

Study Plans: Manual #1

Construction

'Slingshot 16'
Trimaran



'Slingshot 19'
Trimaran



Photos and text by Frank B. Smoot

www.diy-tris.com

Your 'Slingshot 16' and 'Slingshot 19' Trimaran Free Study Plans (Both are Covered Here For Simplicity)

...from Designer / Builder / Sometimes Sailor Frank Smoot (AKA 'Trimaran Frank')

About The Boats:

The 'Slingshot 16' is a 1-2 seater trimaran, and the 'Slingshot 19' is a 2-3 seater trimaran. Both boats been developed to sail in perfect balance. With the 2-seater setup, but boat can remain in ideal helm balance whether soloing or carrying a passenger, thanks to a unique sliding seat arrangement. You can also rig them both with several very different kinds of sail rigs, and with either folding or fixed amas.

NOTE: The Slingshot 19 plans include full details to build both the folding akas and 19' amas. **NOTE:** The basic Slingshot 16 plans include construction details for the standard 14' cruising amas and one-piece (non-folding) akas. Supplementary plans are also available that include full construction details for the larger 16' performance amas and also for folding akas for the Slingshot 16.

NOTE: Plans for the 2-seater version of the Slingshot 16 are not yet available, but are in the works.

About the speed of these two trimarans: You may not want to go 14 mph, but it's nice to know your boat can safely do that. (It could probably do more, but somehow that seems fast enough for me.) You can choose among 5 different sail rigs, either stayed or freestanding (unstayed). And you can initially build the Slingshot 19 with fixed akas, then later convert to folding akas (for easy trailering) if you wish.

This design flexibility (as well as the super-shallow draft, the very light weight, and the ability to turn on a dime) is the key to enjoying your boat the way YOU want it.

And of course, the foot-pedal steering allows you to have both hands free to eat, drink, take off your jacket, apply sun glob, or whatever else you'd like to do while at full sail. And the remotely raiseable / lowerable rudder will come in handier than you can imagine. Same with the leeboards that stay exactly where you put them - up, down, or anywhere in between - with no lead weights involved.

In short, these are tested and proven designs and, if built carefully and solidly, will give you years or decades of very enjoyable sailing!

About Purchasing Full Construction Plans

Upon purchase, the **full building plans** for the Slingshot 16 and 19 trimarans are delivered to you in multiple documents, some of which contain construction photos and explanatory text, and others that contain excellent detailed drawings by my associate and CAD expert, Jerome Delaunay.

In the same way, these **study plans** are condensed into two documents:

Manual #1 - Construction

Manual #2 - Drawings

My goal is to provide you with a clear sense of what both of these small trimarans are all about, to help you understand how they are built, and to help you decide if these boats are a good 'fit' for you.

Enjoy!

Purchase Full Slingshot 16 Construction Plans at: <http://www.duckworksheets.com/plans/smoot/slingshot16/index.htm>

Purchase Full Slingshot 19 Construction Plans at: <http://www.duckworksheets.com/plans/smoot/slingshot19/index.htm>

About The Pages Not Shown In These Study Plans

These study plans don't include most of the pages that would be in the plans you'd purchase, which explains the lack of consecutive page numbers. Here's a general idea of what's on those missing pages:

- laying out and cutting out the main hull side panels
- installing the bottom panels
- hull interior details
- mast step & interior details
- misc. hull details
- leeboard construction and installation details
- sliding seat details
- rudder construction details
- steering line and foot pedal details
- ama construction details
- one-piece, non-folding aka details
- folding aka with longitudinals details
- folding aka without longitudinals details
- details for setting up unstayed / freestanding sail rigs
- details for setting up stayed sail rigs
- build dimensions for five different kinds of sails
- build details for two kinds of goosenecks
- build details for a freestanding tubular aluminum mast

At every stage of construction, I have done my very best to take photos that make the build process clear, and to provide genuinely helpful explanatory text.

We'll get started on the next page with some information about the "Hull & Amas" (outriggers, floats) Section

NOTE: Most of the photos and text in this Study Plans Manual are about the Slingshot 19, but the construction process for the Slingshot 16 is essentially the same.

So please don't be confused by the fact that all the references that follow will be to the Slingshot 19. Both are great boats!

Happy building and sailing!

— Frank B. Smoot

Purchase Full Slingshot 16 Construction Plans at: <http://www.duckworksheets.com/plans/smoot/slingshot16/index.htm>

Purchase Full Slingshot 19 Construction Plans at: <http://www.duckworksheets.com/plans/smoot/slingshot19/index.htm>

Three Ways To Build And Rig The Slingshot 19

Option One

Build it as a simple, non-folding trimaran with one-piece aluminum tubes for akas. Akas are the crossbeams that attach the amas (outriggers / floats) to the main hull. This is the simplest construction method and provides the lightest finished boat. The pieces are transported on a trailer and can be assembled at the launching point in as little as 15 minutes.

Your only sail-rig option when building this way is a single sail on an unstayed mast. But if speed is your concern, don't worry. The 14 mph top speed observed in this boat was set with the boat rigged just as described above, and with a single sail of 107 sq. ft. on an unstayed mast. You can also make your unstayed sail rig bigger. I have one of 128 sq ft that I use most of the time.

Option Two

Build it as a 'folder' (folding amas and akas) with the same sail rig possibilities described in Option One above. It will weigh a bit more and be a bit more complicated to build, but it will be much simpler to rig and de-rig, and will save you a good deal of time and effort.

Option Three

Build it as a 'folder' with the ability to use a stayed sail rig - one that uses shrouds and a forestay to hold up the mast. This option will allow you to carry the greatest amount of sail, especially when sloop-rigged, but will also be the most complicated to set up and sail. It's good to have options!

Photo 3 (top) - On the beach with 128 sf sail with partial battens and longitudinals

Photo 4 - Underway with Hobie / sloop rig and longitudinals



Features

Top Speed (typical):	14 mph
Number of Occupants:	Two-Three
Length Overall:	18' 10"
Beam Overall with Fixed Akas:	12'
Beam Overall with Folding Akas:	14' 6"
Main Hull Max Beam:	26"
Length of Amas (outriggers / floats):	18'
Weight of Main Hull:	125-150 lbs (57-68kg) depending on plywood choice
Weight Fully Rigged:	Approx. 225 lbs (102kg)
Draft Fully Loaded:	5" max
Sail Area With Base Rig:	107 sq ft
Sail Area With Sloop Rig:	148 sq ft
Sail Rig Type:	Several options, both stayed and unstayed (freestanding)
Mast:	Aluminum tubing, either unstayed or stayed freestanding)

Materials & Resources

Plywood for Main Hull and Amas:

6 sheets of 6 mm ply (recommended for all main hull panels)

4 sheets of 3 mm ply

1/2 sheet of 1/2" ply (this plywood should have 4 or more plies)

All plywood sheets are 4' x 8'

NOTE: All plywood should have waterproof glue. Boil test if uncertain.

Lumber:

8 linear ft. of 1" x 6" (3/4" x 5-1/2") clear or nearly so

80 linear ft. of 1"x2" (3/4" x 1-1/2") clear or nearly so

110 linear ft 1/2x 3/4" molding (shoe or rectangular)

Aluminum Tubing:

Akas: (2) 3" x 12' x .065 or .083 wall thickness

Optional Freestanding Mast: (1) 3" x 12' x .083 wall thickness and (1) 2.5" x 12' x .065 wall thickness

Boom: (1) 1-3/4" x 12' x .065 wall

Glue and Resin

Either (for 'PL Premium' construction):

1-1/2 gallons of epoxy resin (including hardener)

1 case (12) 10 oz. tubes) of 'PL Premium' "3X" Waterproof Polyurethane Construction Adhesive or equivalent.

Or (for epoxy resin taped joint construction):

3 to 4 gallons of epoxy resin (including hardener)

Appropriate thickening agents (colloidal silica etc.) if you plan to tape the interior seams

200' of 2" or 3" fiberglass tape

Fiberglass cloth:

13 yards of 6 oz. x 72" wide (main hull exterior and deck, and cockpit floor)

20 yards of 4 oz. x 30" wide (ama hulls and deck)

Hardware:

All imaginable sizes and types of stainless steel bolts are available online from Bolt Depot
www.BoltDepot.com

All aluminum tubing specified in these plans is available from Alro Metals
www.alrometals.com

© Frank Smoot 2016

Photos 30-31 - Now we're back to looking at photos of the actual Slingshot 19 hull. This is exactly what your hull should look like when all five hull panels are fully installed. Of course, I'm using cheap 3mm lauan plywood here. If you opted for a better grade of plywood, your hull will probably look prettier than this one.



Photos 40-42 - Now the entire outside of the hull has received an additional coat of 6 oz. fiberglass cloth and two filler coats. In 5 days it will be cured enough for final sanding and painting, though you will most likely wait longer than that simply because you may take your time doing interior work.



Photos 72-73 - With the hull upright again and all glassing finished, it's time to confirm the layout of hatches and deck doubler, prior to cutting out / installing.



Photos 77-78 - Lots of progress here. The mast partner holes have been cut out, the decks painted, the deck plates and front grab handle are installed, and the leeboards are installed along with their ½" ply reinforcing plates, ½" ply washers, and heavy-duty stainless steel fender washers on both sides.



Photo 129 - Note also that the locations for the ama-aka attachment bolts have been laid out.



Photos 130-131 - Making sure all the fairing is done before starting the fiberglassing step.



Photo 132 - Here you can see some 1x4" supports that have been screwed (very lightly) to the tops of the amas. The first layer of 1x4 is about $\frac{3}{4}$ " narrower than the width of the ama top on both sides, so that fiberglass applied to the bottom and side panels can be trimmed off.

Next, some pieces of 1x4" about 24" long are screwed to the first pieces. These longer pieces will then be screwed to the tops of sawhorses when the amas are inverted, providing a sturdy support for glassing the ama sides and bottoms.



Photo 133 - Actually, one ama was screwed to the workbench and the other to sawhorses. (I think I only had one pair of horses at that time :) In any case, it's a good shot of the fiberglass cloth being applied.



Photos 134-135 - Fast-forward a bit. The glassing of the top has also been completed now, with the glass cloth lapping about 1" onto the sides. Then it was all allowed to cure for 5 days before final sanding and painting of the bottom and sides.



Photos 140-142 - First assembly of the finished boat! As with all of my boats, first assembly and sail testing is done with the simplest, most basic configuration. The akas are 3" diameter 6061 T6 aluminum tubes, 12' long, with .065 wall thickness. This is more than adequate, though .083 wall thickness is also available and very likely costs less. Feel free to use either. The sail is the most basic option as well, a 107 sq ft. leg-o-mutton on an unstayed mast. I much prefer sails with booms, and I like my booms on the foot. No bad tacks, and very easy to control sail shape.



A note about performance:

This is certainly not the biggest sail rig you could put on this boat. As you'll see a bit later, I have used two other sail rigs (and many more not shown here).

Is bigger always better? This boat has reached its top (recorded) speed of 14 mph exactly as you see it here. Granted a bigger sail rig will generally offer better performance in lighter air. But if that bigger sail isn't reefable - and quickly so - it can become a liability when the winds pick up. All in all, a moderate sail like this one might just be the best choice for all-around sailing.



Folding Aka Section - Introduction

There are three basic ways to set up the akas on your Slingshot 19 trimaran for sailing. Selecting the right option is important because different options work best for different sail rigs. So it's important to understand how the construction methods differ, and why. Let's look at each one:

Option One: One-Piece, Non-Folding Aluminum Tubing

This is the simplest, lightest, quickest, and cheapest to build. It consists of two 12' 6061-T6 aluminum tubes bolted crosswise to the main hull, 8' apart. Each tube is 3" O.D., and the wall thickness should be .083". You can also use .065", but it will cost more and not be quite as strong.

This setup allows you to bolt the amas directly to the ends of the aka tubes. It's quite strong once assembled, and is much less work to build than the folding akas. But the downside is that you will need to assemble and disassemble the akas and amas each time you sail. You will also have to set your trailer up to carry these parts separately. But I did this for years, so it works just fine.

Option Two: Folding Akas With Longitudinal Supports (Longitudinals)

Eventually, I got tired of assembling and disassembling my boat every time I wanted to sail. The obvious solution was to make akas that would fold, so the amas could be brought in close to the main hull and opened to full width without doing any assembly. After substantial experimentation, I arrived at the design shown here. It has been tested on 5 different boats, and is very functional and even sturdier than the one-piece akas.

The original design did not include the longitudinal supports shown in these plans. These were added when I decided to experiment with sloop rigs, which almost always require stayed masts with shrouds and a forestay. The 5/16" eyebolt mounted to the breasthook provided plenty of strength for attaching the forestay, but I also needed to be able to attach shrouds at the right locations.

This meant I had to have a strong attachment point where none existed in the original folding aka design. Ergo, the longitudinals were added - allowing an almost infinite range of locations for the strong point. I settled on points that are 30 degrees aft of athwartships at the mast base, giving ideal triangular support for the mast. If you want to use a conventional sloop rig, or even just a main without a jib on a stayed mast, this is how you will build your boat.

Option Three: Folding Akas With No Longitudinal Supports (Longitudinals)

As I noted, this was the original style I designed. Since there are no longitudinal supports to connect shrouds to, you will be restricted to using only unstayed / freestanding masts. But that's what I personally have ended up doing. After years of experimentation, I have concluded that unstayed sail rigs have so many advantages over stayed ones that they're all I use anymore. The 14 mph top speeds I have seen on all my boats were all achieved with unstayed sail rigs. And the 128 sq ft vertical batten sail I now use on my Slingshot 19 delivers all the performance I could ask for.

Stayed Sail Rig (With Shrouds) vs. Unstayed / Freestanding Sail Rig

Which Setup Is Right For You?

If you would like to use a stayed sail rig (be it sloop, cat-rig, or whatever) on your Slingshot 19, the following section will show you how to set your boat up accordingly. Many people do want to use sloop rigs, and I used one myself for a while.

As you will see a bit later you also can sail with an unstayed (freestanding) sail rig. As it turns out, this is my personal preference. The boat weighs less, is easier to get in and out of, and to my eye, looks better as an unstayed rig. And of course, the simplicity of an unstayed rig along with the fact that there are no shrouds in the way of the boom has always appealed to me.

On the other hand, a stayed rig can be bigger in terms of overall square footage of sail you can carry. It may also be easier to reef, and may also 'point' higher into the wind (though my personal experience hasn't confirmed this widely-held belief).

The pros and cons could be discussed endlessly, but in reality, either sail rig will work just fine. So, respecting the chronological order in which these sail rig variations were actually tested, we'll start with setting your boat up for a stayed rig.

NOTE: You will ONLY be able to use a stayed sail rig if you have already made the conversion to the folding ama setup as described above. Maybe there's some other way to do it with the "solid aka" setup described earlier, but that's beyond the scope of these plans.

The Longitudinals

In terms of what you will need to build, the principle difference between the stayed and unstayed sail rigs is a pair of 'longitudinals'. These are sturdy members that run 'longitudinally' (fore-and-aft) well outside of the main hull, and are connected to the aka pivot bolts on both ends. A bit forward of the middle of these longitudinal members is a place where you can attach the shroud that holds up your stayed mast.

Some trimaran designers like to attach the shroud to the ama. I have tried it both ways, and feel the approach used here is both sturdier and easier to rig. Additionally, if you ever want to set up a 'trapeze' (or anything else to sit or stand on while you hike out), these longitudinals will give you something to attach it to.

There follows a series of photos of the finished longitudinals used on the prototype Slingshot 19. While there are no photos of the actual build process, the images in the Drawings Manual are fully detailed, and all measurements are taken from the actual longitudinals used on this time-tested rig.

Photo 11-14 - This set of shots shows the ends of the center sections from several angles.

NOTE the little black dot near the 2x4" spacer block on one of the aka sections. This is actually a plastic "through-deck pad eye" or "fairlead" (depending on who you ask). Its function is to both guide the rope that will be used to open the aluminum aka tubes and lock them in place, and to minimize friction while this is being done. (Front aka only.)



Photo 29 - Here's the completed tri, fully closed, sitting on its trailer. There will be a few differences between this photo and what you're building, specifically in the rudder and in the opening aft of the rear aka. But the longitudinals are the same as the ones you'll be building.

NOTE: This folding system is subject to potentially damaging stresses at all points except when fully open, when the aluminum tubes are fully supported by the wooden inner sections. As such, the amas must be supported when fully CLOSED just as well as when fully open. Spend as little time as possible with the amas in-between open and closed.



Photos 30-31 - A stern view of the finished tri showing the folding akas both open and closed. Even if you don't end up building the longitudinals, your boat should otherwise look just like this if you have gone with the folding option.

NOTE: The amas are each supported in two places on this trailer. You will also want to set your trailer up so that the amas are supported during transit, and at approximately the same level as they will be when open. If you don't do this, you may end up placing an unhealthy amount of stress on both the ends of the aka center sections and on the bolts and blocks on top of the amas.



Photos 32-33 - Here you see the completed boat being 'inspected' by Chuck Leinweber (AKA Chuck The Duck), proprietor of Duckworks (www.duckworksmagazine.com). He stopped by for a visit the day before he started his participation in the 2013 Everglades Challenge - which he successfully completed!



Photo 37 - A couple of things worth noting here. First, the aka pivot bolts will obviously have to be a lot longer than with the unstayed sail rig, as they have to now go through the longitudinal as well. Second, the eye-nut you can see at the top of the pivot bolt is not necessary. A plain S/S nyloc nut should be used here.

NOTE: The best way to determine the correct length of the bolts you'll need (and these are 3/8" stainless) is to actually build all the wood pieces, stack them together, and then get bolts about 1" longer.



Photo 38 - Here you can see the opposite longitudinal as well as the near one, and you can see both sides of the reinforcing block to which the shroud bolt and eye nut will be attached. Note also the round Tivar® washer between the ama bolt block and the aluminum tube.



Photo 39 - A somewhat messy (but hopefully helpful) shot of the back end of the boat, showing amas, aka, and longitudinal, as well as the aft ama support on the trailer.



Photo 40 - The sun has come out a bit and the condensation is off the lens. Here I've opened the amas about halfway. You can see the full length of the ama as well as the two places on the trailer where it's supported in transit.



Photos 55-57 - Getting ready to install the mast step, and then installing it. The carriage bolts go through holes in the sub-deck framing (which you installed way back in Photo 53 of the Hull & Amas Construction Manual).

Note also the cheap but useful compass, and the paddle and its brackets. This is the best and most out-of-the-way place I've found to stow your paddle.



Sail Options And Benefits

It's always tricky trying to pick the 'best' sail rig for a boat. Why? Because there's no such thing! Like every other aspect of boat design, sail selection ends up being a compromise between various factors - in this case, power vs. ease of handling vs. cost vs. situational flexibility vs. reefability vs. set-up / take-down time and difficulty. You get the idea.

So with this in mind, and based on my many years of sailing small trimarans in a wide variety of conditions, I offer you the following thoughts about selecting the 'right' sails for your Slingshot 19. You will find five sail rig options below, along with my thoughts about the advantages and disadvantages of each option.

You will find detailed drawing of all five of the sail rigs discussed here in the accompanying 'Drawings Sails and Rigging' manual.

NOTE: All of the sail rig options below except for the Sloop Rig are designed to be used with freestanding / unstayed masts. Having tried out SO many different rigs over the years, I have reached a few conclusions: Sloop rigs, (or any rigs with jibs) are 'supposed' to point higher (sail closer to the wind) than 'cat-rigged' (a single sail on a single mast, placed well forward) boats.

But in my experience, that just ain't so. Or if there is a difference, it's too fine for me to measure. And of course, virtually all sloop rigs require a minimum of a forestay and two shrouds - the latter of which seriously interfere with sail placement. Plus, they are a pain to rig and unrig, and all those wire attachment points are potential accidents waiting to happen. So for these reasons and more, all of the sail rigs I personally use any more are unstayed / freestanding.

Option One, the 'Base' Sail

107 sq. ft.

Leg-O-Mutton with Foot Boom (loose or laced)

This is the most 'conventional' of your sail options, and in many ways the simplest as well. It's basically a triangle with some draught (camber / belly) built into it. It uses a 'luff sleeve' that both simplifies attachment to the mast and greatly enhances the leading-edge aerodynamics.

If this is the only sail you ever use on this boat, you probably won't miss a thing. This is the sail that I was using when I went 14 mph in this boat. (I may have gone faster other times, but I seldom remember to bring my GPS.) In any case, it's an easy sail rig to assemble and to set up for sailing. With no battens, it can furl and reef around the mast.

You can try it with either a loose or attached foot. (You'll need a row of grommets for the latter.) I suggest you try it both ways, so you can determine firsthand the differences in both use and performance (if any). To rig, you just drop the mast into the holes, unfurl the sail, hook up the boom to the gooseneck, and go. (The mainsheet 'lives' on the boom, already fully rigged.)



Photo 1

107 sq. ft.

Leg-O-Mutton with Foot Boom (loose or laced)

Option Two

110 sq. ft.

Radial Batten 'Fan Sail'

If you've never seen a sail like this, I wouldn't be surprised. As far as I know, it's my own design. Some people mistake it for a 'crab claw', but those have neither battens or a roach. My fan sails have full radial battens and as much roach as I can give them.

Why would I come up with such a strange design? Because it fills so many requirements so nicely. The big roach increases the sail area you can get on a given spar length, the battens both support the roach and make the sail hold its shape, and the fan-style construction allows you to simply fold the sail down for stowage - just like a fan!

But does such a sail shape really work? I have built half a dozen of these now, and I'm convinced they do everything at least as well as any other sail configuration, and better than most. They 'point' (sail close to the wind) as well as any sail rig I've owned - including sloops. And they 'grab' the wind beautifully on a reach or run.



Photo 2
110 sq. ft.
Radial Batten 'Fan Sail'

Option Three

118 sq. ft.

Radial Batten 'Fan Sail'

This is really just a bigger version of the sail shown above, and with all the same benefits. It will provide a bit more power. Otherwise, everything I've said about the 110 sq ft sail applies to this one.



Photo 3
118 sq. ft.
Radial Batten 'Fan Sail'

Option Four
128 sq. ft.
Vertical Batten Sail

I have to say, I'm convinced that this is a great way to go with a sail. Battens are installed for the usual reasons - better sail shape control and more sail area on the same lengths of spars. But whereas most battens in most sails are more or less horizontal, these are vertical. Why? Because a sail with vertical battens can be furled and reefed around the mast. Not so with horizontal battens. A vertical batten sail can even be stowed on the mast.

The initial design of this sail had the vertical battens running about 2/3 of the way down from the top edge of the sail, leaving the bottom 1/3 battless. But I found it very difficult to set the sail in a way that it didn't develop unsightly creases below the battened area. So back to the sailmaker it went, to have the batten pockets extended all the way to the foot. I also had to beef up the first batten, as it wanted to bend under the compression load. So I glued a full-length lighter batten (3/8") to the full-length heavier batten (5/8") and that solved the problem.

Of course, a sail this big will definitely benefit from a forestay, especially one that's adjustable from the cockpit, as mine is. The forestay will not only prevent the mast from bending backwards excessively when close-hauled (which hurts sail shape and efficiency), but will help to keep the boom at a height well above head level. The forestay won't provide as much bend control as a fully shrouded mast, but it's oh-so-much easier to set up, and can be dispensed with entirely in light air.



Photo 4
128 sq. ft.
Vertical Batten 'Fan Sail'

Option Five

Approx. 153 sq ft

(Area varies according to your sail selection)

Sloop Rig

I'm providing this option mostly because (a) I have tried it out so many times, and (b) lots of people simply prefer sloop rigs - possibly because that's all they've ever used, and it fits their mental image of how a sail boat 'should look'. I am pretty clear about the pros and cons of sloop rigs. I'll start with the pros:

On one hand, the sloop rig generally allows for more sail on a given boat than a cat-rig does. This 'can' be a plus. Also, a split rig design means both sails can be smaller, and that it can be sailed with one or the other of the sails stowed. Sloops are alleged to point higher, and maybe some of them actually do. You can also, in theory, trim a pair of sails more efficiently than a single sail. Also, mast bend is better controlled, and a pivoting mast is great aerodynamically.

BUT... will the bigger sail area actually translate into better performance? Maybe in light air. But for me, the greatly increased time and effort to set up a stayed rig vs. an unstayed one is almost never worth it. And whereas tacking can be done entirely with the rudder on my cat-rigged boats, a sloop typically requires careful jib tending on every tack.

OK, so my prejudice is obvious. I definitely prefer unstayed masts with single sails. But you will ultimately need to decide for yourself what sail rig is best for your purposes. That's why I'm such a believer in having lots of options!



Photo 5
Approx. 153 sq. ft.
Sloop Rig