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Radio Control Model Flyer

P **2 PLANS IN THIS ISSUE**
Stearmanezer FF - OZ trophy winner!
There be Dragons! - Indoor FF unorthodox

THE BIG COVER UP!

The art of covering - a new series

Revolution In the Sky

MICRO RC GETS SMALLER!

REVIEWS: PICCOLO CP AIRWOLF - KANGKE CAP 232 - MS SWIFT - JAMARA CESSNA 120 & FLIPPY - FALCON KITS FALCON 36

THE MODEL FLYING MAG WITH EVERYTHING! * RADIO CONTROL * F/F * C/L * ELECTRIC

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EDITED BY: Ken Sheppard (01525 222573) **PUBLISHER :** Alan Harman **DESIGN:** Reid & Reid Creative Associates **PHOTOGRAPHY:** Ken Sheppard **ADVERTISEMENT MANAGER:** Colin Spinner **ADVERTISING ASSISTANT:** James Kirk **EDITORIAL MANAGER:** Andrea Berridge **OFFICE MANAGER:** Paula Gray **EDITORIAL ASSISTANT:** Matt Benfield **CONTRIBUTORS:** Phil Ball, John Barnes, David Boddington, Mark Denham, Rob Halleron, Graham Iredale, Richard Kremer, Christopher Kronis, Ken Osborne, Chris Scott, Ken Swailes and Ramon Wilson.

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 By Christopher Kronis

ARMCHAIR FLYING

Here's a rig you can fly from your favourite armchair!

Have you ever thought of flying your electric model indoors? I have, as I wanted to avoid the aggravation of having to wait for the weekend, and for good weather to fly my electric model. So I decided to design and build a test bed which would enable a model aircraft to be "flown" from the comfort of ones own room. Perhaps the design has not eliminated the aggravation altogether, but apart from the fact that it alleviated it to a great extend, it has also proved to be an excellent training tool for the beginner, as well as providing the experienced pilot with the opportunity to log valuable quality flight hours, comparable to that of a computer flight simulator.

When designing the test bed, two options were considered. To support the model on a bench stand, or to hang it from the ceiling. The two cases with the forces acting on the model are shown in Figures 1 and 2. For the model to "fly", it needs to have freedom of movement in the three rotational axes, namely the Roll, the Pitch and the Yaw, which are controlled by the ailerons, the elevators and the rudder respectively. It must of course be restricted from moving in the linear X, Y and Z axes, otherwise it could fly out of your window.

If it was possible to support the model from a point exactly coinciding with the Centre of Gravity (CG), then it would have neutral stability. In this condition, if the model were to be disturbed from its equilibrium position and placed in a new position, it would remain in that position until disturbed again. It is not however practical to achieve this. If you study Figures 1 and 2, you will notice that in the first case the point of support S is higher than the CG, whereas in the second case, it is lower than the CG. This fact results in the following effects:

1) If power is applied and the centre of thrust is below the point of support (S), then the force of Thrust (T) together with the horizontal support reaction (Rh) would produce a couple or moment tending to produce a nose-up attitude. In the case in which the centre of thrust is above S, then a nose-down moment would result.

2) If the model is rotated in pitch or roll, in the case where the model is supported from above, the forces of the weight, together with the vertical support reaction (Rv), would tend to produce a restoring couple or a moment tending to bring the model back to its equilibrium position. In the case where the model is supported from underneath, these forces tend to produce an overturning moment. In aerodynamic terms, the first case is said to have positive stability, whereas the second case to have negative stability. These conditions are shown in Fig. 3 and Fig. 4.

As you can see from the pictures, the method of supporting the model from underneath on a bench stand, was selected for the prototype. A Hitec Sky Scooter was modified for the purpose. The main modifications were the addition of two more motors on the wings, to increase the airflow over the wings and the control surfaces, and hence to increase their effectiveness. The problem with the negative stability explained above, was solved by including a spring at the support. Fig 5. shows how the spring reaction forces counteract the negative stability moments produced by the movement of the model about the rotational axes. As you can see, a clockwise rotation about the point of support, is

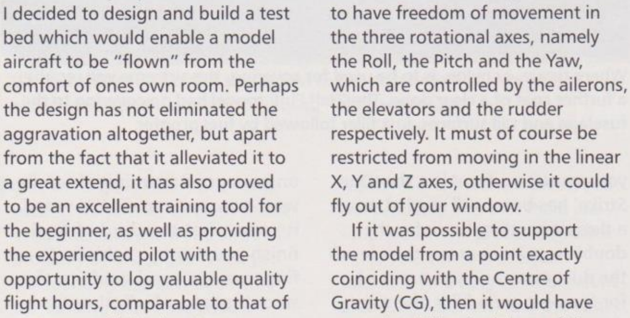


Fig. 1. Forces and moments acting on a model supported from a point underneath the fuselage, in level flight.

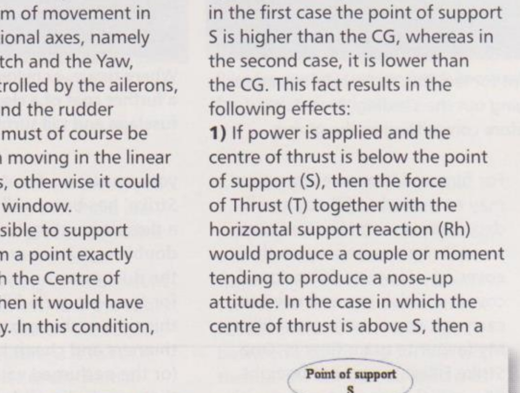
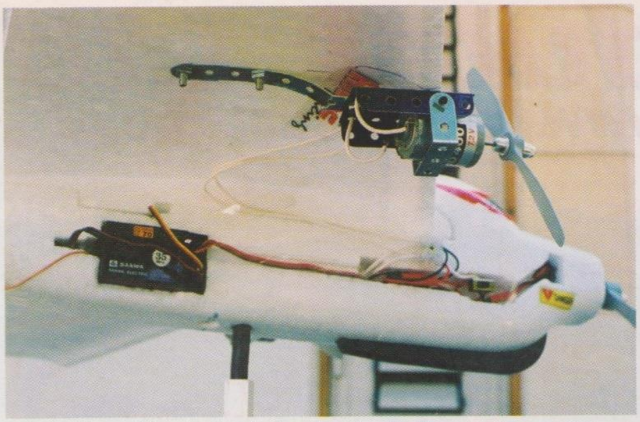


Fig. 2. Forces and moments acting on a model supported from a point above the fuselage, in level flight.



ABOVE: View of the starboard wing, showing the Meccano type engine pylon and the wiring of the system.

ABOVE: View of the top of the model showing the bolted attachment of the engine pylons. These engines can be easily removed so the model can be flown conventionally on the single central engine.

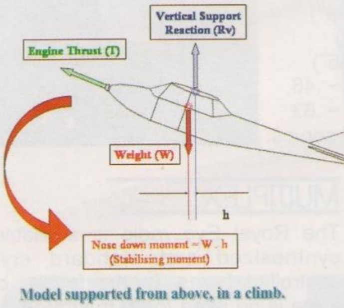


Fig. 3. Positive stability moments

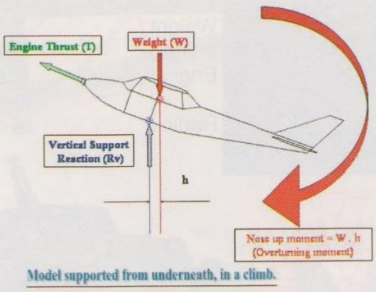


Fig. 4. Negative stability moments.

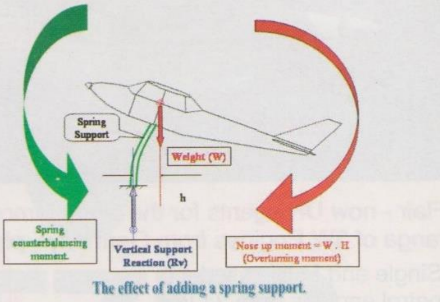


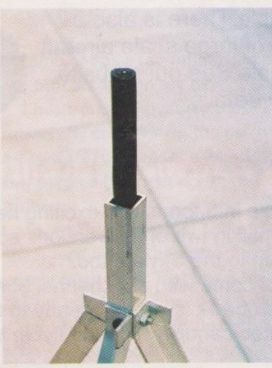
Fig. 5. Using a spring to support the model.

counteracted by a counterclockwise spring support moment. It is theoretically possible, by selecting a spring with a suitable stiffness, to balance the two kinds of moments so that an overall neutral stability is achieved. In practice, this condition may be difficult to be satisfied completely.

When using springs, oscillations may occur which may be undesirable. This is why car suspension systems, which include springs, also use dashpots that provide damping to suppress oscillations. The same applies to the case of the model test bed. But how much damping should be applied? To understand the effect of damping, Fig6. shows the response of a system, which is disturbed by a step function. In the first case, damping is low and you can see that the system oscillates many times before it settles down in the equilibrium position. In the second case, damping is said to be critical and the system reaches the equilibrium position in the fastest possible time with no oscillations, whereas in the third case with high damping, the system's response is very sluggish. A value of damping near to critical would probably be desirable in our case. The problem of supporting the model was solved very simply by using a piece of polymer rod of the appropriate diameter, length and composition, which provided spring and damping functions all in one, with no elaborate mechanical systems such as springs and dashpots.

An aluminium tube of length about 2 to 3 cm was inserted and glued centrally underneath the fuselage exactly coinciding with the vertical CG line. The diameter of this tube should be 0.5mm to 1.0mm larger than the diameter of the polymer rod. On the top of the stand, which was constructed using aluminium angle legs, a length of square hollow section was attached. Inside this square tube a circular tube of the same diameter as the one attached to the underside of the model was glued which accepts the polymer rod inside it. The length of the polymer rod is selected by trial and error to give the required stiffness. Some grease (Vaseline is suitable) can be used to allow the model to rotate with ease about the yaw axis. You may find that if the model is heavy, particularly if you add more motors to increase the airflow, then you may not be able to find a polymer rod with the desired stiffness. To increase the stiffness of the rod it is possible to insert a spring steel rod centrally inside the polymer rod.

The model aircraft test bed is in effect an open air wind tunnel, with the motors producing enough airflow to make the control surfaces effective in maneouvring the model. I believe many modellers will find it useful as a means of helping them get the hang of flying their models on the bench, before attempting real flight. The system is easy and inexpensive to build, and should give many hours of enjoyment.



ABOVE: Photo of the top of the aluminium stand, showing how the angle legs are attached to the square hollow section, with the polymer rod inside it. Notice the spring steel rod inserted centrally in the polymer rod to increase stiffness.

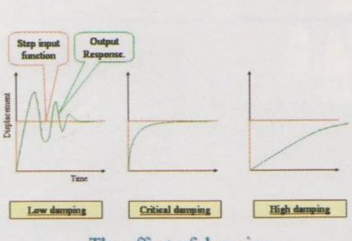


Fig. 6. How the value of damping affects the response of the system.

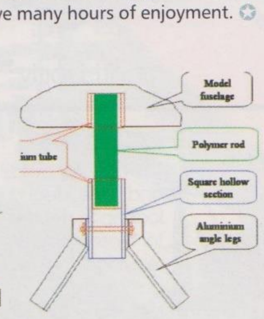


Fig. 7. The model spring support.

ABOVE: Model at rest (power off) on the stand.