Hydrofoil craft have always seemed to me to be such exciting subjects, but the complexity of the hydrofoil appeared so daunting and technical. It was not until I saw the Russian Kometa class hydrofoil "Flying Dolphin" passenger service in action on a recent holiday in Greece that I was driven to attempt a serious model.

There are one or two hydrofoil model kits on the market around the world, and a few rather tenuous model plans available, but to me they all seemed too tricky and delicate. What I wanted was something rugged and reliable. So, in order to explore the hydrofoil concept, it was going to be necessary to design my own model. As an experimental craft it had to be quick to build, and at
Nick Burge's HMS Acrylic in three close-up photos, the clear hull allowing one to see all the internal features described in the text on the previous two pages.

More details on the working torpedo shown in the far left photo will appear in a future issue!

Sceptics often question if model hydrofoils do in fact perform, so these excellent action photos of the finished model should answer a few doubters, and encourage others to have a go.
the same time easy to adapt, for I anticipated the foils would require extensive "trial and error" modification before being fully successful (so I was somewhat surprised when the model worked first time!). For this reason the foil system had to be fully detachable. At the same time the consequences of damage to both the hull and the vulnerable foil system by collision had to be considered and minimised.

Also, since I had no access to specialised materials, machinery or equipment the whole craft had to be made from materials easily obtainable from a model shop or DIY store, and constructed using only the most basic tools.

The resulting model is therefore an exercise in simplification, overcoming all the constructional problems, and so bringing the hydrofoil subject well within the capabilities of the average modeller.

THE HYDROFOIL CONCEPT

A hydrofoil creates lift as it travels through water in the same way as a wing creates lift as it flies through air, i.e through a combination of the reduction of pressure over its upper surface and the deflection of flow by its under surface. Since water is 815 times more dense than air the immersed wing area is only a fraction of the size required to support the same weight in air. At the same time, the lift given by an immersed foil is greater than that provided by the same area of immersed planing surface for a conventional planing hull. This means that to achieve the same speed a hydrofoil will require less immersed area than a planing hull. Since drag is related to the wetted area, a hydrofoil is able to achieve a higher speed than a planing craft of the same horsepower.

Also, since hydrofoil lift increases with the square of the speed, a fast craft will require substantially smaller foils than that of a slower craft.

Speed and efficiency are not the only advantages of the hydrofoil. With the bulk of the craft above the surface of the water and the foils below it, a correctly designed craft can provide a much more stable ride in rough conditions than a conventional craft since it is hardly affected by surface motion.

There are a number of different configurations of hydrofoil design, each with their own advantages and disadvantages, chosen by designers of full size craft according to the crafts' operational "envelope". I'm not going to go into any of this rather technical area, since in this model the prime concern is simplicity and the design limitations are set by the materials, power plant etc, available off-the-shelf.

MODEL DESIGN

The overall concept behind this craft owes a lot to the Russian hydrofoil variants. Hull shape and foil configuration are similar. However the three main criteria of, simplicity, stability and strength, dominated the design resulting in the model having a surface piercing foil system, and a box-like hull form which relies on paintwork for aesthetic appearance.

Hull design and construction. The overall length of 12ins. was set to give ample room for the engine, radio control equipment, etc and in particular to ensure that the extra-long (17ins.) and deep propeller shaft could be accommodated without being too steeply inclined, or without having to position the engine (and hence centre of gravity) too far forward. It also enabled a long "wheelbase" ("foilbase") between the front and rear foils, which would maximise longitudinal stability.

The hull width of 5ins. was dictated by what I deemed to be the maximum span the left and right bow struts could be separated by without the front foil requiring a central support.

Hull bottom was designed to give high lift and low drag. The "step" allows good weight distribution on the planing surface to ensure easy take-off, and the duck tail stern enables a good angle of attack to be maintained. The rear central skeg secures the propeller shaft and acts as a brace for the rear foil, rudder...
and water scoop.

For simplicity and strength the hull was designed with parallel slab sides, these being cut from ¼ in. plywood and reinforced with wood blocks internally at the strut mounting points. Through this arrangement accurate alignment of the strut mountings could be assured and the hull easily built upsidedown on the building board.

The hull bottom was skinned with ¼ in. ply while the removable superstructure and cabin roof was constructed from ¼ in. ply.

To ensure plenty of power an Irvine 40 engine was installed.

FOIL DESIGN AND CONSTRUCTION

Deciding on a method of attaching the foils to the hull gave me quite a headache. Clearly the model had to be able to withstand the occasional collision or run up the bank without suffering major damage. This negated the possibility of making the hull, struts and foils in one piece. Attempts at bolting through hull sides on a previous experimental craft proved that this would not be satisfactory, since the fixings could leak, and run the risk of either pulling through the hull sides or ripping the sides off in the event of disaster.

Inspiration came to me in the form of a fitted kitchen, where wall units are often joined together with nylon bolts and captive nylon nuts. This ideal fixing has the benefit that the "nut" can be fitted through the hull sides and is sealed so it will not leak. In the event of a serious collision, damage may be minimized by the bolts shearing off, with only the loss of the foil unit. Hopefully this will never be tested!

FOIL SYSTEM

Having solved the problem of which enables part of the foils to rise out of the water as speed, and hence lift, is increased. This reduces the immersed structure and thus reduces drag, thereby enabling further speed increases. For a given speed the craft will stabilise at the height above the water which leaves the exact foil area immersed necessary to provide the lift force in opposition to the craft weight. This system also provides roll stability since if the craft were to bank or heel, it would immerse more foil area on that side, which in turn produces a correcting force. The resultant shallow foil configuration is similar to the "Alexeyeve" system employed on most Russian craft whereby foil lift is further stabilised by the "free surface effect" which takes place at foil immersion depths of less than one cord.

The biplane/ladder front foil gives extra take-off lift and helps strengthen (above), the remaining criteria of simplicity and stability had to be addressed. To satisfy both, I opted for a "surface piercing" system.

The complete model showing internal layout of main drive motor, fuel tank, and radio gear.
prevent "sea crash" (nose dive),
supporting 50% of craft weight of 7.5
lb, with the remaining 47% being
carried on the rear foil.

Ideally the foils themselves should
be of aerofoil section but I was
unable to find anything suitable off-
the-shelf. Instead they are made
from aluminium one inch half-
round section strip (used for edging
worktops), which is available from
good DIY stores or builders
merchants and does at least
approximate to aerofoil shape. In
order to ensure that the foil strips
were accurately formed I bent them
around a former made of wooden
blocks. The foils are bolted to the
struts by thin aluminium strips
which enable the angle of attack to
be adjusted with packing pieces if
required and are completely
detachable. The foil span, both at
front and rear is 14\frac{1}{2}in., while the
depth from the keel line is:
Front: 3.25in. and 2.25in.,
Rear.

1.5ins. Foil angle of attack was set
initially to 2°, relative to deck line,
both on front and rear.

**SEA TRIALS**

As the initial buoyancy test in the
bath proved successful — "she
floats!" — I progressed quickly to
hull-borne taxi trials on the lake.

With idle speed confirming that the
servos were connected the right way
round, the throttle was tentatively
pushed open and, as throttle
approached, the bow started to rise
evenly out of the water, followed by
the rest of the hull. Once foil-borne
the craft accelerates quickly to about
12 mph, still at \frac{1}{2} throttle. Full speed
is achieved at about \frac{3}{4} throttle,
indicating that fine
tuning of the foil
configuration could make the boat
even faster. At full speed she
positively thundered across the
water, although the size of
Kingfishers MBC lake only allowed
me to keep the throttle open for
about 30 seconds. I must confess that
I was surprised at the ease of
handling. The craft showed no
tendency to roll or pitch, proving the
surface piercing concept, and even
when the foils became snagged in
floating leaves and debris it was still
manageable. The high anti-roll
stability actually proved a bit of a
problem since it prevented the
craft from banking with the
rudder, making turns flat and
wide.

With the experimental model
having successfully completed its "sea trials" it became clear to
me that the hydrofoil is a much
under-rated technology. At the
same time I was delighted to
be able to demonstrate that a
model of this fascinating
subject need not be any more
complicated than a conventional
boat.