Building a Springer – By Allan Wing

I belong to the Northwest R/C Ship Modelers (NWRCSM) boat club. This club is located in Puget Sound area of Washington State and is currently celebrating its 25th anniversary, with nearly 100 members. The club is dedicated to all types of model R/C boats with many tugboats and a few sailboats. Virtually all the boats are electric powered, with a few steamers. Gas motors are expressly prohibited from club events.

The original Springer was designed in 1998 by Dave & John Springer. John, a NWRCSM club member, designed the boat after a workboat he originally saw in Alaska. The hull lines were simple and he took a very straightforward approach to building his first boat. It soon became popular and many members started to plan for their own "Springer". To develop a "club boat" some basic rules were set so the various models would perform similarly on the water. No limitations or guidelines were placed on the appearance of the boat above the waterline. This model soon become very popular and many club members have at least one "Springer". The concept also traveled south to the San Francisco Club as they expanded on the performance related restrictions and insist that the boat look like a real boat. No hot tubs or outhouses are allowed in their rules. This club also developed a polo version of the Springer and started to have rough and tumble Polo matches. The Puget Sound group has since picked up on this theme as well.

The club has two special Springer events each year where competition is open only to these Springer boats. These are small workboats that are relatively easy and inexpensive to build. I have been a member of the club for two years and when it was decided to build Springers that would also play water polo I decided to get into the act and finally build a Springer.
I had built a sailboat from a kit and models of the tugboats Henry Foss and Tidewater from scratch so I felt that a Springer would be no real challenge. In the following paragraphs I will describe how I built my Springer and the decisions and challenges I faced. It is truly inexpensive and reasonably easy to build but there are some interesting considerations that I had not expected.

The Basic Springer specifications are very simple. The basic boat is to be 18 inches long and 8 inches wide with a flat bottom.
The other specifications are:

A 6-volt battery shall power the motor
The propeller shall be 3 bladed and no larger than 40mm in diameter.
The rudder shall be a maximum area of 4 square inches

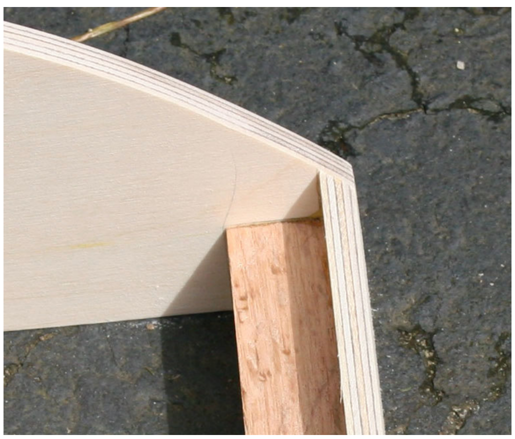
The complete requirements are available on the club WEB site (www.shipmodelers.com)
The cabin and other features on deck will be left to the discretion of the builder.

Hull – Hull profile to conform to original Springer profile. Beam is 8 inches" +- .062, Length 18 inches +- .125"
Rudder – 4 in^2 maximum. Single piece construction (salmon tail allowed).
Drive – Single shaft, direct or reduced drive open propeller. (No Kort nozzles or Z drives)
Propeller – 3 blades, maximum diameter of 40 mm
Motor Type – Builders option
Motor Battery – 6 volts maximum
Gearing – Builders Option

For the water polo version Springer the following specifications were added:

Rudder Shoe - All boats must be equipped with a rudder shoe that extends from the skeg or hull bottom to the rudder shaft. The shoe must be 1/16 inch or less from the rudder in order to prevent the rudder or propeller from snagging a ¼ inch rope used for course boundaries.
Flag Holder – 1 inch 3/32 inch brass tube centered on stern approx. ¼ inch from edge.
Push Knees – ¾ inch wide, minimum 2 ½ inches in height measured from deck, mounted on 7-inch centers.
Door stops – Removable spring type mounted on each knee at or below deck level
Weight – 8 ½ lbs. minimum.

With these specifications in hand I set about to build my Springer. The first consideration was selection of the wood for the hull. With concern for both strength and weight I choose ¼ inch aircraft plywood for the sides and the ends. The other consideration was ½ inch plywood but that would have added close to 12 oz to the finished weight. My goal was to try and get close to the 8-½ lbs. minimum weight for more speed to get to the ball first. I added a ¾ by ¾ inch piece along the top of the sides to add strength, aid assembly and provide a solid point to attach towing bits. I cut the sides to the required profile and then cut the ends at 7 ½ inches to keep the finished boat at 8 inches. I cut the bottom of each end piece at 7 degrees for the stern and 15 degrees for the bow to provide a good fit for the bottom:



I then attached the ¾ inch square material to the top of both the bow and stern pieces, This would allow for a good square edge for attaching the sides. I attached the sides with glue and clamped the sides along with a two brads in the ¾ inch square material. I placed the hull pieces topside down on a flat surface and checked alignment with a T-square. This gave me a hull that was perfectly square.

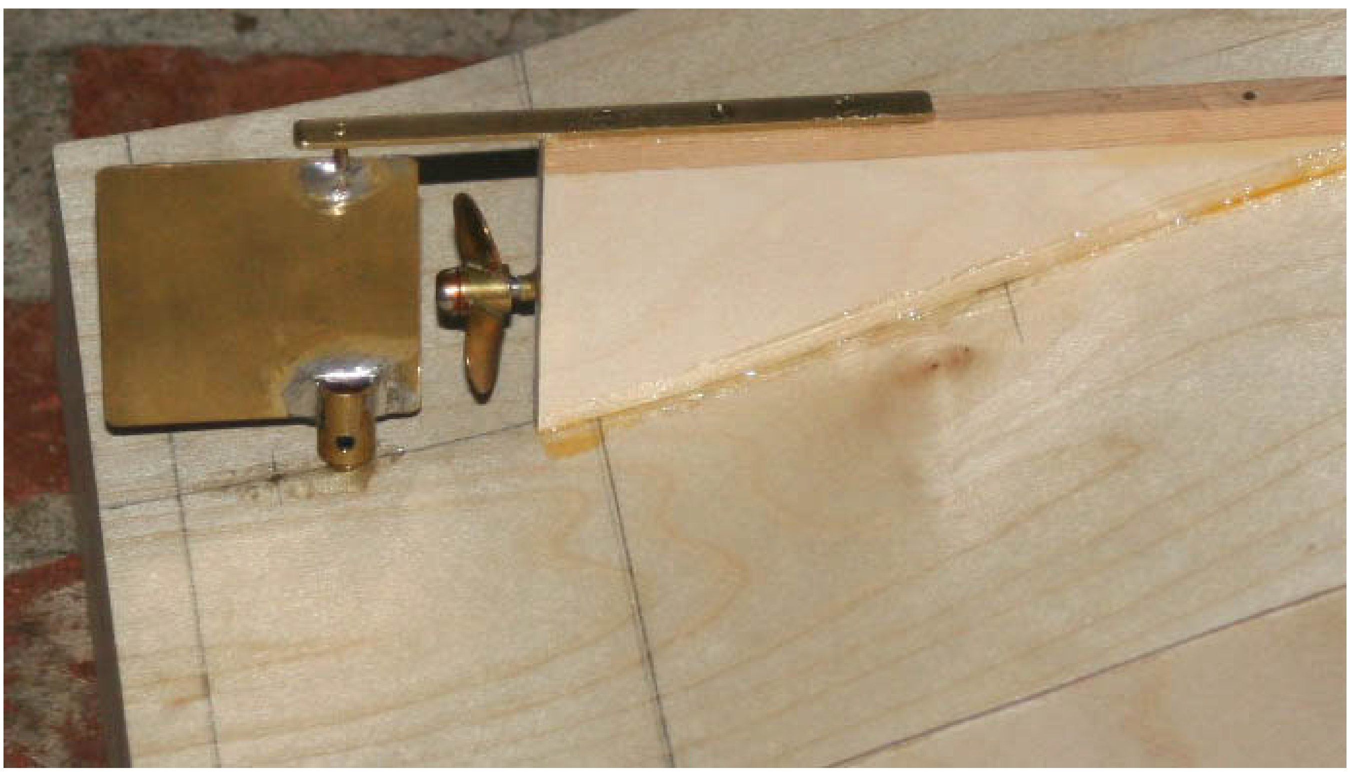
For the bottom I chose 1/16-inch plywood, again trading strength and weight. Many of the club boats have door skin for the bottom, door skin does not provide as much strength as 1/16" plywood but is much easier to form to the bottom. I found out from other club members that choosing thicker plywood proved more difficult to form to the bottom to the profile. I cut the plywood slightly oversized (1/4 inch in width and ½ inch in length) to allow for any alignment errors. In forming the plywood to the bottom I found it tended to bend in both directions not just to the curve of the bottom. I attached ½-inch square pieces of pine across the bottom. Two about ½ inch in from each end, two about equal spacing on each side of the deepest point of the bottom and one 2 inches from the stern. This made forming the plywood to the bottom much easier. I found that even with 1/16-inch plywood it was still very stiff and I was forced to attach the bottom in two steps and use every clamp I could find. Soaking or steaming the plywood first would probably make this step even easier.

As soon the glue set on the bottom I put some scraps of fiberglass and resin along the inside seam to reinforce the joint. The sides have very little surface area for the glue to hold and I felt that that joint needed reinforcement before any other work could be done on the boat.

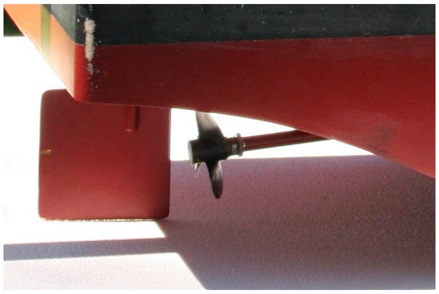
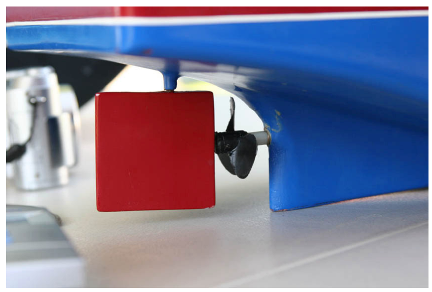
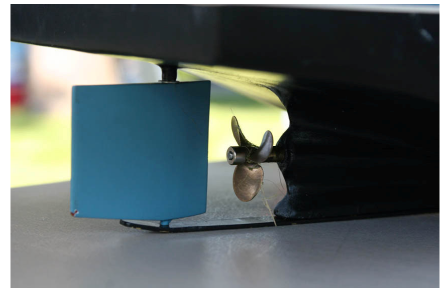
The next step was to determine where to position the rudder, skeg and propeller shaft. There are no guidelines in the specifications. I decided to pick the size and shape of the rudder first. The specification is for a maximum of 4 in^2. I chose a 2-inch by 2-inch rudder as a starting point. The choices here were to go with something 1 ½ inch high by about 2 ½ inch wide or go with something greater height than width. With a 1-½ inch prop the rudder should be at least 1-½ inches high to catch prop wash, larger would be better because the prop wash fans out as you move away from the prop. I decided that the rudder should be a minimum of 2 inches high. The next question should it be more than 2 inches high. In sailboats a rudder that long and narrow top to bottom will create more lift and hence more turning power. In a powerboat the advantages are much less. Also with just over two inches from the bottom near the stern and the deepest part of the bottom I decided to stay with a 2-inch by 2-inch rudder. Next I choose how and where to mount the rudder with respect to the rudderpost. I choose a shaft mount with a slot to hold the rudder. The rudder material I chose was a 2-inch piece of brass I found at the hobby shop.

This mounting holds the brass well and is easy to remove or adjust the angle with the servo. The real question was where to locate the rudderpost. Should it be at the front edge of the rudder, the middle or somewhere in-between. I read some articles on balanced rudders. A balanced rudder is one where the post is not located at the front edge. A balanced rudder provides quicker turning and requires less force to turn the rudder. In a powerboat it also presents a greater rudder area to the prop wash thus exerting more turning force. In talking to some of the club members the most common position was to have 1/3 of the rudder area in front of the post. The Internet articles I read were almost exclusively for sailboats and said that there should be 18 to 22% of the area ahead of the rudderpost. So I went from my original idea of having the post right in the middle to mounting the rudder post ½ inch back from the leading edge, this gives about 25% of the rudder area ahead of the rudderpost. The Springers in the club appear to handle very well with 25% to 30% of the rudder area ahead of the post. The trailing edge of the rudder is not supposed to extend beyond the stern so I positioned the rudderpost on the centerline 1 5/8 inch from of the stern.

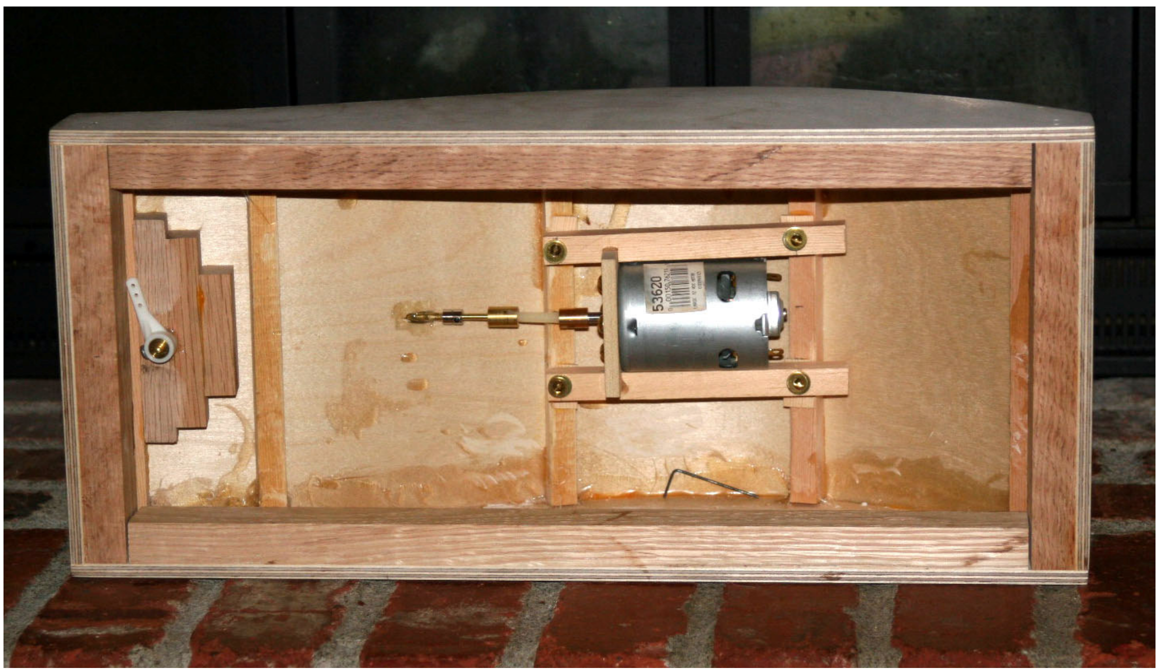
Next I determined where to put the trailing edge of the skeg. I positioned it ¾ inch ahead of the forward edge of the rudder or 2-7/8 inch from the stern. Finally I had to choose the propeller shaft angle and vertical location. the San Francisco Club that has specifications for Springer boats for water polo suggests a 9-degree shaft angle. I choose to use a 0-degree shaft angle to hopefully reduce the amount of lift from the propeller at high speed. For many of the Springer boats the maximum speed is reached when the stern is lifted to the point where the bow is submerged. I used a CAD program to position the propeller shaft so that the motor I had chosen just touched the bottom of the boat. I learned later that putting the propeller as deep as possible will improve efficiency. Also since shaft angle does little to change the amount of lift and a dog bone coupler can handle several degrees of misalignment I would probably go with 5 to 9 degrees of shaft angle and move the propeller another ¼ inch lower. All that said I set up the propeller 3 ½ inches from the top edge of the hull at 0 degrees. It seems to work as well as the others in the club. I used one piece of ¼ inch plywood for the skeg. I cut the trailing edge square and with that edge set on my drill press table I carefully drilled the hole for the shaft log down the center. Drilling for the shaft log would be easier if the skeg was wider than ¼ inch. Some Springers have skegs up to ½ inch wide While some of the Springers that were not built to play water polo have no skeg at all.. Below is a picture of the finished rudder propeller and skeg setup.



The choice of rudder with or without a skeg is optional except for boats built to play water polo. The pictures below show three variations ranging from no skeg to a skeg and finally a skeg with a shoe under to propeller.

Next I mounted the motor. I fashioned a motor mount that attached to the stringers I had attached to the bottom to assist the bending during gluing. This mounting concept allows me to put in different motors. While I choose an inline arraignment others have used a belt drive that allows the motor to either be placed inline like shown here or with the motor mounted aft over the propeller shaft. Club members have used all three arrangements with good results.

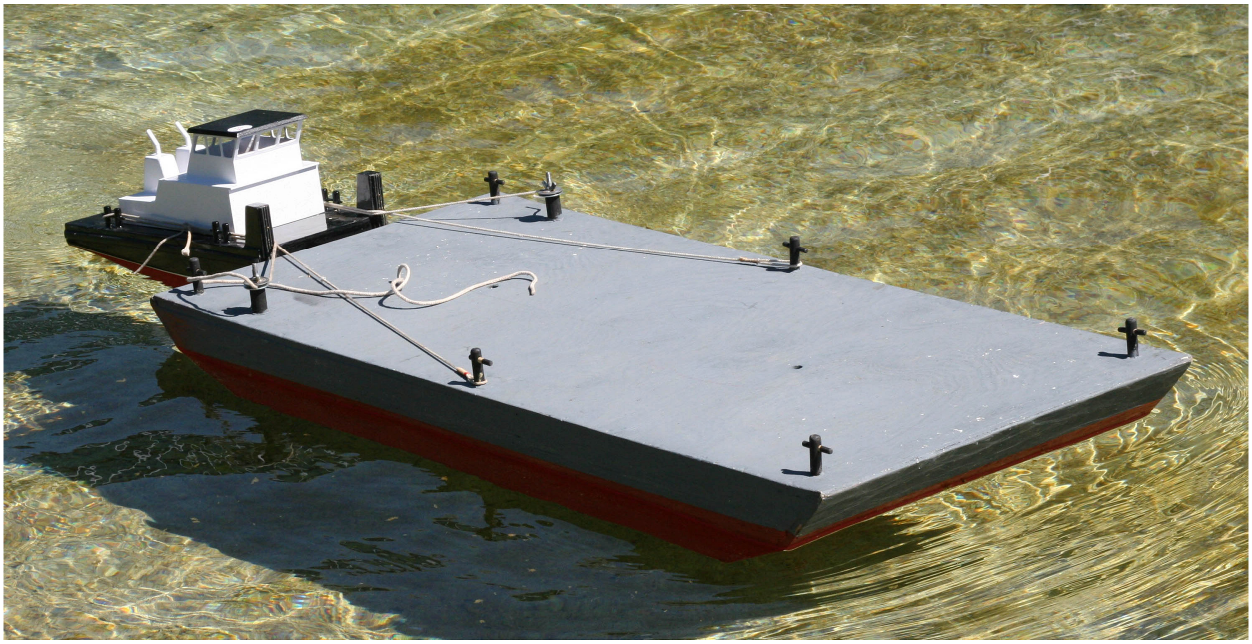


I next fashioned a platform on each side of the motor to mount the batteries. This allows me to mount a 3 ½ Ahr 6 volt battery on each side and move it forward and aft to ballast the boat.

The next step is the selection of a motor and propeller combination. There are several propellers available from Dumas, Octura and Robe. They are available in metric or English sizes. The rules restrict the size to 40 mm. I chose a Dumas 1-1/2 inch propeller with a 2-inch pitch. With this propeller I found that a propeller speed of 6000 to 6500-rpm provided enough power to drive the boat to hull speed or push a barge. Club members have found several combinations to provide these speeds. The motors of choice have been 500 or 600 series engines with either direct drive or some sort of reduction gearing. I recommend not using the high performance motors used for car racing, they draw far more current and often have altered timing for higher forward performance that reduces performance in reverse. The higher torque provided by these motors is not needed for a 1-1/2 inch propeller. When using direct drive use a flat propeller and expect to have a current draw of over 10 amps. For gear reduction use either a belt drive with the motor in line or with the motor mounted parallel and above the propeller shaft, either arraignment works well. The other option is to use one of the gear box combinations available. The available gearboxes range from boat gearboxes or a number of gearboxes used by airplanes. The recommended gear ratios are between 1.5 to 1 and 2.5 to 1. With gear reduction you can use a more aggressive propeller. With gear ratios of greater than 2.5 to 1 and the standard series 500 or 600 motors you will not get maximum propeller speeds of 6000 rpm or more. The gear ratios will affect current draw with a 2.5 to 1 ratio reducing the current at full throttle to less than 4 amps. I am using a Johnson 540 with a Master Airscrew gearbox with a 2.5 to 1 reduction. This provides a full throttle propeller speed of about 6000-rpm and a current draw of 3-3/4 amps. The latest update was to exchange the Dumas propeller for a Rivabo

534-41 40 mm prop. This propeller has greater blade area and more pitch than the Dumas. The boat is more competitive and with the gear reduction and less current draw than direct drive it stays competitive even after 30 minutes of hard running.

I next chose an opening size that would allow easy access to the motor and rudder. I put a 1-inch combing around the opening to keep the inside dry. These Springers often have much of the deck area awash so a high coming is a good idea. I finished off with a cabin that was not too high, added the pushing knees and put a bump strip around the entire boat. I also coated the inside and out with several layers of fiberglass resin to keep it waterproof. The finished boat weighs 9 pounds 11 ounces, a bit over the minimum.



The Springer provides the club with a class boat that provides rather uniform performance with a great deal of opportunity for creativity and options. The pictures below show some of the various boats and the options in deckhouses. The club even has one Springer that has an outhouse for the deckhouse.