ELEMENTS OF STRUCTURE:
KENNECOTT YACHT CLUB & SAILING SCHOOL
Kalee Ann Hartman
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Abstract

The Kennecott Yacht Club and Sailing School is a series of boathouses placed along the water’s edge of the Chesapeake Bay. The yacht club includes marina facilities, a clubhouse and a sailing school. The program is divided among five structures placed along the dock, culminating in a lookout tower. The structures are variations of each other. The boathouses provide dry storage and natural ventilation for dinghies, keelboats and other small craft boats. A glass curtain-wall encloses the structure of the final boathouse to provide a conditioned space for clubhouse activities.

The design of the boathouses is developed from the structure of the various buildings. The pavilion structures are based on a common repeated geometrical order, which triangulates and equalizes the forces. The structure acts as a determinant of form for each boathouse. The columns, trusses and walls are separate elements of the structure meeting at pin connections and ball joints. The rigid frame within the layered roof is the essential element which ties together all the parts and provides stability to the structure.
To my mom —
whose guidance has always taught me to
be willful in all my endeavors; to do so with
strength, tenacity and a good heart. And
to never take on a day without compassion,
humility and a good sense of humor.
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The yacht club is located on the auxiliary campus of the United States Naval Academy. A large portion of the campus is dedicated to recreational activities for midshipmen and naval families stationed in Annapolis. The campus includes a golf course, gym, tennis courts and a primary school.

The yacht club expands the facilities of an existing 50 slip deep-water dock on Mill Creek. The dock is placed at an ideal location for harboring boats due to the proximity to the Chesapeake Bay and the protection created by the shape of the land.
The yacht club consists of marina facilities, a clubhouse and a sailing school. The program is separated into individual boathouses along the water’s edge. The boathouses used for the storage of racing dinghies, keelboats and small craft boats are naturally ventilated while the clubhouse is a conditioned space.

The row of boathouses culminates in a lookout tower. The tower provides sailors with a heightened view of the bay, which is otherwise unseen from the marina’s site. The tower also serves as a landmark for boats navigating their way through the channel leading off the bay.

1 Clubhouse
2 Kayak/ small boat storage
3 Small craft boathouse
4 Sailing school boathouse
5 Lookout tower
6 Floating docks
7 Deep-water slips
8 Loading dock
9 Trailer lot
10 Parking lot
11 Beach
LEFT  Reflected ceiling plan of the clubhouse

BELOW  Section of the clubhouse
The development of the boathouses began with general and progressively more detailed structural studies of the roof. The physical necessity for the structure to resist wind loads defined, in part, the form of the roof. Regulating geometry found within the truss design generated the structural system comprised of both determinate and indeterminate elements.

The structure of the boathouses act like pavilions with non-load bearing walls. The walls and frame within the roof provide necessary lateral bracing. Each element plays an essential role in the strength of the overall structure.
RIGHT Study models of trusses and regulating geometry.

OPPOSITE PAGE
Axonometric of the dock and building structure.
ABOVE  Axonometric diagram of the resulting roof pattern from the orientation of the trusses

OPPOSITE PAGE  Interior perspectives
ENCLOSING THE STRUCTURE

ABOVE  Model study of the structure with the placement of the glazing to provide a conditioned interior space.

TOP  Model study of the roof enclosure
ABOVE  Elevation view of curtain wall enclosure
RIGHT  Diagram of the glass curtain wall wrapping interior bays and joining to the structure
The relationship of the elements to the structure closely resembles the workings of a sailboat. The rigging on a sailboat creates a system of parts and allows the boat to be operable. Likewise, the elements of the structure act in harmony to give the building strength and resistance.

The connections and joints in the structure allow the elements to be individual entities. The joints mediate the intersection of parts. The joints accept the elements of the structure and respond to the necessary structural needs.
ABOVE  |  Model photos of steel panel trusses

RIGHT  |  Ball joint at the top of the column

PREVIOUS PAGES  |  Steel pin connection at the truss and column
APPENDICES

A: STUDIES
B: TOWER
C: PROCESS
In this boathouse model, natural ventilation is the primary concern. It is essential to keep the wooden boats dry to prevent them from weathering. Through the use of thermal buoyancy, the cool air coming off the water is pulled up through adjustable window hatches. The window hatch and wooden slats trap heat from the sun, creating a low pressure moment that draws out the cooler air. The air coming off the water can enter the boathouse in three places: through vents in the floor; low slats in the side walls; and/or through the waterfront facade when the garage door is open (not shown in model).

The slope of the roof is derived from the direction and force of the wind. With prevailing winds coming from the east and winds off the water from the north, a steep slope roof is most suitable to resist these loads. Uplift is a concern with coastal wind loads, therefore the overhang of the roof is minimized.
In this boathouse model, the first level is designated for boat storage and the second level is a conditioned space to be used as a clubhouse. The walls of the first level consist of louvered panels. The panels run vertically on the east/west walls and horizontally on the south wall. The north wall consists of large bay doors. The panels can be rotated 90 degrees to baffle the sun at different times throughout the day. The south panels are divided by the structural bays so they can be individually adjusted as the sun moves across the south facade. The louvered panels also allow for ventilation of the space. The clerestory windows provide daylight into the space when the panels are closed. The slight overhang on the exterior side of the wall provides some additional shading to the windows.

The openings on the second level are designed to diffuse the sunlight. The skylight spanning longitudinally through the space captures light as the sun travels east to west. The skylight’s interior frosted glass lowers light into the space and highlights the wooden trusses. The clerestory windows allow for low-angled sunlight to enter during the morning and evening.
THE TOWER

OPPOSITE PAGE  Watercolor of lookout tower
LEFT  Axonometric of interior stairs
BELOW  Schematic design of the tower
FOLLOWING PAGES  Tower model photos
TRUSS DESIGN DEVELOPMENT

ABOVE: Plan and section of preliminary boathouse
TOP RIGHT: Section perspective of boathouse with wooden trusses
RIGHT: Section perspective of boathouse with steel trusses
PREVIOUS PAGES: Conceptual perspective of a barrel vault structure
TOP OPPOSITE PAGE  Sketch of boathouse with a traditional lighthouse
FAR LEFT  Garage boathouse sketch
ABOVE  Open-air boat storage
LEFT  Sketch of dock pavilions
ABOVE  Early yacht club plan and elevation

RIGHT  Early site plan sketches
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