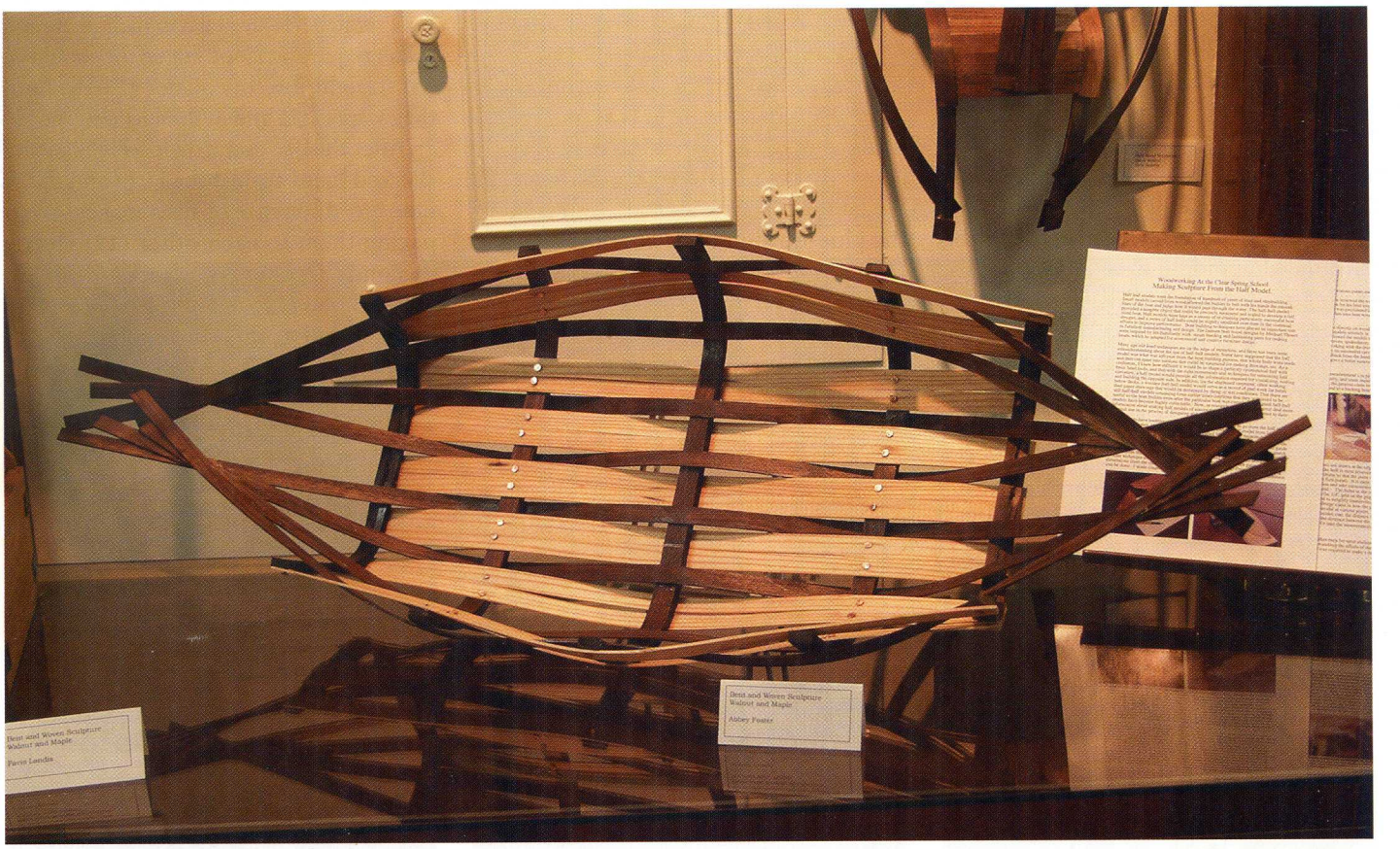
Making Sculpture From the Half Model

New uses for a forgotten technique

TEXT AND PHOTOS BY DOUG STOWE



Half-hull models were the foundation of hundreds of years of boat and shipbuilding. Small models carved from wood allowed the builder to feel with his hands the smooth lines of the boat and judge how it would pass through the water. The half-hull model provided a tangible object that could be precisely measured and scaled to develop a full-sized boat. Half models were kept as a means of re-creating particularly successful boat designs, and a series of half hulls could be slightly modified over time in the continual efforts to improve performance.

We know that many age-old hand techniques are verging on extinction; with modern dependence on the computer, knowledge about traditional design techniques are being lost as well. There may be some misunderstanding about the use of half-hull models. Some have suggested that in boatbuilding, whole model hulls were made, cut in half, and one of those halves was then cut into sections that could be measured for making drawings, etc. According to this theory, half-hull models were interestinng leftovers from the design process. As a craftsman, I know how difficult it would be to shape a perfectly symmetrical hull with basic hand tools, and that with the right instruments and techniques for measuring hull curvature, a half model would provide all the information required for visualizing, scaling and building the whole thing. In addition, for the shipboard carpenter, often working below decks, a wooden half-hull model would serve as a record of past work far better than paper drawings that would be destroyed by damp or wet conditions. That there are still half-hull models remaining from earlier times confirms that they continued to be useful to the boatbuilder even after the particular boat was completed. Half-hull models have become highly collectable, and you will find a great deal of information about making half models of successful boat designs, but oddly, there's little information about their original use in the process of designing and making boats.

I became interested in half-hull models through a lifelong interest in boats. I had considered making boats with my students at Clear Spring High School, but realized that we didn't have enough room or time for each student to make his own. In making a single boat as a class project, a few students would end up doing most of the work, and I was concerned that to be successful, we would have to work from preexisting plans and miss out on the oppor-

1. Use a drawknife to begin shaping the half model.

2. A rasp is useful for finishing the shape.

3. A half model can also be made from layers of stock held together by dowels. Drill completely through the layers, add the dowels, and then shape the half model.

4,5. Trace each layer or "lift" onto graph paper to develop the section drawings.

6. A template cut from paper or carved from thin wood can be used to measure the curvature at various points. Trace the template on graph paper to help when scaling larger sections.

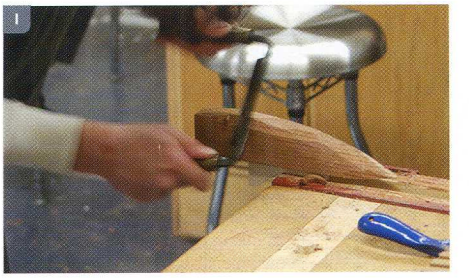
7. A commercially-made surface gauge is a common tool for measuring complex shapes.

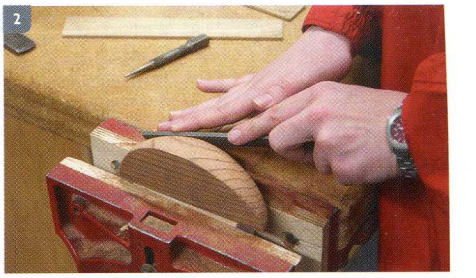
8. To begin our shop-built surface gauges, I drilled 1/8" diameter holes, spaced at 1/4" increments, in walnut stock.

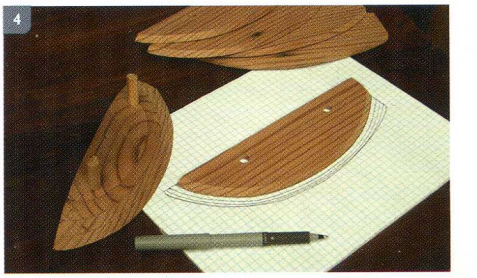
9. 1/8" brass welding stock requires some sanding to slide smoothly in the 1/8" hole. A better choice would be either a #30 or a 3.3mm bit for the holes.

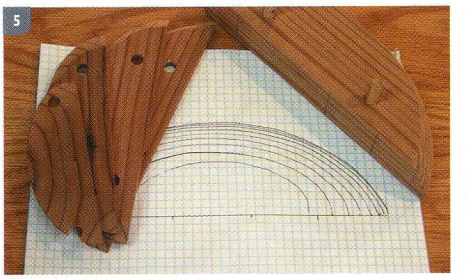
10. A half lap joint allows the parts of the gauge to fit together with a single screw.

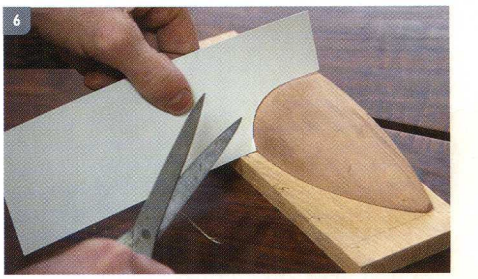
11. Sharpen the ends of the brass rods and put a slight bend in the end. I used a hole drilled in sugar maple to provide leverage for bending.

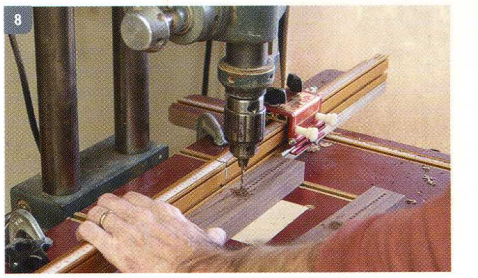


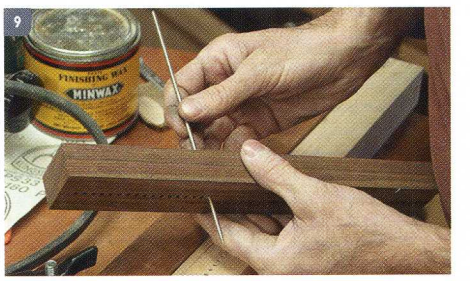


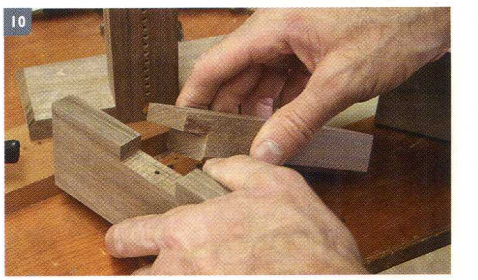


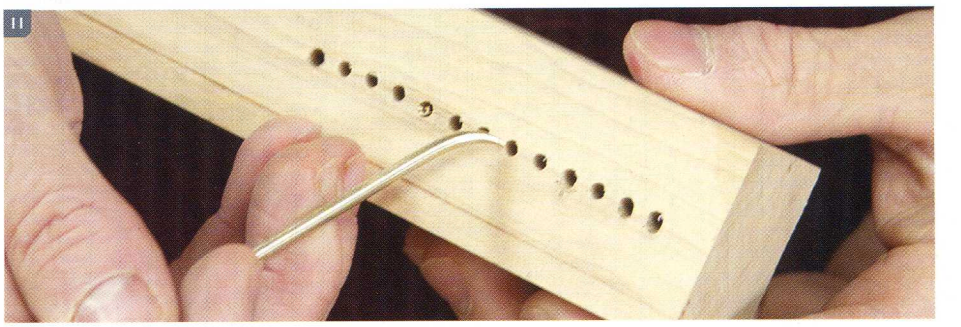






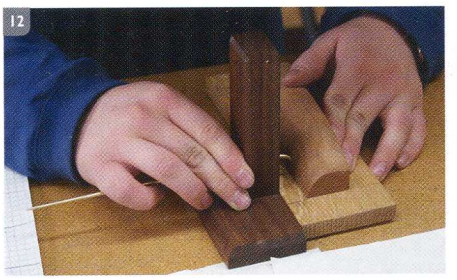


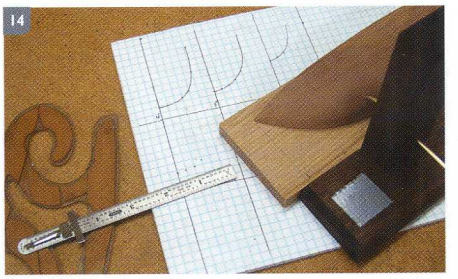


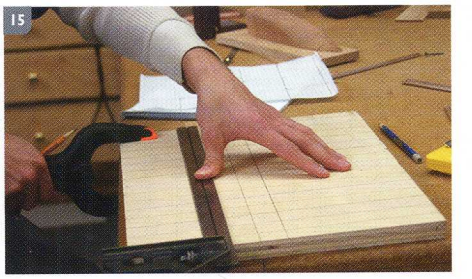


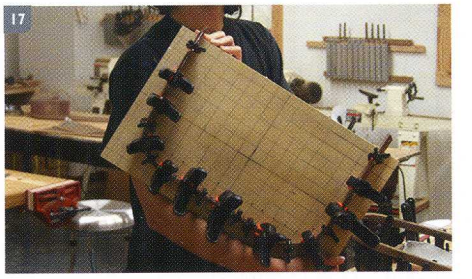
tunity to develop designs of our own. The process of developing original designs would require each student to become acquainted with basic tools for shaping wood, then be responsible for accurate measuring and for putting those measurements into drawings that would allow for the full sculptural form to be created. I have also received feedback from my students that one of the things they particularly like about woodshop is seeing their own ideas brought into physical form.

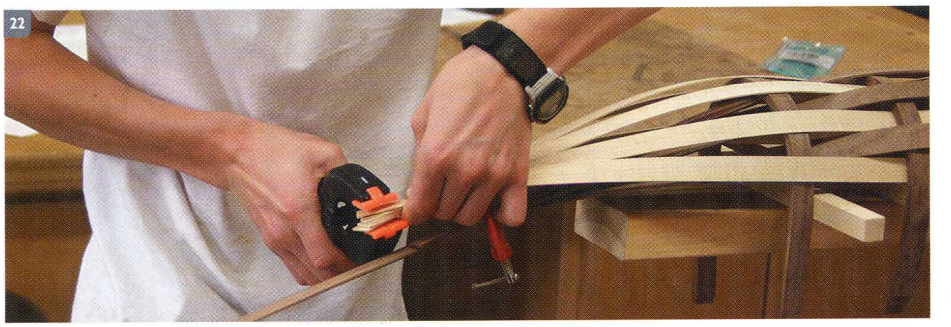
Boatbuilders have traditionally used three different techniques to go from the half model to the finished plan. One common technique was to build the half model from layers of wood connected with dowels. The layers, called lifts, could be separated and traced to develop scaled drawings from which the full-sized boat could be "lofted." Lofting is the term applied to laying out the full-sized patterns that ship











12. To use the surface gauge, align the center mark on the gauge with the section line on the model and push the pin forward until it touches the model. Then withdraw the surface gauge and measure the distance the pin protrudes from the body of the gauge.

13. Developing the section drawings requires intense measuring and drawing.

14. Use the surface gauge or other techniques to develop section drawings of various parts of the hull design.

15. Mark a grid on plywood, scaled up from the 1/4" grid on the graph paper.

16. Hammer nails in place at various points of the grid to form the full-scaled sections.

17. After spreading glue between layers, bend and clamp the strips into place on the jig. We used slower-acting white glue and allowed the bent ribs to dry overnight.

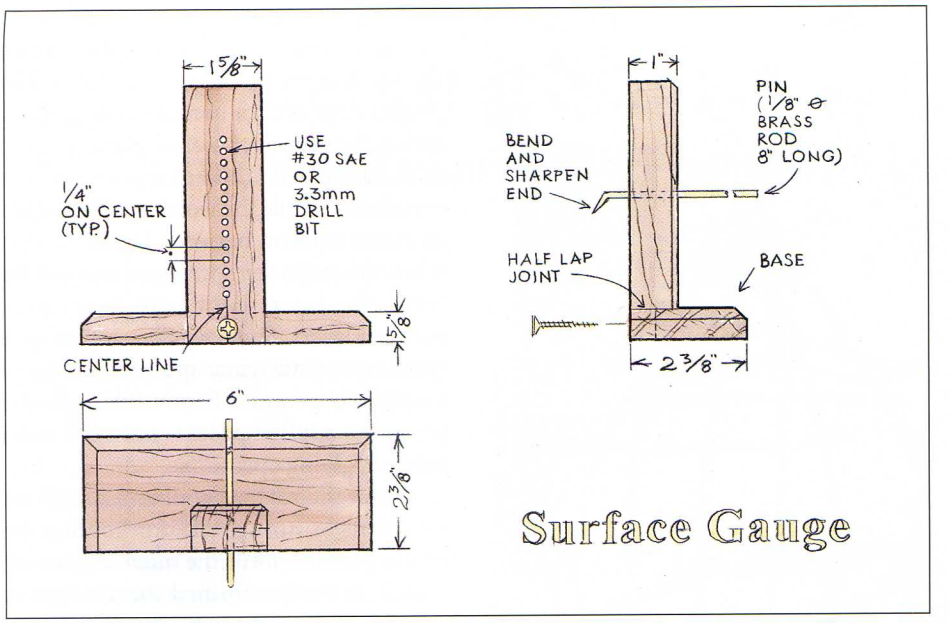
18, 19. Glue the sections on a "strongback." The spacing between sections was derived from measuring the space between sections on the model.

20, 21. Some of the students chose to weave strips between the ribs, giving their sculptural forms basket-like qualities.

22. Bringing the shapes to completion brought challenges and problem solving opportunities and experience.

carpenters use to guide the cutting and shaping of parts. A second technique involved shaping templates to match the various section points along the half hull. These can be cut from paper or cardboard or whittled from thin stock and then traced and scaled to loft the hull design. Still another technique utilizes a common machinist's tool called a surface gauge to transfer dimensions from the shape of the half model to scaled drawings from which the lofting can be done.

In preparation for this project, I made simple surface gauges based on the 1/4" x 1/4" squares on common graph paper to simplify the task of laying out the various points used for lofting the ribs. Captain Nathaniel Herreshoff, one of the foremost designers of yachts in the 19th and early 20th centuries, designed a very similar but

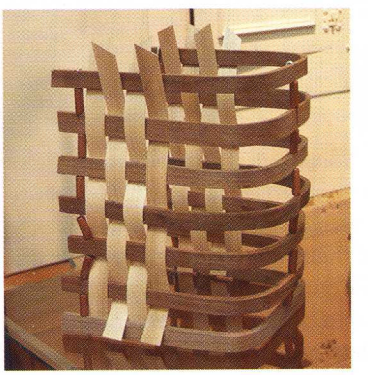


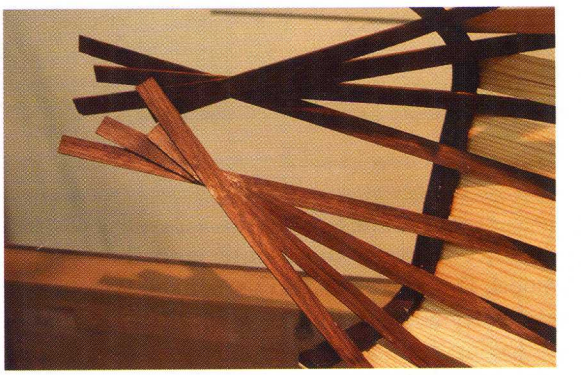
high-precision surface gauge, and had a special bed plate made by Brown & Sharpe for efficiently developing tables of offsets from the half hull. While few naval designers currently use half models, L. Francis Herreshoff, who wrote *Capt. Nat Herreshoff, the Wizard of Bristol*, estimated that his father, who regularly used half models, was far more prolific that other yacht designers in large part because working directly from models required only two-thirds the time needed to design on paper alone. As stated by L. Francis Herreshoff, "a combination of manual and mental work often proceeds faster than either one or the other practiced separately." Remarkably, "Capt. Nat" began designing boats at age 12 by shaping and working with half models; he started with simple line drawings on paper and then went directly to work on wood to develop the design.

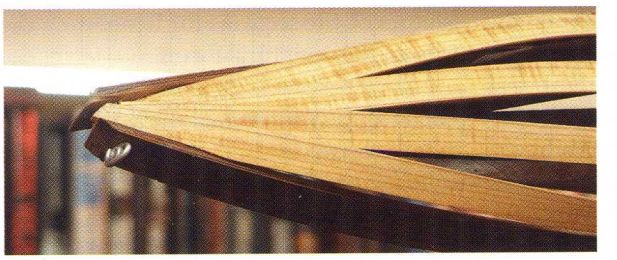
Our project at Clear Spring School was not intended to exactly duplicate and preserve all the intricacies of naval design, but to simply explore the use of half models as a design tool for making sculptural forms. We first drew very simple sketches on paper, then directly on wood. We used the bandsaw to rough out the shape. In order to hold the models securely in the vise, we screwed hardwood blocks to the backs. The blocks allowed the models to be turned and mounted at various angles so that the drawknives, spokeshaves and rasps could have adequate access to the surface being worked. Making the models was a good opportunity to use direct feedback from the hands as a part of the designing process: working with the drawknives in particular gave quick understanding to the impact of the grain direction on successful carving. Developing this sensitivity of the fingers gave a better understanding of the intricacies of shape than simply looking at designs every could.

Next came the most challenging part, taking the measurements to plot the shape on graph paper. Some of the students got this part quite easily, and some required additional coaching, but after watching other students do it, the process came easily for most. To use the homemade surface gauge, the model is attached to a base that provides a frame of reference for measuring, and section lines are drawn at the edge of the backing board at the various points where the curvature of the hull is most pronounced. We taped shims to the underside of the backing boards to bring their top surfaces level to the pointer's position in the bottom hole. The holes in the surface gauge are drilled 1/4" on center to exactly correspond with the 1/4" grid on the graph paper. This was done to simplify the measuring, and it also worked to simplify the process when transferring the measurements from graph paper to a larger grid.

To use the surface gauge, align it with a section line marked on the base. While holding the gauge against the base, slide the brass rod in until it touches the half model. Then pull the surface gauge away and measure how far the brass rod protrudes from the gauge. To take the measurements, we used steel rulers scaled in 1/64". By taking a measurement at each 1/4" increment on the gauge, the shape is gradually plotted on 1/4"-grid graph paper. Where the pointer passed freely over the sides of the model, two measurements were required. The first measurement is taken with the surface gauge tightly up against the model's base. Measure the space between the tip of the brass rod and the top edge of the model. Then measure the amount of protrusion of the brass rod as done before. In placing the measurement on the graph paper, measure down from the grid position the amount of







Details from the finished projects, which were all part of an exhibition of the work at the Carnegie Public Library in Eureka Springs, Arkansas.

Moving beyond the boat shape

TO INSPIRE THE STUDENTS' CREATIVITY, we reviewed the work of Michael Thonet, who used boatbuilding techniques as a foundation for his bentwood furniture, and the current work of Martin Puryear, the American sculptor, who often uses bent wood in the creation of his sculptural forms. I'm sure my students grew tired of me reminding them that we were making sculpture and that the results I hoped for could be something other than a boat. There are students who make a teacher's work particularly rewarding. One senior, diverging from the course followed by the other students, chose to convert the measurements taken from her half model into measurements of length and circumference to create a 360° sculptural design. To form the ends of the teardrop shape, she constructed multisided pyramids held together with copper wire. The angles of the sections were derived mathematically. She glued and wired walnut hoops to take the place of the ribs used by other students, and these hoops were allowed to remain loose both inside and outside the finished form. Longitudinal strips whose lengths were derived from measuring the half model were glued to the pyramidal forms. A rope held these forms in relation to each other and also served to suspend them from the ceiling.

distance between the pointer and the model. This whole process was repeated for each section line.

Laying out the points at a larger scale was difficult for some students, but they gained confidence from watching the efforts of the more rapid learners. To make the full-size form, each student was required to make a decision about the finished size, then divide that length by the length of his or her half model, and then lay out the grid size proportionately larger. For example, to create a sculpture 4 times the length of their model, the appropriate grid size was 1" square. By observing the position of the plotted points and placing points in the same positions in the larger grid, the students were able to lay out the shapes of the sections for laminating the ribs of the sculptural forms.

The degree of curvature of the shape dictated the thickness of the stock and the choice of wood used for laminating the ribs. We used 4d nails driven into 3/4" plywood as a bending jig. White glue was chosen for its longer working time and reduced cold creep, and seven layers were enough so that there was negligible spring-back when the ribs were released from the form. The project required an incredible number of spring clamps, which we bought very cheap at Walmart. We found that putting some pressure on while the wood was flat helped to create suction between layers, so that when the strips were wrapped around the form, the layers bent with fewer gaps between layers. Some squeeze-out of glue was a sign of adequate application, and to keep the bent wood from sticking to the forms we applied paste wax to the form between gluing operations.

When the ribs were all laminated, we used 2x4s as strongbacks for holding the ribs in position while the outer strips were attached. We determined the amount of space between the ribs by measuring between the sections on the half models and multiplying the distance by the same factor used to scale the sections. Crosspieces were nailed to the strongbacks at these intervals, and the ribs were glued temporarily in place while the long strips were attached or woven in place.

The students were encouraged to use a variety of techniques for attaching the strips, and also to use their imaginations to resolve the problems that arose during construction. One of the big challenges was very similar to the challenge faced by boatbuilders…how to bring pieces securely to a point. With our sculpture, some students chose to turn stock on the lathe, while others went back to shaping wood with drawknives, and still others chose even more imaginative approaches.

Making sculptural objects from the half model was a demanding project, best suited to students with some math and drawing skills, and patience for a challenge that can take several weeks of class time to complete. As a teacher, it was exciting to observe creative minds in action, to see the range of creative solutions to common design problems, and to take some time in preserving design techniques from the past that are being lost in our computer-driven age.

We exhibited our sculpture at our Carnegie Public Library during the May Fine Arts Festival in Eureka Springs, Arkansas.

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