Catalyst

Journal of the Amateur Yacht Research Society

Number 43 July 2011

Cover Photo:

Entrants to the Cordless Canoe Challenge - Jeremy Harris' Aero *and the Rutlands'* Little Lady K
Photo: © S Fishwick, Catalyst.

Catalyst

Journal of the
Amateur Yacht Research Society

Editorial Team —
Simon Fishwick
Sheila Fishwick

Specialist Correspondents
Aerodynamics—Tom Speer
Electronics—Simon Fishwick
Human & Solar Power—Theo Schmidt
Hydrofoils—Joddy Chapman
Iceboats & Landyachts—Bob Dill
Kites—Dave Culp
Multihulls—Dick Newick
Speed Trials—Bob Downhill
Steam Power—Lord Strathcona
Structures—Keith Burgess
Windmills & Turbines—Jim Wilkinson

Catalyst is a quarterly journal of yacht research, design, and technology published by the Amateur Yacht Research Society, BCM AYRS, London WC1N 3XX, UK. Opinions expressed are the author's, and not those of AYRS. AYRS also publishes related booklets.

Contributions are welcome from all. Email them to **Catalyst@ayrs.org**, or send (at your risk) disks or typed copy with illustrations to the Society's office. AYRS can take no responsibility for loss or damage in the mail.

AYRS subscribers receive both *Catalyst* and the booklets. Subscription is UK£20/US$30/Eur15 per annum for paper copies, (£10/$15/•15 concession for the retired), £10/$15/•15 for download copies. Subscription requests and all other queries to be sent to the AYRS Office, BCM AYRS, London WC1N 3XX UK, email: **office@ayrs.org**

AYRS is a UK Registered Educational Charity (No 234081) for the furthering of yacht science.

Website: http://www.ayrs.org

© 2011 Amateur Yacht Research Society
BCM AYRS, London WC1N 3XX, UK
All Rights Reserved

ISSN 1469-6754

Writing for *Catalyst*

Summer is the season for sailing and boating (apart from a few hardy souls, or those blessed with tropical or semi-tropical weather), winter is the season for thinking about boats or for writing about your thoughts.

Since winter is coming for most of our members, it may be appropriate to remind you about how to submit articles for *Catalyst*.

The first thing to know is how to get them to us. That's easy - either email them to catalyst@ayrs.org, or send them by post to AYRS Editor, BCM AYRS, London WC1N 3XX, UK. We would prefer them by email.

Sending by email - we can read most common document file formats, but given a free choice would prefer them as Word .doc because we use Word to prepare articles for eventual layout. We can also read most (but not all) picture formats. Photos should always be sent as high quality JPGs; line drawings done on a computer are best sent in their original format or as Corel Draw ver 12 (to pick a common format I know we can read), but make sure that what you send is what you want. Sometimes translations lose something. Remember that we may reduce your A4/letter size drawing to a quarter page, so if sending bitmaps make sure the lines are thick enough and the font is large enough. DON'T send line drawings as JPGs - the file-compression process makes them come out with lots of jagged lines.

If sending things on paper then they MUST be in typescript, double spaced, using a font of 12 point size or larger. We no longer have the effort to retype things (so don't send handwriting), but will put typescript though an optical character reader. Drawings sent on paper need to be in black ink (only), with lines thick enough to reduce them to a quarter size or smaller. Use a good drawing pen, not a ballpoint. Labels and annotations need to be clear enough for copying & reduction.

Clear enough?

So all you need to do now is get writing and send it in!

Water Craft Cordless Canoe Challenge

The Challenge

Craft not to exceed 5m in length; carry at least one person over 12 years old; and be powered by one or more power tools costing not more than £400 in toto.

The course was an L-shaped out and back about 300m total length.

The Yaksmitch Bullett races Kleppie for second place in the Final.
The weather was appalling! (That's rain on the camera lens!)

The Entrants

WotNext

Last year, Tim O'Connor built a lapstrake open canoe into which he fitted a Hobie Mirage drive (that's the pedal-powered device with oscillating fins which projects through a "daggerboard case" out of the bottom of the hull). For the CCC, he "re-engined" it so that, instead of pedals, it used a single cordless drill.

The Yaksmitch Bullet

Gerrand Borthwick brought a K1 racing kayak fitted with two stabilising floats with a drill driving a standard outboard propellor fitted in each. It looked, and was, very fast; and was your Editor's tip for the eventual winner.

Little Lady K

The boat was nothing special – a Natzio "Little Grebe" skiff – but the engine was something else. An outboard, John & Joe Rutland replaced the power head by an ingenious arrangement of three stripped-down drills driving a vertical-shaft through a common chain-drive. It worked but obviously needed some tuning.

Little Lady K's engine, and the drive in close-up

Kleppie

Jonathan Happs brought an old Klepper folding kayak with a single "longtail" style (pusher) drive mounted alongside the stern quarter.

J2O

Built and driven by Jo Moran, this was a Montfort "Aerolite" geodesic canoe, with two side-mounted drive units, each powered by a single drill. There was no rudder and Jo steered by varying the drill speeds – which gave her a lot of trouble.

J2O

Fred's Folly

Fred's Folly

This comprised the floats from Fred Ball's little trimaran, which he has taken to AYRS sailing meetings for the last two years or so, fitted with two "longtail" style units with off-the-shelf outboard propellers.

Four Candles

Alan Craig entered another modified racing canoe, a somewhat more stable white-water racer, without stabilisers, it had three three-blade model-aircraft propellers driven by three motors taken out of their cordless drills; which meant they ran a lot cooler and, being substantially sealed, two could be mounted outside the hull. (Stripped down drills are banned for 2012).

Four Candles and a close-up of her stern gear

FlipTail

Mick Duff's interesting folding dinghy, 6ft long, driven and steered by an over-the-stern longtail unit.

Fast

A trimaran built around a very slender main hull, so slender that driver Dennis Adcock had to perch on a seat on the top. It had a single propellor of a home-grown weedshedding design, driven by a single drill. It had cornering problems, but in a straight line lived up to its name.

FlipTail

Fast

Canute

A very pretty craft built from two pieces of tortured ply, one forming the bow and sweeping down to a flat stern, the other the foredeck which segued into tumblehome cockpit sides and stern, Tobias Vokuhl's *Canute* had a single drill driving a through-the-bottom shaft with a model aircraft propellor, and a largish rudder.

AYRSpeed

Slade Penoyre's entry used an old Sit-On-Top kayak, with two side-mounted paddlewheels, each with their own drill connect by a "belt" (length of rope) drive. The steering was a pair

Canute

of disk wheels mounted forward. Slade distinguished himself by launching the boat from the top of the slipway (lifeboat-style) and driving some way back up when he returned to shore. Unfortunately he had a lot of trouble with slipping belts which limited his speed.

AYRSpeed with Slade Penoyre

Aero

Jeremy Harris' "skin on tin" (fabric over an aluminium frame) skiff driven by a side-mounted outboard arrangement. He was somewhat handicapped in that while on display before the event, an onlooker could not resist the temptation to start the drill, which destroyed the gearbox when the model-aircraft propellor tip hit the ground. Jeremy rebuilt the unit using another gearbox overnight, but the replacement was not a success and the drive shaft slipped irretrievably.

Aero (with the second gearbox)

The Races

The Heats:

WotNext beat *Fred's Folly*
Four Candles beat *Fliptail*
Fast beat *Little Lady K*
Canute beat *J2O*
The Yaksmitch Bullett beat *AYRSpeed.*

Semifinals:

Kleppie beat *WotNext* and *Aero* (gearbox failure)

Canute beat *Four Candles* (which lost a propshaft on weed)

The Yaksmitch Bullett beat *Fast* (which burned out a drill)

Final:

Canute beat *The Yaksmitch Bullett* and *Kleppie*.

The Prizes

Overall winner was *Canute*, and Toby Vokuhl was awarded the main prize of £1200-worth of Makita power tools, donated by Makita UK.

However that was not the end of it, as there were several unpublicised supplementary prizes –

a) The Heath Robinson Prize for creative engineering went to Slade Penoyre for his paddle drive;

b) The C5 Prize for good answers that didn't quite work (younger readers and those outside the UK may Google "Sinclair C5") went to John & Joe Rutland for their outboard unit;

c) The Elegant Solution prize went to Mick Duff for his folding yacht tender *Fliptail*;

d) And finally, the Watneys prize, for the craft closest to water, went to *Four Candles* which, although very fast, came closest to sinking when she shed one of her drive shafts in the semi-final.

Next Time?

The event will be repeated in 2012 (9th-10th June). Entries have to be submitted (with pictures) to Water Craft magazine by 16th April.

Videos of some of the boats can be seen at http://www.youtube.com/watch?v=G9cH8YnZvPI, http://www.youtube.com/watch?v=gnVNEAHqumI http://www.youtube.com/watch?v=t82OL0YObw4.

Canute out of the water, showing her stern gear

Mick Duff's folding dinghy FlipTail, winner of the Elegant Solution prize.

With the floorboards and ribs removed, the whole folded about the hinges at the top of stem and stern posts into a flat package.

Whilst this example, which resembles a bathtub, may not be the prettiest or most seaworthy of its type, the principle is readily adaptable to produce a sharper bow for example.

News from l'Hydroptère

Record attempt around the Isle of Wight

The trimaran l'Hydroptère headed to England in June and prepared to beat the record around the Isle of Wight. This record, of 2h 33 min 55 secs, has been held since November 2001 by Steve Fosset's catamaran Playstation.

Last year l'Hydroptère missed the record by a few minutes. In fact at mid-term of the race, she was 40 minutes ahead of Playstation, but due to a fall in the wind, l'Hydroptère finished 8 minutes after Playstation's record.

This year, with the full support of the House of Champagne Lanson, the official partner of this record, the Hydroptère team attempted this challenge again, more motivated than ever and determined to sign a triple wake of bubbles and spray.

Unfortunately, the weather conditions were not right and l'Hydroptère failed to get close to the record, which remains Fosset's.

l'Hydroptère maxi

Nothing daunted however, the team have begun to pursue Jules Verne's dream to travel around the world as quickly as possible, such is the ambition of l'Hydroptère maxi. The aim of l'Hydroptère maxi project is two-fold:

- To gather the experience of l'Hydroptère and to synthesize it into a new boat.
- To go to the next level in terms of size, for a better performance in choppy seas.

30 meters long with a 32 meter span are the approximate dimensions of this maxi trimaran. L'Hydroptère Maxi's multi-functionality will be fundamental. The speeds envisioned for this maxi are very high. Bigger, higher, wider, this boat adapted to the open seas will aim to seize all oceanic records, focusing on sailing around the world in a shorter time than the present record, that is, in 50 days, with the ultimate dream to be closer to 40.

The experimental process continues

To design l'Hydroptère maxi, the project team decided to follow the same experimental process as the one employed by Alain Thébault for the development of l'Hydroptère. For the project l'Hydroptère, three scale models led to the building of an 18m prototype with a span of 24m in 1994. Within the scope of this new project, the trial platform on a reduced scale is not a model in the meaning of a model but a real racing sailboat among the largest of her class on Lake Geneva. l'Hydroptère.ch, little pioneer brother of the future maxi yacht measures 10.85 meters long with a span of 10.40 meters. As she is easy to transport, she will be able to conquer new records and to make people discover flying sailboats all over the world.

An hybrid sailing boat for an optimal versatility

The sailing sessions made on the 60ft l'Hydroptère gave the opportunity to record numerous data in the field of navigation on foils and to gain much competence. l'Hydroptère is highly performing as soon as the wind enables her to "take off" but she has not been designed to sail in light wind conditions. The objective of offshore records on l'Hydroptère maxi made it necessary to develop a versatile platform. During an ocean crossing weather conditions can vary enormously and history has shown that on these routes, speed records are very often achieved or lost in the zones that habitually experience lighter winds.

These two projects are stretching the technological and geographical limits of the project. Three boats to challenge all the great records: pure speed, Atlantic, Pacific and around the world.

Ultimate Sailing Achieved?

News has reached us from the USA that Eric J Wilhelm has achieved a version of ultimate sailing.

We say a version because he used a helper on a kiteboard to provide resistance to leeway, so the "craft" was not in some people's view, self-contained.

It is also not clear whether he (they?) could control direction or tack (although given the helper on the kiteboard they probably could.

Details at http://www.indestructables.com.

Comments on Sailing a Faster Course

I was embarrased about the way that Michael Nicholl-Griffith's theory about the fastest way to sail a course was apparently destroyed by Paul Ashford, while I can only agree with what Paul states I feel that there must be a rational explanation of the success of Michael when competatively sailing.

I feel that the way in which the Polar diagrams were developed should be questioned, were they actually measured from sailing Michael's boat or a sister boat or were they developed using a VPP program?

I also wonder if one man's hard on the wind can be another man's sailing full and bye because of better setting of sails ie luff, foot and leech tension, mast curve and cut (or age) material of sails.

We all know of the multiplicity of adjustments that can be made but often only keen racing dinghy sailors really pay attention to them. Walk through any dinghy park at the beginning of an event and many of the classes will have multiple control lines and calibrated outhaul and downhaul positions and levers to alter stay tension etc. that are altered to suit wind and point of sailing. Many cruisers tighten the outhaul on hoisting the main and thats it until the sail is lowered at the end of the day, halliard tension often stays the same, how many have a tackle or winch for the downhaul?

The Yachting Magazines frequently have articles giving advice to casual sailors on how to improve their boats windward ability involving all of these adjustments.

If the sails are set and trimmed properly the performance improves and if going to windward the course at which the boat ceases to sail effectively will be much higher than that of a less well trimmed and set sistership which means that the better one can ease a little and foot much better; I wonder if this is why Michael is such a successful racer and produced his theory.

Fred Ball

Hagedoorn – The Beginning

Roger Glencross

In 1975 when I wrote my article on wind powered seaplanes (AYRS publication 85A) I did not have the advantage of having read Hagedoorn's "Ultimate Sailing". All I had was John Morwood's summary in AYRS Airs No.1, which was not sufficiently detailed to explain the workings. The reference to a hapa completely passed me by, since I was new to AYRS and sailing and did not have any grounding in the subject.

As a result of my ignorance, serious errors crept (leapt) into my article. It was only by luck and the Editor that I did not propose a perpetual motion machine, because I barely knew what I was writing about. Not that this should deter anybody from contributing to *Catalyst*! I had worried about problems which did not exist and had no inkling of the many problems which did e.g. hapa stability and control. The kindly American editor, Harry B. Stover, who published this, my first, article, gently suggested corrections of my grosser errors, enabling me to amend the article before publication. Had Harry taken a negative attitude, and had "Ultimate Sailing – introducing the hapa" never been written, I might have been talked out of the whole experiment.

A bad error was that I miscalculated the kiteline angle with the horizon by nearly 90°. I assumed the kiteline would be approximately vertical (like my children's kites) where it is in fact approximately horizontal. So the tendency of the boat (I never gave a thought to hapas) to lift out of the water, which I feared, was non-existent. I had only heard of hydrofoils, and considered that a negative-lift hydrofoil would solve the non-existent problem. In fact, the hapa has a tendency to dive at speed, because the hapa force works in the opposite direction to the kiteline, with the hapa force working downwards (and horizontally). At high speeds the hapa's downwards force will overcome the hapa's buoyancy and the forces from the hapa's stabilisers. A hapa with a rear tailplane or a front skimming surface which are large in comparison to the working hapa area may work, but only by preventing the hapa from achieving high speeds in the first place. I have found that these stabilisers, designed to keep the hapa at a fixed depth, destabilise the hapa because they either over- or under-compensate for any porpoising or pitchpoling. In other words, lacking a long and heavy hull, a hapa lacks longitudinal stability. The stabilisers are also very draggy, destroying the efficiency of the hapa, which is pretty marginal at the best of times. It is awkward working at the air-water interface. I dodge the problem by never sailing the hapa at high speeds, and by having a large hapa.

The plan to take off and land on a boat presumed that the aquaviator was always more or less above the boat, whereas he is in fact well to the side. The idea of flying at 100 to 200 feet, thereby utilising the wind velocity gradient is also impractical with a near-horizontal kiteline. It would be impossibly long, and therefore heavy. I doubt whether an aquaviator would have the strength (and time) to pedal the kiteline in and out anyway. I ignored the huge forces on the kiteline. I had no grasp of the mathematics of the Hagedoorn craft until I read "Ultimate Sailing". However, I would like to use the pilot's leg muscle in some way if I could. It is the only unused source of power available to the unengined machine. Hopefully he can use pedal power to alter the hapa's direction of travel.

The article presumed that a boat was required because I had never heard of proas. I now believe that the hapa-boat or hapa should be a proa. The idea that a boat is used and tacking is achieved by steering the boat's rudder from one tack to the other through the eye of the wind presumes a crew member on the hapa-boat. I reject this set-up because I do not think a volunteer could be found to man a craft under the "control" of a terrified unqualified paraglider pilot twenty feet out to the side! If it is possible to steer a hapa-boat from the paraglider by means of a second kiteline. I cannot conceive how the mechanism would work.

I proposed the use of a hang-glider because paragliders were barely heard of at the time. Having later been in the sea under both a hang-glider and a paraglider, the latter are definitely to be preferred. They are more forgiving (no wires, the lines and canopy are further from the aquaviator, also they are lighter, easier to erect, disassemble and store), and are no less efficient than my first generation hang-glider.

When I read "Ultimate Sailing" I commenced designing my own hapas, believing I was on my own, until I met Theo Schmidt at an AYRS Winter meeting at St. Katherine's Dock, London. He revealed that he was already designing hapas, for Keith Stewart, the kite man. If only I had known, Didier Costes had already patented a hapa (chien de mer), but only in the French patent office. I found this out only years later and he kindly made a hapa for me.

My article concluded with a plea to readers to suggest a boat suitable for my experiment, but answer came there none. This was for two reasons.

Firstly, and this applies also today, was because there are very few people out there. Secondly, all good yachts are designed to have hulls which slide through the water in the most drag-free manner possible.

The hapa and the hapa-boat need the exact opposite attribute. It needs to grip the water as firmly as possible so as to produce the greatest possible lift or thrust per square inch. Clearly the hapa or hapa-boat must be designed bespoke. Perhaps the most badly designed draggiest hull (maybe a semi-inflated inflatable) might suffice. My own design criteria is that it should be the size of one-man sailing dinghy but have the centreboard area of ten one-man sailing dinghies. There is no need for crew space on board for reasons stated above.

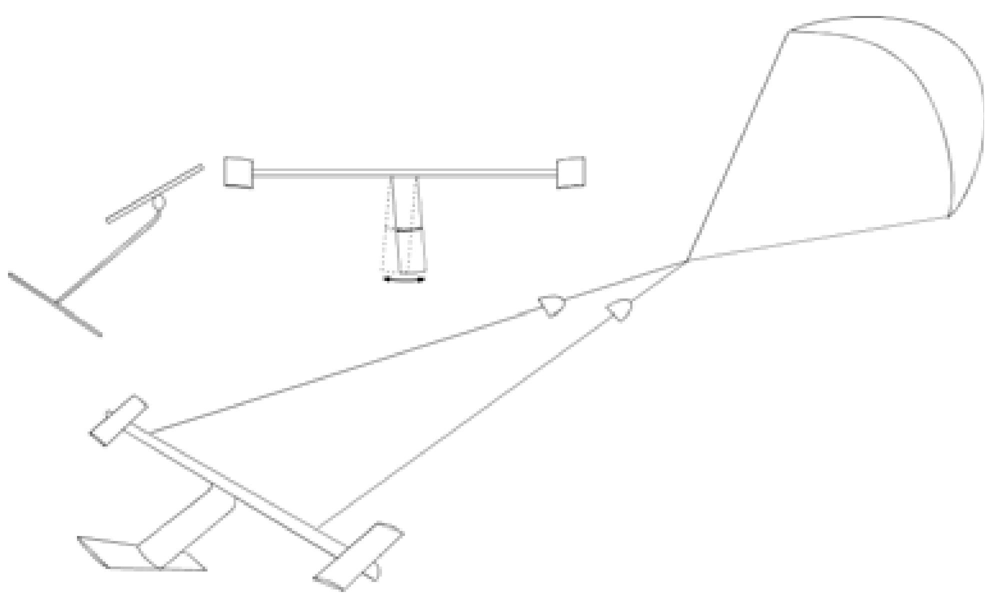
When my copy of "Ultimate Sailing" arrived shortly after my article was published, I was overjoyed that the Author, who was clearly the master, considered the experiment feasible. Not only did he sweep away my imaginary problems, he also provided the underpinning mathematical logic to the whole concept. Even if Professor Hagedoorn's estimated figures are 50% overoptimistic, the craft will still fly (just, slowly and on one course only). I regret that I never had the honour of meeting him. In the hundredth year since his birth, may he rest in peace.

Roger Glencross
2011

Is variable geometry necessary for Ultimate Sailing?

Robert Beigler

Roger Glencross argues that a hapa must produce constant thrust at variable speeds, and must therefore have variable geometry. I am not convinced by either point. The wings of a plane flying a level course must also produce constant thrust at variable speeds. Some of the variation in the coefficient of lift is provided by changes in angle of attack, some by flaps, because that is rather easier than varying the area. As I understand Roger's description, he has only a single line between pilot and hapa. Presumably he then bridles the hapa like a kite, giving him a constant angle of attack. That denies him a simple way of controlling the coefficient of lift. He also needs to change the angle of attack to have full control over his course. If he has only a single line going to the hapa, he can only control his course a little by changing the direction in which the kite pulls, but I don't think he could even stop. In fact, if his only control over the hapa is the bridle setting, and if pull were constant, then the hapa's speed through the water would also be constant.



Roger writes that the kite's lift to drag ratio is about three, therefore if pilot and kite weigh 200 lbs, the hapa must provide a constant lateral thrust of 67 lbs. I believe this to be wrong for two reasons. First, the vertical lift needed also depends on the angle between the horizontal and the line that connects hapa and pilot. The additional vertical lift needed is the product of the horizontal thrust and the sine of the angle. In practice, that should not be a large issue. The second issue is large, though. If the hapa pilot is to do more than gently drift downwind, then the kite must be angled to one side or the other. The closer to the wind the pilot sails, the closer to horizontal the kite's pull will have to be. How close to the horizontal it can get is limited by the kite's lift to drag ratio. That means the horizontal pull will not be a constant one third of the vertical lift needed, it can easily be several times as much as the vertical lift. I don't think there is a limit to the total horizontal force, except those set by wind speed and the strength of the structure. If Roger's argument were correct, the maximal horizontal pull of any kite would be the kite's weight divided by its lift to drag ratio. Any experience with traction kites will show that is not true. Because Roger has neglected what you need to do anything but drift straight downwind, he has calculated the minimum needed to get the pilot out of the water, not the maximum.

It may seem that the variable horizontal force required only increases the need to control the coefficient of lift. That is only partly true. If there is more horizontal force, the hapa can move faster through the water, increasing lift even if the coefficient remains the same. Nevertheless, I am sure that the pilot absolutely must be able to control where the hapa is headed, not only to control the coefficient of lift, but also to control the course. This is necessary both for the safety of other people on the water and for the safety of the pilot. A single line can only provide that control if there is a remotely controlled motor down at the hapa that either changes bridle setting or controls the course by a rudder. The alternative is to control the hapa's course by having two lines. And if two lines are used, one might as well use a proa hapa. I modified Paul Ashford's very elegant anchor dog design (AYRS 114) for two way operation, tested it with a sailing canoe, and described the results some years ago in Catalyst 23, January 2006 (figures 4, 5 and 7). I think the same design would be suitable for ultimate sailing. Attach the proa hapa to the pilot via a loop of line running through a block. Insert into the line a stirrup on either side of the block. Let the pilot control the course with the feet in the stirrups, just a kite surfers control their boards with their feet. In the figure, I have drawn a front and side view of the hapa, and a perspective view of hapa, steering line with stirrups, and the kite. You will have to imagine the pilot. The system is simple enough that it could be tested with a radio controlled model. If I can get hold of a suitable kite cheaply enough, I am willing to do that myself. Please do propose suitable kites. However, don't expect data in less than two or three years. Windy days are rare on Trondheimsfjorden.

Also - a picture of the hinged foil model boat I am developing, but because the rudder doesn't move enough to control the boat, I have no progress to report yet. To fix the rudder I will have to cut open the deck, so I can access the servo. The alternative is a bridle arrangement for towing tests in the river. There is a footpath along a bit with mild rapids, and pretty fast flow for a boat that size. That might already give me a fair bit of information even without taking the time to fix the rudder.

Regards
Robert

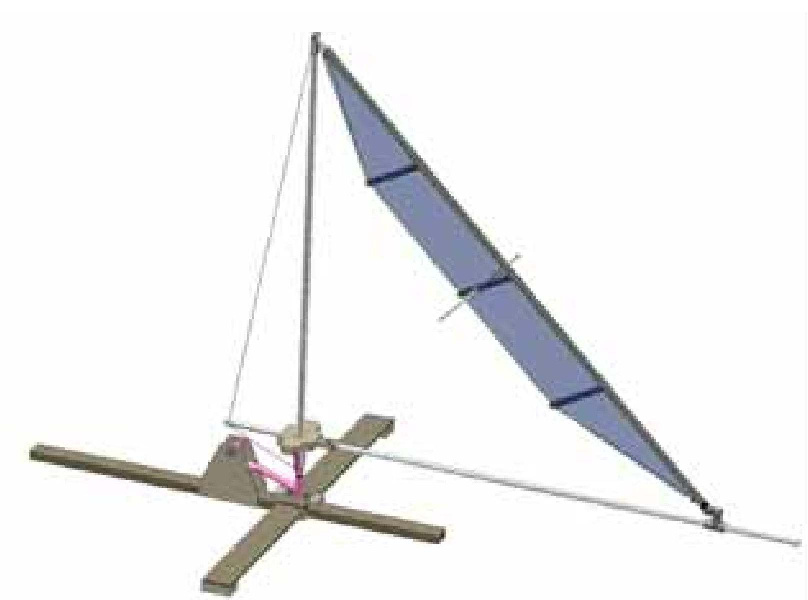
AYRS HOWARD FUND

Morley Tethered Kite Sail Project – Interim Report

Mike Howard

Although Stage One in the development of the Morley Tethered Kite Sail was funded privately, it is, nevertheless, a very relevant part of the overall programme to fulfil the inventor's ambition to see his idea realised full scale. Up until the formation of a project team comprising several members of the AYRS North West Local Group, the inventor, Dr. John Morley, a non-sailor, had had to confine himself to building and testing models. Although the models had performed as he predicted, it did not ensure that the idea would stand being developed to drive a full size boat.

At the first meeting of the AYRS North West Local Group in March 2010, John Morley kindly presented his ideas and demonstrated it with two models of his sail system powered by a twelve inch diameter desk fan. The audience was divided into two camps - one group accepting his ideas with some reservations, the other group being very sceptical and dismissing his idea as non-workable. Before the end of March, as one of the 'believers', I had decided to take up John's cause and applied for funding from the AYRS Howard Fund.



At the 18th September meeting of the AYRS North West Local Group, as I had had no word from the AYRS Committee about my application, we decided to form a project team and develop a small scale static demonstrator. By the end of the next week, I had issued a set of 2D working drawings in PDF format which I had produced from a 3D model developed using Autodesk Inventor 3D modelling software. John Shuttleworth manufactured the timber base frame and the polytarp sail. John Alldred manufactured a very robust set of timber and plywood clevis fittings. Brian Shenstone procured the steel wire rope forestay and mast stay as well as acting as treasurer for the project. I modified an old children's bicycle frame to act as a mast support/pivot and I also manufactured the uPVC sail support structure. Roy Anderson kindly donated three lengths of aluminium tube that formed the three main spars of the rig.

The Static Demonstrator was designed from the onset to be built simply and cheaply and in fact cost less than £100, excluding the generous donations of materials and time from the participating AYRS members. The mast, boom and luff-spar are manufactured from Schedule 40 aluminium tube, being 38.1mm, 31.8mm and 25.4mm outside diameter respectively. The Polytarp sail is 2730mm along the luff with a width of 1075mm, giving 2.3 square metres of sail area. The sail is laced to a uPVC rectangular structure which pivots on the aluminium luff-spar. The three aluminium tubes are joined together using clevis fittings manufactured with a hardwood shank and plywood cheeks, and they form a triangular structure.

When viewed with your back to the wind, the sail lies at an angle of 45 degrees to the vertical, thus it provides lift and eliminates heeling. The whole assembly pivots on the inverted front fork assembly of a children's bicycle. This in turn is secured to a rigid timber cruciform shaped frame. The whole assembly can be easily disassembled and carried on the roof rack of my Citroen C4 hatchback. The sail assembly is controlled by a mainsheet which forms a continuous loop. Each end of the mainsheet is secured to the ends of the cross spar, which passes through the centre of effort of the sail and protrudes about 600mm each side. It then passes through two sets of bulls-eye fairleads/cam cleats before passing through a masthead block.

It took a month or so for the team to manufacture the parts and in the early part of November on a cold and blustery day, we met at my home and assembled the parts into a working static demonstrator. A bit of lateral thinking solved the few minor hiccups. About a week before the November 27th meeting of the AYRS North West Local Group I received a letter from AYRS confirming that I had been successful in my application to the Howard Fund. I was very pleased to be able to announce at the meeting my success in obtaining funding and I was very proud to lead the assembled company out into my garden and show off the completed Morley Tethered Kite Sail - Static Demonstrator.

Over the next month I "played around" with the Static Demonstrator in my back garden, trying various methods of rigging the mainsheets and repairing several of the uPVC parts which I managed to break! January was a dead month due to the severe winter weather. During February and March I hauled the Static Demonstrator down to Crosby beach on several occasions to try it out - to no avail as there was insufficient wind. Finally, towards the end of April, having found a more suitable location and with the arrival of some good steady breezes, the Morley Tethered Kite Sail Static Demonstrator finally "flew". Over the next month John and I carried out a series of trials in varying wind strengths that thoroughly tested the rig, almost to destruction!

Each trial seemed to throw up new ideas to try out. Between trials I was kept busy modifying or repairing the rig which continued to show up its weaknesses. The base frame was stiffened up and various lengths of cross-spar, guiding the mainsheet, were manufactured and tested. Measurements of mast deflection, mainsheet tension and wind strength were recorded. Each trial took place on the open beach at Ainsdale near Southport, Merseyside and lasted between two and three hours. The rig was tested in winds ranging from 12 knots up to gusts exceeding 30 knots. Wind data was obtained by telephone from Crosby Coastguard Station, which is situated about three miles away from our test site.. By the end of the first week of May, John Morley and I decided that the Static Demonstrator had given us enough information to proceed to Stage Two.

Before moving on to explain what we intend to do in Stage Two, let me explain how the Morley Tethered Kite Sail Static Demonstrator performed. Once the windward mainsheet is hauled in sufficiently to give an angle of between 80 and 85 degrees between the sail and the boom, the whole sail assembly swings into and out of the eye of the wind until it settles, full of wind, at its optimum angle of attack. Due to the lift/drag ratio of this particular rig (estimated at 3), the boom lies perpendicular to the wind. Any change in wind direction brings an immediate movement of the sail to realign itself at its best angle to the wind. The sail assembly, once set, is completely self trimming, regardless of the boat's heading - not an easy idea for the small boat sailor to get his head around!.

Stage Two will be a departure from my Howard Fund proposal. Instead of proceeding directly with a full size single sail demonstrator fitted to an Enterprise sailing dinghy, we are going to manufacture a triple sail configuration suitable for mounting on either the Static Demonstrator rig or on a small dinghy or canoe. The reason for this departure is that a triple sail version will drastically reduce the length of both the mast and the boom and provide a more manageable and compact rig. We also want to develop the capability of automatically spilling the wind to prevent excessive lift being generated in severe gusts. This will take the form of an "elastic" element where the mainsheet attaches

to the cross spar. As the triple sail version is unproven, except in model form, it would be too great a risk to proceed directly to a full size demonstrator.

This article has little technical content apart from the description of the rig, which can be seen in the accompanying photographs. In fact there were two main purposes behind the manufacture and testing of the Morley Tethered Kite Sail Static Demonstrator. First and foremost was the aim to prove that a full size rig performed as the inventor had envisaged. The second aim was to encourage members of the local group to participate in a single project which used their combined skills and knowledge. Both aims have been successfully fulfilled and we are all now looking forward to completing Stage Two of our project.

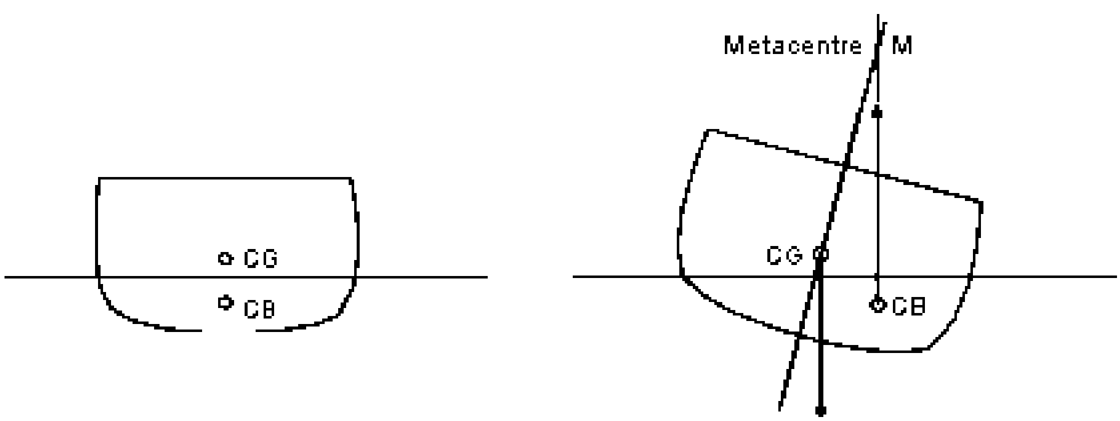
Mike Howard
mjhmpd@yahoo.com

Date: 07.05.2011

Assessment of a Monohull Vessel's Stability with No Hydrostatic Data

William George

Many AYRS' members will be familiar with the concept of the Metacentre – the notional point beneath which a vessel's Centre of Buoyancy moves when the vessel is heeled. If the Metacentre (M) is above the Centre of Gravity (CG), then the vessel is stable and will, when the heeling force is removed, return to an upright position; if the Metacentre is below the CG, then you're in trouble! In practice, the position of the Metacentre moves as the boat heels, but for angles of heel up to say 10° it is typically close (approximately on) the centreline, and close to its initial (upright boat) position, M_0. Measuring the height of the Metacentre above the CG (GM) thus gives a useful measure of a boat's stability. As with all approximations though, this one needs using with care.



William George has done roll testing for many years on all sizes of vessels. What he can tell us is that if a vessel is disturbed and returns to its original condition it has positive initial stability, GM. The question is how accurate is the roll test formula:

$GM = (0.44\ B\ /\ T)^2$

or

William E. George is an internationally recognized author and expert in ship's stability, trim and hull strength. As a marine cargo surveyor with over 29 years of experience, he is also very knowledgeable about cargo stowage, securing, segregation of Hazardous Cargo (HAZMAT).

He is currently a Senior Marine Cargo Surveyor with National Cargo Bureau, Inc. with interests in the areas of Ship's Stability and Trim as well as Staff Training and Instruction, and the author of Stability and Trim for the Ship's Officer, 4th Edition., 2005, as well as the 3rd Edition, 1983, which is a United States Coast Guard License Exam Reference Ship's Officers in the United States.

This material is taken from an email exchange with the AYRS Editor.

$$GM = (0.44\ B\ /\ T)^2$$

where: B = the vessel's beam in feet

T = the full rolling still water rolling period from port to starboard to port in seconds

GM = the initial stability in feet, which includes free surface effects.

Question: Can this be applied to small craft such as yachts?

My answer to the accuracy of these formulas is that if you have a vessel with no hydrostatic data it is much better than nothing. In fact, when comparing rolling test results to actual calculations the results are very good. Free surface corrections are greatly exaggerated. Free Surface corrections assume an angle of heel of 45 degrees when GM alone is only accurate to 8 to 10 degrees at most.

A rolling test rarely exceeds about 1.5 to a 2 degree roll angle. To correct the free surface correction for the actual angle rolled you need to multiply the free surface correction by the angle that the vessel actually rolled. By reducing the excessive free surface correction you will now have a calculated GM_0 that will agree very well with the actual rolling test results.

A key point is the calculation is in the "assumed world", the rolling test is in the "actual world".

In the past with the cooperation of about twenty USCG Fishing Vessel Inspectors each conducted stability tests on 5 fishing vessel of over 20 years of age. We tested older fishing boats because they were the survivors! These older boat varied from abut 120 feet to 32 feet in length. They all had measurable initial stability, and dimensions of freeboard and beam. All was needed was a stopwatch and a tape measure to assess their actual stability without any hydrostatic data or light ship information such as displacement, KG or LCG.

Our test procedure was simple. First we obtain permission from the vessel's master or owner to conduct our field test. Then we measured the beam and freeboard. Once we had these dimensions we could calculate the angle of deck edge immersion in degrees by simply dividing the freeboard by the beam and multiplying by 57.3 degrees. Next we applied an external force to the vessel to get it rolling. For small vessels we just stepped on and off the deck edge. For larger vessels we found three people with a line to the mast could produce a good rolling motion. Once the vessel was rolling we timed the rolling period and calculated the GM_0 by the rolling test formula. I specify GM_0 because any free surface effect that exists is reflected in the vessels rolling period.

Then we analyzed the data by drawing an approximated stability curve of righting arm vs angle of heel. This was done as follows:

The angle of deck edge immersion was the right hand boundary of our curve. We found this could be as little as 10 degrees.

Next we measured the GM_0 from the roll test at 57.3 degrees and drew a straight line to the origin of our plot for zero GZ and heel angle. The initial slope of a stability curve can be graphically established this way or by calculating GZ = GM sin (angle of heel for small angle of inclination).

Now we have a graph of a triangle whose area can be calculated by multiplying the angle of heel up to deck edge immersion by the righting arm, GZ, and dividing by 2. This is our relative measure of the vessel's stability, which is still quite conservative because we could not integrate the true area under the stability curve because we had none. So at the area determined by the triangle cannot be greater than the actual area.

When reviewing the data for about 100 vessels that were found from Alaska to California and the Gulf Coast as well as the Southeastern United States, we found the average residual area of the triangle method was about 3 foot-degrees.

William George

P.S. For small vessels just use the rolling period you observe. For large vessels with a displacement of 30,000 tons, river currents, and numerous mooring lines you can add 1 second.

AYRS NORTH WEST AREA FORUM

Report of the Sixth Meeting held on Saturday 18th June 2011

Six local members attended the Summer meeting of the AYRS NWLG with apologies received from John Shuttleworth and Adrian Denye. The bulk of the meeting was taken up with discussions concerning the next phase of the Tethered Kite Sail Project.

Mike Howard gave a short presentation on the development of the Morley Tethered Kite Sail Static Demonstrator, which was successfully tested during April and May. Photographs and test results were passed around and were accompanied by an explanation of how the sail, once trimmed, automatically adjusted itself to changes in wind direction. A set of drawings and several computer generated 3D images of the proposed full size demonstrator, which is partially funded through AYRS Howard Fund, were also presented.

Mike Howard related the story of his run in with the Local Authority Beach Ranger during the latter stages of the final trial, who had almost put a stop to the proceedings by insisting that further trials would require proof of a third party insurance policy for a minimum of £2,000.000 and a Risk Assessment. Health and Safety rears its ugly head once again! John Alldred related a similar story from twenty years ago when he was testing an autogiro on the same beach. The autogiro was tethered to the rear of his car and in the twenty knot wind was hovering about three feet off the ground. He was approached by a Beach Ranger who informed him that the Mayor was shortly to visit the area and would John please ensure that his autogiro was firmly on the ground during the Major's visit!

This conversation led Colin McCowen to express an interest in the subject of an autogiro powered sailing boat. He related the story of Lord Brabazon of Tara, who in 1933, had fitted such a device to a Bembridge Redwing class half-rater. Much discussion ensued with John Alldred relating his experiences of manufacturing rotor blades and possible sources of variable pitch gearboxes as used on light aircraft in lieu of a masthead brake device. Mike Howard mentioned that he remembered reading about a catamaran powered with a rotor in Catalyst some time back. He recommended Colin to search either Catalyst or the Publications Index on the AYRS website.

Discussions took place on the next phase of the Morley Tethered Kite Sail project, which entails building a full size demonstrator, which will be mounted on an Enterprise class sailing dinghy. Mike Howard suggested that to minimise costs, the sails would be home made using Polytarp, a material manufactured by DuPont. He explained the nature of the material and Colin McGowen and Peter Gilchrist, both of whom have experience of sail making, offered their services. Colin also mentioned a local (Liverpool) supplier who sells odd lengths of polyester sailcloth and Ripstock nylon. Mike Howard mentioned that a variety of sail making materials, tools and fittings were available for sale on E-Bay.

Mike Howard was asked if he had used an anemometer to measure the wind velocity during the trials. He explained that although he has since bought one for future trials, he had telephoned the local (Crosby) Coastguard Station instead to obtain details of wind direction and strength. Colin McGowen mentioned a website - www.metcheck.com - which gives a four hourly weather prediction for any postcode in the UK.

While the members took tea, coffee and home made cakes (thanks to Peter's wife and Col), they inspected the Static Demonstrator, which Mike Howard had repaired and rigged up in the garden; the sun was shining too! Mike Howard demonstrated its operation and discussed improvements which will be incorporated in the next model. Members also used this time for one to one discussions which ranged from canoe sailing to the installation of solar-voltaic panels.

Finally, Mike Howard asked the members if they were receptive to the idea of alternative venues for future meetings. Peter Gilchrist, who lives at Sunderland Point, the 18th century port of Lancaster, offered his home as a possible venue, and stated that, as he was the official local guide, he could also offer a tour of the village! The members thought that this would make an ideal summer outing.

Mike Howard thanked the members for attending and the meeting broke up about five o'clock.

Date of Next Meeting - 17th September 2011

Catalyst Calendar

This is a free listing of events organised by AYRS and others. Please send details of events for possible inclusion by post to Catalyst, BCM AYRS, London WC1N 3XX, UK, or email to **Catalyst@ayrs.org**

November 2011

6th ***Your Projects* – all-day AYRS meeting**
9.30am to 5pm, Thorpe Village Hall, Coldharbour Lane, Thorpe, near Staines
Details from Fred Ball, tel: +44 1344 843690; email fredcball@btinternet.com (new address).

January 2012

6th – 15th London International Boat Show and
12th – 15th The Outdoors Show
EXCEL Exhibition Centre, London Docklands. AYRS will be there. Helpers are wanted to staff the stand, sell publications and recruit new members. If you would like to help (reward: free ticket!) please contact the Hon Secretary on 01727 862268 or email office@ayrs.org

29th All-Day AYRS Meeting
9.30am-4pm, Thorpe Village Hall, Coldharbour Lane, Thorpe, Surrey (off A320 between Staines and Chertsey – follow signs to Thorpe Park, then to the village).
Tea and coffee available but bring your own lunch. Donations invited to pay for hall. Further details from Fred Ball,
tel: +44 1344 843690; email: fredcball@btinternet.com.

29th AYRS Annual General Meeting
4pm, Thorpe Village Hall, Coldharbour Lane, Thorpe, Surrey (as above). Details from the AYRS Hon. Secretary tel: +44 (1727) 862 268; email: secretary@ayrs.org
Note: Items to be considered by the AGM, including nominations for the Committee MUST be received by the AYRS Secretary before 22nd January2012 (post to AYRS, BCM AYRS, London WC1N 3XX, UK, or email: secretary@ayrs.org)

March 2012

3-4th RYA Volvo Dinghy Show, Alexandra Palace London
Many sailing dinghy classes and beach cats will be on display, dinghy skill lectures and demonstrations, new fittings and bargain sailing kit. For details see www.rya.org.uk

10th AYRS South West Area Meeting
Meet at 16:00 at John and Josephine's at Wembury for light refreshments preceding an evening of presentations and discussion on boating subjects - contact John Perry by phone or email for directions. Let John know if you have an idea for a presentation, even a very short one, that you would be prepared to contribute.
Any members who would like to join in a coastal walk during the afternoon before the meeting should come to Bovisand beach cafe (Grid Ref SX492503) at 13:30. We propose to walk the coast path from Bovisand to Wembury, (about 4 miles), then drive the drivers back to the cafe to collect cars.
Contact John Perry -
01752863730(L)
07729334325(M)
j_perry@btinternet.com

April 2012

29th Beaulieu Boat Jumble
The National Motor Museum, BEAULIEU, Hampshire, UK.
AYRS will be there!

May 2012

5th – 7th *Broad Horizons* – AYRS Sailing Meeting (provisional date - earlier than last year)
Barton Turf Adventure Centre, Norfolk UK, NR12 8AZ.
Contact AYRS Secretary, BCM AYRS, London WC1N 3XX, UK; email: office@ayrs.org.
Note: All boats limited to 1.2 metre max draft!

14th - 18th Boat trials, Weymouth
Probably at the Portland and Weymouth Sailing Academy.
Contact: Norman Phillips email: wnorman.phillips@ntlworld.com; tel: 01737 212912.

June 2012

8th- 10th Beale Park Boat Show
As usual we will have a stand and would appreciate small exhibits and display material and of course offers of help to run the stand. Contact: AYRS Secretary, 01727 862268, email office@ayrs.org

AYRS Annual General Meeting 2012

Notice is given that the Annual general Meeting of the Amateur Yacht Research Society will be held on 29th January 2012 in Thorpe Village Hall, Thorpe, near Staines, England, starting at 16.00 hrs. All members and their guests are welcome to attend, but only paid-up members may vote on resolutions.

The business of the meeting will include the following, not necessarily in this order:

1. Receipt of apologies for absence
2. Minutes of the previous AGM
3. Chairman's Report
4. Treasurer's Report and Approval of Accounts
5. Election of Officers and Committee members
6. Appointment of a Reporting Accountant
7. Any Other Business

Relevant documents will be posted on the AYRS website www.ayrs.org.

Matters for discussion under Item 7 should be notified to the Hon Secretary as soon as possible. Email hon.sec@ayrs.org

Any queries should be addressed to the AYRS Office, email office@ayrs.org.

Catalyst — *a person or thing acting as a stimulus in bringing about or hastening a result*

On the Horizon . . .

More sources and resources: reviews, publications and Internet sites

Amateur Yacht Research Society
BCM AYRS, London WC1N 3XX, UK

Printed by Printflow, London EC1V 7JD