Learning to fly rc airplanes

How to Fly RC Airplanes

Things You Need To Know First

LEARNING HOW TO FLY RC AIRPLANES is something you will enjoy your whole life. Please don't make the same mistakes a lot of people new to the hobby do, which is seeing a **real cool plane** in their local hobby shop and buying it as their first plane to learn on. **Big mistake!** And could be a costly one as well. So please read on and we'll take you through the proper steps to starting in the radio control hobby as **smoothly** as possible.

***CHOOSING YOUR FIRST RC AIRPLANE…**

Learning how to fly rc airplanes will take a **stable**, forgiving and **durable plane**. But not to worry. You will be flying that cool plane hanging in the hobby shop before you know it. The **first rc airplane** you will want to buy is called (you got it) a **rc trainer**. These planes are usually larger (for stability) and made of balsa wood. They can be powered by nitro which is gas for small airplane engines or electric motors. And require a **large** area to be flown safely. Keep in mind that these planes are not toys and can be **dangerous**. So be sure to work with an experienced radio control pilot when starting to learn. Now, **park flyers** are another option to train with. They are usually **less expensive** and require less equipment than a nitro powered RC trainer. They can also be flow in a small area such as a park or your back yard if you have a little space. Now these planes tend to be a little more **durable** than a balsa RC trainer. And through some trial and error you could train yourself on a park flyer. But it is always **recommended** to have an experienced pilot train you. It will save you time, money and frustration. I also recommend that you read this **6 Chapter Aeronautical Training Course**

Chapter #1

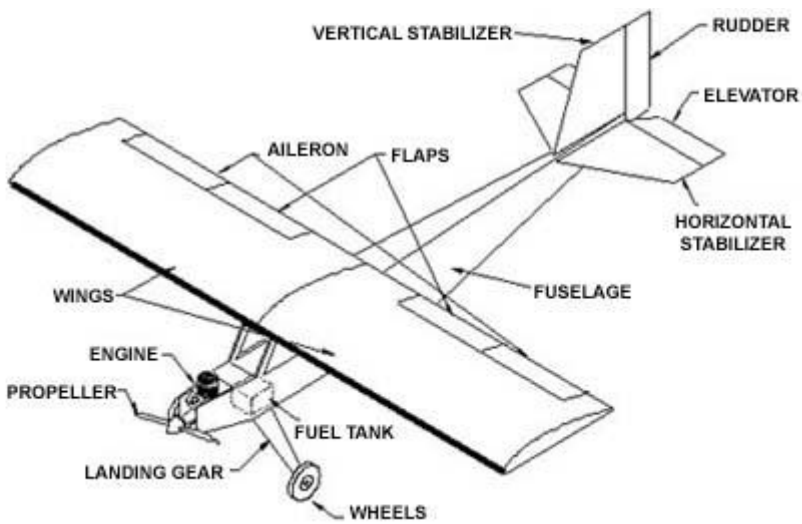
RC Airplane Parts

The RC airplane parts typically consist of:

(see Fig.1 (rc airplane parts) , Fig.3a, Fig.3b)

a) Fuselage
b) Wings
c) Horizontal stabilizer
d) Vertical stabilizer
e) Elevator
f) Rudder
g) Aileron
h) flaps (optional)
i) Wheels
j) Landing gear
k) Engine
l) Propeller
m) Fueltank
n) Servos
o) Rx batteries
p) Receiver (Rx)
q) Push rods
r) Transmitter (TX)
s) TX batteries

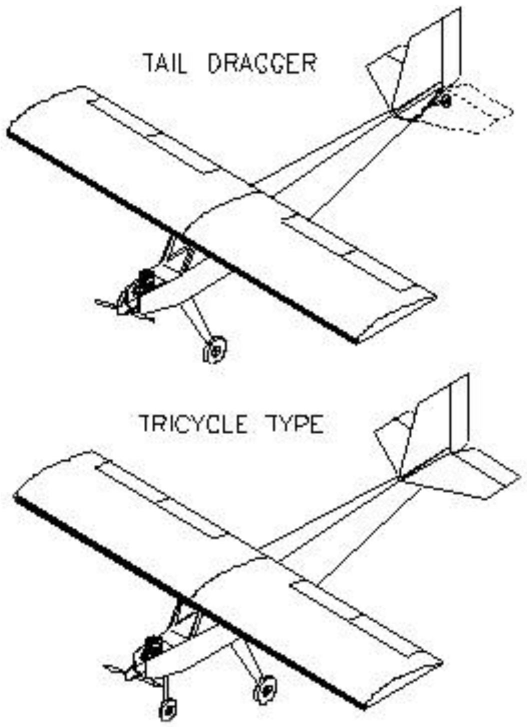
FIGURE 1 ; RC airplane parts



The fuselage is the main body of the rc airplane. It serves as a housing of the internal components and holds together the outer parts. Obviously the wings are what make the rc model airplane fly. This part supports the rc airplane in flight and the size, type, and location of the wing determines the flight characteristics of the rc airplane (see Chapter 2). The aileron located at the trailing edge (see Fig. 1) of the wing is what controls the longitudinal axis or the rolling motion of the wing. It also controls the rc airplane's direction by means of banking the wing either in the left or right direction. Flaps are sometimes added to increase the lift of the wing and to reduce the runway distance on take-off.

The horizontal stabilizer is usually located at the tail of the aircraft. It serves to stabilize it in the lateral axis or to counter act the up and down motion of the aircraft (or pitch). The elevator is attached to the horizontal stabilizer. It controls the up and down motion (or pitch). The vertical stabilizer is also located at the tail and perpendicular to the horizontal stabilizer. It stabilizes the aircraft in the vertical axis. The rudder is attached to the vertical stab, which control the rc airplane in the vertical axis. This mechanism is usually found in full size aircraft but optional in model aircraft. The landing gear along with the wheels supports the aircraft on the ground. The two common types are tricycle and the tail dragger (see Fig 2).

FIGURE 2 : Two basic types of landing gearTwo basic types of landing gear



The engine, propeller and fuel tank is called the power plant. It generates the thrust to support the aircraft in flight. The engine is located usually in the front of the aircraft and drives the propeller to generate thrust. The fuel tank holds the fuel and usually located behind the engine. The radio equipment (see Fig.3a) includes the following: servos, receiver (Rx), and Rx batteries, transmitter (TX). The servos are located inside the rc airplane and serves as actuators. They produce the needed force to control the rc airplane. The pushrods are connected to the servos to transmit the force generated by the servos to the control surfaces of the rc airplane. The receiver is connected to the servos, which transmit the signal from the transmitter. The transmitter, although not attached to the aircraft itself, is also part of the aircraft. That is why it is called remote controlled. It transmits signals from the control input of the RC pilot. Of course, the receiver and the transmitter to transmit and receive electrical signals need batteries (see Fig. 3b).

FIGURE 3a : Three-channel radio controlled rc airplane components

3 channel radio components

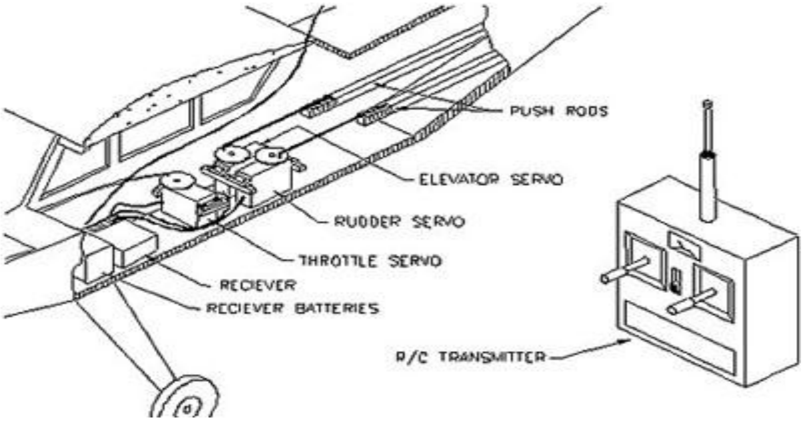
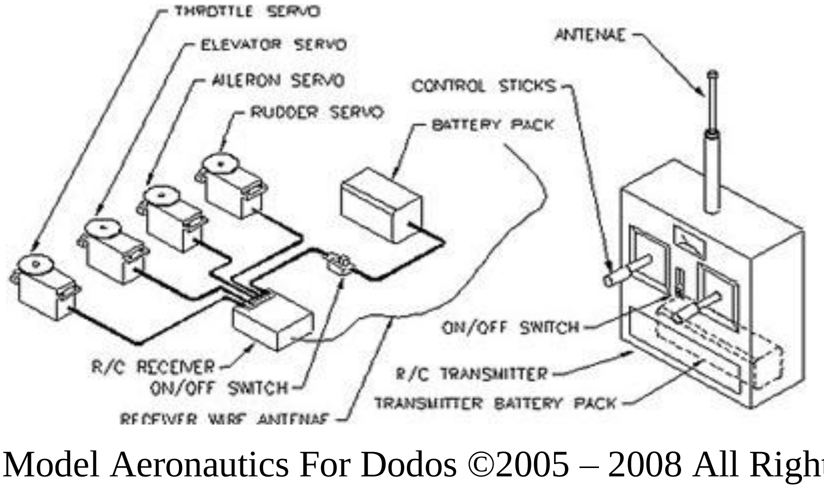


FIGURE 3b : Typical four-channel radio control layout and components



Chapter #2

Why and How RC Model Airplanes Fly

This chapter, we will discuss the aerodynamic forces acting on an rc airplane. Many people just accept the fact that rc airplanes fly because of its wings. Right. But the force that acts on the wings to achieve flight is often overlooked. Yes, we don't have to be a rocket scientist to enjoy this hobby but it pays to learn more about aerodynamics. The wings cross-section is called an airfoil (see Fig. 4a). The forces that acts on the wing of the rc airplane is what makes it fly. Based on the illustration of Figure 4b, the relative wind passes from the leading edge to the trailing edge.

The arrows represent the direction of air molecules and bubble numbers (1) and (2) represents the air molecules. As you can see, the upper camber (Fig. 4a) has a low-pressure area and the lower camber has a high pressure. As the air passes through an airfoil, it separates from the leading edge and travels on the upper camber and the lower camber. The air molecules number (1) and (2) separates from the leading edge and both should meet on the trailing edge at the same point, at the same time. This phenomenon is called the law of continuity.

Without the law of continuity it is impossible for an rc airplane to fly. Because of this, the air molecules on the upper camber travel faster than the air molecules on the lower camber. In Bernoulli's theorem, "as the velocity of air increases, pressure decreases". The pressure on the lower camber is greater than the upper camber; the variance of pressure generates the lift needed by the aircraft.

Figure 4a : Airfoil of a typical rc airplane

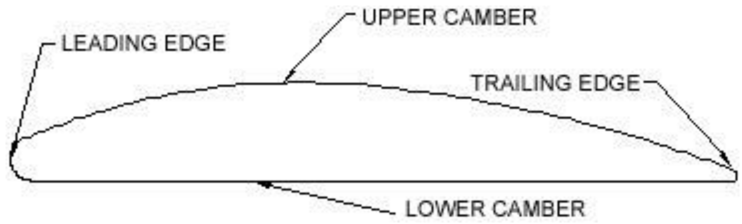
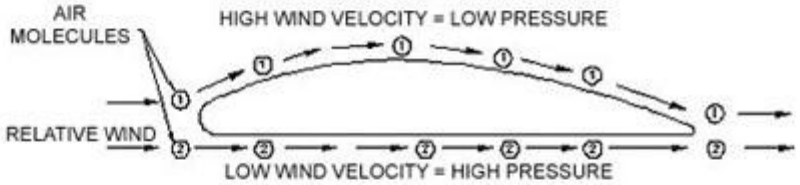


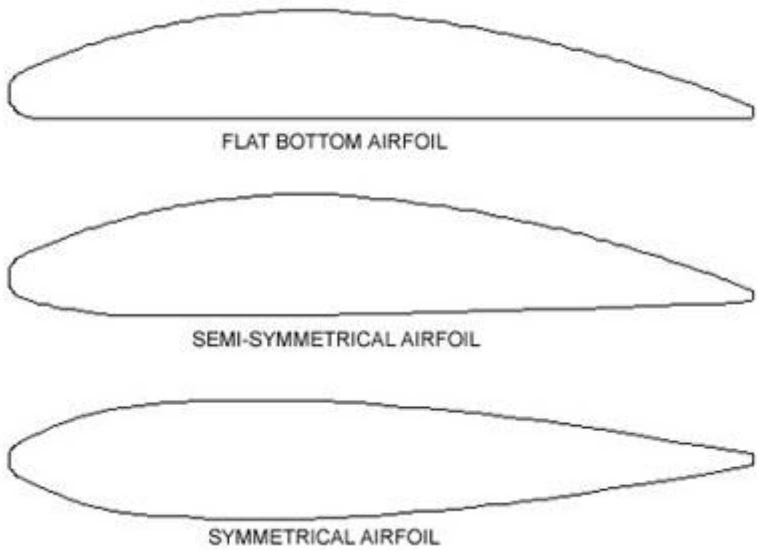
Figure 4b : Airfoil of a typical rc airplane



The three basic types of airfoil in our rc model airplanes are: (see Fig 4c)
1) Flat bottom airfoil
2) Semi- symmetrical airfoil
3) Symmetrical airfoil

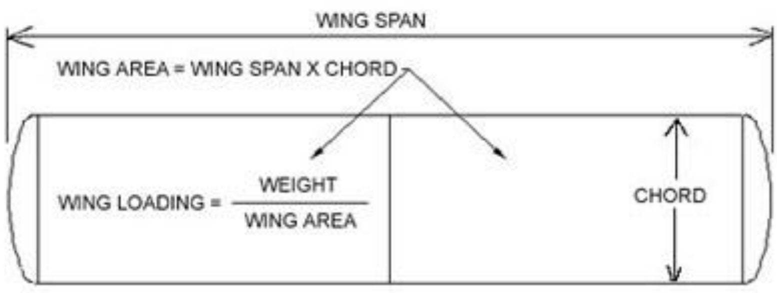
Of the three, the flat bottom airfoil is recommended for trainer rc airplanes due to its inherent stability. The flat bottom design is stable on the longitudinal axis and self-correcting tendency is very ideal for a beginner. The semi symmetrical type is for intermediate flyers and the symmetrical is for the expert who wants to fly aerobatics (see Fig 4c).

Figure 4c: Basic Types of Airfoils types of airfoil



Now that we learned the mystery of flight, we should also learned something about the weight determination. Eventhough flight is generated because we utilize the wings, but if we disregard the weight consideration, it will not fly properly or will not fly at all. Remember, " a feather flies better than a brick". The area of the wing is very important to know if the aircraft could carry its own weight. There is a certain limit of the total weight of the aircraft, depending on its wing area, designed speed and type of airfoil. The weight divided by the total area of its wing span is called wing loading (see Fig. 5).

Figure 5 : Wing Span of a Non-Taper Wing

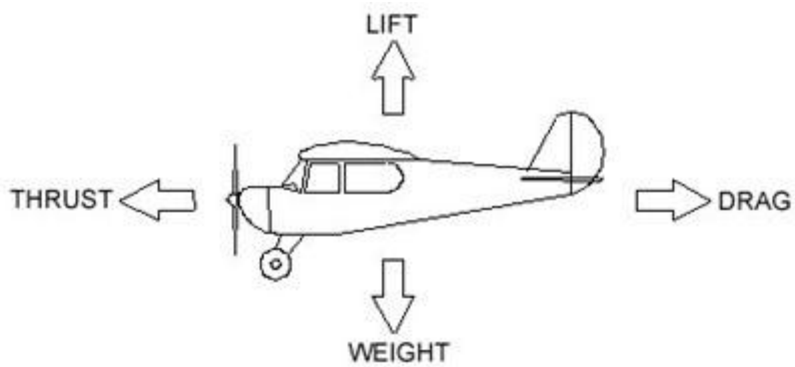


So the next time you but an rc airplane kit and you see the specification (for example: wing loading=800g/sq. cm) you know now that it is the weight carried by the wing per square centimeter. It is advisable to keep the weight down, if the weight of the rc airplane exceeds the recommended weight, the rc airplane needs more airspeed to generate lift (see Fig. 4b). We learned in our previous lesson that as the velocity increases, pressure decreases. The greater the airspeed, the more sensitive the controls become and it will be more difficult to fly the rc airplane. Especially on landing, longer runway is required. The rule of thumb is “keep the rc airplane light”. The lighter the aircraft, the more docile the aircraft can be. This is very important to a beginner because the model aircraft should be very easy to fly and very forgiving.

Adding another set of wings can increase wing area. In early days of aviation, there are biplanes and triplanes that fly in the skies. In fact the first rc airplane was a biplane (The Kitty Hawk) flown and built by the Wright brothers. The monoplanes are more efficient than biplanes and triplanes because it does not have wire braces to hold the wings. The only advantage it has is longitudinal stability.

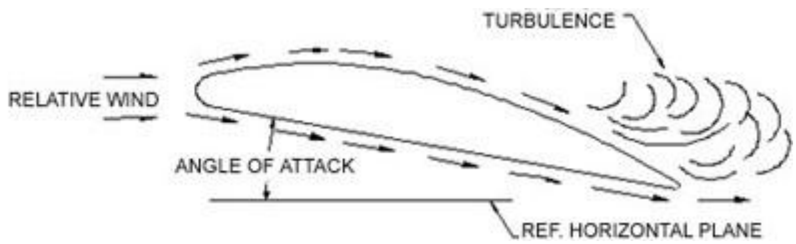
Now let us study the aircraft in flight. There are forces that act on an aircraft in flight, the lift, weight, thrust and drag (see Fig. 6). To achieve a stable straight and level flight, these forces should be balanced, Lift=weight and thust=drag. Lift pulls the aircraft up and weight pulls the aircraft down. If weight is greater than the lift, the aircraft will descend or vice versa. Thrust pulls the aircraft forward and drag pulls it backwards. When the aircraft is taking-off the ground or needs to gain altitude, the thrust should be greater than the drag. As the thrust increases, the lift increases to make the aircraft gain altitude or off the ground. This is also the reason why there is a recommended engine size of the aircraft. The engine to achieve flight must provide the power needed by the aircraft.

Figure 6 : Forces Acting on an Aircraft in Flight



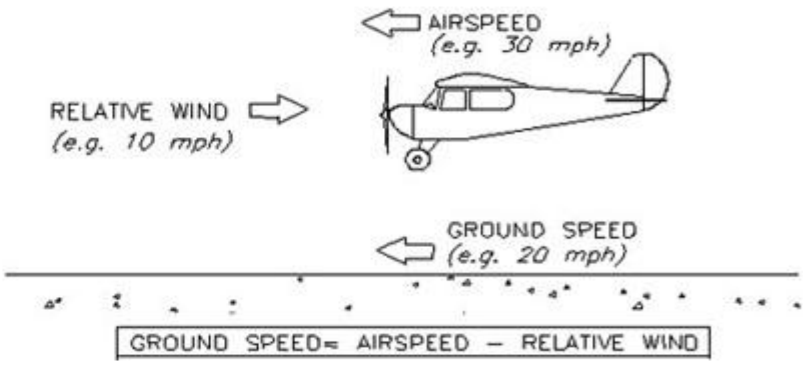
An underpowered aircraft has very terrible consequences. Stalling is losing the lift and control of the aircraft. Flying below the recommended minimum airspeed causes the aircraft loose lift because the smooth airflow of the wing is distorted or turbulence occurs (see Fig.7). This destroys the lifting force of the wing because as we have leaned before, the low-pressure area on the upper chamber creates the lift. This cannot satisfy the law of continuity because of the disturbed airflow. Hence, the control surfaces cannot also do its function because it is depended entirely on the airflow of the wing. If the aircraft has sufficient power, and applied too much angle of attack, the aircraft will also stall because too much drag is present. Increasing the angle of attack, drag will also increase. There are numerous airfoil data from NACA (now NASA) which are used by aircraft designers on designing their aircraft. It contains data about coefficients of lift, drag and angle of attack. But these are beyond the scope of this topic.

Figure 7: Airfoil Turbulence



For example, the rc airplane is just taking-off the ground with just below the normal take-off speed, pull the elevator up, the next thing is that the rc airplane will climb pointing it's nose up and will dive to the left. The reason why rc airplanes dive when on a stall is to gain airspeed. The propeller torque causes the rc airplane to dive left. That is why rc airplanes are safer at high altitudes and dangerous when close to the ground. Take note, airspeed is the speed of an aircraft relative or against the wind. Ground speed is with referenced to the ground (see Fig. 8). Ground speed is equal to relative wind minus the airspeed of the aircraft.

Figure 8 : Airspeed and Groundspeed of an Aircraft in Flight



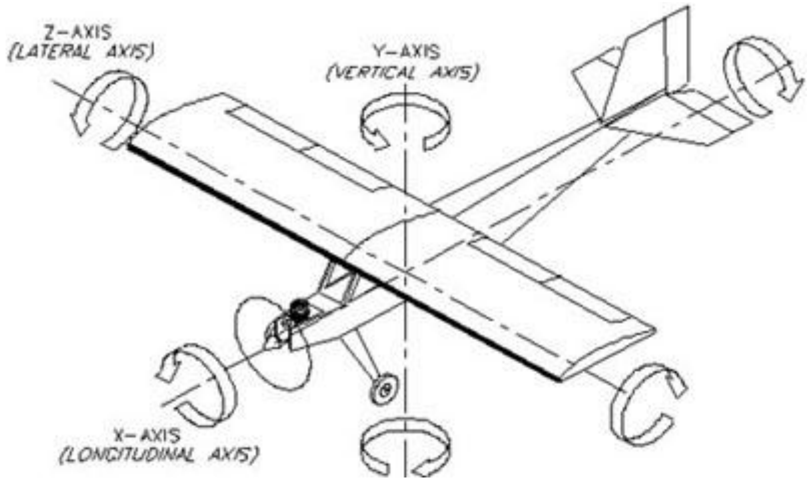
Chapter #3

Airplane Stability and Control

All aircraft needs stability and the only way to stabilize an aircraft (if it cannot stabilize itself) is by its control surfaces. But first let us study the airplane's axis of rotation. The airplane moves on it's three dimensional axis (see Fig. 9a):

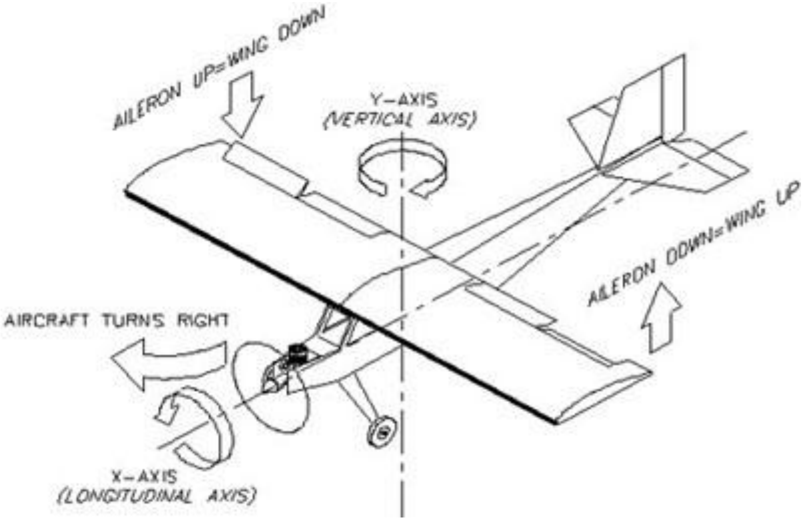
1) "X" axis or the longitudinal axis
2) "Y" axis or vertical axis
3) "Z" axis or lateral axis

Figure 9a : Three dimensional axis of rotation



The aileron controls the longitudinal axis. It serves to stabilize the aircraft by banking and steering left or right (see Fig. 9b). It is a common notion that the rudder in the vertical fin controls the steering of the aircraft. Yes its true, even the Wright brothers used the rudder on their first airplane until they discovered that the aileron is much better. If you have a model with just three channels (rudder, throttle and elevator) it will work just fine. It operates with similar principle but I would suggest that aileron is much better. I remember when I was flying a full size Cessna. It was my first flight and when the instructor let go of the controls and put me in charge, I used to experiment steering the aircraft by its rudder. He said, "Hey, what are you doing?" I said, "I'm steering the aircraft." Then he told me "Who told you to use the rudder? Use the aileron, you can't use the rudder for turning."

Figure 9b : Using aileron on banking and steering the aircraft

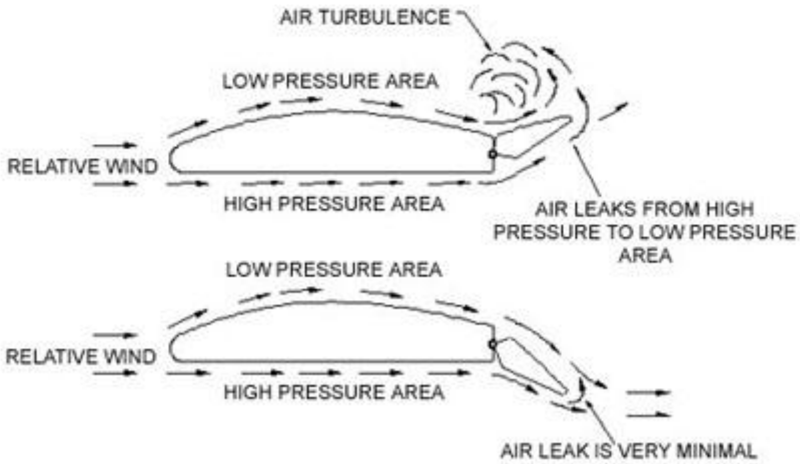


Maybe he is not aware that model aircraft can use rudder for turning. But I also don’t know why is it not possible in the full-scale aircraft. Not until I studied Aeronautical engineering that I discovered how those control surfaces and the viscosity of air aerodynamically affects the aircraft. Because the model is much lighter compared to full-size aircraft, rudder is quite effective in steering the aircraft. Unlike the full-size aircraft, because of the viscosity of air, it’s ineffective.

The aileron works by deflecting the air upwards or downwards. Since the airflow is disturbed, drag increases. But the upper and lower camber has two different functions so it will result in two different manners. Disturbing the airflow in the upper camber will create more drag compared to the lower camber. Why? Because the upper camber, as we’ve learned has lower pressure area that creates the lift. If the airflow is deflected upwards, the high-pressure region will leak to the low-pressure region, hence resulting in a loss of lift. Because of the leakage, turbulence will occur in the trailing edge until it reaches the upper camber. This causes more drag than deflecting the air downwards because the upper region, which is the low-pressure area, will not leak on the high-pressure area. Hence, turbulence is minimal (see Fig. 10).

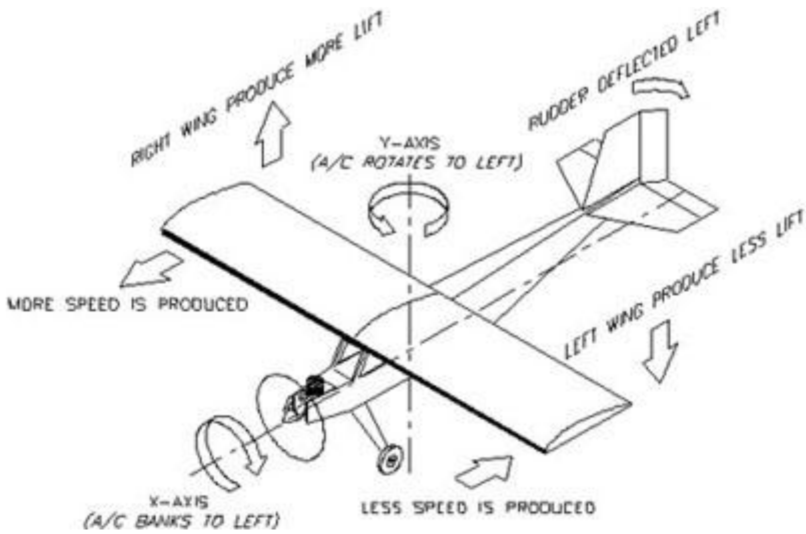
This is why the airplane turns when banking. If you bank the airplane’s wing on the right, it will automatically turn right or vice versa. The drag created on the right wing causes the delay, which gives the left wing more speed.

Figure 10 : Aileron deflection of an airfoil



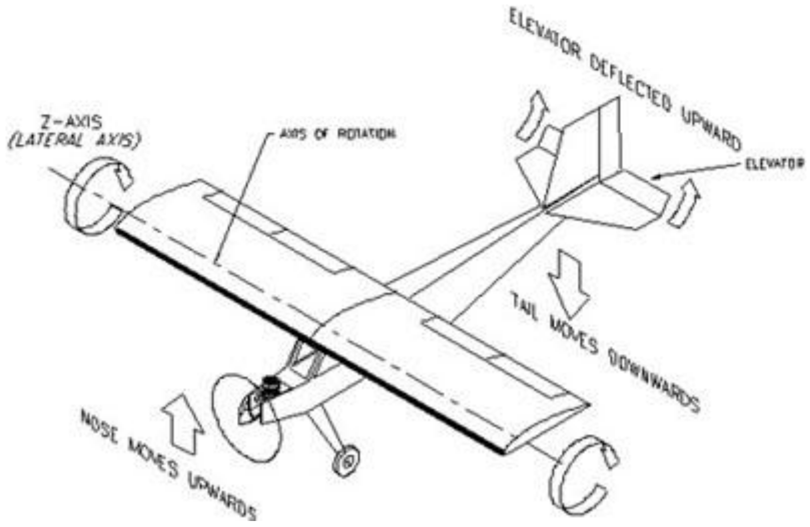
The primary purpose of the rudder is to stabilize the aircraft on its vertical axis. In model aircraft, rudder is utilized for steering. But what is amazing is when you deflect the rudder for example to the left (looking at the back end of the model) the aircraft will turn left and the wing will bank to the left side or vice versa. The explanation is as you turn or rotate the aircraft to the left (along the vertical axis) the right wing travels faster than the left wing. Because the velocity of air is faster in the right wing, more lift is produced. Hence, the result is unbalanced lift that causes the aircraft to bank (see Fig. 9c).

Figure 9c : Rudder deflected to left for steering the aircraft



The elevator located on the tail end of the aircraft controls the lateral axis. Its main function is for take-off and landing of the aircraft. It stabilizes the up and down motion of the aircraft. The elevator pushes the tail down when deflected upwards or vice versa and increase the angle of attack of the wing so more lift is produced (see Fig. 9d).

Figure 9d : Elevator deflected upward



The location of the wing will also determine the stability of the aircraft. The most stable type is the high wing configuration on a typical monoplane. The pendulum stability of its wing gives it the natural stability because the weight is under the wing (Fig. 11a). The shoulder wing type is a little touchy because the weight is near the wing (Fig. 11b). The low wing type is the most sensitive to control because the weight is on the upper portion of the wing. That is why dihedral is used to add stability (see Fig. 11c).

Adding another set of wings can increase wing area. This configuration is called a biplane. The wings are decked together, one in the upper part of the fuselage the other on the bottom (see Fig. 11d). This type is quite common in the early days of aviation. In fact the first airplane flown by the Wright brothers the Kitty Hawk was a biplane. The only advantage is the longitudinal stability and drag is a major concern in this design due to the wire braces to support the wings. Triplanes fighters appeared in WWI and was not very popular it is because drag is also a major issue. That is why monoplanes are quite popular until this day because it produces the least drag.

Figure 11a : High wing monoplane

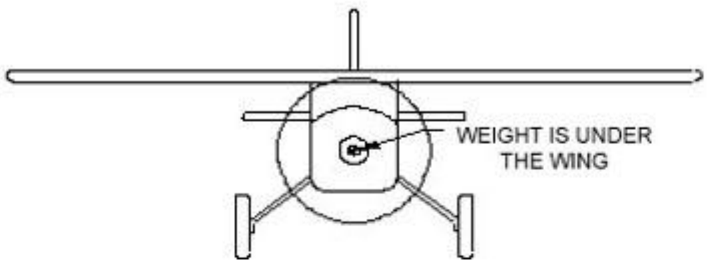


Figure 11b : Midwing monoplane

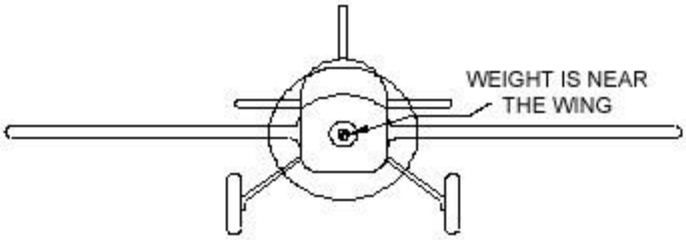


Figure 11c : Low wing monoplane

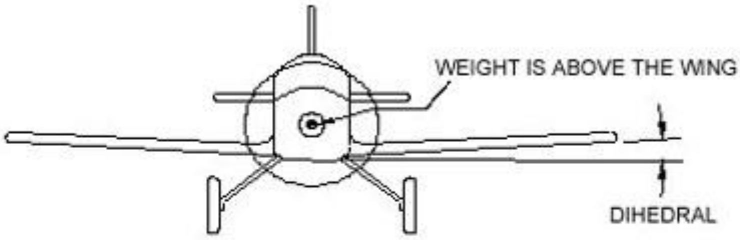
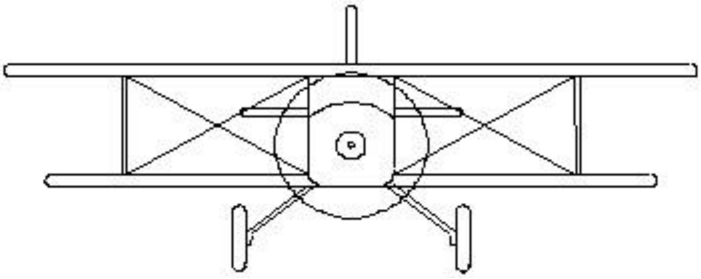
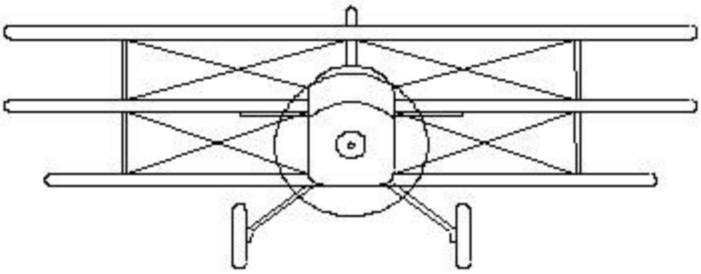


Figure 11d : Typical Biplane



Typical Triplane



Other forces that affects aircraft stability

There are other things to consider to stabilize the aircraft. One of them is the three degrees right thrust, which are necessary to stabilize the directional stability of the aircraft. The reason for this is the aircraft has a tendency to turn left when there is no three degrees right thrust (see Fig 12a). The pilot needs to trim the rudder to the right to counteract the left turn tendency. The engine torque against the propeller (see Fig 12b) causes this phenomenon. Most propellers turn in a counter-clockwise motion (front of the airplane). The opposite force is the engine torque, which is clockwise. So the aircraft has a tendency to bank along with the clockwise motion, which is banking to the left. A three degrees right thrust is needed to neutralize the aircraft to fly in a straight path.

Figure 12a : Top View of Model Aircraft Engine with 3 degrees Right Thrust

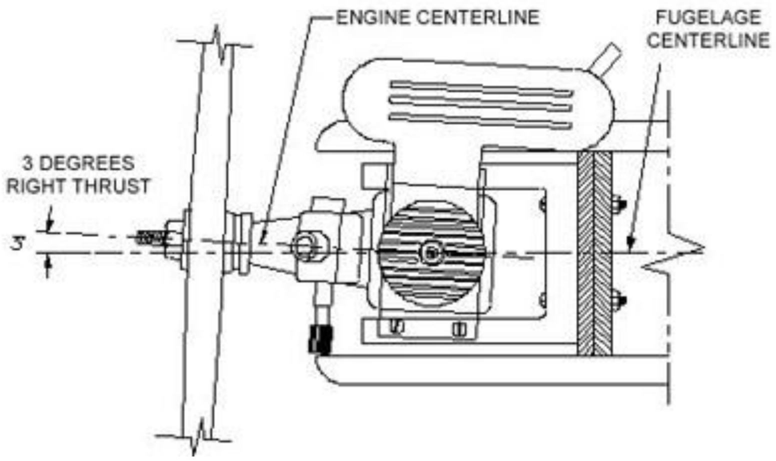
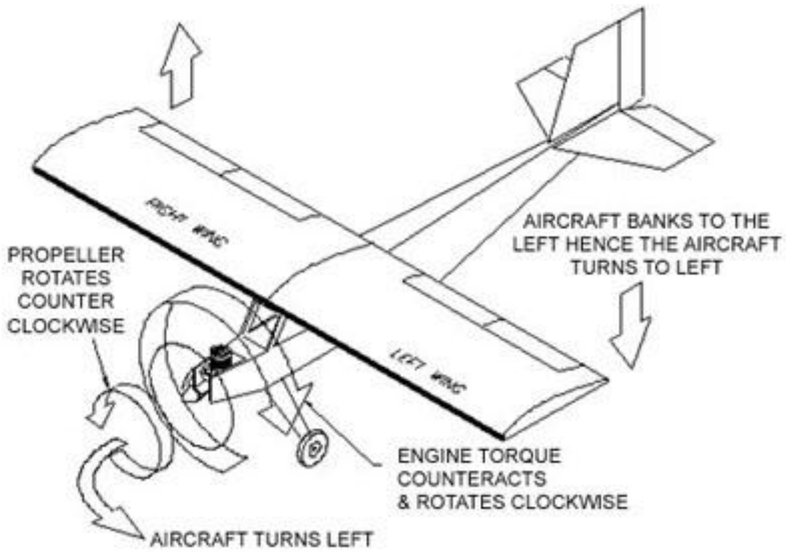


Figure 12b : Illustration of engine vs. propeller torque



What about the down thrust? It is used to counteract a natural tendency of the aircraft to pitch up or to nose up on a typical high wing monoplane. Since the thrust line is below the wing (see Fig. 13a), there is a tendency for the aircraft to pendulum on its neutral point (see Chapter 4). The engine literally pulls the fuselage up being the neutral point as the pivot point. A three degree down thrust is used to counteract this force to balance it aerodynamically (see Fig 13b). If the thrust line is along the neutral point, like in the mid-wing airplanes (see Fig. 11b) there is no need for down thrust.

Figure13a : Illustration of propeller thrust below the neutral point

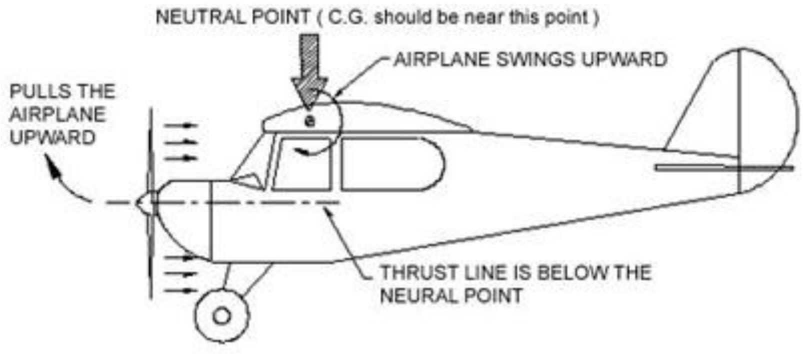
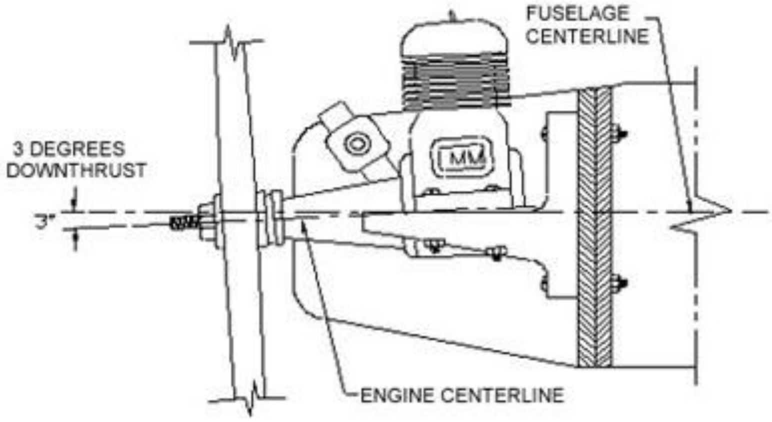


Figure13b : Side view of model aircraft engine with 3 degrees down thrust



Landing gear design also has a destabilizing effect if not properly considered. Trainer type RC airplanes always have tricycle landing gear and a tail dragger is usually not recommended. This is not always explained in detail by other beginner books, I also didn't realize before that this is also important to know for a beginner.

Whenever an aircraft lands, the main gear touches the ground first whether it's a tail dragger or a tricycle type. Sometimes because of the wind direction an aircraft has to "crab". Crabbing is a term used because the airplane flies side ways to counteract the wind perpendicular to the landing strip (see Fig 14a). If the aircraft flies straight without crabbing, the aircraft will deviate from its path (see Fig. 14b).

Figure14a : Aircraft crabbing to counteract wind direction

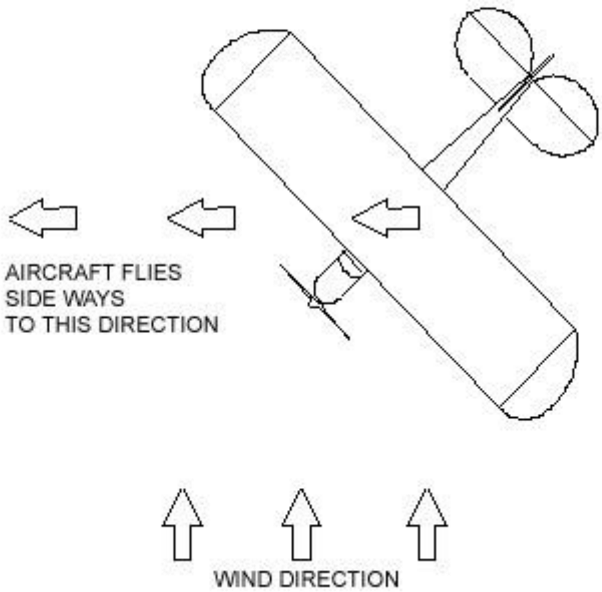
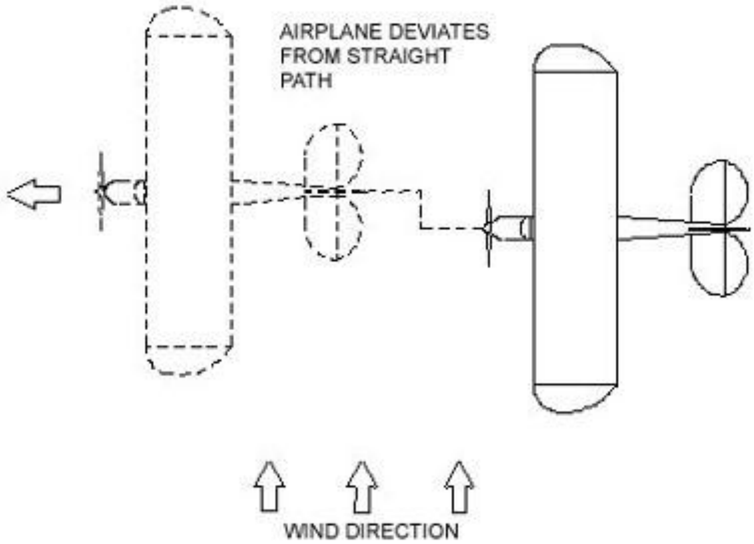


Figure14b : Aircraft deviates from straight path in a crosswind



Because of this, landing a tail dragger is not as easy as we thought. The entire weight of the aircraft is behind the main gear so the momentum is pushing the aircraft instead of pulling it (see Fig. 15a). There is no inherent stability in tail dragger unlike the tricycle type. In a tricycle type, the weight is concentrated in front of the main landing gear (see Fig.15b). The momentum is pulling the aircraft so this is more stable because there is no tendency for the aircraft to tip over when landing and crabbing at the same time. The main gear will just drag and pull the aircraft to a straight path when the wheels strike the ground.

Figure15a : Tail Dragger in a Crosswind Landing

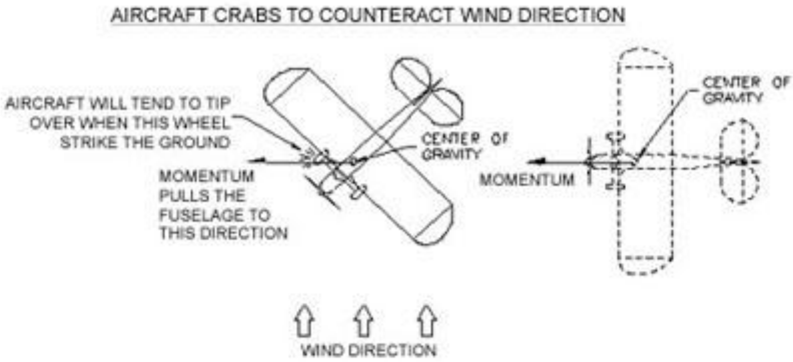
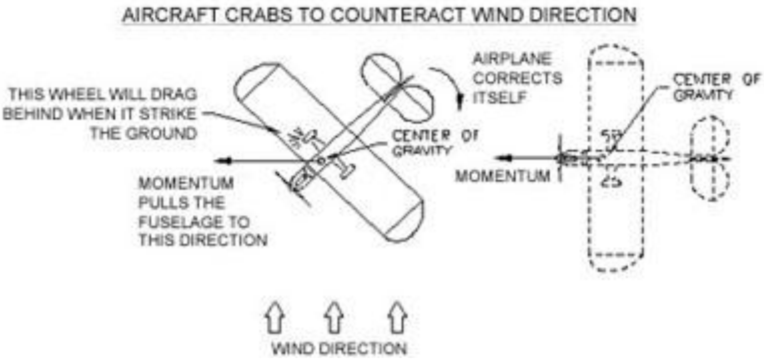


Figure15b : Tricycle Type in a Cross Wind Landing



Chapter #4

Weight and Balance

In Chapter 2, we had a brief lesson on how weight affects the aircraft in flight. Because gravity affects the aircraft weight, it is of utmost importance to keep the weight to a minimum. Also, it is important to determine the distribution of weight. Although the aircraft has normal or below the recommended weight, we need to achieve stability for the aircraft to fly properly. If not, the aircraft is hard to control, which may result in unnecessary crash. The distribution of weight is essential to balance the aircraft. Since majority of the aerodynamic forces acts on the wing, it plays a major role in controlling the aircraft.

Looking at the cross-section of the wing, the aerodynamic center is the pivot point of the lateral axis (see Fig 16a). The center of gravity is where all the aircraft weight is concentrated which must be near the aerodynamic center to achieve stability. Since the airplane has two sets of wings (main and tail wing) there are two aerodynamic centers to be considered. The combination of two aerodynamic centers is the neutral point (see Fig. 16b). If the center of gravity is way behind the neutral point, the aircraft is called tail-heavy which might result in stalling. If its located too far forward, nose-heavy will result and it will be too hard for the aircraft to gain altitude (see Fig. 16b).

Figure 16a : Aerodynamic center of an airfoil

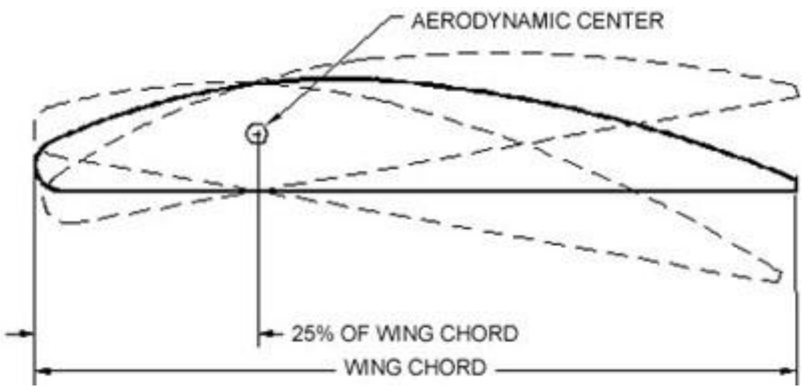
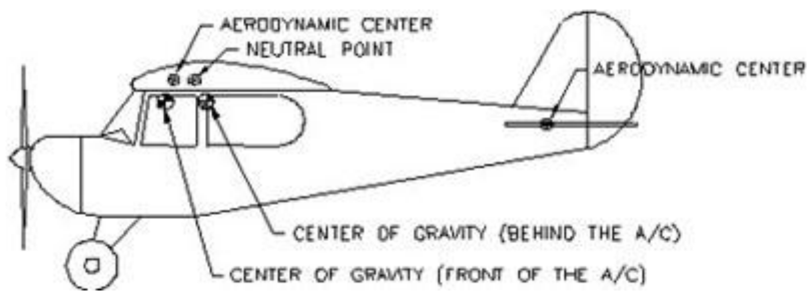
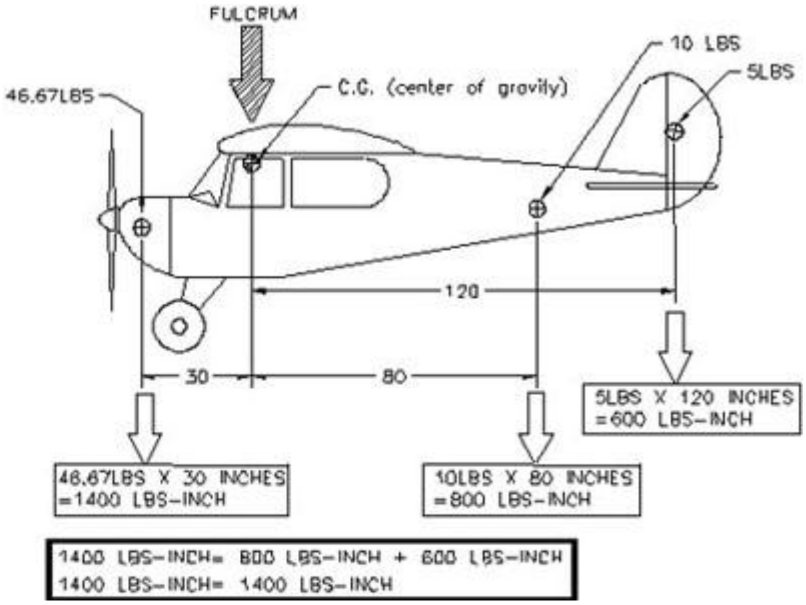


Figure 16b : Neutral Point of Wing and Horizontal Stabilizer



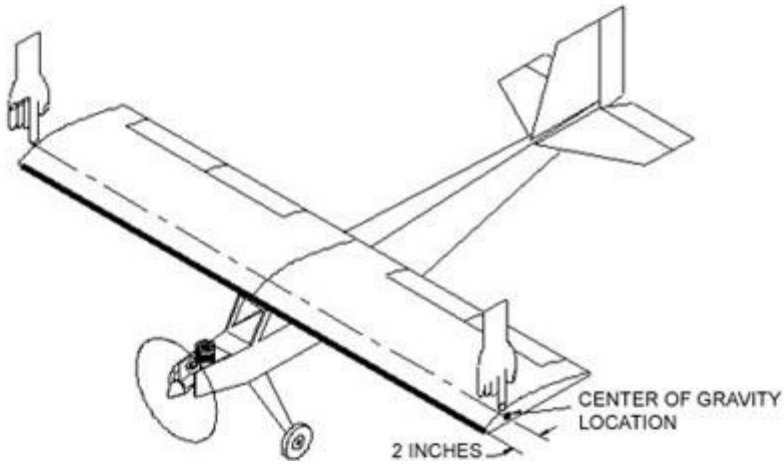
In a full-size aircraft, the center of gravity determination has to be calculated. The arm or the distance of the load (or cargo) multiplied by the weight is called the moment (remember physics?). The fulcrum or the pivot point is the suggested center of gravity location of the aircraft. The moments of the two sides should be equal so as to balance the aircraft (see Fig. 17a). Since our model aircraft is miniaturized, all we need to do is to balance the aircraft with our fingers on the recommended location of the center of gravity. Based on the example illustration of Fig. 17b, the C.G. (or center of gravity) location is 2 inches from the leading edge.

Figure 17a : Illustration of weight and moments



In model aircraft, the distribution of weight depends on the location of the radio equipment installed. Because they are the last thing to be installed and does not affect much the aerodynamic characteristics of the aircraft The servos, batteries and receivers should be located in such a way that the aircraft will balance on the center of gravity. The engine location was already designed on most plans or kits available so there is not much we can do about it. The best thing to do is before permanently installing the equipment is to arrange it temporarily with a tape then balance the aircraft. The model should already be completely built (engine & fuel tank installed, the airframe is already wrapped with monokote, etc). When the desired location is known, then you can permanently install the radio equipment.

Figure 17b : Balancing model airplane by hands

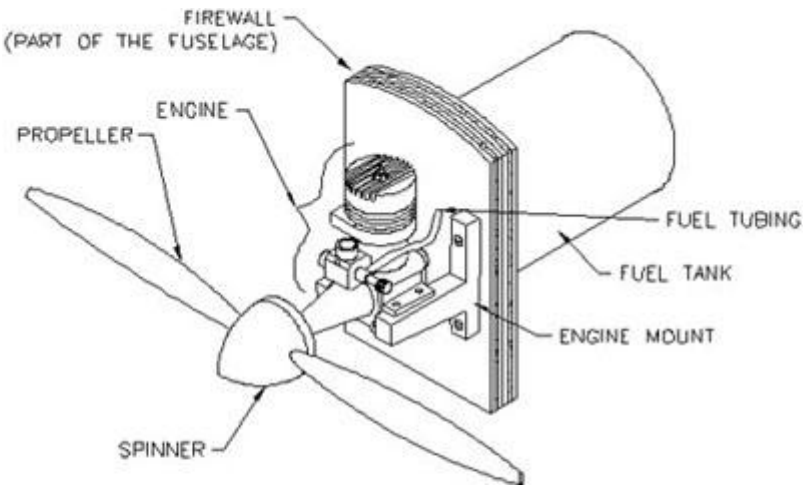


Chapter #5

RC Airplane Engines

The aircraft power plant consists of all the accessories needed by the aircraft to produce thrust. It consists of the engine, propeller, fuel tank, spinner, fuel tubing and other accessories that are directly related for the power plant to function (see Fig.18). The model aircraft commonly utilizes the internal combustion engine and electric motors for thrust. Let us first tackle the internal combustion type (or I.C.E.).

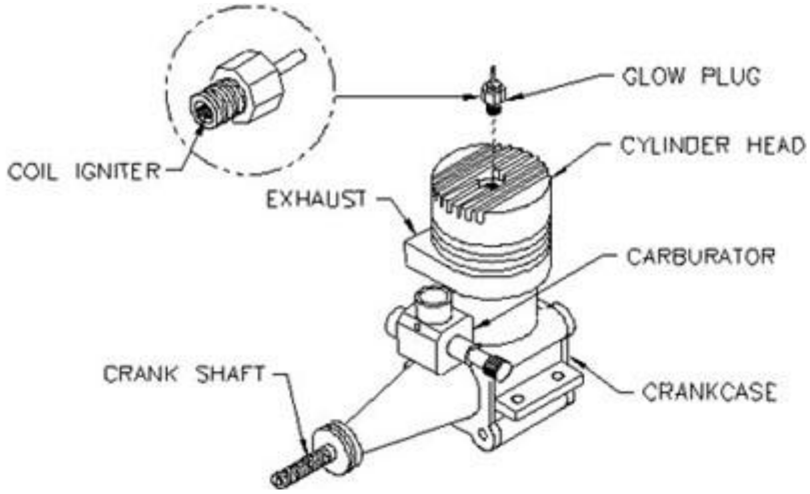
Figure 18 : RC aircraft power plant components for internal combustion engine (I.C.E.)



Usually the model aircraft use three different types of internal combustion engines with regards to the fuel they use.

1) **Glow engine** – engine that uses methanol for fuel and castor oil for lubricant. The igniter is called the glow plug, shaped like a miniature spark plug but uses coil for combusting the fuel and air mixture (see Fig.19). Power source for the glow plug is 1.5volts NiCad (Nickel Cadmium) battery or dry cell with high ampere. Usually 75% methanol and 25% castor oil is the fuel mixture. Castor oil readily mixes with methanol unlike the petroleum based motor oil. But for more speed, nitro methane is added depending on the type of aircraft flyer desire (e.g. pylon racing, sport flying or pattern flyer). This type of engine can either be a four-stroke or a two-stroke engine (see Fig.20a & Fig.20b).

Figure 19 : Typical two cycle glow engine



2) Diesel engine – This type engine use kerosene for fuel (jet engine fuel) and with some additive for easy combustion. It combust fuel and air mixture by means of compression in the combustion chamber unlike the glow engine that utilize glow plug to combust the fuel and air mixture. It has more torque than the glow engine so it can swing larger propellers.

3) Gas engine – Gas engines are commonly used by larger RC airplanes because this type has larger displacement. It uses ordinary unleaded gasoline and petroleum based motor oil. You can compare its size with an ordinary handheld chainsaw.

If you are not very familiar with internal combustion engine you may ask, what is the difference between four strokes and two-stroke engine? A four-stroke engine (see Fig. 20b) combust the fuel and air mixture in the combustion chamber more efficiently compared to a two-stroke engine (see Fig. 20a). It is because the two cycle engine as illustrated in Figure 20a, the fuel and air mixture from the crankcase goes to the combustion chamber and the burned mixture are exhausted at the same time so some of the raw fuel is mixed to the burned fuel and exhausted. Fuel is wasted because the inefficient combustion. Unlike the four cycle which the: 1) Intake, 2) Compression, 3) Combustion & 4) Exhaust are four separate cycles which are more efficient because the fuel is completely burned and exhausted before taking in fuel and air mixture.

Figure 20a : Event cycle of a two stroke engine

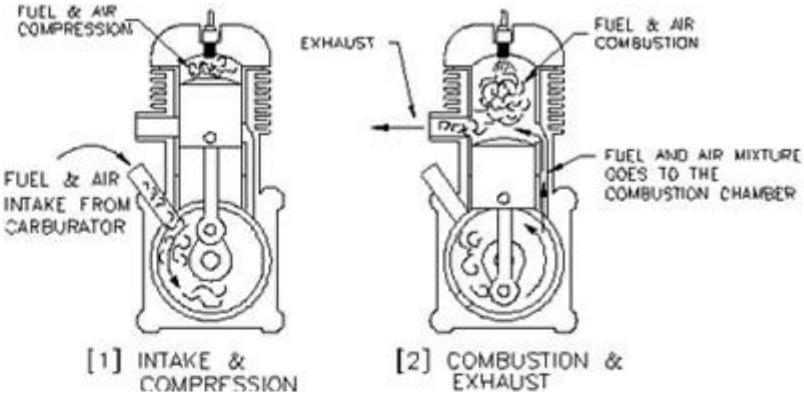


Figure 20b : Event cycle of a four stroke engine

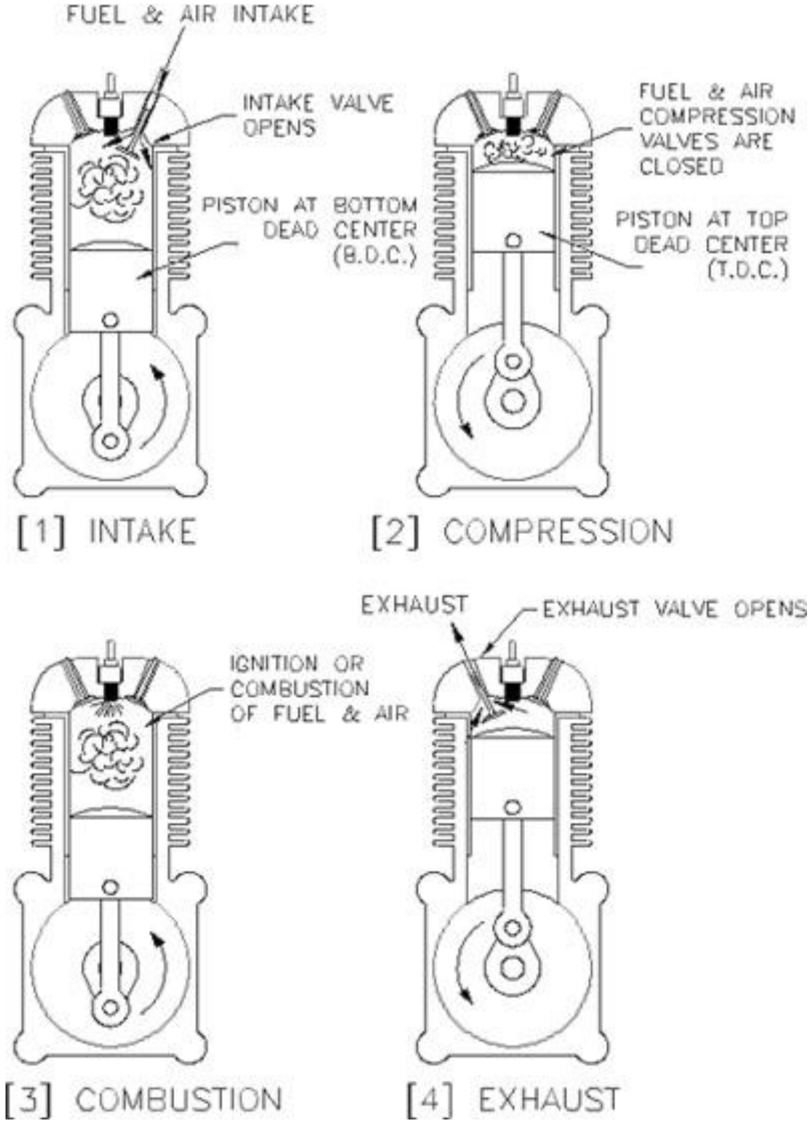
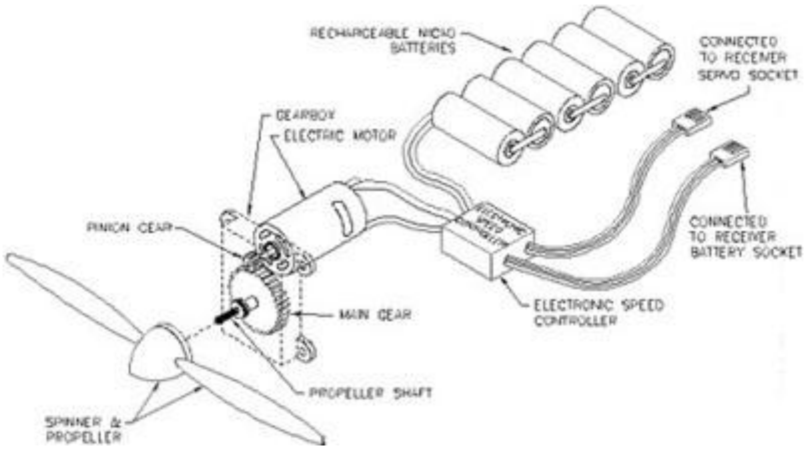


Figure 21: Electric powerplant components



In the past flying electric was not very popular because of the weight penalty of the batteries. But today, there are may who prefer flying with electric motors because of the technological breakthrough. Compared with internal combustion engine, starting is easy, no mess because of the castor oil emitted by the engine, quiet & no need for fuel. The only limitation I perceive is the shorter flying time and it is not as powerful as the internal combustion engine. We don’t need brute force to fly so I think as long as it is strong enough to carry its own weight; there is no problem. Having extra battery packs can solve the limited flying time by charging it alternately after the first one is exhausted.

Chapter #6

Choosing My First Model Airplane

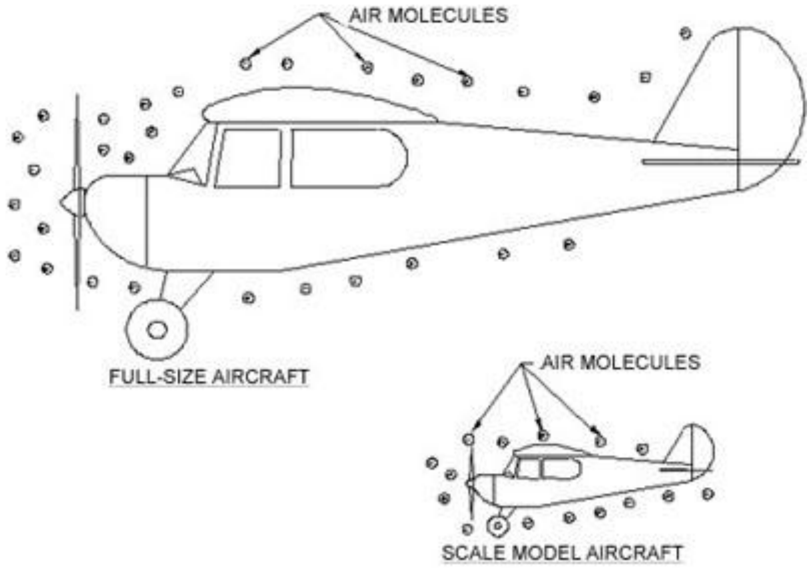
The main intent of this chapter is for the beginner to choose the correct ways to start his/her hobby with minimal error. Of course, there is no such thing as perfect ways to start this hobby. Just avoiding the “don’ts” which we usually ignore and when the consequences arrive we will not be surprised of the outcome. Pilot error occurs because of avoiding the safety measures before flying. Flying with undercharged transmitter or receiver batteries is considered pilot error because we are not careful of the consequences.

Also because we are not aware what to choose for a beginner aircraft, we buy the wrong type thinking that all airplane are the same. For a beginner, I would suggest choosing a high-wing, constant chord (straight wing) and tricycle type landing gear so that we can concentrate on the other controls. These features already have inherent stability as we have tackled before in previous chapters.

I remember when I was a teenager I bought an F16 fighter jet kit (propeller driven). I thought that it’s only a toy airplane and I don’t need any flying skills in order to fly it. I know how to build the plane by studying books and magazine on building model airplanes. But later I learned that I can’t fly it because it is not a trainer aircraft. Then I bought another airplane kit, the piper cub. Yes it was a trainer on a full-size aircraft but I didn’t realize that it is a scale model. I knew later that I couldn’t fly scale model aircraft even though it was a trainer aircraft because it was “scale”.

Why is it that a scaled trainer of a full-size aircraft is not recommended as a RC model trainer aircraft? The reason behind it is the aerodynamic characteristic of a full-size aircraft is different on a scaled down aircraft even if the model is exactly the same dimension from the original. The viscosity and size of air molecules cannot be scaled down for the model aircraft to behave like it’s full-size counterpart. That is why when you scale down an aircraft that is very stable, the miniature will fly terrible. It is called “scale effect”. The model has to be redesigned based on the lift and drag coefficients and Reynolds number on its miniature dimensions to achieve stability. On illustration of Fig. 22, the tiny circles represent the air molecules. On a full-size aircraft, the molecules are small compared with the scale model. For the model aircraft the air molecules are bigger so it will behave differently compared with the full-size aircraft.

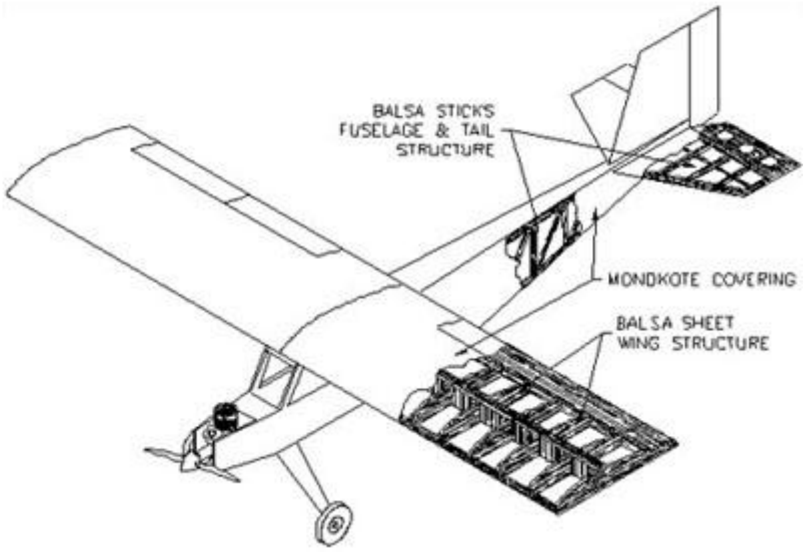
Figure 22 : Full-size and model aircraft comparison



Materials are also a major consideration for a model aircraft. The secret for it to fly successfully is to build it light and strong. Traditionally, balsa wood was the first choice because of its strength to weight ratio and very easy to cut, sand or carve. Because the airframe is consisting mainly of balsa, repair was possible and easier unlike the plastic or foam materials. Other materials are combination of foam core wings covered with balsa skins, molded plastic fuselage and fiberglass fuselage. The covering for bare balsa frame is usually an iron-on plastic called "monokote". It is a strong mylar film coated with pigmented adhesive on one side.

Covering with monokote only need a handy iron to fasten the film to the airframe. After the plane is covered, just apply heat to shrink the film to remove the wrinkles and sags. It is far easier to apply than the traditional silk and dope. The combination of silk and dope provides added torsional strength but heavier compared with mylar film. It also needs an experienced and skillful builder because the total weight will depend on the hobbyist's skill and it should be built as light as possible.

Figure 23a : Typical model aircraft structure

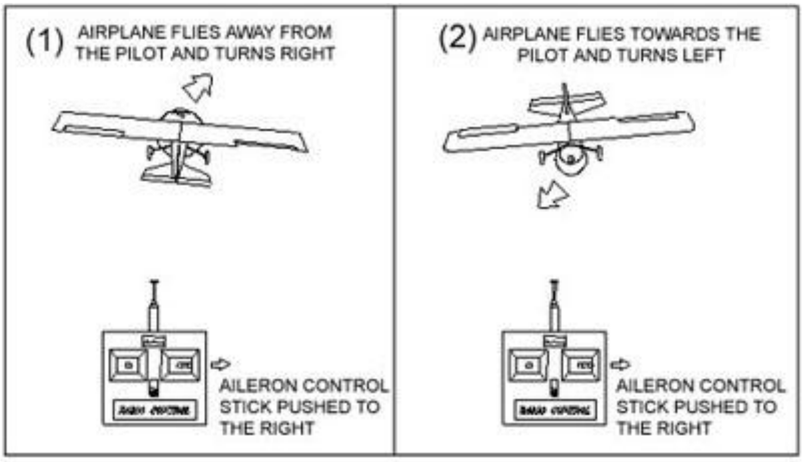


Depending on the hobbyist's desire to enjoy this past time, some enjoys building as well as flying his or her model aircraft. Some love to fly but hates the tedious task of building. One thing in common for us hobbyist is that we love aircraft. We are in to this hobby to enjoy it so the best thing is to make all things simple. Sophistication most of the time will end to frustrations so the next time we plan to buy a model kit is to think ten times or more if this aircraft is suited to your skill. If we overestimated our skill, we will end up a closet full of broken airplanes.

Since flying skill is needed to enjoy this hobby, it is best to ask for help of an instructor. It is almost impossible to teach yourself if you are a beginner because it is important that your model will land in one piece. Take-off and landing is the most important maneuver to learn. Your model is safe whatever maneuver it makes as long as it will not touch the ground. Avoiding crashes is of utmost importance. When you have mastered take-off and landing, it is now possible to teach yourself any kind of maneuver you wish.

Flying a remote controlled model is very different from flying the real thing. Because in a real aircraft if you are in the cockpit, left is left and right is right. In a model aircraft, if your view is at the back, left is left and right is right. But when it is going towards you, then right is not right anymore. If you are not properly oriented confusion will result. Your right will become left and left will become right. Practice flying the airplane towards you because this is very helpful in case of dead stick landing.

Figure 24 : Comparison of aircraft orientation: aircraft flying away vs. aircraft flying towards the pilot



Dead stick landing is when the aircraft losses it's power due to engine failure. Either the engine is not properly break-in or fuel exhaustion is the major cause of engine failure. The only available power is gravity where the aircraft glides until it reaches the ground. Control is very limited because you cannot climb again to make a perfect landing.

Sometimes there is other unexpected event that occurs when we are flying our model. The receiver sometimes experiences interference from other radio transmitter and may cause glitches to the servos. The effect is that the aircraft may suddenly stall and spin dive. The only solution to this problem is to apply opposite control input. When the airplane is spin diving to the right, apply left rudder control and elevator up to recover to a safe altitude. Practice on spin diving and recover in a safe altitude. Radio interference occurs most of the time in AM an FM band (Amplitude and Frequency Modulation) which are used in earlier version of radio controlled flying. Then came the PCM (Pulse Code Modulation) which replaced the AM and FM band which is immune to radio interference.

Today, there are many flight simulators available in the market, which is a very good way to start this hobby. This will orient you on flying "remote controlled". Flying in the cockpit is different from flying remotely piloted (see figure 24). And as the computer nowadays are getting faster and graphic cards available are like true to life, it is easy for us to master the skills of a true RC pilot. Mistake can be repeated because it is only software. Unlike in the earlier days, even the most stable RC aircraft can turn into an expensive litter with a very slight pilot error. The common flight simulators available in the market today consist of a transmitter box, cord, adapter and CD containing the software. All you have to do is to install the software, plug the transmitter adapter cord to the back of your computer's CPU casing (Either com1 or com2). Modern technology is a big factor in learning to fly so I think flight simulators is a very good place to start. There is a free flight simulator I'm using which I've downloaded in the internet. It is called the Flying Model Simulator or FMS. The astounding detail and realistic simulation is very good dispite of being a freeware. You can also add models which are available in the internet. For more info please just follow these links: Flying Model Simulator & RC airplane experiment studio page for FMS

So this ends up our short lesson in RC Airplane: Theories & Practice for Dodos and I hope this short lesson about radio controlled airplane helped you in my own little way. This is a very nice start before building and learnimg to fly your first airplane because you already gained knowledge in pre-flight lesson which is similar to full-size "ground schooling". Thank you for your time and patience in reading my article and enjoy flying!

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