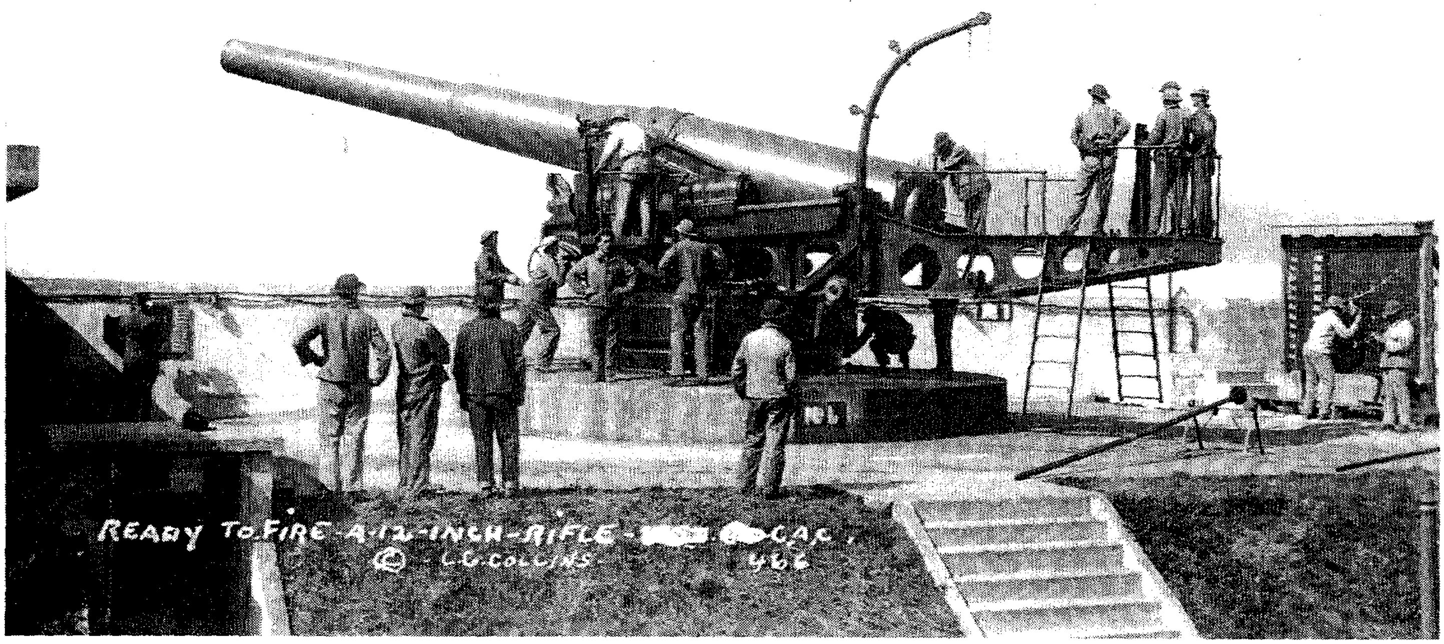
Seacoast Fortifications Preservation Manual

Golden Gate National Recreation Area
San Francisco, California



by

Joe C. Freeman, AIA
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John A. Martini
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National Park Service and KEA Environmental
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ACKNOWLEDGMENTS

The *Seacoast Fortifications Preservation Manual* for the Golden Gate National Recreation Area is the collaborative outcome of much thought, many people, and numerous ideas—not all remembered here. Working together, the National Park Service and KEA Environmental talked through the present and future maintenance needs challenging park personnel in the management of its historic coast defense installations. Spanning nearly 100 years, from about 1870 into the 1960s, the seacoast fortifications are an intensely complex resource that requires teamwork for its interpretation and preservation. The primary authors of the manual included two historians from the National Park Service, Stephen A. Haller and John A. Martini, and three contributors representing KEA Environmental, Joe C. Freeman, David H. Hansen, and Karen J. Weitze. Mr. Haller conceptualized and managed the project for the National Park Service. He developed the scope of work, secured the funding, and served as the lead reviewer across the five authors. His coordination of all National Park Service involvement was essential to the project's success. Dr. Weitze directed the team on a day-to-day level and provided the perspective of an architectural historian. Mr. Freeman served as the project's preservation architect and Mr. Hansen as the lead military historian. KEA historian Christy Dolan served as a research assistant for the team.

Early in the project, the National Park Service hosted a preservation charette to bring together a larger professional group to discuss the batteries and their ancillaries. On a windy, cold December Saturday, a group of 16 preservationists visited selected installations and exchanged perspectives. The *Manual* owes its gratitude to architects Steade Craigo, Hank Florence, and Ric Borjes; to historic materials conservationist Mary Hardy; to landscape architect Denise Bradley; to preservation photographer Brian Grogan; to historians Gordon Chappell and Christy Dolan; to military site volunteers Milton "Bud" Halsey and Eric Heinz; and to maintenance supervisor Tima Alexandro, for joining the authors in volunteering their time that day. In addition, past and present National Park Service maintenance supervisors Charles Schultheis, Therron Hunter, Al Pond, and John Schuster offered their thoughts to Ms. Dolan by telephone. At the Park Archives of the Golden Gate National Recreation Area, Susan Ewing-Haley, Mary Gentry, and Janette Rojas worked with the project team, opening up research files and making available historic photographs and drawings. During the project also, additional representatives from the National Park Service landscape and maintenance departments offered their perspectives and guidance. Mr. Martini, as historian of San Francisco's coast defenses, deserves a double thanks for his willingness to answer email inquires covering a myriad of details. And through Mr. Martini, the project team wishes to thank the other historians of fortifications with whom he exchanged ideas and retrieved even more information—especially Matthew L. Adams of Australia who contributed the history of the U.S. Army Report of Completed Works for the Appendix B collation of Form 7s. Finally, the project team owes its gratitude to the word processing and graphics staff at KEA, and is especially appreciative of the efforts of Gina Zanelli, Julie Mentzer, and Monica Clarke, whose keen eyes and steadfast patience made significant contributions and supported the efforts of all involved.

GLOSSARY OF TERMS

Architecture, Fortifications, and Preservation

active cracking	cracking showing recent movement
adaptive reuse	contemporary reuse for an existing historic structure, often with an updating of infrastructure and added amenities, and, typically with few sustained ties to the original historic function
adobe	sun-dried (unburnt), clay-soil brick; the clay was often mixed with chaff, straw, chopped weeds, tule reeds, or sometimes manure for historic adobe bricks in California, with the individual brick sizes approximately eleven by twenty-five inches and of two-to-five inches thickness; each brick weighed about sixty pounds; Spanish word derived from Arabic *atob* (mud)
aggregate	a constituent in cementitious mixes, usually sand or gravel
alkalinity	the presence of chemical base material such as hydroxides and carbonates of calcium, sodium, or potassium
alligatoring	a surface cracking pattern resembling alligator skin
ammunition hoist	a mechanical device for moving projectiles and powder from the magazine to the level of the gun
ancillary	a dependent structure, often but not always small in scale; associated hierarchically with a primary structure; often found in clusters with other dependent structures
angle iron	iron or steel cross section with two legs ninety degrees apart
architectonic	resembling architecture in manner and organization
area drain	a surface drainage inlet to convey and disperse water
artificial stone	varieties of cement-based, man-made imitations of naturally occurring rock, the latter typically quarried for building
asphalt (asphaltum)	various bituminous substances, both naturally occurring and resultant from petroleum processing; also a bituminous substance mixed with crushed rock for paving
asphalt emulsion paint	a surface coating containing emulsified asphalt for moisture protection
automatic cannon	rapid-fire, light-caliber guns in which the force of the recoil is used to load and fire the piece without the crew having to manually insert and fire each round
backer rod	a foam, tubular-shaped rod placed in a joint that is to receive a sealant to provide a solid base to receive and hold sealant
backfill	filling a previous excavation

balanced pillar mount a mount for smaller caliber coast artillery, which raises the gun above the parapet into the firing position and lowers it below the parapet for loading using a telescoping cylinder

barbette carriage a mount for seacoast artillery in which the gun remains above the parapet for loading and firing

base line a pre-surveyed horizontal line used for accurate position-finding and fire control, with observation posts called base-end stations at either end

base-end station observation station at either end of a base line, containing an azimuth instrument or depression position finder, used to supply position data for the indirect aiming of coast artillery weapons

battery a defensive structure containing all features and appliances necessary to support and serve a number of cannon

battery parade the area in the rear of a battery where troops take formation

Beaux-Arts French term [*Ecole Nationale et Spéciale des Beaux-Arts*, Paris] meaning fine arts; label for an architectural movement and training program, and for its associated architects, 1865-1915; loosely, architecture as fine art, characterized by an emphasis on classical tradition; Beaux-Arts was sometimes used as an alternative term for Classical or Colonial Revival design in the United States during the late nineteenth and early twentieth centuries

benching installing fill materials in lifts

bentonite panel an organic clay sheeting (compressed and rolled) to provide a waterproof membrane

berm a ledge, embankment, or shoulder, often man-made, and typically earthen; also, a narrow path between a fortification parapet and its surrounding ditch

beton agglomere a French term for an artificial stone of cementitious materials in a matrix

binder cementitious materials which chemically bind aggregates in a matrix

bitumen rock largely consisting of hydrocarbons; naturally occurring asphalt

blackboard rack a metal frame extending from the side of the data booth in a mortar battery to support a set of blackboards upon which firing data could be written

blast apron a relatively thin paving of concrete in front of a gun emplacement that protects the ground from erosion, reduces dust, and helps control the possibility of fire

blind drain a hidden drain

bombproof a heavily built shelter, either a separate structure or a room within a battery, that can withstand the effects of bombardment

breast wall — a wall of breast height, typically used to provide a defensive position for infantry soldiers

breech-loading weapon — a weapon in which the round is loaded by opening a plug at the base of the gun tube

built environment — buildings, structures, and ancillaries comprising an inter-related man-made area, often architectural in character

bunker — an indistinct term that generally means a heavily built structure, usually a shelter against bombardment, that may or may not have provisions for defense; no specific meaning in coast defense; comes into popular use during WWI

butyl membrane — a rubberized sheet membrane utilizing butyl

caliber — the minimum diameter of the bore of a firearm, and therefore the diameter of the projectile it fires; also used to describe the length of a cannon, expressed as a multiple of its diameter

camouflage — the measures taken, or the material used, to conceal or misrepresent a military position

cantilever — to project horizontally with one end of the structure (beam or slab) anchored into a pier or wall; also, the term for such an extension or for a projecting bracket

caponier — a protrusion from the wall of a fortification, designed to allow grazing fire from within to sweep across the scarp walls adjacent to the parapet

carbonization — formation of carbon from organic matter under heat and compression

casemate — a chamber within a fortification built with overhead cover, and therefore resistant to bombs or high-angled shell fire

casement window — a window opening on hinges, which are generally attached to the sides of the window frame

castillo — the Spanish term for fortification

cast iron — a brittle iron cast from molten iron to a specific shape

ceiling trolley — a wheeled carriage running on, or in, tracks fastened to the ceiling, from which a projectile was suspended for movement

cement paint — a water-based paint containing Portland cement

cement-stabilization — to stay chemical activity in cement; to prevent further deterioration

chalking — paint deterioration caused by loss of paint binder, leaving dried pigments

chamfer — an oblique surface cut on the edge or corner of a board, usually sloping at forty-five degrees

character-defining / distinctive feature
features particular to a historic structure that distinguish and/or typify its character in terms of its original visual and structural design (and engineering), and in terms of its historic function or use

charette a French term for a small, two-wheeled cart; at the *Ecole Nationale et Spéciale des Beaux-Arts* instructors collected students' drawings for assigned projects in a charette and the term came to be associated with the process of designing, and in particular with a work in progress by a group of architectural professionals

choke point a constricted geographical area, easy to defend.

cold joint a break in a construction installation; a stopping point

cold rolled steel steel pressed and shaped without heat

columbiad a large caliber, smoothbore, breech-loading cannon, designed to fire both shot and shell

common brick utilitarian brick used for normal-load-bearing construction

compressive force the tendency of a mass to bear on a surface by gravity

counter-scarp wall in field fortification, the wall opposite the scarp; more directly, the side of a defensive ditch closest to the opposing force

crazing random hairline surface cracking

cross fire direct fire coming from two opposing directions at once

cultural landscape the comprehensive (and linked) built and natural landscape defining a distinctive cultural-use area

curing chemical process of dehydration by which cement and aggregate harden or set

cut and fill efficient earthwork where cut materials are used to fill low spots adjacent to the cut

dado the lower, broad part of an interior wall, finished in a painted or textured scheme different from that of the overall wall surface

damp course a thru-wall membrane to resist rising damp

deflection deformation of a structural element caused when loading exceeds resistance

deflector a large stone placed within the mass of early concrete fortifications and intended to deflect a projectile that might strike it, thereby protecting interior spaces

delamination deterioration in disconnected sheets or plates

dependent structure ancillary structure

design parameters variables of function, need, or usage that directly affect the design of a building, structure, or object

disappearing carriage a gun mount designed to raise the gun to firing position above the parapet by means of a counterweight, and use the force of recoil to carry the gun back to its loading position below the parapet

dog a metal connector or strap

dormant cracking cracking that is not active

double-hung window a sash-type window with the lower framework typically moving up and down vertically, and the upper framework fixed; single-paned or multi-paned in type

drip line the line where water is shed from a surface

dynamite battery an experimental, and impractical, pneumatic gun that fired dynamite, using compressed air rather than gun powder to propel the dynamite to the target

earthwork a military construction formed chiefly of earth, used in both defensive and offensive operations

efflorescence soluble salts forming on a surface

elastomeric membrane
a flexible sheet of rubberized material used for moisture protection

elevation a scale drawing representing a structure or building as projected geometrically on a vertical plane parallel to the chief dimension

embrasure a small opening in a fortification through which the weapon fires

emplacement a subdivision of a battery that refers to a single gun and the provision of services necessary to its functioning; compare with *pit*

escutcheon plate the door plate to which the handle is attached; or, the door plate protecting the keyhole or locking mechanism

esplanade a level area of a fortification

Endicott William C. Endicott, Secretary of War under the administration of President Grover Cleveland, associated with the program of modernization of American seacoast fortifications at the end of the nineteenth century

epoxy a polymer-based substance where oxygen and carbon atoms bond in a unique way; used in paints and adhesives; usually a two-component paint system where the components are mixed to achieve the chemical reaction that results in a hard and durable finish

existing condition the current condition, inclusive of advancing deterioration, of the physical fabric defining a site, structure, building, or object

expansion joint a joint used to compensate for or isolate structural movement

fatigue natural deterioration or loss of strength in a material

feature mapping the accurate recording of all features in a structure, including the observable imperfections of fabric, as a base for future preservation work or measuring the rate of change in physical condition

field artillery the light and medium artillery pieces, and their units, whose function is to support the army in mobile battles and campaigns, not emplaced permanently in one area

field density field-measure density used to determine degree of compaction; expressed as a percentage

field review (inspection / reconnaissance)
the on-site, physical observation and analysis required to ascertain the current conditions present at a historic property; here, when accompanied by maintenance actions, using the Action Log (Appendix C)

fire control station a structure housing the equipment and personnel necessary to accurately determine the location of targets or to command the fire of several batteries

first system of American seacoast fortification
open fortification works of earthen construction, dating to the 1790s, which represent the first American attempt at a seacoast fortification network

flag a flat slab of stone, or artificial stone, used for paving

flash rust immediate corrosion of bare ferrous metals due to exposure to moisture in the air

flashing a mechanical device used to prevent moisture infiltration

flat trajectory fire high velocity direct fire, in which the projectile travels in a relatively straight line to the target

fog base a base line system positioned at low elevation, to act as an alternate base line in case the view from the primary base-end stations was obscured by fog

footing the perimeter base (or bottom) beam of a structure

formwork the temporary mold of timber or metal boards, or sheets, that is used to give concrete its desired form, and, to give it support until it has hardened sufficiently

French drain an underground linear drain designed to intercept and disperse water

gallery a long room or passage, typically enclosed

garrison the troops permanently assigned to a military post

general management plan
the official master plan for a park, approved after a period of public comment

GPF gun — the U.S. 155mm gun, Model 1918 on field carriage, a large mobile artillery piece used to supplement the fixed seacoast defenses; GPF is the acronym for *Grand Puissance, Fillioux* or high-powered gun, named after its French designer

granolithic finish — a cement-based surface (or floor) finish for concrete resembling granite; often applied when the concrete is fresh (green) and sometimes augmented by a surface hardener based on sodium silicate

gravity / convection ventilation — ventilation using natural convection or air movement caused by differential pressure and air temperature

grazing fire — flat trajectory fire placed low along the ground or water

gritblast — high pressure air cleaning using sand or other grit

groin vault — a vault formed by the intersection of two or more barrel vaults, with the omission of all of those parts that would lie below each of the uppermost vault forms

groupment — an organization of firing batteries grouped together, irrespective of their permanent units, to provide the most effective command and control of an area's harbor defenses

grout — a thin, coarse mortar poured into the joints of masonry and brickwork; to fill such joints

gun — a cannon that fires a high velocity projectile on a flat trajectory

gun platform — that portion of a permanent battery upon which the cannon is emplaced

habitat — the kind of place where a particular animal or plant lives or grows naturally, or, thrives

harmonic movement — coordinated movement due to the effects of wind loading

historic architectural inventory — a systematic inventory recording the physical fabric and setting for historic properties; usually accompanied by photography; here, using the Coast Defense Resource Checklist (Appendix C)

historic structure / resource — generally, with respect to American preservation efforts , a building, structure, or object meeting the requirements of eligibility for the National Register of Historic Places

historic site — generally, with respect to American preservation efforts, a prehistoric or historic archeology site meeting the requirements of eligibility for the National Register of Historic Places

hopper window — a window opening outwards at an angle and having a bin-like appearance when open

horizontal crest	a coastal fortification term that refers to the desire of the designers to keep the highest part of a gun battery, particularly those for guns mounted on the disappearing carriage, flat and unmarked by any object that could be used to identify the location of the battery from the sea
hydrostatic pressure	variation in air pressure that causes moisture to rise vertically in a wall
I beam	a metal structural shape designed to withstand deflection and twisting forces; consists of flanges and web
infrastructure	the structural skeleton beneath the outer skin of a building; also, the comprehensive system underlying a cohesive group of buildings and structures
integrity	with respect to American preservation actions, a reference to the seven points of integrity—location, design, setting, materials, workmanship, feeling, and association—defined within the criteria for eligibility to the National Register of Historic Places
interpretive plan	a document that describes the themes and objectives of a park's public education program, and the means for reaching those objectives
jack	a mechanical device to lift
jamb	a vertical piece forming the side of a doorway or window opening
jig	template
joist	a simple timber, steel, or precast-concrete beam supporting floor boards or ceiling lath
laitance	a condition occurring when concrete is mixed too wet, causing cementitious materials to concentrate and leaving portions of the mix cement-poor
lamellar tearing	stress-related metal deterioration
lampblack	a carbon byproduct of burning hydrocarbons; used as a pigment in paint
lime mortar	a mortar of one part lime and three parts sand
lime wash	a thin lime mortar used as a paint
lintel	a horizontal supporting member above an opening such as a window or door
loam	a loose soil composed of clay, sand, and organic matter, often highly fertile
louver	a slanted board or slat in an opening, overlapping with other boards or slats, and arranged to admit air but to exclude rain
magazine	a room within a battery or an emplacement where munitions are kept; often used more narrowly to indicate a room for the storage of powder
maintenance	the ongoing efforts to clean and repair a structure in order to prevent or slow its deterioration

Mandary flue cap a proprietary name for a type of clay flue cap manufactured by the Superior Clay Company in Ohio

maneuvering ring an iron ring set into the interior wall of a gun pit to aid in moving or adjusting the position of the heavy weapons

microclimate the distinctive climate of a restricted geographic area as defined within the more encompassing climate of a region

microcrystalline wax a fine wax with the ability to fill microscopic pores in materials; a sacrificial coating and protection

mine casemate a heavily protected room or building specially fitted out for the firing of submarine mines

moisture / damp-proof membrane
a surface coating that prevents moisture infiltration

monolithic of one material

mortar (architecture) a mixture, as of lime or cement, sand, and water, which hardens in the air and is used for binding together bricks or stones

mortar (fortification) a cannon designed to fire projectiles in a high, arched trajectory to reach over line-of-sight obstacles

mortar joint the area between individual bricks or stones, and between layers of such masonry, filled with binding material to create a compact mass

mortise a rectangular cavity of considerable depth in a piece of wood for receiving a corresponding projection (tenon) of another piece of wood

muntin a slender, vertical or horizontal, wood or metal piece separating individual window panes

muzzle-loading weapon
a weapon in which the projectile is loaded from the front, or muzzle, end of the gun tube

National Historic Landmark
nationally significant properties in American history and archeology; recognition established through the Historic Sites Act of 1935; official list maintained by the National Park Service on behalf of the U.S. Secretary of the Interior

National Historic Site
nationally significant sites in American history and archeology; program established through the Historic Sites Act of 1935; National Historic Sites are formally a part of the U.S. National Park system and are managed as physical property by the National Park Service

National Register of Historic Places
: the official list of historically significant national, state, and local districts, sites, buildings, structures, and objects maintained by the National Park Service on behalf of the U.S. Secretary of the Interior; established through the National Historic Preservation Act of 1966

native vegetation — vegetation indigenous to a geographic area

neat cement — a mix of one part cement and one part sand without large aggregate

open space — relatively undeveloped land set aside for its recreational, habitat, or resource values

ordnance — artillery pieces and the equipment used to maintain and fire them

Panama mount — a permanently fixed open gun platform upon which a mobile artillery piece can be quickly placed for accurate fire and ease of traverse

parados — an earthen or concrete barrier that protects a battery from fire from the rear

paraffin paint — a paint containing petroleum-based wax

parapet — in coast defense, a wall of concrete or masonry that protects the cannon and those manning it

parging — coating masonry with a cement-rich wash

percolation — filtration of water through a material

pintle — a pin or bolt, especially one on which something turns, as in a hinge

pit — an emplacement containing two to four mortars and the provisions necessary for their service; compare with *emplacement*

plan — a drawing made to scale to represent the top view or a horizontal cut of a structure or building

planes of weakness — cold joints or planes susceptible to differential movement

plasticity index — a scale of relative value indicating swelling or the expansive characteristics of soil

plate — a thin, flat sheet of metal or other material of uniform thickness

plotting room — a room containing the men and equipment required to develop the necessary data to accurately aim a gun or a group of mortars

pneumatic gun — a gun that fires a projectile by the sudden release of highly compressed air

point — to apply a final layer of mortar to a joint

point loading structural loading concentrated on a small cross-sectional area, as in the load of a beam transferred to a column

poultice a material applied to a surface that absorbs a previous coating and draws it out

Portland cement a hydraulic cement made by burning limestone and clay

preservation an effort to sustain the remaining physical fabric of an historic structure, with attention to the seven points of integrity—location, design, setting, materials, workmanship, feeling, and association—as defined by the criteria of the National Register of Historic Places

presidio the Spanish term for a fortified garrison

primary structure the key building or structure defining a cluster of buildings and / or structures; or, the key building or structure supported by a group of ancillary (dependent) buildings and / or structures

prime the first coat of a series of coats, usually paint

projectile a generic term for the destructive missile thrown from a firearm

protection to provide an historic site or property with a defensive system intended to inhibit further loss or deterioration of the existing physical fabric

punching shear a point load acting on a horizontal plane, as in a column resting on a slab

rail a horizontal timber or piece in a window framework, wainscot, or door paneling; paired with *stile*

rapid-fire gun a gun that can be loaded and fired with great rapidity because of a single-motion breech mechanism; such guns also usually employ fixed ammunition, avoiding the need to load the propellant and the projectile separately

rebar reinforcing steel bars used to provide a tensile component to compressive cement; various shapes: billeted, deformed, smooth, and twisted

redan a small fortification consisting of two parapets forming a salient angle, with the rear face of the fortification open

rehabilitation an effort that minimally alters the remaining physical fabric of an historic property, while sometimes adding features to allow efficient contemporary use; executed with an emphasis on the seven points of integrity—location, design, setting, materials, workmanship, feeling, and association—defined by the criteria of the National Register of Historic Places

repoint replacement of masonry joint mortar

resource management zone geographical areas defined in a park's general management plan that are managed according to distinct legislative and administrative requirements, resource values, and public preference

restoration	an effort to retain, preserve, or restore the complete physical fabric of an historic property appropriate to a researched temporal period, with close attention to the seven points of integrity—location, design, setting, materials, workmanship, feeling, and association—defined by the criteria of the National Register of Historic Places
retaining wall	a wall built to hold back a mass of earth; a revetment
rifled artillery	a large caliber, long-range weapon, with helical grooves cut in the bore to impart spin, and therefore stability and accuracy, to the projectile
riser	the vertical face of a stair step
rising damp	moisture rising in a wall due to hydrostatic pressure
Rosendale cement	a Portland-type cement found in New York state; naturally occurring
saddle	a structural implement or connector
salients	the portion of a fortification that projects towards the enemy
sally port	the protected entry way of a fortification
sash	a moveable framework in which planes of glass are set, as in a window
scab	a new piece of wood attached to an existing, deteriorated, or weakened member
scarp wall	in field fortification, the wall closest to the defenders in a ditch built as an obstruction
seacoast fortification	the fortification network designed and emplaced to protect naval bases, seaports and other important coastal waters from the intrusion of hostile warships
second system of American seacoast fortification	open batteries and masonry-faced forts constructed by the United States to protect strategic points on the Atlantic seaboard; predominantly prior to the War of 1812
section	a cross-sectional drawing made to scale representing a vertical cut through a building or structure
Sewell building	a frame building clad with cement stucco applied over an expanded metal lath, and referred to by the name of the army engineer officer who developed the technique, John Sewell
sheepsfoot roller	a heavy steel roller with individual protruding cleats in a shape associated with that of the feet of sheep; used for soil compaction
sheet lead	flat sheets of lead used for flashing
sheet metal	flat, thin metal, usually steel or steel alloy

shell	a hollow projectile, filled with explosives, designed to exercise destructive force by explosive energy
shoring	supporting posts, beams, and auxiliary members placed against the side of a building or structure; especially supports placed obliquely
shot	a solid projectile of dense metal, designed to exercise destructive force through penetration and kinetic energy
shot room	a room within a battery or an emplacement for the storage of projectiles
sloughing (soil)	the movement or partial collapse of an earthen slope
shuttering	overlapping or sheet materials to shed water; shingling
sidewalk concrete	concrete with a granolithic finish or with a finish of small stones imbedded in cement
significance	generally in American preservation efforts, defined through the four criteria (A, B, C, and D) of the National Register of Historic Places; summarized as significance associated with key historic events (A), the lives of important persons (B), established architectural or engineering merit (C), and, the potential to yield worthy new information in history or prehistory (D).
sill	a horizontal timber, block , or the like, serving as the foundation for a wall; the horizontal piece beneath a window, door, or other opening
smoothbore artillery	large caliber weapons with smooth, unrifled bores, designed to fire spherical shot or shell ("cannonballs")
soil grouting	injection of lime or cement into soil for stability
sonic meter	a device using sound waves to determine relative density
sounding hammer	a hammer used to strike concrete to determine consistency by the characteristics of the sound
spall	the flaking off of a material caused by expansion and contraction, or by material decomposition
speaking tube	a metal tube, either imbedded in the body of concrete or suspended from the ceiling, through which voice communication could be had between various parts of an emplacement or battery
splinterproof	a heavy concrete roof designed to protect against shell fragments
stabilization	to reestablish the structural equilibrium of an historic building or structure, or, to arrest further deterioration to an historic property or site, generally
stanchion	an upright bar, beam, post, or support, as in a window, stall, or compartment
stewardship	the management of a property, site, or historic resource

stile a vertical member in a wainscot, window, paneled door, or other piece of framing; paired with *rail*

strategic military art and science applied on the large scale to the employment of nations, their resources, armies and fleets

stud a post or upright wood member in the wall of a building

stirrup a shaped piece of reinforcing steel designed to tie two (top and bottom) horizontal rows of reinforcing

substrate a raw, base material (wood substrate to paint); underlying layer

suction spotting inconsistent absorption by a porous substrate caused by inconsistent surface preparation; volatile solvents evaporate at different rates

surface bonding chemical or friction connection between a substrate and applied finish surface

tactical military art and science applied to the employment of small scale units and capabilities of particular weapons

tamping manipulation of concrete in a form to settle concrete and eliminate voids

Taylor-Raymond hoist
the most successful of several ammunition hoist designs, developed by Harry Taylor through a series of improvements upon an earlier design by Robert Raymond; Taylor and Raymond were both army engineer officers

telautograph booth a free-standing concrete structure (but also a recess) that housed a telautograph, an electro-mechanical distance writing instrument

tensile force force which seeks to pull materials apart

terreplein a term that dates from much earlier fortification practice and meaning the area of a rampart where guns could be maneuvered; by the 1890s, it was used most often to indicate the ground level of a battery, but it soon fell out of use

thermal expansion / contraction
differential movement due to change in size caused by changes in temperature

third system of American seacoast fortification
a system of permanent masonry forts and supplementary batteries, designed between the War of 1812 and the Civil War, to improve upon the protection of strategic points along the Atlantic and Gulf coasts of the United States

tongue-and-groove joint
a common joint consisting of a projecting strip along the edge of a board and a matching groove on the edge of the next board

tramway a light rail line upon which ammunition carts could be pushed or hauled by hand

transfer drawing a detailed drawing made by U.S. Army engineers when a completed battery was transferred to the artillery service; it provided instructions about the use and care of all the equipment and facilities furnished with the battery

transit an optical instrument used to set lines, grades, and elevations

traverse in fortifications, the structure on either side of an emplacement that provides protection from flanking fire; when referring to a cannon and its carriage, it can also mean movement to the left or the right

treatment plan a plan describing specific operations used in maintaining or preserving architectural properties

trench drain a linear drain designed to convey, intercept, or trap water

turret mount a weapon mounted in a rotating, armored enclosure

variable-burning powder propellant charge consisting of various sized grains of powder, which will therefore burn at different rates; the effect will accelerate the projectile more gradually out the gun tube, providing increased ultimate velocity and less strain on the gun barrel

viewshed the panoramic, or otherwise fully encompassing, view *from* an historic site or property

water battery a gun battery placed to lay grazing fire across the water

whitewash a mix a hydrated white lime, alum, water used as a surface coating

wythe the width of a brick

LIST OF ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
APA	American Plywood Association
APT	Association for Preservation Technology
ARADCOM	Army Air Defense Command
ARPA	Archeological Resource Protection Act
ASTM	American Society for Testing Materials
AWPBS	American Wood Preservers Bureau Standards
BC	battery commander
CFR (fort.)	coincidence range-finder [station]
CFR (pres.)	Code of Federal Regulations
CRSI	Concrete Reinforcing Steel Institute
EPA	Environmental Protection Agency
FHWA	Federal Highway Administration
GPF	*Grand Puissance, Fillioux* [a high-powered gun named after its French designer]
GRI	Geosynthetic Research Institute
ICBM	intercontinental ballistic missile
MC	mine casemate
NACE	National Association of Corrosion Engineers
NOMMA	National Ornamental and Miscellaneous Metals Association
OCE	Office of the Chief of Engineers
OSHA	Occupational Safety and Health Administration
psi	pounds per square inch
RCB	Report of Completed Batteries
RCW	Report of Completed Works
SCR	Signal Corps Radio [Army radar classification developed during World War II]
SPIB	Southern Pine Inspection Bureau
SWRI	Sealant, Waterproofing, and Restoration Institute
WCLIB	West Coast Lumber Inspection Bureau
WWPA	Western Wood Products Association

INTRODUCTION

The *Seacoast Fortifications Preservation Manual* for the Golden Gate National Recreation Area is a collaborative effort, drawing upon expertise across several disciplines. Five primary authors contributed to the manual, with other individuals crucial for their roles as discussants, question answerers, and sources of specialized information. The manual is divided into three parts, with appendices supporting the volume.

"Part I: History and Preservation for Coast Defenses" introduces the installations and the preservation process. The four chapters of Part I include an opening conversation with readers of the manual—why preserve coast defenses—and three background introductions to the broader topic of these fortifications and their maintenance. Historian Stephen A. Haller and architectural historian Dr. Karen J. Weitze, leaders for the National Park Service and KEA Environmental team, contributed chapter 1. Mr. Haller, as Park Historian for the Golden Gate National Recreation Area, wrote chapter 2, a look at the national context for the coast defense fortifications of the San Francisco Bay Area. Military historian and preservationist David M. Hansen authored chapter 3, defining the character-defining features of the fortifications and giving readers a basic vocabulary with which to interpret these specialized historic resources. Chapter 4, standards and guidelines for the preservation process, is the joint effort of Mr. Hansen, Mr. Haller, and Dr. Weitze.

"Part II: Engineering, Design, Construction and Maintenance Issues" focuses on historic architectural-engineering practices at the San Francisco batteries. Chapter 5 offers an introductory analysis of the materials used at the San Francisco batteries and at the Nike sites, 1870 to 1970, and is authored by Dr. Weitze. Several complementary paragraphs written by Mr. Freeman, and originally appearing in chapter 7, have been incorporated into chapter 5. Paired with chapter 5 is Mr. Hansen's chapter 6, a discussion of American battery design, concentrated on the Endicott period.

The four chapters of "Part III: Treatments" develop maintenance treatments and procedures, with the individual pull-out sheets of chapter 10 topically addressing known concerns and challenges. Pull-out sheets are organized by historic materials and subtopics, such as "Brick Construction: Mortar and Repointing" and "Metals: Handrails and Guardrails," with each sheet independently formatted. Historical architect Joe C. Freeman contributed chapter 10. Chapters 7, 8, and 9 support the treatments and procedures presented by Mr. Freeman. Chapter 8, discussing safety and security issues at the batteries and their ancillaries, is the joint contribution of Dr. Weitze, Mr. Hansen, and John A. Martini, Curator of Military History for the Golden Gate National Recreation Area. Chapters 7 and 9, contributed by architect Freeman, provide analyses of the elements of deterioration across the coast defense installations, as well as overviews of types of suggested treatment plans. The suggested plans are focused on a range of alternatives from stabilization to restoration.

The appendices offer further source material to the reader. Appendix A gives a list of the coast defense fortifications within the jurisdiction of the Golden Gate National Recreation Area, with a representative selection of ancillaries. The list is intended as a basic guideline for the reader, providing him with beginning and completion construction dates; and, with gun emplacement and removal dates. Installations visited during field work for the manual are so noted. Appendix B is a set of U.S. Army Form 7s, simple plans, elevations, and sections for the batteries. Although the Form 7s are not a complete set, they do offer useful information for future maintenance site work. A brief history of the Form 7, derived from the work of military historian Matthew L. Adams, opens the appendix. Appendices A and B are researched and written by military historian Martini. Appendix C provides the Coast Defense Resource Checklist, with an introductory discussion of its intended use in a future historic architectural inventory and in ongoing maintenance work. Mr. Hansen developed the resource form, with additional comments for its best use found in chapter 4. Also in Appendix C is an Action Log for use by the maintenance staff of the National Park Service. The Action Log can be reproduced in multiple, Completing the concluding sections, Appendix D offers a summary of professional sources for treatment materials and techniques, while Appendix E provides professional cut-sheets discussing manufacturers' standards for items often required in the maintenance of historic structures—such as appropriate soil stabilization products, concrete pigments, coatings, and epoxy injection.

Over 100 illustrations accompany the *Seacoast Fortifications Preservation Manual* for the Golden Gate National Recreation Area, inclusive of historic photographs from the collections of the Park Archives of the Golden Gate National Recreation Area; contemporary photographs at the batteries taken by Mr. Hansen; and, sketches provided by architect Freeman. Together these illustrations offer the reader a close look at the range of challenges present at the coast defense sites of the San Francisco Bay.

Text and illustrations are offered to encourage thoughtful maintenance and preservation at the batteries and ancillaries of the Golden Gate National Recreation Area, and to further encourage such efforts for all coast defense fortification sites—American and international.

Chapter 1: Why Preserve Coast Defenses?

The Golden Gate National Recreation Area is challenged to protect, preserve, and interpret a grouping of more than fifty coast defense fortifications, ranging in age from fifty-five years to more than a century, inclusive of the remaining earth-and-brick batteries of the early 1870s, to the experimental and sophisticated reinforced concrete structures of the Endicott period through World War II (Maps 1–4). Augmenting the oversized scale of the primary gun emplacements that define the batteries, themselves sometimes eight in number at a mortar site, are approximately 160 ancillary structures and associated features of the coast defense cultural landscape. Ancillaries include casemates that served as the explosive operating units for mines placed under bay waters; fire control stations for modernizing the command required with the expanded range and accuracy of modern guns; and, searchlights at multiple points of land jutting out along the coastline both north and south of the harbor entrance. Mine casemates and fire control stations, the latter also known as base-end stations, first appeared during the 1890s, while systematic searchlights followed after the turn of the century. Extending coast defense through World War II and into the Cold War decades of the 1950s and 1960s are radar stations and Nike antiaircraft batteries, with Nike emplacements found from the northernmost edges of today's park to the far south (Maps 5–7).

Significance

The seacoast fortifications of San Francisco Bay are significant as well-preserved examples of nearly every important development in military fortification engineering from before the Civil War to the guided missile era; as tangible manifestations of changing periods of the nation's history and of its changing military responses; and as associative links with people important to the history of the nation as a whole from John C. Fremont and "Kit" Carson to Irvin McDowell and Douglas MacArthur. The military reservations that provide a relatively unchanged physical context for these fortifications also provide a spectacular backdrop of largely undeveloped open space at the very verge of a great urban metropolis. This open space is not only a defining factor in the San Francisco Bay Region's world-renowned scenic beauty, but has become the core of land around which is established the first of the nation's urban national park areas.

Public Law 92-589, the enabling legislation which created the Golden Gate National Recreation Area in 1972, stated that the new park's purpose was, "to preserve for public use and enjoyment certain areas on Marin and San Francisco Counties, California, possessing outstanding natural, historic, scenic, and recreational values…" [1] This national park is one of the 375 units (at the time of this writing) of a world-renowned system of natural reserves, scenic areas, and historic sites whose overall mission is to "preserve unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of this and future generations."[2]

The *Golden Gate National Recreation Area/Point Reyes National Seashore General Management Plan* (1980) placed all the fortifications within a preservation zone, where the historic resources are "to be managed and used primarily for the purpose of facilitating public enjoyment, understanding, and appreciation of their historic values" and for "protection of structures from influences and uses that could cause deterioration.[3]

In carrying out its mission of historic preservation, the National Park Service adheres to the provisions of the National Historic Preservation Act of 1966, as amended. This act requires the heads of all federal agencies to establish a preservation program that identifies, evaluates, protects and nominates historic properties to the National Register of Historic Places. The Act stipulates that such historic properties "are managed and maintained in a way that considers the preservation of their historic, archeological, architectural, and cultural values …and gives special consideration to the preservation of such values in the case of properties designated as having National significance."[4]

In accordance with the above laws, regulations and policies, the seacoast fortifications within Golden Gate National Recreation Area have been determined eligible for, or placed upon, the National Register of Historic Places as: the Fort Mason Historic District; the 6-Inch Disappearing Rifle; the Fort Miley Military Reservation; the Fort Baker, Barry and Cronkhite Historic District; Fort Funston; and the Hill 640 Military Reservation. In addition, the following coast defense properties have been designated National Historic Landmarks because of their national significance: the Presidio of San Francisco; Fort Point; and Alcatraz Island. The entire seacoast fortification network at Golden Gate National Recreation Area is presently in the process of being nominated as a National Historic Landmark, and is being managed as such until an official determination is made.

Therefore, within the framework of the mission of the National Park Service; the legislated purpose of the Golden Gate National Recreation Area; and established legislation and approved park policy; the answer to the question "Why preserve coast defenses?" is clear: "It is policy, firmly based upon law."

Reasons to Preserve

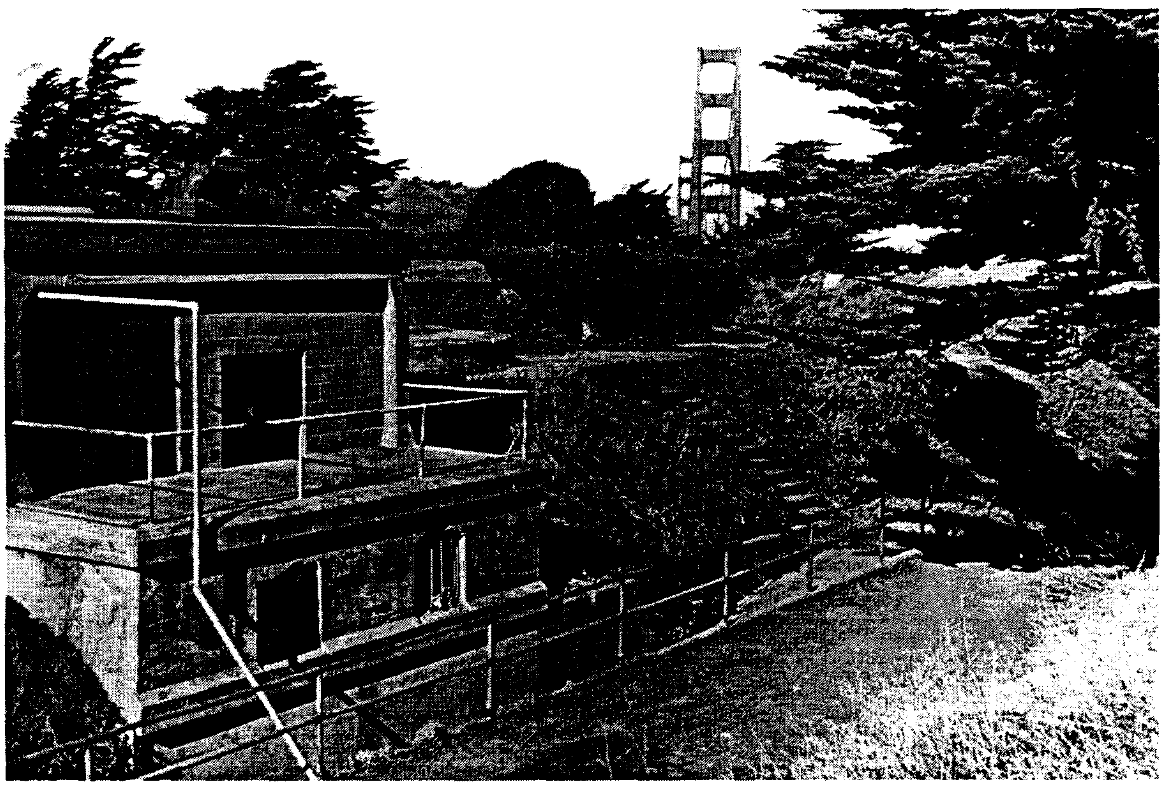
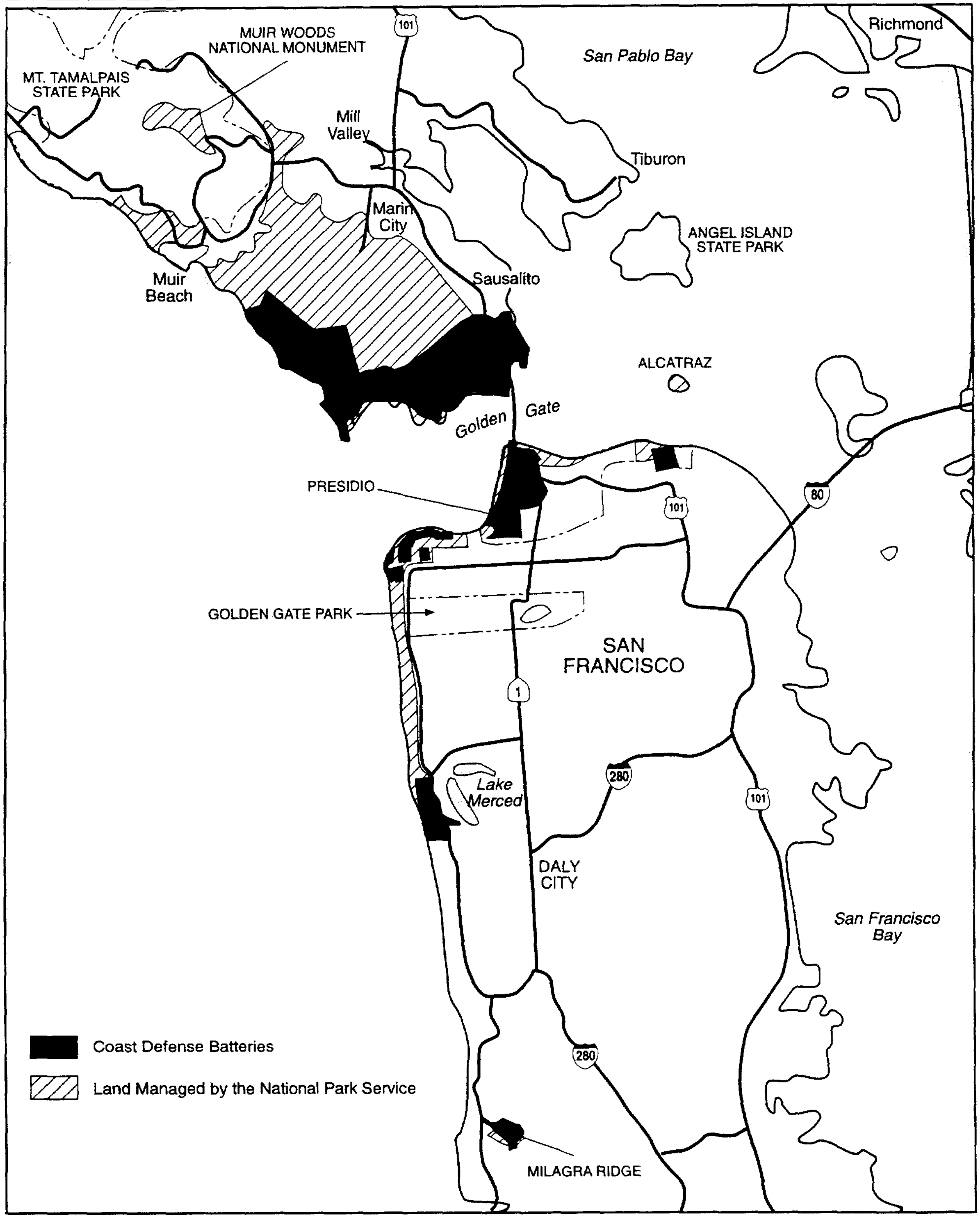
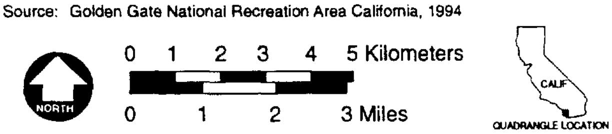


Plate 1. Battery Godfrey, Fort Winfield Scott, constructed 1892-1896. Looking northwest at loading platform.

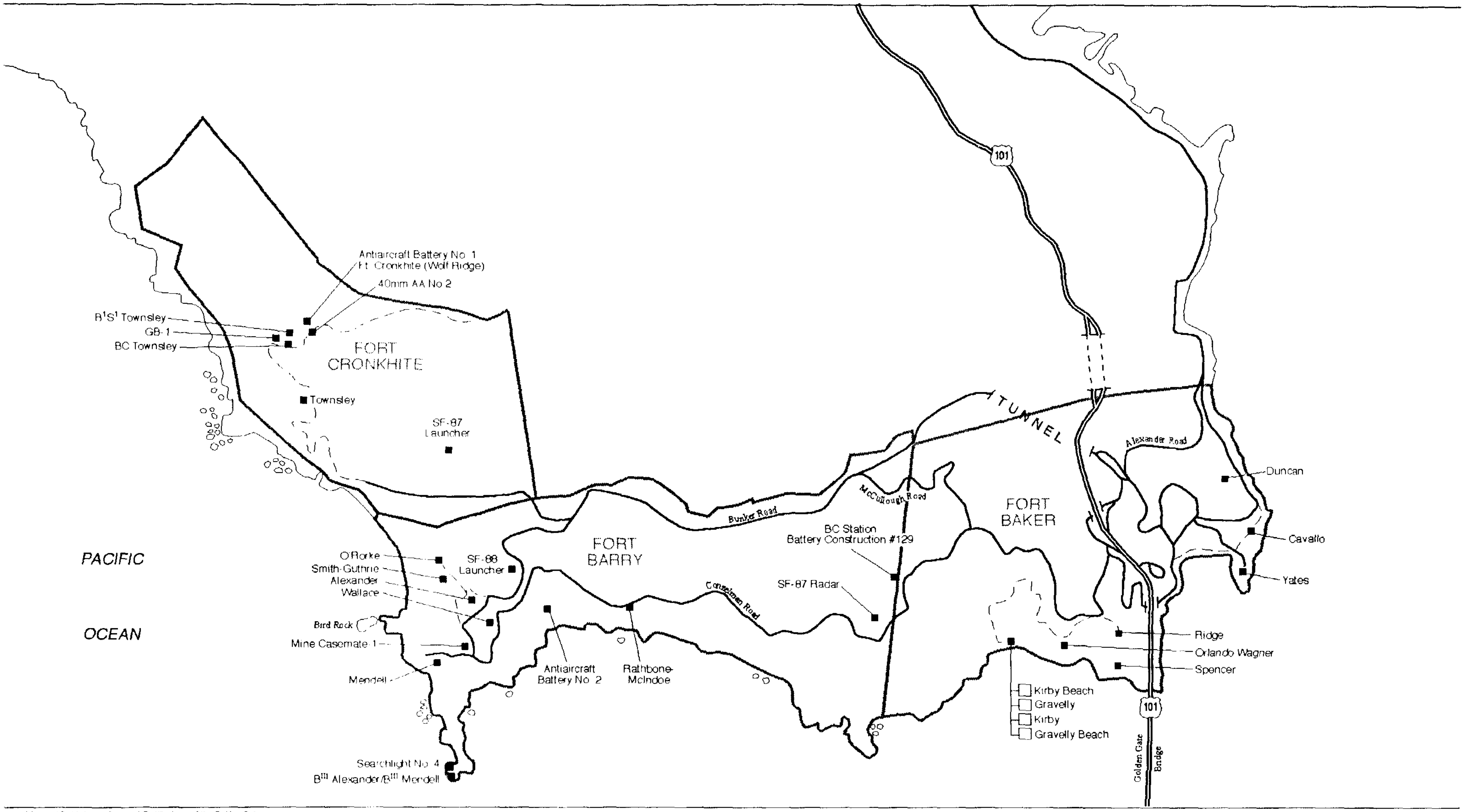
Today walkers, hikers, and joggers are confronted with many images as they explore trails within the park. A single view can yield a close look at a stolid defense site of the 1890s, such as that of Battery Godfrey, and simultaneously include one of the elegant Moderne towers of the Golden Gate Bridge of the late 1930s—the pair of historic resources framed by the mature landscaping evocative of the complexities of the immediate setting of the Presidio. The man-made beauty inherent in the sculptural forms of many gun pits, such as at Battery Kirby at Fort Baker, offer any park visitor a heightened moment of pause when, after climbing up steep battery steps to the blast apron, he turns back to be rewarded with the sweeping precision of a crisp circular form not quite anticipated (Plates 1 and 2).



Source: Golden Gate National Recreation Area California, 1994

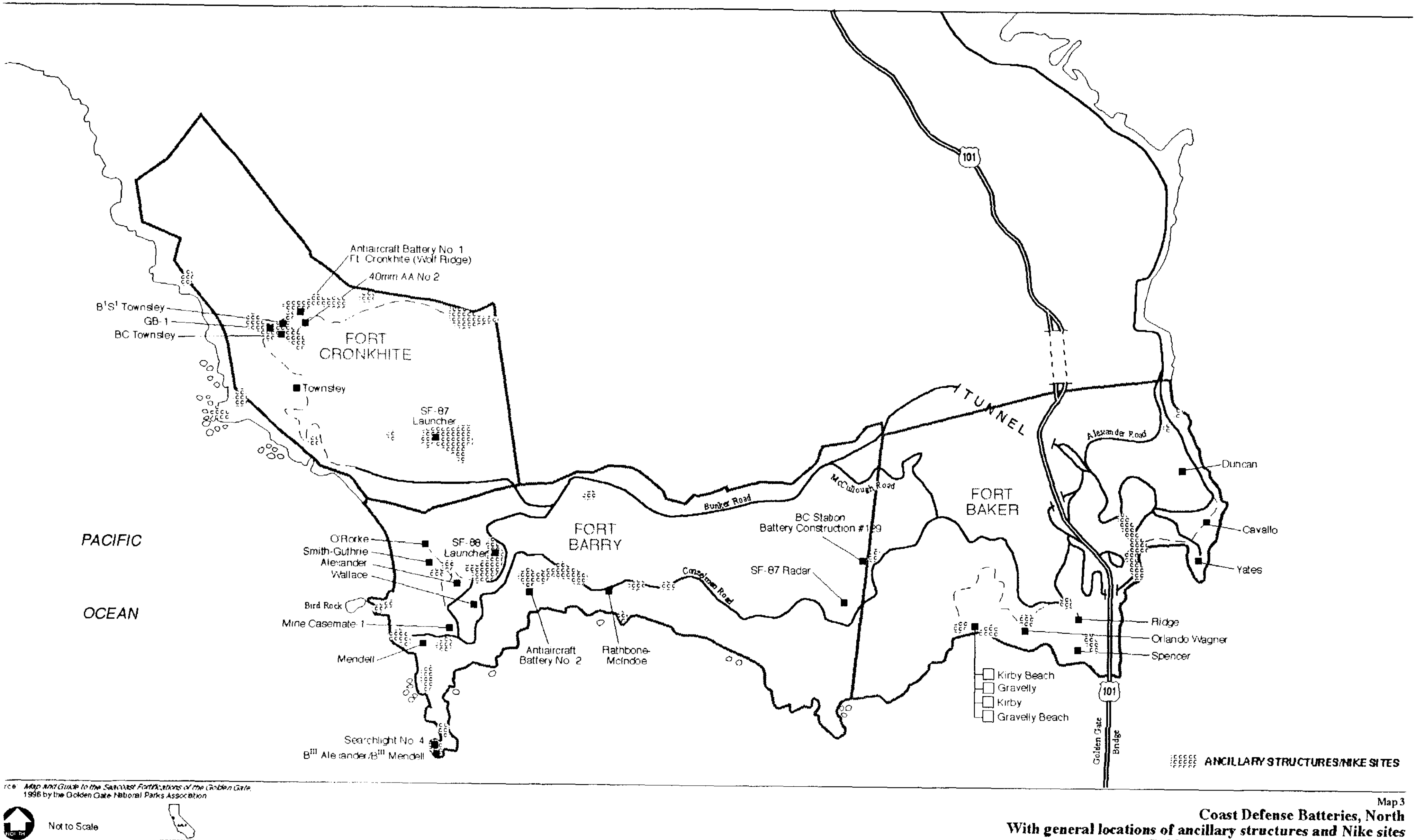


Map 1
Coast Defense Locations, General
Golden Gate National Recreation Area



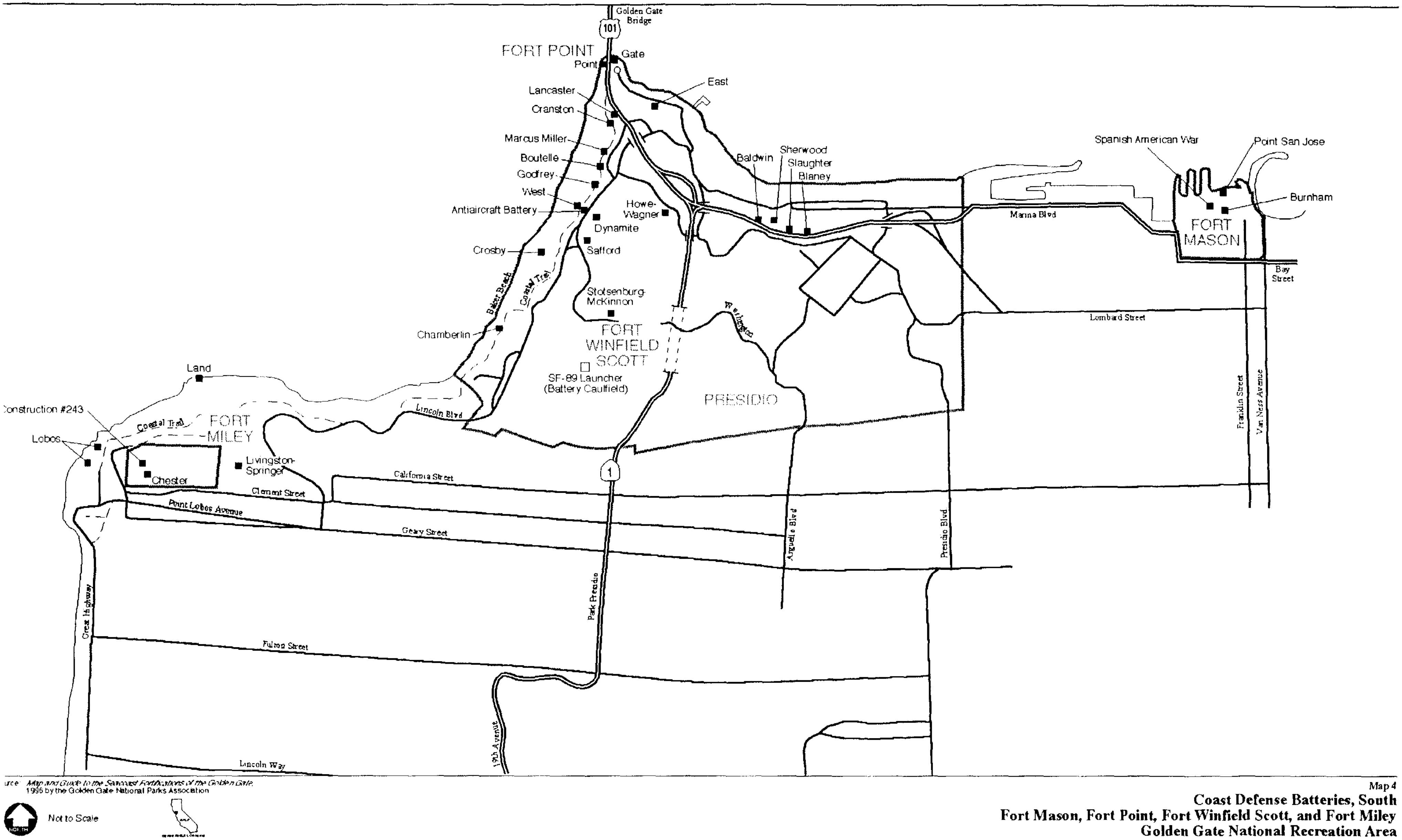
Map and Guide to the Seacoast Fortifications of the Golden Gate, 1996 by the Golden Gate National Parks Association

Map 2
Coast Defense Batteries, North
Fort Baker, Fort Barry, and Fort Cronkhite
Golden Gate National Recreation Area



rce: Map and Guide to the Seacoast Fortifications of the Golden Gate, 1996 by the Golden Gate National Parks Association

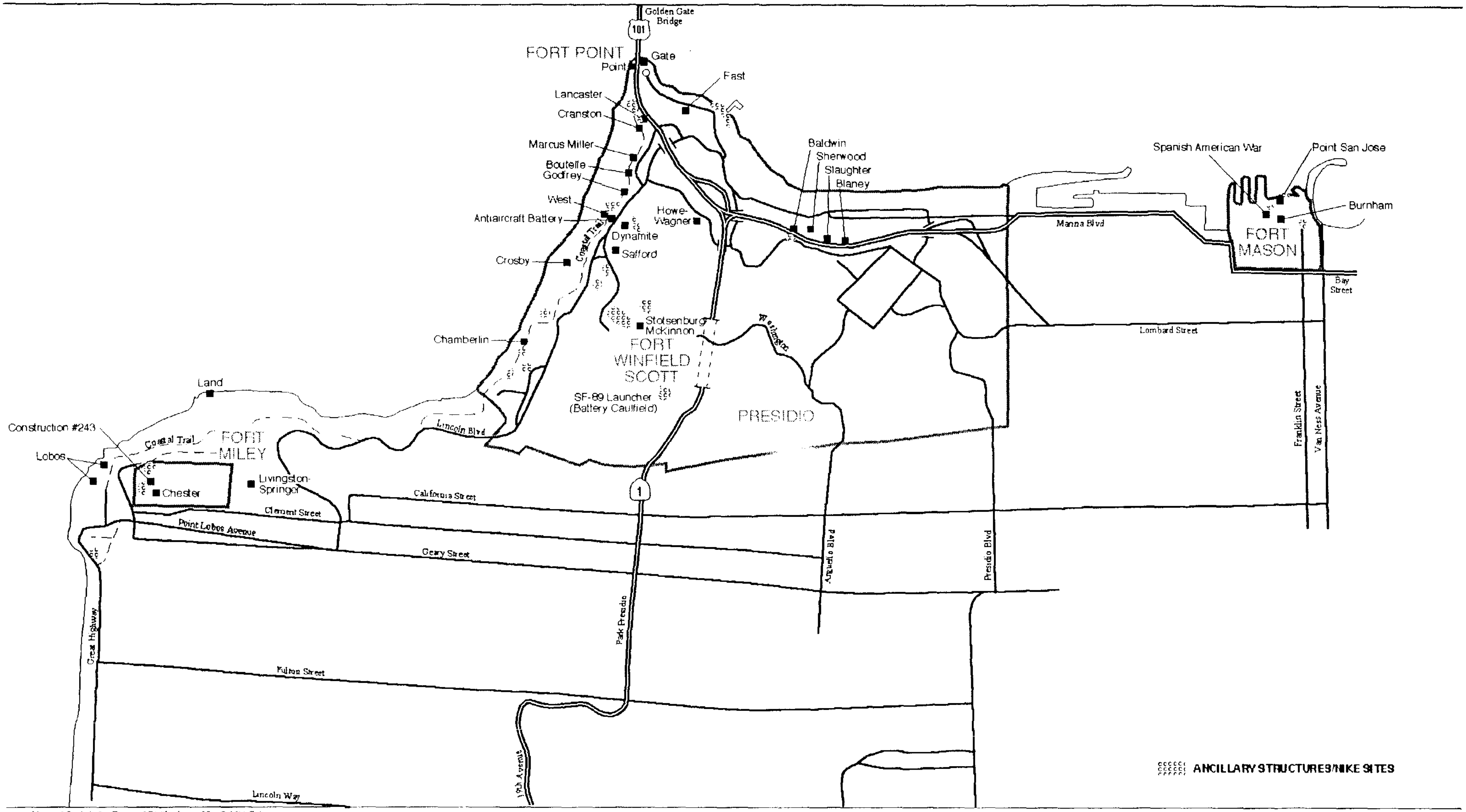
Map 3
Coast Defense Batteries, North
With general locations of ancillary structures and Nike sites
Golden Gate National Recreation Area



urce: Map and Guide to the Seacoast Fortifications of the Golden Gate, 1996 by the Golden Gate National Parks Association

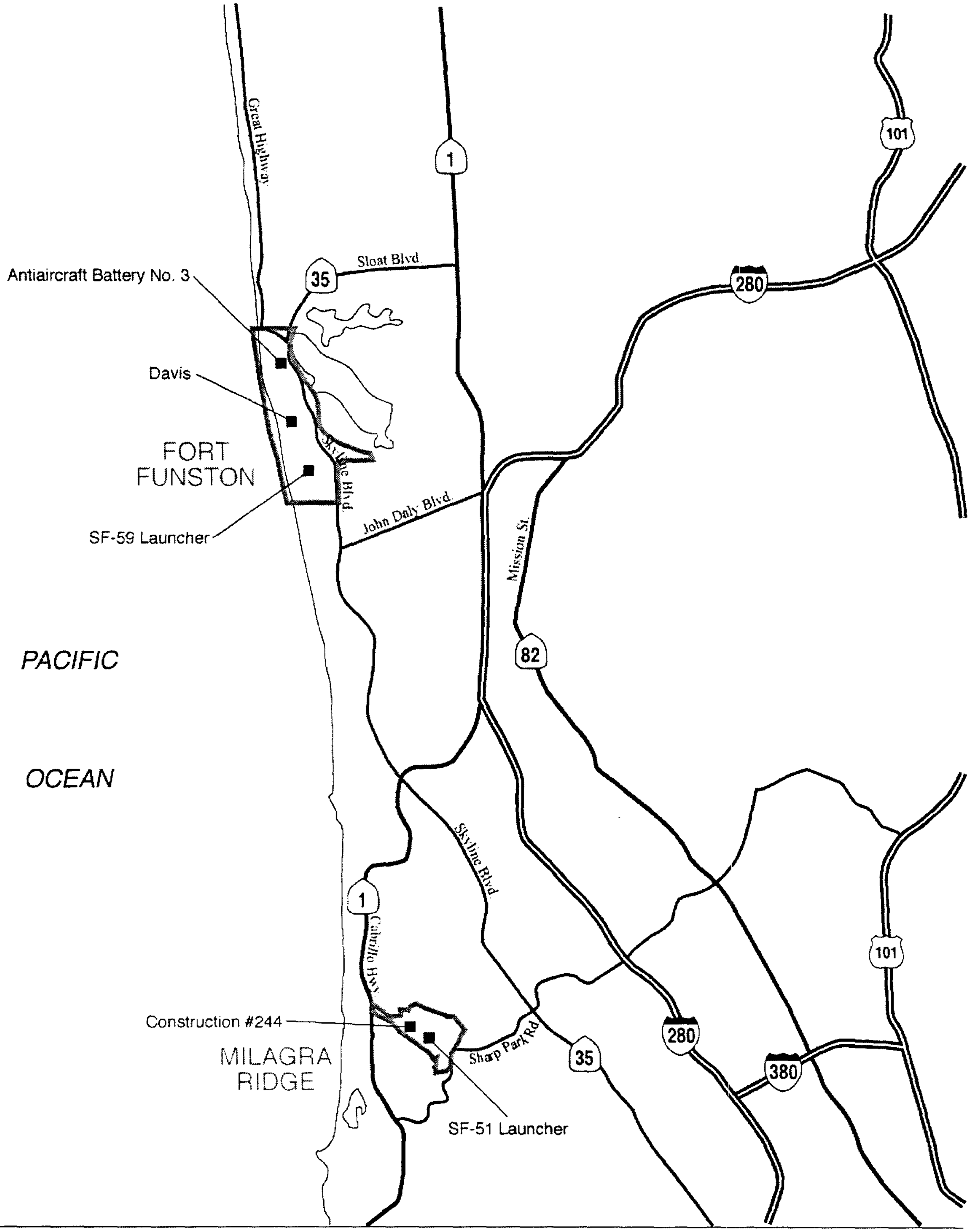
Map 4

Coast Defense Batteries, South
Fort Mason, Fort Point, Fort Winfield Scott, and Fort Miley
Golden Gate National Recreation Area



Source: *Map and Guide to the Seacoast Fortifications of the Golden Gate*, 1996 by the Golden Gate National Parks Association

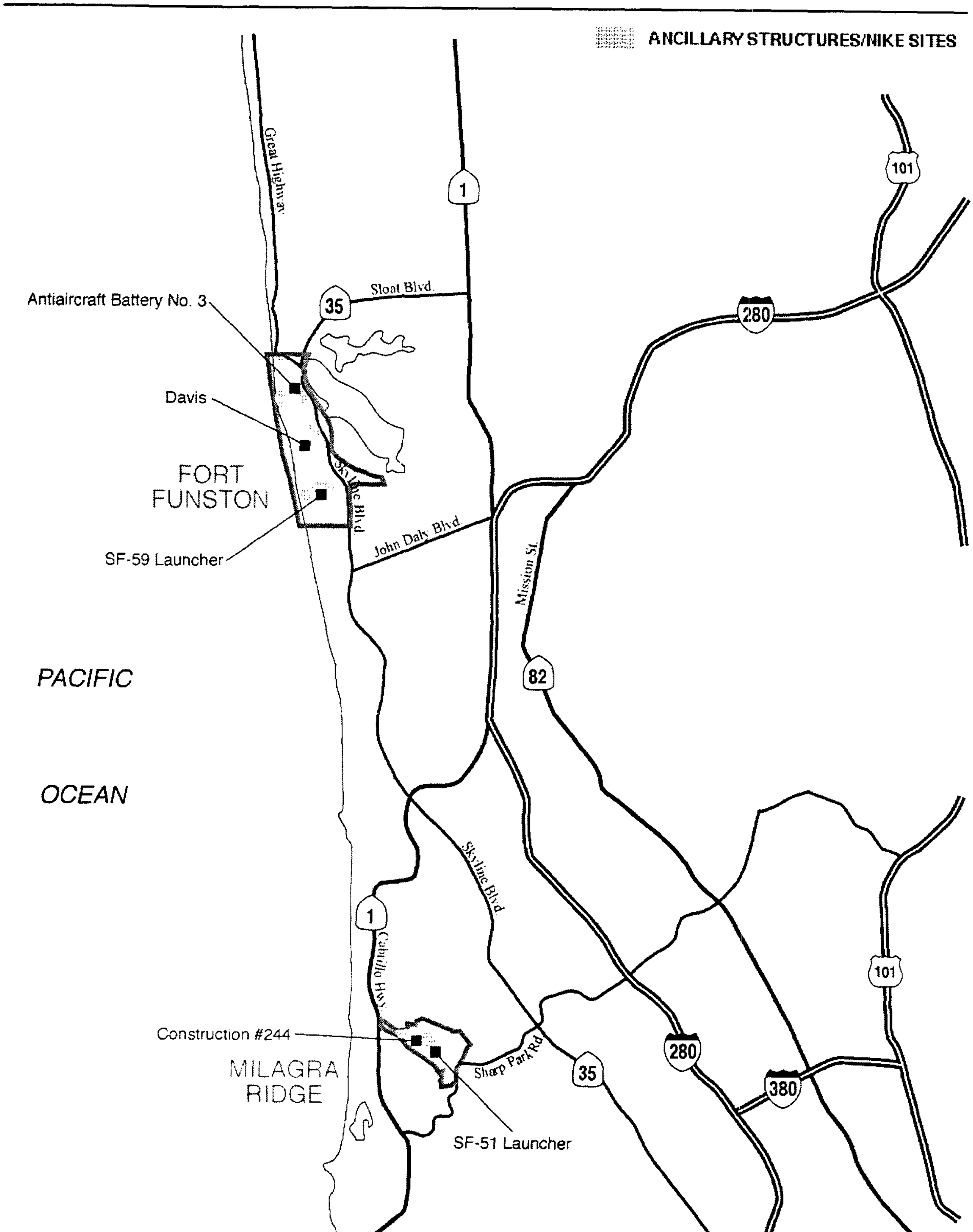
Map 5
Coast Defense Batteries, South
With general locations of ancillary structures and Nike sites
Golden Gate National Recreation Area



Source: *Northern California Atlas & Gazetteer,* 1995 DeLorme Mapping

Not to Scale

Map 6
Coast Defense Batteries, Far South
Fort Funston and Milagra Ridge
Golden Gate National Recreation Area



Source: *Northern California Atlas & Gazetteer*, 1995 DeLorme Mapping

NORTH

Not to Scale

Map 7

Coast Defense Batteries, Far South
With general locations of ancillary structures and Nike sites
Golden Gate National Recreation Area

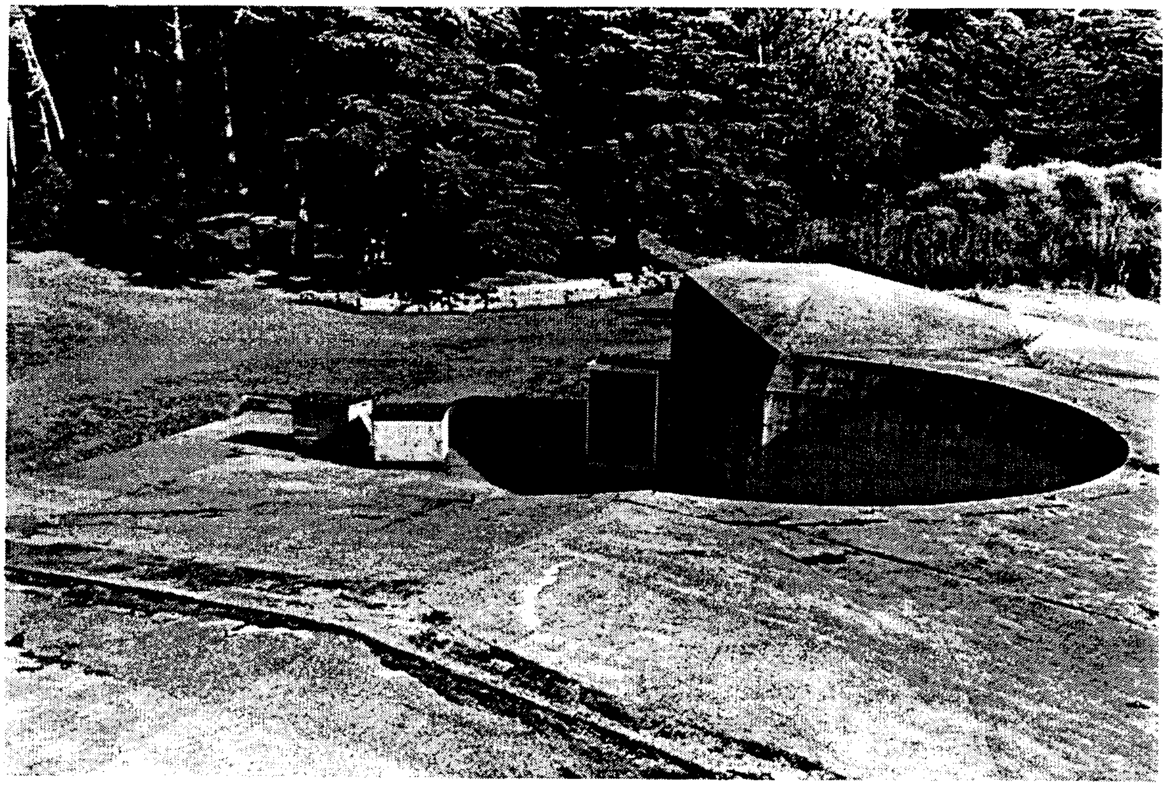


Plate 2. Battery Kirby, Fort Baker, constructed 1899-1900. Looking into emplacement from battery crest.

Explorations in the immediate proximity of a battery can yield not just a better understanding of the primary structure, but also of its important ancillaries. For World War II Battery Construction #129 within Fort Baker, a battery commander's station gives a clear sense of the role of the observation post, half-buried, with its viewshed framed by a bunker-like horizontal, panoramic opening. And when one comes upon Battery Wallace, one is stopped, as one is always stopped, by the graphic announcement of a formal name and date of construction: *Battery Wallace 1942*. As is often true when we confront the painted signage and imagery added to the equipment of war, from aircraft to the command blockhouses controlling missiles, we are pulled back into the past through specificity (Plates 3 and 4). We preserve coast defenses, then, so that we may allow future generations to see and touch the past.

As history moves forward, these many and diverse defense resources remain what they were designed and engineered to be: an intimate part of the land forms on which they are both imbedded and perched. The Army built the coast defense fortifications bracketing the San Francisco Bay, from batteries to ancillaries, with deliberate care in their texturing and coloration, achieved through planted foliage, coated blast aprons, and structural paint schemes. When addressing the larger cultural landscape of coast defense within the Golden Gate National Recreation Area, one is asked to reflect on the original beaches and man-made cuts and fills; the contours of the hills, deliberately altered by emplacements to re-achieve the appearance of a natural vista from the vantage of hostile approaching ships; the roles of native and introduced plantings—from grasses, iceplant, and eucalyptus in the Endicott years to exotic kudzu by the late 1930s; the roadways, paths, and parade areas both at and between the installations; and, the line-of-sight viewsheds from the batteries themselves, engineered seawards. The setting for San Francisco's coast defenses is made even more complex by the long and prominent history of the Presidio, Fort Baker and other posts, each accented through a formal built environment and landscaped grounds.

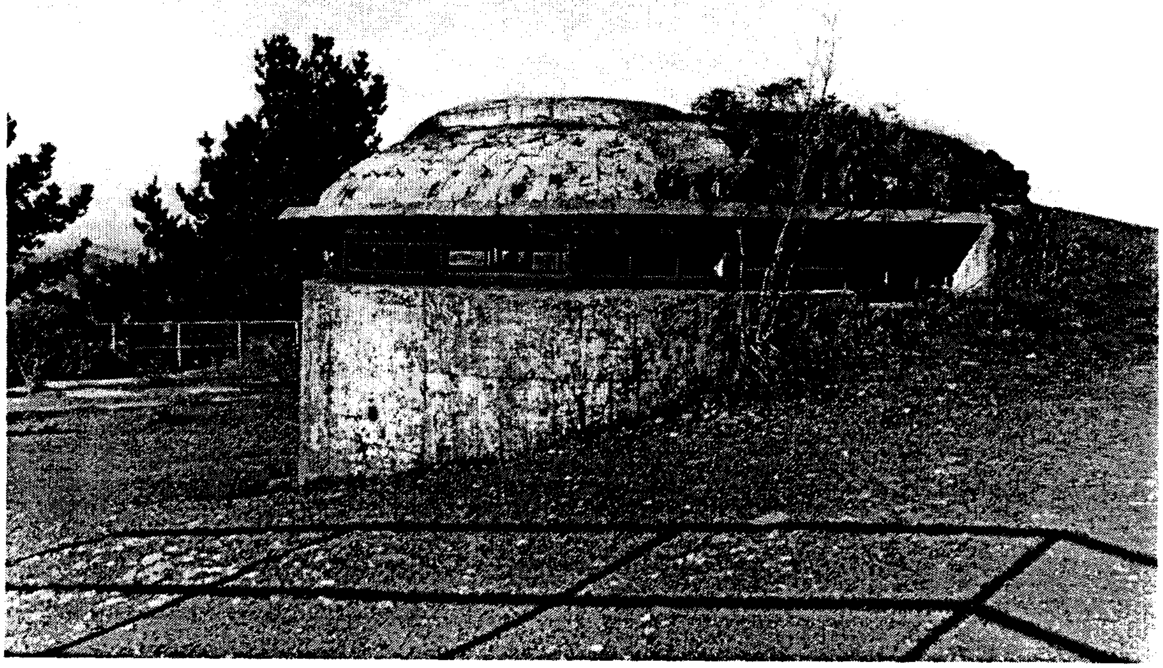


Plate 3. BC Station, Battery Construction #129, Fort Barry, constructed 1942-1944. Looking east.

Plate 4. Battery Wallace, Fort Barry, constructed 1917-1921. With casemating of its two guns in 1942-1943. Emplacement entry.

Interpretation of such a resource demands repeated looks at the many included sites within the coast defense system of fortifications, coupled with renewed archival siftings through Army reports; through letters between military engineers, as well as between commanders; and through drawings, plans, and historic photographs. We preserve coast defenses, too, so that tomorrow's historians may apply knowledge and interpretations to physical fabric in its more encompassing context, rather than applying what they discover only to changed land forms and mere records of what is no longer there to be seen.

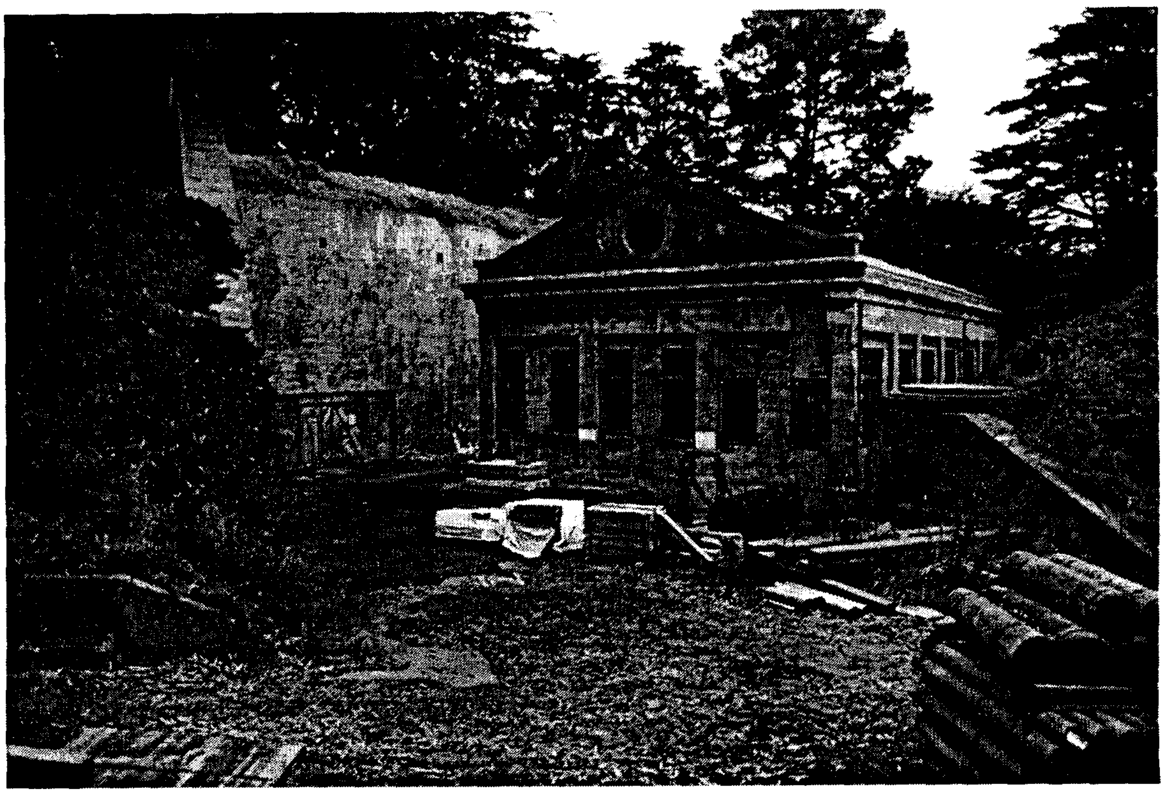
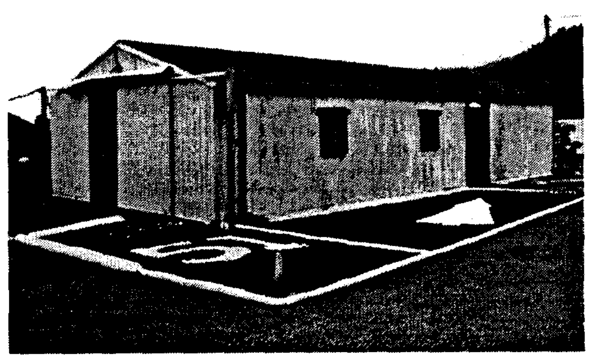


Plate 5. Power plant at Battery Dynamite, Fort Winfield Scott, constructed 1894-1895, with major additions and remodeling, 1899-1900.

Plate 6. **Butler Manufacturing Co., Missile Assembly Building, Nike Site SF-88L, Fort Barry, erected 1962. Courtesy of the Park Archives of the Golden Gate National Recreation Area.**



The larger cultural landscape of coast defenses within the Golden Gate National Recreation Area offers structures that contrast widely with each other, from the formal Beaux-Arts classicism found in the mid-1890s power plant built to accompany Battery Dynamite, to the simple corrugated, metal-frame Butler building used to house the missile assembly for Nike during the early 1960s. The power plant was exemplary of the high stylistic trends of its time, while the Nike structure harkened straight back to World War II and the opening of the Cold War, with little change (Plates 5 and 6).

Links Between the Coast Defenses of San Francisco and the Northwest

In undertaking a maintenance manual for the coast defense fortifications of the Golden Gate National Recreation Area, the National Park Service at the Presidio, San Francisco, follows in the footsteps of the Washington State Parks and Recreation Commission, for the planned management of its coast defense installations, and, the National Park Service through the National Maritime Initiative, for the similarly thoughtful management of its coastal lighthouses. In the Northwest, military historian David Hansen authored the *Coast Defense Resources Management Plan* for Washington State Parks (1989), following this effort with the context statement titled *Never Finished: The National Coast Defense Program in Washington State* (1997). At the national level, the *Historic Lighthouse Preservation Handbook* (1998) is recently accessible not only in printed format, but also on a National Park Service website. For the coast defenses of the San Francisco Bay, discussed herein, the National Park Service is challenged by an even greater breadth of resources, in type and time period, than in either the Washington management document or the lighthouse handbook.

In particular, the Golden Gate National Recreation Area hopes to continue discussions and research put forth for the Washington coast defense fortifications, encouraging further detailed scholarship focused on engineering history for the Pacific. In 1886 Secretary of War William C. Endicott had convened a board to develop modern coast fortifications effective against the evolving sophistication of naval weapons. Endicott's name later became associated with those coast defenses built during the 1890s and into the first years of the twentieth century. Commonly referenced as the Endicott period, this fifteen-year span was of key importance in the design and engineering experimentation for fortifications along America's seaboards. Yet in the middle 1880s, the West Coast was so sparsely settled and militarily remote, that the Endicott Board had recommended augmentation at only three Pacific harbors among the twenty-seven reviewed nationwide: San Francisco, the Columbia River between Oregon and Washington, and, San Diego. In the Northwest, the Columbia River location ranked eighteenth in urgency for construction, with batteries begun at Fort Stevens, Oregon, in 1896; and, at Chinook Point and Fort Canby, Washington, in 1897 and 1899. The U.S. Army Corps of Engineers added Puget Sound to the national program in 1894, with construction first undertaken at Fort Worden beginning in 1896. Hence, erection of coast defenses in the Northwest was a phenomenon of the turn of the twentieth century. Subsumed under the jurisdiction of San Francisco, the Columbia River and Puget Sound fortifications were perfectly timed and orchestrated to draw directly upon the work that occurred first at the Golden Gate, between 1891 and 1898.

The U.S. Army Corps of Engineers had initiated construction of the Northwest coast defenses under the leadership of Captain Walter L. Fisk. An engineer on his staff, Harry Taylor, actively involved himself in solving some of the design problems that arose in this period. In early 1898 Taylor sent his assistant, M.L. Walker, to study and review the coast defense fortifications then just-finished and under construction in San Francisco. Although unnamed by the War Department until 1902, these batteries included the Fort Winfield Scott installations Marcus Miller (built between 1891 and 1898), Godfrey (1892-1896), Howe-Wagner (1893-1895), Boutelle (begun 1898), Dynamite (1894-1895), Saffold (1896-1897), Cranston (1897-1898), Stotsenburg-McKinnon (1897-1898), and Lancaster (begun 1898) on the south side of the bay, and, the Fort Baker batteries Spencer (1893-1897) and Duncan (begun 1898) on the north. The Endicott Board recommendations of 1886 had ranked San Francisco second in needed new construction, and several of the first Endicott batteries built bracketing the bay were characterized by their unusual, sometimes singular, design and engineering, and were overseen directly by the division engineer Charles Suter. Both Suter and Taylor worked steadfastly as engineering designers of coastal fortifications, collaborating on some of the first work undertaken at Fort Worden in Washington. Suter's contribution, in particular, needs the attention of historians. Another motivation in the preservation of coast defenses is the uncovering of details important in engineering history—so that from our archival discoveries we may interpret the critical physical features of individual batteries. Where such features are unique, we learn to pause and appreciate, to link specific achievements and failures with the engineering of coast defenses that came before, and followed afterwards—linking San Francisco to the nation's seaboards in a historic continuum.

Properties Addressed in the Maintenance Manual

In undertaking the preparation of a coast defense maintenance manual, the National Park Service limited itself to those batteries, and a representation of their related ancillary structures, currently within the boundaries of the Golden Gate National Recreation Area. Although such a demarcation is necessarily somewhat artificial with respect to Army history, it allows the clearest and most efficient management of the park's historic resources. In his thorough and exemplary 1979 study, *Seacoast Fortifications San Francisco Harbor*, Erwin N. Thompson acknowledges this dilemma, and includes discussion of the related batteries and ancillary structures on Angel, Alcatraz, and Yerba Buena Islands. The Fort McDowell Endicott batteries of 1899 to 1901 on Angel Island—Drew, Ledyard, and Wallace—are especially noteworthy from the vantage of engineering history, and although they presently are managed under the ownership of the State of California, may merit cross-referencing during later research efforts for the National Park Service properties.

In addition, the National Park Service is in the process of preparing a National Historic Landmark nomination for the seacoast fortifications of San Francisco Bay, under a multiple property designation. The landmark nomination, as a historically comprehensive interpretation of the coast defenses surrounding San Francisco Bay, extends outside of the management boundaries of the Golden Gate National Recreation Area. The proposed National Historic Landmark includes numerous properties not discussed in the maintenance manual: these are six batteries, a mine casemate, and a Nike site on Angel Island; selected buildings, magazines, tunnels, and walls on Alcatraz Island; a mine storehouse on Yerba Buena Island; and thirty-three ancillary structures (fire control stations, a mine casemate, searchlights, generator buildings, antiaircraft emplacements, and World War II SCR 296-type radars) at the six additional military reservations of Devil's Slide, Little Devil's Slide, Frank Valley, Hill 640, Pillar Point, and Wildcat Ridge, to the north and south of the Golden Gate National Recreation Area.

Within the jurisdiction of the Golden Gate National Recreation Area, and referenced in this manual, are fifty total batteries: six batteries of the Civil War and post-Civil War eras (Forts Baker, Mason, and Winfield Scott); thirty-one batteries of the early-modern Endicott, Taft, and World War I eras (Forts Baker, Barry, Mason, Miley, and Winfield Scott); and, thirteen batteries of World War II (Forts Baker, Barry, Cronkhite, Funston, Miley, and Point, with one installation at Milagra Ridge).[5] For the purposes of representative field review, the maintenance manual team looked at twenty of these batteries, and sampled an additional nine ancillary structures. The full list of batteries, with visited batteries and ancillaries marked by asterisks, is given in Appendix A, with many of the Army's Form 7s—simplified elevations, sections, and plans—reprinted in Appendix B. Batteries selected for field review were agreed upon by the National Park Service and the maintenance manual team, and offer a cross section of age and type, as well as presenting the range of maintenance issues found in the Golden Gate National Recreation Area.

A Preservation Charette

At the outset of the field inspections, the maintenance manual team, under the direction of KEA Environmental, gathered together on December 12, 1998 for an informal charette of interested preservation professionals. Our goal was to discuss firsthand the types of challenges raised in the care and interpretation of coast defense fortifications. We can preserve such resources only if we can manage them well over time. Attending the all-day event were members of the National Park Service, the maintenance manual team, and representatives of the preservation community. Four historical architects and an architectural historian were in attendance, including Ric Borjes and Hank Florence from the National Park Service, Golden Gate National Recreation Area and Seattle offices, respectively; Steade

Craigo and Joe Freeman, AIA restoration architects from Sacramento, California, and, Austin, Texas; and Dr. Karen Weitze, from KEA Environmental and maintenance manual project manager. Mary Hardy, from the Berkeley firm of Siegel & Strain Architects, represented the specialty of historic materials conservation, while San Francisco landscape architect Denise Bradley represented that discipline. Brian Grogan, of Grogan Photography & Preservation Associates, Yosemite, California, brought the fine arts perspective. Mr. Grogan is the large-format photographer for the National Historic Landmark nomination in progress for the San Francisco coast defense fortifications. Three military historians, with many years experience, brought superlative expertise to the gathering: John Martini, curator of military history for the Golden Gate National Recreation Area; David Hansen, a member of the maintenance manual team and author of earlier studies and published articles on the coast defenses of Washington; and, Milton "Bud" Halsey, Colonel USA, retired, manager of the restored Nike missile site SF-88L, Fort Barry. Mr. Halsey's first-hand experience in the preservation and interpretation of the Nike site complemented all discussions of the battery locations throughout the day. Three historians further augmented the expertise of the military group: National Park historians Steve Haller and Gordon Chappell, and, KEA historian Christy Dolan. Filling out the charette were the Marin Buildings and Utilities Supervisor from Fort Baker, Tima Alexandro, and, a National Park Service volunteer for Battery Chamberlin and site representative for the Coast Defense Study Group, Eric Heinz.

The morning opened with general introductions and a presentation of the larger goals of the National Park Service in its work with coast defense fortification restoration and interpretation, both in the San Francisco Bay Area and in Puget Sound. Ric Borjes stated the desire for a practical tool available to his personnel in the Golden Gate National Recreation Area, one that could aid in prioritizing needed maintenance and stabilization work at the batteries and their associated ancillary structures, and, could serve to effectively organize annual plans and budgets, using a collaborative team of individuals ranging from volunteers and students, to contracted preservation specialists. Hank Florence spoke about the upcoming projects planned for Washington, with work continuing at Fort Worden, and with a management manual similar to that undertaken by the National Park Service in San Francisco planned for the summer of 1999. Efforts in the Northwest are geared toward an international conference on coast defense fortifications tentatively set for 2001. Both Mr. Borjes and Mr. Florence are seeking a united Pacific Coast perspective on coast defenses, and are hopeful that coordination of their projects can serve the National Park Service in other districts, as well as enhancing our understanding of the historic ties between the fortifications of San Francisco, the Columbia River, and Puget Sound.

Before leaving on selected site tours of the batteries, military historians Martini and Hansen opened discussions for the group through two lively and thorough slide presentations, focused on the coast defenses in San Francisco and Puget Sound. Mr. Martini poignantly reminded the group of sixteen professionals that park preservation and interpretation always begins with the public. Growing up in the Bay Area, Mr. Martini happened upon the batteries as a boy, exploring them repeatedly, and never forgetting his first experiences. Similarly, years of military service and participation in organizations like the Coast Defense Study Group bring layers of experience to later efforts focused on the interpretation of defense sites. Charette members Bud Halsey and Eric Heinz both added this kind of irreplaceable perspective, with factual knowledge of the working details within functioning military installations of the recent past, complemented by understandings focused on the usefulness of items like military procedures and technical manuals, themselves now historic resources. Mr. Hansen, not only a military historian, but an architectural-engineering historian as well, gave the group a professionally reflective introduction to the batteries, making correlations between military needs and engineering innovations documented in the infrastructure. He pointed out that we must remember that buildings are designed for the use of specific groups of people, operating under the quite definitive constraints of their own times and places. We must acknowledge the client, here the U.S. Army.

The Army required that its coast defenses achieve some very basic design parameters. The fortifications needed to keep men and equipment—from the ammunition to the loading mechanisms—warm, dry, and safe from premature explosion, while simultaneously guaranteeing that the batteries and their ancillaries were strong enough to withstand attack. Planning for the coast defense fortifications went slowly, moving through a bureaucracy of cross-checks and approvals. The design and engineering process inside the Army, therefore, was necessarily one overly dependent on the drafting boards: early construction tended to be overdesigned, making the batteries physically more extensive than they might have been if practical observations could have been forthrightly incorporated into the process. Predictably experimentation to strengthen the batteries occurred from the first, with massive poured concrete receiving rock, iron, and steel reinforcing in a variety of treatments that ranged from dismal failures to transitional, qualified successes. There was also the matter of adaptation to evolving weaponry, both from the vantage of defense against advancing naval guns, and from the vantage of effective land retaliation.

Mr. Hansen noted, like civil engineers of the early twentieth century, that batteries were much like ships—they really were never finished, demanding continuous maintenance and improvements. The earthen embankments immediate to the batteries protected the fortifications, deflecting projectiles away from the installations. As cannon adapted to the disappearing carriage, Army engineers developed mechanisms to load the guns behind walls and then raise them to fire. The resulting batteries had two stories, the upper area open behind walls, and the lower fully enclosed as rooms. Such a design also required hoisting heavy and dangerous ammunition from a low point upwards, making clear just how the physical form of the battery would always be subservient to ordnance. In other cases, barbette carriages did not require the crested upper wall design, and thus also affected experimentation with placement of the ammunition magazines on a more nearly equal level to the guns. Over time batteries tended to become larger, with individual emplacements separated within single installations and with batteries increasingly spread out across the coastal terrain. Less dramatic, engineering efforts also attacked problems of water percolation through the porous concrete; varieties of deliberate plantings immediate to the installations; and, methods of blending the batteries into their hosting land forms. And in all cases, Army procedure dictated how the post would be commanded. Such procedure also changed over the decades and is reflected today in the nearly archeological remnants of items like the turn of the century blackboard racks in the data booth at Battery Stotsenburg-McKinnon (Plate 7).

Graffiti

The charette then reconvened at the post-Civil War era Cavallo Battery, north of the Golden Gate Bridge. A massive earth-and-brick battery, Cavallo has sustained major, recent problems with vandalism by graffiti artists, even with regular patrolling by park personnel and within locked fencing. In many places on the battery's brickwork there are layers of graffiti, and in some areas, the art work has been carved into the face of the masonry. A single treatment to remove paint is neither possible, nor practical, as the different paints each are defined by a distinct chemical make-up. Architect Joe Freeman suggested that the most straightforward solution might be to temporarily mask the graffiti with a breathing, benign paint similar in color to the bricks. Such a tack would discourage the graffiti artists; could be repeated; and, at a later date, as conservation techniques become more sophisticated, the interim masking and the hidden graffiti could be removed. Conservationist Mary Hardy carried these thoughts further with the idea of letting the graffiti fade through natural weathering, while architect Steade Craigo reiterated the fragile nature of the masonry itself. In the future, with the graffiti cleaned from the surfaces of the battery, a microcrystalline wax could be used to coat the brickwork, allowing the material a viable protection from wandering artists.

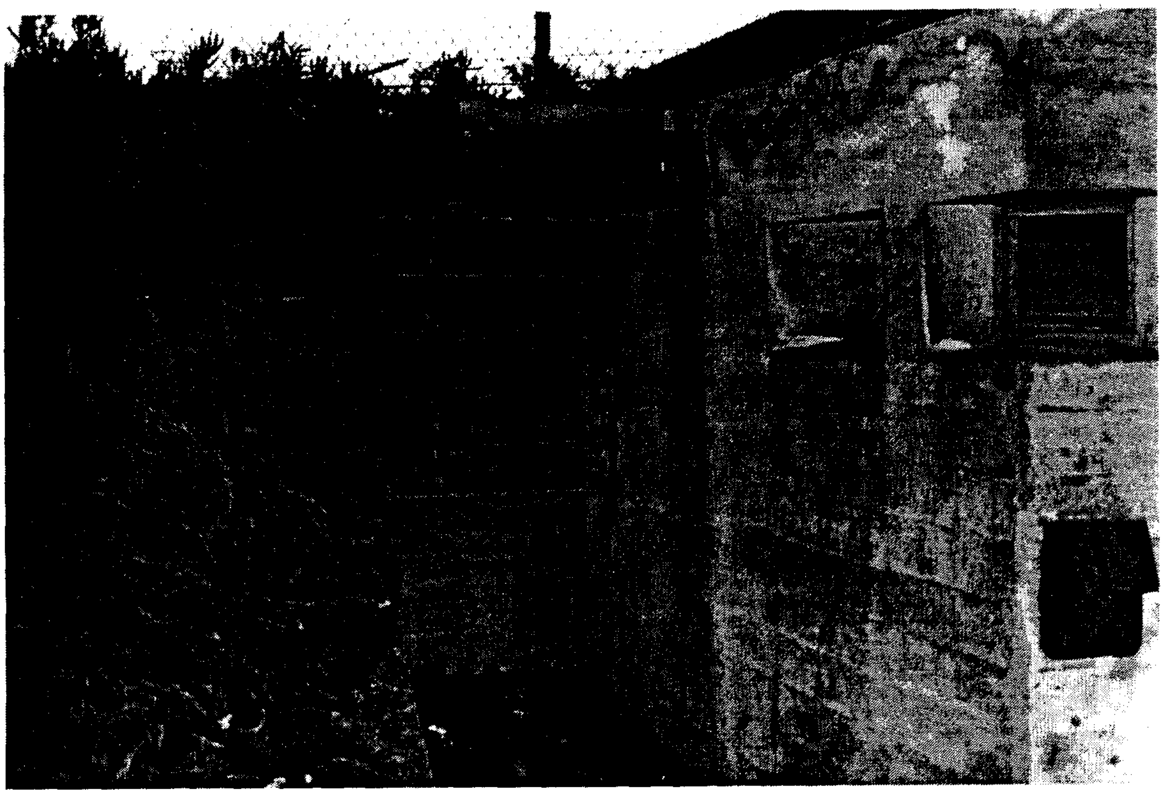


Plate 7. Battery Stotsenburg-McKinnon, Fort Winfield Scott, constructed 1897-1898. Blackboard racks at data booth.

Vegetation and Habitat

The vegetation issues, while not as technically complicated, raise their own sophisticated questions. Gathered at Cavallo Battery overlooking the adjacent Battery Yates, the charette group discussed the challenges of discovering the original plantings at the batteries; the role of native vegetation; differing landscape and camouflage plans in sequential eras; and the maturation of unintended vegetation on site (Plate 8).

At Batteries Cavallo and Yates, grass species, coyote bush, sage, and lupine dominate the current vegetation. The lupine, a low-growing plant, is now home to a protected species of butterfly. Here issues of contemporary habitat will need to be weighed against historical accuracy, and in fact a landscape plan for the batteries might suggest that the lupine stay as a reasonable historic planting. Characteristics such as low plant height, vegetation density, overall coloration, and untended vigorous growth are parallel with original plans for the site, and can perhaps be employed as landscape maintenance plan parameters to achieve the dynamics of sustaining needed habitat. Indeed, at other battery sites with the Golden Gate National Recreation Area, the Army deliberately planted lupine as the selected ground cover. At some installations, such as the grouping Sherwood, Slaughter, and Blaney observed in the late morning and Stotsenburg-McKinnon visited in the afternoon, cypress and eucalyptus trees—typically introduced to augment Presidio landscaping or to hide the installations—are damaging the concrete installations through their root growth, cracking both walls and foundations. And there, a sensitive regional plant species, San Francisco lessingia (*lessingia germanorum*), is currently growing on the bermed earthworks.

Plate 8. Preservation charette group at the CRF station for Battery Yates, located at Cavallo Battery, Fort Baker, 1903. Discussion of vegetation and habitat issues.

Concrete Design and Site Settlement

At Battery Marcus Miller, inspected next, charette participants discussed the spalling concrete, damage from the region's earthquakes, rusted and fallen cables, removal of valued metals (here bronze hinges) by vandals, interior flooding, clay layered over floorings, remnants of historic paint schemes and tinted surfaces, and scored flagging around the gun pits. Mr. Hansen and Mr. Craigo pointed out relatively subtle design details, such as chamfered corners and the use of an incised drip line. The range of aesthetic and structural details supported the need for a careful inventory site by site, with eyes toward identifying the character-defining features common across the San Francisco batteries and those occurring only rarely, or perhaps, unique. Review of available archival records will also help to ascertain how much cut and fill has taken place. Soil stability might be enhanced—and settlement minimized—through soil grouting, injecting concrete into the soil surrounding certain installations in order to tie battery foundations to the host land forms.

Observations

At the close of the charette, the group reconvened at the Presidio to draw together the thoughts of the participants. Given what we had seen firsthand, and with the specialized professional backgrounds brought to this type of historic resource, what did the group feel was generally applicable? What's ahead for the Golden Gate National Recreation Area in the preservation of its coast defense fortifications? The group identified the themes of inventory; management; interpretation; maintenance; public involvement; realistic assessments; variable funding; and appropriate professional advice.

To conclude the charette, and to open the chapters that follow, the group suggested that we most effectively preserve such specialized resources as coast defense fortifications when we understand them as fully as possible. To begin an inventory and track integrity of the historic resource, a checklist is suggested, given in Appendix C. The checklist is intended for use after becoming familiar with the broad character-defining features of the coast defenses within the Golden Gate National Recreation Area, presented in chapter 3. For maintenance, we begin by looking at causes of deterioration. Here the checklist achieves a second life as a tool for recording recurring problems, and for making annual workplans. Both inventory and maintenance site visits can additionally benefit from selected use of the simple plans, elevations, and sections provided through the reprinted Form 7s historically compiled by the Army (Appendix B). Even before we begin our efforts, though, we can secure the sites, and restore minimal insurances of public safety. Simple assessments for replacement of handrails, clearance of inappropriate vegetation, and removal of debris can be a start. Straightforward actions, such as repainting wood and metal detailing where it is intact and in reasonably good condition, can slow down site degradation. And everyone agreed the an understanding of the cultural landscape, looking both seawards and toward the coast defenses, is essential for the resource we have here, one that is so completely integrated with the land.

Table 1
Coast Defense Fortifications
Preservation Needs and Goals at the Golden Gate National Recreation Area

Need	Goal
Identification of Historic Resources	*Park Inventory*
*Establishing character-defining features for the batteries *Listing and mapping ancillary structures *Determining the larger cultural landscape	*Use of National Park Service personnel *Volunteer teams *Specialized contributions in architectural/landscape history
Management of Batteries and Ancillaries	*Effective Long-Range Planning*
*Determination of sites for interpretation *Decisions across the resources for stabilization, preservation, rehabilitation, or restoration *Stewardship plans	*Interdisciplinary meetings within National Park Service *Site reconnaissance *Management decisions and allocation of National Park Service resources
Appropriate Interpretation of Coast Defenses	*Enhancement of Role in the Golden Gate National Recreation Area*
*Continued archival research *Communication with other managed coast defense fortifications / parks *Interim solutions for site security and stabilization	*Attractive resource for visitors *Tourist destination *Integrated resource across National Park Service regionally and nationally
Maintenance	***Stabilization of All Resources***
*Monitoring and testing at selected sites *Selected treatments applicable at multiple sites *Vegetation management *Graffiti removal / treatment prioritized *Address issues of site drainage and settlement	*Easily available, effective products *Practical treatments *Economies of scale through chosen methods *Involvement of varied personnel, including volunteers
Realistic Assessments	*Development of the Golden Gate National Recreation Area*
*Maintenance manual specific to Golden Gate National Recreation Area *Variable funding projections *Variable personnel assigned to tasks *Achievement of public safety	*Maintenance manual broadly useful across National Park Service *Optimal use of limited monies and people *Sustainment of desirable parklands
Leveraging Professional Advice	*Well Maintained Resources, Accurately Interpreted*
*Targeting specialty testing—chemical, physical, and acoustical in type *Developing tiered approaches to problem solving and analysis *Consideration of large-format photography for selected recordation and for wider audience park publications and brochures	*Protection of coast defenses *Balanced allocation of funding *Public advocacy for its historic resources, with sustained involvement

[1] As quoted in *Statement for Management, Golden Gate National Recreation Area* (San Francisco: National Park Service, 1992), 7.
[2] *The National Parks: Index 1997-1999* (Washington, D.C.: U.S. Department of the Interior, 1999), 2.
[3] *Golden Gate National Recreation Area/Point Reyes National Seashore General Management Plan / Environmental Impact Statement* (San Francisco: National Park Service, 1980), 20.
[4] *National Historic Preservation Act of 1966, as amended* (Washington, D.C.: The Advisory Council on Historic Preservation, 1993), 27.

[5]There are also were also six Nike missile launch sites within the present boundaries of Golden Gate, including one on Angel Island State Park. Although many of the treatments recommended in this manual may be successfully used to preserve certain historic fabric at the Nike sites, these sites are different enough from the gun batteries to be dealt with separately. They are referenced in, but are not intended to be a part of, this study.

Chapter 3: Character-Defining Features

> It is of the highest importance that the artillery organizations be encouraged to take pride in their guns and emplacements. Everything in and about the emplacements should at all times present a spick and span appearance.[1]

Looking at the remnants of the fortifications that once protected the entrance to San Francisco Bay, it is difficult to appreciate what they once were. Slopes that were crisp and groomed a century ago are now muted by erosion, unplanned and untended vegetation, and a web of trails. The massive concrete emplacements are separated from their view of the sea by walls of trees, and their once-trim parapets and traverses are marked with crumbling concrete as well as the free expression of a thousand sentiments from hands that wielded an equal number of spray-paint cans. Wooden doors are shattered, steel doors are shredded with rust and corrosion. Some structures have disappeared altogether.

The atmosphere of neglect disguises one of the nation's most complete and compact representations of coastal fortifications. Pushing aside the effects of contemporary indifference reveals a rich pattern of military architecture. Coastal fortifications were once a keystone of national defense, and both treasure and talent were invested in their construction. The character of the defenses between the 1870s and World War II finds expression in the selection of location and sites, the choice of materials used in their construction, and the manner of their design. The location of the defenses moves from close to the water and harbor entrances, to distant from them. Concrete becomes the preferred building material, wholly displacing the earlier preference for brick and stone. The plan of the batteries shifts from two guns side by side in a single emplacement, to two guns each in its own emplacement—separated from the other by hundreds of feet. The design of individual structures migrates from simple storage to sophisticated specialization.

Most discussions of character-defining features have as their orientation the conventional structures of our community, the commercial buildings and private dwellings that make up our cities and towns. In these structures, the idea of materials, craftsmanship, decorative details, and interiors have a familiar vocabulary because we encounter these buildings every day, and we come to know what to expect in similar buildings. We also know that architects design with such qualities in mind. All of these aspects of character-defining features disappear when we turn to fortifications. Their forms are architectonic rather than architectural, and we need to look carefully at their use and history to determine the unique nature of their distinctive qualities.

Location and Site

Principal Character-Defining Features

Since coastal fortifications were built to mount artillery, the location of the gun batteries was affected by the range of the armament. The ordnance available in the 1870s had a range that was short, and thus the batteries built at the time had to be close to the water. They also had to be close to the narrowest area of the harbor entrance. As the range of cannon increased, there was greater flexibility in where the fortifications could be located.

Change Over Time

The guns mounted in the 1870s had a range between 4,200 and 5,000 yards, and as a result they occupied sites that were close to the shore. The engineers could not afford to sacrifice any of their ability to cover a water area by choosing locations that might be better from the point of view of construction or protection. Typically, the batteries of the 1870s flanked a waterway in a long line, in a fashion reproduced by West Battery and East Battery, or as a defended point such as Ridge and Cavallo Batteries. The locations in

San Francisco were notable in that they were very high; on the north side of the Golden Gate, Ridge Battery and Cliff Battery occupied positions more than 400 feet above the sea.[2] These were enviable positions from the point of view of the defenders, giving them the ability to fire down on hostile vessels. Batteries at lower elevations (although no site occupied in the 1870s at San Francisco could be considered low) had to do with bombarding the ships from the sides, the above-water hulls being more difficult to penetrate.

The locations selected for the construction of the 1890s (and later) often duplicated—and therefore displaced—the locations chosen for earlier works. Distance from the shore was less of a consideration—the maximum range of heavy guns had increased to about 12,000 yards with an expected "working" range of about 5,000 yards—but the sites occupied by earlier batteries were still desirable because, given the topography, they were the right ones. Height remained the defenders' best ally in implementing the recommendations of the Endicott Board. Thus Battery Spencer occupied the location of Cliff Battery, Batteries Marcus Miller, Cranston, and Godfrey obliterated most of West Battery, and Battery Yates found its place on top of the Cavallo Battery outwork.

Another aspect of location, as a character-defining feature, had to do with a weapon that was one of the strongest elements of the defense. Submarine mines were powerful deterrents to an attacking fleet, so mine fields were carefully located on both sides of the harbor entrance. Electrical cables connected the mines to the shore, and the mines could be exploded electrically at just the right moment. The mine fields needed protection, and some batteries occupied locations chosen for their view of the mine fields rather than positions from which they could bombard vessels. Batteries Duncan, Yates, Slaughter, Sherwood, Blaney and Baldwin, in conjunction with other batteries at Fort Mason and Fort McDowell, overlooked the interior mine fields, and together they created an internal corridor to the defenses that did not before exist. Their positions east of the Golden Gate reflected the importance assigned to the mine defense. Seaward, batteries of 6-inch guns at Fort Scott and Fort Barry occupied positions where they could defend the minefields west of the harbor entrance.

Locations for the mortar batteries also reflected the particular aspects of this artillery weapon. Batteries Howe-Wagner, Stotsenberg-McKinnon, and Alexander were placed well back from the shore because the mortars had a minimum range; locating them too close to the shore would create a gap in the defended water area. In addition, the engineers preferred to locate a mortar battery behind a large hill or elevation that not only obscured the battery from view, but also provided it with substantial protection from naval bombardment.

The batteries of the 1890s began a trend that continued to World War II: the spread of the defenses to the north and south to locations that could support the defenses in the immediate vicinity of the Golden Gate. Fort Miley, the first of these specialized posts, occupied a position that denied a sheltered location from which vessels could attack the batteries farther north. The spread of the defenses was an indication that geography could hinder as well as help. The same geography that gifted the engineers with high elevations also presented them with a difficult problem in coast defense—defending a port that was essentially a gap in an unbroken coastal scarp.[3]

By the advent of World War II, the range of the guns had increased to more than twenty-five miles, and the location again reflected the change in technology. Gun batteries pushed further outward, as did the proliferating numbers of fire control stations now required for the long-range cannon. With weapons so powerful, there was no consideration of their position in regard to the shoreline. Instead, location was a matter of selecting the best site to make the most of the guns to be mounted there. Location in this period also reflects an increased desire to take advantage of existing terrain for added protection from the air, a new and more deadly form of assault than that offered by the warships that were the targets of the coast guns.

In addition to the geographic location of the batteries, their character was also defined by changes to the sites themselves. In the 1870s and through the Endicott period, the site improvements were often not much more than a cleared space or road to the rear of the battery. This feature was often identified as the battery parade, a space used to form up the artillery detachment before it took to the guns, but it was also used as a means of point-to-point communication. East Battery retains its parade as a path used by visitors today. Battery Spencer features an approach road that is a covered way, a conventional feature of much older fortifications. Roads and parades were often surfaced with crushed rock or brick, or compacted clay. Gutters and drains trimmed the edges.

The areas in front of Endicott and Taft works were graded flat with a slight angle of depression that continued the concrete slope of the battery. Although distinct angles in earth were discouraged in the 1890s as potentially giving away the location of the guns, Cavallo Battery was a complete exercise in earth shaping. The site and the structure itself were made of the same material, and at its completion, it appeared to emerge from the earth with a symmetry and regularity that made it immediately distinguishable from its surroundings. The sites of batteries built during the period of air power display the great attention that was devoted to duplicating natural land forms. The splayed emplacements of Battery Townsley are an effective demonstration of the care that was taken to work the construction into the landscape when regularity might otherwise reveal its position. Wherever possible, the site was carried over the work through camouflage. Roads in this period did not so much connect the elements of the defense as they led past them.

There were other site features of smaller scale. Stone retaining walls survive at Battery Blaney, and the right wall of Battery Crosby extends as a retaining wall. The lightly-built structures of the Endicott-Taft fire control systems were given a degree of protection by modifying the construction sites with a depression or surround of earth. The early battery commander's stations for Saffold and Godfrey are indications of these practices.

Construction Materials

Principal Character-Defining Features

Construction materials exhibit the adaptation of common materials to the specific requirements of military architecture; the techniques of construction exhibit a high degree of craftsmanship, and in the case of concrete, a growing understanding of how the material can be used.

Change Over Time

The defenses of the 1870s were distinctly different from those that had preceded them as well as from those that followed. They were built largely of earth, and viewed today, they appear to be sculpted from the surrounding terrain. That is a deceptive vision. Earth was the material that was used in the greatest quantity, but it was earth placed over and around armatures of brick, concrete, and stone. The traverse magazines were concrete or brick rooms covered in deep banks of earth; emplacements featured granite blocks to support the heavy muzzle-loading cannon. Brickwork faced the parapets and the entry to the magazines. These other critical building materials were disguised by the mounding of earth around the structural elements, and today they have become further obscured by lush plant growth.

Earth was the natural choice for a number of reasons. As presented in almost every overview of the history of fortifications, the American Civil War demonstrated that the age of the masonry fortress had passed, to be replaced by earthworks that could better absorb the force of the more powerful ordnance then arriving in arsenals throughout the world. They also could be built and repaired more easily. Earth remained the best choice in the 1870s for another reason—military technology was moving forward rapidly, and it was difficult to know what to prepare against. The defenses built by the United States at that time were intended to be only an interim solution. They would do until the nature of the threat could be better perceived and the capacity of the nation to support a specific type of coast defense was better understood, and the designs of proposed new guns and carriages could be settled upon.

The brickwork in this period formed the round-arched passageways that connected different portions of the defenses. Exposed arch faces were made of common brick that was not sanded to shape; mortar joints were tapered instead. The craftsmanship was at a level equal to other well-built masonry structures, and it has contributed to the generally excellent condition still apparent today (Plate 11). There was little stone. At Cavallo Battery, lintels and sills were of cut granite set into the brick walls. East Battery contains an indicator of things to come. The groin formed by the intersection of two galleries is rendered in concrete, not brick. It is a limited application of the material, and early evidence that concrete was considered simple to fashion into complex shapes, more economical than brick and requiring less skill.

Plate 11. The quality of brickwork in the surviving elements of the 1870s is very high, reflecting both the careful selection of materials as well as the skill of the masons. Cavallo Battery.

Earth remained an essential feature in the 1890s. Each battery was designed to resist the penetration of a projectile, the resistance calculated in so many feet of earth placed in front of so many feet of concrete. In addition to its protective values, earth was graded into the natural contours surrounding each structure (Plates 12 and 13). It remained equally important in later years, as earth cover protected fortifications from attack and observation by both sea and air.

There were some shortcomings. The long side slopes of Batteries Howe and Wagner were made of clay faced with a deep layer of loam, and then planted. Moles and gophers criss-crossed the area with burrows, and in the heavy rains of the 1894-1895 winter, the slopes turned liquid and flowed into the mortar pits. After the exhausting work of removing some 1,000 cubic yards of material by hand and

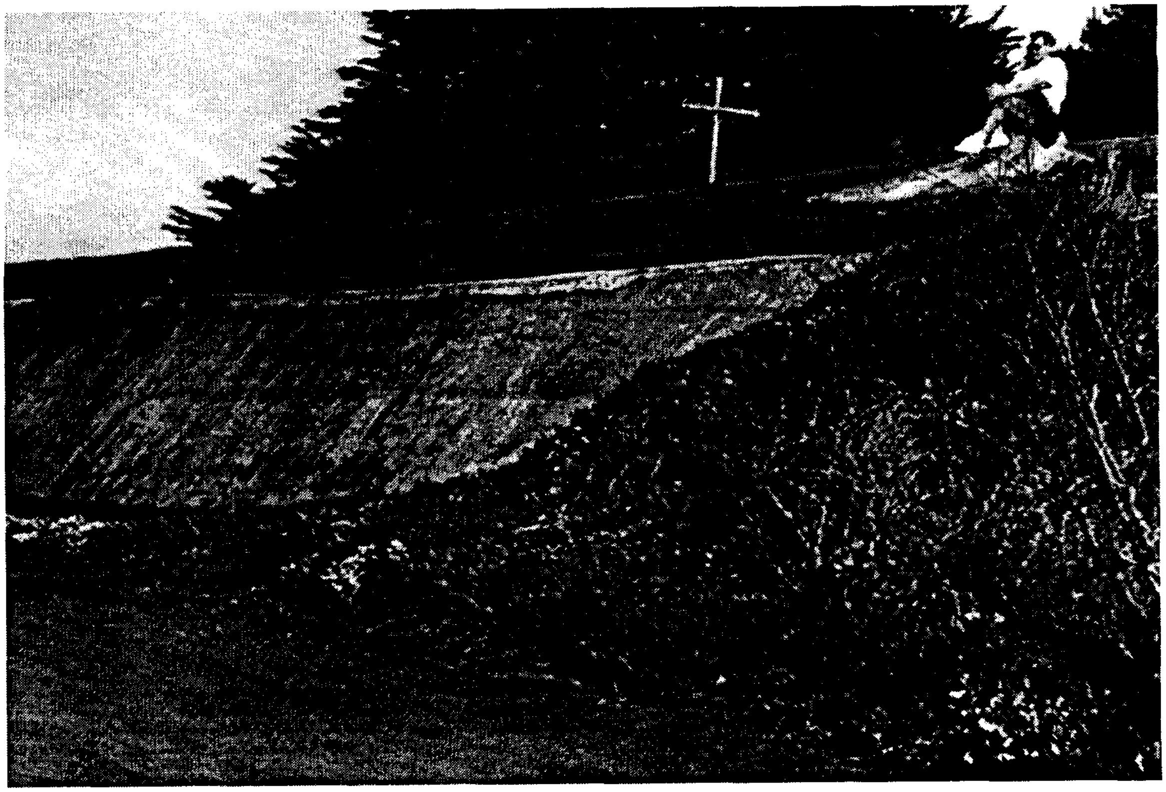


Plate 12. Earth was a critically important component of fortification construction: its loss can distort the intended appearance of a structure. Battery Godfrey.

Plate 13. Earth remained a constant in the fortifications built after the Civil War. Here at the Fort Barry mine casemate, it covered a modern structure of reinforced concrete, rendering that structure invisible to eyes that might view it from the sea or the air.

carried out in pails, the slopes were rebuilt.[4] Landslides in disturbed slopes were not uncommon, and earth would settle in unanticipated ways or not hold the slopes intended for it. The material continues to act in the same manner in fortifications currently held as historic properties. For example, the state of New Jersey recently went to considerable expense to stabilize the earth slopes surrounding a battery at Fort Mott State Park.[5]

Brick and stone were not part of fortifications built after the 1870s. Some defenses on the East Coast retained masonry as a decorative element in concrete or as an anchor for door hinge-pins, but these practices were not incorporated into the works at San Francisco. Concrete was the material of choice for all modern work. It was rapidly replacing stone as a choice in commercial building and paving, and seemed ideal for the type of defenses contemplated by the Endicott Board.

Concrete was the hallmark of the new fortifications, and it made manifest the break with all previous techniques of fortification. The construction of new works of concrete made it clear that the form of American coast defenses had come of age, and the selection of concrete as the material of the future emphasized how tentative had been the system of the 1870s.

The coast defense weapons of the 1890s were more massive, more strongly built, and more complex than any that had preceded them. Guns and their carriages could weigh hundreds of tons, other mechanical devices required electrical power to operate, and electricity illuminated the interior of the emplacements. These new and sophisticated devices required protection from naval weapons that were equally impressive, and they also required a clean environment. These were qualities that concrete could provide better than anything else available to the designers and builders. Concrete was the material of modernity, and fluid shapes of concrete symbolized what was up to date in both civil and military architecture well into the 1940s.[6]

Portland cement was used in all the concrete placed in the defenses of San Francisco. As a result, the fortifications built in the fifty-year period from the close of the nineteenth century to the close of World War II are notable for the quality of their basic fabric. Moreover, they are also distinctive for the finish given the concrete. More than anything else, it is the visible surface of a concrete structure that best expresses the care with which it was built.

Vertical and horizontal surfaces have differing character-defining features. Vertical surfaces often show indications of the formwork or shuttering that was erected to hold the mixed concrete in place until it hardened. Sometimes these features were disguised or softened by parging the surface or sanding it to remove the shuttering marks. Some batteries show several of these features together, as at Battery Marcus Miller. In that instance, the differences in the finish are also indications of a difference in construction sequence, the center part of the emplacement being completed first to allow mounting the gun at the earliest opportunity (Plate 14). Horizontal surfaces were considered walking surfaces and received a different treatment. Often the aggregate was a coarse sand of ground granite used in many paving applications, and it had a look and feel that was distinct. Horizontal surfaces were also marked in flags, the division of the plain surface into regular shapes by narrow grooves pressed into the wet concrete. The purpose was in part decorative, but it was also an aid in drainage and the control of surface cracking (Plate 15).

The nature of finished surfaces changed in the 1930s and 1940s. The methods of building with concrete had altered over the years, and the structures built during that time contain reflections of those practices.

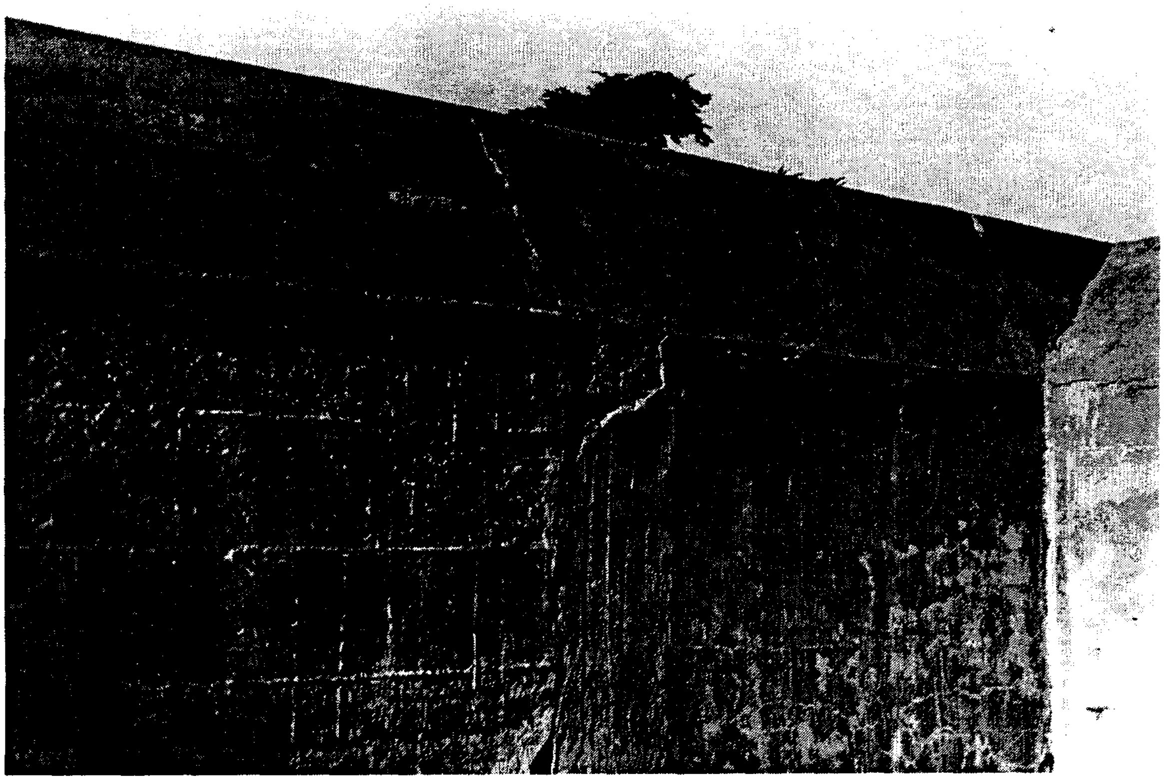


Plate 14. Concrete often retains evidence of how it was placed and finished. Different methods can still be seen today, and are expressions of building history. Battery Marcus Miller.

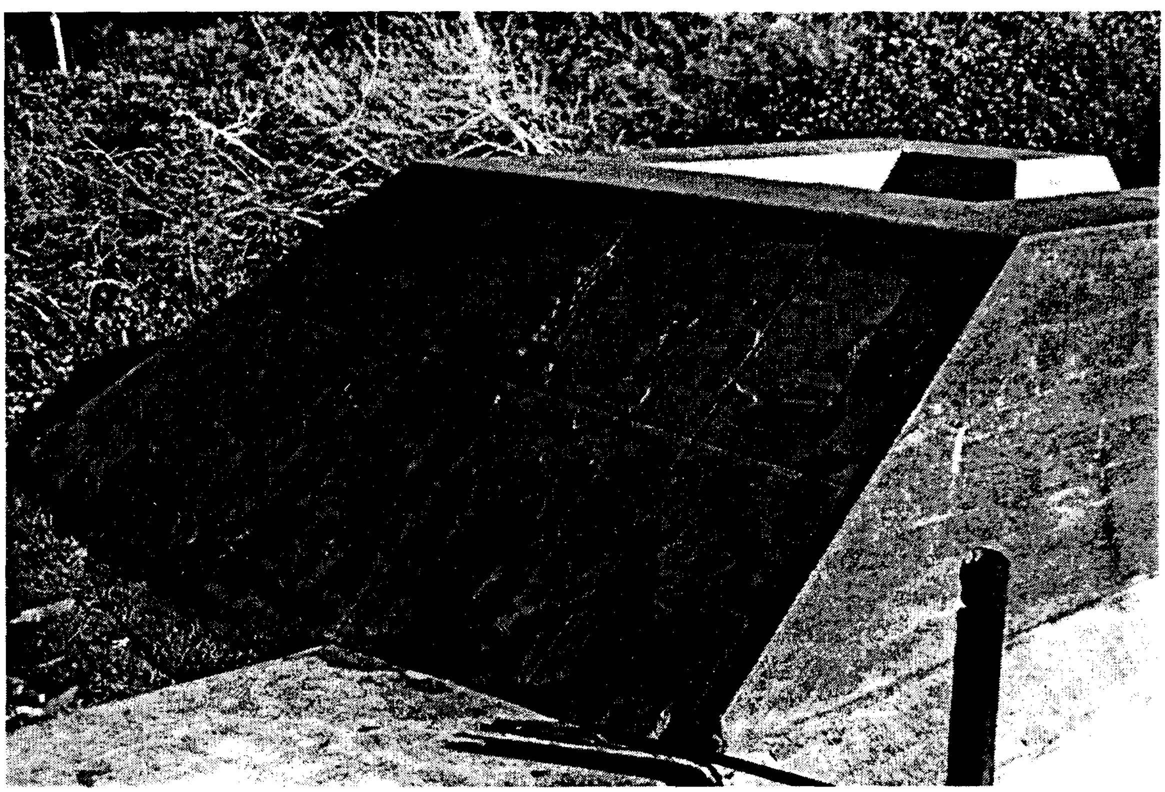


Plate 15. Exposed concrete was often finished very carefully, both for the sake of appearance as well as helping to produce a waterproof surface. Crows nest, emplacement one, Battery Crosby.

Plywood panels replaced the use of individual form boards, and specialized hardware (some of which remains intact at the ceiling level of emplacement two, Battery Construction #129) helped speed the erection of the formwork. Surfaces were not parged because the shuttering itself tended to leave a more handsome and finished appearance. Some horizontal surfaces were rendered with a cement-rich mixture that left a smooth, almost lustrous surface that was unbroken by flags, while other floors were completed in a manner that was similar to earlier practices.

One of the results of early concrete construction was an unusually porous mass, and there were many efforts to control water penetration and to encourage run-off. These efforts could leave visible marks on the defenses, and they are an important aspect of their history as structures. While many surface coatings were tried, the one that is the most evident today is tar, and many horizontal surfaces retain surviving flecks and splotches of the tar layer. The introduction of the Taylor-Raymond ammunition hoists in 1904 brought about significant modifications to many existing batteries, including the addition of layers of new concrete over the old. The event was an opportunity for greater efforts at waterproofing, and sometimes layers of sheet lead or tar were incorporated into the modifications; Battery Godfrey contains exceptionally clear evidence of the practice. The forward slope of Battery Godfrey also depicts an example of an informal response to the need to promote surface drainage as well as to build up the surface of a settled mass. Drains of iron pipe with an in-fill of local clay saturated with oil or asphalt are the distinguishing marks of an expedient repair to a permanent structure.

Painted surfaces are also a character-defining feature, and paint was applied on both the exterior and the interior. In most early batteries, interior painting schemes were simple, often little more than a white ceiling and upper walls, with black lower walls (Plate 16). The result was a more reflective surface that made the most of the limited lighting in place, coupled with one that hid dirt and scuff marks that were inevitable during use. Exterior colors served to dull the surface of new concrete, which could be almost white in bright sunlight. The painting of Battery Duncan was an exception, and the upper walls of the tall traverse were rendered in red to better match the clay of its building site.[7] Battery Duncan also contains the fading evidence of another feature once common in coast defense practice—the painting of a time-range grid on a traverse wall where it could be seen by the gun crew.

Other less prominent materials also contribute to the character of the defenses. Wood, bronze, ferrous metals, and clay tile all served their own particular purpose and were part of the composite.

Bronze frequently found use in hinge-pins, and was typically cast into a unit that could be incorporated into a structure during its construction. Although the doors are missing in some places, the bronze hinge-pins remain intact, except in those places where they have been robbed out of the structure for their salvage value. Battery Spencer bears ample testimony to the practice. Door closures, where they remain, can also be bronze.

The most readily visible use of wood is in the heavy doors that close most of the entrances. A wooden door built of layers of tongue-and-groove boards, and held together with iron straps and through-bolts was a typical feature of early magazines and gun emplacements from the 1870s through the initial years of the Endicott period. They were not a universal success, and the intent was to replace them with riveted doors of iron and steel.[8] Newer construction included metal doors, and as a result an addition to an older battery (the power room at Battery Saffold, for example) would carry doors of metal while the balance of the battery retained the original wooden versions. Fewer wooden doors were replaced in the San Francisco defenses than elsewhere, perhaps because the generally benign climate was more favorable to their continued good condition (Plate 17).

Wooden boards set high on the interior walls of concrete emplacements provided a fastening surface for the brackets that held electrical wiring, and wooden wiring chases were a common feature of many Endicott and Taft structures, particularly in fire control buildings. Wood-framed Sewell buildings (a type

Plate 16. The simple contrasting color scheme of black and white was basic to early concrete fortifications. This interior view of Marcus Miller also shows the round-arched ceilings that were also typical of the first construction work of the 1890s.

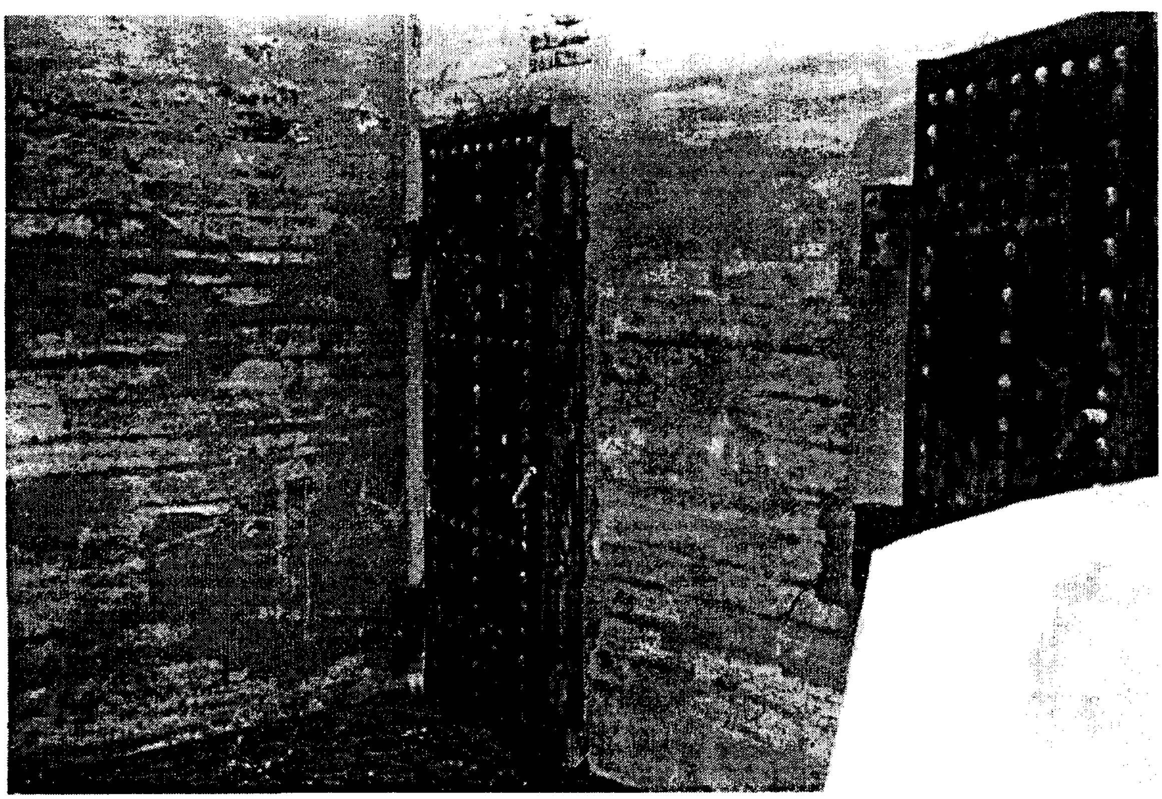


Plate 17. The steel doors and window closures of Battery Dynamite are among the most massive in the defenses, and may indicate the replacement of original closures when this portion of the battery was converted to a telephone switchboard.

of construction that called for cement plaster over expanded metal lath) were used for many auxiliary purposes in coastal fortifications, although none have been identified to date in the San Francisco defenses. The latrines built for Batteries Stotsenburg-McKinnon and Duncan were probably of Sewell construction; the concrete floors and partial walls are all that remain today. Wood plaques also carried identifiers for speaking tubes (Battery Crosby has one such plaque in place, although it is heavily damaged and unreadable) and doors. Wooden window sash is also a common feature of the early San Francisco defenses, although they were less frequently used in other locations of the same time period. During the World War II period, wood found employment for the interior doors and partitions of the Fort Barry mine casemate, the combined mine casemate at Baker Beach, temporary magazine doors at Battery Construction #129, and other locations.

Features of iron and steel are an expected component of fortifications. They are character-defining because of their intended purpose, but also because they help moderate what would otherwise be a plane of concrete; in addition, they often contain a level of detail that is otherwise absent from the structures. Most prominent and already mentioned are the heavy doors, both single- and double-leaf, but also important in their ability to add detail to fortifications are the shutters in observation stations and telautograph booths, ceiling beams and reinforcing bars, trolley I-beams, lighting fixtures, curved pipe railings (Battery Kirby), ladders (Battery Boutelle), stairs (Battery Marcus Miller), gates (Battery Construction #129 and Battery Townsley), stanchion and chain railings (Battery Stotsenburg-McKinnon), window grilles (Batteries Mendell and Duncan, as well as others), ventilator openings (Battery Crosby), and components of ammunition service and supply. Many of the elements are damaged or in some cases missing altogether, and their current state helps promote the sense that the fortifications are of little historical value (Plate 18).

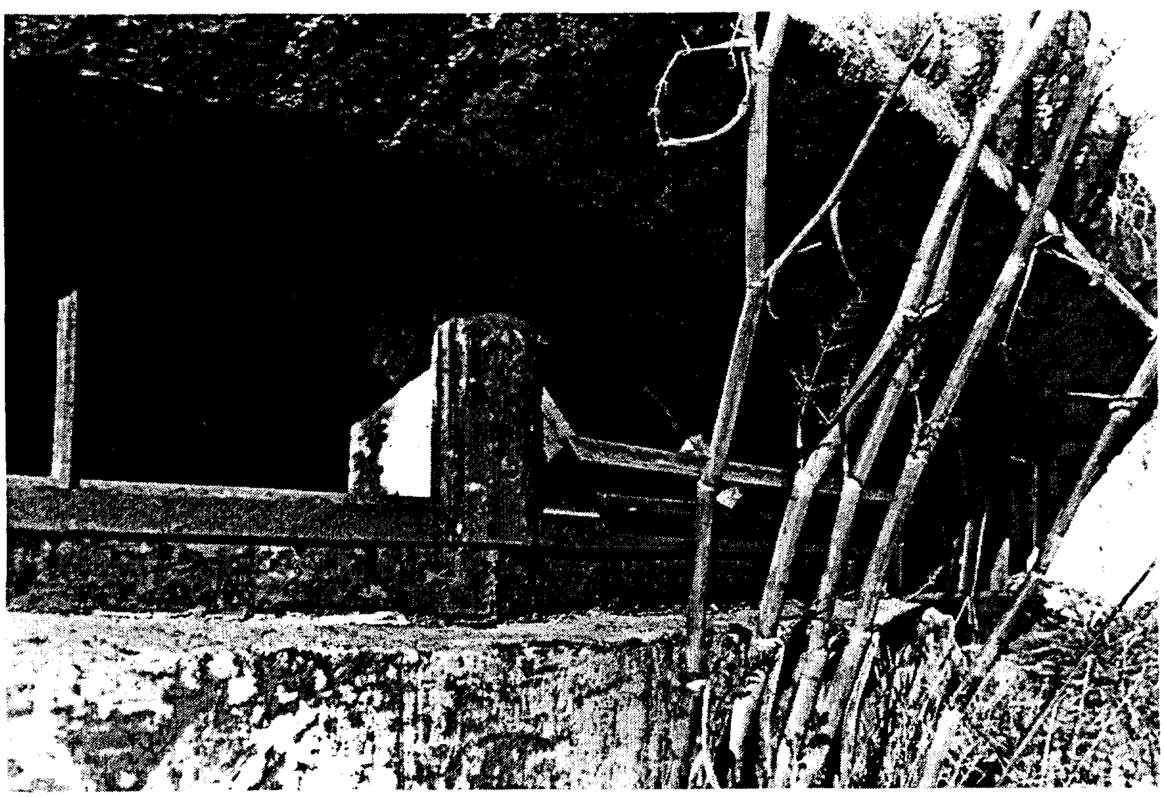


Plate 18. Metals—usually bronze, iron, and steel—served may specialized uses in fortifications, such as this tilting sash at the BC Station, Battery Construction #129.

Clay tile appears as electrical ductwork (an unusual example is in the ramped passage of emplacement three, Battery Godfrey) and as a sub-surface applique to help move water away from concrete walls. That use carried through World War II. Clay tile also appeared in one visually distinctive and widely used form, and it apparently has but one surviving example. Roof ventilators in concrete structures that served auxiliary purposes (power plants, plotting rooms, storage battery rooms, latrines, and so on) were often fitted with a decorative clay cap. These were always fragile, and today all are gone save one, and it is perhaps the most unlikely survivor of all. In the gardens that have been built in the remnants of Battery Lancaster, the single example of a "Mandary" flue cap stands among the plantings, its pagoda-like form making it appear to be a consciously selected element of the landscape.[9]

Structure

Principal Character-Defining Features

Each of the three major periods of construction—1870s, Endicott-Taft, and World War II—produced structures that characterized the style of fortifications then in force. The structures, and the collections of multiple structures, ranged from simple forms in the 1870s, to complex in Endicott-Taft, and to sophisticated in the final years of coast defense.

Change Over Time

The basic character of the fortifications of the 1870s emphasized their impermanence and their place in military architecture as transitional designs. Although West and East Batteries were little more than enhancements on the hastily built works of the Civil War, more regard needs to be given to Cavallo Battery. As mentioned earlier, its character devolves from the material used in its construction, but with its salients and parapet enclosing the entire work, it was also self-defensible. That capacity was unique among the other coastal fortifications of the 1870s, and the battery was arranged in that manner because of its isolated location. Its articulate combination of slopes and angles have been called handsome, and few can fail to be impressed by this singular structure.[10] The architectural quality of Cavallo Battery places it with that small group of fortifications that are recognized and valued by the general public, an aspect that is enhanced by the emergence of its conspicuously artificial form from the surrounding terrain.

The work of the Endicott and Taft boards produced a dizzying variety of structures with an equally diverse catalog of character-defining features. For gun and mortar batteries, the major features are in the plan, the program contained by the plan, and the external form. The time of the design—whether it was done before or after 1900 —also had a particular influence on the appearance of gun batteries.

The large-caliber gun batteries in San Francisco were among the first designs to be put into concrete, and Batteries Marcus Miller and Godfrey are good examples of early floor plan designs. The interior plan was simple, and consists basically of narrow rooms that seem to be little more than spaces hollowed out of the concrete mass for the storage of projectiles and powder. A single passageway, also narrow, led into the shot room, which itself connected to a forebay that linked the powder room to a small hoist shaft leading to the exterior. The passageway was long, in the case of Battery Godfrey some forty feet, but about half that distance in Battery Marcus Miller. The passageways were the principle entry as well as serving as the galleries for ammunition supply. Moving ammunition into Marcus Miller was direct since the entry gallery was at the same elevation as the roadway behind it. That same movement was more difficult at Battery Godfrey because there the entry passageways were at the foot of a long, narrow, and comparatively steep ramp that led below the road elevation. Considering that the projectiles fired by the

Plate 19. Tramways with turntables at intersections carried small rail cars that could be pushed by several men to carry ammunition into the interior of a battery. They were an uncommon feature of fortifications built in the United States. Battery Stotsenburg-McKinnon.

12-inch guns of the battery weighed a half-ton each, moving them down the ramp and into the magazine must have been a tedious and difficult requirement to meet (Plate 19).

The plans of Endicott batteries shifted as engineers began to see more efficient ways to meet the needs of the artillery service, and understanding the evidence of that pattern of change is key in a comparative evaluation of individual batteries. As an example, Battery Saffold is also an early battery, designed in 1896, and it reveals a shift in floor plan that underscores change as an early constant. The entryway at Saffold is a true circulation corridor, and the magazine spaces open onto the corridor, each with its own entry. There was also an additional room in the interior; called a bombproof, intended for shelter during bombardment, and its inclusion demonstrates the desire for more specialized spaces within the battery interior.

While changes in the nature of the interior floor plan may be difficult to perceive in structures whose interiors are not accessible, the exteriors contain a great many examples of improvements made after their initial construction. Almost all major caliber gun batteries show the effect of additions and other improvements. Not long after Batteries Marcus Miller and Godfrey were completed, the artillery officers complained that they did not offer all the space that was necessary, and engineer officers had their own list of changes they wanted to make as well. As a result, small separate structures were tacked onto the new batteries. On the right rear of emplacement three of Battery Marcus Miller, the engineers situated storerooms, a latrine, and a motor-generator room; they also added a plotting room behind emplacement one. Engineers built a similar collection of rooms into a much more constricted space between the right side of Battery Godfrey and a retained 1870s magazine. In much the same vein, the magazine space of the same battery was expanded by the addition of a large room; the windows of the enlarged magazine are visible at the rear of the battery.

There were other conspicuous changes as well. Between 1904 and about 1912, all the big gun batteries underwent further modifications that brought them closer to the appearance they have today. The greatest impact came about as a result of modifications to the method of delivering ammunition from the magazine to the emplacement above. The hoists installed when the batteries were first constructed were limited in many ways, and in 1904, the Army began a nationwide program to upgrade the ammunition delivery service. They installed a new mechanism called a Taylor-Raymond hoist, which required considerable reworking of most existing gun batteries. Old hoist shafts were closed, new shafts were cut through mass concrete, space was created for the new hoist mechanism in the magazine, and a heavy concrete roof called a splinterproof was built over the top of the replacement hoist. At about the same time, special booths (to house a distance writing instrument called a telautograph) were built to the rear of many emplacements, and extensions were added to some loading platforms. Earth was removed from the rear of the traverses of Marcus Miller and Godfrey, permitting movement between the loading platforms of adjacent guns for the first time since the batteries were built. The final conspicuous change came when the battery commander's stations were added to most gun batteries.

Battery Spencer shows best the changes that could be brought about by the collective improvements. Because of the compressed and angular plan, the battery parade is more like a courtyard, and it is easier here than it is at other batteries to see the net effect of the changes from a single position. The tall telautograph booth, the free-standing truck recesses, the small platform extension at emplacement one, the battery commander's station, and the Taylor-Raymond hoist positions with their thick concrete covers, all indicate improvements to the battery to keep it modern and useful. This battery too had its complement of out-buildings to make up for specialized spaces not foreseen when the battery was first designed. There was so little room on the site that these new structures had to be fitted into either side of the approach road, forming a corridor for visitors today.

After the enhancements of the Taft board had been considered and put into place, the construction of fortifications effectively came to a halt until the advent of World War II. There was some modest activity, and Battery Wallace was one of the few projects built in the United States after World War I. While it appears to be wholly unrelated to features common in Endicott works, Battery Wallace and others like it were the natural outgrowth of the designs that took shape at the turn of the century.

The fundamental character-defining feature of the first concrete batteries was a two-story appearance. The magazines were on the first or ground floor, and the gun above was on a higher level with the ammunition hoist connecting the two. That was never a wholly satisfactory design for a number of reasons, and after much experimentation, the engineers were able to do away with the hoist and it became possible to place ammunition storage and the gun on the same level. Battery Wallace, a later version of that idea, was built for a different type of gun, but it contained an equally dramatic element that set it and later batteries aside from what had been built before. They were now to be single-story structures. The guns were widely separated from each other, and the magazines and storage spaces between the guns were covered with a heavy layer of earth (Plates 20 and 21).

Battery Wallace, Battery Davis, Battery Construction #129 and others like them, are the culmination of what had been learned during the construction of the Endicott and Taft periods. Where plotting rooms, power plants, latrines, store rooms, and guard rooms had been added onto the exterior of the gun batteries of the 1890s, later designs of that period (Battery Mendell) had incorporated those features into the floor plan at the outset. It was only natural that all of those elements would be in place when the next generation of coast defenses came to be built. The character-defining feature of these plans was efficiency, and the visual quality was characterized by a subtle appearance that made them seem more a part of the landscape. In some ways, the designs had come full circle, the works of World War II bearing similarities of form to those of the 1870s. Missing from that assessment is the acknowledgment of the sophistication of these last fortifications, for they represented the conquest of many of the problems of design and construction experienced in the first generation of concrete fortifications.

Linking Analysis to the Coast Defense Resource Checklist

The major divisions of this chapter—Location and Site, Construction Materials, and Structure—also form the core of the Coast Defense Resource Checklist. The checklist is the device by which much of the content of this manual is conveyed to the resources. Those preparing inventories will have to be alert to the variable nature of fortification structures and look beyond the brief and comprehensive categories included on the checklist.

The character-defining features of fortifications are often nuanced, surprising in a resource whose most conspicuous aspect is great size. For example, there are many types of railings and rail fittings, and the checklist should note the varieties—or link to another document that catalogs these differences. Failure to identify and acknowledge the importance of such detail can lead to unfortunate choices, such as the replacement handrail at Battery Chester. These details change from one structure to the next. Iron doors may cover ventilation openings in one battery, but a grill might be used for the same purpose in another. Noting both uses is a part of any inventory.

Vegetation poses its own set of challenges. The control of the landscape was presumed in fortification design, especially during the period when aircraft came into military use for observation. Yet few of the landscape decisions made by the builders are recognizable today. Small trees that may have been planted on the slopes of batteries have grown to a maturity they were never intended to reach. Heavy underbrush has effectively destroyed the visible evidence of any original groundcover. The combined effect can often isolate a coast defense structure from a necessary view of the water area, and that view as well is a character-defining feature. The fundamental purpose of plant materials in fortifications was to disguise and obscure the location of a structure, but not at the cost of reducing their effectiveness.

The lesson to be learned from this chapter is that the successful comprehensive identification of character-defining features moves from the general to the specific. The general is included on the Coast Defense Resource Checklist, but the specific must remain in the hands—and eyes—of those who will complete the forms.

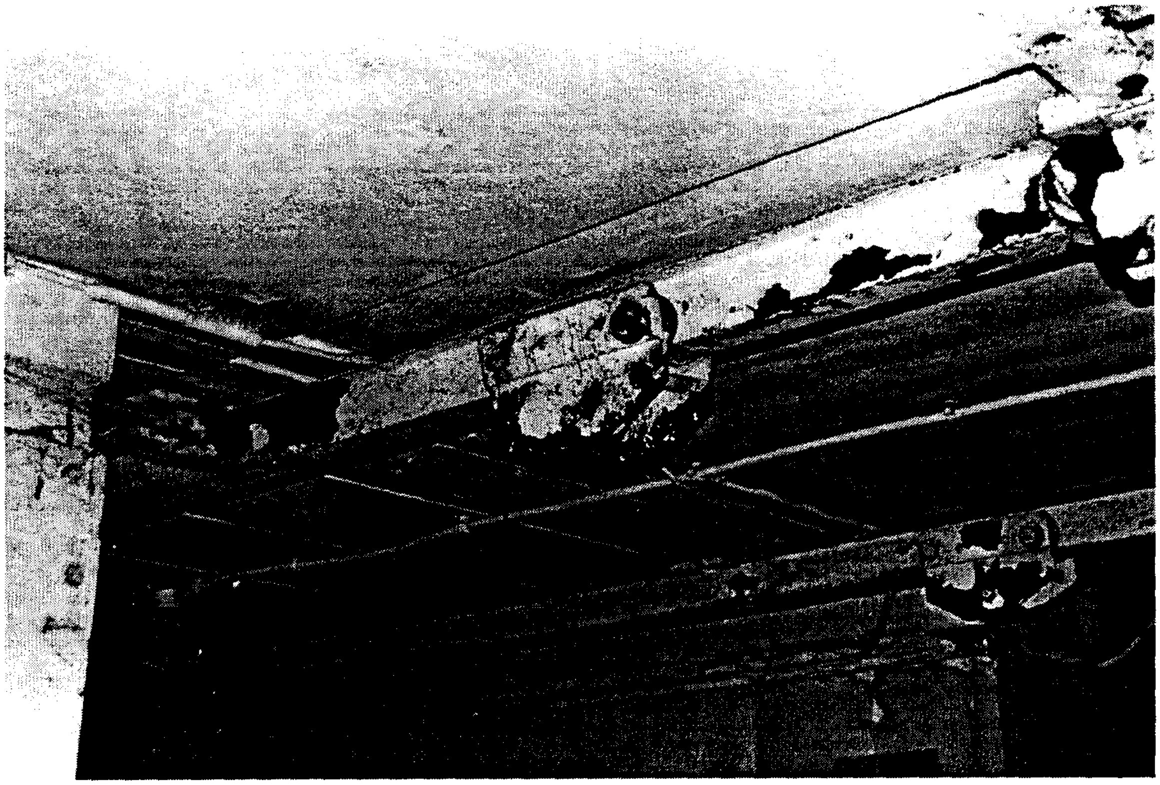


Plate 20. Almost all mortar batteries featured ceiling trolleys for delivering ammunition to the exterior of the emplacement. Trolleys found the same use in batteries for large-caliber guns, but there they led to an ammunition hoist. Battery Stotsenburg-McKinnon.

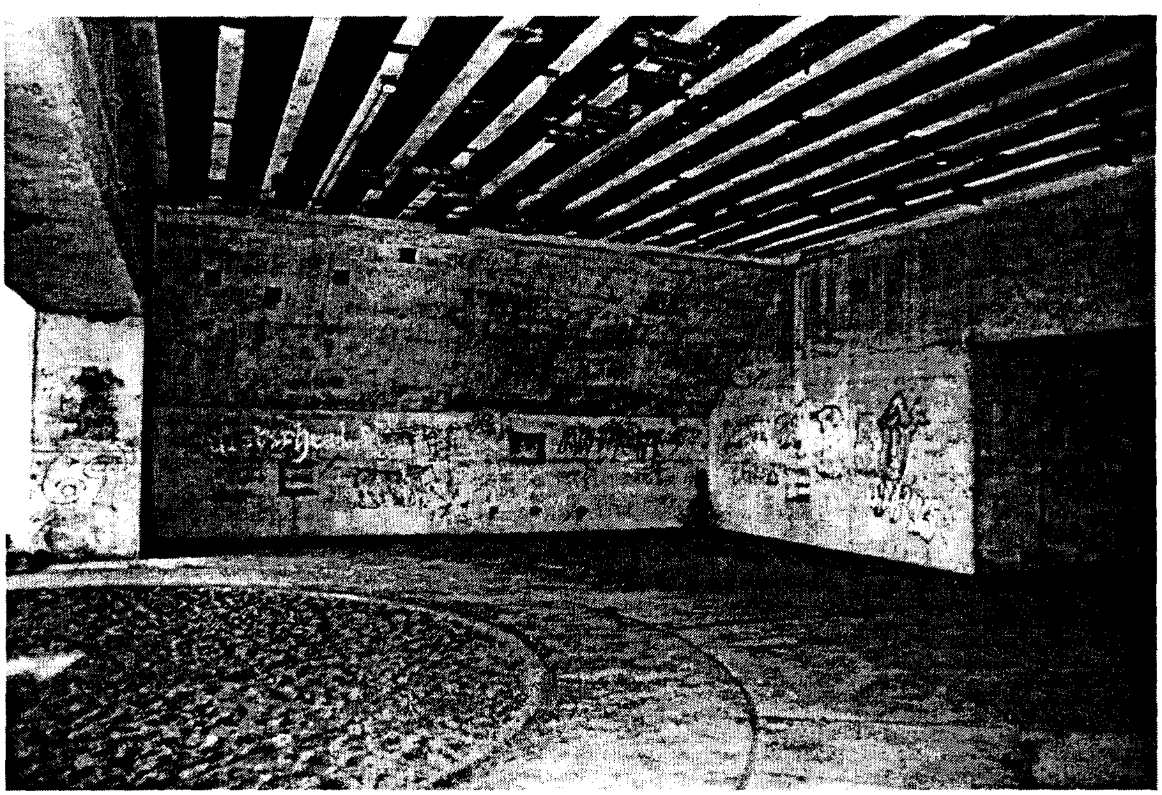


Plate 21. Ceiling trolleys were efficient, and they were also out of the way, leaving ample space in the battery. Fastenings for overhead trolleys dot the ceiling of emplacement one, Battery Wallace.

[1] U.S. Army Corps of Engineers, Board of Engineers, *Mimeograph No. 102*, "Storage of implements, etc., at emplacements," 16 January 1907. Hereafter cited by mimeograph number, title, and date. Erwin N. Thompson, *Historic Resource Study, Seacoast Fortifications, San Francisco Harbor, Golden Gate National Recreation Area* (Denver: U.S. Department of the Interior, National Park Service, 1979), 93.

[2] *Mimeograph No. 2*, "Memoir of Mortar Battery No. 1, Fort Point, Cal.," 30 September 1895.

[3] San Francisco's port, as essentially a gap in an unbroken coastal scarp, made defense in depth more difficult. In the case of San Francisco, defense in depth was accomplished by the creation of mine fields and covering batteries *inside* the harbor entrance, a less than satisfactory solution. At other locations, local geography allowed the use of more numerous headlands and islands *outboard* of the harbor mouth. A well-maintained navigation channel through shallow water at still other locations also helped govern the nature of approach for any attacking fleet. These advantages are not present at San Francisco.

[4] U.S. House of Representatives, *Annual Report of the Chief of Engineers, United States Army, to the Secretary of War*, 1895, 517.

[5] Watson and Henry Associates, "Concrete Stabilization, Battery Gregg and Postern Tunnel, Fort Mott State Park," project specifications, 17 February 1995.

[6] Keith Mallory and Arvid Ottar, *The Architecture of War* (New York: Pantheon Books, 1973), 281.

[7] U.S. House of Representatives, *Annual Report of the Chief of Engineers, United States Army, to the Secretary of War*, 1899, 987.

[8] *Mimeograph No. 64, 16th endorsement*, 19 June 1903.

[9] *Mimeograph No. 48, 42nd supplement*, "Brick switchboard room, type B, at Fort Totten, N.Y.," 16 December 1907, sheet 3.

[10] Thompson, 106.

Chapter 5: Historic Materials and Maintenance Methods

Modern-era coast defense fortifications currently within the Golden Gate National Recreation Area range from the 1870 earthen barbette East Battery, at Fort Winfield Scott, on the south side of the entrance to the San Francisco Bay, to the recently restored Nike missile installation SF-88L of the late 1950s and early 1960s, at Fort Barry, on the north (Plates 22 and 23). As one might anticipate, the challenges surrounding our understanding of the historic materials used to erect such a wide range of defense structures outpace our current knowledge. Nonetheless, much archival detail does exist. What follows is an introduction to topics of further research, many deserving of future consideration and some, perhaps, of more interest than others in the active preservation and maintenance of the batteries and their ancillary structures.

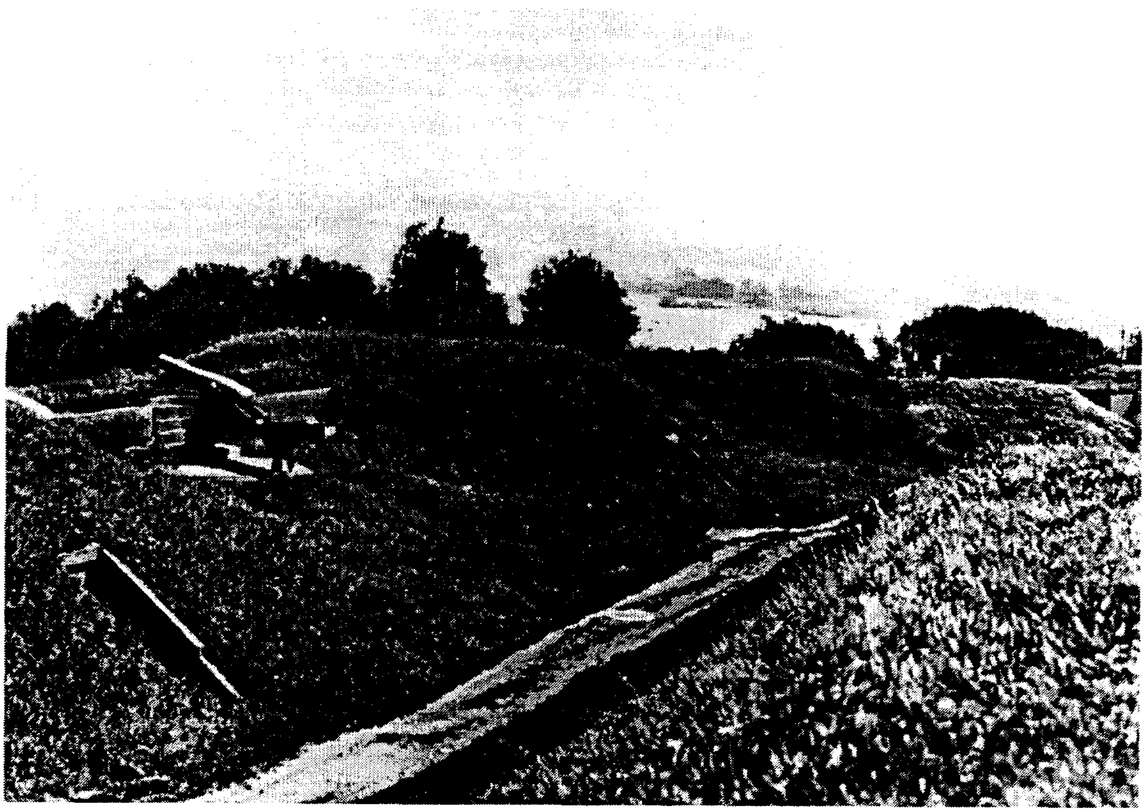


Plate 22. East Battery, Fort Winfield Scott, constructed 1872-1876. Panama Pacific International Exposition in the background to the southeast. View of circa 1914-1915. Courtesy of the Park Archives of the Golden Gate National Recreation Area.

Chronology of Structural Events: What was Built When, With What Materials?

Post-Civil War, 1865-1876

Post-Civil War construction methods and materials were characterized by a dependence on brick and stone masonry combined with enhanced earthworks. Despite the reduction of masonry fortifications such as Fort Pulaski during the Civil War, U.S Army engineers continued to rely on masonry construction through the 1870s. However, the masonry was used in support of earthworks. The brick masonry consisted of multiple wythe brick walls joined by regularly spaced header courses. The brick was set in lime-sand, cement, lime-sand mortars, or cement-sand mortars and the joints were concave or flush.

Spans were accomplished by means of segmental arches and vaulting. Wooden slab doors on metal strap hinges provided closure for bombproofs, magazines, and casemates. The guns were paired and set on terrepleins behind masonry or concrete parapets fronted by earthen berms. Emplacements were separated by masonry bombproofs covered by earth, and powder magazines were placed in central locations and reached by vaulted tunnels. The powder magazines and tunnels were also earth-covered. Earthworks were sodded to combat erosion and to blend the fortification with the adjacent landscape.

Some thought was given to the composition and slopes of the fortification's earthworks. Civil War experience with the bombardment of earthen fortifications indicated that certain slopes, densities, and compositions reacted in specific ways to both explosive ordnance and solid shot.

During the three-year period of 1868-1870, the U.S. Army Corps of Engineers initiated expansion and modernization of the coastal fortifications defending the harbor of San Francisco. Although battery construction for the harbor as a whole had begun in the early 1850s, on Alcatraz Island, the Army soon established a permanent defensive installation at Fort Point and by 1860 had plans for a large fort and permanent batteries at Lime Point to the north, and, batteries on Angel Island and at Point San Jose in the harbor and to the south. Temporary batteries followed with the Civil War, with that at Point San Jose falling into this category. Although the Army had constructed it only six years earlier, the earthen structure, with wooden platforms and magazine, was already in severe decay.

Plate 23. Nike Site SF-88L, Fort Barry. Actual view taken sometime between 1965 and 1970. Courtesy of the Park Archives of the Golden Gate National Recreation Area.

In 1868 engineers had begun the preliminary site work for the new batteries needed both north and south of the entrance to San Francisco Bay. At Fort Point, south of the harbor mouth, the Army completed a 600-foot seawall in late 1868 to protect the proposed "eastern battery" [a never-completed water battery], simultaneously undertaking experiments with the readily available "building sands" immediate to the harbor, and with Pacific Coast cements and limes. At what would be named Fort Baker (in 1897), the Army removed approximately 165,000 cubic yards of site rock through explosive blasting during 1868 and 1869, with plans for three earth-and-brick batteries at the water's edge and on the overlooking bluff. During 1870 to 1876 five batteries were under construction within the geographic parameters of this study, with substantial additional activity on Alcatraz Island: East and West Batteries to the south and Gravelly [historically, Gravelly Beach; now co-located with the Endicott-era Battery Kirby and World War II Battery Gravelly Beach], Ridge [historically two sites, Ridge and Cliff], and Cavallo Batteries, to the north. These were each open, earthen barbette batteries, requiring angled embankments for parapets, terrepleins, and traverses, and incorporating in their construction significant cubic yardage of stone, brick, and unreinforced concrete masonry for ammunition magazines, arched passageways, and gun mount foundations and platforms.[1] The Army engineered Cavallo Battery to an especially high level, considering it nearly a fortification in its own right (Plate 24).

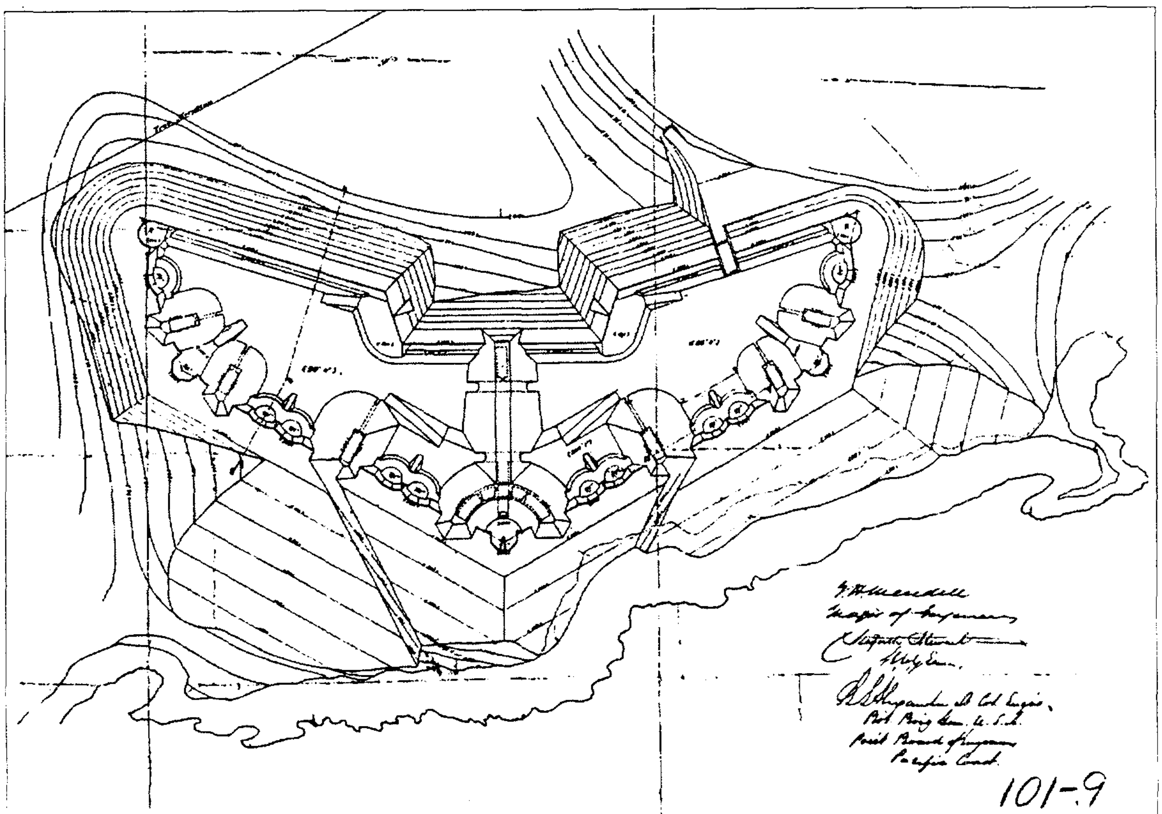


Plate 24. Cavallo Battery, Fort Baker, constructed 1872-1876. Plan of proposed works. Courtesy of the Park Archives of the Golden Gate National Recreation Area.

Foreshadowing technical challenges to come were the details of completing construction. Foundations for the gun platforms represented the heaviest construction, and were poured concrete, without reinforcing. Above the concrete foundations were the actual platforms, either of granite masonry or timber, with the latter set in the concrete. (Granite may have been the choice for mortar platforms, as was the case for the Endicott mortar battery, Howe-Wagner of 1893.)[2] As the gun platform structures were substantially heavier than the earth-and-brick works that surrounded them, they typically had settlement problems. By 1876, at least at Gravelly Battery, the Army poured additional concrete between the separating platform timbers. At Battery Cliff, the Army chose not to install the timber platforms at all—due to their known short life—and in early 1893 completely dug up the concrete foundations of the gun platforms to prepare the site for the Endicott battery Spencer.[3] Overall, woodwork employed redwood, oak, pine and sugar pine. Early mention is made of "asphaltic" and boiled oil coatings for the platforms, and lead painting of the wood doors, presumably for damp-proofing. Metal work and plate covers were noted as cast iron. And from the start, the batteries at San Francisco had a landscaping element: for the earthen batteries of the early 1870s, exterior and interior slopes were carefully sodded. Grass types mentioned in this period included barley and oats, with sodding described in "square yards" and assumed to be prepared squares (as distinct from sown seed).[4]

Endicott and Taft Periods, 1885-1916

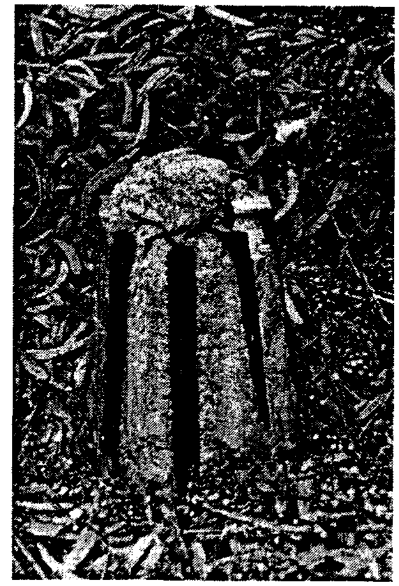
During a long hiatus from the middle 1870s until about 1890, no battery construction went forward for San Francisco's harbor until Congress appropriated funding for the U.S. Army Corps of Engineers to act upon the recommendations of the Endicott Board. Beginning with two adjacent installations at Fort Winfield Scott, Marcus Miller and Godfrey, in 1891-1892, the years through 1904 saw construction for twenty-nine batteries which are still extant and discussed in this manual: nineteen to the south, and ten to the north. This fourteen-year period witnessed many experiments in strengthening concrete; in more effective damp-proofing through applied coatings; in revisions of site excavations and fill; and in landscaping. Limited reinforcing of the battery concrete occurred from the first.

In its infancy, concrete construction was crude and experimental. Quality was limited by inexperience in storing, mixing, placing, and finishing concrete. Construction details were developed locally based on common practice and a limited number of manuals and trade publications. Despite difficult building sites and a variety of unstable soil conditions, the San Francisco Bay Area had an abundance of beach sand and gravel and suitable stone for concrete aggregates. Water was available from local springs or reservoirs. In order to construct fortifications on selected sites, roads and logistical planning were required to transport workers, tools, materials and equipment.

By 1890, the U.S. Army Corps of Engineers had tested various concrete mixes and had a sense of proper mix proportions. The dry materials were mixed with water to produce a workable mix of a consistency that was neither too dry or too wet. Forms were of horizontal wood planks braced to withstand the weight of the mass of wet concrete. Experiments began with imbedded iron streetcar cables and rails, with aluminum-bronze hold-down bolts. Set in a circular pattern below the gun platform the reinforcing extended downwards fourteen to seventeen feet to bedrock, with alternating layers of radiating rails and coils of cable—the Army placed ten to sixteen flat rails in a spiral pattern, every two feet vertically. First such experimentation was emplacement three, Battery Godfrey, in 1895, with emplacements one and two handled in the same manner in 1896.[5] (See Plate 10, chapter 2.) Interestingly, even though the Army initiated Marcus Miller before Godfrey, work on the gun platforms was in a reversed order. The foundations for the gun platforms at Marcus Miller, however, are still recorded as more conservative in the Army annual reports, with no notation of cable-and-rail reinforcing.[6] The other sections of the batteries were not reinforced—although they were thought to be strengthened. At both Marcus Miller and Godfrey, the Army used a combination of machine-mixed and hand-mixed concrete, adding to the latter a nearly equal cubic yardage of broken concrete taken from "old magazines" (presumably from West Battery) and a small cubic yardage of rock boulders.[7]

The matter of proto-reinforcing is uncertain for the other early Endicott batteries in San Francisco, but it appears that the Army used the cable-and-rail experiment a second time at Battery Spencer on the north side of the bay, shortly after finishing the platform foundations at Godfrey.[8] For the batteries that were either in construction as of 1897, or still not fully completed, Army annual reports reference the use of steel I beams for the roof structures of the magazines—possibly as reinforcement in some cases and for ceiling trolleys. The Army introduced the use of steel I beams for battery roof reinforcement about 1895, overengineering the technique with beams from four to ten inches wide, spaced two feet apart.[9] The

Plate 25. Battery Duncan, Fort Baker, constructed 1898-1899. Pier base at rear of emplacement near entry road. Illustrates use of streetcar rails as reinforcing.



closely spaced beams were tied together with steel rods and corrugated metal pans, fitted and sprung between the bottom flanges of the I-shaped beams. Concrete was then poured over the assembled metal framework. Subsequent variations deleted the metal pans and substituted a flat formed and exposed concrete soffit between the beams. Rusting of the exposed portions of these beams caused the beams to be entirely covered in concrete so that the soffit appeared to be a continuous surface. Spencer may be the only San Francisco battery to use both iron cable-and-rail reinforcement for the foundations of its three gun platforms and steel I beams (for the ceiling trolleys of its magazines).[10] (See Plate 27, below.) Batteries that used I beams for proto-reinforcement during the 1893-1898 period included at least those of Spencer, Howe-Wagner, Saffold, Lancaster, Cranston, Boutelle, and Stotsenburg-McKinnon, and an added guardroom at emplacement one, Godfrey.[11] Isolated use of iron cable car rails does appear to have occurred elsewhere among the pre-1900 batteries, with a remnant of a pier (of unknown original purpose) still in place at Battery Duncan today (Plate 25). These first batteries continued to use cast iron for ladders, some stairs, and cranes.[12]

The evolution of concrete from unreinforced to reinforced, during the period, shows a growing understanding of the material and its characteristics. Plain concrete's primary limitation was a lack of tensil strength. This limitation was structural and affected horizontal spans, and therefore the enclosure of space. Prior to the introduction of steel into concrete, constructors had begun to understand and solve expansion and contraction problems. The use of weakened plane joints to isolate different elements in the construction and the use of surface scoring to reduce cracking was understood. Experience gained in mixing and placement of the material produced increased efficiency and better quality control. But plain concrete could not be made to span useful lengths without the benefit of arches or vaulting. For this reason, steel beams were placed so as to span between walls. The introduction of steel elements within the body of the concrete changed the material from a static compressive material to a material useful in resisting both tension and compression. In addition to experimentation with strengthening concrete construction, the Army became more sophisticated in other ways. Batteries routinely included surfacing layers of bituminous rock, three-to-six-inches thick.[13]

As of 1892, Army annual reports discuss temporary construction sites accompanying work on the batteries, with the comparisons between hand-mixing and machine-mixing the concrete. Specific recipes for battery concrete are reported, with further notations as to the physical locations of the regionally-excavated rock, gravel, and sand, and mention of the purchased Portland cement by brand name. Of interest, while work went forward on Batteries Marcus Miller and Godfrey, the Army made a change from asphaltum floors to ones of "sidewalk concrete" (alternately described as "artificial stone" and "granolithic finish."). The floors of the three emplacements at Marcus Miller were originally split: those of emplacements one and two were asphaltum, while emplacement three was sidewalk concrete. All three emplacements of Godfrey went in as sidewalk concrete.[14]

The Army plastered concrete, inside and out, with top surfaces further coated with a "bituminous paint," and with the chemical composition of both the asphaltum and bitumen paint changing as the batteries went forward. By 1897, the Army used "paraffin paint" over plastering as a maintenance technique at the batteries.[15] Another finishing technique tried as of 1896 forewent hard exterior plastering, due to the quick appearance of hairline cracking. Workers created a smooth concrete surface by using tongue-and-groove flooring boards as the final exterior formwork. They then troweled on a two-inch thick layer of concrete mixed with fine gravel and sand. The surface gravel-concrete layer replaced plasterwork, and was finished with a cement wash tinted with lampblack to dull and darken concrete's generic lightness against the landscape.[16] At Battery Duncan, set high on an isolated red-rock knoll at Fort Baker, the Army went to further extremes to blend the installation with the surrounding land form. Here the walls were visible at a distance, and were deliberately tinted red.[17] (Plate 26)

The Army also experimented with blast aprons—those features protecting a battery from its own blast effects—through variations in the extent of the aprons, their respective depths, and the physical composition. Trials with asphaltic concrete for blast aprons occurred as early as emplacement one at Marcus Miller.[18] In 1899 for Battery Kirby, at Fort Baker, the Army built the blast aprons on a composite of natural ground and fill, attempting to stabilize them by distributing "old flat iron traverse circles" throughout the concrete.[19] And, generally, a continued experimentation characterized a repetitive treatment for exposed battery surfaces—what worked best for minimal blast damage; for keeping out moisture; for achieving a reasonable weathering of settlement at the site; and, for accommodating the effects of the microclimate. As early as 1897, the Army removed the macadam from the upper ramparts (terrepleins) at Battery Godfrey, replacing them with concrete pavement. Godfrey had been finished for less than two years. The Army planned the same replacement for Marcus Miller.[20]

Site excavation for the batteries involved substantial earth moving. Dependent on the underlying soil and rock layers for stability, battery sites also demanded a variety of drains and culverts—particularly when clay was encountered. The Army prepared the site using plows and scrapers, and by blasting. Day labor removed undergrowth and trees.[21] Excavated material not reused in "strengthening" the concrete was typically placed in an immediately adjacent dump site.[22] Often the battery was backcovered with sand, in addition to earth, for greater protection from artillery fire. Planting the battery slopes continued for

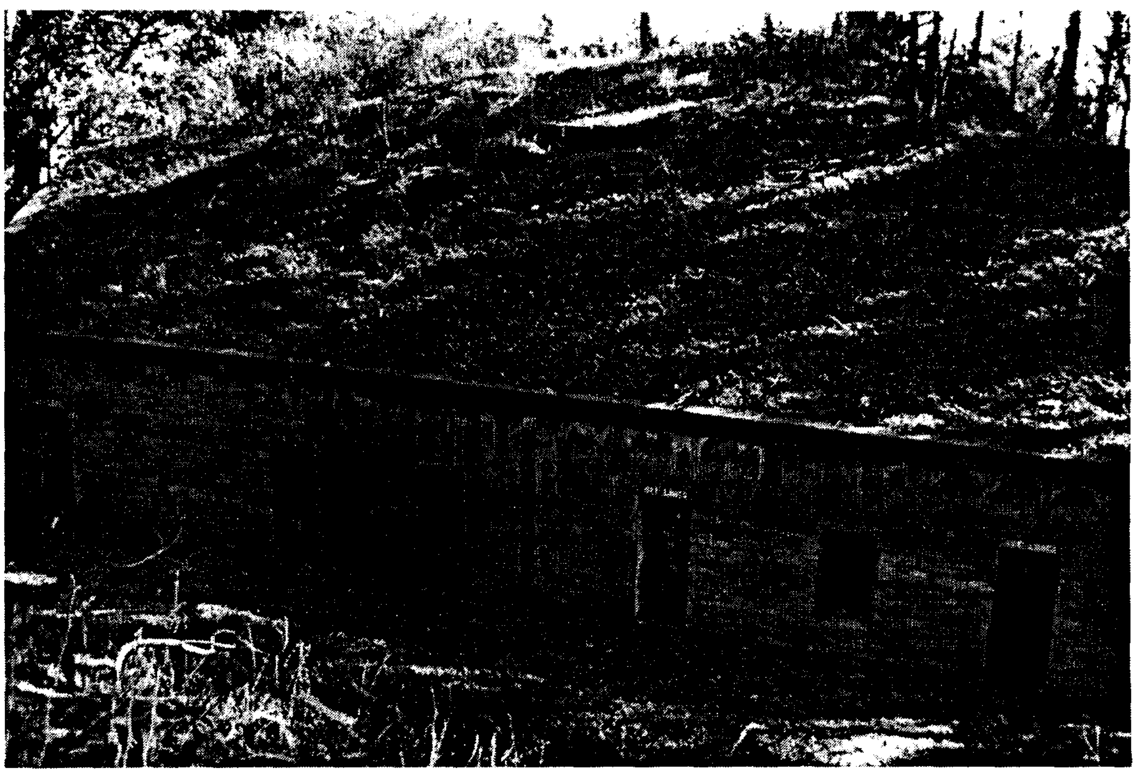


Plate 26. Battery Duncan. Rear of traverse showing fenestration, ladder to BC station, and BC station (overgrown at top of elevation).

these first Endicott defenses, sowing oats and barley into a layer of added garden loam, fertilized with manure (Plate 27).

Beginning in 1894, the Army substantially expanded its efforts at the batteries. Personnel began artificially watering battery slopes during the dry months in this year. While the Army did adopt this policy nationwide by circa 1910, using a hose attached to hydrants located at the site, San Francisco may well have been among the first locations to formalize the practice at the batteries—as a byproduct of a higher Army profile achieved due to the Midwinter Fair of January through June 1894. San Francisco's Midwinter Fair, like the Panama-Pacific International Exposition of twenty years later, was a world's fair, intended to showcase the West—with the Midwinter a directed effort by California to promote itself on the heels of the Columbian Exposition in Chicago of 1893. As of 1895, with the mortar batteries at Howe-Wagner, much more complex underlying slope work preceded grass sodding, in order to hold steeper ¾ slopes, with benching, blind drains, base retaining walls, and gutters.[23] By 1893 the first major ancillary structures associated with the batteries were in construction, with one mine casemate completed, and two nearly so. Associated roadways were formally designed, with drains and macadam surfacing.[24] At Battery Howe-Wagner, the Army built a seven-foot high redwood picket fence 1900 feet in length around the site, treating it with a dull-red lime wash .[25] A cultural landscape was unfolding.

At about the turn of the century, Army engineers had reached another set of plateaus in the use and maintenance of materials, and in detailing, for the San Francisco batteries. By 1900, experimentation in a finer quality concrete had occurred. In reorchestrating the mix of sand and gravel for the concrete, engineers developed a much harder substance, which in turn encouraged them to omit broken stone in a first trial at the small battery Orlando Wagner, Fort Baker. Use of large stone in attempts to strengthen the concrete continued, however, with a quarry opened for this purpose at a 100-foot elevation in the cliffsite at Batteries Mendell and Alexander in 1901.[26] Simultaneously the Army continued active

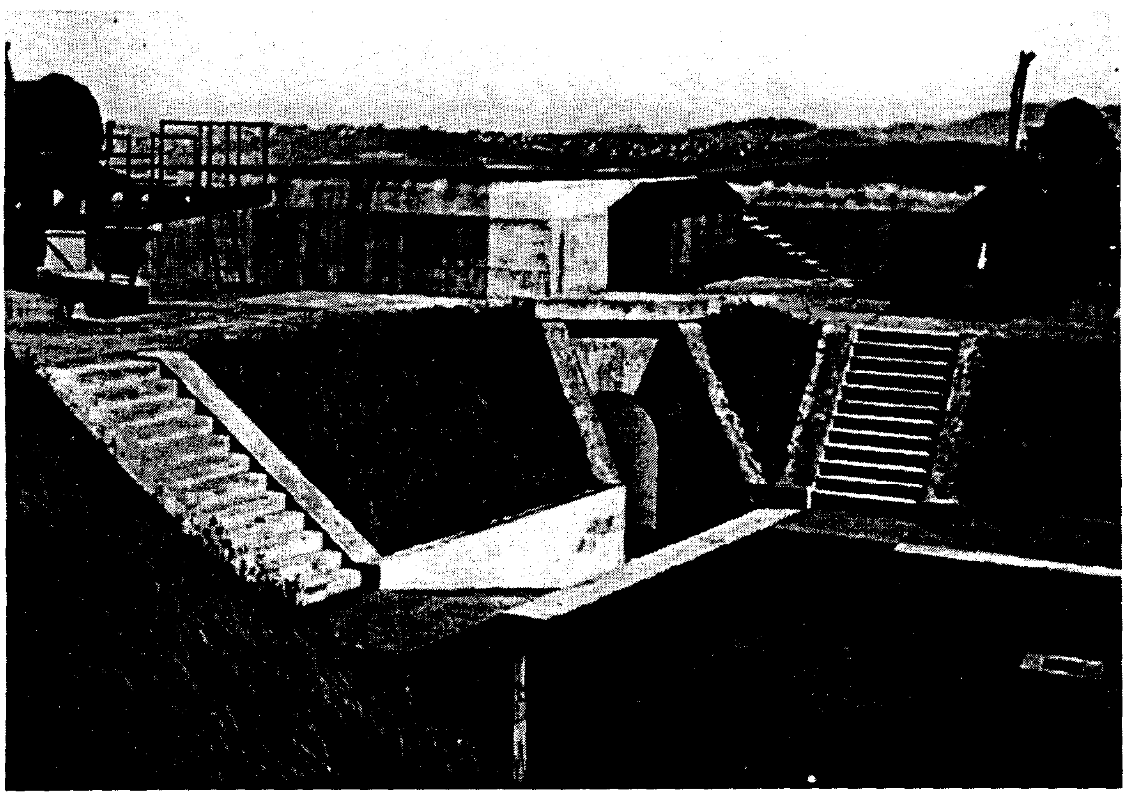


Plate 27. Battery Spencer, Fort Baker, 1893-1897. Courtesy of the Park Archives of the Golden Gate National Recreation Area.

experimentation with concrete mixes, especially with regards to the selected Portland cement. First mention was of the imported Josson & Co.'s Portland cement in 1893, and Josson's and Gillingham's in 1896.[27] In 1901, although the Army was still actively relying on two foreign Portland cements (Hemmoor's and Cannon's), it was also testing an American-made product, Red Diamond, manufactured in Utah. Red Diamond came in sacks, unlike the foreign imports which were shipped in barrels, and although of good quality, a percentage hardened in the sacks due to dampness. The Army then used these rock-like bags of cement as boulders in the subfoundation concrete work at Battery Boutelle. Foreign Portland cements were still the preferred choice, but clearly the Army was seeking widened choices through active testing of as many brands as possible. At Battery Livingston-Springer, engineers tried five brands: Scales, Josson, Cannon, Alsen, and a minor amount of Red Diamond. Of these, they used three times as much Cannon as each of the other foreign Portland cements.[28]

At the same battery, engineers demonstrated an enhanced sophistication in their understanding of, and compensation for, the planes of weakness that would inevitably manifest themselves once the concrete began to settle—due to the inherently heavier concretework of the gun platform foundations. Army *Mimeograph No.8* of 1896 had first described planes of weakness in batteries, with attempted solutions for the settlement problems. Initially efforts were focused to create as monolithic a structure as possible, and the planes of weakness manifested themselves in unwanted locations. By pouring the batteries in fully separate sections, planes of weakness were somewhat predefined.[29] In 1901, engineers in San Francisco additionally incorporated lead flashings in the construction at Battery Boutelle—to move the water away from the planes of weakness, and thus keep them from becoming a guaranteed conduit of moisture to rooms within the structure. At Battery Kirby, at this same time, leaks over the winter of 1900-1901 had forced Army engineers to re-excavate emplacement one to assess cracking from uneven settlement of the concrete. Engineers concluded that *after* settlement had fully stopped they would need to *go back* and apply lead flashings there as well.

These issues at Batteries Boutelle and Kirby make a more comprehensive point: learning at the batteries was so fluid, with overlapping and varied progress at sites under construction at the same time, that a battery started at an earlier date (Boutelle, 1898) could showcase an innovation not found in a battery begun later (Kirby, 1899), due to a later completion of the first battery (Boutelle, 1901) than that of the second (Kirby, 1900).[30] At the mortar battery Livingston-Springer, under construction simultaneously, the Army tried yet another experiment to circumvent settlement cracking and leaks. Here they weighted the battery walls with foundation offsets proportional to the expected loads, thus attempting to equalize the loads through the battery. At Livingston-Springer, engineers placed sheets of "tarred paper" between the joints of the floors and the walls, to prevent their bonding, and to create planes of weakness where they would be least likely to create unwanted leaks.[31]

At the same time, both at Orlando Wagner, Fort Baker, and just previously at the recently completed batteries on the south side of the bay, a shift occurred from wooden doors to ones made of steel sheet metal riveted to angle-iron frames.[32] Stairs at the batteries were primarily wood through 1898, with Marcus Miller somewhat unusually noted as receiving wood, cast iron, and concrete stairs in that same year, the latter for its added guard house. Although concrete stairs did appear as early as 1895 at Battery Godfrey, the Army did not incorporate them as a major design feature until 1899, at Battery Kirby.[33] The Army first mentioned adding iron handrails for the San Francisco batteries in its 1898 annual report, at Batteries Cranston, Lancaster, Marcus Miller, and Stotsenburg-McKinnon, all at Fort Winfield Scott.[34] As such, site safety must have become a concern, as handrails were added at existing batteries at about this same time.

Also in 1901, the Army began a radical experiment in its landscaping for battery slopes. Up until this year, no mention occurs of any sodding or seeding other than oats and barley, a consistency that appears to have been unbroken in San Francisco from the batteries of the early 1870s through those of 1900. In the first year of the new century, however, the Army tried alfalfa at Orlando Wagner, and a combination of oats, iceplant (*mesembryanthemum crystallinum*), bunch grass (*arundinario*), lupine, and gum (eucalyptus) trees at Livingston-Springer.[35] Since Livingston-Springer was a mortar battery, it challenged engineers through its very steep surrounding embankments. Land slides had been a significant problem for the mortar batteries from the first winter at Howe-Wagner during 1894-1895.

The experimental solution at Livingston-Springer, like solutions for other continued problems in battery construction, showed an advancing sophistication and, literally, the creation of a larger landscape. The Army planted 500 pounds of oats to cover the outer slopes of the battery, with significant labor expenditure. With this solution, the outer slopes seeded themselves very quickly and blended the grassy land form into its surroundings as observed from the sea. Army personnel made cuttings of iceplant, which was described as already "of very vigorous growth in this locality," establishing it on the inner slopes of the battery. The Army apparently did not purchase the cuttings, as the annual report showed no associated cost, but rather had men make the cuttings themselves from a site not too far distant. As the labor expenditure was only fifteen to twenty percent of that for the oats, it is assumed that the area planted was relatively small. The iceplant, also a quick grower that was drought resistant, held the steep inner slopes even more tightly than the oats, and thus protected the men and the guns from slides. The inner slopes, however, would have been an intense green with closely spaced white or pink flowering—and as such would called attention to the battery if visible to enemy ships, unless further camouflaged by a more encompassing (and dense) landscape of iceplant, or of iceplant and added low-bush, flowering, shrubs. In its inner placement, this initial planting of iceplant could not be seen. Perhaps most interesting of all, the Army planted bunch grass on all barren sandy dunes in the near vicinity of the battery. The bunch grass did two things: it prevented the sand from blowing into the mortar pits, a danger to the battery, and, it initiated a change in the larger landscape and what would come to be perceived as "the natural landscape." Complementing the bunch grass, the Army planted 100 pounds of lupine, apparently both buying seed and "gathering" it, and 4,000 eucalyptus trees immediate to the battery on the host military reservation.[36]

Efforts at Livingston-Springer in 1901 pointed to a new way of landscaping the batteries. The Army sought not just site stability, but also camouflage. Army personnel created a landscape based upon the immediate native vegetation, reorchestrating it at the batteries to include not just grasses, but also denser, low- and intermediate-height vegetation, and, trees. On the north side of the bay, during 1902, the Army used lupine and sagebrush stalks as a "brush foundation" for a 1500-foot segment of road set in deep sand between Batteries Mendell and Alexander—indicating that both the lupine and sagebrush, like the iceplant, were already actively established throughout the military reservation. At Battery Chester, also in 1902, the Army controlled the sand at the installation itself by heavily loaming the sand before seeding the slopes, and by planting the barren sand some distance from the battery to bunch grass and lupine.[37] The first couple of years of the twentieth century also witnessed heavy road building by the Army, connecting batteries. The Army typically macadamized the roads leading to the batteries, but used rock taken from site excavations for surfacing between closely spaced batteries. At Livingston-Springer red rock paved the immediate roadway at the battery.[38] At this same time, the Army also began to landscape the road banks to stabilize the sand, and likely to make them less visibly stark. At Chester, the Army bracketed both sides of the road with bunch grass.[39]

Although the Army annual report for the defenses of San Francisco harbor contains substantial information on battery construction, the information becomes more generic, with less identification of work at explicit installations, after 1902. Batteries Chester, Livingston-Springer, and Mendell are nearing completion, and Alexander, Baldwin, and Blaney are in active construction. Engineers reached the third plateau for reinforcing experimentation at the rapid-fire batteries of this group, those of Baldwin and Blaney. Heretofore the Army had specified nationwide that steel I beams were to be used for reinforcing the concrete masonry of the battery roofs, with the walls handled variously through differing concrete mixes and inclusion of large rock. Although structurally sound, the placement of steel I-beams was cumbersome, expensive, and, due to the weight of the dead load of the beams, required greater depth and more heavy concrete for coverage. The understanding that steel and concrete expanded and contracted at similar rates and the development of sophisticated mathematical calculations brought about a better integration of steel and concrete. That integration took the form of critically placed round, reinforcing rods, later modified to include twisted square bars. Placement of reinforcing bars required the construction of a metal armature (or "cage") inside the wooden forms (See Plate 28). By the time reinforcing steel bars became common, it came to be understood that the placement of large pieces of broken rock added little to the strength of the mix and were difficult to place in the confined space inside the forms. Reinforcing bars and the elimination of large rocks allowed more precision in form construction and resulted in carefully formed concrete columns, overhead slabs, and superior concrete construction. Army mimeographs officially recommended the use of twisted steel for the first time in 1902-1903, with published plans showing the size and placements for reinforcement.[40] San Francisco began employing three-fourths-inch twisted steel set at one foot centers for its rapid-fire batteries as of 1903.[41]

Endicott battery construction continued for only a few more years, through 1905 in San Francisco, with all five of the batteries from 1903-1905 likely employing twisted steel reinforcing: Chamberlin, O'Rorke, Smith-Guthrie, Yates, and Rathbone-McIndoe (Plate 28). Beginning in 1905 as well, the Army began to widen the 10-inch and 12-inch gun platforms, including those at Batteries Mendell, Kirby, Lancaster, Cranston, Marcus Miller, and Chester; this work also used the modern reinforced concrete technology.[42] This type of reinforcing was directly traceable to the patents of San Francisco engineer Ernest L. Ransome. Stanford University had used Ransome's bars in its museum of 1891, one of the earliest such major applications.[43] Just as the Endicott period closed, with a long hiatus in the erection of batteries lying ahead, numbers of steel companies and dealers offered the twisted bar as representing the "American system of concrete reinforcing." By this date, steel manufacturers added carbon to the reinforcement steel, increasing its strength (Plate 29).

With increased bearing strength and the flexibility to shape concrete elements it was possible to anchor increasingly complex gun mounts directly to concrete platforms. Precision in the placement of anchor bolts to fit gun mounts that were manufactured elsewhere was a necessity. Jigs, templates, and other mounting devices were devised to hold the anchor bolts during the placement of concrete. The placement of other inset metal items such as maneuvering rings, stair railing, handrails, hinges, and other items required setting and holding these items in place during the concrete pour. Setting inset items in concrete was a skill as new as concrete was a material. Where voids were cast into the concrete in order to receive inserts, such as handrails, molten sulfur was used as a grout.

Between 1905 and 1917, the Army built no batteries for San Francisco, with a general construction stoppage nationwide. During this dozen-year period, Army efforts were largely concentrated on making repairs, further enlarging gun platforms, and landscaping. The latter, treatment of the landscape, is of the most interest. In 1905, Army engineers reduced the steep slopes at the mortar battery Livingston, taking the slope out just over six feet and decreasing its pitch from 3:4 to 2:3. The Army replanted the inner slopes again to iceplant for one of the mortar pits, seeding the sister pit to Australian rye grass. As both pits had held iceplant in 1901, the revegetation marked a change, with a first documented appearance of rye grass.[44] In 1907 the Army noted, after inspections of batteries on the south side of the harbor, that in some cases installations still appeared as abrupt breaks in the landscape, rather than blending in. For Fort Winfield Scott, in particular, it was stated that in such a heavily forested location, trees should be encouraged to grow up and provide concealment.[45] On the north side of the bay, Cavallo Battery had become bucolic, looking agrarian in the midst of fenced horse pastures (Plate 30).

As of the spring of 1910, the Office of the Chief of Coast Artillery, in Washington, D.C., issued a memorandum taking the position that San Francisco had been approaching since 1901-1902. "Whenever coast defenses are hearafter [sic] erected, all exterior slopes of these defenses will be made to conform in aperance [sic] as posible [sic] to the surrounding ground, and geometrical contours will be carefully avoided." The memorandum directed coast defenses to plant "such trees and shrubs, as can be obtained in the neighborhood of the defenses, on the slopes of the defenses and around about them in such a way as to make them as effective a concealment of the defenses as posible [sic]... the engineer officer will

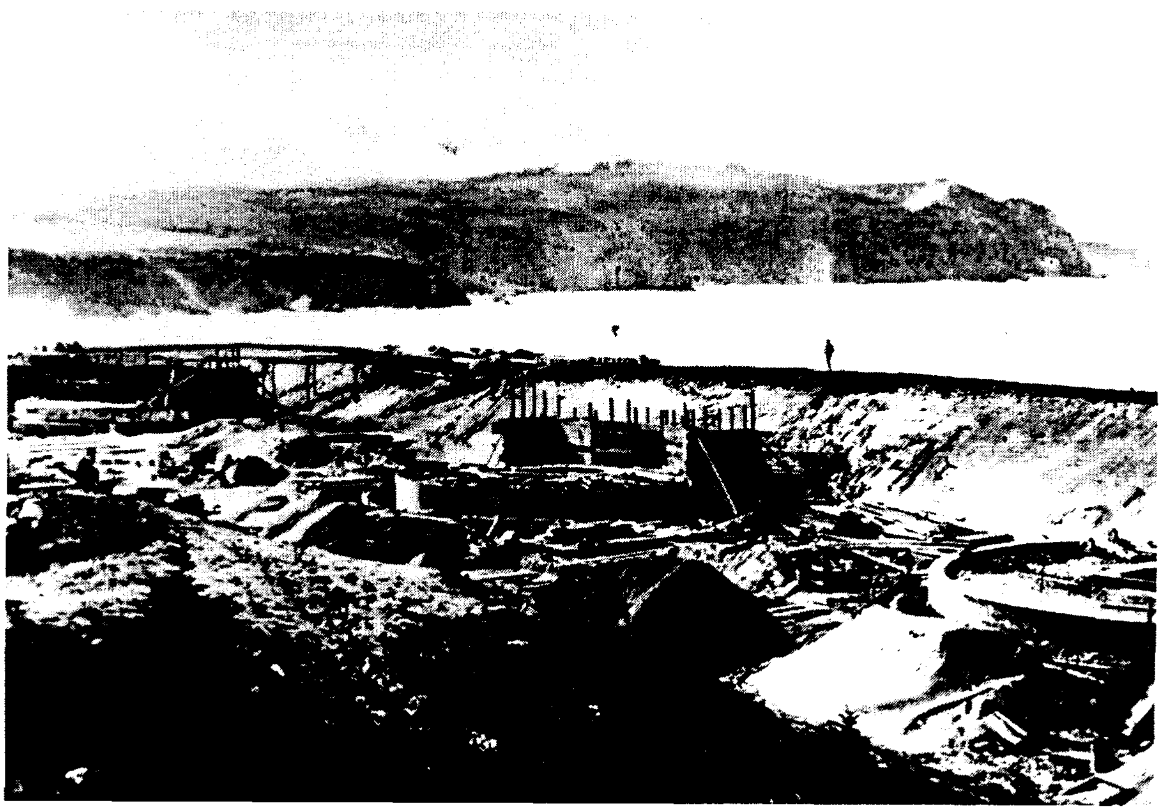


Plate 28. Battery Chamberlin, Fort Winfield Scott, 1903-1904. Under construction. Courtesy of the Park Archives of the Golden Gate National Recreation Area.

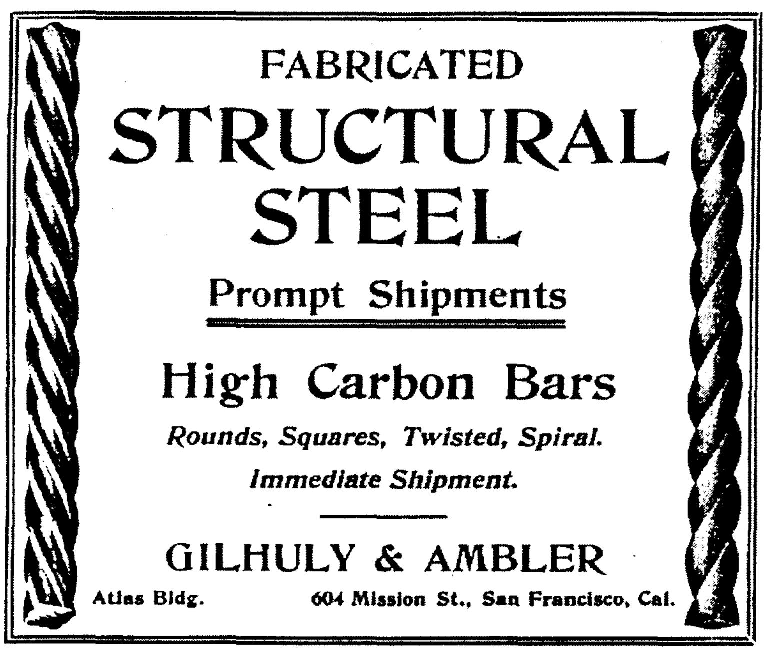


Plate 29. Advertisement for reinforcing steel in *Architect and Engineer of California*, August 1907.

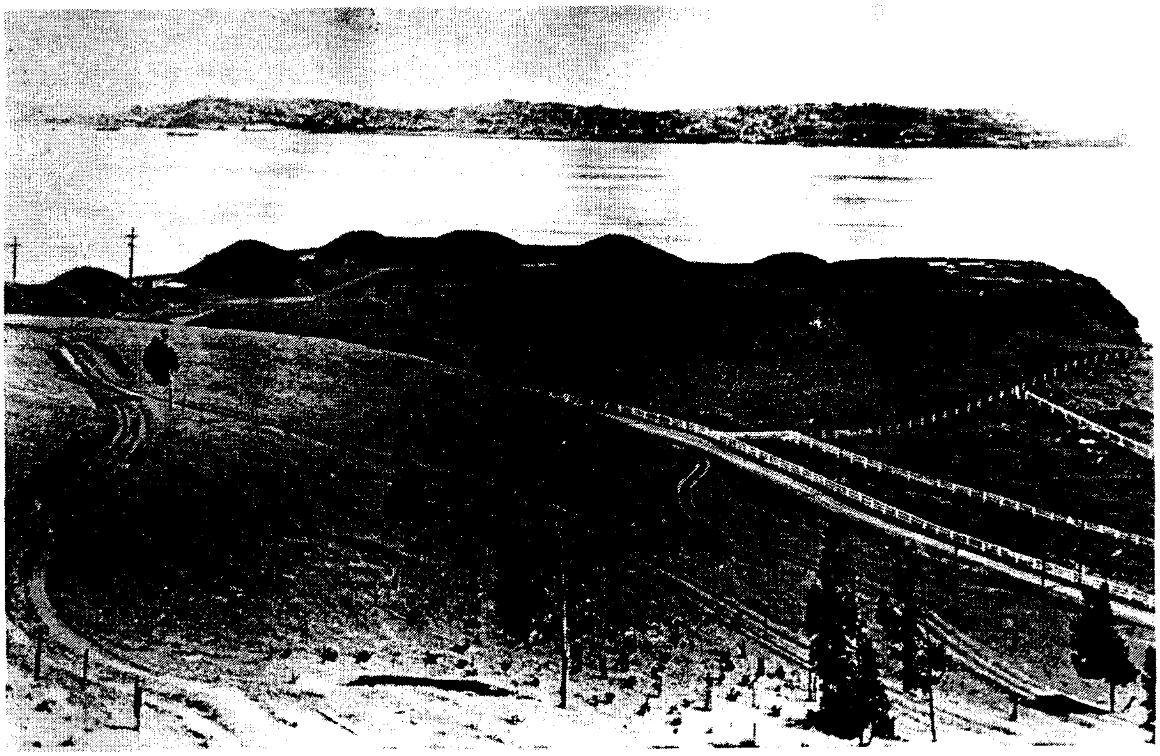


Plate 30. Batteries Cavallo (1872-1876) and Yates (1903), Fort Baker. View of about 1914. Courtesy of the Park Archives of the Golden Gate National Recreation Area.

personally see that they are properly cared for, and thet [sic] those that die are replaced when practicable [sic]." The Coast Artillery memorandum went on to describe a hierarchy of landscaping that would be most appropriate for camouflage. "Tall trees...should be planted in rear of and between adjacent batteries and in rear and on the sides of stations; low trees at the foot of batteries, bushes and shrubs on the superior slopes of batteries and low shrubs in irregular splotches between guns." The memorandum further directed that during seasonal planting, company commanders would be responsible for assigned grounds on the military reservation, where they would remove native trees and shrubs for transplanting at the batteries. A prescribed fallback position was to obtain vegetation from willing local landowners, or to find vegetation suitable to the native landscape and import it. A final point established the new formality of battery landscaping practices. The Coast Artillery asked "post commanders [to] start small nurseries at which bushes, trees, etc., may be produced and cultivated." Most compelling here, the Coast Artillery's directives are filed with the Stotsenburg-McKinnon emplacement books. Stotsenburg-McKinnon, like Livingston-Springer and Howe-Wagner before them, were mortar batteries, and demanded more sophisticated landscape and camouflage solutions due to their steeper slopes.[46]

The Army's efforts at landscaping may well have accelerated in the years immediately before the Panama Pacific International Exposition—the world's fair planned for San Francisco in 1915. The watershed year for landscape issues was 1912. At that time, after internal debate, the Army decided to "throw open all the batteries" for public visitation during the upcoming fair. It had been standing practice to fence the batteries to protect them from vandals since early in the Endicott period. Making them publicly accessible also implied an active interest in making them attractive—as the Army quite deliberately sought public goodwill and was still existing without Congressional support for new batteries.[47] The major nursery for the exposition was on the Army's grounds, established at a location in the southeastern portion of the Presidio described as "Tennessee Hollow." The directors of the exposition had appointed John McLaren, landscape architect of Golden Gate Park, as the fair's landscape engineer. Beginning in early 1912, he organized the collection of specimen plants from throughout the Bay Area, ranging from large trees to cuttings of iceplant, for propagation in an exposition nursery. After using a temporary nursery in Golden Gate Park, McLaren set up the permanent facility in Tennessee Hollow, where six greenhouses, potting sheds, a heating plant, and a lath house for small plants accommodated preparations for the exposition.[48]

The Panama Pacific International Exposition nursery at Tennessee Hollow of 1912-1914, on Army land, also notably supports the April 1910 memorandum of the Coast Artillery—to undertake such small nurseries for the propagation of native vegetation appropriate for camouflaging the batteries. And, as it was McLaren's nursery, that at Tennessee Hollow also indicates a strong likelihood that landscaping efforts on the part of the Army in San Francisco would take on the character of the California Arts and Crafts movement. Not only would native vegetation be a central feature, but chosen plants would be ones already present in the existing beach and cliff landscape near the batteries, with consideration of issues like relative natural textures, and, especially, color. Horticulture had occupied a special place in the California psyche since its shepherding by agronomist Edward James Wickson during the 1890s. Wickson, who had assumed editorship of the *Pacific Rural Press* in San Francisco during 1875, lectured at the University of California in Berkeley. In 1887 he directed all the university's agricultural lands, and in 1905 he became dean of the College of Agriculture. He published prolifically, and was well-read by the small farmer and all those who cultivated their own gardens. Wickson advocated planting flowers, shrubs, vines, and trees, most notably eucalyptus, around the California ranch house. He complemented John McLaren directly.

Wickson's books, from *The California Fruits and How to Grow Them* (1889) to *California Garden* (1915) to *California Garden Flowers* (1926), went through many editions, and he, like the Army and McLaren, talked quite a bit about appropriate landscaping.[49] Wickson described iceplant in detail, noting that "one is apt to find [it] installed here and there on the California beaches, wherever it can find a nook out of the sand-blow and the brine...and grows easily from long stem-cuttings even carelessly covered with soil, at distances of a couple of feet each way. It grows very flat...and is popular for covering rocks..."[50] For the fair, as for the batteries beginning with Stotsenburg-McKinnon in 1901, iceplant took on a concerted role. McLaren, working with San Francisco architect Hart Wood (as chief draftsman for Bliss & Faville), designed a 1150-foot iceplant double-hedge running across the grounds, eight feet in diameter and twenty feet high, with a thirty-foot tall formal Beaux-Arts arched entry (Plates 31 and 32). Using *mesembryanthemum spectabilis*, an iceplant that flowered heavily in pink, McLaren and Wood planted 8700 boxes, turning them on their sides for the much-talked about living wall.[51] The Tennessee Hollow nurseries had nurtured the iceplant cuttings, and in all likelihood, the Army's beaches had served as their source.

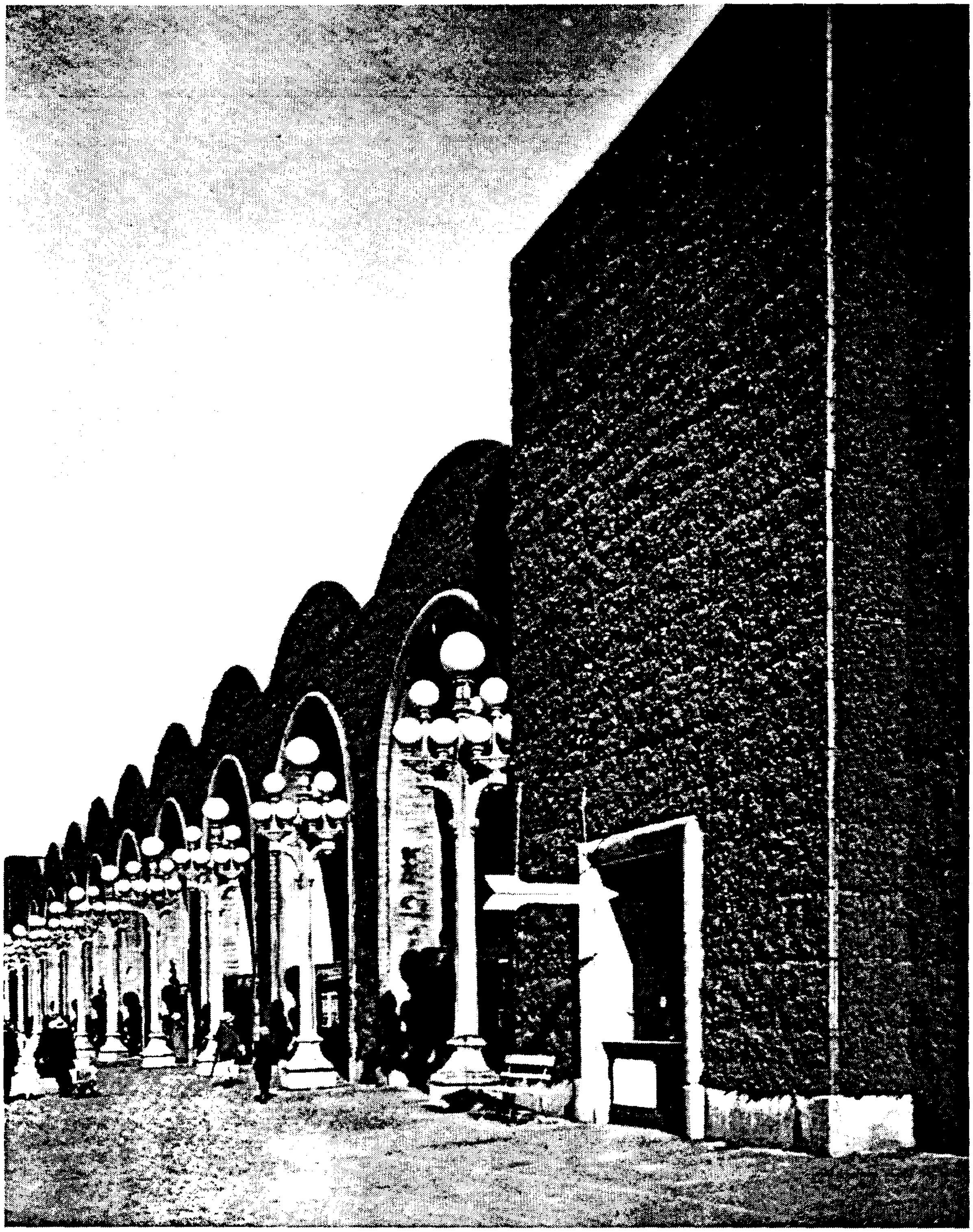


Plate 31. Hart Wood and John McLaren, iceplant wall, Panama Pacific International Exposition, San Francisco, 1915. Center arched entry thirty feet high. From *The Architect*, July 1915. Courtesy of the California State Library, Sacramento.

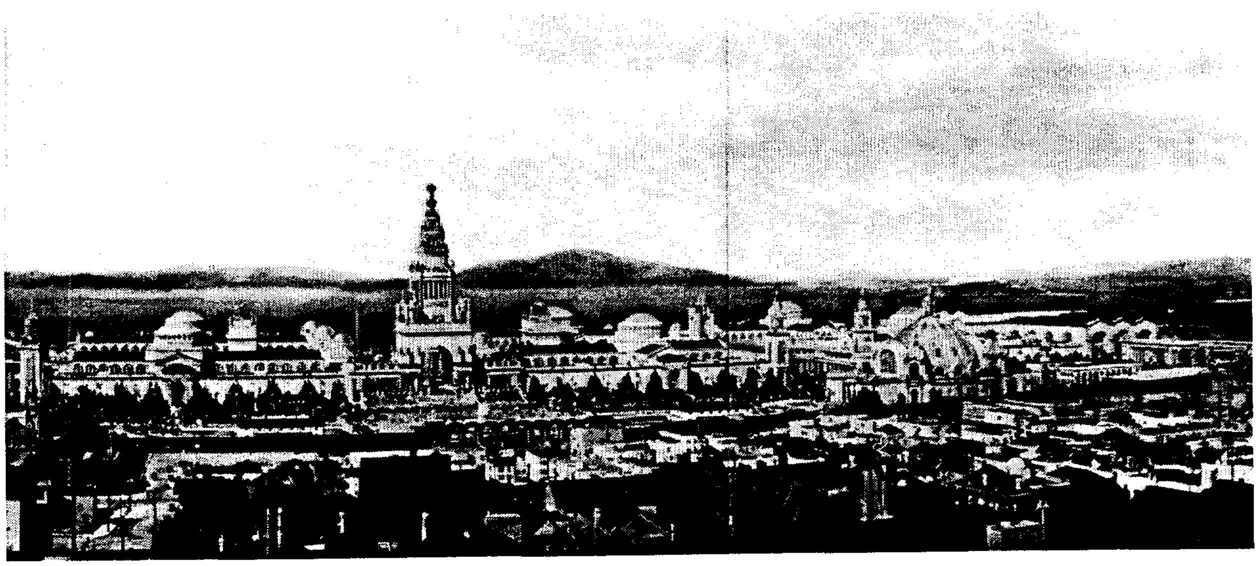


Plate 32. Wood and McLaren, 1150-foot long, living wall of flowering iceplant, Panama Pacific International Exposition, San Francisco, 1915: midground. Frank Morton Todd, *The Story of The Exposition*, 1921. Courtesy of the California State Library, Sacramento.

World War I — World War II, 1917-1945

During the final era of battery construction for San Francisco, that of World War I through World War II, achievements continued to focus on improvements in the technologies of reinforced concrete, and on experiments in landscaped camouflage. In mid-1915, the War Department convened a board to review coast defenses for San Francisco, with several new works projected. Of these, the only sizable project that was built was Battery Wallace, at Fort Barry, begun in 1917 and completed in 1921. The War Department aborted other plans. By late 1917, in fact, the Army dismounted the less-effective guns of the San Francisco coast defenses for use elsewhere during World War I—primarily the 5-inch and 8-inch guns and some of the 12-inch mortars. During this period, steel reinforcement still focused on the twisted bar, with the practice fully accepted following the rebuilding of San Francisco after the earthquake of 1906. In San Francisco, the Pacific Coast Steel Company offered "square corrugated and cold twisted, plain rounds and squares," while Woods, Huddart & Gunn advertised "twisted squares, plain squares and rounds." Predictably, as was true at the end of the Endicott period, experimental steel bar forms for reinforced concrete construction were also advocated, including Havemeyer Deformed steel bars promoted by the Southern California Iron & Steel Company.[52]

Reinforced concrete construction benefited from the development of excavation and grading equipment that made earthwork more efficient. Motorized rollers aided in the compaction of sub-foundation base materials and soil stabilization. Special rebar configurations such as stirrups, saddles, dowels, and other fittings had been standardized. Concrete mixes, free of large ungraded pieces of rock, utilized carefully graded aggregate proportions. Plywood forms were used to form large expanses of concrete surface. Chamfers, which first appeared around the turn of the century, were common devices to ease the sharp edges of the formed concrete. Improved concrete forms reduced the amount of finish work needed after forms were removed. Where weakened plane joints had been used to isolate concrete movement, expansion joints and control joints were "cast in" the larger concrete pour. Real advances, nonetheless, awaited experimentation during the 1920s and 1930s, when a highly vocal group of talented civil engineers took up the topic of reinforced concrete construction for hydroelectric projects.

These men included individuals prominent in both San Francisco-Berkeley and Los Angeles, who published their work for dam construction both in civil engineering journals and as circulating offprints. In the Bay Area, discussions by Carl Ewald Grunsky, J.B. Lippincott, Lars R. Jorgensen, John Debo Galloway, Walter LeRoy Huber, and Charles Derleth were especially noteworthy. Huber, Galloway, and

Jorgensen worked for Pacific, Gas & Electric in San Francisco. Jorgensen, a Danish engineer who had emigrated in 1901, was a particularly active discussant regarding the issues of site stability, water tightness, and appropriate amounts of steel reinforcement.[53] Army engineers appended some of Jorgensen's published discussions to their files for Battery Davis, Fort Funston, 1936-1940. The key offprint, *Solidification of Sand, Gravel and Granular Materials by Chemical Means*, addressed stabilization of a site through injecting several chemicals into "the mass to be solidified, where they react with one another to form a mortar which binds the granular material or poor rock together, forming a cemented solid mass in place." The method was intended to petrify loose ground, "rejuvenate" poor rock, and widen planned foundations—applicable not just to dams, but also to batteries.[54] It was the precursor of today's soil grouting.

With Battery Davis, the issues shifted from reinforcement of the concrete foundations and superstructure, to stabilization of the larger site. In addition to the Jorgensen offprint, the Battery Davis files included further professional engineering debate and methodology for "cement-stabilization." Army engineer Norman W. Haner, in a report of December 1938, argued that the second method, cement-stabilization, was simpler than chemical stabilization, and more reliable, and that both methods were more economical than the heretofore-used concrete spread footings.[55] Cement-stabilization created a cement-solidified backfill, on which the footings then rested. Load tests supported the hypothesis that cement-stabilized ground allowed less settlement of the heavy concrete structure than did an untreated base surface for the foundations.[56] (See Chapter 10, Sitework: Soil Stabilization.) Appended to the analysis of cement-stabilization were two articles from *Engineering News-Record*, authored by key engineers from the Portland Cement Association, and cost breakouts for its use in the construction of the Spring Street "Soil-Cement Project" in Redwood City of October 1937.[57] One article, in particular, "How to Process Soil-Cement Roads," set out the process step by step, with illustrations for each layer of the process. The Army photographed construction at Battery Davis very thoroughly, including documentary photographs of the cement-stabilization process nearly identical to those appearing in *Engineering News-Record*—from the machinery pulverizing the base soil, to the spreading of the contents of cement sacks, to the mixing of the soil and dry cement, to the spraying of water and the mechanical mixing of the soil, cement, and water, to the final compacting of the mix with "sheepsfoot rollers."[58]

Generally, with the batteries of the late 1930s and early 1940s, concrete and its reinforcing met detailed Federal specifications, as did treatments for damp-proofing. At Battery Townsley, Fort Cronkhite, for example, the cement was of Class A and Class B types, mixed per cubic yard in proportions of 5.5 bags (517 pounds) to 4.5 bags (423 pounds), with water content also called out precisely at six gallons for the Class A cement and 6.5 gallons for the Class B. Chemical composition for the Portland cement adopted standards of the Portland Cement Association, as did the sizing of the aggregates. Reinforcing steel was of Type B deformed bars, set in size and weight, and of square and round type.[59] Curing the poured concrete required fourteen continuous days keeping all surfaces wet, with the battery protected from too much sun, heavy rain, or mechanical damage.

The Army accomplished damp-proofing the foundations, and those parts of the structure in contact with replaced fill, by applying an asphalt coating to the concrete and constructing a "drainage course of split furring tile on the roof and sides," allowing water to flow away from the batteries into open-tile drains running traversely near the concrete footings.[60] Both asphalt and tile met prescribed specifications, with the tile three inches thick for the roof areas and 1.5 inches thick for the vertical walls, laid without mortar and with the split cells paralleling the slope for the roof, and, with a sand-cement mortar, the split cells running vertically for the walls. A one-foot thick layer of one-fourth inch gravel was allowed as substitution for the roof tile (Plate 33). This method of providing a damp-proof membrane for the batteries had been in place nationwide, more or less, since the publication of Colonel Eben Eveleth Winslow's *Notes on Seacoast Fortification Construction*, of 1920, with the porous layer established either as tile or broken stone. The Army had first discussed engineering of its damp-proof membranes for San Francisco coast defenses with one for Battery Mendell in 1903, noting use of "three-inch book tile." Engineers specified that the book tile be laid on a three-ply felt, tar, or asphalt coating, between it and the concrete, and that the tile be covered by a layer of fine dry sand from the neighboring hillside. For Battery Alexander, engineers used "S-shaped Spanish" tile, set in a heavy mortar on the concrete and covered with a triple layering of straw, six inches of coarse shale from nearby excavations, and sand.[61]

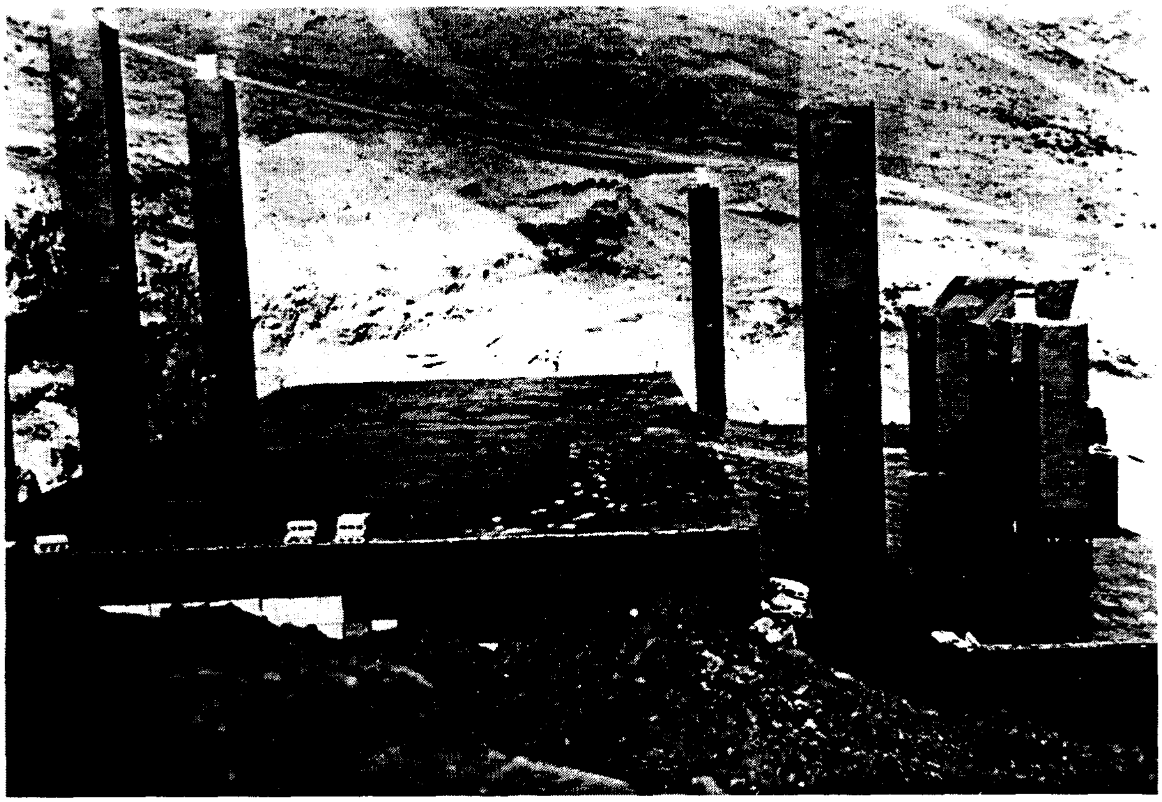


Plate 33. Battery Townsley, Fort Cronkhite, 1938-1940. Under construction, showing damp-proof membrane. Courtesy of the Park Archives of the Golden Gate National Recreation Area.

Predictably, experimentation with camouflage vegetation continued with the World War II batteries, with continued positioning on the issue of native plants. In the late 1930s, the Army completely cleared a site before beginning construction, leaving trees and shrubbery outside the immediate area. At Battery Davis—a site previously heavily planted to eucalyptus, the 1938 planting plan for the vicinity included small areas of *leptospermum*, 825 acacia trees, 1,420 pine trees, 1,070 eucalyptus trees, and selected areas of kudzu.[62] (Plate 34) The maintenance and operations plan from the same time noted that the Army collected and sowed seeds, from what it interpreted as plants typical of ("native to") the surrounding area, at the battery itself—including seeds from sagebrush, wormwood, *baccaris*, and lizard leaf. For erosion control, and to protect the sown—"native"—vegetation, the Army also planted lupine, vetch, *meliolotus indica* (all members of the pea family), and barley mustard. The intentions were to create both a temporary landscape, and a longer-term one. "The foreign plants will prevail for approximately two years and then will be crowded out by the native [typical] growth." Immediate post-construction photographs show a palm-like tree and hanging vines at the face of the battery, in addition. The Army watered landscaping carefully, with an automated sprinkler system in place, and continued planting and seeding any surviving bare spots near the battery.[63] (Plates 35 and 36) The Army also employed netting and a camouflage "mottled" paint scheme. Although not acted upon in 1910, Coast Artillery directives of that period had also suggested "the front [of the batteries] will be splashed with different colored paints."[64] As time went forward, the Army increasingly addressed camouflage not just from the land and sea, but from the air.

Plate 34. Fort Funston, inclusive of vicinity of Battery Davis, landscape plan, 1938. From Erwin N. Thompson, *Historic Resources Study Seacoast Fortifications San Francisco Harbor*, 1979.

Chapter 7: Elements of Deterioration

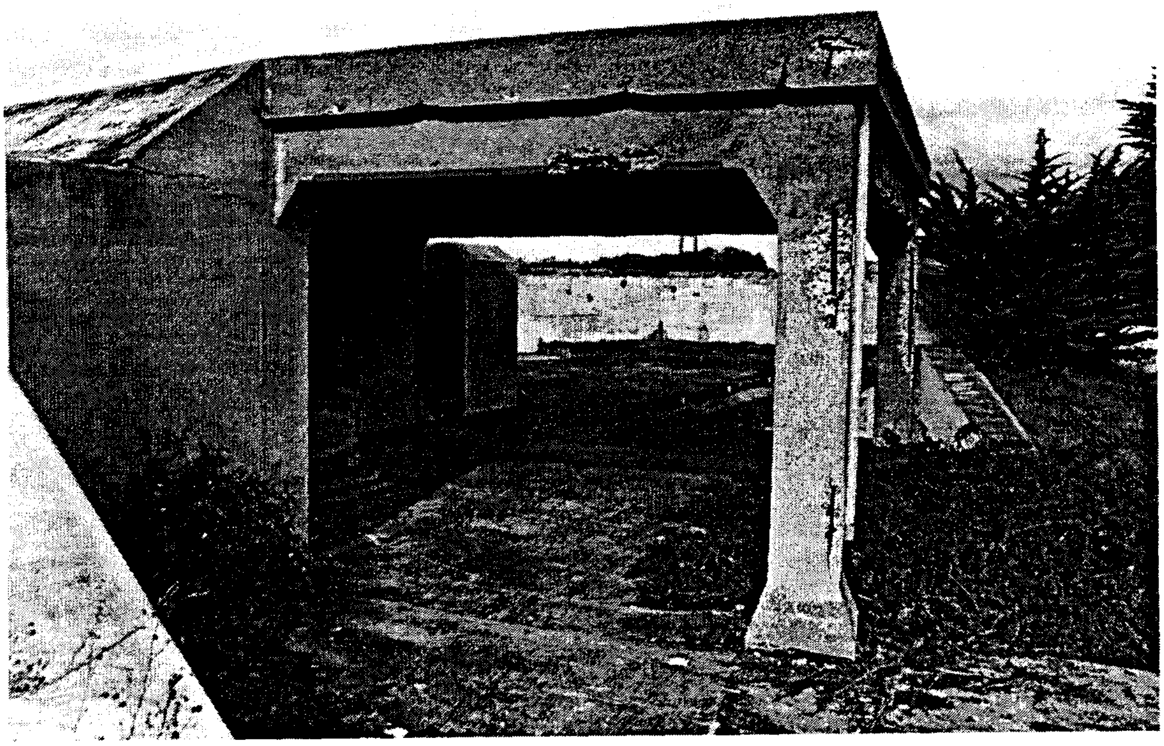


Plate 47. Concrete spalling is evident in the splinterproof at Battery Crosby, Fort Winfield Scott, constructed 1899-1900. Splinterproof added between 1904 and 1912.

Just as the fortifications reflect the evolution of fixed weapons from smooth-bore cannon to large caliber rifled guns and missiles, the fortifications show an evolution of construction methods and materials that parallel technological innovations that occurred from the Civil War to the Cold War (Plate 47). Construction methods and logistics such as roads for access, materials storage and handling, and water and power for construction permanently altered the immediate building sites and the surrounding landscape. Beyond the design influences of terrain, armament, and military doctrine, the fortifications represented mastery of traditional brick masonry construction, experimentation with plain and reinforced concrete construction during its formative period, and ultimately proficiency in advanced reinforced concrete construction.

The U.S. Army Corps of Engineers was well-informed about advances in the technology of limes, mortars, and cements both in the United States and in Europe in the latter half of the nineteenth century. Indeed, the military's interest paralleled early experimentation in the development of Portland cement in England and Europe and the Rosendale cements in the United States. Due to the limitations in the quality, consistency, and quantity of naturally occurring cements, military engineers sustained a keen interest in the manufacture of kilns, rock crushers, testing methods, structural calculations, and in new uses for cementitious materials. The value of cement in military construction was obvious. When combined with sand, gravel, crushed stone, and water in proper proportions, cement became concrete. Concrete had enormous structural advantages, particularly in resisting compressive forces. But concrete was found to be weak in resisting tensil forces. The U.S. Army Corps of Engineers was aware of concrete's tensil limitations and had been following French experiments that placed tension-resisting metal within the compression-resisting concrete. The French called the reinforced concrete mix *beton agglomere.*

Concurrent developments in steel manufacture, and an understanding that certain steel configurations could span great distances, led to the replacement of wooden structural elements in situations requiring long spans. The Chicago fire of 8 October 1871 pointed out the benefits of fireproof construction and lead to the combination of steel I-beams with either hollow tile or concrete to produce fireproof floor and roof systems. The parallel developments of fireproof construction and the combining of concrete and reinforcing steel to create a material that resisted both tension and compression merged near the end of the nineteenth century to form reinforced concrete, a material that would change the building culture of the twentieth century. That the U.S. military was an early observer, experimenter, and builder in reinforced concrete was not an accident of history; rather, it was the result of fifty years of attention by the U.S. Army Corps of Engineers. That attention would have profound effects that changed the military fortifications from brick masonry construction to one that relied heavily on reinforced concrete at the end of the nineteenth century.

In 1871, as an example of the military's concern with the technological possibilities of both concrete and steel, Quincy Adams Gillmore of the U.S. Army Corps of Engineers issued a report on *beton agglomere* under *Professional Papers, Corps of Engineers, U.S. Army, No.19.* In the report Gillmore discusses the raw materials, characteristics, and potential uses of an experimental material that would become known as reinforced concrete. Beyond its general use in construction, Gillmore noted that *beton* could be "used in fortifications, for foundations, generally, both in and out of water; for the piers, arches, and roof surfaces of casemates; for parade and breast-height walls, for counterscarp walls and galleries; for scarp walls, except those that shield guns; for service and storage magazines; for pavements of magazines, casemates, galleries, &c, and generally for all masonry not exposed to direct impact of an enemy's shot and shell." Gillmore's reservations about exposing *beton* to direct fire may reflect both a lack of understanding of reinforcement and ongoing experiments into impact-absorbing earthen fill configurations.

Existing Conditions

<u>Causes of Deterioration</u>

The historic and architecturally significant coast fortifications in the Golden Gate National Recreation Area have been exposed to a harsh environment high in moisture and salt. Built largely on seismically and structurally unstable soils and steep slopes, the fortifications have experienced all of nature's destructive forces except for the damaging effects of regular freeze-thaw cycles. In addition to wind loads, salt-laden moisture, and seismic instability, the fortifications have suffered from intrusive vegetation, vandalism, general neglect, and a lack of regularly scheduled maintenance. Methods used to construct the fortifications were themselves characterized by change, primarily due to steadily advancing experimentation at the batteries. Brick masonry and concrete construction, used in association with earthworks, dominate the construction materials. The relatively small number of materials used in the fortifications, and their consistency of design and construction techniques within distinct periods, however, is a counterpoint to the irregularity of historic construction methods over multiple periods—and as such offers an advantage in developing a treatment program.

Deterioration may be caused by a single condition or by the combined effect of a number of conditions acting together. Based on the building types, materials, and environment, the following causes of deterioration are present and typical:

1. Erosion by wind and/or water.
2. Seismic movement or soil instability.
3. Moisture infiltration.
4. Salt- and moisture-related corrosion.
5. Thermal expansion and contraction.
6. Intrusive vegetation.
7. Inherent design and structural deficiencies.
8. Removal of building elements.
9. Lack of regular maintenance.
10. Vandalism.
11. Visitor impact.

Identifying Characteristics

Preliminary identification of deteriorated conditions requires review of drawings and associated documents, visual inspection, and analysis. Deterioration may be recognized by the following indicators:

1. Presence of moisture.
2. Discoloration, staining, efflorescence.
3. Cracking within a material.
4. Cracking or separation at joints of different materials.
5. Sagging, deflection, or material failure.
6. Material loss, spalling, surface erosion, or exfoliation.
7. Accumulation of soil or organic matter at or on building elements.
8. Mildew, fungus, or plant growth.

Some signs of deterioration may not be readily apparent due to vegetative cover, soil covering, or the nature of the original construction. While the indicators of deterioration, listed above, may suggest active deterioration of a specific kind, the exact location and extent of deterioration requires more careful analysis. Indications of deterioration may also suggest that testing is required. Indications of deterioration usually do not occur in isolation but in related groups. Recognition of patterns of related elements of deterioration is critical to understanding active and latent deterioration and taking appropriate corrective action.

General Conditions Assessment

The historic and architecturally significant buildings and structures that comprise the coastal fortifications around San Francisco Bay have suffered extensive past deterioration and continue to suffer from the effects of active deterioration. Historic engineering records, in the form of annual reports from the Secretary of War, reported deterioration even as the batteries were under construction. Original architectural and engineering drawings for a number of the batteries were marked with specific recommendations for maintenance. Despite the effects of nature, historic use, and abandonment, the batteries and supporting facilities retain significant integrity of materials, context, and association.

The consistency of the materials and construction techniques within each period leads to a certain consistency in the elements of deterioration. A general assessment of condition includes the following material-specific items:

Earthworks

Bermed earthworks, built in association with masonry or concrete batteries were placed so as to absorb impact of shells and to blend, or hide, fortifications from view. Earthworks are in generally good condition with isolated erosion and soil instability. Seismic activity and erosion have undermined some smaller concrete structures at Battery Townsley and Battery Crosby. Battery Mendell was placed on an eroding sand hillside and has developed serious structural problems. Other batteries including Battery Boutelle exhibit major cracking. Trails often contribute to erosion. At most batteries, soil migration and washing have affected surface drainage by obstructing positive drainage away from structures and filling surface and subsurface drainage systems.

Vegetation

Fortification sites were greatly disturbed during initial construction. Natural topographic profiles were altered and vegetation was planted to reduce erosion and provide natural camouflage. Existing vegetation is not fully original to the sites. Vegetation has overgrown most of the sites to the extent that it has obscured character-defining features. And while grasses and low vegetation have had some beneficial effect by holding soil materials in place, larger trees have caused structural deterioration. Large tree roots threaten both masonry and concrete structures. In addition, surface vegetation provides a host for insects and the accumulation of moisture.

Brick Masonry

Original brick masonry, typically found in the post-Civil War period, remains in generally sound condition with isolated brick surface deterioration and mortar joint deterioration. Bricks at Cavallo Battery and Ridge Battery show signs of surface spalling in areas of exposure and stress. Mortar joint deterioration of the Portland cement mortar materials is localized to areas that have been exposed to wet-dry cycles. Some mechanical actions such as expansion and contraction have caused loss of mortar in the joints. Vandalism and graffiti have had the most damaging effect on extensive amounts of historic brickwork at Cavallo Battery. Spray paint, applied in multiple layers, will require drastic intervention to remove or mitigate.

Concrete

Plain and reinforced concrete at the fortifications has experienced moderate deterioration due to moisture infiltration, intrusion of vegetation, inherent concrete defects, soil movement, and corrosion. Concrete deterioration, while isolated, requires complex and expensive measures to arrest active deterioration and to preserve and restore surfaces and configurations to original lines. Many concrete problems may be hidden within masses of concrete and may be detectable only through testing. Concrete deterioration is visible in the forms of cracks, spalls, separations, material loss, rusting reinforcing steel, the presence of moisture, and stains related to moisture.

Metals

Metals, in the form of inset reinforcing steel, metal hardware, window bars, handrails, fittings, ladders, doors, gun mounts, and anchor bolts are in fair condition due to corrosion caused by moisture, the salt-rich environment, and galvanic action caused by contact between dissimilar metals. Many metal elements, including handrails, have been removed.

Wood

Wooden elements in the coastal fortifications are limited to wood doors, windows, frames, and isolated superstructures. Superstructures include framing, roof decking, and trim. Wooden doors, of slab and beaded board construction with metal straps and hardware, are typical through the Endicott and Taft periods Wood superstructures can be seen at Battery Spencer (latrine), the meteorological station at Fort Baker, and at the observation post below Point Bonita Lighthouse. The wood is in generally poor condition from the effects of vandalism, moisture, and rot.

Waterproofing

Asphalt waterproofing, originally applied to concrete surfaces in contact with earth and protected by hollow clay tile, is in unknown condition. Although waterproofing conditions are hidden by earthworks, it would be reasonable to expect degradation of the asphalt materials due to age. In some cases erosion has exposed edges of waterproofing coatings and tile. The superior slope at Battery Godfrey is an example of this type of erosion.

Roofing

Roofing is limited to isolated, small buildings (such as those at Battery Spencer and some observation posts) and is usually either a built-up "tar and gravel" roof or organic, granular surfaced roll roofing. Roofing materials are in poor condition. A number of unsealed bare concrete roofs are in fair condition.

Doors and Windows

All wood doors and windows, and wood door and window frames, were found to be in poor condition from moisture and vandalism. Metal doors were found to be in fair condition with active deterioration in progress from the effects of moisture and corrosion. In some cases metal doors have been welded shut and in other cases metal plates have been installed for security.

Coatings

Camouflage Coatings: Few examples of camouflage coatings remain. Those that do remain are in very poor condition. Remnants of an early (1890s) camouflage treatment can be seen at Battery Duncan, Battery Dynamite, and Antiaircraft Battery No. 1. Other remnants of camouflage coatings remain in varying states of deterioration.

Other Coatings: Other coatings used on the fortifications include standard military paint coatings, primers, and finish coats, for concrete, wood, and metal.

Ventilation

Ventilation of interior spaces at batteries and associated buildings has been limited due to the closure of doors and windows for reasons of security and the incapacity of original mechanical and gravity ventilation systems. The lack of ventilation has resulted in the accumulation of moisture within interior spaces. The failure to dissipate accumulated moisture has led to increased corrosion of reinforcing steel, imbedded metal items, and fixed and mounted metal equipment. Closure of openings for security reasons has contributed to moisture problems related to lack of vent.

Trails

Existing hiking trails associated with the fortifications are in fair to poor condition. Trails are often not clearly defined or marked, are overgrown with vegetation, and often have steep slopes. Some batteries and associated structures are enclosed by fences for security reasons and lack access. Trails have also contributed to erosion problems.

Maintenance

No active cyclical maintenance program appears to be directed at the fortifications. The fortifications are subject to infrequent condition inspections and irregular maintenance and repair.

Interiors

Interior spaces at Battery Chamberlain and Battery Wallace have been the subject of preservation and interpretive activities. But most spaces have been sealed or are not otherwise accessible. Drawings and limited inspection reveal that interior spaces are generally utilitarian spaces with simple wall coatings of whitewash, unfinished, or painted concrete. In some cases floors are finished in vinyl composition tile. The interiors have suffered primarily from moisture infiltration and lack of ventilation. Interior surface coatings have been damaged by moisture penetration through exterior walls and roof structures.

Levels of Treatment

Architectural treatment is governed by provisions of *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings* (1995). These standards set forth appropriate treatment for historic buildings and structures. As a general guideline for treatment, the standards limit treatment in order to retain original historic fabric, character-defining features, and integrity. Architectural treatment, whether interim stabilization, preservation, or full repair and restoration, is dependent on what treatment is appropriate for a particular period in order to express original construction and use. Other factors affecting treatment include funding and interpretation. Each period, post-Civil War, Endicott and Taft, World Wars I and II, and Cold War, has distinct character-defining features. And although each period may have distinct characteristics, many fortifications saw use in more than one period.

Three general treatment levels are available and allow flexibility in planning, funding, and interpretation.

Stabilization

Control deterioration in order to retain historic configurations and materials. Stabilization may involve using temporary, intrusive, non-historic means that are reversible.

Preservation

Control and arrest deterioration in order to retain historic configurations and materials using appropriate means. Preservation seeks to maintain existing historic materials with only limited replacement of missing or deteriorated materials.

Repair and Restoration

Control and arrest deterioration while replacing missing or deteriorated materials using historically appropriate materials and means. Although restoration can be specific to a period, it may also include modifications that occurred in later historical periods. Restoration seeks to replace missing elements and to renew or replace severely deteriorated elements. Some modern materials and methods may be required due to the severity of the conditions encountered.

Common Treatment

Certain treatments are common to stabilization, preservation, and restoration. These treatments, however, may vary in scope according to intentions:

1. Site Cleaning: Remove trash and debris from the site.
2. Vegetation Removal: Trim back vegetation from contact with concrete and masonry materials and remove from the site. Remove dead wood and trees with harmful root growth.
3. Limited Earthwork: Remove soil wash from surface drainage paths. Establish adequate surface drainage away from structures.
4. Drains: Clean out cast concrete gutters and downspouts and coordinate with surface drainage.
5. Ventilation: Establish a ventilation program that regularly vents interior spaces by use of mechanical fans and/or natural convection.
6. Security: Increase site monitoring by appropriate means.