BOW REVERSE:
FASHION OR NEED?

by Andrea Mancini

Fashion, design, style, are all part of the fundamental characteristics that make up a yacht, which is neither just a toy or mode of transport nor a sophisticated piece of technology but it actually stands for something: a luxury item, a status symbol. This is how fashion suddenly becomes need, the need to impress an owner. This is where designers, project managers and shipyards, all try to come up with something different, unique, preferably yet to be seen, " different from anything that floats"! These are the very words uttered by Henk de Vries, owner of the Dutch shipyards Feadship, on occasion of the launching ceremony for "Predator", a Mega yacht of some 72 meters. It was launched earlier this year and distinguishes itself for its very 'unusual shape' for a yacht or even any boat of that sort. De Vries' words happened to be the exact resumé of the owner's mandate. The rather incredible upside down bow which coins the term "bow reverse", is only the more striking aspect of these new shapes and styles: a clean and smooth deck with minimal superstructures, narrow forward sections with slick and lean hull lines, complete the picture.

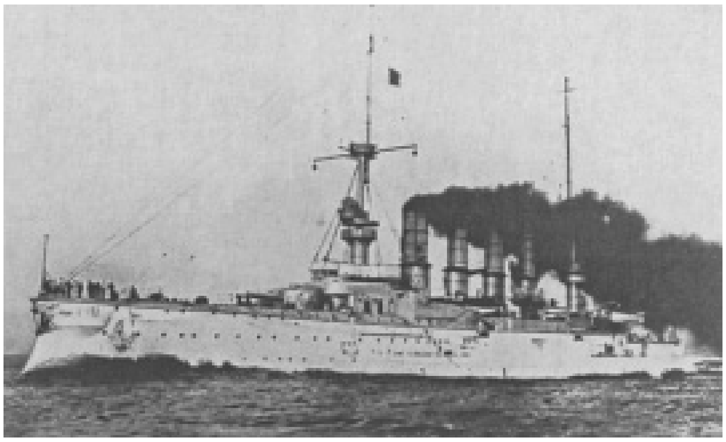


Figure 1 - The German armoured cruiser “Scharnhost”(on the left) was built by Bloom& Voss in Hamburg. It was launched in 1907 with an overall length of 145 metres (the same ship yard built the “Sigma” 100 years later).It featured a reverse bow, narrow slim lines, with a limited superstructure: resemblance to Megayacht “Predator” of 72 metres (on the right) is quite evident.

Hence, to get back to the title, are these “new” hull shapes just a question of fashion, are they supposed to just impress, or do they actually satisfy a requirement by improving performance, safety, or comfort of “Item Yacht” ? In fact, as often is the case, the hull shapes described above with the bows' upright tilting backwards, the narrow hull with a high length to beam ratio (L/B) and limited volumes forward, are not really that new, both in terms of architecture and design as well as pure technology. Actually, bow shapes like “Predator's”, together with the long and narrow lines of the hull and no superstructures, are slightly reminiscent of military ships of 100 years ago (Figure 1), like Cruisers and Battleships (in this instance, the long submerged bows also constituted a weapon to be used as a ram). The new 118 m long Megayacht “Sigma”, also of recent launch by the German Shipyard Bloom & Voss, with its very rounded, stern tilting bow, its unmistakable clean and smooth deck, its superstructures condensed under a single tower, is by far more reminiscent of a submarine than a yacht (Figure 2). So much so that more than one person present at the launch wondered if this strange object was to float or dive! Finally Sebdas 50, the new project by the Australian design company going by the same name, again with its aggressive sleek lines and the inevitable reverse bow, takes one back to the basic design of the Turbinia, the first

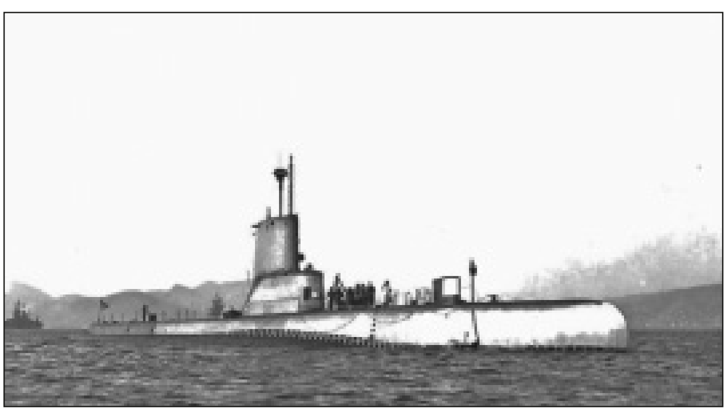


Figure 2 - The US Navy submarine “Sea Poacher” (SS-406), on the left hand side was launched in 1944. On the right the megayacht “Sigma” of 119 metres which was launched earlier this year by the German ship yards Bloom& Voss: is characterized by a fully rounded reverse bow, with an unmistakably smooth and uncluttered deck layout. The superstructure is concentrated into a single central control and command bridge. The similarities between the two vessels clearly stand out.

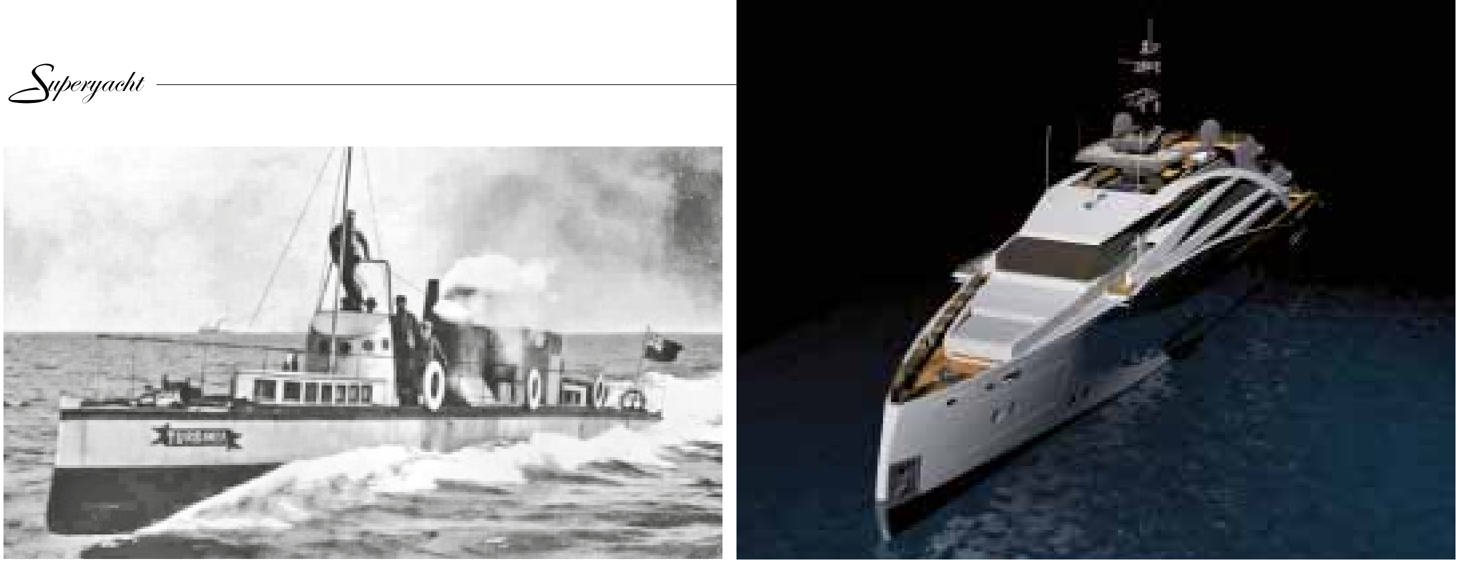


Figure 3 - "Turbinia" on the left was the first ship to be equipped with a turbine and with an overall length of more than 30 metres. In 1894 it reached 35 knots. It really recalls "Sebdas 50" (on the right): both sport taught and aggressive lines, reverse bows, and limited superstructures.

vessel to be fitted with a turbine engine. It was over 30 meters in length and in 1894 it reached a speed of 35 knots (Figure 3).

Thus in view of the three examples above, are we witnessing a return to the past, or are we confronted with a leap into the future that we are not ready for ? In fact, as often is the case but not just in the nautical world, "old" ideas just need to be revisited but put into practice with new technology to satisfy new requirements.

Let us then closely examine the reasons for the changes, looking further than the need to "invent" new expedients and styles just to impress. What are then the true advantages of a vertical bow, or even a reverse one, and what about the new shapes that go with it, both from a technical point of view i.e. performance, safety and comfort, and a design and use stand point.

Bow reverse: fashion or need?

Firstly, handling at sea is improved. In fact, straight and sharp bows or even 'reverse' bows, are inevitably matched to equally narrow and sleek forward sections which, on the one hand, have the disadvantage of reducing volume below, whilst on the other, they have the advantage of being "wave piercing". These shapes in fact stop the hull from following the wave's motion but, quite literally pierce the wave going through it instead. This aspect tied in with hull length, or rather, a high L/B ratio, allows for high speed to be maintained even in a swell. What effectively happens, is that these shapes limit pitching and sussultatory movement (the vertical movement provoked by the waves) but above all, they

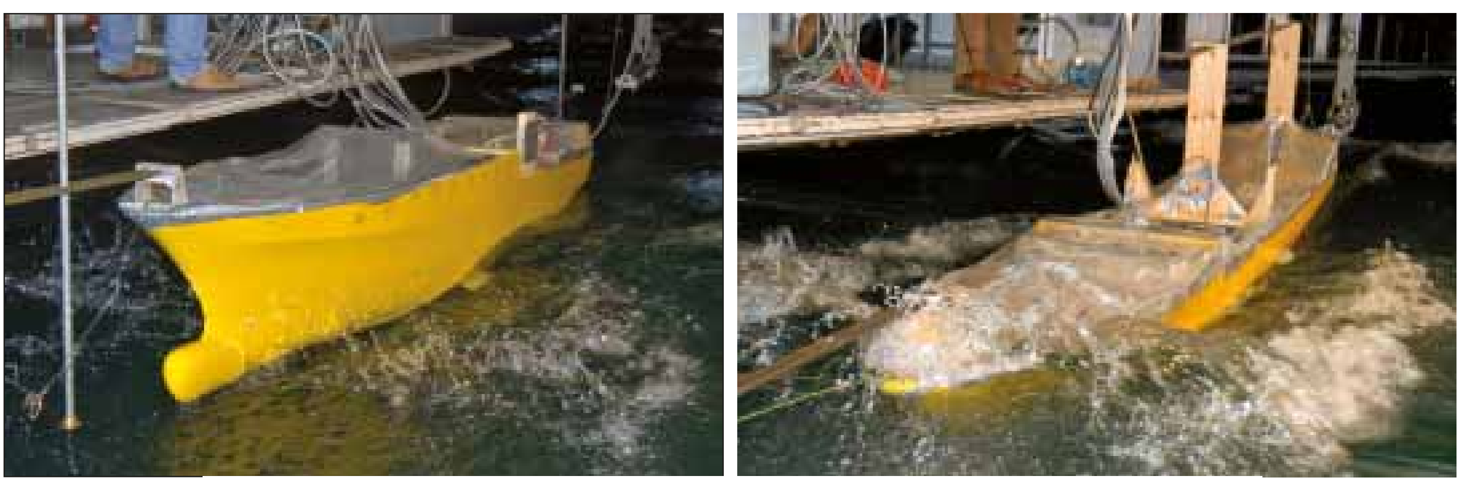


Figure 4 - A sequence of slamming impact on a model boat with traditional bow lines taken during seakeeping trials at the Rome INSEAN naval basins.


Figure 5 - A model with traditional bow lines pitching at the Rome INSEAN naval basins, is in reality (a photograph taken in East Med. waters on board a 130 metre ship).

limit the slamming impact of the bows caused by the very pitching and sussultatory movement combined to the speed of the vessel. As the photo in Figure 4 reproducing a slamming sequence eloquently suggests, these impacts bring tremendously concentrated pressure to bear onto the forward section of the hull, especially so, if the hull presents itself horizontally, or sub-horizontally to water impact, as is the case with traditional hulls. Impact can thus cause serious and sometimes irreparable damage to the structure besides making life on board extremely uncomfortable if nay impossible (Figure 5). It is therefore quite obvious that narrow bows which in turn form part of practically vertical parts of a considerable share of the foredeck, have a limited slamming impact both in terms of proportion and frequency and are thus better suited for heavy seas. Figure 6 gives a very good idea of just how much structural stress the ship is put through because

Bow reverse: fashion or need?

Figure 6 - Diagram illustrating structural stress in proportion and frequency due to pitching and slamming impact.


Figure 7 - Concept view of the DDG-1000, multi-purpose class destroyer also known as “Zumwalt” measuring 183 metres. It is scheduled to be built imminently for the US Navy. The resemblance to the “Sigma” 119 metres is outstanding!

of ‘slamming’. This would therefore explain why boats with a traditional bow shape are forced to reduce speed in head on, heavy sea conditions.
These concepts are hence old and consolidated facts as the pictures of the Turbinia and the 1st world war battleships that we referred to earlier bear witness (Figures 1 and 3). There are however also facts that are being re-discovered in the light of know-how and technology that are available today in fields where speed and safety are qualities that need to irrevocably co-exist. This is exactly what is happening with some types of military ships like Destroyers where the “wave piercing” shapes of the hulls are matched to the superstructures and the topsides by way of Stealth Technology, that is, shaped and equipped to escape radar detection (the “invisible” planes so designed are now famous) (Figure 7). It is also the case with both military and civil smaller fast ships (lengths around the 50 meter mark as an indication) where to achieve more efficient wave piercing shapes, the bows have become practically upright vertical known as “Axe Bow”. Looking at the bow on the “Doña Diana” the likeness with an axe is unmistakable (Figure 8). She is a back-up ship of 51 meters of recent build, designed to motor at 25 knots in difficult conditions whilst providing transport to and from North Sea oil platforms.

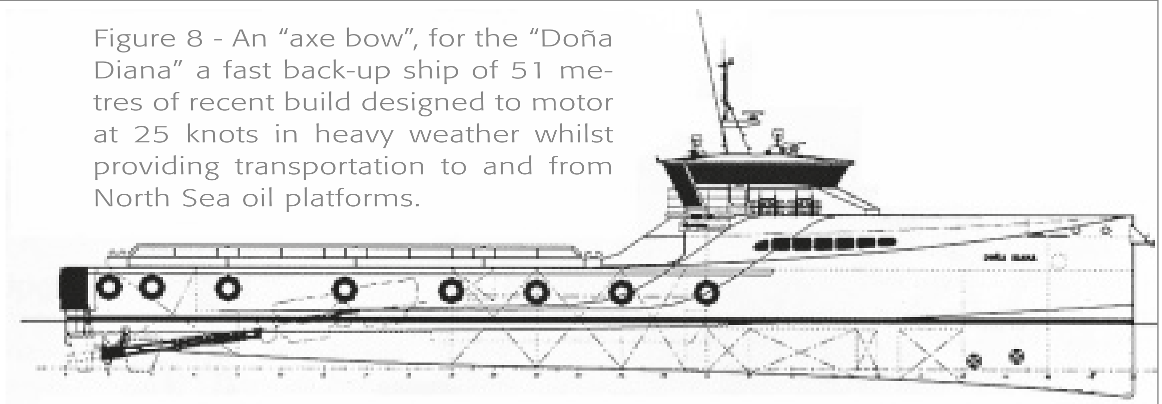


Figure 8 - An “axe bow”, for the “Doña Diana” a fast back-up ship of 51 metres of recent build designed to motor at 25 knots in heavy weather whilst providing transportation to and from North Sea oil platforms.

Bow reverse: fashion or need?

This bow shape considerably improves handling at sea whilst at the same time maximising water line length thus permitting higher displacement speeds as well as reduced consumption. However, this will later be discussed further. Figure 9 illustrates other vessels with the same designs: a military patrol boat (notice the similarities with the Predator) and a rescue/support ship.
However, the need to keep up performance even in adverse weather conditions, is ever present even with the more traditional maritime transport

Figure 9 - A military patrol boat “Damen Sea Axe” 5109 (on the left) and a rescue/support ship (on the right). Both vessels were designed by Damen the Dutch ship yards where the R&D department developed the “axe bow”.

vessels, such as passenger liners or cargo ships where time schedules are of the utmost importance. In 2005, for instance, the first, definitely non-conventional container ship with a revolutionary reverse bow known as the “X-Bow” (Figure 10) was launched. These are small ships (indicatively around the 100 meter mark) designed for short voyages and they offer the following advantages: they maintain speed in rough sea conditions, they reduce fuel consumption in certain conditions (for example when the ship is not fully laden or on ballast only), slamming impact is considerably reduced as well as pitching , which all results into lesser risk of damage or cargo loss (which is sheltered by the superstructures moved to the bow). But of course we have yet to see a yacht looking like that, is it maybe just a question of time ?

Figure 10 - X-Bow, ships with a revolutionary reversed bow geared to reduce slamming as well as pitching and sussultatory movement.

Whilst maximising water line length and limiting beam dimensions, these bow shapes also improve the hydrodynamic performance of the hull. What happens is that, the length of the vessel, plus a high L/B ratio standing at 6 for the yachts we mentioned in this article and, more generally, the slenderness of the hull results in higher displacement speeds. A bit of a golden egg situation really, as whoever designs boats knows only too well. Small wonder therefore, that military ships that are non-planing but at the same time need to be fast, are always long and narrow. Just as how in the past, the Blue Ribbon regattas that established the fastest ship across the Atlantic, used to be contended by transatlantic ships over 200 meters long that used to travel at an average speed of nearly 30 knots like the unforgettable Rex that won in 1933. All this is explained by the so called critical speed, that is, the speed at which the hull creates a transversal wave of the same length as the hull itself. Breaking this speed, which in fact represents the displacement limit, the vessel will create a longer wave than the hull itself and, to coin not too a scientific term, it will “sit-back” as the stern will rest on its own wave. Consequently the friction due to the wave formation produced, will quickly begin to increase. However, this critical speed, or rather the wave formation produced by a hull in motion, is a function of the speed to length ratio of the hull: all other conditions being equal, a longer vessel can be faster with the resistance to wave formation remaining practically unaltered therefore a power increase would only be due to an increase of other hydrodynamic resistances such as, water friction or keel fowling. In technical terms, the Froude value remains unchanged. This value is nothing more than the speed to keel length ratio (the ratio otherwise expressed is also indicated as Relative Speed). For example, if we take away the jutting parts forward and aft off a vessel with a 50 metre water line length, thus equating water line length to length overall, we would increase the former’s length by approximately 10%, and we would also increase speed by about 1 knot nearly with the same power output, all other conditions being equal. The graph in Figure 11 shows the trend of the Froude number equal to 0.4 (critical speed) as a function of the speed and the length of the keel: for example, yachts such as SABDES, Predator, and

Bow reverse: fashion or need?

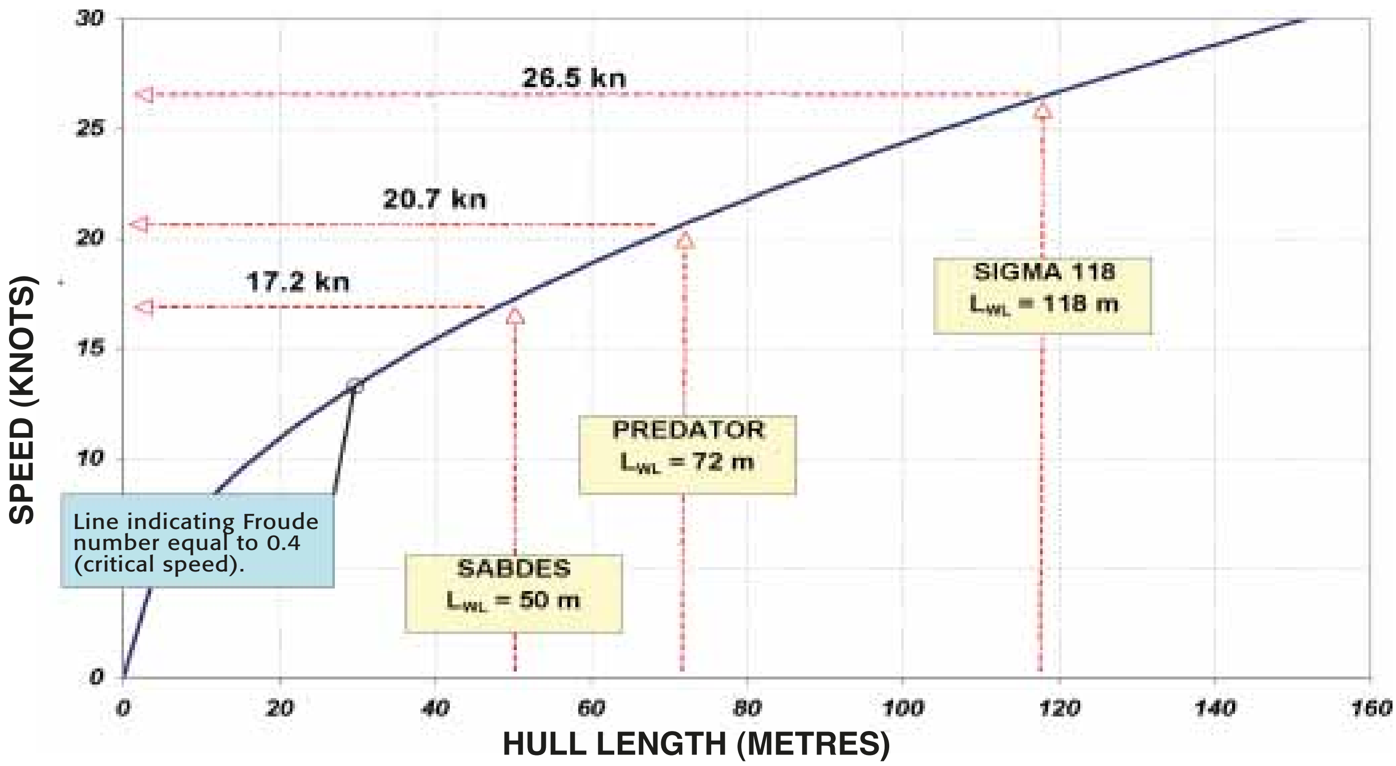


Figure 11 - Flow Chart according to Froude number equal to 0.4 (corresponding to critical speed) and to the critical speeds relative to the three other yachts taken into account.

Sigma of 50, 72 and 118 meters respectively, have a respective critical velocity of 17.2, 20.7 and 26.5 knots. Naturally critical velocity must not be taken for net speed, but as the speed at which the phenomenon, applicable to a more extended speed range, reaches the highest value. Therefore if nominal critical velocity equating to Froude Number FN=0.4 is equal to 20 knots for example, the same speed ratio will be true for a further 2.3 knots.
As we mentioned earlier, these hull characteristics, that is, the high L/B ratio and the "wave piercing" shapes also ensure an above average ride during difficult crossings because the ship's stance remains constant and near horizontal, whereas on other yachts comfort suffers considerably. All else aside, the number of people who enjoy long crossings as a way of 'living' the sea is increasing all the time and their primary need is becoming top comfort. Therefore to be able to do 20, 25 knots on a non planing ship without losing the

Figure 12 - A preliminary study of a 53 metre Superyacht carried out by the architects' Studio Associato Marco Rossetti and Ivano Cantalo. (www.ayd.it).

Figure 13 - Super Sail Yacht of 57 metres: "Green Jet" a concentration of futurist solutions for both its design and technological aspects by the Slovenian designer Erik Ifrer, also with its unmistakable bow tilted backwards.

lull and consistency of the motion, is not to be overlooked, particularly if it allows one to behave normally on board; so even in rough conditions one can be moving about the yacht, dining at table, or resting in one's cabin, all things unthinkable on a planing yacht at speed.

Let us now examine the design aspect which is heavily conditioned by the types of projects we have just described. So, as far as the hull is concerned, we are talking about slim and sleek lines, slender forward sections and vertical bows. Now, regarding the superstructure of large yachts that is, where space is never amiss, one is no longer tied to the classical design of two or three decks extending over the whole length of the vessel albeit enhancing internal space. There is now room for superstructures reduced down to a minimum, wide decks with plenty of outdoor space to have a more direct feel of the sea, hence the hull suddenly becomes the dominant part of the yacht's lines.

This is to signify and prove, that designing a big yacht today doesn't mean designing a big 'container', but a slick lined enticing object, near to the water, of a reduced visual impact: in short, a beautiful but different item all together! Figures 12 and 13 give us a brief summary of things discussed as they illustrate respectively the project of two young designers from Rome for a 53 metre bow reverse and of a sailing super yacht also with an unmistakable bow tilting backwards. Costs should perhaps now be examined. They happen to be lower both in terms of construction and of maintenance in respect to traditional yachts of the same dimensions and performance. Fewer superstructures to build means having fewer materials to buy, less furniture, fewer installations, lesser overall weight. Smaller engines may be installed also by virtue of the greater hydrodynamics enjoyed by the hull because of its extra length. In a nutshell, you spend less and can save up to 20-30%, which is not inconsequential even when it comes to luxury. One should also mention a cost reduction when it comes to running costs: non planing hulls that reach speeds of 20 knots reduce fuel consumption. One could even begin to look at the eco-friendly aspects of these yachts, especially if new technical and design solutions are found that are finalised to reducing consumption and pollution. These could be on board garbage/waste disposal systems, controlled low emission engines, eco-friendly antifouling paints, etc.

Bow reverse: fashion or need?

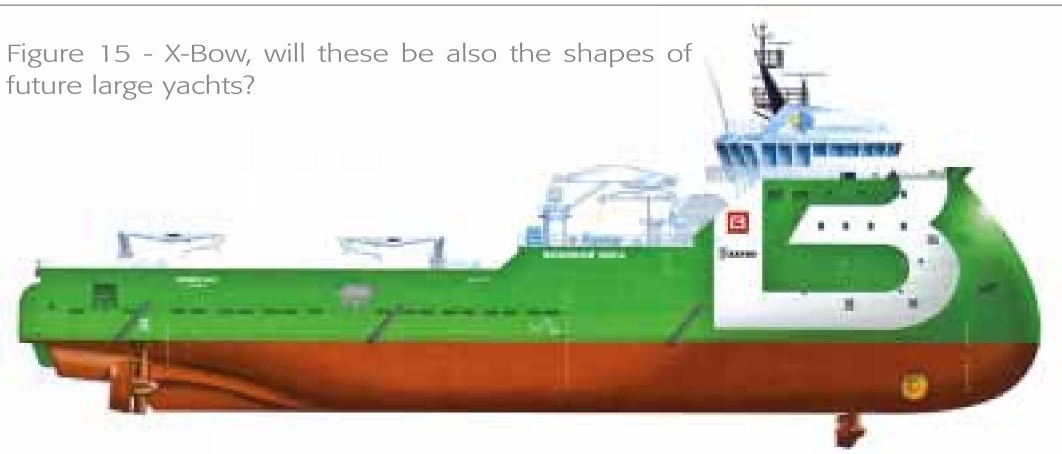
The concept touching on greater attention for the environment coming from luxury recreational yachting, is increasingly being examined by designers and boat-builders alike, maybe thanks to a cultural evolution, maybe because it is fashionable, but more probably due to the more stringent anti pollution regulations. For example the SABDES project or the MY H2OME (Fig.14) we

Bow reverse: fashion or need?

talked about in the last SY issue, are exactly yachts conceived to have greater hydrodynamics, that reach 20 knots without planing, saving fuel and covering longer crossings without however sacrificing neither style or design. Always with safety, comfort and, why not, luxury in mind.
To conclude these deliberations over the technical aspects of the new bow shapes, another consideration springs to mind: yachts of such lengths, that therefore allow hulls to be built with the characteristics we discussed, are only realistic in the world of Mega Yachts, where we are already witnessing a “go bigger & longer” trend! All this is possible also because when one would sit and imagine and then design a yacht one is hardly confronted with a space problem foreseeing superstructures extending in length and height. The shear size of the hulls guarantee plenty of volume space for sleeping quarters, saloons, tech-rooms, lounging areas with everything really, that constitutes a grand luxury yacht. The classical concept of boats 40 or 50 metres long with two or three tier decks may thus be abandoned in favour of sleek and slender lines instead; low, practically non-existent superstructures, large decks and open air spaces. Similarly we could have proportionately narrower yachts, that is with greater L/B ratios thus achieving greater hydrodynamics for the hulls. Therefore, from the moment regulatory or economic limitations cease to interfere with the size of the yacht or even better, the length of it, the ‘distinguishing mark’ will become the length of the yacht. The trend will be ever longer boats where the LWL will equal or surpass the LOA: resulting in greater speed, efficiency, handling and comfort!
What about tomorrow? Will ever increasing lengths urged by the need to impress, after rekindling shapes of the past, give way to new concepts, new hull and yacht shapes? Or will the new shapes be inherited from the military or cargo vessels. Will we then see an X-Bow yacht with its unusual and definitely curious lines as in Figure 15?

Figure 14 - M/Y “H20ME” a Navirex project for a 44 metre yacht equipped with a hydrodynamically more efficient displacing hull capable of reaching high speeds (20 knots) with reduced consumption and long range capacity without sacrificing any of its style, particular design, safety, comfort and luxury.

Figure 15 - X-Bow, will these be also the shapes of future large yachts?



Bow reverse: fashion or need?

DATA ABOUT THE NEW REVERSE BOW YACHTS WE HAVE MENTIONED

SIGMA
L.O.A.: 119 m
Max beam: 18.87 m
Draught: 5.15 m
Max speed: 23 knots
Shipyard: Bloom & Voss
Project by: Martin Francis
Design by: Philippe Starck
Launch date: 2008.

PREDATOR
L.O.A.: 72 m
Max beam: 11.40 m
Draught: 3.70 m
Shipyard: Feadship De Vries
Project by: De Voogt
Design by: Bannenberg
Launch date: 2008.

SABDES
L.O.A.: 50 m
Max beam: 8 m
Draught: 2.60 m
Project & design by: SABDES
Superyacht Developments
Propulsion: hybrid diesel/electric
Max speed: 25 knots.