Preliminary
Historic Structure Report

CENTRAL WHARF

Architectural Data Section

Salem Maritime National Historic Site
Massachusetts

by

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Forward

The purpose of this preliminary Historic Structure Report is to expedite a decision on the recommended design for the rehabilitation of Central Wharf, as necessary to meet the deadline of December 31, 1975 for construction of this Bicentennial project.

This report was prepared with assistance from Mr. Lawrence Ketchen, a consulting civil engineer with extensive experience in wharf construction, in particular the wharves at Nantucket, Massachusetts.

The final Historic Structure Report is forthcoming; it will contain information on the historical development of the wharf.

Anticipated Use and Needs for the Wharf

According to the Master Plan, and a discussion with the park superintendent, Central Wharf is planned as a "visitor relaxation area." There is a need for a launching area for small boats, and a mooring area is mentioned.

Introduction

Central Wharf, with its north end abutting Derby Street, extends approximately 800 feet into the South River. The wharf is "T" shaped; it is about 55 feet in width at the southern end, and 175 feet at the northern end. The average side differential is 9 feet, with spring sides to 13 feet; mean low water is used as elevation 0.0 feet. The asphalt surface is about 11 feet above elevation 0.0 feet.

The wharf, like all marine structures built "against the sea," has suffered serious damage from the water, wind and mechanical damage by land and water equipment. This structure has been repaired, expanded, and rebuilt many times. Since it is easier to drive new piling into the channel bottom, than into existing wharf material, a new wharf was often several feet outside the older wharf. This accounts for the layered interior of Central Wharf.

Evaluation of Present Structural System

The most recent reconstruction of Central Wharf took place in 1939 (see drawings 1-7 NHS-SM/5300). This reconstruction by the National Park Service involved the entire wharf, replacing piles, timber sheeting, tie rods and anchors, and disturbed the earth fill down to elevation -1.0 feet along the west wall, and to elevation +7.0 feet along the east wall. In addition, a marine railway was constructed on the east face, for the purpose of launching boats.

The reconstruction is of a standard form with load piling driven 5 feet on center around the perimeter of the wharf, approximately 2 feet outside the previous wharf. The load piles were driven 15 feet below elevation 0.00, and were approximately 28 feet in length. Horizontally placed wood planking was supported by load piling, this sheeting held the earth fill.

Vertical planking was placed in front of the horizontal planking between the load piles along 200 feet of the west bulkhead, at the southern end. This planking carries no load and was likely installed later than 1938 as protection against the northeast storm effects. The lateral support for wharf is provided by a tie rod through each pile, anchored by a horizontal timber deadman placed parallel to the bulkhead line, about 18 feet from the face of the wall. Depth of water along the east face varies from 0.0 feet (M. L. W.) to -3.0 feet at the outborad end. The south end and west bulkhead are located in deeper water, 4.0 to 6.0

feet, and necessitated a variation of the wall construction to support addition horizontal loading. Wakefield piling supplements the construction system consisting of load piles with horizontal planking and tie rods fastened to deadmen. Wakefiled piling is driven to elevation -17.5 feet, and is built up of three pieces of planking spiked together with the center piece off-set to form a tongue and groove. The horizontal support is accomplished by a bolt through the load pile, a horizontal wale timber, and through the top of the Wakefield piling. In addition, a tie rod is strapped to the load pile and goes through the top of the Wakefield piling diagonally to a deadman.

The west face, in brief, is of two story construction. The lower sheeting is supported on both faces for approximately two thirds of its length. The upper five feet (-5.0 to 0.0) acts as a beam fixed near the slip bottom and simply supported by a wale at the top.

Evaluation of Present Structural Conditions

A detailed inspection of the timber piling and sheeting and tie rod collars was carried out from a boat, around the perimeter of the wharf. This survey was made at low tide, April 1, 1974 (1:10 p.m.). The bulkhead piling and horizontal timber sheeting placed in 1939 is generally in excellent condition, showing no evidence of decay or borer attack.

There is severe deterioration of 90% of the west bulkhead; it bulges, leans outward, and in some areas is totally collapsed. The earth fill is being washed away by the tides, and it is slumping into the water. Consequently, piles of the George B. Lane Wharf of 1896-97 have been exposed, and have collapsed into the water, resulting in the loss of the historic fabric.

About 20 piles on the west face of the wharf have broken at the metal tie rod collars. The oak fender piles on the west face have rotted, because they were not treated.

The Wakefield piling, driven below the channel bottom should be in good condition and reusable without reworking.

Damage to the east bulkhead is much less extensive, and is confined largely to one area, about 150 feet long, a large displacement of the bulkhead. The vertical planking and the southern end of the east bulkhead has suffered from teredo attack, because it was improperly treated with creosote. Teredo is a marine borer, common to these waters. The

infestation has been kept under control because of water pollution, but as the harbor is cleaned up, Teredo will become more prevalent. There is, however, no such damage to the load piles, or the horizontal sheeting, because of the much heavier creosote treatment.

The corner of the wharf just to the north of the marine railway will require further structural investigation. It leans out slightly at that spot. Where a load of rip-rap was placed in about 1971, evidently for the purpose of stabilization.

The south end of the wharf is in good condition. The inshore north-west end, in steel sheet piling, driven in about 1950, is also in good condition, with an acceptable degree of corrosion.

The asphalt surface of the wharf is extensively broken up, due to washing and settlement of the fill, as the bulkheads moved out from their original positions.

Where tie rods have been exposed by archeological excavations or tidal washing of the fill, there is evidence of heavy corrosion of the tie rods. Tie rods examined show reduction in cross sectional area of up to 60%.

Two sets of tie rods were installed on the west, south and the southern end of the east side of the whraf, the lower set terminating in a metal collar around each pile at elevation -1.0 feet. Approximately 1/3 of these metal plate collars, 5 inches x 1/2 inches, have rusted, so that

where the tie rods have not failed, the collar failures have produced the same effect. The metal collar failures are in the area designated as a mooring on the 1948 Bureau of Yards & Docks drawing, 464088. While the failures were due to overstressing the drastically reduced metal areas, the primary cause is the very high corrosion rate evidenced in the mooring area. Collars on either side of this area show only nominal rusting, within tolerable or expected limits. This damage indicates that there may have been some electrolitic action at one time in the mooring area. About 10 to the collars have rusted out on the east face of the wharf, at the outboard end.

Where the timber deadmen anchors have been exposed by archeological excavation, they are in good condition, because the timbers were wet, buried and away from oxygen. Both outboard corners of treated wood are in excellent condition.

Causes of Present Structural Conditons

The reasons for destruction of the 1939 wharf structure are multiple. The present poor condition of the Central Wharf is primarily due to years of neglect and lack of maintenance.

Tie rod failure accounts for much of the damage. The steel rods were galvanized before they were placed in 1939 but this was insufficient protection against corrosion. The earth fill of the wharf contains a high percentage of ash since wharves, particularly in periods of decay and decline, were often used for dumping refuse. Ash in the soil proves to be extremely corrosive to steel.

The structural condition of the west bulkhead contrasts sharply to the east bulkhead. A reason for the difference in deterioration is that the channel on the west side is at least five feet deeper than that on the east. On the east side mean low water and the channel bottom are both at elevation 0.0 feet the channel bottom on the west side is at about -5.0 feet. Therefore, the lateral pressure of the wharf fill is much greater on the west side. The construction of the west bulkhead was reinforced to counter this pressure. Apparently the reinforcement was insufficient.

Another cause of the destruction has been dredging. While under the jurisdiction of the Navy, dredging was evidently accomplished several times. It is likely that the dredging undermined the structure of the

wharf. The dredging, at least once, was carried out against the advice of National Park Service personnel.

The reasons for the dredging around Central Wharf was to accomodate the mooring of boats, both large and small. During the 1940's the wharf was used by the Coast Guard, for mooring their boats. It was used later as a marina for private boats, according to a photograph in the park files. In the 1960's, a submarine was tied up to the east side of the wharf. The mooring points, and ~~blocks~~ floats used for smaller boats correspond with the areas of greatest failure and damage to the bulkheads. The propellers of boats tend to wash the channel bottom away from the piles. Also, with electrical service available on the wharf, electrolitic corrosion on the metal collars and bolts under water may have occurred, particularly on the west side.

Evaluation of Methods and Materials for Rehabilitation of Central Wharf

Criteria for consideration:

1. Of utmost importance is the preservation of the historic resource.

2. Consideration of the life span of the rehabilitation method and materials.

3. Consideration of the economics of the method and materials.

There are four principal materials which can be employed in the construction or reconstruction of waterfront structures: timber, steel, reinforced concrete and stone. Combinations of two or more of these materials are possible so that any set of conditions may be met.

Timber:

In the past, the use of timber for wharf construction was dictated by the abundance of the raw material, easy access and movement, ease of fabrication and assembly, and ease of replacement and repair. Timber while no longer cheap nor abundant, is still a very light, flexible material. Timber piling and sheeting, when pressure treated with creosote, is also a very durable material. The present wharf structure was built about 36 years ago. The timber portions, with minor exceptions, are in excellent condition, and can be reused with a lifespan of at least 25-50 years. In addition, timber is historically correct for uses on Central Wharf.

Structural Steel:

Structural steel is an excellent material for use in pier and wharf construction. The more recent developments in corrosion resistant steel, Cor-ten has eliminated the need for extensive protection on wet-dry applications. Cor-ten rusts once and forms a protective skin. The great number of sizes and shapes allows selection of economical units. Steel piling allows greater loads per section and will withstand the punishment of rough handling and hard driving, better than wood or concrete. Cor-ten steel sheet piling is long lasting and would require a minimum disruption of the existing substructure for installation. The life span of a steel bulkhead is a least 75 years.

Steel is not a material which is historically accurate. Timber was always the material used on Central Wharf. Therefore, there is some concern that a Cor-ten bulkhead would be a problem aesthetically. One suggestion has been to veneer the steel bulkhead with a non-load bearing solid timber bulkhead. Another possibility would be to place a large overhanging timber cap on the steel bulkhead and a rather extensive fender system on front. This would minimize but not eliminate the "look" of a steel bulkhead.

Reinforced Concrete:

Reinforced concrete may be used in the form of precast sheet piling and as precast square or round piling, in bending and bearing. In either form, the units may be prestressed or post-tensioned to increase their

useable stress limits. Reinforced concrete units are heavy, must be handled carefully and are subject to destructive action caused by the wet-dry and freeze-thaw cycles. The inherent strength of practical minimum sections of concrete units creates over design and uneconomical solutions for light structures.

Stone:

Large cut or split granite blocks laid up to approximate a gravity retaining wall of triangular or trapizoidal form is the method of construction used on Derby Wharf. Central Wharf never received such a treatment. When the stone is placed correctly, interlocked with steel or wrought iron dogs, chinked with smaller stones, and backed up with an appropriate reverse filter blanket, the stone construction is the most effective over a long period of time. The cost of quarrying, handling, shipping and placing such stones make this method of wharf construction infeasible.

Timber and steel construction are the two methods I consider most suitable for the rehabilitation of Central Wharf based on the criteria established on page 11.

Evaluation of Possible Structural Solutions

Given these two materials, wood and steel, there are a number of possibilities for rehabilitation.

East Bulkhead

For the east bulkhead, there are two approaches to consider, (1) repair the existing timber bulkhead, or (2) replace the bulkhead with steel. These procedures are as follows:

1. Repair and rebuild a 150 foot section in the middle of the bulkhead wall and a corner of the wall just north of the marine railway, near the Naval Training Center building. Pull and redrive piling, remove and reset sheeting on damaged areas with existing timbers, and new timbers when necessary, using the same type of construction specified in the 1938 drawings.

2. Pull timber piling and remove sheeting, furnish and install steel sheet piling, wales and cap, along the 1939 bulkhead line.

South Bulkhead

The south end of the wharf is in good condition and does not need repair or rebuilding, the possibilities for treatment are as follows:

1. Leave the timber bulkhead intact.

2. Pull timber piling and remove sheeting, furnish and install steel sheet piling wales and cap along the 1937 bulkhead line.

West Bulkhead

The west bulkhead presents a different problem. The repair solution cannot be considered because of the severely deteriorated condition of the west wall. The bulkhead will have to be entirely rebuilt in (1) timber, or (2) steel.

1. Pull timber piling and remove sheeting. Redrive piling and reset sheeting with existing timber and new timbers when necessary, using the same method of construction specified on the 1938 drawings.

2. Pull timber piling and remove sheeting, furnish and install steel sheet piling, wales and cap.

The Marine Railway

At the marine railway area, there are two possible solutions.

1. Eliminate the present ramp by the construction of a new bulkhead to the outer edge of the ramp, and then continuing north along the outside face of the ramp bulkhead to the point where the existing bulkhead is at full height.

2. Retain the ramp, and construct a low timber wall at the top of the present ramp. Remove the present rail and tie system, replace the mud and silt with stone or bank run gravel.

Steel Tie Rods

The tie rods proved to be the weakest link in the 1939 rebuilding scheme. It was the tie rod failure which resulted in the bulkhead failure. The

use of tie rods is necessary in both timber and steel wharf construction. Steel sheet piling requires fewer tie rods, however.

There are basically two configurations for the tie rods in the proposed reconstruction: (1) tie rods attached to timber deadmen, (2) tie rods extending across the width of the wharf.

Method 1. The 1939 reconstruction provided 18 foot galvanized steel 5 feet o. c., tie rods bolted to horizontal timber deadmen, approximately four feet below the capsill. If the south and east bulkheads of the present wharf are retained, all of the tie rods should be uncovered for examination. This will require excavations four feet below the surface of the wharf.

When the minimum remaining diameter of the rod is less than that shown on the following table, the tie rod should be replaced by a rod of the original diameter.

Original tie rod diameter	Present tie rod diameter
7/8" Ø	3/4" Ø
1" Ø	7/8" Ø
1 1/8 " Ø	1" Ø
1 1/2" Ø	1.1/4" Ø
2" Ø	1 3/4" Ø

Tie rods left in place should be cleaned by wire brushing. The, both the existing and all new tie rods should be given a coat of hot bituminastic paint, wrapped with spiral applied overlapping burlap strips, and the wrapping given a final hot bituminastic coating. Rods treated in this manner will Have a lifespan of at least 75 years.

Method 2. The second possibility for the design of the tie rods would require one or both faces of the wharf to be constructed of steel sheet piling. This type of construction is more self-supporting than timber bulkheads; it needs fewer tie rods, and the tie rods can be closer to the surface of the wharf. The advantage of this method is that it would require less excavation of the wharf fill. If the wharf is entirely rebuilt with steel, the tie rods would run from bulkhead to bulkhead, and approximately two feet below the capsill. If the south and east bulkheads are retained, a steel waler could be attached inside the timber bulkhead, and the same type of tie rod system could be employed.

Timber Cap and Fender System

A timber cap and fender system is a component of any method of rehabilitation selected. Fenders protect the bulkhead wall from damage caused by boats moored to the wharf. These fenders are timber piles, driven independent of the bulkhead wall, at a spacing of 10 to 15 feet on center. Small boats moor to the fenders, not the wharf structure. A timber cap is also a protective device for the wharf. If the west bulkhead is rebuilt in steel sheet piling, some of the timber from the present bulkhead could be salvaged and reused for this fender and capping system.

Surfacing

Following the backfill and grading operations, it will be necessary to apply a final surfacing for the wharf. Thus far, the archeological

excavations have not revealed the type or types of surfacing originally on the wharf. Compacted earth or clay with a gravel or cinder surface was the most common; brick, cobble stone, Belgian block and timber planking were also used, but these were much more expensive treatments, and it is likely that evidence of these treatments would be found in the wharf fill.

There are three possibilities for the final surfacing of the wharf, packed earth with a gravel/cinder surface, asphalt, and salt-resistant sod. Asphalt would require the least amount of maintenence, but it is the least accurate historically. Salt-resistant sod is the surface the Park Superintendent indicated would satisfy management requirements most effectively. While more research is needed, it appears that the most historically accurate material is gravel or cinders on a packed clay base. Both the asphalt and gravel treatments are estimates at about $15,400, sod is estimated at about twice that figure.

Possibilities for Meeting Management Requirements

Launching:

Launching can be accomplished on the marine railway if it is rebuilt. A paved surface with a material such as granite blocks would facilitate launching. However, there is no public access to the ramp under the present plan for the visitor center and maintenance wing. Access would require removal of the maintenance wing.

Mooring:

Mooring of small boats could be accomplished on the west side of the wharf, after it is rebuilt, because the channel is deepest on the west. A simple fender system could accommodate the mooring of small craft, providing only tie up points and vertical wooden ladders. The use of floats is a visual intrusion, and requires maintenance and handling each season.

Additional Design Considerations

Level of the Wharf:

One problem which must be considered is the possibility of raising the level of Central Wharf. Presently, the entire park waterfront is too low, because the level of the ocean continues to rise. During high tides, several times a year, the wharf is partially covered with water. The water causes the fill to wash out into the channel, especially if high winds accompany the high tides. Water floods the Naval Training Center building on rare occasions.

The possibilities for solving this problem are as follows:

1. Leave the level of the wharf at its present height, and make provisions for periodic repairs to the wharf surfacing and perhaps also to the Naval Training Center building.

2. Raise the level of the wharf in this proposed rehabilitation by adding 1-2 feet to the capsill. This added height could function as a parapet wall to help keep water off the wharf. A parapet type cap is historically inaccurate in profile for this wharf; the fill was always as high as the capsill. One advantage of a parapet is that it would function as a low safety barrier, there is some concern that OSHA could require a safety barrier on the wharf. One problem in raising the level of the wharf is that the adjacent waterfront and wharves could not be raised; water could flood Central Wharf from these areas. Fill, however, could be added to the wharf to the cap of the raised capsill,

this could be graded to Derby Street and the adjacent areas. If the surface of the wharf is raised, the Naval Training Center building, presently on the surface of the wharf, would also have to be raised.

Dredging:

Dredging is a very important consideration in the design of the wharf. The area near Derby Wharf and Hatch's Wharf (adjacent to Central Wharf on the east) cannot be dredged. Further structural studies are needed on this subject to determine exactly what the limits of dredging would be. It is certain, though, that the east side of Central Wharf if left intact and repaired, could not be dredged to accomodate mooring. The east side, if replaced with steel could withstand dredging. The west side could likewise be dredged if it is rebuilt on steel.

Project Time Schedules

In the development of the project time schedule, the advance planning and construction phases must overlap to meet the December 31, 1975 deadline for Bicentennial projects. The time schedule is as follows: The design phase is relatively small, with drawing and specification production the predominant phases. The total number of drawings is estimated as four or five. The design, drafting and specification work can be accomplished in 2 to 3 months. It will be another 2 months before a construction contract can be awarded. There will be approximately a 2 month lead time after the construction contract is awarded, for obtaining certain construction materials, particularly steel tie rods and sheet piling, large bolts and creosoted timbers. An advance estimate of actual construction time is between 5 to 8 months depending on what method is chosen.

Construction Equipment

Construction equipment will involve a land based crawler crane rigged with swinging hammer, a truck crane to handle piling and sheeting onto the job. Excavation can be most easily and efficiently handled with a Gradall unit operating from a center beam on the wharf. Space will prevent storing all excavation proceeds and three or four six yard six yard trucks will be required to move the material to a storage site at the pier head.

The possibility of using floating equipment for pile driving and handling is limited to the west side where the channel depth is adaquate.

The channel depth on the east side is not adaquate to accomodate floating equipment.

Borings and Soundings

A review of existing borings and sounding, made in 1948 and delienated on Bureau of Yards and Docks drawing #464088, indicates bottom and subsurface conditions typical to this area. Observation of tidal level indicators and tidal currents within this very restricted and protected position of Salem Harbor are contraindicative of changes in foundation conditions over long periods of time. The existing borings and soundings are therefore considered adaquate for design and construction purposes at this time.

Surveys and Aerial Photographs

A topographical survey of Central Wharf was contracted for several months ago and is now complete. Aerial photographs before, during and after construction provide valuable records for future use. Photographs are recommended for this project.

Permits

Permits to repair or construct in or over tidal water, or to dredge in tidal waters of Massachusetts are required by both the State Waterways Division and the U. S. Army Corps of Engineers. In addition, the city in which the structure is located requires a building permit. Initial steps have been taken to acquire these permits, these procedures, however, depend on the completion of the final construction drawings and technical specifications.

Cost Estimates as of May 1, 1974

Case I: Repair and rebuild the ~~east~~ bulkheads reusing existing material and replacing damaged timbers. Examine all tie rods, replace two thirds of rods, and protect all rods. Backfill and grade.

Excavation to tie rods (includes mobilization)		$ 28,000
Pull and redrive piling, remove and reset sheeting		96,500
Examine tie rods and install new rods		39,300
Replace and install missing hardware		5,300
Backfill and compaction		6,000
Remove bollard base and piping		25,700
Surfacing, gravel or asphalt		15,400
Dispose of excess materials		1,000
Fender system		5,000
Union labor fringe benefits, Health and Welfare, SS and Insurance, 25% of labor		30,000
Labor adjustment for tidal work		15,000
	Total	$267,200
Contractors overhead, 18%		48,096
		$315,296
Contingency, 10%		31,529
	Total	$346,825

Case II: Repair east bulkhead reusing existing material and replace damaged timbers. Install a steel waler 2 feet below the capsill on the south and east bulkheads. Install new steel tie rods running across the wharf. Protect all rods. Rebuild the west bulkhead using steel sheet piling, wales and cap. Backfill and grade.

Excavation to tie rods (includes mobilization)		$ 28,000
East Bulkhead, pull and redrive piling, remove and reset sheeting in damaged areas, west bulkhead, pull piling and upper sheeting		71,240
West bulkhead, furnish and install steel sheet piling, wales and cap.		82,620
Examine tie rods and install new rods		34,400
Apply protective coating to all rods		5,500
Replace and install damaged and missing hardware		3,500
Fender system		5,000
Remove bollard bases and piping		3,000
Surfacing, gravel or asphalt		15,400
Labor adjustment for tidal work		15,000
Union Labor frings benefits Health and Welfare, SS and insurance, 25% of labor		24,000
	Total	$313,360
Contractors overhead and margin, 18%		56,404
		$369,764
Contingency, 10%		36,976
	Total	$406,740

Case III: Rebuild the east and south bulkheads using steel sheet piling, steel wales, cap and new tie rods. Attach a non-load bearing timber facade to the steel sheet piling, reusing the existing material and replacing damaged timbers.

Mobilization		$ 2,600
Pull Piling, remove sheeting		10,392
Install new tie rods		40,000
Apply protective coating to all rods		6,000
Furnish and install steel sheet piling, wales, and cap		160,000
Produce a lamination		150,000
Hardware		2,500
Backfill and compaction		25,700
Remove bollard bases and piping		3,000
Union labor fringe benefits, Health and Welfare, SS and Insuracne, 25% of labor		35,000
Surfacing, gravel or asphalt		15,400
Labor adjustment for tidal work		15,000
	Total	$465,592
Contractor overhead and margin, 18%		83,806
		$549,398
Contingency, 10%		54,939
	Total	$604,337

Recommendations

Package No. 111 is titled "Restoration of Central Wharf." The NPS Administrative Policies Handbook terms restoration as, "The process of accurately recovering the general appearance of a site as it appeared at some period in time, by the removal of non-historic natural and man caused intrusions. . . ." If a date prior to 1820 is selected for restoration, 500 feet of the wharf would have to be removed, which does not meet management requirements for function. Restoration is not practicable, because it is not possible to peel away the 1939 wharf and the 1897 wharf and find the 1820 wharf intact. Evidently, during each rebuilding some destruction occurred to earlier structures through excavation. Nevertheless, substantial in situ historic fabric exists in Central Wharf. If the remains of an early wharf were exposed, they would deteriorate due to the change in environment. The alternative is to remove the timbers, pressure treat with polyethelene glycol, and replace. Since this treatment method is extremely expensive, not guaranteed permanent, and violates the requirement to restore in situ, this method is unacceptable for stabilization of all of archeological remains. I consider the 1939 wharf structure a significant, while perhaps not yet historic, accretion of the structure. It is the layered aspect of the historic fabric which makes the wharf valuable today. All of the additions and accretions to the wharf tell its story through the centuries. Elimination of any of these accretions, including the 1939 bulkhead, for the purpose of restoration is questionable on our part, as trustees of this historic resource.

It is my recommendation that the wharf be repaired and rebuilt to provide a container for the historic fabric. The least intrusive method of construction should be employed in the rehabilitation of the wharf. While the steel sheet piling could be driven with minimal disturbance to the historic fabric, the removal of the 1939 wharf and replacement with steel must be considered a radical intervention into the historic structure. Repair of the east bulkhead will require limited disturbance of the wharf structure in the areas of failure, the structure and fill behind it would be left intact. The repair solution, therefore, is lower on the scale of intervention than the steel replacement solution. I believe that the repair scheme is feasible only on the east and south sides. The west bulkhead is 90% destroyed, and it cannot be repaired. It will need total rebuilding, and the most modern materials should be used. The primary objective of the rehabilitation is to package the historic fabric of the wharf. This can best be accomplished in the west side by the use of steel sheet piling. This would be the least intrusive in this case, because it would cause less disturbance to the structure than redriving and resetting timber piling and sheeting. I would propose that the existing timber be salvaged and used as a fender and cap system for the wharf. I do not recommend the application of a timber "false front" over the steel sheeting. The Cor-Ten steel forms a deep brown patina, and is a material which need not be marked. The fender system, however, will accomplish this to a certain degree. The idea of faking a timber wharf over the steel is not a responsible use of materials.

I recommend that the problem of raising the level of the wharf be studied further. This is a problem which is not confined to Central Wharf, but affects the entire park waterfront. One implication of raising the wharf level is the demolition of the Navy building. This is difficult for me to justify. I do, however, feel strongly that the maintenance wing of the building should be demolished. It blocks visual and physical access to the wharf, and its configuration is historically inaccurate, because the long dimension of all buildings on Central Wharf ran parallel to the long dimension of the wharf. If some of the visitor center activities could be limited or decentralized to other points in the park, maintenance facilities could be added to the main block of the building. I am also concerned that the landscape plan for the area around the visitor center is inappropriate to the nature of the resource. The little gardens, and paths and benches deny the essentially industrial nature of Central Wharf. The proposed parking lot is unfortunate. If ever a decision is made to expose corner of the Forrester Wharf, this will be located in the middle of the parking lot. I recommend that if indeed a parking lot is necessary on Central Wharf, it be paved with Belgian black, as is Derby Street. I also request that further study be made on the subject of exposing and stabilizing archeological wharf remains for public display.

I suggest that management requirement for Central Wharf as a marina for small boats be strictly limited to the west side with dredging performed only on the west side.

The appropriate surfacing for Central Wharf is hard packed clay with crushed gravel or cinders on top.

My recommendations are as follows:

East Bulkhead: repair, reusing existing material.

South Bulkhead: leave intact.

West Bulkhead: rebuild, using steel sheet piling.

Marine Railway: repair and surface the ramp.

Tie rods: attach steel walers 2 feet below the capsill on the west and south sides, run new tie rods across the wharf.

Timber cap and fenders: reuse existing material, drive at frequent intervals.

Case II, page 25, is the cost estimate for my recommendations. This estimate is about $80,000 more than the programmed amount for the restoration of Central Wharf.

Addendum, incorporating the comments of Historian Snell:

Page 20. "A parapet type cap is historically inaccurate. . . ." Photograph #6 in the Derby Wharf HSR indicates that a raised cap would be, on the contrary, historically accurate. It shows piles driven about a foot above the capsill, and the earth and gravel fill is about a foot below the capsill. This photograph is dated "before 1893." The wharf was rebuilt in 1896-1897, and presumably the wharf, before 1893, was in a state of deterioration, similar to its present condition. The photo may possibly show the fill washed away from the wharf, rather than a parapet cap. The historian believes that a raised cap was the method used in the 19th century to deal with the rising level of the ocean.

Page 27. "If a date prior to 1820 is selected for restoration, 500 feet of the wharf would have to be removed. . . . " The existing documentation dates the extension 1805-1820. The historian places the date early, about 1807, during a shipping embargo when plenty of cheap labor was available.