Catalyst

Journal of the Amateur Yacht Research Society

Number 56 March 2020

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As examples, the polar diagram p16 of *Catalyst 28* was re-created from a photocopy, photos of shunting in the Champion article in *Catalyst 27* (pp 19-21) were screen grabs from a video supplied on DVD. The rest of the images in that article were scanned from photographs, and the text was OCRed (Optical Character Recognition software) or keyboarded.

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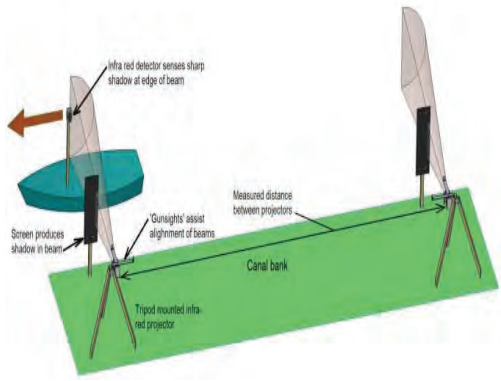

Regulars

Cover Picture - AYRS Chairman Fred Ball heads for the course at Speedweek 2019 Photo: John Perry

Catalyst

Journal of the
Amateur Yacht Research Society

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Annual General Meeting 2020

The minutes of the 2020 Annual General Meeting will be posted in the AYRS Forum, in the members-only section (https://www.ayrs.org/phpbb/viewforum.php?f=40) just as soon an someone has checked them to make sure I haven't forgotten anything! In brief, the usual reports have been accepted; the Amendments to the Articles to allow the Committee to work by electronic conferencing etc have also been approved, thus substantially reducing necessary travelling impact; and we have a new Chairman, John Perry, and several new committee members including Mark Salvage ("Sav"); and Kim Fisher has stepped down from Vice-Chairman to an ordinary Member..

Fred Ball Prize

It was proposed at the AGM that, in memory of Fred Ball our late Chairman (see back cover), AYRS should launch a Prize for a practical demonstration of a novel advance in yacht science, technology or technique. The rules are not yet finalised, but the idea is that they should be similar to those for the old John Hogg Prize (see https://www.ayrs.org/about-ayrs/john-hogg-prize/) but with the emphasis on practical achievement - the sort of thing that Fred himself might have done. Open to the public, not just members, final entries, which should preferably be supported by video or other evidence of practicality, would need to be in by October, say, although early entry would give the judges an opportunity to see things for themselves. Details will be on the website in due course

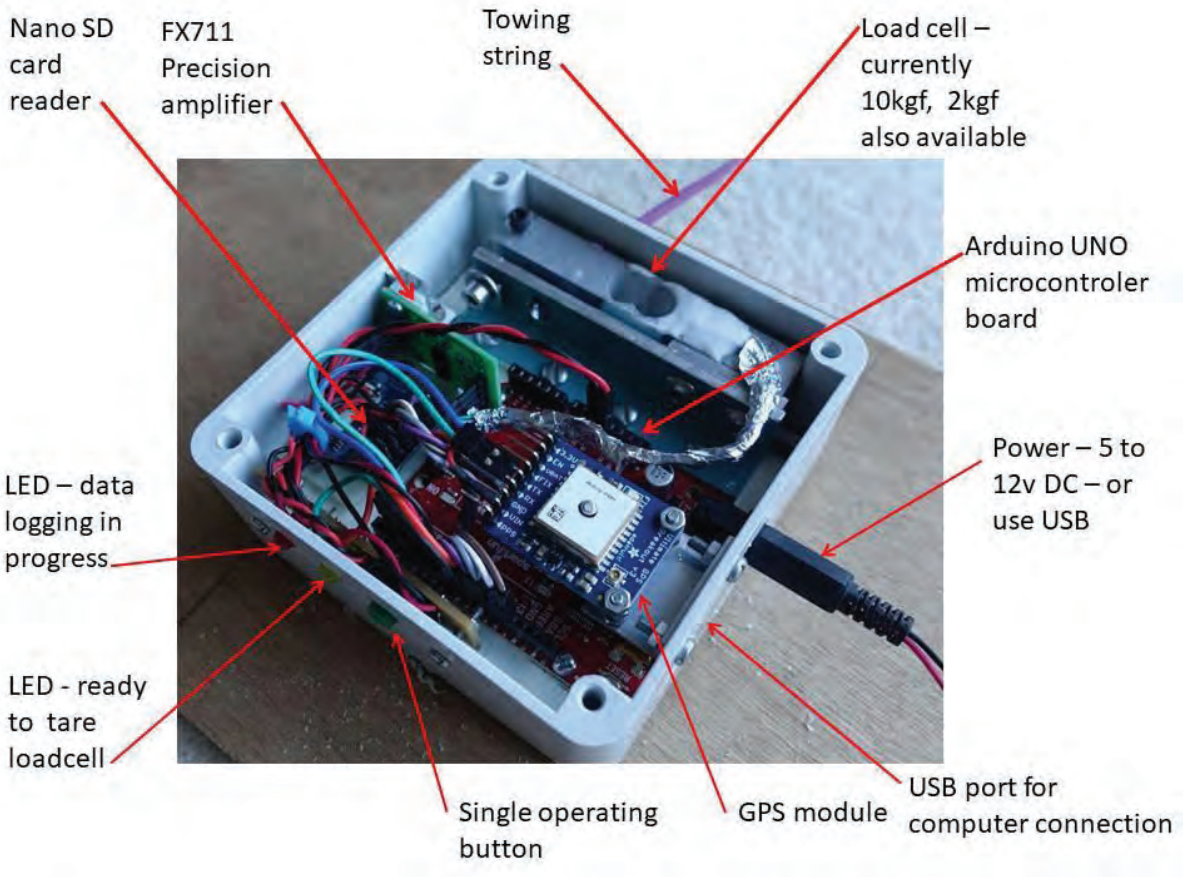
RYA Dinghy Show

Just a reminder that the RYA Dinghy Show is at Alexandra Palace, London on 29th february - 1st March. AYRS is on Stand W6, in the corridor by the exit. We'd love to meet as many members as we can.

Simon Fishwick
AYRS Editor

Practical Tow Testing

John Perry



The Tow Test Data Logger (TTDL)

This is something I put together a few days before the AYRS meeting on the Basingstoke Canal (see report on page 16). Considering that I am not an electronics engineer I was surprised that I was able to produce this gadget in a relatively short time, this just shows how easy it has become to assemble a 'hobby level' control and/or instrument system using fairly inexpensive parts that I think are mainly sold for school and college science projects. I have the advantage that I have done quite a lot of computer programming over the years, including C++ which is the language used for the Arduino microcontroller boards and derivatives. However, both the wiring and the writing of the software are well covered in various tutorial videos on YouTube so even if you have never done wiring or software you should be able to build this kind of project – I think you could do worse than to buy something like a 'Sparkfun Inventor Kit' (Google will find it) then look on You-Tube for some lessons, for example those produced by Paul McWhorter (find him with the YouTube search box).

The system as used at this meeting is shown above. Note the little purple string at the top of the picture – this is attached to the towline so that the tension in the line is measured by the loadcell which is firmly mounted on a base plate in the bottom of the plastic box.

Operation

The gadget is controlled with a single operating button on the side of the box. The sequence of operation is as follows:

- Connect power to TTDL – a yellow light illuminates when the unit is ready, if this does not happen there is probably no SD card inserted in the slot on the side of the unit.
- With all tension off the towline, press the operating button to tare the loadcell – the yellow light then goes out.
- Start test run and establish steady speed and course before reaching the start line. As the start line is crossed press the operating button again. A red light illuminates to show that data is being written to the SD card. (The system records the time that the button is first pressed, so the period for which it is held down does not matter, within reason).
- Press the button again on crossing the finish line. The red light extinguishes to show that a set of data has been recorded.
- Repeat test runs at different speeds.
- At end of testing remove SD card from TTDL and transfer to a computer to examine the collected data. The test runs are numbered and for each test run the data will include a long series of towline tension readings (approximately 10 per second) followed by a calculated speed and the mean, maximum and minimum towline tension.

GPS module

The unit as shown above includes a GPS module which was intended to provide an alternative method for speed measurement. I found that I could get the GPS recording speed without the loadcell system in use, or I could get the loadcell recording without the GPS in use, but not the two together. I think combining the two systems made the software too much for the Arduino board to cope with – not enough dynamic memory for the global variables. To include the GPS I probably need to change to an alternative microcontroller board which should be feasible but I ran out of time to do this before the Basingstoke canal meeting.

Error limits – Towline tension measurement

The load cell system in the TTDL was calibrated by mounting the unit with the base vertical and hanging a 1kg deadweight from the cord attached to the load cell. This deadweight had previously been weighed using a precision laboratory balance reading to 1mg in 5kg. The TTDL was checked after the weekend of use using the same deadweight that had been used for initial calibration and was found to read the same as before the weekend to within 5 grams which is considered to be satisfactory. The software for the TTDL does re-tare the load cell system each time the unit is powered up so as to establish a zero tension reading but the gain of the system from input to output is represented by a constant in the software which has not been reset since the unit was first calibrated. It would be possible to include a software function to allow the system gain to be re- checked against a deadweight load at intervals during a series of test runs.

Error limits – Speed measurement

I suspect that with the current equipment and procedure the error limits for speed measurement are greater than for the towline tension measurement. The error in distance measurement is likely to be relatively small, using a surveyors tape over a 50m run perhaps +/- 0.1%. However, the error in determining start and end times for each run is probably at least +/- 1 second, so +/- 2 seconds for timing a run which is a +/- 7% error limit for a run duration of 30 seconds. Clearly the aim should be to improve on the accuracy of speed measurement for any future towing tests.

Sample data, Discussion and Conclusions

Data collected towing with electric outboard, Saturday 21 September

The readings we took towing the surf canoe on Saturday were expected to be erratic because:

- The towed boat was yawing from side to side so the hull was not always well aligned with the direction of tow – this would be expected to result in a varying towing force and an increase in mean drag.
- The speed achievable by towing with the electric outboard was low, for the data plotted in chart 1 the average speed was only 1.35 knots, so hull drag would be low and hence fluctuating wind forces from the fairly strong breeze may have unduly influenced the tension readings.

Chart 1 shows the data from just one of the towing tests carried out on Saturday and it is clear that the tension readings are fluctuating wildly so

further analysis hardly seems worthwhile.

Data collected towing with manual winch, Sunday 22 September

Chart 2 shows a typical data set from one of the test runs carried out on Sunday, using the shore mounted winch to tow the row boat with two persons on board. In this case the towing speed and the towline tension was higher than for the test runs on Saturday, this being possible because the winch can provide greater towline tension than the electric outboard. Wind speed was lower than on Saturday and this together with the greater speeds and hence greater hull drag would make aerodynamic forces a less significant contribution to towline tension. The row boat has a rudder which made it possible to keep to a straight line much more accurately than with the surf canoe.

It is clear from Chart 2 that towline tension was reducing during the first ten seconds of the run, then levelled off. This is typical of the tests carried out on Sunday and is believed to be due to the short run up to the start of the measured distance, this resulting in the boat being under acceleration from rest as it entered the measured distance. The acceleration taking place during the first part of the run also means that the actual speed over the later part of the run would have been higher than the mean speed of 3.19 knots that was calculated from the run duration and distance. Although the variation of towing force during the last 20 seconds of this run is much less as a percentage of the mean than for the Saturday runs it is still considerable and is thought to be at least partly due to uneven torque being applied to the winch from the crank handles.

Comparison with Michlet drag prediction

The mean towline force for the final 10 seconds of the data plotted in Chart 2 is 22N, i.e. 2.24kgf. Unfortunately, only speed averaged over the whole run was determined, the speed averaged over the last 10 seconds cannot be accurately determined. However, a rough estimate can be made by assuming acceleration from rest during the first 10 seconds of the run following the 0 to Pi/2 part of a sine curve, then a constant speed thereafter. On this basis the speed for the later part of the run is estimated to be about 3.6 knots.

Chart 3 shows a drag prediction for the row boat using the free to download Michlet software. Michlet is not CFD software in the sense that it is does not solve the Navier Stokes equations for multiple small

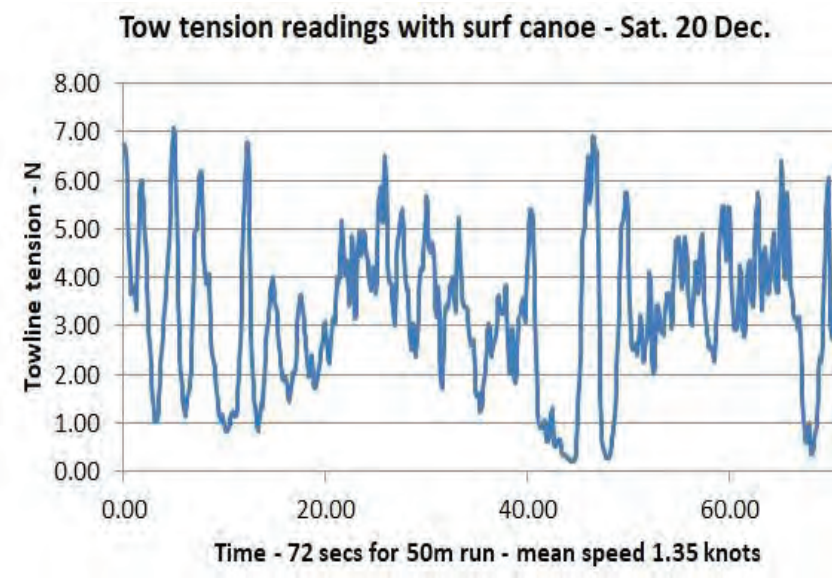


Chart – 1 Sample data from Saturday 21 September

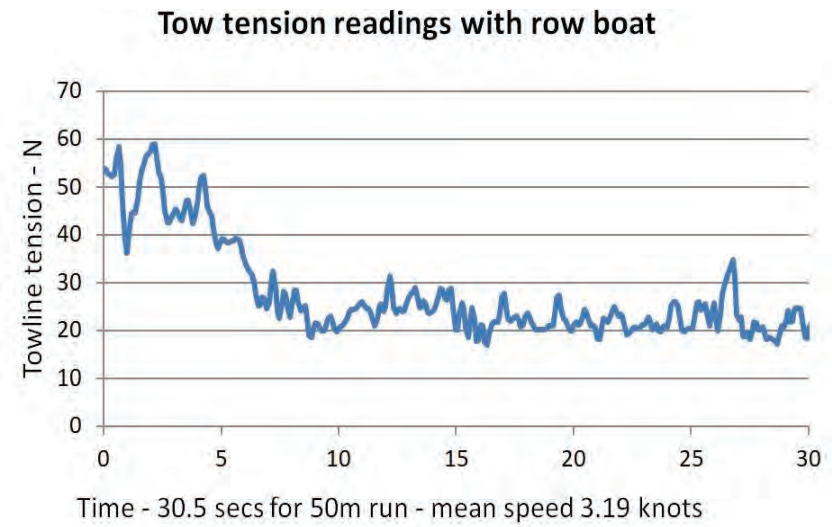


Chart 2 – Sample data from Sunday 22 September

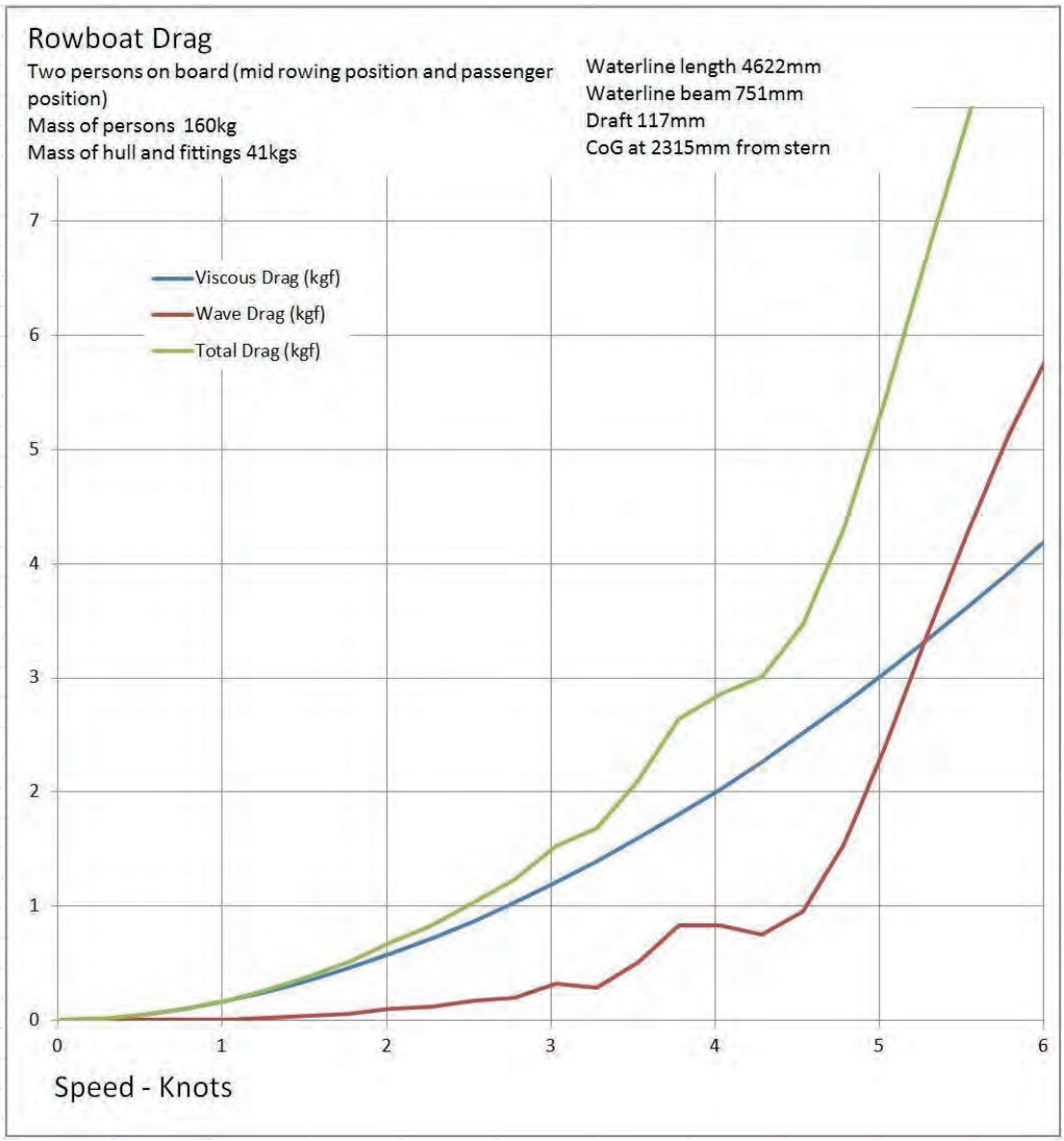
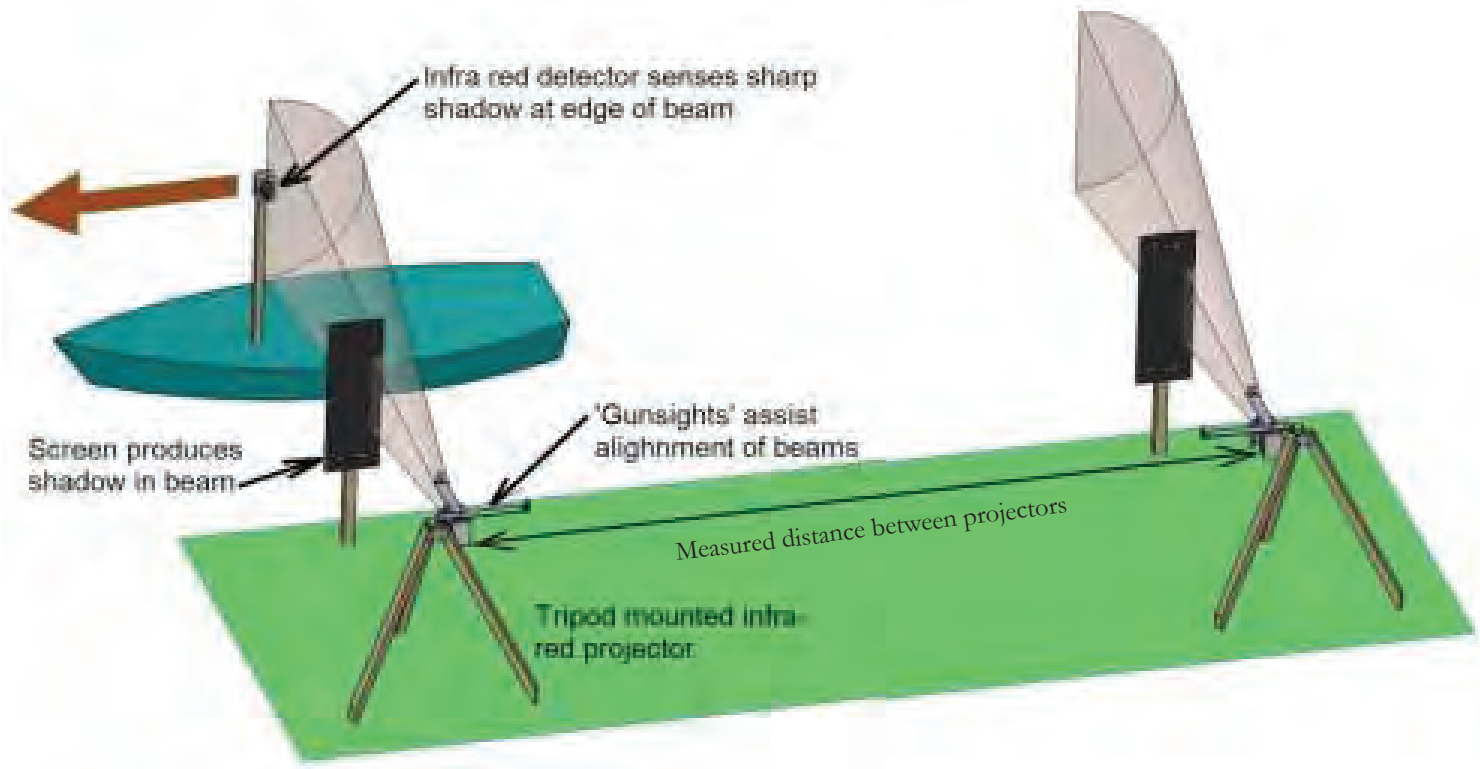


Chart 3 – Michlet drag prediction for row boat with 160kg payload (two persons)

elements of fluid. Rather, Michlet estimates hull drag by combining an ideal flow method, including wave making, with a skin friction estimate based on a viscous friction factor. Compared to CFD, Michlet makes a number of assumptions so it is considered to be an approximate method but it is relatively easy to apply based on a set of hull offsets. One of the assumptions made by the Michlet software is that the cross section dimensions of the hull are small compared to the length, for the narrow rowing boat we are considering here this is probably a valid assumption.

Plotting a drag of 2.24kgf against a speed of 3.6 knots would give a point on chart 3 that is close to the predicted total hull drag (the green line), certainly the discrepancy is well within the likely error limits for the experimental method. However, before we can say that we have validated the Michlet software I think we really should have some more data points collected with improved measurement accuracy, particularly with regard to speed measurement.



Hull drag measurement by tow testing

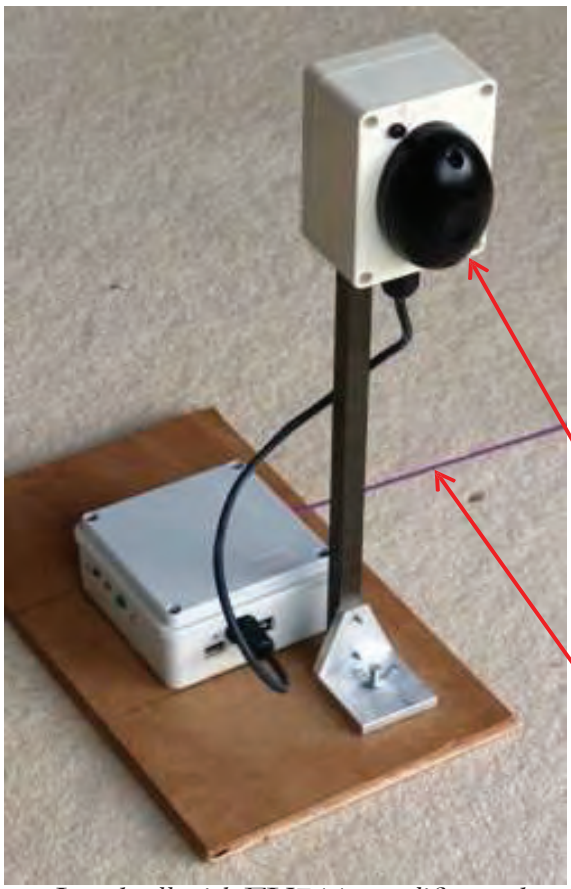
We made hull drag measurement by tow testing the main activity at the AYRS meeting held at the Basingstoke Canal Centre in September this year.

In including tow testing in the programme for the canal centre meeting my intention was simply to offer an activity that would enable everyone to get involved in some experimental work, even if some of the helpers were only able to look on and make helpful suggestions from the security of the canal bank! I never expected that we would produce ground breaking experimental results, especially with equipment which had never been previously used afloat.

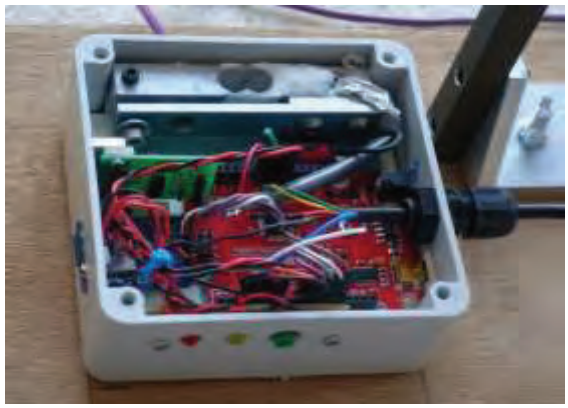
As I wrote earlier, I don't think it is realistic to expect open water towing to give measurements of hull drag to the level of accuracy that would be possible with tow testing in purpose built tow testing tanks. After all, if this were possible, why were very large and expensive tow testing tanks, such as the one at Haslar near Portsmouth, ever constructed? However, with some refinement of our equipment, I am hopeful that we might get some drag measurements that we could compare with the results of theoretical methods such as the free-to-download Michlet software and we might also, for example, be able to do basic measurements on novel hapa and hydrofoil designs and perhaps investigate the effect that wave action has on the drag of small hulls. Other suggestions for the use of simple tow testing equipment would be welcome.

It is clear that the biggest errors in our experiments on the Basingstoke canal were in the speed measurement which was by timing the passage of the towed boat between two flags set up a measured distance apart on the canal bank. GPS would offer more accurate speed measurement than that method but reading about the errors inherent in GPS I don't think it would match the accuracy that we are already achieving for the towline tension measurement using a load cell. So I considered two alternatives. One was to tow with a shore mounted electric winch, measuring the line speed with an encoder on pinch rollers running in contact with the line. The second was to continue to use timing (by a microcontroller system) between measured start and finish lines but to define these lines with infra-red beams projected across the waterway rather than with flags (even though the flags did include a genuine AYRS burgee!).

The tripod mounted infra-red projectors – the temporary blue cardboard parts are to be replaced with metal parts



Load cell with FX711 amplifier and Infra-red detector and load cell – clamps or lashings are used to attach this unit to the boat being tested



Load cell, FX711 amplifier, Arduino microcontroller and SD card reader/writer

Infra-red sensor (as used with traffic barriers). This is mounted on a box that contains battery and voltage regulators for the system

Cord from load cell attaches to towline

For the time being I have decided to go with the second method which is applicable either to towing with a tow boat or to towing with a winch mounted on a bridge across the waterway or on a promontory into the waterway. The drawing on page 7 shows the principle and the photos opposite show the equipment I have put together. Although I have opted for the use of infra-red beams, the winch method certainly has advantages so if this project continues we might do well to re-visit that option at some stage. An electric winch could give a steady tow without risk of water disturbance from a tow boat. It would require a power supply that we can take to a possibly remote waterside location, either a portable generator or a suitable battery.

With reference to the drawing, the screens set up on the bank provide sharply defined shadows in the beams projected across the water and the detector mounted on the moving boat picks up the time of crossing the edges of these shadows. The further the screens are from the infra-red sources the sharper should be the shadows and my preliminary tests suggested that with the source on the landward side of a canal towpath and the screens set up on the water edge, say 2 to 3 m distant, we should get pretty sharp shadows. I then found that it is likely that adequately sharp shadows can be achieved with less separation between source and screen, so I made trial screens from bits of card mounted on arms projecting about 250mm forward from the infra-red source. This is the current state of the equipment as shown in the photographs. I just need to replace the bits of blue card with more durable metal parts.

The reason each projector has two arms at right angles and 'gunsights' fitted on these arms is to help with setting up the system with parallel start and finish lines. With careful setting up using a surveyors tape, or a 'laser tape' instrument, I am hopeful that we could achieve an accuracy of around +/- 150mm in setting start and finish lines a nominal 50m apart, so with timing to a millisecond we should have a speed accuracy in the region of +/- 0.3%. Going to, say, 100m separation may give further improvement in speed measurement and also allow a greater averaging time for the towline tension readings. Checking the loadcell system several times over the last few weeks, using the same deadweight each time, the system has given readings consistent to within 5 grams in 2kg, so that is within 0.25%. It may be possible to improve on this by re-calibration against an accurately measured deadweight shortly prior to each set of tests.

A couple of days before our meeting I did carry out a test of the system by walking the detector unit past the two projectors and all worked satisfactorily in our garden (despite light rain that was doing no good to the temporary cardboard screens on my projectors!). Since the speed timing and the towline tension measurement are both carried out on the boat that is under test I was able to make a single self-contained unit to process all the data and record it as a text file on an SD card, this is much more convenient than having to correlate data from separate instruments. I had intended to repeat this demonstration at the Thorpe meeting but with so many projects to be presented and discussed there simply was not time in the day to do so, maybe next time this will be possible.

Possible applications

It is unlikely that tow testing on open water will ever achieve sufficient precision to resolve the small differences in hull drag between, say, two race canoe hulls which are both competitive but are of slightly different shape. Such differences in drag are tiny, but may still be significant in top level competition. Even professional towing tanks probably cannot resolve such tiny differences in drag with any certainty. Hull testing tanks typically have the hull under test attached through a force measuring system to a moving gantry which spans the tank. This ensures that the hull is kept at a known orientation to the direction of travel, the course is a straight line, the speed is constant and can be accurately measured, the water and the air above are still. I understand that the tank is typically left to settle for some hours before each test run. A question to consider:- if accurate hull drag data could be obtained simply by towing with a loadcell on open water why were expensive hull testing tanks ever built?

Having made the above point I think there are some potential applications for relatively simple tow testing equipment, these are suggestions:

- Computer Fluid Dynamics (CFD) is likely to be the future for predicting the performance of sailing craft at the design stage and for design optimisation. However, it is still useful to have even an approximate experimental method to confirm that there is no gross error in the CFD software or in the information fed into the software. One of those present at our meeting used to be involved in professional wind tunnel work and he told us that the present use of wind

tunnels is mainly to 'calibrate' the results of CFD work.

- Some AYRS members are interested in 'Hapas' (towed hydroplanes used to stabilise a sailing boat and/or to resist leeway). AYRS members have tested hapas by dragging them along with a string from the shore or from a tow boat but as far as I know little if anything has been done to measure towing forces. In the absence of such information even approximate measurements could be useful in comparing alternative hapa designs. The same could be said for novel hydrofoil configurations, a subject of much interest to the author of this report!
- Hulls are known to have significantly higher drag in rough water than smooth water. Tow testing on open water could put some numbers to this and could inform the development of velocity prediction software which is used, among other things, to set up handicapping systems for yacht racing.

Suggestions for improvements for future work

- There must be an adequate distance to establish steady speed and course before the start of each run.
- Speed measurement needs to be better than with the current equipment and procedure.
- GPS speed measurement would be an improvement on the method we used this weekend but for low speed testing it may well be less accurate than speed measurement by an improved timing procedure. A longer run distance and duration might be the first improvement to consider for speed measurement by timing. The start and stop lines could be better defined by using four markers to set up two transit lines, rather than just two markers. Automatic timing could be considered, possibly with infra-red light beams. If towing is done with a shore mounted winch then speed could be measured at the winch, perhaps by measuring the rotation of the winch drum with allowance for build-up of line on the drum, or rotation of a jockey wheel running on the line or by electronically detectable markers attached at intervals to the line.
- A shore mounted winch has the advantage that the test is not influenced by prop wash or other water disturbance from a towing boat, however the winch line needs to be quite long! A motor drive to the winch could be considered to control speed and to avoid the torque fluctuations that tend to occur with hand cranking.
- It may be worth trying an elastic element in the towline to damp out fluctuations in towline tension, although it could be argued that averaging readings in the software achieves a similar result

Shape and profile of a common sculling oar.

Alex Quertenmont

I've tried different shapes and profiles of an oar for Kasala, a small cruising sail boat designed to be propelled by sail or sculling oar. After multiple attempts, I finally came up with a simple and efficient design that I want to share with other amateurs.

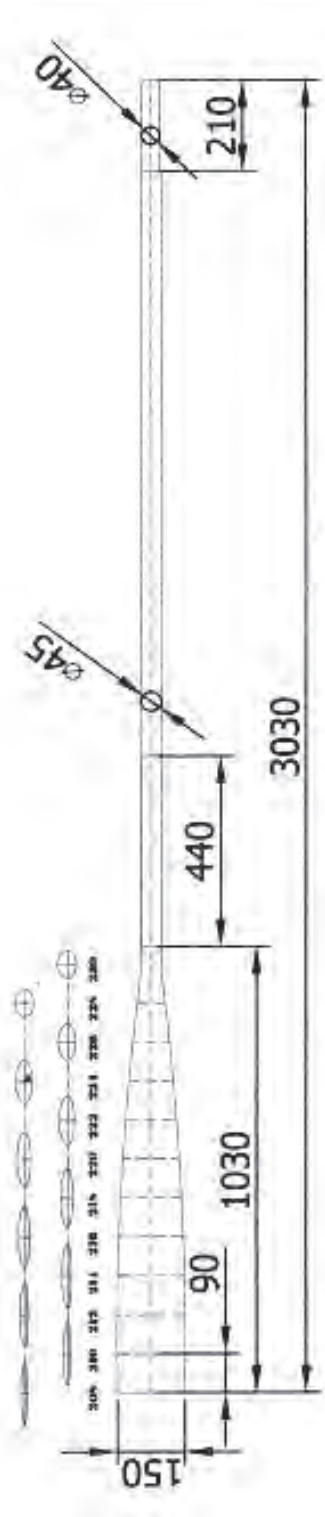
There is no "standard" type of sculling oar. Each boat and each sailor should suit their own paddle depending of the height of the oarlock, the height of hands, type of sculling technique and of course, the type of boat. But there are general rules that could be helpful when you want to shape your own oar.

One of the most problematic issues we found with a sculling oar is that you could never try it for real on a fixed pontoon or in a swimming pool, for example. They all seem to perform fine in those conditions but as soon as you try them in a boat, the oar tend to escape from the oarlock most of the time when you reach high speeds or hit rough waters. After multiple attempts and errors, a design was achieved that appears suitable for a heavy craft equipped with a dagger or a centreboard.

The shape should be long and narrow leading in high aspect ratio. The section close to the water surface should be as narrow as possible to prevent the oar from being pushed out of the oarlock. Finally, it seems that a straight cut to the bottom performs better in all kinds of sailing conditions. The maximum width of this shape should preferably be 6 inches (150 mm).

The profile I used is based on the one we encounter in the centreboard of a proa. Actually, they work in the same way, reversing their leading and trailing edges at each tack, like what a sculling oar does at the end of each stroke. So, adapting profile P30208 found at the end of the blade to P30230 near the surface at the round section of the oar handle, we can count on an asymmetrical profile that can deliver the power we expect. Like a propeller, the flatter area should always face the rear. It is this face that will float above the water before you begin your sculling movements.

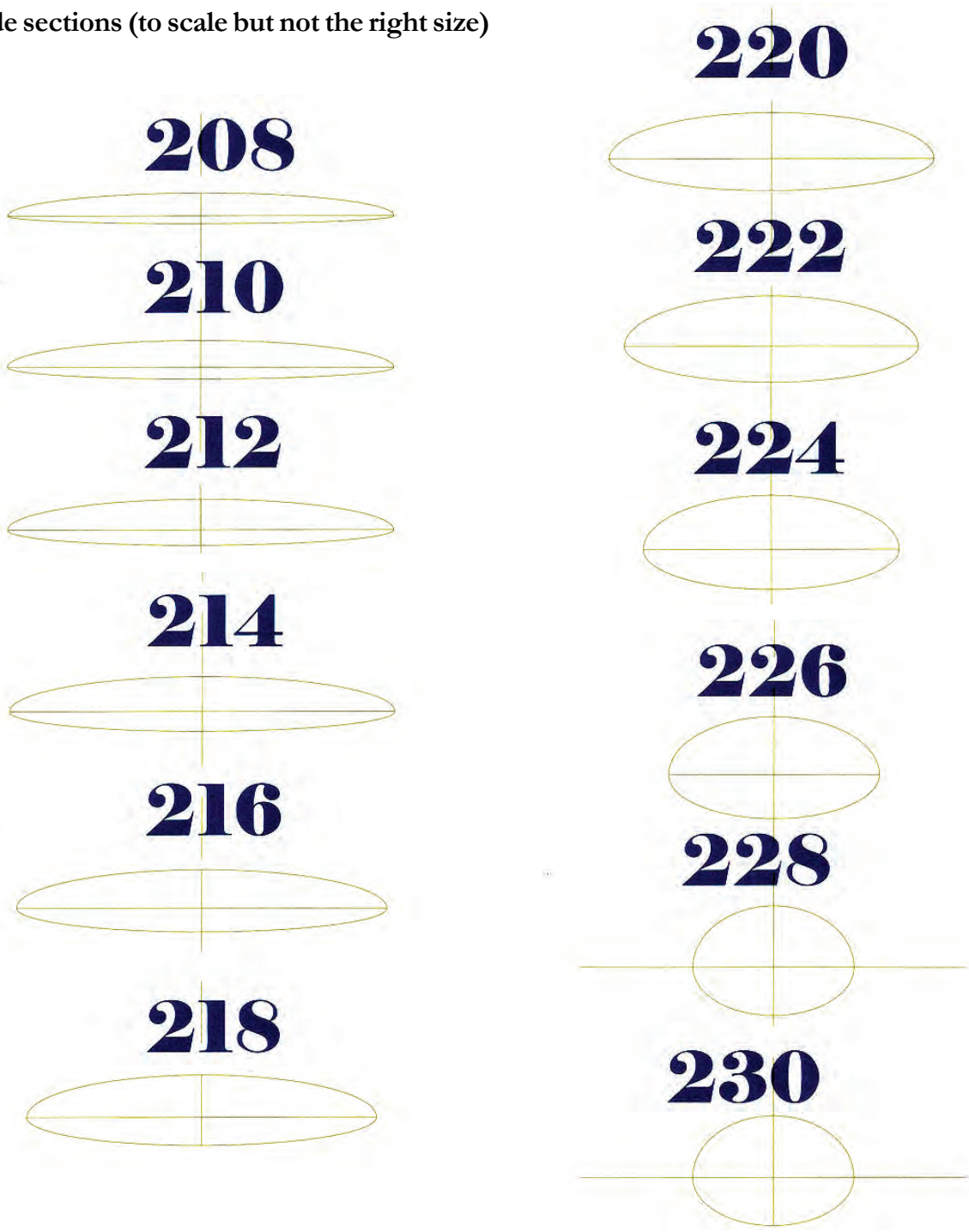
The thickness of the handle should be well



designed too. If it is too thick, it will lead to a heavy and inefficient paddle. If it is too thin, it could break when you need extra power in rough seas or extreme conditions. A bit of elasticity is welcomed, especially at the end of the stroke; it seems that it brings a special kick that is beneficial for the movement and propulsion. But this section will depend on the length and the type of material used to craft the oar. I prefer to use white ash.

When designing my sculling oar for Kasala, I limited the length at 3 meters (10 feet) due to the storage available on deck. But other suitable lengths could easily be scaled out of my design. You will find hereunder a general layout of the entire sculling oar and also scale drawings of the different profile sections used.

Blade sections (to scale but not the right size)



Record of the NW UK Local Group Summer Meeting held on Saturday 15th June 2019 – report by Mike Howard

Mike Howard opened the meeting by outlining the progress which had been made with regards the Members Questionnaire which had been widely circulated to the membership in mid December 2018. A Final Report based on the detailed analysis of the results had been completed by Mike in mid May, which had consumed 46 manhours, and which had now been circulated to all members of the AYRS Committee. It had received a favourable reception. There was a lot of support for local groups so Mike has volunteered to carry out the location of membership 'clusters'. He is awaiting the approval of this task by the AYRS Committee. Several members asked if the Final Report was going to be published so that members could read it and Mike that he would push for its publication. *[It has been available for some months in the Members-Only area of the AYRS Website Forum – https://www.ayrs.org/phpbb/viewtopic.php?f=33&t=3580]*

The AYRS NWLG Summer Meeting inspecting Adrian Denye's Youth Trainer

Mike presented a report on the Northern Boat Show which was held over the weekend of 31st May to the 2nd June. It was held on the weekend of the river Mersey River Festival which featured little marine activity and which seems to have turned into an Arts Festival. The Boat Show was very poorly supported with only about a dozen stands relating to boating activities and another half dozen or so relating to other activities.. On the Sunday, the Boat Show was cancelled by the Mayor's Office due to the celebrations relating to the return of the Liverpool football squad from their triumph in Madrid. Several days after the event, Mike spoke to one of the NBS Organisers, who expressed their frustration at the lack of enthusiasm within Culture Liverpool for the NBS. "It's like we are doing them a favour" they lamented.

Adrian replied to the question of introducing young people into the sport of sailing. He expressed his opinion that RYA Instructors spend much of their time explaining how to overcome the idiosyncrasies of the various classes of racing dinghies instead of explaining and demonstrating the fundamentals of sailing. In his club, which is based on tidal waters, few youngsters who have undergone RYA approved training understand the working of the tides! Perhaps it is time for AYRS to introduce a basic sailing guide?

Colin McCowen regaled the audience about his discovery of Spotify (a popular music app) before moving on to explain how he raises and lowers his wing sail single handed. He uses a forward facing spar which pivots on a tube placed across his canoe forward of the mast heel. A rope stretches from the top of the mast to the end of the spar. A block and tackle

Adrian Denye demonstrates the Rigid Wing Sail Trim Tab

fixed to the stem head and the upper end of the spar is used to control the raising and lowering of mast. A backstay prevents the mast from tumbling forward. A round-the-table discussion highlighted several other more orthodox methods of mast positioning, including sheerlegs, tubular side stays, tabernacle mounted masts and an extended pulpit device used in the same way as Colin's device.

Adrian updated the meeting with regard progress on the America's Cup. Problems during the testing of the electro-hydraulic powered foil canting system have delayed the delivery of the standardised system to each of the teams resulting in a somewhat delayed and shortened trial programme. Videos of the testing rig are available on YouTube and help to emphasise the size and complexity of the foiling system. *[Type into your browser - 'Americas Cup, testing the foil cant system'].*

After refreshments had been served (thanks Col) the members went outside to view Adrian's ex AYRS MicroTransat Challenge prototype. Adrian explained how he had modified the trimaran's main hull by cutting away part of the upper deck fairing to create a cockpit suitable for young people to learn to sail in it.. A seat and a simple steering mechanism have been fitted for manned sailing. Adrian was quick to point out that the craft could easily revert to its former role as an autonomous trans-Atlantic sailing boat if the project was resurrected. He also showed off the rigid wing sail he has built for this boat. This features a NACA 0018 sail with a NACA 0012 trim tab.

Back indoors Adrian expanded on the latest development of the Saildrone Project. These autonomous sailing craft have now reverted to six metre long monohulls as the trimaran configuration gathered up too much weed on extended year long voyages. The hull cross section is now hexagonal to simplify the arrangement of equipment hatches on the top surface and the solar panels on the upper sides. Mike asked if Sail Buoy had been awarded the prize for the first autonomous craft to cross the Atlantic under sail. Adrian was of the opinion that Offshore Sensing had intervened electronically during the voyage thus contravening the rules governing autonomous operation. There is still time for AYRS to complete the MicroTransat Challenge!

The next to speak was Richard Fish who explained how he has gathered together an array of inexpensive electronic equipment in order to develop a system to gather information about the pressure differentials over the surfaces of a rigid wing sail. Adrian offered his wing sailed trimaran as a trials horse. Richard is using both a Pi Zero and an Arduino micro computer, a Beitan BN-200 GPS and up to eight Bosch bmp280-12c sensors to build his system. A digital compass and accelerometers will also be linked into his system. He has also ordered analogue differential pressure sensors that work on the strain gauge diaphragm principle. Mike promised to put him in touch with Richard Walker who had already vetted this type of electronic equipment for use on the AYRS MicroTransat Challenge craft.

Richard also demonstrated a model showing how a NACA 0012 airfoil solid wing section set inside and pivotted within a similar outer airfoil section with a larger chord could be adjusted to provide a self stabilising wing sail. This eliminates the tail fin found on conventional solid wing sails.

John was then asked about his current R&D project. John stated he was still experimenting with determining hull resistance using scale models in a home made test tank. A discussion took place with regards tank cross section and also the control of the model using simple micro processors. Mention was made of AIRFOIL TOOLS a free computer based computer programme to enable the offsets

to be developed for any one of 1600 airfoil shapes. Several of the members present have successfully utilised this useful tool. Discussion of the relevance of both Froude and Renolds Numbers took place.

Finally, Colin Weir explained in simple English the two year University course he has recently started. Essentially it is further research into the development of high flying drone aircraft using solar generated electric power. His studies have so far embraced analysing studies of wing shape and wing twist emanating from research carried out in the 1920's through to recent NASA inspired research. Colin's research has so far embraced wing planform ratios, lift distribution and drag coefficients in aircraft flying at 50,000 to 80,000 feet using slow speed propellers. Wing twist is key to the development of proverse yaw which allows the elimination of the tail fin, much like a gull in flight! (I think I have got it right!).

He has also visited the Ornithology Department of the World Museum in Liverpool who hold an extensive collection of preserved birds. Colin stressed that aircraft designed to fly in the thin atmosphere at these altitudes are built very lightly. One member asked how these aircraft are launched and Colin stated either in very calm weather or by high altitude balloons.

Finally Mike asked Colin Weir to explain why he thought the two AYRS MicroTransat Challenge research projects offered to Glyndwr University had failed to find students willing to undertake them. Colin explained that you needed to pitch any research to fall within the parameters of the student's course work; plus you need an enthusiastic Tutor and an enlightened student. Colin stated that Rob Bolam, the Tutor involved in promoting the AYRS inspired research projects had been very disappointed when they were not taken up.

Mike suggested that a good proportion of University students were not interested in non commercial research projects and that given the choice between AYRS and JCB, JCB would be the winner. Colin Weir stated that a project to design an autonomous drone offered to all students at Glyndwr University, for entry into a competition, had drawn only five students, one from the UK and four from overseas. Adrian suggested that a link up with a commercial company, where the company and AYRS shared the cost of the research by a student might be one formula to try. Mike thought that the take up of this idea would be unlikely.

The meeting broke up at 5.45 pm, after a series of quite diverse and interesting subjects had been discussed at some length. Once again it has been proven that open discussion of a subject, particularly an individual's pet project, helps its inventor to concentrate his mind and develop his confidence in the project. Almost everyone of the NWLG are now engaged in some kind of R&D project , including the Author who is still 'playing about' with CORREX sheet.

AYRS weekend meeting at the Basingstoke Canal Centre - 21 to 22 September 2019 - report by John Perry

The Basingstoke Canal Centre (BCC) proved to be a good venue for AYRS members in the South East of the UK to meet and discuss their projects and we were also able to carry out some experimental work towing small craft on the canal and measuring towline tension.

The program for the weekend had suggested a cruise down the canal on Saturday, leaving experiments for Sunday. I was a bit surprised that everyone was keen to start with the experiments straight after lunch on Saturday. So as we finished lunch in the café at the BCC, I explained the test procedure as I envisaged it, suspecting that it might not work out quite that way in practice.

The equipment we had available included:

- Fred's small catamaran fitted with an electric outboard motor to act as a towing boat (Figure 1).
- An electronic unit (Figure 2) which times a run over a measured distance while recording values for towline tension. I will refer to this as a Tow Test Data Logger (TTDL) and I have included some more information about it in a separate article.
- A manually driven towing winch (Figure 3) which Fred had built with bicycle parts.
- Approximately 60m of 3mm cord was wound on a drum adapted from a bicycle wheel. Bicycle cranks were made into handles to turn by hand, driving the drum through a derailleur chain gear.
- A selection of small craft that we could tow to measure hull drag.

Figure 1 – Fred's Catamaran – The main building of the BCC is behind and the Canoe Club building is in the distance

For the Saturday experiments we used a sit-on-top surf canoe and on Sunday we used the rowing boat that I built for Josephine a couple of years ago.

We had lovely sunny weather on Saturday and by the afternoon the BCC was a busy place. Even this late in the summer there were quite a few people staying on the campsite, including three members of our group and the café was doing a good trade with campers, boaters and people walking the towpath. Canoes, rowing boats and pedalos were being hired out to join the canoes from the Basingstoke Canal Canoe Club and the BCC tripper boat. The result was quite a lot of traffic on the canal and we needed to have clear runs for our experiment.

Rob and Niels, who are both regular users of the canal, suggested we move a few hundred metres along the canal to where it opens out into a small lake.

Our little convoy of boats set

Figure 2 – Tow Test Data Logger (TTDL) attached to a base board. Battery pack at right

Figure 3 - Towing winch

off and, on arrival at the widening of the canal, we landed and used an improvised surveyor's wheel to measure out a 50 metre run and mark it with pretty flags on the towpath at the start and finish. The TTDL was lashed down to the rear cross beam of Fred's catamaran and the tow was connected to a little surf canoe manned by Niels. With the TTDL being on the towing boat it seemed a good idea to use a light towline, just a length of whipping twine, since this would not trail in the water and add to the measured drag.

Almost immediately the towline snagged the propeller of the electric outboard. After struggling a while trying to unwind the line, we realised that the best way to clear the tangle would be to remove the propeller – the propeller is attached with a plastic wing nut which made that easy. Niels suggested leading the towline over a line between the two catamaran sterns, this avoided further prop fouling.

We completed several runs over the 50 metre course and successfully transferred the accumulated data from the TTDL to a laptop computer. However, it was clear from observation of the procedure that the towing was not straight and steady. Surf canoes are designed for manoeuvrability so they don't have very good directional stability and the brisk cross wind was not helping. For much of the time the canoe was veering from side to side with the towline pulling at an angle of up to about 25 degrees away from the course of the towing boat.

Our speed measurement was also likely to be in error since Fred, who was in charge of the towing boat, was unable to keep an eye on the flags set on the towpath while also being ready to press the timing button on the TTDL and steer the boat. We had observers on the bank to shout to Fred when we judged that he was passing the start and finish flags.

I have included a sample of the collected data in an appendix to my article. Although these early results will have been subject to considerable error we had at least shown that the electronic system was working as intended.

We returned to the BCC and Rob Ames then gave us a guided tour of the facilities of the Basingstoke Canal Canoe Club (BCCC). The BCCC has its own building on the BCC site and the main part of this building is used for storing club owned canoes – they have dozens of them! This means that members do not necessarily need to own their own canoes, the club owned ones being free for members to use. The club owns a wide variety of different canoe types so members can try different ones before considering buying their own. Rob showed us various canoes ranging from robust plastic Canadian canoes used for camping expeditions to graceful sea kayaks to very light and tippy racing kayaks used for races such as the Devizes to Westminster canoe marathon that some BCCC members have competed in. Now I know what K1, K2, K3 and K4 mean – these are Kayaks designed for one, two, three and four paddlers. The BCCC certainly seems to be a fine club and not having to buy your own equipment makes it a low cost way to get into boating.

It was now time for us to gather in the BCC meeting room for tea followed by a slide presentation.

I had prepared a set of slides showing some of the remarkable developments in sailing yacht design that have been happening over the past year or two, particularly with the use of hydrofoils which are now revolutionising pretty well all areas of competitive sailing wherever class rules allow them.

The first two Americas cup hydrofoil monohulls were launched only days before our meeting. In France, four new Ultime class 100 foot ocean racing trimarans have been recently launched and one of these has already been wrecked, but the sponsors have recently announced that an even more advanced replacement is already being designed. All these trimarans are capable of lifting all hulls clear of the water under suitable conditions.

Turning to smaller boats, the long running Solitaire du Figaro race series adopted a new one design boat this year, a monohull with retractable stabilising foils to replace circa 300kg of water ballast on the windward side with a comparable amount of foil lift well out to leeward. So, in effect, they have 600kg less displacement combined with an increase in available righting moment. I could

have continued with a mention of Alex Thomson's new IMOCA 60 monohull launched only days before our meeting, this being the second IMOCA 60 capable of sailing with the hull completely clear of the water.

Then, after another tea break, we had some general discussion about how AYRS members might find projects that are not too overshadowed by the well-funded and mostly commercially sponsored projects that I had just been talking about. I am sure that there are possibilities; I have ideas for projects myself but time is the limiting factor (tow testing is not really one of the projects I have in mind – the tow testing discussed here was mainly intended to give a focus to this meeting).

Next we had a short group brainstorming session to help Mark T. sort out a design detail on a trimaran design project. We concluded that Mark could do with 8 off plastic collars that will clamp round a 4" OD aluminium tube. I think I did say that if Mark makes the rest of the boat I will go to my lathe and turn those collars for him!

Finally Fred showed us a device he had made to compare the drag of two hulls under tow. This is a variation of the old idea of comparing hull drags by towing two hulls with tow lines attached to the ends of a pivoting beam so that the hull with the least drag moves ahead of the other causing the beam to rotate – a simple way to determine which of two hulls has the lower drag, but it does not give an absolute value for drag magnitude.

The advantage that Fred's device might offer is that the difference in towline tension is applied to a small lightweight indicator rather than to a relatively heavy pivoting beam, this may improve sensitivity. On the other hand some friction can be expected at the two pulleys and I think care would be needed to avoid any rotation of the beam during towing since I think that would flip the indicator.

Figure 5 - Supper at Potters PH

Some of our group left for home at that point but seven of us stayed for supper. Niels recommended the Potters Inn which is almost adjacent to the BCC site. We had a nice meal sitting round a big oval table.

On Sunday morning we were just preparing to go afloat when it started to rain heavily so we rushed into the BCC café to shelter, along with a good many other people – the café was packed out. Then after lunch the rain eased, and we were keen to try out the towing winch that Fred had built.

We placed the winch where the bank juts out into the canal near a swing bridge outside the BCC building. This meant that we could set out a 50 meter run along the canal in front of the BCC building, but with the towline being only about 60m long, and also the position of moored boats, there was almost no distance to spare at start of the run and little more at the end.

Niels produced a surveyors tape from his van to measure the run with better accuracy than the improvised surveying wheel would have done. Actually, through the weekend Neils produced various

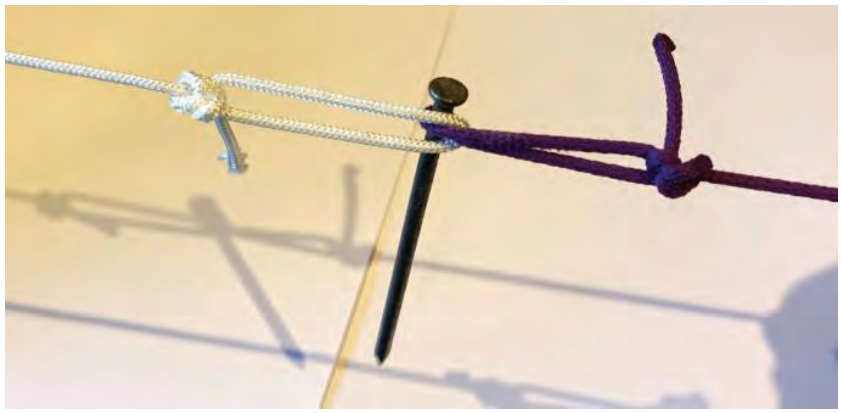


Figure 6 – Quick release for tow line

useful objects from his van. Fred suggested that a four-inch nail would be handy to make a quick release for the towline (see figure 6) and sure enough Niels had one in his van. Then at the end of the weekend we were considering a short cruise on the canal but we had more people than boats - not to worry – Neil had four spare canoes in his van!

For a towed boat on Sunday we used the sliding seat rowing boat that I constructed for Josephine a couple of years ago, this has a rudder making it easier to keep on course than a rudderless canoe. Also, I had a drag prediction for this boat, produced with the free-to-download Michlet software, so there was the possibility to compare the theoretical and experimental results.

Because we were using the towing winch, the TTDL had to be mounted on the towed boat so it should not matter if the towline was dragging in the water a little. However, on the very first run the towline dragged a bit too deep in the water and fouled some obstruction on the bed of the canal – Niels nail had to be quickly extracted to release the tow before something broke. We continued and managed to complete several runs.

Some of the winch handle winders became rather competitive so Josephine's rowing boat was exiting the run at a good speed and heading straight towards the steel sheet piling along the canal bank. I had to quickly release the towline while Josephine had to throw the helm hard to port to miss the steel piling and also dig in a paddle to slow the boat before it hit something else.

Once we had finished our experiments on Sunday we still had time for a short cruise on the canal, but at that point the rain came again so after a final tea in the café we packed up and headed home.

Conclusions – The event as a whole and the BCC as a venue

My view is that the AYRS needs to hold more such events if it is to flourish. On this occasion we actually attempted some 'yacht research' which, if nothing else proved to be a good 'team building' exercise. But our events don't have to include such experiments. A slideshow of a boat building project or of a sailing adventure or simply a gathering in a pub or member's house or perhaps a visit to a maritime museum would bring members together to share ideas and could be the basis for an event.

The attendance at this event was quite small but I think those that did attend enjoyed it, despite the wet weather on Sunday. I suspect that it may be necessary to hold events on a regular basis in order to build up attendance – perhaps people are reluctant to attend an event happening for a first time, maybe thinking that it will be disorganised or not even happen. But if they hear reports of events happening on a regular basis perhaps they will feel that something worth joining in with must be going on – well maybe! I do know that the AYRS committee is very much open to suggestions for events and will support members who would like to organise them.

The BCC offers an attractive stretch of water suitable for canoeing, rowing, paddleboarding and low power motor/steam/electric boats, but not for sailing due to overhanging trees and low bridges. It is accessible from large population centres and my quick study of the AYRS membership list suggested that about half the AYRS members live within 80 miles from this venue. There is a campsite, café and meeting room on site – all very useful facilities for a weekend AYRS gathering, provided that we are not contemplating actual sailing or operation of large craft. Craft that can be manhandled can be simply slipped into the canal over the timber-capped sheet piling of the canal bank and there are wooden stagings for boarding small craft. For launching larger craft from road trailers there is a public slipway a couple of hundred metres along the canal in the Basingstoke direction. This slipway is accessed via the carpark of the Potters pub and the pub locks the gate across the slipway 'for safety reasons'. However, I understand that they will unlock this gate for a £10 donation to a local hospital charity.

On the Monday after this event Josephine and I took the rowing boat for a cruise along the canal and I can say that we found it a very pretty waterway. Much of it runs through woodland and there are small lakes that open off the canal in places and which have been designated as nature reserves. If we hold another AYRS meeting at the BCC and are not so busy with experiments and dodging rainstorms perhaps members would enjoy a simple cruise along the canal, perhaps including a stop at one of the canal side pubs

Report on AYRS meeting held at Thorpe Village Hall, Surrey on 3rd November 2019 - report by John Perry

Another busy meeting with a constant flow of presentations from about 09:30 through to 16:30, albeit with a lunch break and a few coffee/tea breaks. It seems that the AYRS still has members who are busy with projects and who are constantly coming up with new ideas. But if the society is to continue with its current and longstanding 'business model' we would just like to see a bit more written about all these ideas and projects so that we can send out more publications!

Fred's trimaran with experimental floats

Weymouth Speedweek 2019

Fred Ball started the proceedings with a review of the Weymouth Speedweek held in October. Speedweek this year offered superb sailing for windsurfers and kite surfers with strong winds throughout the week, rising to gale force at times. The wind direction was consistently from the south west giving flat water in the lee of Chesil beach. These conditions enabled the speed sailing record for Portland Harbour to be broken several times during the week. The final record stands at 41.2 knots held by kite surfer James Longmuir, although, as Fred noted, kite surfers and windsurfers were about equally included in the ten fastest times of the week. For further details see www.speedsailing.com

The strong winds which so well suited the kite and board sailors overwhelmed the two small experimental craft present and neither of these were able to complete a single run down the speed course. Malcom Barnsley - lead designer for the world record holder 'Sailrocket' - brought along his small trimaran (about 12 foot main hull length), this now having been fitted with two fully immersed Tee foils close by the main cross beam, together with a Tee foil rudder. It was afloat only briefly at Portland this year, we hope to see more of it another time.

The other experimental craft was Fred Ball's own trimaran, about 14 foot main hull length and overall beam just a little less than the length. Fred's trimaran was fitted with two different experimental floats, both intended to be planing hull forms, the idea being to compare the merits of these two float designs. Fred did say that with hindsight it would have been better to compare each experimental float in turn against one of the proven floats previously fitted to this craft rather than comparing two unknown designs against each other.

Fred had this craft afloat three times during the week and every time it refused to answer the helm properly, tending to gently turn into the wind then come to a near standstill. The second time Fred sailed this boat it was towed

Fred sailing after a tow start

by a safety boat to get it moving and then it did sail moderately quickly out of the marina area and into the wild foam tossed waters of the main harbour – see photo above.

At that point the lee bow (the one with the big box shape at the front) started to submerge, despite apparently having considerable volume. At that point Fred wisely took a tow from a safety boat back to the shore. For his final attempt Fred unfastened the cross beams and reattached them a few inches higher so that the floats were only very slightly immersed with the craft at rest. This was found to offer no significant improvement over the previous configuration.

There was some discussion at our meeting as to why Fred's trimaran could not be steered – after all it has a conventional centreboard located in the conventional position for a trimaran centreboard and it has a decent size rudder blade, so what could be wrong? Fred's own best guess is that the wind was simply too strong for it and he feels that it might perform better in lighter winds.

Charles Magnan presents his reefable soft wingsail

A reefable and stowable soft wing sail – Charles Magnan

The America's Cup racing in 2017 clearly showed how well wing sails can work, particularly dual element wing sails, but that contest also clearly showed the limitations of that style of wing sail in that they were vulnerable to damage, needing to be stored indoors when not in use and, in large sizes, they require a tower crane to be standing by to take them on and off the boat before and after every sail. So it is not surprising that since the America's Cup in 2017 there has been a lot of interest in 'soft' wing sails which can be lowered and folded or flaked down when not in use and ideally can be reefed according to wind strength. Groupe Beneteau is a major yacht builder which has been experimenting in this area and, as with some other projects, they have sailcloth draped around a mast , the section of the wing being formed by internal 'ribs' (to use aircraft terminology) which slide up and down the mast as the sail is raised and lowered. Because the sailcloth is wrapped around ahead of the mast as a single sheet it does not take kindly to being 'scrunched up' into a bundle as the sail is lowered or reefed, this is particularly damaging to modern Mylar or laminated sail materials.

The modification that is the basis of Charles's project is to include a zip at the 'nose' of the wing sail so that as the sail is lowered or reefed the zip can be progressively opened allowing the

Charles demonstrating attachment of sailskin to rib

Intermediate Rib

sail material to be neatly flaked down into separate bundles on each side of the base of the wing. A roller on each side could be an alternative to flaking. The zip at the front of the wing is covered by a flap of sailcloth making a reasonably clean leading edge to the wing.

Charles has made a dinghy sized prototype for one element of a two element wing sail, this is now close to being ready for on-water trials. The canvas work has been done professionally and this looks strong and well made. The ribs at the top and bottom of the wing (Charles is holding one in the picture) are 200gm/m^2 carbon cloth vacuum bagged to 10mm Corecell. The intermediate ribs are a more open framework, see picture at right. A sliding part within each intermediate rib allows the 'tail' of the rib to be opened out, which makes it easier to remove the sail-skins from the ribs and flake them down for reefing. (I use the term 'sail skin' for each side of a soft wing sail, this being the term adopted in the class rule for the next America's Cup races). Clipped onto each side of each rib are flexible channel sections (the white parts in the pictures) and the sail skins are attached to these by a series of twist lock fasteners.

To remove the sail skins from the ribs, the flexible channels are unclipped from the ribs and rolled up with the sail skin, or for longer term storage the channels can quite easily be removed from the sail skins using the twist lock fasteners.

Charles went on to tell us about his experience with using vacuum bagging to make the ribs for his wing sail and for other boat related projects he is working on.

He has a Robinair vacuum pump as used by refrigeration engineers. For the wing sail ribs he bagged the laminates and core down to a sheet of glass and he achieved nice looking foam sandwich parts with a gloss finish one side and a peel ply finish the other side.

Vacuum Storage bags

Charles has also experimented with the use of vacuum storage bags (see picture) and a household vacuum cleaner for less critical work. Vacuum storage bags were a new thing to me but looking at the internet I soon realised that they are intended for compressing clothing or bedding to take up less wardrobe space or to fit within airline baggage limits.

From what Charles told us they could certainly be useful for easy vacuum bagging of moderate sized parts, say a rudder or centreboard, but I think not a complete boat hull. Charles did note that if you use a household vacuum cleaner with a vacuum bag to hold vacuum while a part is curing you need to just switch the vacuum cleaner on at intervals to keep up the vacuum, as the bags include a one way valve which will hold a reasonable vacuum between times.

On the other hand, if you leave a domestic vacuum cleaner running without airflow for long periods you will probably burn out the motor.

A neat sculling system - Chris Watson

Chris' system is a foil that propels a boat by waggling it back and forth in the water, similar to the technique generally referred to as single oar sculling (as opposed to normal sculling which is conventional rowing using two oars, one in each hand). There are two different techniques to do this. One, which is by far most commonly seen in SE Asia, is such that the direction of water flow over the blade reverses with each stroke, the high and low pressure sides of the blade remaining the same (at least for travel in one direction). The other system, which is based on European & N American practice, is the type Chris showed us. With this, the


Chris with his sculling rudder – (another regular attender just in the picture at the left of the photo!)

water flow across the blade does not reverse but is always from a leading edge to a trailing edge; the high and low pressure sides of the blade swapping over at each stroke.

I will not speculate here as to which is the more effective system but Chris told us that he finds his one at least comparable to conventional oars for propelling a small dinghy. The device can be used with a conventional transom sculling notch, or a transom mounted rowlock. The hinge at the top of the aerofoil section blade is a heavy duty stainless steel door hinge — Chris told us that this is not unduly expensive even though it incorporates stainless steel ball races. The 'flap angle' of the blade is limited by a simple adjustable cord made off on a cleat. The piece of elastic hanging loose in the picture is used to dampen the 'clunk' as the blade flaps over between strokes. The area of blade in the water is probably similar to that of a typical pair of oars, but the blade gives a more continuous thrust than you can get from oars, and you have the benefit of a variable 'gear ratio' by adjusting the line limiting the flap angle. Hence I would expect this device to work well against a strong headwind or as a low speed propulsion device for a fairly large heavy boat. It did occur to me that if this device were made with an additional hinge so that the handle folded alongside the blade it would actually be a more compact item to stow than a conventional oar.

Wave powered boat with three hulls

Another thought was that it could be applicable to the running and sailing races such as the Three Peaks race for which the racing rules allow sailing boats to be propelled by human power in a calm. A device of this kind would be easy to stow and could be used with minimal need for extra fittings to attach it to a sailing yacht.

Wave Powered Model Boats – Chris Watson

Chris went on to show us three little models he has made by gluing sheets of transparent plastic. These are all wave powered boats and Chris told us that they all work well when tested in a bath or a pond. One was reminiscent of the 'Salter Ducks', once considered as a way to generate 'renewable' energy, but rather than using the articulation between the two hulls to power a generator the movement is taken via a pair of push/pull rods to flap two vanes at the back end of the craft. These vanes are flexible, like a fish's tail, and so they provide propulsive force.

The second model works on a similar principle but has three hulls, with a pivot axis between the forward hull and the slightly overlapping pair of smaller rear hulls.

The third model is a bit different to the other two in that it can be wave powered or human powered, or possibly both at the same time. It is a catamaran with hull forms similar to a classic Wharram catamaran. (See Chris' article in Catalyst 50). A pivoted vane below the boat swings up and down when actuated by a lever arm extending above deck level. So, by working on this lever, a human can power the boat along by flapping the vane vertically, as a whale's tail rather than horizontally as a fish's tail.

Vertical flapping has the advantage that it can be used in quite shallow water by keeping the amplitude of the motion small with the vane close to the surface. Also, if the lever is locked to hold the vane at maximum depth the vane will be in fairly still water down below the surface turbulence so that if the boat above is rocking about in waves the vane will be flapping relative to the stiller

Wave powered model boat, comparable to 'Salter ducks

Catamaran for human power or wave power

water and will provide forward propulsion.

This is similar in principle to the Liquid Robotics Inc. 'Wave Gliders' which are autonomous vessels used for oceanographic research and I recall that at a previous AYRS meeting Chris showed us a working model he had made based on the Liquid Robotics vessels.

Chris also mentioned the Japanese team lead by Dr. Yutaka Terao which completed a 4,350 mile voyage in the Pacific ocean with a wave powered boat. The hoped for average speed was in the three to four knot range but unusually calm seas reduced this to an average of about 1.5knots. A review of the history of wave powered boats, including this Japanese one, can be found at http://folk.ntnu.no/eirikbo/wavepropulsion/index.html

Surf Rescue craft – Kim Fisher and Chris Watson

Kim presented this project which he is carrying out in collaboration with Chris. The aim is to produce a rescue craft, primarily for use by beach lifeguards, which has greater capability than a simple surfboard but is less expensive and simpler to deploy than powered craft such as RIBS and jet skis.

The concept that Kim and Chris have developed to meet this requirement is a broad stable boat that is symmetrical about a horizontal mid plane so that it remains functional if it gets capsized in the surf. This symmetry also simplifies construction, requiring only one set of moulds. As shown in the pictures, it is roughly rectangular in plan form and in cross section it is a 'tunnel hull' along most of its length, but not at the bows where bridging the tunnel hull gives extra buoyancy to mitigate bow burying in surf. The tunnel hull below the water gives good stability and on the upper side the same form provides a recess to help avoid crew and casualties being swept off in rough water.

Interestingly, it is proposed to propel this craft by the single operator using a forward facing stand up rowing technique. Vertical tubes are bonded into the hull on each side of the boat and poles slot into these to support the rowlocks for stand up rowing. Certainly you can find plenty of material on the internet about Australian surf rescue teams using rowing boats, often with a person standing at the stern using a steering oar, but from my quick look at YouTube I think the rest of the crew are seated and rowing conventionally so it will be interesting to see how the standing and forward facing rowing technique develops for this application.

The exterior of the boat is smoothly curved all over, with no awkward projections that could hinder getting a casualty on board over either the bow or the stern. There are strong tubular stainless steel rails running along the sides of the boat both above and below. The upper rails act as grab rails and securing points for towlines and equipment whereas the rails underneath are used as runners allowing the boat to be dragged down a rough beach without damage or they can act as skids for rescue work on ice. This boat should be useful on water, ice or even pushing it over soft mud.

Comparing this craft with the surf boards that are standard equipment at many beach lifeguard stations, this craft is likely to be more suitable for conveying a disabled casualty and a much better platform to provide a 'refuge' between the point of rescue and the shore . Whereas a surfboard remains on shore most of the day, this craft could possibly be stationed just outside the surf line with the operator sitting well up on a fabric seat clipped to the two poles that support the rowlocks. Watching the swimming area from such a location places the craft in a good position to move down the wave direction to make a rescue, avoiding delay in running down the beach with a surf board then battling out against oncoming surf (dare I mention Baywatch!).

Comparing this craft with powered rescue boats such as RIBs, it is obviously much less expensive, both in initial cost and in maintenance costs. It is also much lighter so can be carried on a car roof rather than requiring a trailer and it can be dragged down a beach by one person rather than

requiring a launch trolley and in most cases more than one person to handle both a heavy boat and a launch trolley. As previously mentioned, it can also double as a craft for rescue on ice and on mud flats.

Although at the present time oars are considered to be the simplest and cheapest propulsion for this craft some consideration has also been given to powering it with two electric thrust units with ducted propellers, one on each side of the craft. These would be on swinging mounts so whichever way up the craft is they would drop down and be immersed.

The prototype that Kim and Chris have very recently completed is the third and largest prototype. The first one was only about 2.4m long and clearly too small for rescue work. The second was longer and the current prototype is about 3.5m in length with a weight of about 50kgs.

Kim showed a number of pictures of the construction of the current prototype. Basically it is a pair of grp mouldings taken from a single female mould, although roto-moulding would be considered for any future production run. Coremat was used in some areas of the laminate for stiffness and toughness and Bighead fasteners were glassed in to provide fastening points for fittings. The stainless rails are attached to these fasteners and spaced off the boat with custom made plastic parts that were 3D printed at a very reasonable price. A horizontal slab of polyurethane foam is placed internally between the two mouldings to provide reserve buoyancy in the event of hull damage and both mouldings are bonded to this slab so as to make a stiff floor in the central

area where the crew will stand. The foam slab extends right to the sides of the craft and grp laid up on the edges of the foam slab ties the top and bottom moulding together at the edge seam (See article in Catalyst 54).

Kim explained many details of the construction which would interest other amateur boat builders but I shall not go through all these points in this report since I hope that Kim will himself be writing in more detail for our publications.

So what next for this fascinating project? - Well the prototype boat is now ready to start trials and I am sure Kim and Chris will be keen to hear from volunteer test crew who have experience of beach rescue and/or experience of handling small engineless craft in difficult conditions. My own thought is that the proposed method of propulsion is the biggest unknown. Some time may be need to be set aside to develop and prove the operating techniques to reach a level of expertise to make a convincing demonstration, perhaps on video, for potential users such as the RNLI. Meanwhile, Kim is planning to bring the prototype to our meeting at Thorpe in January and we also plan for it to be the central feature on our exhibition stand at the RYA dinghy show in March – contact Kim if you would be able to help with setting this up.

Hull drag measurement by tow testing – John Perry

[John Perry then spoke about his conclusions from the towing trials at the Basingstoke Canal Centre meeting reported earlier in this Catalyst, and which we have not repeated here - Editor]

Reminiscences of supervising the timing of windsurfing events during the 1970's – Graham Ward

As a short interlude, Graham gave us some anecdotes from the time when he was involved in supervising the windsurfing events that were based on the speed canal on the French Mediterranean coast. For example, he told us about some of the checks he was required to carry out to make sure that no one was fiddling with the equipment used for timing the speed runs. This included taking apart the synchronised video cameras that monitored the start and finish of the runs to make sure that the analogue electronics within the cameras had not been tampered with to give a slower frame rate and hence a faster speed measurement! It turned out that all was perfectly above board, and the windsurfers really were travelling at some tens of knots, something that in those days some people were finding hard to believe could be real.

Inside the trimaran cabin

Finite element analysis on a 6m Trimaran – John Perry

A friend of mine has a small French manufactured trimaran with a tiny cuddy cabin. He would like more stowage space for small items in the cabin so he is considering cutting two holes through the bulkhead at the forward end of the cabin to give access into small stowage lockers that he would fit into the presently empty space forward of the bulkhead. This bulkhead is supporting the mast so he asked me if I could give an idea of whether the bulkhead with holes cut in it would still be strong enough to take the download from the mast which he estimated at up to 1200kgf. I carried out Finite Element Analysis (FEA) to compare maximum stress levels before and after cutting the holes in the bulkhead. We were not so much concerned with the actual level of stress or factor of safety, we simply did not want any modifications to the boat that would cause stresses to be significantly higher than the present situation without the modifications.

I presented the results to our meeting as a simple example of the application of FEA stress analysis to small boat design work. The first set of results were for cutting the holes through the bulkhead without making any other alteration to the boat and this did significantly increase the maximum stresses. The mast step is mounted on the cabin top slightly aft of the supporting bulkhead, there being a small 'fillet' within the cabin space that is clearly intended to transfer load from the mast step onto the bulkhead – see photo above. It was clear from the distortion plots produced by the FEA that the main cause of high stresses was this fillet being rotated by the mast load so that the lower corner of the fillet pressed into the bulkhead, bending the bulkhead forward. Moving the mast step a few inches forward to centre the load over the bulkhead would

correct this problem but this would require alteration to the moulded grp cabin roof and of course helm balance could also be affected. So I ran the analysis again with a small stiffening member bonded to the forward side of the bulkhead, such a stiffener could easily be incorporated in the structure of the new stowage cupboards. We were pleased to find that with the holes cut though the bulkhead in combination with this additional stiffener the maximum stresses were actually well below the levels for the unmodified structure.

Review of recent worldwide advances in sailing and sailing boat design – John Perry

I gave the meeting a review of recent developments in the world of sailing, as I see it, based not on personal experience but on 'surfing' relevant websites. This did produce some interesting discussion, particularly with regard to the America's Cup, an area where there has clearly been a lot of innovative work during the past year or so. However, I will refrain from further detail here since this is already a long report and unlike the other presentations covered above, this was not about any AYRS members projects (although it could of course inspire future member's projects).

However, if it is of interest to the audience, I am happy to continue to offer my take on current developments in sailing at future meetings and I have also wondered about having a section of our website that reports on such developments.

A model for a rudder design – Mark Tingley

Mark Tingley rounded off our meeting with a quick presentation of a balsa wood model he has made for a trimaran rudder design. I think this stems from a problem he has previously mentioned in connection with his present trimaran which has a dinghy style pivoted rudder blade. He has found that the rudder blade can swing back when sailing fast, even in deep water, it doesn't only happen if the blade touches the bottom in shallow water. With the blade fully down the rudder is partially balanced but once it swings back, even only slightly, the helm becomes very heavy and the boat becomes difficult to steer, even sometimes impossible to steer - he said that if he applied enough force to steer the boat with the rudder partly raised he would simply bend the tubular aluminium tiller.

The model that Mark presented showed a partially balanced spade rudder with the rudder stock fitted through a section of the hull stern which hinges up about a pivot axis at deck level a little forward of the rudder stock. This is basically as the rudder arrangement found at the sterns of the 26 foot Firebird catamarans that were built in Cornwall back in the '90s – I think a small fleet of them are still based at Falmouth. The advantage of this arrangement is that the balance of water pressure on the rudder remains essentially unchanged as the rudder lifts since the pivot axis lifts with the blade itself. However, as soon as helm is applied there will be a tendency for the aft section of the hull together with the rudder to lift and this could potentially cause loss of steering control even though the rudder remains balanced. I guess that on the Firebird catamarans there must be some kind of locking device to hold down the pivoting stern section when under way but if this is so then it rather defeats the purpose of having a lifting rudder. Mark Tingley's proposal is to include a locking device, of his own design, which leaves the pivoting stern free to jump up when the helm is more or less cantered but locks the stern down if the helm moves more than a small angle off centre. Mark considers this to be a reasonable compromise - the rudder is still vulnerable to damage if helm is applied beyond this small angle while sailing in shallow water but, short of rudder damage, full steering ability should always be available.

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

March 2020

29th Feb – 1st March RYA London Dinghy Show, Alexandra Palace N22 7AY.
The RYA Dinghy Show is the only show in the world dedicated to Dinghy Sailing. It's a great day out for all the family and offers visitors the opportunity to visit the AYRS Stand.

14th March AYRS NW UK Local Group Spring Meeting, 1pm – 5pm
Warrington, WA1 4EF
Contact: Colin McCowen, email: colin.mccowen@virginmedia.com

April 2020

4th AYRS South-West UK Local Group meeting, 1pm - 6pm
Forder Community Hall, Saltash, PL12 4QR NB nearest public parking is ½ mile away. Bring lunch. Donations invited for use of hall. Programme will include chats and a short stroll outdoors if the weather suits. See details on AYRS website. Followed by evening meal in the Cecil Arms, Saltash. Contact: John Perry, chairman@ayrs.org. Tel: 01752 863730

May 2020

8 – 10th Sailing Meeting (Broad Horizons 2020)
Barton Turf Adventure Centre, Norfolk NR12 8AZ
A sailing meeting, not discussions (although there will be time for that in the evenings), so bring your boat(s)! .
If staying on site, please send in a booking form; see http://www.btac-services.co.uk/2020_booking_form_rally_participants.pdf; otherwise contact Sheila & Simon Fishwick email: bookings@btac-services.co.uk or sfishwick@ayrs.org.

EXPRESSIONS OF INTEREST WOULD BE WELCOME AS SOON AS POSSIBLE SO WE CAN CONFIRM THE BOOKING WITH THE SITE!

June 2020

6th Solent Area evening meeting
Venue TBA. Coincident with America's Cup World Series races, so somewhere in Portsmouth/Southsea area.
See AYRS website for updated information.
Contact chairman@ayrs.org.

13th AYRS NW UK Local Group Summer Meeting, 1pm – 5pm
Leigh, Lancs WN7 3NH
Contact: John Alldred, email: john@alldred.me.uk

July 2020

TBA Solent Area on-the-water meeting
Chicester Harbour. details and venue to be arranged. See AYRS website for latest information.

September 2020

TBA AYRS NW UK Local Group Autumn Meeting

October 2020

3rd – 9th Weymouth Speedweek
Portland and Weymouth Sailing Academy, Portland Harbour, Dorset UK. See http://www.speedsailing.com/ More experimental boat entries are welcome and wanted!

7th (TBC) Speedsailing -AYRS meeting
19.30 for 20.00hrs, Weymouth Sailing Club, Nothe Parade, Weymouth, Dorset DT4 8TX.
Contact: AYRS Secretary, email: secretary@ayrs.org. Check the AYRS website before going just in case the location changes (unlikely)!

November 2020

TBA AYRS South-East UK Area meeting
(Possibly at Basingstoke Canal Centre) See AYRS website for latest information For details email secretary@ayrs.org.

January 2021

24th TBC AYRS All-day Meeting
Venue and date to be confirmed. All-day, bring your lunch! For details see AYRS website. Contact: secretary@ayrs.org.

24th TBC AYRS Annual General Meeting
To follow the All-day meeting (see above). Agenda, Committee report and other papers will be posted in due time on the AYRS Forum https://www.ayrs.org/forum.
AYRS still desperately needs new Committee members, especially those with computer and management skills!
Contact: AYRS Secretary; email: secretary@ayrs.org **before 24th December**.

Fred Ball, 1937 - 2020

Fred Ball, AYRS' current Chairman, died at his home in Virginia Water on 3rd January 2020 after a very short illness.

He'd been an AYRS Committee member almost without interruption for years, certainly since I joined the Committee in the early 1980s. As friend and mentor I valued him greatly, one could always be sure of wise advice.

He took his role as a Committee member very seriously, he was always willing to help organise meetings or show stands. Much of AYRS display hardware was stored in his garage or stables and indeed he had made most of it himself. He's going to be a very hard act to follow and live up to his standards.

AYRS sends its condolences to his wife, Margaret - herself a helper at many of the things Fred organised - and to his sons and grand-children.

We are all going to miss him

Simon Fishwick
AYRS Editor

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

On the Horizon . . .

Nothing much really.

Would you like to write something?

Email it to catalyst@ayrs.org please.
Guidance notes are inside the front cover.

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