

## Modeling Furled Square Sails

I had decided long ago that I would display sails on my HMS Endeavour model. When the time finally came to craft them, I had no idea that it would be as big a problem as it turned out to be. I had read and dismissed all the advice on this forum and others that it is impossible to make “scale” sails. At least at the scale of my model (1:60), that advice was completely correct. I discovered that there is no readily available cloth with a weave fine enough to represent sail cloth at such a small scale. And the smallest needle and thread that I could find for stitching the seams between the sail cloth panels scales out to be something like sewing small rope with a pointed piece of ½” steel rod.

Someone somewhere suggested that I fit the ship with furled sails. Since I intend to display the model as diorama of how the ship appeared within an hour or so after dropping anchor in Tahiti, furled sails would be more appropriate. And though this notion seemed to have the potential to succeed, I still had a lot of stuff to work out. Here is the method that I settled on. It’s mostly based on trial and error (many errors...) As far as I know, no one has written about a specific technique for modeling furled square sails.



I used this photo of the Freemantle replica of the Endeavour as a model for furled square sails. Note the sails hung furled under the yard, which is appropriate for this particular ship.

## Material

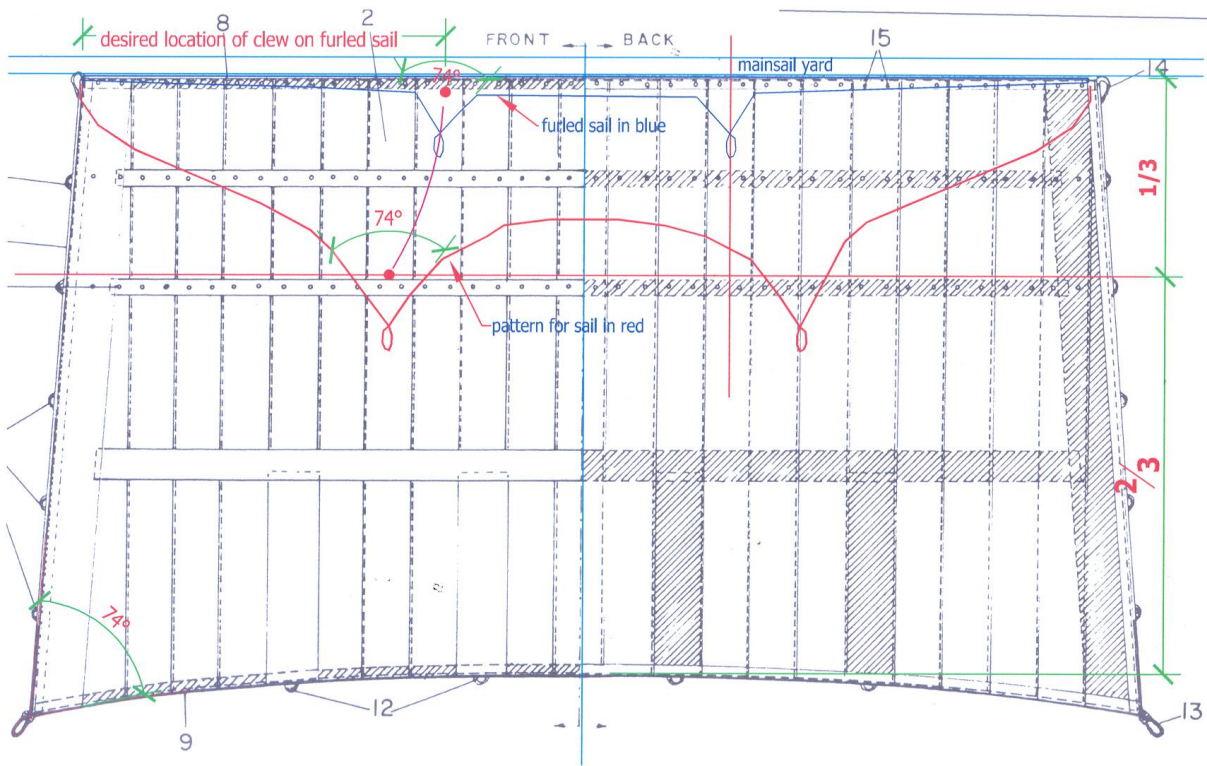
The thinnest cloth that I found for sails was fine cotton linen handkerchiefs. Even this scaled out to be a little more than 1/4" thickness. I tried washing out the sizing in drafting linen, hoping that this fabric would be thin enough to be realistic. But, getting the thermally set sizing out is no easy task. And the weave is still too coarse at 1/60 scale. It turns out that a single ply of Kleenex tissue comes very close to representing canvas at 1/60 scale, but I tried sewing it with the smallest needle I could find and the results were a disaster; the holes left by the needle would not close around the thread, and the tissue tore easily.

I settled on the linen handkerchiefs. I washed them to remove the starch and then soaked them in tea so they weren't such a bright white. I learned that I had to rinse them well several times. When dry, I ironed them using plenty of spray starch. They were almost as stiff as card stock. I was able to trace the pattern that I had drawn onto this starched fabric lightly with a pencil, and cut it with scissors. The heavy coat of spray starch kept the fabric from unraveling along the edges.

## Pattern

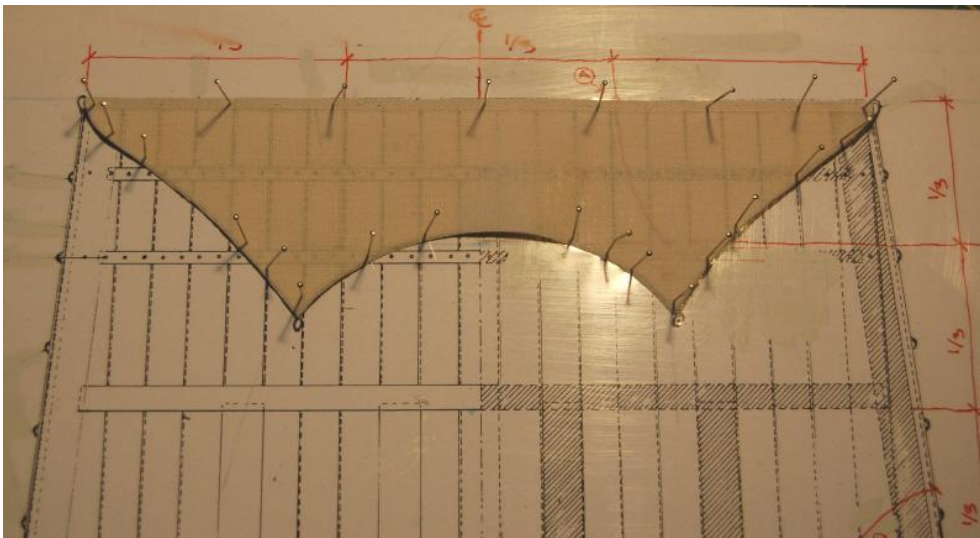
The pattern was drawn based on the assumption that in scale, the cloth was about three to five times thicker than the real sail. (I put a question out on the forum asking about the thickness of sail cloth, but got no responses.) Anyway, I couldn't use the whole sail as a pattern; the fabric was just too thick. From the photos of the Endeavor replica with furled sails, I got an idea of what the volume of furled canvas should look like. Pretty much, a furled sail isn't bigger than the yard. And the way that the clew corners are drawn up to the yard makes the furled bundle of canvas at the yard ends very thin. I made a photo copy from the AOS book on the Endeavor of the sails at 1:60. I drew a pattern which would only be about 1/3 the length of the full sail.

Like the photos, the sail clews would be hanging out with the clew-line blocks attached. In furling the sails, the clews on the sails are drawn up close to the clew garnets on the yards. So, I made the pattern such that the sail clews ended up in the right place in the furled sail by drawing an arc swung from just above the ear-ring at the clew to the place where the clew of the furled sail would be drawn on the yard. The angle of the canvas corner at the clew was drawn in the pattern the same as it is in the fully unfurled sail. At this point, "connecting the dots" with smooth curves defined the pattern. Here's how I drew up the pattern. The blue line shows the furled sail. The red line is the pattern that I cut to. The arc shows where to position the clew in the pattern to have it arrive in the right place when the sail is furled.



Main Course sail

Using spray mount adhesive (3M Super 77), I glued the above pattern to a piece of 1/8" foam core. I spray-mounted a piece of stiff .005 (approx) inch clear plastic film over this. The plastic was thin enough to push a thin pin into, to hold down the cut piece of linen. The Elmer's glue I used to hold the bolt rope in place during the sewing doesn't stick to the plastic.



Linen pinned to the plastic covered drawing on the foam core. Holes made by the pins close up during the last step where excess glue and spray starch are "washed" out of the sail.

## Construction

Note that the particular linen handkerchiefs that I found had extra bands of stitching to give it a decorative border.



Men's cotton linen handkerchief with decorative border

I used this extra border at the head of each sail. I figured that the threads lashing the sail to the yard would have a better chance of not pulling out of the fabric along this edge. As it turned out, the side bolt rope stitching which was not sewn to this thicker border actually held very well. These furled sails would show none of the details of the sails such as the panel stitching, reef bands or reinforced corners, with the exception of the canvas reinforcement at the head, represented by this extra band of weave. So, if a person is looking for it, he/she will find this reinforcement of the sail represented on the model.

Using a small paint brush, I put several thin coats (diluted about 50/50 with water to a milk-like consistency) of white glue (Elmer's Glue) all along all edges. I didn't want it to build up so thick that I could not push a needle through it. But I needed it to penetrate the fabric so that the weave didn't unravel. Also, it would be a sort of "primer" base to glue the bolt ropes to.

For the bolt rope I used three cotton threads twisted into a single strand with my Model Shipways ropewalk. As it is, it is probably too large a diameter for a bolt rope, but I couldn't find any reference to correct sizes for this rope. Visually, I think that the overall effect appears too thick. Maybe someone can find a source for smaller needles and thread to sew the rope to the pattern. It could be that needles used by plastic surgeons are smaller than the #10 quilting needles and the 50 wt. thread that I used, but I couldn't find anything smaller either locally or on line.

Using more diluted Elmer's glue, I glued the bolt rope to the previously "primed" edges. At the head I ran the top bolt rope past the corners for a short distance and then back to the sides of the sail to make the ear rings at the head. I fit the boltropes with clew loops as separate pieces.

This whole thing was tedious enough without trying to make the clew loops on a single continuous piece of thread.



Ear ring loops at the clews



Clews glued to the pattern. Outside edge aligns with outside edge of pattern.

Gluing these pieces of rope to the sail pattern is pretty easy. I positioned them so that the outside face of the rope aligns with the outside edge of the pattern. This gives you about two or three parallel threads of the linen fabric weave to stitch the ropes to. At the upper corners I followed the lines of the bolt rope on the pattern.



The upper rope glued and stitched to the pattern. Note the stitching over the little piece of rope that was glued in at the corner. That's one of the few areas of stitching that is readily visible on the finished furled sail

I glued a small piece of “primed” thread in the corner so I'd have something to stitch to. When the rope was pretty much secured to the pattern, I brushed a few more coats of the diluted glue all along the outside edges. This is the place where a good glue bond is needed, but where I wouldn't be pushing the sewing needle through.

The next step was to sew. I got so that I could stitch up one sail in about four hours. I did try an experiment in that on one sail where I did not stitch the upper rope more than ½” from either end. By the time that sail was tied to the yard and furled with its gasket ropes, I could not see that the bolt rope had not been sewn completely. Note that fashioning the clew corners and loops as separate entities not only made life easier in that one doesn't have to fashion the loop on the fly while gluing the rope on to the pattern, but the break in the bolt ropes makes it easier to furl later.

The sail comes off the plastic easily with gentle lifting. In fact, this is the whole reason for the plastic film. I couldn't think up another way to hold the fabric in place and glue the rope to it, and still be able to take it off in one piece. The glue dries clear, and there will be a dried thin film of it that has to be carefully trimmed prior to sewing. Inspecting the other side, I usually found spots where I would have to trim off some fabric where the rope was too far inside the pattern. And at other spots, the bolt rope didn't completely cover the pattern edge. In that case, a light brushing with water will loosen up the glue enough to shift the rope by gently pushing it.

I don't know the name of the stitch, but I simply went around the bolt rope over and over, keeping the needle as close to the inside face of the bolt rope as possible. I had to be mindful that at least two of the parallel threads of the linen weave were being sewn to the bolt rope. For the most part, the glue kept those threads from pulling loose out of the weave. At times the glue was too hard or too thick to push my needle through, so I would gently wet the area I was sewing just

enough to slightly soften the glue. At this point, if the tea stain that was used to “dye” the sails hasn’t been rinsed out enough, you will notice that it might start to bleed a bit. But, it probably doesn’t matter too much, because the sails will be furled.

To push the needle through the linen, I used the other side of the foam core. I laid the sail flat on it and pushed the needle through the sail and partly into the foam core. The glue connection isn’t strong enough to put up the strain of pushing the needle through the dried glue that has absorbed by the fabric without some kind of backing. For the most part, I was able to stitch without ripping the threads out of the linen.

I noticed that a space between stitches of about  $\frac{1}{2}$  a thread diameter looked better than stitching so close that it looked like the bolt rope had been served. And, it was easier to fold the sail later on when furling to the yard. For me, anyway, all this work was done wearing strong magnification glasses. At the upper corner ear rings, the sewing moved from the bolt rope to the little added piece of rope glued into the corners. There will be some tension strain at this point when the sails are bent to the yard. An extra stitch or two here is a good thing. Also, at such a small scale, the smallest misplaced stitch can appear to be a very large error. So, I found that using the same color thread for both the bolt rope and the stitching makes some of these errors less noticeable.

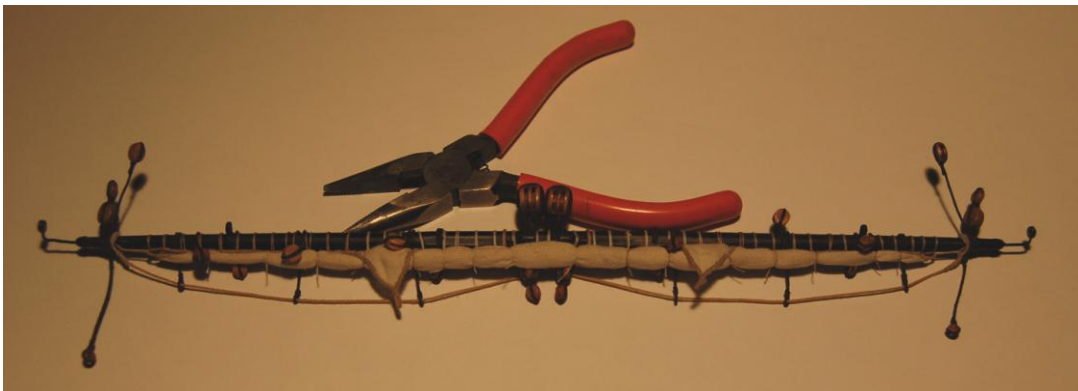
When the sewing is all done, I took a damp rag and blotted at the edges of the sewn sail. Sometimes I brushed water onto the sail, and gave areas a quick scrub with a stiffer paint brush and blotted the excess water off with a dry rag. I even experimented with immersing the entire sail in water with a drop or two of fabric softener. Whatever way you chose to dampen the sail, the key is getting the water off by gently blotting. And if the sail is fully immersed, wait for it to dry before continuing any more of this part of the process. The point of all this is to remove the spray starch and glue that has been absorbed into either the fabric or the rope, while leaving just enough glue to hold the sewing in place. I found that overall, the sail fabric can be made supple and soft again, and the sewn boltrope is still firmly attached.

That’s pretty much the worst of it. I marked the center for the ropes that would tie the sails to the yard with a graphite pencil. I noticed that the sails hung better if the lashings to the yard were as close to the upper bolt rope as possible. Otherwise, the sail doesn’t look like it’s hanging. And, don’t tie too tight. You will have to get the thread that serves as the gaskets to furl the sails between the sailcloth and the yard. I used the same color thread to attach the sail to the yard as I used for the stitches. I now wish that I had used a slightly darker thread, so I didn’t have so much contrast between the threads and the blackened yards.



This photo shows how coarse the weave of fine linen is at this scale.

For furling, I start close to the yard ends, rolling the sail forward around the side bolt rope using tweezers to get it rolled evenly. I tied it about  $\frac{1}{2}$ " in from the end. Then I rolled at points close to center of the yard, and tied them. I learned that these tied areas will have to be redone as more and more of the sail is furled, but unless one has ten hands, you will have to sort of work the sail into its furled shape. At the clews, I used tweezers to tuck in the extra canvas as best I could. Once the sail is tied in about six places along its length, it gets easier to tune it up so it looks right.



This whole story still isn't finished. I have yet to tuck the ropes into the folds of the sail canvas to represent the buntlines, leechlines and bowlines. I expect that I will have to carefully cut the furl gaskets to push these lines into the furls. I am at a point on my model now where I am just rigging

the jeers, braces and lift lines used to maneuver the yards. Even with just the main course rigged, the number of loose rigging lines is making work go very slow. If I had put all the sail rigging lines in the canvas before hanging the yard, it would be an impossible confusion of lines to deal with. The good news is that most of these sail rigging lines will be slack.



I have to say that the final effect does not betray the vast amount of time that it took to construct these furlled sails, but maybe that's a good thing. Furlled sails are not very glamorous to behold, as can be seen in the photos of the replica.