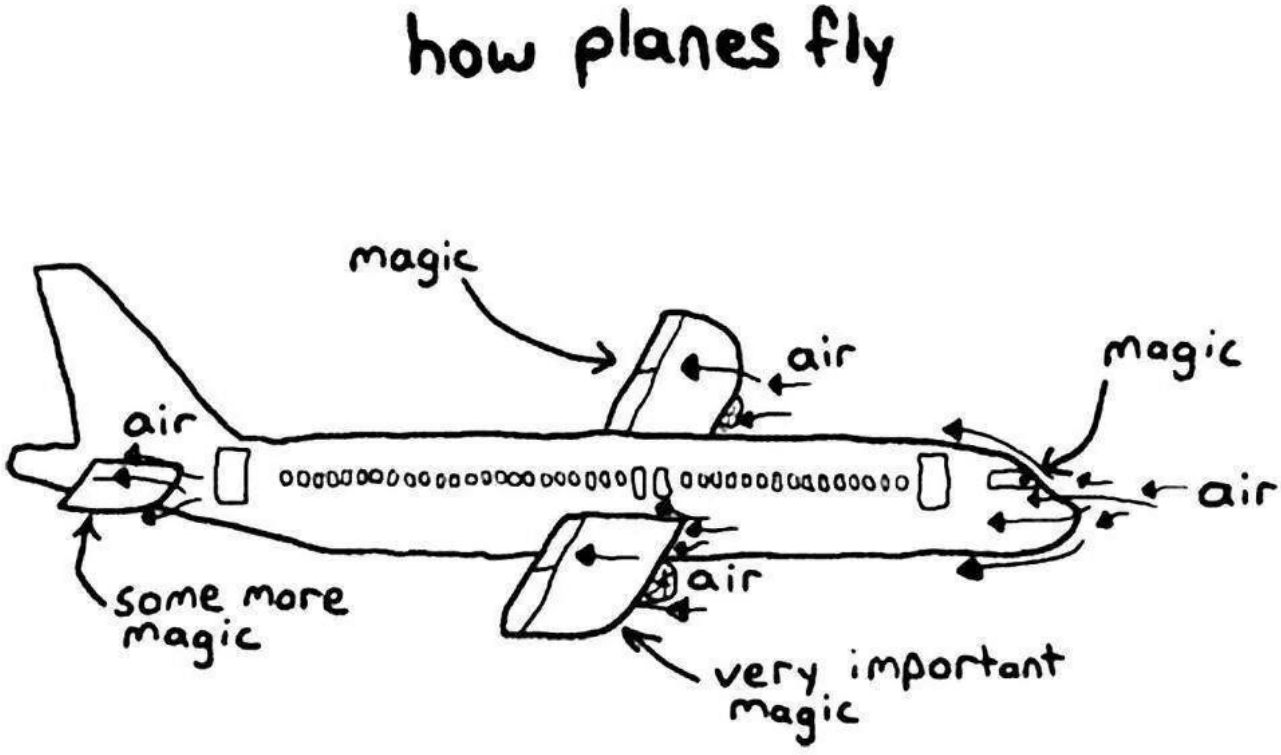
Tyldesley Model Flying Club.



‘Wings’ Training Scheme.

An Introductory Booklet by Andy Ellison.
Version 2 (2015)

NAME.....

The ***Tyldesley Model Flying Club "Wings Training Scheme"*** aims to teach club members how to fly their models safely and to give them a basic understanding of their equipment, its operation and its limitations The course has been revised in 2015 to place more emphasis on achieving the nationally approved solo flying standards and consists of a series of progressive stages in a well established and proven training syllabus. Consequently, when a pilot is ready for their flying test they will be able to undertake it as if it was just another training flight.
Towards the culmination of your training you will undergo the British Model Flying Association Fixed Wing 'A' Certificate test. This precedes an observed +twenty flight assessment to underpin your training, establish consistency and demonstrate your adherence to local club rules and BMFA guidelines. Following this observed period there will be a discussion between you and your instructors to achieve a consensus and if they are happy, clear you to fly with no further instructor supervision required.
At this point you will be a club certified pilot and be awarded your 'Wings'.

The national 'A' Certificate tests require the pilot to perform simple flying tasks and demonstrate to the Examiner that he is in full control of his model at all times and in various situations and attitudes within the ability of the model. They also require the pilot to answer safety related questions to demonstrate that he has a good knowledge of pit safety procedures, local club rules and the legalities surrounding model aircraft flight. All aimed at ensuring you are an extremely competent and safety conscious individual whilst maintaining the clubs excellent safety record. The club does not set the standard for this test as that is set nationally. We do however have certified BMFA Examiners who uphold that national standard and will undertake this aspect of your training.

Course Length
The time it takes to complete the scheme depends largely on you. No two people progress at the same rate. Some are ready in a few months while others may take a few seasons. Age is a factor, as is mechanical competence. Also the quality of your equipment and your maintenance of it can seriously affect your airtime. Poor preparation and readiness will likely see you spend most of your flying day carrying out work which should be done at home. There are however some areas where you can help your instructors to better assist you and speed up your progress :

- Liaise closely with your instructor and mutually arrange to fly as often as you can. Flying for a few times regularly is much more productive than flying lots on one day and then having a large time gap before you do so again. The single biggest reason for not succeeding is the realisation that it is not as easy as it looks and the failure to respond to that with regular practice. Weather conditions means the hobby is a self-restricting one. Do not add to that with poor attendance when weather conditions are good.
- Ensure that when you come to the flying field your aircraft and equipment are in proper working order, i.e. batteries are charged, control rods and connectors checked and secure, and the model is in a fit state to be flown. Ensure that you have sufficient supplies of the consumable items and be prepared to do the maintenance of your equipment yourself.
- Please try not to waste the instructors time. Our instructors are volunteers and pay subscriptions to the club just the same as you. You will get along much better if the advice given by them is followed and not simply discarded for often bad advice from somebody else. Do this often enough and it is likely that you will be seeking a new instructor. If you do need assistance from persons other than your instructors, do try to take it from members who are actively flying all the time and not the ones who always seem to be crashing and fixing.
- Do not tinker once your equipment is set up for you to fly. Your instructors will spend a considerable amount of time adjusting your model for you until you are both happy with its flying characteristics and able to handle them. An instructor will soon get fed up with you if you repeatedly reset your radio gear, play with your linkages or re-programme your model set ups without good reason. Again, if you are to take advice from elsewhere make sure it is from a good flier rather than a good talker.

The individual and the test
The BMFA tests are conducted to a national standard by Examiners appointed specifically to the club. Leaflets explaining the standards and expectations of these national tests will be provided to you throughout your training.
Please note that it is not the policy of TMFC to pass pilots through the flying test if they only have flying experience of one model aircraft. It is expected that at this stage the Trainee has progressed onto a more advanced model than a basic trainer and has no reliance on electronic stabilisation (if fitted). Advice on a suitable second model will be given throughout the training programme, and it is not unusual for Trainees to be flying this model alongside their trainer by the time they are learning to take off and land. You should also note that there is a minimum weight limit of 1kg for eligible models that can be used for the 'A' certificate. Some modern foam trainers are below this weight.

What, and how, you will be taught on the scheme.
The training program is run throughout the club by specially appointed Instructors. These Instructors will take the individual through many different stages of model flying from basic circuits, through aerobatics and on to the BMFA 'A' certification following a carefully designed and structured training syllabus.
You may perhaps feel at first that it is unnecessary to be taught the simple aerobatic manoeuvres included. These are there to not only allow a pilot to get the maximum enjoyment from his flying, but also to enable him to revert back to what he has learnt throughout his training to safely avoid an emergency situation should one arise. This could happen when there is no longer an Instructor by his side to advise him of the appropriate action to be taken.
Also throughout your training, you will be shown many other aspects of the hobby such as basic Pit Safety, Engine/Motor/Battery care and various ground training exercises. There are also regular ground school sessions following the clubs monthly meetings, and as a novice you will find them very educational. Your progress throughout the scheme will be recorded on your own personal Flight Training Log which is completed by your Instructors as you move through the scheme.

The instructors
The Club has several members who are both willing to serve and appointed by Committee, to teach newcomers how to fly. Each Instructor has his own personal traits and you may find that because of this, different Instructors may teach the same task in a slightly different way. Accept this with the knowledge that no matter how you are taught it, the end goal will hopefully be the same. There are however a number of points which need to be emphasised to enable you to aid the Instructors in assisting you.

Firstly, your Instructors word is law when your aircraft is in the air. If he tells you to do something - do it immediately without question. The reason may not at first be apparent, and you may by all means discuss it on the ground after the flight if necessary, but obey implicitly whilst your model is flying and remember that your training is a privilege.

Secondly, Wait your turn. Occasionally the system by which you are allocated an Instructor is varied to suit the Instructors on the field at any one time depending on how they wish to teach. Follow the example of others to ensure you get your fair share of flight time but remember that the instructors are there to fly their own models also.

Thirdly, Be ready to fly for when the instructor is free. This is especially important when the field is busy. An Instructors time is precious and often in demand. He may have to share it between numerous trainees at any one time. Do not waste your opportunity by being unprepared for your flights when your turn comes around.

Fourthly, Model aeroplanes crash. Sometimes that is just how it is. Please do not hold your Instructor responsible if the aircraft crashes during a test flight or at any other time. No responsible Instructor will allow your aircraft to crash if he can possibly avoid it and he will do all he can to prevent the aircraft from getting into a situation which could result in an accident. During your training there will be many occasions when you are required to fly near the ground where safety margins are very small (Take-off and Landing for example) so hard landings and worse are an unavoidable hazard of the hobby. You must accept these hazards, trust your Instructor and have confidence in the robustness of your model.

Also Remember This:-
The Instructors are not only there to help Trainee's, they are also there to maintain discipline on the flying field at all times. So even if you have passed the associated test, you are not exempt from being taken to task by the instructors if you begin to fly or act negligently on the field. They are also there to assist you further should you require "Advanced tuition" on aspects of flying not covered by the training scheme. And they do of course, wish to fly their own models as well.

When your training is completed and you have satisfactorily passed the required tests for your class of aircraft, you will be allowed to fly without any Instructor supervision. It is your responsibility to ensure that you maintain a level of flying ability commensurate with the standards required by the club. This means regular flying and regular practice. Flying ability can soon degrade to a level below the minimum required standard, especially after a winter season of bad weather and a low number of flying hours.
If your flying standards do drop to an obviously unacceptable standard you may well be required to again undergo some instruction until your ability returns.

The TMFC Wings Training Syllabus.

This syllabus is structured in such a way that it places the building blocks for the next stage in place before you move on. There are 14 stages from start to finish. The system of training is well established and proven within TMFC and many of your Instructors were taught this way. The British Model Flying Association also now utilise our clubs scheme as its approved national training syllabus.

You should be aware that whilst some stages of this syllabus may be completed in one flight, that does not set a precedent for the other stages. How long a Trainee spends at a particular training stage is very dependent on many varying factors including ability, type of model, frequency of attendance, weather conditions, Instructor availability etc. Any Trainee unhappy with their rate of progression through the Wings training scheme is encouraged to take the matter up in the first instance with their Instructors.
Also if it becomes apparent that due to an absence from flying, a novice cannot perform a flight stage for which they have previously been signed off, it is quite permissible for the instructors to impose a regression so that a flight stage may be repeated satisfactorily.

Stage 1
Pit Safety. The Instructor will introduce the novice to the basic field safety rules and how they are applied. He will demonstrate the principals of radio use, model set up, engine/motor safety, the airworthiness checks and introduce the trainee to the national safety codes. He will also allow the novice time to read chapters 5 & 6 from the 'Up and Away' training manual.

Stage 2
Introduction to flight. The trainee will be introduced to the basic principals of flight. The Instructor will demonstrate the basic components of a turn, straight and level flight, cruising speed, the effects of power increases/decreases, the functions of the basic controls and the extents of the available airspace. The Trainee will learn the correct way to hold the transmitter, and be introduced to the concept of proportional control.

Stage 3
Trimming / Basic Circuits / Figure eight's. The Instructor will introduce the Trainee to the concept of trimming the aircraft for straight and level flight and performing the basic circuit in both the left hand and the right hand directions. The Trainee will

learn the principals of the effect of wind on a model and demonstrate the correct use of the throttle. The Trainee will also learn the correct method of flying figure 8 circuits and judge how to vary the angle of bank dependent on the wind strength and direction to hit certain key points as determined by the Instructor.

Stage 4
Circuit transition. The Trainee will learn the correct methods of transition from one direction of flown circuit to another without height gain or loss by using procedure turns and half figure eight circuits.

Stage 5
Climbing, diving and Stalling. The Trainee will learn the principals of height gain and height loss through the correct use of the throttle and elevator. By the end of the exercise the Trainee will be able to double their height and halve their height in the same circuit. The Trainee will also learn the principles of slow speed flying near to and beyond the Stall point of their model. The Trainee will learn to recognise an incipient stall and the correct recovery from a fully stalled situation. The purpose of this exercise is to prepare the novice for take off and landing .

Stage 6
Taxiing. If the model is suitable, the Trainee will learn the basics of the first stages of take off, the taxi up to flight transition. Utilising the throttle and rudder controls to effect a steady, straight taxi run along the runway, the Trainee will develop the necessary ground handling skills to progress to the next stage. This exercise may initially be taught with the models wings removed.

Stage 7
Take off, climb out and manoeuvre. The Trainee will learn the skills required to transition the model from the taxi to airborne and into the standard circuit of the day. They will also acquire the knowledge of actions to be taken in emergency situations and the best means of recovery from them with safety in mind.

Stage 8
Landing approaches and overshoots. The Trainee will utilise the skills he has learnt to this point by performing accurate and co-ordinated landing approaches from various directions and situations. These will be aborted on the Instructors command and a high-power overshoot effected to return to a safe altitude.

Stage 9
Landings. The trainee will discover that this stage is a natural progression from stage 8. First landings are often performed from a perfect landing approach when conducting overshoot practice. This will then progress to practising landing approaches from various directions both powered and deadstick, into wind and crosswind.

Stage 10
Solo Flight. The Trainee will perform a consolidation exercise of everything learnt to date in their first solo flight. They will be under in-direct supervision of their Instructor who will be watching nearby. This stage is a major milestone in any pilots career and model flying is no exception.

Stage 11
Aerobatics. The trainee will be introduced to the concept of basic aerobatics and combine them with all manoeuvres learnt up to this point. Basic aerobatics will typically be loops, rolls, Immelman turns, Reversals and the Stall and recovery. Advanced aerobatics such as Bunts, stall turns, spins and inverted flight may be taught if the novice demonstrates an ability to take them on board but this is not mandatory.

Stage 12
BMFA ‘A’ Certificate. On agreement by the Instructors the candidate will be tested by a BMFA Examiner to the standards set out in the Nationally approved training schemes of the sports governing body, the British Model Flying Association. The criteria for this test is set by the parent body organisation and not the club. The required minimum standards must be met in order to pass and does include verbal examination questions.

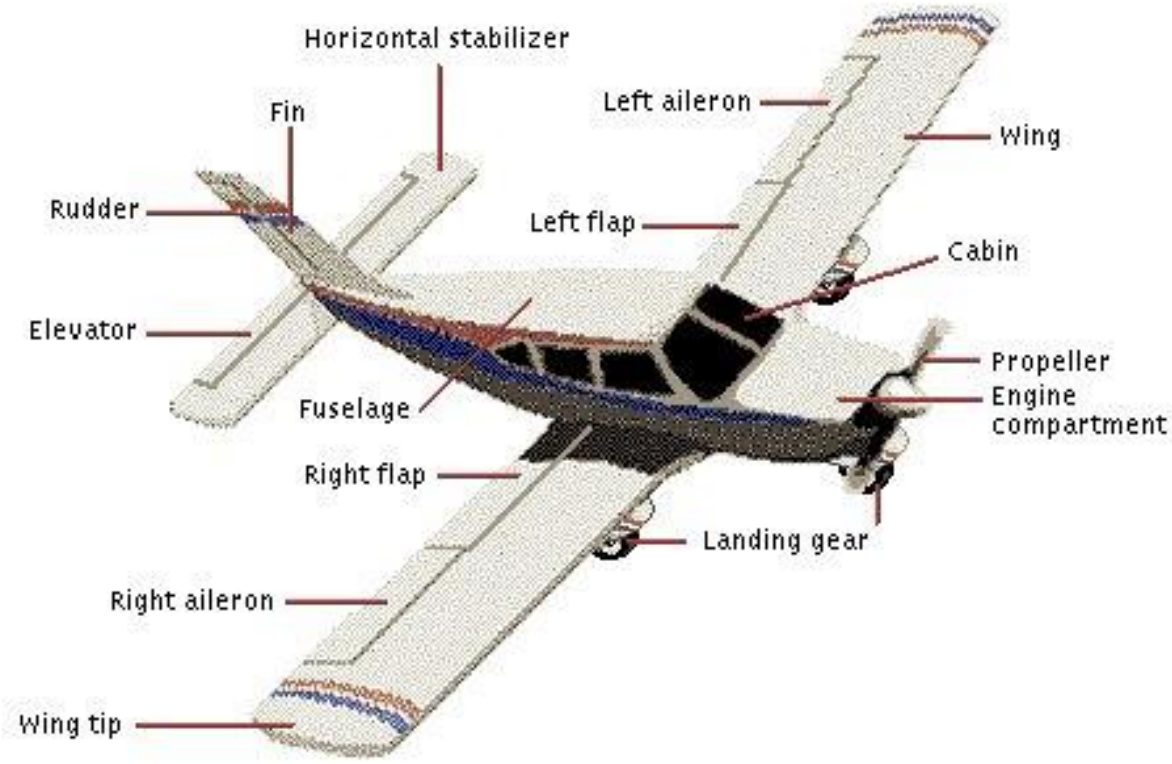
Stage 13
+Twenty Flights. The candidate is required to log at least twenty flights under the indirect supervision of a club instructor. The flights should be flown to BMFA ‘A’ Certificate standard and contain various elements learnt on the scheme, including basic aerobatics. The flights **MUST** be incident free and at least two different models must be used. Use of Electronic stabilisation is not permitted.

Stage 14
Sign Off. On completion of the required number of flights, a majority decision of the club instructors is required to complete the clubs training and gain clearance to fly with no instructor supervision. The instructors will be looking for consistency in your flight safety and ability and demonstrable compliance and knowledge of club rules. If your flying or safety is inconsistent, further flights may be required or further instruction may be given.

PRINCIPLES OF FLIGHT
GENERAL
Within any group of novice pilots there will normally be a wide range of aviation knowledge and expertise. Some of them might be licensed to fly full scale aircraft, others might have had some previous experience flying model aircraft, while there are bound to be others who have little or no knowledge of the subject and these days the latter is the norm. While this information might be of general interest to those who already have extensive knowledge of aircraft and flying, it is intended primarily as an aid for those modellers whose knowledge of the subject is limited. In this section we will cover the essential parts of an aircraft, the function of the main components; and the theory of flight from a general point of view.

PARTS OF AN AIRCRAFT
The essential parts of an aircraft are:

- The fuselage or body.
- The wings or main plane.
- The tail section or empennage.
- The propulsion system or engine.
- The undercarriage or landing gear.



Sometimes we will hear the term "airframe" being used. Simply the airframe is the complete structure of an aircraft, less the engine, instruments and ancillary equipment such as radios So let's take a look at each of these parts.

THE WING
Most modern day aeroplanes are monoplanes, meaning that they have one wing only. Among aeromodellers, however, biplanes (aeroplanes having two wings) are still popular.

The main structural members in any wing are the Spars. These are beams that run the full span of the wing and are responsible not only for carrying the bulk of the load, but for providing stiffness to the wing to prevent twisting or distortion.

The aerofoil sections that separate the upper and lower surfaces of the wings and give them their unique shape, are called WING RIBS. They also provide a surface on which to attach the covering. Quite often high wing monoplanes employ BRACING STRUTS. One end of each strut is normally attached to a bracket on the lower part of the fuselage while the other end is attached to the wing at approximately the mid-point. The purpose of wing struts is to prevent the wings from folding during flight by transferring part of the wing load back to the fuselage.

Bi-planes normally uses INTER-PLANE STRUTS as well as CABANE STRUTS Cabane struts are used to support the upper wing above the fuselage, while inter-plane struts are used to join the upper and lower wings, usually in the outer area of the wings.

- AILERONS are the movable control surfaces on the wing that provide control of the aircraft in the rolling plane. They are normally hinged on the rear spars and form part, or in some cases all, of the trailing edge of the wing.

- FLAPS are rarely used on radio controlled trainer aircraft, but on the other hand, are frequently incorporated in scale aircraft. Not so much for functional control, as full scale appearance. When used functionally, however, flaps provide better performance on take-off, and permit steeper approach angles and lower approach speeds on landing. Thus it can be seen that flaps provide both a lift and drag function.

TAIL SECTION OR EMPENNAGE.

The tail section, or empennage, consists of the fixed vertical stabiliser or fin, the rudder, the horizontal stabiliser or tail plane, and the elevator.

- The HORIZONTAL STABILISER is the fixed airfoil mounted horizontally on the tail section to provide longitudinal stability of the aircraft.
- The ELEVATORS are moveable control surfaces hinged on the trailing edge of the horizontal stabiliser. While the stabiliser provides longitudinal STABILITY, the elevator provides longitudinal CONTROL, i.e., control in the pitching plane.
- The FIN is the fixed vertical airfoil located just ahead of the stern post, and is used to provide directional stability.
- The RUDDER is the control surface that is hinged to the fin to provide directional control. Note also that while the fin provides directional STABILITY the rudder provides directional CONTROL.

UNDERCARRIAGE

There are two primary undercarriage configurations, nose wheel and tail wheel.
Aircraft employing a nose wheel are referred to as having a TRICYCLE undercarriage, while those employing a tail wheel are fondly referred to as TAIL DRAGGERS. Like their full size counterparts, most trainer model aircraft are fitted with a tricycle undercarriage because they are easier to handle on the ground. For the student pilot, the tricycle undercarriage is normally considered the better option because it reduces the tendency to ground loop and/or nose over during take-off, landing or while taxing. Aircraft are normally fitted with either fixed or retractable undercarriage. The undercarriage used on radio control trainers is usually fixed and made of piano wire (tempered steel spring wire). Retractable undercarriages are installed on scale models, where the full- scale aircraft employs retractable gear.

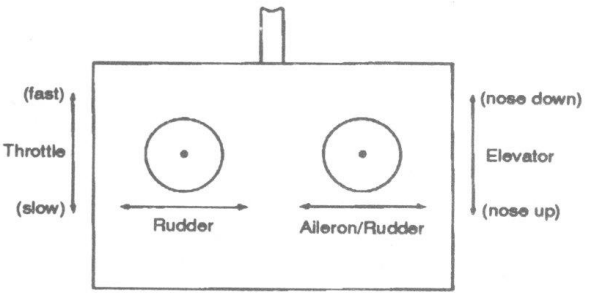
<u>WHAT YOUR RADIO CONTROLS DO</u>

Within Tyldesley MFC the main transmitter stick mode in use is Mode 2. On the transmitter the right-hand stick controls the elevator and the ailerons. Moving the stick towards you will raise the nose of the aircraft in level flight: moving it away from you will lower the nose. Moving the stick to the left or right will cause the aircraft to bank in the same direction and turn that way. These controls are spring loaded so that they always return to the neutral position when released. This particular stick is the equivalent of the control column in a full-size aircraft and is therefore often referred to as 'the stick'.

On the left-hand control stick, back and forward operates the throttle. This control is not spring-loaded but operates on a ratchet so that it remains in whatever position it is set.

Side to side movement on this control operates the rudder in the appropriate sense on 4-channel aircraft. On 3-channel aircraft (elevator, rudder and throttle), the rudder is sometimes connected to the 'aileron' control on the right-hand stick. Discuss this with your instructor.

The set-up will look like this:



Alongside each of these controls on the transmitter are sliding levers which are the trims for each control. What they effectively do is to alter the neutral position of the related control so that by using them when the aircraft is in the air you can cancel out any out-of- balance forces which make the aircraft tend to climb/dive or turn.

Get very familiar with your transmitter. Hold it as if you were flying and get to know where all the controls are by touch. When you are actually in the air there simply won't be time to look at the transmitter to find out where a particular control is located – and if you do you'll probably be unable to find your aircraft when you look up!!
Now, having told you all about the controls on your radio, let's see how these relate to the control surfaces on your aircraft.

Elevator. The elevator is used to hold the aircraft level. Backward movement on the stick will cause the nose to rise and the aircraft to climb, although not for long unless power is increased. Similarly, forward movement on the stick will cause the nose to go down and the aircraft will dive, building up a lot of speed unless power is reduced. So you see, the throttle and elevator controls effect one another to an extent. An increase in power in level flight will cause the aircraft to climb unless the stick is moved forward to hold the aircraft level, in which case the aircraft will fly faster. Similarly, If power is reduced the aircraft will descend unless the stick is held back, in which case the aircraft will fly more slowly. If you find that to hold the aircraft level you need a constant pull or push on the stick, you need to use the trim facility. Just move the trim lever in the

same direction as the pressure you are using to hold the aircraft level until the aircraft will fly level with the stick in neutral. You will, of course, have to continue to make the necessary stick movements after trimming.

Aileron. The aileron control is used to keep the wings level when in level flight. The stick is moved to ‘pick up’ the wing which is down. You will find that if you can keep the wings level the aircraft will fly in a straight line. However, if you fly in a straight line for very long the aircraft will soon be out of sight. You must continually make turns and to do so you must use the aileron control – whether it is linked to the ailerons in a four channel aircraft or to the rudder in a three channel aircraft. Moving the aileron control to the side will cause the aircraft to bank in that direction. When the aircraft has banked about twenty degrees use the control to stop the aircraft banking further and to hold that steady angle of bank.

The aircraft will now start to turn, but it will also tend to drop its nose so be ready to apply a little ‘up’ elevator to keep the nose up. This will also help the aircraft to turn. To straighten out from the turn, simply bank the aircraft back until the wings are level (and relax the back pressure on the elevator) until the aircraft is once again in level flight.

Rudder. In the preliminary stages of your training you will find that you do not need to use the Rudder very often. It is however a primary flight control controlling the Yaw axis and will come into its own when you begin to taxi and take off. You will also be shown how the Ailerons can be substituted by the Rudder to steer your aircraft in the sky, and how the Rudder is introduced into aerobatics. If you have a four channel trainer you will soon discover that you do not need to use the rudder at all to turn – it is done entirely by the use of the ailerons and the elevator. With three channel aircraft rudder (connected to the ‘aileron’ control on your transmitter) is a primary flight control and you will use it from the outset. The control procedure is exactly the same, stick left and the aircraft will bank and turn left, stick right and the aircraft will turn right.

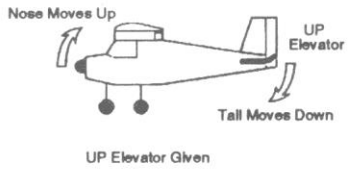
The reason why the Aileron and Rudder controls have a similar effect on you trainer is due to the high wing configuration and its associated dihedral.

The big advantage of having separate aileron and rudder controls comes when the aircraft is on the ground and it can be steered whilst taxiing by use of the rudder. The rudder may also be linked to the nose or tail wheel to give more accurate ground control.

Throttle. The throttle control determines the amount of power the engine is providing to fly the aircraft. Full throttle is used for take-off, overshooting and many aerobatic manoeuvres. Low throttle settings give glide, taxiing power and, with the trim fully back, ‘engine stop’ facility. Intermediate throttle positions are used for different conditions of flight and for that power setting which gives a pleasant, relaxed flying speed, neither too fast or too slow, is known as ‘cruising speed’. The setting for this

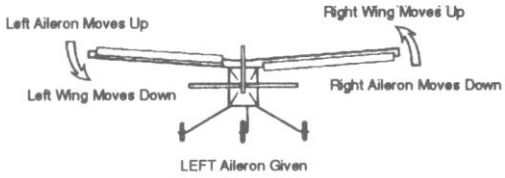
varies between aircraft, but is normally rather less than half throttle, and will be dictated to you by your instructor.

Elevator. The elevator controls the pitching moment. That is to say it raises and lowers the nose of the aircraft, like this:



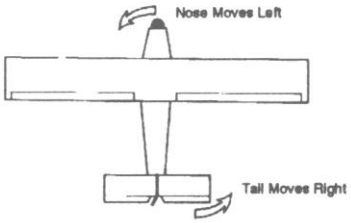
UP Elevator Given

Aileron. The ailerons give lateral control, banking the wings from side to side, like this:



LEFT Aileron Given

Rudder. The rudder moves the nose of the aircraft to the right or the left:



LEFT Rudder Given

FLIGHT AND HOW IT IS ACHIEVED.

THE AEROFOIL

In order for your model to be capable of flight it has to be able to generate lift. This as you will learn is a force resulting from the movement through the air. On your model the lift is generated chiefly by the wing, and this wing is so designed as to enhance the effect of this generating process. The wing has an aerofoil section, the purpose of which is to produce lift. Even a flat surface is capable of producing lift, albeit very inefficiently. To demonstrate this, take a board and swing it at a straight angle to the air. Note that there is no lift generated; neither is much force required to swing it Now tilt the board slightly so as to swing it at a slight upward angle Note that the air hitting the board gives the board a slight upward lift. Also note that it now takes more force to swing the board. As the board is progressively tilted upward, the lift increases, but more and more power will be required to swing it. Once the board is tilted beyond a certain angle, lift will no longer be generated and a great deal of power will be required to swing it. This point can be related to the stall angle of an aerofoil.

From the foregoing we can conclude that while a flat board could be used as a wing, too much power would be required to overcome the excessive amount of drag created by it. Consequently, a more streamlined shape is needed. There are three general shapes of aerofoil used for model aircraft:

- Flat Bottom - This type of aerofoil is used primarily on trainers and slow flying aircraft Sometimes it is referred to as a cambered aerofoil, sometimes as a Clark-Y aerofoil.
- Semi-Symmetrical -This type of aerofoil is most commonly used on sport aircraft as well as on many Second World War scale models. It too is a cambered aerofoil.
- Symmetrical -This type of aerofoil is used on pattern and advanced aerobatic aircraft as it is especially suited for inverted flight. It has no camber.

LIFT

There are three main forces which act on the wing to generate lift.

- As the aircraft moves through the air, a high pressure air mass is created under the wing, which in turn tends to lift the wing.
- A low pressure area is created on top of the wing which tends to pull the wing upward. Since the air travelling over the upper surface of the wing has a greater distance to travel than the air passing under it, the air above the wing is less dense and thus at a lower pressure. Consequently, the wing is drawn upward into the area of low pressure.

- The downward flow of air at the wing's trailing edge also produces a degree of lift The air flow over the upper surface of the wing moves at a much faster speed than the air passing under it; therefore, when these two streams of air meet at the trailing edge, a downward flow of air results which produces an upward reaction on the wing.

From the foregoing, we can see why the lifting forces would be greater on a flat bottom or semi-symmetrical wing (cambered wing) than on a symmetrical wing (non-cambered wing). In other words, we can see that a cambered aerofoil produces lift at zero degrees angle of attack whereas the non-cambered aerofoil does not produce any lift at zero degrees, and will only produce lift when it is set at a positive angle of attack.

FACTORS AFFECTING LIFT
Four main factors influence the lift on an aerofoil. These are:

- WING AREA
- SPEED
- THICKNESS AND SHAPE OF THE WING
- ANGLE OF ATTACK OF THE WING

Generally speaking, the greater the wing area, the greater the lift, the greater the speed the greater the lift, the thicker the wing (up to a point) and the greater the camber, the greater the lift; and the greater the angle of attack the greater the lift.

7. FLIGHT
There are four forces acting on any aircraft in level flight.

- Lift
- Weight
- Thrust
- Drag

When an aircraft is flying straight and level at any steady speed, the four force's are in balance. i.e. lift equals weight and thrust equals drag. When these forces are in balance the aircraft is said to have reached a terminal velocity.

When an aircraft takes off, these forces are not in balance. At the start of the take-off run -the aircraft is moving slowly so there is very little frontal surface or plan drag -mainly just the drag resulting from friction as the wheels pass over and through the grass. At the same time, however, the throttle is fully advanced and the thrust is at a maximum. Consequently, the aircraft will accelerate as there will be more thrust than drag. When the pilot feeds in some up elevator, the nose of the aircraft will lift, increasing the angle of attack of the wing. The increased angle of attack will produce more lift than is required to overcome the weight of the aircraft and the aircraft will begin to accelerate upwards. Now we have a situation in which the aircraft is accelerating forward because thrust is greater than drag (i.e. it is gaining flying speed) and it is accelerating upwards because lift is greater than weight (i.e. it is climbing). If the attitude of the aircraft is not changed, the aircraft will continue to accelerate and climb until drag equals thrust. At this time, the aircraft will settle into a state of equilibrium.

Reducing the thrust will require an increase in the angle of attack of the wing if straight and level flight is to be maintained. If during straight and level flight the thrust is reduced, the aircraft will no longer be in equilibrium as drag will be greater than thrust The slower speed will reduce the lift generated by the wing, so more lift will have to be generated. More up elevator will increase the angle of attack and thus increase the lift of the wing The increased angle of attack also increases the drag with a corresponding reduction in speed These forces will interact until a new terminal velocity is reached and the forces once more are in equilibrium.

From the foregoing, it is concluded that there is a terminal velocity for each speed during level flight. For each terminal velocity the wing angle of attack will be different. And the wing's angle of attack will be greater at slower speeds than at higher speeds.

STABILITY
Earlier in this paper we discussed stability in a very general sense. We noted, for example, that the horizontal stabiliser and elevators combine to produce stability in the pitching plane; and that the fin and rudder combine to produce stability in the yawing plane Now we will take a look at some other aspects of stability which impact on how well our aircraft flies

Any aircraft in flight is constantly subjected to a variety of forces that tend to disturb it from its normal horizontal flight path These include such things as rising columns of warm air, down drafts, gusty winds, etc which when encountered in flight tend to make the aircraft's nose rise or fall, a wing to drop or the nose to yaw to the left or right How the aircraft reacts to these disturbances depends on how stable the aircraft really is.

Stability is defined as the tendency of an aircraft, when displaced in flight, to return to its straight and level attitude without any corrective action by the pilot

Stability may be classified as POSITIVE, meaning that if disturbed, the aircraft will return to its original straight and level attitude, NEUTRAL, meaning that it will maintain its last attitude without either returning to straight and level flight, or moving further away from it; and NEGATIVE, meaning that once the aircraft is displaced by a disturbance, it will move progressively further away from its last attitude.

In fact, negative stability is just another way of saying "instability". Obviously, as students we want to train on an aircraft that has lots of positive stability - aircraft that will practically fly hands off; an aircraft that for all intents and purpose will recover from any unusual position when the pilot lets go of the controls This is why a student should select a good stable aircraft on which to receive his training. After becoming proficient on a trainer you can move on to an aircraft that has neutral stability,

i.e. pattern and other aerobatic aircraft. However, if you want to enjoy radio control flying, you should never build an aircraft with negative stability.

Glossary of Terms

LIFT - The upward force that causes an aircraft to fly.

WEIGHT - The gravitational force acting downwards on an aircraft.

DRAG - The force acting on an aircraft that tends to prevent forward motion.

THRUST - The forward force exerted by the propeller.

TERMINAL VELOCITY - When an aircraft reaches a constant speed, the thrust and drag are equal The rate of travel at this point of equilibrium is called the terminal velocity.

CENTER OF GRAVITY (CG) - The point through which the total weight of the aircraft is considered to act. The balance point.

WING ROOT - The inboard section of the wing, i.e. the section nearest the fuselage.

CHORD - The width of the wing measured in a straight line from the leading edge to the trailing edge.

MEAN AERODYNAMIC CHORD (MAC) - The average chord of the wing.

WING SPAN - The total distance from one wing tip to the other.

ANGLE OF INCIDENCE - The angle at which the wing, horizontal stabiliser, and engine are positioned on the blueprint or drawing by the designer. This angle is measured in relation to a reference or datum line.

ANGLE OF ATTACK - The angle at which the wing, horizontal stabiliser and engine actually meet the oncoming air during flight. The term is used almost exclusively with reference to the wing.

STALL - When the angle of attack of the wing exceeds the point where it produces lift, the wing will stall, or quit flying, and the aircraft will start to fall.

WASH-OUT - The "twist" purposely built into the wing so that the angle of incidence at the wing tip is less than the angle of incidence at the wing root. This causes the inboard section of the wing to stall before the outboard section, thus providing maximum stability and control at lowest possible speed.

WASH-IN - The reverse of wash-out Wash-in is most undesirable in that it produces instability, loss of low speed control and tip stalling.

TIP STALL - The condition that occurs when one or both wing tips stall before the rest of the wing. Such a stall is dangerous in that it usually results in an uncontrollable spin.

TORQUE - The force generated by the turning propeller which tends to turn the aircraft in the opposite direction. This force may be compensated for by offsetting the engine or the vertical stabiliser during construction of the aircraft, or by manually feeding in right rudder or right rudder trim during flight.

WING LOADING - The gross weight of the aircraft divided by the area of the wings In full scale aircraft wing loading is expressed as pounds per square foot. In model aircraft, however, it is expressed as ounces per square foot. i.e. the number of ounces that each square foot of wing must support.

THRUST LINE - The centre or datum line through the model’s airframe.

Pre Flight check lists.

Before You Leave Home

Always check the following* Support Equipment *before you leave home:

- Fresh Elastics or Wing Bolts
- Spare Glow Plug
- Charged Starting Battery and Wire Clip or Glow Plug Driver
- Transmitter, Buddy Box and Umbilical Cord
- Spare Propeller
- Starting (Chicken) Stick or Electric Starter
- Screwdriver(s), Needle Nose Pliers
- Fuel, Fuel Pump and Tubing
- Paper Towels and Cleaning Liquid

Always conduct the following* Aircraft Inspection *before you leave home:

- Wings and Fuselage – check for and fix loose covering and tears
- Propeller – check for nick or chunks missing, replace if necessary
- Wing Dowels – check for looseness or damage, repair if necessary
- Control Surfaces – Check all surfaces for damage or loose hinges
- Servo – Check if all servos are securely fastened to their mounts
- Servo Wheels – Check if all servo wheels are securely fastened to the servos
- Push Rods – Check that both ends of the push rods are securely fastened
- Fuel Tubing – Check for small tears or nicks, replace if necessary
- Landing Gear – Check that all landing gear screws and supports and secure
- Repairs – Ensure that repairs are completed at home prior to driving to the field

At the Field – Pre-Flight Checks

Before mounting the wings

- Receiver plugs check
- Battery plug check
- Servo wheel screw check
- Clevis to servo and clevis to pushrod connection check
- Aileron servos to aileron connection check
- Fuel tubing, check for kinked lines inside the fuselage
- Tank clunk, if visible, check to ensure clunk is free

With the wings attached

- Check for any pinched wires
- Check for alignment of all surfaces
- Control surface hinge check
- Control linkage to control horn check
- Check for nicks to the propeller
- Check landing gear mounts
- Fuel tubing check for punctures or tears
- Shake the airframe to make sure clunk is free

With the frequency peg on the board

- Check to see if all the surfaces are moving freely.
- Check to see if all the surfaces are moving in the correct direction.
- Range check the aircraft as per your radio manufacturers instructions.

Appendix 1 - Training record.

NAME.....

Flight Stage	Passed By : (Instructors Signature)	Seconded By : (Instructors Signature)	Date
Stage 1 Pit Safety.			
Stage 2 Introduction to Flight			
Stage 3 Trimming / Basic Circuits / Figure 8's			
Stage 4 Circuit Transition			
Stage 5 Climbing, Diving and Stalling.			
Stage 6 Taxiing.			
Stage 7 Take off, climb out and manoeuvre.			
Stage 8 Landing approaches and overshoots.			
Stage 9 Powered and Deadstick landings.			
Stage 10 Solo Flight			
Stage 11 Aerobatics.			
Stage 12 BMFA 'A' Certificate			
Stage 13 +Twenty Flights			
Stage 14 Instructor Sign Off			