Form No. 10-306 (Rev. 10-74)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY -- NOMINATION FORM

FOR FEDERAL PROPERTIES

FOR NPS USE ONLY
RECEIVED FEB 8 1983
DATE ENTERED

SEE INSTRUCTIONS IN *HOW TO COMPLETE NATIONAL REGISTER FORMS*
TYPE ALL ENTRIES -- COMPLETE APPLICABLE SECTIONS

1 NAME

HISTORIC Steam Schooner Wapama (Tongass)

RECEIVED
JAN 07 1983

AND/OR COMMON
Wapama

OHP

2 LOCATION

STREET & NUMBER Historic Ships Unit, National Maritime Museum, Golden Gate National Recreation Area (Hyde Street Pier) __NOT FOR PUBLICATION

CITY, TOWN
San Francisco __ VICINITY OF

CONGRESSIONAL DISTRICT
Fifth

STATE
California

CODE
06

COUNTY
San Francisco

CODE
075

2 CLASSIFICATION

CATEGORY	OWNERSHIP	STATUS	PRESENT USE	
__DISTRICT	X PUBLIC	__OCCUPIED	__AGRICULTURE	X MUSEUM
__BUILDING(S)	__PRIVATE	X UNOCCUPIED	__COMMERCIAL	__PARK
X STRUCTURE	__BOTH	__WORK IN PROGRESS	__EDUCATIONAL	__PRIVATE RESIDENCE
__SITE	**PUBLIC ACQUISITION**	**ACCESSIBLE**	__ENTERTAINMENT	__RELIGIOUS
__OBJECT	__IN PROCESS	X YES: RESTRICTED	X GOVERNMENT	__SCIENTIFIC
	N/A __BEING CONSIDERED	__YES: UNRESTRICTED	__INDUSTRIAL	__TRANSPORTATION
		__NO	__MILITARY	__OTHER:

4 AGENCY

REGIONAL HEADQUARTERS: *(If applicable)* National Park Service, Western Region

STREET & NUMBER
450 Golden Gate Avenue, Box 36063

CITY, TOWN
San Francisco —— VICINITY OF

STATE
California 94102

5 LOCATION OF LEGAL DESCRIPTION

COURTHOUSE, REGISTRY OF DEEDS, ETC. Not Applicable

STREET & NUMBER
N/A

CITY, TOWN
N/A

STATE
N/A

6 REPRESENTATION IN EXISTING SURVEYS

TITLE National Register of Historic Places

DATE
April 24, 1973

X FEDERAL __STATE __COUNTY __LOCAL

DEPOSITORY FOR SURVEY RECORDS U.S. Department of the Interior, National Park Service

CITY, TOWN
Washington

STATE
D.C.

7 DESCRIPTION

CONDITION		CHECK ONE	CHECK ONE
__EXCELLENT	__DETERIORATED	XUNALTERED	__ORIGINAL SITE
__GOOD	__RUINS	__ALTERED	__MOVED DATE N/A
XFAIR	__UNEXPOSED		

DESCRIBE THE PRESENT AND ORIGINAL (IF KNOWN) PHYSICAL APPEARANCE

With the exception of some minor wear and tear after a long career as a working vessel and as a museum ship, the S.S. Wapama is essentially the same vessel launched in 1915. She possesses remarkable integrity since in every case where restoration or repair has been necessary replacement of timbers has been in-kind utilizing historic construction techniques and materials.

The Wapama is a wooden-hulled, steam-propelled vessel 204.8 feet long with a beam of 40.2 feet, a depth of hold of 14.3 feet, a gross tonnage of 951 tons, and a net tonnage of 584 tons. Built with Douglas Fir, the Wapama departs from established shipbuilding practices of her time in that the ship is not reinforced with diagonal straps of iron to strengthen the hull. Rather she is solidly built of wood with approximately three times the number of timber fastenings an iron-reinforced vessel would have. The uniqueness of Wapama's construction illustrates the human factor of ship design. Rather than accept the standard approved design forwarded by the American Bureau of Shipping, the shipwrights who built the Wapama relied on their years of experience and the "feel" of what would work based on their intuition to construct the vessel. It is perhaps due to this continuation of older shipbuilding traditions and the feeling of individuality on the part of the shipwrights that the Wapama has survived her contemporaries.

Known as a "single end steamer," the Wapama has her engine and machinery housed aft. Some vessels had their engines housed midships and were known as "double ended." A high superstructure on the stern and a high forecastle on the bow are distinctive features of the Wapama. The masts and spars support booms for loading and off-loading cargo and are equipped with two sets of friction winches. These powerful winches were designed to allow the Wapama to load and off-load by herself without the use of shore cranes. The ability to do this was an asset in the lumber trade, where many ports were primitive and lacked shore facilities for cargo loading. The winches, developed after years of experience, were a necessity. The Wapama has one main hatch for loading cargo; it is twelve by twenty-four feet. In addition to sixty passengers, the Wapama could carry 1,100,000 board feet of lumber, which included a deckload fifteen feet deep.

The interior of the Wapama is divided into various sections, the largest being the holds where the cargo was stowed. There are, additionally, the spaces reserved for machinery, the engine room, and the areas reserved for human use and occupation such as the crew quarters, the galley, the passenger areas, and the pilothouse. Because the vessel has a radical sheer, all interior woodwork is fitted to the sheer and camber of the ship. This means that no wall, doorway, or other openings are square. The panelling of cabins was specially cut at an angle to fit into the Wapama. This fine example of the joiner's work is one of the more noticeable features of the Wapama's interior. Another distinctive feature is the curved staircase leading from the lounge to the dining saloon. This elegant staircase, solid wood panelling, polished brass, and fine detailing set the passenger areas apart from the utilitarian work areas and crew quarters.

The engine, which is intact, is a triple expansion engine, I H P 800 built by the Main Iron Works of San Francisco. This type of marine engine is no longer built; there are few intact examples left in the United States and none known to be in place inside a wooden hull save Wapama's. The engine is powered by water tube boilers which are also intact. The boilers burn diesel oil. Features such as ladders, steam lines, and many

(SEE CONTINUATION SHEET)

8 SIGNIFICANCE

PERIOD	AREAS OF SIGNIFICANCE -- CHECK AND JUSTIFY BELOW				
__PREHISTORIC	__ARCHEOLOGY-PREHISTORIC	__COMMUNITY PLANNING	__LANDSCAPE ARCHITECTURE	__RELIGION	
__1400-1499	__ARCHEOLOGY-HISTORIC	__CONSERVATION	__LAW	__SCIENCE	
__1500-1599	__AGRICULTURE	__ECONOMICS	__LITERATURE	__SCULPTURE	
__1600-1699	X ARCHITECTURE	__EDUCATION	__MILITARY	__SOCIAL/HUMANITARIAN	
__1700-1799	__ART	__ENGINEERING	__MUSIC	__THEATER	
__1800-1899	X COMMERCE	__EXPLORATION/SETTLEMENT	__PHILOSOPHY	X TRANSPORTATION	
X 1900-	__COMMUNICATIONS	X INDUSTRY	__POLITICS/GOVERNMENT	__OTHER (SPECIFY)	
		__INVENTION			

SPECIFIC DATES 1915 BUILDER/ARCHITECT James H. Price, Master Builder
St. Helens Shipbuilding Company

STATEMENT OF SIGNIFICANCE

The Wapama is the last surviving example afloat of some 225 steam schooners specially designed for use in the 19th and 20th century Pacific Coast lumber trade and coastwise service. These vessels formed the backbone of maritime trade and commerce on the coast, ferrying lumber, general cargo, and passengers to and from urban centers and smaller coastal settlements.

While one of many such vessels, the Wapama was also unique in her construction, varying from established shipbuilding practices of the time. As such she is Nationally significant in the area of Naval Architecture as the only known example of a vessel of this type of construction in the United States still extant.

Due to her important role in Pacific Coast maritime trade, commerce, and industry, the Wapama is Nationally significant as a Pacific Coast expression of America's dependence on maritime trade and commerce and because she alone illustrates the maritime aspects of America's timber industry. Her areas of significance are in Commerce, Industry, and Transportation.

The S.S. Wapama is the last intact, floating American coastwise steamship to carry passengers and cargo, and as the sole representative of hundreds of wooden steamers which operated on America's Atlantic, Gulf, and Pacific coasts in the 19th and 20th centuries, she helps us understand that aspect of American history and is of exceptional value in illustrating that important theme in the history of the nation. She is of National significance.

The Wapama was nominated to and placed on the National Register of Historic Places on April 24, 1973 at a State level of significance in the areas of Commerce and Transportation. Due to inadequacies of that nomination and because of new and important information this revised nomination has been prepared to better represent the Wapama's areas of significance and to raise her recognized level of significance to a National level.

This statement of significance is based on the more detailed history which follows and on the professional evaluation of the Wapama's construction by Naval Architect Zachary M. Reynolds which is attached to this nomination.

HISTORICAL BACKGROUND

The influx of settlers and the resultant spread of urbanization on the Pacific coast brought about by the discovery of gold in California in 1848 depended upon a ready supply of lumber for construction. AS new towns arose, and as additional construction took

(SEE CONTINUATION SHEET)

9 MAJOR BIBLIOGRAPHICAL REFERENCES

American Bureau of Shipping. Rules for Building and Classing Wood Vessels. (New York: American Bureau of Shipping, 1943)

Haas, Irvin. America's Historic Ships: Replicas and Restorations. (New York: Arco Publishing Company, 1975)

(SEE CONTINUATION SHEET)

10 GEOGRAPHICAL DATA

ACREAGE OF NOMINATED PROPERTY Not Applicable

UTM REFERENCES

	ZONE	EASTING	NORTHING
A	10	550960	4184660
B			
C			
D			

VERBAL BOUNDARY DESCRIPTION

The area of the ship.

LIST ALL STATES AND COUNTIES FOR PROPERTIES OVERLAPPING STATE OR COUNTY BOUNDARIES

STATE		CODE	COUNTY	CODE
	N/A	N/A	N/A	N/A
STATE		CODE	COUNTY	CODE
	N/A	N/A	N/A	N/A

11 FORM PREPARED BY

Revision of Nomination prepared by Allen W. Welts 2/28/73

NAME / TITLE James P. Delgado, Park Historian
Golden Gate National Recreation Area

ORGANIZATION National Park Service

DATE December 17, 1982

STREET & NUMBER Building 201, Fort Mason

TELEPHONE (415) 556-9504

CITY OR TOWN San Francisco

STATE California 94123

12 CERTIFICATION OF NOMINATION

STATE HISTORIC PRESERVATION OFFICER RECOMMENDATION

YES X NO ___ NONE ___

STATE HISTORIC PRESERVATION OFFICER SIGNATURE

In compliance with Executive Order 11593, I hereby nominate this property to the National Register, certifying that the State Historic Preservation Officer has been allowed 90 days in which to present the nomination to the State Review Board and to evaluate its significance. The evaluated level of significance is X National ___ State ___ Local.

FEDERAL REPRESENTATIVE SIGNATURE

TITLE Associate Director, Cultural Resources DATE 2/7/83

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I HEREBY CERTIFY THAT THIS PROPERTY IS INCLUDED IN THE NATIONAL REGISTER

for Linda McClelland DATE 3-24-83

DIRECTOR, OFFICE OF ARCHEOLOGY AND HISTORIC PRESERVATION

ATTEST: DATE

KEEPER OF THE NATIONAL REGISTER

UNITED STATES DEPARTMENT OF THE INTERIOR
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TITLE:
Historic Ship Register
DATE: 1980

DEPOSITORY FOR SURVEY RECORDS:

International Congress of Maritime Museums. Published Copies of the Historic Ship Register can be found in any accredited Maritime Museum in the United States or abroad.

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other engine room fittings are in place. Some minor brass fittings were removed from the ship between 1949 and 1958. Other machinery, such as steering gear, the winches, and pumps are also intact. Also intact and in place on deck are two original lifeboats.

Beginning in 1958 the Wapama has undergone restoration by shipwrights and museum technicians attached first the State of California's State Maritime Historical Park and after 1977 to the National Maritime Museum. Rotten or broken woodwork was and is being replaced utilizing historical construction techniques and materials. Any vessel, either afloat or ashore, undergoes deterioration due to a number of factors. During the active life of the Wapama, she, just like any other ship, underwent constant repair and replacement of timbers. The restoration activity therefore continues a process which began when the ship was launched.

After 1958 the Wapama was also fitted with displays and furnishings to better interpret her history. Since the ship was placed on a preservation dry dock barge in 1979, many of these displays, furnishings, and rare items such as maker's plates, brass lamps, and navigational instruments have been temporarily removed from the ship and placed in museum storage. These artifacts are accessioned as one collection and can be seen in Building 315 Fort Mason, San Francisco.

As mentioned above, deterioration of a wooden vessel is a normal part of any ship's life. Therefore the Wapama has weakened somewhat with age and the onset of some decay in the ship's hull. Restoration work is planned but has yet to take place due to the high costs and a lack of funds. To avoid undue stress on the hull, the Wapama was temporarily removed from the water in 1979 and placed on a preservation dry dock where she presently sits. Restoration monies are being sought.

place in established urban centers, more lumber was required. At first lumber was imported from distant ports on the eastern seaboard and in the South Pacific. Logging of redwood groves near San Francisco Bay also met some of the demand, but by 1850 it was apparent that much more timber was required for the construction needs of several decades to come. The development of logging camps and mills on the rugged California and Oregon coasts in large stands of virgin Douglas fir and redwood solved the need for additional lumber. Since no direct route to the redwoods existed on land and rail and wagon roads were difficult to build, the sea became the major highway of Pacific coast lumber trade and commerce.

There were problems inherent in using the sea. Pacific coastal fogs, strong winds, rocks, and powerful currents plagued the mariner, and most shipping ports were mere "dog-holes" or slight indentations on the shore where a ship could barely fit, anchored close to shore and imminent destruction and forced to load with wire chutes, cables, or lighters.[1] These conditions quickly gave rise to a fleet of small sailing schooners built to manuever in these difficult locations. The sailing schooners, now represented by two examples, one of these being the C.A. Thayer, a National Historic Landmark vessel moored at the Historic Ships Unit, National Maritime Museum, San Francisco, did yeoman service in the lumber trade. Yet at the same time that the sailing schooner was developed and used on the Pacific coast, the dangerous conditions of the lumber trade provided the incentive for the development of the steam-powered lumber carrier:

> The paramount advantages inherent in operating steam ships, rather than sailing vessels into these dangerous inlets led to the introduction of the "steam schooner" in this trade at a time when sail was yet undisputed on the world's bulk trade routes.[2]

The first steam schooners were built in San Francisco in the early 1880s and were small craft which carried both sail and steam engines; "they employed their sail when it was advantageous."[3] In time the sails disappeared and the masts became supports for massive cargo booms, engines were built to be more powerful, and the steam schooners grew in size to carry larger cargoes. Yet in essentials the tiny steam schooners of the 1880s and the large steam schooners of the 1900s remained quite similar. One of the large steam schooners of the 1900s was the S.S. Wapama.

The Wapama was built by the St. Helens Ship Building Company of St. Helens, Oregon, which was part of a major complex of lumber industries owned by Charles R. McCormick. McCormick's steamship company was to own and operate the new ship. McCormick, originally the owner of a small mill on the Columbia River, entered the shipping business in 1904. By 1915, when the Wapama was built, McCormick owned a large fleet of some twelve vessels and had expanded his business to encompass many aspects of the lumber trade. By 1945 the McCormick interests included several companies and many retail

(SEE CONTINUATION SHEET)

lumber yards.

With offices in New York, San Francisco, and South America, "McCormick Enterprises became internationally known."[4] The Wapama, a part of that shipping and lumber empire, was launched on January 20, 1915:

> Another product of the plant of the St. Helens Shipbuilding Co., the hull of the new McCormick steamer Wapama, was launched there yesterday. The initial plunge of the big coaster was fully as successfully engineered as the others have been there....On the next voyage of the Klamath, she will tow the Wapama to San Francisco to have her machinery installed and she goes into commission in April on the Portland-California route.[5]

The steam schooner Multnomah (not the Klamath) towed the Wapama to San Francisco. The San Francisco Examiner for February 12, 1915 reported the arrival of the two ships:

> ARRIVED Saturday, February 13, 1915, 9:30 PM, 75 hours from Astoria, steamer MULTNOMAH, Foldat, with WAPAMA in tow. Passengers, 470 piles and 650,000 board feet of lumber, to Chas. McCormick.

Two months later the San Francisco Examiner reported that

> The steamer WAPAMA, latest addition to the already large fleet of coasters belonging to the Chas. R. McCormick Company, will be ready for its trial trip in about ten days. The vessel will have accomodations for forty-five cabin passengers and fifteen steerage. The lumber carrying capacity will be 1,100,000 board feet.[6]

On May 2, 1915 the Examiner reported that the Wapama would leave that day on her first operating voyage. On May 9, just one week later, the Examiner noted that

> The Charles R. McCormick steamer WAPAMA is due to arrive here Tuesday enroute south, to complete the first round trip between San Francisco and northern ports. The new vessel will have sixty passengers aboard and full freight list, including one million board feet of lumber.

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Thus the Wapama began a long career on the Pacific coast, continuing a tradition of coastwise passenger and freight service that dated to before the California Gold Rush as well as continuing the vital lumber trade, which had by that time expanded to serve the needs of the United States and the world with lumber and just not the Pacific coast. Coastal shipping was vital to the commerce of the United States, and the Wapama entered into the ranks of American coastal steamers. Eventually she alone would survive as the role representative of that vast fleet.

In 1930 McCormick sold the Wapama and another of his steam schooners, the Celilo, to Albert E. Gillespie of San Francisco. Gillespie was the manager of a new firm, the Los Angeles-San Francisco Navigation Company, which was popularly known as the "White Flyer Line." Operating between Pier 17, San Francisco and San Pedro the Wapama, though no longer in the hands of her lumber company owners continued to play an important role in Pacific coast shipping. At the same time, some of her former running mates were operating throughout the Pacific, some on trans-Pacific runs, adding to the significance of these hard-working vessels.

Albert Gillespie died in 1932 and apparently the fortunes of the "White Flyer Line" changed. In 1937 Gillespie's widow sold the Wapama to Erik Krag of Mill Valley, California, who planned to continue using the ship between San Francisco and Los Angeles. Krag later recalled the venture:

> I bought the WAPAMA for $12,500 and then made the mistake of sending her to the Bethlehem Shipyard. You know how shipyards are. By the time she got out of there WAPAMA had cost me another $10,000. I incorporated the Viking Steamship Co. to operate the vessel. She was coastwise; we charged $8.00 for the trip to Los Angeles, dinner and breakfast included....She made two trips for me, both of which lost money, and then I laid her up.

Krag sold the Wapama in December of 1937 to the Alaska Transportation Company, which intended to run the ship between Seattle and various ports in Southeastern Alaska.[7] In 1938 the Wapama's name was changed to Tongass by her new owners. The Tongass

> carried mail and freight and passengers to the little cannery ports....She was the only link to the outside world. Alaskans in the obscure ports grew to love the ungainly little Tongass, for she was steady and dependable....[8]

(SEE CONTINUATION SHEET)

In 1947 the Alaska Transportation Company suspended operations. In 1949 the Tongass ex Wapama was sold to a scrap yard. Very little was removed save some brass fittings and the ship was left to quietly rot on Puget Sound. In the mid-1950s one reporter remarked upon her fate:

> No one seems to have the heart to really wreck the little old lady, however, and she's still almost intact, and she's still afloat. A stubborn fire broke out in her engine room a few months ago, but it was put out....The wooden steam schooners were tough little ships and the Tongass ex Wapama, last of the breed, is proving it to the bitter end.[9]

Fortunately help was on the way. In 1955 legislation was introduced by the California State Legislature to establish a State Maritime Historical Park in San Francisco. In 1958, funds were allocated to acquire the Tongass for the park:

> The State Division of Beaches and Parks yesterday authorized purchase of the Tongass, last of the Pacific Coast's steam lumber schooners, for the San Francisco Maritime Museum. The vessel is in Seattle. A $16,000 check is being sent to the owner, J. Mendelsohn & Son, for the purchase. The total cost, including refurbishing and towing the schooner to San Francisco, is estimated at $83,000.[10]

The Tongass was towed to San Francisco Bay, where additional restoration took place to supplement the work done to allow for the ship to be brought to California. After the initial restoration was completed, the Tongass, her original name restored by the State along with her hull, was brought to the Hyde Street Pier on the San Francisco waterfront to join the fleet of the State Maritime Historical Park. There she became a favorite attraction in the popular park, which often hosted as many as 230,000 visitors. While moored to the Hyde Street Pier, the Wapama underwent additional restoration by the park's trained shipwrights in a piecemeal fashion.

In 1977 the Wapama, along with the other vessels in the State Maritime Historical Park was transferred to the United States Department of the Interior, National Park Service's Golden Gate National Recreation Area to become part of the National Maritime Museum of San Francisco. Restoration work continued, but by 1979 it became apparent that major work was required below the waterline. Without funding to do the job, and in hopes of avoiding damage to the ship by the extreme currents and tidal surges of the Hyde Street Pier location, Wapama was removed from the water in early 1979 and placed on a preser-

(SEE CONTINUATION SHEET)

vation dry dock barge to await preservation monies.[11] The Wapama is still out of the water awaiting the needed funding and work.

The Wapama's career and contributions are underscored by the knowledge that she is the last American coastal passenger and freight carrying steamship as well as the last of 225 Pacific Coast lumber steam schooners. She represents America's long and honored ties with the sea in her present role as a museum ship.

FOOTNOTES:

[1] Karl Kortum and Roger Olmsted. "A Dangerous Looking Place: Sailing Ship Days on the Redwood Coast." California Historical Society Quarterly, Volume L, Number 1, March 1970.

[2] San Francisco Maritime Museum. "Restoration of the Steam Schooner Wapama, Report #1..." (San Francisco, 1960)

[3] Ibid.

[4] Jack McNairn and Jerry MacMullen. Ships of the Redwood Coast. Stanford, California: Stanford University Press, 1945. p. 59

[5] Portland Oregonian, January 21, 1915

[6] San Francisco Examiner, April 12, 1915

[7] "Abstract of Correspondence Concerning WAPAMA in the Files of the Bureau of Marine Inspection and Navigation, now the National Archives." Typescript Manuscript in the National Maritime Museum, San Francisco.

[8] Gordon Newell, "Last of the Steam Schooners." n.d. clipping from an unidentified magazine. Filed in the National Maritime Museum, San Francisco.

[9] Ibid.

[10] Sacramento Times, January 10, 1958

[11] San Francisco Chronicle, March 2, 1979

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Significance under "Criteria for Evaluation" D

In addition to historical significance, the Wapama is a vessel especially significant in that her hull contains nationally significant historical data not otherwise available. As already indicated in this form, the Wapama did not conform to the official standards of shipbuilding practice of her time. But the Wapama WAS representative of an older standard, though one that was not reflected in the measured drawings and plans of maritime architects current at the time of her construction. The S.S. Wapama was built by experienced shipwrights based on the inherited knowledge of generations of master shipwrights, journeymen shipwrights, and apprentices, passed through apprenticeship from one generation to the next, from at least the 16th Century on down, as they graduated to larger and larger wooden hulls. Unsophisticated in the theories, mathematics, and practices of naval architecture, they were experts in the construction of wooden hulled ships based on centuries of experience with vessel designs that had worked, discarding designs that had not--discarding designs of ships that had sunk or faced other problems due to design defects. These shipwrights were building on a tradition of experience passed from generation to generation. The S.S. Wapama represents the final era of the construction of large wooden hulls for commercial service.

In a modern engineering sense, or in the complicated mathematics involved, these shipwrights did not even know why they were doing some of the things they were doing, did not know the actual mechanics of stresses in the hulls they were building, but they knew on the basis of tradition where a ship needed to be strong, in which direction it needed reinforcement at a given location, even if they did not know the scientific theories and mathematics involved. Thus the Wapama, built without such calculations, contains in its hull knowledge of the state of the art of building large wooden-hulled vessels at the end of a long historical development that is not contained in any present or historic form of documentation. The hull itself is the only record of the state of the shipbuilding art involving wooden hulls at the beginning of the 20th Century, a period in which such hulls were being eclipsed by iron and steel hulls. While comparatively unsophisticated plans for the Wapama may once have existed, they no longer survive, and if the hull itself were to be lost, only detailed measured drawings, beam by beam, board by board, spike by spike, nail by nail, could preserve that data.

Today a naval architect, making detailed measurements of stresses and strains and movement of members in the hull of the vessel over a period of months and analyzing them by use of a high speed digital computer can figure out in several months what it took the shipwrights who built the Wapama several centuries of accumulated experience to learn by trial and error.

EVALUATION OF CONSTRUCTION TECHNIQUES AND VARIATIONS FROM STANDARD SHIPBUILDING PRACTICES

Steam Schooner Wapama

PREPARED FOR THE NATIONAL PARK SERVICE

By

Zachary M. Reynolds
Naval Architect
681 Market Street, Room 281
San Francisco, California 94105

(415) 543-2177
(415) 388-5009

1981

THE WOODEN HULL; Limitations and Development

The timber vessel, built with lateral planking attached to transverse frames, has an inherent weakness brought about by the inability of the individual planks to work together as though they were a single element.

Vessels are designed and built in such a manner that the entire hull is considered as a single beam. Strength is derived from the ability of the extreme fibres of the hull to flex about a common axis in such a way that they maintain parallel chords with resistive moments and shear developed through the entire section in proportion to the distance of any chord from the axis of flexure. To maintain this continuity of internal resistive forces, the internal shear forces must exist as vertical and horizontal components for any element over the depth of the section. The difficulty in a timber vessel arises from the fact that the shear forces required for equalibrium cannot be completely transmitted across plank seams.

For a timber vessel with lateral planking, the external load which produces vertical shear may be transmitted from plank to plank. However, the internal resistive shear which is composed of a horizontal component cannot be transfered from plank to plank by mere contact. Horizontal plank seams therefore constitute shear boundaries. Because of this boundary condition for each plank, the timber hull cannot be conceived as a simple beam which develops a

flexural resistance over its entire depth. The timber hull is weak due to the difficulty in establishing an effective shear field, and is naturally restricted in length as a result.

The primary path for this horizontal shear is through the plank fastenings into the frame timbers. The frames accept this product of horizontal shear as moment, and communicate this through the depth of the vessel eventually as horizontal end reactions. However, a pure moment produces no end shear in a beam without a reverse change in flexural slope over the length of the beam. Therefore the frame itself must have boundary conditions which produce this reverse slope, and must have a relative stiffness commensurate with the loads it is expected to carry.

Early efforts to accomplish the required frame arrangements resulted in massive keelsons and deck timbers with large frames placed very close together. The efficiency of the fastenings becomes paramount since they must maintain the paths for the internal resistive forces. Unfortunately the combined efficiency of fastenings, lateral planking and vertical frames is some fraction of a completely intact section, as may be achieved in an all welded steel hull.

The laterally planked timber hull behaves to some degree as a single beam, and to some degree as a mere arrangement of numerous individual planks.

Besides the frame connections, horizontal shear between

planks can be carried to some extent by friction between the planks, and/or by edge fastenings.

Early solutions to the shear field problem emerged at two distinct eras of wooden shipbuilding. Prior to the 1400's, lateral planking was laid in such a fashion that seams were overlapping, called clinker built. Since overlapping seams cannot create frictional boundaries across which horizontal shear may be partially transmitted, a proliferation of frames and fastenings were required. Within the 15th century the Spanish and Portuguese developed a planking system where seams were butted, not overlapping. This system was used extensively on a type of vessel called a "caravel". The Santa Maria, Columbus' flag ship was a typical caravel. By butting the plank seams, friction between adjacent seam surfaces could carry some fraction of the internal shear load, thereby relieving the frames and fastenings. As a consequence the caravels were built with a relatively greater strength than other vessels of the period. The caravel type of planking, now called "carvel", was eventually accepted world wide and is today a standard form of planking on all large vessels.

The second advent in improving the shear field of a timber vessel surfaced in the latter 19th century. It was discovered that diagonal members, extending from the deck to the floor timbers, contributed so significantly to hull strength that planking and framing timbers could be sub-

stantially reduced from sizes normally in use without diagonal members. It was within this period prior to and including the time of Wapama's construction that diagonal carvel planking recieved much attention and general acceptance as a method of increasing the longitudinal strength of timber vessels. It was also understood that diagonal steel strapping in association with lateral timber planks improved the strength of vessels.

These concepts of diagonal carvel and diagonal steel strapping were set down in a standard format as expressed in the "Rules" of classification societies in the early 1900's. Later texts dealing with timber construction, mostly for civil structures, present more formulated approaches than these early classification "Rules".

EARLY SHIPBUILDING; Standard Designs of Proven Worth

Early designers lacked an adaquate technology to deal with the salient problems of timber vessels. As a consequence the design and construction of vessels was approached with a fundamentally pragmatic appreciation of success. The advance of shipbuilding techniques was necessarily slow and labored, progressing more as an art than a science. Radical departures from standard forms were discouraged as often by failure as by stoic resistance to change. Of course, the more successful designs were copied and the art developed at some reasonably uniform level within the world shipbuilding community. Variations would exist where major shipbuilders favored one construction or design over others. Such designs could be identified by the geographic area from which they came, or even by the particular shipyard which developed them.

At the hub of this effort to encourage proven designs were the hull insurance groups. Insurance was issued to a vessel based upon a survey of its construction, fittings, etc. and its proven ability to endure the voyage. Eventually these surveys would reveal characteristics common to the more seaworthy vessels. Various survey societies were then formed to "class" vessels as to their adaquacy for ocean voyages, again based principally on the success of certain identifiable hull types. These survey societies, later to be called Classification Societies, developed certain

rules for the construction of vessels so that the successful aspects of design and construction would be more nearly standard. These classification societies exist to this day, Lloyds Register of Shipping and the American Bureau of Shipping the most notable.

However clear the intent of any effort at classification, every successful variation of a successful design group could not be realistically incorporated into an essentially standard format in the absence of a concise engineering approach to these sturctures. Such a pragmatic system creates a powerful element of stagnation. As a consequence those designs which did not conform to the "Rules" imposed by classification become rare and valuable historical pieces if they have managed to outlive their era.

The SS Wapama represents one vessel of a fleet of many which were meant to supplant the maritime tonnage of the United States during WWI. Ships were in such demand that the US. embarked upon a massive building program, which would eventually catapult the nation into the forefront of maritime powers. Although the use of steel in shipbuilding had already gained nearly universal preference over timber hulls, the United States decided it could not restrict itself to steel since it held such vast timber reserves suitable for hull construction. In this revived role of timber, a technology was sought so that the inherent weakness of timber hulls could be reduced. This resulted in composite timber/steel hulls, and the preference of diagonal over lateral planking.

Timber vessels apparently reached a peak in proliferation in the mid 19th century. Then with the advent of a steel technology, the timber hull was rapidly replaced with the all steel rivited hull. Although the centuries old art of timber hull construction was not lost, it was certainly abbreviated as shipbuilding entered the 20th century. The building program meant to dramatically increase U.S. tonnage appeared to get under way in 1915, the year of Wapama's construction. It would seem that the Wapama was caught at a pivot point in history. Large timber vessels (over 200ft) were rare, and it was recommended at the time that they

be reinforced with some type of steel strapping. This would be an effort to overcome the weakness of timber hulls, due largely to the inability of timber planking to carry shear completely across seam boundaries. In fact the use of steel became an important element in wooden vessel construction at this time. Classification societies were requiring the use of steel strapping for vessels of the Wapama's size. Edge fastenings were required on all ceiling planks, and steel fastenings were favored over treenails. Extremely large wooden hulls over 300ft employed steel extensively in reinforcing. As an alternative to steel strapping, ABS was allowing double diagonal carvel planking in association with lateral hull planking.

Various specifications were set forth during this time for the construction of timber vessels. Under the "Rules" presented by ABS and Lloyds, the Wapama represents a significant departure, as follows:

1. Steel strapping, or any other steel reinforcing is not evident,
2. Edge fastenings in upper ceiling are not evident,
3. The Wapama utilizes sister frames within the bilge radius. The use of sister frames is not documented in the popular literature of the time, nor acknowledged by ABS.

The most compelling feature of the Wapama, aside from its 65 years of age, is the use of sister frames and the apparent non-use of steel strapping. As noted above, the

use of steel strapping was a classification society requirement for vessels of the Wapama's size. Yet the structural analysis of the effectiveness of the sister frames shows that they provide a substantial amount of stiffness to the hull within the region where they are used. This stiffness is achieved because frame rigidity is greatly increased since the sister frames fill the voids between the complete frames and develop a solid network of timber material. It is also evident that the number of fastenings are increased by 50% in the area of the sister frames. This arrangement of frames would allow horizontal shear to be carried by a solid network of vertical timbers, and vertical shear to be carried by a solid network of lateral planking.

When steel strapping was used on timber hulls, it was laid between hull planking and frames. This rendered the strapping virturally inaccessible for maintainence and repair. Over the years, corrosion would eventually destroy the strapping and its ability to add stiffness to the hull. Although timber is affected by rot and marine life, it is essentially an inert material and tends to outlast steel in a marine environment.. In this sense it would be no coincidence that the Wapama survived other vessels of its class which were reinforced with steel strapping rather than sister frames.

The Wapama exhibits other variations in construction than appear to have been recommended at the time. Survey indicates that less metal fastenings and more treenails

were used than allowed by ABS. The construction of floor timbers utilized a system of "naval timbers", which was definitely discouraged by ABS, and allowed only infrequently on vessels.

The naval timber method of bottom construction provides a relatively weak arrangement of floor timbers, and could be partially responsible for the extreme set-up of the bottom structure. However regarding the wooden trunnel fastenings, hull planking removals indicated that the metal fastenings had deteriorated significantly so that effective fastening was accomplished by the trunnels.

It is not really known to what extent the construction methods of the Wapama were followed on the West Coast of the United States. The Wapama may have been a perfect example of West Coast shipbuilding, or it may have been unique to the St. Helens yard in which it was built. The publications of that period, circa 1915-1920, which document wooden shipbuilding practices and the ABS "Rules for Construction of Wood Vessels" were all products of an East Coast Establishment. There may be areas yet to be exposed by plank removals which conform more closely to the construction techniques embraced by the East Coast. Yet at this time all evidence points to the Wapama representing a uniqueness, the documentation of which has not survived the vessel.

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