The U.K. Cherub Class Dinghy

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The UK Cherub Class

Suddenly it seems the world is full of “high performance” Classes. One trapeze, two trapezes, asymmetric spinnakers, you name it. Is the Cherub just another one? The answer is quite firmly no. The Cherub stands apart from the majority in a lot of ways.

The Cherub is the lightest 2 person class sailed in any numbers in Britain. The all up sailing weight is less than the hull weight of many of the current one manufacturer one-designs.

It suits a lower crew weight than any other trapeze boat, with the exception of a few youth trainers. No other performance class has had as many women helming and crewing on equal terms at the top level, including National & World Championship Winners. Husband/Wife Boyfriend/Girlfriend Brother/Sister combinations of crew are common. Perhaps the best known of these was Nicola Bethwaite crewed by Julian Bethwaite (designer of the 49er), World Champions in 1976.

The boat has evolved to need skill and speed to sail it fast, not weight and brute strength. Despite this the boat suits a reasonably large range of crew weights, with combined weights from 16 to 24 stone having been seen in the top ten in recent years. The ideal is probably 17 to 22 stone. With the current rash of boats with adjustable racks it is interesting to note that, like most development classes, crew weight is not as significant a factor as in a one design, and some of the lightest crews are the fastest in heavy weather.

It’s bloody quick offwind. It’s not sufficiently overcanvassed and too short to be very quick in light airs, especially upwind, but the downwind speed in a decent breeze is exceptional. Exceptional as in having, in our experience, a higher top speed than any UK designed class. Cherubs have never been notorious for hanging about in a decent breeze, having an excellent power to weight ratio and not too much wetted surface. Recent analysis of video footage has produced good evidence for Cherubs hitting anything up to 25 knots in bursts, which is pretty fair by anyone’s standards, but of course maintaining that sort of speed over a measured course for a real speed record is another matter.

Originally designed in New Zealand, the Cherub is mainly found in Australia, New Zealand and the UK. At the moment the three countries sail boats to slightly varying rules, but all the Class Associations are working towards bringing the Class together again.

The UK Cherub especially is an appreciably different boat to the NZ/Australian version. The UK have simplified rules which permit a slightly narrower boat with a self draining cockpit and a less restricted sail plan with the option of a bowsprit and thus an asymmetric spinnaker. The New Zealanders have adopted the asymmetric, whilst the Australians are strongly considering it, and the 1996 International Championships in Sydney were won by an Australian built and owned UK rules Cherub.

A boat to learn top class handling skills. Cherub Sailors have won a great many Olympic medals. Jamie Wilmot, Julian Bethwaite and numerous other antipodeans started out in Cherubs. Why is it countries as small as Australia and New Zealand produce such a large proportion of the world’s best Sailors? Because they learn racing and boat handling in Cherubs and other similar boats.

Its a Development Class, not a One Design. This means that every few years you have to get a new boat because the old one is no longer fast enough. This distinguishes it from all the popular One Designs, where every few years you have to get a new boat because the old one is no longer fast enough. Still, at least with the Development Class each new boat is faster than the one before.

The Cherub is a class for designers and builders as well as sailors. One of the aims of the class is to provide an inexpensive platform where prospective designers can try out ideas. What do the names Bethwaite, Farr, Murray, Howlett & Bowler have in common (other than being amongst the worlds leading sailboat designers and engineers)? The answer is that they have all designed Championship winning Cherubs. The majority of UK boats have always been homebuilt, and the class has pioneered home building in foam sandwich in the UK.

Do you really believe that anyone can sit down with a clean piece of paper and get a boat exactly right? If you do you’ve never sailed a Laser, an Enterprise, an ISO, or just about any other one design. Development classes inevitably evolve into better boats, and if the boat doesn’t suit you just change it until it does. Do you really want a cunningham “purchase” consisting of little loops and knots in rope just because the designer got it wrong? It also means that the whole boat can be tuned to suit the crew weight and size.

Finally, and most important of all, it’s great fun to sail, especially if you aren’t afraid of getting wet.

Dimensions

Hull	
Length Overall & WL	3.7m
Weight of Bare hull	50kg
Overall Beam	1.8m
Spars	
Mast around	6.7m
Bowsprit must be retractable	
Sails	
Total area main and jib	12.5 sq.m.
Spinnaker	15 sq.m. nominal

Photo: U.K. Cherub Association

Development

Innovations and features over the years include:-
1970 The first World Championship winning Cherub was a foam sandwich boat - one of the first foam sandwich racing dinghies, and both structural foam and carbon fibre were being used in the UK as early as 1976
1972 Over rotating wing masts (now out of favour)
1973 First Class in the UK to move to fully battened loose footed mainsails.
1974 First Restricted Class in the UK to use daggerboards rather than pivoted centreboards.
Early 1980s Rudder gantries
Mid 1980s Use of Australian techniques i.e. crew taking the mainsheet upwind
1990 Although not the first class in the UK to use asymmetric spinnakers, the Cherub almost immediately evolved a full low aspect ratio sail which was similar to the latest developments in Australia, quite different to the flat sails initially used in other classes.

A History of the Cherub Class

The Sixties and Earlier

The story goes that back in 1951 John Spencer designed a 12 foot cruising dinghy for a Mr. Ray Early to sail round the Auckland Area in New Zealand. When asked what their new boat was, his wife said "I don't know, but she's a perfect little cherub to sail".
The Class was introduced to the UK in the 1956 when boats were built by McCutcheon's of Cowes. Early Cherubs had appreciably less sail area than modern ones, with stated dimensions of 62 sq.ft. for the mainsail, 27sq. ft for the jib, and 60sq.ft spinnaker. The spinnaker was particularly unusual, since it was typically a virtually flat triangular sail with wire luffs, which could be carried with the true wind forward of the beam. This sail, set from a spinnaker pole that could be 9 ft long, resulted in spectacular close reaching performance, but was rather less effective on a run. Cherub design in the UK was very much in the mainstream of dinghy design at that period. A Cherub hull of that era tends to look pretty much like a baby Scorpion.
In the late 60s the first of many infusions of antipodean ideas occurred. John Spencer's Mk8 design was introduced into the UK, which had a wider and flatter hull shape, and planed appreciably faster. The theme in design through the next few years was beam. The only restriction on beam is that the boat should be no more than 5 feet at mid length, and boats of this era flared out a great deal after that. One result of this was that if the boat was allowed to heel a lot the poor crew was left attempting to stand on a gunwale that was sloping steeply towards the bow. Large and solid foot stops to brace the front foot against were a common feature! At least two UK boats had a maximum beam in excess of 6 feet, giving something close to Merlin-Rocket proportions. The Cherub Class International Association was formed in 1967 with membership comprising the New Zealand Australian & UK Associations.

The Early 70's

Russell Bowler won the first (1970) World Championships, held on the Swan River, Perth, Australia. His boat, the original Jennifer Julian, was probably one of the first ever foam sandwich dinghies. At the time of writing Russell is Chief Structural Engineer for Bruce Farr Associates.
In 1970 the International Association adopted a package of rule changes. The most significant was the adoption of a larger jib, taking the area of main and jib up to about 110 sq. ft, and the replacement of the wire luff spinnaker with a more conventionally shaped sail, but still set from the 9 foot pole. The Cherub started to get a reputation as an extremely rapid boat when the wind was blowing hard. UK boats of this period were typically fairly wide and deep Veed designs, with less rocker

than most classes, but still a great deal by modern standards.

The First Worlds in the U.K., 1974

The 1974 Worlds in the U.K were completely dominated by Australian and New Zealand boats. Hulls were mainly narrower and flatter with much lower rocker and lots of panel curvature. Rigs were much more powerful. Some of the Australian boats carried over-rotating wing masts in spruce and balsa. These were developed from work by the well known Australian designer Frank Bethwaite in the Australian NS14 Class. This line of development led directly to the Tasar which he designed for Performance Sailcraft (The original Laser builders). Frank's daughter Nicola was second in this event, and was to win the 1976 Worlds in Australia with brother Julian crewing. Julian Bethwaite of course went on to invent the modern asymmetric spinnaker and to have an enormous influence on the development of the 18 foot skiff and high performance classes all over the world.

photo : Cherub Assoc.

The beamier boats started going out of favour. The Forman 4 et al were still wider than tends to be fashionable now, but the trend was for less extreme boats. The underwater shape by now was significantly different from the majority of classes as planing performance started to become the most significant factor in design. Arguably this was the time at which the modern Cherub started to evolve. In the late 70s the UK boats started getting very much flatter, to the extent that UK boats in the 1978 Worlds in New Zealand were actually flatter than the local boats.
One shouldn't leave discussion of the 60s and 70s without acknowledging the debt the class owed to Freddy Babcock through that era. His company, Watling Joinery, donated many prizes, and he devoted an enormous amount of time and effort to the class, serving it in many ways, notably as Class Association President.

1980 Worlds - Felpham, U.K.

The 1980 Worlds in the U.K. were again dominated by Aussies and Kiwis. The top Aussie boat, Wop, was a particularly boxy design with very minimal rocker and a flat transom, coupled with a very fine bow. This boat would have won the worlds but for a (well deserved) disqualification for barging at a mark. The Wop design and its development, Foreign Affair, dominated the class in Australia to the extent of almost stopping development.

The UK Cherub 1984

From 1981 to 1984 there were no new Cherub designs, due to a package of rule change proposals under consideration. These were adopted by the UK Class Association (but not the Australian or New Zealand Associations). in 1984. The revised rules relaxed the mid-length chine restrictions, and permit sailplan development The area of main and jib also increased slightly to 125 sq.ft.
Its interesting to note that these changes were supported by John Spencer, the original designer of the class, but the Australian Cherub Association, very much the largest at that time, was very much opposed.
The initial bunch of new rules designs tended to have both the narrower chine beam and a greater rise of floor. Whilst they all seemed to be able to go quickly at certain times and in certain conditions none really established a dominance over the old rules designs.
Perhaps the nearest to demonstrating extra speed was the Deeley V, with a fine straight entry and plenty of rise of floor. Reputedly designed "without regard to human error" the design tended to prove the point with spectacular pitchpoles, but could be extremely fast in between times.
Rigs moved from the old "threepenny bit" mainsail with overlapping jib to a fuller headed mainsail with a large roach and a smaller jib with minimal overlap.

Late 1980s

A couple of minor rule changes occurred at this time. The most significant was that false floors, and thus fully self draining boats were permitted. Although British sailors went to the 1990 Worlds in Australia they borrowed local boats. At this time the Australians were all sailing Wop developments, and design innovation seemed to be limited.

Photo: Jim Champ

The real breakthrough came with what was in fact a sort of evasion of the rules. By drawing a boat with the rise of floor measurement falling on the flaring topside, rather than at the chine, Alistair Cope and, slightly later, Dave Roe designed boats that were narrower on the waterline than any before, but were

flat floored with low rise of floor. Dave Roe's Italian Bistro proved to be a major leap forward in design, planing faster and earlier than anything else in the fleet, and managing to combine that with docile handling and surprisingly good weight carrying ability. In 1991 a significant rule change brought the introduction of bowsprits and larger spinnakers were permitted. This inevitably meant asymmetric spinnakers.
A year or so had been spent in intense development until the final rule was defined, which gives a sail of a nominal 140 sq. ft, (actually about 150-160 sq.ft.). This, coupled with the new flat narrow hull shapes has led to a boat with quite astonishing medium winds performance offwind.

Up to the Present

Meanwhile in Australia the International Association had elected to update the fore and aft rig to a more modern layout based roughly on the UK rig. Surprisingly perhaps, however, they elected to make the sails a tight one design, rather than adopting the loose restrictions used in the UK. In 1995 there was a surprise innovation in Australia. Iain Murray & Associates designed a Cherub to the UK rules, complete with asymmetric spinnaker, for Hugh Treharne (Tactician on Australia 2 in 1983 amongst other achievements) and some other prominent Australian sailors. They wanted a suitable boat for their sons to sail in-between the junior classes and the skiffs, and felt that the International rules Cherub with its boxy hull shape and conventional spinnaker was too far removed from the mainstream of development. Their initiative was not greeted with enthusiasm by the Australian Cherub Class, and the first three boats were registered in the UK. The 1995/6 worlds saw the new rules UK boats competing against the Australians for the first time. Unfortunately the top U.K. sailor, Dave Roe, suffered an appalling run of bad luck, breaking every spar on the boat. In the only two races he finished without gear failure he was second to one of the IMA Sports Cherub designs, and in two other races he lost a spar whilst in second place. The Sports Cherub, called by that name, won the regatta easily, counting four firsts and a second.

Photo : Hamo Thorneycroft

After the 1996 Worlds it became obvious that a full reamalgamation of the Class under UK rules seemed unlikely, and the UK Class association conducted a ballot on a number of rule changes to further enhance the potential for development. These rules will permit a slightly narrower waterline hull, a little more overall beam and slightly more sail area. The most obvious change will be that there is no longer a requirement for a fair sheerline or 5 foot beam at mid length, so the hulls will be flared out to maximum beam for the whole of the crew's working area, making for a much better trapezing platform.

Jim Champ, 1997 (with acknowledgements to numerous previous compilers)

Heavy Weather Cherub Sailing

Introduction.

Sailing a Cherub in enough wind to be not entirely in control of one's destiny is for most of us why we do it. It is also why some people give up, never achieving any control over their destiny in winds over force 4. It is relatively easy to move from another class and sail a Cherub in a force 2/3, but in windier conditions many of the more subtle techniques are unique. Hardly surprising really - there is simply no other 2-man spinnaker boat this side of the Equator which is anywhere near as light, short and fast. Neither is it any use consulting the books - when these aren't over-generalising, they are usually talking about Fireballs, and anyone who has tried a Fireball will know how different that is!
It is a mistake to assume that Cherub heavy weather experts are born that way. I moved to Cherubs having been a Mirror heavy weather expert, and was quite shocked - while I could get around pretty well in the middle of the fleet by "survival" methods (like it says in the books), there were lunatics "going-for-it", getting away with it, and going very fast. A year later we were beginning to get the hang of it. In my time sailing Cherubs I often sailed past open-mouthed newcomers in windy races. A year later they were often sailing past me! The moral is "Keep Trying".
Neither is it true that you need lots of crew weight - it is not advantageous in all respects. Lightweights can have a relatively flexible rig, progressively losing power as the wind increases. In order to keep up in all winds up to about force 4, the heavies need a much stiffer rig, and I can assure you that this can make things very difficult when it gets really windy. Also, the heavies with all that weight and power are far more prone to the traumas of nose-diving downwind. With the normal 10 stone crew my last boat, 'Amber Dragon', used to go bows-down at every opportunity, but with a 2 stones lighter crew it was hardly noticeable. Dave Roe and Wendy Barclay were not noted for boat speed problems in a breeze, and they were only about 18 stone between the two.

Go For It.

Trying it when you're not sure you can do it is the only way to improve. Secondly, the boat is usually much more controllable when it is going faster. The worst thing to happen in a force 5 is for the boat to stop moving! There are very few exceptions to this rule, and you need a lot of experience before applying them. The only two I can think of at the moment are when a) you are protecting a very big lead at the end of a race or b) you are protecting your points score at the end of a series.

The Boat Must Work.

This sounds very mundane, but is very important. Everything must come easily to hand, must work first time, and must work consistently. If it doesn't, fix it, don't wait for next time. An awkward jam cleat is no disaster in a force 3, but in a force 6 it will sap your energy, take your concentration off the job in hand, and might even tip you in. In particular, helms (i.e. usually owners) pay far too little attention to trapeze and spinnaker systems - crews are expected to be superhuman. Crews should be allowed to make a contribution to the front end setup, that way they can't gripe when things don't work. If you want a list of the obvious things which are missing from many boats:-

- Jib cleats that you can uncleat with a straight pull, yet jam easily.
- Really good non-slip (Pro-grip for Windsurfer booms is best) and footloops (2 per side) for the crew.
- Thick, non-stretch spinnaker sheets.
- Ratchet blocks on the spinnaker sheets (these are dead good).
- Spinnaker sheet cleats that work.
- Easy to use spinnaker pole/bowsprit.

Remember too, if anything breaks, its the quickest way of going from first to last.

Keep the Boat Dry.

Water in the boat not only slows you down, it slops around and makes balance difficult. The faster you go, the more water comes in, and you've got to get it out. Use big self-bailers; place one forward for beating and one right at the back of the cockpit for fast downwind legs. Of course those of you with self-draining boats are laughing - should have happened years ago!

Develop Step-by-Step Methods.

Elegance is of no consequence in these conditions, but mistakes are. Doing manoeuvres step-by-step is much safer as both crew members know what is going on and what happens next. It is possible to practice in lesser winds, and also to practice the various emergency alternative methods (e.g. the crew doing the entire spinnaker drop). Good examples suitable for this step-by-step method are spinnaker hoisting/dropping and tacking. It is best if you can work it so that at any one time one member of the crew is doing nothing too drastic - that way you can get away with the odd mistake. If both crew members are flying around the boat at once, a small error can have very wet consequences.

Upwind.

The theory is simple - ease sheets a little, bear away a bit and plane to windward. It is relatively easy in a long, moderately heavy, stable boat on flat water, not so easy in a short, light boat in a breaking chop. Maintaining planing speed is the critical thing - drop down to displacement speed and you are just another pathetic little 12ft boat. Keep an eye on your stern wake from time to time; if it ever gets within 3ft of the transom, you're doing something drastically wrong.
The two main targets in achieving speed are to keep the boat flat and to get the correct fore-and-aft trim. Keeping the boat flat is vital. Planing upwind is much less forgiving than planing downwind, and a slight error in trim results in a large loss of speed. Move back so that the bottom of the stem is just skimming the water, but avoid overdoing it. If the bows are too far up they can be knocked off sideways by the waves, and if you do lose the plane you will stop dead. To keep the boat flat you will have to play a lot of mainsheet, which gets to be hard work - this is just tough, there's no easy way! Provided that you are moving fast you can also feather up in the gusts, which requires a lot less effort. This however is a transient measure, and continued for any length of time will lose boat speed.
There are two schools of thought over mainsheet trimming - it can be taken in the conventional way by the helm or in the antipodean style by the crew. Both methods have their supporters, and it seems to be largely a matter of personal preference. A good guide is who has the most spare strength available. On the whole the crew method seems to be marginally more effective, if only because it's easier to play the sheet two-handed, but Dave & Wendy go quite fast enough using the conventional method.
You will have to be prepared to de-power the rig, just enough so that you're not underpowered in the lulls. Flatten the mainsail by tightening the clew outhaul and putting on lots of cunningham. This bends the mast and opens the leech, especially if you have a mylar main. Then, if necessary, de-power more by letting the top of the mainsail twist off by releasing the kicker. If you can maintain a fast planing speed without difficulty, it may be a good idea to raise the daggerboard by eight to twelve inches. If the conditions are gusty or choppy don't bother, and certainly don't get the crew in from the wire just to adjust the daggerboard. Knowing just how much to bear away is very difficult. The extra speed can change the apparent wind angle dramatically, and with spray everywhere it is very easy to lose all sense of direction. If there are no other boats around for reference, bear away only far enough to maintain a reasonable planing speed. If you have a compass, keep an eye on it to check that you're not going very rapidly in the wrong direction!
Frequent tacking should be avoided at all costs. It is an opportunity for things to go wrong and it slows you down considerably. Even a good tack will probably

cost you about four boat lengths in a force six. When you do tack, adopt a system. Before coming in from the wire, the crew should release the jib sheet a few inches - without this the helm may have to dump the whole mainsail, giving lee-helm and making a tack impossible (crews please note). Once in, the crew should shout "hook off" (or similar!) when unhooked, but should stay well to windward and preferably sit out. This ensures that boatspeed is maintained until the exact moment between waves when the helm wants to tack. Again, if the crew moves across too early, the helm will have to dump the main and a tack will be impossible. When you do tack, don't sheet in too hard too soon - get the crew out on the wire and a bit of speed up first; those moments of low speed are when you are most susceptible to being knocked flat by a gust. None of this is very elegant, and you may see people doing flashy techniques in more stable boats, but it works - quite important in a howling gale. To sum up, get that boat flat, and work hard to do it. The harder you work, the faster you will go.
There's the weather mark..... nicely on the lay-line..... here comes the reach, maybe we can have a rest..... tiller up, sheet out, what does Deeley say next?..... what do you mean, you haven't read the next bit?..... never mind, its only *Downwind*.....AAAGH..... Splat.....Glug

Downwind.

Before you sailed a Cherub, you probably thought that upwind was the hard bit - Wrong Again! Most people, provided they don't mess up the tacks, will arrive at the windward mark sooner or later. The shock comes the first time you bear away only to see the entire foredeck disappear below the water, so a few basic points:-

1. Cherubs are very short of length, and are therefore just as inclined to fall over forwards as sideways, and you will therefore have to position your ballast (you) as far behind the transom as possible.
2. Cherubs also go mega-fast, and steering errors are fatal. The cretin holding the stick at the back should therefore attach himself to the boat as solidly as possible in order to maintain control. Short of a six-inch nail through a painful place, the best way is to get thoroughly sat out, bum over the side, and let the crew do any leaping about. At these speeds you can't leap about fast enough anyway, so balance is achieved mainly using steering and sail trim.
3. The wag who coined the phrase "keep your weather eye open" obviously never tried a Cherub down a two-sail reach. Helms will soon discover that a torrent of stingy white stuff makes a beeline for the "weather eye", causing total blindness and dislodging your contact lens. The Deeley principle is "keep your weather eye closed, and your leeward eye open". This works much better as the leeward eye is offered considerable protection by the hooter - the bigger the hooter the better it works.
4. Crews need to adapt a bit too. Unless you're Alex Windsor you won't stay on the side of the boat with your feet together. Don't try trapezing too low - it's harder to get in and out, and you'll get knocked off by the waves. Balance is crucial, but beware of overcompensating. Cherubs don't roll, they are either steady or capsized. The thing you will be trying to achieve is dynamic balance. It's a bit like riding a bike. Statically it would fall over, but the faster you go the easier the balance becomes, provided you stay in control and do the right things. Crew co-ordination and timing are essential.

Bearing away.

Getting successfully from the beat to the reach is surprisingly difficult. As you approach the weather mark, both helm: and crew should shuffle back in the boat. Get the boat bolt upright and don't be too hasty. Steadily ease both sheets as you bear away. Don't force yourself to have to use too much rudder, as this won't work.

Turning Corners.

All the marks always cause problems, and it is worth sticking to a couple of basic principles. The first is to keep clear of other boats. Boats always get close at marks, and close encounters rapidly start to cut down the options available. Tactical advantage is pretty meaningless if it is blowing hard enough, and the priority is to be able to round the mark the way you want to. The second principle is to plan mark rounding before you get there. The classic case is when you are broad 3-sail reaching up to the wing mark with a gybe and a tight 3-sail reach to come. Work your way up to windward of the mark, gybe at your leisure, and approach the mark flat-out on the new tack.

2-Sail Reaching

You will be 2-sailing a reach either because it is too close to hold the kite, or if it is broader, because it is simply blowing too hard or the waves are too big. The two cases are rather different. The close 2-sail reach is in some ways easier, because you are very unlikely to succumb to a terminal nose-dive. It tends to be hell for the helm however, as spray production is at its maximum and vast amounts of mainsheet trimming are required. This is a time where the crew trimming the sail really can pay off as out on the trapeze is also out of the worst of the spray. The centreboard needs to be about a foot up, but this can be a problem if you have come directly from a beat and the crew is still flat out on the wire. In any case, keep the boat dead upright (mainly with sail trim) to reduce the inevitable weather helm. Correct jib trim is vital, as under or over trimming both lead to excessive weather helm. The standard technique of bearing off in gusts and heading up in lulls is not always very effective, and the straight line course is often the best. If you are getting overpowered, flatten the mainsail (clew outhaul and tack downhaul and let it twist off at the top (kicker). You will only be 2-sailing a broad reach if it is real Armageddon time. This is the worst condition for nosediving (see later), and without the spinnaker the boat is badly balanced. Again, plate about a foot up, and flatten the mainsail. It is essential that the helm maintains control here, so get yourself jammed onto that back windward corner. The crew should also be well back and should do all the leaping about. Boat dead flat again. Heel to leeward causes huge weather helm and the danger of a broach, and heel to weather forces the helm into the boat making steering impossible due to the acute angle between tiller and extension. Keep playing those sheets - No Cleating! If the crew can trapeze without causing nose-dives or getting knocked off by the waves, you can have some real fun giving it the old "bearing off in the gusts and catching the waves" bit. If things get really bad though, you will be better off with both helm and crew sitting out over the back corner. But watch that heel, there's no way you'll survive a broach with the crew five feet away from that beloved trapeze wire.

3-Sail Reaching

This, believe it or not, is a real doddle once you get the hang of it. The 3-sail reaching itself is far easier than 2-sail reaching, the only flies in the ointment being hoisting, gybing and lowering the kite. The hoist should be carried out step by step, keeping control of the boat all the time. Pole on first (helm on transom to balance), hoist kite, trim guy (get it right first time), then sheet. I find it is best to bear away to a very broad reach (not a run, that's too unstable), as this allows a quicker, snag-free hoist. As soon as the crew has the guy set up, start heading up. The crew goes for the trapeze taking the sheet, and you're away. Of course it's easier for the asymmetric boys, just stay at the back of the boat, bear off onto a broad reach, and pull the strings. The drop is done the same way. Give yourself room to bear away, crew in from the wire, kite into the chute, and pole off. Don't drop the sheets under the bows! 3-sail reaching a Cherub is the business, especially when you compare it with other so-called "high performance" boats. If things look a bit tight, the centreboard should be about a foot up; if it's broader maybe 18 inches. The pole should be just a couple of inches off the forestay. The best thing is that the combination of big kite and long pole/bowsprit gives the boat completely neutral helm, making bearing away and heading up dead easy. The kite also lifts the bows, reducing the tendency to nose-dive. The neutral helm allows you to get completely carried away with steering up and down in the gusts, although this requires vast amounts of spinnaker sheet playing - crew biceps and ratchet blocks are at a premium. In fact, bearing off in the gusts is virtually automatic - dump the mainsheet as the gust hits and off the boat goes on its own!

It is surprising just how much wind you can handle with the kite up, and it gets interesting when you start to catch and overtake waves. This comes as something of a culture shock at first, but just try not to bottle out. Both helm and crew need to be thoroughly attached to the boat as the deceleration as you skip from wave to wave can be dramatic. I ended up doing this in the last races at Portsmouth in both '83 & '84 - lying 2nd, nothing to lose, everything to gain and the wind blowing a gale. We gained huge distances on both occasions; we failed to win, but it was good fun, especially in the bar afterwards!

Most beginners lose out when they are hard pressed to make a mark, and have to start to dump power. The first rule is not to let the spinnaker collapse under any circumstances. Losing power starts with the mainsail. Flatten it with the clew outhaul, then let it twist a lot; remember that the bottom of the sail is being backwinded by the kite while the top is in free air. Next ease the mainsheet, but this will be limited by the rapidly increasing lee-helm. At the same time, the crew can let the kite luff curl back a bit, but don't let it collapse. The boat can be allowed to heel a bit; although you will slow down, this will help restore neutral helm and allow you to point higher. The final and best trick of all is to let the jib out - not just a bit, let it flap completely. This works a treat. Oh, the crew left the jib sheet in the bottom corner of the cockpit? What hard luck!

Running

Those of you with asymmetrics can ignore this bit unless it is howling so badly that you daren't stick the kite up at all. The real danger for you is that the transition between sitting on the side with the kite blanketed and being blown flat by the kite filling can get quite narrow. However even for those with conventionals it is probably faster and safer to sail the runs as two broad reaches unless you are absolutely clapped out and need a bit of a rest (relative term!). The run is a bit less physical, but it more than makes up for it in nervous stress. Whether or not you have the kite up makes little difference, although it does cut down on the nosedives, but hoisting and dropping may cause problems. I don't much like dead runs as they cut down the steering options (can't bear off) and the boat is less stable. The best heading seems to be about 10 or 15 degrees off the dead run. This has the additional advantage that the gybe can be made at an opportune moment part way down the run, rather than at one of the marks. In order to improve stability, the helm and crew should be as far apart sideways as possible. The helm should get fixed to the usual back windward corner, and the crew should do the leaping about. In particular, the crew should avoid the natural tendency to go for the weather gunwale, as this forces the helm into the boat, inviting an uncontrollable weather roll. If it is really blowing, the crew can get into the back of the cockpit, behind the mainsheet and opposite the helm. This works very well, but avoid broaching, or you will be in big trouble.

Gybing

I spent a whole season in 1978, and another in 1983, falling in on every gybe, and it wasn't until 1984 that I realised why. Gybing is like that; you get it either right or wrong, and there is no in-between. The key thing, after ignoring what the books say, is to go into the gybe right. Go into it right, and you will get away with it. Go into it wrong, and you will need divine intervention. Starting with a 2-sail gybe, get the boat at maximum speed. This means a reach, and it means sitting out hard. Wait for a good wave, and go for it so that the bows will be out of the water during the gybe. Don't move across the boat too soon, as this will cause the boat to heel, giving enormous weather helm and big problems. In fact, you should almost roll gybe (honest!). The helm should move across first, so that tiller and sheet hands are changed over before the boom comes across. Don't rely on the crew getting the boom over; I usually sheet in some mainsheet as I start to move across. That also gives you some sheet to release to lessen the impact of the shock when the boom flies. A 3-sail gybe is really no different. Go for the maximum speed right up to the gybe, don't start fiddling with the kite. All the sorting out is done afterwards. It helps if, after the gybe, the helm pulls in the retriever line and the old guy (new sheet) to stop the spinnaker flying everywhere. Don't try heading up until the kite is fully set. Asymmetrics have it easy again of course, head into the gybe flat out, get the main across, and don't try to point up until you're fully sorted out.

Losing Control

Of course this happens when you simply get it wrong, or are hit by a massive gust. However there are a couple of specific high speed problems that are worth being aware of. The first is rudder ventilation. Sometimes incorrectly called cavitation, this occurs when the pressure differences caused by the rudder's operation suck air down the side of the foil from the surface. You can tell this has happened because the steering goes very light whilst there is still hull in the water. About the only thing you can do is to return the rudder to a central position and dump power. Like a skid in a car or bike, if you try and turn more it will just make the situation worse.

Its really caused by an inappropriate rudder section, be it the one you've built yourself or the one that was made by the bloke who specialises in Enterprise blades. Typically caused by too fat a section. The rudder stalling, like an aeroplane wing or an oversheeted sail has similar effects, although the feel is different. This is often caused by too fine a section. Obviously there's an awful lot more to rudder sections than that. All else being equal, the larger the blade the less likely you are to have problems because you need less of an angle on the rudder for it to have the given effect. Of course if you make the rudder big enough you'll never go fast enough to have any problems.

A new problem that has surfaced in recent years is that of the boat just taking off. There are no easy cures for this one unfortunately. Some designs seem more prone to it than others, notably wider sterned boats. It seems to be made worse by the extra lift that asymmetric kites develop. Occasionally if you're unlucky with a combination of wind and waves downwind, whilst you're racing along with the bow in the air the stern joins it too. Everything goes quiet, and the steering goes light as there is very little foil left in the water. Of course this only happens for a few tenths of a second until you rejoin the water. The problem is the landing. Cherubs, unlike shortboards, are not especially controllable in mid air, and no-one seems to have developed the art. If you're lucky you'll keep sailing, if you're unlucky its major pitchpole or even breakage time.

Nose-diving

This is dependent on your hull design, rig design and crew weight, and varies a lot with wind and sea conditions, but all Cherubs do it. The first, and obvious, solution is to get to the back of the boat. One theory I have heard is to pump rapidly as you go into the nose-dive - I've never found this works, and frankly don't see why it should. You will often find that bearing away will promote a nose-dive while heading up will get you out of it. Under these circumstances, you should bear off in the lulls and head up in the gusts, in order to make the next mark. The generally accepted wisdom is that nose-diving is more of a problem in waves, but I think this is wrong, at least when you become more competent. For every bit of wave that goes up, there's a bit that goes down, and if you sail a slalom course through the gaps you will often get away with it. This option just doesn't exist on flat water, and I've always found this more difficult. Some designs, usually the finer bow ones, will go into quite dramatic semi-nose-dives without slowing down too much. In these cases, it is a matter of experience knowing just how far you can let it go before bottling out. When the nose-dive is looking pretty terminal (waterline back to the mast!), the crew can dump either the jib or the kite. This is a last resort, as it will produce vast amounts of weather helm and possibly a broach. There are two types of capsize. The usual one is the slow one, bows in the water, rudder up in the air, and the boat just falls over sideways. As you become more experienced, this one becomes easier to avoid. The real goodie is the true pitch-pole, which is much rarer, but completely unavoidable as it happens so quickly. The bows go in, the boat decelerates very rapidly throwing both helm and crew forwards, the mast hits the water with the boat stern up, and one usually head-butts the mast at around spreader level.

Conclusions

In writing this, I've realised what the key principle is - keep as many options open as possible at all times. Mistakes and problems usually happen when you get down to your last option - the forced gybe, the enforced luff by another competitor when you're in a mess with the kite, etc. This doesn't mean fudging decisions, but it does mean that you are more likely to be able to accomplish the dodgy manoeuvres under the least unfavourable conditions

Bill Deeley (long standing Cherub Sailor & Designer, written about 1985) (slightly adapted and updated by Jim Champ, 1993).

Building a Cherub - Introduction.

Disclaimer

This document is compiled by an amateur, not a professional. It has been compiled in good faith, but almost certainly contains errors and inaccuracies. "Best practice" also changes frequently with changes in technology and materials. None of the procedures listed are guaranteed to work, and some or all of them may be hazardous. If you feel unable to take responsibility for your own actions and errors without resorting to the legal profession then you are advised not to read it, let alone build anything based on information here. In any case you are advised not to build a boat without someone experienced in the materials to contact for advice

Wood or Foam Sandwich?

These days foam sandwich is the popular option for the home builder of Cherubs. It is probably the easier material to work in and gives a low maintenance boat. On the other hand wood is still a nice material to work with and does produce a really pretty boat if you get it right! A wooden boat built in the hi-tech manner described in the article below, which is some way removed from traditional boatbuilding, will also be a little more proof against knocks and dents than a foam boat.

These articles are intended as a selection of hints about Cherub building in particular, not a complete "how to". There are many books available in shops and from libraries that will give you most of what you need. Other good sources of information are the suppliers of boat building materials.

Home building is usually a rewarding process. A mixture of blind determination and some skill in handling tools is important, although enough determination and patience can make up for a shortage of skill! Probably the most discouraging factor is the air of mystery that surrounds boatbuilding. Just remember that skilled traditional boat building is an arcane and complex art that has almost nothing in common with building a modern Cherub!

I suppose it has to be conceded that the Cherub, being a very light boat with considerable performance and very high stresses, demands careful consideration in the building process. It means among other things careful assessment of materials, quality of jointing, use of suitable adhesives, and above all finding out what other people have done successfully - and unsuccessfully in the past. There is no substitute for talking to other people who have built new boats or owned second-hand boats. The class association will always be happy to put you into contact with people who have had considerable experience of wooden construction. Fortunately Cherub sailors tend to be a friendly and open bunch, and are always ready to help with genuine enquiries.

Design.

There are a great many designs of Cherub. Most recent designs were designed for foam sandwich, so you may be a bit on your own working out details of bulkheads if you choose to build in wood. However the designer will always be happy to make suggestions, and most have enough experience of wooden boats to be able to give you some extra information in exchange for their design royalty. In selecting a design it is best to talk to others in the class. At any given time there is usually a dominant design that is a safe bet, and they can give you advice on what suits your crew weight or sailing area.

Preparation.

Having selected your design and bought your drawings you will have, at best, a large selection of drawings, a table of offsets, a selection of detail sketches, and a list of suggested materials. At worst you'll just get a series of scale drawings and sections. If you don't have a table of offsets you will have to cross check regularly as temperature and humidity changes can distort drawings.

If you are building in foam you will need a jig, and in wood a set of building frames. Either way the aim is to get as fair a hull shape as possible and one as near to the designer's intentions as possible. There are two ways of doing this. Firstly you can trust to luck, make the formers to the shapes given and, once it is all set up, fill in the dips and pare down the bumps that will almost inevitably appear when sighting from various directions. This sometimes works well, especially when you are on your 5th or 6th boat and have had some practice! It can also be a bit risky if some of your measurements - notably rise of floor - are near the limits before you start paring!

The second method is to 'loft' the lines, which is basically drawing them out full size (emulsion painted sheets of hardboard are good), having drawn an accurate grid of station and water lines on which to plot the offsets. If you don't have a table of offsets you can scale them from the drawings, although this is tedious and it is easy to make mistakes. The great advantage of lofting is that by referring back and forth between elevations and plan you iron out bumps and hollows and can easily check that measurements are within the limits allowed. Another benefit is that many of the construction details can be plotted and the details taken off by paper patterns. For information about lofting refer to 'Complete Amateur Boat building' by Michael Verney (pub. John Murray) and 'Boat Building' by Howard Chapelle (pub. Allen & Unwin). Don't refer to them too much for constructional details though - Cherubs are rather different.

Jim Champ (adapted from Dick Jarret) 1996

Building a Foam Sandwich Cherub.

Why Foam Sandwich?

The first thing to realise about foam sandwich construction is that it is easier for the amateur to build a strong light foam sandwich Cherub than it is to build a plywood one. The second thing to realise is that the materials involved are inherently more hostile to humans than those used in building wooden boats, and rather more handling precautions need to be taken. This is especially true for those of us who are used to being up to our wrists in Aerolite 306, with no greater precautions than a bucket of water to wash off acid spills (not that such practices are a good idea).
There are two stages in building a foam boat. The first stage is to build the mould or jig that the hull is to be made about, and the second is the construction of the boat itself. The alternatives are to build the boat from a female mould, or to build it on a male jig or mould. Building a female mould is a very lengthy business, as it involves making a complete model of the finished boat, absolutely fair, or taking a mould off an existing boat. The class mould was taken off Norwegian Blue, Dave Roe's boat. Building inside a female mould is not really an amateur's project as it involves vacuum bagging etc. Similarly there is little advantage for the amateur in building from a male mould.

Planning the project.

This is vitally important with a foam boat. Whereas with a wood boat you can move fittings about easily, on a foam boat you need plywood or high density foam pads built in at an early stage. It is possible to do this later, but it is a lot of hassle. Before you start work out your internal layout as best you can, including any likely changes in the future (!) and draw up a diagram showing exactly where you are likely to want fittings. You can neither screw nor bolt fittings into foam sandwich, no matter how big a backing plate you put on.

Building the Jig.

It is often possible to borrow a jig from someone else who has made a boat. In the UK most jigs seem to be used quite a number of times. However if you are building to your own design you have no choice. Spend a considerable amount of time on this. If the mould is not true, fair and symmetrical then the final boat won't be - one or two of the early Bistros are a little crooked about the transom at deck level for this very reason. The mould is normally constructed of 12mm plywood formers at 12" intervals with battens at reasonably close intervals. Mark out the plywood formers using templates drawn on drafting film, not forgetting to allow for the thickness of your battens. Also build a ply keel former (longitudinal). This is used to help align all the transverse formers. The formers should be screwed down to a pair of rails, 4" by 2" is adequate, to keep the whole thing solid. Once you are confident that they are all in exactly the correct place you can start putting on the battens. 1/2" square is perfectly adequate for these. Start with the chines gunwales and centre line, double and triple checking that everything is fair. They are best screwed down so you can alter them. Once the main battens are in you should put in sufficient others to support any large areas of foam, especially in areas like the underside where space is critical. Once they are all on it is a case of sanding and adjusting until you have exactly the shape you want. After some 4 months graft you will be in the same position as the someone who is borrowing a jig!

Materials.

One advantage of being an amateur is that time is less of a constraint. If a pro goes a couple of days over building a boat then he doesn't eat for a few days, whereas an amateur just doesn't get to sail so quickly. Therefore there is less need to compromise on materials in favour of speedy construction. The other factor is that you are saving so much money on the cost of a new boat that it is easier to spend a bit more money on the constituents.

Foam.

8mm or 10 mm Termanto or Divinycell is normally used. The hull floor and the false floor should be 75/80g/cm3 for dent resistance as should high load areas like the front bulkhead & space frame , but 55g/cm3 is adequate for topsides and other verticals. Use the heavy foam for sidedecks and anything else likely to be exposed to the dreaded trapeze hook! Pads for fittings can be made from 200g/cm3 foam.

Fibres

There are several choices of fibre layup that will work well. Most boats at the moment are built from two layers of 200g glass on the outer shell. The best weaves to use are either 45/45 bi-directional or crows foot. Bi-directional is strongest, easy to use, but rather expensive. Crows foot weave is very easy to shape and a bit cheaper. Standard weave is difficult to get to run over corners and chines, and also weakest. Local reinforcement can be a very good idea. Unidirectional carbon is favourite, as it is very easy to use. It should go in the areas subject to heavy loads from the rigging, front bulkheads, space frames etc.

Resin.

The major choice is between polyester and epoxy. Polyester is cheaper and easier to use, Epoxy is more expensive, but is reckoned to lead to a longer lived boat (Flat Stanley for instance). Polyester also smells strongly, and as far as I am concerned is right out if you are building the boat in the living room or a garage attached to the house. On the other hand epoxy is mildly carcinogenic and can cause allergic reactions, but in both cases it is important not to get the stuff on your hands. Barrier cream and plastic gloves are firmly recommended. Scott Bader (Strand Plastics) are a good supplier for polyester resin and SP Resins SP320 and Ampreg20 are favourites amongst the Epoxies.

Building The Boat.

Attaching the foam to the jig.

First cover the jig with plastic sheet to stop the foam getting glued to the jig - most embarrassing. Obviously don't get any wrinkles on the battens because it will stop you fastening it down properly. Next attach the foam. Tie it on with wire, the handiest to use is probably 1.5mm pvc coated (inner core of telephone cables!). Use large pieces where possible, but where there is much curvature - bow etc. - you will need to use smaller pieces to prevent it cracking as it is bent. Take a lot of trouble over this, get it absolutely flush to the battens, and keep gaps between sections to an absolute minimum. At this stage you will need to put ply pads in where any fittings will go - bow fitting, shroud plates, etc.

Next you should fill all the gaps and fair off the foam. Use lots of very light filler as all this is adding unhelpful weight. Be careful fairing off the foam, it is very easy to sand away lots of foam and leave the filler standing proud! All raised portions must be lost, but small shallow dents don't really matter too much. Once all the foam is in place, all gaps filled, and all is fair - check 3 times! - coat the foam with a mixture of resin and microballoons or litecell. The aim is to fill all the open cells on the surface with light filler, otherwise it will get filled with heavy resin when you put the glass on. The best tools to use for this are a one foot plastic ruler or a piece of formica with a straight edge.

The Outer Skin.

Apply the laminates next. If you can arrange it so that the fibres run at 45 degrees to the centre line the boat will be much stronger than if they are aligned and at 90 degrees. You may use a bit more cloth, but it is well worth it, especially if you are using a light lay-up. Use a brush and a consolidating roller to ensure full impregnation - which can be a problem with Kevlar - and good resin to glass ratios. Remember you need enough resin to fully impregnate the fibre, but any more is just parasitic weight. Peel ply can be used and is very effective but rather expensive. A resin to glass ratio of 1.1-1.3:1 is achievable with polyester, and 1.8:1 with epoxy.

The Inner skin.

Once you have done this cut all the wire ties and turn the hull over. It will be very floppy so support it in a good cradle. This can be used as the basis for a trailer when you've finished the boat! 1 layer of 200g glass is sufficient for the interior, with perhaps a bit of unidirectional carbon where the rig loads come, and an extra layer of glass around where the daggerboard slot will come.

Space frames and bulkheads.

These can be made outside the boat and cut to shape and fitted later. A really good trick is to compress them while they are curing. Do this with a couple of sheets of flat wood (chipboard is fine), covered with melinex - polythene may wrinkle. Put one piece on a flat floor, add your lay-up, and put the other sheet on top and weigh down with anything to hand - I used the last 5 years of Yachts and Yachting and Boards magazines. Bulkheads can have one layer of 200g glass each side, but the space frame and high load points should have uni-directional carbon reinforcement under the glass. The bulkheads can be glued straight in with epoxy fillets, but the space frame should be glassed in to distribute the loads. It should hit your ply pads too!

Daggerboard case.

Use low density foam. Glass one side of the foam and allow to cure. Then bend each half of the case around the daggerboard and clamp in place. Don't forget the plastic sheet to stop it sticking. Glass around the outside, then remove the board and cut the case down leading and trailing edges. Coat the inside surface with a gel-coat type layer, preferably with graphite in, so that the fibres cannot get worn down. The two sides are then spaced apart a bit with foam or wood, and the whole lot glassed together again.

Decks and Interior.

Made in much the same as the bulkheads. You can use a jig - especially if you are making neat rolled side-decks, or use the bulkheads as a jig. Don't forget ply pads where fittings will go - jib sheets, cleats etc. etc.

The False Floor and Finishing Touches

Use high density foam. Glass on the bottom layer before you put it in the boat, using one layer of 200g glass. Put a fair bit of light resin/filler paste on top of the bulkheads and weigh it down (Y&Y again ?) until it is cured. Once it is firmly attached you can put the top layer of glass on. Use two layers of 200g. Leaving the top layer off while you attach it leaves the floor more flexible while you fasten it down.

Lastly run an extra layer of glass over the gunwale where hull and decks join, partly to keep the whole thing together, and also to give some abrasion resistance for rigging on concrete and to help protect against unplanned impacts from solid objects!

Fairing and smoothing

Absolutely crucial of course, not for strength but for boat speed. Use the lightest filler you can afford, mix it in resin, and spread it on as evenly as you can. A plastic ruler is very good for this. Once it is cured you can start sanding it all off again, the aim being to get down to a fraction of a millimetre above the top layer of cloth. In practice you are bound to end up sanding some cloth off, but make sure it is the very bare minimum. If you have a layer of Kevlar you must not expose it. Kevlar doesn't sand off - it leaves little fibres sticking out!

Cost & Time.

It will take you in excess of 200 hours to build a hull once your jig is finished. Most people seem to take about 4 months to fit it all in including fitting out etc. Foam sandwich is a more expensive option than wood, but the final total will depend tremendously on materials. As of 1991 the bottom cost is probably about UK£500 for a glass/polyester boat, going up to UK£800 plus for an epoxy/part kevlar hull.
If you don't want to do the whole job yourself, whether through lack of time, skill, or inclination, an obvious alternative is to start with a part built shell. Quite a nice option is to buy a shell complete with false floor, which means that the trickier jobs are done.

Jim Champ. This article was compiled in 1991 with the help of Dave Roe, Alistair Cope, Bill Deeley, Simon Baker and Simon Roberts, and updated slightly in 1996.

Building a Ply/Glass Cherub.

Recommended materials.

Hull floor

4mm ply. 60g kevlar or 105g glass coating on the inside, 105g glass on the outside skin.

Topsides, decks, bulkheads, daggercase sides etc.

3mm ply. 105 g glass or 60g kevlar on at least the inside skin.
Use lightweight Gaboon ply (hardwood veneered looks very nice but can be a bit heavy). Nowadays by far the best source is Israeli made WBP gaboon, which is light, strong and very cheap.

Stringers, stem, other strip wood.

Western Red Cedar is favourite. It splits very easily, and needs to be coated from ply surface to ply surface with glass.

'Decorative' stripwood - Gunwhales etc.

Spruce or mahogany. Spruce is lighter, mahogany is more durable, but can be very heavy. At the most a thin capping is all you should use. Really good clear pine may be almost as light as spruce and is easier to get hold of. Getting suitable wood can be a problem, and be very careful about adding weight. If you are not worried about getting a Grand Piano appearance then use cedar and glass coat it.
Some people have even used balsa wood coated in glass for glass coated stripwood, but of course in this case the wood is doing no useful work, and serious quantities of balsa wood get very expensive.

Building Jig.

Formers are best made from something like 3/8" building grade plywood. Slightly damaged sheets can often be got cheaper. Strip wood can be anything that's reasonably solid and cheap. If you're using second-hand wood make sure you get every nail out! You will need to end up with a set of formers no more than 18" apart (12" near the bow), set on a rigid foundation if you are to produce a fair and symmetrical hull.

Glues.

Use Epoxies. SP320 is the best for the sort of fibre re-inforced ply construction we are talking about here, SP106 or West 105 are cheaper.
Traditionally Cherubs were built out of Aerolite 306 or Aerodux. These still work fine for all wood boats, but the techniques are very different to those described here, and weight is a significant problem with the more traditional sort of construction.

Tools.

A staple gun is essential for fastening plywood down. It is cheaper and lighter to tack down with staples and remove them afterwards than to use expensive marine-grade fasteners and leave them in. Otherwise normal carpentry tools are fine, but you can never have enough G cramps. If you have less than about 15 get borrowing!

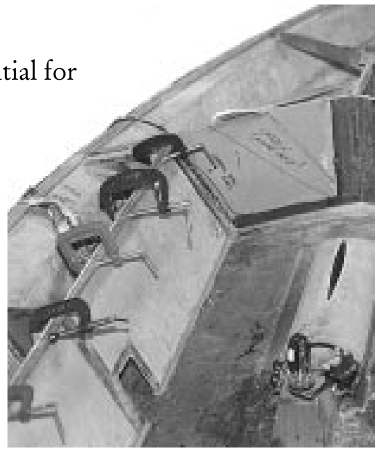


Photo: Jim Champ

Construction.

Advice is always helpful, but make sure you understand it completely! Be a bit careful of people who have built 5 Enterprises. They will probably tell you that such and such a bit has to be that thick or glued on that way. It may well end up too heavy and not strong enough! If advice does not seem to add up pay attention to your own inner murmurings. One excellent piece of advice is to have a comfortable 'thinking chair' in which you can put your feet up with a cup of tea - or something else relaxing - and look and think hard about the current problem. Thinking time is rarely wasted - especially if it means you don't have to do something twice!

Cherub Specifics.

I will assume that you are building a self draining boat, to be quite honest if you don't you will curse yourself when you start sailing it!

Ply joints.

Any place where two bits of ply join at an angle needs a generous lightweight fillet, preferably with glass reinforcement running 1" or more from either side of the join. Beware weight. Use the lightest possible filler. The glass over the join should be cut on the bias at 45 degrees - it will go round corners more easily and is twice as strong.

Bulkheads.

Wooden boats are like banana skins. The longitudinal seams will split open unless they are sufficiently braced across the join. This is mainly achieved by transverse bulkheads. Locate these about halfway between the mast and the bow, under the mast, at the rear of the daggerboard case, under the mainsheet position, and between the mainsheet and the transom. The transom itself forms the final bulkhead. This one needs to be 6mm wherever rudder fittings will attach, and really solidly glassed in. Cherubs are notorious for rudder fitting problems. It is better to have a smallish drain vent in the transom rather than a completely open one, both for strength and for sailing. A longitudinal bulkhead will run from bow to stern. Don't forget to arrange for the minimum 3 buoyancy tanks.

Outer Skin.

Absolutely vital is a really good join at the centerline and chines on the outer skin. Some people cold-mould the bottom out of thin ply strips, and this gives a really strong boat if you have the time and skill. In the days before false floors two layers of 3mm ply for the bottom skin were recommended, and in this case the joints were staggered.
A single of 4mm ply is recommended. A lot of modern designs are very flat floored, and it might be possible to get away with a single sheet, but this will very much depend on the amount of rocker. Normally you will need a joint in the middle. For the reinforcement you could put stringers on the inside, (and in any case one light stringer will probably be needed to keep the profile correct), but a much better way of stiffening up and supporting the outer skin is run the inside fibre coating over epoxy fillets onto the hog and chines. This provides a really good support with a minimum of hard spots. The hull skin should also be glass coated on the outside, and this should be done last of all, running from the underside of one gunwale to the other.
You will need to scarph joint two pieces of wood for the bottom panels as 12'6" lengths of marine ply are rarely available, and this is best done on a flat surface before putting the panels on the boat. You may well find that vertical strips need to be cut in the skin on the centre line near the bow because of double curvature. If you have a really complex shape you can make it up from all sorts of odds and bits. In any case, once the boat has been turned up, you will need to add a lot of stiffness in this area, which takes a real pounding going upwind in a chop. Probably the most suitable method is to use two layers of uni-directional carbon criss-crossed diagonally from chine to hog, and then a layer of glass over that. Try to fillet and shape the hog to let the glass go in one piece from chine to chine. This area used to be a common point of failure in the old days, and is one where the use of modern materials really pays off. Extend this extra reinforcement to about six inches behind the daggerboard case.
The glass coating needs to be made with a very low resin to glass ratio. Beware of adding weight! The way to achieve this is to use a heat gun to warm up the resin and a roller to really spread it out. Don't be tempted to warm up your pot full of epoxy though, it will go off in no time at all, leaving you with a beautifully moulded epoxy casting! It is wise to keep your resin in a tray once it is mixed as it will not go off as quickly.

Mast support & Space Frame.

This is an important issue. With the sort of rig tension used these days the peak loads going down the mast probably approach tons! Exactly how you step the mast is up to you, but the favourite location is on the false floor. It is conventional to support the mast with a space frame. This is not the sort of alloy contraption you find on some boats, but a ply/carbon/strip wood construction integrated with the main bulkheads in this area. Longitudinally it runs from the keel under the mast up to the top of the bow, from there up to the prodder anchor point, back down to the mast foot, and from the mast foot back down to the hog. Maybe also back to the post. Laterally it goes from the mast foot and the hog out to the shroud anchorage points, the front bulkhead being angled back on both sides. Arrange it so that the mast sits on the crossing point of the longitudinal and transverse bulkheads. You will need a really strong point for the prodder. It is advisable to have a foredeck on a wooden boat as it does a lot to stiffen up the front of the boat and support the rig loads. The basis for the prodder support can be the beam down the middle of the foredeck, which meets the upward extension of the space frame. Put a transverse bulkhead across too, but make it very light as it will take very little load (except when the crew crawls across the foredeck to disentangle the kite. The bulkhead supporting the foredeck will also be angled, but should run from the shrouds to just in front of the mast.
With the typical Cherub rig of lower shrouds and prodder you will not need to support the mast at deck level, but you might want to put a bit of strength there in case fashions change.

Daggerboard case.

Fortunately the false floor does a lot of the support for the daggerboard case. If you have a stringer each side of the daggerboard case to support the false floor they can support the sides of the daggerboard case. You may well want to bring the daggerboard case up a bit higher as the foundation of a tunnel. This keeps control lines out of the way, and gets the bowsprit out of the way when retracted, and can be used to stow the kite. The tunnel is probably best made from two layers of 3mm ply to give stiffness.

False floor.

You will have a variety of bulkheads to mount the false floor on as detailed before. Naturally all those which are not required to be watertight will be reduced to webs. These should have slim battens mounted on the top. You should also have stringers running down in the main stamping area. Work out exactly where the battens etc. are going to run, and put an extra layer of glass on the underside extending 25mm each side of where the bulkhead will touch. This will reduce the hard spot considerably. The floor should be 3mm ply with a layer of 100g kevlar on the underside. On the topside put a layer of 105g glass, and run it up over the fillet where the sidetank joins. This will stiffen it up, add wear resistance, give you a non-slip surface and make holes much more unlikely. While on the subject of false floors, you will no doubt need hatches in them, but never put them where they can be stepped on. The hatch causes a hard spot which will crack. Right in front of the transom is a good place, and it also gives good access to bolt on rudder fittings.

Side tanks

If you have a reasonably deep false floor you can probably do without side tanks. However I would still advise side decks as they stiffen up the gunwales so much. The join between tank side and floor is a common point of failure, give it a good fillet and glass reinforcement. You may as well have some kind of side tank, because the box section gives so much extra stiffness, but you may well want to run sheets and things through forward.

Time.

Probably 200 hours or so with experience, and maybe approaching 300 for the first time builder. Cost of materials depends vastly on what you use and where you can get it. As of 1991 you would probably spend between UK£300 and UK£600 pounds on the hull, which is appreciably cheaper than foam sandwich. Finally - don't forget: If in doubt - think. If still in doubt, ask a few people and think again. "Think twice and cut once is a very appropriate maxim. Have fun!

Jim Champ, adapted from Dick Jarrett. Andy Paterson of Bloodaxe Boats gave me a great deal of help in preparing this piece, in particular in the choice of materials and other details of fibre-ply sandwich construction.

Fitting Out A Cherub.

Rigging

Keep It Simple.

There is absolutely no need for complex controls on a Cherub. The modest sail area means that the rig is kept powered up most of the time, and spectacular rig controls only distract from the serious business of sailing the boat as fast as possible.

Standing Rigging.

You need two shrouds, one set of spreaders, lower shrouds to gooseneck height, and a prodder. The lowers don't need to be adjustable, but you need an easy way to tension them. A kevlar lashing is as good as any, very cheap and very effective. The lowers must be anchored with T terminals. Any kind of rivet will either snap or pull through the mast. The other end should be absolutely rock solid, bolted and ideally putting its anchorage in compression - e.g. running round the gunwhale. All fittings must be stronger than you think. Everything should be bolted on and attached to something secure. If you have the slightest nagging doubt about something it will break. Cherubs seem to put phenomenal loads on fittings.

Necessary Gear

Main sheet
Jib sheet
Spinnaker Sheet
Spinnaker halyard/retrieve
Pole or Bowsprit/retrieve
Kicking strap
Cunningham
Outhaul

Optional Gear

Jib slot (barber hauler etc.)
Prodder adjustment
Main halyard

Unnecessary gear

Jib halyard
Adjustable standing rigging
other trendy trivia

Mainsheet.

There are two popular mainsheet systems. One is to have a central post (like a hoop, but lighter and cheaper), and the other is to have a fixed bridle at the transom which joins the mainsheet at boom height. In either case the mainsheet is led to the centre of the boat, has a ratchet block, and if there is a jammer it should be arranged so that the crew can use it from the trapeze.

Jib sheets.

They can be led to anywhere convenient, with a jammer that can be freed and jammed from just about anywhere in the boat, since the crew will be trapezing right at the back of the boat on windy two-sail reaches. Inboard from the shrouds is a good place, out of the way but accessible. Continuous jib sheets are popular.

Spinnaker sheets

These are invariably continuous. Ratchet blocks are essential, and the same comments on jammer location apply. A lot of spinnaker sheets are led through the topsides and this makes for a very clean sidedeck. The turning point for the spinnaker sheets will never need to be aft of the mainsheet, and may be as far forward as the shrouds with some sails. All sheets should be long enough for the crew to be able to fully free the sail from on the trapeze at the back of the boat. If they are too short you will regret it!

Other Spinnaker Gear.

The adoption of asymetrics has simplified spinnaker handling a lot. There is no spinnaker guy, and the sheet is really easy to handle and rarely cleated. The spinnaker halyard will double as the retrieve line. A double patch system is normal, with a chute or hatch about a foot behind the stem to reduce tangles with the jib foot. The halyard and the retrieve should be arranged so that helm or crew can handle it. Launching and retrieving is quicker if one takes the halyard and the other the pole and sheet, but if it's blowing 30 knots the helmsman will be a little preoccupied with keeping the black plastic stick out of the water!
There's more than one way of dealing with the bowsprit of course, the choice being between "one string" and "two string" systems. One string systems have the advantage of speed and simplicity of handling, but two string systems give you more options to take the kite down steadily when things don't look too clever. You take your choice!
A typical one string system is arranged so that the halyard runs down the mast, forwards to a location near the bow, back round a block on the inboard end of the bowsprit, back to the bow & another block, and finally back into the cockpit and the cleat. The tack of the kite is attached to a "guy" coming through the pole and to an anchor point in the boat. Its set up so that the line is taut and the spinnaker tack right down to the pole end when the pole is pulled fully out.
The "guy" is set up just the same in a two string system, but instead of the halyard a second line runs up to the bow and back to the end of the pole to pull the pole out. Depending on the friction in the system and the strength of the crew you might wish to have a 2/1 purchase on this, but plenty of people get away without a mechanical advantage. There's no retrieve for the spinnaker pole as such, pulling the kite in is enough to bring it back in. If your spinnaker pole isn't strong enough to operate without a bobstay then the best way of arranging one is to have the "guy" running through the end of the spinnaker pole and out again and then down to the bow. In this case the line is tidied up by having it pass through a ring or pulley inside the pole, which in turn is pulled back with shock cord. This works well enough, but you'll probably need a little more purchase on the outhaul to make sure the bobstay is tight enough. The anchorage at the bottom of the bow is also a problem. Apart from the water resistance, if it's not well integrated in the hull it can pull the bottom of the stem off!

Sail Shape Controls

Kicker and cunningham are usually led back to mid length so that the helm can adjust them while sailing. You will need at least 6/1 cunningham with a mylar mainsail, and probably more. Kicking strap purchase should probably be 16/1 or 24/1, but it all depends on where the take-off on the boom is, and how low the other anchorage is. The boom take off should be a nylon strap. Proctor make very good and extremely expensive ones for the 14s. The outhaul is normally cleated on the underside of the boom. You may not use it much when actually sailing, but you will need it when you see exactly what the wind is doing when you get out to the start. 6/1 is probably about right as you won't get a good pull at it.

Optionals.

The jib slot normally has a lateral control on a short length of track. About 3" of movement is all you will ever need, but if you don't know where that 3" is going to come you will want it longer. A lot of people have a height control, but it can be as simple as a cleat on the track, because you usually adjust it on the opposite tack. Don't clutter up the crew's area with a lot of string designed to let you adjust the slot in any direction at any time. He'll only trip over it and fall out on the last tack. Some people have a control to adjust the prodder. I don't bother because I want a rigid prodder to induce pre-bend. A length of track on mast or foredeck with a locking pin on the prodder slider is normally all you need. You may feel the need of a main halyard (I don't!). Wire is probably still best if you don't have a halyard lock. Be very cautious about Kevlar in this application because it's notorious for breaking without warning. Spectra on the other hand seems prone to slippage or stretch. With a 10/1 cunningham you can stretch just about anything. A reliable halyard lock is great - again Proctor make a really good and expensive one for 14s. Personally I consider the loop of rope and hook approach to be far safer since you can get the main off so much faster when capsized. Don't use kevlar for the loop though - it breaks. Use pre-stretch terylene - the length isn't enough for stretch to be a problem. Whilst on the subject of main halyards I'll mention my favourite technique for landing on lee shores. Bring the boat hove to a little short of dead upwind of your destination. Pull both foils right out of the water (daggerboard rudders are great for this). Now you can just drift in sideways until the water is shallow enough, then immediately let the boat capsize, pick it up and carry it up the beach. (Don't try this at home with a Laser 5000 children). Even at inland clubs I find this easier than using a jetty.

Unnecessary.

A jib halyard is basically a device to put a 2/1 compression load down the mast. As no one uses a forestay you can't take the jib down while sailing, and rigging a boat on its side is so much more civilised. Have a wire strop and a T terminal, and use a short lashing to get the tension. Adjustable standing rigging has never been used in Cherubs. It's heavy, expensive and complicated. Other gadgets also have no place.. Most of all, remember that the boat is weighed dry. Take all those ropes, weigh them, soak them in water and weigh them again. The difference will amaze you! Finally, don't spend too much time worrying about gear. Instead go sailing! Provided all the gear works and is reliable then it is probably good enough. Being able to change the sail shape in the middle of the race is unlikely to make much difference to your final position, but capsizing at every gybe mark certainly will. There is nothing that improves boat speed as much as crew speed!

Installing a Bowsprit.

The Pole.

Unstayed Carbon fibre poles are now more or less standard. Most are now home built, but a Windsurfer mast (7.4 or better stiffness) will also be good. If you can get a broken one with the right bit left so much the better. The length of the pole is not restricted, but about 10 foot 6" from the mast foot is typical. Unstayed poles are recommended if at all practical, it's a lot less hassle.

Spinnaker Pole Mountings

New Boats.

The best place for the spinnaker pole to retract to is under the tunnel supporting the daggerboard case. Make sure the tunnel is wide and deep enough so that the kite will stow easily and the spar won't get snagged. At the bow you will need to support the bowsprit in two places, and these will need to be very strong. The first is where the pole comes through the topside, and the second should be a small bulkhead about 18" or so further back. It is best to have the pole sliding through a tube, and the whole assembly needs to be very thoroughly glassed in. The whole structure must be rigid, and you may well have to reinforce the topsides, especially if its a wood boat. The position of the tube is critical. The Tack of the spinnaker should be exactly on the centreline of course, and the pole must retract into the tunnel without hitting mast, dagger case or the tunnel itself. This means that the pole will need to be very slightly offset to one side of the centreline at the bow - right is conventional.

Old Boats.

Life is a bit tougher for you. The chances of having a suitable tunnel are minimal. I don't know of any UK built boats which have one. As far as the kite is concerned the existing stowage arrangements will do, but don't forget the longer luffed asymmetric will come further back in the boat. Arranging the pole is very much a matter of compromise. It wants to be as low as possible in the boat so the crew doesn't trip over it too much, but you will be limited by the height of the bow tank, not to mention the need to keep the end out of the water! If you have a full height bow tank then you will either have to rip the foredeck off and put a low tank in or else make a tube that extends right through the tank. If you do this the bowsprit will retract nearly back to the transom! The pole support arrangements will be much the same as on a new boat, but the bulkhead and anchorages will need to be looked at very carefully as loads are being put on that the structure was never designed for. Wood boats with 3mm topsides will have particular problems and will need extensive reinforcement.

Making the bits.

The tube that the pole slides through should be at least 4 layers of 200g glass (or better). Mould it round the pole. The technique used with mast building of coating the "mould" in wax and melting it out out afterwards with hot water will be best, but failing that put on several separate layers of polythene sheet. It needs quite a few layers because the lay-up will shrink a little on curing. Unless you use wax you will have a lot of trouble getting the tube off the pole. Cooling the whole assembly down to shrink the tube helps. I suppose foam sandwich is probably favourite for the bulkhead, even on wooden boats, because the width of the foam helps support and keeps everything stiffer. Glass it in well, and make sure its attached to something strong. If its just glassed onto topsides and decking it will all warp.

Assembly.

This is definitely a job for measuring 3 times and gluing once. Start by fitting the bulkhead, but leave a bit of play where the tube comes through the topside. Check and double-check that everything is lined up correctly both with the pole in position and retracted. There is at least one boat where the kite tacks down 6 inches from the centreline - you don't want yours to be the second.

Building a Rudder Gantry

These are by no means essential. They help keep the back of the boat clear and aid steering on a two sail reach. On the other hand the loads are tremendous and a failure is a guaranteed race loser.

Materials

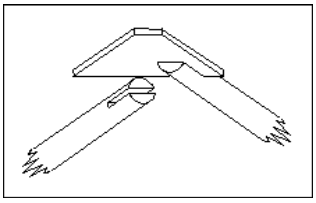
Successful gantries have been made out just about everything from wood merchants dowel, reinforced with carbon to titanium! The trouble is that unsuccessful gantries have been made out of just about all these materials too. The secret of a good gantry is the joining of all the components. The individual beams rarely fail, it's usually a join or the attachment to the boat. If you stick some bits of wood dowel together and bodge it with a bit of epoxy filler it's unlikely to stay together. Similarly if you attach a gantry - which creates considerable and variable tensile loads - straight to the outside skin of a foam sandwich transom the transom will delaminate and the outer skin will be pulled off. Aluminium - let alone titanium - fabrication is a rather specialised area, and best left to those with appropriate experience. Aluminium gantries assembled from pieces bolted together tend to fail, and an all welded construction is recommended. Without specialist facilities and experience you will be better off using epoxy/glass construction.

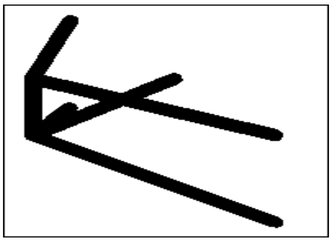
The Bars

If you can reliably make good solid tubes then make some and use those for the structure. If you've just built a set of carbon spars it probably won't stretch you too much. Alternatively it is possible to buy suitable glass or carbon tubing. It's also quite easy to fabricate your own. The alternatives seem to be half inch ordinary builders dowel or one inch balsa. There doesn't seem to be a lot of difference in practice. The way I wrap the laminate round the core is as follows:- cut out the fibres for the lay-up first and lay it out on a flat surface on a sheet of polythene. I used enough unidirectional carbon to go around the core about 2 and a half times, with an outer layer of enough glass to go round about 1½ times, the glass being on the outside for protection. I wetted out the resin with epoxy and then wrapped the whole lot round the dowel, making sure no polythene was trapped under the cloth. I then wrapped adhesive tape very tightly round the polythene, starting in the middle and working outwards in order to compress the laminate right down onto the core and squeeze out excess resin to keep the resin to glass ration as low as possible. Take the normal precautions - gloves and barrier cream etc. - when handling the epoxy of course. Once you have the bars - prefabricated or bought - assembly can commence

Assembly.

This is where the project will go right or wrong! I started by making up two V shaped assemblies for the top and bottom. The join was made by cutting a 3mm slot about two inches into the end of each bar and sliding in a ply flange which overlapped the tubes by about two inches. I then put 3 layers of carbon and two of glass over both tube and flange and let the whole assembly set rigid. The flanges can be trimmed down later. I joined the two halves together with a hollow tube through which the pin for the rudder stock runs, and used similar flanges running the full length of this tube up to both the top and bottom V shaped assemblies. It's also conventional to add a further tube running diagonally upwards from the centre of the lower assembly to the transom to brace the structure further. In all cases webbing the joints is vital and adds immensely to the strength and stiffness of the structure.





Attaching to the boat.

Also vital. A solid stiff rudder and gantry assembly floating a few feet behind the boat has no effect on the steering! There is no substitute for having really stiff and solid mounting points built into the boat. On my boat I have ply pads built into the structure, and the gantry has flanges built onto the end of the bars reinforced with carbon and glass in a similar way to the bracing webs. The gantry is then through bolted through flange and pads onto the transom. Alternatively take the bars of the gantry right through the foam transom. Glass or carbon strips can then be run round transom and bars, and also along the false floor. In this way the loads from the gantry come right through the transom and are well spread, avoiding the risk of delamination of the transom. On wood boats the bars should come right through the transom beams and be well epoxied and filleted in.

Fittings

A lot of problems with composite gantries and rudder stocks come when aluminium or stainless steel fittings are attached. It is virtually impossible to get a reliable bond between metal and composites. If you must use metal fittings then bolt them on solidly to ply pads - nothing else will do. Much better is to fabricate the fittings from epoxy/glass. A pintle will rotate just as happily in a glass tube as in a metal one, and you will find it a great deal easier to integrate the glass tube with the rest of the structure. No doubt it would be possible to create carbon pins for the male part of the fitting, but I prefer to have female fittings on both stock and gantry and run a single stainless steel pin right through the lot.

Jim Champ, 1991/6

Building Carbon Masts

Introduction

Mast building is probably the most challenging laminating job the amateur boat builder is likely to take on. It means handling a lot of material in a particularly tricky lay-up, and the consequences of getting it wrong are serious. If you build part of your boat with an unnecessarily strong lay-up then you've wasted a little bit of material and added a few grams of unnecessary weight, and if you make it too light then there'll be a small loss in stiffness and possibly the need to reinforce it. The kind of lay-ups described in other sections of these articles are very much on a "that will be plenty strong enough and adequately light" basis. Masts are more difficult. OK the possibility of making it badly and it ending up breaking is there, but that.s not the major issue. What's more serious is that the actual stiffness on the mast has - of course - a huge effect on the performance, and the actual difference between what we'd regard as a stiff mast and a bendy one is not really very much. This means that's its reasonably easy to end up with a telegraph pole or a fishing rod...
Don't take on a mast until you've done a good lot of laminating and can consider yourself reasonable skilled. You're also well advised to do a boom or a bowsprit first because the much smaller size makes the project easier, there's less of a worry about it ending up too stiff, and in any case its not such a big lump of cash in the bin if you get it very badly wrong.
This article is also rather less of a "how-to" than the others in the series, and rather more of a "how we did it". The folk who are building masts within the UK fleet are doing it with the benefit of some years experience and several boats behind them. There's no substitute for "getting your hands sticky". Its also well worth pointing out that there's no consensus as to the best way of building masts yet, and there are other methods that work just as well - maybe better.

Designing the Section.

Its possible to start with a theoretical list of stiffness values and so on, and then go from there. This is what the companies who build big one off yacht masts and so on must do. All any of us have done is to start from a know alloy mast with published data as a basepoint, and then say - well, a bit stiffer sideways, much the same fore and aft, bendier at the top and so on. Working out the values for mast taper is mostly informed guesswork as the figures are not published, and although we have tried to measure one, we didn't really get any results that we had too much confidence in.
Designing the section isn't about the cross sectional shape itself, so much as identifying the dimensions and fibre lay-up that will give you the stiffness you want. The maths is roughly Mechanical Engineering graduate student level, which may not daunt you, but rather does me. If you have access to reliable information that other people have worked out then all well and good. Basically a carbon mast tends to consist of a substantial layer of unidirectional fibres sandwiched between two layers of woven carbon which are primarily there to keep the unidirectional carbon in column and prevent buckling and peeling.
There are two ways of going about working out what this this lay-up should be.
One is to start with an existing mandrel or mould and then work out what lay-up is going to give you the stiffness you want.
The other alternative is to work out what lay-up you want to use, and then build a mandrel or mould to give you a section that will do the job you want. For instance Dave Roe's 1997 mast was based on 4 layers of unidirectional fibre. The actual mathematics required to design the lay-up is beyond the scope of an article like this - suffice to say if you haven't got either the mathematical skills or access to someone who has, or access to the technical information on the materials you propose to use, then probably you shouldn't be getting into mast building at the present state of the art
As an example one starts with the stiffness value of the particular carbon that you intend to use for the main structure of the mast, take off an allowance for the amount of resin that is likely to be in the lay-up, add allowances for internal and external skins (usually an order of magnitude smaller than the main unidirectional fibres), add an allowance for the mast track and then see what sort of figure you arrive at. This result may be unsatisfactory for one reason or another, in which case you have to repeat the exercise until you get something appropriate. A particular consideration here - especially with dinghy masts - is that they get bashed about a fair bit, what with beaches and trailers and roof racks and so on. Its probably fair to say that anything with a wall thickness of less than 1.5mm will be too prone too damage when not in use, no matter how appropriate the structure is for sailing with.
A couple of rules of thumb that can be of use are:-
Carbon rigs tend to be at least 20% stiffer than the equivalent section in alloy. This means that you can usually go one section size down when basing a carbon rig on an existing alloy one.
A 200g carbon cloth makes for about 0.2mm of section thickness in a lay-up.

Material

You must be using a low viscosity resin with a very long cure time. It will take you hours to laminate up the tube. Resins from the Ampreg range are the conventional choice - Ampreg 26 is good. There are several reasons for using the Ampregs, which are, on the face of it, very expensive, but basically it boils down to "you get what you pay for" and in the case of the Ampregs you get an easy to handle lower toxicity resin with lots of desirable properties like low heat sensitivity, especially when cured. Don't economise on

resin. Especially, whatever you do, don't consider using polyester resin!
There are all sorts of nasty small scale phenomena that can occur in carbon masts which just aren't an issue in a relatively low stressed hull construction that can cause all sorts of problems. One of the worst is "microcracking" which occurs if the resin takes up load before the carbon and cracks. Suddenly the carbon is unsupported and... I'm sure you can guess what happens next.
In the UK we tend to use fairly ordinary grades of carbon, which seem quite adequate. For the woven cloth inside and out we use a single layer of 200gsm carbon, which is the most economical currently available. Two layers of 100gsm carbon, aligned in different directions would be superior, but four or five times the cost. Higher grades or carbon could certainly reduce the size and weight - Dave Roe has calculated that he could make a 1.5 inch diameter mast that would be around 70% of the weight of the current ones, but that the material cost would be something like three times greater...

Laying it Up

Release Agent

In the past we've used a lot of paraffin wax as a mould release agent that can be melted out. If you have appropriate facilities and are using an aluminium mandrel then laminating and curing at a relatively high temperature can help considerably as the thermal expansion of aluminium exceeds that of carbon lay-ups. Experience seems to indicate that ordinary mould release agents just won't guarantee you to be able to get the mast off the mandrel. This is an area that the commercial mast makers are looking at a lot, and will need to be solved before true mass production mast making can happen.

Consolidation

Lay-up consolidation is absolutely essential. The best bet seems to be vacuum bagging. There are people who use tape successfully, but there are a number of dangers in this, most especially that of dragging the lay-up round the mast in a spiral which will probably result in less stiffness than was planned. I don't propose to go into a full treatment of vacuum bagging for the amateur here, but there's space for a few pointers. Supposedly there are some good books on the subject, but we've all learnt from talking to people. There's a lot of people who use the techniques in one industry or another these days, at least in our part of the world.
Peel ply is essential. Perforated release film is good, but hopefully the peel ply will soak up the resin unless you've got far too much in the lay-up anyway. Breather cloth is quite cheap, and you may as well use the real thing, even though some people use Chopped strand mat instead (about all its good for!). Even old blankets from a car boot sale will do the job at a pinch though, and are much better than nothing. You can use virtually any airtight sheet plastic for bag film but proper bag film is very thin which leads to smaller wrinkles, a better finish and less extra work. You will need to smooth the bag down as the vacuum goes in to minimise the wrinkles. Where the vacuum goes in is important - in practice bags always leak, and so if you have a leak near the inlet you may not get much vacuum at the other end. A tube with holes in to distribute the vacuum is thus a very good idea to equalise things out. SP recommend no more than 0.5 bar for the vacuum but by the time you've spent 4 hours laminating it up so the first layer is half set, you're working maybe in 16 degrees instead of the specified 21 then you may need to go higher simply because the viscosity is higher and the mix has half gone off as well. In practice if all the bleed cloth is saturated in epoxy you won't get much more resin out of the mix, and if you've put 4 layers of unidirectional on that's about right. The danger with more tractable lay-ups is that you can actually suck so much resin out of the cloth that the strength is badly compromised
Having said that the lower the resin ratio the better (well almost) and carbon masts need to be as dry as you dare go. At a maximum you should be looking at a lay-up that is one gram of resin for every two grams of fibre. If you're not confident about achieving that then maybe you want to tackle another boat before you do a mast. Unidirectional cloth that has glass binder is useful for helping you see how well wetted out the lay-up is. Its also worth noting that the consolidation effect of the vacuum increases exponentially with the decrease in pressure, and at the far end small improvements can lead to big changes.

Inner Layer

The technique we've used is to lay the mast up around a mandrel - effectively a male mould - and vacuum bag the mast onto that. Others have apparently made spars by making a female mould and using a bag on the inside to consolidate the lay-up. I guess that this would be more work on the mould, and more trouble to lay up, but be considerably easier to remove mast from mould.
The first (inmost) layer of lay-up is local reinforcement where fittings and so on will go. This is usually plain glass, and then a layer of light kevlar. This has two roles. The first is to add local strength where fittings and so on penetrate the mast, and the second is that the glass insulates the electrochemically active carbon from the fittings. Kevlar is chosen because its excellent for resisting crack propagation and so on, but has a tendency to go "furry at the edges", which glass doesn't suffer from.
The next layer should be Carbon cloth, 45/45 degree aligned for torsional strength. This is adequate for a dinghy mast, but something bigger will need to be designed more carefully. Its worth noting that, in contrast to a metal mast, fibre masts are not made out of a homogenous material, and can and will have significantly different properties according to the alignment of the fibres. It is not especially easy getting

the fibres properly aligned and can be wasteful of cloth. None of this job is easy!

The Main Fibres

Once these layers have been cured and tidied up the main lay-up of uni-directional fibre can be commenced. This needs to be done as a single job, which will take several hours. Obviously it needs to be done carefully, making sure that all the fibre is properly wetted out (not always easy to tell with carbon,) and that there are no voids and that the fibres are correctly distributed round the spar.

Fair up this layer before you put the outer skin on. Here you've got to be careful with the (virtually inevitable) wrinkles. If you have longitudinal wrinkles of carbon sticking out then you can sand them down without too much worry. After all what they principally represent is fibres that have been squeezed out as the laminate compresses down, so you can take them out without compromising strength or lay-up thickness. Horizontal wrinkles are trouble because if you sand them off you are breaking into the carbon at a single point, making a spectacular weak point. This is mainly a matter for very careful vacuum bagging.

Mast Track

The track - provided you aren't making a trackless mast for a sleeve luff rig - should be made from half inch diameter pultruded tube from whatever your handiest source is. Glass is cheaper, heavier, and has less impact on the final bend characteristics. Carbon is more expensive, lighter, and contributes more to stiffness, especially fore and aft. Glue the track on with a reasonably strong filled epoxy mix, and then fair up the gap between tube and mast to your preferred shape with something a bit lighter.

Outer skin

Lastly on goes an outside layer of 200gsm carbon, this time aligned 0/90 degrees to the mast, plus appropriate local reinforcement where needed. It goes round the mast track of course. Should you ever wish to modify the stiffness of the mast by adding (not always successful without great care) or removing fibre, you should sand off this entire layer and then replace it when you've made the changes. One has to be very careful about adding extra fibres later, because its very difficult to get really first class bonding between the original and added structure, which means that there's always the possibility that the load won't be distributed between the fibres that well. There is no especial constructional reason for having the 45/45 layer on the inside and the 0/90 layer on the outside other than it is easier to make a neat job of the 0/90 lay-up. As mentioned above the optimum would be a thinner layer of both each side of the uni-directionals.

How it used to be done - Bethwaite Pine/Balsa Wing mast built around 1974 - photo Jim Champ

Getting it off and Putting the Fittings on.

A lot of people commercially are working on reliable release and easy lamination. It can be big trouble. Quite often its easier to simply cut the mast down one side and take it off like that. After you do that you'll need an outer layer of carbon again, but its not as disastrous as you might think because your cut is aligned with the majority of the fibres anyway. If you have an alloy mandrel you can make it as cool as possible to shrink it out from the lay-up, if you used wax then very hot water down the centre of an alloy mandrel gets it out a treat, or alternatively you can melt it out with a heat gun (don't get the lay-up too hot!).

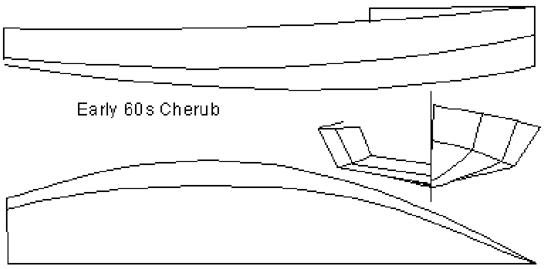
Cut out the slot in the mast track. I suppose in theory the slot reduces the effect of the outer layer of fibres, but the track itself contributes plenty of strength in that area, and it doesn't seem to be a problem.

Fit out the mast out pretty much as normal - but be *very sure* that the fittings have been placed where the reinforcement for them was. Corrosion is a significant consideration - carbon is electrolytically active and there's a considerable potential between it and aluminium. Make sure there's no contact between aluminium and carbon - stainless rivets are definitely preferred. This applies to other fittings as well. Again glass can be used as an insulator, but resin coat the alloy fittings too and generally do your best to keep them isolated. In this context its worth noting that I've heard reports that RS600 mast bottom sections - which have an aluminium sleeve to shorten the mast to reduce sail area - have, in some circumstances, actually failed because of the expansion caused by corrosion of the aluminium. Be very careful with rivets and avoid them if you can. In particular make sure that the holes you drill for rivets are as tight as possible in order to avoid the rivet expanding in the hole and causing a local distortion in the structure. For similar reasons backing washers on rivets are nothing but a good thing if you can possibly get them on.

Jim Champ, 1998, with grateful thanks to Dave Roe Simon Roberts & Tim Dean.

A Guide to Cherub Designs

This is a list of U.K. Cherub designs compiled by various people over the years. It is believed to comprise all designs built in any numbers, and the vast majority of one-offs.
In the early days design numbers seem to have been kept in step. For instance so the only known Jeffries design is the Jeffries 5, a Greg 5 development. U.K. development was not really influenced by the Antipodes until the Spencer 7 was introduced.



Spencer 2
Adopted as a one-design when the class was introduced to the UK. Many different deck layouts. These early boats are typically fairly narrow with small transoms and plenty of rocker, especially forward of the mast. A boat of this era looks something like a small Scorpion.

Spencer 2a
No built in buoyancy, bags under decking. e.g. 151, 258.

Spencer 2b
Conventional built in bow and side tanks and also a stern tank. e.g. 154, 645.

Spencer 2c
Double-bottom self draining. e.g. 155.

Spencer 2d
Fully rolled side tanks, with or without stern tanks or semi-length false floor. e.g. 157, 634, 650.

Spencer 2e
Conventional bow and side tanks with hinged plate instead of dagger board. e.g. 695.

Casson 2
Full main bulkhead, minimum width side tanks, daggerboard. e.g. 629.

Gregory 2
As Spencer 2d, but with full length hinged plate. e.g. 660.

Gregory 3
The first real UK design after the NZ restrictions adopted. Wider chines at transom, full length centrecase, low bow tank, double skin floor. Early versions 703, 704. Later versions had side tanks widened aft. e.g. 717,738,918.

McCutcheon 2
Similar to Mk 2e but with wider transom and half height bow tank. e.g. 709, 735.

Casson 4
Similar to Mk 3, but with shorter plate, single skin floor and full main bulkhead. e.g. 727, 1006.

Hawkesworth 2
Similar to Mk 2d, no stern tank, wider transom, bulge in bow sections. e.g. 698.

Gregory 3a
Similar to Mk 3, but with integral spray chine forward. e.g. 921, 923, 1002.

Gregory 5
More beam but narrower transom. Fuller bow with integral spray chine. Max. rise of floor at mid-length. e.g. 920 1005.

Gregory/Howard 5
Extra beamy version of Mk 5. e.g. 1012.

Jeffries 5
Basically a simplified dagger plate version. e.g. 1008.

Gregory 6a
Max chine beam further aft, spray chine, narrow side tanks, very wide. e.g. 1017.

Gregory 6
As above but no spray chine. e.g. 1018.

Gregory 6p
As above but hull in glass fibre and slight reverse camber in topsides at transom. e.g. 1019, 1020.

Forman 1
Extreme Mk 5 development, 6' ,3ö beam, no spray chine, plate retracts under foredeck, semi-rolled decks. e.g. 1025.

Spencer Mk 7
Orthodox dagger plate NZ design. Shallow foredeck rise, sidedecks slope down outboard. e.g. 1361, 1363, 1372.

McCutcheon 8
Modified Mk 7, with fuller bow sections, hinged plate, inward sloping sidedecks. e.g. 1015, 1369.

Barton/Spencer 7
Mk 7 with forward retracting plate. e.g. 1377, 1510.

Forman 2
Narrower development of Mk 1, 5' 8" beam, cambered topsides, convex fwd, concave aft. Sliding plate. e.g. 1496.

Forman 3
6' 3" beam, extremely narrow bow, chine angle disappears at transom, sections more rounded, less veed. e.g. 1652.

Spencer 8
Design for heavier crew weight. Wider chines than Mk 7.

Spencer 7b
GRP version produced by Peter Caisley.

Caisley/Steele 1
Mk 7 with swinging plate.

Jennifer Julian (Bowler)
Narrow beam, deep veed, low keel rocker. Versions exist in ply, GRP and GRP/foam sandwich. e.g. 1717.

Forman 4
First deep vee design in UK. Designed for easy construction. Identified by wide side tanks with straight carlins and overlapping panels fwd. e.g. 1702, 1704.

Forman 4b
Identical to Mk 4, but with narrower curved decks. Very numerous design in UK. e.g. 1699,1708,2120,2124.

Gregory 7 (Easy Rider)
Very beamy with pronounced rocker and a local dip in the chine at mid-length. Short hinged board. e.g. 1710, 1711.

Caisley/Steel 2
Development of C/S 1, about 6' beam with max. chine depth well aft and wide tanks sloping inboard. e.g. 2102.

Forman 4c(g)
GRP version of Mk 4b, with slightly slimmer hull, no overlapping chine and max. chine beam further forward. Various decking and internal layouts exist. e.g. 2315, 2114, 2113, 2312, 2403, 2502.

Caisley/Steel 3
Slightly smoother development of C/S 2, narrower decks, less buoyancy. Noticeably more Veed at the transom than at mid length. e.g. 2150.

Forman Mk4c(w)
All wood version with various layouts built to same hull lines as GRP shell. e.g. 2109.

Forman 4c(gt)
As above, but shells joined by glass tape. e.g. 2402.

Forman 5
Development of Mk 4, low rocker, wide transom chines, full bow. e.g. 2137.

Forman 4d(gt)
Development of Mk 4c with additional curvature in aft bottom panels. Glass taped. e.g. 2350, 2344.

Farr
Moderate NZ design. Considerable panel curvature. Standard NZ layout with full bow tank and two side tanks aft. Appreciable rocker, mainly forward. e.g. 1982, Queenie SJB which was 3rd in the 1974 worlds.

Webb
Cold moulded hull with low rocker. e.g. 2333, 2349.

Babcock 1 (DBS)
NZ influenced design, low rocker, very slim.

Forman 6
Further development of Mk 4 & 5. Wider chines at transom than Mk 4, with panel curvature as Mk 4d. Slightly finer bow, increased freeboard. e.g. 2345, 2401.

Robinson 1
Forman Mk 4 development. Low rocker, less panel curvature. Rig well forward. Stern tank. e.g. 2404.

Selby 2
Wide transom chines to give parallel planing surface. Mast well aft. e.g. 2340.

Tyrer
Designed for heavier helmsman. Rig well forward. Wider chines at mid-length. Very high floor rise at transom with considerable curvature. Low rocker. e.g. 2334.

Hill 1
Very unusual design with huge open cockpit (later modified to Australian-type layout). No side tanks, buoyancy in bow and stern tanks. Cold moulded hull, stepped chine fwd. e.g. 2407.

Ellway 1
High chine rise forward with distinctive spray chine. Deep veed aft with wide chines at transom, low rocker.

Robinson 2
Australian influenced design. Wide flat sections aft, low rocker. Semi self-draining cockpit.

Forman 8
Moderate development of Mk 6. More panel curvature, fuller bow. Moderate rocker. Very numerous design. e.g. 2549, 2548, 2511.

Spithead Special (Duke/Robinson/Hows)
Radical design. Scow-like forward sections with chines sloping down to base of stem. Moderate rocker, concentrated forward. Later versions (Easter Beagle) have higher freeboard. e.g. 2540.

Botting 1
High chine rise forward, fine veed entry. Flat sections aft, low rocker, deep stem. e.g. 2425.

Deeley 1
Radical design. Extremely fine veed forward sections, considerable panel curvature and wide chines aft. Low rocker, high freeboard. Semi self-draining. e.g. 2434.

Parker
Very flat transom, low rocker, full bow with very exaggerated flare above waterline.

Paterson 1
Wide Veed aft sections, low rocker, very long straight entry, mast stepped well aft, wide beam.

Hot Dog (Duke 2)
moderate Spithead Special development. Moderate rocker concentrated well forward. Low chine rise, much panel curvature. e.g., 2530

Hill 2
Australian influenced design. Moderate rocker, considerable panel curvature, low bow tank, 2 aft tanks. e.g. 2503

Babcock 2
Similar bow to Easter Beagle and Hot Dog. low rocker, wide deep veed aft sections e.g. 2550

Ellway 2
Design for heavy helmsman. Rocker aft, high chine rise forward, wide chines at transom, much panel curvature. Flat decks e.g. 2512

Deeley 2
Mk 1 development. more moderate veed bow, wider flatter transom, less rocker aft, crew deck. e.g. 2534, 2603

Botting 2
Development of mk 1. Fine veed forward sections, low rocker. e.g. 2546

Robinson 3
Moderate design. Fine bows and high chine rise forward, moderate rocker, concentrated forward. e.g. 2542

Ellway 3
Development of Mk 2 for normal crew weight distribution. more even rocker, more chine rise, very parallel chines, finer bow. e.g. 2612 Old Peculier.

Deeley 3
Aft sections similar to mk 1. more moderately veed and less fine bow sections. More even and increased rocker. Some have crew deck. e.g. 2604

Forman 8s
Foam sandwich mk 8 by Omega boats. Slightly wider at transom and finer entry. Curved topsides e.g. 2608

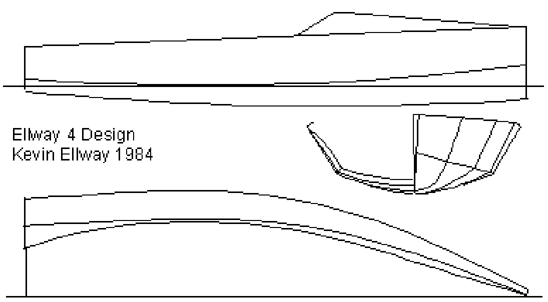
Paterson 2.
Wide, moderately flat transom, low rocker, moderate chine rise forward, e.g. 2601

Murray
Australian design, fine bow with high chine rise, fairly narrow chines at transom, very low rocker. e.g. 2606. Iain Murray, who I believe was about 16 when he produced the design, later became well known from his involvement in the America's Cup.

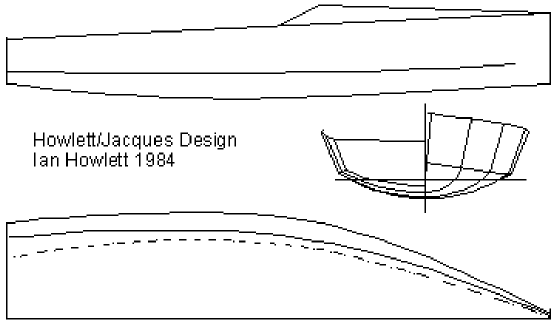
Murray mod Snow
Fuller bow than standard Murray, more veed aft sections, but still pretty flat. Very low rocker 2705 Flat Stanley. Flat Stanley was the 1980 World Champion.

Wop
As far as is known, no boats have ever been built in the UK to this design, and certainly none have been registered. Very boxy design, with max rise of floor at mid length and virtually flat transom. Very influential design in Australia. Runner up in 1980 Worlds.

Ellway 4
Moderate interpretation of new-rules design. Utilises reduction of chine beam but still relatively flat. U-Sections forward. Relatively wide and moderately flat transom. Moderate rocker. e.g. 2626.



Howlett
Designed by the 12 metre and Int. 14 designer. Considerable rocker, U-Sections throughout. Full forward sections. Chines wide at transom but with considerable rise. Mast stepped well aft. Quick in light airs, but lacking top speed. e.g. 2624. Rebel



Paterson 3
Radical interpretation of new-rules. Considerable rocker. Fully utilises new mid-length restrictions. U-sections throughout. Narrow chines at transom. Mast stepped well forward. e.g. 2623.

Sothcott 1
Moderate rocker, high freeboard, U-sections. Chines narrow at transom and with enormous chine rise. e.g. 2625 Heffalump (later modified with flatter transom).

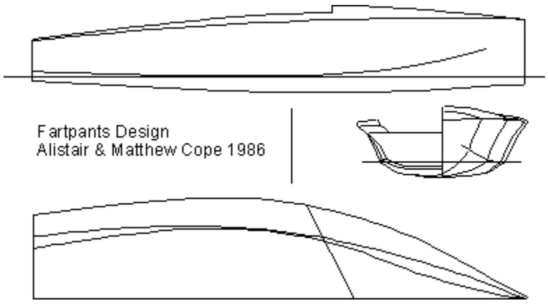
Robinson 4
Moderate new rules development of mk 3. Low rocker, U section bows, crew deck.

Deeley 5a
Low rocker, high freeboard, wide at gunwales. U-sections, fine entry, fully utilises new mid-length restrictions. Moderately narrow chine at transom. e.g. Last Amber Dragon 2626

Ellway 4a
Development of Mk 4, with more rocker aft, narrower chines at transom.

Paterson Mk 4
Full bows, moderate rocker, 6" maximum rise of floor, minimum width chines, narrow flat transom.

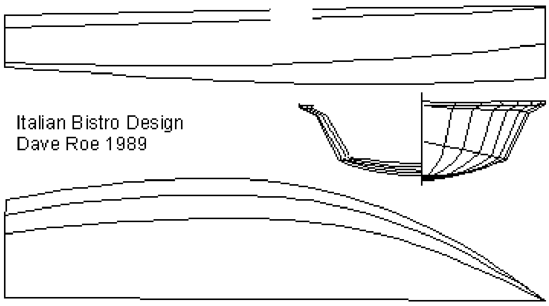
Fartpants(Cope)
Designed to be a weight carrier. slightly hollow V bow, low rise of floor, narrow beam, very flat floor with lots of turnup to chines, slight negative rocker aft. The first "narrow flat" Cherub. e.g. 2634.



Handley
Radical round bilge design. No foredeck. lowish rocker, very flat floor aft, U bows. 2636.

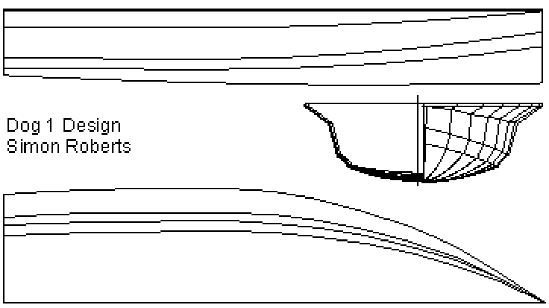
Deeley 6
More moderate development of mk 5.

Italian Bistro (Roe Mk 1)
Very influential and reasonably numerous flat low rocker design. quite fine V bows, moderate beam, low rocker and rise of floor, mainly built in foam sand-



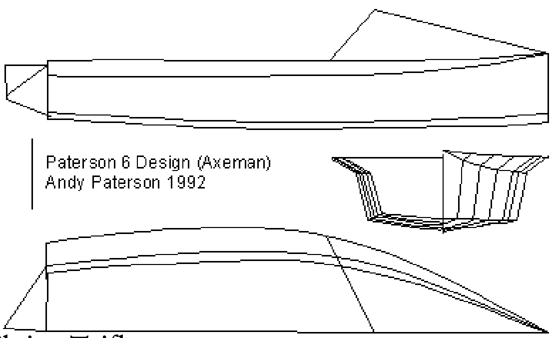
wich. e.g.2637, 2641.

Dog 1 (Roberts mk 1)
Bistro development with double chines and slight hollow between chines. Very low rocker. The double chine helps to minimise waterline beam within the



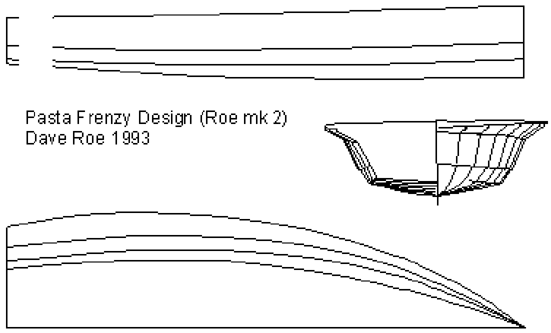
rules. e.g. 2645.

Paterson 6
Moth influenced design with distinctive high foredeck. Very slab sided and flat floored. At least one modified to Mk6a with flat foredeck, finer bow, wider beam and bowsprit snout. e.g. 2650.



Flying Trifle
Notable for extreme topside flare aft. Low rocker, flat aft. e.g. 2652.

Pasta Frenzy (Roe mk 2)
Bistro Development with double chines and lower rocker. At least one modified to 1997 rules with wider beam and bowsprit snout.

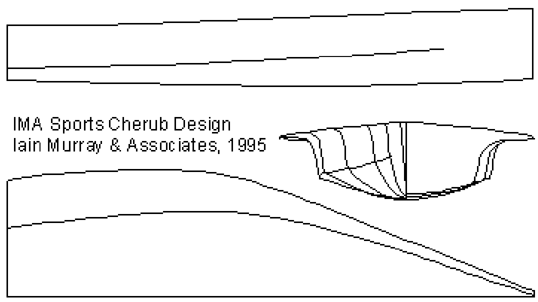


Platypus (Roberts mk 2)
More moderate development of Dog 1.

Barr
Designed by Duncan Barr, I know very little about this boat. 2658.

Death by Chocolate (Harrison)
Fine bow with straight entry. Plenty of curvature at mid length with quite a lot of rise of floor. Curvature washes out to fairly narrow moderately V'd transom with no panel curvature. Moderate even rocker. 2663.

IMA Sports Cherub (Iain Murray & Associates)
Single chine, low rocker, U'd sections throughout, maximum rise of floor at mid length and plenty of rise of floor at transom. Not unlike Deeley 5, but finer forward . Very flared topsides. Only built in Australia e.g. 2667.



Hardon (Clifton 1)
Radical design by Simon Clifton with very low rise of floor and low rocker. 2669

Septic Slug (Roberts mk 3)
First 1987 rules design. Waterplane distribution rather further aft than earlier boats. Bowsprit snout and very "curvy" lines to the topside flare.

This list is inevitably going to require updating as new designs appear. I would also be very grateful for drawings of those designs - the majority - that have not been included as graphics here. Some of the older designs would be especially welcome in order to demonstrate development over the years.
Jim Champ, 1997

UK Cherub Class Rules 1997

1 Introduction

The object of these rules is to provide a set of rules to which inexpensive high-performance dinghies may be designed and built.

2 Constitution

2.1 Administration

The Association shall hold an Annual General Meeting, normally at the National Championship. The date and venue of the A.G.M. shall be published at least one month before it is due to be held. The A.G.M. shall elect the following Association Officials: President, Secretary, Treasurer, Registrar, Technical Officer.
It may also elect the following additional Officials: Magazine Editor, Publicity Officer, Fixtures Secretary. All these Officials shall be members of the Association Committee. The A.G.M. may elect additional committee members up to a total of ten.

2.2 Amendments To Class Rules

Changes to these Rules may only be made as a result of a 2/3 majority vote in favour in a postal ballot of all paid up members of the association. Proposals for changes to these rules may be submitted to the Association Committee at any time. Such proposals must be signed by five members and must detail the precise wording of the proposed change. The Committee shall consider each proposal and may suggest possible changes to the proposers. The final wording shall be agreed upon within four months of the original submission. The Committee shall, within a further three months, conduct a postal ballot of all members. The ballot shall include the full detailed wording of the proposals, any explanation submitted by the proposers and any comments from the Committee or Technical Officer. The ballot will close one month after the date of posting (this date to be stated in the ballot). The Committee shall decide the exact date on which any change shall come into effect. This shall be not less than three months or more than six months from the closing of the ballot.

3 General

3.1 Title

The class shall be known as the UNITED KINGDOM CHERUB 12ft. DEVELOPMENT CLASS.

3.2 Insignia

The insignia shall consist of a heart shaped silhouette of a size which would approximately be contained in a 300mm diameter circle. The insignia shall be placed on both sides of the mainsail, approximately one third from the top, and shall be of a colour contrasting with the mainsail.

3.3 Registration

On completion of measurement by an authorised measurer and subject to conforming with the class restrictions and payment of the prescribed fee, each boat shall be issued with a registration number by the Class Registrar. This number shall be displayed on both sides of mainsail directly under the insignia and on the spinnaker at approximately half height on both sides, in contrasting colours. The numbers shall be approximately 300mm high and have a trunk width of approximately 50mm.

3.4 Crew

The crew shall consist of two persons. One member of the crew may use a trapeze.

3.5 Interpretation

The CHERUB is a development class and these rules may not cover every eventuality. In cases where doubt exists, account should be taken of the intentions and spirit of the rules and the matter should be referred to the Technical Officer and Association Committee.

4 Class Restrictions

4.1 Hull

4.1.1 Length - Between Stem and Transom shall not exceed 3.70m. (Note: For boats with inset or open transoms this measurement shall be taken from the after extremity of the hull skin at or below the waterline.)
4.1.2 Beam - The maximum beam shall be 1.80m. (Note: Footstops and footloops only may extend beyond this beam.)
4.1.3 Depth of Hull - Depth at mid-length, measured vertically from sheer to the lowest point of the hull, shall be at least 450mm.
4.1.4 Stem - The profile of the stem shall be approximately vertical for a minimum of 200mm from its' bottom.
Bowsprit support - structures to support the bowsprit may extend beyond the stem to a maximum of 4000mm from the transom.
4.1.5 Chine(s) - Chines shall be fair and continuous curves. There will be at least one chine at least 2000mm long. No part of the outer skin above a chine shall be inside a vertical line passing through the chine.
4.1.6 Anti-multihull rule - In any cross-section of the hull, no horizontal line shall pass through the hull skin more than once either side of the centreline. (Note: It is not the intention of this rule to prohibit 'tubular wings'.)
4.1.7 Weight - The weight of the hull in dry condition

shall not be less than 50kg. The weight shall include all permanently fixed fittings and bowsprit, but shall exclude sails, spars, standing rigging, centreboard, rudder and other loose gear.
4.1.8 Buoyancy - The hull shall be fitted with built-in buoyancy not less than $0.26m^3$ contained in at least three separate compartments of at least $0.02m^3$ each.
4.1.9 Centreboard and rudder - Centreboard and rudder shall not be ballasted (i.e. shall float). The centreboard shall be fitted on the centreline of the hull.

4.2 Spars

4.2.1 Spars - Spars shall be capable of being passed through a 100mm diameter ring when stripped of all fittings. Spars may not be constructed permanently bent. (No spar is built or remains perfectly straight: it is the intention of this rule to prohibit spars being designed and built intentionally bent.)
4.2.2 Spinnaker Pole - Either a Spinnaker Pole or a Bowsprit may be used for setting a spinnaker, but both may not be carried in any race.
4.2.3 Bowsprit - The bowsprit, if fitted, shall be retractable to within 300mm from the outermost support. The outer end of the bowsprit shall be solid or capped. No sail other than a spinnaker may be set from the bowsprit.

4.3 Sails

4.3.1 Material - The sails may be constructed from woven fibre cloth, unwoven fibre cloth, flexible plastic film or composite materials consist of any combination of the three. All sails shall be stowable in sail bags of normal dimensions.(for the purpose of this rule, 'long' sail bags for the stowing of rolled up sails are regarded as normal).
4.3.2 Mainsail and Jib
4.3.2.1 Sail Area - The areas of the mainsail and jib will be measured in accordance with the IYRU measurement instructions(1979), part IV, measurement and calculation of sail area (printed in appendix 1). The following are excepted:
a) Section 2 shall not apply (i.e. the area of the spars shall not be included in the measure sail area).
b) Section 6, spinnaker, shall not apply.
The combined area of the mainsail and jib shall not exceed $12.50m^2$
4.3.3 The mainsail must be removable without releasing the standing rigging.
4.3.4 Spinnaker - Spinnakers shall be measured in a dry condition. All measurements shall be taken with the sail pulled taut between the relevant points.
The following measurements shall be taken. Length of the Luff, Leech and Foot, and the cross width between the mid points of the luff and leech. The following parameters shall be calculated.

L = Mean of luff / leech length.
DL = Difference of luff and leech.
F = sq.rt.((Foot Length)^2-DL^2)
G = sq.rt.(Cross Width^2-(DL/2)^2)
Area = LF/6 + 2LG/3

The area of spinnaker may not exceed $15m^2$. Only one spinnaker may be carried on board in any race.
4.3.5 I.SA.F. rules 50.2 Spinnaker Poles, Whisker Poles and 50.4 Head Sails shall not apply.

4.4 Not Permitted

The following are not permitted:
a) Any contrivance other than a trapeze extending out board to support the crew. Only one member of the crew may use the trapeze at any one time.
b) Spinnaker sheet catchers on the stem which may be dangerous to other crew or craft.

I.Y.R.U. MEASUREMENT INSTRUCTIONS 1979

Part IV: Measurement and Calculation of Sail Area

As applicable to U.K. CHERUB Class Rule 4.3.3.1, Sail Area (mainsail and jib), as adopted by the UK CHERUB Class Owners' Association, effective from November 1987

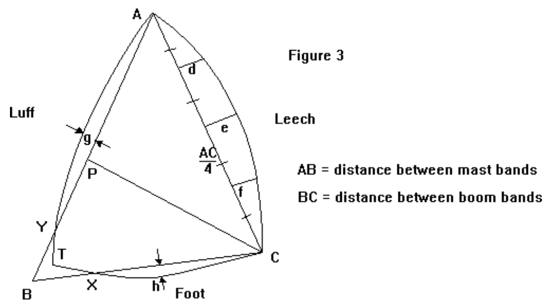
1. General

1.1 The intention is to establish a reliable and simple method of measuring the whole driving area of the sail plan.
1.2 It is not possible to frame methods to deal with every eventuality and therefore in the case of unique or difficult shapes of rig the measurer may need to use his judgement in dividing he rig for measurement in order to calculate the area accurately. "Combination" rigs such as a soft trailing edge on a heavily shaped wing spar or a rig where the camber and shape is produced by tensioning when it is on the yacht, may be more conveniently and equitably measured in an "assembled for sailing" condition, rather than in component parts. In these cases the measurer shall record the method used.
1.3 Elements of the sail plan which are vertical, or nearly so, when the yacht is not heeled shall be measured. Elements of the sail plan which are horizontal or nearly so when the yacht is not heeled, such as fences and end plates, are not measured, provided that: i) the surfaces of such elements are not able to make an angle, measured at right angles to the fore and aft axis of the yacht greater than 10 degrees to the horizontal when the yacht is not heeled, and ii) the total area of their surfaces does not exceed ten per cent of the measured sail area excluding such surfaces. For the purpose of calculating the area of horizontal, of nearly horizontal surfaces, only the area of one side of each fence and the surface of an end plate which is adjacent to the sail shall be included in the area.

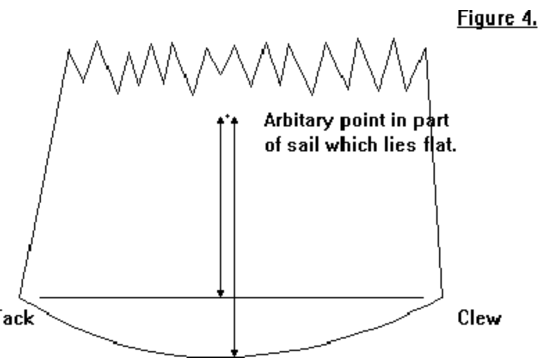
1.4 A “soft sail” is any sail made up of cloth or other material which is flexible and can be rolled up or folded.
1.5 For the purposes of measurement of sail area the term “sail..” shall be deemed to be that part of a soft sail outside the spars and includes the headboard, tabling and battens which extend beyond the edge of the sail. It shall not include cringles which are wholly outside the sail or bolt or foot ropes which are inside the spars.
1.6 The area of any hole in the sail, the maximum dimension of which does not exceed 50mm, shall not be deducted from the measured area.

2. Spars & Wing Sails

(Not applicable. The area of the spars shall not be included in the measured sail area.)
3. Soft Sails set on Spars
3.1 When the sail is set on spars and between measurement bands the distance between the bands is used to obtain the primary dimensions of the main triangle.
3.2 Area using measurement bands
3.2.1 With battens set in their pockets the sail shall be pegged out on a flat surface with just sufficient tension to remove waves or wrinkles from the edge rounds and to spread the sail, as far as possible, substantially flat. Once the sail has been pegged out in this way all the required measurements shall be taken and no alterations to the tensions shall be made.
3.2.2 Needles shall be fixed at the head and clew, making allowance for that part of the sail inside the spars so that the distance between the needles is the length of the leech. A third needle shall be fixed at a point so that it is the distance between the measurement bands on the mast from the head needle and also the distance of the boom measurement band from the mast from the clew needle. If the boom is shorter than the foot of the sail or if there is no boom, the length of the foot shall be that found by measurement with the sail set on the mast. A thin line shall be stretched round these needles to define the main triangle. See fig (3).



3.2.3 The area of the main triangle shall be calculated from one of the following formulae or by a scale drawing.
(a) Area = /s.(s-a).(s-b).(s-c)
where s = (a+b+c)/2
and a = length of luff b = length of leech c = length of foot
(b) Area = ABx CP where CP is the minimum distance from C to 2 * the thread from A to B.
3.2.4 The area of the luff round shall be calculated and added to or subtracted from the area of the main triangle. If the curve is fair and continuous its area shall be taken as two thirds of the product of the chord length and the maximum perpendicular offset to the chord. In fig (3) below the area of the luff round is 2g(AY)/3. The offset to the chord shall be taken as the maximum distance between the point on the sail corresponding with the aft edge of the mast, and the thread defining the main triangle.
3.2.5 The area of the leech round shall be found as follows: either (a) where the leech is a continuous fair curve from point A to point C in fig (3) the area is taken as AC (1.16d + e + 1.16f)/4 where AC is the leech length indicated in fig (3); d, e and f are the perpendicular offsets between the points on the thread from A to C a quarter, a half and three quarters of the distance between the leech measurement points A and C and the edge of the sail. For the purposes of the measurement of the offsets, any hollows in the leech shall be bridged. or (b) where the leech is not a fair curve from point A to point C in fig (3) the area of the leech round shall be found by dividing the area into trapeziums, triangles and segments and measuring each. For the purpose of this instruction the area of a segment shall be taken as two thirds of the product of the chord of the round and the maximum perpendicular offset to the chord.
3.2.6 The area of the foot round, if the sail can be pegged out substantially flat, shall be measured in the same manner as the luff round.
3.2.7 Where the foot has a “shelf” or a substantial amount of shape so that when the foot is extended there is loose or bulging material above it, then the area of the “flow” of the bulging material shall be determined as follows (see fig. 4) A measurement shall be taken from the straight line joining the tack to the



clew, in the way of the greatest fullness, to an arbitrary point where the sail does lie flat. A second measurement is then taken from the arbitrary point to the point of greatest fullness following the folds or bulges of material. The difference between the two measurements represents the offset of the rounded foot. The area of the foot round is taken as two thirds of the length between the tack and clew multiplied by the offset.

3.2.8 The area of the shape BYTX in fig (3) is not deducted from the area of the main triangle.
3.3 Where there are no measurement bands on the spars
3.3.1 With battens set in their pockets the sail shall be pegged out on a flat surface with just sufficient tension to remove waves or wrinkles from the edges and to spread the sail, as far as possible, substantially flat.
3.3.2 Needles shall be fixed at the head, tack and clew. A thin line or thread shall be stretched tight between head, tack and clew to define the main triangle.
3.3.3 The area of the main triangle shall be calculated in the manner indicated in Section 3.2.3 above.
3.3.4 The area of the luff, leech and foot rounds shall be found in accordance with the instructions 3.2.4, 3.2.5, 3.2.6, 3.2.7 above.

4. Soft Sail not set on a Spar

4.1 A soft sail which is not set on a spar, such as a headsail, set on a stay or flying, shall be measured in accordance with instruction 3.3 above, except that if the leech has an offset not exceeding 5 per cent of the leech length and is a fair curve the area of the leech the area of the leech round shall be measured in accordance with 3.2.4.
4.2 If the luff of the sail is wired, sufficient tension shall be applied to remove bends or kinks in the wire.

5. Sail of Unusual Shape

The foregoing instructions assume that the sails are essentially triangular. If a quadrilateral or multilateral sail is to be measured the sail is to be divided into suitable triangles whose area can be measured and added. The areas of the luff, foot and leech rounds shall also be added, or subtracted as the case may be. The measurer shall record the method he has used to assess the area of the sail.

6. Spinnaker

(Not applicable. See CHERUB Rules and Restrictions, 1997, Rule 4.3.4 Spinnaker.)

History Spot

There's room here for pictures of some older boats people may find of interest.

Photo Alison Wilde

Queenie Sarah Jane Blucher II

This NZ boat is a Bruce Farr design and was third in the 1974 Worlds at Torbay in the UK.
These pictures, taken many years later, show the boat rigged with an Australian spruce/balsa/pine over-rotating wing mast (see picture on page 22) and a 1984 rules mylar mainsail. The full width radiused traveller is original.
Readers of Frank Bethwaites' High Performance Sailing may be interested to know that this is almost certainly one of Nicola Bethwaite's masts from the 1974 Worlds in which she was runner up.

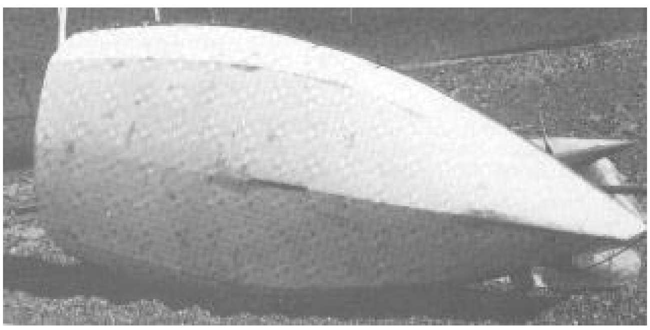


Photo Jim Champ

Flat Stanley

Another Kiwi boat, this one won the 1980 Worlds at Felpham, Sussex. Sold in the UK after the event, new owner Guy Lewington managed to win just about everything worth winning over the next few years with this boat.
Its an extremely solid kevlar/foam sandwich hull, apparently decked, though this is not obvious in the photograph, with old packing cases and bits of wood picked up off the beach!