Client: Army Corps of Engineers, Hydrologic Engineering Center
Project: SF Fisherman's Wharf Breakwater Shooting Script

THE FISHERMAN'S WHARF BREAKWATER

STILL PHOTO - Aerial of Fisherman's Wharf STILL PHOTO - Fishermen working on nets STILL PHOTO - Hyde Street Pier BROKEN DOWN PIER CATCH BEING UNLOADED	San Francisco possesses one of the finest natural harbors in the world. Once a renowned center for the commercial fishing industry, this port was a leading supplier for a number of species of fish such as sole, salmon, shrimp, and crab. Yet commercial fishing at San Francisco's Fisherman's Wharf has declined considerably. this decline is not due to a scarcity of fish.
AERIAL- Golden Gate Bridge DOLLY - Dilapidated Piers	Today's diminishing fishing fleets still follow the same path as the wind powered crab boats that sailed silently from the ocean, through the gate, and into the bay not so long ago. This historic path is also the path of ocean generated waves and currents. These waves and currents, along with wind generated waves from across the bay, are wreaking havoc on the vessels and piers of San Francisco's Fisherman's Wharf.
AERIAL - Historic ships	Berthed adjacent to Fisherman's Wharf at the Hyde Street Pier, are five historic vessels, preserved through the efforts of the Sate Maritime Museum and the Golden

Gate National Recreation Area. These vessels are completely without protection from the waves. Among the ships is the C.B. Thayer, a three masted lumbar schooner built in Humbolt Bay in 1895. The Thayer was the last commercial sailing vessel in operation on the West coast, and was purchased by the state in 1957. Maintenance and repair on the Thayer will run in the neighborhood of $85000 this year. Broken loose from it's mooring, the giant ship crashed into a pier during a winter storm and ended up with a hole that requires replacement of a large portion of it's exterior hull.

SHIP - CB Thayer

HULL OF THAYER

FISH BEING LANDED

BROKEN DOWN BOATS & PIERS

The costs are not usually as high, yet are possibly proportionate, for the fisherman. Their problems are similar. The undeterred waves are tossing the boats up against the piers, other boats, and occasionally sinking them. Portions of pier that have fallen into disrepair or allowed to rot have been removed, thereby removing any protection that they once afforded from the destructive wave action.

Maintenance on each boat averages around $500 a year, not including the additional cost

LOAD OF FISH - being hoisted out of boat with crane	of the heavy ropes and chains needed to tie the boats to the pilings in an effort to prevent damage.
EXT PROCESSING PLANT	Because of the unprotected condition of the wharf, little expansion or improvements have take place to accommodate the fishermen. The processing plants located at the wharf can only process a relatively small amount of the fish landed. The rest, roughly one million pounds a year, are trucked north to the Fort Bragg area to be processed. The fish are then trucked back again to the Bar Area to marketed.
MAN ON FORK LIFT - moves into plant	
INT PROCESSING PLANT - fish being filleted	
FISH BEING WEIGHED	
EXT STREET - early AM	
SEAL/FISHERMEN	Fishing equipment and supply houses and machine shops are few because of lack of business. Sanitary facilities, utilities, and locker storage are all severely inadequate. Berths are in demand, and the wharf is crowded with inactive craft and party boats taking up a large portion of the berthing spaces. San Francisco is considered, by the fisherman, to have the worst facilities on the coast.
SUNKEN BOAT IN HARBOR	
BUSINESSES AT WHARF	Fisherman's Wharf, with it's restaurants, shopping, and museums, has always been a tourist attraction. But without commercial

VENDORS/TOURISTS - on busy street

SWIMMER - AQUATIC PARK

BAY MODEL / GGNRA - proposed improvements

AERIAL - Fisherman's Wharf and Aquatic Park area

CONSTRUCTION BARGE - driving piles

fishing activities to observe, or historical fishing vessels to visit, the wharf would lose the maritime character that now draws tens of millions of visitors each year.

It would be futile to improve or expand the berthing, landing and support facilities without a protective structure, such as a breakwater, as part of a redevelopment plan. At the request of local interest, the Committee on Public Works of the House of Representatives adopted a resolution authorizing a study to determine the advisability of providing harbor protection. That was in 1966, and due to political and financial difficulties, the report did not appear until ten years later. Today, after years of effort, the project has been rekindled and the construction of a breakwater is about to begin. Outstanding among the team of participants in this massive effort is the deceased Congressman Phil Burton, State Senator Milton Marks, San Francisco Supervisor John Molinari, past Fisherman's Wharf Association's presidents Sal Balestrieri, Virgil Caselli, Pat Flanagan, Deputy San Francisco Port director A. Taormina, and the 1974 Mayor's Commission on Protection and Beautification of Fisherman's Wharf headed by Alexandro

	Baccari.
STYROFOAM CUPS FLOAT IN HARBOR	A breakwater must be built that will maintain or increase a flushing mechanism in the harbor in order to avoid increased growth of algae an bacteria, oil and gas contamination, and the buildup of floating debris.
BAY MODEL - tracer fluid released	Tidal movements and wave action contribute to the high water quality of the wharf through constant flushing of the harbor water with fresh ocean water. The Bay Model in Sausilito can be used to illustrate the high energy mixing and circulation that occurs outside the harbor and proposed breakwater area, and the comparatively low energy mixing of the inner harbor area where there is quite a bit less flushing action taking place. These low and high energy mixing patterns have also shown up in both water quality and in hydrodynamic measurements. The question that is being asked, then, is if a breakwater is constructed would it decrease that circulation even further and create additional or new water quality problems?
BAY MODEL / GOLDEN GATE BRIDGE	At this point HEC, the Hydrologic Engineering Center, was asked to become consultants on the project by the San Francisco District and the South Pacific Division of the Army Corps

of Engineers. A new numerical modeling method will be applied to evaluate the potential problems that may develop in the construction of a breakwater. HEC was formed to provide a link between the basic research of academics and the practical needs of the Corps field offices. It's primary functions is applied research, training, and technical assistance to the Corps and other field agencies.

AERIAL - Corps Boat/Grizzley in the Harbor

The cost and time involved in building a numerical model is minimal in comparison to that of a physical model. The already existing Bay Model is not being used for this study because the wharf area is too small and not physically accurate enough to be suitable for the localized nature of this investigation.

HEC's first step was to organize and conduct elaborate field investigations for a period of one year in order to evaluate the existing conditions and to understand the physical and water quality characteristics that currently exist in and surrounding Fisherman's Wharf. This data is then used to calibrate the computer model, which in turn simulates the actual conditions of the study area.

FIELD STUDIES - inner Harbor

In gathering informations on the water quality a Van Doren bottles is used t collect water samples at various depths and locations within and outside the harbor area. The samples are placed in bottles and labeled as to depth, location, and time they were taken, then stored in a temperature controlled environment until they can be analyzed in the lab at a later date.

An accurate assessment of the field conditions is the key factor in these investigations. This includes knowing the existing water quality conditions which are the result of mixing and the reaction and exchange that takes place in the harbor due to growth of various kinds of organisms, and the hydrodynamics, in terms of discerning the circulation and flushing patterns.

This information must be collected simultaneously, either collected separately would be meaningless in the attempt to evaluate their net effect. While a group of scientists collect water quality data, additional teams of scientists are simultaneously collecting hydrodynamic information such as current measurements, bathymetric depth, and bottom profiles.

LAB - Davis, CA

Water quality tests are conducted by Ecological Research Associates in the lab at Davis, California. Biological oxygen demand, or BOD, is a critical parameter in this study because of the question of water quality and flushing. A bottle is filled with water taken from the sample site and an initial reading is taken for oxygen level. The bottles then incubate in the dark at a constant temperature of 20 degrees centigrade for five days. The oxygen content is then measured again, the original content is subtracted, and the result is the BOD, or use of oxygen over a five day period.

Tests are also carried out for water chemistry constituents. Nitrate is analyzed in addition to ammonium nitrate and phosphorus. Chemicals are added to the seawater which in turn changes color according to the particular constituent that it is being tested for. The color change is determined with the use of a spectrophotometer.

CURRENT METER

And endico current meter is used to collect information on circulation patters throughout the harbor in addition to the outer regions beyond the proposed breakwater. This instrument measures the magnitude of velocity of the current, the direction the

current is moving, and the depth at which the specific measurement is being taken. A profile can be obtained of the current's velocity from the bed of the harbor to the surface by supplying the computer with this continuously collected data. This profile is then used to evaluate the overall effects of the tidal, wind, and wave currents.

CLAM SHELL DEVICE

A clam shell device collects samples of sediment sands and bay muds from the bottom of the harbor. These samples are taken in various locations in order to get profiles and comparisons of the material that washes into the harbor and accumulates there during storm wave action. Organic materials, petro chemicals, and various kinds of petroleum products are tied up in the sediment. Highly benthic organisms, these muds tend to have a biological demand of their own. Thus analysis of the benthic materials is very important from a wave quality modeling standpoint.

COMPUTER TERMINAL - Bill Norton

Having collected the information needed to describe the water quality characteristics, the currents and flushing action, the bathymetry of the area, and the meteorological characteristics as well, the data is fed into a family of models known as RMA 2 and RMA 4

developed by Research Management Associates. These models allow very extensive and sophisticated simulations of the mixing action the harbor now experiences, and what it would experience after the construction of a breakwater. An engineer can execute these models over and over again in a matter of minutes.

COMPUTER ROOM - readout

One of the alternatives HEC has been asked to consider is a free standing sheet pile breakwater beyond Hyde Street Pier and Pier 45. The arrows are velocity vectors that indicate the net circulation pattern of the inner and outer harbor areas.

AERIAL - Grizzley in the Wharf

Using this hybrid modeling approach, the information on water quality and hydrodynamics collected in the field is used to calibrate the models. This assures confidence in the answers obtained. If what is measured in the field can be simulated with the computer model, then the model is operating properly.

COMPUTER TERMINAL - Bob MacArthur running simulations

The computer's programming offers a lot of flexibility in the fact that once everything is operating correctly, and the models are calibrated with the information collected in the field, rapid changes can be made to the

	program and several different conditions can be simulated. Simulations can be changed hydrodynamically with changes in wind and weather conditions. They also can be changed physically by inserting the breakwater alternatives which vary in shape, position, and design. In a physical model, to make these changes, concrete would have to be jackhammered up and then the model rebuilt again. This process could take months, whereas using a computer model it may take only several days.
AERIAL - Field work from Grizzley COMPUTER TERMINAL - Bob (cont)	
AERIAL - Field work from Grizzley (cont)	Studies of simulations of the before project and after project conditions indicated that there is a considerable decrease in circulation inside the harbor as a result of the positioning of the two breakwater alternatives looked at. No appreciable signs of water quality problems are seen at this point, and minor modifications to the proposed breakwater configurations will help mitigate the problems that do show up.
SIGN - “Boat for Sale”	Wave actions has caused considerable damage to the historical ships and fishing fleets of Fisherman’s Wharf. Because of high maintenance costs and inadequate support facilities, the fishermen are leaving. There is no doubt that the construction of a protective

breakwater is needed and will alleviate the problems of the fishermen and allow proper development of the area.

UNLOADING GRIZZLEY at dock

By using numerical modeling techniques HEC is able to rapidly evaluate the best alignment configuration and characteristics of a breakwater to take advantage of nature's energies to keep the harbor clean, maintain good water quality and circulation, and protect the historical ships and fishing fleet from wave damage.

SEAL - swimming in Harbor

WASHING DOWN the Grizzley

The Corps is grateful to the city, the local citizens committees, and congressional support for the authorization for the construction of the breakwater. This group effort has caused this project to materialize.