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DESIGN: STRANGE BOATS BY GLIDER YACHTS CANTIERE DELLE MARCHE: A RECORD YEAR TECHNICAL: CRUISING ON AN AIR BUBBLE LYNX YACHTS: HEADING TOWARD EVOLUTION VSY: WILL HYDROGEN FUEL THE FUTURE? BENETTI YACHTS: A FULL SEASON CANTIERI DI PISA: AN APPRECIATED RETURN

MANGUSTA YACHTS MGS54 EL LEON ARCADIA YACHTS A105 RJ CBI NAVI STELLA DI MARE PERINI NAVI SEVEN



#### CRUISING Qujaryunit TECHNICAL

## ON AN AIR BUBBLE

by Andrea Mancini

Cruising on an air bubble is worth it: all it takes is the right hull. The ASV or (Air Supported Vessel) conceals the trick under water which makes cruising with the support of an air bubble below the surface not only doable but above all very effective as well as efficient, thanks to years of R&D and loads of technology.



When we envisage ways to improve performance and in more general terms, a boat's efficiency we'd think about foils today. They're also deployed on competitive sailing yachts. Nevertheless there are available alternatives to these which better performance and efficiency. These alternative ways are less invasive and go almost unnoticed when compared to foils yet they're equally efficient.

So we're back to ASVs where the external section of the hull is highly similar to that of a standard planing one, but for a little trick which is nothing more than a cavity filled with air, or a sort of air pad which enhances performance while tangibly reducing fuel consumption even by half in some cases. But let's proceed step by step.

ESI or Effect Ship International a Norwegian world leader company for this applied technology with dozens of patents to its name carried out lengthy trials where ASV hulls take after the same principle deployed for Surface Effect Ships or (SES). They're large catamarans which cruise partly off the water as they're supported by external fans delivering forced air downwards forming an air bubble which is trapped between the hulls.

ASVs though contrarily to SESs are made up of "normal" mono conventional looking hulls... at least in appearance! In fact the external lines of an ASV are the same as those of any traditional one. Externally the silhouette of an ASV is that of a "normal" boat. The tangible differences are below in the bottom of the hull, in such a way as to exploit a given cavity which is artificially filled with air which is trapped in the cavity.

Any air in excess needs to evacuate by way of the stern hull lines which have to allow this without creating additional drag or resistance to advancement. This means the geometry and consequent design of the hull bottom retaining the air bubble plays an all important role in determining efficiency aimed at reducing any unwanted additional drag.

These special shapes in fact considerably reduce drag by as much as 40 even 50% on fast planing and semi planing hulls while little extra power goes into maintaining forced air inside the cavity. The air trapped in the cavity of the hull bottom acts also as shock absorber which dampens



ProZero 18m ASV by Tuco Marine A cavity situated amidships of the ASV hull designed to contain forced air funnelled down from the exterior via a fan and air duct.

This picture shows both the size and shape of the cavity containing the air bubble/pad.

pitching while it enhances sea keeping and manoeuvrability over waves.

Let's now take a closer detailed look into ESI's technology regarding ASVs, by starting with some of the pictures in this article which best describe the progress made from the first 20 metre prototype built a decade ago to the construction of a fast 20 metre entirely electric ferry capable of reaching 30 knots: BB GREEN the very first fast ferry in the world to sport zero emissions!

ASV technology today has made zero emission fast ferries a reality of which BB GREEN is only the first demonstrator. Norwegian ESI company and other partners are currently fine tuning a number of Green Fast Ferries (GFF) with EC's backing and R&D programmes, or fast zero emission ASVs for commuters. There is global growing interest for these vessels starting with Norway that



installed IPS (Pods) which positioned in this way are far enough from the cavity and from possible ventilation problems arising from air sucked in by the propeller.



An ASV Mono hull model being tank tested at 30 knots at the Gothenburg premises in Sweden: More than in many words this underwater photograph shows how an ASV hull works as the air bubble extends over a considerable length of the hull bottom.

#### Superyment <u>TECHNICAL</u> on an air bubble

Cruising



The stern flap closes the cavity off to prevent air from escaping. This is a fundamental element deployed to ensure the correct functioning of an ASV hull.





The two pictures show how the 65' ASV Mono hull lies without the fan blowing (picture above) and with the fan in action (picture below).



Tuco Marine's ProZero 18m ASV while cruising. This 18 metre carbon sandwich work boat is propelled by a pair of IPS 600 (2x320 Kw engines) up to 40 knots. The overall fuel consumption of this vessel at 30 knots including the fan plant which pumps air down into the cavity is a little over 3 litres per nautical mile. These figures considering the speed and a displacement of 20 tons are further demonstrated in the picture: the hull is partially off the water (thanks to the air support and relatively light displacement) and is almost horizontal to the surface with a resulting clean low wake. These two latter facts translate into a highly efficient propelling system.

has already set aside several million euro to install electric power points to recharge new generation ferries which will be connecting downtown Oslo with the portion of suburbia overlooking the fjord.

We're looking at real vessels which cruise with surprising results. But let's go onto the next topic starting with an ASV mono 65' prototype a 20 metre ASV motor yacht more precisely and following numerous tank tests it was built on a 1 to 1 scale in 2010. Sea trials revealed actual reduction in drag and confirmed as much as 50% less drag. Theses notable results coupled to appreciated and functional aesthetics of the yacht won an award for innovation in 2011. To reach these goals ESI worked for ten years and also thanks to SES Europe an associated company focusing on EC funded research programmes and the development of ASV technology for several hull configurations (mono, catamaran, tri-maran) as well as for (planing, semi planing hulls with bulbous keels and not etc.) with patents in 65 countries, which embrace all possible applications with no limits in terms of diverse uses and boat sizes. Leaving aside tri-marans or catamarans that command less interest in yachting markets, let's see how planing hulls better their efficiency thanks to ASV technology.

Concurring elements are a further three, other than the support of the hull, less drag, enhanced manoeuvrability

and sea keeping.

- The extent of the planing surface area.
- Hydrostatic Volume of thrust;
- Air pad/bubble.

But while the first two elements are present on any planing hull, in varying degrees, an air bubble is an ASV's main feature since it can support more than 2/3 of the vessel's weight. In a nutshell the Hydrostatic volume of thrust is the volume of the immersed hull which according to Archimedes's law concerning thrust diminishes as speed increases when dealing with a planing hull because the boat tends to lift off the water as it thrusts upwards by the dynamic pressure of the water itself (which is speed generated) acting on the surface of the hull bottom i.e. the surface of the planing area.

The air bubble lodges in an ad hoc cavity built into the hull bottom taking up most of the immersed area, while the height, shape and overall volume of the cavity are defined conjunctly to the shape of the ASV hull to optimize loss of air from the supporting air bubble in the cavity while cruising in flat or rough seas.

The air filling the cavity is taken from bow situated intakes and pushed inside through a duct by

deploying a powerful fan which re-

quires from 10 to 15% of the energy required to power up the vessel. The actual pressure required in the cavity is not high we're talking about a range between 3.5 and 4.5 kPa (0.035 - 0.045 bar). This pressure range suffices to form a bubble or air pad which completely separates the entire cavity from contact with the water thereby significantly reducing the wetted surface area and consequent drag.

Even when the air emission system can inject nearly 15 cubic metres of air per second (on hulls equal in size to the ASV 65' or the BB GREEN), the volume of air and relative pressure in the cavity needed for standard cruising mode in calm waters are both very small. When cruising in heavy weather more air needs to be funnelled since loss of air from the cavity increases as the seas grow and the ventilator /fan will require more power.

To avoid loss of air from the cavity there is an adjustable flap installed aft of the cavity itself which is set at an angle according to load and sea state. Next to the cavity there are two planing elements installed longitudinally which shut off each side of the cavity and ensure partial support and space enough in which to install a POD at a safe dis-

tance from the cavity.

But how does an ASV hull behave



with ASV hulls since they're more stable than classic single hulls, there's less pitch and roll while cruising of course but also when lying to an anchor. The air bubble reduces slamming effectively while cruising which translates into greater all round comfort.

Lastly in terms of liveability since our

ASV hulls are beamier they have more exploitable space inside than many conventional hulls of the same size possess. And all of this poses no problems as in terms of design, superstructures and layouts. An ASV hull is also compatible with many other modern ones it can sport a vertical or axe bow with or without bulb and so on.

Have you at this point in time already had any firm requests for ASV technology applied to a yacht?

We're currently gathering data and input from shipyards to best exploit our ASV technology in the yachting world as well aside from the existing ones, (fast shuttle ferries, patrol boats, work boats etc.). The Norwegian Export Credit may well finance operations while transferring technology to other sectors to build corresponding prototypes by which to gain more visibility and opportunities. We will be present at the coming Sea-Tec to be held in Carrara Italy next April.

## Which is the smallest length you recommend for an ASV hull?

15 metres is the lowest possible entry level when envisaging twin props. If you're envisaging a single propeller then the limit is of about 12 metres.

FOR YACHTS AND DADDY'S VIEW POINT Interview with Ulf Tudem

ASV HULLS

Such an efficient hull delivering considerable comfort is in more ways than one "normal" especially when

there are no other add on parts like foils for instance. Therefore an ASV hull can effectively become a revolutionary novelty in recreational boating as well. But how well can it be adapted to a yacht? We popped UlfTudem the creator of this hull a few questions on this topic. He's currently MD at ESI (Effect Ship International) owners of Air Supported Vessel (ASV) technology.

#### What are your thoughts about ASV technology applied to recreational boating? How well would an ASV hull adapt to yachts?

Also boats from 50' or 15 metres up to at least 60 can profit from ASV technology for diverse reasons.

As for efficiency, most of the time ASV hulls require by comparison less fuel 30, 40 % less since their drag coefficient is much lower than conventional hulls. This translates into smaller engines in terms of power, size, and weight and less pollution. Additionally ASV hulls perform well with Volvo Penta PODs as well as with other brands while maintaining all of their features in terms of versatility and efficiency.

In terms of accrued comfort there's much to be gained

# Cruising

on an air bubble



The air contained in the cavity of an ASV acts like a shock absorber which dampens slamming motion as well as pitch thereby enhancing sea keeping qualities. In the picture the 65' ASV Mono hull prototype powered up by a pair of IPS 600 pods.



The graph compares three vessels displacing 25 tons. The red line identifies drag coefficients of a 20 metre ASV, a green line identifies a conventional planing hull's of the same size and a pale blue line traces the results obtained for a fast catamaran. The performance of the ASV hull is clearly better than the planing one (- 40% at 25 knots). And the ASV hull performance compared to the fast catamaran is still more than 10% better.

when cruising? When cruising slow or manoeuvring in restricted waters and ports the fan/ blower would be switched off and the ASV will handle in much the same way as a normal V shaped hull would, but nevertheless slightly better thanks to two PODs installed well apart from one another.

When air is blown through the duct into the cavity and the aft flap closes; the response is almost immediate and the vessel will lift up by 40, 50 cm at this point 70, 80% of the vessel's weight is supported by the pressurized air bubble and when cruising the vessel will be higher off the surface with surprising acceleration and with an almost horizontal set up.

Hump speed disappears as planing cruising speed sets in quickly.

The boat handles well and safely with enhanced sea keeping qualities thanks to the air bubble below acting



Considering speeds varying between 25 and 30 knots, the graph shows 65' Mono hull ASV fuel consumption measured against conventional yachts' of the same size. Conventional yachts require 10 to 12 litres/mile while the 65' Mono hull ASV requires less than 5 litres/mile. Less than half!



This graph compares Tuco Marine's 18m ProZero with fans switched on (orange curve) with fans switched off (pale blue curve). The graph also underscores greater efficiency when the ASV hull cruises in air supported mode and also shows that fuel consumption grows very slowly with speed at least up to 31, 32 knots.

as a shock absorber. And if the blower/fan stops functioning even at more than 30 knots rest assured nothing happens other than a gentle progressive deceleration brought about by loss of pressure in the cavity. The boat will continue to cruise more slowly between 18 and 19 knots. That's all!

As for performance the data collected during trials on the ASV mono 65' prototype are astonishing inasmuch as fuel consumption of traditional yachts of the same size cruising between 25 and 30 knots require 10 to 12 litres per nautical mile while the ASV 65' at the same speeds requires less than 5 litres per mile.

Less than half! less drag, in addition to less pollution







Thanks to ASV technology BB GREEN (www.bbgreen. info) is the fastest completely electric commuter in the world. Built entirely in carbon sandwich in Riga by Latitude Yachts, backed up by the European Community's 7th Framework Program with the following specific objective: to deliver a zero emission fast commuter to the townspeople.

BB GREEN is the first all electric fast ferry in the world. This has been possible thanks to the efficiency an ASV possesses. With an LOA of about 20 metres and a beam of 6, BB GREEN reaches a top speed of 30 knots powered by a mere 560 Kw made up of two 280 Kw engines. At about 25 knots the vessel requires 21 – 22 KWh/NM which is a really excellent result. This degree of efficiency has been confirmed several times over starting with the hull lifting off the surface while cruising ( the portion of the hull with black anti-fouling paint is clearly higher off the surface when compared to the picture in which the vessel is not moving). And again by the fact that no waves are generated despite the fact BB GREEN is cruising at 26 knots!

	Princess V 62	ASV Mono 65 IPS
LOA	19,39 m	19,98 m
Beam	4,99 m	5,40 m
Trial displacement	23 t	22,5 t
Engines	2400 HP	870 HP
Volume required by eng.	2 × 17,8 litri	2 x 5,9 litri
Power deployed per fan		80 – 120 HP
Top speed	37 kn	33 kn
Consumption at 33 kn	11,3 litres/NM	5,7 litres/NM
Consumption at 27 kn	10,7 litres/NM	5,6 litri/NM
Angle at 30 kn	4,5 °	0,5° – 1°
Volume-interior space	+	++
Wake when criusing	-	+++
Emission (in water /air)	-	+++
Sea Keeping	++	+++
Manoeuvrability	+	++
Source: Effect Ships International AS (2010)		



BB GREEN'S ASV hull boasts a virtually flat wake. This too is proof of elevated efficiency since waves are dissipated energy.

translates in requiring less horse power without sacrificing performance and a notable saving in purchasing price and running costs.

The figures in the following page compare the 65' ASV with a similar yacht a Princess V62 clearly highlighting ASV technology better than so many words would. Obviously 'all that glisters is not gold'.

For example the ASV 65 IPS has an extra plant installed, namely the ventilation system which does absorb energy, space and it is not noise free.

In addition to that there's the large cavity below hull which steals space inside the boat, and so does the blower fan and relative air duct which is not negligible.

However it is also true that the volume the cavity requires is generally never exploited (bilge space) this is often compensated by and large, by less powerful engines which ASV hulls require and are in fact beamier as the data in the table above shows.

# Cruising

### on an air bubble



The air duct in construction which delivers air to the cavity on board of 65' Mono hull ASV from which we can estimate the unit's considerable size which is one of this hull's weaknesses.

A view of the air duct inside Tuco Marine's 18m ProZero ASV is also shown.







Project MSS ASV "Soft Motion", a 21 metre built to operate in coastal/inshore waters for Torghatten Nord, a company which runs several shipping lines in Norway's Fjords. Studio Sculli handled project design and the architecture.



On the left, Surfer 17000, a fast commuter destined to shuttle technicians and/or material to wind farms situated in the North sea.

Developed by British yard Alnmaritec (www.alnmaritec. co.uk). Often difficult weather conditions and big seas confirm ASV hulls' excellent sea keeping qualities. Project design and architecture by Studio Sculli.

Above, Model MSS ASV "Soft Motion": a 21 metre being tank tested at Gothenburg Sweden at 30 knots.





Namastè, a 72' sporty looking modern yacht designed by Studio Sculli on an ASV hull. As can be clearly seen the hull shape does not condition exterior design.

Namastè's two different layouts: cabin space is in no way affected by the ASV hull, it is in fact more than that of a "normal" mono hull of the same 72' ( the ASV is beamier as well).

We interviewed Mauro Sculli yacht designer (refer to dedicated box) on this point as he offered diverse proposals based on ASV hulls, for both commercial shipping, work boats such as BB GREEN which we've already mentioned, as well as those deployed to and from Offshore rigs in the North Sea and others: for example, the 21 metre ASV MSS, including the Surfer 17000, to underscore once again the excellent sea keeping qualities typical of ASV hulls.

#### A YACHT DESIGNER'S OPINION.

Interview with Mauro Sculli, in the design studio by the same name.

The space exploited by the hull cavity in an ASV hull obviously affects the volume available inside as well. We asked Mauro Sculli yacht designer who has offered project designs for work boats and yachts sporting ASV hulls and how much these beamier hulls impact on the interior layouts as well as exterior design.

An ASV hull featuring a large cavity under the hull which is designed to contain an air bubble. What happens when you are asked to draw up the interiors and the external lines?

The cavity obviously removes a portion of the hull volume amidships and this means the flooring on which you tread is situated higher up. Consequently ASV boats are a little higher off the surface when compared to conventional ones. This difficulty is the first to be addressed as it involves architecture as well as design and consequent looks too. On the other hand as for availability of interior space measured against the otherwise exploitable space which has been removed from the cavity you have a beamier boat and a larger exploitable surface area. In fact an ASV boat with an efficient cavity will be up to 20% beamier than a conventional mono hull of the same length, which also translates into added comfort.

The area on which you tread is a little higher up because of the cavity does this hinder or limit the minimum dimensions of an ASV?

Actually the cavity can represent a limit in terms of size but not only because of reduced height inside. The entry level limit for this technology set out by ASV experts is around the 12 metre mark mainly because the fan plant and air duct require that certain specifications and standards are complied to. Boats can get smaller only up to a point but fan plants don't as such, so the exploitable space on board gets proportionally less and less and the ASV plants get exponentially costlier and larger. Some progress has been made in the course of the past few years, on this issue also by deploying singly hybrid engines on smaller boats.

Considering small catamarans for instance; where available interior space is consistently less because at centre catamarans are completely out of the water while ASVs sport more headroom amidships with their cavity submerged below the hull in the water. More benefits are therefore available from 12 to 14 metres up. Performance practically speaking remains almost the same. Below certain limits though cost to efficiency ratios become less interesting specially where the plants needed become too costly in proportion to the overall cost of the boat and the extra expense is no longer easily justifiable below a given size.

Talking of plants installed to deliver the required air to fill the cavity with. Are they

## Superguent TECHNICAL On an air bubble

#### the only items needed. Is there anything else aside from the air duct and fan plant system that is required?

In the main there's the fan plant and air duct. In addition to those, air vents are needed in the bow and a flap is required aft in the stern which monitors the pressure in the cavity.

### Which kinds of boats have been designed so far with ASV hulls?

We've come up with several projects. While we were involved with the European BB GREEN project we also drew up project design work for an all electric 20 metre work boat capable of cruising at more than 30 knots. The boat has since been built and is operational in Riga Latvia thereby demonstrating it is possible to cruise also at high speed with no pollution whatsoever. This was followed by several other projects, to name a few: a 20, a 21 and 38 metre for inshore transportation along Norwegian Fjords commissioned by Torghatten Nord. These are mono hulls requiring ASV technology with low impact on the environment. Then British yard Alnmaritec which builds several types of different work boats asked us to deliver a project for a 24 metre capable of carrying 12 or 24 technicians at high speed from and to wind farms installed in North sea waters. I must say that style-wise there's something definitely military about the exterior lines nevertheless she's beautiful.

#### And what about yachts?

Well, as for these we've satisfied a request for a 72' and an 80' with ASV technology from a Turkish yard which is bent on acquiring the know- how. The paper work clearly shows an extra cabin when compared to traditional hulls of the same length and typology. But aside from the obvious extra space ASV configurations possess, their lines and silhouettes look good. The 88' looks even better than the 72' thanks to the longer overall length which tends to conceal the greater height of the top sides off the waterline due to the ASV hull we mentioned earlier.

#### Finally what's your opinion concerning this technology and how realistic is it for yachts?

My point of view is undoubtedly a positive one based on 10 years of experience and experiments with ASV technology. Yet to this day it is still something so innovative that to many the results obtained are difficult to believe and comprehend. Ensuing diffidence is to some extent understandable. An owner or even a shipyard will more often than not pay little attention to novelty until someone else has successfully built a few models which cruise well, proving trial results, tests and the promised facts. That is the first handicap, to which the second is linked also. What happens to an ASV hull over waves? what happens when there is a sea and the cavity loses contact at



some point with the water? And what happens to the air bubble, cushion or pad supporting the hull when air loses compression and the hull 'falls' onto the water? A legitimate fear even if this does not happen in reality. Tests and recorded footage show this, and I'm happy to add that I personally experienced several sea trials in a sea and the ASV hull behaved perfectly well in those conditions if not better than when it was flat. When the hull lifts off the water the air contained in the cavity loses pressure, and if it is true the hull is no longer supported by air pressure and tends to drop downwards, it is also true the fan continues to blow air down the duct into the cavity. This way the moment the hull and therefore the cavity begins to drop back into the water, the air recompresses instantly and even acts like a shock absorber. In actual fact in a sea even a big sea an ASV hull works better than a conventional one with a dampened softer ride over waves.

So we're dealing with basically psychological aspects as well as cultural ones that for the time being can slow down widespread use of this technology. Many yards and companies are interested in applying this technology but as often happens in the yachting world, most want to be sure, want to see and test drive a boat possessing all the same features at least as the traditional one they request. Toward this end the first ASV yacht prototype a 65' built ten years ago in Turkey, has been substituted by two other boats that are currently cruising: the 20 metre BB GREEN which is also 100% electric and an 18 metre support vessel built at Tuco Marine both are of course ASV hulls which have been fine tuned and improved in the course of the past ten years dedicated to more experiments and research work.

Anyone stepping on board these boats today immediately realizes the boats will lift, slip along with no difficulty whatsoever and behave unexpectedly well. They're soft over waves and comfortable. In a nutshell he /she will acknowledge the fact that all that has been said about these hulls is true.





## COME AND SEA



















