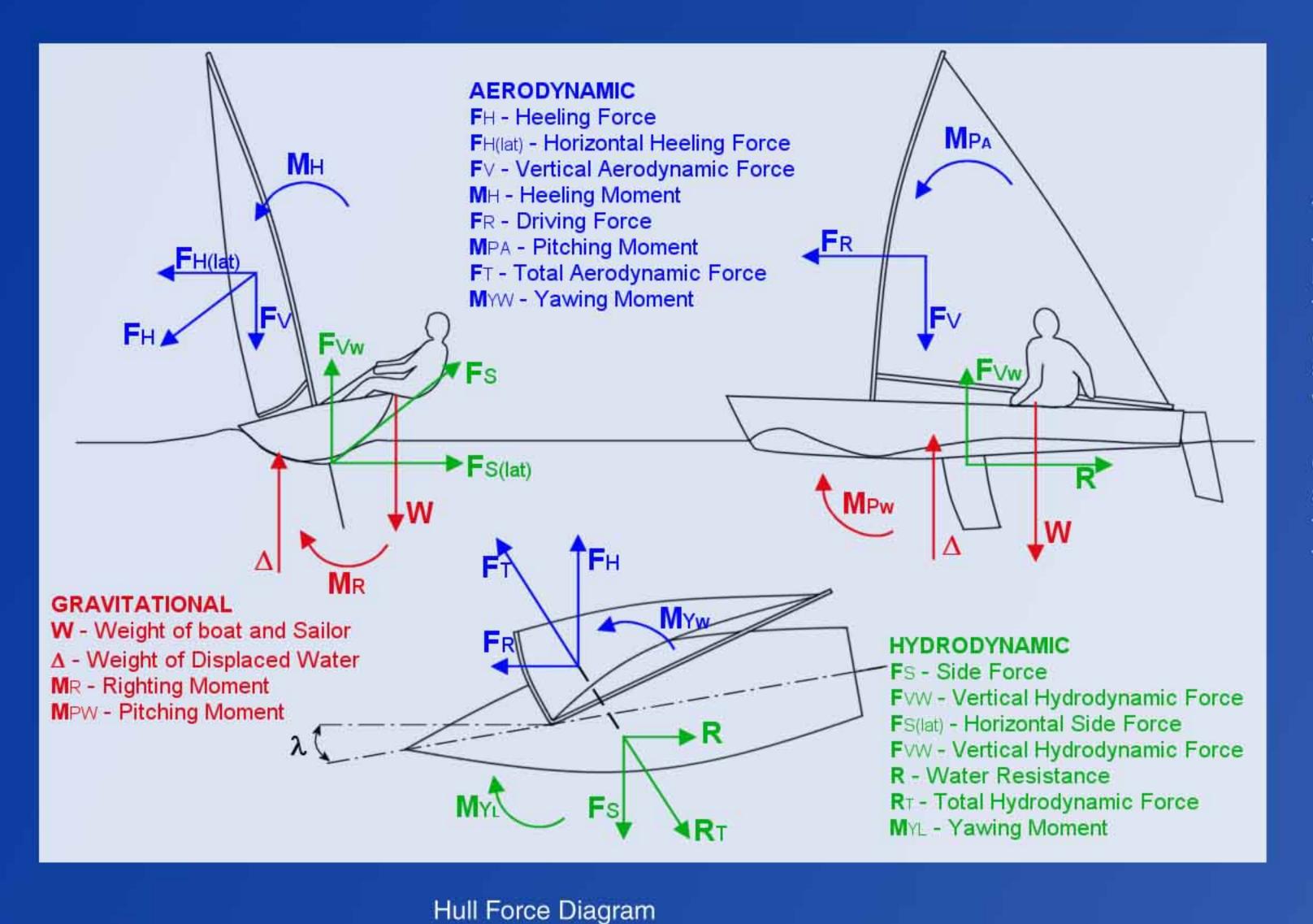
# THE HIGH SPEED FUTURE OF SAILING

Sailing is a sport that is enjoyed by people of all ages all over the world. Dinghies are small, low cost sailing boats that can be sailed on small bodies of water. For most the thrill of sailing is due to the high speeds that can be reached using only the power of wind. An extremely effective way of making a boat go faster is by making it ride on hydrofoils, thus significantly reducing the drag.

The aim of Future Foils is to design and build a hydrofoil sailing dinghy that can be batch produced and sold at a price competitive to equivalent conventional dinghies.



# Hullform

It was decided to construct a new hull, and not retrofit to an existing one, to allow the application of appropriate technology and allow easy strengthening at the attachment points of the hydrofoil frame. Hence, the hull was designed for use in and out of water, i.e.when sailing on the

A hull design program called Hullform was used. This allowed generation of different hull shapes and provided vital hydrostatic information used for calculations to establish buoyancy and extreme sailing conditions.

Laser dinghies are one of the most popular dinghy sailing boats on the market. From a commercial aspect of the project, it was decided to base the hull design on that of a Laser, with a few changes to make the hull more relevant to the project.

The final hull design resulted in a 30% decrease of beam width, reducing weight and thus increasing displacement speed. Changes were kept to a minimum to ensure the overall design appeals to the current sailing market.

# Control

The skill of sailing lies in the act control. The skipper and crew take the dynamic power of the wind and the unpredictable ocean environment, and focus that energy into the singular act of motion in a desired direction.

The Mathematical models generated for our hydrofoil craft (based on the force models) show that with the varying attitude and direction of the sail and motion, the load distribution between the three foils varies significantly. In order to keep the craft performing as designed, in a near level flying mode and below the free surface, it is important that the system of foils adjusts accordingly to these varying loads.

The mechanical design element of the team have come up with a passive system (fig. Control System Concept), that we believe excels over the current methods of foil control. The system works by introducing air to the surface of the foil at points that progress from wing tip to root as the foils rise towards the free surface. The system results in a progressive change in lift relative to the ride height of any individual foil.

# Force Analysis

The forces and moments shown are those acting on a displacement hull boat. An understanding of these forces is necessary for the modelling of the boat on hydrofoils. The boat will start off as a displacement hull and will rise up onto the hydrofoils at the right speed. Once the boat is riding on the hydrofoils the hull model is simplified because the hydrodynamic forces are calculated by analysis of the foils.



The design above shows the method of construction used for the previous year's foils. The method proved very labour intensive and produced a heavy final product. This years work is looking to generate a far more lightweight and versatile design that can be applied to a batch production system of manufacturing.

The system contains no moving parts and is simple to design accurately and manufacture, making it a key element of the product in terms of commercial production and

# Output from Hullform program

Time Plan

TIME PLAN

Make Test Foils

# CAD Generated Concept Design

In the remaining time the boat design will be completed, built and tested. The plan below shows how this will be done. The colour code shows the main disciplines involved in each process.

Commercial Research

The electronics aspect of the project is involved with the evaluation and testing of the boat. This consists of

monitoring a number of variables with sensors placed on the boat.

# Sensors

- Strain gauges Where required by boat/foil design group
- Boat speed Apparent wind
- Height above water Integrated with mechanical control system or using trailing wand

- Remote data logging - RF link to shore
- Microprocessor based
- Budget £150 - 8-bit resolution (256 Levels)
- 3(+) inputs (could be multiplexed)
- Standard maximum input voltage allowing for sensor switching - Radiometrix (www.radiometrix.co.uk) TX1 and RX1 considered for transmitter receiver

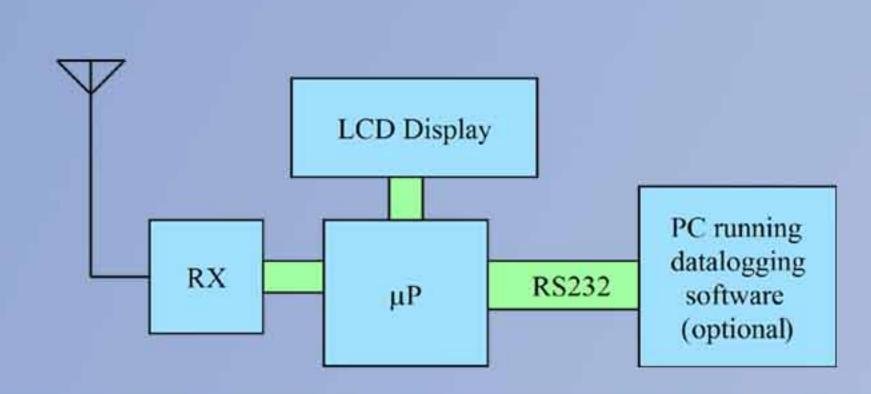
- Sufficient range to provide useful results (up to 12km using correct antenna)
- Could include local LCD display for boat crew - Waterproofed packaging - Must survive spray and full immersion

Section Completed

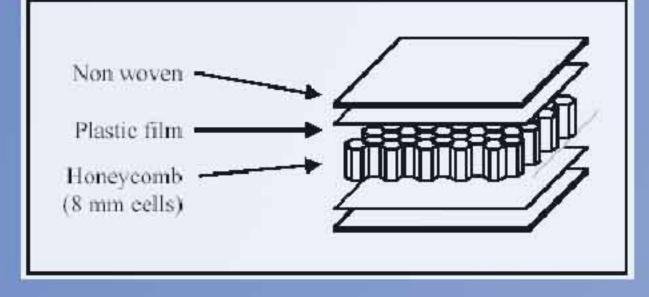
- Could also log to onboard RAM for operation without receiver on shore

# Receiver

- RS232 output for data logging on PC/Laptop using suitable software
- LCD display for real-time values allowing system to be used without a laptop



Transmitter System Diagram (top) & Receiver System Diagram (bottom)



Honeycomb Material (Nidaplast)

# Material Specification Density: 80Kg/m<sup>3</sup>

Compressive Strength (at break, at 20°c): 1.3MPa Compressive Modulus: 1.5MPa Ultimate Perpendicular Tensile Strength (at break): 0.5MPa

Shear Strength (at 20°C): 0.5MPa Shear Modulus: 8MPa Very good chemical resistance

Manufacturing

20 Easter Vacation

Ecological and recyclable plastic

Product Life Cycle

Material Advantages

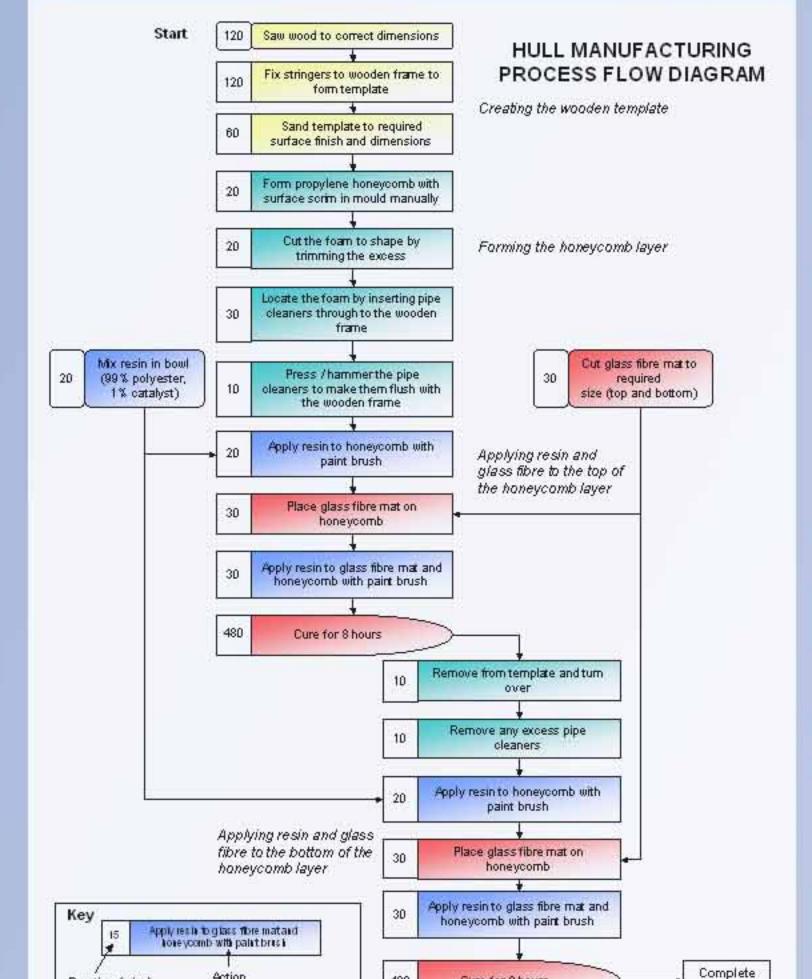
For a same stiffness they are lighter than single piece products As they do not bend under their own weight, they constantly offer a rigid aspect

They make excellent shock absorbers



Material Comparison Chart

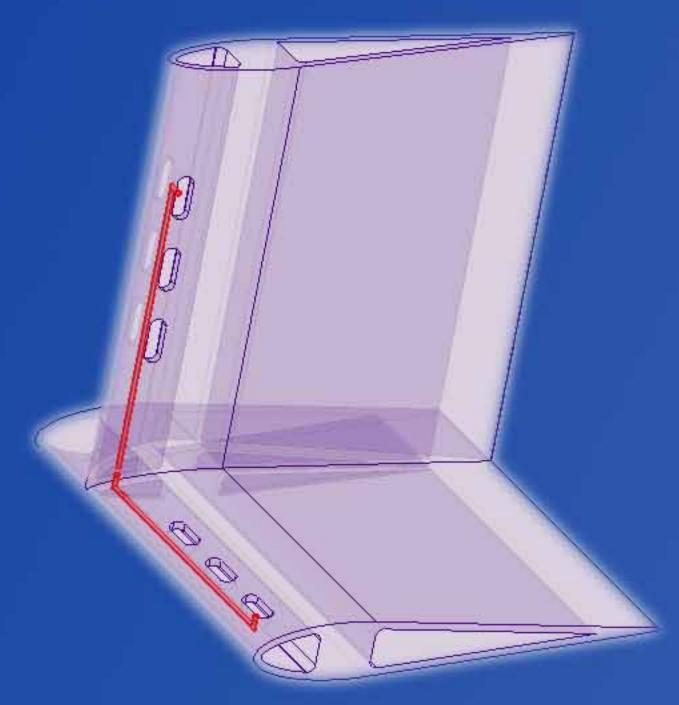
his diagram demonstrates the life cycle of the project. Starting th the concept idea of a hydrofoil assisted boat. A feasibility dy is then carried out to ensure the product can be made, nd that there is a market that we can sell our product to. The quirements for the product are developed, which leads to an itial product specification. If this were a large project with efined customers, contracts would be drawn up outlining pectations and specifications of the products. The design is n created in detail and full scale development is carried out. product is evaluated to ensure specifications are met. If the duct passes the evaluation stage it will enter production and ove into service. Once the end of the products life is reached it ost be disposed of in an environmentally acceptable manner.



# Not yet completed, no time plan Not yet completed, have time plan

Poster Produced by: Kiran Asthana, Matt Caldwell, Tom Carey, Ian Godfrey, Tom Kennaugh, Paul Price, and Paul Wilde

Website - http://futurefoils.webhop.net/



Control System Concept

