International A – Class.

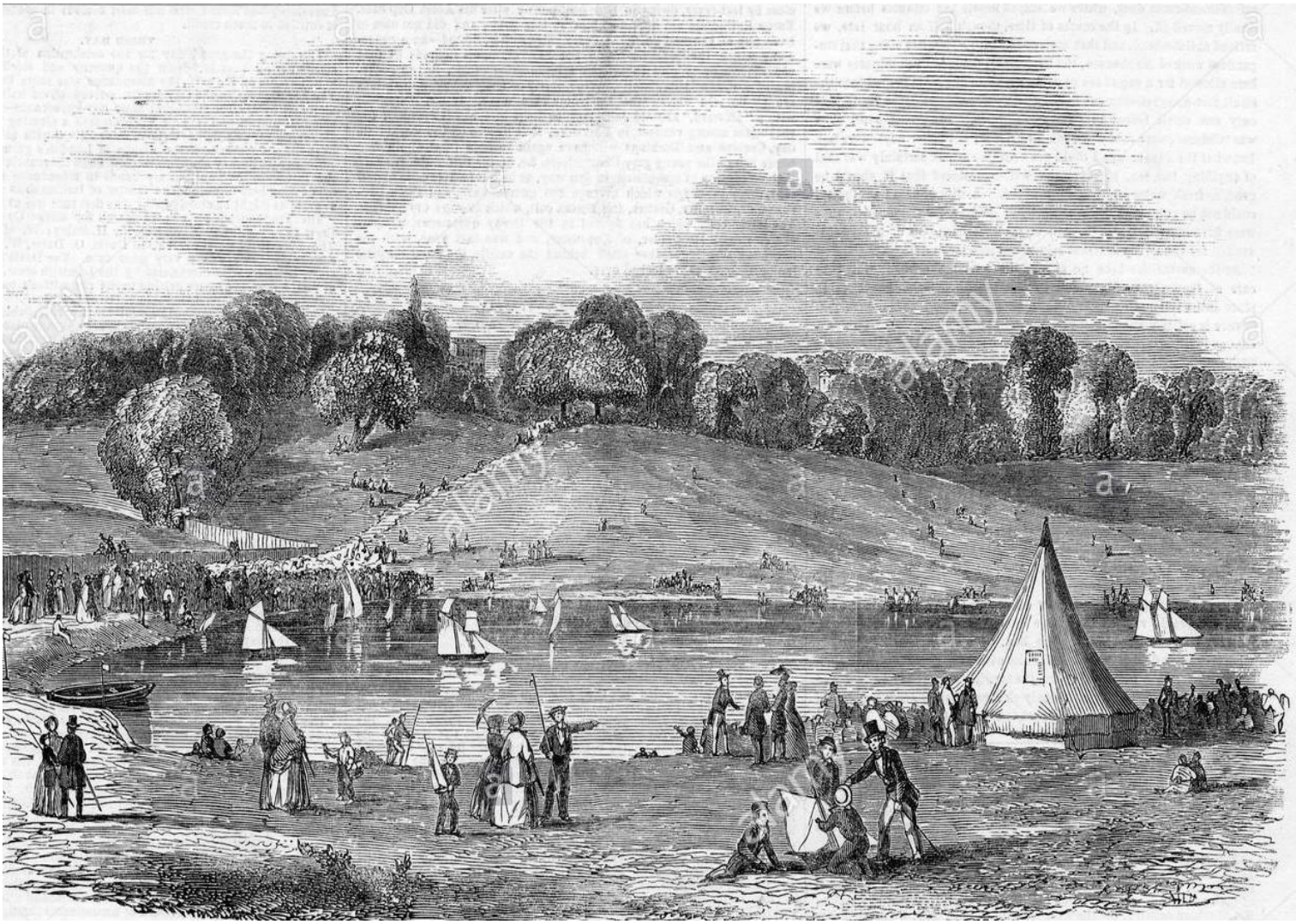
(Innovation of Design and Construction)

Introduction.

The purpose of this article is to describe how design and construction of model yachts has evolved over the last century. The article will be split into different parts, each will be published periodically once a category of completion is finalised. This first part illustrates some of the techniques and processes that have been used in the past, or still being used today. The article will also feature some new ideas being put into practise, as we progress further into the millennium. Using the first recognised competitive model yachting class, in company with one of the most radical model yacht designs of today, it is hoped this and future related articles will provide both education and inspiration, for others to continue in their innovative development of yacht design and construction.

The Beginnings.

Since before the 1900's building enthusiasts would draw or sketch their ideas on paper or canvas, prior to constructing the latest yachts. Others with a more of a natural talent, would skip the whole drawing process and just shape blocks of wood, carving out hollows to form symmetrical hull shapes. The next stage would be to create a simple rig using mostly a wooden mast and cotton sails. Finally, these yachts after a few weeks of construction would be ready to launch at nearby lakes. The launch often would be a family event, a day out with a picnic whilst testing their new inventions.



International A – Class.

(Innovation of Design and Construction)

Birth of the A – Class.

Moving forward from those early years, sailing enthusiast's saw potential in these models, so to introduce competition a formula was devised in 1922, by the editor of the Yachting Monthly magazine. This was a testing ground for later use in the full sized 5.5m Class. The model yachting equivalent became known as the A – Class. Gosport being the home of the famous A - Class and the Model Yachting Association Championships, which were always held at the Walpole Lakes from 1923 until 1933. This tradition was broken when Fleetwood, Lancashire, constructed its own model yacht lake, and held the Championship in 1933 until 1935. The regatta was eventually shared between the two clubs, an agreement which is still in practise today.

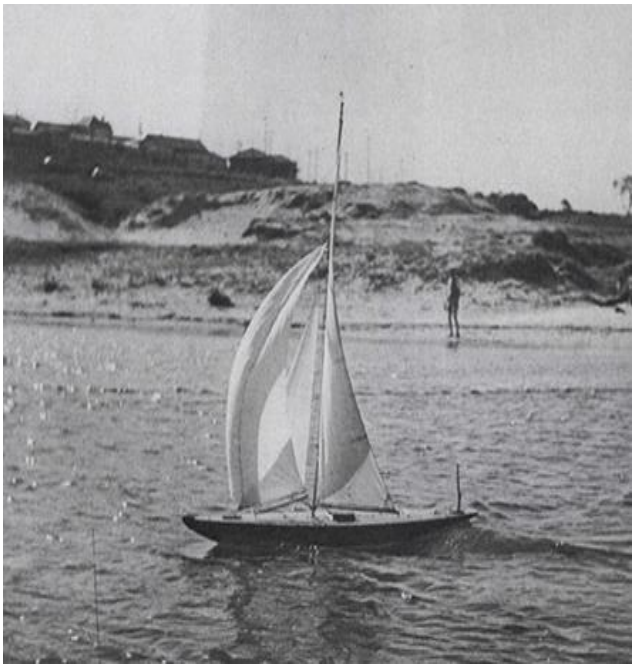
A – Class Formula.

The class formula seems complicated when people first observe its identity. However, with more study to this mathematical equation and the legislation which surrounds the class, it is possible to produce a design which will remain competitive for several years.

$$\text{Rating} = \frac{L + \sqrt{S}}{4} + \frac{L \times \sqrt{S}}{12 \times 3\sqrt{D}} + \text{Penalties}$$

Early years of Racing.

The A – Class Championship and Yachting Monthly Cup is the most prestigious regatta in the UK model yachting calendar. Competitors from all around the world and from different walks of life gather for 5 days of racing. In the late 1920's – 1970's, before radio control was even invented, as many as 50+ yachts would compete against each other. In these early years, some owners would hire crews to race their yachts, whilst the owner would sit at the side of the lake watching.

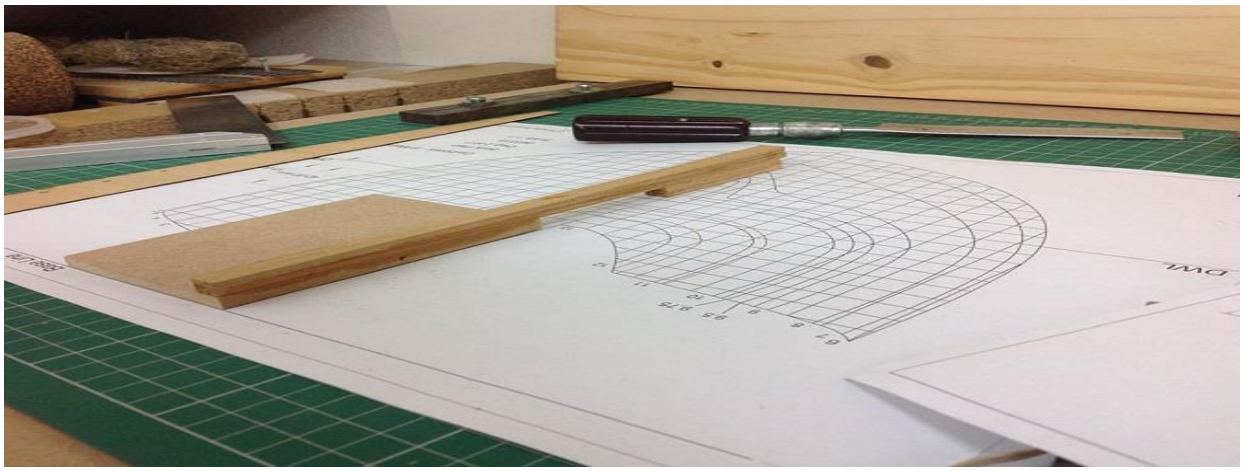


International A – Class.

(Innovation of Design and Construction)

Traditional Design and Construction Technique.

Design and construction for these yachts remained the same for decades. As previously stated, intricate designs were drawn and the attention to detail of these plans, including the manual calculations made would be an improved skill past through generations of enthusiasts. Accuracy of the hull shape was obviously important, with designers preferring to draw on gridded paper. The squares providing reference points, keeping the alignment correct throughout the design.



Construction also evolved through the generations. Into the 1920's and beyond, carving a hull shape was no longer the best practise when making a model for competitive racing. The more accepted type of hull construction was fixing wooden planks over a frame which represented the hull shape. This technique of 'Planking' had more than one style of construction process, all were as effective as each other. This traditional method of building is still widely used today.

International A – Class.

(Innovation of Design and Construction)

Development.

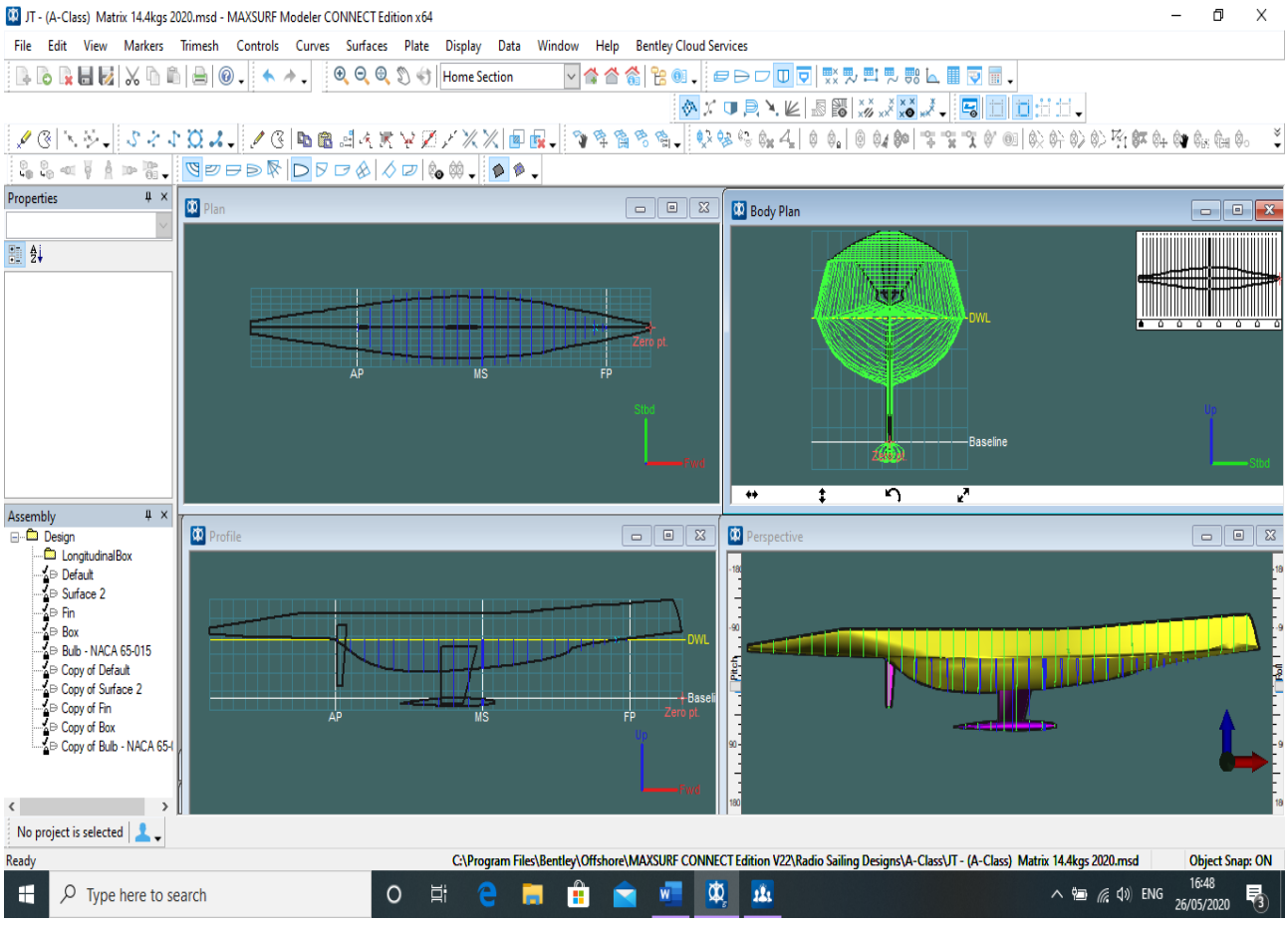
However, as we progress through the 20th Century, other design ideas, materials and hull construction techniques began to change. The invention of glass fibre started to replace wooden hulls. This was a major step forward when saving weight within the construction of the moulded hull. In addition, designers began to increase the overall length of their yachts, which meant the boats became more stable, thereby increasing speed and performance. Rig design was also evolving continually with aluminium replacing wooden masts, cotton sails had been replaced years before with more exotic material such as Mylar.

Throughout the 1980's development across the classes began to pick up pace, as more exotic materials such as carbon fibre were being introduced both in hull and rig construction. Although carbon is expensive the benefits are significant, in comparison to other hull materials. Carbon used for mast construction was also considered another step up in technology from aluminium. Rigs using carbon fibre are far more efficient, lighter with extra stiffness to allow the sails to keep their shape for longer, as they do not flex as much as an aluminium mast.

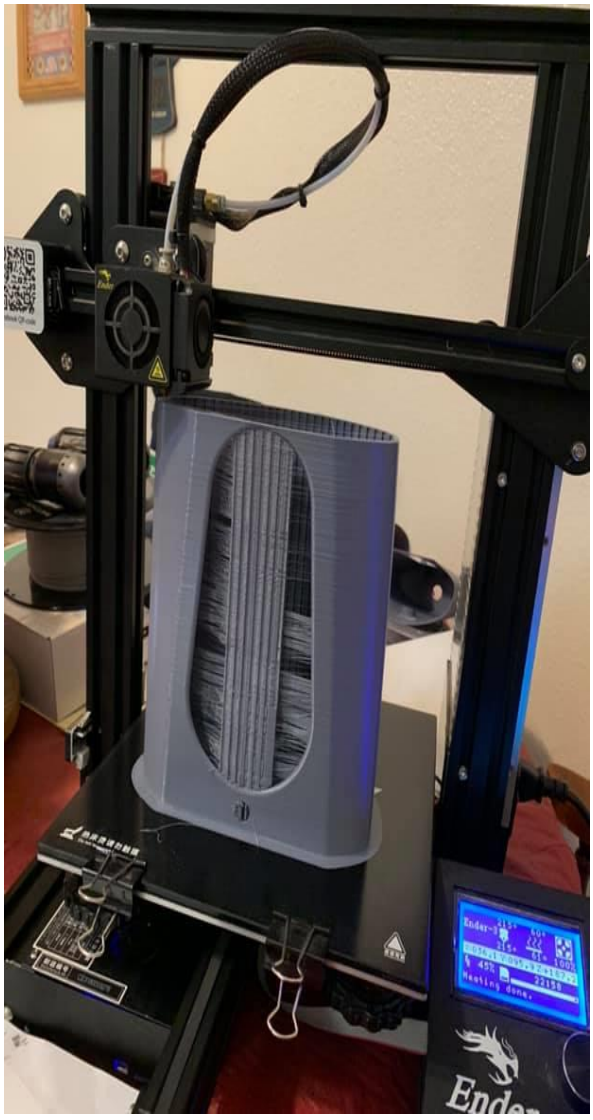
Computer Aided Design (CAD).

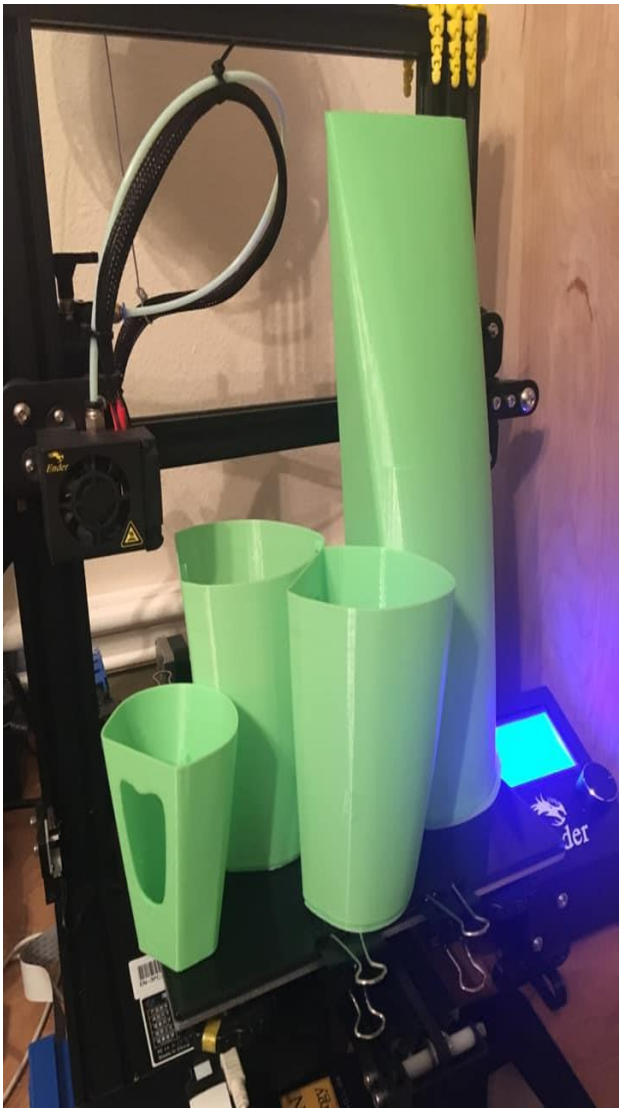
After the 1980's and the invention of the home computer, the system of development started to move away from the designer's drawing board. A new era began in the form of Computer Aided Design (CAD) software. This was a game changer for developing yachts of all types. Ultimately, the designer was able to digitally draw with more accuracy and even provide model predictions, on how a hull would perform at certain angles of heel and weather conditions. Different programs allowed designers and building enthusiasts to explore different methods of construction, this included the analysis and recording of their finding, which traditional designing methods could never achieve.

Designing with the use of CAD software became an effective way of producing, testing and developing your design without constructing anything first. By modelling your hull shape, any limitations would be eradicated prior to the construction of the yacht. That is the theory once put into practice.



3-Dimensional Printing.
Today and looking further into the future, CAD software has been further developed to work in conjunction with 3-Dimensional (3D) Printing. How this works is via a computer, the designer will send a design file to a 3D printer. Once the printer receives the file, it will begin to build symmetrically the desired hull shape, using PLA which exposed to heat will melt, allowing the printer to draw the desired hull shape before the moulded PLA hardens. The creation of the hull shape will be constructed as one unit or in sections depending on the size. The builders time and effort will be hugely reduced which means quicker results.





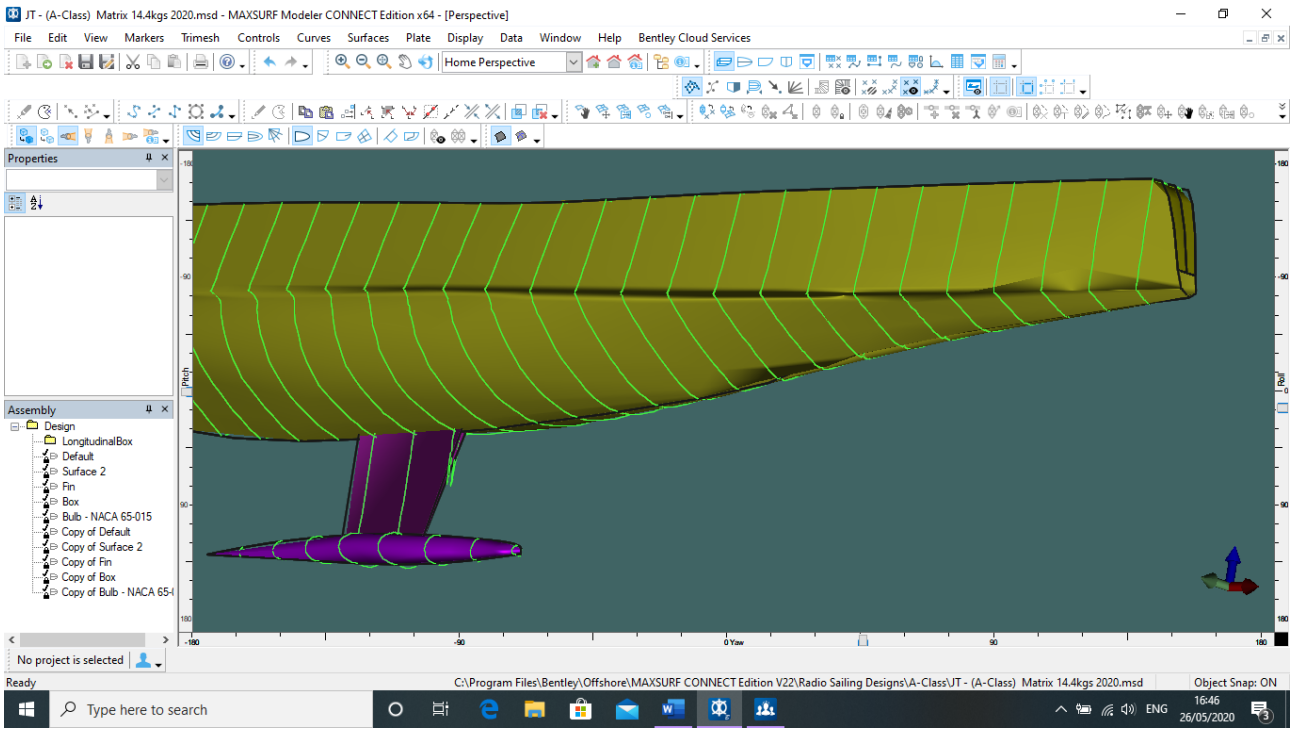
Part 2 – Matrix Introduction.

Up to now we have covered in brief and through history the timely developments of yacht design and construction. In this section, we shall describe and observe the design and construction methods, used to produce one of the most radical A – Class yachts seen today.

To begin, I am self-taught when it comes to using CAD software, there has been many occasions when I have wanted to throw my computer away through frustration. Therefore, I recommend for all enthusiast's wishing to use this type of design technique, it will be beneficial to either attend a recognised CAD software course or if not available, follow the many 'YouTube' tutorials on this subject. It also becomes a personal choice which type of CAD software you use. There are many free online or cheap programs available, but they all have their limitations. I have purchased a recognised piece of software which is suited for my needs. If designers wish to start using CAD, always have an idea on what requirements your software needs to do before purchasing.

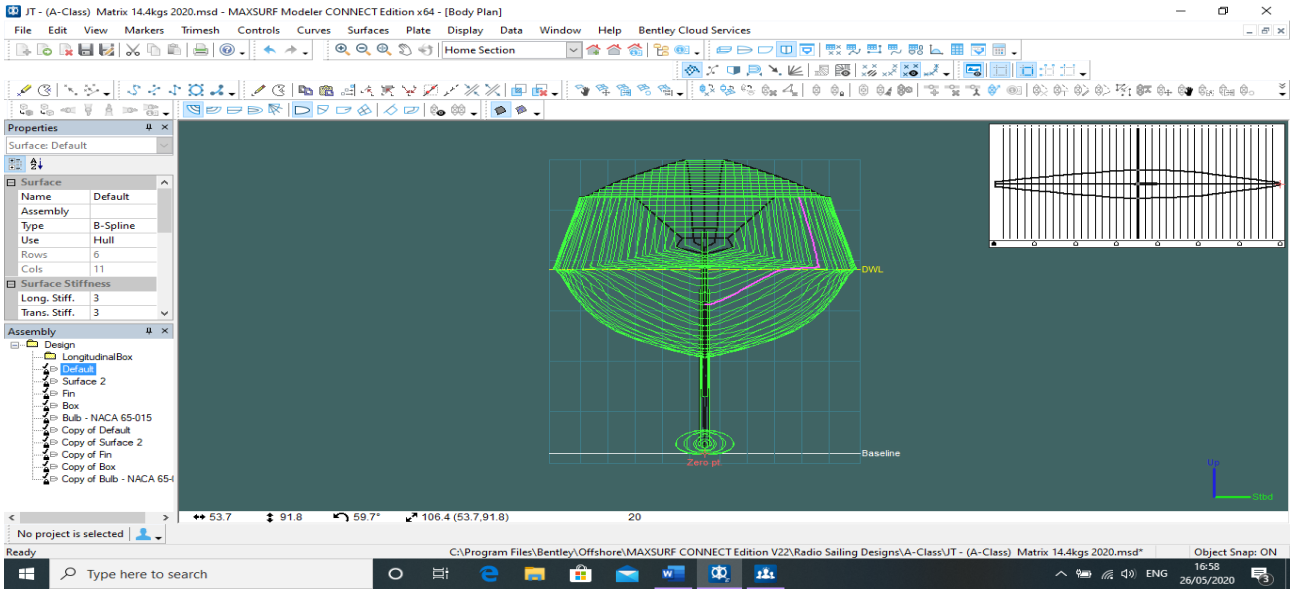
Matrix (A – Class) Design and Construction.

Using the latest CAD software, I was able to create a modern shape keeping within the A – Class rule. The thought process behind this design is the basic understanding that speed through the water has a close relationship with hull waterline length. Therefore, the hull shape was developed to allow the waterline length to extend quickly as soon as the yacht heels, but also being careful not to encourage unwanted drag in light wind conditions.

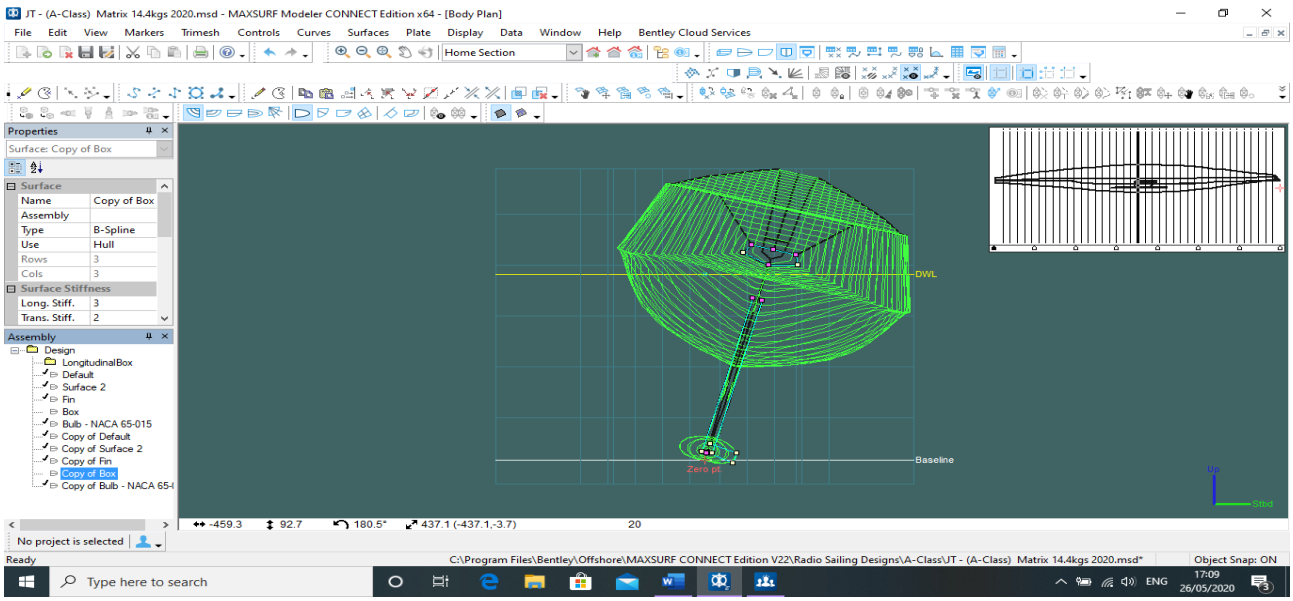


Starting at the bow, this aspect of the hull is reversed from the traditional shape, this allows the cutting action through the waves to be faster, as the bow is effectively closer to the waterline. The shearline on the topside of the bow is slightly raised to provide enough freeboard, when hard pressed on the ‘Running’ leg of the course whilst using a spinnaker. Moving away from the bow, a chine running along the full length of the yacht, effectively changes the surface hull shape to a ‘V’ section. This chine is strategically positioned at the waterline towards the midpoint of the overall length of the hull.

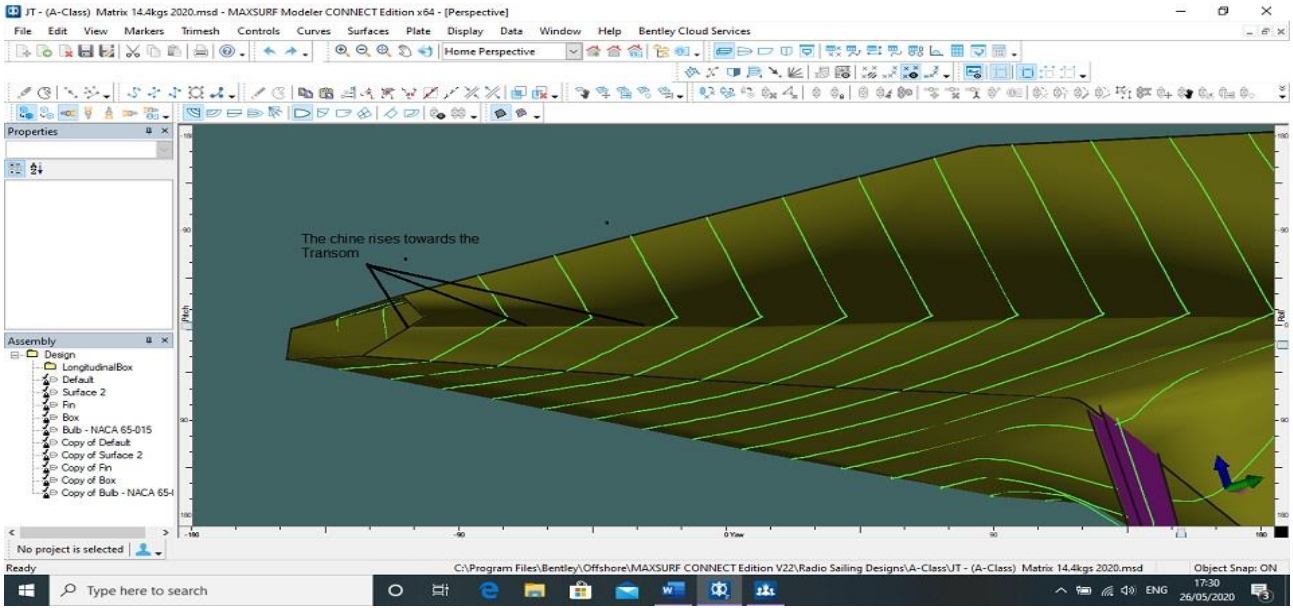
Therefore, as the yacht heels when sailing and with the bow closer to the water, this action allows the waterline to extend quickly to the full length of the hull. The chine effectively changes the hull shape, allowing the waterflow to run smoother along and away from the canoe body. Hence, the increase in speed is due to the close relationship between waterline length and the hull moving through the water.

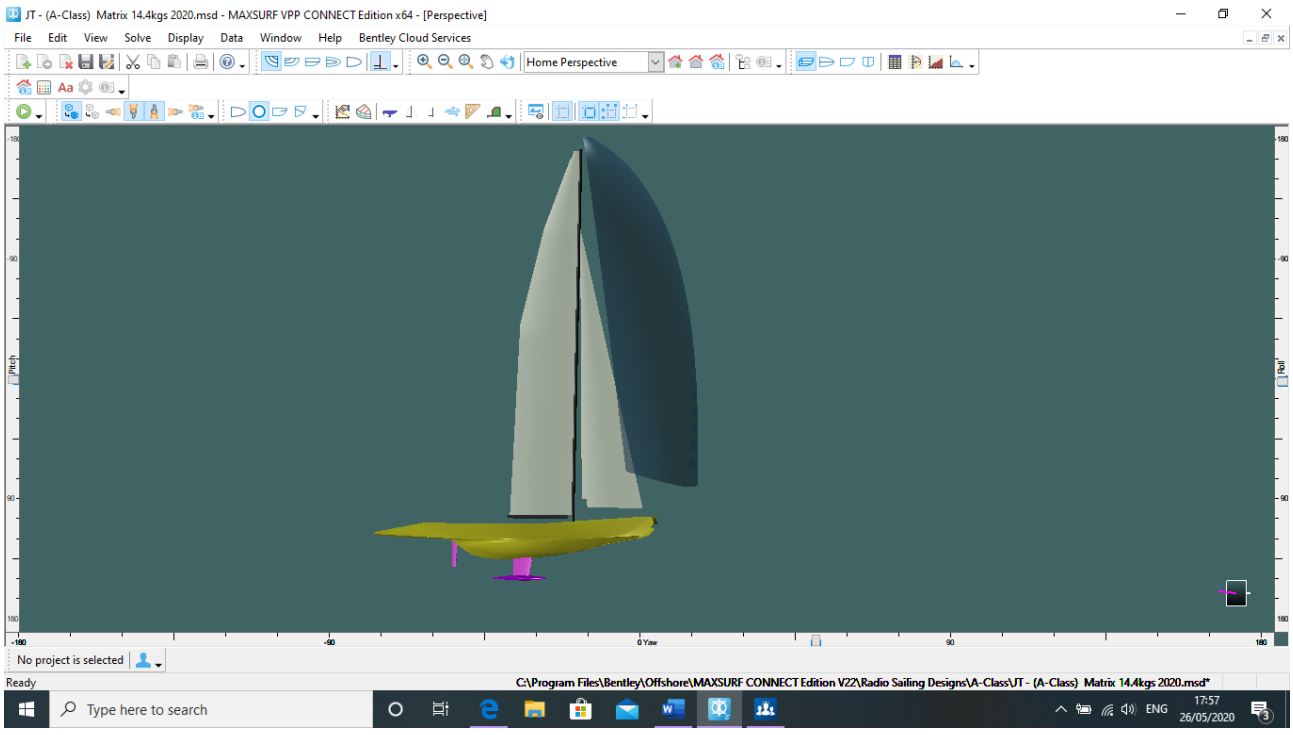


An illustration of the yacht at 15 degrees of heel, displaying how the hull shape changes, allowing the extension of the waterline length.



The stern sections of Matrix are shaped mostly to do the same job as the rest of the hull. However, a compromise has been incorporated within the hull structure. In strong wind conditions the skipper needs the full length of the hull to keep the yacht stable when powering to windward. However, in light wind conditions, the transom may cause excess drag, which will slow the yacht down. Therefore, the hull is seen to change shape again at the chine, from the rudder position moving towards the transom. As you follow the hull to the transom, the chine lifts which reduces wetted surface area and of course reduces drag.





This concludes the thought process behind the design. Moving forward we now go into the specifics of the construction, which will involve most of the practises described in previous pages. This will be described in Part 2 of this article to be published soon.

International A – Class.

(Innovation of Design and Construction)

I give thanks to those who donated their pictures, with some retrieved from online open source material.

By John Taylor