

## Negotiating Balance Penn Greene

This Integrative Project is the design and construction of a small versatile kayak. It is intended for a user wanting to travel as light as possible for long periods of time. It is a negotiation of two highly dynamic elements – the human body and moving water. A kayak suspends a person on the surface of the water, balanced at the juncture of sea and sky.

The design of this boat is highly influenced by sailboat lines. Sailboat hulls possess an elegance and simplicity that begs to glide through water. The prow is strong, and cuts the water. Sweeping curves define the crisp shape, sweeping back to a transom that minimizes drag of the exiting water. A well -designed hull offers little resistance as it gracefully slices through the water. Sea kayaks, however, have a very springy form. The bow and stern typically have upsweeping points, which facilitate maneuverability in surf and rough water. They're playful. The initial concept was to integrate the elegant lines of a sailboat with the playfulness of a kayak: to maintain the paddling character of a sea kayak, while borrowing the directional qualities inherent in the form of a sailboat.

Much of my research focused on the elements involved in hull design. I needed to define the properties I wanted instilled in this kayak, and then incorporate these elements into my design. The most basic relationship between various properties of a hull lies between the length and width. Longer boats don't need to be as wide to support a weight, and therefore tend to be faster, yet less nimble. Too, the hull shape influences the stability of the boat. A boat flatter on the bottom will be more stable while upright, but when leaned during a stroke or turn, will become suddenly tippy. This would be a boat with high initial stability, but low secondary stability. A boat possessing a 'V' shape would have low initial stability but, when leaned, would become more stable. This helps in turning. The rocker of the boat must also be considered. This is the curve extending from the bow (front) to stern (back). When a boat with a lot of rocker is leaned, the waterline shortens, and the boat feels shorter, making it more responsive and easier to turn.

My design process has been facilitated by a number of different sketching methods. I have done many studies in line on paper, which was then translated into forms in the 3d modeling software, Rhino. On paper, I discovered I would obsess on a curve that extends through space, but I could only see the curve from one direction. On the computer, I was able to see the curves well, but the progression of the planes formed by the curves was very difficult to conceptualize. A kayak is a deceptively simple form dictated by five or six lines. The flow of these lines is therefore crucial, and each must be perfect. I made molds of these models, and covered them in a plastic, which allowed me to view how the planes between the lines progressed. This was a slow process. Only after creating an 18-inch model could I see that something was wrong with a curve. In an effort to see how the lines

interact with each other to form the planes, I moved beyond the computer, and created a nine foot long (approximately half-scale) adaptable model of a kayak . What is useful about this tool is that it is completely adjustable. It is built upon a central beam. Along this beam are adjustable cross sections of the boat. Along these are flexible rods running the length of the model. These represent the lines that I struggled with on paper and again in Rhino. Using this hull tool, I was able to create different hull iterations in a minute or so. These lines are connected to form a plane with a stretchy Lycra-like material. It allowed me to see the relationship between the planes, and to balance the sides, bottom and top of the boat.

The kayak itself is constructed of thin strips of cedar, and is sheathed in fiberglass. Cedar conforms well to a template and the strips, once joined and glued together to form something very light and very strong. Kayaks, while necessarily light and sturdy, should not be completely rigid; they need to flex, as wood does in nature. While providing support for the tree, the trunk and branches sway with the wind. By using a bead and cove method, the strips interlock and conform to the curves of the boat hull. When the boat hull and deck are completely, and separately, formed by the cedar, the deck (top) and hull are popped from the jig, sanded smooth, and covered, inside and out, with fiberglass, and are saturated with epoxy resin. This makes the boat watertight, lends abrasion-resistance, and provides strength.



Figure 1

A driving concept in the design has been the quote, “You don't sit in [a kayak]. You wear it” (Schade, 143). To enhance the sense of connection between the paddler and the boat, I highlighted sections of the craft with different shades of cedar. Most of the deck is western red cedar, which has a rich red-brown color. On those portions of the deck above the paddler's legs, I laid strips of blond cedar (Figure 2).



Figure 2

Inuit kayaks derive their dimensions directly from the paddler. The length of the boat is three wingspans, and it's width is that of the paddler's hips, plus a fist on either side. Most of the effort involved in paddling is transferred into the boat from the seat, so a proper fit is essential. I borrowed from the Inuit mind-set and took curves straight from my body to define the shape of the seat. (Figure 3)



Figure 3

Small boats have the ability to discuss balance through their form. I have grown up building boats, and I obsess over each detail of a craft that is my own design.

This kayak is new exploration of something I have been experimenting with for nearly two decades. I have been constructing wooden boats since I started my first plywood rowboat with my dad, and I have had a love of boatbuilding since. Building boats satisfies my loves of woodworking and being outdoors. For me, small, handmade boats are one of the most intimate ways to connect with aquatic ecosystems. A boat puts a person at the crossroads between water and air, coast and

sea. This has been an exploration in both design and craft. It has impacted me on a personal and intellectual level – I have wanted to design my own boat for years, and have wanted to experience the process in its entirety. I have discussed balance through the form of this project and the resulting realization reflects this on the water. I will continue to tease from nature the elusive, perfect craft, whose nimble form lightly suspends me at the juncture of sea and sky.



The little boat in the water for the first time.

## Works Cited

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Teale, John. *How to Design a Boat*. 3rd. Dobbs Ferry, NY: Sheridan House, 2003. Print.