techniques that allow the diver to connect and disconnect hydraulic tools underwater in order to use several tools during a single dive. Two commercially available non-air including couplings were tested and evaluated for use as underwater mateable hydraulic quick-disconnect couplings. Tests were conducted at 1-ft, 35-ft, and 75-ft depths. It was found that both non-air-including couplings met or exceeded the performance requirements established for underwater mateable hydraulic connectors.

N-1362
Evaluation of Hydroacoustic Rapid-Impacting Pile Driver, Nov 1974, C. J. Ward, ADA004937

Tests to evaluate the driving capabilities of the rapid-impacting hydroacoustic pile driver on various types and sizes of vertical piles and horizontal batter piles are described and discussed. The functional and operational characteristics of the driver are described, test results and output analysis are presented, and the hydroacoustic driver is compared operationally and economically with the vibratory driver and conventional diesel pile hammer.

N-1363
On-Site Testing of Divers' Compressed Air, Nov 1974, H. P. Vind, C. W. Mathews, ADA002220

A nationwide survey of commercially available instruments for analyzing divers' air was conducted. Many instruments and devices were found which could be used for these analyses. They ranged from simple colorimetric chemical detector tubes to sophisticated infrared analyzers and gas chromatographs. An air purity test kit containing colorimetric detector tubes for carbon momoxide, carbon dioxide, hydrocarbons, hydrogen sulfide, and halogenated solvents was assembled at CEL for on-site and testing of divers' compressed air. The kit also contained a modified fram fluidic monitor and an ultraviolet lamp for detecting oil in air.

N-1364
Behavior of Steel Bar Reinforced Concrete Spheres Under Hydrostatic Loading, Apr 1975, N. D. Albertsen, ADA011810

Four reinforced and two unreinforced concrete spheres of 32.00-in. OD and 2.71-in. wall thickness were tested under hydrostatic loading to determine the effect of embedded steel reinforcement on structural behavior. Test results show that the reinforced spheres (0.44 or 1.10% steel by area) failed by implosion at values for the ratio of implosion pressure to concrete strength (P_{im}/f'_c) that were on the average 5% lower than for the unreinforced spheres of the same size. In addition, the reinforced spheres developed cracks in-the-plane-of-the-wall at the inner surface of the reinforcement cage prior to implosion. Implosion results for the unreinforced spheres are 10% lower than predicted by an empirical equation developed from previous tests of unreinforced 16-in. OD spheres. These results provide initial insight into the vehavior of hydrostatically loaded steel bar reinforced concrete spheres and indicate that additional test data is required before definitive design guides can be developed.

N-1365
Guideline Systems for Deep-Sea Deployments, Dec 1974, F. C. Liu, ADA004931

A guideline is a mechanical cable stretched between the surface and the seafloor to direct a suspended payload to a seafloor site. Two series of sea tests were conducted: one at the 600-ft depth and the other at the 4,500-ft depth. The results of these two sea tests have shown that, after the lift line and the guideline are sufficiently uncoupled from surface excitation, single and double guideline systems can be operated in water depths to at least 4,500 ft without serious entanglement problems. Payload rotation produced during the deployment test was found to be small and results from variations in static forces. The design of guideline hardware and at-sea handling is discussed. In addition to surface motion compensation, a means for releasing in-line torque must be provided to achieve entanglement-free operations.

N-1366
Insulation Boards in Switchgear at Navy Shore Facilities, Dec 1974, D. E. Weems, ADA004939

The Civil Engineering Laboratory was tasked to determine the cause of failures experienced with the insulation boards used in recently procured electrical power switchgears at Navy shore facilities. Phenolic and polyester glass materials used as bus supports (the area of failure)

were tested under high voltage to ascertain their time-to-track resistance properties. Also samples of the same materials were coated with silicone grease and tested. It was found that polyester glass insulation material meeting the requirements of MIL-M-14G type MAT-30 will provide reliable service when used as bus supports in 15-kv switchgear. The application of silicone grease caused little improvement in the track-resistance properties, and under certain environments could cause an adverse condition. Porcelain insulating material will not track and, under adverse environments, it the best material for bus supports.

N-1367
Adhesives for Use Underwater, Dec 1974, R. W. Drisko, J. B. Crilly, R. M. Staples, ADA004938

An investigation was conducted into finding materials and procedures for mixing, applying, and curing rapid-setting epoxy adhesives under seawater. Separate formulations were developed for use at 5C and 20C. They were easily mixed and applied underwater from a plastic cartridge. A simple system of chemical heating was found to accelerate underwater curing, especially in cold waters.

N-1367S
Adhesives for Use Underwater – Field Testng, Jul 1976, R. W. Drisko, ADA028660

Field tests were conducted at Port Hueneme, Calif, and Panama City, Fla, on an adhesive developed at CEL that is capable of being applied underwater. The tests indicate that sandblasting rusty steel results in bonding as strong as or stronger than wire-brushed surfaces and in stronger bonding than on waterblasted surfaces. Bonding strengths of field-applied specimens were about one-sixth to one-third those of laboratory-applied specimens.

N-1368
Crash Rescue and Fire Fighting Concepts for Expeditionary Airfields, Dec 1974, T. T. Fu, ADB001631L

Crash rescue requirements for Marine Corps V/STOL expeditionary airfields have been developed based on the specific needs and the constraints of minimal logistic burden. Helicopters are determined to be essential for off-base crash rescue, but they are generally too slow to result in life-saving benefits in case of major crash fires. Helicopters are therefore not recommended for involvement with fire fighting. The overall crash rescue concepts for both on-base and off-base situations are summarized.

N-1369
Finite Element Analyses of a Quick Camp Module, Jan 1975, J. E. Crawford, F. R. Johnson, ADA004932

Three-dimensional finite element analyses of a Quick Camp module are described in this report. The Quick Camp system was developed at CEL by modifying standard shipping containers and is intended to provide rapidly deployable, cost-effective camp facilities for Naval construction forces. The objectives of the structural analysis were (1) to provide information about the static structural response of the module to three types of loading and (2) to study the feasibility of analytically evaluating the structural response of a module during emplacement by a helicopter. The results of the analyses show that in general (with the exception of severe service conditions), the module is adequately designed.

N-1370
Evaluation of a 35-GPH Portable Desalination Plant and Conceptual Design of a 220-GPH Containerized Plant, Jan 1975, J. C. King, ADA004928

A small 35-gph distillation type desalination plant, complete with an oil-fired boiler and controls for unattended operation, was procured for test and evaluation. The plant was operated for over 2,000 hr to determine its performance and durability. It was found to be reliable, easy to set-up and operate, and relatively insensitive to incorrect adjustments. The model tested, as well as watermaker plants of other sizes, has an inherent disadvantage of a low product-to-fuel ratio (10-to-1) when an oil-fired boiler is used as a heat source. However, because of their simplicity and reliability, watermaker plants are believed to have considerable merit for use in providing drinking water immediately after field forces establish a beachhead. Consequently, a conceptual design was prepared for a 220-gph plant that can be fully self-contained in a standard 8 x 8 x 20-ft container.

N-1371
The Motion of Floating Advanced Base Components in Shoal Water – A Comparison Between Theory and Field Test Data, Jan 1975, D. A. Davis, H. S. Zwibel, ADA007489

As part of the Navy's program to develop mobile port facilities, an analytical model has been developed to compute the relative motion between vessels in regular and random seas. The model, which considers all six degrees of vessel motion, is based on strip theory and is suitable for analyzing all single hull, linearly moored vessels. Ship motion and wave data obtained during recent offshore discharge of containership II (OSDOC II) field tests were used to validate the model. The results presented herein suggest that the model closely predicts the absolute motion of ocean going vessels (2,000 tons and larger), but that its predictions of lighter motions when the lighters are in close proximity to larger craft are less accurate. The probable cause of this disparity is hydrodynamic interaction, an effect which is not presently considered in the model.

N-1372
Development of Harbor Oil-Spill Removal/Recovery Systems, Phase I, Jan 1975, A. Widawsky, ADB002854L

An oil-spill removal system comprises four subsystems: containment, removal, storage and transfer, and separation. On the basis of data supplied by manufacturers, CEL selected six containment booms, ten removal devices, three pumps, two towable tanks, and three oil-water separators for test and evaluation. Performance tests of these subsystems were conducted in rivers, wave tanks, and on land. Results of these tests, combined with deployment and maintenance characteristics, yielded the highest rated items for each subsystem. These items were then assembled into two oil-removal systems: a confined-area system and an open-area system. Both systems were tested in a Naval harbor using intentional oil spills and proved to be highly effective in removing the spilled oil. As a result of this program, several recommendations were made for improving the performance and deployment of the subsystems.

N-1373
Permeation of Chloride and Sodium Ions Through Protective Coating for Naval Shore Structures, Feb 1975, E. S. Matsui, ADA004934

A method of measuring the permeability of salt ions through a paint film by the radiometric method is elaborated. It demonstrates that the radiometric method is precise and sensitive. The radiometric method is also useful in the investigation of other parameters which influence permeability of salt ions through paint films.

N-1374
Field Testing of Water Emulsion Epoxies, Feb 1975, R. W. Drisko, J. B. Crilly, ADA004935

The Civil Engineering Laboratory conducted a field test of two water emulsion epoxy coatings, a low solvent epoxy coating, a regular solvent epoxy coating, and a control alkyd coating. The coatings were placed on either sand-blasted steel panels or over weathered alkyd coatings panels

for exposure at Kwajalein, Marshall Islands (a marine atmospheric environment). Test data were collected after one-half year and 1 year of exposure; the test panels are still in position for further study. After 1 year of exposure, the low solvent epoxy and the alkyd control panels are in better condition than the two water emulsion epoxy systems and the regular solvent epoxy panels.

N-1375
Solid-State Trip Circuit Breakers in Navy Electrical Power Systems, Feb 1975, D. E. Weems, ADA004933

An investigation was made of the suitability of solid-state trip circuit breakers as substitutes for electromechanical circuit breakers in Navy electrical power systems. Two types of tests were conducted: ambient temperature was varied to determine its effect on the time-versus-current curve, and a salt-fog environment was simulated to determine its effect on the physical behavior of the circuit breakers. The effect of temperature on the time-versus-current characteristics was negligible; the characteristics were still within the manufacturers' specified tolerance for this temperature range. The results of these temperature tests indicate that the solid-state circuit breakers are superior to the molded-case circuit breakers for installation where high ambient temperatures prevail or where coordination of protective devices is important. The salt-fog tests showed that the electronic trip units are more vulnerable to failure in a heavy salt-laden environment than the trip units of electromechanical circuit breakers.

N-1376
The Man-Made McMurdo Ice Wharf – History, Construction and Performance, Feb 1975, J. L. Barthelemy, ADA007527

During the winter months ending DF-73 and commencing DF-74, the winter-over Public Works Department at McMurdo station constructed a surface-flooded ice structure along the fast-ice shelf in Winter Quarters Bay, Antarctica. Dimensions of the completed appendage included a 460-ft seaward face, a 635-ft backside face, a width of approximately 170 ft and a thickness approaching 29 ft. The giant ice structure served effectively as a whaft during DF-74 resupply operations. It provided both a vertical face for docking and a large, horizontal top-surface for cargo handling. The man-made ice wharf was the latest solution to the problem of shipping operations in McMurdo Sound. Prior to DF-65, ships were forced to unload cargo onto the annual ice. After that date, the natural-ice shelf along Winter Quarters Bay was used successfully as a docking facility. Unfortunately, subsequent ablative melting eroded and undercut the seaward face, and it became necessary to attach a prosthetic extension to the quay perimeter. In a 4-yr period ending in DF-72, a 464-ft-long protective face constructed from steel supports and timber inserts was installed. However, much of this addition was destroyed by storm. Two of the less severely damaged sections were reconstructed into small piers for the DF-73 resupply program. They provided immediate, but temporary relief. It is hoped that the surface-flooded ice wharf will provide a more permanent solution.

N-1377
Demineralized Water and LOX Supply, Feb 1975, B. Swaidan, R. Fashbaugh, ADB002853L

The Civil Engineering Laboratory was tasked to determine the requirements and to develop methods of supply for aircraft consumables (demineralized water and liquid oxygen) at expeditionary MARCORPS V/STOL fields. A mobile and flexible concept has been formulated that is based on a modular and containerized supply system that conforms to ISO standards. Furthermore, the modular and containerized system offers unique advantage because modules can be transported by land, sea, or air.

N-1378
Effectiveness of the Static Charge Reducer in Attenuating Static Charges During Hydrocarbon Fuel Handling Operations, Feb 1975, J. C. King, ADB002864L

Effectiveness of the static charge reducer in attenuating static charges during hydrocarbon fuel handling operations poses a high hazard of fire and explosion. The Navy has relied on relaxation tanks to attenuate static charges before the fuel enters a receiving tank. However, within the past few years the static charge reducer (SCR) has been marketed for this purpose. CEL has tested the SCR's performance and compared it with that of relaxation tanks in reducing static charges associated with the handling of JP-4 and JP-5 fuel. It was found that the performance of the SCR and relaxation tanks was essentially the same in reducing static charges of up to -340 mc/m^3, except during turn-on of the SCR, when a potentially hazardous condition might exist. Because of this potential hazard, it is recommended that the SCR not be used without a relaxation tank backup until it has been determined that use of the SCR alone is free from hazard during turn-on. If the SCR is found to be safe under turn-on conditions, considerable savings could be realized through using it with large fuel systems, but not with systems smaller than 500-gpm because of the expense of monitoring equipment.

N-1379
Maintenance Painting and Cleaning of Navy Buildings, Feb 1975, R. W. Drisko, J. B. Crilly, ADB002852L

Cooperative maintenance painting programs are being conducted at several Navy and Marine Corps installations. The most extensive one is being conducted on the exteriors of wooden World War II barracks type buildings initially painted with camouflage paint at MCB, Camp Pendleton. Isophthalic alkyd paint MIL-P-52324 was performing the best of seven topcoats tested after 1-1/2 to 2 yr. Washing tests were conducted on painted building interiors and exteriors using both specialized and conventional procedures. Cleaning with high-pressure water was very effective on wooden, masonry, and cement-asbestos exteriors. Washing of interior walls has been found to be more economical than repainting when such washing provides a satisfactory appearance.

N-1379S
Maintenance Painting and Cleaning of Navy Buildings – Results of Exterior Paint Tests at Camp Pendleton, Dec 1975, R. W. Drisko, ADA021841

A 2-1/2-to-3-yr exposure test of severn paint systems was conducted at MCB, Camp Pendleton on exteriors of wooden buildings previously painted with camouflage paint. Isophthalic alkyd paint (MIL-P-52324) performed the best of the seven test systems.

N-1380
Evaluation of the Hi-Dro Cushion (Rich) Fendering System, Feb 1975, J. A. Drelicharz, ADA007488

The Hi-Dro cushion fendering system is a series of clustered fluid-filled vinyl cylinders mounted vertically between two bearing surfaces. The vinyl cylinders (cells) have an orifice at either end. In this application the cells are partially submerged. The surface end of the cell has a small orifice which permits initial charging of the cell with seawater, gravity charging during operation, and drainage on withdrawal of this system. The opposite end possesses an orifice of larger proportions and controlled design diameter. Its function is to moderate the duration of discharge from the cell when a force is applied to its walls. This attenuation of a force by controlled discharge is the basic operating principle of the system. Approximately 120 ft of this innovative fendering system was installed at Port Hueneme, Calif, in April 1970. A final inspection was completed after 3 years of service. The fender has performed satisfactorily and is a balanced design, the limiting factors being abrasion of the timber bearing surfaces and corrosion of fasteners in the assembly.

After routine maintenance and minor repairs, the Hi-Dro system was re-installed for in-service use by the Naval Construction Battalion Center, Port Hueneme.

N-1381
Offshore Discharge of Containership II, Post OSDOC II, Test and Evaluation of Ancillary Aspects of Container Handling, Feb 1975, J. J. Traffalis, ADB002871L

This report gives the results, findings and recommendations of a jointly sponsored (NAVFAC/MERDC) test program to: (a) provide baseline comparative data not obtained in OSDOC II; (b) evaluate various spreader bars; and (c) test selected hardware and techniques for improving the handling of containers.

N-1382
Evaluation of Over-Rust Primers, Feb 1975, E. S. Matsui, C. V. Brouillette, A. F. Curry, ADB002865L

Various over-rust primers top-coated with government specification paint TT-E-489D were applied over brush-off, sandblasted, and wire-brushed rusted steel specimens and were exposed 3 years at three marine atmospheric test sites. The performance of the coating system at the CEL test sites was compared with that of the government specification test standard coated over sandblasted, brusn-off sandblasted, and wire-brushed steel specimens. The results indicate that a coating system using a superior over-rust primer can provide protection comparable to that of the test standard applied over the sandblasted steel specimens. A test standard coated with a wash primer (Formula 117) provided poorer protection than the same coating system without the wash primer when applied over the rusted steel specimens.

N-1383
Experimental Investigation of an Electromechanical Swivel/ Slipring Assembly, Mar 1975, L. W. Tucker, ADB002866L

Destructive kinking of electromechanical cables, when used to lower heavy objects to the seafloor, has been a serious ocean engineering problem. In an effort to find a solution to this problem, CEL conducted a test and evaluation program on a commercially available swivel/slipring assembly and a modified version of the same unit. Both units were subjected to mechanical and electrical testing in the laboratory and deep ocean. The units proved to be mechanically reliable, requiring no repair throughout the test program. Electrically, the original slipring assembly has excessive crosstalk between circuits at frequencies above 10 kHz and could not carry the power required by the operation equipment selected for the deep ocean tests. A new slipring assembly with nine rings was installed in the modified unit which provided acceptable crosstalk levels up to 500 kHz. The power rating for the slipring assembly was increased from 115 volts AC at 3 amperes to 2,400 volts AC at 5 amperes for four rings and 600 volts AC at 5 amperes for the remaining rings. The final ocean tests were conducted using equipment with a history of cable-kinking problems. During two depolyments with the swivel/slipring assembly to 3,000 ft, no further problems occurred. This swivel/slipring assembly met all operating requirements and proved to be a reliable system.

N-1384
Maintenance of Floors and Floor Coverings, Apr 1975, W. R. Lorman, T. Roe, ADA009247

This technical note deals with reducing the cost of maintaining the principal types of floors and floor coverings in common use throughout the Naval shore establishment. It includes discussion of soilability and proper selection of flooring materials, a review of current practices in cleaning floors and floor coverings, and sets forth possible improvements in Navy maintenance procedures. Most problems with Navy floors and floor coverings are caused by improper maintenance, although inappropriate type of flooring and inferior installation are contributory factors. Flooring that disseminates static electricity and does not spark when struck by ferrous metals is not considered in this technical note.

N-1385
An Evaluation of Air Bearing Systems for Cargo Movement in Marine Corps Supply, Mar 1975, M. J. Wolfe, ADA009248

The Civil Engineering Laboratory (CEL) investigated the operating characteristics of air bearing devices to establish whether they can be profitably incorporated into the Marine Corps logistics system. Representative air bearing devices were experimented with over a variety of surfaces. From the test it was concluded that virtually any surface not already suitable for air bearing operation can be made so without difficulty. However, bearing devices cannot operate in rough terrain. Three other items designed, developed and tested at CEL were: (1) a system consisting of four air bearing jacks to move a container without requiring that the container be lifted; (2) a steel framework equipped with air bearings to move a container in a Lash barge; and (3) two self-loading/ unloading transporters which can move cargo in and out of a container. With the transporters two men can pull a 20-ton load out of a van container in less than 30 sec. In this investigation it was found that air bearings offer outstanding promise as a means for moving heavy loads a short distance on improved surfaces.

N-1386
Naval Beach Group Capabilities in Support of SMLS or Barge/ Container Missions, Apr 1975, R. C. Towne, J. A. Drelicharz, ADB004844L

New engineering support functions required by the Seaborne Mobile Logistic System (SMLS) or generated by the introduction of new cargo concepts, i.e., large barges/20-ton containers used in the early follow-on supply operations, project new mission requirements for the Naval Beach Group Units (NBG). These NBG support functions are analyzed relative to the cargo handling systems proposed for transferring cargo ashore and operation during the early-ashore time frame. No significant increased requirements or changes in NBG missions are anticipated as a direct result of presently structured SMLS type operations; but an increased capability requirement in operations and equipment is apparent, based on future large barge/container oriented logistic system operations.

N-1387
Study of Domestic Hot Water Use in Navy Bachelor Enlisted Quarters, Apr 1975, J. C. King, ADA011805

Criteria presently used for determining hot water demand and storage volumes for military bachelor enlisted quarters (BEQ) are based on civilian-type facilities. These criteria were suspected of being inapplicable for BEQs because the military way of life affects such factors as the time and nature of hot water demand. Loads can occur at random times or at a definite time of day and can vary from high peaks to a constand demand. To obtain criteria specifically applicable to BEQs, the Naval Facilities Engineering Command requested that the Civil Engineering Laboratory conduct a detailed investigation, using metering and recording instrumentation in recruit- and service-type BEQs in Northern, Southern, and tropical climates. From data thus obtained, CEL could develop criteria for the sizing in new BEQ installations of domestic water heaters and hot water storage tanks to cover a wide range of climatic areas. This report covers work done by CEL in this investigation. The resulting design criteria are presented for each type of BEQ as a series of curves, showing required heater recovery as a function of storage tank volume (both on a "per man" basis), with inlet cold water temperature as a design parameter. This approach permits the designer to examine trade-offs between heater recovery and storage volume so that a minimum-cost installation can be selected.

N-1388
Prototype Powerline Transient Source and Direction of Propagation Detector, May 1975, M. N. Smith, K. T. Huang, ADA011809

Random impulse voltage transients that occur on electrical power distribution systems can cause physical damage to critical loads, resulting in operational failure. There are numerous transient detection devices, but until recently no device could determine the direction of propagation of transients on a powerline. This report is an evaluation of two prototype transient-direction detectors. Tests revealed they provide a simple and accurate means of locating the source of impulse transients on electrical powerlines.

N-1389
The Coanda Effect Oil/Water Separator: A Development Study, May 1975, D. Pal, ADA011806

A new method of separating free oil from oil/ water mixtures is under development at the Civil Engineering Laboratory. This technique utilizes the fluid-dynamic phenomenon, called the "wall attachment, or Coanda effect." Such a separator would be considerably smaller than the conventional gross separators of the laminar flow types. This report describes in detail the development program of the separator from the original single-stage separator through the 20-gpm multistage separator.

N-1390
Effects of Charge Shape and Composition on Blast Environment, May 1975, J. E. Tancreto, ADA011807

Blast pressures were obtained from surface bursts of hemispherical, spherical, and cylindrical composition B explosive and from encased RDX slurry charges. Charge weights varied from 0.50 to 3.7 lb. Pressure measurements taken between 2 and 50 ft from the charge varied from less than 1 psi to over 1,000 psi.

The pressure-time records were evaluated for peak pressure, impulse, and positive-phase duration. The effects of charge shape and composition were of primary importance, but surface hardness and slight charge elevation effects were also investigated.

Peak-pressure and peak-scaled unit impulse equivalencies (by weight of TNT hemispherical surface bursts) are calculated for composition B spheres and cylinders and for the RDX slurry charges. Test results indicate that the blast environment from composition B depends more on the shape of the charge than on its chemical difference from the TNT standard. The composition B equivalencies determined in this study might be more properly labeled as shape factors which could be applied to any high explosive.

N-1391
Expendable Power Sources for Undersea Applications, May 1975, J. F. McCartney, ADB004843L

Under sponsorship of the Naval Electronics Systems Command, low-cost, expendable power sources for undersea data gathering and transmitting systems have been investigated. This investigation was initiated with a review of power requirements for present and projected missions. Power is needed at levels of from 1 W to 1,000 W for periods of 0.1 yr to 10 yr in the ocean to depths of 20,000 ft with some applications requiring prototype hardware within the next few years. State-of-the-art and advanced power sources and power systems were surveyed and tabulated. The performance of these systems was compared with the mission requirements to determine selected candidates for more detailed investigation. Many types of batteries could fulfill mission requirements up to about 1 yr, but development is needed for low-weight sources for longer periods of time. Development should be aimed at pressure-balanced primary and secondary batteries; seawater batteries; towed generators; seawater electrolyte fuel cells and simplified low-power fuel cells; surface, snorkeling, or periodically surfacing power sources with transmission cables to undersea systems; mechanical, electrical, or liquid replenishment of submerged power sources; and underwater connectable power sources. These recommended power source methods should be developed concurrently with advanced lightweight radioisotope fuel power sources to assure the availability of suitable power sources for future undersea systems.

N-1391S – Classified report, Jan 1976, ADC005278

N-1392
Antifouling Marine Concrete, May 1975, J. S. Muraoka, H. P. Vind, ADA014173

A method was developed for incorporating mixtures of creosote and other toxic chemicals into concrete by first impregnating a porous expanded shale aggregate with the toxic mixture. The impregnated aggregate was then mixed with portland cement and water to produce an antifouling marine concrete. Concrete panels made from aggregates impregnated with mixtures of creosote containing tributyltin oxide at levels of 100 to 250 ml per liter remained free of fouling for 4 yr. The antifouling concrete is not quite as strong as concrete made with sand and gravel, but it is strong enough for construction in which a compressive strength of 3,500 psi is acceptable.

N-1393
Metal Hydrides for Energy Storage Applications, Jun 1975, S. C. Garg, A. W. McClaine, ADA014174

A survey was made of metal hydrides for energy storage in the form of hydrogen, heat, and a combination of both. Five intermetallic compounds were found to be promising energy storage vehicles. They were: MgNi, FeTi, LaNi(5), La(0.3), Ni(5), and Mischmetal Ni(5). The most important property common to all these hydrides is their ability to store large quantities of hydrogen per cubic foot of the hydride: between 5 and 7 lb/cu ft, compared to a liquid hydrogen density of about 4.4 lb/cu ft. Each of these compounds was found to be able to store hydrogen under different experimental conditions, and each has its unique properties and handling characteristics.

Several areas where metal hydrides can be of use are discussed in detail, including energy storage at remote bases and combat zones, underwater fuel storage, fuel and heat storage in closed system operations, and their use in heat pumps and automotive applications. Because of the abili*y of metal hydrides to supply hydrogen and absorb exhaust heat at the same time, and to deliver this absorbed heat during recharging where it can be used, they are useful in achieving better utilization of available energy.

N-1394
Upgrading Survivability of Concrete Arch Magazines – Results of a Finite Element Analysis, Jul 1975, J. N. Ferritto, ADB006046L

The existing standard earth-covered concrete arch igloo magazine has been analyzed using finite element techniques and found capable of withstanding a total long-duration dynamic pressure of 25 psi from the detonation of a nuclear weapon. The arch load capacity was increased to 100-psi limit by the addition of soil fill above the structure and on its sides to produce a much flatter slope, reducing drag and reflected pressures. Methods for increasing the hardness of the entryway, blast door, and rear closure were studied.

N-1395
Air Inflated Portable Maintenance Shelter, Jul 1975, F. W. Brier, ADA014199

The need for adequate shelter for maintenance and repair of construction and other types of equipment at polar camps motivated development of a portable maintenance shelter. The portable maintenance shelter described in this

technical note is a commercially available pneumatic structure composed of an air-inflated frame and a nylon-reinforced polyvinyl chloride cover. The 22-by-22-ft shelter is adequate for the repair and maintenance of equipment as large as a size 6 snow tractor. From the field test at Williams Field, Antarctica, it was concluded that if fabrication techniques can be improved the shelter will be suitable for use at temporary camps or other facilities in polar regions. However, additional testing is required to determine its durability and low-temperature limitations.

N-1396
The Survival of Sewage Bacteria at Various Ocean Depths, Jul 1975, H. P. Vind, J. S. Muraoka, C. W. Mathews, ADA017700

Sewage outfalls in the ocean are usually relatively close to shore at depths of 200 ft or less. An investigation was undertaken to ascertain if the principal species of bacteria in sewage, Escherichia coli, would survive for shorter or longer periods if the sewage were discharge at depths of 1,000 ft or so, where there is no light, and where the pressure is greater and the temperature is lower. Cultures of the Seattle strain of E. coli in autoclaved seawater were placed in 25-ml bags made of dialyzing tubing. Some of the bags were suspended near the surface of the ocean, some at depths of 200 and some at depths of 1,000 ft. Some of the bags were suspended in opaque containers to protect them from sunlight; others were suspended in translucent containers. All of the E. coli cultures exposed near the surface of the ocean in translucent containers died in approximately 4 hr. Those suspended near the surface in opaque containers survived for periods of an estimated 2 wk. Cultures of E. coli suspended in either translucent or opaque containers at depths of 200 and 1,000 ft (where little or no light penetrates) also survived for periods of an estimated 2 wk, with only slight differences in the mortality rates at these two depths. If the sewage were discharged at a depth of 1,000 ft, there would be no danger of contaminating surface waters because the cold, deep water does not mix with the warmer surface waters. If the sewage were discharged at a depth of 200 ft, there would probably also be no danger of contaminating surface waters unless the thermocline was deeper than that. If the sewage were discharged at shallow depths, there would be contamination of surface waters; but at least one species of the contaminating microoganisms would probably survive for only a few hours in sunlight.

N-1397
Transient Susceptibility Tests of AN/GYK-3(V) Digital Data Processing System at Skaggs Island, Aug 1975, M. N. Smith, ADA014200

Susceptibility tests were made on an AN/GYK-3(V) Digital Data Processing System at the Navy Security Group Headquarters at Skaggs Island, Calif, utilizing the Power Transient Synthesizer and Power Transient Monitor developed by the Civil Engineering Laboratory. These tests were to determine the quality of electrical power required by the system to operate with a minimum of failures. Eight components of the system were tested individually, and then the system as a whole was tested. Results indicated that the AC sensing section of the Status Display Console ID-1289 was extremely sensitive to powerline transients and often initiated premature system power down. A number of minor problems resulting from inoperative circuits caused by grounding, loose connections, etc., and improperly calibrated components were also discovered and corrected during the tests. Identification of these problems would have been virtually impossible without the use of the specialized CEL equipment.

N-1398
Solid Waste Handling and Disposal at Naval Shore Facilities - Air Curtain Destructor Experiment, Jul 1975, J. S. Williams, S. C. Garg, ADB006047L

The concept of using an air curtain to minimize particulate emissions from open pit incinerators was investigated through full scale field tests. Changes in the pit configurations and modifications of the blower nozzle were made during the test period. Some reduction in particulate emission was achieved through the installation of a curved deflector plate at the top of the pit wall. However, in all tests, the observed smoke emission was found to exceed the local APCD limits. It is recommended that open pit incinerators be used only in areas where disposal of large amounts of untreated lumber is required, and only where other methods of disposal are not available.

N-1399
Structural Tests of a Fiberglass-Reinforced Polyester Housing System and its Components, Jul 1975, W. A. Keenan, ADA017693

A prototype fiberglass-reinforced polyester (FRP) housing system and certain of its components were load tested to evaluate their structural performance for compliance with HUD Guide Criteria developed for Operation Breakthrough. Serviceability and structural safety of a two-story test house were determined under nine combinations of horizontal and vertical dead, live, wind, and earthquake loads. In addition, typical roof and wall panels and sill joints were environmentally conditioned and loaded to failure to measure the effects of exposure to high temperatures and humidity on structural performance. The test house simulated the living/bedroom portion of a two-story townhouse, but lacked the stiffening effects from adjoining modules. It, thus, provided a conservative model to simulate structural response of the prototype system. The house was fabricated of FRP sandwich panels for exterior walls, interior partitions, roof ceilings, and conventional wood joist construction for floors. Construction details of the test house and wall, roof, and joint test specimens were representative of those used in the prototype housing system. The test house satisfied the HUD Guide Criteria recommendations under all combinations of loads except wind load. The modes of failure in the test house, wall and roof components, and sill joints demonstrated the need for stricter quality control in fabrication techniques, especially at adhesive joints.

N-1400
Evaluation of the Linalog Pipeline Inspection System for the Detection of Corrosion in Navy POL Pipelines, Sep 1975, M. E. Hollan, ADB007688L

The field utility and accuracy of the Linalog Pipeline Inspection System offered by AMF Tuboscope, Inc., has been evaluated to determine the applicability of the system to Navy POL pipelines. The utilization of an in-service pipeline inspection system to detect pitting offers a considerable cost saving over the method currently being used to locate pipeline damage caused by corrosion. Evaluation of the Linalog system performance has indicated that this system is satisfactory for use by the Naval Shore Establishment if utilized as directed within this report. This restriction is necessary because it was found that the Linalog inspection instruments designed for particular pipe diameters exhibit an upper limit to the pipe wall thickness that can be inspected satisfactorily. The limits are tabulated within the report.

N-1401
Electromagnetic Shielding Requirements Within Naval Hospitals, Sep 1975, J. L. Brooks, ADB007689L

A study of the possible hazards created by using electronic diagnostic and monitoring equipment that is susceptible to electromagnetic interference (EMI) was conducted

by the Civil Engineering Laboratory (CEL). This work is applicable to Naval hospitals and was sponsored by the Naval Facilities Engineering Command. The investigation revealed that recent advances in medical procedures coupled with the ever-increasing use of electronic equipment and devices do, *in fact, present* compatibility problems that are unique to hospitals. Most problems caused by EMI, while not directly hazardous to life, do affect the patients well-being in that they create nuisances that cause delays, distortion of electronic readouts, or malfunctioning of peripheral equipment. This report details the nature of the EMI problem and presents recommendations to alleviate the problems both for new hospital construction and for retrofitting existing hospitals.

N-1402
Durability of Plastics in Anaerobic Marine Sediments, Oct 1975, J. S. Muraoka, H. P. Vind, ADA017701

Specimens of a wide variety of plastic sheets, ropes, and electrical cable insulations were partially buried in anaerobic harbor sediments to determine the effect of hydrogen sulfide on polymeric materials. For comparison, specimens of the same materials were exposed in aerobic surface waters. After 2-1/2 yr, the specimens were all recovered. Very little change was noted in the appearance, strength, or hardness of any of the specimens of synthetic polymeric materials. In contrast, nothing remained of samples of wood and short lengths of cotton and hemp rope exposed for comparison. Similarly, natural rubber covers of samples of insulated electrical cable deteriorated during the 2-1/2 yr, but plastic and synthetic rubber covers of other insulated cables underwent no visible deterioration.

N-1403
Kink Formation and Rotational Response of Single and Multistrand Electromechanical Cables, Oct 1975, F. C. Liu, ADA017699

Mathematical models for double-armored and multistrand cables were formulated to simulate straight cable sections. Numerical solutions for free-end and fixed-end cables under tension were obtained with a computer. Controlled cable tests were conducted to generate data on the rotational behavior of six cables of different size and construction. Part of the data was used to compare with results from the analytical models. Experimental results and model predictions for elongation and rotation were in good agreement for the case of a double-armored cable. Experimental and predicted values of rotation for a 3 x 19 nonrotating, multi strand cable were not in good agreement, apparently because of the difficulty in modeling the complex construction of the cable. Two types of cables were subjected to constant tension and were twisted until kinks developed. These test results show that the buckling criterion for a solid rod can be used as a criterion for kinking of double-armored and multistrand cables.

N-1404
Ship-to-Shore Hose Handling Tests, Oct 1975, F. J. Campbell, ADA017692

Tests were recently conducted at the San Diego Naval Station to determine the best procedures and equipment the Navy can use to transfer waste from a ship's holding tank to pier waste-handling facilities. Procedures tested included loading, transporting, connecting, disconnecting, unloading, cleaning, and storing hose for a sewage-handling system. Equipment tested during the program included four types of transport vehicles, plastic and rubber hoses, metal and plastic hose caps and plugs, two powered reels, two types of storage and loading racks, a hose cleaning rack, a hose cleaning apron, and two types of hose supports.

Two systems, one for high ship turnover ports and one for low ship turnover ports, were selected as most applicable for sewage transfer operations. Criteria for determining manpower requirements and the numbers of equipment needed for a system are outlined.

N-1405
Polar Transportation Equipment - Five-Ton Truck With High Flotation Tires, Nov 1975, M. W. Thomas, ADA017698

A Dodge 8W500 5-ton truck with 19.75 x 20, low-pressure, high flotation tires was tested in the continental United States and at McMurdo, Antarctica, to determine its suitability as a cargo transporting vehicle in snow-covered polar regions. The tests indicated the vehicle was satisfactory when operated on well-constructed, hard-packed snow roads, but unsatisfactory for operation over deep, undisturbed, snow surfaces as well as over partially compacted surfaces such as snow trails processed by vehicle traffic.

N-1406
Earth Science Related Environmental Factors in Polar Region Construction, Nov 1975, J. E. Cronin, ADA017697

A literature search was conducted to identify earth-science-related environmental factors affecting construction and transportation in the polar regions. The three polar "earth materials" - snow, ice, and frozen ground - were considered. The study was to produce a document that would provide an overview of the subject and bring together a source of references for more detailed study as required.

The pertinent physical properties of each material are discussed at the beginning of each section. Problem areas studied were limited to foundations and construction *methods, roadway construction, excavation* (including drilling and trenching), and utilities and pipelines. A major portion of the study is devoted to frozen ground because of the volume of research in this field and the current upsurge of activity in regions underlain by this material.

General problem areas for further research are outlined in the closing.

N-1407
High Explosive Field Test of a Hardened Water Well, Nov 1975, R. S. Chapler, J. A. Norbutas, ADA017695

In support of Project SANGUINE, CEL designed and field tested a hardened water well which was intended to supply coolant to underground shelters and equipment before, during, and after nuclear attack. Failure of the pump due to clogging in the first field test led to redesign and the need for retest. To accomplish this, CEL participated in the explosive test Project ESSEX, Phase 1, at Fort Polk, La, in October 1973. A redesigned water well was constructed at a location where ground motions were predicted to be similar to those experienced in the previous field test. This report describes the test setup and the results obtained. In summary, although electrical power to the well site was interrupted a few seconds after detonation, the pump and well were found to be operable after the test. Also, the permeability of the water bearing strata was reduced, decreasing the well output, and well water of high turbidity and solids content was discharged for nearly 2 hr after detonation. However, the CEL-designed hardened water well had survived the blast environment and remained operable.

N-1408
Applications of the Magromover in Amphibious Logistics, Nov 1975, M. J. Wolfe, ADB008311L

The Magromover is an air-powered device designed primarily to move van containers. It was operated at the Civil Engineering Laboratory in a variety of test conditions to determine if and where it could be used in Marine Corps and Navy logistics operations. Emphasis was placed on measuring rate of travel, maneuverability, and slope climbing ability. During the test program the Magromover carried loads ranging from an empty container (tare weight of 5,000 lb) to 45,000 lb.

It was determined that the Magromover meets the requirements for horizontal movement of loads: it moves forward, backward, sideways in either direction, and rotates clockwise and counterclockwise. While it can climb slopes up to 10% and negotiate small obstacles (lin. or less), it appears best to limit consideration of potential uses of the Magromover to only those tasks where the operating surface is flat and free of high door sills and similar obstructions. It is, for example, suited more for moving on a deck of a ship than between decks.

N-1409
Underwater Explosive Excavation Testing at San Nicolas Island, California, 1972-1973, Nov 1975, L. W. Hallanger. ADA017653

A series of tests designed to provide preliminary information on a variety of topics relating to nearshore underwater explosive excavation was conducted at San Nicolas Island, Calif, during 1972-1973. Topics investigated included: (1) suitability of standard Navy demolition materials for use in underwater excavation projects; (2) potential for modifying certain standard Navy demolition charges to allow their use or to improve their performance in underwater applications; (3) suitability of certain commercially available conventional explosives in underwater applications, (4) suitability of commercial field-mixable, two-component explosives for underwater applications; (5) identification of operational restraints for nearshore explosives work; (6) validation of techniques that appear to be suitable for nearshore explosive excavation work; and (7) determination of the limitations inherent in the techniques that can be applied. Data obtained from a total of 55 test shots consisting of 198 separate charges are presented. In addition, results from underwater operations with a modified track drill and comments on two commercial field-mixed, two-component explosives are included. Specific observations are made regarding: operations and techniques, drilling, logistics and materials, and measurements and data.

N-1410
Reduction of V/STOL Downwash Effects by Jet Exhaust Flow Control, Dec 1975, D. E. Williams, ADA021965

The performance of V/STOL aircraft is influenced significantly by ground effects during landing and takeoff when the propulsive flow of the aircraft is directly downward. To mitigate downwash effects, a new landing mat concept was developed at CEL whereby exhaust flow is controlled by either a very thin array of diamond patterns or parallel ribs. The impinging jet flow aligns itself with the long axis of the grid pattern, expanding in two directions along a single line rather than radially outward over the plane of the ground. Grid height or thickness is small compared with jet diameter. A method for calculating grid height was developed by combining Froessling's solution for boundary layer thickness and Glauert's solution for wall jet thickness.

N-1411
Effect of Atmospheric and Laboratory Irradiation on Attenuated Total Reflectance Spectra of Organic Coatings, Nov 1975, P. J. Hearst, ADA018908

Attenuated Total Reflectance (ATR) spectra were obtained before and after irradiation of coating films as part of an investigation to develop better accelerated test methods for determining coating performance. The coatings included alkyd, oil, vinyl-alkyd, vinyl copolymer, partially hydrolyzed vinyl copolymer, epoxy-amine, and epoxy-polyamide films. Clear and pigmented films had previously been irradiated in air with a mercury arc and with a xenon arc. These studies were extended to include longer xenon-arc irradiation and atmospheric exposures. 500-hour xenon-arc irradiation had little effect on an alkyd film, slightly reduced the peak heights of a vinyl film, and produced a strong increase in the carbonyl absorption of an epoxy film. Five-month atmospheric exposure produced a general reduction in the peak heights of the ATR spectra of alkyd, vinyl, and epoxy films and produced increases in the carbonyl peaks of the epoxy films. Since the main effect on the surface of coating films, as judged by ATR spectra, is an increase in carbonyl content, this method of testing coatings appears most suited for those synthetic coatings that do not have strong initial carbonyl absorption.

N-1412
Prediction of Paint Performance From a Combination of Accelerated Laboratory Tests, Nov 1975, R. L. Alumbaugh, P. J. Hearst, ADA018954

The Civil Engineering Laboratory investigated various accelerated laboratory test procedures for use in predicting the long-term performance of paint systems for steel exposed to a marine atmosphere. Accelerated laboratory test procedures included determining the electrical properties of the paint systems on steel panels (AC and DC resistance and AC capacitance), the water vapor permeability of free films of the paint systems, and the performance of the paint systems on steel panels exposed to a wet-and-dry-cycle test procedure. Results of the accelerated laboratory tests on 12 paint systems were correlated with their long-term performance in two different marine atmospheric environments using linear regression analysis. Results of the linear regression analysis indicated that individual accelerated laboratory tests were not particularly good predictors of paint performance. However, certain combinations of the different accelerated laboratory test results showed promise as good predictors of paint performance when the paint systems correlated were of the same generic type. Coefficients are given for linear prediction equations where good correlation was obtained between the accelerated laboratory test results and long-term performance of the paint systems.

N-1413
Expedient Deep-Water Propellant Anchor Mooring System, Nov 1975, D. G. True, J. A. Drelicharz, J. E. Smith, ADA021842

The Civil Engineering Laboratory has investigated the best means for installing the CEL 20K propellant anchor quickly, effectively, and efficiently in the seafloor. This anchor can achieve holding capacities of 20,000 lb in water depths of 20,000 ft. Several concepts were examined for launching the anchor system and deploying the anchor and line. Also included were advanced concepts for laterally distant anchor deployment. Alternate components were identified, and candidate systems were synthesized and evaluated.

A buoy-launchable, free-falling, bale-on-anchor system was selected as best satisfying the broadest range of foreseeable needs. Preliminary design information is given for this "standard expedient mooring system package." The system includes a feature for automatic length adjustment, stopping, and locking of the line at the anchor to provide a taut surface moor; this feature can be deleted to reduce cost. The package can be towed to a site or launched from a suitable carrier. A launching system is described that permits the proposed package to be launched from most surface vessels having an open cargo deck capable of accommodating the size and weight of the package; no ship-borne load-handling equipment is required.

N-1414
Evaluation of Power Line Transient Suppressors, Dec 1975, M. N. Smith. ADB012697

Raw commercial power has the potential to damage critical electrical and electronic systems employing semiconductors because of random power line anomalies. An especially damaging power line anomaly is the impulse voltage (spike) type of transient. With the use of impulse voltage transient suppressors, the peak levels of these transients can be lowered to levels that critical systems can tolerate. This report covers tests conducted on four commercially available suppressors and a suppressor under development at CEL. A CEL Power System Synthesizer was used to generate impulses for testing. A brief description of previous testing of metal oxide varistors and a comparison of cost effectiveness of all suppressors tested at CEL are included. The metal oxide varistor was found to be the preferred suppressor.

N-1415
Development of an Ice Excavation Machine, Dec 1975, K. D. Vaudrey, ADA018956

A review of operational requirements indicates a continuing need for equipment to excavate ice to facilitate polar construction. A 30-hp ladder-type trencher was selected and purchased for its low ground pressure and versatility. The chain was outfitted with specially designed conical ice teeth, and a rotating ice chipper drum was designed and fabricated for the backhoe arm. Both modifications were tested in a laboratory situation for performance and suitability for field operation. A similar, but larger machine with identical teeth, procured under a separate task, was observed during an extended Antarctic ice-trenching operation. Laboratory tests and field observations showed that the ice excavation machine was easy to operate and provided maintenance-free performance during all of its trials.

N-1416
Sea-Ice Removal Techniques for Winter Quarters Bay, Antarctica, Dec 1975, F. W. Brier, K. D. Vaudrey, ADA018950

During the winter months of DF-73 an artificial ice wharf was constructed in Winter Quarters Bay, Antarctica, to serve as a temporary docking facility. In January 1974, the artificial wharf cracked at several locations during ice breaker maneuvering to clear annual sea ice from the Bay. Subsequent discussion indicated that an area of open water adjacent to its seaward face would have prevented the damage. This report describes testing of a modified earth trencher to create an open-water area in the Bay. The trenching machine exceeded initial estimates of cutting speed, but rapid freeze-back of the trench prevented creation of an open-water area.

N-1417
Ice Engineering: Elastic Property Studies on Compressive and Flexural Sea Ice Specimens, Dec 1975, K. D. Vaudrey, ADA019028

A description of the elastic property studies on sea ice is presented along with a summary of the results of the experimental effort. Both laboratory and field tests were performed on compressive and flexural sea ice specimens to determine the following elastic material properties: compressive strength, flexural strength, and modulus of elasticity. Tests were conducted at four different ice temperatures, with the compression specimens also including two crystal orientations. The possible compressive failure modes and their causes are also discussed.

N-1418
1975 Inspection of Experimental Marine Piling, Dec 1975, T. Roe, ADA021843

The cooperative-treated piles at Coco Solo, Canal Zone, and the cooperative-, CEL-, and CEL/industry-treated piles at Pearl Harbor were inspected by a diver in March and April 1975. After 12 yr at Coco Solo, only the dual-treated piles are performing satisfactorily. At Pearl Harbor, the remaining cooperative-treated piles are performing satisfactorily as are many CEL- and CEL/industry-treated piles. These piles were impregnated with either creosote containing a toxic additive, a selected single treatment, a solution containing two toxic compounds, or a dual treatment.

N-1419
Hydraulic Fluidic Level Control Unit, Dec 1975, E. R. Durlak, R. H. Fashbaugh, ADA019049

An experimental hydraulic fluidic control unit has been developed that will detect and correct angular variations, such as those experienced by a bulldozer grader blade. The developmental testing was accomplished in two phases. The first phase developed a hybrid electrical/hydraulic system, while the second phase eliminated the electrical interface. The necessary modifications to the equipment were accomplished at CEL. The fluidic control unit requires only an input pressure source, which is normally available from the hydraulic control system of the vehicle. Some additional development work remains on fine tuning the dynamic response of the control unit.

N-1420
Experimental Piping and Conduit Installations on the Navy Fuel Department Pier, Point Molate, California, Jan 1976, T. Roe, R. L. Alumbaugh, ADB009724L

Nonspecification piping and conduit were installed on the fuel pier at Point Molate, Calif. The PVC-jacketed galvanized steel conduit was in excellent condition after 57 mo of service. The polyethylene-jacketed steel pipe was in excellent condition after 53 mo in aviation fuel service and after 61 mo in fire main service. The polyethylene-jacketed polyacetal pipe for fuel drains had snaked severely from thermal expansion after 40 mo of service.

N-1421
Feasibility of Using Aluminum Conductor Cables for Shore-to-Ship Electrical Power Service, Jan 1976, D. E. Weems, ADA021844

Electrical power is currently supplied to ships while in port by cable with three copper conductors. At 6 lb/ft, such cables weigh 600 lb or more. The Civil Engineering Laboratory conducted a feasibility study to determine if aluminum, rather than copper, could be used as the conductor and thus reduce the weight of the cable. Results of the study indicate that aluminum conductors would cause more problems than would be solved by their use: increased cross section area, reduced flexibility, increased rate of fatigue, and increased susceptibility to corrosion. In addition, the aluminum conductor cable manufacturers contacted indicated their reluctance to produce a cable with the number of fine aluminum strands required. Another part of the study was to determine whether increased cable size would reduce the surface temperature of the cable to enable personnel to handle it without burning their hands. Though a slight reduction was possible by increasing the size of the conductor, the largest temperature changes would result from eliminating direct exposure of the cable to the sun.

N-1422
Ground Transportation for Polar Operations – 16-Wheel Low-Ground-Pressure Vehicle (LGPV-16), Jan 1976, M. W. Thomas, ADA021845

Transportation operations at remote sites in polar regions require specialized equipment due to the climatic and terrain conditions. Design criteria were developed for a multipurpose, 5-ton-capacity, high-flotation-tired, prototype vehicle to move personnel and cargo and to provide fire-fighting/crash-rescue capabilities to aircraft operations. Contracts were awarded for the design and fabrica-

tion of a 16-wheel low-ground-pressure vehicle (LGPV-16). After delivery of the vehicle in late 1970, initial testing indicated the need for a tire with better flotation and traction capabilities. After new tires had been installed and minor modifications made to the suspension system, the vehicle was retested before shipment to Antarctica. During the Antarctic testing the vehicle did not fulfill performance requirements set forth in the design criteria, mainly because the complete drive-train system is underdesigned for the severe operational conditions when driving over deep snow. The vehicle was returned to the continental United States where the decision has been made to discontinue further development.

N-1423
Exposure and Tensile Strength Tests of Natural and Synthetic Fiber Ropes Treated With Candidate Antifouling Materials, Feb 1976, T. Roe, J. S. Muraoka, ADB009725L

Samples of one natural fiber and three synthetic fiber ropes were treated with candidate antifouling materials, or combinations thereof, and exposed, along with untreated samples, at a depth of 70 ft in the Pacific Ocean off Port Hueneme, Calif. Samples were removed from this exposure after 3 and 6 mo, examined for fouling, and tested to determine their tensile strength. A third set was examined for fouling after 8 mo of exposure. TBTO (tri-n-butyltin oxide) was the most effective antifouling agent. Longer term exposure tests were not completed because of the loss of the Submersible Test Unit (STU) on which the rope samples were mounted.

N-1424
Inspection of Objects Retrieved From the Deep Ocean-AUTEC Acoustic Array, Feb 1976, J. F. Jenkins, ADA021892

Information on the corrosion of materials exposed to marine environments must be obtained if ocean structures are to be designed with predictable lifetimes. A large amount of relevant information can be obtained at a relatively low cost by evaluating the condition of objects retrieved from the sea. To optimize these evaluations, they must be performed logically and uniformly. Development and application of guidelines for such evaluations can provide this optimization. As a part of the development of guidelines, this report describes an evaluation of the AUTEC acoustic array emplaced in 1962 and retrieved from the Tongue-of-the-Ocean, Bahama Islands, after 12 yr of exposure. The condition of the array as well as the application and revision of the inspection guidelines are discussed.

N-1425
Attack Resistance of Structural Components, Feb 1976, J. E. Tancreto, ADA024053

This report describes an investigation of forceful entry resistance of walls, floors, and roofs of secure facilities. Attack resistance of conventional and secure construction methods is reviewed and data from tests on various barriers is summarized. Data from limited in-house tests and from other sources were used to develop several proposed barrier concepts for 10- and 20-min denial times.

N-1426
Underwater-Applied Coatings for Steel Structures, Mar 1976, R. W. Drisko, ADA022450

Several underwater-applied epoxy coatings were developed for protecting steel structures in seawater. The more promising formulations were laboratory and field tested at different times using a brush, a roller, and a curved plastic applicator developed by the Navy Coastal Systems Laboratory. The coating that was the easiest to apply underwater is now marketed by a commercial supplier. Sandblasting was found to be the best method of preparing steel surfaces for painting underwater, and waterblasting was the next best of the five methods tested.

N-1427
Stress Concentration Factor Determination in Station Post Insulator, Feb 1976, D. T. Corrente, ADA022458

A computer model of a station post insulator was analyzed for stress concentration with a finite element program for an applied stress of 1,000 psi. A stress concentration factor of 2.01 was obtained for the vertical stress between the sheds; this corresponded to a strain of 195 μin./in. The prototype, which was strain-gaged and loaded, yielded a strain value of 200 μin./in. Other computer information obtained were the shear, radial, and circumferential stresses and strains throughout the entire station post insulator.

N-1428
A Comparison of Installation and Protection Techniques for Nearshore Electrical Cables, Mar 1976, P. J. Valent, R. L. Brackett, ADB010796L

Difficulties experienced with conventional nearshore electrical cable installation, immobilization, and protection techniques are reviewed. Improvements to these techniques and new concepts to minimize or eliminate difficulties are suggested. Viable concepts and techniques are compared in terms of dollar cost and of product quality; the more desirable concepts are called out. Horizontal drillholes for conveying cables beneath the nearshore zone are shown to be competitive for traverses of 4,000 ft or less on rock. The needs for a seafloor crawling rock trencher and an improved seafloor track-drill are demonstrated. A machine capable of deep plowing-in and burying of cables on nearshores of unconsolidated material is needed. To function satisfactorily in all soil environments, the machine must be capable of fluidization, jetting, and mechanical cutting.

N-1429
Engineering Properties of Epoxy Resin as a Structural Adhesive for Cracked Reinforced Concrete Waterfront Facilities, April 1976, W. R. Lorman, ADA025400

The assessment of technical literature pertaining to the engineering properties of epoxy resin as an adhesive material for cracks in reinforced concrete waterfront facilities covers the period from 1950 to 1975. The review reveals that the available engineering data suffice for establishing a practical guide for civil engineers concerned with such application of epoxy resin. The report outlines the essentials of approaching a structural bonding problem, and briefly describes the procedure for consolidating a cracked concrete structural member by pressurized injection of epoxy resin. The report pertains to crack repairs that are essential for the stability of concrete waterfront structures; it is not intended to deal with sealing cracks and joints either against penetration of foreign matter or to prevent leakage.

N-1430
Instrumentation of Replacement Base Insulator Assembly - VLF East Tower, Lualualei, Hawaii, Apr 1976, S. K. Takahashi, ADA026188

The cone-type base insulators beneath a 1,500-ft-high guyed VLF antenna were replaced with station post-type base insulators. Strain gages were mounted on both types of insulators during the tower raising and lowering operations to determine the distribution of load on the base insulator assembly. The maximum strain deviation for the cone-type insulators from the average strain was 6%, which indicated that the load was distributed almost equally on the three insulators at the midtier. The strain deviation for the station post-type insulators varied from -36 to +52% when compared with the average strain value. Finite element computer analyses were performed for both the cone and post insulators subjected to a direct axial load. The vertical and circumferential stresses compared very well with the average values of the experimental strain readings.

N-1431
Revised Aircraft Load Curves and Vehicle Ice-Thickness Tables for Annual Ice Sheet Operations Near McMurdo, Antarctica, Apr 1976, K. D. Vaudrey, ADA024051

Updated aircraft load curves and vehicle ice-thickness tables are presented for operations on the sea-ice sheet near McMurdo Station, Antarctica. First, material property research on sea-ice is reviewed to demonstrate the current knowledge of ice-sheet bearing strength. Then the elastic finite element computer code is discussed; how it models an ice sheet and accepts material property and loading condition parameters.

The load curves and ice-thickness tables give minimum ice-sheet thicknesses for specified aircraft and vehicle weights over four seasonal periods during the operating season. In addition to the tables and curves, operational field procedures are included to provide guidance for both day-to-day monitoring of the ice sheet and visual observation of ice-sheet behavior.

N-1432
Rock Spalling Through Electrohydraulics, Apr 1976, R. J. Odello, ADA024038

This report describes theoretical and experimental efforts to spall rock using high-pressure, short-duration stress pulses created by electrohydraulic discharges. An electrohydraulic power supply with a maximum voltage capability of 17,000 V and a capacitance of 45 μf was used. Specimens were granite cylinders 15 in. (38 cm) in diameter by 18 in. (46 cm) high. The spalling concept consisted of creating a compressive stress pulse at an axial hole in the cylinder, and spalling the specimen when the pulse is reflected as a tensile wave at the outer surface of the cylinder. The tests indicated that the electrohydraulic equipment as it was utilized in these tests was not powerful enough to spall the granite specimens. The analytical efforts indicated that the spalling concept is feasible if the proper stress pulse shape is obtained; a method for estimating the necessary pulse shape parameters is presented.

N-1433
Three-Dimensional Static Finite Element Analysis of Lined, Right-Angle Cross, Circular Tunnel Intersections in Rock, Apr 1976, T. K. Lew, ADA026106

This report presents the results from static elastic finite element analyses of an unlined, a reinforced-concrete-lined, and a steel-lined right-angle cross, circular tunnel intersection in rock under a triaxial state of stress. Results from the analysis, such as stresses in the medium and deflections and forces in the liners, are presented and discussed.

It was found that the maximum stress concentration in the rock adjacent to the liner was about three. The disturbance in the stress field caused by the presence of the intersention in the rock was limited to about four tunnel radii from the center of the intersection. The crown deflection at the intersection for the cases analyzed was about 40% larger than that for the tunnel section far away from the intersection. The circumferential springline thrust in the liners at the intersection was about 1.5 times larger than that in the liner far away from the intersection. Moreover, the magnitude of the circumferential bending moments in the liners at the intersection was generally smaller than that in the liner far away from the intersection. The distortion of the liners at the intersection influence the bending moments in the liner section to distances up to six tunnel radii from the center of the intersection.

N-1434
Development of a Computer Program for the Dynamic Nonlinear Response of Reinforced Concrete Slabs Under Blast Loading, Apr 1976, J. M. Ferritto, ADA024050

A computer program was developed to determine the nonlinear dynamic response of reinforced concrete slabs subjected to blast pressure loading. Given the explosive parameters and geometry of the slab, the program computes the blast environment and the structural resistance, mass, and stiffness of the slab and solves for the dynamic response. The program will assist engineers in the design and analysis of facilities intended to contain the effects of accidental explosions. The report gives a user's guide and sample problems with data input and program output.

N-1435
Expendable Doppler Penetrometer: Interim Report, Apr 1976, R. M. Beard, ADA026107

An expendable penetrometer using the Doppler principle has been developed to expediently test seafloor soils at water depths to 20,000 ft. The velocity of the penetrometer is measured as it penetrates seafloor soils; from the velocity record, soil penetrability and an estimate of soil strength are available. The penetrometer weighs 365 lb, is 10 ft long, is 3-1/2 in. in diameter, and is easily deployed from a ship. Initial testing indicates that the concept of a Doppler instrumentation system is workable, that penetration can be accurately determined, and that deceleration can be ascertained. The penetrometer reaches a terminal velocity of about 80 ft/sec which, based on penetration theory, is sufficient to obtain about 30 ft of penetration in a pelagic clay. It is anticipated that with experience the penetrometer in many cases can be used by itself to design direct-embedment anchorages, thereby eliminating the need for cores and geophysical measurements for this purpose. For other cases, the penetrometer will supplement soil coring and geophysical measurements for anchorage and foundation design.

N-1436
Seawater Absorption and Compressive Strength of Concrete at Ocean Depths, Apr 1976, H. H. Haynes, R. S. Highberg, B. A. Nordby, ADA026192

The results of two limited investigations on seawater absorption and compressive strength of 6 x 12-in. concrete control cylinders subjected to ocean environmental conditions are given. Seawater absorption of field-dry concrete was found to be 2.36% by weight after exposure to a pressure head of 550 ft for 84 days. Uniaxial compressive strength of concrete saturated and tested under a pressure head of 20,000 ft decreased by 10% when compared to the compressive strength of fog-cured concrete. Concrete under 1-ft and 500-ft pressure heads had a strength similar to that of fog-cured concrete.

N-1437
Underwater Repair of Electromechanical Cables, Apr 1976, G. A. Edgerton, ADA026338

Procedures have been developed which will allow the underwater repair of electromechanical cables by divers with a minimum amount of training and with off-the-shelf materials. These simple techniques allow repair of electrical systems in-situ as opposed to resurfacing before effecting repairs. The technique combines the use of standard electrical wire crimping equipment, Tygon tubing, and RTV. The splices have been successfully tested in the Civil Engineering Laboratory's pressure vessel facility with cyclic pressures to 500 psig (34 atm) and temperatures to 3C. These splices have also been used successfully to effect repairs at sea to depths of 70 ft (22 m), for both data and power conductors.

N-1438
DOSIST II - An Investigation of the In-Place Strength Behavior of Marine Sediments, Jun 1976, H. J. Lee, ADA026189

DOSIST II (Deep Ocean Sampling and In-Situ Testing) was a cruise in the Western North Atlantic Ocean conducted to evaluate the in-place engineering behavior of several typical deep ocean sediments. In-place vane shear tests were performed, and sediment cores (gravity, piston, and box) were taken. Laboratory tests were conducted on the cored samples to classify the sediments and to determine which testing procedure best reproduces the measured in-place strength. This was found to be consolidated-undrained triaxial testing. The sediments tested in-place were a foraminifera-dominated calcareous ooze and a proximal turbidite. Both of these sediments are nearly cohesionless and retain little of their in-place strength when sampled. A deep sea pelagic clay was cored and subjected to laboratory testing, but was not tested in-place. Estimated in-place strength profiles were derived for each of these sediments to subbottom depths in excess of 50 ft (15 m).

N-1439
Fungal-Resistant Organotin Resins, Jun 1976, M. D. Steele, R. W. Drisko, ADA026190

A series of alkyd resins were prepared that had tin chemically bonded to them. These resins had more resistance to fungal growth than did the original alkyd resins from which they were prepared. This resistance does not appear to be lost as readily by leaching with rain as that of a resin to which bis (tri-n-butyltin) oxide is added as a preservative.

N-1440
Materials for Oil Spill Containment Boom, Jun 1976, D. E. Brunner, ADA026139

A study was recently conducted at the Civil Engineering Laboratory to investigate containment boom material requirements, which were defined and weighted in terms of their relative importance. When available, standard test procedures for use in evaluating each requirement were identified. Both substrate materials and coatings to be applied are discussed in this report. From the limited investigation, polyester was the most promising substrate material, followed by nylon. Chlorosulfonated polyethlene, polyurethane with a polyether base, chlorinated polyethylene, and poly(vinyl chloride) formulated with ultraviolet inhibitors are the most promising coating materials. One substrate and coating combination could not be identified as best because of the variation in material properties.

N-1441
CEL 10K Propellant-Actuated Anchor, Jun 1976, J. F. Wadsworth, R. J. Taylor, ADA026202

CEL has developed a new lightweight propellant-actuated embedment anchor with a nominal long-term holding capacity of 10,000 lb (45 kN). Through the use of stock components, the anchor can be inexpensively fabricated and used. Land tests have demonstrated the structural integrity of the design and verified the predicted ballistic performance. Sea tests were conducted in a coral seafloor at Midway Island. The anchors that were successfully embedded indicated holding capacities on the order of 30,000 lb (45 kN). Further testing is required to ascertain the system's reliability in other seafloor materials, but the 10K anchor should provide the Navy with an easily handled, medium-holding-capacity anchor.

N-1442
Structural Analysis of Failsafe Insulator Assemblies: Q9a, Q9b and Q7a, Jun 1976, S. K. Takahashi, T. K. Lew, ADA026251

Three types of failsafe guy insulator assemblies of the OMEGA navigation station guyed tower were load-tested statically to about twice the actual operating working load (AOWL). The primary purpose of the tests was to determine the behavior of the insulator cluster when the centerpost insulator was removed from the pentapost configuration. The tests showed that all pentapost and quadrapost configurations tested were safe at twice the AOWL; however, the Q9a quadrapost insulator system seemed to be headed toward the instability range beyond this load. Computer solutions were obtained and compared well with the experimental data. Finite element solutions can be used with economy to obtain the stress concentration factors between the sheds of the insulator and to predict the load distribution in the failsafe guy insulator system.

N-1443
Evaluation of Utility Equipment for Harbor Oil Spill Removal/Recovery Systems, Jun 1976, S. C. Garg, ADA026252

The following items of equipment for harbor oil spill cleanup operations were evaluated: a power assistance unit for deploying and retrieving boom, a 20-ft utility boat, a 28-ft flattop boat, three boom mooring systems, a dust abatement attachment for a sorbent distributor, and the associated connectors, shackles, and lines. A description of the test program, the test results, and recommendations for deployment, use, and retrieval of the equipment are presented. Manpower and time measurements for deployment and retrieval were made. Deficiencies in equipment, as observed, and methods to remove the deficiencies are described.

N-1444
Doubling the Drawbar of Marine Corps Bulldozers, Jul 1976, H. A. Gaberson, P. L. Stone, ADA026253

The theoretical prediction that vibratory locomotion can be used to double the otherwise available drawbar pull of bulldozers was experimentally proved. This report documents the design and tests of a "bolt-on" thrust doubling kit installed on an 11,000-lb bulldozer; drawbar pulls as high as 20,600 lb were measured. The kit is needed to upgrade the performance of the lightweight helicopter liftable bulldozers used by Marines at advanced bases. By adding only 10% to the weight of the tractor, its power output can be doubled. A detailed documentation of the tests are given along with an appendix containing all the required design theory. The report thus contains in one package all that is currently known concerning the use of vibratory locomotion for high traction development. When the largest of the two sets of weights fabricated, are installed on the kit, it constitutes the largest low frequency (1-30 Hz) counterrotating mechanical oscillator ever built. Its force output can exceed 40,000 lb. An alternative internal combustion free piston weight reciprocator concept is presented; this system, which actually becomes an auxiliary engine, will require considerable development, but it alone holds the promise of doubling the power output of existing lightweight tractors.

N-1445
Marine Corps Modular Fuel Transporting and Dispensing System, Jul 1976, M. E. Hollan, ADA028617

To insure the continuing capability of the Marine Corps Amphibious Assault Fuel System (AAFS) and Tactical Airfield Fuel Dispensing System (TAFDS), the Modular Fuel Transporting and Dispensing System was developed by CEL. This modular fuel system was developed to achieve the logistical flexibility needed to support remote expeditionary sites that have no land lines of communication. The fuel system, composed of two types of SIXCON-sized modules, is helicopter transportable, compatible with ISO container standards, and modular in design. The tank module has a 1,090-gal (0.413 m^3) capacity. When empty this module can be collapsed to one-third its erected height for ease of storage and transportation. The pump module contains an engine-driven pump, filter/separator, fuel monitor, hoses, and all ancillary equipment necessary to deliver clean-dry fuel.

N-1446
The CEL 100K Propellant anchor - Utilization for Tanker Moorings in Soft Coral at Diego Garcia, Jul 1976, D. G. True, R. J. Taylor, ADA028607

This report documents the design of the CEL 100K Propellant Anchor, and outlines the mooring requirements and designs as well as the procedures, equipment, and operations involved in installing the propellant anchors and connective gear for tanker moorings at Diego Garcia. This successful installation demonstrated that this type of anchor can be used to advantage in Navy and other applications, particularly where uplift-resistance is desired or where effective anchoring is needed in a hard seafloor.

N-1447
Concrete Cover in Thin-Wall Reinforced Concrete Floating Piers, Jul 1976, W. R. Lorman, ADA028616

A critical appraisal of the technical literature dealing with thin-wall reinforced concrete pontoons, corrosion of steel reinforcement in concrete exposed to marine conditions, and cracking of reinforced concrete exposed to weathering was made for the period covering the past 75 yr. The assessment revealed useful information leading to the recommendation that additional experimentation is unnecessary for establishing a guide to fixing the minimum depth of concrete covering steel reinforcement in a floating pier or landing stage consisting of an assembly of precast concrete cells wherein the allowable maximum overall thickness of wall in any cell is restricted to 2 in.

Based on the information developed in this study, it is concluded that a 5/8-in.-thick concrete cover is the minimum acceptable, provided that certain limitations are observed regarding composition of the concrete, size of the reinforcing steel, and application of protective coating to the reinforcement and the exterior of the floating structure.

N-1448
Concrete for Ocean Thermal Energy Conversion Structures, Aug 1976, H. H. Haynes, R. D. Rail, ADA031045

The purpose of this study was to assess the state of the art of concrete technology and construction practices as they are related to the construction of massive floating structures to house ocean thermal energy conversion (OTEC) systems. The relevant capabilities and limitations of available concrete technology and construction practices are described and deficient areas are identified. Recommendations for research and development are given by which reasonable improvements can be made in the near term to provide greater assurances of long-term safe and reliable operation of the OTEC systems and to provide lower cost structures.

N-1449
Detection of Voids Underground and Under Pavements, Aug 1976, M. C. Hironaka, R. D. Hitchcock, J. B. Forrest, ADA030997

Voids occurring under paved areas and beneath the ground surface at Naval and other Government installations lead to serious and costly problems. Available methods for detecting such voids nondestructively were evaluated so that timely repairs could be made and growth of the voids prevented.

There is no one method capable of accurately locating and defining voids under all circumstances. However, either one or a combination of these three methods appear to be the most promising: (a) earth resistivity, (b) seismic techniques, and (c) subsurface radar. The effectiveness of these methods in detecting voids depends on soil properties, surface material properties (e.g., type of pavement), ground surface geometry, and accessibility with respect to the detecting equipment.

Field investigations using the above three methods are recommended to provide quantitative evaluations of accuracy, reliability, and cost under various site conditions. Based upon the results of these field investigations, development of advanced acoustic holographic methods may be warranted.

N-1450
Experimental Polyurethane Foam Roofing Systems, Aug 1976, J. R. Keeton, R. L. Alumbaugh, E. F. Humm, ADA031046

An experimental roofing installation is described in which polyurethane foam is spray-applied to metal Butler-type roofs and then coated with five different elastomeric coatings. The coating systems included a catalyzed silicone rubber, a moisture-curing silicone rubber, a hypalon mastic, and two catalyzed butyl-hypalons. Temperatures are recorded on top of the foam, on the metal roof deck, and in the building attics reveal the insulating quality of the foam. Fuel usage before and after application of the foam is included - a natural gas savings of 53% is indicated after foaming. The performance of each of the five coating systems over a 22-mo period is summarized. Best overall performance was observed with the silicone rubbers; the poorest performance was with one of the catalyzed butyl-hypalons. Hail damage was observed on all of the coating systems except the silicones. Minor roof repairs that were done within the first year after installation are reported.

N-1451
Sanitary Landfill Simulation - Test Parameters and a Simulator Conceptual Design, Aug 1976, W. V. Miller, C. J. Ward, R. A. Boettcher, N. P. Clark, ADA030998

Specific physical characteristics of a typical solid waste landfill were selected based on their correlation with potential landfill design/ operation procedural changes and their suitability in being monitored under varying conditions within a sanitary landfill simulator (SLS). Design requirements of an SLS were outlined relating to scaling, pressure, temperature, gas composition, operation, maintenance, instrumentation, and control. A conceptual design meeting these requirements was developed for laboratory equipment capable of simulating a section within a landfill representative of actual landfill conditions. The basic concept had a limited chamber temperature capability of 200F; however, operation of a 1,500F chamber to support pyrolysis was considered.

N-1452
High Voltage Cable Splicing and Cable Termination Techniques, Aug 1976, D. E. Weems, ADA030872

The splicing and termination of underground electrical distribution cable requires that the integrity of cable conductor and insulation be maintained throughout its length. A large number of commercial cable splice and termination kits are available which are claimed to fulfill these requirements. The Civil Engineering Laboratory was requested to investigate the suitability of these kits for use at Naval shore facilities. Of special interest were the slip-on cable splice and cable termination for solid dielectric insulated cable. These slip-on devices proved to be the easiest and fastest to install with good reproducibility, and the electrical characteristics were as good as, or better than, the other types of cable splice and cable termination kits tested.

N-1453
Deep Ocean Cable Burial Concept Development, Aug 1976, P. K. Rockwell, ADA030941

Seafloor cable systems are failing in increasing numbers due to fishing-trawler-induced damage. It has been demonstrated that the burial of seafloor cables markedly reduces the incidence of damage. The objective of this work was to identify viable cable burial system concepts and to perform the research and analysis necessary to select the most promising approach to burying cables 3 ft deep in the seafloor to depths of 6,000 ft. The three major problem areas considered were the propulsion, excavation, and running gear subsystems. Propulsion systems investigated

included towing, thrusters, tracks or wheels, and cable traction. Excavating means included fluidizing, plowing, water jetting, trenching, and direct insertion of the cable. The running gear systems investigated were skids, rolling elements, and a water cushion. Subsystem candidates were combined into system concepts, and the concepts were rated according to their power and force requirements, probability of cable damage, capability of handling different soils and terrains, controllability, weight, size, and complexity. It was concluded that the system with the best chance of successfully burying cables in the deep ocean while meeting the operational requirements and design requirements would be self-powered with thrusters, supported on skids, and utilize vibratory plowing and/or water jetting for the burial means.

N-1454
Portable Gas Analyzers for Boiler Monitoring, Sep 1976, R. S. Chapler, ADB015607L

Performance improvement of small boilers requires that the boiler operator or maintenance men be equipped with means to measure boiler efficiency. Since the heat losses in a boiler that can be manipulated by an operator are easily monitored by flue-gas analysis, for this study 10 commercially available, low-cost, portable gas analyzers were selected, tested, and evaluated to permit a life-cycle cost comparison and to make a comparative evaluation. It was found that when the number of boilers monitored are less than 12, the less expensive analyzers are most attractive for life-cycle cost and in desirability. When more than 48 boilers are monitored, the more expensive gas analyzers become more cost competitive but do not appear to achieve any concurrent increase in desirability. The simpler, low-cost, wet-chemistry analyzers retain their desirability for any number of boilers monitored and therefore are recommended for use by Navy boiler operators for determining boiler efficiency and for diagnosing field problems.

N-1455
Field Test for Detecting Lead-Based Paints, Sep 1976, H. P. Vind, C. W. Mathews, ADA033494

A field method for determining whether the lead content of a paint film exceeds the 0.5% limit imposed by federal law and by NAVFAC Instructions appears to be partially fulfilled by a simple spot test introduced at the University of Rochester, New York. In the test, a drop of sodium sulfide solution is placed on a chip of paint and layers of paint that contain lead turn black or gray. The Civil Engineering Laboratory modified the lead-indicating reagent by adding solvents to improve its ability to penetrate paint and a thickening agent to simplify its application and improve its ability to adhere to walls and ceilings. In CEL tests with the modified sodium sulfide reagent, all the lead compounds tested gave positive results. Conveniently, the minimum concentration of lead that could be detected was approximately equal to the maximum legal limit of 0.5%. Nearly all of the other inorganic compounds commonly employed in the paint formulations reacted negatively. Exceptions were a few biocides and driers usually employed in paint in concentrations too low to interfere with the test for lead.

N-1456
Strumming Suppression - An Annotated Bibliography, Oct 1976, B. E. Hafen, D. J. Meggitt, F. C. Liu, ADA033551

Vortex-excited vibration of cables and cable systems is a commonly observed phenomenon in the ocean. This cable strumming effects the response of instrumentation, such as hydrophones, and enhances the possibility of a fatigue failure. This document presents the results of a literature search on this subject. Although the present requirement is for the reduction of cable strumming, the literature cited includes information from any attempt to suppress vibration due to flow around a bluff body.

N-1457
Air Pollution Episode Decision Processes for the U.S. Navy, Oct 1976, R. E. Bergman, ADB015608L

In order to avoid hasty and unsubstantiated decisions during air pollution episodes, the Civil Engineering Laboratory has compiled within this document information on how Naval shore establishments can organize and quickly make logical, reasonable decisions that pertain to a particular episode. This detailed analysis of rational options is based on the military combat form "Estimate of the Situation." This form should originate at the pollution source site and be reviewed by higher headquarters.

N-1458
Criteria for Grounding Conductive Floors in Naval Hospitals and Ordnance Facilities, Oct 1976, J. L. Brooks, B. C. Streets, ADA033665

An investigation of the criteria for grounding conductive floors in Naval hospitals and ordnance facilities has been completed. First, current publications concerned with conductive floor installations were reviewed. Then manufacturers of conductive flooring materials were contacted for the latest technical information available on grounding systems for conductive floors. Finally, a survey was made of existing grounding systems at selected Naval hospitals and ordnance facilities. From this information, design and installation criteria, acceptance testing procedures, and maintenance requirements for conductive flooring installations were developed.

N-1459
Infrared Temperature Monitoring of VLF Antenna Insulators, Oct 1976, J. C. King, ADB016603L

As part of a Navy program to develop antenna insulator technology for Navy very low frequency (VLF) systems, the Civil Engineering Laboratory during FY-75 measured radio frequency heating of insulators both in the field and in the laboratory with an infrared (IR) imaging set. This set presents a live thermal picture which yields temperature data on localized, as well as overall, insulator heating. This report outlines the types of tests and test conditions on which the IR equipment was used, describes how the equipment was used, and illustrates the type of data that were obtained during testing. Also included are heat rise data collected during the various tests.

N-1460
Study of Electrical Power Generation From the Wind With Small-Scale Plants at Navy Remote Sites, Oct 1976, R. N. Thomas, ADB016628L

The electrical output of a commercially available wind-driven generator was computed from wind data at several Navy remote sites that now rely on diesel electric power. It was found that electrical power can be supplied at equal to or less than the cost of fuel required to generate an equal amount of energy at Cape Prince of Wales, AK, Nantucket Island, MA; Grand Turk Island, W.I.; McMurdo Sound, Antarctica; Barbados Island, W.I.; and Adak Island, AK. However, the wind system must provide direct energy to the circuit with no storage, and a control system must be provided to serve this function.

N-1461
Evaluation of Totally Enclosed Elastomeric Bearing as a Hinge Joint Base of Guyed VLF Tower, Nov 1976, G. Warren, ADA033482

The Civil Engineering Laboratory has conducted an evaluation of a totally encased elastomeric bearing as a hinge bearing joint at the base of large, guyed VLF towers. The test program included laboratory evaluation of a bearing from Andre Rubber Company, Limited, as well as a CEL-fabricated bearing; field measurements of tower base movements at Annapolis, Md; and finite element analysis of bearing components. Results indicate that encased elasto-

meric bearings similar to the Andre bearing are suitable for use as base hinges. Geometric modifications of the steel components must be made to reduce contact stresses during application of horizontal shear loads from the tower. In addition, special precaution must be taken to ensure that the elastomer is properly lubricated and is isolated from oxidation and ozone attack.

N-1462
A Remotely Controlled Incremental Seafloor Corer, Nov 1976, M. C. Hironaka, ADA035801

A bottom-resting corer has been designed that can be remotely operated from a control console located aboard a support vessel; the corer can obtain relatively undisturbed samples of the complete sediment profile to 50 ft (15 m) in water depths to 6,000 ft (1,830 m). The corer is 10 ft wide by 13 ft long (24 ft wide by 27 ft long with bearing pads extended) by 17 ft high, and weighs 26,500 lb when submerged in seawater (30,200 lb in air). It is operated via a combined load/power/telemetry (electromechanical) cable to take core samples from the same hole in the sediment profile in ten increments, each sample of which is 3 in. in diameter and 5 ft long. The corer is completely self-contained, including core barrels and drill pipes necessary for sampling to 50 ft. The corer has not been evaluated at sea. Sufficient land tests have been performed to suggest that the mechanical design is functional. Problems still exist in the system, but most of these appear to be correctable and of a nondevelopmental nature.

N-1463
OTEC Single Anchor Holding Capacity in Typical Deep Sea Sediments, Dec 1976, P. J. Valent, R. J. Taylor, J. M. Atturio, R. M. Beard, ADB016629L

This report specifies and evaluates anchors capable of mooring an Ocean Thermal Energy Conversion (OTEC) power plant. Existing and extrapolated single anchor holding capacities were determined using standard analysis techniques. The range of loading and seafloor characteristics treated cover both deep ocean and relatively shallow Gulf Stream type OTEC sites. Deadweight anchors using a grid-like arrangement of cutting edges below the anchor block were found to be superior to all other anchor types for general OTEC application. Deadweights measuring from 40 m square (130 ft) for the deep ocean environment, to 60 m (197 ft) square for the high energy Gulf Stream type environment are required to resist horizontal mooring loads ranging from 18 MN (4×10^6 lb) to 180 MN (40×10^6 lb). Properly designed cutting edges increase the deadweight holding capacity to almost three times that of a similar deadweight without cutting edges. Simplicity, reliability and large holding capacity favor the selection of the deadweight type anchor for OTEC. Pile type anchors were found to offer no advantage over the deadweight for most locations considered. Their attractiveness was increased somewhat for rock seafloors in the high energy environment because deadweight cutting edge efficiency is severely reduced there. In general, pile installation complexity and low lateral capacity limits their attractiveness for use as OTEC anchors. Low holding capacities, which would require bridling several anchors together, made selection of standard burial type or plate type anchors impractical.

N-1464
Aluminum Frame Motors – Environmental Testing, Dec 1976, D. E. Weems, ADA035802

The Civil Engineering Laboratory has conducted environmental tests to determine if aluminum frame motors instead of cast iron frame motors would be suitable for use in salt fog environments similar to those experienced at Naval Shore Facilities. The aluminum frame in the salt fog environment had minimal corrosion, indicating it is superior to cast iron for these applications. During the laboratory testing the steel shaft corroded sufficiently to inhibit rotation after prolonged exposure. This was due to the shaft being stationary during testing. This suggests that the shaft of this motor should be rotated periodically in corrosive environments to eliminate seizure.

N-1465
Energy Utilization of Solid Waste at Small Naval Bases – An Economic Decision Model and Comparison of Two Types of Systems, Dec 1976, P. L. Stone, ADB016588L

The decision model presented allows a quick estimate of savings-to-investment ratio that may be achieved by burning solid waste to generate utility steam at military bases having 10 to 50 tons per day (9 to 45 Mg/da) of waste fuel. The two types of systems compared use either a rotary grate or a controlled-air furnace for burning the waste fuel.

N-1466
1976 Inspection of Experimental Marine Piling, Dec 1976, T. Roe, ADA035800

The cooperative-treated piles at Coco Solo, Canal Zone, and the cooperative-, CEL-, and CEL/Industry-treated piles at Pearl Harbor were inspected by a diver in March and April 1976. After 13 yr at Coco Solo, only the Douglas fir piles treated with ammoniacal copper arsenite followed by creosote (dual treatment) are performing satisfactorily. At Pearl Harbor, the remaining cooperative-treated piles are performing satisfactorily as are many CEL- and CEL/Industry-treated piles. These piles were impregnated with either creosote containing a toxic additive, a solution containing two toxic compounds, or a dual treatment.

N-1467
PVC-Coated Fencing Posts and Accessories in a Marine-Atmospheric Environment, Dec 1976, E. S. Matsui, ADB016689L

PVC-coated galvanized steel fencing posts and auxiliary hardware were installed at the Civil Engineering Laboratory to determine their performance in a marine-atmospheric environment. A salt-spray (fog) test was also run on the same materials. The results indicate that the fencing materials with the thicker PVC coating and heavier zinc underlying coating provided significantly better protection than the thinner PVC-coated and lighter zinc-coated fencing materials. PVC-coated but ungalvanized steel fencing materials and uncoated galvanized fencing materials do not provide adequate protection in a corrosive marine-atmospheric environment.

N-1468
Flanged Acrylic Plastic Hemispherical Shells for Undersea Systems -Static and Cyclic Fatigue Life Under Hydrostatic Loading, Jan 1977, J. D. Stachiw, R. Sletten, ADA036931

Twenty-four acrylic plastic windows in the shape of hemispherical domes with equatorial flanges have been thermoformed from flat sheets and tested under short-term, long-term, and cyclic pressure loading at 65F to 75F (18.5C to 24.1C) ambient temperature. Two kinds of flanges were studied: Type I, a flat lip with a rounded heel and instep, and Type VI, a conical lip with a rounded heel. The 14,500-psi, short-term critical pressure for hemispherical windows with $t/R_i = 0.364$ was found to be independent of the equatorial flange configuration. Both the static and cyclic fatigue lives of the windows were also found to be independent of equatorial flange configuration. In either case, the maximum acceptable working pressure for 65F to 75F temperature range was found to be 1,000 psi. Only by elimination of the O-ring groove in the bearing surface of the window flange and the use of a thin neoprene bearing gasket between the acrylic flange and the steel seat is it possible to extend the working pressure for 65F to 75F (18.5C to 24.1C) temperature range to 2,000 psi. Operating the flanged windows at pressures in excess of the safe working pressures shown above will generate fatigue cracks in the bearing surface of the flange in less than 1,000 pressure cycles; at 5,000-psi pressure the cyclic fatigue life decreases to less than 100 cycles.

N-1469
Externally Generated Light (EGL) Systems for Hyperbaric/ Hypobaric Chambers, Jan 1977, K. O. Gray, ADA036917

Lighting systems for hyperbaric/hypobaric chambers are described. Methods of interior illumination without introduction of any potential fire source in the chamber are presented. The systems utilize light generated outside of the chamber environment, filtered for reduction of infrared radiation, and then introduced through either large (viewport sized) or small (pipe sized) transparent hull penetrations. Accessory devices for use with externally generated lighting (EGL) systems are also described.

N-1470
Conductive Flooring for Naval Ordnance Facilities, Jan 1977, P. J. Hearst, ADB016690L

Available conductive floorings, problems with conductive floorings, and performance experiences at Naval ordnance facilities are discussed. The information available is not adequate to make valid performance comparisons of these floorings, but it should be useful as guidelines for decisions on the selection, use, and maintenance of conductive flooring. Problems related to the grounding of these floors, to the Navy's minimum resistance requirements, and to the measurement of electrical resistance are also discussed.

N-1471
Solid Waste Disposal by Landspreading Techniques, Feb 1977, E. R. Durlak, ADB017149L

Landspreading is the disposal of solid waste by mixing compostable materials into the topsoil so that the decomposition process remains aerobic. Some of the advantages for landspreading include minimum settling of the land, no formation of undesirable odors or leachates, a potential for the support of vegetation, continued usefulness of the land, restoration in a minimum amount of time, and improvement in soil texture and water retention. Construction industry rototillers were selected as the most likely candidates for successfully homogenizing solid waste into the topsoil to depths up to 20 in. Three types of these machines in two types of soil were studied, as well as the agricultural, chemical, and biological aspects of this process. Six test plots containing different amounts and types of solid waste in various concentrations have been a part of a study conducted by CEL. Results show that the rototillers can adequately mix 10 to 12 in. of soil with solid waste piled about 12 in. deep on the ground. The mixture in the test plots is both homogeneous and uniform to about 16 in., providing a mixture of well-aerated, conditioned mix suitable for some vegetative growth if desired. While landspreading conditions the soil and improves water retention, growth of plants depends on many factors, including soil nutrients often lacking in solid waste. A later examination of the test sites shows some plant growth; studies are continuing for evaluation of this potential. Estimates are given for the operational aspects of the landspreading process including an economic evaluation.

N-1472
Expedient Structural Sandwich Soil Surfacing of Fiberglass Reinforced Polyester and Polyurethane Foam, Feb 1977, M. C. Hironaka, R. B. Brownie, S. Tuccillo, ADA038417

A structural soil surfacing (FOMAT), consisting of a rigid polyurethane foam core sandwiched between two fiberglass reinforced plastic (FRP) layers, is being developed to fulfill a need for a designable, heavy-duty, expedient surfacing for Marine Corps amphibious landing applications. In analytical and laboratory investigations, FOMAT showed very good potential for meeting expedient surfacing requirements. The FOMAT constructed of 15- and 20-pcf-density foams will adequately carry F4 aircraft wheel loadings as determined from finite element computer analyses and plate loading tests in a mechanical simulated subgrade. Tests performed on FOMAT with 20-pcf foam core showed that it meets or exceeds F4 aircraft arresting gear hook/impact and jet engine heat/blast performance specifications for a heavy-duty matting. Construction of FOMAT under field conditions indicated a problem with bonding of the polyurethane foam core and the bottom FRP layer, causing premature termination of simulated F4 aircraft wheel traffic tests on eight FOMAT panels located on heavy clay, lean clay, and sand soils. FOMAT panels consisting of 15- and 20-pcf density and 1- and 2-inch-thick foam cores were subjected to the traffic loadings. At a maximum of 40 passes on two panels of 2-in.-thick, 15-pcf and 2-in.-thick, 20-pcf foam core, a wheel deflection of 1 in. on the FOMAT surface was ex perienced. Development of field construction techniques to insure positive bond between the foam core and bottom FRP layer is recommended.

N-1473
Techniques for Transfer Immittance Measurements, Mar 1977, K. T. Huang, D. M. Shiroma, ADA039181

High frequency injection and electromagnetic coupling techniques are developed for measuring the transfer immittance of a power element. Techniques for producing artificial open and short circuits, which allows testing of power elements while in normal operation on-line, are described. An example is provided, giving the instrumentation and procedures for determining the transfer immittances of a two-port network.

N-1474
Underwater Applicable Antifouling Paints - Initial One-Year Study, Mar 1977, R. W. Drisko, L. K. Schwab, T. B. O'Neill, ADA037873

Epoxy coatings with antifouling properties were field-tested to determine (1) the minimum tin content necessary to retard marine biological fouling and (2) whether a leaching agent such as rosin was necessary to permit toxicant release at a rate sufficient to retard fouling. Only paint with 6% tin compared favorably in fouling resistance with the copper-based antifouling paint used as a standard. It may be that fouling resistance will not be greatly affected if the tin content is reduced below 6% and rosin is incorporated into the formulation to accelerate the release of tin.

N-1475
In-Situ Measuring Techniques for Pile Length, Mar 1977, J. B. Forrest, ADA039288

This report describes an investigation of procedures for determining in-situ the length of foundation or sheet piles. Two techniques were evaluated, one based upon the reflection of sonic energy, and the other upon sensing the electromagnetic flux field that builds up around ferrous objects in the earth's magnetic field. The sonic technique was found to operate satisfactorily within limits on piles made of steel, concrete, and wood, both with the tops exposed and with the tops encased in a concrete decking. The electromagnetic flux-sensing method involves inserting a probe into the soil in the vicinity of the pile. This method appears to be satisfactory for locating tips of ferrous metal piles either in situations where the probe can be jetted into the ground or where it can be inserted into a pre-drilled hole.

N-1476
An Offshore Mechanized Sorbent Oil Recovery System Using Vessels of Opportunity, Mar 1977, J. Der, D. E. Brunner, ADB018107L

An experimental prototype offshore oil recovery system for use on vessels of opportunity has been developed by the Civil Engineering Laboratory. The system is based on the concept of mechanized broadcasting, harvesting, and recylcing polyurethane sorbent chips. A two-component, drop-type sorbent broadcaster uniformly distributes the sorbent, even in the high wind and wave conditions expected in the

open ocean. The unique feature of this concept is the wave-following characteristics of the foam chips which serve to sorb the oil from the water. In this system increased waves or surface turbulance enhances oil recovery. Theoretical analyses of vessel motion indicated the harvester can be rigidly mounted to a barge-type vessel but that at least vertical articulation is required when mounted on an offshore work boat. The experimental prototype was functionally tested at sea without oil. The test indicated that the waves and surface currents generated by the vessel bow can increase the interaction between the sorbent and the oil and enhance the sorption process. The tests also aided in identifying the sorbent characteristics required for use in a system of this type. The resulting system can be air-transported by C-130-type aircraft and installed on a preselected barge or offshore work boat within 9 hr.

N-1477
Insulation Testing of Navy Shore-to-Ship Electrical Power Cables, Mar 1977, W. Pierpoint, ADB017644L

Shocks from Navy shore-to-ship electrical power cables are increasingly causing injuries to personnel. Deteriorated insulation was reported as the most common cause for these shocks; a number of new concepts for testing the cable were researched. Because of the construction of the shore-to-ship cable, air pressure testing was developed as the most feasible method for detecting insulation deterioration. If the cable can maintain internal air pressure, there can be no breaks in the cable jacket, thus minimizing the possibility of an electrical shock hazard.

N-1478
Clear Waterproof Sealers for Masonry, Mar 1977, T. Roe, J. B. Crilly, ADA039609

Ten clear, waterproof masonry sealers were given an initial screening in the wind-driven rain test. Five passed the screening and were applied to masonry blocks which were exposed to marine atmospheres at Port Hueneme, Calif, and Kwajalein, Marshall Islands, for 2 yr. Inspections were made after 1 and 2 yr. After removal from test they were subjected to the wind-driven rain test described in Federal Specification TT-P-0035. Four systems exposed at Port Hueneme and three systems exposed at Kwajalein passed this test. However, when appearance is also considered, only one system was clean, smooth, and glossy after 2 yr at Port Hueneme; two systems - one clean, smooth, and glossy, and the other, clean, smooth, and dull - had satisfactory appearance after 2 yr at Kwajalein. In addition, two sets of coated blocks were stored at the Laboratory for 6 mo to further coalesce before being exposed at Kwajalein. This procedure improved the waterproofing capability of one of the systems.

N-1479
Polymer-Modified Concrete for Military Construction, Apr 1977, J. R. Keeton, R. L. Alumbaugh, ADA039801

Results are given of tests made with polymer-modified concretes in which the polymeric materials are added to the concrete in the mixer. Polymers used were either epoxy or saran latex. Epoxy- or latex-modified concretes provided compressive, splitting tensile, and flexural strengths from 2.8 to 4.6 times those of similar concrete without the polymer. Epoxy-modified concretes achieved compressive strengths from 7,770 psi to 10,150 psi over test ages of 1 day to 365 days. Latex-modified concretes reached compressive strengths from 4,160 psi to 10,110 psi over test ages from 3 days to 365 days. Splitting tensile strengths of epoxy-modified concretes ranged from 900 psi to 1,340 psi for test ages from 1 day to 356 days; corresponding strengths of latex-modified concretes ranged from 600 psi to 970 psi. Flexural strengths of epoxy-modified concretes ranged from 1,300 psi to 1,610 psi; corresponding strengths of latex-modified concretes ranged from 770 psi to 1,570 psi. Significant reductions were observed in water absorption of polymer-modified concretes. Bond strength of polymer-modified concrete was slightly higher than in concrete without the polymer. Young's moduli of polymer-modified concretes were only 1.4 to 1.8 times those of similar concrete without the polymer. Epoxy-modified concretes cost between $432 and $465 per cu yd more than conventional portland cement concrete; corresponding cost of latex-modified concrete is about $278. Typical mix designs and mixing, placing, and curing procedures are presented.

N-1480
Fungal-Resistant Organotin Paints, May 1977, R. W. Drisko, T. B. O'Neill, L. K. Schwab, ADA043366

Fifteen experimental paint formulations were prepared from three organotin alkyd resins. Laboratory chamber testing (ASTM D3273-73T) and field testing of these paints at Puerto Rico have shown varying degrees of resistance to mildew growth. Thirty-two different microorganisms were isolated from the painted panels at Puerto Rico and identified in the laboratory. In a laboratory study, triphenyltin compounds useful in paint vehicles were found to be almost as effective as corresponding tributyltin compounds in controlling mildew growth and may be much safer to handle. An organotin compound was found to provide mildew resistance to a chlorinated rubber formulation (TT-P-95, Type I) that is useful on many masonry and concrete surfaces.

N-1481
Cost-Effectiveness Analysis of Lubricant Reclamation by the Navy, May 1977, C. W. Anderson, ADB019134L

The major portion of used lubricants at Naval shore bases may be grouped into three categories based on source, base stock, and contaminants: (1) crankcase lubricants, (2) gear lubricants, and (3) turbine lubricants. Processing of used lubricants for further uses includes: re-refining, reprocessing, energy recovery (boiler), energy recovery (diesel engine), and other end uses. Utilization of re-refined lubricants will require modification of present Military Specifications for lubricants. Burning of used lubricants having low flash point [140F (333K) or less] or high lead content (0.05% Pb or more) is not recommended. If not reused, the lubricants must be disposed of in an environmentally acceptable manner. Used oil includes used lubricants and contaminated JP-5, but bilge pumpage is excluded; overall, conclusions pertaining to the disposition of used lubricants may be extended to include all used oil. This report includes a format for monetary, energy, and environmental items to aid Public Works engineers and planners in determining the most cost-effective used oil disposition.

N-1482
Reflective Floor Finishes for Aircraft Maintenance Hangars, May 1977, R. L. Alumbaugh, D. Gurganus, ADA041653

The Civil Engineering Laboratory in cooperation with the Atlantic Division, Naval Facilities Engineering Command and the Naval Air Station (NAS) Oceana, Va, investigated reflective floor finishes for improving illumination levels underneath aircraft in Naval aircraft maintenance hangars. For the investigation, the deck of the east barrel of Hangar 122, NAS Oceana, was painted; the adjacent west barrel was left uncoated as a control. Three urethane reflective floor finishes were included in the investigation: two moisture-curing urethanes and one catalyzed chemically resistant urethane (CRU). In addition, two human factors studies were conducted by the Navy Safety Center, Norfolk.

Results indicate that illumination levels underneath aircraft on the coated decks increased up to tenfold over the control deck. The increase is also indicated by results of human factors studies; aircraft maintenance personnel required less auxiliary lighting with the reflective-coated deck. A general preference was expressed by personnel for

the reflective-coated deck. The chemically resistant urethane performance was superior to the two moisture-curing urethane systems.

N-1483
Manual Nut Splitters for Diver Use, May 1977, S. A. Black, S. S. Sergev, ADA041164

A diver-operated, compact, manual nut splitter was designed, built, and tested that can split stainless steel nuts (R_C 50 hardness) up to 1 in. across the flats. The nuts can be split in 30 to 45 sec with a powered wrench or in 3 *min manually*. Four tool kits, each consisting of the nut splitter and spare parts were delivered to the Navy Underwater Construction Teams for their use.

N-1484
Validation of Simulation Techniques for Electromechanical Couplings in Electrical Motors, May 1977, K. T. Huang, D. M. Shiroma, ADA041305

High frequency injection and electromagnetic coupling techniques are used to measure the parameters of a single-phase induction motor to determine its equivalent circuit. This equivalent circuit is then programmed on the analog computer for verification. From the equivalent circuit, the electromechanical coupling which correlates the electrical and mechanical parameters can be determined. The analog simulation of the single-phase induction motor can then be used for experimentation, analysis, and design.

N-1485
Wind-Generated Electric Power at Navy Sites, Jun 1977, D. Pal, ADB020115L

An extensive review of commercial wind generators and techniques to utilize their output are presented. Methods for analyzing wind characteristics at a possible site are described, and wind speed and power duration curves, specific power output, and energy pattern factors are fully discussed. *The concept, design, and* field testing of an automatic load-matching system for utilizing the output of a commercial 5-kW wind-driven generator are described in detail; both systems are operating successfully at Laguna Peak (PMTC). Eleven possible sites for future tests were identified along with their selection criteria. Based upon a comparison of present energy costs and estimated wind-generated power costs, it was found that wind power could be cost effective at the present time at the Barrow and Grand Turk sites.

N-1486
Automatic Light Sensing and Control of Lighting Systems for Energy Conservation, Jun 1977, M. N. Smith, ADB020187L

The rapidly rising cost of electrical energy makes its conservation increasingly more important. Electrical consumption can be reduced in a number of ways. One of the simplest is through lighting reduction; within this area are a number of options. One easy and often used approach is by removal of lamps; however, lamp removal without proper guidance can have seriously adverse effects on health, safety, productivity, and security. Another option is through use of controls; this may be as simple as installing switches. Automatic control systems to maintain required illumination levels are necessary if natural daylight from windows are to be effectively used. This report covers (1) an industry survey for commercially available control systems, (2) an evaluation of one commercial automatic control system, and (3) the development and evaluation of two different control systems developed by the Civil Engineering Laboratory. Evaluation of the control systems determined that electrical conservation was realized.

N-1487
Porous Friction Surface Runway at USNAS Dallas, Texas, Jun 1977, R. B. Brownie, ADA042181

The performance of the porous friction surfacing (PFS) on a runway at the U.S. Naval Air Station, Dallas, Tex, was evaluated. Runway friction measurements with a μ-meter, field permeability measurements, visual condition surveys, corings of the pavement for determination of asphalt binder properties, and an investigation of aircraft accidents attributed to hydroplaning were accomplished. The results of these investigations show that the porous friction surface is providing (1) a highly skid-resistant surface for high-speed jet aircraft operations, (2) an excellent surface with few visible defects, and (3) a minimum service life of 5 yr with a potentially much longer life.

N-1488
The RDX Contamination Incident at Naval Torpedo Station, Keyport, Washington, Jul 1977, C. E. Payne, D. B. Chan,

From 1966 to 1969, ordnance demilitarization at the Bangor Annex of the Naval Torpedo Station, Keyport, Washington, resulted in TNT and RDX contamination of the soil and groundwater in the vicinity of a wastewater disposal pit. From March 1971 until May 1976, several Navy activities, as well as other Federal, State, and County agencies were involved in determining the magnitude of the problem, determining measurement criteria, and reaching the optimal solution to the problem. The following corrective measure was adopted in December 1974: seal the disposal pit with a layer of bituminous asphalt and regrade the area to provide drainage away from the pit. As a result of the Keyport incident, the Navy has since developed criteria, technological approaches, and contingency plans for coping with TNT/RDX contamination and similar problems.

N-1489
Dynamic Loading Effects on Embedment Anchor Holding Capacity; Interim Report, Jul 1977, Z. M. Gouda, D. G. True, ADA042906

This report provides interim guidelines for designers of dynamically loaded seafloor foundations and anchors based on available knowledge of terrestrial and seafloor soils. Investigations of the response of selected seafloor soils to dynamically induced forces are reported, and the development of standardized design procedures for propellant-actuated direct embedment anchors is presented. These procedures must account for the strength of seafloor soils over the short and the long term around a seafloor embedment anchor sustaining static and dynamic loads. Important findings were that the soil parameters relevant to the holding capacity of deeply embedded propellant-actuated anchors are: soil moduli, creep, suction, cyclic strength loss, stress-strain relationships under dynamic loading, and responses to shock and slow loading. Some anchor-related parameters are: (a) the anchor embedment depth, buoyant weight, angle-of-line pull, and size and shape of flukes; and (b) magnitudes of the static and dynamic components of loading and the dynamic loading period for loads produced in the line by current fluctuations, waves, vortex shedding, impact, or line snap, and for loads produced more or less simultaneously in the line and the sediment by earthquakes or underwater blasts. It is recommended that planners use the interim design guidelines in this report for the engineering of embedment anchors to sustain dynamic loading until revised guidelines are developed. Field data from dynamically loaded embedment anchor moorings in actual use and other operating seafloor structures should be collected over extended periods of time for use in verifying and refining the present design methods. Revised guidelines should be available in 1978.

N-1490
Drydock Waste Treatment Study, Jul 1977, R. D. Saam et al., ADA043950

This technical note characterizes wastes generated in the drydock environment and recommends treatment methods to remove contaminants. Heavy metals are primary contaminants. Theoretical and experimental analysis of heavy metal treatment methods are presented. This analysis indicates that sulfide precipitation would be a prime candidate for heavy metal removal but would require further research and development.

N-1491
Reduction of Embedment Anchor Capacity Due to Sediment Distance, Jul 1977, K. Rocker, ADA046016

The results of field testing propellant-actuated embedment anchors are presented. A large number of field tests were run in which 9 x 18-in. anchors were fired or pushed into a very soft, moderately sensitive clayey silt. A comparison is made between the predicted and observed holding capacities. The measured short-term holding capacities of these anchors were 75 to 85% of those predicted. This reduction in capacity could not be attributed to sediment disturbance during anchor penetration, but is thought to result primarily from sediment disturbance during anchor keying. Sediment disturbance during penetration does have a significant effect on anchor keying distance and, depending on the sediment strength profile and penetration, has an indirect effect on anchor holding capacity. A recommendation is made to reduce the computed holding capacity by 20% for anchors in the field.

N-1492
A Metal Hydride Heat Pump, Jul 1977, A. W. McClaine, ADB020555L

This report describes the analytical and experimental work performed on a metal hydride heat pump concept. A sensitivity analysis and a performance analysis of the metal hydride heat pump were made, as well as a comparison of it with comparable vapor compression heat pumps. The results of these analyses indicate that presently known and available metal hydrides can be employed to build a heat pump with performance characteristics much like those of a well-designed vapor compression system; however, the metal hydride heat pump would not at present be cost effective. A promising hydride that could make this concept cost effective should have a percentage of hydrogen to activated hydride above 2%; greater if the hydride cycles slowly. The hydride should have a high enthalpy of reaction, preferably above 10,000 Btu per pound of hydrogen, but it should have fairly low equilibrium pressures. The pressure ratio over the temperature range should be less than 10 if possible. The hysteresis effect should be small, and, finally, the material should be cheap and plentiful.

N-1493
Flow-Induced Vibrations of Three-Dimensional Bluff Bodies in a Cross Flow; an Annotated Bibliography, Jul 1977, R. D. Rail, B. E. Hafen, D. J. Meggitt, ADA043918

Literature on flow-induced vibrations of spheres, spheroids, short cylinders and other three-dimensional bluff bodies has been reviewed. Information considered pertinent to the analysis and design of large submerged cable structures subjected to currents in the deep ocean is consolidated and presented in an annotated bibliography. Of particular interest is the vortex shedding from, and vortex-induced motions of and forces on three-dimensional bodies representative of buoys, sensor packages and similar components of mid-ocean arrays. Since very little information was found that is directly applicable to analysis and design further research is recommended.

N-1494
Optimum Dynamic Design of Nonlinear Reinforced Concrete Slabs Under Blast Loading, Jul 1977, J. M. Ferritto, ADA045465

A computer program was developed to determine the nonlinear dynamic response of reinforced concrete slabs subjected to blast pressure loading. Given the explosive parameters and geometry of the slab, the program computes the blast environment and the structural resistance, mass, and stiffness of the slab and solves for the dynamic response. The program contains optimization subroutines that provide for automatic optimum design of least-cost structural slabs. The program will assist engineers in the design and analysis of facilities that are intended to contain the effects of accidental explosions. The report gives a user's guide and sample problems with data input and program output.

N-1495
Investigation of Materials for Ship-to-Shore Low Pressure Steam Hoses, Jul 1977, T. Roe, Jr., ADA044588

Causes of failure of ship-to-shore low pressure rubber-lined steam hoses were investigated. At the present state of the art, the average life for a steam hose is about 6 mo to 1 yr. Suggested operating procedures to obtain maximum service life are offered.

N-1496
Investigation of Spray-Applied Polyurethane Foam Roofing Systems - I, Jul 1977, R. L. Alumbaugh, J. R. Keeton, ADA043995

An experimental investigation of the performance and properties of spray-applied polyurethane foam roofing systems is described. Polyurethane foam studied included densities of 2.0 and 2.5 pcf. Elastomeric coating systems included catalyzed silicone, moisture-curing silicone, butyl-hypalon, neoprene-hypalon, hypalon, butyl, chlorinated rubber, catalyzed urethane, moisture-curing urethane, and an acrylic emulsion. In addition, a fibrated aluminum-asphalt was included. Properties of the coating systems such as adhesion, tensile strength, elongation, impact, and wind-driven-rain absorption are also reported. Experimental roofing panels were located at a seashore site, a desert site, and a cold weather site. After exposure periods of up to 2 yr, performance of the silicones and the catalyzed urethane was rated as excellent at all three sites. Rankings based on the laboratory tests showed a catalyzed urethane as first, followed by the silicones and a neoprene-hypalon. Adhesion characteristics of coatings applied to foam which had been allowed to degrade for periods up to 9 days prior to coating application are also reported. Noticeable loss of adhesion was observed in the panels in which the foam had been allowed to degrade for 3 days or more prior to coating.

N-1497
Mechanization of Housing Solid Waste Collection, Aug 1977, C. J. Ward, D. L. Cannon, ADA045468

Increased cost of solid waste handling and disposal at Navy Shore Facilities has set a high priority on development of new methods and equipment that can reduce expenditures. One technique often used to cut costs is to automate labor-intensive tasks. Development of a mechanized, residential housing collection attachment would eliminate the need for manual loaders. Retrofitting the attachment to existing Navy industrial collection vehicles would eliminate the need for specialized residential collection vehicles. A refuse attachment was conceived, and a small working model was constructed for study. A full-scale attachment was designed, fabricated, and assembled, and engineering drawings were prepared. A used industrial refuse tank was modified as necessary for installing the attachment, and the complete system was laboratory-tested.

N-1498
Improved Hardware and Techniques for Maintenance and Repair of Split-Pipe-Protected Cables, Aug 1977, R. L. Brackett W. R. Tausig, ADA046022

The U.S. Navy currently maintains and operates numerous underwater power and signal cables. Most of these cables utilize split pipe systems to protect the cable from damage in the surf zone and when crossing exposed rocky seafloors. Past experience has shown that the hardware used to install the split pipe system lacks the reliability and maintenance-free operation required for the life of these cables. Based on previous experience with cable failures, the areas determined to be in greatest need of investigation are fasteners for holding the split pipe halves together, immobilization of the pipe, and cathodic protection for the entire system. This report presents the results of laboratory tests on both prototype and commercially available hardware components which appeared to be suitable replacements for the existing split pipe hardware. Also described is the installation of a 300-ft-long test section of split pipe at Anacapa Island which will be inspected during a 5 yr period to determine the long-term performance of selected hardware.

N-1499
Cable Strumming Suppression, Sep 1977, B. E. Hafen, D. J. Meggitt, ADA047996

This report presents a consolidation of existing data on various devices used to suppress vortex-induced motions of cables and circular cylinders in the ocean. The types of devices discussed herein include "fringe," "hair," and ribbon flexible fairings and helical ridges. In general, the available data show that all of these methods do, in fact, suppress vortex-induced vibrations to a greater or lesser degree. However, because of the diverse ways in which suppression effectiveness has been measured, comparisons among different types of devices are difficult to make. Criteria for such comparisons are suggested. Relatively few measurements of the effects of strumming suppression devices on the drag of a cable or cylinder have been reported. The available data indicate that a large drag penalty may be incurred by use of such devices, depending on the configuration employed.

N-1500
Corrosion Analysis of St. Croix Underwater Tracking Arrays, Sep 1977, J. F. Jenkins, AD

The condition of three underwater tracking arrays recovered after exposure of 79, 129, and 130 months at depths of 3,090 ft (940 m), 3,298 ft (1,005 m), and 3,517 ft (1,072 m) in the vicinity of St. Croix in the U.S. Virgin Islands was analyzed. The arrays were of two different types and were constructed primarily of carbon steel. There was little significant deterioration of the carbon steel. This was attributed to protection afforded by zinc anodes, zinc-rich paints, and other coatings. The amount of biofouling found on the arrays was much less than that found on structures exposed near the surface; however, the amount of fouling present may be significant for other structures or equipment. A procedure for inspecting structures retrieved from the deep ocean is included as an appendix to this report.

N-1501
A Self-Contained Experimental Diver Heater, Sep 1977, S. A. Black, S. S. Sergev, ADA047995

Free-swimming divers working in cold water for extended periods of time require a self-contained, active heat source to maintain their physiological thermal equilibrium. Previously, the accelerated reaction of magnesium with seawater was shown to be a suitable heat source for diving applications. The magnesium heat cell was configured as a short-circuited battery with alternate electrodes of magnesium and steel spaced closely together; the unit is activated by immersion in a seawater electrolyte. An experimental heater was fabricated that incorporated known improvements in the cell. The self-contained unit provided 1,000 W for up to 8 hr. A human factors study was made that identifies heater configurations for closed-circuit scuba divers.

N-1502
Computer Technique for Calculation of Potential Distribution in Multidielectric Media, Sep 1977, K. T. Huang, B. R. Milner, A. W. McClaine, ADA048057

A finite-difference method computer program for calculating the potential distribution for axisymmetric insulator configurations was developed. The program allows the use of unequal grid spacings and multiple dielectric constants. In addition, methods were developed to determine the potentials of conductors whose potentials are unknown, satisfy unknown grid boundary conditions, calculate electric flux line distributions, and plot the field lines by computer. The program has the flexibility to solve similar types of problems that involve the solution of Laplace's or Poisson's equations. Problems that consist of two-dimensional geometries can be treated by using a variation of the axisymmetric program.

N-1503
Shrinkable Splice Covers for Shore-to-Ship Cables, Oct 1977, P. J. Hearst, ADA049244

The splicing of THOF-400 flexible shore-to-ship power cable with shrinkable tubing was investigated, and the spliced cables were subjected to flexing, water immersion heat cycling, and abrasion. The conductors were spliced with compression fittings, and these were insulated with heat-shrinkable tubing splices. Splice covers made with large heat-shrinkable polyolefin tubing gave satisfactory performance, but properly prepared vulcanized neoprene splice covers gave better performance. An ambient-temperature-cured polyurethane material showed promise as a splice cover but has not been sufficiently developed for this use.

N-1504
Expansive Cement Concretes for Naval Construction, Nov 1977, J. R. Keeton, AD A048058

Expansion and subsequent shrinkage characteristics of shrinkage-compensating concrete were determined in mesh-reinforced prisms. The prisms were cured in fog for 14 days and then subjected to drying in either 25%, 50%, or 75% relative humidity (all at 73F). The concretes were made with four different aggregate types: (1) moderate quality river aggregate, (2) moderate quality limestone aggregate, (3) lightweight coarse aggregate and river sand, and (4) lightweight coarse and fine aggregates. Maximum aggregate size was 3/8 in. The effects of the following variables on expansion and shrinkage were determined: amount of cement, amount of reinforcement, prism thickness, and relative humidity of shrinkage environment. Design recommendations are made for use of shrinkage-compensating expansive concretes in various climatic areas.

N-1505
1977 Inspection of Experimental Marine Piling at Pearl Harbor, Hawaii, Nov 1977, T. Roe, ADA049229

The cooperative-, CEL-, and CEL/-Industry-treated piles at Pearl Harbor were inspected by a diver in April 1977. The remaining cooperative-treated piles are performing satisfactorily as are many CEL- and CEL/ Industry-treated piles. These piles were impregnated with either creosote containing a toxic additive, a solution containing two toxic compounds, or a dual treatment.

N-1506
Maintenance Testing of Navy Underground High Voltage Cables, Nov 1977, J. L. Brooks, G. B. Beck, ADA049254

Methods of testing high voltage underground cable were investigated in order to find an alternative to the DC high-potential (hi-pot) test for cable maintenance testing. The search for such a method proved fruitless, however. The problems of using the DC hi-pot test are discussed, and a recommended procedure of testing is presented. In addition, a new method of locating cable faults is described and recommended.

N-1507
Solid Waste Source Separation Experiment, NCBC, Port Hueneme, Dec 1977, C. J. Ward, W. V. Miller, ADA050881

Recently promulgated EPA guidelines on solid waste source separation, mandatory for Federal agencies, have placed a high priority on the test and evaluation of alternative approaches and of additional costs attributable to source separation. A 4-mo-long test at the Naval Construction Battalion Center, Port Hueneme, Calif, called for base-wide voluntary source separation of solid waste into two categories during 1976. The test was oriented toward waste heat recovery from the combustibles (for steam generation) which, although at odds with the EPA guidelines for source separation, is in the best interest of energy conservation since Navy shore facilities typically use steam for base heating needs. Considered a successful test, indicating the workability and cost-effectiveness of source separation, it generated a large amount of information on the various technical, cost and human factors associated with source separation.

N-1508
Attack Resistant Walls; Preliminary Tests, Dec 1977, R. J. Odello, ADB024508L

Eight different concepts for attack-resistant walls were conceived and analyzed in an effort to determine methods for estimating denial times. In addition to acting as structural components, the walls were intended to provide denial times of 20 to 30 min against penetration by a determined group of attackers with hand, power, and burning tools. The analysis included estimates of denial time, costs, weight, and thickness for each concept. The three best concepts, selected on the basis of maximum denial time and minimum cost, weight, and thickness, were then subjected to simulated attacks. Concepts 1 and 2 (with measured denial times of 27.25 and 35.21 min, respectively) were similar 200-mm- (8-in.-) thick concrete masonry units and 100 mm (4 in.) of steel-fiber-reinforced concrete backing. Concept 1 had a no. 8 reinforcing bar and mortar filling in each core; Concept 2 had expanded steel grating in the backing. Concept 6 (the third concept chosen) had a denial time of 26.7 min and consisted of nine layers of 3/4-in. plywood alternated between eight layers of 10-gage steel plate. Reasonable estimates can be obtained by extrapolating data from existing tests to estimate denial times for walls. Further study is needed on the possible use of explosives for producing person-passable openings in these types of walls.

N-1509
Assessment of Various Constructional Materials as Armor for Protecting USN Shore Facilities Exposed to Small-Arms Fire (U), Dec 1977, W. R Lorman, ADB025074L

This report serves in quantifying the minimum thicknesses and corresponding weights and costs per square foot of surface area required of various homogeneous and composite armors to defeat high-velocity, low-mass ballistic rounds fired at a nominal 25-yd range. Thus, the structural engineer can select relatively low-cost materials (metallic, polymeric and glass, and inorganic nonmetallic) for use in such construction.

N-1509S – Classified report, Mar 1978, ADC013504L

N-1510
Attack-Resistant Walls; Explosive Tests, Dec 1977, R. J. Odello, ADB025244L

This study was designed to determine if attack-resistant walls that exhibit good denial times when subjected to hand- and power-tool attacks can produce similar denial times when subjected to attack by explosives. Two of the wall concepts tested were based on mortar-filled, 8-in. (200-mm) concrete masonry units with 100-mm (4-in.) steel-fiber-reinforced concrete backing. One had reinforcing bars in each core; the other had no reinforcing bars, but had a 1-1/2-in. no. 6 expanded steel grating embedded in the backing. The third concept consisted of nine layers of 3/4-in. plywood interbedded with eight layers of 10-gage steel plate. The walls tested had denial times of only 5 to 12 min when explosive attacks were used, compared to 25- to 30-min denial times in hand- and power-tool attacks.

N-1511
Tunneling with Controlled Stress Waves, Dec 1977, R. J. Odello, ADA051489

This report describes a concept for hard rock tunneling that uses controlled stress waves to fracture rock. Tests with high explosive charges demonstrated the feasibility of the concept, but follow-on tests with an electrohydraulic stress wave source were unsuccessful. Development of a repeatable stress wave source is necessary to the success of the concept. Extrapolations of test data indicate that the concept could reduce the specific energy requirements for hard rock tunneling by an order of magnitude compared to present tunnel boring machines.

N-1512
Heat-Activated Alarm System for Railroad Boxcars Carrying Explosives, Dec 1977, J. L. Brooks, ADA051868

An alarm system concept designed to alert train operators of excessive heating of any of the wheels of a boxcar laden with high-explosives has been developed. The excessive heat was determined to be caused by friction between a wheel and brake shoe that does not properly release while the train is in motion. The alarm system consists of heat sensors that are located on the boxcar above each wheel. These are wired to an alarm transmitter mounted near the top of the boxcar. This concept requires that each boxcar laden with high explosvies be outfitted with the sensors and a transmitter. A receiving system is then located in the train caboose to decode the alarm signals, identify the boxcar, and sound the alarm. The system hardware, tests, and evaluation are described.

N-1513
Acoustic Retrieval of Seafloor Geotechnics, Dec 1977, H. Lee, R. J. Malloy, ADA050884

Acoustic profiling is a rapid and relatively economical means of obtaining considerable information about large areas of the seafloor. Acoustic data can be quantified, and basic theory suggests that these data incorporate seafloor physical parameters similar to those used by geotechnical engineers in foundation and anchor design. This report summarizes the basic acoustic reflection theories and reviews earlier field efforts to quantitatively classify the seafloor with acoustics. It appears that sediment density can be measured with an accuracy range of about ±10%. This in turn leads to sediment classification into at least two categories: sand and clay. Experiments to date have not had sufficient control of physical sampling relative to acoustic testing, and greater accuracies may be possible. The potential for indirectly measuring shear wave velocity and directly inferring shear strength is explored and rejected for the short term. Shear information is contained in acoustic data but is too small to be measured. Shear strength can, in many cases, be deduced from acoustically measured density data, if a few cores are available for calibration. Further work is recommended to determine the true accuracy of acoustic measurements and to develop quantitative acoustic systems to satisfy Navy needs in seafloor geotechnical engineering.

N-1514
Earthwork Construction in Support of a Marine Amphibious Force - A Case Study, Jan 1978, P. S. Springston, ADA050797

A Marine Amphibious Force (MAF) level Marine Air/Ground Task Force (MAGTF) will generate multiple, large-scale horizontal construction projects totaling thousands of cubic yards of earthwork. Even with Naval Construction Force (NCF) support, a landing force commander may be confronted with simultaneous critical earthwork requirements that would exceed the engineering capability of the MAF. A hypothetical earthwork construction case is defined by a set of limiting assumptions. Within the boundaries set by these assumptions, facility construction activity estimates are calculated and arrow networks are drafted. The Critical Path Method (CPM) is utilized to predict project earliest finish dates and resource allocation. The presented data (networks, resource requirements, project durations, etc.) will be of use to researchers and planners in the area of amphibious logistic support. Specific Initial Operating Capability dates for facilities will vary with operational requirements; thus, a general discussion of the projections was substituted in lieu of specific conclusions of whether facility construction was in pace with tactical and operational requirements.

N-1515
Long-Term Stress-Strain Behavior of a Seafloor Soil, Feb 1978, P. J. Valent, ADA053506

A calcareous deep-sea soil from the central Caribbean was subjected to a series of consolidation, triaxial shear, and triaxial shear creep tests to determine its response to loadings of engineering interest. The soil, classified as an inorganic silt, tended to densify during transport. Compression index C_c is 0.80; empirical terrestrial engineering correlations between C_c and other easily and rapidly measured index parameters may be in error by 30%. No significant crushing of the hollow foraminifera tests (shells) comprising the coarse-size fraction of the sediment was noted in the consolidation tests up to stresses of 1,530 kPa (32,000 psf). This coarse-sized fraction does, however, undergo significant crushing if material finer than 0.43 mm is removed, suggesting that the fine-sized fraction distributes loads on the coarse-sized test (shell) surfaces. Grain crushing may be partly responsible for the curved failure envelope developed from the triaxial shear tests. For specimens consolidated up to 30 kPa (4 psi) the angle of internal friction of the calcareous ooze is 0.60 rad (34 deg); specimens consolidated to greater pressures describe a flattening of the failure envelope to 0.49 rad (28 deg). Triaxial shear creep tests indicate that creep failure in this soil is not a significant engineering problem. The data suggest that material consolidated to higher stress levels than those used here (< 100 kPa) and then shear loaded undrained will develop failure strains at stress levels less than 80% of short-term failure stress levels.

N-1516
Repair System for Damaged Coatings on Navy Antenna Towers, Pt. I, Mar 1978, L. K. Schwab, R. W. Drisko, ADA053507

A series of epoxy coating systems (some solvent-based and some water-emulsion) and an alkyd coating system were exposed on steel panels to a tropical environment for use in repair of damaged coatings on antenna towers. Laboratory bonding tests were conducted before and after exposure. Three candidate coating repair systems were applied on a tank exterior at San Nicolas Island, and a larger experiment using two surface preparations and 16 coating systems on an antenna positioner was initiated at the Pacific Missile Range, Point Mugu, California. Coating systems are also being - or have been - exposed in a laboratory salt spray cabinet. Results of all these studies are described in this report.

N-1517
Analysis of Chamberlin Flat Plate Solar Collector Using National Bureau of Standards Test Criteria, May 1978, E. R. Durlak, ADA054215

Test results are presented for a flat plate, single glazed solar collector tested in accordance with the National Bureau of Standards test criteria. A description of the test apparatus and instrumentation is given. A graph of solar collector efficiency is presented. There was good agreement between test results and data taken from the manufacturer's brochure.

N-1518
Optimum Dynamic Design of Nonlinear Plates Under Blast Loading, Mar 1978, J. M. Ferritto, ADA055601

A computer program was developed to determine the approximate nonlinear dynamic response of plates subjected to blast pressure loading. Given the explosive parameters and geometry of the plate, the program computes the blast environment and the structural resistance, mass, and stiffness of the plate and solves for the dynamic response. The program contains optimization subroutines that provide for automatic optimum design of least-cost plates. The program will assist engineers in the design and analysis of blast doors that are intended to contain the effects of accidental explosions. The report gives a user's guide and sample problems with data input and program output.

N-1519
Power System Simulator, Apr 1978, K. T. Huang, ADA054476

A power system simulator (PSS) that can be parametrically programmed to simulate the electrical transient performance of a medium-sized power system and its elemental components is described. It employs analog circuit modules to achieve simulation. Once programmed, the analog computer can be used to test the system for transients, load response, etc., by varying the parameters of the modules. The input and output terminals of these modules are interconnected according to a signal flow diagram of the selected power system to form a simulated power system. If a simulated transient is injected into an input terminal of the simulated power system, different transient responses will appear on the terminals of each module simultaneously. These responses can be recorded for use in transient analysis. The output of each module can also be read through an output meter on the front panel. Besides the transient simulation, the PSS can be used for studying electrical steady-state problems at various AC frequencies. A definite advantage of the analog simulation is that voltages and currents can be recorded with meters or oscilloscopes at any point in the system.

N-1520
Modular Mooring System for Ocean Construction; User's Guide, Apr 1978, J. M. Atturio, ADA055926

The modular mooring system is a reusable, multileg mooring system for vessels of opportunity. This document describes modular mooring components, outlines maintenance requirements, and describes system performance. Mooring components were purchased to establish a spread mooring for small ocean construction vessels of the LCM 6 to LCU size. The system components, packaged in four multi-purpose equipment shelters to facilitate shipping and storage, include two hydraulic winches, an anchor windlass, 3,200 ft of 1/2-in. alloy steel chain, four urethane foam mooring buoys, 4,800 ft of braided nylon, and four 200-lb Danforth anchors. Analysis of the system showed that vessel excursion and system stresses in shallow water are especially sensitive to wave excitation. Mooring line forces approaching 10,000 lb are predicted for all vessels in sea state 4 conditions. A suggested mooring design procedure is included.

N-1521
Nearshore Trenching Technology Development, Jun 1978, W. R. Tausig, ADA057941

Cables and pipelines that traverse the nearshore and surfzone regions often fail because of damage from hydrodynamic forces and anchor snags. This report discusses the technology base necessary to design and operate ocean-bottom trenching equipment for operation in sand, rock, and coral. It also reviews the state-of-the-art in all operational trenching concepts. This investigation addresses only the trenching mechanism and does not consider the platform for its support or transportation under water. Two basic trenching concepts have been identified as applicable to the Navy's needs:

(1) The ladder-type mechanical trenching system using carbide cutters can (with limitations) improve the performance of the Navy's trenching capability using state-of-the-art technology.

(2) The high-pressure waterjet trenching system utilizing the cavitation phenomenon is the development area that shows the most promise for providing significant performance improvements.

N-1522
Results of Some Uplift Capacity Tests on Direct Embedment Anchors, Jun 1978, P. J. Valent, ADA057942

This report presents results of uplift capacity tests on direct embedment fluke-type anchors in some cohesive ocean sediments. Most of the tests were short-term tests with a duration of one to four minutes between the first load application and the completion of pull-out. Data on the optimum fluke design, on the travel distance required to effect fluke keying, and on the relationship of developed uplift capacities to those predicted are presented and discussed. A modification to the standing relationship for predicting uplift capacity is offered. Recommendations are made regarding optimum fluke design and uplift capacity prediction techniques.

N-1523
Acoustic Siting and Verification of the Holding Capacity of Embedment Anchors, Jul 1978, R. J. Malloy, P. J. Valent, ADA058713

In order to determine the holding capacity of a direct embedment anchor, a 3.5 kHz battery-powered pinger system (Pinger Probe) has been developed, tested and evaluated. In some applications, use of the Pinger Probe can eliminate the necessity for a pre-installation site-survey, and can eliminate navigational errors resulting from attempts to reoccupy a favorable site (by providing the capability for simultaneous siting and installation). The Pinger Probe works like a bottom-finding pinger providing, in addition, data on subbottom reflectors. By monitoring the acoustic returns on the ship's precision depth recorder, the following data are provided in real time during the anchor implantment: (1) soil thickness over bedrock, (2) an indication of soil type, (3) sediment stratification and seafloor topography with better horizontal and vertical resolution than from surface-operated systems, and (4) a measure of anchor fluke embedment.

N-1524
Laser-Based Remote Measurement of Large Biaxial Deflections, Jul 1978, G. Warren, ADA058726

A laser-based displacement measurement package is being developed as a tool for continuous, remote monitoring of the dynamic response of slender, very low frequency (VLF) antenna towers. The displacement monitor is designed for use where instrumentation cables are prohibitive due to intense electric fields. The system has been tested on antenna towers 380 m in height to obtain biaxial displacement with a single sensor. Examples of results are presented with comparisons of results from velocity gages and accelerometers.

N-1525
Anacapa Island Split Pipe Inspection of June 1977 and April 1978, Sep 1978, W. R. Tausig, R. L. Brackett, ADA060323

The U.S. Navy currently maintains and operates numerous underwater power and signal cables. Most of these cables utilize split pipe systems to protect the cable from damage in the surf zone and when crossing exposed rocky seafloors. Past experience has shown that the hardware used to install the split pipe system lacks the reliability and maintenance-free operation required for the life of the cables. Based on previous experience with cable failures, the areas determined to be in greatest need of investigation are fasteners for holding the split pipe halves together, immobilization of the pipe, and cathodic protection for the entire system. As a result, CEL tested prototype and commercially available hardware components which appeared to be suitable replacements for the existing split pipe hardware. The candidate hardware was then used in a 300-ft-long test section of split pipe installed March 1976 at Anacapa Island, to be inspected during a five-year period. Results of the CEL hardware tests, Anacapa pipe installation, and first inspection are documented in TN-1498. This report is a follow-up to TN-1498 and presents the results of the test installation inspections for June 1977 and April 1978; the second and third inspections to be made since the March 1976 installation was completed.

N-1526
Performance of Lead-Acid Gelled Electrolyte Batteries in the Deep Ocean Environment, Sep 1978, W. D. Briggs, AD

Standard lead-acid batteries with liquid electrolyte experience dramatic capacity losses when charged and discharged under deep ocean conditions. Recently developed commercial lead-acid batteries with gelled electrolyte were tested to determine their performance at high pressure and low temperature.

Batteries from three manufacturers were divided into control and test groups. The test groups were modified to allow pressure compensation with white mineral oil. The performance of the test batteries was not degraded by exposure to the mineral oil or high pressure (10,000 psig). An average loss of capacity of 10% was experienced when the batteries were cycled cold (32F) and at pressure (10,000 psig). However, this capacity loss is significantly less than the 35-70% loss experienced in previous tests with standard batteries in similar conditions. Thus, lead-acid batteries with gelled electrolyte were found to be suitable for use in deep ocean conditions in a pressure compensated mode.

N-1527
Improved Chemicals for Fiberglass-Reinforced Plastic Soil Surfacings - Field Evaluation, Sep 1978, M. C. Hironaka, ADA060094

A new chemical formulation was recently developed for constructing fiberglass-reinforced plastic surfacings for soils; it consists of a polyester resin, cumene hydroperoxide catalyst, and Vanadium Ten-Cem/N,N-dimethyl-p-toluidine solution promoter. This report documents the field testing of this new formulation with present Marine Corps spraying equipment. It was found that the new formulation is superior to the formulation used in the past because it: (1) provides surfacings with higher strength properties, (2) is easier to mix due to the constant ratio of 1.0 to 0.25 between catalyst and promoter for any temperature, (3) is more economical to use in temperatures below 110F, and (4) increases pumping/spraying reliability by eliminating the catalyst material that precipitates out of the emulsion during storage and eventually causes fouling of check valves and other pumping mechanisms. Furthermore, it was found that the resin used in this new formulation has a shelf life of more than 5 yr based on accelerated aging tests as compared to the previously used resin, which had a guaranteed shelf life of only 4 mo at the same temperatures.

N-1528
Sea/Lake Water Cooling for Naval Facilities, Sep 1978, J. Ciani, ADA062434

Seawater cooling was found to be economically feasible for a trial Naval facility in San Diego, Calif. Later, an operational test was performed at the Naval Security Group Activity (NSGA), Winter Harbor, Maine. A preliminary design and environmental impact assessment were performed for a seawater cooling system at NSGA. This work was supplemented with seawater temperature measurements in the adjoining bay, a study of biofouling and its prevention in this system, and land and offshore surveys at NSGA. A separate study found that the life cycle cost of this seawater cooling system was less than that of a conventional air conditioning system. It was concluded that a seawater cooling system for NSGA would cost about $150K, and annually save over 200 MWh of energy and $9,000. Also, a study of the Navywide potential of sea/lake water cooling found that if such cooling were installed at 25 Navy sites, 59×10^3 MWh and $3 million could be saved annually. This report recommends that: (1) a final design and installation of an operational test seawater cooling system for NSGA, Winter Harbor be made; (2) seawater temperatures be measured at Apra Harbor, Pearl Harbor, Chicago, and Point Mugu as potential sites; and (3) a parametric model be developed for estimating the capital and energy costs of sea/lake water cooling systems.

N-1529
An Assessment of Transportable Breakwaters With Reference to the Container Off-Loading and Transfer System (COTS), Sep 1978, D. B. Jones, ADA062432

A study covering three specific designs for a tethered float breakwater and simple and legged versions of the sloping float (inclined pontoon) breakwater has resulted in improved definition of certain aspects of the logistic burden connected with transportable breakwaters in military operations. Performance data reported for the two types were analyzed in order to determine the transverse cross-section dimensions required for 50% reduction of the significant wave height associated with the Pierson-Moskowitz wave spectrum with 7-second peak period. Specific designs with this capability were then examined to assess requirements for overseas transportation, installation, and cost. The stated performance requirement was drawn from an analysis of the Container Off-Loading and Transfer System (COTS). This analysis concluded that wave-induced motions of moored lighters, barges, and floating platforms (with natural periods between 2 and 7 seconds) could adversely affect cargo flow rates. Thus, a breakwater effective for 7-second waves could decrease the frequency and duration of occasions when the system is degraded by wave action. Bargeships, ships with well decks, or large ocean-going barges would be required to transport the modules of the various designs for a 7-second breakwater. A LASH bargeship is the most likely carrier for COTS breakwaters. LASH capacity varies from 750 to 3,600 lineal feet of breakwater, depending upon the particular vessel and the breakwater design. For the various points in the COTS where a breakwater would be beneficial, the length of breakwater required varies from 650 to 4,000 feet.

N-1530
Seismic Liquefaction Potential, Sep 1978, J. M. Ferritto, J. B. Forrest, ADA062433

This report presents a summary of the factors causing seismically induced soil liquefaction. The report presents the current procedures in use to compute the liquefaction potential of a site. Risk analysis procedures are presented to better estimate the probability of liquefaction.

N-1531
Effectiveness of Rust Removers for Use at Naval Shore Facilities, Sep 1978, E. S. Matsui, ADA062435

The Civil Engineering Laboratory has appraised the relative merits of some of the available rust removers and converters to ascertain their suitability for Naval use. The test results indicate that coatings applied to test panels treated with the rust removers provided corrosion protection as good as that of coatings applied to the sand-blasted control panels. Therefore, the rust removers are judged satisfactory for Naval use. All three rust removers investigated provided poor protection against corrosion, and their use is not recommended at the present time.

N-1532
Investigation of Energy Saving Potential of Transient Suppressors, Sep 1978, R. I. Staab, M. N. Smith, ADB032391L

Investigations of energy savings due to transient suppressors have been completed by the Civil Engineering Laboratory. Energy consumption is reported for a load consisting of a cycling motor and a bank of fluorescent lights, both protected by transient suppressors and unprotected. The results of laboratory disassembly of three commercially available suppressor packages are also reported.

N-1533
Implementation of the Lead-Based Paint Poisoning Prevention Act at Navy Activities, Oct 1978, H. P. Vind, C. W. Mathews, R. L. Alumbaugh, G. W. Hamilton, ADA066187

The Civil Engineering Laboratory investigated ways to implement the Lead-Based Paint Poisoning Prevention Act (LBPPPA) in Navy housing. According to the act, cracked or peeling paint must be wire-brushed before repainting. There appears to be no pre-repainting requirement for the removal or covering of lead-based paint that is sound and tight, unless the integrity of the paint cannot be maintained. The maximum concentration of lead permitted in new paint is 0.06%. An inexpensive chemical kit and a lead-in-paint analyzer were both developed at CEL and were found potentially useful for implementing the LBPPPA. Recent amendments to the act appear to eliminate the necessity for, but not the desirability of, such field kits and instruments.

N-1534
Digest of Equipment for Converting Solar, Wind, and Geothermal Energy into Electric Power for USN Application Ashore, Nov 1978, W. R. Lorman, ADA066221

This document enumerates principal requirements of self-sufficient electric power conversional equipment under active consideration by CEL. Data pertain to financial requirements, physical characteristics, and potential outputs of solar, wind, and geothermal energy-conversion systems; these systems are part of USN shore energy research and development program. Data are intended for use by CEL systems analysts as input to mathematical model for planning and optimizing power systems throughout the Naval Shore Establishment.

N-1535
Mechanical Properties of Preservative Treated Marine Piles – Results of Limited Full Scale Testing, Nov 1978, M. L. Eaton, J. A. Drelicharz, T. Roe, AD

Forty southern pine and thirty-five Douglas fir piles were destructively tested at the Forest Research Laboratory, Corvallis, Oregon. The forty southern pine piles represent eight different preservative treatments (including one lot untreated), five replicates each. One of these treatments was omitted for Douglas fir. The findings were, in general, a reduction in desirable wood characteristics stemming from preservative treatments; in particular, more reduction for dual treatment than for creosote. This, with the higher cost of dual treatment, suggests that before dual treatment can be recommended, it will require evidence of materially greater longevity for the use and environment intended.

N-1536
Emergency Exiting From Secure Navy Spaces: Studies of the Implications of the Life Safety Code, Security Regulations, and Human Factors Engineering, Dec 1978, H. Self, K. O. Gray, B. M. Cohn, W. E. Backes, AD

This Technical Note is an evaluation and summary of an investigation by Gage-Babcock and Associates (GBA) of Navy practices in emergency exiting from secure spaces. These practices are analyzed in terms of (1) the Life Safety Code of the National Fire Protection Association, (2) security regulations, and (3) human factors engineering considerations. Hardware for securing emergency exits from secure spaces is evaluated, and recommendations for new designs and changes in the Life Safety Code to improve both security and life safety are presented in the GBA reports. These reports are included in this note as appendices.

N-1537
Underwater Splicing of SD Coaxial Cable – FY78 Progress, Dec 1978, A. Inouye, ADA066128

Splicing of SD List 1 coaxial cable on the seafloor has been demonstrated to be feasible using a grease/gel filled coaxial splice. Experimental electrical models fabricated for underwater mating have been operated successfully at 6,000 VDC and 5,000 psig ambient pressure with leakage currents less than 1 μa. Impedance mismatches of the electrical models were about 0.4%. The search for a compatible dielectric grease for use with the SD cable splice identified a gelling agent (Cab-O-Sil) which can be used to gel liquids to a grease-like consistency. Castor oil, available in liquid form only, has some unique properties desirable for SD cable splicing applications. These are: (1) low water absorption (about 1%), (2) little or no change in dielectric constant with about 1% water absorption, compatibility with high density polyethylene, and ability to gel using Cab-O-Sil. Electrical splice models filled with gelled castor oil have been mated several times at 5,000 psig ambient pressure in seawater at 8°C. The splice was subjected to 6,000 VDC with no high voltage breakdown and leakage currents were less than 1 μa in each case. Due to lack of internal seals, the splice failed after a 30 day duration in the pressure vessel because seawater was forced into or migrated to the cable and splice interface area. The tests do show the feasibility of the underwater splicing concept of SD coaxial cables.

N-1538
1978 Inspection of Experimental Marine Piling at Pearl Harbor, Hawaii, Dec 1978, T. Roe, AD

In 1978, a diver made the final inspection of the cooperative-, CEL-, and CEL/industry-treated piles at Pearl Harbor. The cooperative piles are performing satisfactorily, especially those with dual treatments. Satisfactory CEL- and CEL/industry-treatments were creosote which contained a specific toxic additive or additives and creosote-free treatments which were either a solution containing two toxic compounds, or a dual treatment.

N-1539
Airfield Marking Paints – A State-of-the-Art Report, Dec 1978, R. W. Drisko, ADA066145

A state-of-the-art summary has been prepared on the subject of airfield marking paints. Information is presented on the composition of such paints, federal specifications, available test methods, reflectorization methods, deterioration mechanisms, skid-resistance relationships, surface preparations, application requirements, and alternative marking systems. Information on traffic paints was used where it was relevant. A summary of recommended airfield marking practices was prepared to provide practical information to people responsible for airfield marking.

N-1540
Survey and Preliminary Feasibility Assessment for a Running Gear Module for a Deep Ocean Work Vehicle, Jan 1979, H. G. Herrmann, ADA066024

Background information impacting the technical feasibility of developing an active running gear system for use on a deep ocean vehicle is summarized along with preliminary conceptual configurations for such a system. Characteristics and available performance data on some 66 existing seafloor vehicles (none of which are designed for the environment or operating scenario/mission of interest to this study) are reviewed and summarized along with likely environmental conditions. It is concluded that either a rotor/screw or track running gear type will provide the best potential performance on the very weak and highly plastic cohesive soils to be encountered in the deep ocean. Draw bar pull forces of the order of 400 pounds are developable using an active running gear module which is lightweight (possibly neutrally buoyant in some cases) is compatible with, and relies on, its host vehicle for power and control functions. Potential areas of significant work capability enhancement using such an active running gear module are summarized along with identified technical deficiencies and plans for addressing/satisfying these.

N-1541
Determination of Oil in Water by Organic Carbon Analysis, Jan 1979, P. J. Hearst, AD

A method was investigated for determination of oil in water by establishing the organic carbon content attributable to the oil and by converting this value to the oil content. Samples were homogenized with the aid of an emulsifier, and a correction was made for the carbon contributed by the emulsifier. Aliquots of 35 μl or less were injected into the organic carbon analyzer because larger samples were incompletely combusted and gave reduced recoveries. With corrections for the carbon content of the water or the seawater used to prepare the samples, samples containing 17 mg/l of white mineral oil or Navy distillate fuel gave recoveries of about 85% with standard deviations of about 10%. Samples of about 50 mg/l gave recoveries of about 65%. If the factor of 1.39, instead of the theoretical factor of 1.18, had been used to convert from carbon content to oil content, the calculated recoveries would have been 100% for 15 mg/l oil samples and 76% for 50 mg/l oil samples. The method will give only an upper limit for the oil concentration unless a correction is made for dissolved organic materials.

N-1542
Coefficients of Friction Between Calcareous Sands and Some Building Materials, and Their Significance, Jan 1979, P. J. Valent, AD

Friction tests of a coralline and an oolitic sand and a foraminiferal sand-silt against smooth and rough steel and concrete surfaces were run in a modified soils direct shear machine. Friction test results for these calcareous materials did not differ markedly from the results for a quartz sand. These results indicate that there is nothing inherently different in the capability of these calcareous materials to develop frictional forces on typical building material surfaces – when compared to quartz-predominant sands – except that some calcareous materials experience large volume decreases during shear. These large volume decreases would impair the development of high effective normal stresses against the building material surface, resulting in low friction forces on piles, some anchors, and penetrometers in calcareous materials. This latter hypothesis is stated, but not directly addressed in this reported work.

N-1543
CEL Blast Wave Propagation Code for Air Ducts, Jan 1979, R. S. Chapler, R. H. Fashbaugh, AD

Refinement of a CEL hydrodynamic code for prediction of air blast propagation in variable area ventilation ducts was completed. Code solutions are one-dimensional and achieved using a refined finite-difference pseudo-viscosity method in a Lagrange formulation for solution of either classical nuclear blast waves or general time variant pressure waves. Solutions for a single constant area duct with the effects of viscosity at the wall are included. An example case is presented with a description of the single duct geometry, the applied nuclear blast parameters, and the code input parameters, including their magnitudes and their sources. A 2-m-diam duct with a length of 200 meters subjected to a side-on 1,000 psi overpressure is analyzed, and the time histories of the blast parameters are presented for three locations in the duct. The effects of wall friction are demonstrated graphically for friction factors of 0.016 and 0.030. Sequential application of the code to each duct in a branched duct system provides solutions for complex air entrainment systems. A description of the modified CEL Blast Wave Propagation Code basic functions, input quantities, formats and outputs (including a sample input data card listing), input data listing, and an output listing sample are appended.

N-1544
Proposed Method for Placing Freshly Mixed Concrete in the Deep Ocean, Jan 1979, R. D. Rail, H. H. Haynes, AD

Potential applications for placing concrete in the deep ocean are basically in three areas: in situ construction of seafloor structures, foundations and massive anchors for fixed ocean facilities, in situ hardening of objects on the seafloor, and containment of hazardous substances for environmental protection. This report presents a method for in situ placement of fresh concrete on the seafloor in which concrete is mixed on a surface platform and transported to the seafloor via a pipeline suspended from the platform. The proposed development integrates existing technologies of the concrete, oilwell, and marine industries and extends them to new applications in a new environment, and would require a modest development effort as well as simulated tests to verify engineering assumptions based on extrapolation of existing knowledge to the new conditions. The proposed method would greatly extend the Navy's capability to place concrete in the deep ocean for the above applications which would require concrete to be placed underwater in quantities of hundreds and thousands of cubic yards in water depths of many thousands of feet.

N-1545
Long-Term Holding Capacity of Statically Loaded Anchors in Cohesive Soils, Jan 1979, R. M. Beard, AD

The Civil Engineering Laboratory has conducted model anchor tests, intermediate scale field tests, laboratory soil investigations, and finite element analyses to optimize procedures for estimating long-term holding capacity of statically loaded plate-like anchors embedded in cohesive seafloor soils. Also, work was done to determine relationships between long- and short-term holding capacity. This report presents the results of these tests and analyses. It is concluded that the long-term holding capacity in cohesive soils can be readily analyzed using drained strength parameters and holding capacity factors originally developed for cohesionless soils. It is also concluded that suction is an integral part of short-term holding capacity and that it should not be ignored. Procedures for estimating both long- and short-term holding capacity are given, and design factors of safety are recommended.

N-1546
Investigation of Chemical Binders for Beach Sand, Feb 1979, T. Roe, S. Tuccillo, R. Lorenzana, AD

An additive was sought for seawater such that the mixture could be sprayed on beach sand to make a trafficable crust for amphibious warfare operations. None met all requirements, but a proprietary polyisocyanate met most. It could not be premixed with seawater, but it penetrated seawater-wet sand and produced a 6-inch-thick crust of 100 psi compressive strength in one hour at a cost of $8 to $10 for materials per square foot of sand stabilized.

N-1547
MARCORPS Laundry/Shower Module - Washing and Drying Test Program, Feb 1979, T. A. Knepper, D. B. Chan, AD

The washing and drying test programs conducted during FY-77 for the Marine Corps laundry/shower module project are described. A washing and drying method is chosen which allows continuous laundering of field utility clothing within a 5-minute retention time. Wastewater recycling alternatives are also described.

N-1548
Drydock Certification, Mar 1979, J. B. Forrest, J. M. Ferritto, AD

No procedure is presently defined for reliably measuring the foundation condition of existing graving drydocks. Because of unknown or misunderstood soil and groundwater flow conditions, drydocks have not always continued to perform as designed. This report presents the initial year's effort of a longer term program to develop a systematic, defined evaluation routine for drydock foundations. The causes of a few previous drydock failures are discussed, and areas of potential difficulties are identified. Potential measuring devices and procedures for measurement are discussed briefly, and the need for advances in particular areas such as in void detection are noted.

A brief review of available analytical computer models dealing with groundwater flow is presented. Those models considered most appropriate for treating the subsurface flow regime beneath a drydock have been selected for application. Attention is also directed toward available soil-structure interaction computer models, and some of their shortcomings or deficiencies are identified.

This report singles out several critical categories for drydock analysis from a geotechnical viewpoint and recommends areas for further endeavor.

N-1549
User's Manual for FVSOLVR and FVPLOT: Field Solving and Plotting Computer Programs, Mar 1979, B. R. Milner, AD

FVSOLVR and FVPLOT are, respectively, computer programs which solve and plot field distributions for problems that involve the solution of Laplace's equation. The programs were developed primarily for solving electric field and equipotential distributions, but may be adapted to solve problems such as temperature distributions or problems which involve the solution of Poisson's equation. They can also be used with either axisymmetric or two-dimensional geometries. This user's manual provides the detailed information required to implement problem solutions with these programs.

N-1550
Development of Supercorroding Alloys for Use as Timed Releases for Ocean Engineering Applications, Mar 1979, S. A. Black, AD

A family of supercorroding magnesium alloys that react spontaneously and vigorously with seawater have been developed at CEL. Supercorroding alloys are so named because of their high corrosion rate in seawater. Investigations of several different alloy formulations show that the alloys can be useful for generation of hydrogen for ocean buoyancy, fuel for thermodynamic engines and fuel cells, production of heat for divers and as self-destructing links for retrieval of oceanographic instruments.

Supercorroding alloys with magnesium as the anode material and with several different cathode materials were fabricated and tested to determine mechanical and corrosive characteristics. Alloys with 5 atomic percent iron cathode produce 950 ml of hydrogen per gram of alloy and 13.3 K joules of heat per gram. One gram is over 90% reacted within one minute from immersion. Compacting and sintering produces samples with 9 ksi shear and tensile strengths. Corrosion rates for sintered samples are approximately 9×10^{-3} inches per hour. Alloys with other cathode materials and different levels of cathode content were fabricated and tested. Sufficient data is available on several different formulations of supercorroding alloys to permit preliminary selection for specific applications.

N-1551
Radioisotope Tracer Technique of Measuring Adsorption of Paint Driers by Pigments, Mar 1979, E. S. Matsui, AD

A sensitive radioisotope tracer technique to measure the amount of paint drier adsorbed on paint pigments has been developed. This technique was found to be very sensitive and precise, and reliability and reproducibility of the procedure were very good. The laboratory results indicated that paint driers were adsorbed by pigments during storage, and the amount of adsorption varied among the paints.

CONTRACT REPORTS

CR 73.007
Development and Fabrication of Prototype Advanced Surfacing Systems for Military Use on Soils, S. Austin, R. McIntosh, Seattle, Wash, Aerospace Group, Boeing Co, Nov 1972, N62399-71-C-0016, AD756687

Fiberglass reinforced resin surfacing materials were selected and verified. Operational usage studies were performed, and two surfacing systems employing resin surfacing material were developed as a parallel effort: (1) a high rate system with truck-mounted equipment; and (2) a low rate system with trailer-mounted equipment. The high rate system has the capability to surface an area of 10,000 square feet with 2 pounds per square foot surfacing within 1 hour and while utilizing not more than nine operating personnel. The low rate system has the capability to surface an area of 2,000 square feet with 2 pounds per square foot surfacing within one hour and while utilizing not more than five operating personnel.

CR 73.008 – Cancelled

CR 73.009
Concrete Vessel Size and Pressure Capability Study, W. Rockenhauser, Monroeville, Pa, Dec 1972, N62399-71-C-0028, AD759798

The size and pressure limitations of concrete vessels, as applied to potential hydrospace simulation, are investigated. It is shown that within the range of practical interest, there is essentially no size limitation. Current concrete technology permits design pressures of the order of 3,000 psi, possibly 3,500 psi. It is also shown that without development of new technology, the concrete vessel concept is not an attractive design solution for internal pressure much above those levels.

CR 73.010, vol. 1
Survey of Solid Waste Handling Unit Operations and Applicable Equipment, vol. 1, Long Beach, Calif, SCS Engineers, Dec 1972, N62399-72-C-0017, AD910116L

This report describes solid waste handling methods applicable for use at Navy shore installations. Methods covered include those for solid waste gathering, storage, collection, transportation, transfer, processing, and final disposal.

CR 73.010, vol. 2
Survey of Solid Waste Handling Unit Operations and Applicable Equipment, vol. 2, Long Beach, Calif, SCS Engineers, Dec 1972, N62399-72-C-0017, AD910117L

This report describes the types and associated characteristics of commercially available equipment employed in solid waste handling systems. Equipment is discussed in sections corresponding to the primary function each performs.

CR 73.011
Solid Waste Composition and Emmision Factors for Selected Naval Activities, Long Beach, Calif, SCS Engineers, Dec 1972, N62399-72-C-0017, AD910118L

This report presents an analysis of the characteristics and quantities of solid waste generated by Navy shore installations. The raw data was obtained during a survey of five Navy installations in the summer of 1972.

CR 73.012
Analysis of Responses to Questionnaire for Naval Shore Facilities Solid Waste Management Practices and Procedures, Long Beach, Calif, SCS Engineers, Dec 1972, N62399-72-C-0017, AD910119L

This report presents and evaluates data obtained on solid waste practices at Navy shore stations sampled in a mail survey conducted March – April 1972.

CR 73.013
Flight Accuracy Study of Glide-Out Anchor, Seattle, Wash, Marine Systems Center, Honeywell Inc., Feb 1973, N62399-72-C-0003, AD758722

The document covers the work performed during a study made of the glide-out anchor to improve the glide accuracy of its present design. Wind tunnel testing and model analysis was employed in the program study.

CR 73.014
Analysis of Instrumentation Systems to Monitor Trace Amounts of Oil in Water, A. Ambruso, C. H. Beebe, S. G. Ricchio, Anaheim, Calif, Advanced Technology Operations, Beckman Instruments Inc., Nov 1972, N62399-72-C-0019, AD911175L

Conceptual studies were performed of various measurement techniques to monitor oil in water. The objective was to define a prototype instrument system capable of continuously monitoring a water discharge line which may contain crude or refined petroleum products. A literature search was performed to determine measurement techniques. An evaluation of performance data from the literature was performed in terms of how feasible a particular instrument or technique was in meeting the requirements of this project. The most feasible systems were: sample solvent extraction with NDIR analysis, and sample pyrolysis with flame ionization detection.

CR 73.015
Test and Evaluation of Oil Water Separation Systems, A. V. Sims, Pasadena, Calif, Ben Holt Co., Nov 1972, N62399-72-C-0021, AD910697L

A test program was performed to evaluate the performance of individual oil-water separation devices and a series combination of those devices. Twenty-seven test runs were made to evaluate four oil-water separating devices and a combined unit consisting of three of the devices in series.

CR 73.016
Analysis of Electrochemical Energy Source for Military Diver Heating, P. L. Howard, Millington, Md, P. L. Howard Associates Inc., May 1973, N62399-73-C-0010, AD763801

An analysis of a shorted MG-steel seawater battery as an electrochemical energy source for military divers heating shows it is practical. Theoretical available energy is 3025 whr/lb of magnesium. The present system is a single multiplate cell with all plates shorted. A heat exchanger unit and circulating system transfer the available heat to the diver. Control may be either in the cell or in the heat exchanger. The report primarily discusses the electrochemistry of the system.

CR 74.001
Turbojet Aircraft Engine Test Cell Pollution Abatement Study, G. F. Davies, R. H. Crow, Alhambra, Calif, C. F. Braun and Co., Jun 1973, N62399-72-C-0020, AD768287

The report summarizes the results of a survey and analysis of the application of conventional air pollutant abatement systems to the exhaust gas from jet engine test cells. The following methods for gas treatment were investigated: wet scrubbers, incinerators, electrostatic precipitators, filters, dry inertial collectors. The least costly methods for meeting present emission standards are water scrubbing systems. One of the most attractive of wet scrubbers using Koch flexitrays is developed in detail. The report covers the associated problem of water supply and disposal. The report also includes research and development suggestions for test cell emission control.

CR 74.002
Feasibility Study for an Inflatable Bow Ramp, G. F. Reitmeier, M. B. Punnett, J. W. Phillips, Buffalo, N.Y, Birdair Structures Inc., Jun 1973, N62399-73-C-0003, AD768373

The report describes a feasibility study for developing an inflatable bow ramp for the 1179 class LST. The ramp must be 110 ft long, 16 ft wide, and carry the maximum loads

imposed by an M103 tank. Ten possible conceptual configurations were investigated with a more detailed design analysis effort being concentrated on two of the concepts. The ramp will be constructed of a two-ply neoprene fabric and inflated with an inflation system separate from ship air supply. A scale model of one concept was built and tested which verified design calculations.

CR 74.003 - Not available

CR 74.004
Development of a Preliminary Design for a Blast-On Structures Simulator, D. W. Baum, S. P. Gill, Hayward, Calif, Artec Associates Inc., Jul 1973, N62399-73-C-0007, AD914375L

A preliminary engineering design and cost study is presented for a blast-on structure simulator (BOSS) capable of simulating the airblast from a 1 megaton surface burst at 1,200 psi overpressure. Design drawings and construction cost estimates are provided for a single module proof test and three module system test. Labor and material cost estimates are based on rates currently prevailing at Naval Weapons Center, China Lake, California, a possible site for a future proof test. Environmental considerations affecting test planning are also discussed.

CR 74.005
Vertical Breakout Behavior of the Hydrostatic Anchor, M. C. Wang, V. A. Nacci, K. R. Demars, Kingston, R.I., Coll. of Engineering, Univ. of Rhode Island, Feb 1974, N62399-72-C-0005, AD775658

The vertical breakout behavior of the hydrostatic anchor depends greatly upon the anchor geometry, including anchor diameter and skirt length; the soil strength properties; and the pressure difference between the ambient pressure and that underneath the porous stone. For the range of conditions studied, the anchor capacity increased linearly with increasing pressure difference provided that the anchor skirt length based upon the Coulomb failure theory resulted in an equation which predicts satisfactorily the experiment results.

CR 74.006
Alternative Strategies for Optimizing Energy Supply, Distribution, and Consumption Systems on Naval Bases, vol. 1. Near-Term Strategies, T. Consroe et al, Bethesda, Md, Booz-Allen and Hamilton Inc., Nov 1973, N62399-73-C-0029, AD777471

The report describes an assessment of alternate strategies for optimizing energy supply, distribution, and consumption systems on Naval bases. It contains the results of cost/benefit analyses of six near-term energy conservation strategies applicable to continental United States (CONUS) Naval bases. Implementation of these energy conservation strategies would not require research and development expenditures and would result in an energy savings roughly equivalent to 11 percent of current CONUS Navy energy use.

CR 74.007
Alternative Strategies for Optimizing Energy Supply, Distribution, and Consumption Systems on Naval Bases, vol. 2. Advanced Energy Conservation Strategies, T. Consroe et al, Bethesda, Md, Booz-Allen and Hamilton Inc., Jan 1974, N62399-73-C-0029, AD786757

The report describes five advanced strategies for optimizing energy supply, distribution, and consumption systems on Naval bases: (1) solar energy applications; (2) automated building control and monitoring systems; (3) electrochemical sources - fuel cells; (4) advanced transportation technology; and (5) total energy systems, for each advanced strategy, the report contains a technology assessment, a discussion of applicability to the Navy, a discussion of costs and benefits, and recommendations for Navy implementation.

CR 74.008
Experimental Prototype Oily Wastewater Treatment System, Pasadena, Calif, Ben Holt Co., Mar 1974, N62399-74-C-0004, ADA004990

An experimental prototype oily wastewater treatment system rated at 20 gpm consists of three stages: a parallel corrugated plate gravity separator, a coalescer with prestrainer and prefilter, and two carbon columns for removing oil from mechanical emulsions in water of varying salinity, as well as organic moieties for different levels of disposal options. The system is to be evaluated and modified as a test bed for further development prior to field test.

CR 74.009
The Inspection and Evaluation of Experimentally Treated Wood Piling, H. Hochman, Oxnard, Calif, Jun 1974, N68305-74-C-0010, AD783100

Experimentally treated wood piles at Coco Solo, Canal Zone, were inspected in March 1974 and at Pearl Harbor in April 1974. Findings indicate dual-treated piles will last twice as long as creosoted piles in waters of high borer hazard. Creosote combination treatments of higher retention are performing equally well.

CR 75.001
A Study of Insulator Breakdown Under Navy Antenna HV RF Conditions, C. N. Richards, La Jolla, Calif, Science Applications Inc., Mar 1974, N62399-73-C-0033, AD787067

Conditions leading to initiation of corona streamers and breakdown in gases are reviewed. The effect of electric field strength at electrode surfaces and the pressure of the gas in the electrode gap on the acceleration of free electrons with the ions and molecules in the gas are identified. The presence of water drops or contaminants can reduce corona onset field from about 30 kV/cm to about 6 kV/cm, can affect the voltage distribution, and can cause heating in strong VLF fields.

CR 75.002
Global-Local Finite Element Structural Analysis, Analytical Considerations/Element Formulation, S. B. Dong, Los Angeles, Calif, School of Engineering and Applied Science, Univ. of California, Oct 1974, N62399-73-C-0020, ADA003936

The analytical developments for a computer code based on the concept of "global-local finite elements" are presented in this report. In this type of analysis, both the classical Ritz and the finite element approaches are used simultaneously. The role of the global functions will be to capture the bulk of the response, while the finite elements provide the necessary adjustments to satisfy whatever local geometric and material property variations that exist.

CR 75.003
Alternative Strategies for Optimizing Energy Supply, Distribution, and Consumption Systems on Naval Bases, vol. 3. Assessment of Total Energy System Applications at Naval Facilities, D. Kennedy, D. Wulfinghoff, R. Shaw, Bethesda, Md, Booz-Allen and Hamilton Inc., Nov 1974, N62399-73-C-0029, ADA003590

The key topics investigated and discussed are: advanced research in total energy systems; opportunities for heat recovery from prime movers at Naval facilities; and the feasibility of using in-port steaming to provide power for Naval shore facilities.

CR 75.004
User's Manual for CEL/NONSAP, a Nonlinear Structural Analysis Program, K. J. Bathe, F. E. Peterson, Berkeley, Calif, Engineering/Analysis Corp., Oct 1974, N62399-73-C-0019, ADA004988

This user's manual documents the input data required for the computer program CEL/NONSAP. NONSAP is a nonlinear structural analysis program that predicts either static or dynamic response of structural analysis with material and/or geometric nonlinearities. The program can also be used to

analyze linear problems. The following element options are contained in the program: truss, two-dimensional continuum, three-dimensional continuum and three-dimensional nodal tie elements. The three-dimensional nodal tie elements may be used to simulate structural dislocations and special conditions.

CR 75.005
Theoretical Basis for CEL/NONSAP, a Nonlinear Structural Analysis Program, K. J. Bathe, F. E. Peterson, Berkeley, Calif, Engineering/Analysis Corp., Oct 1974, N62399-73-C-0019, ADA004989

This program documents the theoretical basis for the computer program CEL/NONSAP. NONSAP is a nonlinear structural analysis program that predicts either static or dynamic response of structural systems with material and/or geometric nonlinearities. The finite element procedure is used for spatial discretization of the incremental equations of motion, and a step-by-step technique is used to compute the time dependent response. The algorithm used to solve the discrete set of nonlinear equations is a modified Newton iteration. Derivations of the finite element matrices are given for those elements currently operations in the NONSAP program element library.

CR 75.006 - Cancelled

CR 75.007
Finite Element Formulation and Solution of Contact-Impact Problems in Continuum Mechanics, T. J. Hughes, R. L. Taylor, J. L. Sackman, Berkeley, Calif, Structural Engineering Lab, Univ. of California, May 1974, N62399-73-C-0023, ADA011054

This report presents a general theory of contact-impact problems cast in a variational theorem suitable for implementation with the finite element method. The numerical scheme is described as is the structural analysis computer code in which it is contained.

CR 75.008
Finite Element Formulation and Solution of Contact-Impact Problems in Continuum Mechanics - II, T. J. Hughes, R. L. Taylor, J. L. Sackman, Berkeley, Calif, Structural Engineering Lab, Univ. of California, Jan 1975, N62399-73-C-0023, ADA011103

Herzian contact-impact problems are solved which demonstrate the veracity of the numerical algorithm employed. The importance of the impact and release conditions is emphasized. A methodology is developed for nonlinear contact/impact problems.

CR 76.001
Evaluation of Mechanized Collection Systems and Development of Criteria for Prototype Refuse Collection Truck Attachment for Navy Housing Collection, Long Beach, Calif, SCS Engineers, Jul 1975, N68305-74-C-0014, ADA014906

Refuse collection requirements for Navy family housing are analyzed, and municipal experience with prototypes of mechanized collection devices are evaluated with the purpose of establishing design criteria for a truck attachment usable at Navy shore stations. A number of commercially available and conceptual devices are considered. The report recommends development of a semi-continuous device and further investigation of low-cost storage containers.

CR 76.002 - Cancelled

CR 76.003
Deep Anchor Long-Term Model Tests, B. C. Yen, Long Beach, Calif, Dept. of Civil Engineering, California State Univ., Dec 1975, N68305-74-C-0002, ADA022142

The results of a laboratory study investigating the behavior of deeply embedded model anchors is presented. Emphasis is placed on long-term static holding capacity. Quantitative data describing the soil-anchor interaction, including pore pressure responses to applied loads, is presented and analyzed. For long-term static loading it was found that two distinct stages of soil-anchor behavior governed by different mechanisms existed. The first stage was dominated by local shear and consolidation, while the second stage was dominated by soil creep. For the normally consolidated soil tested, for which the liquidity index was generally greater than 1, there was no evidence indicating that long-term holding capacity is less than short-term holding capacity.

CR 76.004
Survey of Available Systems for Improving Heat Transfer in Air Conditioning Chiller Condensers, J. S. Williams, Newbury Park, Calif, Jul 1976, N68305-76-C-0018, ADA029378

A survey of available systems which claim to maintain or improve the heat transfer ability of air conditioning condensers was performed. Two systems were identified, both of German origin. One system called the "M.A.N. On-Load Tube Cleaning System" uses small brushes to keep the condenser tubes clean. This system is distributed by Water Services of America, Inc. The other system, handled by Amertap of Mineola, New York, uses small foam rubber balls to maintain and clean the condenser tubes. Several users of these systems were identified and visited. The M.A.N. system appears to require less day to day maintenance and is more widely used.

CR 77.001
Finite Element Formulation and Solution of Contact-Impact Problems in Continuum Mechanics - III, T. J. Hughes, R. L. Taylor, J. L. Sackman, Berkeley, Calif, Dept. of Civil Engineering, Univ. of California, Jul 1975, N68305-75-C-0004, ADA022038

Several Hertzian contact-impact problems are solved to verify the algorithm employed and to determine the limitations of Hertzian theory. Theoretical work was completed for nonlinear compressible, nearly incompressible, and compressible elastic bodies. Detailed algorithms are presented for the two-dimensional contact surface search algorithms.

CR 77.002
Finite Element Models for Large Displacement Contact-Impact Analysis, T. J. Hughes, et al, Berkeley, Calif, Dept. of Civil Engineering, Univ. of California, Jul 1976, N68305-75-C-0004, ADA030280

Theory and algorithms for large displacement contact-impact analysis in two dimensions are presented. The theory allows for arbitrary contact surface development, stick, slip and frictional sliding conditions. Sample problems which employ the algorithms are given.

CR 77.003 - Cancelled

CR 77.004 - Cancelled

CR 77.005 - Classified report, Dec 1976, ADC009818L

CR 77.006
Placement of Concrete in the Ocean, G. W. Evans, J. Herndon, Duncan, Okla, Halliburton Services, Dec 1976, N68305-76-C-0038, ADA039096

This report presents state-of-the-art and proposed methods of concrete placement in the ocean to depths of 20,000 feet. Current technology includes bucket, tremie pipe, pumping, preplaced aggregate and bagged concrete methods as well as oil field cementing techniques. Problem areas, limitations and deficiencies of the current technology are discussed. Five new concepts of ocean concrete placement are presented and evaluated, most of which are variations of the current tremie method or bucket placement. Recommendations are made for research on materials and their properties, test methods, control devices and guidance systems for placement. A comprehensive bibliography is included.

CR 77.007 - Cancelled

CR 77.008
Operational Testing of a Controlled Air Incinerator With Automatic Ash Handling, N. Kleinhenz, H. G. Rigo, Xenia, Ohio, Systems Technology Corp., Nov 1976, N62583-76-M-X553, ADA044337

Mass and energy balances derived from four days monitoring of the normal operation of a commercially available incinerator of the controlled-air type are presented. These balances provide data which will allow extrapolation of heat losses and efficiency if a similar incinerator operation were to be installed for heat recovery at a small military base.

CR 77.009
Operational Testing of a System for Solid Waste to Energy Conversion, H. Kleinhenz, H. G. Rigo, Xenia, Ohio, Systems Technology Corp., Nov 1976, N68305-76-C-0007, ADB017044L

A performance evaluation based on 48 hours monitoring of a packaged heat recovery incinerator installation is presented. The evaluation includes heat balance analysis, stack emissions, and general observations. The heat balance data is of greatest significance since it will allow extrapolation of heat balances for other operating conditions.

CR 77.010
Experimental Studies of Fatigue Failures of Down Lead Cables, C. V. Chelapati et al., Long Beach, Calif, Dept. of Civil Engineering, California State Univ., Dec 1976, N68305-76-C-0015, ADA037164

Eight hard-drawn copper cables were tested to failure under static lateral axial load and either dynamic lateral load or torsional couple. Due to the large number of test parameters involved and the limited number of specimens tested, firm conclusions cannot be drawn about the fatigue life of copper cables under dynamic lateral or torsional loading combined with axial tension. With axial and lateral load, fatigue failure occurred at 4,000 cycles; with axial and torsional load failure occurred at about 10,000 cycles.

CR 77.011
Development of Alternative Approaches to a Small Scale Solid Waste Transfer/Resource Recovery Station for Navy Installations, H. G. Rigo, B. A. Hausfeld, Xenia, Ohio, Systems Technology Corp., Jan 1977, N68305-76-C-0025, ADB017043L

A "functional module" approach was used in preparing alternative preliminary designs of an experimental transfer/resource recovery station for Navy bases generating 15 to 25 tons per day of solid waste. Alternate equipment components and processes were examined for each functional module, and their life cycle costs were compared to identify the most cost effective equipment and processes. The selected modules were combined to form alternative system designs to process two types of solid waste: completely mixed waste, and waste from which most glass and metals have been source segregated. All alternative system designs were then subjected to a life cycle cost analysis, and ranked according to cost. The recommended system for the Navy's experimental transfer/resource recovery facility was clearly identified. The least cost system requires source segregation of most metals and glass, and produces densified RDF for use in an incinerator/heat recovery boiler unit to produce steam for use on base.

CR 77.012
Evaluation of Solvent Recovery Systems for Potential Utilization at Navy Shore Activities, J. S. Williams, Newbury Park, Calif, Nov 1976, N62583-76-M-W820, ADB018105L

Several distillation and activated carbon adsorbing solvent recovery systems were evaluated for use at shore activities. Results indicate that recovery of Stoddard's Solvent by live steam distillation systems may be economically feasible for large shore activities.

CR 77.013
Coal Gasification Study, San Francisco, Calif, Bechtel Corp., Apr 1977, N68305-76-C-0009, ADA041860

The general problem of providing fuel gas for Navy base facilities is studied. The intent is: first, to provide designs of a coal gasification plant producing 6 x 10^9 Btu/day reactor output, based on two types of reactors; second, to conduct parametric studies leading to means for the costing of similar plants operating on different feedstocks; and third, to provide a method for estimating the change in boiler rating which must follow the substitution of fuel gas for either oil or coal firing.

The performance and economics given are based on conceptual design methods. The economic results allow comparison of fuel-gas and fuel-oil costs on the basis of the Navy's method of analyzing costs using "Economic Analysis Handbook," NAVFAC P-442, 1975. The costs are the sum of all future outlays discounted to the present but allowing escalation at different rates for utilities and feedstock over a 25-yr production period.

CR 77.014
Coal Gasification Study Handbook, San Francisco, Calif. Bechtel Corp., Apr 1977, N68305-76-C-0009, ADA042385

The purpose of this handbook is to provide: first, a procedure for evaluating the costs of a coal gasification plant in terms of the capital investment and operating costs. These are to be sensitive to several parameters defining coal, fuel gas, and sulfur emissions; second, a procedure for the derating of Navy base boilers, to reflect the change in performance resulting from introduction of fuel gas in place of coal or oil.

The gas implant analysis is based in part on a detailed analysis of the gas treatment section of the plant. The remaining part of the plant performance is based on conventional stoichiometry and near approach to equilibrium in the gas production section. The boiler derating method is based on observations of the relative contribution to heat transfer made by radiation and convection, and on conventional relations describing these transfer processes.

CR 77.015
The Development of Methodology for the Determination of R Values of Existing Structures by Nonsteady State Heat Transfer Measurements, H. F. Poppendick et al, Solana Beach, Calif, Geoscience Ltd., Jun 1976, N62583/76-M-W928, ADA041235

Energy conservation surveys of Navy facilities often require data on in-place R-values of existing structures. Such information has been difficult to obtain due to transient conditions caused by day-and-night temperature changes.

This study indicates R-values can be calculated within about a 6% accuracy from heat flux and inside-outside wall surface temperature data that have been integrated over a 24-hr period.

CR 77.016
Air Leakage Measurements in Navy Housing in Norfolk, Virginia, P. L. Lagus, La Jolla, Calif, Systems, Science and Software, May 1977, N62583/77-M-R178, ADA049276

Air leakage measurements by the tracer dilution technique were conducted in two separate three-bedroom apartments in the Willoughby Bay housing area, Norfolk Navy Base, Norfolk, Va. Sulfur hexafluoride was used as the tracer gas, and the gas concentration was measured with a portable electron capture gas chromatograph at 10-min intervals during 2-hr test periods to determine dilution rates. Air change rates were determined directly from the logarithmic dilution rate of the tracer gas. The procedures used were documented in detail for possible incorporation into a field measurement procedure that is being developed at the Civil Engineering Laboratory.

CR 77.017
Improved Chemical Components for Formulating Fiberglass-Reinforced Plastic Soil Surfacings, S. S. Drake, H. E. Filter, D. L. Stevens, Midland, Mich, Dow Chemical Co., May 1977, N68305-76-C-0003, ADA041605

A stabilized resin was formulated which displayed a shelf life by accelerated test methods substantially in excess of 5 yr at 75F. It was discovered that 2,4-dinitrophenol and p-tolyhydroquinone act synergistically to enhance stabilization.

A new, reliable catalyst system was developed that gives reliable cure with adjustable gel times over a temperature range of 40F to 120F. The catalyst is cumene hydroperoxide (CHP) and the promoter is a solution of Vanadium Ten Cem (5% metal) and N,N-dimethyl-p-toluidine in a 2.4/2.0 ratio by volume.

The newly developed formulation uses components with longer shelf lives, is useable over a wider temperature range, and results in better FRP properties.

CR 77.018
Solar Air Conditioning Study, R. Merriam, Cambridge, Mass, Arthur D. Little, Inc., Apr 1977, N68305-76-C-0029, ADA043951

The state-of-the-art of solar cooling is evaluated to determine the near-term performance potentials and life-cycle costs of the most promising approaches. The heat-actuated absorption cycle, Rankine cycle, and desiccant dehumidification cycle are examined. The principles of operation are described, performance coefficients are reviewed, operating constraints are examined, and the commercial status of each approach is evaluated. An analysis of the major solar cooling demonstrations (as of 1976) is carried out. Savings-to-investment ratios are calculated for solar cooling systems in buildings in seven locations within the United States.

CR 77.019 - Cancelled

CR 77.020
Austenitic Electrodes for Underwater Wet Welding, E. P. Sadowski, New York, N.Y., International Nickel Co. Inc., Jun 1977, N68305-77-C-0013, ADA045583

Twelve austenitic electrodes were evaluated for use as wet welding electrodes. The type electrodes investigated were: Inco-Weld A and two modifications, INCONEL Welding Electrodes 112 and 182 and a semi-commercial stainless electrode designated R-142 and five modifications. E6013 was used as a standard. The welds were head-on-plate and three bead multipass deposits. Most welds were made automatically in 3-1/2% NaCl solution with gravity fed electrodes and controlled travel speed. Direct current, straight polarity and the drag technique were used.

The evaluation was based on operability, porosity, crack resistance and undercut. The factors considered for operability were bead appearance, slag removal, arc stability and ease of operation. The effect of travel speed, current and coating thickness on bead appearance and porosity were determined. The coating thickness was also related to depth of cup.

Ten lb each of 0.190 and 0.220 in. coating diameter R-142 and 0.190 in. coating diameter INCONEL Welding Electrode 112 were shipped to the Civil Engineering Laboratory, Naval Construction Battalion Center at Port Hueneme, Calif, for further evaluation.

CR 78.001
A Survey of Available Data on the Normal Drag Coefficient of Cables Subjected to Cross-Flow, W. L. Dalton, Rockville, Md, MAR, Inc., Aug 1977, N62583/77-M-R443, ADA048263

The Civil Engineering Laboratory is conducting a research program with the goal of developing mathematical models to aid in the computer simulation of the behavior of cable structures in the ocean. One of the major goals of the program has been prediction of the normal drag of a vibrating cable. Two simulation models have been independently developed which, when used together, result in the capability of predicting the normal drag of a vibrating cable. The models predict the frequency and amplitude of the cable vibrations based upon the mechanical properties of the cable and the fluid flow properties; a factor is then computed which, when multiplied by the non-vibrating drag coefficient for the cable, results in the effective drag coefficient for the cable. Thus, the non-vibrating drag coefficient must be known. A survey has been conducted to identify available drag coefficient of non-vibrating cables and to assess the quality of the data as to its applicability for use in design of undersea cable structures.

CR 78.002
Concepts for Reducing Crime, Theft, and Destruction of Naval Shore Property, K. Cunningham et al, Arlington, Va, Westinghouse Electric Corp., Sep 1977, N68305-77-C-0017, ADA048441

Concepts for crime reduction on Navy industrial type environments through control of environmental design are presented. Examples of crime prevention methods used in the public sector are discussed. Various opportunities for input of physical security engineering and crime reduction factors into the planning, design and construction of new facilities are identified with reference to the Navy's Facility acquisition system.

CR 78.003
Preliminary Design of a 10 kWe Solar Heated Open Brayton-Cycle Engine, Cambridge, Mass, Arthur D. Little Inc., Nov 1977, N68305-76-C-0014, ADA051101

This report discusses the results of the first phase of a two-phase program to assess the applicability of electric power generation from solar energy at Naval bases, particularly advanced bases which require small, mobile systems not under development in the civilian sector.

For purposes of establishing a baseline system against which the costs and benefits of various solar-to-electric energy conversion processes can be compared, an open-cycle air turbine/generator set was chosen with tracking parabolic dish reflector to focus direct solar radiation onto a collector/heat exchanger providing heat for the engine. Preliminary system designs and cost estimates were prepared for the solar "fired" open-cycle air turbine generator. Where possible, technical and cost information for the various subsystems was obtained by direct contacts with firms in related product areas, in particular, firms in the antenna field and firms producing small Brayton-cycle engines. A cost of $42,000 per unit estimate was projected

for a production level of 1,000 units per year. At production levels high enough to warrant true assembly line techniques, optimistic cost estimates were as low as $12,000 per unit. Based upon the capital cost estimate of $42,000 per unit and upon overall annual performance of the unit at a site with favorable insolation, it was projected that cost of power from the system would be $0.27/kWh (270 mils/kWh).

CR 78.004 - Cancelled

CR 78.005
Preliminary Design of an Experimental Containerized Freeze Desalination Unit, J. Fraser, S. Thompson, Andover, Mass, Concentration Specialists Inc., Dec 1977, N68305-77-C-0019, ADA051171

A preliminary design of a 20,000 gpd containerized indirect contact freeze desalinator was completed. The system consists of a freezer with a defrosting cycle; wash column; indirect contact melter; and pumps, compressors, heat exchangers and controls necessary to make a complete system. At a nominal design point of 3.5% feed and at 70F, power consumption is estimated to be 77 kWhr/kgal. The construction cost of a prototype unit is estimated to be $280,000. The system is designed to operate on virtually any type of feed water. Projected performance data is given for the system operating with feed salinities from 0.5% to 5% and feed temperatures from 40F to 100F. In addition to a system with a defrosted freezer, studies were conducted of a scraped tube freezer which indicated that both the capital and operating cost of that type of freezer would be much more expensive.

CR 78.006
Effectiveness of Building Insulation Applications, J. D. Verschoor, Denver, Colo, Research & Development Center, Johns-Manville Sales Corp., Nov 1977, N68305-77-C-0009, ADA053452

Conduction heat transfer was measured through ten fiberglass insulated wall and ceiling test panels. Three with R-7, R-11, and R-19 (ceiling) insulation were reference panels. Seven panels with voids, overlaps, and fixtures were compared to the reference panels. Only the void showed marked increase in conduction loss. Work was performed under phase I of the contract. Evaluation of the same panels for convection loss is being contemplated.

CR 78.007
Engineering Report on Wave Tank Tests on Split Pipe, T. Yamamoto, Corvallis, Ore, Wave Research Facility T.R.3, School of Engineering, Oregon State Univ., Dec 1977, N68305-77-C-0041, ADA055623

Laboratory wave tank tests were conducted to measure and record the horizontal and vertical wave forces on a prototype split pipe with nearly full scale design wave conditions. The ranges of the Reynolds number and the Keulegan-Carpenter number covered are 10^4 and 2×10^5 and 1 to 40, respectively. The tests are done for three water depths, (4 ft, 6 ft, and 8 ft), three wave periods (2 sec, 4 sec, and 6 sec), four wave heights and four orientations (0, 45, 90, and -45 deg), of the bolting flanges of the split pipe. The lift, drag, inertia and maximum horizontal force coefficients were evaluated based on the Airy wave theory and the Morrison equations and other wave force equations. The wave force coefficients are dependent on the Reynolds number, Keulegan-Carpenter number and the flange angle.

The single most important design parameter is determined to be the flange angle. When the flanges are parallel to the bottom, both horizontal and vertical forces are minimum, but the forces are increased by up to seven times when the flanges have large angles to the flow direction. Thus, the disorientation of the flanges by the waves may be a major contributor to split pipe failures.

CR 78.008
A Preliminary Design, Economic and Energy Analysis, and Environmental Impact Assessment for a Seawater Cooling Project, Naval Security Group Facilities at Winter Harbor, Maine, J. Hirshman, Port Everglades, Fla, Ocean Technology Div., Tracor Marine, Mar 1977, N68305-77-C-0012, ADA056603

Preliminary design and analysis were performed for a proposed seawater air conditioning system for an existing U.S. Navy building at Corea, Maine. Two major options were examined. The first, to use seawater for the entire cooling load (100 tons); the second, to use additional cooling and dehumidification (enhancement) if necessary, when the seawater temperature is too high.

A number of alternate enhancement methods were examined, and preliminary designs developed, including one for a solar/desiccant drying system. The existing air conditioning system was also considered for use for enhancement, if desired. The initial costs would be lower than for a new enhancement system; however, life cycle costs for this option would be higher due to greater energy use. The life cycle costs for the seawater system are lower than for a conventional system.

If the seawater system can be used without enhancement, it can save 87% of the electrical energy used for air conditioning. With enhancement it can save 68% of the electrical energy. No significant long-term adverse environmental impacts are foreseen. Minor temporary disturbance of the site will occur during construction.

CR 78.009
Bottom Temperature Measurements in Prospect Harbor, suppl. no. 1 to CEL CR 78.008; and, Biofouling and Its Prevention in Prospect Harbor, suppl. no. 2 to CEL CR 78.008, J. Hirshman, Port Everglades, Fla, Ocean Technology Div., Tracor Marine, Nov 1977, N68305-77-C-0012, ADA056604

Maximum seawater temperatures were measured on the bottom of Prospect Harbor, which adjoins the Corea, ME, detachment of NSGA Winter Harbor, ME, from July to October at two water depths. At a water depth of 45 ft the average temperature reached 50F near the end of July and remained above 50F until the end of the measurements in October. Higher temperature transients exceeding 53F occurred in August and early September for several hours; the highest of these was 55.8F. At a water depth of 20 ft the temperatures were several degress higher until early September, when the temperatures at the shallower location closely followed those of the deeper. It was concluded regarding the NSGA Winter Harbor seawater air conditioning (AC) system that (1) enhancement is required during the hottest weather, (2) reduction in the heat gain is desirable and (3) the seawater intake should be at the deeper location (45-50 ft).

A detailed examination was made of the biofouling community in Prospect Harbor, the NSGA seawater AC system components, which are sensitive to biofouling, and biofouling countermeasure systems. It was concluded that: (1) this system must cope with a serious biofouling problem, (2) a seawater well sunk into the bottom sediments could be used as the seawater intake and would provide the most suitable solution to this problem, (3) sufficient sediment thickness is available for such a well but it is not certain whether the sediments in the intake area can support the required flow (permeability), and (4) copper-nickel alloy tubing or ultraviolet treatment may be required to supplement the seawater well.

CR 78.010
Test Program for Physical Cleaning and Fouling Prevention in Reverse Osmosis Systems, V. S. Allen, F. Shippey, Westlake Village, Calif, Membrane Systems, Feb 1978, N68305-77-C-0014, ADA055624

A number of in-situ physical cleaning methods were tested as alternatives to using chemicals to clean reverse osmosis and ultrafiltration membranes. Flow surging, air surging, continuous air addition and ultrasonic cavitation were used alone and in combination with each other as cleaning methods. Ultrasonic cavitation alone and in conjunction with flow surging were the most effective of the methods tested.

CR 78.011
Thermal Stratification Enhancement for Solar Energy Applications, R. I. Loehrke et al, Fort Collins, Colo, Mechanical Engineering Dept., Colorado State Univ., Jul 1977, N68305-76-C-0036, ADA055918

A study is presented that shows methods to enhance stratification in liquid storage tanks. The report focusses on the development of a passive inlet distributor which minimizes mixing between incoming and stored fluids at unlike temperatures. Theoretical analyses and scale model tests were performed. Computer simulations were used to compare mixed storage with stratified storage in a solar space heating system. Test results showed that in some cases nearly ideal stratification can be obtained and the computer simulations indicated that the load carrying capability of a solar system may be increased 5-10% through the use of stratified storage.

CR 78.012
Materials Study for High Pressure Sea Water Hydraulic Tool Motors, B. Bhushan, S. Gray, Latham, N.Y., Mechanical Technology Inc., Feb 1978, N68305-77-C-0001, ADA055609

The objective of the program was to conduct a comprehensive materials study for a small, compact, positive displacement hydraulic motor which will use pressurized sea water as the working fluid. Gear, vane and piston-type motors were selected for the study. The design analysis of the critical components of each motor type were conducted using a baseline motor size of 10 gpm at 100 psi and 5.8 input horsepower in order to establish the loading and speed requirements. Based on materials requirements, an extensive literature search was conducted of published test data on materials, data relevant to seawater lubricated conditions. In the event that test data on materials was not available, tests were conducted to obtain friction, wear and corrosion data under simulated conditions. Two test rigs were prepared for the studies, one a continuous sliding tester capable of up to 2,000 psi at 1,500 fpm, and the other a reciprocating tester capable of up to 1,500 psi and 250 fpm average speed. The material combinations tested included plastic-metal, metal-metal and nonmetal-metal categories. Submersion tests in sea water were conducted to study corrosion resistance of selected metals and metal couples. Particularly successful combinations in the material testings were: Torlon 4301 (polyamide-imide with fillers) versus Inco 625, and high purity alumina versus plasma sprayed tungsten carbide.

In the continuing design analysis of the motor types, techniques for balancing the internal loads to reduce the contact requirements, and techniques for self-adjustments for wear rate were studied and developed. In the overall assessment of suitability to sea water operation, top ranking was given to the double entry vane motor, this followed by the double row axial piston multi-lobe cam design. The materials evaluated in the study were particularly well matched to the vane motor.

Future work recommendations for continuing sea water motor development included: building and developing a double entry vane motor, an experimental and analytical study of rolling and rolling-plus-sliding contact conditions under sea water lubrication conditions, and further studies of a more basic nature of the lubrication improvements possible with very small quantities of soluble additions and those from reactive motor materials.

CR 78.013
Reducing Vandalism in Naval Bachelor Enlisted Quarters, vol. 1: Project Summary, C. Brady, M. Brill, Buffalo, N.Y., Buffalo Organization for Social & Technological Innovation (BOSTI), Apr 1978, N68305-77-C-0018, ADA058858

Results of a study on the extent of vandalism in Naval BEQs are presented in three "stand-alone" volumes. Volume 1 summarizes vandalism damage which was found to be a problem of high incident rate and high maintenance cost. Volume 2 focuses on concepts for remedial programs to combat the problem. Volume 3 proposes administrative measures to deal with the problem.

CR 78.014
Cogeneration at Navy Bases, Navy Energy Guidance Study, Phase I, A. I. McCone et al, San Francisco, Calif, Bechtel National Inc., May 1978, N68305-77-C-0003, ADA057405

This report analyzes the cost effectiveness of electric power generation at two Navy bases using existing boilers and turbine-generator systems. This study focused on cogeneration which occurs when steam from the power generation turbine can be used to satisfy heating and process steam demands. It was found that cogeneration is the most cost effective means of electric power generation. In contrast, condensing generation is less efficient than power supply from a public utility, and it is usually more expensive. However, occasional use of condensing generation for peak shaving is warranted because it reduces the demand charge. Application of these findings at Philadelphia Naval Shipyard could save up to $800,000 per year in fuel plus electricity purchases. Capital, operating and life cycle costs for new facilities show that it is not economical to install new electric power generation facilities at Navy bases if oil is used.

CR 78.015
Determination of Types and Quantities of Solid Waste Associated With Marine Amphibious Force (MAF) Operations, Long Beach, Calif, SCS Engineers, Feb 1978, N68305-77-C-0039, ADB030562L

The MARCORPS requires a system to manage and dispose of solid waste generated in a Marine Amphibious Force (MAF) environment. This report identifies the types, quantities and generation rates of MAF solid wastes associated with current MAF operations and provides a basis upon which to develop state-of-the-art disposal practices.

CR 78.016
Reducing Vandalism in Naval Bachelor Enlisted Quarters, vol. 2: Demonstration and Design Guidelines, C. Brady, M. Brill, Buffalo, N.Y., Buffalo Organization for Social and Technological Innovation (BOSTI), Apr 1978, N68305-77-C-0018, ADA058028

Results of a study on the extent of vandalism in Naval BEQs are presented in three "stand-alone" volumes. Volume 1 summarizes vandalism damage which was found to be a problem of high incident rate and high maintenance cost. Volume 2 focuses on concepts for remedial programs to combat the problem. Volume 3 proposes administrative measures to deal with the problem.

CR 78.017
Reducing Vandalism in Naval Bachelor Enlisted Quarters, vol. 3: Project Methods and Results, C. Brady, M. Brill, Buffalo, N.Y., Buffalo Organization for Social and Technological Innovation (BOSTI), Apr 1978, N68305-77-C-0018, ADA058144

Results of a study on the extent of vandalism in Naval BEQs are presented in three "stand-alone" volumes. Volume 1 summarizes vandalism damage which was found to be a problem of high incident rate and high maintenance cost. Volume 2 focuses on concepts for remedial programs to combat the problem. Volume 3 proposes administrative measures to deal with the problem.

CR 78.018
Fabrication of Fiberglass Reinforced Plastic Surfacing Under Wet Conditions, T. J. West, Walnut Creek, Calif, Dow Chemical U.S.A., Sep 1978, N68305-77-C-0005, ADA059698

The purpose of this investigation was to develop a system to be used in the construction of fiberglass-reinforced plastic surfacings for soil under wet conditions. The effect of water in the substrate and in the fiberglass mat, on laminate properties, has been defined and solutions have been developed for some of the problems. A system of chemical components has been developed for the field placement of the reinforced plastic soil surfacings under wet

conditions, that is superior to that presently used and is usable with the basic spray equipment now used by the Marine Corps.

It was established that the resin viscosity should be less than 100 cps at the temperature of application for optimum flexural strength. The incorporation of a surfactant into the wet fiberglass mat was found to result in improved resin penetration into the woven roving and increased flexural strength. The addition of 15 percent styrene to the presently used Port Hueneme resin (Selection RS50338) and the incorporation of Triton X100 into the water in the fiberglass mat results in flexural strengths of 25,000 psi - a considerable improvement over the 4,000 psi obtained with undiluted Port Hueneme resin.

DERAKANE (trademark of The Dow Chemical Company) 510-A-40 when diluted with 15 percent styrene and, used with Triton X100, gives laminates having flexural strengths of 30,000 psi, meeting the 28,000 psi flexural strength specification. This resin does not have the desired five year shelf life.

CR 78.019
Gasification at Navy Bases, A. I. McCone et al, San Francisco, Calif, Bechtel National Inc., Jul 1978, N68305-77-C-0021, ADA060475

The work described in this report was performed under Contract N68305-77-C-0021 with the Civil Engineering Laboratory (CEL) at the Naval Construction Battalion Center at Port Hueneme, CA. The title of the contract was "Coal Gasification Feasibility Study." Coal gasification is recognized as a way to produce a clean burning boiler fuel from coal within acceptable environmental limits. The study was to assist the Navy in determining how coal might best be utilized, by comparing gasification with central direct coal-fired boiler systems at each of five bases. Bechtel showed in a previous study for CEL that gasification plants could be economically attractive at Navy bases. Gas from a plant producing 250 x 10^6 Btu/hr with a load factor of 90 percent was shown to have a lower life cycle cost than continued use of fuel oil. This second study examined plants as they would actually be operated. A conceptual design study comparing coal gasification with central direct coal-fired boilers at five bases was performed. The major finding at the five bases studied was that actual load factors are 36 percent or below. Because gasification plant capital costs are high, the reduced load factor makes gasification less attractive. The results showed that coal gasification offers lower life cycle costs than central coal-fired boilers at only one of the bases studied, Camp Pendleton. Installations at Mechanicsburg, PA; Great Lakes, IL; and at Norfolk and Quantico, VA, were not shown to be favorable candidates for coal gasification. A design optimization study for a coal gasification plant at Camp Pendleton was recommended as the next step.

CR 78.020 – Cancelled

CR 78.021
Reducing Vandalism in Naval Bachelor Enlisted Quarters, Volume 4: Analysis of Theft and Theft-Related Property Damage, C. Brady, M. Brill, Boston Organization for Social and Technological Innovation (BOSTI), Jul 1978, N68305-77-C-0018, ADA062988

Results of a study on the extent of vandalism in Naval BEQs are presented in four "stand-alone" volumes. Volume 1 summarizes vandalism damage which was found to be a problem of high incident rate and high maintenance cost. Volume 2 focuses on concepts for remedial programs to combat the problem. Volume 3 proposes administrative measures to deal with the problem. Volume 4 is an analysis of theft and theft-related property damage.

CR 79.001
A Land Management Technique for the Optimal Placement of Facilities in an Amphibious Objective Area (AOA), Ford, Bacon and Davis, New York, New York, Oct 1978, N68305-77-C-0032, ADA064858

At present, a number of separate maps, charts, and tables are required, and manual techniques are used to estimate construction effort and determine where facilities should be placed in an AOA. Present techniques are time consuming, which makes it difficult to optimize placement of facilities within operational constraints to minimize the construction effort and avoid relocation of facilities at a later time.

A methodology is developed which is expected to reduce horizontal construction effort by 20%; included are depictions of significant attributes of terrain, facilities, and their interrelations. The methodology was successfully exercised in a near-operational, MAF-size example.

Automation of the methodology and of the construction effort computations to produce a computerized system is presently underway.

CR 79.002
Dead Band Controls Guide, J. P. Paoluccio, Joseph Paoluccio, Consulting Engineers, La Jolla, Calif, Nov 1978, N68305-78-C-0011, ADA064771

The purpose of this guide is to show methods of reducing energy consumption in new and existing heating, ventilating and air conditioning (HVAC) systems by using the Dead Band control strategy.

Dead Band control strategy and its application to HVAC systems is discussed for three representative climatic zones in the continental United States. Computer modeling techniques provide predictions on energy savings due to control system modifications for six types of HVAC systems and two types of building construction, thermally heavy and thermally light.

The operation of six HVAC systems is described and illustrated for existing and Dead Band control strategy. Computer simulation of these various systems demonstrates that substantial energy savings can be achieved by employing Dead Band control strategy. Bar graphs are provided illustrating relative energy used for each HVAC system. Engineering guidelines for the design of Dead Band control systems are presented in form of control schematics and logic diagrams for each HVAC system. Economic guidelines include techniques for estimating construction and maintenance cost, and performing economic analysis for each system.

CR 79.003
72-Hour Operating Test of a Packaged Heat Recovery Incinerator, L. W. Anderson, Systems Technology Corp., Xenia, Ohio, Aug 1978, N68305-77-C-0037, ADA065415

The performance of the North Little Rock, AR, municipal heat recovery incinerator installation was monitored over a 4-day period. The average energy contents of the solid waste, as fixed, was 3,800 Btu/lb. The average conversion efficiency over the 4-day period was found to be 50.7% based upon the low heating value of the solid waste.

CR 79.004
Fire Tests of Polyurethane Foam Roof Deck Construction on Steel Decks, K. Rhodes, Underwriters Laboratories, Inc., Northbrook, Ill., Dec 1978, N68305-78-C-0010, ADA065403

Fire tests were conducted on built-up roof assemblies specified by the Navy consisting of spray-applied polyurethane foamed plastic covered with specified elastomeric coatings. The Standard UL 790 entitled "Tests for Fire Resistance of Roof Covering Materials," was utilized to measure the resistance to fire originating from sources outside a building on which they may be installed. A 20 ft by 100 ft building ("White House") was used to evaluate the ability of the built-up roof assembly to resist spread of fire on the underside as a result of fire originating from interior sources. Prior to the White House test, 25 ft

tunnel tests and small-scale furnace tests were conducted to (1) provide data for screening and selection of candidate systems likely to perform successfully in the "White House" test and (2) provide additional data on underdeck spread of flame and damage for comparison with performance characteristics of "Fire Classified" assemblies.

As a result of these fire tests and comparisons with previous results for other assemblies, three candidate systems are eligible for Underwriters Laboratories Inc.'s Classification and Follow-Up Service as "Fire Classified" Roof Deck Constructions.

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